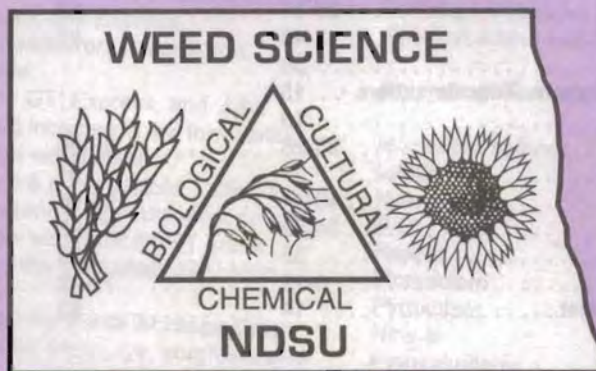


NORTH DAKOTA
STATE DEPOSITORY
DOCUMENT

2008 NORTH DAKOTA WEED CONTROL GUIDE



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WEED GUIDE INFORMATION

The information in this guide provides a summary of herbicide uses in crops grown in North Dakota and is based on federal and state herbicide labels, research at ND Ag. Experiment Stations, and information from the North Dakota Department of Agriculture.

ALWAYS READ AND FOLLOW LABEL DIRECTIONS

Instructions for registered uses of herbicides are given on container labels. The label is the final guide and should be followed strictly. The information in this guide only applies to North Dakota because some herbicide uses are allowed only by supplemental or specific ND labeling. Persons are required to possess labels at the time of application.

This bulletin is provided for your information. North Dakota State University or its officers or employees make no claims, representations, or guarantees as to product performance nor accept responsibility for results from using herbicides. See legal disclaimer on the next page.

Below is information to aid in using this guide:

Herbicides. Herbicides in tables are listed by trade name followed by common name in parenthesis except where several brands are available. Contact chemical suppliers and the ND Dept of Ag for new label information.

Rates. Rates in tables are based on broadcast application and are expressed according to formulated product per acre with active ingredient (ai) or acid equivalent (ae) per acre given in parentheses. Commercial formulations of the same herbicide may vary in amount of ai.

For example, a pint of 4 lb ae/gal 2,4-D contains 0.5 lb while a pint of 6 lb ae/gal 2,4-D contains 0.75 lb or a quart of 3 lb ae/gal glyphosate contains 0.75 lb while a quart of 4.5 lb ae/gal glyphosate contains 1.125 lbs.

What is the difference between ai and ae? The label of commercial products list both active ingredient (ai) and inert ingredients. Inert ingredients are not phytotoxic but are used to create stable formulations and to aid in application, herbicide retention, deposition, and absorption. The active ingredient of some herbicides are formulated with salts or esters (See Herbicide Compendium). Glyphosate is formulated at 3, 4, 4.17, and 5 lb of pure glyphosate acid per gallon. Glyphosate is also formulated as the pure acid and with three different salts, isopropyl amine (ipa), diammonium (2(NH₃)), and potassium (K). The salts that are formulated with glyphosate molecule do not contribute to weed control. The ai of glyphosate is the weight of both glyphosate acid plus the salt formulated with the glyphosate molecule. The acid equivalent (ae) of glyphosate is just the weight of glyphosate without the the salt. Glyphosate formulated at different concentrations and with different salts require using acid equivalent (ae) when calculating rates. The following table will help to understand the relationship between ai and ae.

Product/A	Rate as acid equivalent (ae)			
	0.38	0.57	0.75	1.125
	fl oz/A			
3 lb ae / 4 lb ai	16	24	32	48
4 lb ae / 5.4 lb ai	12	18	24	36
4.17 lb ae	12	18	24	36
4.5 lb ae / 5.5 lb ai	11	16	22	32
5 lb ae / 5 lb ai	10	15	20	30

Weed Control Ratings. Herbicide effectiveness ratings listed in tables show general comparative ratings based on field observations. Weed control may be equal or greater than what is indicated in the table under favorable conditions. However, weed control may be reduced and unsatisfactory results obtained in unfavorable conditions.


Units of Measurement

oz = ounce (16 oz/lb)
 fl oz = fluid ounce (128 fl oz/gal)
 pt = pint (8 pt/gal)
 gal = gallon
 ae = acid equivalent
 ai = active ingredient
 conc = concentration
 v/v = volume/volume
 lb, lb/gal = pound, pounds/gallon
 gpa = gallons per acre

Crop Designation

HRSW = Hard red spring wheat

Type of Application

EPP = Early preplant
 PPI = Preplant incorporated
 PRE = Preemergence
 EPOST = Early postemergence
 POST = Postemergence
 POST Directed = Postemergence directed
 = Aerial application prohibited

Types of Formulation

DF = Dry flowable
 DS = Dispersible solution

Abbreviations Used

EC = Emulsifiable concentrate
 EW = Emulsion in water
 F = Flowable
 ME = Micro-encapsulated
 S = Solution
 SG = Soluble granule
 SP = Soluble powder
 WP = Wettable powder
 WDG = Water dispersible granule
 XP = Extruded paste (granules)

Miscellaneous

ACCase = Acetyl CoA carboxylase
 ALS = Acetolactate synthase
 AMS = Ammonium sulfate
 CEC = Cation exchange capacity
 DAA = Days after application
 DNA = Dinitroaniline
 IMI = Imidazolinone
 MSO = Methylated seed oil
 NIS = Nonionic surfactant
 ND DA = ND Dept of Ag
 OM = Organic matter
 PHI = Preharvest interval
 RUP = Restricted Use Pesticide
 SU = Sulfonyleurea
 TPS = Triazolopyrimidine sulfonamide
 UAN = Urea ammonium nitrate

GENERAL INFORMATION

LEGAL DISCLAIMER

The weed control suggestions presented in this guide are based on Federal label clearance and on information obtained from the North Dakota Agricultural Experiment Station and the Research Reports of the North Central Weed Science Society and Western Society of Weed Science.

CAUTION: Instructions for registered uses of herbicides are given on container labels. **Read and follow label instructions carefully.** Pesticide labels supercede recommendations given in this guide. The weed control suggestions in this circular are based on the assumption that all herbicides mentioned will continue to have a registered label with the Environmental Protection Agency. This guide contains recommendations for herbicides that are labeled only for North Dakota. The user of any pesticide must possess a copy of the label at the time of application. State labels can be obtained from chemical dealers or distributors or found on the web at: <http://www.cdms.net/manuf/manuf.asp>.

Use pesticides only on registered crops. Some formulations of an active ingredient may not be labeled for certain uses. Federal law makes liable for seizure any raw agricultural commodity that possesses a pesticide residue for which no exemption or tolerance has been established or that exceeds the tolerances established by the Food and Drug Administration. Persons using pesticides in a manner contrary to label instructions are subject to penalty under federal and state laws. North Dakota State University or its officers or employees makes no claims or representations that the chemicals discussed will or will not result in residues on agricultural commodities and assume no responsibility for results from using herbicides

USE PESTICIDES ONLY AS LABELED.

Pesticide Labeling and Registration

No pesticide may be sold or used in the United States until the U.S. Environmental Protection Agency (EPA) has registered and approved the product use and the labeling. Canadian and other foreign labeled pesticides may not be used in the United States until registered by the EPA.

TYPES OF PESTICIDE REGISTRATIONS

Federal EPA Registrations, also known as 3e and 2ee labels, are the most common and widely used type of pesticide registration. Product labels of pesticides being applied must be at the application site during the time of application. Aerial applicators must have the label at the loading site.

Section 24(c) Registrations, also known as (SLN) State Local Needs registrations:

- are state-specific registrations issued by states
 - are used to address a special local need
 - must prove there is an existing or imminent pest problem for which a federally registered pesticide is not available
 - can be used to address pest resistance management.
- SLN registrations can be used to register additional uses or add limitations for a federally registered pesticide, like adding application sites, pests, or alternate control methods to those listed on federally registered labeling. SLN labels are initiated by the ND Department of Ag and must be approved by EPA. Supplemental labeling must be provided for each SLN registration. Applicators must have

the SLN label and federal label in their possession at application. These registrations are legal only in the state or local area specified in the labeling.

Section 18 "Emergency" and "Crisis" exemptions from FIFRA allows the unregistered use of a pesticide to address an emergency pest situation and are used when an emergency or crisis pest situation:

1. Is an emergency and non-routine
2. Has no or ineffective alternative management tools
3. Is severe and can be documented to cause yield or economic loss (>20%) on the specified crop.

Both types of exemptions from registration allows use of a pesticide for a non-registered purpose for a specified period of time. ND "Emergency" Section 18 exemptions are registrations initiated by the NDDA, are approved by the EPA, and can be declared if both federal and SLN registrations are not or cannot be enacted in time to prevent the condition. In rare occasions, when time is critical and the emergency is acute, NDDA can declare a "Crisis" exemption without written approval of EPA. The NDDA informs EPA of the condition prior to the action and allows EPA to support the state action. This process usually takes 10 to 14 days to complete. The duration of a "Crisis" exemption (14 to 21 days) is shorter than an "Emergency" exemption. If an "Emergency" exemption is being reviewed by the EPA at the time the "Crisis" exemption is declared the EPA may elect to grant the "Emergency" exemption and increase the period of duration. An applicator must possess federal labels and Section 18 exemption labeling at application.

RESTRICTED USE PESTICIDES (RUP)

EPA categorizes pesticides as either unclassified (general use) or restricted. **Restricted-Use Pesticides (RUP)** are pesticides that can cause harm to humans or environment and must be applied by certified applicators. Only certified dealers may sell RUPs and only certified applicators may purchase, apply or recommend an RUP. Private and commercial applicators must record certain information for all pesticide applications.

RESTRICTED USE HERBICIDES:

All products and premixes containing the active ingredients listed below are restricted use pesticides. See Table X1, Herbicide Mode of Action for products containing these active ingredients.

Alachlor = See Mode of Action #15

Atrazine = See Mode of Action #5

Isoxaflutole = See Mode of Action #27

Paraquat = See Mode of Action #22

Picloram = See Mode of Action #4

Brand names of other RUP:

Amitrole-T, Cytrale (amitrole)

Kerb 50W (pronamide)

Sulfuric acid

SAFETY AND EMERGENCY PHONE NUMBERS:

ND Poison Control Line: 800 222-1222

ND Emergency Assistance Line: 800 472-2121



Report pesticide incident to NDDA: 701 328-2232

CHEMICAL WEED CONTROL FOR FIELD CROPS

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Preplant / PRE Herbicides to Crop																																		
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds and volunteer crops.	Preplant or any time prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. May be applied with dicamba at 2 fl oz/A. A4-6 Q1 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae																													
3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz																													
4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz																													
4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz																													
5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Paraquat	2 to 4 pt 2SL RUP 1.3 to 2.7 pt 3SL (0.5 to 1 lb)	Emerged annual grass and broadleaf weeds.		Non-residual, contact, herbicides; thorough coverage essential. Apply with NIS at 0.25% v/v to small weeds. Refer to pages 108-109 for commercial mixtures. B4 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Thifensulfuron	0.3 to 0.6 oz DF 0.45 to 0.9 oz SG (0.225 to 0.45 oz)	Several broadleaf weeds.		May be applied with glyphosate. Apply with a NIS at 0.25 to 0.5% v/v. No crop rotation restrictions the following year. Refer to pages 108-109 for commercial mixtures. B22 S1 S3 S5 X1																														
Tribenuron	0.17 to 0.33 oz DF 0.25 to 0.5 oz SG (0.125 to 0.25 oz)																																	
Thifensulfuron + Tribenuron	4:1 ratio 2:1 ratio 1:1 ratio	Broadleaf weeds including wild buckwheat and RUR canola.		Improves broadleaf weed control including wild buckwheat when applied with glyphosate. Apply with NIS at 0.25 to 0.5% v/v. Refer to pages 108-109 for commercial mixtures. B22 S1 S3 X1																														
Paramount (quinclorac)	0.33 lb DF (0.25 lb)	Field bindweed: Runners at least 4 inches long. May control foxtail species, cleavers, barnyardgrass, and volunteer flax.		Always apply with MSO adjuvant at 1.5 pt/A. May add AMS at 2.5 lb/A or UAN at 1 gal/A to improve control. Apply after harvest but prior to frost. Suggested use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. B19 T1 T6 Y15 Y24																														
Not for Barley																																		
Everest / Pre-Pare (flucarbazone)	0.2 to 0.4 oz WDG (0.14 to 0.28 oz)	Soil residue may control foxtail, mustard, and pigweed species.	Preplant: 7 days prior to planting to jointing.	See Everest listing on page 10. NIS is not required if weeds are not emerged.																														
Not for Barley or Durum Wheat																																		

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Far-Go (trilalate) 	HRSW & DURUM: 1 qt 10 lb 10G (1) BARLEY: 1.25 qt 12.5 lb 10G(1.25 lb)	Wild oat.	Spring: HRSW, Durum and Barley. Apply before or after seeding. PPI 3 or more days before seeding.	Application before seeding: PPI with field cultivator set at 4 inches deep. Two pass incorporation is recommended. Application after seeding: Apply before kernel sprouts exceed 0.5 inch in length and incorporate with harrows set more shallow than seed. A1 B14 S6
Buckle (trilalate & trifluralin) 	DURUM & BARLEY: 10 to 12.5 lb G (1 to 1.25 & 0.3 to 0.4 lb) Spring: For HRSW and Durum 10 lb G (1 & 0.3 lb)	Wild oat and foxtails.	Fall: Apply within 3 weeks of freeze up. Spring: Barley. Prior to or after seeding. Spring: HRSW and Durum: PPI only.	Do not apply to HRSW. Incorporate within 24 hours after application. Second incorporation should be more shallow than first. Stand reduction may occur. Do not apply on soil treated with trifluralin the previous year. A1 A3 B14 B25 S2 S6 Y20 Y25 X1 Use only in designated counties in North Dakota. Apply only to fields fallowed the previous year. Do not apply to soil treated with trifluralin the previous year. B14 B25 S6
Trifluralin Not for Winter Wheat	1 pt 4E 5 lb 10G (0.5 lb) 4 lb 10G (0.4) 3.5 to 4 lb 10G (0.35 to 0.4 lb) 1 pt 4E (0.5 lb) 1 pt 4E 5 lb 10G (0.5 lb) 3.5 to 5 lb 10G (0.35 to 0.5 lb)	Foxtail.	Spring: PPI. Spring: After seeding. Fall: After September 1 until freeze-up.	FOR BARLEY ONLY. Incorporate twice 2 to 3 inches deep. FOR DURUM WHEAT ONLY. For foxtail suppression only. A1 B23 S2 Y18 Y24 X1 FOR HRSW ONLY. For suppression of foxtail only. Use west of Hwy 3 only. S2 Plant 2 to 2.5 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow 1 to 1.5 inches deep. B23 S2 Y1 Y18 Y24 X1 Incorporate once in fall within 24 hours after application. Keep spring incorporation depth more shallow than fall. Stand reduction may occur. A1 A3 B23 S2 X1 Y1 Y18 Y24 FOR HRSW AND DURUM ONLY. For foxtail suppression only. S2

POST Herbicides to Crop

Prowl H₂O (pendimethalin) Not for Barley	1.5 to 3 pt (0.7 to 1.4 lb)	Foxtail and some small-seeded broadleaf weeds.	Wheat: 1- to 3-leaf.	Soil residue provides PRE control of weeds. Does not control emerged weeds. Adjust rate for soil type. Allow a 60 day PHI. Refer to label for tank-mixtures.
MCPA amine MCPA ester	0.5 to 1.33 pt 4SL 0.5 to 1.33 pt 4EC (0.25 to 0.66 lb)	Broadleaf weeds.	Crop: Emergence until prior to boot. Winter wheat: In spring from 4-leaf until prior to boot.	Apply 0.5 to 1 pt/A from emergence to tiller stage. Use 1 pt/A for volunteer sunflower. Use high rate for large or perennial weeds. Refer to pages 108-109 for commercial mixtures. B1 B2 S3-5
2,4-D amine 2,4-D ester	0.5 to 1 pt 4SL 0.5 to 1 pt 4EC (0.25 to 0.5 lb)		Crop: 3-leaf until prior to boot. Winter wheat: Well tillered until prior to boot.	2,4-D labels vary on application timing; follow label directions. Do not apply from early boot to dough stage. Do not apply to winter wheat in fall. Refer to pages 108-109 for commercial mixtures. B1 B2 S3-5
Dicamba	2 to 4 fl oz (1 to 2 oz) Barley: 2 to 3 fl oz (1 to 1.5 oz)	Broadleaf weeds including wild buckwheat, sunflower, Russian thistle and ALS-resistant kochia.	HRSW: Up to 5-L Durum: Up to 5-L Barley: Up to 4-leaf HRWW: pre-joint	Apply at proper crop stage to avoid injury. Dicamba must be applied before 6-leaf stage. Use low dicamba rate and high MCPA rate on 4-leaf HRSW or durum. Barley is relatively susceptible to injury from dicamba. Do not apply dicamba with 2,4-D to barley. B2 B11 S1 S3-5 X1 Y11 Y24

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Clopyralid & MCPA	1.75 to 2.33 pt (0.09 to 0.12 & 0.5 to 0.68 lb)	Broadleaf weeds and Canada thistle.	Crop: 3-leaf until prior to boot.	Apply to Canada thistle at the rosette to early bolting stage. Do not harvest hay from treated fields.
Clopyralid & 2,4-D	2 to 2.67 pt (0.09 to 0.13 & 0.5 to 0.67 lb)		Crop: 4-leaf until prior to boot.	Refer to narrative for crop rotational restrictions. Refer to pages 108-109 for commercial mixtures. B10 T2 T6 Y20 Y24
Starane (fluroxypyr)	0.5 to 0.67 pt (1.5 to 2 oz)	Kochia including ALS resistant, volunteer flax, and few other broadleaf weeds.	Crop: 2-leaf through flag leaf emergence. Weeds: 4 to 8 inches tall.	Refer to label for weeds controlled, registered tank-mix options, and rates. Refer to pages 108-109 for commercial mixtures. B10 S3
WideMatch (clopyralid & fluroxypyr)	1 to 1.33 pt (0.09 to 0.125 & 0.09 to 0.125 lb)	Broadleaf weeds including kochia (ALS-resistant and -susceptible), wild buckwheat, vol. flax, and Canada thistle.	Crop: 3-leaf through flag leaf emergence. Weeds: Up to 4 inches tall or vining.	An economical formulation of clopyralid. Apply with 2,4-D, MCPA, and Harmony GT to increase spectrum of broadleaf weed control. Compatible with all POST grass herbicides labeled in small grains. Refer to label for application information and rotational crop restrictions. B10 S1 S3 T2 T6 Y20 Y24
Bromoxynil	1 to 2 pt (0.25 to 0.5 lb)	Small broadleaf weeds.	Crop: Emergence until prior to boot stage.	Contact non-residual herbicide; apply to small weeds. Controls ALS-resistant kochia. Refer to label for tank-mix options and pages 108-109 for commercial mixtures.
Bromoxynil & MCPA	1 to 2 pt 4EC 0.8 to 1.6 pt 5EC (0.25 to 0.5 & 0.25 to 0.5 lb)	Small broadleaf weeds including wild buckwheat, sunflower, Russian thistle and ALS- resistant kochia.	Crop: 3-leaf stage until prior to boot stage.	B1 B2 B8 S1 S3 S4 X1
Bromoxynil & 2,4-D	0.75 to 1.5 pt (0.18 to 0.38 & 0.25 to 0.5 lb) Rates vary by label.		Crop: 3-leaf stage until prior to boot stage.	B2 B8 S2 S6 X1
Starane NXT (bromoxynil & fluroxypyr)	14 to 21 fl oz (4 to 6 oz & 1 to 1.5 oz)		Crop: 3-leaf stage to flag leaf emergence.	The standard rate is 14 fl oz/A. Higher rates or a tank- mix partner may be required for high weed populations and weeds greater than 4 inches tall. B2 B8 S2 S6 X1
Aim (carfentrazone)	1/2 fl oz EW (0.128 oz)	Small broadleaf weeds including pigweed and kochia.	Crop: Up to jointing stage. Weeds: Small. Up to 2 inches tall.	Contact, non-residual herbicide. May cause cosmetic speckling/spotting on wheat leaves. Apply with NIS at 0.25% v/v. Refer to label or narrative for tank-mix options, and application information. Refer to pages 108-109 for commercial mixtures. B4S1 S3 S5 X1
Rage D-Tech (carfentrazone & 2,4-D)	8 to 12 fl oz (0.128 to 0.192 oz & 4 to 6 oz)	Broadleaf weeds.	Crop: 3-tillers to jointing stage. Weeds: Small.	Apply with NIS at 0.25% v/v. Crop leaf speckling may occur when dew is present on leaves. Do not apply with bromoxynil. Refer to label or narrative for additional information. B4S1 S3 S5 X1
Huskie (bromoxynil & pyrasulfotole & mefenpyr safener)	11 to 15 fl oz EC (0.18 to 0.24 lb)	Most all annual broadleaf weeds including resistant weeds.	Crop: Up to flag leaf emergence. Weeds: Up to 4 inches tall.	Apply with AMS at 0.5 lb/A or UAN at 1 to 2 qt/A to optimize broadleaf weed control. Most crops can be planted the year following application. Refer to label for tank-mix options and additional information. B8 B15 S1 S3-5 S7 X1

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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Short Residual Sulfonylurea (SU) Herbicides

Thifensulfuron	0.3 to 0.6 oz DF 0.45 to 0.9 oz SG (0.225 to 0.45 oz)	Mustards, redroot pigweed, lambsquarters, wild buckwheat, smartweed, and sunflower.	Crop: 2-leaf until prior to flag leaf emergence.	Do not apply higher tribenuron rates with POST grass herbicides. Addition of MCPA e or 2,4-D e enhances broadleaf weed control and crop safety. Apply with a NIS at 0.125% v/v except when adding 2,4-D or MCPA at 0.75 pt/A. Apply with another broadleaf herbicide to reduce weed resistance. No crop rotation restrictions the following year. Refer to label or narrative for list of registered tank-mixes. Refer to pages 108-109 for commercial mixtures. B22 S1 S3 S5 X1
Tribenuron	0.17 to 0.33 oz DF 0.25 to 0.5 oz SG (0.125 to 0.25 oz)	Mustards, marshelder, prickly lettuce, Russian thistle, Canada thistle.		
Thifensulfuron + Tribenuron 4:1 ratio (TankMix) 2:1 ratio (H. Extra) 1:1 ratio (Brd.Spec)	Product rates vary by ratio and formulation.	Provides a broader spectrum of control than either a.i. alone. Choose ratio based on prevalent weeds.		

Long Residual SU Herbicides

Metsulfuron	1/10 oz XP (0.06 oz)	Broadleaf weeds including perennial sowthistle. Partial control of wild buckwheat.	Crop: 2-leaf until prior to boot.	Addition of 2,4-D ester or MCPA ester improves broadleaf weed control and crop safety. Apply with a NIS at 0.125% except when adding 2,4-D or MCPA at 0.75 pt/A. Refer to label for crop rotation restrictions. Apply with another broadleaf herbicide to reduce weed resistance.
Metsulfuron & Thifensulfuron & Tribenuron	2/10 to 4/10 oz DF (0.116 to 0.231 oz)	Broadleaf weeds including perennial sowthistle. Improved control of wild buckwheat.	Crop: 2-leaf until prior to flag leaf emergence.	Ally Extra at 2/10 oz/A contains 1/20 oz Ally + 0.15 oz Harmony Extra. Do not apply within 22 months of last metsulfuron treatment. Do not apply to soils above pH 7.9. Refer to section on herbicide resistance. B17 S1 X1 Y3 Y6 Y24
Agility (dicamba & thifensulfuron & tribenuron & metsulfuron)	1.6 to 3.2 oz SG (1.16 to 2.32 oz)	Most annual and perennial (top-growth only) broadleaf weeds.	Crop: 2- to 6-leaf.	
Peak (prosulfuron)	0.38 to 0.5 oz DF (0.22 to 0.29 oz)	Broadleaf weeds.	Crop: 3-leaf until 2nd node is detectable.	Refer to label for application information, herbicide and crop rotation restrictions. A8 B20 X1 Y6 Y16 Y24

Very Long Residual SU Herbicides

Amber (triasulfuron)	0.28 to 0.56 oz DF (0.21 to 0.42 oz)	Broadleaf weeds.	Crop: 2-leaf until prior to boot stage.	Add NIS at 0.125 to 0.25%v/v. Refer to label for application timings, tank-mix options, weeds controlled, soil pH restrictions, resistance weeds, and crop rotation restrictions. B5 X1 Y3 Y6 Y24
Rave (triasulfuron & dicamba)	HRSW = 4 oz DF (0.352 to 2 oz) Barley = 2 oz DF (0.176 to 1 oz)		HRSW : Up to 5-leaf stage. Barley: Up to 4-leaf stage.	
Chlorsulfuron	1/6 to 1/3 oz DF (0.125 to 0.25 oz)	Broadleaf weeds and suppression of foxtail and Canada thistle.	Crop: 2-leaf until prior to flag leaf emergence.	Apply with a NIS at 0.125% except when adding 2,4-De or MCPAe at 0.75 pt/A. Refer to label for application timings, tank-mix options, weeds controlled, soil pH restrictions, resistance weeds, and crop rotation restrictions. Refer to Glean ND Supplemental label for control of foxtail. B9 X1 Y3 Y6 Y24
Chlorsulfuron & Metsulfuron	2/10 to 4/10 oz DF (0.15 to 0.3 oz)			

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST Grass Herbicides				
Axial Axial XL (pinoxaden + cloquintocet safener) Not for Durum	8.2 fl oz 16.4 fl oz (0.05 lb)	Green and yellow foxtail, wild and volunteer oat, Persian darnel, and annual ryegrass.	Crop: 2-leaf to boot. Grasses: 1-leaf to 6-leaf + 3 tillers.	Apply Axial with Adigor adjuvant (co-pack) at 9.6 fl oz/A. Axial XL is formulated with Adigor adjuvant. May be tank-mixed with most broadleaf herbicides. Refer to label for registered crops, crop and weed stage, application and tank-mix information, and restrictions. B7 S2 S6 X1
Achieve Liquid (tralkoxydim)	6.9 fl oz (0.18 lb)	Green and yellow foxtail, wild and volunteer oat, Persian darnel, and annual ryegrass.	Crop: 2-leaf to boot. Foxtail: 1- to 5-leaf. Wild oat: 1- to 6-leaf.	Do not apply Achieve on spring wheat east of ND Hwy 281 or in the following ND counties: Dickey, LaMoure, Stutsman, Foster, Eddy, Ramsey, and Towner. Add AMS at 7 to 15 lb/100 gal water. Add Supercharge at 0.5% v/v. Refer to label or narrative for tank-mix information and restrictions. B3 S2 S6 X1
Discover Discover NG (clodinafop + cloquintocet safener) Not For Barley	3.2 and 4 fl oz 12.8 to 16 fl oz (0.05 to 0.06 lb)	Wild and vol. oat, green and yellow foxtail, barnyardgrass, Persian darnel, and annual ryegrass.	Wheat: 2-leaf until prior to boot. Wild oat: 1- to 6-leaf. Foxtails: 1- to 5-leaf.	Discover is a co-pack of product plus DSV adjuvant to cover 40 to 50 acres/box. Discover NG is formulated with DSV adjuvant. Apply with MSO adjuvant at 0.25% v/v. Apply higher rates for Persian darnel and ryegrass. Refer to label for tank-mix information. B12 S2 S6 X1
Puma (fenoxaprop-P + mefenpyr safener)	0.33 to 0.66 pt (0.04 to 0.08 lb)	Wild oat, green and yellow foxtail, millets, corn, and barnyardgrass.	Wheat: Emergence to 60 days PHI. Barley: 1-leaf to 4-leaf stage. Grass weeds: 1-leaf to 2-tiller.	Do not apply to barley after the 4-leaf stage of growth. Apply 0.33 pt/A for green foxtail, vol. corn and millet. Apply 0.4 pt/A for yellow foxtail and proso millet. Apply 0.66 pt/A for barnyardgrass and wild oat. Refer to label for tank-mixing information. B21 S2 S6 X1
Avenge (difenzoquat)	2.5 to 4 pt (0.62 to 1 lb)	Wild oat	Crop: Prior to flag leaf emergence. Wild oat: 3- to 5-leaf stage.	Labeled on all barley varieties. Use the high rate on 3-leaf wild oat. Injury may occur when crop is under stress. Refer to label for tank-mix options and registered wheat varieties.
Assert (imazamethabenz) Long residual	1 to 1.5 pt (0.31 to 0.47 lb)	Wild oat, wild mustard, and other mustard species.	Crop: 2-leaf to jointing. Wild oat: 1- to 4-leaf stage.	Refer to narrative for crop rotation restrictions. Do not tank-mix with dicamba, or amine phenoxy. Use MSO-type adjuvants or NIS + petroleum oil adjuvant. Refer to label for tank-mix options and additional adjuvant information. B6 S6 Y2 Y6 Y24
Everest (flucarbazone) Not For Barley Short to Long residual	0.3 to 0.6 oz WDG (0.21 to 0.42 oz)	Wild oat, green foxtail, mustards, and pigweed. Partial control of yellow foxtail, barnyardgrass, downy brome, Japanese brome and Persian darnel	Wheat: 7 days PRE to prior to jointing. Grass weeds: Up to 4 leaves.	Apply with NIS up to 0.25% v/v or basic pH blend adjuvant at 1% v/v except when adding an emulsifiable concentrate (EC) or ester formulated broadleaf herbicides. Apply 0.3 oz/A for green foxtail, 0.4 to 0.6 oz/A for wild oat, and 0.6 oz/A for high grass densities and weeds that are partially controlled. 2,4-D or dicamba is required for safening when tank-mixing with SU herbicides. B13 S2 S6 X1 Y24
Maverick (sulfosulfuron) Not For Barley Very Long residual	2/3 oz DF (0.5 oz)	Downy brome, Japanese brome, quackgrass, mustard species and volunteer sunflower.	Wheat: Emergence to prior to jointing. Bromes: 2- to 3- tillers. Wild oat: 1- to 4-leaf stage.	Add NIS at 0.5%v/v. Refer to label or narrative for application timings, tank-mix options, weeds controlled, resistance weeds, and crop rotation restrictions. Fall applications provide greater brome and cheatgrass control than spring applications. Spring applications may control wild oat. B16 X1 Y4 Y6 Y24
Olympus (propoxy-carbazone) Not For Barley Very Long residual	0.6 to 0.9 oz/A WG (0.42 to 0.63 oz)	Quackgrass, downy brome, Japanese brome, foxtail barley and mustard species.	Wheat: 2-leaf to jointing. Grasses: 2-leaf to 2-tiller. Broadleaf weeds: Less than 2 inches tall or in diameter.	Not recommended for spring wheat due to injury. Injury to spring wheat may significantly reduce yield. Do not apply after jointing begins. Allow a 71 day PHI. Apply with NIS at 0.25 to 0.5% v/v. May be applied with fertilizer. Use high rate for wild oat and brome species. Refer to label for tank-mix options, crop rotational restrictions, and additional information. B18 S2 S6 X1 Y24

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Rimfire (mesosulfuron & propoxycarbazone & mefenpyr safener) Not For Barley Short to Long residual	1.75 to 2.25 oz WG (0.035 to 0.045 & 0.143 to 0.184 oz)	Wild oat, barnyardgrass, seedling foxtail barley, bromus grass species, and mustard species.	Wheat: 1-leaf to flag leaf emergence. Grasses: 1-leaf to 2-tiller. Broadleaf weeds: Less than 2 inches tall.	Apply with MSO adjuvant at 1.5 pt/A, or NIS at 0.5% v/v + 28% UAN at 1 to 2 qt/A, or basic pH blend adjuvant at 1% v.v (0.8 to 1.6 pt/A). Do not use petroleum oil or adjuvants containing organosilicone because wild oat control will be reduced. Refer to label for tank-mix options, crop rotational restrictions, and additional information. B18 S2 S6 X1 Y24
Silverado (mesosulfuron & mefenpyr safener) Not for Barley Short residual	1.75 to 2.25 oz WG (0.035 to 0.045 oz)	Wild oat, mustard species, and volunteer canola.	Wheat: 1-leaf to prior to jointing. Wild oat: 1-leaf to 2-tiller. Broadleaf weeds: Less than 2 inches tall.	Do not apply after jointing begins. Apply with a Bayer-approved adjuvant. Will control ACC-ase resistant wild oat. Allow a 55 day PHI. Refer to label for tank-mix information, crop rotation restrictions, and additional information. B18 S6 X1 Y24 Z1

HERBICIDE RESISTANT WHEAT

CLEARFIELD WHEAT

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Beyond (imazamox) Long residual	4 fl oz (0.5 oz)	Annual grass and broadleaf weeds including wild oat, green and yellow foxtail, Japanese brome, downy brome and Persian darnel.	Wheat: 4-leaf to prior to jointing. Weeds: 1 to 3 inches tall.	Apply only to Clearfield wheat varieties. Apply with NIS at 0.25% v/v plus UAN at 1 to 2 qt/A. Refer to label for weeds controlled, application information, and crop rotation restrictions. Will suppress feral rye. Will not control ALS-resistant kochia and wild oat. ClearMax can be applied in winter wheat up to 18 fl oz/A. A7 B24 L1 L4 X1 Y2 Y24
ClearMax (imazamox & MCPA)	4 + 8 fl oz (0.5 & 4 oz)			

Weed control from postemergence applications.

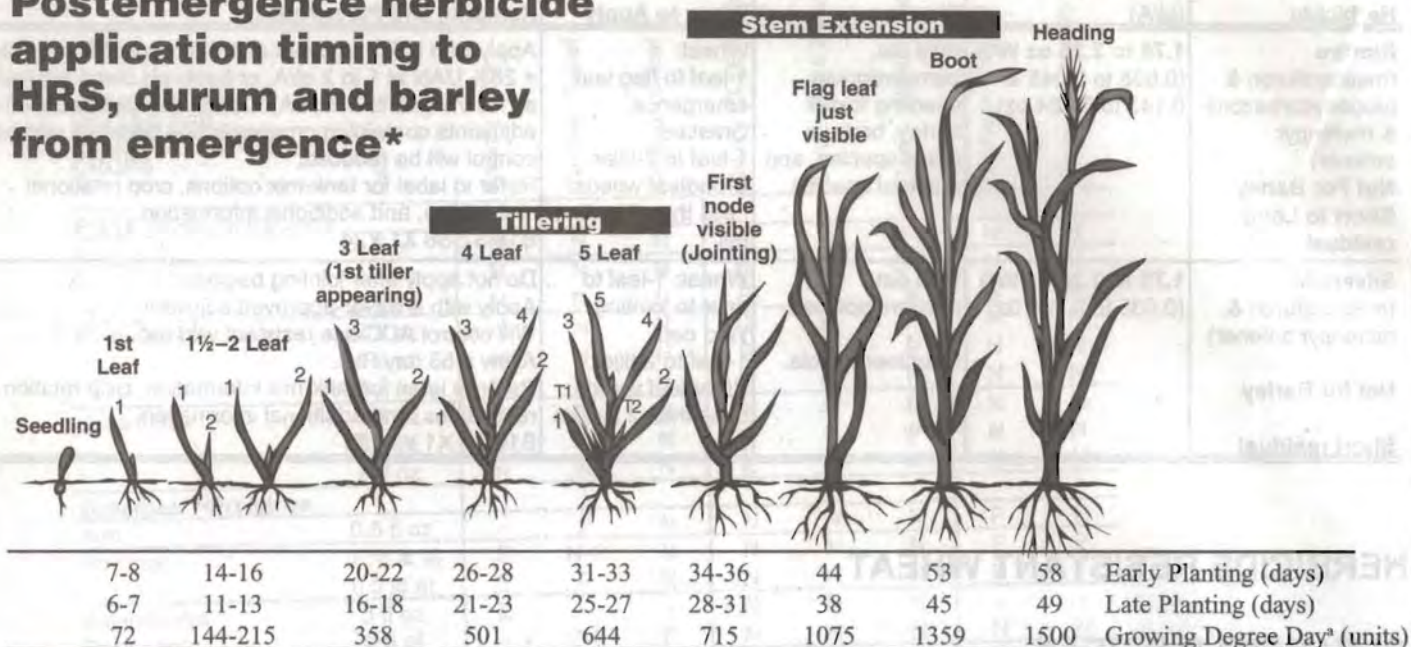
POST GRASS HERBICIDES	Wild oat	Foxtail, Green	Foxtail, Yellow	Barnyardgrass	Downy brome*	Japanese brome*	Persian darnel	Ryegrass, Annual	Quackgrass	Foxtail barley
Achieve	E	G-E	G	F	N	N	G	G	N	N
Assert	F-G	P	P	P	-	-	-	-	N	N
Axial	E	E	G-E	G-E	N	N	E	E	N	N
Beyond/ClearMax	E	E	G-E	E	G-E	E	E	G-E	F	-
Discover	E	E	G-E	E	N	N	G-E	G-E	-	N
Everest	G-E	E	P-G	F-G	P-F	G	F-G	P-F	P-F	F
Maverick**	E	P-F	P-F	P	F-G	G	-	P-F	G	-
Olympus	G-E	P-F	P-F	G	F-G	E	N	-	F-G	G
Puma	E	E	E	E	N	N	-	-	N	N
Rimfire	G-E	P-F	P-F	G	P-F	G	F-G	-	F	F-G
Silverado	G	P	P	N	P	P-F	F-G	-	N	P-F

*Early fall applications provide better control than late fall or spring. Earlier spring application are more effective than late spring or mid-season application.

**Suggested for use only in continuous wheat because of crop rotation restrictions.

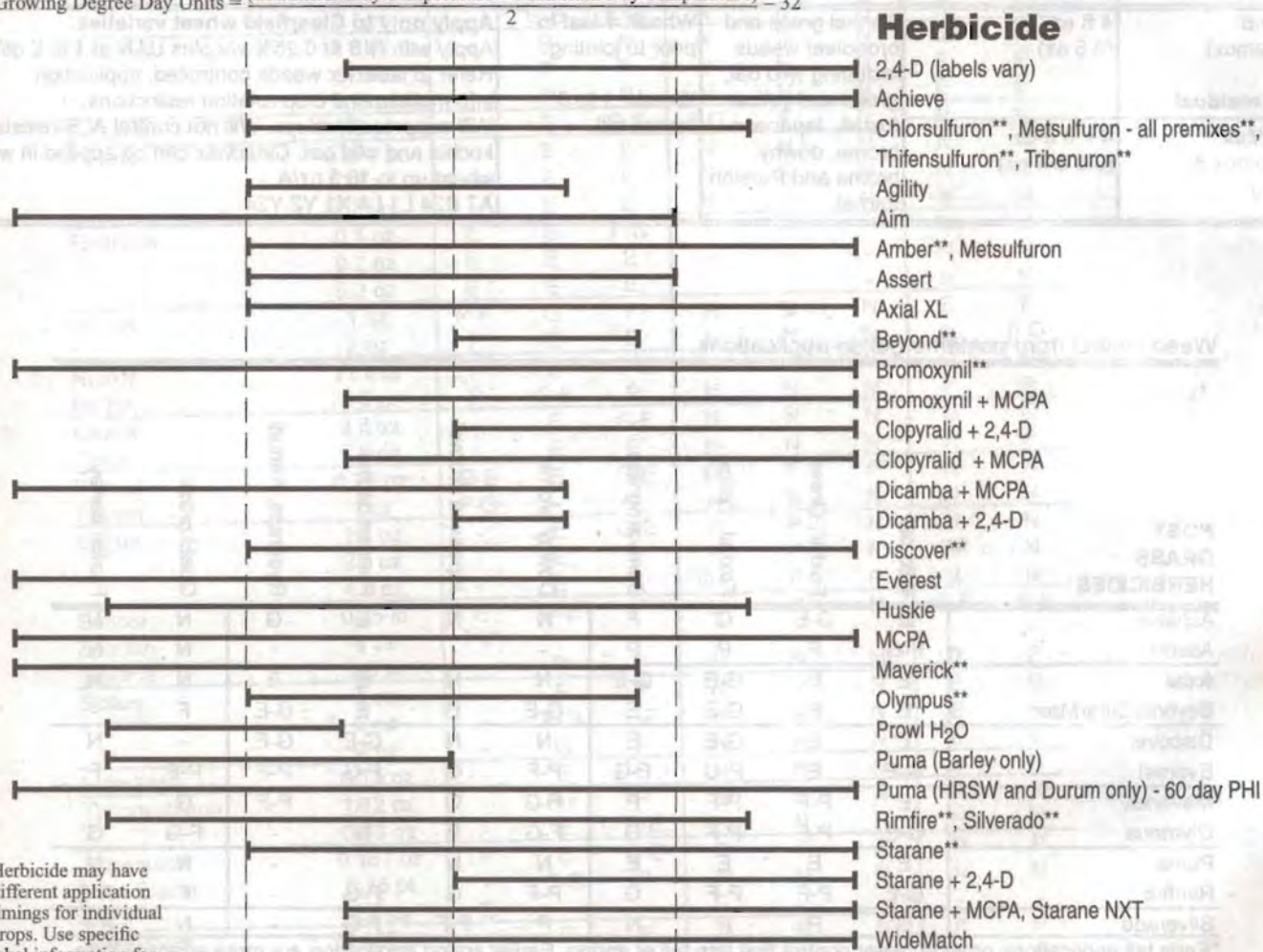
Refer to page 121 for description of E-G-F-P-N.

Postemergence herbicide application timing to HRS, durum and barley from emergence*



The lettering on the drawing represents the following: 1=1st leaf on the main stem of the plant; 2=2nd leaf on the main stem; 3=3rd leaf on the main stem; 4=4th leaf on the main stem; 5=5th leaf on the main stem and T=Tiller – not counted as a leaf when determining leaf stages.

^aGrowing Degree Day Units = $\frac{\text{Maximum Day Temperature} + \text{Minimum Day Temperature}}{2} - 32$



* Herbicide may have different application timings for individual crops. Use specific label information for individual crops.

** The addition of MCPA or bromoxynil does not restrict application timing. The addition of 2,4-D generally restricts the earliest application to the 4-leaf stage. The addition of dicamba generally restricts application to the 2- to 4-leaf stage.

Remember to always follow the label — it's the law!

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Refer to label for adjuvant use. Apply with AMS fertilizer. May be applied with 2,4-D. A4-6 Q1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae																													
3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz																													
4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz																													
4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz																													
5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.		Apply to small weeds. Thorough coverage essential. Apply with NIS at 0.25% v/v. B4 S1 S3-4 X1																														
MCPA amine MCPA ester	0.5 to 1 pt 4SL 0.5 to 1 pt 4EC (0.25 to 0.5 lb)	Broadleaf weeds.	Oat: Emergence until prior to boot stage.	Possible oat injury at any stage. B1-2 S3 X1																														
Bromoxynil	1 to 1.5 pt EC (0.25 to 0.38 lb)	Small broadleaf weeds including wild buckwheat, and volunteer sunflower.		Bromoxynil is a contact herbicide; apply to small weeds. Controls ALS-resistant kochia. Refer to label for tank-mix options. Refer to pages 108-109 for commercial mixtures. B2 B8 S3 S4 X1																														
Bromoxynil & MCPA (Premix)	1 to 2 pt 4EC 0.8 to 1.6 pt 5EC (0.25 to 0.5 & 0.25 to 0.5 lb)		Oat: 3-leaf until prior to boot stage.																															
Dicamba + MCPA	2 to 4 fl oz + 0.5 to 0.75 pt 4L (0.06 to 0.12 + 0.25 to 0.38 lb)	Broadleaf weeds.	Oat: 2- through 5-leaf stage.	Use the low dicamba rate and high MCPA rate on 5-leaf oat. Early application increases crop safety. B2 B11 S1 S3 X1 Y13 Y24																														
Clopyralid & MCPAe	1.75 to 2.33 pt (0.09 to 0.12 & 0.5 to 0.68 lb)	Broadleaf weeds and Canada thistle.	Oat: 3-leaf to jointing or to boot if risk of injury is acceptable.	Apply to Canada thistle at the rosette to early bolting stage. Refer to narrative for crop rotational restrictions. Refer to pages 108-109 for commercial mixtures. B10 T2 T6 Y20 Y24																														
Starane (fluroxypyr)	0.67 pt (2 oz)	Kochia including ALS-resistant and volunteer flax.	Oat: 2-leaf through flag leaf emergence. Weeds: Small.	Non-residual herbicide. Allow a 40 day PHI. Refer to label for tank-mix options. Refer to pages 108-109 for commercial mixtures. B10 S3																														
WideMatch (clopyralid & fluroxypyr)	1 to 1.33 pt (0.09 to 0.125 & 0.09 to 0.125 lb)	Broadleaf weeds including kochia (ALS-resistant and -susceptible), wild buckwheat, vol. flax, and Canada thistle.	Oat: 3-leaf through flag leaf emergence. Weeds: Up to 4 inches tall or vining.	An economical formulation of clopyralid. Apply with 2,4-D, MCPA, or Harmony GT to increase spectrum of broadleaf weed control. Compatible with all POST grass herbicides labeled in small grains. Refer to label for application information and rotational crop restrictions. B10 S1 S3 T2 T6 Y20 Y24																														
Thifensulfuron	0.3 to 0.4 oz DF 0.45 to 0.6 oz SG (0.225 to 0.3 oz)	Broadleaf weeds including wild buckwheat, cocklebur, ragweed and lanceleaf sage.	Oat: 3- through 5-leaf stage but before jointing.	Do not use on Ogle, Porter, or Premier oat varieties. Refer to label for list of tank-mix herbicides. Addition of MCPAe at 0.75 pt/A enhances broadleaf weed control and oat safety. Apply with a NIS at 0.125% v/v except when adding MCPA at 0.75 pt/A. Refer to pages 108-109 for commercial mixtures. B22 S1 S3 X1																														
Thifensulfuron & Tribenuron 4:1 ratio (TankMix) 2:1 ratio (H. Extra) 1:1 ratio (Brd.Spec)	0.3 to 0.4 oz DF 0.45 to 0.6 oz SG (0.225 to 0.3 oz)																																	
Peak (prosulfuron)	0.38 to 0.5 oz DF (0.22 to 0.29 oz)	Broadleaf weeds.	Oat: 3-leaf until 2nd node is detectable.	Apply with a NIS at 0.25% v/v. Refer to label for list of tank-mix options, weeds controlled, and crop rotation restrictions. B20 X1 Y3 Y16 Y24																														

SMALL GRAIN PRE/POST-HARVEST

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																									
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.	Wheat: Dough stage to harvest.	Apply to small weeds. Thorough coverage essential. Apply with NIS at 0.25% v/v. Allow a 3 day PHI. B5 S1 S3-4 X1																									
Rage D-Tech (carfentrazone & 2,4-D)	16 to 32 fl oz (0.256 to 0.512 oz & 8 to 16 oz)	Broadleaf weeds.	Wheat: Dough stage to harvest.	Apply with MSO at 1 to 2% v/v or petroleum oil at 1.5 to 2% v/v. 28% N at 2 to 4% v/v or AMS at 2 to 4 lb/A may be added. Allow a 3 day PHI. B5 S1 S3-4 X1																									
2,4-D ester	1.5 to 3 pt 4EC/SL (0.75 to 1.5 lb)			Use only when the weeds will interfere with harvest operations. Do not feed straw to livestock. Use only 2,4-D brands labeled for preharvest application. CAUTION: Drift to broadleaf crops is especially hazardous at this time. B25-26 Q1 T4-6 X1 Z1																									
For HRS, Durum, and Winter Wheat, Barley, and Rye																													
Dicamba + 2,4-D For HRS, Durum, and Winter Wheat Only	0.5 to 1 pt + 1 to 2 pt 4EC/SL (0.25 to 0.5 + 0.5 to 1 lb)		Wheat: Hard-dough stage and green color is gone from the nodes (joints) of the stem.	Allow a 7 day PHI. Do not feed treated straw to livestock. CAUTION: Drift to broadleaf crops is especially hazardous at this time. B11 B25-26 B28 Q1 T5-6 X1 Y11 Y24 Z1																									
Ally (metsulfuron) + 2,4-D For HRS, Durum, and Winter Wheat and Barley Only	1/10 oz XP (0.06 oz) + 1.5 to 3 pt 4EC/SL (0.75 to 1.5 lb)		Wheat and barley: Dough stage. Allow a 10 day PHI.	For use in wheat/fallow or continuous wheat. Do not use if crop was treated previously with an ALS herbicide. Apply with NIS. May be tank-mixed with dicamba in wheat for resistant weed management. Ally has no grazing restrictions. Refer to Ally label for crop rotation intervals. Refer to 2,4-D label for grazing restrictions and for brands labeled for preharvest application. B17 B25 B27 Y3 Y24																									
Glyphosate For HRS, Durum and Winter Wheat and Feed Barley Only.	Up to 0.75 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds including Canada thistle.	Wheat and barley: Hard-dough stage, 30% or less grain moisture. Allow a 7 day PHI.	<table border="1"> <thead> <tr> <th>lb ae/gal</th> <th>lb ai/gal</th> <th>0.38 ae</th> <th>0.57 ae</th> <th>0.75 ae</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>24 fl oz</td> <td>32 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>18 fl oz</td> <td>24 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>16 fl oz</td> <td>22 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>15 fl oz</td> <td>20 fl oz</td> </tr> </tbody> </table> <p>Do not apply more than 0.75 lb ae/season. Do not apply on wheat or barley grown for seed because reduced germination/vigor may occur. Apply 0.75 lb ae/A for Canada thistle control. May be applied with 2,4-D or dicamba for improved broadleaf weed control. Apply with AMS fertilizer. Follow label directions. Refer to label for adjuvant use and additional information. A4-6 B25-26 B29-30 T2 T6-7 X1 Z1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.57 ae	0.75 ae	3	4	= 16 fl oz	24 fl oz	32 fl oz	4/4.17	5.4/5.1	= 12 fl oz	18 fl oz	24 fl oz	4.5	5.5	= 11 fl oz	16 fl oz	22 fl oz	5	6.1	= 10 fl oz	15 fl oz	20 fl oz
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HERBICIDES REGISTERED ON SMALL ACREAGE CROPS IN NORTH DAKOTA

The following chart is only an aid to know registered herbicides on the following crops. Not all labels of similar active ingredients cover identical crops. Not all formulations are registered in the state of North Dakota. Refer to the ND Dept of Ag web site for formulations registered in the state. Many products require specific application instructions and not all formulations can be used in-crop with adequate crop tolerance. For example glyphosate is registered on most crops listed but glyphosate applied over-the-top of all crops listed below will kill crop plants. Glyphosate, in most cases, is labeled for weed control prior to planting or emergence of crops or as a directed application between rows with adequate equipment to prevent herbicide exposure to crop plants. User must refer to label of specific product:

1. To determine what crops are registered.
 2. For application instructions.
 3. For all other restrictions and use information. User must follow label directions.
- Refer to pages 127 to 132 for additional information on products listed.

Herbicides registered on small acreage crops.


BUCKWHEAT						
Aim (carfentrazone)	oxyfluorfen					
ET (pyraflufen)	Poast (sethoxydim)					
glyphosate						
JUNEBERRY						
glyphosate	Poast (sethoxydim)					
LAWN (Grass weed control)						
Acclaim Extra (fenoxaprop), Dimension/Ultra (dithiopyr), Drive (quinclorac), Pendulum (pendimethalin), Weed B Gon Crabgrass Killer for Lawns (MSMA).						
LAWN (Broadleaf weed control)						
	MCP	2,4-D	dic	tric	sulf	
All in One Weed Killer*	MCPP	x	x	-	-	
Coolpower	MCPA	-	x	x	-	
Horsepower	MCPA	-	x	x	-	
Trimec Classic	MCPP	x	x	-	-	
Trimenc Plus*	MCPP	x	-	-	-	
Trimec 889	MCPA	x	x	-	-	
Turflon Ester	-	-	-	x	-	
WBG/Chickweed, clover...	-	-	-	x	-	
WBG Max	MCPP	x	x	-	-	
WBG Max - 25% more..	MCPA	-	x	x	-	
Weed Stop for Lawns	MCPP	x	x	-	-	
Weed Stop for Lawns2X	MCPP	x	x	-	x	
Abbreviation: dic = dicamba, tric = triclopyr, sulf = sulfentrazone, WBG = Weed B Gon. *Contains MSMA						
MILLET						
Aim (carfentrazone)	Peak (pro sulfuron)					
dicamba	2,4-D					
MINT						
Assure II (quizalofop)	glyphosate					
Basagran (bentazon)	oxyfluorfen					
bromoxynil	paraquat					
Chateau (flumioxazin)	Poast (sethoxydim)					
clethodim	Prowl H ₂ O (pendimethalin)					
clopyralid	Spartan (sulfentrazone)					
Diuron/Karmex (diuron)						


ONION	
bromoxynil	paraquat
clethodim	Outlook (dimethenamid)
Dacthal (DCPA)	Poast (sethoxydim)
Fusilade DX (fluazifop)	Prefar (bensulide)
glyphosate	Prowl H ₂ O (pendimethalin)
Goal (oxyfluorfen)	trifluralin
RYE	
Aim (carfentrazone)	MCPA
bromoxynil	Peak (pro sulfuron)
glyphosate	2,4-D
SORGHUM	
Aim (carfentrazone)	paraquat
atrazine	Paramount (quinclorac)
Basagran (bentazon)	Peak (pro sulfuron)
bromoxynil	Permit (halosulfuron)
dicamba	Priority (carfentrzn&halosulfrn)
G-Max Lite (atra&dimethenmd)	Prowl H ₂ O (pendimethalin)
Intrro (acetochlor)	Sequence (glyt & metolachlor)
s/metolachlor (metolachlor)	Starane (fluroxypyr)
Micro-Tech (alachlor)	Yukon (dicamba&halosulfuron)
Outlook (dimethenamid)	2,4-D
TRITICALE	
Achieve (tralkoxydim)	Finesse (chlor & metsulfuron)
Agility (dic&thif&trib&metsulfrn)	Glean (chlorsufuron)
Aim (carfentrazone)	metsulfuron
Ally Extra (met&thifen&tribenrn)	Peak (pro sulfuron)
bromoxynil	Rhomene (MCPA)
dicamba	Starane (fluroxypyr)
DoubleUp B+G(brmxynl&2,4-D)	thifensulfuron & tribenuron
ET (pyraflufen)	tribenuron
Far-Go (triallate)	2,4-D

CORN



Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Paraquat RUP	2 to 4 pt 2SL 1.3 to 2.7 pt 3SL (0.5 to 1 lb)			Non-residual, contact, herbicides; thorough coverage is required. Apply with a NIS at 0.25% v/v to small weeds. Refer to pages 108-109 for commercial mixtures. B5 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	½ to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Thifensulfuron	0.3 to 0.6 DF 0.45 to 0.9 oz SG (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat and RUR canola.		May be tank-mixed with glyphosate. Improves broadleaf weed control including wild buckwheat. Add NIS at 0.25 to 0.5% v/v. S1 X1																														
2,4-D	0.5 to 1 pt 4EC/SL (0.25 to 0.5 lb)	Most broadleaf weeds except kochia, wild buckwheat and nightshade.		Excellent wild mustard and winter annual mustard control. May be tank-mixed with glyphosate. Improves broadleaf weed control. Refer to pages 108-109 for commercial mixtures. S1 X1																														
Select Max (clethodim)	4 to 5 fl oz (0.5 to 0.63 oz)	Annual and perennial grasses.		Controls volunteer corn and other emerged grasses prior to planting.																														

Soil-Applied Herbicides

Acetochlor & dichlormid safener 	1.25 to 2.75 pt 7EC (1.1 to 2.4 lb) 1.5 to 3 pt 6.4EC (1.2 to 2.4 lb)	Grass and some broadleaf weeds.	PPI, PRE, EPOST or Fall.	Weak on wild mustard and wild oat. Greater weed control compared to metolachlor or Outlook. Adjust rate according to soil type. PPI gives more consistent weed control than PRE. Refer to label for tank-mix options. Refer to pages 108-109 for commercial mixtures. A1 A3 C4 S4
Metolachlor & dichlormid safener s-Metolachlor & benoxacor safener	1 to 2 pt (0.95 to 1.9 lb)		PPI or PRE. Fall: After Sept 30 but before ground freezes.	s-Metolachlor may give greater weed control than metolachlor at the same product rates. Poor wild oat and wild mustard control. Adjust rate according to soil type. Less weed control than acetochlor products. PPI gives more consistent weed control than PRE. Refer to label for tank-mix options. Refer to pages 108-109 for commercial mixtures. A1 A3 C11 S4
Outlook Propel (dimethenamid-P)	16 to 21 fl oz (0.75 to 1 lb)		EPP, PPI or PRE.	Refer to pages 108-109 for commercial mixtures. C11 S4
Prowl Prowl H₂O (pendimethalin)	2.4 to 3.6 pt 3.3EC 2.1 to 3 pt 3.8ACS (1 to 1.5 lb)	Annual grass and some broadleaf weeds.	PRE or EPOST. Corn: Before 4-leaf stage. Weeds: Less than 1 inch tall.	DO NOT INCORPORATE. Seed corn at least 1.5 inches deep to ensure adequate separation of seed from herbicide. C14 Y1 Y18 Y24
Atrazine RUP	1.1 to 2.2 lb DF (1 to 2 lb)	Broadleaf weeds.	PPI and PRE. Spring only.	Soil residue will injure most crops planted the following year. Use higher rate on fine-textured soils. Consult label for crop rotation restrictions. Refer to pages 108-109 for commercial mixtures. C6 S4 Y1 Y4 Y8 Y24 X1

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Python (flumetsulam)	0.8 to 1.33 oz DG (0.64 to 1.06 oz)	Annual broadleaf weeds including nightshade.	EPP, shallow PPI, PRE or POST. Corn: Early spike stage.	Refer to label for tank-mix options and crop rotation restrictions. Python and Hornet have no grass activity and will leave a residue the following year. C15 S4 S7 X1 Y2 Y13 Y24
Balance Pro (isoxaflutole) RUP 	1.5 to 3 fl oz (0.75 to 1.5 oz)	Annual grass and broadleaf weeds including foxtails, millet, sandbur, pigweed, kochia, lambsquarters, nightshade, and mustards.	EPP, PPI or PRE. Corn: From 21 days before seeding until prior to corn emergence.	Adjust rate according to soil texture and pH. Shallow PPI and seed corn 1.5 inches deep. Cover seed completely with soil. Refer to label for rates, tank-mix options, and instructions to avoid corn injury. Injury is expressed as yellowing/chlorosis and may occur from misapplication, stress conditions. Refer to pages 108-109 for commercial mixtures. A1 C7 S4 Y8 Y24

POST Herbicides

Atrazine + oil adjuvant RUP	0.42 to 1.1 lb DF + 1 qt (0.38 to 1 lb)	Annual broadleaf weeds.	POST. Corn: Up to 12 inches tall. Weeds: Up to 1.5 inches tall.	Apply with other POST broadleaf and/or grass herbicides. Improves control of many grass and broadleaf weeds. Atrazine soil residue may injure crops planted the following year. Refer to pages 108-109 for commercial mixtures. C6 Y4-7 Y24
Aim (carfentrazone)	1/2 fl oz EW (0.128 oz)	Pigweed spp, lambsquarters, nightshade. Partial kochia control.	EPOST. Corn: Up to 12 inches tall. Weeds: SMALL - Up to 2 inches.	Contact herbicides may cause speckling/spotting on corn leaves that intercept spray. May tank-mix with most registered herbicides except bromoxynil. Refer to pages 108-109 for commercial mixtures. B4 C5 S3 S4-5 X1
Bromoxynil	1 to 1.5 pt EC (0.25 to 0.37 lb)	Small annual broadleaf weeds.	POST. Corn: Prior to tasseling. Weeds: Small	Contact, non-residual herbicide; apply to small weeds. Refer to pages 108-109 for commercial mixtures.
Dicamba	0.5 to 1 pt (0.25 to 0.5 lb)	Broadleaf weeds.	EPOST. Corn: From spike to 8 inches tall.	Apply at 0.5 pt/A with drop nozzles when corn is 8 to 36 inches tall or 15 days prior to tassel. Refer to pages 108-109 for commercial mixtures. C10 X1 Y11 Y24
Permit (halosulfuron) 	2/3 to 1.33 oz DF (0.5 to 1 oz)	Most large-seeded broadleaf weeds and nutsedge.	POST. Corn: Up to 36 inches tall.	Add NIS at 0.25 to 0.5% v/v or oil adjuvant with 28% UAN at 2 to 4 qt/A. Refer to label for additional information. C13 C20 Y3 Y24
Callisto (mesotrione)	3 fl oz (1.5 oz)	Most broadleaf weeds.	POST. Corn: Up to 30 inches tall or 8-leaf stage. Weeds: Small.	Apply with petroleum oil adjuvant at 1 qt/A + UAN at 2.5% v/v or AMS at 8.5 lb/100 gallons water. MSO or MSO blend adjuvants are not prohibited. Atrazine at 0.42 lb/A improves broadleaf weed control. Refer to pages 108-109 for commercial mixtures. Refer to label for additional information. C2 C9 X1 Y4 Y9 Y24
Impact (topramezone)	1/2 to 3/4 fl oz (0.175 to 0.26 oz)	Most broadleaf weeds and foxtail.	POST. Corn: Up to 45 day PHI. Weeds: Small.	Apply with petroleum oil or MSO-type adjuvant at 1 to 1.5% v/v plus 28% UAN at 1.25 to 2.5% v/v or AMS at 8.5 lb/A. Atrazine at 0.42 lb/A improves control of grass and broadleaf weeds. Impact may leave a residue the following year after application. Refer to label or narrative for tank-mix options, crop rotation restrictions, and other restrictions. C9 Y3 Y24
Laudis (tembotrione & isoxadifen safener) 	2 to 3 fl oz (0.88 to 1.31 oz)	Most broadleaf weeds and some grasses including barnyardgrass, yellow foxtail, proso millet. Partial green foxtail control.	POST. Corn: Up to V8. Weeds: Less than 3 to 4 inches tall.	Apply with MSO-type adjuvant at 1.25 pt/A or petroleum oil at 1% v/v plus 28% UAN at 1.5 qt or AMS at 1.5 lb/A. Atrazine at 0.42 lb/A improves control of grass and broadleaf weeds. Refer to label or narrative for tank-mix options, crop rotation restrictions, and additional information. C9 Y3 Y24

CORN

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Accent (nicosulfuron)	2/3 oz DF (0.5 oz)	Annual grasses, quackgrass and and some broadleaf weeds.	POST. Corn: Up to 20 inches with 6 or fewer collars. Use drop nozzles on 20 to 36 inch corn.	Use the lower rate when tank-mixed with labeled products. Apply with oil adjuvant at 1 to 2 qt/A + 28% UAN at 2 qt/A or AMS at 2 lb/A or with basic pH blend adjuvant at 1% v/v. Do not apply to corn previously treated with Counter 15G insecticide. Refer to label or narrative for other tank-mix options, crop rotation restrictions, and additional information. A7-8 C2-3 X1 Y3 Y24
Resolve (rimsulfuron)	3/4 to 1 oz DF (0.188 to 0.25 oz)		POST. Corn: Up to 12 inches tall with 5 or fewer collars.	Apply with oil adjuvant at 1 to 2 qt/A + 28% UAN at 2 qt/A or AMS at 2 lb/A or with basic pH blend adjuvant at 1% v/v. For corn hybrids of at least 77 day CRM. Refer to label for tank-mix options and crop rotation restrictions. A7-8 C2-3 X1 Y3 Y24
Steadfast (nicosulfuron & rimsulfuron)	3/4 oz DF (0.375 & 0.188 oz)			
Stout (nicosulfuron & thifensulfuron)	1/2 to 3/4 oz DF (0.338 to 0.5 & 0.025 to 0.038 oz)		POST. Corn: Up to 16 inches tall with 5 or fewer collars.	Apply with oil adjuvant at 1 to 2 qt/A + 28% UAN at 2 qt/A or AMS at 2 lb/A or with basic pH blend adjuvant at 1% v/v. Use on corn hybrids of at least 88 day CRM. Refer to label for tank-mix options and crop rotation restrictions. A7-8 C2-3 X1 Y3 Y24
Option (foramsulfuron & isoxadifen safener)	1.5 to 1.75 oz WG (0.53 to 0.61 & 0.53 to 0.61 oz)		POST. Corn: 6 or fewer collars. Weeds: 1 to 3 inches tall.	Apply with an approved MSO-type adjuvant at 1.5 pt/A + liquid nitrogen fertilizer at 1.5 to 2 qt/A. All crops can be planted the following year. Apply Option with Define SC at 9 fl oz SC for improved yellow foxtail control. Refer to label for tank-mix options, rotational crop restrictions, and additional information. A8 C12 S2 X1 Y3 Y24

NDSU Micro-rates

Stout + dicamba + atrazine + adjuvant RUP (nicosulfuron + thifensulfuron) or Stout + Lumax + adjuvant RUP (nicosulfuron + thifensulfuron) + (mesotrione & s-metolachlor & atrazine)	1/5 to 3/4 oz DF + 4 fl oz + 0.42 lb DF/3/4 pt L ((0.338 to 0.5 oz & 0.025 to 0.038 oz) + 0.188 oz + 0.375 lb) 1/5 to 3/4 oz DF + 3 pt ((0.338 to 0.5 oz & 0.025 to 0.038 oz) + (0.1 lb + 1 lb + 0.375 lb))	Grass and most broadleaf weeds. Stout rates less than 0.75 oz/A will not control yellow foxtail, wild proso millet, volunteer cereals, and quackgrass Lumax and atrazine improves yellow foxtail control.	POST. Corn: Up to 12 inches tall. Weeds: Small	User assumes all risk of inadequate weed control when herbicides are used at less than labeled rate. Accent at 0.33 to 0.67 oz DF/A or Steadfast at 0.38 to 0.75 oz/A can be substituted for Stout. Apply with basic pH blend or MSO-type oil adjuvant. Steadfast and Stout at 0.38 to 0.75 oz DF/A or Accent at 0.33 to 0.67 oz DF/A will control green foxtail and wild oat. Atrazine at 0.42 lb/A or 3/4 pt/A will allow most crops to be planted the following year, including sugarbeet, sunflower, and canola. Refer to Accent and Steadfast above for other precautions. Refer to label or narrative for tank-mix options, crop rotation restrictions, and additional information. A7 C2-3 C6 C9-10 X1 Y3 Y4 Y7 Y9 Y11 Y24
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Preharvest Application

Glyphosate	Up to 3.7 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds.	Preharvest.	<table border="1"> <thead> <tr> <th>lb ae/gal</th> <th>lb ai/gal</th> <th>0.75 ae</th> <th>1.5 ae</th> <th>3 ae</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>64 fl oz</td> <td>128 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>48 fl oz</td> <td>96 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>44 fl oz</td> <td>88 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>40 fl oz</td> <td>80 fl oz</td> </tr> </tbody> </table> <p>Apply when grain moisture is 35% or less and corn seed is physiologically mature (black layer formed). Allow a 7 day PHI. Apply with AMS fertilizer. Refer to label for adjuvant use. Follow label directions. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.75 ae	1.5 ae	3 ae	3	4	= 32 fl oz	64 fl oz	128 fl oz	4/4.17	5.4/5.1	= 24 fl oz	48 fl oz	96 fl oz	4.5	5.5	= 22 fl oz	44 fl oz	88 fl oz	5	6.1	= 20 fl oz	40 fl oz	80 fl oz
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Paraquat RUP	1 to 2 pt 2SL 0.8 to 1.3 pt 3SL (0.25 to 0.5 lb)	Annual broadleaf and grass weeds.		Apply with NIS at 0.25% v/v. Apply when grain moisture is 35% or less and corn seed is physiologically mature (black layer formed). Allow a 7 day PHI. C23																									

HERBICIDE-RESISTANT CORN

CLEARFIELD CORN

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Lightning (imazethapyr & imazapyr)	1.28 oz WDG (0.672 & 0.224 oz)	Annual grass and broadleaf weeds.	POST.	Apply only to Clearfield corn varieties. Apply with adjuvant and liquid fertilizer. Refer to label for weeds controlled, application information, and crop rotation restrictions. Apply with dicamba or Distinct for broad-spectrum broadleaf weed control including ALS-resistant kochia. C19 Y2 Y24 X1

LIBERTY LINK CORN

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Liberty (glufosinate)	28 to 34 fl oz (0.37 to 0.44 lb)	Annual grass and broadleaf weeds.	POST. Corn: Up to 24 inches tall or 7 collars (V7).	Apply only to glufosinate-resistant corn varieties. Liberty is contact, non-selective, non-residual herbicide. Apply with AMS at 3 lb/A. Controls weeds resistant to other herbicides. Refer to label for rotational crop restrictions and additional information. C20 S2 S7 X1
Liberty + Define (glufosinate + flufenacet)	28 to 34 fl oz + 9 oz SC (0.37 to 0.44 + 0.28 lb)	For improved yellow foxtail control.	POST. Corn: Up to 5 collars (V5). Weeds: 1 to 3 inches tall.	

ROUNDUP READY CORN

Herbicide	Product/A (ae/A)	Weeds	When to Apply	Remarks and Paragraphs																												
Glyphosate	Maximum single application = 0.75 lb ae Maximum in-crop = 1.5 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds.	POST. Corn: Up to 30 inches tall or 8 collars.	Apply only to Roundup Ready corn varieties. <table border="0"> <tr> <td></td> <td></td> <td>Maximum -</td> <td>Maximum -</td> </tr> <tr> <td></td> <td></td> <td>single appl.</td> <td>in-crop</td> </tr> <tr> <td></td> <td></td> <td>0.75 ae</td> <td>1.5 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>40 fl oz</td> </tr> </table> Apply with AMS fertilizer. Refer to label for tank-mix options, application information, and restrictions. A4-7 C21 X1			Maximum -	Maximum -			single appl.	in-crop			0.75 ae	1.5 ae	3	4	= 32 fl oz	64 fl oz	4/4.17	5.4/5.1	= 24 fl oz	48 fl oz	4.5	5.5	= 22 fl oz	44 fl oz	5	6.1	= 20 fl oz	40 fl oz
		Maximum -	Maximum -																													
		single appl.	in-crop																													
		0.75 ae	1.5 ae																													
3	4	= 32 fl oz	64 fl oz																													
4/4.17	5.4/5.1	= 24 fl oz	48 fl oz																													
4.5	5.5	= 22 fl oz	44 fl oz																													
5	6.1	= 20 fl oz	40 fl oz																													
RU OriginalMax RU PowerMax RU WeatherMax (glyphosate)	Maximum single application = 1 qt (1.125 lb ae) Maximum in-crop = 2 qt (2.25 lb ae)		POST. RUR Corn 2: Up to 30 inches tall or 8 collars. Drop nozzles: 30 to 48 inches tall (free standing).	Apply only to Roundup Ready Corn II varieties. Refer to glyphosate above for remarks. Apply with AMS fertilizer. Refer to paragraph for use of other glyphosate formulations. Refer to label for additional information, and restrictions. 4-7 C21 X1																												

Refer to page 126 for control of volunteer Roundup Ready canola and soybean in Roundup Ready corn.

WEED MANAGEMENT IN ROUNDUP READY CORN

NDSU recommends using herbicides with different modes of action and different weed control management practices in Roundup Ready corn production to delay development of glyphosate resistant weeds. See pages 106-107 for more information on weed resistance.

COMMANDMENT #1 - Control weeds when 2 to 4 inches tall to avoid yield loss. Remove weeds early especially when grass weed populations are high.

Glyphosate at 1.5 oz ae/A controls foxtail, at 2.25 oz ae/A controls volunteer small grain, and at 3 oz ae/A controls wild oat and downy brome. Use higher rates on broadleaf weeds, larger weeds, tolerant weeds, or if weeds are under environmental stress. See glyphosate section on page 68 for more information about increasing weed control from glyphosate.

Three Systems of Weed Control in RR Corn

1. PRE followed by glyphosate POST: All PRE herbicides require rain for activation.

Pages 16 and 17 list many registered PRE herbicides that can be used in herbicide resistant corn. PRE herbicides (acetochlor) at 2/3 the labeled rate will give 60 to 90% grass and broadleaf weed control, will reduce weed infestations emerging with corn, will allow more flexibility in application of POST herbicides, and will help protect yield from early season weed competition. NDSU studies often show greater grass and broadleaf weed control from acetochlor compared to other similar herbicides. Soil-applied atrazine is less effective than POST-applied due to soil adsorption and tie-up.

2. Glyphosate + POST broadleaf herbicide (different mode of action):

Several herbicides listed in the following table will help improve control of weeds not controlled by glyphosate. Glyphosate has no soil residual and will not control weeds emerging after application. Glyphosate may not control some weed species or biotypes. Many POST herbicides listed will give residual weed control. Most herbicide companies have marketing programs in RR corn. Follow label directions for tank-mix and application information. Corn is most tolerant to dicamba from spike to 4-inch corn stage.

3. Glyphosate (EPOST = 2 to 4 inch tall weeds) followed by glyphosate (POST = less than 24 inch tall corn):

This program will increase the risk of weed resistance unless other strategies are used in rotational crops - see Herbicide Resistant Weed Section, page 106-107.

The following table shows herbicides to apply in tank-mix or sequentially with glyphosate in RR corn for control of weeds not controlled by glyphosate. Weed ratings are control without glyphosate. Refer to label for tank-mix and specific application information. Residual weed control listed in the table refers to control of subsequent flushes of weeds after herbicide application.

Herbicide	Application	Weed Rating	Residual Control
Acetochlor	PRE	60-90%	No
Atrazine	PRE	Low	No
Bentazone	POST	High	Yes
Carfentrazone	POST	High	Yes
Dicamba	POST	High	Yes
Fluroxypyr	POST	High	Yes
Glufosinate	POST	High	No
Metolachlor	POST	High	Yes
Paraquat	POST	High	No
Trifluralin	PRE	Low	No

Herbicides to apply in tank-mix or sequentially with glyphosate in RR corn.

	Rate/A	Cost/A	Buckwheat, Wild	Canola, Vol. RR ¹	Horseweed (Marestail)	Kochia	Lambsquarters	Mallow, Common	Nightshade species	Prickly lettuce	Ragweed, Common	Smartweed, Annual	Waterhemp	
Preplant or PRE herbicides - no residual weed control			Weed Control Ratings³											
2,4-D	0.5 - 1 pt	\$1.00 - 2.00	P	P-G	E	P	E	P	N	E	E	F	G	
Aim	0.5 - 1 fl oz	\$2.80 - 5.60	P	N-P	N	F-E	F-G	-	N	F	N	N	E	
Dicamba	2 - 4 fl oz	\$1.25 - 2.50	E	N-P	E	G-E	F-G	P	G	G-E	E	E	F-G	
Thifensulfuron	See label	\$4.50 - 9.00	E	G-E	N	E ⁴	E	G-E	N	E ⁴	G	E ⁴	E ⁴	
Preplant or PRE herbicides - with residual weed control - See Combination herbicides for corn.														
Acetochlor	1.25 - 2.25 pt	\$12.50 - 25.00	P	N	N	F	E	N	G-E	-	F	P	E	
Atrazine ²	0.5 - 0.75 lb ai ²	\$1.25 - 2.00	E	E	E	E	E	-	E	E	G-E	E	E	
Balance Pro ²	1 - 2 fl oz	\$8.00 - 16.00	N	E	G-E	E	E	N	G-E	-	G-E	G	E	
Camix ²	0.8 - 1.6 qt	\$12.00 - 24.00	N	E	E	P-F	E	N	E	-	E	E	E	
Outlook	10 - 14 fl oz	\$12.00 - 16.50	N	N	N	N	E	N	G-E	-	N	N	G-E	
Radius ²	8 - 12 oz WDG	\$11.50 - 17.00	P	E	G	G	G	G	P	-	G	G	E	
SureStart ²	1.5 - 2 pt	\$15.00 - 17.00	E	E	E	E	E	-	E	-	E	E	E	
POST herbicides - See Combination herbicides for corn.														
Atrazine	<12 inches	0.38 lb ai	\$1.00	E	P-F	E	E	E	-	G-E	G	F-G	G	G
Callisto ² + atra ⁵	<30 inches	2 - 3 fl oz	\$10.00 - 14.50	E	E	E	E	E	-	E	E	E	E	E
Dicamba	<6 inches	4 - 8 fl oz	\$2.50 - 5.00	E	P-F	E	E	G-E	G	G-E	G-E	E	E	G-E
Halex GT ²	<30 inches	3.6 to 4 pt	\$-	E	E	E	E	E	-	E	-	E	E	E
Hornet ²	<24 inches	2 - 3 oz WDG	\$8.00 - 12.00	F-G	E	E	G-E ⁴	E	-	E	E	E	E	E
Impact ² + atra ⁵	45 day PHI	0.5 - 0.75 fl oz	\$10.50 - 15.50	E	E	E	E	E	-	E	E	E	E	E
Laudis ² + atra ⁵	<V8	2 - 3 fl oz	\$8.00 - 12.00	E	E	E	E	E	-	E	E	E	E	E
Lumax ²	<12 inches	1 - 2 pt	\$6.60 - 13.50	E	E	E	E	E	-	E	-	E	E	E
Resolve ²	<12 inches	1 oz DF	\$7.00	N	E	N	E ⁴	F	-	P	-	P	-	F-E ⁴
Status	4-36 inches	2.5 - 5 oz WDG	\$6.25 - 12.50	E	G-E	E	E	E	G	E	E	E	E	E
WideMatch ²	<V5 stage	0.75 - 1 pt	\$6.10 - 8.20	E	P	E	E	E	G	E	E	E	E	E

¹See page 126 for size of volunteer canola and herbicide rates.

²May carry over more than one cropping season. Follow labeled crop rotation restrictions. See pages 110-116.


³E = Excellent (90-99%), G = Good (80-90%), F = Fair (65-80%), P = Poor (40-65%), N = None.

⁴Except where resistant populations have developed. ⁵Atrazine at 0.38 lb ai/A. Atrazine and mixtures containing atrazine are RUP.

Combination Herbicides for Corn:

Trade Name	Manufacturer	Applied at (Prod/A)...	Cost/A	Gives the equivalent product/A rates of:
Basis	Dupont	0.33 oz	\$5.30	0.66 oz Resolve + 0.11 oz Harmony GT
Breakfree ATZ Lite	Dupont	1.33 qt	\$16.00	See Keystone LA
Camix	Syngenta	0.8 qt	\$12.00	0.7 pt Dual II Magnum + 2.15 fl oz Callisto
Field Master	Monsanto	1.33 qt	\$9.30	0.75 pt Harness + 0.5 lb ai atrazine + 5.3 fl oz RU PowerMax
G-max Lite	BASF	1.5 pt	\$11.25	8.5 fl oz Outlook + 0.5 lb ai atrazine
Halex GT	Syngenta	2.6 pt	\$-	0.7 pt Dual Magnum + 2.15 fl oz Callisto + 1.8 pt glyphosate-ipa (3 lb ae/gal)
Hornet	Dow	2 oz	\$8.00	2.67 fl oz Stinger + 0.47 oz Python
Keystone LA	Dow	1.33 qt	\$16.00	1.66 pt Surpass + 0.5 lb ai atrazine
Lumax	Syngenta	2 pt	\$13.50	0.7 pt Dual II Magnum + 2.15 fl oz Callisto + 0.25 lb atrazine 90DF
Priority	Tenkos	1 oz	\$10.00	0.5 fl oz Aim + 0.67 oz Permit
Radius	Bayer	9 fl oz	\$12.70	8 fl oz Define + 0.9 fl oz Balance pro
Sequence	Syngenta	1.5 pt	\$10.35	18 fl oz glyphosate-ipa + 0.6 pt Dual II Magnum
SureStart	Dow	1.5 pt	\$14.10	14 fl oz Surpass + 1.7 oz Stinger (Hornet) + 2 oz Python (Hornet)
		1.75 pt	\$16.40	16 fl oz Surpass + 2 oz Stinger (Hornet) + 2.3 oz Python (Hornet)
		2 pt	\$18.75	19 fl oz Surpass + 2.3 oz Stinger (Hornet) + 2.6 oz Python (Hornet)
WideMatch	Dow	1 pt	\$8.15	4 fl oz Stinger + 4 fl oz Starane
Yukon	Gowan	4 oz	\$7.50	0.5 oz Permit + 3 fl oz Banvel/Clarity

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Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. Commercial mixtures available. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae																													
3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz																													
4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz																													
4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz																													
5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Paraquat	2 to 4 pt 2SL RUP 1.3 to 2.7 pt 3SL (0.5 to 1 lb)			Non-residual, contact herbicides; thorough coverage essential. Apply with a NIS at 0.25% v/v to small weeds.																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.		Refer to pages 108-109 for commercial mixtures. B4 S1 S3-4 Q3 X1																														
Thifensulfuron	0.3 to 0.6 oz DF 0.45 to 0.9 oz SG (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat and vol. RR canola.		Improves broadleaf weed control including wild buckwheat when tank-mixed with glyphosate. Add NIS at 0.25 to 0.5% v/v. D15 D18 S1 X1																														
2,4-D	1 to 2 pt 4EC/SL (0.5 to 1 lb)	Preplant burndown of emerged annual broadleaf weeds. Days before seeding: 1 pt amine = 15 days. 1 pt ester = 7 days. 2 pt amine or ester = 30 days.		A preplant application for use only in reduced tillage. Soybean injury may occur. Seed at least 1.5 to 2 inches deep to ensure seed is separated from the herbicide. Refer to pages 108-109 for commercial mixtures. D2 X1																														
Prowl Prowl H₂O (pendimethalin)	2.4 to 3.6 pt EC 2.1 to 3 pt ACS (1 to 1.5 lb)	Annual grass and some broadleaf weeds.	PPI. Fall or Spring.	Adjust rate according to soil type. Do not apply Sonalan or trifluralin PRE. No wild mustard and poor wild oat control. Green foxtail has become resistant to dinitroaniline (DNA) herbicides in North Dakota. Refer to pages 108-109 for commercial mixtures. A1-3 D13 S7 X1 Y18 Y24																														
Sonalan Sonalan 10G (ethalfluralin)	1.5 to 3 pt 5.5 to 11.5 10G (0.55 to 1.15 lb)																																	
Trifluralin	1 to 2 pt (0.5 to 1 lb)																																	
Sencor (metribuzin)	Soil pH >7.5 = 0.25 lb DF Soil pH <7.5 = 0.33 to 0.5 lb DF	Broadleaf weeds including wild mustard.	PPI.	Sencor may injure certain soybean varieties. Refer to pages 108-109 for commercial mixtures. D12 S7 Y4 Y17 Y24																														
Metolachlor s-Metolachlor	1 to 2 pt (0.95 to 1.9 lb)	Grass and some broadleaf weeds.	PPI or PRE.	s-Metolachlor may give greater weed control than Metolachlor at equal product rates. Poor wild oat control and wild mustard control. PPI gives more consistent control than PRE. PRE requires precipitation for herbicide activation. Adjust rate according to soil type and OM.																														
Intrro (alachlor)	RUP 2 to 3 qt (2 to 3 lb)			Outlook gives greater nightshade control. Refer to pages 108-109 for commercial mixtures. A1 C11 D8																														
Outlook Propel (dimethenamid-P)	16 to 21 fl oz (0.75 to 1 lb)		PPI, PRE or EPOST.																															
Valor (flumioxazin)	2 to 3 oz WDG (1 to 1.5 oz)	Small-seeded broadleaf weeds including pigweed, nightshade, kochia lambsquarters, and B. wormwood.	EPP, Shallow PPI, and PRE.	Requires precipitation to activate herbicide. Refer to label or narrative for tank-mix options, application information, rate structure, and crop rotation restrictions. Refer to pages 108-109 for commercial mixtures. D6 D16 S3-5 S7 Y24 D6 D14 S3 S4-5 S7 X1 Y2 Y19 Y24																														
Spartan (sulfentrazone)	3 to 8 fl oz F (1.5 to 4 oz)																																	
Python (flumetsulam) 	0.8 to 1.33 oz DG or 5 to 3 A/pack (0.64 to 1.06 oz)	Python does not control ALS resistant kochia.		D10 S4 S7 Y2 Y13 Y24																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST Herbicides				
Basagran (bentazon)	1 to 2 pt (0.5 to 1 lb)	Some broadleaf weeds. Suppression of biennial wormwood and Can. thistle.	POST. Soybean: Any stage. Broadleaf weeds: Small.	Contact, non-residual herbicide; thorough coverage required. Apply with oil additive at 1 qt/A. Two applications at a 7 to 10 day interval improves weed control. Apply first treatment at unifoliate to first trifoliate soybean. D4 E6 S4 S7 T2
Rezt (Co-pack of bentazon & sethoxydim)	1.6 + 1.6 pt (1 & 0.2 lb)	Grass and broadleaf weeds.	POST. Soybean: Emergence to 30 days PHI.	Apply with oil adjuvants at 1 to 2 pt/A. Refer to Basagran and Poast sections for additional information. Tank-mix with Raptor at 2 fl oz/A for improved weed control. D3-4 E6
Ultra Blazer (acifluorfen)	0.5 to 1.5 pt (0.125 to 0.375 lb)	Wild mustard, redroot pigweed, and volunteer flax.	POST. : Soybean: 1 to 2 trifoliates. Weeds: 1 to 4 inches tall.	Contact, non-residual herbicide; thorough coverage required. Apply when temperature exceed 70 F. D5 S4
Cobra (lactofen)	6 to 12.5 fl oz (1.5 to 3.2 oz)	Small broadleaf weeds.	POST. Up to 45 days before harvest. Weeds: 2 to 6 inches.	Contact herbicide, thorough coverage required. Apply with oil adjuvant at 1 to 2 pt/A. Refer to narrative for environmental response, tank-mix options, and for white mold suppression. D5 S4
Flexstar (fomesafen + adjuvants)	0.75 to 1 pt (0.176 to 0.24 lb)	Broadleaf weeds including pigweed, cocklebur, Venice mallow, mustard, ragweed, smartweed, black nightshade, kochia including resistant. Poor hairy nightshade control.	POST. Soybean: Prior to flowering. Weeds: 2- to 4-leaf stage.	Contact herbicide requiring thorough coverage. Use at 1pt/A in ND east of I-29 and south of I-94 and at 1 pt/A in MN south of I-94. Use 0.75 pt/A in ND east of Hwy 281 and in MN south of US Hwy 2. Refer to label for crop rotation restrictions. Use MSO adjuvants at 1% v/v + AMS at 10 lb/100 gal water. Follow restrictions for each geographic region. To improve kochia control apply with oil adjuvant, at high water volume, and to kochia less than 2 inches tall. Sequential applications may be necessary. A7 D7 S3 S4-5 Y12 Y24
FirstRate (cloransulam)	0.3 oz WDG or 10 A/pack (0.25 oz)	Venice mallow, cocklebur, horseweed, ragweed, sunflower, and wild mustard.	POST. Soybean: Up to 50% of plants flowering. Weeds: Up to 10 inches tall.	Apply with NIS at 0.125% v/v or oil adjuvant at 1.2% v/v alone or with 28% UAN at 2.5% v/v. Refer to label or narrative or label for weed size, tank-mix options and crop rotation restrictions. Refer to pages 108-109 for commercial mixtures. D6 X1 Y2 Y24
Thifensulfuron	1/12 oz DF 1/8 oz SP (0.062 oz)	Wild mustard, pigweed, and lambsquarters. No ALS-resistant kochia control.	POST. Soybean: Fully expanded 1st trifoliate leaf until 60 days PHI.	Apply with a NIS at 0.25% v/v or oil additive plus 28% UAN or AMS. Refer to label for tank-mix options. D15 S1 S5 X1
Pursuit (imazethapyr)	3 fl oz (0.75 oz)	Annual broadleaf weeds including nightshade, kochia, pigweed, and mustard.	POST. Soybean: Fully expanded first trifoliate leaf but prior to flowering.	Apply with NIS or oil adjuvant and liquid fertilizer. MSO-type oil adjuvants have given greater enhancement than petroleum oil or NIS. Refer to narrative for application information, weed size, crop rotation restrictions, and other use information. Raptor has less soil residual carryover than Pursuit. Poor common lambsquarters (>2 inches), ragweed, wild buckwheat and biennial wormwood control. No control of ALS-resistant kochia. A7 D9 D11 S4 X1 Y2 Y6 Y24
Raptor (imazamox)	4 to 5 fl oz (0.5 to 0.625 oz)	Annual grass and broadleaf weeds.	Weeds: Small and actively growing.	

SOYBEAN

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Assure II Targa (quizalofop)	4 to 10 fl oz (0.44 to 1.1 oz)	Annual grasses and quackgrass.	Soybean: Prior to pod set.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. Grass control is reduced by tank mixtures or close interval application of POST broadleaf control herbicides. Antagonism generally can be avoided by applying a higher rate of grass herbicide or apply the grass control herbicide 1 or more days before or 5 to 7 days after the broadleaf control herbicide. Do not cultivate prior to 5 days before or 7 days after application. Refer to label for tank-mix options. Refer to page 126 for control of volunteer corn. D3 X1
Fusilade DX (fluazifop-P)	5 to 12 fl oz (1.25 to 3 oz)		Grass weeds: Refer to table below.	
Fusion (fluazifop-P & fenoxaprop)	4 to 12 fl oz (1 to 3 oz & 0.32 to 0.96 oz)			
Poast (sethoxydim)	0.5 to 1.5 pt (0.09 to 0.28 oz)	Annual grasses.	Soybean: All stages.	
Clethodim	4 to 16 fl oz (1 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: Refer to table below.	
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)			

GRASS CONTROL WITH POST HERBICIDES

Herbicide	Weed size (inches)	Rate (fl oz/A)	Herbicide	Weed size (inches)	Rate (fl oz/A)	Herbicide	Grass size (inches)	Rate (fl oz/A)
Green and yellow foxtail			Wild-proso millet			Volunteer corn		
Assure II/Targa	2 to 4	8	Assure II/Targa	2 to 6	8	Assure II/Targa	6 to 30	4 to 8
Fusilade DX	2 to 4	10 to 12	Fusilade DX	4 to 8	6	Fusilade DX	12 to 24	4 to 8
Fusion	2 to 4	8	Fusion	4 to 8	6	Fusion	12 to 24	6
Poast	1 to 8	1 pt	Poast	4 to 10	0.5 pt	Poast	1 to 20	1 pt
Clethodim	2 to 8	4 to 6	Clethodim	1 to 10	4 to 6	Clethodim	4 to 12	4
Select Max	2 to 6	9	Select Max	2 to 6	9	Select Max	12 to 24	6
	6 to 8	12		6 to 8	12		1 to 12	6
Wild oat, Vol. small grains, Sandbur			Quackgrass				12 to 24	9
Assure II/Targa	2 to 6	8	Assure II/Targa	6 to 10	10 fb 8		24 to 36	12
Fusilade DX	2 to 6	8	Fusilade DX	6 to 10	12 fb 8			
Fusion	2 to 6	8	Fusion	6 to 10	12 fb 12			
Poast	1 to 4	1 pt	Poast	6 to 8	1.5 fb 1 pt			
Clethodim	2 to 6	6	Clethodim	4 to 12	8 fb 8			
Select Max	2 to 6	9	Select Max	4 to 12	12 fb 12			
	6 to 8	12						
						Refer to page 126 for control of volunteer corn.		

Preharvest Application

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	Up to 0.75 lb ae See Remarks.	Preharvest weed control.	Prior to harvest. Apply after pods have set and lost all green color. Allow a 7 day PHI.	Apply with AMS fertilizer. Refer to label for adjuvant use. Do not apply on soybean grown for seed because reduced germination/vigor may occur. A4-6
Paraquat	8 to 12 fl oz 2SL RUP 5.6 to 8.4 fl oz 3SL (0.13 to 0.188 lb)	Desiccant.	Prior to harvest. Allow a 15 day PHI.	Apply with NIS at 0.125% v/v. Apply when at least 65% of seed pods are a mature brown color or when seed moisture is 30% or less. Q3

ROUNDUP READY SOYBEAN

Herbicide	Product/A (ae/A)	Weeds	When to Apply	Remarks and Paragraphs																					
Glyphosate	<p>Maximum single application = 1.5 lb ae</p> <p>Maximum in-crop = 2.25 lb ae</p> <p>See Remarks.</p>	Annual and perennial grass and broadleaf weeds.	<p>POST. Soybean: Emergence through R2 of full flowering. The R2 stage ends when a pod 3/16 inch long at one of the four uppermost nodes appears on the main stem along with a fully developed leaf (R3 stage).</p> <p>Allow a 14 day PHI.</p>	<p>Apply only to glyphosate-resistant soybean varieties.</p> <table border="0"> <tr> <td></td> <td>Maximum -</td> <td>Maximum -</td> </tr> <tr> <td></td> <td>single appl.</td> <td>in-crop</td> </tr> <tr> <td></td> <td>1.5 ae</td> <td>2.25 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 40 fl oz</td> </tr> </table> <p>Apply with AMS fertilizer. Multiple applications may be necessary for weed flushes. Drift and off-site movement may cause injury or death to other plants and crops. Refer to label for weeds controlled, application information, adjuvant use, tank-mix options with residual herbicides and restrictions. Cannot plant harvested patented soybean seed.</p> <p>A4-6 A7 D17 S4 X1</p>		Maximum -	Maximum -		single appl.	in-crop		1.5 ae	2.25 ae	3	4	= 64 fl oz	4/4.17	5.4/5.1	= 48 fl oz	4.5	5.5	= 44 fl oz	5	6.1	= 40 fl oz
	Maximum -	Maximum -																							
	single appl.	in-crop																							
	1.5 ae	2.25 ae																							
3	4	= 64 fl oz																							
4/4.17	5.4/5.1	= 48 fl oz																							
4.5	5.5	= 44 fl oz																							
5	6.1	= 40 fl oz																							

Refer to page 126 for control of volunteer Roundup Ready corn and canola in Roundup Ready soybean.

ROUNDUP READY/STS (sulfonylurea-tolerant) SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Thifensulfuron	<p>0.33 oz DF</p> <p>0.5 oz SG</p> <p>(0.25 oz)</p>	Annual broadleaf weeds including, wild buckwheat, lambsquarters, mustard species, and volunteer RR canola.	<p>POST. RUR/STS soybean: 1st fully expanded trifoliolate to 60 days PHI.</p>	<p>Apply only to RUR/STS soybean varieties.</p> <p>Apply with glyphosate at 0.38 to 1.125 lb ae/A. Apply with NIS at 0.125 to 0.25% v/v to non-loaded glyphosate. Refer to label for adjuvant use. Apply with AMS at 4.25 to 8 lb/100 gal water. Refer to label for weeds controlled, application information, and crop rotation restrictions. Refer to page 126.</p> <p>D15 D17-18 X1</p>

Refer to Roundup Ready soybean above for use of glyphosate in RUR/STS soybean.

WEED MANAGEMENT IN ROUNDUP READY SOYBEAN

NDSU recommends using herbicides with different modes of action and different weed control management practices in Roundup Ready soybean production to delay development of glyphosate resistant weeds. See pages 106-107 for more information on weed resistance.

COMMANDMENT #1 - Control weeds BEFORE 2 to 4 inches tall to avoid yield loss.

Remove weeds early especially when grass weed populations are high. Data from the mid-west may indicate that soybean yield may not be reduced by weeds up to 6 inches tall. However, data from the northern Plains show that, especially under dry conditions, soybean yield loss may occur if weeds greater than 4 inches are allowed to compete with soybean.

Glyphosate at 1.5 oz ae/A controls foxtail, at 2.25 oz ae/A controls volunteer small grain, and at 3 oz ae/A controls wild oat and downy brome. Use higher rates on broadleaf weeds, larger weeds, tolerant weeds, or if weeds are under environmental stress. See glyphosate section on page 68 for more information about increasing weed control from glyphosate.

Three Systems of Weed Control in RR Soybean

1. PRE followed by glyphosate POST: All PRE herbicides require rain for activation.

Page 22 lists many registered PRE soybean herbicides that can be used in herbicide resistant soybean. PRE herbicides at 2/3 the labeled rate may give 60 to 90% control of some grass and broadleaf weeds, will reduce weed infestations emerging with soybean, will allow more flexibility in application of POST herbicides, and will help protect yield from early season weed competition.

2. Glyphosate + POST broadleaf herbicide (different mode of action):

Several herbicides listed in the following table will improve control of weeds not controlled by glyphosate. Glyphosate has no soil residual. Glyphosate has no soil residual and will not control weeds emerging after application. Glyphosate may not control some weed species or biotypes. Many POST herbicides listed will give residual weed control. Most herbicide companies have marketing programs in RR soybean. Follow label directions for tank-mix and application information.

3. Glyphosate (EPOST = 2 to 4 inch tall weeds) followed by glyphosate (POST = 14 to 21 days later):

This program will increase the risk of weed resistance unless other strategies are used in rotational crops - see Herbicide Resistant Weed Section, page 106-107.

The following table shows herbicides to apply in tank-mix or sequentially with glyphosate in RR soybean for control of weeds not controlled by glyphosate. Weed ratings are control without glyphosate. Refer to label for tank-mix and specific application information. Residual weed control listed in the table refers to control of subsequent flushes of weeds after herbicide application.

Herbicides to apply in tank-mix or sequentially with glyphosate in RR soybean for control of weeds not controlled by glyphosate.

Rate/A	Cost/A	Buckwheat, Wild	Canola, Vol. RR ¹	Horseweed (Marestail)	Kochia	Lambsquarters	Mallow, Common	Nightshade species	Prickly lettuce	Ragweed, Common	Smartweed, Annual	Waterhemp
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Preplant or PRE herbicides - no residual weed control

Weed Control Ratings³

Herbicide	Plant	Rate	Cost/A	Buckwheat, Wild	Canola, Vol. RR ¹	Horseweed (Marestail)	Kochia	Lambsquarters	Mallow, Common	Nightshade species	Prickly lettuce	Ragweed, Common	Smartweed, Annual	Waterhemp
2,4-D ester	Plant >7 d	0.5 - 1 pt	\$1.00 - 2.00	P	P-G	E	P	E	P	N	E	E	F	G
Aim		0.5 - 1 fl oz	\$2.80 - 5.60	P	N-P	N	F-E	F-G	-	N	F	N	N	E
Thifensulfuron		See label	\$4.50 - 9.00	E	G-E	N	E ⁴	E	G-E	N	E ⁴	G	E ⁴	E ⁴
Rage D-tech	Plant >14 d	8 - 24 fl oz	\$ -	E	G-E	N	E ⁴	E	G-E	N	E ⁴	G	E ⁴	E ⁴

Preplant or PRE herbicides - with residual weed control - See Combination herbicides for soybean.

Herbicide	Rate	Cost/A	Buckwheat, Wild	Canola, Vol. RR ¹	Horseweed (Marestail)	Kochia	Lambsquarters	Mallow, Common	Nightshade species	Prickly lettuce	Ragweed, Common	Smartweed, Annual	Waterhemp
Prowl, Sonalan, Treflan ² - PPI	See label	\$3.00 - 8.00	N	N	N	P	F-E	N	N	N	N	P	F-E
Python ²	0.8 - 1 oz DG	\$8.00 - 10.00	F-G	E	E	E ⁴	E	-	E	-	P	G-E	E ⁴
Spartan ²	3 - 4.5 fl oz	10.00 - 15.00	P-F	P	E	E	E	-	F-E	P	P	E	E
Valor	2 - 2.5 oz WDG	9.40 - 11.75	P-F	P	E	E	E	E	E	E	P	F	E

POST herbicides - See Combination herbicides for soybean.

Herbicide	Rate	Cost/A	Buckwheat, Wild	Canola, Vol. RR ¹	Horseweed (Marestail)	Kochia	Lambsquarters	Mallow, Common	Nightshade species	Prickly lettuce	Ragweed, Common	Smartweed, Annual	Waterhemp	
FirstRate ²	<50% flowr	0.3 oz WDG	\$8.70	P-F	P-G	E ⁴	P ⁴	P	-	N	-	E	E	N
Flexstar ²	< Flowering	0.5 - 0.75 pt	\$7.00 - 10.00	P	E	N	G-E	P-F	G-E	F-E	-	G-E	G-E	E
Harmony GT	60 day PHI	1/12 oz XP	\$1.20	P	P-F	N	F-G ⁴	G	N	N	P ⁴	N	G-E	N
Pursuit ²	< Flowering	2 - 3 fl oz	\$8.15 - 12.20	P	E	N	E ⁴	P-F	P	E	E ⁴	P	G	N
Raptor ²	< Flowering	2 - 3 fl oz	8.15 - 12.20	P	E	N	E ⁴	F	P	E	G ⁴	P	G-E	N

¹See page 126 for size of volunteer canola and herbicide rates.

²May carry over more than one cropping season. Follow labeled crop rotation restrictions. See pages 110-116.

³E = Excellent (90-99%), G = Good (80-90%), F = Fair (65-80%), P = Poor (40-65%), N = None.

⁴Except where resistant populations have developed.

⁵Registration Pending

Combination Herbicides for Soybean:

Trade Name	Manufacturer	Applied at (Prod/A)...	Cost/A	Gives the equivalent product rates of:
Authority Assist	FMC	-	Pending	- fl oz Spartan + - fl oz Pursuit
Authority First	FMC	2.4 oz 3.2 oz	\$9.60 \$12.80	3 fl oz Spartan + 0.2 oz FirstRate 4 fl oz Spartan + 0.3 oz FirstRate
Authority MTZ	FMC	10 oz 12 oz	\$10.30 \$12.40	3.6 fl oz Spartan + 3.6 oz Sencor 4.33 fl oz Spartan + 4.33 oz Sencor
Boundary	Syngenta	1.2 pt	\$11.70	0.83 pt Dual Magnum + 4 oz Sencor
Domain	Bayer	9 oz	\$7.00	4.33 fl oz Define + 4.33 oz Sencor
Extreme	BASF	1.5 pt 2.25 pt	\$6.75 \$9.00	2 fl oz Pursuit + 12 fl oz glyphosate-ipa (3 lb ae/gal) 3 fl oz Pursuit + 18 fl oz glyphosate-ipa (3 lb ae/gal)
Gangster (co-pack)	Valent	1.8 oz	\$12.50	1.5 oz Valor + 0.3 oz FirstRate
Pursuit Plus	BASF	1.8 pt 20 fl oz	\$12.40 \$8.60	1.28 pt Prowl H ₂ O + 2.9 fl oz Pursuit 0.88 pt Prowl H ₂ O + 2 fl oz Pursuit
Rage D-tech*	FMC	8 fl oz 16 fl oz	\$3.35 \$6.65	½ fl oz Aim + 0.5 pt 2,4-D ester - apply only EPP. 1 fl oz Aim + 1 pt 2,4-D ester - apply only EPP.
Sequence	Syngenta	1.5 pt	\$10.35	18 fl oz glyphosate-ipa + 0.6 pt Dual II Magnum
Sonic	Dow	3.2 oz	\$12.80	See Authority First

* Plant no earlier than 14 days after application

DRY EDIBLE BEAN

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. Commercial mixtures available. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae																													
3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz																													
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5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Paraquat	RUP 2 to 4 pt 2SL 1.3 to 2.7 pt 3SL (0.5 to 1 lb)			Non-residual, contact, herbicides; thorough plant coverage required. Apply with a NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Eptam (EPTC)	3.5 to 4.5 pt 15 to 20 lb G (3 to 4 lb)	Grass and some broadleaf weeds.	PPI.	PPI immediately after application. Consult label for rate range for specific tank mix. A1-3 E2 S4																														
Prowl Prowl H ₂ O (pendimethalin)	2.4 to 3.6 pt 3.3EC 2.1 to 3 pt 3.8ACS (1 to 1.5 lb)		PPI. Fall or Spring.	Apply when soil temperature is <45 F for fall applications. Adjust rate according to soil type. Refer to label for rotational restrictions and tank-mix options. A1 D13 S7 Y20 Y25																														
Trifluralin	1 to 2 pt EC 5 to 10 lb 10G (0.5 to 1 lb)			PPI within 24 hours after application. Refer to label for tank-mixtures and crop rotational restrictions. A1 A3 D13 S7 X1 Y1 Y18 Y24																														
Sonalan (ethalfluralin)	1.5 to 4.5 pt EC (0.55 to 1.69 lb) 5.5 to 11.5 lb 10G (0.55 to 1.15 lb)			No wild mustard and poor wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Use EC formulation in spring and 10G formulation in fall. Refer to narrative for rotational restrictions. A1 A3 D13 S7 Y18 Y24 X1																														
Metolachlor s-Metolachlor	1 to 2 pt (0.95 to 1.9 lb)	Grass and some broadleaf weeds.	Spring: PPI or PRE.	s-metolachlor may give greater weed control than metolachlor at equal product rates. Poor on wild mustard and wild oat.																														
Outlook Propel (dimethenamid-P)	16 to 21 fl oz (0.75 to 1 lb)		PPI, PRE, or EPOST.	Adjust rate according to soil type and OM. PPI improves consistency of weed control. Outlook provides greater nightshade control.																														
Intro (alachlor)	RUP 4 to 6 pt (2 to 3 lb)		PPI.	Refer to pages 108-109 for commercial mixtures. A1 C11 E3 S4																														
Permit (halosulfuron)	1/2 to 2/3 oz DF (0.38 to 0.5 oz)	Cocklebur, Venice mallow, ragweed, nutsedge smartweed, sunflower, and nutsedge.	PPI or PRE.	Use lower rate on coarse-textures soils. Refer to label for tank-mix options, crop rotation restrictions, and other restrictions. C13 Y3 Y24																														
Pursuit Plus (imazethapyr & pendimethalin)	20 fl oz (0.5 oz & 0.42 lb)	Broadleaf weeds including pigweed, wild mustard, and nightshade.	PPI. Up to 1 week before planting.	May be tank-mixed with other labeled herbicides including Prowl H ₂ O. A1 A7 D9 E4 G1 H1 S4-5 S7 X1 Y2 Y20 Y25																														
Pursuit (imazethapyr)	2 fl oz (0.5 oz)	Pursuit Plus may control wild buckwheat. No control of ALS-resistant kochia.	Shallow PPI, PRE, POST. Drybean: After 1 st trifoliolate but prior to flowering.	User assumes all risk of crop injury. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply prior to or during stress conditions (cold/wet). Allow a 60 day PHI. Refer to label for tank-mix options, application information, weed size, crop rotation restrictions, and other use information. A7 D9 E4 G1 H1 S4-5 X1 Y2 Y24																														
Raptor (imazamox)	4 fl oz (0.5 oz)	Annual grass and broadleaf weeds. No control of ALS-resistant kochia.	POST. Drybean: After 1 st trifoliolate but prior to flowering.	Apply with NIS or oil additive plus 28% UAN. Do not use oil adjuvant + 28% UAN during high temperature and humidity. Refer to label for use information. A7 D11 S4 X1 Y2 Y6 Y24																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Basagran (bentazon)	1 to 2 pt (0.5 to 1 lb)	Some broadleaf weeds. Suppression of biennial wormwood and Canada thistle.	POST. Dry bean: After emergence. Broadleaf weeds: Small.	Contact herbicide; thorough spray coverage required. Apply with oil adjuvant at 1 qt/A. Two applications at a 7 to 10 day interval improves overall weed control. Apply the first treatment at unifoliate to first trifoliate dry bean. D4 E6 S4 S7 T2
Rezult (bentazon & sethoxydim)	1.6 + 1.6 pt (1 & 0.2 lb)	Grass and broadleaf weeds.	POST. Dry bean: 1 st trifoliate to 30 days prior to harvest.	Add oil adjuvants at 1 to 2 pt/A. Tank-mix with Raptor at 2 fl oz/A for improved weed control. Refer to Basagran and Poast sections for use information. D3-4 E6 S7
Reflex (fomesafen)	0.75 pt (0.19 lb)	Annual broadleaf weeds including ragweed, kochia, and nightshade including ALS-resistant.	POST. Dry bean: 1 st trifoliate to bloom. Weeds: 1 to 4 inches.	Apply with NIS at 0.125 to 0.25% v/v or oil adjuvant at 0.5 to 1% v/v. Allow a 30 day PHI. Oil adjuvant may increase risk of crop injury. Refer to label for weeds controlled, application information, risk of crop injury, and crop rotation restrictions. A7 E5 S3 S4-5 Y14 Y25
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Dry bean: Allow a 30 day PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations.
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	Grass: Refer to soybean section on page 26.	Refer to soybean section, label, or narrative for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. D3 X1
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)			

NDSU Micro-rate

Rezult + Raptor + Reflex + Clethodim + MSO adjuvant	0.5 to 0.6 & 0.5 to 0.6 pt + 1 fl oz + 2 to 4 fl oz + 2 fl oz (optional) + 1 to 1.5 pt/A	Grass and broadleaf weeds, including kochia, pigweed, and nightshade. May not control wild buckwheat.	POST. Weeds. Small. Must be less than 2 to 3 inches tall.	User assumes all risk of inadequate weed control when using this reduced-rate treatment. Must be applied with MSO or MSO + basic pH blend. Clethodim can be excluded if grass infestation is low. Refer to label for crop rotation restrictions and additional information. A5 A7 D3-4 D7-11 E4-6 S3-4 X1 Y2 Y12 Y24
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Preharvest Application

Glyphosate	Up to 0.75 lb ae	Harvest aid/ Weed control.	After dry bean pods have turned yellow and leather texture. At hard dough bean seed stage and 30% or less seed moisture.	DO NOT USE AS CROP DESICCANT. Only certain formulations are labeled. Refer to label. Non-selective, non-residual, translocated, foliar herbicide. Allow a 7 day PHI. Do not apply to dry bean grown for seed because reduced germination/vigor may occur. A4-6 X1
Paraquat RUP	1.5 to 2 pt 2SL 1 to 1.3 pt 3SL (0.375 to 0.5 lb)	Desiccant.	At least 80% pods are yellow/brown.	Apply when no more than 40% (bush type beans) or 30% (vine type) of the leaves still green. Sequential applications may be needed. Contact herbicides; thorough coverage required. Allow a 7 day PHI for paraquat. Allow a 3 day PHI for Aim. Allow a 5 day PHI for Valor. B5 Q3
Aim + MSO adjuvant (carfentrazone)	2 to 6 fl oz EC + 1 qt/A (0.53 to 1.5 oz)			
Valor + MSO adjuvant (flumioxazin)	1.5 to 3 fl oz + 1 qt/A (0.77 to 1.53 oz)			
Registration Pending				

FIELD PEA


Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Paraquat	2 to 4 RUP 1.3 to 2.7 pt (0.5 to 1 lb)			Non-residual, contact herbicides; thorough coverage required. Apply with a NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Far-Go (triallate)	1.25 qt EC 12.5 to 15 lb 10G (1.25 lb liquid or 1.25 to 1.5 lb 10G)	Wild oat.	PPI.	PPI immediately after application. A two pass incorporation is recommended. A1 A3 B14 F1																														
Prowl Prowl H ₂ O (pendimethalin)	1.75 to 3.6 pt EC 1.5 to 3 pt ACS (0.72 to 1.5 lb)	Grass and some broadleaf weeds.	PPI. Fall or Spring.	Apply in fall when soil temperature is <45 F. Adjust rate according to soil type. No wild mustard and poor wild oat control. Some pea varieties may be injured. A1 D13 F1 S7 Y1 Y6 Y18 Y24																														
Trifluralin	1 to 1.5 pt 5 to 7.5 lb 10G (0.5 to 0.75 lb)																																	
Sonalan (ethalfluralin)	1.5 to 2 pt 5.5 to 7.5 lb 10G (0.55 to 0.75 lb)																																	
Metolachlor s-Metolachlor	1 to 2 pt (0.95 to 1.9 lb)		PPI or PRE. Fall or Spring.	s-Metolachlor may give greater weed control than metolachlor at equal product rates. Poor wild mustard and wild oat control. PPI improves consistency of weed control. Refer to pages 108-109 for commercial mixtures. A1 C11 E3 F1																														
Spartan (sulfentrazone)	2.25 to 8 fl oz F (1.125 to 4 oz)	Small-seeded broadleaf weeds including kochia, pigweed species, lambsquarters, and nightshade.	Fall, EPP, shallow PPI, and PRE.	Use lower rates on light soils with OM <3%. Requires precipitation to activate herbicide. Refer to label or narrative for rate structure, and crop rotation restrictions. Refer to pages 108-109 for commercial mixtures. D14 F1 J3 S1 S3 S4-5 S7 Y19 Y24																														
Pursuit Plus (imazethapyr & pendimethalin)	20 fl oz (0.5 oz & 0.42 lb)	Broadleaf weeds including redroot pigweed, mustard, and nightshade.	PPI. Up to 1 week before planting.	May be tank-mixed with other labeled herbicides. Addition Prowl/H ₂ O may be added. May control wild buckwheat and ALS resistant kochia. A1 A7 D9 E4 G1 H1 S4-5 S7 X1 Y2 Y18 Y24																														
Pursuit (imazethapyr)	2 fl oz (0.5 oz)	No control of ALS-resistant kochia.	Shallow PPI, PRE.	User assumes all risk of crop injury. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply prior to or during stress conditions (cold/wet). Allow a 60 day PHI. Refer to label for tank-mix options, application information, weed size, crop rotation restrictions, and other use information. A7 D9 E4 G1 H1 S4-5 X1 Y2 Y24																														
Metribuzin	0.33 to 0.5 lb DF (0.25 to 0.38 lb)	Suppression of lambsquarters, henbit, mustard, and chickweed.	PRE.	Only certain formulations are registered. Adjust rate according to soil type. Apply at 20 gpa. Refer to narrative for application and environment information, and special precautions that may affect weed control and crop safety. Allow a 50 day PHI. F1 F5 S7 Y17 Y24																														
	0.167 to 0.25 lb DF (0.125 to 0.19 lb)		POST.																															
Thistrol (MCPB)	2 to 6 pt (0.5 to 1.5 lb)	Broadleaf weeds: Small.	POST. Pea: 3 nodes until prior to flowering.	Slight, temporary injury may occur. Do not apply when temperature exceeds 90 F or when peas are stressed. Suppresses Canada thistle. F1 F3																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Basagran (bentazon)	1 to 2 pt (0.5 to 1 lb)	Wild mustard, cocklebur, sunflower, ragweed, Venice mallow and suppression of Canada thistle and biennial wormwood.	POST. Dry pea: At least 3 pair of leaves or 4 nodes.	Contact herbicide; thorough spray coverage required. Apply with oil adjuvant at 1 to 2 pt/A to small weeds. Allow a 30 day PHI.
	1 pt / 1 pt (0.5/0.5 lb)		Apply twice. Make second application 7 to 10 days after first.	Two applications at a 7 to 10 day interval improves overall weed control. Apply to small weeds. D4 E6 F2 S7 T2
Rezult (bentazon & sethoxydim)	1.6 + 1.6 pt (1 & 0.2 lb)	Grass and broadleaf weeds.	POST. Pea: At least 3 pair of leaves or 4 nodes.	Refer to Poast, Basagran, and Rezult sections for additional information. Tank-mix with Raptor at 2 fl oz/A for improved weed control. D3-4 E6 F1 F2 S7
Pursuit (imazethapyr)	2 fl oz (0.5 oz)	Annual broadleaf weeds. No control of ALS- resistant kochia.	POST. Pea: At least 3 inches tall but prior to 5 nodes and prior to flowering.	User assumes all risk of crop injury. Apply only with NIS at 0.25% v/v. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply during stress conditions (cold/wet) or when stress conditions are predicted within one week of application. Allow a 60 day PHI.
Raptor + Basagran or Result (imazamox + bentazon/ sethoxydim)	4 fl oz + 6 to 16 fl oz (0.5 oz + 3 to 8 oz bentazon)	Annual grass and broadleaf weeds. No control of ALS- resistant kochia.	Weeds: 2 to 6 inches.	Refer to label for application information, weed size, crop rotation restrictions, and other use information. Risk of Raptor carryover is less than Pursuit. Basagran or Rezult antagonizes Raptor and reduces risk of injury to field pea. A7 D3-4 D11 E4 E6 F1 S4 X1 Y2 Y24
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Pea: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. Refer to soybean section for information on broadleaf herbicide tank-mix antagonism and methods to avoid reduced grass control.
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	Grass: Refer to soybean section on page 26.	Refer to label for tank-mix options. Allow a 60 day PHI following Assure II. Allow a 30 day PHI following clethodim and Poast. D3 X1
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)			

Preharvest Application

Glyphosate	Up to 2.25 lb ae	Emerged grass and broadleaf weeds. (0.75 ae)	Weed control and harvest aid. Pea: 30% or less seed moisture.	Only certain formulations are registered. Refer to labeled. Apply with AMS fertilizer. Refer to label for adjuvant use. For spot treatment, use a 2% solution, on perennial broadleaf weeds at or beyond the bud stage. Crop will be killed in treated areas. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. Do not apply on field pea grown for seed because reduced germination/vigor may occur. A4-6 A7 F4 X1
		Perennial weeds. (1.5 ae)	Spot treatment.	
Paraquat RUP	1.5 to 2 pt 2SL 1 to 1.3 pt 3SL (0.375 to 0.5 lb)	Desiccant.	Harvest aid and desiccant for all pea varieties.	Contact herbicide; through coverage required. Apply with NIS at 0.25% v/v. Allow 7 days for PHI and before grazing. Refer to label for application information, weed size, crop rotation restrictions, and other use information. B5 Q3
Aim (carfentrazone) + MSO adjuvant	2 to 6 fl oz EC + 1 qt/A (0.53 to 1.5 oz)			

CHICKPEA/GARBANZO BEAN AND LENTIL

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 G1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.		Non-residual, contact, herbicide; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Far-Go (triallate) Far-Go EC 	1.25 qt EC 12.5 to 15 lb 10G (1.25 lb liquid or 1.25 to 1.5 lb 10G)	Wild oat.	PPI.	PPI immediately after application. A two pass incorporation is recommended. A1 A3 B14 G1 H1-2 Y24																														
Prowl Prowl H₂O (pendimethalin)	1.75 to 3.6pt 3.3EC 1.5 to 3 pt 3.8ASC (0.72 to 1.5 lb)	Grass and some broadleaf weeds.	PPI. Fall or Spring.	Adjust rate according to soil type. No wild mustard and poor wild oat control. Apply in fall when soil temperature is <45 F. D13 Y18 Y24																														
Trifluralin (trifluralin)	1 to 2 pt 5 to 10 lb 10G (0.5 to 1 lb)		PPI. Fall or Spring. See Remarks for use in Lentil.	Lentil: Tolerance is marginal and injury may occur under stress conditions. Apply at 1 to 1.5 pt or 5 to 7.5 lb 10G. Refer to label for additional information. A1 D13 G1 H1 H3 S7 X1 Y18 Y24																														
Sonalan (ethalfluralin)	1.5 to 2 pt 5.5 to 7.5 lb 10G (0.55 to 0.75 lb)			Lentil: Fall-apply Sonalan 10G just prior to snow cover into stubble on fields that have been direct-seeded with 30% or less soil disturbance for 2 to 3 years. Incorporate once using minimum soil disturbance with a rotary hoe or heavy harrow. Refer to label. A1 D13 G1 H1 H3 S7 X1 Y18 Y24																														
Metolachlor s-Metolachlor	1 to 2 pt (0.95 to 1.9 lb)		PPI or PRE.	S-Metolachlor may give greater weed control than metolachlor at equal product rates. PPI improves consistency of weed control. Refer to pages 108-109 for commercial mixtures. A1 C11 D8 G1																														
Outlook Propel (dimethenamid-P)	16 to 21 fl oz (0.75 to 1 lb)		Shallow PPI, PRE, or EPOST to third leaf lentil.	Poor wild mustard and wild oat control. Adjust rate according to soil type and OM. Shallow incorporation improves consistency of weed control. Refer to label for tank-mix products. A1 C11 D8 E3 H1 S4																														
Pursuit Plus (imazethapyr & pendimethalin)	20 fl oz (0.5 oz & 0.42 lb)	Broadleaf weeds including redroot pigweed, mustard, and nightshade.	PPI. Up to 1 week before planting.	May be tank-mixed with other labeled herbicides. Addition Prowl/H ₂ O may be added. My control wild buckwheat and ALS resistant kochia. A1 A7 D9 D13 E4 G1 H1 S4-5 S7 X1 Y2 Y18 Y24																														
Pursuit (imazethapyr)	2 fl oz (0.5 oz)	No control of ALS-resistant kochia.	Shallow PPI, PRE.	User assumes all risk of crop injury. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply prior to or during stress conditions (cold/wet). Allow a 60 day PHI. Refer to label for tank-mix options, application information, weed size, crop rotation restrictions, and other use information. A7 D9 E4 E6 G1 H1 S4-5 X1 Y2 Y24																														
Spartan (sulfentrazone) Chickpea Only	2.25 to 8 fl oz F (1.125 to 4 oz)	Small-seeded broadleaf weeds including kochia, pigweed species, lambsquarters, nightshade, and b. wormwood.	Fall, EPP, shallow PPI, and PRE.	Do not apply to lentil. Use lower rates on light soils with OM <3%. Do not use on sand soil with < 1% OM. Requires precipitation to activate herbicide. Refer to label or narrative for tank-mix options, application information, rate structure, and crop rotation restrictions. D14 F1 J3 S1 S3-5 S7 Y19 Y25																														

CHICKPEA/GARBANZO BEAN AND LENTIL

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Metri Metribuzin (metribuzin)	0.33 to 0.5 lb DF (0.25 to 0.38 lb)	Suppression of lambsquarters, henbit, chickweed and mustard.	PRE.	Rate should be adjusted for soil type. Refer to narrative for application and environment information, and special precautions that may affect weed control and crop safety. Allow a 75 day PHI. H1 S7 Y17 Y24
Lentil Only	0.16 to 0.25 lb DF (0.12 to 0.19 lb)		POST.	
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Crop: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. Refer to section in soybean for information on broadleaf herbicide tank-mix antagonism and method to avoid reduced grass control. Allow a 60 day PHI for Assure II. Allow a 50 day PHI for Poast. Allow a 30 day PHI for Clethodim. D3 G1 H1 X1
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	Grass: Refer to soybean section on page 26.	
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)			

Preharvest Application

Glyphosate	Up to 2.25 lb ae	Emerged grass and broadleaf weeds.	Harvest aid and desiccant.	Only certain formulations are registered. See label. Apply with AMS fertilizer. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. Refer to label for adjuvant use. Do not apply on field pea grown for seed because reduced germination/vigor may occur. For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will be killed in treated areas. A4-6 F4
		Perennial weeds.	Spot treatment.	
Paraquat RUP	1.5 to 2 pt 2SL 1 to 1.3 pt 3SL (0.37 to 0.5 lb)	Desiccant.	POST. Allow a 7 days PHI.	Contact herbicide; thorough coverage required. Apply when at least 80% of the pods are mostly ripe with no more than 40% (bush type beans) or 30% (vine type) of the leaves still green. Q3

SUNFLOWER

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. Refer to pages 108-109 for commercial mixtures. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Paraquat	2 to 4 pt 2SL RUP 1.3 to 2.7 pt 3SL (0.5 to 1 lb)			Non-residual, contact, herbicides; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. Thorough coverage essential. B5 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Eptam (EPTC)	2.5 to 3.5 pt (2 to 3 lb)	Grass and some broadleaf weeds.	PPI.	No wild mustard control. PPI immediately after application. A1-3 E2 J1 J3																														
Prowl Prowl H₂O (pendimethalin)	2.4 to 3.6 pt 3.3EC 2.1 to 3 pt 3.8ACS (1 to 1.5 lb)		PPI.	No wild mustard and poor wild oat control. Adjust rate according to soil type. Refer to narrative for tank-mix options and rotational restrictions. A1 D13 X1 Y1 Y6-7 Y18 Y24																														
	3 to 3.6 pt 3.3EC 2.7 to 3 pt 3.8ACS (1.25 to 1.5 lb)		PRE - 30 days before to 1 day after seeding.	For use in no-till sunflower only.																														
Trifluralin	1 to 2 pt EC 5 to 10 lb 10G (0.5 to 1 lb)		PPI.	No wild mustard and poor wild oat control. PPI within 24 hours after application. A1 D13 J1 S7 X1 Y1 Y18 Y24																														
Sonalan (ethalfluralin)	1.5 to 3 pt EC 5.5 to 11.5 lb 10G (0.55 to 1.15 lb)		PPI. Spring. Fall: From October 1 to December 31.	No wild mustard and poor wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. A1 D13 J1 X1 Y18 Y24																														
	7.5 to 11.5 lb 10G (0.75 to 1.15 lb)	Foxtail.		For use in reduced or conservation tillage. Incorporate twice at 2 to 3 inches deep using a V-blade under-cutter or rotary hoe. For fall applications, incorporate once in the fall and once in the spring before seeding. A3 J1 Y18 Y24																														
Dual Magnum (s-metolachlor)	1 to 2 pt (0.95 to 1.9 lb)	Grass and some broadleaf weeds.	PPI or PRE.	No wild oat or wild mustard control. PPI improves consistency of control. Requires moisture for activation. A1 C11 D8 E3																														
Spartan (sulfentrazone)	3 to 8 fl oz F (1.5 to 4 oz)	Small-seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, shallow PPI, PRE or fall.	Requires precipitation for activation. EPP applications up to 30 days prior to planting improves likelihood of activation by moisture. Adjust rate to soil type. Provide adequate furrow closure at planting. Temporary sunflower injury may occur in coarse, low organic matter soils with pH greater than 7.8. May give 6 to 8 weeks residual weed control. Refer to narrative for application information, crop rotation restrictions, and other information. Refer to pages 108-109 for commercial mixtures. D14 J1 J3 S1 S4-5 S7 Y19 Y24																														
Assert (imazamethabenz)	0.6 to 0.8 pt (0.19 to 0.25 lb)	Wild mustard.	POST. Sunflower: Less than 8 leaves or 15 inches. Mustard species including canola: Prior to bloom.	Sunflower injury may occur when applied at high temperature and humidity. Refer to narrative for rotational restrictions. Apply with NIS at 0.25% v/v. J1-2 Y2 Y6 Y24																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Sunflower: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations.
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	Grass: Refer to soybean section on page 26.	Refer to soybean section, label, or narrative for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. Allow a 70 day PHI. D3 J1 X1
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)			

Preharvest Application

Glyphosate	Up to 0.75 lb ae See Remarks.	Preharvest weed control.	Backside of sunflower heads yellow and bracts turning brown.	Apply with AMS fertilizer. Only certain formulations are labeled. Allow 7 days between application and harvest or livestock feeding. Refer to label for adjuvant use. A4-6
Paraquat RUP	1.5 to 2 pt 2SL 1 to 1.35 pt 3SL (0.375 to 0.5 lb)	Desiccant.	Seed moisture content under 35%.	For use on confectionery and oilseed varieties. Apply with NIS. Randomly sample 10 average heads for seed moisture. Allow a 7 day PHI. Q3

HERBICIDE RESISTANT SUNFLOWER

CLEARFIELD SUNFLOWER

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Beyond (imazamox)	4 fl oz (0.5 oz)	Annual broadleaf weeds including wild mustard and black nightshade. No ALS-resistant kochia control.	EPOST. Sunflower: 2 to 8-leaf stage. Broadleaf weeds: Less than 3 inches tall. Grass weeds: Less than 4 to 5 leaves.	Apply only to Clearfield sunflower varieties. Apply with NIS at 0.25% v/v + UAN at 2.5% v/v. MSO and oil adjuvants are not prohibited but may increase activity of Beyond to cause temporary crop injury. Can be applied following a labeled soil-applied grass herbicide. Refer to label for weeds controlled, adjuvant use, tank-mix options, crop rotation restrictions and additional information. A7 J1 J4 S3 S4 Y1-2 Y24

EXPRESS SUN SUNFLOWER

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Tribenuron	0.33 to 0.67 oz DF 0.25 to 0.5 oz SG (0.125 to 0.25 oz)	Annual broadleaf weeds including wild mustard. Control or suppression of Canada thistle. No grass or ALS-resistant kochia control.	EPOST. Sunflower: 1-leaf stage but prior to bud formation. Broadleaf weeds: Less than 3 inches tall.	Apply only to Express Sun sunflower varieties. Apply with MSO-type oil adjuvants at 1% v/v. NIS or petroleum oil adjuvants are not prohibited. Apply following a labeled soil-applied grass herbicide or with a registered POST grass herbicide. Sequential applications are allowed but observe a 14 day interval between applications and do not exceed 1 oz/A. Allow a 70 day PHI. Refer to label for weeds controlled and additional information. A7 J1 J5 S3 T2 Y1-2 Y24

SAFFLOWER

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Paraquat RUP	2.5 to 4 pt 2SL 1.7 to 2.7 pt 3SL (0.63 to 1 lb)	Emerged annual grass and broadleaf weeds.		Non-residual, contact, herbicides; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Eptam (EPTC)	3.5 pt EC 15 lb 20G (3 lb)	Grass and some broadleaf weeds.	PPI.	Refer to incorporation discussion in narrative for details. Poor wild mustard and wild oat control. A1-2 E2																														
Trifluralin	1 to 2 pt EC 5 to 10 lb 10G (0.5 to 1 lb)		PPI. Fall or spring.	No wild mustard and poor wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions.																														
Sonalan (ethalfluralin)	1.5 to 3 pt EC 5.5 to 11.5 lb 10G (0.55 to 1.15 lb)		PPI. Fall or Spring.	A1 D13 S7 X1 Y18 Y24																														
Metolachlor s-Metolachlor	1 to 2 pt (0.95 to 1.9 lb)		PPI or PRE.	S-metolachlor may give greater weed control than metolachlor at equal product rates. Poor wild mustard and wild oat control. PPI gives more consistent weed control. A1 C11 D8 E3																														
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	POST. Safflower: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations.																														
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.	Grass weeds: Refer to soybean section on page 26.	Refer to soybean section, label, or narrative for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. Allow a 70 day PHI. D3 J1 X1																														
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)																																	

Preharvest Application

Glyphosate	Up to 2.25 lb ae See Remarks.	Preharvest weed control.	When seed coat turns white, at least 20 days after end of flowering on secondary branches.	Apply with AMS fertilizer. Only certain formulations are labeled. Allow 7 days between application and harvest or livestock feeding. Refer to label for adjuvant use. A4-6
Drexel Defol (sodium chlorate)	1 gal 6SL (6 lb)	Desiccant.	After physiological maturity and 7 day PHI.	Contact herbicide; thorough coverage required. Apply aerially at 5 to 10 gpa or by ground at 20 to 30 gpa. Most active with warm, sunny conditions.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz																													
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.		Contact herbicide; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1 lb)	Grass and some broadleaf weeds.	PPI. Fall.	Adjust rate for soil texture. Deep incorporate within 24 hours after application. Keep spring tillage depth shallower than fall and plant shallow. A1 D13 K1 K5 S7 X1 Y18 Y24																														
Bromoxynil	1 pt (0.25 lb)	Small broadleaf weeds.	Flax: 2- to 8-inches tall.	Poor wild mustard control. Good buckwheat control. Flax injury is possible. K1 K2																														
MCPA	0.5 pt 4EC/SL (0.25 lb)			Use MCPA ester on hard-to-kill weeds. Early application is less injurious to flax. K1 K4																														
Bromoxynil & MCPA	0.9 pt 4EC 11.4 fl oz 5EC (0.23 & 0.23 lb)			Apply to small weeds prior to bud stage of flax. Risk of flax injury. Refer to pages 108-109 for commercial mixtures. K1-2 K4																														
Clopyralid & MCPA	1.33 to 1.75 pt (1.1 to 1.5 & 6.25 to 8.25 oz)	Broadleaf weeds including Canada thistle and per. sowthistle.	POST. Flax: 2- to 6-inches tall. Canada thistle: 4- to 6-inches tall.	Apply after most thistle shoots have emerged. Allow a 72 day PHI. Follow rotational crop interval and other precautions on product label. K1 K3 T2 Y20 Y24																														
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Flax: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. May be tank-mixed with bromoxynil or MCPA ester for broad-spectrum weed control. Refer to soybean section, label, or narrative for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. Allow a 75 day PHI for Poast and 60 day PHI for clethodim. Refer to label for PHI of Assure II/Targa. Clethodim may injure flax when applied during bloom. D3 K1 X1																														
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	Grass: Refer to soybean section on page 26.																															
Clethodim	4 to 8 fl oz (1 to 2 oz)	Annual grasses and quackgrass.																																
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)																																	

Preharvest Application

Glyphosate	Up to 0.75 ae See Remarks.	Emerged grass and broadleaf weeds including Canada thistle and perennial sowthistle.	Flax: Physiologically mature. Seed contains 30% or less moisture.	Only certain formulations are labeled. See label. Allow a 7 day PHI. Do not apply to flax grown for seed because reduced germination/ vigor may occur. A4-6 Q1
Drexel Defol (sodium chlorate)	1 gal 6SL (6 lb)	Desiccant.	70 to 80% of the bolls should be brown.	Contact herbicides; thorough coverage required. Do not graze or feed treated straw. Allow a 7 day PHI.

CANOLA, RAPESEED, AND CRAMBE

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1 lb)	Grass and some broadleaf weeds.	PPI. Spring or Fall.	Use only 1 to 1.5 pt/A on tame mustard varieties. Adjust rate according to soil type. Use only labeled formulations on crambe. D13 K5 L1 S7 Y1 Y18 Y24																														
Sonalan (ethalfluralin)	1.5 to 2.5 pt 5.5 to 9.5 lb 10G (0.55 to 0.95 lb)	Grass and some broadleaf weeds. May control or suppress ALS-resistant kochia.	PPI. Fall or Spring.	Adjust rate for soil type. No wild mustard and poor wild oat control. May result in reduced crop stand or early injury. May provide greater broadleaf weed control than trifluralin. D13 L1 S7 Y18 Y24																														
Clopyralid	4 to 8 fl oz (1.5 to 3 oz)	Broadleaf weeds including Canada thistle and perennial sowthistle.	POST. Crop: 2- to 6-leaves. Annual weeds: Small. Thistle: 4 to 6 inches tall.	Apply after most thistle shoots have emerged. Allow 7 days after application to graze or harvest treated crambe for livestock forage. Allow a 50 day PHI. Follow rotational crop interval and other precautions on product label. L1-2 T2 Y20 Y24																														
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Crop: Refer to PHI. Clethodim: Prior to bolting.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. Avoid drift to small grain and desirable grass species. Clethodim may injure canola when applied during bloom. Allow a 60 day PHI for Assure II and Poast. Allow a 70 day PHI for clethodim. L1 D3 X1																														
Poast (sethoxydim)	1 to 1.5 pt (0.2 to 0.3 lb)		Grass weeds: Refer to soybean section on page 26.																															
Clethodim	4 to 6 fl oz (1 to 1.5 oz)																																	
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)																																	

TAME MUSTARD

Trifluralin	1.5 pt 7 lb 10G (0.5 to 1 lb)	Grass and some broadleaf weeds.	PPI. Spring or Fall.	Adjust rate according to soil type. D13 K6 L1 Y1 Y18 Y24
Clethodim	4 to 6 fl oz (1 to 1.5 oz)	Annual grasses and quackgrass.	POST. Crop: Prior to bolting and allow a 70 day PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. Avoid drift to small grain and desirable grass species. L1 D13 X1
Select Max (clethodim)	9 to 16 fl oz (1.125 to 2 oz)		Grass weeds: Refer to soybean section.	

CLEARFIELD CANOLA

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Beyond (imazamox)	4 fl oz (0.5 oz)	Annual grass and broadleaf weeds.	POST. Canola: Prior to bloom. Grass and broadleaf weeds: Small.	Apply only to Clearfield canola varieties. Apply with NIS at 0.25% v/v plus UAN at 1 to 2 qt/A. Apply with Stinger for improved Canada thistle control. Refer to label for weeds controlled, application information, and crop rotation restrictions. Will not control ALS-resistant kochia. Allow a 60 day PHI. A7 L1 L3 X1 Y2 Y24

LIBERTY LINK CANOLA

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																																				
Liberty (glufosinate)	28 to 34 fl oz (0.37 to 0.44 lb)	Annual broadleaf weeds and control or suppression of grasses.	POST. Canola: Cotyledon up to early bolting stage. Broadleaf weeds: Up to 3 inches tall. Grass weeds: See Remarks.	Apply only to Liberty Link canola varieties. Use low rate when tank-mixing with a POST grass herbicide. Apply with AMS fertilizer at 3 lb/A. Allow a 65 day PHI. Growth stage of grass weeds at application: <table border="1"> <thead> <tr> <th>Grass weed</th> <th># leaves</th> <th>Inches tall</th> <th># tillers</th> </tr> </thead> <tbody> <tr> <td>Green foxtail</td> <td>1 to 6</td> <td><4</td> <td>2 or less</td> </tr> <tr> <td>Yellow foxtail</td> <td>1 to 4</td> <td><2</td> <td>prior to tillering</td> </tr> <tr> <td>Wild oat*</td> <td>1 to 4</td> <td><4</td> <td>1 or less</td> </tr> <tr> <td>Barnyardgrass</td> <td>1 to 6</td> <td><3</td> <td>1 or less</td> </tr> <tr> <td>Proso millet</td> <td>1 to 6</td> <td><3</td> <td>1 or less</td> </tr> <tr> <td>Vol. wheat*</td> <td>1 to 4</td> <td><4</td> <td>1 or less</td> </tr> <tr> <td>Vol. barley*</td> <td>1 to 3</td> <td><3</td> <td>—</td> </tr> <tr> <td>Vol. corn</td> <td>1 to 4</td> <td><6</td> <td>—</td> </tr> </tbody> </table> * = A second application may be required. Refer to label for additional information. Liberty is a non-residual, contact herbicide. A7 L1 L4 S7 X1	Grass weed	# leaves	Inches tall	# tillers	Green foxtail	1 to 6	<4	2 or less	Yellow foxtail	1 to 4	<2	prior to tillering	Wild oat*	1 to 4	<4	1 or less	Barnyardgrass	1 to 6	<3	1 or less	Proso millet	1 to 6	<3	1 or less	Vol. wheat*	1 to 4	<4	1 or less	Vol. barley*	1 to 3	<3	—	Vol. corn	1 to 4	<6	—
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Vol. wheat*	1 to 4	<4	1 or less																																					
Vol. barley*	1 to 3	<3	—																																					
Vol. corn	1 to 4	<6	—																																					

ROUNDUP READY CANOLA

Herbicide	Product/A (ae/A)	Weeds	When to Apply	Remarks and Paragraphs															
Glyphosate	Maximum single application = 0.38 lb ae Maximum in-crop = 0.75 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds.	Canola: Emergence to bolting - (5- to 6-leaf). Do not apply after the 6-leaf stage or once bolting begins because canola injury may occur. Apply once or twice as needed.	Apply only to Roundup Ready canola varieties. <table border="1"> <thead> <tr> <th></th> <th>Maximum - single appl.</th> <th>Maximum - season</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4 = 1.5 pt</td> <td>2 pt</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1 = 1.12 pt</td> <td>1.5 pt</td> </tr> <tr> <td>4.5</td> <td>5.5 = 1 pt</td> <td>1.33 pt</td> </tr> <tr> <td>5</td> <td>6.1 = 15 fl oz</td> <td>1.25 pt</td> </tr> </tbody> </table> Apply with AMS fertilizer. Sprayer overlap may result in yellowing, delayed flowering, and growth reduction. Allow a minimum interval of 10 days between applications. Allow an 8 week PHI. Avoid drift. Refer to label for additional application information. Refer to page 126 for control of volunteer RUR canola. A4-6 L5 X1		Maximum - single appl.	Maximum - season	3	4 = 1.5 pt	2 pt	4/4.17	5.4/5.1 = 1.12 pt	1.5 pt	4.5	5.5 = 1 pt	1.33 pt	5	6.1 = 15 fl oz	1.25 pt
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Refer to page 126 for control of volunteer Roundup Ready canola, corn and soybean.

SUGARBEET

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Paraquat RUP	2 to 4 pt 2SL 1.3 to 2.7 pt 3SL (0.5 to 1 lb)	Emerged annual grasses and broadleaf weeds.		Contact, non-selective, herbicide; thorough coverage required. No soil residual activity. Apply with NIS. A4 Q3																														
Far-Go (triallate) 	1.5 qt EC 15 lb 10G (1.5 lb)	Wild oat.	PPI.	Incorporate immediately after application with a tillage tool set 3 to 4 inches deep. A second incorporation will improve wild oat control. A1-3 M7																														
Eptam (EPTC)	2.3 to 3.4 pt (2 to 3 lb)	Annual grasses and some broadleaf weeds.		Eptam may cause some sugarbeet stand reduction and temporary stunting. A1-3 M1-2 M5-6 S4																														
Eptam (EPTC) + Ro-Neet (cycloate)	1.1 to 2.3 pt + 2.7 to 3.3 pt (1 to 2 + 2 to 2.5 lb)			Less sugarbeet injury than from Eptam alone. Refer to narrative for suggested rates for various soil textures and organic matter. A1-3 M1-2 M5-6 S4																														
Ro-Neet (cycloate)	4 to 5.3 pt (3 to 4 lb)			Sugarbeet has better tolerance to Ro-Neet than to Eptam. Weed control poor on fine textured, high organic matter soils. A1-3 M1-2 M5-6 S4																														
Nortron Etho Ethotron (ethofumesate)	6 to 7.5 pt (3 to 3.75 lb)	Good pigweed and fair to good kochia control.	PPI or PRE.	Incorporation generally improves weed control. Band application reduces cost and risk of carryover into the next year. A1 M1-2 M9 S4 Y14																														
	3 to 4 fl oz (0.09 to 0.125 lb)	Improves broadleaf weed control, including kochia, pigweed, lambsquarters.	POST in combination with Progress, Betanex, or Betamix.	Crop rotation restrictions allow no more than 12 fl oz total during the growing season. Thus, POST Norton can be applied three times at 4 fl oz/A or four times at 3 fl oz/A. M1-2 M9 Y14																														
Clopyralid	0.25 to 0.66 pt (0.09 to 0.25 lb)	Cocklebur, sunflwr, marshelder, wild buckwheat and Canada thistle.	POST. Sugarbeet: 2 to 8 leaves.	Refer to narrative for rates and sizes for various species. Clopyralid may be tank-mixed with Betanex or Betamix. Refer to narrative for rotation restrictions. Allow a 45 day PHI. M1-2 M8 M13 M18 S7 Y20 Y24																														
UpBeet (triflurosulfuron)	0.5 oz DF (0.25 oz)	Annual broadleaf weeds.	POST. Weeds: Cotyledon to 2-leaf.	Apply two or more times in combination with Betanex, Betamix, or Progress. Do not exceed 2.5 oz/A/season. Allow a 60 day PHI. M1-2 M8 M14 M18																														
Desmedipham & Phenmedipham	0.75 to 7.5 pt (0.06 to 0.6 & 0.06 to 0.6 lb)	Annual broadleaf weeds.	POST. Sugarbeet: Cotyledon up to 8-leaf stage.	Risk of sugarbeet injury is increased by morning or midday application and by certain environments. Split application with reduced rates has reduced sugarbeet injury and increased weed control compared to single full-dose application.																														
Desmedipham	0.75 to 7.5 pt (0.12 to 1.2 lb)		Broadleaf weeds: Cotyledon up to 4-leaf stage.	Refer to paragraph for rate adjustment information. Allow a 75 day PHI. M1-2 M4 M8 M11 M18																														
Desmedipham & Phenmedipham & Ethofumesate	0.56 to 5 pt (0.04 to 0.38 & 0.04 to 0.38 & 0.04 to 0.38 lb)																																	
See herbicide brand options listed with individual herbicides: Desmedipham or Desmedipham & Phenmedipham or Desmedipham & Phenmedipham & Ethofumesate + Triflurosulfuron + Clopyralid + MSO adjuvant	MICRO-RATE PROGRAM 8 to 12 or 8 or 12 or 5.7 to 8.7 fl oz + 0.125 oz + 1.3 fl oz + 1.5% v/v (0.08 + 0.125 + 0.004 lb + 1.5% v/v) MID-RATE PROGRAM 12 to 16 or 12 to 16 or 8.7 to 11.6 fl oz + 0.125 oz + 1.3 fl oz + 1.5% v/v. (0.125 + 0.16 + 0.004 + 0.03 lb + 1.5% v/v)	Annual broadleaf weeds and fair to good annual grass control. Generally provides poor control of ALS-resistant kochia. Increasing clopyralid rate from 1.3 to 2.6 fl oz will improve control of lanceleaf sage with some risk of increased sugarbeet injury.	POST. Sugarbeet: Apply a minimum of three times with subsequent treatments at 5 to 7 day intervals. Micro-rate can be applied starting at cotyledon sugarbeet stage. Mid-rate can be applied starting at 4-leaf sugarbeet stage.	Use mid-rate for difficult weed problems or when application has been delayed. A herbicide for grass control at 1/3 to 1/2 normal rate can be added. Nozzle plugging from herbicide precipitation in the spray tank can be reduced by: - Mixing in warm water - Raising water pH to 8 or 9 - Premixing UpBeet - Use of a grass herbicide, and - Frequent sprayer cleaning. Allow a 75 day PHI. A5 M1-2 M4 M8-9 M11 M13-14 M18																														

SUGARBEET

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Assure II Targa (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses.	POST. Sugarbeet: Refer to PHI. Annual grass weeds and vol. wheat or barley: 2 to 6 inches tall. Refer to soybean section on page 26.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. Apply with AMS or UAN fertilizer for greater control of certain grass species. Refer to soybean section for rates for different grass species. Allow a 45 day PHI for Assure II. Allow a 60 day PHI for Poast. Allow a 40 day PHI for Clethodim. A5-6 D4 M1-3 M10 M12
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)			
Clethodim	6 to 8 fl oz (1.5 to 2 oz)			
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)			
Trifluralin	1.5 pt (0.75 lb)	Late emerging annual grass and some broadleaf weeds.	POST. Sugarbeet: 2 to 6 inches tall and well-rooted prior to incorporation.	Must be incorporated. Beet roots must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugarbeet. A1 A3 M1-2 M15 Y18 Y24
Dual Magnum (s-metolachlor)	1.33 to 1.67 pt (1.25 to 1.6 lb)		POST. Sugarbeet: 4 or more true leaves.	Emerged weeds not controlled. Rain or sprinkler irrigation needed for activation. May be applied more than once but total applied must not exceed 2.6 pt/A for Dual Magnum or 21 fl oz/A for Outlook. Lay-by Dual Magnum or Outlook/Propel should not be applied where PPI or PRE ethofumesate was used because sugarbeet injury may be severe. Allow a 60 day PHI except the PHI is 95 days for Outlook/Propel applied to 9-leaf through 12-leaf sugarbeet. C15 M16 M17
Outlook Propel (dimethenamid)	18 to 21 fl oz (0.84 to 0.98 lb)		POST. Sugarbeet: 4 to 12 true leaves.	

ROUNDUP READY SUGARBEET

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																																								
Glyphosate	<p>Maximum single application up to 8-leaf stage = 1.125 lb ae</p> <p>Maximum single application from 8-leaf sugarbeet to canopy closed = 0.75 lb ae</p> <p>See Remarks.</p>	Annual and perennial grass and broadleaf weeds.	EPP, PRE, or POST. Allow a 30 day PHI.	<p>Apply only to Roundup Ready sugarbeet varieties.</p> <p>Only use registered glyphosate brands</p> <table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.55 ae</td> <td>1.97 ae</td> <td>3.38 ae</td> <td>3.71 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> <td>84 fl oz</td> <td>4.5 qt</td> <td>5 qt</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> <td>3.38 qt</td> <td>3.7 qt</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> <td>56 fl oz</td> <td>3 qt</td> <td>3.3 qt</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> <td>50 fl oz</td> <td>2.7 qt</td> <td>3 qt</td> </tr> </table> <p>Max. single app. from sugarbeet emergence to 8 leaves = 1.125 lb ae. Maximum from sugarbeet emergence to 8 leaves = 1.97 lb ae. Max. single application from 8 leaves to closed canopy = 0.75 lb ae. Maximum from 8 leaves to closed canopy = 1.55 lb ae. Maximum from sugarbeet emergence through harvest = 3.38 lb ae. Maximum preplant/preemergence per season = 3.71 lb ae. Maximum total for year = 6 lb ae. Apply with AMS fertilizer. Refer to label for tank-mix options, application information, and restrictions. A4-7 M19 X1</p>	lb ae/gal	lb ai/gal	0.75 ae	1.125 ae	1.55 ae	1.97 ae	3.38 ae	3.71 ae	3	4	= 32 fl oz	48 fl oz	64 fl oz	84 fl oz	4.5 qt	5 qt	4/4.17	5.4/5.1	= 24 fl oz	36 fl oz	48 fl oz	64 fl oz	3.38 qt	3.7 qt	4.5	5.5	= 22 fl oz	32 fl oz	44 fl oz	56 fl oz	3 qt	3.3 qt	5	6.1	= 20 fl oz	30 fl oz	40 fl oz	50 fl oz	2.7 qt	3 qt
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POTATO

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Paraquat RUP	1.5 to 2 pt 2SL 1 to 1.3 pt 3SL (0.275 to 0.5 lb)			Non-residual, contact, herbicides; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Eptam (EPTC)	3.5 to 9 pt EC 15 to 30 lb 20G (3 to 6 lb) 5.25 to 7 pt EC 22.5 to 30 lb 20G (4.5 to 6 lb)	Grass and some broadleaf weeds.	PPI, Dragoff, or Directed spray at layby. Fall: Incorporate after October 15 until freeze-up.	Incorporate immediately after application with tool set 4 to 6 inches deep. Weak on wild mustard. Refer to label for rates depending on use. Allow a 45 day PHI. May be applied with metribuzin at 0.33 to 0.67 lb/A. A1-3 N1																														
Trifluralin	1 to 2 pt EC 0.8 to 1.7 lb 60DF (0.5 to 1 lb)		PoPI.	Adjust rates according to soil type. No wild mustard and poor wild oat control. Incorporate above the seed piece after planting or immediately following drag-off or hilling but before potato and weed emergence.																														
Prowl Prowl H ₂ O (pendimethalin)	1.75 to 3.6 pt 3.3EC 1.57 to 3 lb 3.8ACS (0.72 to 1.5 lb)		PRE or EPOST. Potato: Before 6 inches tall.	Incorporation improves consistency of weed control.																														
Outlook Propel (dimethenamid)	16 to 21 fl oz (0.75 to 1 lb)		PPI or PRE.	Only one application allowed. Allow a 40 day PHI.																														
Metolachlor s-Metolachlor	1 to 2 pt (1 to 2 lb)		PPI or PRE.	s-Metolachlor may give greater weed control than metolachlor at equal product rates. Allow a 40 day PHI. A1 C11 N1 S7 X1 Y1 Y18 Y24																														
Linuron	1.5 to 4 lb DF 1.5 to 4 pt L (0.75 to 2 lb)	Annual grass and broadleaf weeds.	PRE to potato. Small grass and broadleaf weeds.	Seed piece must be planted at least 2 inches deep. Apply after drag-off or hilling. The higher rates are for fine-textured soils. Apply with surfactant to emerged weeds. A2 N1																														
Metribuzin	0.33 to 1.33 lb DF (0.25 to 1 lb) 0.33 to 0.67 lb DF (0.25 to 0.5 lb)	Annual broadleaf weeds and grass suppression.	PRE to potato. POST. Weeds: Up to 1 inch tall.	Apply after planting and before potato emergence or after drag-off. Do not incorporate. Adjust rate according to soil type. Residue may injure susceptible crops the following year. N1-4 Y1 Y4 Y17 Y24 Only for russet type or white skinned varieties that are not early maturing. Do not use on early maturing, smooth skinned white or red-skinned varieties or Atlantic, Shepody, Chipbelle, Bellchip, or Centennial varieties. Use low rate for pigweed or lambsquarters control. Allow a 60 day PHI. Soil residue may injure crops the following year. N1-3 Y17 Y24																														
Chateau (flumioxazin)	1.5 oz (0.77 oz)	Annual broadleaf suppression.	PRE to potato.	Apply after planting and before potato emergence. There must be a minimum of 2 inches of soil over the vegetative portion of the potato. Refer to label for use instructions. D16 S3-4																														

POTATO

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Matrix (rimsulfuron)	1 to 1.5 oz DF (0.25 to 0.375 oz)	Annual grass and broadleaf weeds and quackgrass.	PRE to potato and weeds. After hilling or drag-off but before potato emerge.	Requires 1 inch water after application for activation. May be applied with Dual, Eptam, Prowl, and Sencor. Can be applied in two sequential treatments of 1 oz/A PRE followed by 1 oz/A POST.
		Suppression of common lambsquarters.	POST. Potato: Up to 14 inches tall. Annual weeds: Small.	Apply to annual weeds less than 1 inch tall. Apply with NIS at 0.25% v/v or oil adjuvant at 1% v/v. Refer to label for application information and restrictions. N1-3 X1 Y3 Y24
Matrix (rimsulfuron) + Metribuzin	1 to 1.5 oz DF + 0.33 to 0.75 lb DF (0.25 to 0.375 oz + 0.25 to 0.56 lb)	Annual grass and broadleaf weeds including common lambsquarters, ALS-resistant kochia, wild buckwheat and suppression of quackgrass.	PRE to potato and weeds. After hilling or drag-off but before potato emerge.	Follow varietal restrictions on Sencor label. Injury may occur when Sencor is applied POST to early maturing smooth-skinned white and all red-skinned potato varieties - use only the low rate of Sencor and consider benefits of weed control vs risk of potato injury prior to application to "at risk" varieties. Allow a 60 day PHI.
		1 to 1.5 oz DF + 0.25 to 0.67 lb DF (0.25 to 0.375 oz + 0.188 to 0.5 lb)	POST. Potato: Up to 14 inches tall. Annual weeds: Small.	Use the low rate of Sencor when applied PRE to coarse textured soil. Soil residual may injure susceptible crops the following year. N1-3 Y1 Y3-4 Y17 Y24
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3 lb)	Annual grasses.	POST. Potato: Refer to PHI.	Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations.
Clethodim	6 to 16 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: Refer to soybean section.	May be tank-mixed with Sencor. Allow a 30 day PHI. D3 N1 X1
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)			

POTATO VINE DESICCATION

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Desiccate II (endothall)	2 to 4 pt (0.5 to 1 lb)	Desiccant.	Allow a 10 day PHI.	Apply with AMS at 5 lb/A. Requires spray solution pH above 7. Use higher rate during cool, cloudy weather and on dense vine growth. May require two applications. Allow a 10 day PHI.
Reglone (diquat)	1 to 2 pt (0.25 to 0.5 lb)		Allow a 7 day PHI.	Apply with a NIS. Diquat at 2 pt/A can be applied to all potatoes varieties and seed potato. Sequential application may be made up to a total of 3 pt/A. Allow at least 5 days between applications.
Firestorm (paraquat) RUP	0.7 to 1.35 pt 3SL (0.25 to 0.5 lb)		Allow a 3 day PHI.	Paraquat use is for fresh market potatoes ONLY. Do not use paraquat on potatoes that will be stored or used as seed pieces.
Rely (glufosinate)	48 fl oz (0.375 lb)		Allow a 9 day PHI.	Do not apply to potato grown for seed pieces. Best results when applied at the beginning of natural potato vine senescence. Requires thorough coverage. Apply in 20 to 100 gpa by ground and 5 to 10 by air. Use higher spray volumes on dense potato vines. Do not apply during extended cold, cloudy weather.
Aim (carfentrazone)	3.2 to 5.9 fl oz EW (0.8 to 1.6 oz)		Allow a 7 day PHI.	Apply with MSO at 1 qt/A. Use sequential applications and higher spray volumes on dense potato vines. Thorough coverage essential. B4 S1 S3-4 X1
Sulfuric acid RUP	20 gal		Allow a 5 day PHI.	Extremely corrosive.

LEGUME FORAGES

Alfalfa or Trefoil Establishment, No Companion Crop

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraph																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Apply with AMS fertilizer. Refer to label for adjuvant use. A4-5 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Paraquat	2 to 4 pt 2SL RUP 1.3 to 2.7 pt 3SL (0.5 to 1 lb)			Non-residual, contact, translocated herbicides; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. B4 S1 S3-4 Q3 X1																														
Aim (carfentrazone)	1/2 to 1 fl oz EW (0.128 to 0.256 oz)	Small broadleaf weeds.																																
Eptam (EPTC)	2 to 4.5 pt EC 10 to 20 lb 20G (1.75 to 4 lb)	Grass and some broadleaf weeds.	PPI.	Poor wild mustard control. Incorporate immediately after application. The 2 pt/A rate can be used on all varieties. A1																														
Treflan (trifluralin)	1 to 1.5 pt (0.5 to 0.75 lb)			Alfalfa stand reduction/stunting may occur but reduced weed competition will help alfalfa establishment.																														
2,4-DB ester 2,4-DB amine	2 to 4 pt 2EC/SL (0.5 to 1 lb)	Small broadleaf weeds.	Alfalfa: More than 2 trifoliolate leaves. Weeds: <3 inches.	Sweetclover may be killed by 2,4-DB. Poor wild mustard control. No absinth wormwood control. Allow a 60 day PHI or grazing interval.																														
Bromoxynil For Alfalfa Only	1 to 1.5 pt (0.25 to 0.38 lb)		Refer to Remarks.	Sweetclover may be killed. Refer to "Legume Forages with companion crop" for comments. P2																														
Pursuit (imazethapyr) For Alfalfa Only	3 to 4 fl oz (0.75 to 1 oz)	Annual broadleaf and grass weeds.	POST. Alfalfa: At least 2 trifoliolates. Weeds: 1- to 3-inches tall.	Excellent alfalfa safety. Apply with oil additive at 1.5 to 2 pt/A alone or with UAN at 1 to 2 qt/A. No absinth wormwood control. Can be tank-mixed with bromoxynil or Poast. A7 P3 Y2 Y25																														
Raptor (imazamox) For Alfalfa Only	4 to 6 fl oz (0.5 to 0.75 oz)																																	
Poast (sethoxydim)	0.5 to 1.5 pt (0.19 to 0.28 lb)	Annual grasses.	POST. Alfalfa: Allow a 15 days PHI.	May be applied to alfalfa and sainfoin. Apply with oil adjuvant at 1% v/v but not less than 1 pt/A.																														
Clethodim	6 to 16 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: Refer to soybean section on page 26.	Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations. D3 X1																														
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)																																	

LEGUME FORAGES Established Alfalfa

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraph																														
Paraquat RUP	2 to 3 pt 2SL 1.3 to 2 pt 3SL (0.5 to 0.75 lb)	Small annual weeds and early germinating weeds.	Alfalfa: Before spring regrowth is 2 inches tall.	Apply to well established stands, at least 1 year old, after dormancy but before spring regrowth reaches 2 inches. Allow a 60 day PHI or grazing interval. A4 Q3																														
	1 pt 2SL 0.7 pt 3SL (0.25 lb)	Larger weeds.	Between cuttings - includes first-year alfalfa.	Apply up to 5 days after cutting. Allow a 30 day PHI. May be applied to dormant alfalfa. A4 Q3																														
Trifluralin	1.5 to 2 pt (0.75 to 1 lb)	Annual grasses.	Weeds: Prior to emergence.	Apply when crop is dormant, or in fall after a cutting. Incorporate by irrigation or mechanical equipment. X1																														
	20 lb 10G (2 lb)																																	
2,4-DB ester 2,4-DB amine	2 to 4 pt 2EC/SL (0.5 to 1.0 lb)	Broadleaf weeds.	Weeds: Less than 3 inches tall.	Sweet clover may be killed by 2,4-DB. No wild mustard or absinth wormwood control. Allow a 30 day hay, harvest or grazing interval.																														
Pursuit (imazethapyr) For Alfalfa Only	3 to 4 fl oz (0.75 to 1 oz)	Annual broadleaf and grass weeds.	POST. Alfalfa: At least 2 trifoliates. Weeds: 1- to 3- inches tall.	Excellent alfalfa safety. Apply with oil additive at 1.5 to 2 pt/A alone or with UAN at 1 to 2 qt/A. No absinth wormwood control. Can be tank-mixed with bromoxynil or Poast. A7 P3 Y2 Y25																														
Raptor (imazamox) For Alfalfa Only	4 to 6 fl oz (0.5 to 0.75 oz)																																	
Poast (sethoxydim)	0.5 to 1.5 pt (0.2 to 0.3 lb)	Annual grasses.	Grass. Alfalfa: Allow a 15 day PHI.	Oil adjuvant at more than 1 qt/A is not needed. See Select Max label for detailed adjuvant recommendations.																														
Clethodim	6 to 16 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: Refer to soybean section on page 26.	Apply in two sequential applications for quackgrass control. D3 X1																														
Select Max (clethodim)	9 to 32 fl oz (1.125 to 4 oz)																																	
Glyphosate	0.75 to 1.5 lb ae See Remarks.	Alfalfa and emerged grass and broadleaf weeds.	Apply in spring or fall for quackgrass control.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Apply where crop destruction is acceptable. Treated crop and weeds can be harvested and fed 36 hours or longer after treatment. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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HERBICIDE RESISTANT ALFALFA

ROUNDUP READY ALFALFA - Established

Herbicide	Product/A (ae/A)	Weeds	When to Apply	Remarks and Paragraph
Glyphosate	Up to 1.5 lb ae See Remarks.	Emerged annual and perennial grass and broadleaf weeds.	RR Alfalfa: Emergence to 5 days prior to any cutting (PHI). Apply as a single application or multiple applications at least 7 days apart.	Apply only to glyphosate resistant alfalfa. Apply with AMS fertilizer. Multiple applications may be necessary to control weed flushes. Drift and off-site movement may cause injury or death to other plants and crops. Refer to label for weeds controlled, application information, adjuvant use, tankmix options with residual herbicides, and restrictions. A4-7 P4 S4 X1

CHEMICAL FALLOW

For Future Planting of Wheat, Durum, Barley, and Oat - Refer to label for other registered crops.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Trifluralin	6 to 10 lb 10G (0.6 to 1 lb)	Grass and some broadleaf weeds.	PPI in fallow.	Incorporate the first time within 24 hours after application. Delayed second incorporation until weed control is necessary. D13 S7 Q8 X1 Y1 Y18 Y24
Valor (flumioxazin) Future Planting of Wheat and Durum	2 to 3 oz WDG (0.063 to 0.094 lb)	Most small-seeded broadleaf weeds.	Post-harvest in fall until 30 days prior to planting.	Apply in spring with glyphosate or 2,4-D for control of emerged vegetation. Apply with NIS at 0.25% v/v or petroleum oil adjuvant at 12 pt/A for burndown applications. Refer to label for additional information. D16 V1
Atrazine Future Planting of Wheat and Durum Only RUP	0.55 to 1.11 lb DF (0.5 to 1 lb)	Annual broadleaf and grass weeds including downy brome.	Weeds: Before emergence.	Plant at least 2 inches deep and allow at least 12 months before planting. Refer to label for restricted application areas. Apply with paraquat at 1 to 2 pt/A + NIS at 0.125 to 0.25% v/v to emerged weeds less than 6 inches tall. C6 V1 Y4 Y8 Y24
Paraquat RUP	1.5 to 4 pt 2SL 1 to 2.7 pt 3SL (0.375 to 1 lb)	Emerged annual grass and broadleaf weeds.	Weeds: Less than 6 inches tall.	Non-residual, contact, herbicides; thorough coverage required. Apply with NIS at 0.25% v/v to small weeds. Refer to pages 108-109 for commercial mixtures. B4 S1 S3-4 Q5 X1
Aim (carfentrazone)	0.5 to 1 fl oz EW (0.128 to 0.256 oz)	Broadleaf weeds including pigweed and ALS kochia.	Weeds: Less than 2 inches tall.	
Thifensulfuron + Tribenuron 4:1 ratio (TankMix) 2:1 ratio (H. Extra) 1:1 ratio (BrdSpec)	Product rates vary depending on ratio and formulation.	Annual broadleaf weeds.	Any time after harvest until 60 days prior to planting crop.	Apply with NIS at 0.25 to 0.5% v/v unless restricted by the tank-mix partner. Apply in a tank-mixture with other registered herbicides to delay weed resistance. Products containing tribenuron give season-long Canada thistle control. Products containing metsulfuron give season-long control of perennial sowthistle. Refer to pages 108-109 for commercial mixtures. A7 X1 Y3 Y24
Metsulfuron	0.1 oz DF			
Thifensulfuron & Tribenuron & Metsulfuron	0.2 oz DF 0.3 to 0.5 oz SG			
Chlorsulfuron & Metsulfuron	0.2 to 0.3 oz DF			
2,4-D	1.5 to 4 pt 4EC/SL (0.75 to 2 lb)	Broadleaf weeds and suppression of Canada thistle.	POST.	Use the higher rate for perennial weeds. B2 Q1
Dicamba	0.5 to 1 pt (0.25 to 0.5 lb)			Soil residual from fall application may damage broadleaf crops seeded the next year. B2 X1 Y11 Y24
Distinct (dicamba & diflufenzopyr)	6 oz WDG (3 oz & 1.2 oz)			Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. Refer to label for tank-mix options. Distinct at 6 oz 70WDG/A = 6 fl oz Clarity. C10 Y11 Y24

CHEMICAL FALLOW

For Future Planting to Wheat, Durum, Barley, and Oat

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds.	Weeds: Less than 12 inches tall. See label.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated, foliar herbicide. Apply with AMS fertilizer. Use the lower rate for annual grasses. Glyphosate will not control glyphosate-resistant volunteer crops. Apply with 2,4-D or dicamba for improved broadleaf weed control. Refer to label of tank-mix partner for rates, adjuvant use, application information, crop rotation restrictions, and other restrictions. A4-6 A7 Q1 X1 Y11 Y24</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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Clopyralid & 2,4-D	4 pt (0.19 & 1 lb)	Broadleaf weeds including Canada thistle.	Canada thistle: Prior to bud stage.	Apply after a majority of rosettes have emerged. Refer to narrative for rotational restrictions. Refer to pages 108-109 for commercial mixtures. B10 T2 T6 X1 Y20 Y24																														
Tordon 22K (picloram) RUP	0.25 to 0.5 pt (0.063 to 0.125 lb)	Annual weeds.	Weeds: Actively growing.	Refer to label for grazing and rotational restrictions. Do not rotate to corn or sorghum the following year. Rates greater than 0.5 pt/A should be used post-harvest when rotating to follow the following year. T2-4 T6 T15 X1 Y1 Y21 Y24																														
Tordon 22K (picloram) + 2,4-D RUP	0.5 to 1 pt + 1 to 2 pt (0.125 to 0.25 + 0.5 to 1 lb)	Perennial weeds.	Canada thistle: Prior to bloom. Field bindweed: Actively growing.	Refer to label for grazing and rotational restrictions. Do not rotate to corn or sorghum the following year. Rates greater than 0.5 pt/A should be used post-harvest when rotating to follow the following year. T2-4 T6 T15 X1 Y1 Y21 Y24																														
Paramount (quinclorac) Future Planting of Wheat and Durum Only	0.33 lb DF (0.25 lb)	Field bindweed: Runners at least 4 inches long.	Postharvest or in the spring prior to seeding of wheat including durum.	Apply with MSO adjuvant at 1.5 pt/A. AMS at 2.5 lb/A or UAN at 1 gal/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested to use in a 3-year program with 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. May control foxtails, barnyardgrass, and volunteer flax. Q2 T1 Y15 Y24																														
Starane (fluroxypyr)	0.67 pt (2 oz)	Kochia including resistant biotypes.	Weeds: 4- to 8-inches tall.	No residual weed control. Controls ALS-resistant and dicamba-resistant kochia. Do not plant any crop for 120 days after application. B10 S3 X1																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Annual and perennial grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	<table border="1"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Apply with AMS fertilizer. Use the lower rate for annual grasses. Glyphosate will not control glyphosate resistant volunteer crops. A4-6 Q1 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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2,4-D	1.5 to 4 pt 4EC/SL (0.75 to 2 lb)	Annual broadleaf weeds, biennial thistles, and suppression of perennial broadleaf weeds.	<p>Weeds: Emergence to bud stage.</p> <p>Pasture grasses: After 5-leaf stage.</p>	<p>Apply only 2,4-D brands registered for use in CRP. Do not graze animals for 7 days after application or within 3 days of slaughter.</p> <p>Do not apply after boot stage on grasses for seed production. Use 2 pt/A on annuals and gumweed and 4 pt/A on sages and other perennials.</p> <p>Controls buckbrush/western snowberry. Refer to pages 108-109 for commercial mixtures. T2 T3 T8 X1</p>																														
Dicamba	0.5 to 4 pt (0.25 to 2 lb)		Grasses: After 3-leaf stage of seedling grasses. Weeds: Prior to bud stage for thistles and knapweeds.	<p>Apply with a NIS. Spray drift from dicamba may injure nearby susceptible crops and trees. Rates greater than 1 pt/A may injure newly seeded grasses.</p> <p>Consult the label for grazing restrictions and tank mixtures with other herbicides. Refer to pages 108-109 for commercial mixtures. T2 T3 T10 X1 Z1</p>																														
Dicamba + 2,4-D	1 to 4 pt + 2 pt 4EC/SL (0.5 to 2 + 1 lb)		Biennial thistles: Rosette stage.	<p>Apply with NIS at 0.25 to 0.5% v/v. Refer to pages 108-109 for commercial mixtures. T2-3 T8 T10 X1 Z1</p>																														
Overdrive (dicamba & diflufenzopyr)	6 oz WDG (3 oz & 1.2 oz)		Prior to bud stage for thistles and knapweeds.	<p>Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. Canada thistle suppression only. C10 T2 Y11 Y24</p>																														
Metsulfuron	1/10 to 1 oz DF (0.06 to 0.6 oz)	Season-long control of perennial sowthistle.	Fall or spring to early summer. Weeds: Less than 4 inches tall.	<p>Apply with phenoxy type herbicide to small annual weeds or before thistle plants bolt.</p> <p>Apply with NIS at 0.25 to 0.5 % v/v or oil adjuvant at 1% v/v.</p> <p>Add 2,4-D for Russian thistle control.</p> <p>Use Cimarron Max for control of buckbrush and perennial species. T2 T11 X1 Y3 Y24 Z1</p>																														
Chlorsulfuron & Metsulfuron	<p>Annual weeds = Rate I: 1/4 oz + 1/4 oz DF</p> <p>Perennial weeds = Rate II: 1/2 oz + 1/2 oz DF (0.15 to 0.3 & 0.188 to 0.375 oz)</p>	Annual, perennial weeds, and brush species including Canada thistle, per. sowthistle, other thistles, snowberry or buckbrush.		<p>Also registered on pasture and rangeland. Cimarron Xtra = Co-pack of metsulfuron + Telar. Rate I treats 40 acres. Rate II treats 20 acres.</p> <p>Apply with NIS at 0.25% v/v or petroleum or MSO oil adjuvant at 1% v/v. Safe to most grasses. May be tank-mixed with phenoxy type herbicides. Refer to label for additional information.</p> <p>No grazing or haying restrictions. Refer to pages 108-109 for commercial mixtures. T2 T11 X1 Y3 Y24 Z1</p>																														
Cimarron Max (metsulfuron & 2,4-D & dicamba)	<p>Annual weeds = Rate I: 1/4 oz DF + 1 pt</p> <p>Perennial weeds = Rate II: 1/2 oz DF + 2 pt (0.15 to 0.3 oz & 0.36 to 0.72 lb & 0.125 to 0.25 lb)</p>			<p>Cimarron Max = Co-pack of metsulfuron + Weedmaster (2,4-D + dicamba).</p> <p>The 0.25 oz + 1 pt rate will treat 20 acres. Apply with NIS at 0.25 to 0.5% v/v. Safe to most grass but refer to label for NIS rates for certain grass species. T2 T11 X1 Y3 Y24 Z1</p>																														

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Clopyralid	1/3 to 2/3 pt (2 to 4 oz)	Broadleaf weeds including Canada thistle and knapweeds.	Weeds: Actively growing and prior to bud stage for thistles and knapweeds.	Apply after most thistle shoots have emerged but before bud stage. Do not apply clopyralid & 2,4-D to new grass seedings. Use lower rate for annual broadleaf weeds and higher rate for perennial thistles and knapweeds. Do not cut treated grass for hay within 30 days after application. T2 Z1
Clopyralid & 2,4-D	4 to 8 pt (1 to 2 oz & 0.19 to 0.38 lb)			
Crossbow (triclopyr & 2,4-D) 	1 to 6 qt (0.25 to 1.5 & 0.5 to 3 lb)	Trees, brush and broadleaf weeds.	Spring: Prior to bud stage for thistles and knapweed. Fall: To rosettes.	Provides more consistent musk thistle and brush control (except buckbrush and western snowberry) than 2,4-D alone. Will control most unwanted tree species. Use highest rate for elm and Russian olive. Observe grazing and haying restrictions. T9
Redeem (triclopyr & clopyralid)	Annual weeds = 1.5 to 2.5 pt Perennial weeds = 2.5 to 4 pt (0.4 to 1.1 & 0.15 to 0.4 lb)	Annual and perennial weeds, brush, and trees.	Spring: Prior to bud stage for thistles and knapweed. Fall: To rosettes.	Apply with NIS at 0.25% v/v. Cost-effective formulation of clopyralid. Provides broad-spectrum broadleaf weed control including thistles and knapweeds but not leafy spurge. Use high rates for perennial weeds. Observe grazing and haying restrictions for lactating animals. T2 T14 Z1
Starane (fluroxypyr)	0.67 to 1.33 pt (2 to 4 oz)	Kochia and a few broadleaf weeds.	Spring: Kochia less than 6 inches tall.	Will kill desirable legumes but controls kochia, including ALS-resistant kochia. B10 S5
Milestone (aminopyralid)	3 to 7 fl oz (0.75 to 1.75 oz)	Most annual and perennial composite weeds, including wormwood and thistles. See label.	Spring: Rosette to bolting or in fall.	Apply up to 14 oz/A for spot treatment. Milestone can leave a residue for several years following application. Legume species are very susceptible. Refer to label for crop rotation restrictions if CRP breakout is planned. T12 Y24 Z1
Tordon (picloram)	0.25 to 0.5 pt (0.06 to 0.13 lb)	Annual broadleaf weeds.	Weeds: Small and actively growing.	Use 0.25 to 0.5 pt/A for small annual weeds. Use 2 pt/A for suppression and 4 pt/A as spot treatment to control perennial weeds. Rates over 2 pt/A may suppress perennial grasses. Observe grazing restrictions. Apply with 2,4-D to provide cost-effective weed control. Picloram can leave a residue for several years following application. Refer to label for crop rotation restriction if CRP breakout is planned. T2 T3 T15 Z1
	1 to 4 pt (0.25 to 1 lb)	Perennial broadleaf weeds and trees.	Emergence to bud stage.	
Plateau (imazapic)	4 to 12 fl oz for pasture, rangeland, native prairie restoration, and wildflower establishment. (1 to 3 oz)	Foxtail and annual and perennial broadleaf weeds including leafy spurge.	PRE or POST. Grasses: 7 to 10 days after planting. Weeds: Up to 6 inches tall. Early September to early October. Apply in mid-September for leafy spurge control.	Use on newly established or existing grass stands. Has PRE activity on annual weeds. Use an MSO type adjuvant at 2 pt/A. 4 fl oz/A controls/suppresses annual weeds. 12 fl oz/A controls annual weeds plus leafy spurge and Russian knapweed. Rates above 8 fl oz/A can cause reduced grass production, especially cool-season grasses. Use lower rates in areas of low rainfall. High risk of injury to switchgrass. No grazing restrictions specified. Does not control absinth wormwood, Canada thistle, or spotted knapweed. T13 T17 Y24 Z1

GRASS ESTABLISHMENT

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
Glyphosate	0.38 to 1.5 lb ae See Remarks.	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual translocated, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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2,4-D MCPA	0.5 to 1 pt 4EC/SL (0.25 to 0.5 lb)	Broadleaf weeds.	Grasses: After 5-leaf stage.	Use rates listed for establishing grasses. T8 X1																														
Bromoxynil	1 to 2 pt (0.25 to 0.5 lb)		Grasses: Anytime after emergence.	Grass tolerance is excellent. Can be applied to grass-alfalfa mixtures. Registered CRP species include wheatgrasses = crested, tall, western, bluebunch, and intermediate, perennial ryegrass, fescue, Russian wildrye, and alfalfa.																														
Bromoxynil & MCPA	1 to 2 pt 4EC 0.8 to 1.6 pt 5EC (0.25 to 0.5 & 0.25 to 0.5 lb)		POST: Grasses: 3-leaf stage or larger.	Refer to bromoxynil section above for registered grass species. Refer to pages 108-109 for commercial mixtures. Consult label for list.																														
Starane (fluroxypyr)	0.67 to 1.33 pt (2 to 4 oz)	Kochia and a few broadleaf weeds.	Spring: Kochia less than 6 inches tall.	Will kill desirable legumes but controls kochia, including ALS-resistant. B10 S5																														

VEGETATION CONTROL FOR CRP BREAKOUT

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																									
Glyphosate	0.75 to 1.5 lb ae See Remarks.	CRP vegetation and weeds.	14 to 21 days prior to tillage.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.75 ae</td> <td>1.125ae</td> <td>1.5 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Wheatgrasses may be adequately controlled by glyphosate applied in the spring. However, smooth brome grass requires at least fall plus preplant spring applications of glyphosate and in-crop chemical and/or mechanical control for adequate season-long control. Always add AMS for improved weed control. Refer to label for adjuvant use. Allow 14 to 21 days prior to tillage. Glyphosate provides greater Canada thistle control when fall-applied than spring-applied. A4-6 R1 X1 Addition of 2,4-D: Addition of 2,4-D or will increase alfalfa and sweet clover control but decrease grass control. Always use AMS to overcome antagonism of 2,4-D on grass control and will improve control of perennial weeds, such as leafy spurge and Canada thistle. CRP grasses and forbs may become a problem in planted crop. A1 A4-6 R1 X1</p>	lb ae/gal	lb ai/gal	0.75 ae	1.125ae	1.5 ae	3	4	= 32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 22 fl oz	32 fl oz	44 fl oz	5	6.1	= 20 fl oz	30 fl oz	40 fl oz
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SPECIAL WEED PROBLEMS

North Dakota Noxious and Troublesome Weeds

www.ag.ndsu.nodak.edu/invasiveweeds/

**By North Dakota Law, all land owners must control noxious weeds on their property.
Refer to the following Extension Circulars for additional information:**

	<u>Page</u>
Bindweed, field*	52-53
Extension Circular W-802, "Identification and Control of Field Bindweed"	
Knapweed, diffuse*	54
Knapweed, Russian*	54
Knapweed, spotted*	54
Extension Circular W-1146, "Know your Knapweeds"	
Lythrum or purple loosestrife*	55
Extension Circular W-1132, "Identification and Control of Purple Loosestrife"	
Quackgrass	55
Saltcedar*	55
Extension Circular W-1223, "Saltcedar Identification and Control"	
Spurge, leafy*	56-57
Extension Circular W-765, "Leafy Spurge Identification and Control"	
Extension Circular W-866, "Integrated Management of Leafy Spurge"	
Extension Circular W-1088, "Leafy Spurge - Biology, Ecology and Management"	
Starthistle, yellow*	54
Extension Circular W-1222, "Yellow Starthistle Identification and Control"	
Thistle, bull	60
Thistle, Canada*	58-59
Thistle, musk*	60
Thistle, plumeless	60
Extension Circular W-799, "Perennial and Biennial Thistle Control"	
Extension Circular W-1120, "Thistles of North Dakota"	
Toadflax, dalmatian*	61
Toadflax, yellow	61
Extension Circular W-1239, "Dalmatian and Yellow Toadflax, Identification and Control"	
Wormwood, absinth*	61
Extension Circular W-838, "Absinth Wormwood Control"	
 * Weed is a North Dakota State Noxious Weed.	
Other extension circulars that have additional information:	
Extension Publication "Right-of-Way Certification Manual"	
Extension Circular W-1097, "Weed Control in Tree Plantings"	
Shelterbelt weed control	62
Total vegetation weed control	63
Troublesome weeds in pasture, rangeland, and noncropland	64
Troublesome weeds in cropland and other areas	64

BINDWEED, FIELD

Extension Bulletin W-802, "Identification and Control of Field Bindweed" provides additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																									
Glyphosate + dicamba	Up to 1.5 lb ae + 1 pt (1.5 lb ae + 0.5 lb) See Remarks.	Preplant, fallow, post-harvest, and CRP.	Actively growing. Vines: At least 12 inches long. Apply at beyond full bloom.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>1.5 ae</td> <td></td> </tr> <tr> <td>3</td> <td>4</td> <td>= 64 fl oz</td> <td></td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 48 fl oz</td> <td></td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 44 oz</td> <td></td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 40 fl oz</td> <td></td> </tr> </table> <p>Less potential for soil residual than with higher rates of dicamba. Prepackaged mixtures available. Apply with AMS fertilizer. Refer to label for adjuvant use. Refer to pages 108-109 for commercial mixtures. A4-6 Q1 Z1</p>	lb ae/gal	lb ai/gal	1.5 ae		3	4	= 64 fl oz		4/4.17	5.4/5.1	= 48 fl oz		4.5	5.5	= 44 oz		5	6.1	= 40 fl oz						
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Glyphosate + 2,4-D	Up to 0.375 lb ae + 1.5 pt 4EC/SL (0.38 + 0.75 lb)	Preplant, fallow, post-harvest.	Vines: 6 to 18 inches.	Suppression in patches or individual plants. Allow at least 7 days between application and tillage. Control is reduced under dry conditions. Add AMS to improve weed control. A4-6 Q1 Z1																									
2,4-D amine or ester	1.5 to 2 pt 4SL (0.75 to 1.0 lb) 1.33 to 2 pt 4EC (0.66 to 1.0 lb)	Spring wheat and barley.	Crop: Tiller stage.	The high rate may injure crop but may be beneficial, especially in small areas, to control bindweed. Does not provide long term control. T6 Z1																									
Tribenuron + 2,4-D + dicamba	0.17 to 0.3 oz DF 0.25 to 0.5 oz SG + 0.5 pt 4EC/SL + 2 to 3 fl oz (0.125 to 0.25 oz + 0.25 + 1 to 1.44 oz)	Spring wheat including durum.	Crop: Tillering and before crop exceeds the 5-leaf stage.	Treatments will provide season-long control. 2,4-D enhances weed control and crop safety. Apply with NIS at 0.125% v/v. See section on herbicide resistance. Crop rotation restrictions the following year for metsulfuron. Do not apply metsulfuron within 22 months from last metsulfuron treatment or on soils above a pH of 7.9. Refer to metsulfuron label for additional restrictions. Refer to pages 108-109 for commercial mixtures. B11 B17 T6 Y3 Y11 Y24 Z1																									
Metsulfuron + 2,4-D + dicamba	1/20 to 1/10 oz XP + 0.5 pt 4EC/SL + 2 to 3 fl oz (0.0375 to 0.075 oz + 0.25 lb + 1 to 1.44 oz)																												
2,4-D	1 pt 4EC/SL (0.5 lb)	Corn.	Corn: 3 to 8 inches tall.	Use drop nozzles after corn is more than 8 inches tall. Provides field bindweed suppression only. C23 T2 Z1																									
Dicamba	0.5 to 1 pt (0.25 lb)		Corn: See remarks.	Apply 0.5 to 1 pt/A up to 8 inches tall. Apply 0.5 pt/A post-direct from 8 inches to 36 inches tall or 15 days prior to tassel. C10 C17 T6 Z1																									
Glyphosate	1 to 1.5% solution or Up to 3 lb ae (3 lb ae) See Remarks.	Patches in wheat, barley, oat, corn, soybean or trees.	Crop: Prior to heading or flowering. Bindweed: Bud to flowering stage.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>1.5 ae</td> <td>2.25 ae</td> <td>3 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 64 fl oz</td> <td>96 fl oz</td> <td>128 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 48 fl oz</td> <td>72 fl oz</td> <td>96 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 44 oz</td> <td>66 fl oz</td> <td>88 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 40 fl oz</td> <td>60 fl oz</td> <td>80 fl oz</td> </tr> </table> <p>Crop will be killed in treated area. Avoid drift or spraying tree foliage. Repeat applications are required for complete control. Treat bindweed when actively growing. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 T4-6 Z1</p>	lb ae/gal	lb ai/gal	1.5 ae	2.25 ae	3 ae	3	4	= 64 fl oz	96 fl oz	128 fl oz	4/4.17	5.4/5.1	= 48 fl oz	72 fl oz	96 fl oz	4.5	5.5	= 44 oz	66 fl oz	88 fl oz	5	6.1	= 40 fl oz	60 fl oz	80 fl oz
lb ae/gal	lb ai/gal	1.5 ae	2.25 ae	3 ae																									
3	4	= 64 fl oz	96 fl oz	128 fl oz																									
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Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Paramount (quinclorac)	0.33 lb DF (0.25 lb)	Fallow, post-harvest or preplant in spring prior to seeding wheat including durum.	Bindweed: Actively growing and regrowth at least 4 inches long.	Apply with MSO adjuvant at 2 pt/A. AMS at 2.5 lb/A or UAN at 1 gal/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested to use a 3-year program with 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. May control foxtails, barnyardgrass, and volunteer flax. Q2 T1 Y15 Y24 Z1
	0.5 lb DF (0.375 lb)	CRP, pasture, rangeland.	Fall: Prior to frost Bindweed: At least 4 inches long and actively growing.	Allow 309 days before grazing and haying. Use an MSO-type adjuvant at 2 pt/A. Only suppresses perennial broadleaf weeds. T1 Z1
2,4-D ester	2 to 4 pt 4EC/SL (1 to 2 lb)	Fallow or post-harvest, and CRP.	Bindweed: Actively growing and regrowth 12 inches to bud.	In CRP, apply only registered brands of 2,4-D. Cultivate fallow until early July to achieve optimum growth at time of application. Spray in late August or September. Respray in following crop. Does not provide long term control. T4-6 T8 Z1
Dicamba	2 to 4 pt (1 to 2 lb)			Mid to late fall treatments more effective than summer treatments. Rotate to wheat, corn, soybean or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per pt/A dicamba used, excluding days when ground is frozen. Surfactant improves consistency of control. Commercial mixtures with 2,4-D available. T4-6 T10 Z1
Tordon 22K (picloram) + 2,4-D RUP	0.5 to 1 pt + 1 to 2 pt 4EC/SL (0.125 to 0.25 + 0.5 to 1 lb)	Fallow, post-harvest, CRP, and pasture.		Refer to label for crop rotation and preplant interval recommendations. Primarily for small grain/fallow rotations. Y21 Y24 Z1
Dicamba	4 to 16 pt (2 to 8 lb)	Patches or individual plants in CRP, pastures, fallow, and noncropland.		Apply to foliage and/or soil. Consult label for grazing restrictions. Use low rate only in fall and high rates in dense or old stands. Addition of NIS improves consistency of control. Q1 T4-5 T10 Y11 Y24 Z1
Tordon 22K (picloram) + 2,4-D RUP	2 to 4 pt + 1 to 2 pt 4EC/SL (0.5 to 1 + 0.5 to 1 lb)			Picloram + 2,4-D is more cost-effective than picloram alone at higher rates. Consult reference for grazing restrictions. T4-5 T15 Y21 Y24 Z1
Paramount + Overdrive (dicamba & diflufenzopyr)	8 oz DF + 6 oz WDG (6 oz + 3 oz & 1.2 oz)	Noncropland.	Fall: Bindweed: Prior to a killing frost. At least 4 inches of stem.	Allow 309 days before haying and grazing. Use an MSO-type adjuvant at 2 pt/A. Q2 C10 T1 T10 Z1

KNAPWEED, DIFFUSE AND SPOTTED AND STARHISTLE, YELLOW

Extension Bulletin W-1146, "Know Your Knapweed" provides photos and additional information.

Extension Bulletin W-1222, "Yellow Starthistle Identification and Control" provides photos and information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
2,4-D amine or ester	2 to 4 pt 4EC/SL (1 to 2 lb)	Fallow, post-harvest, CRP, pasture, and rangeland.	Rosette stage is preferred.	Several years of annual treatment are necessary. Apply only 2,4-D brands registered for CRP. T4-6 T8
Dicamba	2 to 4 pt (1 to 2 lb)		Bud to bloom is second best.	Plants are controlled slowly. Surfactant improves consistency of control. T10
Tordon 22K (picloram) RUP	1 to 2 pt (0.25 to 0.5 lb)	CRP, pasture, rangeland, and noncropland.	Rosette stage preferred.	Consult label for grazing restriction. Apply up to 2 pt/A broadcast and 4 pt/A for spot treatment. T8 T15 Y21
Tordon 22K + RUP 2,4-D amine / ester	1 to 2 pt + 1 qt 4EC/SL (0.25 to 0.5 + 1 lb)		Bud to bloom is second best.	
Plateau (imazapic)	6 fl oz (1.5 oz)		Rosette stage in the fall.	For yellow starthistle only. Do not apply more than 4 oz/A in CRP. Apply with MSO adjuvant at 1 qt/A plus 28% UAN at 1 qt/A. Refer to label. T13 T17
Milestone (aminopyralid)	3 to 7 oz (0.75 to 1.75 oz)		Spring: Rosette to bolting. Fall: Rosettes.	Apply up to 14 oz/A for spot treatment. Use lower rates for yellow starthistle. Refer to label for grazing restrictions. T12 Z1
Clopyralid	2/3 to 1 pt (4 to 6 oz)	Noncropland and right-of-way.	Rosette to bud stage.	Apply with NIS. Stinger is labeled for CRP. Y20
Glyphosate	1.5 to 2.25 lb ae See Remarks.	Fallow and noncropland.	Bud to bloom stage - late summer to early fall.	Other vegetation will also be killed. Retreat the following spring with 2,4-D at 2 to 4 pt/A to control seedlings and escapes. Refer to label for adjuvant use. Add AMS fertilizer. A4-6 T4-8

KNAPWEED, RUSSIAN

Extension Bulletin W-1146, "Know Your Knapweed" provides photos and additional information.

Herbicide	Product/A (ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Tordon 22K (picloram) RUP	3 to 4 pt (0.75 to 1 lb)	CRP, pasture, rangeland, and noncropland.	Apply following several hard frosts (mid-October). Plants may be dormant with grey stems and no leaves.	Consult label for grazing restriction. Apply up to 2 pt/A broadcast and 4 pt/A for spot treatment. T8 T15
Plateau (imazapic)	12 fl oz (3 oz)		Application in mid-September or during flowering in mid-summer provides shorter-term control than late applications.	Apply with MSO adjuvant at 1 qt/A plus 28% UAN at 1 qt/A. Rates above 8 fl oz/A can reduce grass production. Refer to label. T12 T17
Milestone (aminopyralid)	4 to 6 oz (1 to 1.5 oz)		Spring: Bud to flowering stage. Fall: Dormant plants.	Apply up to 14 oz/A for spot treatment. Refer to label for grazing restrictions. T12 Z1

LYTHRUM OR PURPLE LOOSESTRIFE

Extension Circular W-1132, "Identification and Control of Purple Loosestrife" provides additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Aquamaster Glypro Rodeo (glyphosate)	1 to 1.5 gal/100 gal 1.3 to 1.9 fl oz/gal water of a 4 lb/gal conc. (1 to 1.5% conc.)	Drainage and aquatic sites.	July to early September.	Use only registered 4 lb ae/gal glyphosate formulations. Apply with an NIS approved for use in aquatic sites at 0.75% v/v. Control seedlings using a 2,4-D formulation labeled for use near water. Biological control agents have been introduced for control. A4-6 A17 T19 X1
Garlon 3A (triclopyr)	1 to 3 gal/100 gal water (3 to 9 lb)			Minimize overspray to open water especially application along shore of flowing water. Does not affect cattail or desirable grass species. T19
Habitat (imazapyr)	1 pt (0.25 lb)			Plants actively growing.
Milestone (aminopyralid)	1 pt/100 gal (0.125% conc.)	Non-irrigation ditch banks, wildlife or natural areas, seasonally dry wetlands, including riparian areas.	July to early September.	Do not apply directly to water. Safe under or near many tree species. T12.
Milestone VM Plus (triclopyr & aminopyralid)	1 gal/100 gal (1% conc.)			
Biological Control	Insects			Two leaf feeding beetles (<i>Galerucella</i> spp.) have worked well in the state. Contact your local weed control officer or state APHIS officer in Bismarck. T19.

QUACKGRASS

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.75 lb ae	See label.	See label. Generally 6 to 12 inches tall	See label for registered uses, rates for different formulations, and application information. A4
Maverick Olympus	2/3 oz DF 0.6 to 0.9 oz WDG	Wheat		See label for registered uses, rates for different formulations, and application information. B16-18 Y24
Accent Steadfast Resolve Option	2/3 oz DF 3/4 oz DF 1 oz DF 1.75 oz WDG	Corn.		See label for application information, adjuvants, use information, and crop rotation restrictions. MSO adjuvants give greater control than other adjuvant types. C3 C12 Y3 Y24
POST grass herbicides	See page 26.	Labeled broadleaf crops.		Apply with oil adjuvant at 1% v/v but not less than 1 pt/A. Oil adjuvant more than 1 qt/A is not needed. D3

SALT CEDAR

Extension Bulletin W-1222, "Saltcedar Identification and Control" provides additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Arsenal Habitat Stalker (imazapyr)	1% solution to foliage or 2 qt/A aerial applied to foliage or 12 oz/gal as a cut stump treatment immediately after cutting.	Wildlife openings and wildlands.	August or September is best but can be applied anytime saltcedar is found. Plants should have green leaves (foliar application).	Thoroughly wet foliage. Do not cut down and remove for at least three years following foliar treatment or regrowth will occur. Apply with MSO-type adjuvant at 1 qt/A for foliar application or 0.5 to 1% for backpack sprayer or 0.25% v/v NIS. Avoid drift and contact with desirable plants. Do not contaminate surface water.
Garlon 4 (triclopyr)	25% v/v + petroleum oil (1 qt + 2 qt) (1 lb)	Non-cropland as basal bark or cut stump.	Treatment in late fall or early spring are most successful; otherwise any time when the bark is not frozen.	Do not spray over open water or irrigation ditches. Complete coverage around the stem or over the cut stump is required for good control. Do not allow spray runoff to puddle.

SPURGE, LEAFY

Extension Bulletins W-765, "Leafy Spurge Identification and Control", W-866, "Integrated Management of Leafy Spurge", and W-1088, "Leafy Spurge - Biology, Ecology and Management" provide additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
2,4-D amine or ester	2 to 4 pt 4EC/SL (1 to 2 lb)	Fallow.	Leafy spurge: Actively growing.	Cultivate or respray whenever regrowth is 4 to 6 inches high. Retreat in next years crop. T4-5 T8																														
Dicamba	2 to 4 pt (1 to 2 lb)	Fallow or post-harvest.	Leafy spurge: Spring: True flower stage. Fall: 4 to 12 inch regrowth.	Rotate to wheat, corn, soybean, or sorghum only. Crop injury may occur when the interval between application and planting is less than 45 days per pt/A dicamba used excluding days when ground is frozen. Surfactant improves consistency of control. T4 T10 Y11 Y24																														
Paramount (quinclorac)	0.5 lb DF (0.375 lb)	Pasture and rangeland.	Fall: Prior to frost Leafy spurge: Actively growing.	Allow 309 days before grazing and haying. Use an MSO-type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q2 T4-5 Z1																														
2,4-D amine or ester	2 to 4 pt 4EC/SL (1 to 2 lb)	CRP, pasture and rangeland.	Leafy spurge: Early bud stage and fall.	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days or beef cows for 3 days after treatment. In CRP, apply only registered 2,4-D brands. T4-5 T8 T16 Z1																														
Tordon 22K (picloram) + 2,4-D ester or amine RUP	1 to 2 pt + 2 pt 4EC/SL (0.25 to 0.5 + 1 lb)	CRP, pasture, rangeland and roadsides.	Leafy spurge: Spring: True flower stage. Fall: 4 to 12 inch regrowth.	Tordon + 2,4-D at 1 pt/A + 2 pt/A is the most cost-effective treatment in NDSU data. Retreatment at the same rate will be necessary for several years regardless of herbicide or rate. Annual control was greater and years of retreatment needed were less with the 2 pt/A Tordon rate. Fall treatments should use 2 pt/A and apply for 3 to 5 years consecutively. T4 T15-16 Z1																														
Tordon 22K + Plateau + 2,4-D + MSO adjuvant (picloram + imazapic) RUP	1 pt + 4 fl oz + 1 qt 4EC/SL + 1 qt (4 oz + 1 oz + 1 lb)		Leafy spurge: True flower growth in spring.	Do not apply in fall. Addition of Plateau improves long-term leafy spurge control. 2,4-D is not required but does increase spectrum of weeds controlled. Follow labels of all herbicides used. Apply only in spring when plants are in true flower. Some grasses may show temporary stunting. T5 T13 T15-16 Z1																														
Dicamba	4 pt (2 lb)			Surfactant improves consistency of control. T10																														
	4 to 16 pt (2 to 8 lb)	Patches or individual plants in CRP, pasture or noncropland.	Leafy spurge: Spring: True flower stage. Fall: 4 to 12 inch regrowth.	Consult label for grazing restrictions. NIS improves consistency of control. Re-treatment necessary. Q1 Z1																														
Tordon 22K (picloram) RUP	4 pt (1 lb)			Consult narrative for grazing restrictions. T15 Z1																														
Glyphosate	0.75 to 1.5 lb ae See Remarks.	CRP and trees.	Leafy spurge: After July 1 to actively growing plants.	<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.75 ae</td> <td>1.125 ae</td> <td>1.5ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Glyphosate is non-selective; avoid spraying tree foliage. Following spring: Retreat with 2,4-D at 2 to 4 pt/A to control seedlings and escapes. Refer to label for adjuvant use. Add AMS fertilizer. A4-6 T4 T7 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.75 ae	1.125 ae	1.5ae	3	4	= 16 fl oz	32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 12 fl oz	24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 11 fl oz	22 fl oz	32 fl oz	44 fl oz	5	6.1	= 10 fl oz	20 fl oz	30 fl oz	40 fl oz
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2,4-D amine	2 to 4 pt 4SL (1 to 2 lb)																																	
Casoron 4G Norosac 10G (dichlobenil)	150 to 200 4G 60 to 80 lb 10G (6 to 8 lb)	Trees.	Leafy spurge: Late Nov. to early March - before emergence.	Season long suppression only. Must be applied before leafy spurge emerges. No POST control.																														

Herbicide	Product/A (ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Paramount + (quinclorac) Overdrive (dicamba & diflufenzopyr)	8 oz DF + 6 oz WDG (6 + 3 & 1.2 oz)	Noncropland.	Spring: True flower. Fall: Prior to frost.	Allow 309 days before grazing and haying. Use an MSO-type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. C10 Q2
Krenite (fosamine)	12 to 16 pt (6 to 8 lb)	Noncropland, adjacent to water and trees.	Spring: True flower growth stage. Fall: Early.	Inconsistent control. Best control with high humidity and good soil moisture. Do not contaminate water during application.
Aquamaster Glypro Rodeo (glyphosate)	2 pt 4SL (0.75 lb ae)	Adjacent to water.	Mid-July to mid- September.	Use only registered 4 lb ae/gal glyphosate formulations. Apply with a NIS approved for use near water. Subsequent years: Control seedlings with a 2,4-D formulation labeled near water. A4-6 T8
2,4-D amine	2 to 4 pt 4SL (1 to 2 lb)		Leafy spurge: Actively growing.	Use only 2,4-D formulations labeled for use in or near water, such as Agrilance "AgriSolutions 2,4-D Amine 4", Nufarm "Weedar 64", UAP "Savage" and "Amine 4 2,4- D", or Van Diest "Navigate". T4-5 T8
Glyphosate & 2,4-D	54 fl oz 2.4SL (0.38 & 0.63 lb)	Noncropland, pasture, and fallow.	Leafy spurge: Seed set stage or actively growing in fall.	Some grass injury and stunting may occur; injury is greater with fall than spring treatments. Not to be used in consecutive years. A4-6 Q1 T8 Z1
Plateau (imazapic)	8 to 12 fl oz (2 to 3 oz)	Pasture, new or existing grass plantings in cropland, CRP or noncropland.	Early to mid September.	May be used on CRP, pasture, rangeland, industrial sites, roadside right-of-way or noncropland. Apply with MSO adjuvant at 1 qt/A plus 28% UAN at 1 qt/A. Rates above 8 fl oz can reduce grass production, especially cool season species. Safe under most tree species but will cause temporary yellowing of spruce candles. See label for additional information. T13 T18 Z1
Cultivation		Cropland.	Leafy spurge: 2 to 4 inches tall.	Leafy spurge will not survive intensive tillage. Repeat when plants are 2 to 4 inches tall. T5
			Late fall.	Cultivate when plants are 3 to 6 inches tall on fallow or post-harvest in Sept. and again in Oct.
Biological Control	Insects and Grazing	CRP, pasture, rangeland and noncropland.	See narrative.	Several insects are available. Sheep and goats can be used for management of leafy spurge infestations. See narrative for additional information. T18

THISTLE, CANADA

Extension Bulletin W-799, "Perennial and Biennial Thistle Control" provides photos and additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Tribenuron	0.33 to 0.67 oz DF 0.25 to 0.5 SG	Wheat, barley and pasture.	Thistle: Rosette to pre-bud stage.	Apply with 2,4-D ester. Apply with NIS except when adding 2,4-D ester at 0.75 pt/A. See narrative for rotational restrictions. Refer to pages 108-109 for commercial mixtures. B22 T2 T6 Y1
Thifensulfuron + Tribenuron 4:1 ratio (TankMix) 2:1 ratio (H. Extra) 1:1 ratio (BrdSpec)	0.3 to 0.4 oz DF 0.4 to 1 oz SP			
MCPA or 2,4-D amine or ester	1.5 pt 4SL (0.75 lb) 1.33 pt 4EC (0.66 lb)	Wheat and barley.	Crop: Tiller stage.	Patch spray at higher rates may injure crop but may provide greater thistle control. Small grains are more tolerant to MCPA than 2,4-D. Suppression only. T6
2,4-D ester or amine	2 to 4 pt 4EC/SL (1 to 2 lb)	Fallow or post-harvest.	12 inches tall and actively growing.	Cultivate fallow until early July to achieve rosette stage at time of application. Spray in late August or Sept. Retreatment necessary. Suppression only. T2 Z1
	3 to 4 pt 4EC/SL (1.5 to 2 lb)	CRP, pasture, and rangeland or trees.		Apply only registered 2,4-D brands in CRP. Refer to paragraph for livestock grazing restrictions. Use only amine formulation in trees. Suppression only. Refer to pages 108-109 for commercial mixtures. T2 T4-6 T8 Z1
Clopyralid & MCPA	1.75 to 2.33 pt (0.09 to 0.122 & 0.5 to 0.68 lb)	Wheat, barley, and CRP.	Crop: 3-leaf to jointing.	Rosette technique: Glyphosate or clopyralid fall-applied to Canada thistle in the rosette stage provides greater control than when applied to bolting or flowering stems. Refer to paragraph T2 for control of Canada thistle using the rosette technique. See narrative for rotational restrictions. Refer to pages 108-109 for commercial mixtures. B10 T2 T6 T8 Y20 Y24
Clopyralid & 2,4-D	2 pt (0.09 & 0.5 lb)		Crop: 4-leaf through jointing.	
	4 pt (0.19 & 1 lb)	Fallow.	Thistle: Rosette until prior to bloom.	
Clopyralid	4 to 6 pt (0.19 to 0.29 & 1 to 1.5 lb)	CRP and pasture.		
	0.25 to 0.67 pt (0.09 to 0.25 lb)	Sugarbeet, wheat, barley, oat, corn.	Thistles: Rosette to pre-bud stage.	See narrative for rotational restrictions. High rates in pasture is expensive but very effective. B10 M13 T2 Y20 Y24 Z1
	0.67 to 1.3 pt (0.25 to 0.5 lb)	CRP, pasture and rangeland.		
Hornet (flumetsulam & clopyralid)	2 to 5 oz WDG (0.37 to 0.09 & 1 to 2.5 oz)	Corn.	Corn: Up to 24 inches tall. Use drop nozzles on 20 to 24 inch corn.	Add a NIS at 0.25% v/v or oil adjuvant at 1% v/v. Refer to label for tank-mix options and crop rotation restrictions. C15 T2 Y2 Y20 Y24
Dicamba	0.5 to 1 pt (0.25 to 0.5 lb)		Corn: POST up to 5 inches tall.	Do not apply more than 0.5 pt/A after corn is more than 5 inches tall. Can be applied 15 days prior to tasseling. C10 T2 Y11 Y24
Distinct Overdrive (dicamba & diflufenzopyr)	6 oz WDG (3 oz & 1.2 oz)	Corn, fallow, and noncropland.	Corn: 4 to 24 inches tall.	Distinct is labeled in cropland. Overdrive is labeled in CRP, pasture, rangeland, and noncropland. Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. Canada thistle suppression only. C10 T2 Y11 Y24
Basagran (bentazon)	1 to 2 pt (0.5 to 1 lb)	Soybean, dry bean: Any stage. Field pea: More than 3 leaf pairs or 4 nodes.	Canada thistle: 6 to 8 inches tall.	Contact herbicide; thorough coverage required. Apply with oil additive at 1 qt/A in two sequential applications. Rosette technique: Repeated in-crop applications control Canada thistle during the growing season but allow fall rosette growth. Refer to paragraph T2 for control of Canada thistle using the rosette technique. D4 F2 T2

Herbicide	Product/A (ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Glyphosate	Up to 2.25 lb ae. See Remarks.	Patches in corn, wheat, oat or soybean.	Prior to heading or flowering.	lb ae/gal lb ai/gal 0.75 ae 1.5 ae 2.25 ae 3 4 = 32 fl oz 64 fl oz 96 fl oz 4/4.17 5.4/5.1 = 24 fl oz 48 fl oz 72 fl oz 4.5 5.5 = 22 fl oz 44 fl oz 66 fl oz 5 6.1 = 20 fl oz 40 fl oz 60 fl oz
				Refer to label.
	Up to 2.25 lb ae. See Remarks.	Preharvest wheat, corn, soybean, field pea, and lentil.	Crop seed is physiologically mature. Thistle: At or beyond bud stage.	Refer to label for adjuvant use. Apply with AMS fertilizer. Avoid drift to non-target plants. Crop will be killed in treated area. A4-6 T2 T4-5 T7 X1
		Fallow or post-harvest. CRP, noncropland and around trees.	Canada thistle: Rosette or beyond bud stage.	Wait 3 or more days after application before tillage. A4-6 T2 T4-5 T7 X1 Avoid spraying tree foliage. A4-6 R1 T2 T4 U1 V1 X1
Dicamba	2 to 4 pt (1 to 2 lb)	Fall or post-harvest.	Thistle: At least 6 inches tall. Most effective when thistle is in the rosette stage.	Rotate to wheat, corn, soybean, or sorghum only. Residue may injure sensitive crops the following year. May be tank-mixed at a lower rate with 2,4-D or glyphosate to reduce soil residual. NIS improves consistency of control. C10 T2 T4-6 T10
	1 pt (0.5 lb)	CRP, pasture and rangeland.	Thistle: Rosette to 12 inches tall. Fall: Mid-summer mowing promotes active growth.	Consult label for grazing restrictions. NIS improves consistency of control. Cultivate fallow until early July to achieve rosette stage at time of application, followed by spray in late August or September. Retreatment necessary. Refer to narrative for additional information. T2 T10 Z1
	4 to 8 pt (2 to 4 lb)	Thistle patches in CRP, pastures, noncropland, and fallow.	Thistle: Rosette to prebud stage. Fall: Rosette following light frost but prior to a killing frost.	Apply with NIS at 0.25% v/v. Observe grazing restriction for lactating animals. T2 T13 T17 Z1
Transline (clopyralid)	0.67 to 1.3 pt (0.25 to 0.5 lb)	Pasture, rangeland, and noncropland.		Apply up to 14 oz/A for spot treatment. Use low rate in fall, in low density stands, or areas with good grass stands. Fall application is more consistent than spring. Refer to label for grazing restrictions. Commercial mixture with 2,4-D available (ForeFront) to broaden spectrum of weed control. T12 Z1
Milestone (aminopyralid)	5 to 7 fl oz (1.25 to 1.75 oz)	CRP, pasture, rangeland, and noncropland.		Redeem is more cost-effective than Curtail at the same active ingredient use rate. Apply with NIS. Observe grazing restriction for lactating animals. T2 T14 T17 Z1
Redeem (clopyralid & triclopyr)	2.5 to 4 pt (0.25 to 0.4 + 0.7 to 1.1 lb)			Apply with NIS at 0.25 to 0.5% v/v or PO at 1% v.v. Safe to most grasses but refer to label for NIS rates for certain grass species. T2 T11 X1 Y3 Y24 Z1
Cimarron Max (metsulfuron & 2,4-D + dicamba)	1/4 oz DF + 1 pt (0.15 oz & 0.36 & 0.125 lb)			Retreat at the same rate the following year. Addition of 2,4-D at 1 qt/A with Tordon at 1 pt/A may improve control. Mid-summer mowing promotes active growth for fall treatment. Refer to narrative for additional information. T2 T15 Y24 Z1
Tordon 22K (picloram)	0.5 to 2 pt (0.125 to 0.5 lb)	CRP, pasture, rangeland and fallow.	Thistle: At least 12 inches tall and actively growing.	
	4 pt (1 lb)	Patches of plants in CRP and pasture.	Thistle: Actively growing.	Consult reference for grazing restrictions. T2 T15 Z1

THISTLES, BIENNIAL: BULL, MUSK, AND PLUMELESS

Extension Bulletin W-799, "Perennial and Biennial Thistle Control" provides photos and additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																								
2,4-D	3 to 4 pt 4EC/SL (1.5 to 2 lb)	CRP, pasture, rangeland, and noncropland. (Refer to Remarks and Paragraphs for restrictions)	Late-fall or early spring when thistles are in the seedling to rosette stage. Biennial thistles reproduce only by seed, so control prior to flowering will eventually eradicate infestations. Consult respective label for grazing restrictions.	In CRP, apply only registered 2,4-D brands.																								
Dicamba	1 to 2 pt (0.5 to 1 lb)			Apply with NIS. at 0.25% v/v. Use high rate for patch treatment.																								
Overdrive (dicamba & diflufenzopyr)	6 oz WDG (3 & 1.2 oz)			Labeled only in noncropland. Apply with NIS at 0.25% v/v.																								
2,4,D + Dicamba	2 pt 4EC/SL + 1 to 4 pt (1 + 0.5 to 2 lb)			Apply with NIS at 0.25% v/v. Refer to pages 108-109 for commercial mixtures.																								
Cimarron Max (metsulfuron & 2,4,D & dicamba premix)	1/4 oz DF + 1 pt (0.15 oz & 0.36 & 0.125 lb)			Apply with NIS at 0.25 to 0.5%v/v or PO at 1% v/v. Refer to label for rate of NIS. Safe to most grass species.																								
Transline (clopyralid)	0.33 to 1.33 pt (0.125 to 0.5 lb)			Transline is not labeled for use in CRP. Very effective but more expensive than other treatments.																								
Clopyralid & 2,4-D	4 to 6 pt (0.19 to 0.29 & 1 to 1.5 lb)			See remarks for Redeem below.																								
Redeem (clopyralid & triclopyr)	2 to 3 pt (0.19 to 0.29 & 0.6 to 0.8 lb)			More cost-effective than clopyralid + 2,4-D at the same active ingredient rate. Apply with NIS at 0.25% v/v.																								
Tordon 22K (picloram) RUP	0.5 to 2 pt (0.125 to 0.5 lb)			Use high rate for patch treatment. Apply up to 2 pt/A broadcast and up to 4 pt/A for spot treatment.																								
Tordon 22K (picloram) + 2,4-D RUP	1 + 2 pt 4EC/SL (0.125 + 1 lb)			In CRP, apply only registered 2,4-D brands.																								
Glyphosate	Up to 2.25 lb ae See Remarks.		<table border="1"> <thead> <tr> <th>lb ae/gal</th> <th>lb ai/gal</th> <th>0.75 ae</th> <th>1.5 ae</th> <th>2.25 ae</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>64 fl oz</td> <td>96 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>48 fl oz</td> <td>72 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>44 fl oz</td> <td>66 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>40 fl oz</td> <td>60 fl oz</td> </tr> </tbody> </table> <p>Non-selective, non-residual, foliar herbicide. Refer to label for adjuvant use. Add AMS fertilizer. A4-6 T2 T4 T6-7</p>	lb ae/gal	lb ai/gal	0.75 ae	1.5 ae	2.25 ae	3	4	= 32 fl oz	64 fl oz	96 fl oz	4/4.17	5.4/5.1	= 24 fl oz	48 fl oz	72 fl oz	4.5	5.5	= 22 fl oz	44 fl oz	66 fl oz	5	6.1	= 20 fl oz	40 fl oz	60 fl oz
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Milestone (aminopyralid)	3 to 5 oz (0.75 to 1.25 oz)	Spring: Rosette to bolting plants. Fall: Seedlings and rosette plants.	Use higher rate on plants in late-bolt to flowering growth stages. Commercial mixture with 2,4-D available (ForeFront) to broaden spectrum of weed control. Refer to label for grazing restrictions. T12 Z1																									

TOADFLAX, DALMATIAN AND YELLOW

Extension Bulletin W-1239, "Dalmatian and Yellow Toadflax Identification and Control" provides photos and information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Tordon 22K (picloram) RUP	2 to 4 pt (0.5 to 1 lb)	CRP, pasture, rangeland, and noncropland.	Toadflax: Actively growing through full bloom.	Use maximum rate for yellow toadflax. Apply 2 pt/A for broadcast and 4 pt/A for spot spray. Retreat as necessary.
Plateau (imazapic)	12 fl oz (3 oz)		After hard frost when 25% of foliage is necrotic.	FOR DALMATIAN TOADFLAX ONLY. Applications prior to hard frost may result in poor control. Apply with MSO-type adjuvant at 1 qt/A. Retreat as necessary.
Telar (chlorsulfuron)	2 to 3 oz DF (1.5 to 2.25 oz)	Pasture and noncropland.	PRE to early POST.	FOR DALMATIAN TOADFLAX ONLY. Apply at 25 gpa or more and use NIS at 0.25% v/v. Retreat as necessary.

WORMWOOD, ABSINTH

Extension Circular W-838, "Absinth Wormwood Control" provides additional information.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks and Paragraphs																														
2,4-D	4 pt 4EC/SL (2 lb)	CRP, pasture, rangeland, noncropland, trees, fallow, or post- harvest.	Apply when plants are at least 12 inches tall and actively growing.	In CRP, apply only registered 2,4-D brands. Plants are controlled slowly. Do not graze dairy cows for 7 days after treatment. Use amine formulation near trees. T8 Z1																														
Dicamba	1 to 2 pt (0.5 to 1 lb)		Herbicides applied in late-June to mid- August have given greater residual control than fall or spring applications.	DO NOT apply near trees. Apply with NIS. Observe grazing restrictions. T10 Y11 Y24 Z1																														
Clopyralid & 2,4-D	2 pt (0.09 & 0.5 lb)	Cropland.	Plants can be mowed in early to mid-summer to promote active regrowth prior to fall treatment.	See narrative for rotational restrictions. Do not apply to new seedings of grass. Do not cut treated grass for hay within 30 days PHI. Consult label for grazing restrictions. B10 Y20 Y24 Z1																														
Redeem (clopyralid & triclopyr)	1.5 to 2 pt (0.14 to 0.188 & 0.42 to 0.56 lb)			More cost-effective than clopyralid + 2,4-D at the same ai use rate. Apply with NIS. Observe grazing restrictions. T13 Z1																														
Milestone (aminopyralid)	3 to 5 oz (0.75 to 1.25 oz)			Use higher rate when plants are taller than 12 inches. Commercial mixture with 2,4-D available (ForeFront) to broaden spectrum of weed control. Refer to label for grazing restrictions. T12 Z1																														
Tordon 22K (picloram) RUP	0.5 to 2 pt (0.125 to 0.25 lb)			0.5 pt/A is the most cost-effective. Apply 4 pt/A for spot treatment. Refer to paragraph for grazing restriction. Use high rate for dense stands. T15Y24 Z1																														
Glyphosate	Up to 1.125 lb ae. See Remarks.	Trees, noncropland, fallow or post-harvest.		<table border="0"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.38 ae</td> <td>0.57 ae</td> <td>0.75 ae</td> <td>1.125ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>24 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>18 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>16 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>15 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> </tr> </table> <p>Avoid spraying tree foliage. Apply with AMS fertilizer. Refer to label for adjuvant use. Use the high rate for dense stands. A4-6 T7 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.57 ae	0.75 ae	1.125ae	3	4	= 16 fl oz	24 fl oz	32 fl oz	48 fl oz	4/4.17	5.4/5.1	= 12 fl oz	18 fl oz	24 fl oz	36 fl oz	4.5	5.5	= 11 fl oz	16 fl oz	22 fl oz	32 fl oz	5	6.1	= 10 fl oz	15 fl oz	20 fl oz	30 fl oz
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SHELTERBELT WEED CONTROL

Extension Bulletin W-1097, "Weed Control in Tree Plantings" provides additional information.

Herbicide	Product/A (ai/A)	Remarks	Refer to Paragraph U1																														
Casoron (dichlobenil)	100 to 200 lb 4G (4 to 8 lb)	Volatile, especially from wet soil. Preemergence herbicide for control of annual and perennial weeds in new plantings established at least 4 weeks. Most effective when applied in November or March just before rain or snow to activate and move dichlobenil into the soil.																															
Finale (glufosinate)	2 to 6 qt (0.5 to 1.5 lb)	Non-selective, non-residual, contact herbicide. Directed application only. Controls many annual and perennial weeds. Use 1.5 to 4 fl oz/gal for spot application. Use 3 to 4 qt/A for weeds less than 6 to 8 inches tall or 5 to 6 qt/A for weeds greater than 6 to 8 inches.																															
Fusilade DX (fluzifop-P)	1 to 1.5 pt (0.25 to 0.38 lb)	Translocated, postemergence, non-residual herbicide for control of annual and perennial grasses. Spot spray or apply over-the-top of woody species. Add oil additive at 1 qt/A.																															
Glyphosate	2% solution or Up to 1.125 lb ae See Remarks.	<table border="1"> <thead> <tr> <th>lb ae/gal</th> <th>lb ai/gal</th> <th>0.38 ae</th> <th>0.57 ae</th> <th>0.75 ae</th> <th>1.125ae</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>= 16 fl oz</td> <td>24 fl oz</td> <td>32 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 12 fl oz</td> <td>18 fl oz</td> <td>24 fl oz</td> <td>36 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 11 fl oz</td> <td>16 fl oz</td> <td>22 fl oz</td> <td>32 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 10 fl oz</td> <td>15 fl oz</td> <td>20 fl oz</td> <td>30 fl oz</td> </tr> </tbody> </table> <p>Non-selective, non-residual, translocated, postemergence herbicide. Effective on annual and perennial plants. Directed spray only. Apply with AMS. Avoid contact to desirable species. For hand-held sprayers, use 1 to 1.5 fl oz/gal for small annual weeds or 2.5 to 3 fl oz/gal for perennial weeds. Refer to label for adjuvant use. A4 X1</p>	lb ae/gal	lb ai/gal	0.38 ae	0.57 ae	0.75 ae	1.125ae	3	4	= 16 fl oz	24 fl oz	32 fl oz	48 fl oz	4/4.17	5.4/5.1	= 12 fl oz	18 fl oz	24 fl oz	36 fl oz	4.5	5.5	= 11 fl oz	16 fl oz	22 fl oz	32 fl oz	5	6.1	= 10 fl oz	15 fl oz	20 fl oz	30 fl oz	
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Goal (oxyfluorfen)	5 to 10 pt 1.6E 4 to 8 pt 2XL (1 to 2 lb)	Residual, preemergence or contact herbicide for control of broadleaf weeds including kochia and some grass weeds. General: Do not incorporate in soil. Apply POST with NIS at 0.25% v/v. User must possess North Dakota 24C SLN label at time of application. Can be applied with a residual herbicide or as a split application. Conifers: Apply pre-transplant, POST or POST-directed prior to bud-break or after new foliage has hardened off. Hardwoods: Apply pre-transplant or POST-directed prior to bud-break. Spray only the base of deciduous trees and <u>not over-the-top</u> . If a non-dormant application is required, apply after new foliage has expanded and hardened off and NOT during periods of new growth. Avoid direct or indirect spray contact with foliage of deciduous trees.																															
Karmex/Direx (diuron)	2.5 to 5 lb DF (2 to 4)	Preemergence herbicide for plantings established at least one year. Apply as directed spray. Tolerance of labeled species is fair to very good. Do not use on light soil or in low, wet areas.																															
Plateau (imazapic)	8 to 12 fl oz (2 to 3 oz)	Apply with MSO at 2 qt/A. Controls many broadleaf weeds including leafy spurge. Can spray in and around tree species. Do not use on new plantings or seedling trees. Fall treatment will kill lilac and will cause temporary yellowing of spruce candles. Higher rates will reduce grass stands. Refer to label for list of tolerant tree species. Use caution on trees not listed on label.																															
Poast/Vantage (sethoxydim)	1.5 to 2.5 pt Poast 2.25 to 3.75 pt Vntg (0.1 to 0.5 lb)	Translocated, postemergence, non-residual herbicide for control of annual and perennial grasses. Spot spray or apply over-the-top of most woody species. Add oil additive at 1 qt/A. Use a minimum of 5 to 10 gpa. Spray to wet foliage.																															
Princep 4L Caliber 90 Simazine 4L Simazine 90DF (simazine)	2 to 4 qt 2.2 to 4.4 lb DF (2 to 4 lb)	Use only on tree plantings at least three years old. Preemergence herbicide that is most effective on annual broadleaf weeds. For adequate annual grass control apply with a preemergence, residual grass herbicide. Apply in fall or spring in full or split-rate applications. Use high rate in fine textured soils. Refer to label for list of registered tree species.																															
Clopyralid	0.25 to 0.67 pt (0.1 to 0.25 lb)	Safe to some conifer species only. Translocated, postemergence, broadleaf herbicide. Effective on weeds in the legume, smartweed (polygonum) and sunflower (composite) families. Provides excellent control of Canada thistle and knapweeds. Apply to actively growing weeds.																															
Stomp Pendulum (pendimethalin)	2 to 4 qt 3.3 to 6.6 lb WDG (2 to 4 lb)	Preemergence herbicide for control of annual grasses and some small-seeded broadleaf weeds. Apply before bud break to avoid potential growth suppression. Apply with preemergence broadleaf herbicide for broad spectrum annual weed control.																															
Trifluralin	1 to 2 pt (0.5 to 1 lb) 80 lb 5G (4 lb)	Apply PPI for new plantings or established trees. Gives season long control of many annual grasses and some broadleaf weeds. Does not control weeds in the sunflower, legume or mustard family. Poor perennial weed control but may suppress field bindweed. Cultivation may be required for broadleaf weed control the first season. Apply with a residual preemergence broadleaf herbicide for broad-spectrum weed control.																															
2,4-D amine	1 to 2 qt 4EC/SL (1 to 2 lb)	Translocated, postemergence, broadleaf herbicide. Directed application only. Used to reduce infestations of perennial weeds. Broadleaf plants and deciduous trees very sensitive. Avoid drift to desirable species. Use only amine formulations. Use low pressure, coarse spray droplets and apply only in calm weather.																															

TOTAL VEGETATION WEED CONTROL

Herbicide	Product/A (lb ai/A)	Remarks	Refer to Paragraph V1																									
Glyphosate	Up to 1.5 lb ae See Remarks.	<table border="0" style="width: 100%;"> <tr> <td>lb ae/gal</td> <td>lb ai/gal</td> <td>0.75 ae</td> <td>1.25 ae</td> <td>1.5 ae</td> </tr> <tr> <td>3</td> <td>4</td> <td>= 32 fl oz</td> <td>48 fl oz</td> <td>64 fl oz</td> </tr> <tr> <td>4/4.17</td> <td>5.4/5.1</td> <td>= 24 fl oz</td> <td>36 fl oz</td> <td>48 fl oz</td> </tr> <tr> <td>4.5</td> <td>5.5</td> <td>= 22 fl oz</td> <td>32 fl oz</td> <td>44 fl oz</td> </tr> <tr> <td>5</td> <td>6.1</td> <td>= 20 fl oz</td> <td>30 fl oz</td> <td>40 fl oz</td> </tr> </table> <p>Non-selective, non-residual, translocated herbicide. Effective on annual and perennial grass and broadleaf plants. May be mixed with 2,4-D or dicamba for broad-spectrum of weed control. A4-6</p>	lb ae/gal	lb ai/gal	0.75 ae	1.25 ae	1.5 ae	3	4	= 32 fl oz	48 fl oz	64 fl oz	4/4.17	5.4/5.1	= 24 fl oz	36 fl oz	48 fl oz	4.5	5.5	= 22 fl oz	32 fl oz	44 fl oz	5	6.1	= 20 fl oz	30 fl oz	40 fl oz	
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Finale (glufosinate)	3 to 6 qt (0.75 to 1.5 lb)	Non-selective, non-residual contact herbicide. Use 1.5 to 4 fl oz/gal for spot application, 3 to 4 qt/A for weeds less than 6 to 8 inches, 5 to 6 qt/A for weeds greater than 6 to 8 inches.																										
Paraquat RUP	2 to 2.7 pt (0.75 to 1 lb)	Non-selective, non-residual , contact herbicide. Controls top-growth only of perennial species. Add NIS and repeat application as necessary. Avoid drift and contact with desirable species.																										
Diuron/Direx Karmex (diuron)	1 to 8 gal 5 to 15 lb (4 to 32 lb)	Refer to label for use in irrigation ditches. Higher rates needed for perennial grasses and broadleaf weeds. Deep rooted perennials will require retreatment. Long residual .																										
Hyvar X Hyvar X-L (bromacil)	3 to 15 lb DF 0.75 to 6 gal L (2.4 to 12 lb DF 1.5 to 12 lb L)	<p>Apply PRE or EPOST. Requires moisture for activation.</p> <table border="0" style="width: 100%;"> <tr> <td></td> <td>Annual weeds</td> <td>Perennial weeds</td> <td>Woody plants</td> </tr> <tr> <td>Hyvar X</td> <td>3 to 6 lb DF</td> <td>7 to 15 lb</td> <td>7 to 15 lb</td> </tr> <tr> <td>Hyvar X-L</td> <td>1 to 3 gal/A</td> <td>3 to 6 gal/A</td> <td>3 to 6 gal/A</td> </tr> </table> <p>Non-corrosive, nonvolatile, nonflammable. Refer to label for tank-mixes. Bromacil can move horizontally in soil after application. Long residual.</p>		Annual weeds	Perennial weeds	Woody plants	Hyvar X	3 to 6 lb DF	7 to 15 lb	7 to 15 lb	Hyvar X-L	1 to 3 gal/A	3 to 6 gal/A	3 to 6 gal/A														
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Hyvar X	3 to 6 lb DF	7 to 15 lb	7 to 15 lb																									
Hyvar X-L	1 to 3 gal/A	3 to 6 gal/A	3 to 6 gal/A																									
Krovar I (bromacil + diuron)	6 to 16 lb DF (4.8 to 12.8 lb)	Control of annual grass and broadleaf weeds. Apply PRE. Requires moisture for activation. Refer to label for registered tank-mixes. Bromacil can move horizontally in soil after application. Long residual.																										
Oust XP (sulfometuron)	2 to 4 oz DF (1.5 to 3 oz)	Use high rate in high moisture areas except in residential properties. Will control leafy spurge at 3 oz/A. Do not spray near water. Long residual.																										
Landmark MP Landmark II MP (sulfometuron & chloresulfuron)	1 pkg/5 A to 1 pkg/2.5 A (1.5 to 3 oz)	Apply PRE to EPOST for broadleaf weeds. Will control/suppress leafy spurge. May be applied with Krovar I DF, or Hyvar X to control ALS resistant weeds. Long residual.																										
Plateau (imazapic)	8 to 12 fl oz (2 to 3 oz)	Add MSO at 2 pt/A. Controls many broadleaf weeds including leafy spurge. May use up to 12 fl oz in combination with Arsenal, Sahara, glyphosate, Oust, diuron and other total-vegetation-control herbicides. T12																										
Pramitol 25E (prometon)	5 to 10 gal (10 to 15 lb)	Use 5 to 7.5 gal/A for annual and susceptible perennial weeds, 7.5 to 10 gal/A for hard-to-kill perennial weeds. Apply before weeds emerge or EPOST. Long residual.																										
Spike 20P (tebuthiuron)	3.75 to 20 lb (0.74 to 4 lb)	For long-term woody plant and some broadleaf weed control. Avoid application in areas with surface or high water tables. Do not exceed 4 lb ai/A in a three year period. See label for specific species controlled, grazing and haying restrictions and other information.																										
Spike 80DF (tebuthiuron)	1.5 to 5 lb (1.2 to 4 lb)	Long residual.																										
Sahara (imazapyr & diuron)	3 to 4 A/copack or 6.5 to 13 lb DF (0.5 to 1 & 4 to 8 lb)	Provides residual PRE and POST control of annual weeds and POST control of perennial weeds. Apply Sahara POST with NIS at 0.25% v/v or MSO-type adjuvants at 1.5 to 2 pt/A alone or with UAN at 2 to 3 pt/A. Apply Topside 2.5G prior to weed emergence at 0.5 to 0.7 lb 2.5G/100 sq. ft. Can be tank-mixed with Roundup, Finale, Krovar, Hyvar X, Oust, Garlon, and Clarity. Do not apply with 2,4-D due to reduced weed control. Long residual.																										

TROUBLESOME WEEDS IN PASTURE, RANGELAND, AND NONCROPLAND

Weed	Herbicide	Product/A	Remarks and Paragraphs
Buckbrush (West. snowberry)	2,4-D amine or ester Cimarron Max	2 to 3 qt 4EC/SL 0.25 oz + 1 pt (co-pack)	Anytime during the growing season when plants are not stressed.
Baby's breath	Escort Escort + dicamba	0.3 to 0.6 oz DF 0.45 oz DF + 1 pt	Very effective. Best when applied from bolting to pre-flower growth stage. Use NIS at 0.25% v/v.
Burdock	2,4-D amine or ester Cimarron Max Dicamba	1 qt 4EC/SL 0.25 oz + 1 pt (co-pack) 1 pt	Early summer prior to flowering.
Curly dock	Cimarron Max Dicamba Metsulfuron + NIS Redeem Starane Tordon + 2,4-D RUP	0.25 oz + 1 pt (co-pack) 0.5 to 1 pt 1/10 oz + 0.25 to 0.5% v/v 1 to 2 pt 0.5 to 0.67 pt 0.5 to 1 pt + 1 to 2 pt 4EC/SL	Early spring to bolting is best. Herbicides will control curly dock when treated later in the summer but will need higher rates.
Dandelion	2,4-D amine or ester 2,4-D+MCPA+dicamba Express + NIS Redeem	2 to 4 pt 4EC/SL See label 1/6 to 1/3 oz + 0.25 to 0.5% v/v 1.5 to 2 pt	Best in early fall following several light frosts. Express labeled only on cropland and fallow.
Foxtail barley	Plateau	8 to 12 fl oz	Apply with MSO at 1 qt/A + 28% UAN at 1 qt/A.
Goldenrod	2,4-D amine or ester Cimarron Max Metsulfuron + NIS Tordon + 2,4-D RUP	3 to 6 pt 4EC/SL 1 oz + 4 pt (co-pack) 1/3 to 1/2 oz + 0.25 to 0.5% v/v 1 pt + 1 qt 4EC/SL	Mid-June through flowering when plants are not stressed.
Gumweed	2,4-D amine or ester Cimarron Max Metsulfuron + NIS	1.5 to 2 pt 4EC/SL 1 oz + 4 pt (co-pack) 1 oz + 0.25 to 0.5% v/v	Early spring when plants are not stressed.
Houndstongue	2,4-D amine or ester Metsulfuron + NIS Plateau	2 pt 4EC/SL 1 to 2 oz + 0.25 to 0.5% v/v 8 to 12 oz	2,4-D: Apply to 1 st year plants from May to June. Met: Very effective through the growing season. Plateau: Controls plants applied PRE and POST.
Mint	Cimarron Max Dicamba + 2,4-D Metsulfuron + NIS Tordon + 2,4-D RUP	1 oz + 4 pt (co-pack) 1 pt + 1 qt 4EC/SL 1/3 to 1/2 oz + 0.25 to 0.5% v/v 1 pt + 1 qt 4EC/SL	Mid-June through flowering when plants are not stressed.
Poison ivy	Crossbow Garlon 3A or 4	1.5 gal 3 to 4 pt or 2 to 3 pt	Plants actively growing.
Prairie wild rose (State flower of ND)	Cimarron Max Dicamba + 2,4-D Tordon + 2,4-D RUP	0.5 oz + 2 pt (co-pack) 1 pt + 1 qt 4EC/SL 0.5 pt + 1 qt 4EC/SL	Anytime during the growing season when plants are not stressed.
Prickly pear cactus	Tordon RUP	2 pt	Late-spring to early summer.
Ragweed	Cimarron Max Redeem Tordon + 2,4-D RUP	0.25 oz + 1 pt (co-pack) 1.5 to 2 pt 1 pt + 1 qt 4EC/SL	Mid to late summer.
Fringed sagebrush	2,4-D ester Cimarron Max Tordon RUP	2 to 4 pt 4EC/SL 1 oz + 4 pt (co-pack) 1 to 2 pt	Best in May. Plants should be leafed out and growing in good moisture conditions.
Silver sagebrush	2,4-D ester	2 to 4 pt 4EC/SL	
Green sagewort	2,4-D ester Tordon + 2,4-D RUP	4 pt 4EC/SL 1 pt + 1 qt 4EC/SL	
WY big sagebrush	2,4-D ester	4 pt 4EC/SL	
Swamp smartweed	Dicamba Metsulfuron + NIS Tordon + 2,4-D RUP Weedmaster	0.5 to 1 pt 1/10 oz + 0.25 to 0.5% v/v 1 pt + 1 qt 4EC/SL 1 pt	Plants 1 to 4 inches tall. Mid to late summer.
Trees, volunteer	Crossbow Tordon+2,4-D+Remedy RUP	2% solution or 2 gal/A 2% or 1 pt + 1 qt 4EC/SL + 1 pt	Apply with NIS at 0.5% v/v. Apply after tree leaves have fully expanded.
Wild licorice	2,4-D amine or ester	1 to 2 pt 4EC/SL	Early June when plants are not stressed.

TROUBLESOME WEEDS IN CROPLAND AND OTHER AREAS

Weed	Herbicide	Product/A	Remarks and Paragraphs
Alfalfa	2,4-D + dicamba Clopyralid/clopyralid + 2,4-D	2 pt 4EC/SL + 0.5 pt 2/3 pt / 4 pt	Glyphosate (2 to 4 pt/A) is less effective.
Buffalobur	Dicamba	0.5 pt	Cobra, 2,4-D, MCPA, and Pursuit are less effective.
Cleavers/Catchweed bedstraw	Paramount Starane Thifensulfuron + tribenuron	0.33 lb DF + MSO at 1.5 pt/A 2/3 pt 4 oz SP / 0.6 oz SP	Liberty is less effective. Apply Paramount with MSO at 1.5 pt/A
Cattail	Glyphosate (only 4 lb ae/gal no adjuvant formulations)	4.5 pt of 4 lb ae/gal conc.	Apply with approved NIS at 0.25% v/v. Apply at early to full bloom stage (late July to mid August). A4
	Arsenal/Habitat	2 to 4 pt (1% v/v solution)	Apply to cattail with green foliage/after leaf elongation.
Curly dock	Clopyralid / clopyralid+2,4-D	2/3 pt / 2 pt	Thifensulfuron + tribenuron is less effective.
Common milkweed	Glyphosate Tordon RUP / + 2,4-D Tribenuron+2,4-D+dicamba	2% 2 to 3 pt / 2 pt + 2 pt 4EC/SL 1/3 oz DF + 0.75 pt + 2 fl oz	Glyt - Suppression only. Will require retreatment. A4 Tordon - Apply at late bud to early flower stage. See T3. Trib + 2,4-D + dic - Apply high rates for spot treatment.
Dandelion	2,4-D amine or ester Clopyralid Dicamba Tribenuron + NIS Glyphosate Impact	2 to 4 pt 4EC/SL Refer to premix label. 0.5 pt. Apply with 2,4-D 0.5 oz SG. Apply with 2,4-D. 1 to 1.5 lb ae 0.75 fl oz	2,4-D - Best control when applied in fall. Clopyralid - Apply premixes - Curtail, Hornet, WideMatch Dicamba - Residue may injure crop to be planted. Tribenuron - May give only partial control. Glyphosate - May give only partial control. Impact - May give only partial control.
Equisetum (Horsetail) (Scouring rush)	MCPA Permit Python Remedy/Garlon Telar (Glean) or Oust	1 qt/A 4EC/SL 1.33 oz DF + MSO 1.33 oz DF + MSO 2 qt 3 oz DF + adjuvant	Glyphosate is less effective. Retreatment necessary. Permit - Apply two applications each at 1.33 oz/A. Python - Apply with NIS or oil adjuvant PRE or POST. Remedy/Garlon and MCPA - Apply fall or spring. Telar and Oust - Will result in total vegetation control.
False chamomile	Bromoxynil + MCPA Most SU herbicides Tordon RUP Glyphosate	1 pt 4EC See label + adjuvant 1 to 1.5 pt 2 pt of a 3 lb ae/gal conc.	Bromoxynil + MCPA - Plants should be <4 inches tall. SU herbicides - Apply with NIS at 0.25 % v/v. Tordon - Use high rate for plants >4 inches tall. Glyphosate - Avoid spraying desirable vegetation. A4
Flax, volunteer	Flexstar/Reflex Paramount Pursuit + Sencor (PRE) Starane Thifensulfuron + tribenuron Tribenuron + 2,4-D Ultra Blazer	0.5 to 0.75 pt + oil adjuvant 0.33 oz DF + MSO adjuvant 0.375 + 1 to 2 fl oz 2/3 pt 0.4 oz SP / 0.6 oz SP 1/3 oz + 0.75 pt 4EC/SL 1.5 pt + adjuvant	Flexstar/Reflex - Apply oil adjuvant at 1% v/v. Paramount - Apply with MSO adjuvant at 1.5 pt/A. Starane - No adjuvant needed. Thifensulfuron + tribenuron - Apply with NIS at 0.25% v/v. Tribenuron - Apply with NIS at 0.25% v/v. Ultra Blazer - Apply with NIS at 0.25% v/v.
Hemp dogbane	2,4-D + dicamba Glyphosate	1 to 2 pt 4EC/SL + 1 pt 2% v/v	Dicamba at 2 pt/A will injure some crops planted the next year. A4
Horseweed (Marestail)	2,4-D Callisto, Impact, Laudis FirstRate Hornet Python Spartan Valor	1 to 2 pt 4EC/SL 3 fl oz, 3 fl oz, 2 to 3 fl oz 0.3 oz WDG + adjuvant 3 to 4 oz WDG + adjuvant 1 oz WDG 3 to 6 fl oz 2 to 3 oz WDG	Glyphosate, atrazine, paraquat are less effective. Pursuit is not effective. 2,4-D applied as a preplant burndown to some labeled crops is effective. Callisto, FirstRate, Peak, and Spartan may injure successive crops. Follow label guidelines.
Nightflowering catchfly	Thifensulfuron + tribenuron Thifensulfuron Huskie (not confirmed)	0.6 to 1 oz SG 0.5 oz SG 15 fl oz	Apply with NIS at 0.25% v/v. Apply with NIS at 0.25% v/v. Huskie controls other cockle species.
Sowthistle (Ann. or perennial)	Cimarron Max Metsulfuron	0.25 to 0.5 oz + 1 to 2 pt 1/10 oz DF + adjuvant	2,4-D, dicamba, Curtail, and glyphosate are less effective.
Waterpod	2,4-D, Pursuit or SU	See label.	See Pursuit label for crop rotation restrictions.
Wild cucumber	Dicamba Glyphosate	0.5 to 1 pt 0.38 to 0.75 lb ae	Dicamba may injure or kill trees. Mechanical control or handweed is best. Dicamba may injure trees. A4
Yellow nutsedge	Permit Basagran (sequential apps)	2/3 to 1.33 oz DF + adjuvant 1.5 pt fb 1.5 pt + oil adjuvant	Pursuit, Dual, glyphosate are less effective. Permit may injure crops planted the following years.

GENERAL INFORMATION

A1. PPI AND PRE HERBICIDES

Incorporation of herbicides

Good weed control with PPI and PRE herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature, soil type and weed species. For these reasons, PRE herbicides applied to the soil surface sometimes fail to control weeds. Herbicides that are incorporated into the soil surface usually require less rainfall after application for effective weed control than unincorporated herbicides. Small weeds just emerging through a PRE herbicide may be controlled by a rotary hoe or harrow, which may also help activate the herbicide under dry conditions.

Many factors influence the activity and performance of soil-applied herbicides. Factors that should be considered are: rate too low for soil type, high weed pressure, weeds not listed on label, poor control in wheel tracks, cloddy soil, wet soil, amount of previous crop residue, dry weather, poor incorporation, improper setting of incorporation implement, herbicide resistant weeds, incorporation too shallow or deep, incorporation speed too slow, worn sweeps on cultivator, single pass instead of two pass incorporation, and second incorporation deeper than first. Consider these possibilities before poor weed control is attributed only to the herbicide.

Buckle, Eptam, Far-Go, Ro-Neet, Sonalan, and trifluralin require incorporation. Eptam, Far-Go, and Ro-Neet must be incorporated immediately (within minutes) after application. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Sonalan incorporation may be delayed up to 48 hours. Pendimethalin is labeled only PPI in soybean, dry beans, and pulse crops and PRE, not PPI, on corn. Alachlor, acetochlor, dimethenamid, and metolachlor may be used PRE but PPI improves weed control, particularly on fine textured soils. Incorporation of alachlor, ethofumesate, and metolachlor may be delayed several days. Incorporation of Eradicane and Eptam can be delayed up to 4 hours when applied with liquid fertilizer and the same day when impregnated on dry bulk fertilizer. Ro-Neet can be incorporated up to 4 hours after application and up to 8 hours when impregnated on dry fertilizer.

A second tillage at right angles to the initial incorporation is needed if a disk or field cultivator is used. The second incorporation will incorporate any herbicide remaining on the soil surface and provide more uniform distribution in the soil, thereby improving weed control and reducing crop injury.

A2. SOIL ORGANIC MATTER TEST

Many herbicides are partially adsorbed and inactivated by soil organic matter, so knowledge of the organic matter level will serve as a guide in selecting an effective herbicide and rate of application. Most soil-applied herbicides require higher rates to be effective in high organic matter soils, but crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, thereby reducing weed control. However, organic matter level generally affects herbicide performance more than clay content.

Some herbicides give good weed control only when organic matter levels are low. Lorox has not been effective in the Red River Valley, except on coarse-textured soils with less than 3% organic matter. The lower the organic matter, the more effective they become. The rate of most soil-applied herbicides must be adjusted according to organic matter levels; apply the high labeled rates on high organic matter soils. Many herbicides such

as Far-Go, trifluralin and most POST herbicides are affected only slightly by organic matter levels. Organic matter levels should be determined on each field where organic-matter-sensitive herbicides are to be used. Organic matter levels change very slowly, and testing once every 5 years should be adequate.

A3. FALL HERBICIDE APPLICATION

Acetochlor, Eptam, Far-Go, metolachlor, Ro-Neet, Sonalan, sulfentrazone, and trifluralin may be fall applied. Trifluralin should be fall-applied when soil temperatures are consistently below 50 F. Sonalan can be fall-applied between October 1 and December 31 in sunflower and dry edible bean in reduced till or conservation tillage systems. Sonalan can be incorporated with a V-blade plow or undercutter. Fall treatments of acetochlor, Eptam, Far-Go, metolachlor, and Ro-Neet should be applied after October 15 and until soil freeze-up. Application of herbicides after October 15, when soil temperature has cooled, minimizes herbicide loss by volatilization and microbial and chemical degradation. Acetochlor, metolachlor, EPTC, and sulfentrazone fall-applied may give poor weed control in spring because of insufficient residual activity. Both granular and liquid formulations of herbicides are registered for use in fall. Granular herbicides fall-applied generally give more effective weed control than the liquid formulations, especially under heavy crop residue situations.

Eptam (EPTC) fall-applied at 4 to 5 pt/A or 17 to 22 lb/A 20G or Ro-Neet (cycloate) at 5.3 pt/A give good control of annual grasses and certain broadleaf weeds. Both must be incorporated into the soil immediately after application to prevent loss of herbicide. The liquid and granular formulations of Eptam may be fall-applied for weed control in dry bean, potatoes, sugarbeet, and sunflower. Ro-Neet is registered only on sugarbeet.

Far-Go (trillate) is applied at 2 to 3 pt/A or 10 to 15 lb/A 10G in the fall when temperatures are consistently below 50 F. See tables for specific rates of liquid and granules for each crop. Far-Go performs best when incorporated immediately after application; however, Far-Go granules may be surface applied in the fall and incorporated with normal tillage operations the following spring. Research at NDSU with fall application indicated that, at similar rates, the granular formulation performed more effectively than the liquid formulation but fall surface-applied Far-Go gave less consistent weed control than when fall incorporated.

Trifluralin fall-applied at 1 to 2 pt/A, or 5 to 10 lb/A 10G (depending on crop) controls annual grasses and some small-seeded broadleaf weeds. Trifluralin liquid or 10G formulations may be applied in spring or fall for weed control in soybean, canola, tame mustard, safflower, dry bean, sunflower, flax, wheat, and barley. Sonalan can be fall-applied or spring-applied but the label does not specify the number of incorporations required. However, herbicide must be thoroughly and uniformly mixed in the top 2 to 3 inches of soil. The number of incorporation passes differ depending on formulation. For Treflan HFP and 10G, incorporation must be performed within 24 hours after application. Sonalan HFP and 10G must be incorporated within 48 hours after application. The second incorporation of Treflan HFP and Sonalan HFP can be done anytime after the first, but the second incorporation of Treflan 10G must be done no sooner than 5 days after the first. The second incorporation of Sonalan 10G must be done no sooner than 3 to 5 days after the first. Delay between first and second incorporation of 10G formulation allows the active ingredient to release from granule. The first incorporation is to cover the granule and the second is to thoroughly mix the active ingredient. Pendimethalin at 2.4 to 3.6 pt EC/A fall-applied in sunflower gives good control of annual grasses and some broadleaf weeds except wild mustard. Incorporation may be delayed 7 days. The liquid may be fall-applied for weed control in sunflower.

A4. POST APPLIED HERBICIDES

Weed control from POST herbicides is influenced by rate, weed species, weed size, and climatic conditions. Low labeled rates will be effective under favorable conditions and when weeds are small and actively growing. Use the highest labeled rates under adverse conditions and for well established weeds.

Sunlight inactivates some herbicides by the ultraviolet (UV) spectrum of light. Trifluralin and Eptam degradation is minimal when incorporated soon after application. "Dim" herbicides (Achieve, Poast, and Select) are highly susceptible to UV light and will degrade rapidly if left in nonmetal spray tanks for an extended period of time or if applied during mid-day. To avoid UV breakdown, apply soon after mixing and with an effective oil adjuvant which speeds absorption.

Ideal temperatures for applying most POST herbicides are between 65 and 85 F. Speed of kill may be slow when temperatures remain below 60 F. Some herbicides may injure crops if applied above 85 F or below 40 F. Avoid applying volatile herbicides under conditions where vapors and particle drift may injure susceptible crops, shelterbelts, or farmsteads.

Temperatures following herbicide application influence crop safety and weed control from herbicides. Crops often metabolize herbicides but metabolism slows during cool or cold conditions, which extends the amount of time required to degrade herbicides in plants. Rapid degradation under warm conditions allows crop plants to escape herbicide injury. Herbicides may be sprayed following cold night-time temperatures if day-time temperatures warm to at least 60 degrees.

Some "Fop" ACCase herbicides are more effective during cold/cool temperatures and are much less effective when grass weeds are drought stressed. Other ACCase herbicides, such as Assure II, Poast, and Select control grasses best in warm weather when grasses are actively growing. ALS grass herbicides in wheat generally provide more consistent and greater grass control in warm, dry conditions compared with cool, wet conditions. Cool or cold conditions at or following application of ACCase herbicides and significant rainfall shortly after Achieve application may increase injury to wheat. Wild oat is a cool season grass but green and yellow foxtail are warm season grasses which may stop growing under cold conditions, resulting in poor control. Grass and broadleaf weeds are controlled most effectively when plants are actively growing.

Cold temperatures, including freezing conditions following application of ALS herbicides, Sencor, and bromoxynil may increase crop injury of labeled crops with little effect on weed control. Delay applying fenoxaprop, ALS herbicides, and Sencor until daytime temperatures exceed 60 degrees F and after active plant growth resumes.

Basagran, Cobra, Flexstar, Reflex, Liberty, paraquat, and Ultra Blazer are less likely to cause crop injury when cold temperatures follow application but less weed control may result.

2,4-D, MCPA, dicamba, clopyralid, fluroxypyr, and glyphosate (resistant crops) have adequate crop safety and provide similar weed control across a wide range of temperatures, but weed death is slowed when cold temperatures follow application.

Dew at application may reduce weed control if spray, in combination with dew, runs off the leaf surface. If no spray run-off occurs after application, weed control may be equal or greater than if no dew was present at application. Rainfall shortly after POST herbicide application reduces weed control because herbicide is washed off the leaves before absorption is complete (See rainfall interval chart below).

Minimum Interval Between Application and Rain for Maximum POST Weed Control.

Herbicide	Time Intrvl.	Herbicide	Time Intrvl.
Accent	4-6 hr	Olympus	4 hr
Achieve	1 hr	Option	2 hr
Aim	6-8 hr	Paramount	6 hr
Amber	4 hr	paraquat	0.5 hr
Assert	3 hr	Peak	4 hr
Assure II*	1 hr	Permit*	4 hr
atrazine*	4 hr	Plateau	1 hr
Avenge	6 hr	Poast	1 hr
Axial XL	0.5 hr	Progress*	6 hr
Basagran*	4-8 hr	Puma	1 hr
Betamix*/Betanex*	6 hr	Pursuit	1 hr
bromoxynil*	1 hr	Rage D-Tech	6-8 hr
bromoxynil + MCPA	1 hr	Raptor	1 hr
Callisto	1 hr	Redeem	2 hr
Celebrity Plus	4 hr	Reflex	1 hr
chlorsulfuron	4 hr	Remedy	6-8 hr
Clarity*	6-8 hr	Rezult	4 hr
ClearMax	1 hr	Rimfire	4 hr
clethodim*	1 hr	rimsulfuron	4 hr
clopyralid*	6-8 hr	RT Master II	1-2 hr
clopyralid+2,4-D/MCPA*	6-8 hr	RU Original Max	1-2 hr
Cobra	0.5 hr	RU Private labels*	4-6 hr
Desiccate II	5 hr	RU UltraMax II	1-4 hr
dicamba*	6-8 hr	RU WeatherMax	1-4 hr
Discover	0.5 hr	RU PowerMax	1-4 hr
Distinct/Overdrive	4 hr	Select Max	1 hr
diquat	0.5 hr	Silverado	4 hr
Everest	1 hr	Spartan Advance	4-8 hr
Extreme	1 hr	Starane/NXT	1 hr
FirstRate	2 hr	Status	4 hr
Flexstar	1 hr	Steadfast	4 hr
Fusilade DX	1 hr	thifensulfuron	4 hr
Fusion	1 hr	tribenuron	4 hr
glufosinate	4 hr	Tordon 22K	6-8 hr
glyphosate* (Full adj.)	1-4 hr	TD CT/iQ	2 hr
glyphosate* (Part adj.)	4 hr	TD HiTech	2 hr
glyphosate* (No adj.)	4-8 hr	Touchdown Total	1 hr
Goal	1 hr	Ultra Blazer	4 hr
Halex GT	4hr	UpBeet	6 hr
Hornet	2 hr	Weedmaster*	6-8 hr
Huskie	1 hr	WideMatch*	6 hr
Impact	1hr	2,4-D amine*	4-8 hr
Laudis	1 hr	2,4-D ester*	1 hr
Lumax	4 hr		
Maverick	4 hr		
MCPA amine*	4-6 hr		
MCPA ester*	1 hr		
Milestone	4hr		

* Or generic equivalent

GLYPHOSATE

Glyphosate at 0.188 lb ae/A controls foxtails, at 0.28 lb ae/A controls volunteer small grains, at 0.38 lb ae/A controls wild oat less than 4 inches tall, at 0.75 lb ae/A controls spring germinating and over-wintering downy brome, at 0.75 lb ae/A controls quackgrass at least 8 inches tall (3 to 4 leaf stage) and actively growing, and at 0.75 to 1.125 lb ae/A when Canada thistle is actively growing and just before the bud stage. Glyphosate at 1 lb ae/A is required to control fall planted rye or wheat prior to seeding crops in spring. Tillage should not occur until at least 1 day after treating annual weeds and 3 days after treating perennial weeds.

Glyphosate can be applied in the spring before emergence of conventional crops. Potential for crop injury exists when 2,4-D or dicamba mixtures with glyphosate are applied immediately before or after planting due to the PRE soil activity of 2,4-D and dicamba. A rain event after application and before crop emergence increases risk of 2,4-D or dicamba injury to the emerging crop seedlings.

Below is additional information that may help growers increase effectiveness and consistency of weed control with glyphosate.

1. Glyphosate is very water soluble. High water solubility is why glyphosate absorption through plant cuticles is slow, activity is greater in humid conditions, NIS adjuvants are either recommended with partial or unloaded formulations or are included in loaded formulations, and why oil adjuvants are not recommended because of their antagonistic effect.
2. Glyphosate activity greatly increases under humid conditions. Inversely, weed control is reduced under low humidity and when weeds are drought stressed.
3. Glyphosate is not deactivated by sunlight. Time of day application studies show that activity of glyphosate is greatest when applied after 10:00 am and before 4:00 pm.
4. Use the lowest water volume (gpa) allowed on the label. Low spray water volumes produce spray droplets of high glyphosate concentration which results in greater absorption. Low spray volume also reduces the amount of antagonistic salts in water to interact with glyphosate.
5. Dew on plant foliage at application may reduce weed control. Dew on leaves dilutes herbicide concentration in spray droplets and negates the effect of low spray volume at application. For best results, allow at least a 6 hour rainfast period for all glyphosate formulations regardless of label rainfast recommendation.
6. Use drift management techniques. Glyphosate is a non-selective, non-residual, translocated, foliar herbicide. Glyphosate can cause severe injury or death of plants intercepting even a small amount of active ingredient in down-wind spray droplet drift.
7. Glyphosate is not volatile. Glyphosate does not produce fumes or vapor after application. Off-target movement of glyphosate is from droplet or particle drift, not volatility.
8. Always add AMS to glyphosate. AMS enhances glyphosate absorption and translocation and deactivates antagonistic hard water salts. The ammonium in AMS makes glyphosate-NH₄ as water in the spray droplet on the leaf surface evaporates; glyphosate-NH₄ is more readily absorbed than other ionic forms of glyphosate. Addition of AMS increases

weed control under good and adverse growing conditions and with or without antagonistic salts in water (See Section A6). Allow sufficient time for AMS to dissolve before application.

9. Glyphosate labels suggest AMS at 8.5 to 17 lb/100 gallons water. However, analysis of water across the state has shown that lower rates (4 to 6 lbs/100 gal) of AMS are adequate. Add AMS at a minimum of 1 lb/A if using greater than 12 gpa spray volume or 4 to 6 lb/100 gallons of water. The amount of AMS needed to overcome antagonistic ions can be determined as follows:
$$\text{lbs AMS/100 gal} = (0.002 \times \text{ppm K}) + (0.005 \times \text{ppm Na}) + (0.009 \times \text{ppm Ca}) + (0.014 \times \text{ppm Mg}) + (0.042 \times \text{ppm Fe})$$
See A6 for more information.

Some locations, particularly in western ND, have hard water that exceeds 1600 ppm or even 2500 ppm of combined hardness and require AMS at 8.5 to 17 lb/100 gal water. Growers should know their water quality to determine AMS rate.

If using adjuvants called "Water Conditioning Agents", or AMS Replacement adjuvants, use only those containing at least 4 lbs of AMS/100 gallons of water at their recommended rates. Data show generally less control from most adjuvants in these categories as compared to NIS plus AMS.

10. Add NIS of high quality if the glyphosate label allows use. Research has shown greater weed control even when NIS was added to full-load glyphosate formulations. Use reputable adjuvants from major adjuvant manufacturers. Do not believe claims of cutting herbicide rates by 50%.

11. Oil adjuvants antagonize glyphosate. (See #1). To control volunteer Roundup Ready crops, to delay weed resistance to glyphosate, and to control weeds that have developed tolerance or resistance to glyphosate require other herbicides to be added with glyphosate. Many of these herbicides are oil soluble (POST grass herbicides, HPPD inhibitor herbicides) and are greatly enhanced by oil adjuvants (petroleum and MSO). The oil adjuvants antagonize glyphosate. AMS has been shown to partially overcome oil adjuvant antagonism of glyphosate from MSO. Adjuvants known as High Surfactant Oil Concentrates (See page 133) also enhance oil soluble herbicides without decreasing glyphosate activity. Using higher rates of glyphosate may partially overcome oil adjuvant antagonism but control of some weeds species may not be adequate.

11. Glyphosate applied during cool and cold weather will kill weeds. The end result (weed control) will be the same as from application in warm weather but the end result will take longer. Ideal temperatures for applying most POST herbicides are between 65 and 85 F. Weeds may be killed slower when temperatures remain below 50 F. Cold weather is a stress to plants. AMS and NIS can be used to overcome the reduced control of stressed plants.

12. Weed control is reduced when glyphosate is applied to desiccated plant tissue affected by frost. Below freezing temperature may burn off top growth and desiccate plant tissue. Plant material injured by freezing temperatures will not translocate herbicides. Application to new plant growth is required for optimum herbicide activity.

13. Plants do not metabolize glyphosate. Herbicide metabolism is the process whereby tolerant plants avoid phytotoxicity. Except for glyphosate, plants metabolize herbicides, but metabolism slows during cool or cold conditions, which extends the amount of time required to degrade herbicides in plants. No plant has been identified that can metabolize glyphosate, including Roundup Ready crops. Therefore, absorbed glyphosate will remain in the plant until warm temperatures cause plants to resume translocation and glyphosate will be moved via the phloem to growing points.

14. Dust inactivates glyphosate.

Glyphosate absorption in plants is slow which partially explains the 6 to 8 hour rainfast period. Slow absorption allows glyphosate on the plant leaf surface to be inactivated by dust present either on the leaf surface or in windy conditions. This applies also to using slough water for spraying. Mud and soil in slough water will inactivate glyphosate. Addition of NIS or AMS will not overcome inactivation from dirt. Glyphosate is strongly and irreversibly absorbed to clay particles and organic matter.

15. Do not use reduced glyphosate rates.

The price of glyphosate has decreased and weed control is relatively inexpensive compared to conventional weed control strategies. Reducing glyphosate rates may encourage the development of resistant weed biotypes. See "Herbicide Resistant Weeds", Paragraph X1 for more information.

16. Do not apply glyphosate brands formulated with surfactant (partial or full adjuvant formulations) to bodies of water because they include adjuvants that are toxic to fish and aquatic life. Only some non-adjuvant loaded formulations, such as Aquamaster, Glypro, and Rodeo, and some 4 lb ae/gal formulations of glyphosate can be applied on water. An approved NIS surfactant at 0.5 to 1% v/v must be added to non-loaded glyphosate formulations for weed control. Refer to the Adjuvant Section, pages 133, for a list of NIS adjuvants registered for use in water.

Registered Glyphosate Products:

Trade Name	Manufacturer	Active ingredients	lb ae/ gal	lb ai/ gal	Adjuvant Load*
Accord	Dow	glyphosate-ipa	4	5.4	None
Aquamaster	Monsanto	glyphosate-ipa	4	5.4	None
Buccaneer	Tenkos	glyphosate-ipa	3	4	Partial
Buccaneer Plus	Tenkos	glyphosate-ipa	3	4	Full
Clearout 41 Plus	CPT	glyphosate-ipa	3	4	Full
Cinco	UAP	glyphosate-ipa	4	5	No
Cornerstone	AgriLiance	glyphosate-ipa	3	4	Partial
Cornerstone Plus	AgriLiance	glyphosate-ipa	3	4	Full
Credit Duo	NuFarm	glyt-ipa & glyt-NH ₄	3	4	Partial
Credit Duo Extra	NuFarm	glyt-ipa & glyt-NH ₄	3	4	Full
Credit Systemic	NuFarm	glyphosate-ipa	3	4	Partial
Credit Syst Extra	NuFarm	glyphosate-ipa	3	4	Full
Duramax	Dow	glyphosate-dma	4	5.4	Full
Durango DMA	Dow	glyphosate-dma	4	5.4	Full
Extra Credit 5	NuFarm	glyphosate-ipa	3	4	Full
Gly-Flo	Arysta	glyphosate-ipa	3	4	Partial
Glyfos	Cheminova	glyphosate-ipa	3	4	Partial
Glyfos X-tra	Cheminova	glyphosate-ipa	3	4	Full
Glyphosate 41%	Helim Agro	glyphosate-ipa	3	4	None
Gly Star Original	Albaugh	glyphosate-ipa	3	4	Partial
Gly Star Plus	Albaugh	glyphosate-ipa	3	4	Full
Mad Dog	UAP	glyphosate-ipa	3	4	Partial
Mad Dog Plus	UAP	glyphosate-ipa	3	4	Full
Makaze	UAP	glyphosate-ipa	3	4	Full
Mirage	UAP	glyphosate-ipa	3	4	Partial
Mirage Plus	UAP	glyphosate-ipa	3	4	Partial
Rattler	Helena	glyphosate-ipa	3	4	Partial
Rodeo	Dow	glyphosate-ipa	4	5.4	None
RT Master II	Monsanto	glyphosate-K	4.5	5.5	Full
RT 3	Monsanto	glyphosate-K	4.5	5.5	Full
RU Original Max	Monsanto	glyphosate-K	4.5	5.5	Full
RU PowerMax	Monsanto	glyphosate-K	4.5	5.5	Full
RU/Private labels	Various	glyphosate-ipa	3	4	Partial
RU UltraMax II	Monsanto	glyphosate-K	4.5	5.5	Full
RU WeatherMax	Monsanto	glyphosate-K	4.5	5.5	Full
Strikeout	-	glyphosate-ipa	3	4	Full
Touchdown CT	Syngenta	glyphosate-K	4.17	5.1	Full
Touchdn HiTech	Syngenta	glyphosate-K	5	6.1	None
Touchdown iQ	Syngenta	glyt -(2)(NH ₃)	3	4	Full
Touchdown Total	Syngenta	glyphosate-K	4.17	5.1	Full

*Full = No additional NIS needed.
 Partial = Additional NIS needed.
 None = Additional NIS at full rate required.

Glyphosate product rates based on formulation, acid equivalent (ae) and active ingredient (ai).

lb ae	lb ai	0.38 ae	0.57 ae	0.75 ae	1.125ae	1.5 ae
fl oz/A						
3	= 4	= 16	24	32	48	64
4	= 5.4	= 12	18	24	36	48
4.17	= 5.1	= 12	18	24	36	48
4.5	= 5.5	= 11	16	22	32	44
5	= 6.1	= 10	15	20	30	40

Pounds ae/gal or ai/gal are found on glyphosate product labels.

Refer to page 4 for an explanation of active ingredient (ai) and acid equivalent (ae).

A5. SPRAY ADJUVANTS

POST herbicide effectiveness depends on spray droplet retention, deposition, and herbicide absorption by weed foliage. Adjuvants and spray water quality (Section A6) influence POST herbicide efficacy. Adjuvants are not needed with PRE herbicides because retention and absorption by foliage does not occur.

Spray adjuvants generally consist of surfactants, oils and fertilizers. The most effective adjuvant will vary with each herbicide, and the need for an adjuvant will vary with environment, weeds present, and herbicide used. Adjuvant use should follow label directions and be used with caution as they may influence crop safety and weed control. An adjuvant may increase weed control from one herbicide but not from another. Comparisons of adjuvants should be made at marginal control levels to determine the effectiveness of adjuvants for specific herbicides, sprays, water types or volume, and weeds. Effective adjuvants will enhance herbicides at reduced rates and provide consistent results under adverse conditions. However, reduced below labeled rates exempt herbicide manufacturers from liability for nonperformance.

Commercial adjuvants differ in effectiveness with herbicides. Data from the table below are from experiments conducted in ND from 1992 through 1995 comparing commercial adjuvants with Roundup (glyphosate with surfactant) or Honcho (glyphosate without surfactant). Data are included only when a differential in control occurred among adjuvant treatments. In some experiments, all treatments gave similar control, probably because of a more humid and favorable environment for glyphosate uptake and translocation. Roundup/Honcho was applied at lower than labeled rates (2.7 to 4 fl oz/A) so that control would not be complete and differences were much greater at some locations than others.

Commercial adjuvant effect on glyphosate phytotoxicity to selected grass and broadleaf plants^{a,b}.

Adjuvants	1992-1995 ^a		1993-1995 ^a		
	Grass	Brdlf	Grass	Brdlf	Grass (range)
	----- % control -----				
Surfactants					
None	--	--	49	31	11-68
X-77	62	38	66	40	29-82
R-11	72	55	74	51	34-89
Preference	70	40	67	38	31-84
LI-700	55	36	58	42	16-85
Silwet L-77	66	44	56	40	16-73
Spray Bstr S	65	41	64	41	26-76
Activator 90	67	41	64	41	25-85
APSA-80	--	--	74	50	26-90
Surfactant + Fertilizer					
Cayuse+R-11	--	--	82	66	66-94
Class Act	--	--	90	75	80-98
Dispatch	--	--	85	69	73-91
Surfate	--	--	89	75	71-97

^aData for 1992-1995 represent 13 values selected for grass and 12 for broadleaf weeds, except Silwet L-77 had one less site than other adjuvants listed.

^bIn 1992, the Honcho formulation (without surfactant) was used and all surfactants were applied at 1% v/v. In 1993-1995, Roundup (with surfactant) was applied and all surfactants were applied at 0.5% v/v except Silwet L-77 was applied at 0.25% v/v in 1995 only. Cayuse + R-11 each were applied at 0.5% v/v.

Class Act and Dispatch were applied at 2% v/v, and Surfate was applied at 1.5% v/v in 1992 and 1% v/v in 1993-1995.

All adjuvants enhanced glyphosate (Roundup and Honcho), but some were more effective than others. The last four commercial adjuvants listed in the table are believed to contain ammonium sulfate (ingredients are often a trade secret) and were more effective than the surfactants as a group. The adjuvants differed in effectiveness across locations, possibly from variable spray water quality and environmental conditions at treatment. The results are averaged over various locations and may not represent adjuvant effectiveness for all situations. However, adjuvants differ in effectiveness and users should compare several products for their specific conditions or select an effective adjuvant from the list.

Surfactants are used at 0.12 to 0.5% v/v (1 to 4 pt/100 gal of spray solution). Surfactant rate depends on the amount of active ingredient in the surfactant and other factors such as plant species and herbicides. The main function of a surfactant is to increase spray retention, but surfactants also function in herbicide absorption. When a range of surfactant rates is given, the high rate is for use with low rates of the herbicide, drought stress, tolerant weeds, or when the surfactant contains less than 50% active ingredient. Surfactants vary widely in chemical composition and in their effect on spray retention, deposition, and herbicide absorption.

Silicone surfactants reduce spray droplet surface tension, which allow the liquid to run into stomata on leaves ("stomatal flooding"). This entry route into plants is different than adjuvants that aid in absorption through the leaf cuticle. Rapid entry of spray solution into leaf stomata from use of silicone surfactants often does not result in improved weed control. Silicone surfactants are weed and herbicide specific just like other adjuvants.

Oils generally are used at 1% v/v (1 gal/100 gal of spray solution) or at 1 to 2 pt/A depending on herbicide and oil. Oil additives function to increase herbicide absorption and spray retention. Oil adjuvants are petroleum, vegetable, or methylated vegetable or seed oils (MSOs) plus an emulsifier for dispersion in water. The emulsifier, the oil class (petroleum, vegetable, etc.), and the specific type of oil in a class all influence effectiveness of an oil adjuvant. MSOs have been especially effective with most all herbicides but generally are equal to or better than the petroleum oils with most herbicides (except Cobra). Vegetable oils (non MSO type) are usually equal to petroleum oils. Results vary when comparing specific adjuvants, even within a class of adjuvants.

Fertilizers containing ammonium nitrogen have increased the effectiveness of most herbicides formulated as a salt. Fertilizers should be used with herbicides only as indicated on the label or where experience has proven acceptability.

AMS is recommended at 8.5 to 17 lb/100 gal spray volume (1 to 2%) on most glyphosate labels. Enhancement of glyphosate from AMS is most pronounced when spray water contains relatively large quantities of certain ions, such as calcium, sodium, and magnesium. AMS may contain contaminants that may not dissolve and then plug nozzles. Use spray grade AMS to prevent nozzle plugging. Commercial liquid solutions of AMS are available.

AMS at 8.5 lb/100 gal (1%) is adequate to overcome salt antagonism. AMS at 0.5% has adequately overcome antagonism of glyphosate from 300 ppm calcium. Use at least 1 lb/A of AMS when spray volume is less than 12 gpa. Ammonium ions also are involved in herbicide absorption and have enhanced phytotoxicity of many herbicides in absence of antagonistic salts in the spray carrier. Herbicide enhancement by nitrogen compounds appears most pronounced in certain species like velvetleaf or sunflower.

AMS enhances phytotoxicity and overcomes salt antagonism for dicamba, glyphosate, Poast, and 2,4-D amine. Liquid 28% UAN fertilizer is effective in enhancing weed control from many POST herbicides and overcoming sodium **but not calcium antagonism of glyphosate**. Sodium bicarbonate antagonism of Poast is overcome by 28% UAN, ammonium nitrate, and AMS. AMS or 28% UAN does not preclude the need for a surfactant. Adjuvants vary in enhancement of herbicide action. The precise salt concentration in water that causes a visible loss in weed control is difficult to establish because weed control is influenced by many other factors.

Some water pH modifiers are used to lower (acidify) spray solution pH because many insecticides and some fungicides breakdown under basic conditions (high water pH). Most solutions are not high or low enough in pH for important herbicide breakdown in the spray tank. pH-reducing adjuvants (example: LI-700) are sometimes recommended for use with herbicides because of greater absorption of weak-acid-type herbicides when the spray solution is acidic. However, low pH is not essential to optimize herbicide absorption. Many herbicides are formulated as various salts, which are absorbed as readily as the acid. Salts in the spray water may antagonize these formulated salt herbicides. In theory, acid conditions would convert the herbicide to an acid and overcome salt antagonism. However, herbicides in the acid form are less water soluble than in salt form. A herbicide acid formed with pH modifiers may precipitate and plug nozzles when solubility is exceeded, such as with high herbicide rates in low water volumes. Antagonism of herbicide efficacy by spray solution salts can be overcome without lowering pH by adding AMS or, for some herbicides, 28% liquid nitrogen fertilizer.

Basic pH blend adjuvants are non-oil and are different from additives that lower spray solution pH. They contain nitrogen fertilizer to overcome antagonistic salts; a surfactant to aid in spray retention, spray deposition, and herbicide absorption; and a buffer to increase pH. Basic pH blends adjuvants increase water pH, which increases water solubility of most ALS and HPPD inhibitor herbicides. For example, Accent solubility at water pH 5 is 360 mg/L, at pH 7 is 12,200 mg/L, and pH 8 is 39,200 mg/L. Basic pH blend adjuvants reduce precipitation problems with Betamix/Betanex/Betamix Progress plus UpBeet at low rates by increasing water pH.

Research has shown that basic pH blend adjuvants enhance weed control similar to MSO type adjuvants. They may be used in those situations where oil adjuvants are restricted. For example, dicamba labels restrict oil adjuvants when used alone or in tank-mix with Accent on corn. Basic pH blend adjuvants are less expensive at field use rates than MSO type adjuvants.

Antagonism of glyphosate by calcium in a spray solution was overcome by sulfuric but not nitric acid, indicating that the sulfate ion was important, but not the acid hydrogen ion. The importance of the sulfate ion explains the effectiveness of ammonium sulfate, and not 28% UAN, in overcoming calcium antagonism of glyphosate. Other herbicides that become acid at a higher pH than glyphosate may realistically benefit from a reduced pH as has been shown for Poast. However, Poast does not require a low pH for efficacy. pH of 4 has overcome sodium antagonism of Poast, but nitrogen fertilizer or AMS also will overcome sodium antagonism of Poast without lowering the pH. The ammonium ion provided by these fertilizers is apparently the important ion.

In summary, adjuvants that are designed specifically to reduce pH generally are not required for herbicide efficacy. The type of acid or components of buffering agents and the specific herbicide all need to be considered before using pH-modifying agents.

Choosing adjuvants with herbicides:

Several POST herbicides allow use of nonionic surfactant, petroleum oil additives, methylated seed oil additives, and nitrogen fertilizer. Questions about adjuvant selection are common. MSO additives have often given greater weed control than petroleum oil additives and nonionic surfactants (NIS) but costs are 2 to 3 times more. The added cost of MSO and increased risk of crop injury when used at high temperatures have deterred people from using this class of adjuvants. Using reduced herbicide rates with MSO can enhance weed control while lowering risk of crop injury.

Some herbicide labels restrict use of oil adjuvants and recommend only use of NIS alone or combined with nitrogen based fertilizer solutions. Follow label directions for adjuvant selection. Where labels allow use of oil additives, a petroleum oil based adjuvants referred to as crop oil concentrates (COC), or methylated seed oil (MSO) adjuvants may be used. The term crop oil concentrate is misleading because the oil type in COC is petroleum oil and not a crop vegetable oil.

NDSU research has shown wide difference in adjuvant enhancement of herbicides. However, in many studies, no or small differences occur depending on environmental conditions at application, growing conditions of weeds, rate of herbicide used, and size of weeds. For example, under warm, humid conditions with actively growing weeds, NIS + nitrogen fertilizer may enhance weed control the same as oil additives. Following are conditions where MSO type additives may give greater weed control than other adjuvant types:

1. Low humidity, hot weather, lack of rain, and drought-stressed weeds or weeds not actively growing due to some condition causing stress.
2. Weeds larger than recommended on the label.
3. Herbicides used at reduced rates.
4. Target weeds are somewhat tolerant to the herbicide. For example, control of wild buckwheat, biennial wormwood, common lambsquarters or ragweed with Pursuit or Raptor, or control of yellow foxtail with Accent.
5. When university data supports use. Most herbicides except glyphosate give greater weed control when used with MSO type adjuvants. Use of oil adjuvants with glyphosate should be used only when research or experience shows no reduction in activity.

A5-7 - SPRAY CARRIER WATER QUALITY

Adjuvant use in low gallonage spray volumes

Many herbicides may be applied in low spray volumes by aircraft. In certain instances, spray adjuvant rates should be adjusted for low sprayer volumes. For example, oil adjuvants are applied with ALS, ACCase, and HPPD inhibitor herbicides and other POST herbicides at 1% v/v or 1 gal/100 gal water. At 15 to 20 GPA, 1% oil adjuvant would provide adequate adjuvant load. However, in aerial applications at 5 GPA, 1% v/v may not provide enough adjuvant for the herbicide.

Some herbicide labels contain information on adjuvant rates for different spray volumes. For example, Pursuit and Raptor labels require oil adjuvants to be added at 1.25% v/v or 1.25 gal/100 gal water for aerial application (5 GPA). Additional recommendations to assure sufficient adjuvant load would be to determine the adjuvant rate on an area basis. Instead of using oil adjuvants at 1% v/v, apply at 1.5 to 2 pt/A to insure adequate adjuvant load at all spray volumes. Surfactant rates of 0.25 % v/v or 1 qt/100 gal water is sufficient across water volumes.

Basic pH blend adjuvants are recommended at 1% v/v regardless of spray volume. Data indicate basic blend adjuvants at 1% v/v from 5 to 20 GPA will provide necessary adjuvant enhancement for similar weed control.

A6. SPRAY CARRIER WATER QUALITY

Minerals, clay, and organic matter in spray carrier water can reduce the effectiveness of herbicides. Clay inactivates paraquat, diquat, and glyphosate. Organic matter inactivates many herbicides, and minerals can inactivate 2,4-D amine, MCPA amine, Achieve, dicamba, glyphosate, Liberty, and Poast.

Water in many parts of the United States is high in sodium bicarbonate, which reduces the effectiveness of amine phenoxys, ALS, ACCase, dicamba, glyphosate, and Liberty. Water with 1600 ppm sodium bicarbonate occur, but antagonism of above herbicides was noticeable at or above 300 ppm. The antagonism is related to the salt concentration. At low salt levels, loss in weed control may not be noticeable under normal environmental conditions. However, antagonism from low salt levels will cause inadequate weed control when weed control is marginal because of drought or partially susceptible weeds.

High salt levels in spray water can reduce weed control in nearly all situations. Calcium and magnesium are antagonistic. Calcium antagonism may occur at 150 ppm. Sulfate ions in the solution have reduced the antagonism from calcium and magnesium, but the sulfate concentration must be three times the calcium concentration to overcome antagonism. Natural sulfate in water can be disregarded. The amount of AMS needed to overcome antagonistic ions can be determined as follows:
$$\text{Lbs AMS/100 gal} = (0.002 \times \text{ppm K}) + (0.005 \times \text{ppm Na}) + (0.009 \times \text{ppm Ca}) + (0.014 \times \text{ppm Mg}) + (0.042 \times \text{ppm Fe})$$

Analysis of spray water sources will determine possible effects on herbicide efficacy. Water samples can be tested at the following laboratory: NDSU Soil and Water Environmental Laboratory, 701 231-7864, Waldron 202, NDSU, Fargo, ND 58105-5575. Analysis is approximately \$25.00 to \$29.00. The analysis may report salt levels in ppm or grains. To convert from grains to ppm, multiply by 17 (Example: 10 grains calcium X 17 = 170 ppm calcium). AMS at 2% (17 lb/100 gallons spray) will overcome the antagonism from the highest calcium and/or sodium concentrations in North Dakota waters. However, AMS at 4 lb/100 gal is adequate for most North Dakota waters. Iron is also antagonistic to many herbicides but not usually abundant in ND water.

Water often contains a combination of sodium, calcium, and magnesium, and these cations generally are additive in the antagonism of herbicides. Many adjuvants are marketed to modify spray water pH, but low pH is not essential to the action of most herbicides. AMS, granular or liquid, and 28% UAN fertilizer help overcome antagonistic salts in spray carrier water. Generally, 4 gal of 28% UAN/100 gal of spray has been adequate. UAN overcomes mineral antagonism of most herbicides, but not glyphosate. AMS and 28% UAN enhance herbicide control of certain weeds even in water without salts. Nitrogen fertilizer/surfactant blends may enhance weed control of most herbicides formulated as a salt.

A7. USING HERBICIDES AT REDUCED RATES

Ideally, control of target weeds at the lowest herbicide rate provide the greatest return over herbicide and application costs. This "best" herbicide rate will be different for every herbicide-weed-environment-adjuvant combination. Sometimes, the "best" rate will be lower than the lowest rate on the herbicide label. Below are factors considered by companies when they write a label.

Weed Size and Crop Size. Companies make an assumption of weed and crop size at herbicide application. Small weeds are more susceptible to herbicides than large weeds, but small crop plants may also be more susceptible. Reduced herbicide rates may be used if herbicides are applied to weeds smaller than listed on label. The crop will probably be smaller so knowledge of crop safety also is needed.

Environment. Companies write labels that cover most environments in which herbicides are used. Environment has a large influence on efficacy of herbicides. Herbicide rates may be reduced under ideal environmental but special knowledge and experience is needed on the environment-herbicide interaction.

Adjuvants. Most POST herbicides require addition of adjuvants such as surfactants, crop oils, methylated seed oils, or fertilizer. See section on spray adjuvants (A5) for more information. Adjuvant information is fairly general on pesticide labels to address adequate weed control under most situations. Herbicide rates sometimes can be reduced by using adjuvants that are highly effective with a specific herbicide but additional knowledge is needed. The herbicide-adjuvant combination must be safe on the crop as well as provide good weed control.

Weed Species. Labels sometimes list weed species separately on the label with different rates for different weeds. Herbicide rates may be reduced when highly susceptible weed species are present.

Performance Complaints. Using reduced rates may result in poor weed control. User assumes all risk and liability of unacceptable weed control when less than labeled rates are used.

Are Low Rates Legal? A herbicide user can legally choose a rate lower than listed on the herbicide label unless the label specifically prohibits low rates. However, the company has no obligation to support herbicide efficacy when the application rate was less than labeled rates. Herbicide users should not expect a company representative to provide any comfort or assistance if weed control is less than expected from a rate of herbicide that is less than the labeled rate.

Crop injury may occur from a contaminated sprayer. The risk of damage is greatest when spraying crops highly susceptible to the previous herbicide, when the previous herbicide is very active in small amounts, or when tanks are not cleaned after using non-selective herbicides (glyphosate and Liberty). Rinsing with water is not adequate to remove all herbicides. Some herbicides have remained tightly adsorbed in sprayers through water rinsing and even through several tank-loads of other herbicides. Then, when a tank-load of mixture including an oil adjuvant, nitrogen solution, or basic pH blend adjuvant was put in the sprayer, the herbicide was desorbed, dispersed into the spray mixture, and damaged susceptible crops. Highly active herbicides that have been difficult to wash from sprayers and have caused crop injury include dicamba and ALS herbicides.

Herbicides difficult to remove from sprayers are thought to attach to abrasions on tank liners or formulation carrier residues remaining from spray mixtures that deposit in a sprayer, including the boom, hoses, and nozzle bodies. The herbicide must be desorbed from the residue or the residue removed in a cleaning process so the herbicide can be removed from the sprayer. Sprayer cleanout procedures are given on many herbicide labels and the procedure on the label should be followed for specific herbicides. The following procedure illustrating a thorough sprayer cleanout procedure is effective for most herbicides:

- Step 1.** Drain tank and thoroughly rinse interior surfaces of tank with clean water. Spray rinse water through the spray boom. Sufficient rinse water should be used for 5 minutes or more of spraying through the boom.
- Step 2.** Fill the sprayer tank with clean water and add a cleaning solution (many labels provide recommended cleaning solutions). Fill the boom, hoses, and nozzles and allow the agitator to operate for 15 minutes.
- Step 3.** Allow the sprayer to sit for 8 hours while full of cleaning solution so the herbicide can be fully desorbed from the residues inside the sprayer.
- Step 4.** Spray the cleaning solution through the booms.
- Step 5.** Clean nozzles, screens, and filters. Rinse the sprayer to remove cleaning solution and spray rinsate through the booms.

Common types of cleaning solutions are chlorine bleach, ammonia, and commercially formulated tank cleaners. Chlorine lowers the pH of the solution which speeds the degradation of some herbicides. Ammonia increases the pH of the solution which increases the solubility of some herbicides. Commercially formulated tank cleaners generally raise pH and act as detergents to remove herbicides. Read herbicide label for recommended tank cleaning solutions and procedures.

WARNING: Never mix chlorine bleach and ammonia as a dangerous and irritating gas will be released.

Sprayers should be cleaned as soon as possible after use to prevent the deposit of dried spray residues. A sprayer should not remain empty overnight without cleaning; fill the tank with water to prevent dried spray deposits from forming. A clean sprayer is essential to prevent damage to susceptible crops from herbicide contamination.

SPRAYER CLEANING SOLUTIONS FOR HERBICIDES

Ammonia + water:

2,4-D, Accent, Ally XP, Amber, Amplify, Assure II, Basis, Cimarron/Max, Classic, dicamba, Escort, Exceed, Expert, Finesse, FirstRate, Harmony GT, Glean, Option, Peak, Permit, Python, Resolve, Steadfast, Stinger.

Ammonia + Simple Green at 1:1 ratio + water:

Callisto, Lumax.

Kerosene or diesel fuel followed by ammonia + water:

2,4-D ester

Ammonia or commercial tank cleaner + water:

Action, Basagran, Beacon, Buctril + Atra, bromoxynil, Callisto, Classic, Cobra, Dual/II/Magnum, Extreme, Fusilade DX, Fusion, Gauntlet, Gramoxone, Harness, Harmony Extra XP, Hornet WDG, Lasso, Lightning, Moxy, Moxylin, Northstar, Prowl, Pursuit, Pursuit Plus, Raptor, Reflex, Resource, Select, Surpass, Treflan, trifluralin, and Ultra Blazer.

Water: Command, Extreme, glyphosate, Lightning, Raptor.

Detergent + water: Aim, Atrazine, and Sencor.

Commercial tank cleaner + water:

Flexstar, Liberty, Liberty ATZ, Shotgun, and Touchdown

Detergent or commercial tank cleaner + water:

Celebrity Plus, Clarity, Distinct, Marksman, Poast Plus, Turbo, Ultra Blazer, Yukon.

Ammonia, commercial tank cleaner, or detergent + water:

Poast.

Baking soda (1 to 2 lb/100 gal water): Engame

A9. SPRAY AND VAPOR DRIFT

Refer to NDSU Extension Circular A-657, "Herbicide Spray Drift" and Circular WC-751 "Documentation for Suspected Herbicide Drift Damage" for additional information. Off-target herbicide movement from fields into areas containing crops or other susceptible plant species should be avoided. The risk of injury to non-target plants varies greatly among herbicides. In general, POST herbicides that are highly phytotoxic at low rates (2,4-D, MCPA, dicamba, Tordon, glyphosate, Liberty, paraquat, and all ALS herbicides) have the greatest potential for damaging non-target plants. Spray drift and injury to plants are affected by several factors.

Wind velocity and direction: Apply when wind direction is away from susceptible plants, when velocity is 10 mph or less, and in the absence of temperature inversions. Vertically stable air (temperature inversion) occurs when air near the soil surface is cooler or similar in temperature to air above the crop. Normally, air near the soil surface is warmer than air above the crop. Warm air rises and cold air sinks, which causes vertical mixing of air and dissipation of spray droplets. Small spray droplets can be suspended in stable air, move laterally in a light wind, and affect plants more than two miles downwind. Inversions can be identified by fog or dust from a gravel road.

Distance between nozzle and target (boom height): Adjust boom as close to the target as possible while maintaining uniform spray coverage. Choose nozzles with a wide angle as opposed to narrow angle nozzles.

Herbicide formulation: Some herbicides volatilize under warm or hot temperature and cause plant injury from vapors or fume drift. Low volatile esters of 2,4-D or MCPA may produce damaging vapors between 70 to 90 F. Amine formulations are essentially non-volatile even at high temperatures. Temperature on the soil surface often is several degrees warmer than air temperature. Herbicide vapor can drift farther and over a longer time than spray droplets. Wind blowing away from susceptible plants during application will prevent damage from droplet drift but a later wind shift toward the susceptible plants could move damaging vapors to the plants. To minimize the risk of drift injury, dicamba and ester formulations of 2,4-D and MCPA should not be used near susceptible plants.

Spray shields: Small plastic cones that fit around individual nozzles reduce drift by approximately 25 to 50% and spray shields that enclose the entire boom reduce drift by approximately 50 to 85%. Spray shields provide greater drift reduction when winds are low and droplets are relatively large. Therefore, spray shields should not be used as a substitute for other drift control techniques but as a supplement to all other applicable methods of drift reduction.

Drift control: Spray drift can be reduced by increasing droplet size. Droplet size can be increased by reducing spray pressure, increasing nozzle orifice size, using special drift reduction nozzles, including additives that increase spray viscosity, and orienting nozzles rearward on aircraft.

Drift-reducing nozzles: Several sprayer nozzles are designed to reduce spray drift. These nozzles increase spray droplet size and reduce the number of small droplets. These drift-reducing nozzles are flat-fan types and are adapted for conventional sprayer equipment. The two primary types of drift-reducing nozzles are pre-orifice and air-induction (venturi) designs.

Pre-orifice nozzles: The two most common designs are Drift Guard and Turbo TeeJet nozzles from Spraying Systems Co. Pre-orifice nozzles regulate the liquid flow rate prior to the exit orifice and cause a pressure drop within the nozzle so fewer fine spray droplets are produced. Drift Guard nozzles are available in 80° and 110° spray angles with a recommended pressure range of 30 to 60 psi. The Turbo TeeJet design combines pre-orifice technology with a turbulence chamber to produce a wide-angle flat-fan spray pattern that greatly reduces the amount of spray in fine droplets. Turbo TeeJet nozzles are available in 11001 to 11008 sizes with a spray pressure range of 15 to 90 psi although pressures below 30 psi are recommended to maximize average droplet size and drift reduction.

Air-induction (venturi) nozzles. These include the AI TeeJet from Spraying Systems Co., the TurboDrop and TurboDrop XL from Greenleaf Technologies Inc., the Lurmark Ultra-Lo-Drift from Precision Fluid Control Products, the Spraymaster Ultra from Delavan Spray Technologies, and the Lechler ID from Hardi. Each nozzle has a distinct design, but the technology is basically the same. Each includes a pre-orifice to regulate the flow rate so a large exit orifice can be used to produce the spray pattern. Additionally, venturi nozzles include an air-induction assembly that incorporates air into the liquid stream, thereby forming air-filled spray droplets. The design allows air-filled droplets to shatter upon impact thus improving spray coverage and retention of large droplets. A spray pressure of 40 psi will maintain a good spray pattern but pressures greater than 60 psi result in the most consistent performance of POST herbicides. The air-induction system operates more efficiently at higher spray pressures and, in contrast to standard flat-fan nozzles, the droplet size spectrum of venturi nozzles is not greatly influenced by this pressure change.

Drift reduction. Research at NDSU has shown the greatest reduction in spray drift with air induction or Turbo TeeJet nozzles operated at low pressure (20 psi). Drift Guard nozzles significantly reduce drift compared with a standard flat-fan nozzle but produce a quantity of fine droplets that result in greater spray drift than air induction or Turbo TeeJet nozzles. The following table compares droplet size data for various sprayer nozzles (Univ. of Tennessee Agric. Experiment Station, Bull. 695).

Nozzle	Pressure (psi)	Droplets <191 um (%)	VMD* (um)
Extended Range 8002	40	65	154
Drift Guard 8002	40	32	292
Turbo TeeJet 11002	40	32	271
Turbo TeeJet 11002	15	19	393
TurboDrop 11002	60	10	520

*VMD = volume median diameter = diameter in which 50% of the spray volume is in droplets smaller than, not an average droplet size.

Percentage of small spray droplets (<191 um) is the best indicator relating to spray drift. Air induction nozzles (TurboDrop) produced the largest spray droplets and the fewest number of fine spray droplets compared with other nozzles. The data in the table also illustrates the importance of using low spray pressures to maximize the drift-reducing potential of Turbo TeeJet nozzles.

Herbicide performance. NDSU research has demonstrated weed control from glyphosate, Raptor, Pursuit, Distinct, Assure II, and Poast to be similar when applied through drift-reducing nozzles or standard flat-fan nozzles. The same results were observed with fast-acting contact herbicides of Gramoxone Extra and Aim. Reflex applied with drift-reducing nozzles was the only herbicide examined in which weed control was slightly less as compared with a standard nozzle. All other herbicides gave similar control regardless of nozzle.

Sufficient spray coverage to maintain effective weed control is a common question of using nozzles that produce large spray droplets. In most situations, coverage is adequate. Total spray coverage will decrease as droplet size increases, but the number of drops delivered to the target weed will generally still be sufficient for excellent weed control with drift-reducing nozzles.

Spray Droplet Diameter (µm)	Spray Volume		
	5 gpa	10 gpa	20 gpa
	— drops per square inch —		
200	720	1440	2880
300	214	428	856
400	90	180	360
500	46	92	184

Even at 5 gpa spray volume, nozzles that produce large spray drops up to 500 µm in diameter will theoretically produce 46 drops/sq. inch, which should be adequate to cover even small target weeds. Research at NDSU supports this premise as herbicides applied at 2.5 gpa spray volume with drift-reducing nozzles provided weed control similar to herbicides applied with standard flat-fan nozzles.

Large spray droplets may bounce off leaves upon impact, resulting in poor droplet retention. The concern is legitimate when herbicides are applied without adjuvants. Spray adjuvants applied with POST herbicides improve droplet retention and deposition. NDSU research has found that spray retention is similar for drift-reducing nozzles and standard nozzles when herbicides were applied with NIS or MSO type adjuvants.

For maximum drift control without affecting herbicide performance, use air induction type nozzles at more than 60 psi or Turbo TeeJet nozzles at less than 30 psi. Contact herbicides, hard-to-wet weed species, and small target weeds are examples where drift-reducing nozzles may reduce herbicide performance. Weed control with drift-reducing nozzles may be better than with conventional nozzles when environmental conditions favor lateral droplet movement. Remember to always read the label as some herbicide labels place restrictions on the spray application equipment or spray volume/acre that may be used.

A10. FIELD INVESTIGATION OF CROP INJURY:

Keep an open mind and investigate all possible causes and sources of the problem when assessing crop injury. Question all statements from involved persons about the cause and the source of the problem. The truth often is not obvious. Crop injury can have many causes other than herbicides and symptomology does not always provide definitive answers.

NDSU Extension County, Area, or State staff can assist in determining the cause of observed crop injury and provide an opinion on the severity of the injury. Samples may be collected and sent to the Plant Diagnostic Lab (PDL) at NDSU. However, Extension staff are not responsible for conducting an extensive investigation to determine cause of crop injury or economic loss. Extension staff will not act as a mediator in disputes. Independent consultants can be hired for investigations.

North Dakota Law requires that before a person may file a civil action seeking reimbursement for property damage allegedly stemming from the application of a pesticide, the person shall notify, by certified mail, the pesticide applicator of the alleged damage within the earlier of: 28 days from the date the person first knew or should have known of the alleged damage; or before twenty percent of the crop or field allegedly damaged is harvested or destroyed.

Upon notifying the applicator, the person seeking reimbursement for the alleged property damage shall permit the applicator and up to four representatives of the applicator to enter the person's property for the purpose of observing and examining the alleged damage. If the person fails to allow entry, the person is barred from asserting a claim against the applicator. Individuals can contact the ND Dept. of Agriculture at 600 E. Boulevard, Bismarck, ND 58505-20020. (800) 242-7535 or (701) 328-2231.

The Plant Diagnostic Lab at NDSU will analyze samples and evaluate injury symptoms to provide opinions and possible explanations on the causes of the problem. The PDL does not test soil or plant material for herbicide residues. Refer to "Herbicide Carryover" section (paragraph Y23) for list of testing labs. Analysis of plant tissues or soil by a testing laboratory may not provide a definitive answer to the cause of the problem. Each active ingredient must be tested individually, which increases expense. A positive detection can be useful but the detected herbicide may not have caused the symptoms. A negative test does not prove that the herbicide did not cause the problem because the herbicide may cause injury at concentrations less than the detection limit or the herbicide may have been degraded before the samples were taken.

The pattern of crop injury in a field helps identify the source of the injury. A sprayer skip in a field is valuable in diagnosing a herbicide problem, especially if the applicator remembers the time that the skip occurred. Herbicide field history for the past 2 to 5 years should be considered. Uniform damage over the field would suggest herbicide carryover or injury from a direct application rather than drift.

Drift is nearly always worse near the source of the drift with damage becoming less as the distance becomes greater. Lessening of injury with distance may not be evident shortly after the drift has occurred but the differences should become more visible with time since recovery by damaged plants will be more rapid and more complete as distance from the drift source increases. Crop injury that is associated with one or two sprayer tank loads would suggest sprayer contamination or a mistake in mixing where the wrong herbicide or too much of the correct herbicide was put in the sprayer tank. An aerial photograph often is very useful in identifying patterns of crop injury in a field.

The family of the herbicide that caused the injury often can be identified by the injury symptoms and the species that are not injured. Look in the affected field, in surrounding fields and between fields. The approximate date of injury can sometimes be determined by observing or learning the date that the injury first became evident. The size of plants when affected by a growth regulator herbicide can sometimes be determined by the height of the stem where malformed leaves first occur. Plants that are affected as soon as they emerge usually are being damaged by a herbicide in the soil rather than drift. Dates that injury occurred can be related to dates of herbicide application on and around the damaged field.

The direction of the source of herbicide drift can sometimes be determined by finding "drift shadows" by trees, buildings or elevated roads. Anything that intercepts or deflects spray droplets can cause an area of undamaged plants on the downwind side of the object. The shape and direction of the "drift shadow" often will identify the direction of the drift source.

Placing tall stakes at the edge of this line through the damaged field will often form a line that points at the edge of the field that was the source of the spray drift. Spray droplets move with the wind. Spray droplets will only move down wind so the wind direction during application will often indicate which potential drift sources are possible and which are not possible.

A11-13 - MIXING INSTRUCTIONS

Some herbicides like 2,4-D ester, MCPA ester, and dicamba are volatile and a wind shift after application may cause vapor drift in a different direction than the drift of spray droplets. Spray droplets only move in the direction that the wind is moving.

Some sources of unintended herbicide exposure are very difficult to identify. For example, drift or an accidental and unreported spraying of a long residual herbicide on a tolerant crop would have no effect that year but the residual in the soil the next year could damage a susceptible crop. Another example is soil movement due to wind or water erosion, which causes a damaging level of herbicide to move with soil.

An obvious question is whether to destroy or keep the damaged field. A general rule of thumb is that damage from drift is not as bad as the initial appearance would suggest and a decision should not be made within one week of the drift. With growth regulator herbicides, about 10 days is needed before surviving plants will begin to produce new leaves. Evaluation of the level of injury from growth regulator herbicides should not be attempted prior to 10 days after exposure. With ALS-inhibitor herbicides and glyphosate, the less damaged plants begin to visibly recover and separate themselves from plants with more injury about two weeks after exposure. Rapid conclusions can lead to bad decisions with spray drift.

Everyone involved will want to know how much yield loss will be caused by the herbicide damage. Accurate visual estimation of yield loss from a non-lethal exposure to herbicide is not possible. Some means of collecting meaningful yield comparisons is essential in obtaining an accurate estimate of yield loss. When part of a field is injured and part is not injured, yield in the uninjured portion of the field can be compared to yield in the injured portion. Hand harvesting at several places, harvesters with yield monitors or harvesting and weighing yield from strips through the field all could be used. Usually, splitting the field into six or eight strips or pieces is better than comparing one half of the field to the other half of the field.

Obtaining accurate yield loss data is very difficult when the entire field is damaged. Comparisons to nearby fields can be done but variability among fields is great. Use of the average yield of several nearby fields also could be considered.

A11. GROUNDWATER CONTAMINATION:

Groundwater contamination with herbicides is a public concern. Pesticides can contaminate groundwater by movement from small areas contaminated by spills, spray can and tank rinsate, and back-siphoning (point source) or by movement of pesticides used according to their label on relatively large land areas (non-point source). Point source contamination probably accounts for most groundwater contamination problems and can be minimized by using the following precautions:

1. Mix pesticides away from wells and water sources and maintain at least a 150-ft buffer away from water sources.
2. Prevent back-siphoning into the well by using an anti-backflow check valve or maintaining an air gap between the end of the fill hose and the surface water level in the sprayer.
3. Triple rinse or pressure rinse pesticide containers and add rinsate to the sprayer tank. Visually inspect containers.
4. Minimize extra spray solution by mixing only the quantity of spray required. Apply extra spray solution to fallow land or to a labeled crop following label recommendations.
5. Properly seal active and abandoned wells.

Non-point source groundwater contamination can occur over a broad area as the chemical is leached by water through the soil profile. The potential for non-point source pollution of groundwater with a herbicide depends on soil type, irrigation or precipitation, depth to groundwater, herbicide application rate and frequency, and herbicide mobility. Non-point pollution of groundwater can be minimized by using the following practices:

1. Select herbicides with short residual and limited soil mobility.
2. Properly calibrate sprayers to prevent application of excessive rates of herbicide.
3. Apply herbicides only when necessary and follow all herbicide label recommendations and guidelines.
4. Use good agronomic practices that minimize weed competition and maximize herbicide performance such as crop and herbicide rotation, cultivation, and cover crops.
5. Use band applications rather than broadcast applications to reduce the amount of pesticide used per acre.
6. Do not apply herbicides near open water.
7. Avoid use of persistent and/or mobile herbicides on soil with a shallow water table (Tordon and triazines).

For further information on ways to prevent groundwater contamination with pesticides, refer to NDSU Extension Service publications EB 49, Persistence and Mobility of Pesticides in Soil and Water, and E-979, Managing Pesticides to Prevent Groundwater Contamination.

A12. MIXING INSTRUCTIONS:

Some herbicide labels list a specific mixing sequence. In absence of specific directions, the recommended sequence for adding pesticide formulations to a tank partially filled with water follows the **A.P.P.L.E.S.** method: **A**gitate, **P**owders soluble, **P**owders dry, **L**iquid flowables and suspensions, **E**mulsifiable concentrates and **S**olutions. Each ingredient must be uniformly mixed before adding the next component, e.g., a soluble powder must be completely dissolved before adding the next component. Adjuvants are added in the same sequence as pesticides, e.g., ammonium sulfate is a soluble powder, petroleum oil and MSO (methylated seed oil) are emulsifiable concentrates; and most surfactants are solutions. Within each group, usually add the pesticide before the adjuvant, e.g., a soluble-powder pesticide before ammonium sulfate.

Many pesticide labels include information on approved tank-mixes. The tank-mix must be applied according to label directions. Non-registered tank-mixes may be applied if all pesticides in the mixture are registered by the EPA on the crop being treated. However, the user assumes liability for crop injury, inadequate weed control, and illegal residues for non-labeled tank mixtures.

A13. HERBICIDE + INSECTICIDE COMBINATIONS are convenient for control of both weed and insect pests. Some combinations have increased crop injury compared to either pesticide applied alone. Efficacy data on herbicide-insecticide mixtures are limited because of the number of potential combinations. Non-registered tank-mixtures should be used with caution until experience or research has shown that the combination is effective and safe. The following information is based on label restrictions and/or research indicating crop injury or decreased control.

2,4-D: Wheat injury but not lower wheat yield with 2,4-D amine combined with Lorsban, 2,4-D, dicamba, bromoxynil+MCPA or Curtail mixed with Asana, Cygon, Di-Syston, Warrior, or Lorsban caused no wheat injury in University of Wyoming studies.

Assert: Use caution when tank-mixing organophosphate insecticides for use on barley and sunflower. Assert and Di-Syston caused barley injury in University of Wyoming research.

Dicamba: Oil-based insecticides increase risk of wheat injury.

Basagran: Basagran should not be tank-mixed with Scout or any organophosphate insecticide as crop injury may result.

Betamix/Betanex: Increased sugarbeet injury occurred from tank-mixtures with Lorsban, malathion, or Sevin XLR. Oil-based additives increase risk of sugarbeet injury.

Bromoxynil: Refer to label for directions on the order of adding products to the sprayer tank and for the complete list of insecticides that can be tank-mixed with bromoxynil.

POST Grass Herbicide:

Assure II, clethodim, Fusilade DX, Fusion, Poast:

Reduced grass control may result from tank-mixes of Fusilade DX with Lorsban, malathion, or Sevin XLR, or Poast mixed with Sevin XLR Plus or Pydrin. No decrease in grass control resulted from Poast tank-mixed with Lorsban or malathion.

Glyphosate: No antagonism or injury to resistant crops occurred when applied in combination with Warrior, Asana, Sevin, and Capture insecticides.

Sulfonylurea Herbicides (SU): Severe crop injury may result from tank-mixing SU herbicides with organophosphate insecticides. Most SU labels do not allow addition of Lorsban or malathion. SU herbicides and insecticides should be tank-mixed only when experience or research indicated crop safety.

A14. HERBICIDE + FUNGICIDE COMBINATIONS can provide weed control and maintain crop protection from some diseases. Information on pesticide labels usually gives all possible registered combinations for each crop. The following table gives information on many possible combinations.

Herbicide/Fungicide Combinations For Small Grains.

Herbicide	Mancozeb	Adjuvant with Mancozeb	Tilt
Affinity Tankmix/BroadSpec, Aim, Ally, Ally Extra, Amber, Assert, Avenge, Curtail/M, dicamba, Discover/NG, Everest, Express, Finesse, Glean, MCPA, Peak, Puma, Starane =			
	Not Prohibited	Yes, if required	Not Prohibited
Achieve	PROHIBITED	PROHIBITED	PROHIBITED
Bromoxynil + MCPA	See Product Bulletin Zee	Not needed	Not Prohibited
Bromoxynil	See Product	Not needed	Not Prohibited
Rimfire	PROHIBITED		
Silverado	PROHIBITED	PROHIBITED	Not Prohibited
2,4-D	Not Prohibited	Not Prohibited	Yes, if required

NDSU studies show Puma or Discover plus Bronate Advanced applied with the strobilurin fungicides of Quadris, Quilt, Headline, and Gem caused severe leaf burn on wheat; new tissue that emerged was unaffected. Bronate, or generic formulations plus strobiluron fungicides may also cause similar injury.

A15. HERBICIDE + LIQUID-FERTILIZER COMBINATIONS require thorough mixing and continuous agitation to obtain even application. Some herbicide + fertilizer combinations will not form a uniform mixture even with agitation. To test, combine small quantities of components to be mixed in the same proportions used in the sprayer tank. One tsp of liquid herbicide in 1.5 pt of fertilizer is equivalent to 1 qt of herbicide in 35 gal of fertilizer. One tsp of DG granules in 1.5 pt of fertilizer is equivalent to 1 lb of DG in 16 gal of fertilizer. One tsp of WP in 1.5 pt of fertilizer is equivalent to 1 lb of WP powder in 32 gal of fertilizer. WP and DG formulations should be mixed with water to form a slurry before adding to fertilizer. Shake after mixing.

Watch the mixture for several seconds and check again after 30 minutes. If the mixture does not separate, the combination is compatible. If the mixture separates or gets very thick or syrupy, do not use. Mixing ability may be improved by adding a compatibility agent. Batches of fertilizer may differ in mixing properties and should be tested separately.

HERBICIDE + DRY-FERTILIZER COMBINATIONS created by impregnation on dry bulk fertilizer are used. Read the label for use directions. Ammonium sulfate, ammonium phosphate-sulfate, diammonium phosphate, potassium chloride, superphosphate, treble superphosphate, and urea are approved fertilizer materials for impregnation. Impregnated fertilizer should be applied and incorporated according to label instructions. Consult the herbicide label for minimum amount of fertilizer/A and maximum amounts of herbicide per given weight of fertilizer. Apply at least 200 to 400 lb/A of dry bulk fertilizer to maintain uniform herbicide application.

A16. HERBICIDE STORAGE TEMPERATURES:

Herbicides may be exposed to freezing temperatures in storage. The following information gives the minimum storage temperature to avoid risk of reduced herbicide activity.

No storage temperature restriction

Acetochlor, Aim, Axial/XL, Balance Pro, clethodim, dicamba, Discover NG, EPTC, Extreme, glyphosate-K, Impact, metolachlor, Outlook, Touchdown, and most dry formulated herbicides in DF or WDG formulations.

May store below freezing but warm before using

Betamix, Betanex, MCPA amine and ester, Tordon, Weedmaster

Do not store below 40 F

Assert, clopyralid + 4-D, Flexstar, Extreme, LI-700, Prowl, Pursuit Plus, Sonalan, Spartan 4F, trifluralin.

Do not store below 32 F

Assure II, Basagran, Beyond, bromoxynil + MCPA, ClearMax, clopyralid, Far-Go EC, Fusilade DX, Fusion, Goal, Grazone P+D, Hyvar, Liberty, Lorox DF, Nortron SC, paraquat, Poast, Pramitol, Progress, Prowl H₂O, Puma, Pursuit, Quest, Raptor, Redeem, Reflex, Regione, Remedy, Thistrol, Ultra Blazer.

Do not store below 20 F

Define, Fusilade DX, Plateau, Ro-Neet, Starane NXT, Weedar 64

Do not store below 10 F

Amitrole T, Arsenal, clopyralid + MCPA, Crossbow, Fusion, glyphosate, Rodeo, Roundup, Starane, WideMatch.

Do not store below 3 F

Atrazine 4L, Low Vol ester, bromoxynil, bromoxynil + atrazine, Discover, Shotgun.

Do not store below -10 F

Callisto, Lumax

Do not store below -30 F

acetochlor

A17. BACKPACK SPRAYER CALIBRATION

No-Math Version:

- Step 1. Mark a calibration plot 18.5 foot wide X 18.5 feet long.
- Step 2. Spray the plot uniformly with water while recording the number of seconds required to spray the plot.
- Step 3. Spray into a bucket for the same number of seconds.
- Step 4. Measure the collected volume of water in ounces.
- Step 5. The number of ounces collected equals the number of gallons per acre the sprayer is delivering.

A18. HAND-HELD SPRAYERS:

Hand-held sprayers are often used for spot treating patches of weeds or for treating small areas such as lawns. Spray coverage should be uniform, leaves of target plants should be wet but the amount of spray solution applied should be limited so that run-off does not occur. Hand-held sprayers should be calibrated by 1) spraying a known area using water, following standard, reproducible procedure, 2) measuring the amount of water applied, and 3) calculating gallons per acre (gpa). For example, 0.75 gallon on 500 sq ft is the same as 65 gallons per acre:

$$43,560 \text{ sq ft per acre} / 500 \text{ sq ft} \times 0.75 \text{ gallon} = 65 \text{ gpa.}$$

The desired rate in lb/A or pt/A can be used to calculate the amount of herbicide to add to the spray solution.

If 3 pt/A is desired: $3 \text{ pt/A} / 65 \text{ gpa} = 0.046 \text{ pt}$ or 0.73 fl oz or 1.5 tsp/gal of spray solution ($16 \text{ fl oz} = 1 \text{ pt}$, $2 \text{ Tbsp} = 1 \text{ fl oz}$).

When calibration of a hand-held sprayer is not possible and the herbicide being used is safe to the environment and non-target plants, a volume of 50 to 70 gpa can be assumed. However, the actual volume applied can vary considerably with the type of sprayer, spray pressure, and technique of the applicator, so calibration is strongly encouraged.

Some herbicide labels specify a percent solution for use in hand-held sprayers. The following chart provides mixing instructions to obtain solutions of varying percent concentrations on a volume/volume basis:

Desired solution volume gallons	% concentration of herbicide				
	0.5	1.0	1.5	2.0	5.0
	Amount of herbicide to add, fl oz				
1	0.6	1.3	1.9	2.6	6.4
2	1.3	2.6	3.8	5.2	12.8
5	3.2	6.4	9.6	12.8	32.0
10	6.4	12.8	19.2	25.6	64.0
100	64.0	128.0	192.0	256.0	640.0
1 pt = 16 fl oz	16 Tbls = 1 cup				
1 Tbls = 3 tsp	1 fl oz = 30 mls				
1 Tbls = 15 ml	1 fl oz = 2 Tbls				

Small Grains - Spring, Durum and Winter Wheat, Barley and Oat

IDENTIFYING LEAF STAGES OF SMALL GRAIN:

The plant leaf stage is determined by the number of leaves present on the main stem. Leaves arise on opposite sides of the stem and develop a collar at the junction of the leaf sheath and leaf blade. The first leaf has a blunt tip. Position the small grain plant with the first leaf pointing to the left. All leaves on the left side of the main stem are designated with an odd number and those on the right side with an even number. Count the youngest leaf when it is at least one-half the length of the leaf below it. Follow this procedure to properly stage small grain plants. Tillers (stooling) usually start to appear at the third to fifth leaf stage. Most tillers arise between the main axis (stem) and leaf. A coleoptilar tiller may also be present. The coleoptilar tiller originates below the soil (near the seed) and is located on the opposite side of the stem from the first leaf. Frequently, tiller leaves are confused with leaves of the main stem when determining correct leaf stage.

Remember to count the leaves on the main stem, but do not include tiller leaves in the leaf stage count. Leaf stage determination in the field can be complicated by loss of older leaves; for example, the first and second leaves may have been removed by abrasion from wind blown soil, drought, frost, disease, or some other form of weathering. The base of the stem should be carefully examined for evidence of scars from lower leaves that have been removed. Such leaves must be counted when making correct leaf stage determination.

Plant growth rate varies considerably, and the approximate days after emergence for appearance of a given leaf stage is influenced mostly by temperature. Daytime highs less than 55 F. delay development, while warm temperatures advance development. Days to emerge can vary greatly depending on soil temperature and moisture.

HARROWING FOR WEED CONTROL:

Harrowing a few days after a spring sown crop has sprouted but before emergence is effective in reducing stands of foxtails, wild oat and other weeds. The weeds must be emerging. Since foxtails are shallow rooted, set the teeth back on the harrow to minimize crop injury. Also, small grains can be harrowed after they have 2 or 3 leaves but before tillering. Harrowing should be performed when a dry soil surface exists so damaged weeds will desiccate rather than be transplanted. Wheat can be harrowed one to three times but barley only once. Oat normally is not harrowed because risk of injury is greater than to wheat or barley.

HERBICIDE USE IN SMALL GRAINS:

B1. Weed control in small grains is required to achieve a profitable yield. Applicable cultural control techniques plus use of herbicides or mixtures may be required to control all weeds. Normal height wheat varieties, rye, and winter wheat are more competitive than semi-dwarf wheat. Herbicides generally are most effective when the crop is competitive. Small grains underseeded to sweetclover, alfalfa, or other legumes should not be treated with ALS or growth regulator herbicides because serious injury or death of the legumes may result. However, bromoxynil is registered for use on small grain/legume mixtures even though some legume injury may occur.

B2. Small grains are susceptible to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until prior to the boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from 5-leaf until prior to the boot stage, are more tolerant than oat to 2,4-D. Wheat and barley varieties differ little in tolerance to MCPA and 2,4-D. Oat is more tolerant to MCPA than to 2,4-D, but injury to oat is possible with either chemical at any growth stage. Use 2,4-D on oat only for such hard-to-kill weeds as Russian thistle, common ragweed, and redroot pigweed and only when the crop is in the 3- to 4-leaf stage. While some injury to oat can be expected, the better control of these weeds with 2,4-D usually will compensate for any yield loss caused by oat injury. Several brands of 2,4-D are available, but there are some differences in application information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

B3. Achieve (tralkoxydim) is labeled for use only in certain geographic areas. Do not apply Achieve on spring wheat in South Dakota, Minnesota, or east of ND Hwy 281. Also, do not apply Achieve in the following counties in North Dakota: Dickey, La Moure, Stutsman, Foster, Eddy, Ramsey, and Towner. Achieve applied in these restricted areas may injure spring wheat. Syngenta will not be liable for injury to spring wheat if Achieve is used in restricted areas.

Achieve at 6.9 fl oz/A applied POST controls green and yellow foxtail, wild and volunteer tame oat, Persian darnel, and annual ryegrass in wheat, durum and barley from 2-leaf to boot stage. Apply Achieve to actively growing 1- to 5-leaf foxtails, 1- to 4-leaf Persian darnel, and 1- to 6-leaf wild oat. Forage grasses have good tolerance to Achieve. Grass weed control may be poor and retillering may occur if plants are stressed at application.

Apply Achieve at 10 to 15 gpa by ground or 3 to 5 gpa by air. Use of water volumes higher than listed may result in reduced grass weed control. Achieve Liquid is formulated with Supercharge adjuvant. One box of Achieve (herbicide + adjuvant) will treat 40 acres at 7 oz DG/A. Always add AMS at 7 to 15 lb/100 gallon water to reduce antagonism from water sources with high bicarbonate levels (> 400 ppm bicarbonate ions), or broadleaf herbicide tank-mixture, or to increase control of stressed weeds. Achieve can be tank-mixed with MCPA ester + or - bromoxynil (maximum of 1 pt/A), 2,4-D ester, clopyralid + MCPA (maximum of 2 pt/A), thifensulfuron, and Starane. Tank-mixing other herbicides, especially dicamba or ALS herbicides, will result in reduced grass weed control. If other herbicides are used, apply Achieve five or more days before the broadleaf herbicide.

B4. Aim (carfentrazone) at 0.5 fl oz 2EW/A applied POST controls small (1 to 2 inch) nightshade, pigweed, lambsquarters, small Kochia (including ALS resistant types), wild buckwheat, and top-growth control of field bindweed in wheat, barley, and oat. Add NIS at 0.25% v/v. Aim may be tank-mixed with most herbicides registered in wheat. Aim is a contact herbicide, requires application to small weeds, and may produce speckling and spotting on crop leaves receiving spray. Symptoms should disappear soon after new growth appears. Degree of speckling is affected primarily by sunlight intensity, humidity, and moisture. Higher humidity and moisture at application increase risk of leaf burn but usually the crop quickly recovers. Data shows that Aim may be safened when tank-mixed with SU herbicides.

B5. Amber (triasulfuron) at 0.28 to 0.35 oz 75DF/A or **Rave** (triasulfuron & dicamba-Na) at 2 oz WDG/A applied POST in barley and 4 oz WDG/A in wheat applied POST controls several broadleaf weeds plus partial control of Canada thistle in wheat and barley. Burndown (speed of weed death) is slower for Amber than other SU herbicides. Amber is similar to Glean in weed control and carryover. Refer to Glean section. Amber and Rave may persist in soil for 4 years or more. Consult label or herbicide carryover/residue section for rotational crop restrictions.

B6-12 - SMALL GRAINS

B6. Assert (imazamethabenz) at 1 to 1.5 pt/A applied POST controls wild mustard and wild oat in wheat and barley. Apply Assert to 1- to 4-leaf wild oat and to wheat and barley in the 2-leaf to jointing stage. Assert also suppresses wild buckwheat that has 3 leaves or fewer. Assert should be applied to small wild oat plants for optimum control. Apply with MSO type oil for greater and more consistent weed control. Refer to herbicide residue section for information on rotational crop restrictions.

Spray solution incompatibility (thickening) may develop if Assert is tank-mixed with dicamba or amine formulations of 2,4-D or MCPA. Thickening results from using hard water, or additives that increase spray solution pH.

Assert 2.5S is formulated as a sulfate ester, is water soluble only at a low pH, and contains chemicals to keep the pH low. The amount of acidifier in the formulation may be inadequate when rates are low or when highly alkaline waters are used or in a mixture with other herbicides or fertilizers that raise pH. These conditions may cause Assert to precipitate and reduce efficacy as well as plug nozzles. Amine formulations of 2,4-D, MCPA, or dicamba impart a high pH to the spray solution and can cause Assert to precipitate even when the spray water is neutral. To reverse thickening, lower water pH by adding an acid, preferably muriatic acid (HCl). Muriatic acid is available at most agricultural outlets and comes in different concentrations (10% HCl to 100% HCl). Regardless of concentration add only enough to change the solution to a liquid state (less than 1 gal/100 gal water when using a 10% HCl conc.)

B7. Axial XL (pinoxaden, "den" class) at 16.4 fl oz/A or Axial at 8.2 fl oz/A plus Adigor adjuvant at 9.6 fl oz/A controls wild oat, green and yellow foxtail, Persian damel, annual ryegrass and suppresses barnyardgrass in HRS, winter wheat, and barley. Apply to crop from 2-leaf until prior to flag leaf emergence and to 1-leaf to 2-tiller grass weeds. Axial is an ACCase inhibitor herbicide, which has the same mode of action as Achieve, Discover, and Puma but Axial has controlled some but not all ACCase-resistant wild oat biotypes. Axial can be tankmixed with most broadleaf herbicides labeled in small grain. Refer to label for tank-mix options and application information.

B8. Bromoxynil applied POST controls kochia, wild buckwheat, fumitory and other annual broadleaf weeds in wheat, barley, and oat from crop emergence to early boot. See label tank-mix options. For increased weed control, bromoxynil + MCPA ester should be applied from the 3-leaf to early boot stage. Several commercial products are available.

Bromoxynil & 2,4-D premixes are similar to bromoxynil + MCPA but may provide better control of redroot pigweed, wild buckwheat, Russian thistle, and larger weeds. Formulation, application rate and stage are specific for each formulation. Refer to label for use information. Some labels include use on tame oat; however, oat grown in ND has shown more potential to injury from 2,4-D because of environmental conditions and is not recommended.

B9. Chlorsulfuron at 1/6 to 1/3 oz DF/A or Finesse (chlorsulfuron & metsulfuron) at 2/10 to 4/10 oz DF/A with 2,4-D or 2,4-D + dicamba applied POST will control most annual weeds and suppress Canada thistle, and at 3/10 to 4/10 oz DF/A will suppress and/or control green foxtail in spring wheat and barley. Follow label for application window and tank-mix herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Finesse can be applied only once every 24 months in North Dakota. Speed at which weeds are killed is relatively slow compared to other SU herbicides.

B10. Clopyralid & 2,4-D at 2 to 2.33 pt/A or clopyralid & MCPA at 1.75 to 2.33 pt/A controls Canada thistle and annual broadleaf weeds in barley, durum, and hard red spring wheat. Canada thistle is most susceptible at rosette to early bolting stages. Curtail will not provide long-term control of Canada thistle with one application but will reduce populations with repeated use. Curtail contains 2,4-D and should be applied to wheat and barley from 4-leaf through jointing only. Do not apply Curtail on oat. See herbicide residue section for recropping restrictions.

WideMatch/generics (clopyralid & fluroxypyr) at 1 to 1.33 pt/A - controls most broadleaf weeds, including herbicide resistant kochia, and volunteer flax. Field bindweed may be suppressed. Apply from the 3-leaf stage to flag leaf emergence in oat, barley, durum, and hard red spring wheat. Apply to weeds up to the 4-leaf stage or vining. Canada thistle is most susceptible at rosette to early bolting stages. WideMatch will not provide long-term control of Canada thistle with one application but will reduce populations with repeated use. All POST grass herbicides labeled in small grains can be applied with WideMatch. Apply with MCPA, 2,4-D, or thifensulfuron + tribenuron to obtain additional wild mustard, redroot pigweed, common lambsquarters, and Russian thistle control. Allow a 40 day PHI. See label for crop rotation restrictions.

Starane (fluroxypyr) at 0.5 to 0.67 pt/A controls kochia (including ALS and dicamba resistant kochia), cleavers, cocklebur, common mallow, ragweed, sunflower, Venice mallow, volunteer flax, and suppresses field bindweed in wheat, barley, and oat. Starane is very effective on kochia and has benefits over dicamba that include excellent wheat, barley, and oat safety; a much wider application window in small grains that extends to flag leaf emergence; control of larger kochia at in-crop use rates; and all POST grass herbicides registered for small grains can be applied with Starane.

Starane at 0.5 pt/A controls kochia less than 4 inches tall and 0.67 pt/A controls kochia up to 8 inches tall while bromoxynil only controls small kochia less than 2 inches tall. Starane is not intended to be used alone. Apply Starane with 2,4-D or MCPA for broad-spectrum broadleaf weed control. Starane is labeled with most POST grass herbicides registered in wheat. Refer to label of tank-mix partner for mixing options. Starane is available in several commercial premixes.

B11. Dicamba at 0.125 to 0.25 pt/A controls kochia, buckwheat, smartweed, and other broadleaf weeds in wheat, barley, and oat. Dicamba can be applied alone but usually is applied with other herbicides such as MCPA, 2,4-D, and SU herbicides to increase control of wild mustard and other annual and perennial broadleaf weeds. Oat is more tolerant than wheat to dicamba. Apply to wheat and oat at the 2- through 4-leaf stage. Barley can be treated during the 2- through 3-leaf stage but tolerance is marginal. Allow 45 days/pt of dicamba for degradation, excluding days when ground is frozen.

B12. Discover/Discover NG (clodinafop + safener) at 3.2 fl oz/A plus DSV at 10.2 fl oz/A or Discover NG at 12.8 fl oz/A controls wild oat, barnyardgrass, volunteer corn, and green and yellow foxtail. Discover at 4 fl oz/A plus DSV at 12.8 fl oz/A or Discover NG at 16 fl oz/A controls giant foxtail, Persian damel, and annual ryegrass. Apply to actively growing grasses in the 1- to 6-leaf stage. Apply Discover to wheat from the 2-leaf stage to pre-boot. Do not apply to winter wheat in the fall. Discover NG contains 0.5 lb ai/gal, includes the adjuvant in the formulation, requires no additional adjuvant, but allows MSO to be added at 0.25% v/v to improve yellow foxtail, Persian damel, and ryegrass control. Discover controls grass weeds over wide environmental conditions and when applied with several broadleaf herbicides. See label for approved tank-mix options.

B13. Everest (flucarbazone) at 0.3 oz WDG/A controls green foxtail and at 0.4 to 0.6 oz WDG/A controls wild oat and suppresses yellow foxtail, downy brome, and Japanese brome in all types of wheat. Everest may be applied at burndown at up to 0.4 oz/A prior to spring or winter wheat. Use high rates to control yellow foxtail, barnyardgrass, downy brome, Persian dandelion, and for high grass weed densities. Apply with NIS at 0.125% when applying with SU herbicides. Do not add any adjuvant when an emulsifiable concentrate (EC) pesticide is included in the tank-mix. Up to 50% of the carrier volume may be liquid nitrogen when applied to winter wheat. Apply in at least 5 gpa by ground to actively growing grass weeds in wheat from emergence to prior to jointing. Everest controls mustard species, annual smartweed, and redroot pigweed. Uptake is primarily foliar but soil residue absorbed by roots may give 2 to 4 weeks residual control of highly susceptible species when the soil pH is 7.2 or higher, depending on rainfall, temperature, and organic matter. 2,4-D or dicamba is required for safening when tank-mixing with SU herbicides. Dicamba may reduce wild oat control. Most crops may be planted the year following application. See label for crop rotation restrictions.

B14. Far-Go (trilalate) at 1 to 1.5 qt/A or 10 to 15 lb 10G applied preplant or PRE incorporated (depending on formulation) controls wild oat in wheat, durum, barley, lentil, or pea. See tables for specific rates. Far-Go is volatile and the liquid formulation must be incorporated immediately after application. Spring-applied liquid formulations has given more consistent wild oat control with less crop thinning than the granular formulation. See section on fall application. Far-Go at 1 qt/A may be applied after seeding in combination with trifluralin at 1 to 1.5 pt/A for both wild oat and foxtail control in wheat, durum, and barley.

Far-Go will control wild oat with a shallow incorporation. Two spike tooth harrowings at right angles will incorporate Far-Go. Deeper incorporation enhances wild oat control from Far-Go. Far-Go applied after seeding (PoPI) should be incorporated **less deeply** than the depth of the crop seed. Far-Go applied before seeding should be incorporated with a field cultivator plus harrow operated 3 to 4 inches deep. Delay wheat seeding for 3 days. Far-Go applied before seeding may injure certain wheat varieties. Spring PPI Far-Go has greater potential for injury to wheat than when applied at other times. Refer to label for varieties that may be susceptible to PPI Far-Go.

B15. Huskie (bromoxynil & pyrasulfotole & mefenpyr safener) at 11 to 15 fl oz/A controls most annual broadleaf weeds, including mustard species, pigweed species, common lambsquarters, wild buckwheat, sunflower, nightshade, kochia, Russian thistle, false chamomile, cleavers, cockle species, chickweed, prickly lettuce, horseweed, and annual and perennial sowthistle in wheat, barley, and triticale. Huskie will not control grass weeds. Apply from 1-leaf to flag leaf emergence. No additional adjuvants are required but AMS at 0.5 lb/A or UAN at 1 to 2 qt/A will optimize broadleaf weed control. Huskie can be applied with POST grass herbicides, fungicides, and insecticides and most crops can be planted the year following application. Refer to label for other information. Bromoxynil and pyrasulfotole both act at different sites in the photosynthetic pathway and will control broadleaf weeds resistant to other herbicides.

B16. Maverick (sulfosulfuron) at 0.67 oz DF/A applied fall POST controls cheat, downy brome, and Japanese brome at 2- to 3-leaf stage in winter wheat or applied spring POST suppresses annual bromes with less than 5-tillers. Maverick at 0.67 oz DF/A applied spring POST controls wild oat in the 1- to 4-leaf stage and may also control cleavers, false chamomile, flixweed, annual smartweed species, mustard species, quackgrass, and sunflower. Apply Maverick with NIS at 0.5% v/v.

Maverick may be applied with most herbicides labeled in wheat. Maverick should be applied with another broadleaf herbicide with a different mode of action to prevent weed resistance. Maverick will not control ALS resistant weeds. Do not apply Maverick with organophosphate insecticides. Maverick spray drift or sprayer contamination causes **severe injury to most** broadleaf crops. Thoroughly clean sprayer to prevent injury to susceptible crops. See sprayer cleanout section. Maverick may persist in soil for 3 years or more. Refer to label or carryover section for recropping restrictions.

B17. Metsulfuron at 1/10 oz DF/A or **metsulfuron & thifensulfuron & tribenuron** at 0.2 to 0.4 oz DF/A applied POST controls broadleaf weeds in wheat and barley and should be applied with another broadleaf herbicide with a different mode of action to reduce development of resistant weeds. Burndown (speed of weed death) is faster with Ally and Ally Extra than other SU herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Do not apply to soils with a pH greater than 7.9. Metsulfuron residue may persist in the soil for 3 years or more. Refer to the herbicide residue crop rotation restriction section.

B18. Olympus (propoxycarbazone) at 0.6 to 0.9 oz WDG/A controls wild oat, foxtail barley, mustard species, and suppresses quackgrass, downy brome, and Japanese brome in spring and winter wheat. Apply to 2-leaf to jointing wheat and 2-leaf to 2-tiller grass weeds. Apply with NIS at 0.25 to 0.5% v/v. Fall/spring applications control cheat. Spring applications control wild oat.

Silverado (mesosulfuron) at 1.75 to 2.25 oz DF/A controls wild oat, mustard species, and volunteer canola in wheat. Apply from 1-leaf to jointing stage and to 1- to 2-tiller wild oat. Apply with an MSO adjuvant at 1.5 pt/A or basic pH blend adjuvant at 1% v/v or 0.8 to 1.6 pt/A. The MSO should contain at least 10% emulsifier and the basic pH blend adjuvant should consist of a NIS plus fertilizer or MSO plus fertilizer adjuvant formulation. Refer to label for tank-mix options. Silverado will control most ACC-ase resistant wild oat populations. Do not apply with malathion, methyl parathion, or mancozeb to avoid crop. Most crops can be planted the year following application; see label or herbicide carryover section.

Rimfire (mesosulfuron + propoxycarbazone) at 1.75 to 2.25 oz DF/A controls wild oat, mustard species, and volunteer canola, and suppresses green and yellow foxtail, barnyardgrass, downy and Japanese brome, Persian dandelion, foxtail barley, quackgrass, chickweed, catchweed bedstraw, henbit, and redroot pigweed in wheat. Rimfire at 1.75 to 2.25 oz/A + Silverado at 0.5 oz/A will provide optimum control of Persian dandelion. Apply from 1-leaf to flag leaf emergence. Apply with an MSO adjuvant at 1.5 pt/A, basic pH blend adjuvant at 1% v/v, or NIS at 0.25 to 0.5% v/v + UAN at 1 to 2 pt/A. Rimfire contains the full labeled rate of Silverado and a low rate of Olympus. Refer to label for tank-mix options. Rimfire will control most ACC-ase resistant wild oat populations. Most crops can be planted the year following application. See label for tank-mix options, crop rotation restrictions and application information.

B19. Paramount (quinclorac) at 0.33 lb 75DF/A with MSO type adjuvant at 1.5 pt/A postharvest to any crop on land to be planted the following year to wheat, including durum, controls some broadleaf weeds including field bindweed. Wheat and sorghum have a 0 hour plant back restriction. Paramount at 0.17 to 0.33 lb DF/A controls green foxtail, yellow foxtail, barnyardgrass, cleavers/bedstraw, volunteer flax, and may suppress small kochia and Russian thistle. Refer to label. Paramount is one of the most effective herbicides on field bindweed. Apply Paramount with another broadleaf herbicide, such as 2,4-D, MCPA, or ALS herbicides, to broaden spectrum of weeds controlled. Refer to label for application and use directions.

B20-24 - SMALL GRAINS

B20. Peak (proflufen) at 0.25 to 0.5 oz 57DF/A applied POST controls broadleaf weeds in wheat, barley, oat, rye, triticale, proso millet, and sorghum. Apply with another broadleaf herbicide with a different mode of action to prevent weed resistance. Burndown (speed of weed death) is relatively average compared with other SU herbicides. Apply Peak with an NIS. Do not apply a foliar or soil organophosphate insecticide within 15 days before or 10 days after Peak. Corn is tolerant to Peak, which is different than other long residue SU herbicides labeled in small grains. Peak may persist in the soil for 3 years or more. Refer to label or herbicide carryover section for rotational cropping restrictions.

B21. Puma (fenoxaprop-P + mefenpyr safener) at 0.33 pt/A controls green foxtail, foxtail millets, and volunteer corn; at 0.4 pt/A controls yellow foxtail and proso millet; and at 0.67 pt/A controls barnyardgrass and wild oat in wheat (including durum) and barley. Puma does not contain phenoxy type herbicides for broadleaf weed control.

Apply at 5 to 10 gpa by ground or 5 gpa by air. Use 5 gpa only on light infestations, small weeds, and during good growing conditions. Apply Puma to wheat and durum from 1-leaf until 60 days prior to harvest and to barley from 1-leaf up to 5-leaf stage of growth. Do not apply Puma to jointed barley; to avoid potential injury, terminate application at 4-leaf barley.

Puma will control grass weeds in the 1-leaf to 2-tiller stage. Low humidity and high temperature can influence foxtail and wild oat control. Puma can be applied with Mancozeb, Stratego, Tilt fungicides; and Peak, clopyralid, clopyralid + MCPA, Starane, WideMatch, or MCPA ester herbicides at all rates of Puma. Other broadleaf herbicides listed for tank-mix applications with Puma may antagonize wild oat and yellow foxtail control. For green foxtail and foxtail millet control, apply Puma at 0.33 pt/A with Amber, bromoxynil, bromoxynil + MCPA, clopyralid, clopyralid + MCPA, dicamba, MCPA ester, metsulfuron, thifensulfuron, tribenuron, thifensulfuron + tribenuron, Starane, or Stinger. For yellow foxtail and wild proso millet, apply Puma at 0.4 pt/A with clopyralid, clopyralid + MCPA, dicamba, MCPA ester, Peak, or Starane. For barnyardgrass and wild oat control apply Puma at 0.66 pt/A with bromoxynil, bromoxynil + MCPA, clopyralid, clopyralid + MCPA/2,4-D, MCPA ester, Peak, Starane, thifensulfuron, and thifensulfuron + tribenuron. Do not apply Puma to corn, tame oat, or rye. Do not apply Puma within 60 days of wheat harvest or 57 days of barley harvest.

B22. Thifensulfuron & tribenuron 1:1 ratio at 4/10 to 8/10 oz SG/A or 4:1 ratio at 6/10 to 1 oz SG/A applied with 2,4-D or 2,4-D + dicamba controls most broadleaf weeds in wheat and barley. Apply with NIS at 0.25 to 0.5% v/v. Even though the soluble granule (SG) formulations are easier to clean from spray equipment than previous formulations, thorough cleaning is required to avoid contamination of subsequent spray mixtures and injury to susceptible crops (A8).

The 1:1 ratio at 0.4 to 0.8 oz SG/A contains the same amount of tribenuron as Express. Apply to broadleaf weeds, including Russian thistle, volunteer RR canola, and Canada thistle, and when antagonism of POST grass herbicide is not important.

The 4:1 ratio at 0.6 to 1 oz SG/A contains a similar amount of thifensulfuron as Harmony Extra but the amount of tribenuron is reduced. Tribenuron antagonizes ACCase POST grass herbicides more than thifensulfuron. Apply the 4:1 ratio for wild buckwheat, redroot pigweed, sunflower, and volunteer RR canola control and when tank-mixing with POST grass herbicides in small grains.

B23. Trifluralin at 1 pt/A of a 4 lb/gal concentrate or 5 lb/A 10G applied after spring seeding and harrow incorporated shallowly is labeled for control of foxtails in wheat and barley. Use the lower rate on coarse textured soils and the higher rate on fine textured soils. Incorporate by harrowing twice at right angles and depth of herbicide incorporation must be above the wheat seed. Wheat should be seeded 2 to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semi-dwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trifluralin applied in this manner does not control wild oat. (See wild oat section for discussion on trifluralin-triallate combination).

Trifluralin at 1 pt/A or 5 lb/A 10G may be fall applied for foxtail control on ground to be planted to wheat or barley the following spring. Some stand reduction may occur from fall applied trifluralin but generally no yield loss occurs. Trifluralin is available in both liquid and granular formulations. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue will not interfere with incorporation. Seed wheat or barley no more than 2 inches deep into a moist seedbed. Refer to the chemical fallow section for information on trifluralin applied in the fallow year for foxtail control in small grains the next year.

CLEARFIELD RESISTANT WHEAT

B24. Beyond (imazamox) at 4 fl oz/A or ClearMax (imazamox + MCPA) at 4 fl oz/A + 8 fl oz/A controls wild oat, foxtail, downy brome, Japanese brome, Persian darnel, and many annual broadleaf weeds in Clearfield wheat from 1-leaf to jointing. Apply with NIS at 0.25% v/v. Beyond will not control ALS resistant weed populations. Refer to label for tank-mix options, crop rotation restrictions, and other application and use information.

B25. Small grain preharvest herbicides can desiccate weeds and crop and provide perennial weed control. Expectations for preharvest weed control may exceed reality. It is difficult to kill or dry down a 3-foot weed in the same manner as a 3-inch weed. Lower portions of the weed may not be affected. Plant desiccation requires 7 to 10 days, or more when wet and cool conditions persist after treatment. All herbicides labeled for preharvest application are translocated and slow acting which requires a longer dry down period as compared to contact type herbicides like bromoxynil or paraquat. The intent of a preharvest treatment should be to facilitate harvest and reduce harvest loss. Preharvest treatments do not decrease yield losses due to weed competition or prevent weed seed production. Herbicide drift from preharvest treatments can cause injury to crops nearby. Consider sensitive crops (sugarbeet, potato, etc.) and other plants (trees, gardens, etc.) in the general vicinity of the field receiving treatment. No herbicides are labeled as a harvest aid for oats. **Paraquat is NOT labeled as a harvest aid in small grains.**

B26. 2,4-D as a Harvest Aid

Apply 2,4-D at 1.5 to 3 pt/A to aid harvest of spring wheat, durum, barley, and rye. Labels vary in crop use. Follow the label. Not all 2,4-D formulations are labeled for preharvest applications. Some 2,4-D labels only allow use on wheat, others allow use on wheat and barley and others allow use on wheat, barley, and rye. Ester formulations will give better control and quicker burndown than an amine formulation. Use at least 2 pt/A of amine formulation for larger weeds. 2,4-D does not control kochia or large pigweed, and wild buckwheat. Weeds with large stems may not burn down and may stay green. 2,4-D can be tank mixed with glyphosate on spring wheat and durum for additional broadleaf and grass control. Follow the glyphosate label.

B27. Ally + 2,4-D as a Harvest Aid

Ally is labeled as preharvest aid in wheat, durum, and barley alone or with 2,4-D or on wheat and durum with 2,4-D and/or dicamba. Ally has a long residue so use only in a continuous wheat or wheat-fallow rotation. The user must follow crop rotation restrictions. Apply Ally at 0.1 oz DF/A + 2,4-D at 1.5 to 3 pt/A to wheat, durum, and barley in the dough stage and at least 10 days prior to harvest. Do not use if crop was treated previously with another SU herbicide. For wheat, Ally + 2,4-D can be tank-mixed with dicamba for faster dry down and for weed resistance management. Follow the label for crop rotation restrictions and refer to the 2,4-D and/or dicamba label for grazing restrictions.

B28. Dicamba + 2,4-D as a Harvest Aid

Dicamba can be applied alone or with 2,4-D in wheat and durum to aid harvest. Apply dicamba at 0.5 pt/A + 2,4-D at 1 to 2 pt/A when wheat is in the hard dough stage and the green color is gone from the nodes of the stem. Dicamba will provide additional control of wild buckwheat, kochia, common lambsquarters, pigweeds, sunflower, and Russian thistle as compared to 2,4-D alone. Allow a 7 day PHI for dicamba but 2,4-D formulations may be more restrictive. Always follow the longest PHI of the herbicide used. Do not feed treated straw to livestock. Caution: Drift to broadleaf crops is especially hazardous at this time.

B29. Glyphosate as a Harvest Aid

Glyphosate is labeled as a harvest aid only in spring wheat, durum, and feed barley. Glyphosate at 0.5 to 2 pt/A of a 3 lb ae/gal concentrate controls annual grass and broadleaf weeds, quackgrass, and Canada thistle. DO NOT apply to wheat or barley grown for seed, or malting barley as a reduction in germination or vigor may occur. Glyphosate drift will injure or kill sensitive plants.

Glyphosate should be applied after the hard dough stage (30% or less grain moisture) of wheat and at least 7 days prior to harvest by air or ground in 3 to 10 gpa spray volume. See label for adjuvant use. Always add AMS. AMS increases control of annual and perennial weeds, especially control of weeds stressed by dry weather. AMS also eliminates antagonism from ions and carbonates in hard water. DO NOT use AMS in place of a NIS. Refer to label for addition of other adjuvants

Glyphosate can be tank mixed with 2,4-D for additional broadleaf control. Glyphosate at 0.75 to 2 pt/A + dicamba at 0.25 to 0.5 pt/A can be applied preharvest to wheat and durum at the hard dough stage after green color is gone from nodes. Allow a 14 day PHI. The tank-mix can be applied by ground or air.

B30. Glyphosate + 2,4-D as a Harvest Aid

Glyphosate + 2,4-D controls annual grass and broadleaf weeds, quackgrass, and suppresses Canada thistle in hard red spring wheat, durum, and feed barley only. Refer to label for rate of each formulation. See paragraph above on glyphosate for application information.

Apply after the hard dough stage (30% or less grain moisture) of wheat and at least 7 days prior to harvest. DO NOT apply to wheat or barley grown for seed, or to malting barley as a reduction in germination or vigor may occur. Be aware of the injury potential of glyphosate drift on sensitive plants.

CORN

C1. A combination of cultural, mechanical and chemical methods is necessary for effective weed control in corn. Control early germinating weeds by cultivation or land preparation before planting if conventional tillage is used. A rotary hoe can be used to control emerging weeds when the corn coleoptile is below the working depth of the rotary hoe or when corn is beyond the spike stage. Cultivate between the rows soon after weeds emerge. Corn is very susceptible to early season competition from weeds. Initial postemergence herbicides must be applied before weeds reach 4 inches in height to avoid yield loss.

C2. NDSU MICRO-RATE PROGRAMS:

Stout is lower cost than Accent but cannot be applied beyond 16 inch tall corn. Early application to small weeds minimizes weed competition with corn and gives greater weed control from reduced herbicide rates. NDSU research has shown Accent, Steadfast, and Stout applied half to full rates plus atrazine at 0.42 lb DF/A + dicamba at 4 fl oz/A + MSO type oil or basic pH blend adjuvants or Lumax at 3 pt/A + PO adjuvants control most annual grass and broadleaf weeds.

Use the highest labeled rate of Accent, Steadfast, and Stout to control yellow foxtail, wild proso millet, volunteer cereals, field sandbur, and quackgrass. Apply before grasses are taller than 2 or 3 inches because control will quickly decline. Yellow foxtail has increased in ND. Dicamba, and especially Distinct, antagonizes yellow foxtail control from Steadfast and Accent. In some cases, MSO adjuvant has overcome yellow foxtail antagonism from dicamba. Atrazine at 0.38 lb ai/A will allow all crops to be planted the following year, unless severe drought occurs in the year of application. MSO adjuvants should be used, when allowed by label, to provide maximum enhancement of weed control. Refer to C5 below for additional information. NDSU research has shown enhancement of yellow foxtail control when Accent, Steadfast, and Stout are applied with Callisto at 3 fl oz/A + atrazine at 0.38 lb ai/A + MSO or Lumax at 3 pt/A + oil adjuvant.

C3. Accent (nicosulfuron) at 0.67 oz 75DF/A applied POST to corn up to 20 inches tall with 6 collars or less or with drop nozzles to corn 20 to 36 inches tall (free standing). Do not apply to corn taller than 36 inches or 10 collars, whichever is most restrictive.

Resolve (rimsulfuron) at 0.75 to 1 oz DF/A applied POST to corn up to 12 inches tall and with less than 5 collars controls most annual grasses, quackgrass, and some broadleaf weeds. Refer to Steadfast paragraph for additional information. Rimsulfuron as compared to nicosulfuron has greater POST activity on grass weeds, shorter chemical residual in the soil but greater biological and residual soil activity on weeds, and has a greater risk of causing injury to short-season corn varieties. Resolve may add short-term residual weed control after activation.

Steadfast (nicosulfuron & rimsulfuron) at 0.75 oz DF/A or **Stout** (nicosulfuron & thifensulfuron) at 0.75 oz DF/A applied POST to corn up to 12 inches tall and with less than 5 collars controls most annual grasses, quackgrass, and some broadleaf weeds. Always add an oil adjuvant at 1.5 pt/A plus nitrogen fertilizer at 1 to 2% v/v or basic pH blend adjuvants at 1% v/v. NDSU research has shown that adjuvant enhancement of Accent, Steadfast or Stout was greatest with an MSO type oil or basic pH blend adjuvant, followed by petroleum oil, and least with NIS + 28%. Weeds controlled are green foxtail, fall panicum, barnyardgrass, field sandbur, woolly cupgrass, wild-proso millet, wild oat, quackgrass, pigweed species, smartweed, wild mustard, jimsonweed, and burcucumber. Poor yellow foxtail control will result if Accent, Steadfast, or Stout are applied at reduced rates, if applied with

dicamba, if yellow foxtail is larger than recommended, or if growing in adverse conditions. NDSU research has shown enhancement of yellow foxtail control when Steadfast or Stout is tank-mixed with Callisto + atrazine + oil adjuvant at labeled rates or tank-mixed with Lumax at 3 pt/A. Use caution when applying Steadfast or Stout to corn hybrids of 88 or less days maturity. See label for herbicide tank-mix options. Do not tank-mix organophosphate insecticides. A soil residue will be present for more than one year. Refer to the label or herbicide residue section for crop rotation restrictions.

C4. Acetochlor & safener at 1.25 to 2.75 pt/A of a 7EC or at 1.5 to 3 pt/A of a 6.4EC formulation applied PPI or PRE control annual grasses and certain broadleaf weeds, including pigweed species and common lambsquarters. Use the higher rate on clay soils high in organic matter. Do not apply acetochlor on sands with less than 3% OM, loamy sands with less than 2% OM, or sandy loams with 1% OM if ground water is within 30 feet of soil surface. Incorporation may improve weed control under dry conditions. Acetochlor may be applied up to 45 days before planting and applied POST to corn up to 11 inches tall. Acetochlor applied PPI or PRE provides greater and more consistent grass and broadleaf weed control than other similar soil-applied grass herbicides.

C5. Aim (carfentrazone) at ½ oz 2EW/A applied POST controls small kochia, lambsquarters, nightshade, pigweed spp. and waterhemp. Apply Aim to corn up to 8 collar growth stage and to weeds less than 2 inches tall. Apply Aim with NIS at 0.25% v/v and liquid fertilizer. Petroleum oil adjuvants may increase weed control but also may increase risk of corn injury. Aim should be applied with another broadleaf herbicide to broaden spectrum of weeds controls. Aim may be tank-mixed with most herbicides registered in corn except Liberty. Refer to label of tank-mix herbicide for tank-mixing options and adjuvant restrictions. Aim is a non-residual, contact herbicide and may produce cosmetic injury symptoms of speckling and spotting on leaves receiving spray. Symptoms should disappear after new growth appears. Do not apply Aim either 8 hours before or after a rain event and maintain an 18 inch boom height over corn canopy to minimize exposure to the whorl of the plant.

C6. Atrazine applied PPI or PRE or at rates greater than 0.75 lb ai/A is not recommend in ND. PPI or PRE atrazine require rates greater than 1 lb/A for consistent in weed control but also causes carryover concerns for more than two years. Atrazine is available as a pre-package mix with several herbicides. Most atrazine premixes contains excessive atrazine rates for normal crop rotation in ND. Atrazine is a restricted use herbicide.

Atrazine at 0.38 to 0.75 lb ai/A applied POST to corn less than 12 inches tall aids in control of broadleaf weeds less than 4 inches tall and grass weeds less than 1 inch tall. Atrazine controls wild oat, gives partial foxtail control and excellent control of broadleaf weeds (including volunteer sunflower) when used in combination with petroleum oil concentrate or emulsifiable vegetable oil adjuvants. NIS is less effective with atrazine than any oil adjuvants. Refer to herbicide residue section for carryover precautions. Refer to label for application information and restrictions.

C7. Balance Pro (isoxaflutole) at 1.5 to 3 fl oz/A applied EPP or PRE controls foxtails, wild proso millet, field sandbur, and woolly cupgrass and annual small-seeded broadleaf weeds including nightshade, kochia, pigweed, lambsquarters, common ragweed, wild mustard, annual smartweed, seedling dandelion, and horseweed (maretail). Balance may cause corn to turn yellow after emergence but yellowing may disappear after 3 to 5 days. Balance Pro requires exact mixing, application, and incorporation to avoid crop injury. Refer to the label for instructions and information. Use exact rates based on soil type, pH, and organic matter to insure adequate corn safety. Rates even slightly greater than labeled for intended soil type, soil pH, and organic matter can cause slight to serious corn injury.

Balance will not control yellow foxtail, wild oat, volunteer grain, and large-seeded broadleaf weeds like wild buckwheat, cocklebur, sunflower, giant ragweed. Balance may give 6 to 8 weeks residual weed control after activation. See herbicide residue section for crop rotation restrictions. Precipitation and soil moisture are more critical to breakdown than other factors.

C8. Basis (rimsulfuron & thifensulfuron) at 0.33 oz 75DF/A applied POST in corn up to 4-leaf (2 collar) controls small foxtail, barnyardgrass, redroot pigweed, wild mustard, common lambsquarters, and annual smartweed. Apply when grasses are 1 to 2 inches tall and broadleaf weeds are 1 to 3 inches tall. Sequential application of Accent may be needed for complete weed control. Always apply Basis with an oil adjuvant at 1 to 2% v/v and nitrogen fertilizer or with basic pH blend adjuvant. Corn varieties of 88 day maturity or less are more susceptible to injury from Basis than varieties greater than 88 days. See label for tank-mix options.

C9. Callisto (mesotrione) at 3 fl oz/A plus atrazine at 0.38 lb ai/A applied POST to corn up to 30 inches tall controls most annual broadleaf weeds and suppresses Canada thistle. Apply with petroleum oil adjuvant at 1% v/v + UAN at 2.5% v/v or AMS at 8.5 lb/100 gallons water. NDSU research has shown improved control of yellow foxtail when tank-mixed with Accent and Steadfast. Refer to label for crop rotation restrictions.

Lumax at 3 pt/A contains 3.2 fl oz/A Callisto & 1 pt/A Dual II Magnum & 0.38 lb ai/A atrazine and can be applied with POST grass herbicides labeled in corn. NDSU research has shown improved weed control, including yellow foxtail control, from Steadfast + Lumax compared to Steadfast + Callisto + atrazine at comparable rates. Dual has no POST activity but emulsifiers in the formulation function as adjuvants to improve weed control. Refer to label for crop rotation restrictions and other information.

Impact (topramezone) at 0.5 to 0.75 fl oz/A plus atrazine at 0.38 lb ai/A applied POST to corn up to 60 inch corn with 6 or less collars controls most broadleaf weeds. Apply Impact with MSO adjuvant. Corn has excellent tolerance to Impact. NDSU studies show that broadleaf weed control from Impact is similar to Callisto but gives near complete common ragweed and yellow foxtail control. Impact will leave a residue in the soil the following year. Soybean, dry bean, canola, flax, safflower, and sugarbeet cannot be planted for 18 months after application. See label or herbicide residue section for information on crop rotation restrictions.

Laudis (tembotrione & isoxadifen safener) at 1.5 to 3 fl oz/A plus atrazine at 0.38 lb ai/A applied POST to corn up V8 stage - controls most broadleaf weeds. Laudis will also control yellow foxtail, barnyardgrass, and proso millet. Always apply Laudis with either MSO adjuvant at 1.25 pt/A plus AMS at 1.5 lb/A or UAN at 1.5 qt/A or PO at 1% v/v plus AMS at 1.5 lb/A or UAN at 1.5 qt/A. Corn has excellent tolerance to Laudis. Laudis will leave a residue in the soil the following year. See crop rotation restriction section for more information.

Callisto, Impact, and Laudis are bleaching HPPD inhibitor mode of action herbicides which symptoms are expressed as white plant tissue which quickly desiccates. All three herbicides are enhanced by atrazine and oil adjuvants, have greater activity on yellow foxtail than green foxtail, will injure corn if applied with organophosphate insecticides, and have no known resistant weeds.

C10. Dicamba at 0.25 to 0.5 pt/A applied POST to corn from emergence to 8 inches tall controls many broadleaf weeds including kochia, smartweed, wild buckwheat and volunteer sunflower, and suppresses Canada thistle. Dicamba can be applied before corn is 3 feet tall or until 15 days before tassel emergence. Drop nozzles should be used after corn is 8 inches tall to reduce injury when dicamba is applied with 2,4-D and to reduce drift potential. Yellow foxtail control may be reduced when dicamba is tank-mixed with Accent, Steadfast, and Option.

Distinct (dicamba & diflufenzopyr) at 4 to 6 oz WDG/A applied EPOST or POST to corn from 4 to 24 inches tall (corn 4 to 10 inches tall is preferred) or **Status** (dicamba & diflufenzopyr & isoxadifen safener) at 5 oz WDG/A applied at 4 to 36 inch tall corn controls annual and perennial broadleaf weeds and will suppress foxtail. Apply with NIS at 0.25% v/v + UAN at 2 qt/A. Refer to paragraph on dicamba for additional information. Diflufenzopyr inhibits auxin transport, is synergistic to dicamba and other growth regulator herbicides, and aids translocation to metabolic sinks and areas of high metabolic activity, such as growing points of shoots and roots. Corn injury can occur when corn is stressed by cold conditions prior to, at, or immediately after application; when Distinct is applied to corn less than 4 inches tall; by using an oil adjuvant instead of NIS + UAN; when a less tolerant variety is treated; and by not allowing the dry product added to the spray solution to totally dissolve. See label for mixing order and mixing instructions. Yellow foxtail control may be reduced when tank-mixed with Accent, Steadfast, and Option.

C11. Metolachlor or s-metolachlor at 1 to 2 pt/A or **Outlook** (dimethenamid-P) at 16 to 21 fl oz/A applied PPI or PRE control annual grasses and certain broadleaf weeds such as redroot pigweed and common lambsquarters. Use the higher rate on clay soils high in organic matter. Incorporation improves weed control. Metolachlor products may be surface applied or incorporated in the fall after September 30 but before ground freezes or applied in the spring.

S-metolachlor may give greater weed control than metolachlor at equal product rates. Metolachlor labels recommend the same product rates as s-metolachlor. Metolachlor products contain both isomers of metolachlor (s-metolachlor and r-metolachlor). S-metolachlor is about 33% more active than the r- and s- form (2 lb ai/A of s-metolachlor = 3 lb ai/A of r- + s-metolachlor). Syngenta developed a process to deliver only s-metolachlor without the r- form, thereby reducing the amount of active ingredient needed.

Herbicide	Ingredient	Typical rates	
		pt/A	lb ai/A
Dual 8E (original Dual)	r+s metolachlor	2	1.95
Dual Magnum, others Dual II Magnum, others	s-metolachlor	1.33	1.27
Parallel PCS, Stalwart Me-Too-Lachlor, others	r+s metolachlor	1.33	1.3

The table above shows the typical rate of s-metolachlor products is about 1/3 less than the r+s products. These rates provide similar levels of weed control because of the greater activity of the s-metolachlor form. The Parallel, Stalwart and Me-Too-Lachlor II (half r- and half s- form) labels recommend the same product rates as Cinch and Dual/II/Magnum (all s- form). As a consequence the mixed r- and s-metolachlor products at labeled rates may provide less weed control than the s-metolachlor products. Under good moisture and light weed populations, control may be similar but under heavy grass pressure and limited rainfall often found in ND, higher rates of r+s-metolachlor products would be required to achieve the same level of control as s-metolachlor products. These r+s metolachlor products should not be compared on a pint vs pint basis against s-metolachlor.

C12. Option (foramsulfuron & isoxadifen safener) at 1.5 to 1.75 oz WDG/A applied POST controls grass and broadleaf weeds, quackgrass, and top-growth of Canada thistle in corn with no more than 6 collars. Always apply with an approved MSO type adjuvant at 1.5 pt/A plus UAN at 1.5 to 2 qt/A. Option applied with atrazine will antagonize yellow foxtail control when applied to foxtail greater than 2 inches tall. All crops can be planted the following year. See label or narrative for tank-mix options and crop rotation restrictions and additional information.

C13. Permit (halosulfuron) at 0.67 to 1.33 oz 75DF/A applied POST in corn controls nutsedge and some broadleaf weeds including sunflower, ragweeds, and cocklebur. Apply with NIS or oil additive. Permit will have a residue in the soil the year following application. Refer to the label or herbicide residue section for more information on crop rotation restrictions.

C14. Prowl or Prowl H₂O (pendimethalin) at 1.8 to 4.8 pt/A EC controls annual grasses and certain broadleaf weeds such as redroot pigweed. Prowl must be used only PRE in corn and not PPI. Do not use Prowl on sands or loamy sands or on soils with less than 1.5% organic matter.

C15. Python (flumetsulam) at 0.8 to 1.33 oz WDG/A applied EPP, PPI, or PRE will control nightshade, pigweed, ALS susceptible kochia, lambsquarters, mustards, annual smartweed, Russian thistle, Venice mallow and lanceleaf sage. Python does not control grasses. As with all soil applied herbicides, Python requires rain to activate the herbicide for adequate weed control and dry weather following PPI and PRE applications will reduce weed control. High soil pH increases Python activity and increases rate of herbicide degradation. Some stunting of corn may occur under poor growing conditions on soils with pH greater than 8.0. Use the higher rate on fine textured soils with greater than 3% OM and the lower rates on coarse textured soils with less than 3% OM. Incorporate into the **top 2 inches** for PPI applications. Soil insecticides should be applied in a T-band to avoid corn injury. Refer to label for tank-mix options. See Herbicide Residue section for information on crop rotation restrictions.

Hornet (clopyralid-K salt & flumetsulam) applied EPP, PPI, or PRE at 4 to 6 oz/A is equivalent to 0.05 to 0.07 lb/A of flumetsulam + 0.13 to 0.19 lb/A of clopyralid. Adjust rate according to soil type. Hornet (flumetsulam + clopyralid-K salt) at 2 to 5 oz WDG/A applied POST controls most annual broadleaf weeds and Canada thistle in corn from emergence up to 24 inches tall. Apply with NIS at 0.25% v/v or oil adjuvant at 1% v/v. Apply with UAN at 2.5% v/v under dry conditions. Hornet does not control grasses weeds.

C16. Starane (fluroxypyr) at 0.67 pt/A controls only kochia (including ALS and dicamba resistant), common cocklebur, common mallow, common ragweed, sunflower, Venice mallow, and suppresses field bindweed in corn. Apply POST as a preplant/ preemergence burndown in no-till or as an in-crop treatment from emergence to V5 stage. Refer to label for application information and restrictions.

WideMatch (clopyralid & fluroxypyr) at 1.33 pt/A controls kochia (including ALS and dicamba resistant), wild buckwheat, Canada thistle, prickly lettuce, sunflower, common cocklebur, common ragweed, common mallow, and suppresses field bindweed in corn. Apply POST to weeds as a preplant/preemergence burndown in no-till corn or as an in-crop treatment from emergence to V5 stage. Can be applied with atrazine for improved common lambsquarters and pigweed control. Can be applied with POST grass herbicides registered in corn. Observe a 90 day PHI. Refer to label for crop rotation restrictions and other application and use information.

C17. 2,4-D amine is not recommended by NDSU on corn because of the high potential for corn injury and stalks to become brittle and break off in windy conditions. The safest application stage is EPP or PRE. Do not apply to corn greater than 8 inches tall. Apply 2,4-D with drop nozzles when corn is 8 to 24 inches tall to reduce corn injury by directing the spray away from the whorl. Do not apply MCPA to corn; it is not labeled and will injure corn.

C18. Emergency control of broadleaf and grass weeds in corn can be obtained with paraquat at 0.8 to 1.3 pt/A applied POST directed only. Apply with NIS at 0.25% v/v. Paraquat applied over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply paraquat before corn is 10 inches high. Weeds should be less than 4 inches tall.

HERBICIDE-RESISTANT CORN

CLEARFIELD CORN

C19. Lightning (imazethapyr & imazapyr) at 1.28 oz WDG/A controls nearly all annual grass and broadleaf weeds except ALS resistant kochia and suppresses quackgrass and Canada thistle. Apply Lightning only to Clearfield corn varieties and to weeds 1 to 3 inches tall. Apply with oil adjuvant and liquid fertilizer. Lightning contains Pursuit and Arsenal, both imidazolinone herbicides. The rate of Pursuit in Lightning is approximately 1.08 oz WDG/A and Arsenal is at 1% the rate of Arsenal that is registered on noncropland. Refer to the rotational crop restriction section of this guide. Use dicamba, Distinct, or herbicides with a different mode of action or use other weed control strategies that will slow development of resistant weeds throughout the rotation.

LIBERTY LINK CORN

C20. Liberty (glufosinate) at 28 to 34 fl oz/A applied POST to Liberty Link corn varieties up to 24 inches with 7 or less collars controls most annual broadleaf weeds, controls or suppresses grasses, and may suppress some perennial weeds. Liberty is a non-selective, non-residual, contact herbicide. Apply to small weeds because of limited translocation. Liberty does not control large or well tillered grasses like yellow foxtail, wild oat, or volunteer cereals. Liberty is non-residual, which may require multiple applications or applying with a residual herbicide to control multiple weed flushes. Apply with AMS fertilizer. Refer to label for weeds controlled, application information and timing, tank-mix options, application information, and other restrictions. Liberty can be used to control weeds resistant to other herbicides.

Liberty + Define SC (glufosinate + flufenacet) at 28 to 34 fl oz/A + 9 fl oz/A controls many grass and broadleaf weeds. Define increases control of yellow foxtail. Refer to the Define label for additional restrictions.

ROUNDUP READY CORN

C21. Glyphosate at labeled rates in Roundup Ready (RR) corn up to 30 inches tall with 8 collars or less will control most annual and perennial weeds. Certain formulations do not require additional NIS, while others require either partial or full NIS rates. Add AMS at 2 to 6 lb/100 gal water or at 1 lb/A if applied at less than 12 gpa to all glyphosate formulations. In-crop application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, translocated herbicide that controls grasses at rates as low as 0.25 pt/A. Labeled rates are required to control broadleaf weeds. However, some broadleaf weeds like kochia, nightshade, wild buckwheat, horseweed (marestail), dandelion, and lambsquarters may not be controlled by glyphosate applied alone or after one application.

ROUNDUP READY CORN II

RR corn II hybrids have increased resistance to glyphosate compared to RR corn hybrids. Not all glyphosate formulations contain use information on RR Corn II. Glyphosate brands allowing application on RR corn II should be applied to RR corn up to 30 inches or 8 collars at a maximum single application rate of 0.75 lb ae/A. Glyphosate brands registered for RR corn II can be applied to RR corn up to 24 inches or 8 collars; or by drop nozzle application to corn from 24 to 48 inches at a maximum single application rate of 0.75 lb ae/A for annual weeds and up to 1.125 lb ae/A for perennial weeds. Generic glyphosate brands can be used on RUR corn II hybrids but application information and restrictions contained on the label must be followed. Use glyphosate according to label directions on the glyphosate brand used and not according to the label on a different glyphosate brand.

Glyphosate is non-residual so multiple applications or combining with a residual herbicide may be needed to control multiple weed flushes. Refer to label for weeds controlled, application information and timing, tank-mix options, and other restrictions. Glyphosate will control weeds resistant to other herbicides.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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SOYBEAN

D1. Soybean is a poor competitor with weeds when cool soil temperatures cause slow germination and growth but competes effectively in warm soils when germination and growth are rapid. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to conditions allowing good competition with weeds. Soybean production requires good cultural practices. Prepare the seedbed prior to planting to kill germinating weeds. A rotary hoe or harrow may be used to control weeds after planting but before the soybean emerge or after emergence when soybean are in the 1 to 2 trifoliate leaf stage. Rotary hoe or harrow help activate PRE herbicides under dry conditions and increase weed control. The rotary hoe is an effective and economical weed control method when the ground is not trashy, lumpy or wet and when weeds are beginning to emerge. Cultivation is most effective when the soybean are slightly wilted during the warm part of the day, because the crop is less susceptible to breakage and the weeds will desiccate quickly.

D2. Preplant 2,4-D at 0.75 to 1 pt/A of a 4 lb/gal concentrate may be applied 7 or more days prior to planting for the ester formulation or 14 or more days prior to planting for the amine formulation. 2,4-D amine or ester at 1 to 2 pt/A may be applied 30 or more days prior to planting. Plant soybean seed at least 1.5 inches deep. Planter press wheels should completely cover seed and separate seed from herbicide layer. 2,4-D may be tank-mixed with glyphosate, paraquat or other herbicides registered for preplant soybean application. Risk of soybean injury from preplant 2,4-D will depend on weather, rainfall, amount of weed vegetation, and previous crop residue. 2,4-D should not be applied if risk of injury and possible stand and yield loss cannot be accepted. Use only 2,4-D products that allow preplant application prior to planting soybean. Always read and follow 2,4-D label directions.

D3. Assure II (quizalofop) at 7 to 10 fl oz/A, **clethodim** at 4 to 16 fl oz/A of 2 lb/gal formulation or 8.5 to 34 fl oz/A of 1 lb/gal formulation, **Fusilade DX** (fluazifop-P) at 5 to 12 fl oz/A, **Fusion** (fluazifop-P & fenoxaprop-P) at 4 to 12 fl oz/A, or **Poast** (sethoxydim) is a 0.5 to 1.5 pt/A plus petroleum oil adjuvant applied POST controls annual grasses and quackgrass. Apply with oil adjuvant at 1% v/v but do not use less than 1 pt/A. Oil adjuvant at more than 1 qt/A is not needed. MSO oils have performed equal to petroleum-based oil additives. See table in the soybean section for rates according to weed species and weed size. Quackgrass regrowth should be retreated when 4 to 8 inches tall. Poast only suppresses quackgrass. Most broadleaf herbicides tank mixed with POST grass herbicides will often reduce grass control compared to the grass herbicide applied alone. Reduced grass control can be avoided by applying the grass herbicide at least 1 day before or 5 days after application of a broadleaf herbicide.

Assure II may provide excellent green foxtail control but less yellow foxtail control. Lower yellow foxtail control may result from applying Assure II at reduced rates, with broadleaf herbicides, or to large or stressed plants. Addition of fertilizer may enhance yellow foxtail control and control of stressed grasses.

Clethodim is a ACCase mode of action herbicide, similar to Assure II, Fusilade, and Poast. However, in NDSU research clethodim controls many grasses documented resistant to other ACCase herbicides. It is recommended that clethodim be used in rotation with herbicides of different modes of action and in a resistant weed management program.

Several generic brands of clethodim are available but not all formulations are identical to the original Select formulation. Select, Clethodim, Trigger and Volunteer are the same but Arrow, Prism, Section, and Select Max all have different formulations. Select Max is a 1 lb/gal formulation, contains activating adjuvants in the formulation, and allows use of NIS, PO, or MSO depending on tank-mix partner.

D4. Basagran (bentazon) at 0.5 to 1 qt/A applied POST controls wild mustard, common cocklebur, Venice mallow, and sunflower and suppresses biennial wormwood and Canada thistle. NDSU research has shown greater broadleaf weed control, especially lambsquarters, redroot pigweed and kochia, by applying Basagran as split treatments either twice each at 1 pt/A, 3 times each at 0.67 pt/A, or 4 times each at 0.5 pt/A as compared to one application at 2 pt/A. Make applications 7 to 10 days apart depending on weed growth rate, growing conditions, size of weeds at application, degree of weed control from first application, and sequential flushes. The first application must be made to small weeds (<1 inch).

The micro-rate may provide greater control of broadleaf weeds than from a single application at full rates and can be used in all crops where Basagran is labeled. Apply with oil additive at 1 qt/A (1 pt/A by air). Do not reduce the amount of oil adjuvant with the micro-rate. MSO adjuvant has shown greater enhancement of Basagran than petroleum oil (COC) adjuvants but the cost of MSO is higher. Basagran is safe to soybean at all stages. The total maximum seasonal use rate is 4 pt/A so the rate of the micro-rate can be increased if weeds are large at application or if sequential applications are delayed due to rain or wind. Result may be more economical than Basagran for grass and broadleaf weed control. If so, use the following chart.

bentazon (lb ai/A)	Basagran (Product/A)	Result (Product/A)
0.25	0.5 pt	0.4 pt
0.33	0.67 pt	0.56 pt
0.5	1 pt	0.8 pt
1	2 pt	1.6 pt

For Canada thistle control, apply Basagran at 1 qt/A when plants are 8 inches tall to bud stage and make a second application at 1 qt/A 7 to 10 days later. Basagran is commonly combined with fertilizer micronutrients that may cause incompatibility problems resulting in zinc precipitation. Chelated zinc materials (black in color) have greater incompatibility problems than unchelated material (clear). Recommendations to prevent precipitation are to fill sprayer with water, add Basagran and thoroughly agitate, then add zinc fertilizer material.

Result (bentazon & sethoxydim) at 3.2 pt/A (1.6 pt/A Result G and 1.6 pt/A Result B) applied POST controls some grass and broadleaf weeds. Apply with oil adjuvants at 1 to 2 pt/A. Refer to label or narrative for tank-mix options. Result is priced economically compared to other POST herbicide programs. Refer to Poast sections for additional information.

D5. Cobra (lactofen) at 4 to 12.5 fl oz/A or **Ultra Blazer** (acifluorfen) at 0.5 to 1.5 pt/A applied POST controls some broadleaf weeds, including lanceleaf sage. Apply with Cobra with oil additive at 0.5 to 1 pt/A or Ultra Blazer with NIS at 0.125% v/v. Cobra is a contact herbicide and requires thorough spray coverage for good weed control. Soybean beyond the third trifoliate leaf stage may interfere with spray interception and reduce weed control. Herbicides will burn soybean leaves but will usually recover. Apply between daytime temperatures of 70 to 85 F. See Cobra label to suppress white mold.

D6. FirstRate (cloransulam) at 0.6 to 0.75 oz WDG/A applied PPI or PRE controls common cocklebur, common lambsquarters, horseweed (marestalk), pigweed species, annual smartweeds, common and giant ragweed, sunflower, and velvetleaf or at 0.3 oz 80WDG/A applied POST to soybean prior to flowering controls cocklebur, Venice mallow, horseweed (marestalk), common ragweed, annual smartweed, sunflower, and velvetleaf and suppresses giant ragweed. Apply to broadleaf weeds less than 10 inches tall. FirstRate gives no nightshade control. Apply with NIS at 0.125 to 0.25% v/v + 28% UAN at 2.5% v/v. Oil additive can be used with or without fertilizer. See label for tank-mix options. See FirstRate under the herbicide residue section for crop rotation restrictions.

D7. Flexstar (fomesafen + adjuvants) applied POST at 0.75 to 1 pt/A controls common cocklebur, annual smartweed, wild mustard, nightshade, pigweed, waterhemp, common and giant ragweed, Venice mallow and small kochia (including ALS resistant). Apply to broadleaf weeds 2 to 4 inches tall. Apply 1 pt/A in ND east of I-29 and south of I-94 and in MN south of I-94. Apply at 0.75 pt/A in ND east of Hwy 281 and in MN south of U.S. Hwy 2. Apply with NIS at 0.25 to 0.5% v/v or oil adjuvant at 0.5 to 1% v/v. Oil adjuvant increase weed control but also increase risk of soybean injury. NDSU research has shown good to excellent kochia control when Flexstar is applied at high spray volumes (>17 gpa), with oil adjuvants (especially MSO type), at labeled rates, and to kochia less than 3 inches tall.

Soybean injury may result when Flexstar is tank-mixed with EC formulation herbicides which act as additional oil adjuvant. Activity of fomesafen increases and risk of crop injury increases as temperature and humidity increases. A maximum of 0.75 pt/A is allowed in most of ND while 1 pt/A is allowed through the Midwest. The reduced fomesafen rate reduces carryover and crop rotation restrictions. Flexstar is labeled on soybean and Reflex is labeled on dry bean. Flexstar contains adjuvants lacking in the Reflex formulation. Reflex may give less consistent weed control than Flexstar and will require better management strategies to achieve adequate weed control. See label or crop rotation restriction section for additional information.

D8. Intro at 2 to 3 qt/A applied PPI or PRE, **metolachlor** or **s-metolachlor** at 1 to 2 pt/A applied PPI or PRE, **Outlook** at 12 to 21 fl oz/A applied PPI, PRE, or EPOST up to third trifoliolate stage control annual grass and some broadleaf weeds, including redroot pigweed and common lambsquarters but are ineffective against wild oat. Apply the higher rate on clay soils high in organic matter. Soybean has good tolerance and incorporation improves consistency of weed control. Dual products may be surface applied or incorporated in the fall after October 15 but before ground freezes or applied in the spring.

D9. Pursuit (imazethapyr) at 3 fl oz/A applied POST controls or suppress many broadleaf weeds, except ALS resistant. Pursuit has controlled foxtail, marshelder, Russian thistle, common cocklebur, sunflower, smartweed, and lanceleaf sage in NDSU field trials. Pursuit will not control Venice mallow, horseweed, wild buckwheat, common lambsquarters and common ragweed. POST application may not provide adequate soil residual to control subsequent flushes of nightshade due to plant foliage intercepting most of the spray. However, even a small amount of Pursuit may give a reduction in number and intensity of flushes of other weeds. Pursuit is enhanced greatest by MSO (1.5 pt/A) and basic pH blend (1% v/v) adjuvants. UAN fertilizer improves weed control, especially common lambsquarters.

Crop injury may result if either Pursuit or thifensulfuron is applied sequentially or tank-mixed together. In sequential application, the first herbicide reduces the ability of soybean to metabolize the second herbicide. Weeds not controlled by the first herbicide may not be controlled after the second herbicide is applied. This is particularly important for lambsquarters. Weeds that escape control from the first herbicide may be larger than labeled size by the time soybean can safely be treated with the second herbicide. Delay cultivation for 14 days after application to avoid reduction in weed control.

Tank-mixtures of Pursuit with Assure II, Fusilade DX, Fusion, or Select may result in reduced grass control. Reduced grass control can be avoided by applying the POST grass herbicide either 1 or more days prior to or at least 5 days after Pursuit.

Pursuit Plus (imazethapyr & pendimethalin) at 1.8 pt/A applied PPI controls most annual grass and broadleaf weeds, including wild buckwheat. ND state labeling allows use in ND only south of State Highway 2 at a reduced rate of 1.8 pt/A which is 75% of the full labeled rate. Pursuit Plus at 1.8 pt/A contains the equivalent of Pursuit at 3 fl oz/A plus 1.75 pt/A of Prowl EC. Add additional Prowl EC at 1.75 pt/A for more consistent weed control. Thoroughly incorporate into the top 1 to 2 inches of soil. Refer to paragraphs on Pursuit and Prowl for additional information on use and restrictions.

D10. Python (flumetsulam) at 0.8 to 1.33 oz 80WDG/A applied PPI or PRE will control many annual small-seeded broadleaf weeds in soybean, such as nightshade, pigweed, kochia, biennial wormwood, common lambsquarters, mustard, annual smartweed, Venice mallow, and Russian thistle. Python does not control large-seeded broadleaf weeds like common and giant ragweed and common cocklebur. Python requires soil moisture for optimum weed control. Python is also strongly affected by soil pH. High soil pH increases herbicide activity and increases speed of herbicide degradation, but also increases risk of crop injury. Excellent broad spectrum weed control may occur when applied on soils with above 7.5 pH, when significant precipitation occurs after application, when rates are based on soil texture and organic matter content, and under light to moderate weed infestations. Some stunting may occur under poor growing conditions on soils with pH greater than 8.0.

Use the higher rates on medium to fine textured soils and the lower rates on coarse textured soils. PPI treatments may be applied up to 30 days before planting and incorporate uniformly into the top 2 inches of soil. Do not apply to soils with a pH greater than 8.0 as crop injury may result. Apply Python with most soil-applied herbicides labeled in soybean. See Python under the Herbicide Residue section for information on crop rotation restrictions.

D11. Raptor (imazamox) at 4 fl oz/A POST plus a soil-applied grass herbicide or Raptor alone at 5 fl oz/A alone POST controls nearly all annual grass and broadleaf weeds in soybean except wild buckwheat, large common lambsquarters, common and giant ragweed, Venice mallow, horseweed, biennial wormwood, and ALS-resistant weeds. In NDSU field trials, Raptor has controlled marshelder, Russian thistle, and lanceleaf sage less than 1 inch tall. Soil residue of Raptor will not control late germinating weeds or weed flushes later in the growing season after rain events. Raptor as compared to Pursuit has greater grass and broadleaf weed control, provides improved common lambsquarters control, and has less carryover and crop rotation restrictions.

D12-D18 - SOYBEAN

Apply **Raptor** with basic pH blend adjuvant at 1% v/v or MSO type adjuvants at 1.5 pt/A. Alternatively, apply with NIS at 0.125 to 0.25% v/v or oil concentrate at 0.5% v/v plus 28% UAN liquid fertilizer at 4% v/v. Use of 28% UAN improves control of some weeds like common lambsquarters. MSO type oil additives should be used when weeds are large and/or stressed. MSO or basic pH blend adjuvants enhance weed control more than NIS or some petroleum oil additives with or without 28% UAN. However, Raptor applied with MSO + UAN may result in crop injury at temperatures greater than 88 F and greater than 80% relative humidity.

Refer to label and paragraph on Pursuit and Raptor for information and restrictions when applying Raptor before or after thifensulfuron or tank-mixing with thifensulfuron or other POST grass herbicides. Crop rotation restrictions are less with Raptor than Pursuit. However, like Pursuit, Raptor carryover is affected by soil pH. As soil pH increases, rate of Raptor degradation increases. At soil pH less than 6.5, rate of breakdown is slow and injury to sugarbeet and other sensitive crops may occur if planted before allowed time interval. See label or Raptor under the herbicide residue section for information on crop rotation restrictions.

D12. Sencor (metribuzin) at 0.25 to 0.5 lb 75DF/A controls annual broadleaf weeds, including wild mustard. Adjust rate according to soil type, pH, and % organic matter. Some soybean varieties are susceptible to metribuzin; consult label for list of susceptible varieties. Soybean injury can be reduced by using herbicide combinations with lower rates of metribuzin.

D13. Sonalan (ethalfluralin) at 1.3 to 3.5 pt/A, **trifluralin** at 1 to 2 pt 4E/A, or **Prowl/H₂O** (pendimethalin) at 2 to 3 pt/A EC applied PPI controls most annual grasses and some small-seeded broadleaf weeds. They give no wild mustard, common cocklebur and sunflower control. Requirements for proper timing and depth of incorporation differ for each herbicide. Adjust rate according to soil type. Trifluralin must be incorporated in the top 2 to 3 inches of soil within 24 hours of application. Trifluralin incorporation may be delayed up to 2 days if applied to a cool, dry soil. Incorporation of Sonalan 10G can be delayed 3 to 5 days after application. Herbicides can be applied with most soil PPI herbicides labeled in soybean. Sonalan has less soil residue than trifluralin or Prowl and is more active at comparable rates.

D14. Spartan (sulfentrazone) at 3 to 8 fl oz/A applied shallow PPI or PRE controls most annual small-seeded broadleaf weeds including ALS resistant kochia, pigweed species, common lambsquarters, eastern black nightshade, annual smartweed, Russian thistle and biennial wormwood. Spartan may partially control other weeds like wild buckwheat, marshelder, wild mustard, common ragweed, hairy nightshade, Venice mallow, and foxtail but provides no perennial weed control. Rate must be adjusted for soil texture, soil pH and organic matter content. Apply 3 to 6 fl oz/A for coarse and medium textured soils, and 4 to 8 fl oz/A for fine textured soils. Herbicide solubility, activity, and phytotoxicity increases as soil pH increases. User must read and follow label for rate information to ensure adequate weed control. Spartan provides excellent burndown weed control and may be applied up to 30 days prior to planting but use the higher rate in the appropriate rate range. Spartan can be tank-mixed with most PPI/PRE herbicides registered in soybean. NDSU research has shown that consistent control of susceptible broadleaf weeds and suppression of foxtail and marginally susceptible broadleaf weeds depends on at least 0.5 to 0.75 inch rainfall shortly after application and before weeds emerge. Spartan will leave a residue in soil for more than one year. Refer to label or crop rotation restriction section for additional information.

D15. Thifensulfuron at 1/8 oz SG/A or 1/12 oz DF/A applied POST controls wild mustard, common lambsquarters, and pigweed and suppresses other broadleaf weeds. Apply with NIS at 0.125 to 0.25% v/v or oil adjuvants at 0.5% v/v plus liquid fertilizer at 4% v/v. DO NOT apply with oil adjuvants when tank-mixing with any other herbicide or severe crop injury may occur. See label or Pursuit paragraph for precautions when tank-mixing with Pursuit and other herbicides. Thifensulfuron as spray drift or sprayer contamination may cause severe injury to susceptible crops such as sugarbeet and sunflower. Thoroughly clean sprayer to prevent contamination of subsequent spray mixture and injury to susceptible crops. Follow label for improved cleanout procedure.

D16. Valor (flumioxazin) at 2 to 3 oz WDG/A applied EPP or PRE controls most small-seeded broadleaf weeds including kochia (including ALS resistant), nightshade, pigweed species, lambsquarters, and Venice mallow and may suppress common and giant ragweed, annual smartweed, Russian thistle, and foxtail and may suppress wild buckwheat. Valor does not control perennial weeds. Apply Valor from 14 days prior to seeding to just before soybean emergence. Valor can be applied with glyphosate in early burndown programs in soybean. Valor requires a minimum of 0.25 inch of rain for activation and requires a bioassay prior to planting sensitive crops. See label for additional information.

Gangster (flumioxazin & cloransulam), a copack of Valor and FirstRate at 1.5 to 3 + 0.3 to 0.6 oz WDG/A, applied EPP or PRE controls most small-seeded broadleaf weeds including ALS-resistant kochia, nightshade, pigweed species, lambsquarters, ragweed, sunflower, smartweed, Venice mallow, and suppress foxtail. Gangster does not control perennial weeds. Apply from 14 days prior to seeding to just before soybean emergence. Gangster can be applied with glyphosate in EPP burndown programs. Refer to label for weeds controlled, rates, and crop rotation restrictions.

HERBICIDE RESISTANT SOYBEAN

ROUNDUP READY SOYBEAN

D17. Glyphosate at 0.38 to 1.125 lb ae/A applied only to Roundup Ready soybean will control most annual and perennial weeds. Refer to label for adjuvant use. Apply with AMS. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, translocated herbicide that can control grasses at rates as low as 1.5 oz ae/A. Labeled rates are required to control broadleaf weeds. However, some broadleaf weeds like kochia, nightshade, wild buckwheat, horseweed (marestail), dandelion, and lambsquarters may not be adequately controlled by one application of glyphosate. Refer to label for weeds controlled, application information, timing, tank-mix options, and other restrictions. Glyphosate will control weeds resistant to other herbicides.

ROUNDUP/STS READY SOYBEAN

D18. Thifensulfuron at up to 0.5 oz SG/A or 0.33 oz DF/A applied with glyphosate only to Roundup Ready/STS (sulfonylurea tolerant) soybean improves broadleaf weed control. Thifensulfuron is effective on wild buckwheat, mustard species, common lambsquarters, pigweed species, annual smartweed, and will suppresses other broadleaf weeds. Apply with NIS at 0.125 to 0.25% v/v to non-loaded glyphosate formulations. Refer to glyphosate label for application and adjuvant information.

DRY EDIBLE BEAN

E1. Navy bean generally is less tolerance to herbicides than other dry beans types or soybean. Rotary hoe before crook stage or after emergence up to 1 to 2 trifoliates.

E2. Eptam (EPTC) at 2.3 to 3.5 pt/A or 11 to 15 lb 20G/A plus Prowl, Sonalan, or trifluralin controls many grass and broadleaf weeds including wild oat and common lambsquarters. Incorporate 4 to 6 inches deep immediately after application. Do not use Eptam on soybean.

E3. Intro (alachlor) at 2 to 3 qt/A only PPI, **metolachlor** or **S-metolachlor** at 1 to 2 pt/A PPI or PRE, or **Outlook** (dimethenamid) at 1 to 2 pt/A PPI, PRE or EPOST up to the third trifoliolate controls annual grasses and some broadleaf weeds. PPI may provide more consistent weed control because PRE and EPOST treatments require rainfall for activation. **Outlook** can be applied in sequential treatments for improved nightshade control in dry bean. Outlook PPI or PRE provides greater nightshade control than Dual or Lasso but may degrade in soil before nightshade emergence ceases. Apply Outlook EPOST up to third trifoliolate dry beans to reduce late nightshade emergence.

E4. Pursuit (imazethapyr) at 2 fl oz/A applied PPI, PRE or POST controls many broadleaf weeds including wild mustard and nightshade in most dry bean types and field pea. Pursuit can be applied ONLY PPI within 1 week of planting or PRE up to 3 days following planting to chickpea/garbanzo bean and lentil at rates listed above.

DO NOT apply POST to chickpea/garbanzo bean or lentil, or Domino variety black turtle bean. Do not apply after crop has begun flowering, if planting is delayed, or cold and/or wet weather are present or predicted to occur within one week of application. Do not use oil additives or liquid fertilizer. Apply with NIS at 0.25% v/v to dry beans with at least one trifoliolate leaf. Refer to the Raptor paragraph in the soybean section for additional information on application use and restrictions. Refer to label for crop rotation restrictions and application information.

User assume all risk of liability for injury.

E5. Reflex (fomesafen) at 0.75 pt/A applied POST with NIS at 0.25 to 0.5% v/v or oil adjuvant at 0.5 to 1% v/v controls many broadleaf weeds. Oil adjuvant may increase weed control but also increases risk of dry bean injury. Refer to the Flexstar paragraph in the soybean section for information on application and adjuvant use and restrictions.

E6. NDSU Dry Bean Micro-rate concept is based on the Sugarbeet Micro-Rate and substitutes additional weed management for reduced herbicide rates. Application to small weeds is essential for success. The micro-rate can be applied more than once in dry beans to control emerging weed flushes but applying a foundation herbicide treatment (DNA or acetanilide) may require only one application. MSO adjuvant is required for optimum weed control. The POST grass herbicide can be excluded if grass populations are low. Preliminary data show weed control can be improved by increasing spray volume. The first application can be made at 10 gpa when weeds are small and less than 3 inches tall. Increase spray volume by 10 gpa for every 3 inches in weed height. Addition of AMS at 1 lb/A also increases weed control. Weed control from the micro-rate is best when temperature plus humidity is greater than 140. Increasing spray volume and using AMS may help improve weed control when the value is below 140.

FIELD PEA

F1. Field pea is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when pea is 3 to 7 inches tall. Apply broadleaf herbicides to small weeds and small pea to reduce risk of pea injury. Do not apply POST herbicides when temperatures are above 85 F or when pea are under heat/drought stress.

F2. Basagran (bentazon) at 1 to 1.5 pt/A applied to 2- to 4-inch tall field pea controls some annual broadleaf weeds and suppresses Canada thistle. Apply in 15 to 20 gpa with MSO type oil additive. Two sequential applications 7 to 10 days apart each at 1 pt/A provides greater broadleaf weed control than one application at the full rate. A second application can be made to pea greater than 6 inches tall. Allow a 30 day PHI. See paragraph under Basagran in soybean section for additional information.

F3. Thistrol (MCPB) at 2 to 6 pint/A applied to 4- to 6-inch pea vines controls some broadleaf weeds including lambsquarters and redroot pigweed and suppression of Canada thistle. Slight pea injury may occur but pea will usually recover. Injury potential increases when pea is taller than 6 inches and when temperatures exceed 85 F or when the pea is under heat/drought stress. Apply prior to flowering.

F4. Glyphosate at up to 0.75 lb ae/A applied preharvest at the hard dough stage of pea grain with 30% or less moisture controls most annual and perennial weeds. Allow a 7 day PHI. Greater perennial weed control may be obtained by allowing a 10 to 14 day PHI. Do not apply to crop grown for seed.

Glyphosate at 1.5 to 2.25 lb ae/A or in a 2% solution for hand-held sprayers applied as a spot treatment at or beyond the bud stage of perennial weeds controls many troublesome weeds including Canada thistle, perennial sowthistle, common milkweed, or quackgrass. The crop in treated areas will be killed. Allow a 14 day PHI. No more than 10% of the total field area may be spot treated at rates greater than 1 qt/A.

F5. Metri and Metribuzin (metribuzin) at 0.25 to 0.33 lb DF/A will suppress mustard species and lambsquarters. Crop injury may result if pea is under stress caused by cold weather. Apply when weeds are less than 2 inches in height or diameter and before the crop is 6 inches tall. Apply Sencor no later than 50 days before harvest.

CHICKPEA/GARBANZO BEAN

G1. Chickpea/Garbanzo beans is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing after seeding up to 3 to 5 days after chickpea germination and again when chickpea is 2 to 4 inches tall. Apply broadleaf herbicides to small weeds and small chickpea to reduce risk of pea injury. Do not apply POST herbicides above 85 F or when chickpea is under heat/ drought stress.

LENTIL

H1. Lentil is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when lentil is 3 to 7 inches tall.

H2. Metri and Metribuzin (metribuzin) applied PRE at 0.33 to 0.5 lb 75DF/A or POST at 0.167 to 0.25 lb 75DF/A in lentil will suppress common lambsquarters, mustard species, henbit, and common chickweed. Apply Sencor PRE before or after planting but before crop emerges. Thorough incorporation by rainfall or mechanical methods is essential for weed suppression. Apply Sencor POST to weeds less than 2 inches tall and lentil less than 6 inches tall. See label for special precautions.

H3. Trifluralin at 1 to 1.5 pt/A or 5 to 7.5 lb 10G/A applied fall or spring controls grass and some broadleaf weeds. Rates should be adjusted based on soil texture and organic matter. Lentil tolerance to trifluralin is marginal, so injury can occur. Cool soil conditions over an extended period of time will delay germination and emergence and increase risk of injury. Trifluralin spring-applied is more likely to cause stand reduction than when fall-applied. If seeding into cool, dry soil after a spring application, the seeding rate should be increased by 15% to compensate for injury that may occur. Seed no deeper than 1.5 inches to reduce the potential for lentil injury.

SUNFLOWER

J1. Sunflower competes poorly with weeds because of slow early growth and minimal ground cover. Cultivation with a spike-tooth or coil spring harrow about 1 week after seeding but before sunflower emergence will kill weeds that emerge before sunflower. Harrow or rotary hoe when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

J2. Assert (imazamethabenz) at 0.6 to 0.8 pt/A applied POST controls wild mustard in sunflower up to 15 inches tall. Severe sunflower injury may occur when applied in high temperature and humidity. Sunflower variety, growth stage, weather conditions, humidity, spray volume, and additives may affect sunflower safety. Risk of injury should be considered when deciding if treatment is warranted. Do not apply to sunflower under drought or heat stress. Apply Assert when air temperature plus relative humidity is below 150. Sunflower damage may range from plant stunting to head deformation. Refer to label.

J3. Spartan (sulfentrazone) at 3 to 6 fl oz/A applied EPP, shallow PPI, or PRE controls most annual small-seeded broadleaf weeds, such as ALS-resistant kochia, pigweed species, common lambsquarters, eastern black nightshade, annual smartweed, Russian thistle, and biennial wormwood. Sulfentrazone may partially control wild buckwheat, marshelder, wild mustard, common ragweed, hairy nightshade, and foxtail but provides no perennial weed control. Rate must be adjusted for soil texture, soil pH, and organic matter content. Herbicide solubility, activity, and phytotoxicity increases as soil pH increases. User must read and follow label for rate information to ensure adequate weed control while maintaining crop safety. Crop injury will be minimized and greater likelihood of activation by rainfall will result if applied up to 30 days prior to planting. Sunflower has good tolerance to Spartan on medium to fine textured soils with OM above 3%. Crop injury may occur on soils with low OM and soil pH greater than 7.5, especially on calcareous outcropping. Do not use on coarse textured soils with less than 1% organic matter. Close furrow at planting to reduce injury. Poor growing conditions at and following crop emergence, cold temperatures, soil compaction, or rate too high based on soil type and OM may result in crop injury. NDSU research has shown that consistent control of susceptible broadleaf weeds and suppression of foxtail and marginally susceptible broadleaf weeds depends on at least 0.5 to 0.75 inch rainfall shortly after application and before weeds emerge. The approximate ranking of crops from most to least tolerant is soybean, flax, chickpea, mint, sunflower, potato, field pea, dry edible beans, safflower, crambe, canola, lentil, and sugarbeet. Spartan has a PPO inhibitor mode of action and will leave a residue in soil for more than one year. Refer to label section for additional information.

HERBICIDE RESISTANT SUNFLOWER

Clearfield Sunflower

J4. Beyond (imazamox) at 4 fl oz/A applied POST to Clearfield sunflower hybrids controls most annual grass and broadleaf weeds with limited crop rotation restrictions. Apply with NIS and UAN. MSO adjuvants are not restricted and will provide greater herbicide enhancement compared to NIS + UAN. However, MSO adjuvants may increase risk of temporary sunflower yellowing and stunting. Weed species that may not be controlled are wild buckwheat, ragweed, common lambsquarters (> 2 inches), biennial wormwood, Canada thistle, and ALS resistant kochia. Refer to the Raptor paragraph in the soybean section for information on application and use restrictions.

Express Sun Sunflower

J5. Tribenuron at 0.25 to 0.5 oz SG/A or 0.33 to 0.67 oz DF/A applied POST to Express Sun sunflower hybrids controls most broadleaf weeds and Canada thistle. Tribenuron does not control grasses or ALS resistant weeds. MSO adjuvants will enhance weed control more than other adjuvant types. Tribenuron may antagonize POST grass herbicides if applied together. The antagonism can be reduced or avoided by applying a higher rate of the grass herbicide or applying the grass herbicide 1 or more days before or 5 to 7 days after tribenuron application. Do not apply any other ALS herbicide on Express Sun sunflower varieties, even other SU herbicides or severe sunflower injury or death will result. Refer to label for use directions and other information.

FLAX

K1. Flax is less competitive with weeds than small grains and should be grown on relatively weed-free fields. Control weeds in and following harvest of preceding crop. Post-harvest tillage of small grain stubble will prevent weed seed production, suppress perennial weeds, and encourage annual weed seed germination prior to freeze-up. Flax should be seeded directly or with shallow spring tillage in fields. Deep tillage of fields could bring dormant seeds to the surface and increase weed problems. For weedy fields, moldboard plow the soil to bury weed seeds, thereby reducing the weed infestation the following crop season. Moldboard plowing can reduce infestations of small-seeded weeds like foxtails and kochia, which have short seed survival.

Delayed seeding of flax with tillage prior to seeding will control wild oat and reduce infestations of other early germinating weeds. However, delayed seeding generally reduces flax yields. Early maturing flax varieties should be used with late seeding. Weed control is needed by flax emergence to reduce yield losses since flax is a poor competitor with weeds. Soil-applied herbicides reduce weed emergence and minimize early weed competition to maximize flax yields. POST herbicides applied soon after weed emergence to small weeds and flax usually give better control and allow more time for flax recovery from possible herbicide injury than treatment to larger weeds and flax.

K2. Bromoxynil at 1 pt/A on 2- to 8-inch flax controls some broadleaf weeds. Some flax leaf burn may occur when applied during high temperatures. Bromoxynil plus MCPA may cause flax injury when applied during hot, humid conditions.

K3. Clopyralid & MCPA at 1.33 to 1.75 pt/A control Canada thistle and many other broadleaf weeds and at 1.75 pt/A suppresses perennial sowthistle. Apply when flax is 2 to 6 inches tall. Adverse growing conditions prior to, during, and following application may reduce weed control and increase risk of flax injury.

K4. MCPA at 0.5 pt/A on 2- to 6-inch flax controls broadleaf weeds. MCPA ester or high MCPA amine rates should be used in flax for improved kochia and Russian thistle control.

K5. Trifluralin at 1 to 2 pt/A or 5 to 10 lb 10G/A fall-applied on fields to be seeded to flax. Granular formulations may be applied to standing stubble. Use liquid or granular formulations when residue will not interfere with incorporation. Seed flax less than 1.5 inches deep into a moist seedbed. Incorporate shallow and seed deep or seed shallow with deep incorporation to maximize crop safety.

Trifluralin is not labeled for spring application in flax because of injury risk but may be spring-applied if user assumes all liability for crop safety. To reduce potential of flax injury, spring-apply no more than 0.5 lb ai/A and incorporate as early as possible to create a firm seed bed through rain and soil compaction. A firm seed bed will promote uniform depth-seeding for uniform emergence. Early application will allow more time for degradation of "hot spots" in soil.

CANOLA AND MUSTARD CROPS

L1. Mustard crops in the early seedling stage are poor competitors with weeds. Control small weeds by harrowing until 3 to 5 days after mustard germination. Harrowing after emergence is not recommended.

L2. Clopyralid at 0.33 to 0.5 pt/A applied POST controls several broadleaf weeds and volunteer crops in canola, rapeseed, and crambe. Clopyralid at 0.25 to 0.5 pt/A is most effective when applied to common cocklebur, giant ragweed, volunteer sunflower, wild sunflower, volunteer alfalfa, and volunteer soybean up to the 6-leaf stage, common ragweed up to the 5-leaf stage; and wild buckwheat in the 3- to 5-leaf stage before vining begins. Clopyralid at 0.5 to 0.66 pt/A is most effective on Canada thistle in the rosette to pre-bud growth stage but rosette application often gives better control than later application.

HERBICIDE RESISTANT CANOLA

CLEARFIELD CANOLA

L3. Beyond (imazamox) at 4 fl oz/A applied POST to Clearfield canola varieties from emergence until prior to flowering controls most annual grass and broadleaf weeds. Apply with NIS at 0.25% v/v alone or with UAN liquid fertilizer at 1 to 2 qt/A. Beyond will not control ALS-resistant weeds. Clearfield canola can be planted on land previously treated with Assert or Pursuit and may reduce or eliminate injury from long residual SU herbicides. See label or information on Raptor in the soybean section for use, weed control, carryover, crop rotation restrictions, and other use information.

LIBERTY LINK CANOLA

L4. Liberty (glufosinate) at 34 fl oz/A applied POST to Liberty tolerant canola from cotyledon to bolting stage controls most annual broadleaf weeds, controls or suppresses grasses, and may suppress perennial weeds. Always apply with AMS at 3 lb/A. If tank mixing with Assure II, clethodim, or Poast then reduce AMS to 1.5 lb/A. Liberty is a non-selective, non-residual, contact type herbicide with limited translocation and should be applied to small weeds. Refer to label for weeds controlled, application information and timing, tank-mix options, and other restrictions. Liberty has a unique mode of action and may be used in weed resistance management.

ROUNDUP READY CANOLA

L5. Glyphosate applied at a maximum of 0.38 lb ae/A with no more than two applications to glyphosate-resistant canola from emergence to bolting controls most annual and perennial weeds. Apply with AMS. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, translocated herbicide. Full labeled rates are required for broadleaf weed control. Glyphosate will control weeds resistant to other herbicides. Refer to label or paragraphs on glyphosate under herbicide-resistant corn or soybean sections for weeds controlled, application information and timing, tank-mix options, and other restrictions.

SUGARBEET

M1. Sugarbeet herbicides may be used to supplement cultural practices. Hand labor, mostly hoeing, may be needed for optimum weed control but can be reduced or eliminated by timely cultivations and herbicide applications.

M2. Herbicides are commonly used as tank-mixtures on sugarbeet. Some herbicide combinations are registered for use as tank-mix combinations, but many other tank-mixes are not registered. Herbicides may be tank-mixed legally if all herbicides in the mixture are registered for use on sugarbeet. However, the user must assume liability for any crop injury, inadequate weed control, or illegal and/or harmful residues.

M3. Assure II (quizalofop) at 8 to 10 fl oz/A plus petroleum oil adjuvants controls annual grasses in sugarbeet. See discussion on Assure II under soybean for additional information. Allow a 45 day PHI.

M4. Betanex/Des/Alphanex (desmedipham) and **Betamix/D-P Mix/ Phen-Des** (desmedipham & phenmedipham) applied POST control annual broadleaf weeds. Sugarbeet injury occasionally occurs from Betanex* and Betamix*. Sugarbeet with four true leaves are much less susceptible to injury than smaller sugarbeet and they gain additional tolerance with increased size. Betanex* or Betamix* may be applied to sugarbeet with less than four leaves. Application rates totaling 3 pt/A or less should be followed by a second application in 5 to 7 days if living weeds are present after 5 days. Split application with reduced rates has reduced sugarbeet injury and increased weed control compared to one full-rate application. See Table 1 below for information on adjusting rates for sugarbeet size, sprayer pressure and presence of a soil-applied herbicide. Risk of sugarbeet injury is reduced by starting application in late afternoon so cooler temperatures follow application. Risk of injury is increased by recent flooding, high temperature, and especially, a sudden change from cool, cloudy conditions to hot, sunny weather. Allow a 75 day PHI for Betanex* and Betamix*.

Betanex*, Betamix*, Broadcast Rate.

Sugarbeet stage	No soil herbicide			
	Low pressure (<100 psi)		High pressure or aerial	
	(lb/A)	(pt/A)	(lb/A)	(pt/A)
Coty-2-leaf	0.25	1.5	0.16	1
2-leaf	0.33	2	0.25	1.5
4-leaf	0.5	3	0.4	2.5
6-8-leaf	0.75	4.6	0.75	4.6

Sugarbeet stage	With soil herbicide			
	Low pressure (<100 psi)		High pressure or aerial	
	(lb/A)	(pt/A)	(lb/A)	(pt/A)
Coty-2-leaf	0.16	1	0.12	0.75
2-leaf	0.25	1.5	0.16	1
4-leaf	0.33	2	0.25	1.5
6-8-leaf	0.5	3	0.5	3

* Or generic equivalent.

M5. Eptam (EPTC) PPI in the spring at 2.3 to 3.4 pt 7E/A or in the fall at 4 to 5 pt 7E/A or 17 to 22 lb 20G/A controls annual grasses and certain broadleaf weeds but may cause sugarbeet stand reduction and temporary stunting. However, no yield reduction will occur if adequate sugarbeet population remains after thinning. Use extreme caution in choosing a safe rate on sandy loam or lighter soils with low OM. Herbicides such as Ro-Neet, Nortron*, or Pyramin cause less sugarbeet injury on the low OM soils where Eptam injury may be excessive.

Ro-Neet (cycloate) spring-applied at 4 to 5.3 pt/A or fall-applied at 5.3 pt/A gives weed control similar to Eptam. Eptam tends to give better weed control than Ro-Neet on fine-textured, high OM soils or under relatively dry conditions while Ro-Neet gives better control than Eptam when spring rainfall is adequate to excessive. Ro-Neet causes less sugarbeet injury than Eptam and is safer on more coarse-textured, low OM soils.

M6. Eptam (EPTC) plus **Ro-Neet** (cycloate) has less potential for sugarbeet injury and is less expensive than Ro-Neet alone. The rate of the mixture must be adjusted for soil texture and OM.

Suggested Eptam + Ro-Neet rates.

Soil type	OM	Eptam + Ro-Neet Rate	
		pt/A	lb/A
Fall applied			
	%	pt/A	lb/A
—	<3	—	5.3
Loam or coarser	3	1.1	4
Loam to clay-loam	3-4	1.7	3.3
Clay-loam	3.5-4.5	2.3	2.7
Clay to clay-loam	>4.5	2.9	3.3
Spring applied			
Loam or coarser	<3	—	4
Loam or coarser	3-3.5	1.1	3.3
Loam to clay-loam	3.5-4.5	1.7	3.3
Clay loam or finer	>4	2.3	2.7

These rates may need to be adjusted on certain fields or with certain incorporation tools based on individual experience. Eptam, Ro-Neet, or Eptam plus Ro-Neet require immediate incorporation for best weed control.

M7. Far-Go (trallate) spring- or fall-applied at 1.5 pt/A or 15 lb 10G/A controls wild oat. Incorporate Far-Go immediately after application at 3 to 4 inches deep. Deep and thorough incorporation will provide the best wild oat control. Delaying the second incorporation for three days or longer delay after the first incorporation often improves wild oat control. One incorporation in the fall followed by spring seed-bed preparation is sufficient for fall-applied Far-Go. Far-Go should be fall-applied when temperatures are consistently below 50 F, which generally occurs after October 15. Far-Go may be applied until snow cover or soil is frozen too hard for incorporation. Far-Go will control wild oat that have developed resistance to ACCase-inhibitor POST herbicides for grass control.

M8. Micro-rate or Mid-rate programs use low rates of herbicides in combination applied three or more times at a 5 to 7 day interval starting when weeds are just emerging. The micro-rate treatment is Betanex* / Betamix* / Progress* plus UpBeet plus Stinger* plus a methylated seed oil (MSO) adjuvant at 8 to 12 / 8 to 12 / 5.7 to 8.7 fl oz/A plus 0.125 oz/A plus 1.3 fl oz/A plus 1.5% v/v. The MSO is essential to increase weed control when low herbicide rates are used. The mid-rate treatment includes Betanex*/Betamix*/Progress* at 12 to 16 / 12 to 16 / 8.7 to 11.6 fl oz/A after sugarbeet has four leaves along with the same rate of UpBeet, Stinger* and MSO.

Add Assure II at 4 fl oz/A or Select* at 2 fl oz/A or Poast at 5.3 fl oz/A to the micro-rate to improve grass control. The micro-rate will not control lanceleaf sage or ALS-resistant kochia.

The micro-rate and mid-rates should be applied a minimum of three times. Three applications of the micro-rate generally has given better weed control than two applications of conventional rates. Three applications of conventional rates sometimes gave better weed control than three applications of the micro-rate. Four micro-rate applications frequently have given better weed control than three applications of conventional rates or the micro-rate due to controlling late-emerging weeds.

Precipitation and nozzle plugging is common with ground application of the micro-rate. Several factors may reduce nozzle plugging. 1) Start with a clean sprayer, spray until the tank load immediately after mixing, spray until tank is dry, flush sprayer between loads, clean sprayer frequently, and never allow spray solution to set in the tank. 2) Allow the sprayer tank water to warm before mixing and increase the pH of water to 8 or 9 by adding ammonia, Quad 7, or other pH increasing agents. 3) Pre-mix the UpBeet in hot water or water with pH 8 to 9. Put UpBeet in the tank first and be sure it is dissolved before adding, in order, Betanex*/Betamix*/Progress*, Stinger*, and MSO type oil adjuvant. A 2% solution of household ammonia at 1 gal/100 gal of water will give about pH 9. Add ammonia slowly as the tank fills so water pH does not go much over pH 9. 4) Add a grass herbicide. Tests using a single nozzle and a small volume of spray solution indicated that Assure II reduced precipitation more than Poast and Select* but all had an effect. 5) Gentle agitation resulted in less precipitation than vigorous agitation.

M9. Nortron/Etho/Ethotron (ethofumesate) at 6 to 7.5 pt/A controls broadleaf and grass weeds including redroot pigweed and wild buckwheat but is weak on yellow foxtail. Nortron* is the best of the soil-applied herbicides for kochia control, providing fair to good control. Nortron* may be applied PRE but research results in North Dakota and Minnesota indicate that incorporation generally improves weed control. Nortron* incorporated at 2 to 4 inches deep gave slightly better weed control than when incorporated at 1 inch deep. Band application of Nortron* reduces cost and soil residue. Nortron* has been relatively safe on sugarbeet but use of Nortron* with Ro-Neet or fall-applied Eptam can cause sugarbeet injury especially on medium to coarse textured soils. Nortron* plus spring-applied Eptam may cause serious injury and should only be used on fine textured soils with over 6% OM. See labels for Nortron* rate adjustment for various soil types.

M10. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil adjuvant controls annual grass weeds and quackgrass in sugarbeet. See discussion on Poast under soybean for additional information. Allow a 60 day PHI.

M11. Progress/Des-Phen-Etho (desmedipham & phenmedipham & ethofumesate) applied POST gives increased control of some weeds and greater risk of sugarbeet injury than Betamix* alone. The active ingredients are in a 1:1:1 ratio. Adjust the rate of Progress* so the total lb/A of the active ingredients is equal to the lb/A of Betamix* if the Betamix* were applied alone. For example, if the normal rate of Betamix* was 0.3 lb/A then Progress* also should be applied at 0.3 lb/A. Risk factors are the same as for Betamix* alone. Allow a 75 day PHI.

*Or generic equivalent.

M12. Clethodim (several trade names) at 6 to 8 fl oz/A or **Select Max** (clethodim) at 9 to 16 fl oz/A plus oil adjuvant at 1qt/A controls annual grasses and quackgrass. See table in the soybean section for rates of clethodim according to weed species and weed size. Quackgrass control requires two sequential applications. Tank-mixing POST sugarbeet herbicides or applying the herbicide within 1 day after clethodim may reduce grass control compared to clethodim applied alone. Reduced grass control can be avoided by applying clethodim at least 1 day before or 5 days after applying the broadleaf herbicide. However, NDSU research indicates less antagonism of grass control with clethodim tank-mixed with Betanex* or Betamix* than Poast or Assure II. Allow a 40 day PHI.

M13. Clopyralid (several trade names) at 0.25 to 0.66 pt/A applied POST controls several broadleaf weeds and volunteer crops. Clopyralid at 0.25 to 0.5 pt/A is most effective when applied with MSO adjuvant to common cocklebur, giant ragweed, volunteer sunflower, wild sunflower, volunteer alfalfa, and volunteer soybean up to the 6-leaf stage, common ragweed up to the 5-leaf stage, and wild buckwheat in the 3- to 5-leaf stage before vining begins. Apply clopyralid at 0.5 to 0.66 pt/A to Canada thistle in the rosette to pre-bud growth stage. Rosette application will give better control than later application. Clopyralid must be applied to sugarbeet in the 2- to 8-leaf stage and allow a 45 day PHI.

M14. UpBeet (triflurosulfuron) at 0.25 to 0.5 oz/A should be used with an adjuvant when applied with clopyralid but without adjuvant when applied with Betanex*, Betamix*, or Progress* except in the micro-rate. UpBeet is a postemergence herbicide that should be applied in combination with other broadleaf herbicides mentioned above. UpBeet will antagonize grass control from Assure II, clethodim, or Poast similar to antagonism caused by Betanex*, Betamix* or Progress*. Research in eastern ND and MN has shown that Betamix* + UpBeet applied once at 1.5 pt + 0.5 oz/A followed 7 days later by 2 pt + 0.5 oz/A generally gave less control than Betanex* + UpBeet applied three times at 7 day intervals using 1 pt + 0.25 to 0.3 oz/A in each treatment. Allow a 60 day PHI. Do not exceed 2.5 oz/A UpBeet in a single growing season.

M15. Trifluralin at 1.5 pt/A can be used on 2- to 6-inch tall sugarbeet for annual grass and broadleaf weed control. Broadcast and incorporate immediately with cultivators or tillage tools adjusted to mix the herbicides in the soil without excessive sugarbeet stand loss. The crop should be clean cultivated before application since established weeds are not controlled. Trifluralin with good moisture conditions will control late germinating weeds that may become a problem late into the season.

M16. Dual Magnum (s-metolachlor) applied preplant incorporated or preemergence has caused excessive sugarbeet injury. A form must be signed before use that releases Syngenta from all liability for sugarbeet injury from Dual Magnum. Apply PPI or PRE in the spring or fall at 1.3 to 2 pt/A. Adjust rate depending on soil texture and OM content. Make fall applications after October 15 but before ground freezes. Lay-by applications can be done without signing a liability release form. Apply lay-by at 1.3 to 1.67 pt/A after sugarbeet has four true leaves. More than one lay-by application can be made but the total applied must not exceed 2.6 pt/A per season. Rain or sprinkler irrigation after application is required for activation.

*Or generic equivalent.

M17. Outlook (dimethenamid-P) at 18 to 21 fl oz/A on medium- to fine-textured soils may be used as a lay-by treatment when sugarbeet has 4 to 8 leaves. Apply once or sequentially but the total applied must not exceed 21 fl oz/A per season. Rain or sprinkler irrigation after application is required for activation. Weeds that emerge prior to activation will not be controlled.

M18. Combinations of postemergence herbicides give more broad spectrum and greater total weed control compared to individual treatments. Clopyralid* + Betanex* or clopyralid* + Betamix* have controlled wild buckwheat, eastern black nightshade, common lambsquarters, buffalobur, giant ragweed, ladythumb, lanceleaf sage, and Russian thistle superior to clopyralid* alone and superior to Betanex* or Betamix* alone.

UpBeet* plus Betanex*, Betamix* or Progress* has provided improved control of redroot pigweed, prostrate pigweed, Kochia, common mallow, nightshade, ladythumb, Venice mallow, nightflowering catchfly, wild mustard and velvetleaf compared to Betanex*, Betamix*, or Progress* alone.

UpBeet generally has little effect on sugarbeet injury. A three-way combination of Betanex + UpBeet + clopyralid has given good to excellent control of all common broadleaf weeds in sugarbeet in research conducted in ND and MN except ALS-resistant Kochia.

*Or generic equivalent.

HERBICIDE-RESISTANT SUGARBEET

M19. Glyphosate at 0.75 to 1.125 lb ae/A applied from emergence to 30 days before harvest to Roundup ready sugarbeet will control most annual and perennial weeds. Refer to labels for adjuvant use. Apply with AMS for most consistent weed control. Glyphosate is marketed under several brand names. The pounds of acid equivalent (ae) per gallon of product varies from 3 lb ae/gallon to 5 lb ae/gallon in different brands so be aware of the formulation being used and be sure the formulation is registered for use in sugarbeet. The total amount of glyphosate that can be applied to sugarbeet at various times is listed in the tables. Glyphosate may be applied up to four times POST to sugarbeet with at least 10 days between applications. Apply glyphosate in the least amount of spray volume allowed but avoid drift of spray droplets. Apply with AMS at 4 lbs/100 gallons of water or more.

Table with multiple columns and rows, containing detailed data and text, likely a continuation of the herbicide application guidelines. The text is mostly illegible due to image quality and bleed-through.

POTATO

N1. Tillage through hilling and cultivation and herbicides are the two primary means of controlling weeds in potato. The first tillage operation after planting is usually a "blind" cultivation or harrowing before the crop emerges. The number of tillage operations will vary, but three cultivations and two hilling operations are common. After emergence, inter-row cultivation is used to control weeds and to form a ridge or hill over the seed piece and developing tubers. Besides controlling weeds, the ridge or hill helps protect tuber from sunburn (tuber greening), late season frosts, excessive rainfall or irrigation and reduces the amount of soil to be moved at harvest. Deep cultivation may cause root and tuber pruning.

N2. Matrix (rimsulfuron) at 1 to 1.5 oz 25DF/A plus NIS or oil adjuvant can be applied PRE or POST alone or with Sencor at 0.25 to 0.67 lb 75DF/A to control annual grass and some broadleaf weeds. Use the low rate of Sencor for PRE applications to coarse textured soil. Soil residual of Matrix and Sencor may injure susceptible crops the following year.

Matrix controls eastern black nightshade and may control or suppress hairy nightshade but gives no black nightshade and common lambsquarters control. Apply PRE to potato and weeds after hilling or drag-off but before potato emerge or POST before potato is 14 inches tall and annual weeds are less than 1 inch tall and quackgrass 4 to 6 inches tall. Best results occur when 0.75 inches of water occur soon after application. Apply with MSO type adjuvants or PO at 1% v/v or NIS at 0.25% v/v to emerged weeds. Matrix can be applied in a sequential program of 1 oz 25DF/A PRE followed by 1 oz 25DF/A POST. Matrix may be tank-mixed with Dual, Eptam, Prowl or Sencor. Follow label directions when tank-mixing Matrix plus Sencor. See Sencor paragraph for additional information.

N3. Outlook (dimethenamid) at 18 to 21 fl oz/A applied PRE preemergence or after drag-off controls foxtail and some small-seeded broadleaf weeds, including nightshade species. Allow a 40 day PHI. Rain or sprinkler irrigation after application is required for activation. Weeds that emerge prior to activation will not be controlled.

N4. Sencor (metribuzin) applied PRE at 0.33 to 1.33 lb DF/A or POST at 0.25 to 0.67 lb DF/A controls many broadleaf weeds and suppresses some grasses. Use lower rate on coarse textured soils and for weeds under 1 inch tall. Do not apply to red-skinned, early maturing, white-skinned varieties; or within 3 days after cool, wet, cloudy weather.

Follow varietal restrictions according to Sencor label. Injury may occur to russet type or white skin potato varieties; therefore, use only the low rate of Sencor and consider the risk of weed control vs potato injury prior to application to "at risk" varieties. Refer to label for application information and restrictions.

FORAGE LEGUMES

P1. Seedling legumes are poor competitors with weeds. Use good management practices in preceding crops, such as clean cultivation in row crops and post-harvest tillage to reduce weed seeds in soil. Weed control for establishment of legumes sown alone can be aided by mowing (except sweetclover), herbicides, or by seeding a companion crop. Strong alfalfa competition may improve control of weeds that escape herbicide activity. Except for use of glyphosate in Roundup Ready alfalfa, there is no chemical control for absinth wormwood.

P2. Bromoxynil at 1 to 1.5 pt/A applied POST to seedling alfalfa controls many annual broadleaf weeds. Apply when alfalfa has at least 4 trifoliolate leaves and weeds have 4 leaves or less, or before rosette weeds are 1.5 inches in diameter. Alfalfa injury may occur if the temperature within 3 days after application exceeds 80 F in the western half of ND or 70 F in the eastern half of ND. Bromoxynil can be tank-mixed with Raptor and Pursuit for improved control of pigweed, kochia, and tansy mustard.

P3. Pursuit (imazethapyr) at 3 to 4 fl oz/A or **Raptor** at 4 to 6 fl oz/A applied POST in the fall or spring controls many annual grass and broadleaf weeds in seedling or established alfalfa, dormant, semi-dormant alfalfa, or between cuttings. Apply when alfalfa has at least 2 trifoliolate leaves and weeds are 1 to 3 inches tall. Alfalfa has excellent safety. Apply with NIS at 0.25% v/v or oil additive at 1.5 to 2 pt/A. UAN at 1 to 2 qt/A can be added.

NDSU research has shown excellent weed control of over 22 annual grass and broadleaf weed species when applied with MSO type oil adjuvant at 1.5 pt/A to establishing alfalfa. Yellow foxtail, common lambsquarters, common ragweed, wild buckwheat and perennial weeds may not be controlled.

HERBICIDE-RESISTANT ALFALFA

ROUNDUP READY ALFALFA

P4. Glyphosate at rates up to 1.5 lb ae/A applied from alfalfa emergence to 5 days prior to cutting controls most annual and perennial grass and broadleaf weeds in seedling or established Roundup Ready alfalfa. Glyphosate applied to Roundup Ready alfalfa has excellent safety. Make applications after weeds have emerged but before alfalfa growth or re-growth interferes with spray coverage of the target weeds. Sequential application should be at least 7 days apart.

Due to the biology and breeding constraints of alfalfa, up to 10% of the seedlings may not contain the Roundup Ready gene and will not survive glyphosate application. To eliminate the gaps caused by stand loss, make first application at or before the 3 to 4 trifoliolate growth stage.

Remove livestock before application and wait a minimum of 5 days after treatment before grazing, or cutting and feeding of Roundup Ready alfalfa forage and hay.

CHEMICAL FALLOW

Q1. Postharvest or fallow weed control in minimum-till situations. Dicamba at 0.25 to 0.5 pt/A, or 2,4-D at 0.33 to 1.25 pt/A can be tank-mixed with glyphosate. Refer to the label for additives allowed. Apply low rates of dicamba or 2,4-D plus glyphosate to weeds less than 4 inches tall and actively growing. Use the highest labeled rates of glyphosate under low humidity, when weeds are drought stressed, or if weeds are tall.

Q2. Paramount (quinclorac) at 0.33 lb DF/A controls field bindweed in fallow, postharvest, or preplant in spring prior to seeding wheat including durum. Apply to bindweed at least 4 inches long. Apply with MSO adjuvant at 1.5 pt/A plus AMS at 2.5 lb/A or UAN at 1 gal/A. Apply after harvest but prior to frost. Use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. Paramount also control foxtails, barnyardgrass, and flax.

Q3. Paraquat at 1.5 to 3 pt/A is a non-selective, contact herbicide that can be used as a crop desiccant or as a substitute for tillage applied alone or with residual herbicides. Apply paraquat before crop emergence. Apply in 5 to 10 gpa of water by air or in 10 to 20 gpa of water by ground. Add NIS at 0.25% v/v. Paraquat is corrosive to aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is toxic so avoid contact with skin; small amounts can be fatal when swallowed. Paraquat is a restricted use herbicide. Paraquat tank-mixed with 2,4-D or dicamba will improve control of annual and perennial broadleaf weeds.

Q4. Spartan (sulfentrazone) applied at 4 to 5.33 oz/A in the fall prior to planting of registered crops or in spring with glyphosate or 2,4-D controls emerged vegetation. Plant small grains 4 months or more after application. Spartan requires moisture for activation.

CRP BREAKOUT

R1. CRP breakout

Field research on vegetation management when breaking land out of CRP is limited. Heavy vegetation produced from many years of growth without grazing or haying will make cultivation difficult. For most situations, haying in the summer will help remove much of the vegetation found in CRP. Burning is not recommended. Burning may destroy standing plant residues but will not kill underground roots. Removing vegetation by burning may increase weed seed germination. Methods to control vegetation without destroying residues should be used to enhance soil quality and control erosion.

Cultivation alone will not give satisfactory control of CRP vegetation. A herbicide treatment applied several weeks prior to tillage will reduce the amount of vegetation. Fall-applied herbicides are needed if conventional tillage methods will be used to prepare a seedbed the following year. Fall application allows breakdown of foliage and root plant biomass. Cultivators and some tillage equipment tend to plug during spring tillage when a fall-applied herbicide is not used. Mechanical and cultural vegetation control methods should be followed by a vigorous weed control program the following spring. CRP grasses and forbs may become a problem in the planted crop. Seeding a broadleaf crop after CRP breakout will provide chemical control options not available in grass crops.

NDSU research found that glyphosate at 0.75 lb ae/A applied fall or spring gave less than 70% alfalfa and smooth brome control. Glyphosate at 1.5 lb ae/A applied in fall gave 98% early season alfalfa and smooth brome control but regrowth occurred by mid-summer. A fall application followed by a spring application of Roundup each at 0.75 lb ae/A or a spring application of Roundup at 1.5 lb ae/A was required for greater than 90% control of smooth brome. A spring application of glyphosate at 1.5 lb ae/A also provided over 90% alfalfa and smooth brome control. Tillage improved control of perennial regrowth (15 to 20% increase) from fall applications of Roundup but did not improve control from spring applications.

S1. Wild buckwheat is especially troublesome in broadleaf row crops where few chemical control options are available. Wild buckwheat twists and climbs up crops in a manner similar to field bindweed. Wild buckwheat makes swathing or combining extremely difficult as it wraps itself around the crop and becomes entangled on the sides of the header. In heavily infested fields, wild buckwheat can essentially pull a crop to the ground and severely impact yield. NDSU weed control trials have shown that several herbicides will provide good to excellent wild buckwheat control in small grains including bromoxynil, bromoxynil (+ premixes), clopyralid (+ premixes), dicamba, Huskie, Python, thifensulfuron at small grains rates (alone and in premixes), and WideMatch. Sonalan, Treflan, Prowl, Sencor, and Valor will suppress wild buckwheat. Python, Pursuit or Pursuit Plus applied PPI or PRE, and Liberty provide excellent wild buckwheat control while glyphosate may need two applications or apply with Resource for control.

S2. Foxtail is most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields regularly chisel plowed generally have more foxtail than moldboard plowed fields. Moldboard plowing buries the foxtail seed, which prevents emergence and reduces viable seed for subsequent years.

Making a decision on whether to control foxtail in small grains is not always easy. Research from NDSU and in Canada has shown that foxtail often will not decrease wheat and barley yields; however, heavy foxtail infestations can cause harvest problems (especially when straight combining) and can cause dockage at the elevator. Herbicide treatment for foxtail may not be warranted when foxtail infestations are light - less than 30 plants/sq. ft and when foxtail emerges after the crop is in the 3- to 4-leaf stage. This is especially true for barley. Once the small grain is in the 3- to 4-leaf stage, it can usually out-compete emerging foxtail. Chemical control is warranted when the foxtail population is heavy (100 plants/sq ft or more). Foxtail also may contribute to moisture stress and cause greater yield loss under drought conditions. Foxtail emerging at the same time or before small grain is more competitive than when emerging after small grain. Some options to consider for foxtail control are:

1. If the foxtail infestation is heavy, and just emerging with the crop, consider harrowing or rotary hoeing as soon as possible. Harrowing or rotary hoeing is not effective once foxtail has 2 to 3 leaves. Small grains can be harrowed or rotary hoed until the 3- to 4-leaf stage with little effect on yield. If a harrow or rotary hoe is not an option, then consider a herbicide.

2. If the foxtail infestation is light to moderate, chemical control may be elective but weed seed may contribute to weed infestations in subsequent crops. Herbicides can still be used if foxtail is a problem after small grain is in the 5- to 6-leaf stage.

S3. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. ALS herbicides provide good control of susceptible kochia populations. Tank-mixing ALS herbicides with other effective broadleaf herbicides with differing modes of action is required to slow development of resistant kochia. Dicamba, Huskie, Starane, and WideMatch control ALS-susceptible and -resistant kochia. Bromoxynil plus MCPA or Aim also give good control of small kochia, but plants should be small and spray coverage good.

Tordon and clopyralid are not effective on kochia and 2,4-D and MCPA no longer control kochia due to resistance from repeated use and near eradication of susceptible kochia biotypes. 2,4-D and MCPA do not translocate readily in kochia.

Treat plants when small (less than 3 inches tall). Kochia seed is short-lived in soil so one or two years of excellent control can greatly reduce kochia populations. DNA herbicides do not give consistent kochia control. However, Sonalan may improve control. Soil-applied Spartan gives good to excellent kochia control. Flexstar or Reflex applied with MSO- type adjuvant in high water volumes of 20 gpa to small kochia may give good postemergence control.

S4. Nightshades have become a serious weed problem in North Dakota due to human activity associated with crop production, like moving tillage and harvesting equipment from field to field or planting crop seed contaminated with nightshade seed. Also, birds and wildlife consume nightshade berries and can transport seed through droppings.

Four nightshade species are found in North Dakota: black nightshade, eastern black nightshade, hairy nightshade, and cutleaf nightshade. Hairy nightshade is the only species densely covered with small hairs. The berries of cutleaf and hairy nightshade remain green at maturity. Only the underneath side of black and eastern black nightshade leaves are black or dark-purple and berries turn black or dark purple at maturity. Eastern black nightshade is very difficult to distinguish from black nightshade before berry formation. Eastern black nightshade forms berries in umbrella-like clusters with berry stems arising from a common point, the calyx of eastern black nightshade is the smallest of the four, and the lobes of the calyx recurve away from the berry. Black nightshade and hairy nightshade berries connect in a racemose fashion (similar to grapes). The calyx of black nightshade is mid-size and the lobes extend outward, while the calyx of hairy nightshade is large and encloses half the berry. It has been reported that leaves from eastern black nightshade plants are translucent and leaves from black nightshade are opaque when held to sunlight.

Nightshade emergence may continue from June through September and is strongly influenced by moisture. Rain events cause multiple flushes of nightshade, so plants can emerge even after normal crop spraying is complete. Hairy nightshade emerging in early fall can produce viable seed before frost while eastern black nightshade requires a longer growing season. Nightshade can compete after crops form a shaded canopy. Consequently, growth of nightshade can accelerate after small grain harvest, which exposes nightshade to sunlight. Nightshade seeds become viable shortly after berry formation and seeds can remain viable in soil for 15 years when deeply buried. Studies show that one nightshade plant can produce 178,000 seeds under competitive situations or 800,000 without competition. Therefore, successful nightshade management requires prevention of seed production.

Nightshade plants remain green after a frost and can cause harvest problems. Berries are poisonous and the juice from ruptured berries can stain crop seed and glue nightshade seed and dirt to harvested seed. In addition, dry nightshade berries are similar in size to soybean or field pea seed and are difficult to separate. Nightshade can be spread to other fields by equipment and contaminated seed is used for planting.

Nightshade biotypes are tolerant to many classes of herbicides, including SUs (except Express). Eastern black nightshade resistance to imidazolinone herbicides has been documented in the Red River Valley of North Dakota. Thus, herbicides may remove competing broadleaf weeds allowing nightshades to proliferate.

S5-7 - ANNUAL WEED CONTROL

Only a few residual soil herbicides, e.g. Balance Pro, Extreme, Gangster, Pursuit, Python, Spartan, and Valor control nightshade flushes and may leave a residue the following year. Use of herbicide resistant crops (Clearfield, Liberty, and Roundup Ready) to control nightshade. Basagran may control hairy nightshade but not eastern black nightshade. Black nightshade is more tolerant to some herbicides (Matrix) than eastern black nightshade. Flexstar/Reflex gives poor hairy nightshade control. Refer to pages 120 to 125 for chemical control options. Other options for nightshade management include planting of uncontaminated seed, using crop rotations, multiple herbicide applications to control late flushes, and inter-row cultivation.

S5. Pigweed control requires higher rates of most herbicides than rates for wild mustard control. All ALS herbicides give good control. Dicamba and 2,4-D also give good control. MCPA is not as effective as 2,4-D in controlling pigweed. The esters of 2,4-D generally are more effective than the amines. Bromoxynil and bromoxynil + MCPA are generally poor on pigweed. A redroot pigweed population resistant to imidazolinone herbicides has been documented in Cass county.

Waterhemp, a related pigweed species, has biotypes that are tolerant to ALS herbicides. Geographic distribution is across the midwest, and has been documented in the Red River Valley. For more information on pigweed species refer to publications "Pigweed Identification" from Kansas State University Ext. Service, (913) 532-5776 (\$1.50) or "Waterhemp Management in Agronomic Crops" (No. X855) from University of Illinois Ext. Service, (217) 333-0005 (\$2.00).

S6. Wild oat is difficult to eradicate because the plants shatter their seeds before crops are harvested and because seed dormancy causes delayed germination. Wild oat is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist. Cultural approaches available for wild oat control in small grains include delayed small grain seeding, post seeding cultivation, and competitive crops. The most practical cultural method of wild oat control is delayed small grain seeding, which involves early soil cultivation to stimulate wild oat germination followed by tillage or chemical control to kill emerged wild oat prior to crop seeding. Delayed seeding may cause a significant wheat yield reduction when compared with early seeding.

Other cultural control practices are planting competitive crops like barley and rye. Wild oat eradication is not practical or economically sound; therefore, a combination of cultural and chemical control methods should be used to manage wild oat populations and minimize yield losses.

Apply POST wild oat herbicides to wild oat and crops at precise leaf stages. Early application may result in better yield because of less competition with the crop, but later flush of wild oat may require a second application. In general, any population warrant chemical control to prevent yield losses and reduce seed production. Wheat yield reduction from foxtail and wild oat competition in NDSU research follows.

Grass Weed Competition in Wheat

Weeds/sq. yard	Foxtail	Wild oats
	% wheat yield reduction	
10	0	8-9%
50	4-5%	18%
75	6-7%	25%
100	8-9%	34%
150	15%	40%

S7. Wormwood, annual or biennial, plants emerge throughout the year, behave like an annual species, and produce up to 1 million seeds/plant. B. wormwood seeds are very small and can be dispersed easily by wind, water, and all human-related operations. B. wormwood thrives in undisturbed (no- or minimum-till) areas, low areas, and areas where soil may remain wet for extended periods of time. Consequently, with every rain event a new flush of wormwood seedlings may appear.

Biennial wormwood survives most PPI, PRE, and POST herbicides and is misidentified as common ragweed. Also, biennial wormwood can emerge late after most POST herbicides have been applied. Rescue treatments with herbicides that control common ragweed, such as Ultra Blazer and FirstRate, have little or no effect on wormwood. B. wormwood plants can grow six feet tall with a woody stem that averages 1 to 2 inches in diameter and can impede grain harvest, including damage to harvesting equipment.

Biennial wormwood is difficult to control because of an extended emergence period and tolerance to many PPI, PRE (acetochlor, metolachlor, Prowl, Sonalan, and Treflan) and POST (most ALS herbicides, Cobra, Flexstar/Reflex, and Ultra Blazer) herbicides used in row crops. Spartan, Python, Sencor, and Valor provide residual biennial wormwood control. Growth regulator herbicides of 2,4-D, clopyralid, clopyralid + 2,4-D, dicamba, Hornet, Status, WideMatch, and the non-selective herbicides Liberty and glyphosate control wormwood. However, biennial wormwood can emerge after most POST herbicides have been applied and produce seed the same season.

Basagran may not control wormwood with one application. Basagran applied as split applications will improve control. Apply the first split when wormwood is 1.5 inches tall and second split 7 to 10 days later. Wormwood rapidly becomes tolerant to herbicides as plant size increases.

PERENNIAL WEED CONTROL

T1. Field bindweed. Paramount (quinclorac) at 0.33 lb DF/A controls field bindweed in fallow, postharvest, or preplant in spring prior to seeding wheat, including durum. Apply with MSO adjuvant at 1.5 pt/A to bindweed at least 4 inches long. Apply after harvest but prior to frost. Use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. Paramount also may control foxtails, barnyardgrass, and volunteer flax. Multi-state field research show excellent field bindweed control at rates of 0.33 to 0.5 lb/A. Yearly applications are required when rates less than 0.37 lb ai/A are used.

T2. Canada thistle is a major problem in ND due to reduced tillage, wet weather, lack of persistent control strategies, and expense of control. NDSU research has shown that clopyralid and clopyralid plus 2,4-D provide the best long-term Canada thistle control. Glyphosate alone or with 2,4-D gives good control applied pre- and post-harvest. However, control is reduced under dry conditions. Several herbicides give good but temporary season-long control: dicamba and tribenuron, including premixes. In small grains, applying tribenuron (plus premixes) plus 2,4-D and dicamba enhances control. 2,4-D applied at jointing followed by clopyralid & 2,4-D applied post-harvest to rosette thistle provided the best long-term control. Pre-harvest glyphosate treatments also give good control. Glyphosate applied alone gave control similar to clopyralid & 2,4-D but less control than glyphosate plus 2,4-D.

Clopyralid, clopyralid & 2,4-D, dicamba, glyphosate, Tordon, WideMatch, and 2,4-D have the greatest activity on Canada thistle in annual cropping systems. Highest rates should be used without interfering with next years cropping pattern. Apply high rates of herbicides to patches before thistle infestations increase. Timing is a critical factor. Herbicides applied after a light frost may enhance control but application when leaf tissue has been destroyed by frost may result in less control due to lack of herbicide uptake.

Tillage can be a critical factor. Tillage in late fall after spraying increases control and may add an additional 30 to 40% control for herbicide treatments that gave 30 to 50% control without tillage. If lower herbicide rates or less effective herbicides are used, tillage is very important. If tillage is not planned, implement a program of multiple applications of the most effective herbicides at the highest rates practical. Spray rosettes of actively growing plants using the rosette technique described below.

Milestone effectively controls Canada thistle, but it is labeled in North Dakota only on noncropland, such as pastures, rangeland, and CRP, because of soil residual that adversely affects many crops in annual crop rotations.

Rosette Technique. The rosette technique maximizes long-term Canada thistle control by encouraging root buds to break dormancy but not initiate flowering. These vegetative shoots provide better absorption, translocation, and activity than flowering shoots. Greatest control occurs when herbicides are applied in the fall to new growth of Canada thistle in the rosette stage. Periodic tillage in fallow controls Canada thistle shoots and other weeds until mid July when the day-length is less than 15 hours. Canada thistle shoots that emerge when day-length is less than 15 hours do not bolt but remain in the rosette growth stage. Apply clopyralid, clopyralid & 2,4-D, glyphosate, or WideMatch to rosettes in late September or early October. For in-crop control, use herbicides and between-row tillage to prevent bolting. Continue cultivation until canopy closure in soybean and until early July in corn. Effective herbicides can be applied post-harvest until early October. Herbicides fall-applied to rosette Canada thistle provide greater control and root kill compared with treating bolted Canada thistle.

T3. Common milkweed has become a severe weed problem in cultivated cropland due to an extensive deep root system, insulating winter snow, moist to wet summer conditions, tolerance to many commonly used herbicides, reduced tillage, and lack of human persistence in control measures. Common milkweed is tolerant to most labeled herbicides. Control requires multiple herbicide applications. Preventing establishment and spread of milkweed patches requires continuous scouting and persistent control efforts. Prevent seed production. Milkweed seed is highly viable and will germinate readily. Pappus on seeds allows long-distance travel and is responsible for establishment in fields. Common milkweed becomes perennial (capable of reproducing from underground roots) approximately 3 weeks after emergence. New shoots develop from established roots and begin emerging in late April and grow more rapidly than spring seeded crops. Milkweed control is expensive. Individual plants and small patches are easier and less expensive to treat than entire fields. Patch spraying covers only a fraction of the area of a broadcast application. Patch spraying allows use of higher herbicide rates with less expense than broadcast spraying.

Common milkweed control and management.
NDSU Research. Herbicides applied in June.

Herbicide	Rate pt/A	Months after application	
		3 mo.	12 mo.
		-- % control --	
2,4-D ester	4	36	48
Dicamba	2	71	61
Dicamba + 2,4-D	0.5+2	26	15
clopyralid + 2,4-D	4	13	6
Tordon	2	86	83
Glyphosate	6	56	99

Express + 2,4-D + dicamba controls only top-growth.

Glyphosate at 1.5 lb ae/A applied preharvest will reduce milkweed densities 85 to 95% compared to in-crop applications, which reduce milkweed densities by less than 40%. Apply herbicides when milkweed is in the late-bud to flowering stage and actively growing. Control patches when small. Patch-spray glyphosate at 6 to 8 pt/A (up to 10 pt/A is allowed). Apply glyphosate with AMS at 4 to 8.5 lb/100 gallons of water. Patch-spray Tordon at 4 to 8 pt/A. Tordon residue will help prevent other shoots from emerging. **CAUTION:** Treated areas will contain Tordon residues for several years after application.

T4-13 - PERENNIAL WEED CONTROL

T4. Fall-applied herbicides can be effective for controlling perennial weeds, provided most stem and leaf tissue has not been killed by frost. Weeds such as field bindweed, leafy spurge and Canada thistle should have 6 to 12 inches or more of stem or rosette tissue before treatment for adequate leaf area to absorb the herbicide. Good leafy spurge control can be expected through mid-October with auxin herbicides even after several light frosts when the leaves are green or red and still firmly attached to the stem.

T5. Mowing or tillage is a good means of reducing perennial weed seed production. If fall herbicide applications are planned, mowing or tillage should be discontinued early enough to allow adequate plant regrowth. Post-harvest treatments can be applied when weed growth is about 1 foot tall. Preharvest herbicide treatment should precede harvest by at least 5 days to allow adequate herbicide translocation in perennial weeds. Fortunately the minimum PHI for many preharvest treatments meets or exceeds this guideline.

PERENNIAL WEEDS IN CROPS

T6. Perennial weed control systems in crops should include in-crop (conventional and particularly Roundup Ready crops if available), preharvest, and postharvest herbicide applications. Regardless of application, retreatment once or twice per year will be required for successful control of perennial weeds. Once large patches are controlled, seedlings will require treatment annually with registered in-crop herbicides. Glyphosate use in Roundup Ready corn, soybean, and canola is a very effective system to control perennial weeds. Decreasing cost of glyphosate enables economical control. NDSU research has shown control of established Canada thistle patches with glyphosate applied preharvest. For postharvest herbicide applications to be effective, treatment of new plant growth is required. Tillage combined with any herbicide treatment enhances control. Tables for each crop or perennial weed listed in this guide gives most effective herbicide choices, rates, and application information.

T7. Glyphosate at 0.75 to 1.5 lb ae/A applied as a spot treatment will give season-long control of perennial weeds in wheat, barley, oat, corn, and soybean. Glyphosate is non-selective so the crop in the treated area will be killed. Avoid drift outside the target area. Glyphosate is non-residual so plants may emerge after treatment and unaffected rhizomes or roots from perennials will continue to grow. See label or tables for application stage and rates. Glyphosate at 0.75 lb ae/A applied preharvest gives good Canada thistle and quackgrass control. When tillage is used after harvest, glyphosate will give greater Canada thistle control when applied preharvest than post-harvest.

PERENNIAL WEEDS IN PASTURES

(See Z1 for haying and grazing restrictions)

T8. 2,4-D ester or amine at 2 to 4 pt/A controls many perennial weeds in pastures. Some perennials such as fringed sagebrush and western snowberry (buckbrush) are controlled with one application and perennials such as Canada thistle, field bindweed, and leafy spurge require retreatment annually. 2,4-D can be used where Tordon cannot, but avoid drift onto susceptible plants. Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

2,4-D formulations registered for use in water include Agrilience "AgriSolutions 2,4-D Amine 4", UAP "Savage" and "Amine 4 2,4-D Weed Killer", Nufarm "Weedar 64", Van Diest "Cornbelt 4 lb Amine" and "Cornbelt Navigate", and Helena "Opti-Amine". Use only 2,4-D formulations registered for use near or in water. Refer to 2,4-D labels for information.

T9. Crossbow (triclopyr & 2,4-D) at 1 to 6 qt/A can be applied to grass pastures for broadleaf weed and brush control. Crossbow plus 2,4-D generally provides better musk thistle and brush control than 2,4-D alone. Do not graze lactating dairy animals or harvest hay from treated areas for 1 year after application. Do not graze beef animals within 3 days of slaughter during the first year after treatment.

T10. Dicamba at 1 to 2 pt/A will suppress some perennials, especially field bindweed and weeds resistant to 2,4-D. Dicamba can be applied in 1 to 5 gpa in pasture, rangeland, and fallow. When applying dicamba at 2 pt/A or less, use 0.5% v/v surfactant or AMS at 2 to 6 lb/100 gal of spray solution. Long-term control generally is achieved with 4 to 16 pt/A but the high rates are economical only for spot treatment. Dicamba has a shorter soil residual than Tordon, but should not be applied where desirable plants may be damaged by herbicide leached to the root system. The label indicates the required delay between treatment and grazing of dairy animals or cutting for hay but varies with rate from 7 to 90 days.

T11. Metsulfuron at 0.1 to 0.3 oz 75DF/A or **metsulfuron & 2,4-D & dicamba** at 0.25 to 1 oz DF/A Part A + 1 to 4 pt/A Part B can be applied in rangeland, grass pastures, and non-cropland for control of noxious and troublesome weeds. Spot treat at higher rates when practical. Spray foliage for thorough coverage but not to run-off. Add a NIS at 0.25 to 0.5% v/v or PO at 1% v/v. Use of NIS may cause temporary yellowing, stunting, and suppression of head development in annual and perennial grasses. To avoid grass injury, do not apply to desirable grasses under stress, nor to grasses grown for seed. Products with 2,4-D, dicamba, and many other herbicides increase control and reduce risk of resistant weeds. Some brands of metsulfuron at 1 to 1.5 oz DF/A can be applied by air (helicopter and fixed wing) for weed control to utility and pipeline right-of-ways, military installations, and rangeland and pasture.

T12. Milestone (aminopyralid) at rates up to 14 oz/A per annual growing season may be applied as a spot treatment to not more than 50% of an area. Milestone has no grazing or haying restrictions but allow 3 days for animals to graze in untreated areas before transferring them to areas with sensitive broadleaf plants. May be applied to waters edge and in seasonally dry wetlands. Do not apply directly to water or to areas where surface water is present. Milestone can be applied to the soil under the canopy of several trees. Refer to label for list of tree species. Apply only as a directed spray under the canopy. Do not apply Milestone over-the-top of any tree. Legume plant and tree species are very susceptible to Milestone.

T13. Plateau (imazapic) with MSO adjuvant at 1 qt/A and UAN at 1 qt/A applied from early September to mid-October controls many grass and broadleaf weeds, including foxtail and leafy spurge in right-of-ways, pasture, rangeland, and CRP. Warm-season grasses are more tolerant than cool-season grasses. Highest rate provides longer control but increases grass injury. Plateau does not control absinth wormwood. Plateau does not injure desirable forage grasses or some broadleaf species including lead plant (*Amorpha canescens*), purple prairie clover (*Dalea purpurea*), prairie wild rose (*Rosa arkansana*), willow, (*Salix species*), and wild raspberry (*Rubus species*).

T14. Redeem (clopyralid & triclopyr) at 1.5 to 4 pt/A controls most annual and perennial broadleaf weeds in grass pastures, rangeland, CRP, and non-cropland. Apply with NIS at 1.5 to 2 pt/A for annual broadleaf weeds, diffuse and spotted knapweed, and yellow starthistle control. Apply with NIS at 2.5 to 4 pt/A for absinth wormwood, fringed sage, Canada thistle, perennial sowthistle, and Russian knapweed. Apply to thistle from rosette to bud stage and in the fall following light frosts but prior to a killing frost. Redeem is more cost-effective than Curtail at the same active ingredient use rate. For lactating animals, do not graze or harvest green forage for 14 days after application. Do not harvest for dry hay for lactating animals until the next growing season. There are no grazing restrictions for non-lactating animals. Do not harvest dry hay for non-lactating animals for 7 days after application.

T15. Tordon (picloram) at 4 to 8 pt/A applied as a spot treatment controls broadleaf perennial weeds such as leafy spurge, common milkweed, field bindweed, Canada thistle, and Russian knapweed on rangelands and permanent grass pastures. Tordon at 1 to 2 pt/A applied POST will suppress growth of perennial broadleaf weeds. Retreatment at the same rates is necessary the following year. The most cost-effective broadcast spring-applied treatment for leafy spurge control is Tordon at 1 pt/A plus 2,4-D at 2 pt/A applied annually for 3 to 5 years. Do not apply Tordon with dry fertilizers.

Tordon is a restricted pesticide because it is toxic to most broadleaf plants. Spray drift will damage broadleaf crops and plants. Tordon is water soluble and may leach in the soil; consequently, do not apply in areas where a sandy porous surface and substrata overlay ground water 10 feet or less below the surface. Tordon must not be allowed to drift into surface water (including wells), irrigation water and drainage ditches or near shelterbelts, shrubs, or trees.

Do not cut grass for feed within 2 weeks after treatment at Tordon rates greater than 2 pt/A. Tordon is excreted in the urine, so do not transfer livestock from treated grass areas onto sensitive broadleaf crop areas for 12 months after application without first allowing 7 days of grazing on untreated grass. When the Tordon rate exceeds 2 pt/A, the total area treated should not exceed 25% of a land owner's acreage found in any particular watershed.

T16. Mixture of Tordon + Plateau applied in June has provided greater leafy spurge control than Tordon + 2,4-D. Use of 2,4-D with Tordon + Plateau is not necessary but will increase the spectrum of broadleaf weeds controlled. Research by NDSU has shown improved leafy spurge control both in-season and the season following application when Tordon and Plateau are used.

Treatment	Product/A	Months after application		
		3	12	15
		----- % control -----		

Tordon + 2,4-D	1 pt + 1qt	75	48	0
Tordon + 2,4-D + Plateau + MSO	1 pt + 1 qt + 4 oz +1 qt	92	83	75

MSO adjuvant is required. Do not apply after July 1. Bromegrass species occasionally have shown short-term injury.

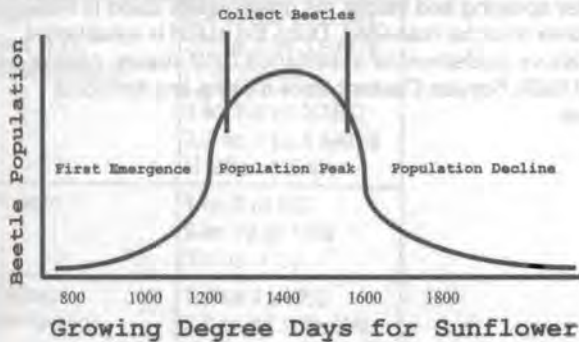
T17. NRCS Policy on Noxious Weed Control in CRP. Taken from ND NRCS Exhibit 3, 2-CRP Manual, para. 210. Established CRP Stands: Policy requires that no clipping or spraying of entire fields should be done during the primary nesting period (April 15 to August 1) for normal weed control. If noxious weeds are present and the critical control period for the weed falls in the primary nesting period, spot treatment of weeds is allowed. Herbicides chosen should maintain the grass and legume mixture. If this is not possible, control of the noxious weeds is a priority over maintaining legumes in the mix. Always notify your local USDA Service Center before making any herbicide applications.

New CRP Stands: Policy requires that weeds (noxious, common, volunteer grain, etc.) be controlled until the CRP stand is established. Clipping and/or spraying during establishment should be used to control weed growth and reduce competition for the new seedlings. Clipping and/or spraying may be done at any time during the establishment period. If noxious weeds are present, control of noxious weeds is a priority over maintaining legumes in the mix. If the legume is killed after spraying and before the grass/alfalfa stand is established then a legume must be reseeded. Once the stand is established follow the above guidelines for established CRP stands. Always notify your local USDA Service Center before making any herbicide applications.



BIOLOGICAL CONTROL OF PERENNIAL WEEDS

T18. Leafy spurge. Eight insects species have been released in North Dakota for biological control of leafy spurge. **Flea beetles** (*Aphthona* spp.) have been the most effective insects due to root feeding by larvae, rapid establishment, and increase after introduction, and ease in capture to transport to additional locations. Flea beetles are distributed through the ND Biological Control Program. Contact your county weed officer or board member for information. Release flea beetles on a well-drained south-facing slope with a moderate density of leafy spurge (60 to 90 plants/square yard) with minimal grass cover. Do not collect or move flea beetles, cultivate, burn site, or apply insecticide within 0.25 mile of release site for 3 to 5 years to allow establishment. During establishment, landowners should prevent expansion of the leafy spurge infestation by treating uninfested perimeters with herbicides. The best time to collect and distribute flea beetles is between 1000 to 1500 accumulated growing degree days (AGDD) for sunflower. Scout for establishment when the total AGDD for sunflower reaches 1100 to 1200. Flea beetle density prior to 1200 and after 1600 AGDD is low.



Use an insect sweep net to collect beetles to estimate density. Collect beetles from 10:00 am to 3:00 pm, greater than 70 F, little or no wind, sunny skies, and when leafy spurge foliage is dry. Sweep 5 times over an area of 1 m². Count the number of flea beetles by removing excess trash and non-flea beetle insects and pour beetles into a graduated container. Every 10 ml of flea beetles is approximately 1000 individuals.

Redistribute flea beetles to other leafy spurge infestations when 500 to 1000 beetles per 5 minute sweeping period are collected. Over-harvest of beetles is not possible because many flea beetles fall to the ground prior to being swept or are on the soil surface laying eggs. Redistribute flea beetles in a small area of 10 ft² or less. A successful release should result in 50 or more flea beetles in 5 sweeps the summer following release. If densities are less than 50 flea beetles per 5 sweeps then re-infest the site with additional flea beetles. A portion of the release area can be treated with Tordon (picloram) plus 2,4-D (2 pt + 2 pt) from early to mid-September to reduce leafy spurge stem density and increase insect establishment.

Research at North Dakota University has shown greater leafy spurge control when herbicides are combined with flea beetles compared to either used alone. Contact your county weed officer for date, time, and location of flea beetle collection in your area and information on purchasing collection equipment. An instructional video is available from the North Dakota Department of Agriculture, "[How To Raise Leafy Spurge Flea Beetles](#), North Dakota's Biological Control Program".

Leafy spurge gall midge (*Spurgia esulae*) prevents galled stems from flowering, thereby decreasing seed production. The gall midge generally infests only part of a leafy spurge population so seed production is reduced but not eliminated. A second control method is needed to reduce the original infestation and

prevent spread by roots and seeds of plants not galled. Research at NDSU has shown that the leafy spurge gall midge is compatible with herbicide treatment in an integrated leafy spurge management program. Herbicides such as Tordon or 2,4-D should be applied at the optimum growth stage for leafy spurge control. Some of the area (perhaps 15 to 25%) must be left untreated to sustain the insect population. This integrated program may be most useful near wooded areas or rough terrain. Consult NDSU Ext. Service Circulars W-866, Integrated Management of Leafy Spurge; W-1088 Leafy Spurge Biology, Ecology, and Management W-1183; and Leafy Spurge Control Using Flea Beetles, for further details.

Grazing. Sheep and goats provide an alternative to herbicides for controlling leafy spurge top-growth in pasture and rangeland with large infestations or along waterways and tree areas. Grazing alone reduces but does not eliminate leafy spurge infestation. Grazing slows the spread and allows grasses to be grazed by livestock. Grazing should be started in spring when plants first emerge. Divide infested areas into sections so animals can repeatedly graze new growth. NDSU research has shown that grazing leafy spurge with goats followed by a fall-applied herbicide treatment provided more rapid and better long-term leafy spurge control than either method used alone. Consult NDSU Ext. Service Circular W-866, Integrated Management of Leafy Spurge, for details.

Recommended stocking rates vary with terrain, leafy spurge density, and rainfall during the growing season. Sheep should be grazed at about 3 to 6 head/A/month or 1 to 2 ewes/A. Angora goats should be grazed at 12 to 16 goats/A/month or 3 to 4 goats/A. Grazing with goats controls leafy spurge with little utilization of the grass species. The stocking rate will decline over time as the leafy spurge infestation is reduced. Animals should be contained for 3 to 5 days so viable seed can pass through the digestive system before they are moved to non-infested areas. Which animal to utilize will depend on a land manager's specific conditions, such as fencing, availability of animals, need to overwinter, and prevailing markets at the time. Consult NDSU Extension Service Circular R-1093, Controlling Leafy Spurge Using Goats and Sheep, for further details.

T19. Purple loosestrife. Six species of insects have been identified as having potential for biological control of purple loosestrife. Three species have been released into North Dakota. The insects and plant parts attacked are:

Galerucella pusilla - a leaf-feeding beetle

Galerucella californiensis - a leaf-feeding beetle

Hylobius transversovittatus - a root-mining weevil

Biological agents hold promise for large infestations, thereby reducing the spread from neighboring states. However, purple loosestrife infestations in North Dakota are very small and isolated and **should be controlled by chemical and/or mechanical methods**. Biological control agents for purple loosestrife may not work well in urban areas because mosquito spraying severely reduces populations of biocontrol agents.

SHELTERBELT WEED CONTROL

U1. Herbicides listed in the table can be used for weed control in shelterbelts and tree plantings. Read and follow label directions. Eliminate perennial weeds with repeated tillage or with non-residual herbicides before trees are planted.

Many herbicides are NOT labeled for over-the-top application to trees and must be applied through directed application. Some herbicides (Stinger) can be applied over-the-top to coniferous (cone bearing) trees but not over-the-top to deciduous (leaf bearing) trees. Most herbicides can injure trees if applied in a manner inconsistent with label directions. Some herbicides should only be applied in fall or early spring before weeds germinate and trees begin leaf growth. Princep can only be applied to well established tree stands (over three years old). Only use herbicide formulations that are labeled in shelterbelts and only as described on the label.

TOTAL VEGETATION WEED CONTROL

V1. Weeds and plants should be controlled before emergence or when very small to minimize the risk of drift, and improve herbicide performance. Total vegetation weed control herbicides are generally applied PRE or EPOST alone or in combination with other herbicides to achieve short to long-term weed control. Addition of a non-selective contact or systemic herbicide at application can provide burn-down of existing vegetation and long-term vegetation control. Initial high rates of a residual herbicide or combination of residual herbicides followed by treatment in subsequent years at rates of 1/3 to 2/3 the initial rate will give satisfactory extended control. For short term bare-ground control, non-residual herbicides can be applied several times per year.

General precautions when using soil sterilants are:

1. Correctly identify the weed species to be controlled.
2. Do not move treated soil.
3. Avoid spray drift and reduce drift potential by applying at lower temperatures, using non-volatile formulations, reducing spray pressure, and selecting nozzles that produce larger droplets.
4. Avoid applying where wind or water will move the treated soil.
5. Do not apply where roots of desirable vegetation may extend into the treated area.
6. Be familiar with and know the risks of the product to be applied.
7. Use a combination of herbicides with different modes of action to avoid resistant weeds.

HERBICIDE RESISTANT WEEDS

X1. Herbicide resistance occurs with repeated use of a specific herbicide for control of weed species that contain some plants in the population with a resistant gene. The resistant type will increase with each use of the herbicide because the gene pool in the field will shift from susceptible to resistant. This shift is permanent, assuming that the resistant type plants are equally "fit" in the cropping environment. Use of one herbicide from a group with one mode of action may give resistance to other herbicides with the same mode of action. However, weed specificity for resistance is known for different herbicides within a mode of action group. For example, wild oat resistant to Hoelon is often but not always controlled by other herbicides with similar chemistry and by Poast or Select of different chemistry, but all with the same mode of action.

Weed plants with a wide genetic diversity develop resistance rapidly, especially for herbicides with one site of action. Kochia developed resistance rapidly in North Dakota to ALS herbicides because of kochia diversity and the SU single site of action. Kochia plants vary in resistance to various SUs, but in general kochia plants rapidly develop resistance to individual SU herbicides. Imidazolinone (Imi) herbicides are in the same action group (ALS inhibitors) as SUs, but weeds do not necessarily have cross resistance. For example, nightshade species exhibit natural tolerance to SUs, but only recently developed resistance to Imi herbicides. Table X1 lists herbicides within various mode of action groups as a guide for possible cross resistance.

Types of Resistance

Altered site of action - ALS inhibitors and other herbicides act on one specific site in a plant selecting for resistant plants in diverse plant species. Herbicides that affect one enzyme in a plant usually are prone to altered site-of-action resistance.

Altered herbicide metabolism - Plants prevent herbicide toxicity by rapid degradation. Corn degrades atrazine by this mechanism. This type of resistance is more complex than altered site-of-action type resistance because it involves several plant processes. Plants with altered metabolism resistance can degrade several unrelated herbicides of different modes of action through multiple genes controlling metabolic processes.

Plants having altered site-of-action resistance often are not affected by herbicide concentration, but plants having altered metabolism resistance are affected by herbicide rate. As rate increases, the plant eventually reaches a point where it cannot degrade the herbicide faster than the herbicide is absorbed.

Cross and Multiple Resistance

A plant with a single resistance mechanism that enables survival when treated with different chemicals is cross resistant to those chemicals. Resistance that develops to one ALS herbicide often confers cross resistance to other ALS herbicides. The same is generally true with imidazolinones. In some cases, resistance that develops to a SU confers cross resistance to imidazolinones.

A plant with two or more resistance mechanisms that survives treatment with different chemicals has multiple resistance. Kochia may be resistant to SUs and atrazine. Different resistance mechanisms are involved; therefore, a kochia plant that withstands treatment with SUs and atrazine has multiple resistance.

Herbicide resistant weed species in ND:

(#) = Herbicide mode of action, see pages 108-109.

ACCase inhibitor herbicides (1):

- Wild oat (All ACCase herbicides except clethodim)
- Green foxtail (All ACCase herbicides except clethodim)
- Yellow foxtail (All ACCase herbicides except clethodim)

Wild oat resistance has been documented in nearly every ND county.

ALS inhibitor herbicides (2):

- Wild oat (Only Assert and Everest)
- Kochia (All ALS herbicides)
- E. black nightshade (Imi herbicides: Raptor and Pursuit)
- Redroot pigweed (Imi herbicides: Pursuit and Raptor)
- Waterhemp (All ALS herbicides)
- Wild mustard (All ALS herbicides)
- Common ragweed (TPS herbicide: FirstRate and SU herbicides)
- Marshelder (Imi - Pursuit and Raptor, and SU - Express)

Mitotic inhibitor (3):

- Green foxtail (Treflan, Sonalan, Prowl)

Growth regulator (4):

- Kochia (2,4-D, dicamba)

Photosystem II inhibitor (5):

- Kochia (atrazine)

Lipid synthesis inhibitor (8):

- Wild oat (Far-Go)

Resistant wild oat biotypes were also found to be resistant to Avenge.

Unknown mode of action (26):

- Wild oat (Avenge)

Resistant wild oat biotypes were also resistant to Far-Go.

Herbicide resistant weed species in the U.S. - not in ND:

Other weeds present in ND that have developed resistance to herbicides in other areas of the nation are listed below.

ALS inhibitor (2):

Yellow foxtail, giant foxtail, waterhemp (ALS + Ps II - 2006, ALS + PPO + Glyt - 2006, ALS + Ps II + PPO - 2006), common lambsquarters, sunflower, common cocklebur, giant ragweed, and Russian thistle.

Growth regulator (4):

Wild mustard and field bindweed.

Photosystem II Inhibitor (5):

Yellow foxtail, redroot pigweed, common lambsquarters, and common ragweed.

EPSP Synthase Inhibitor (9) (Glyphosate) - when discovered:

- Ryegrass (1998)
 - Horseweed (Marestail) (2000)
 - Glyt + ALS (2003)
 - Common ragweed (2004)
 - Glyt + PPO (2006)
 - Glyt + ALS + PPO (2006)
 - Common lambsquarters (2005)
 - Palmer amaranth (2005)
 - Waterhemp (2005) - Glyt @ 3 lb rate, 6 lb = 93% survivorship at 4 and 12 in tall plants
 - Glyt + PPO + ALS (2006)
 - Canada fleabane (Canadian prairie provinces) (2005)
- KS has four glyphosate resistance weeds (2007)
Horseweed, Giant ragweed, Waterhemp, Common ragweed

PPO inhibitor (14):

Common ragweed (2004)

PPO + ALS (2006)

Waterhemp (2006)

PPO + ALS + Glyt (2006)

PPO + ALS + Ps II (2006)

Weeds expressing some natural tolerance to glyphosate:

cinquefoil	clover	common lambsquarters
common mallow	dandelion	horseweed (maretail)
kochia	nightshade	nutsedge
prickly lettuce	smartweed	velvetleaf
waterhemp	wild buckwheat	

Weeds expressing some natural tolerance to Liberty:

grasses common lambsquarters yellow nutsedge

Genetically engineered crops resistant to glyphosate, Liberty, and Raptor (Imi herbicides) can be used to control weeds resistant to other herbicides. However, heavy selection pressure from these herbicides may cause resistant biotypes to occur.

For a comprehensive list of resistant weeds in North Dakota, U.S., and world see web site: www.weedscience.org

STRATEGIES TO MINIMIZE HERBICIDE RESISTANT WEEDS

The following strategies should be effective in reducing problems with herbicide tolerant and resistant weed biotypes, but no single strategy is likely to be totally effective.

General Guidelines:

1. Scout fields regularly and identify weeds that escape herbicide treatment. Monitor changes in weed populations and restrict spread of potentially resistant weeds that match the field history and herbicide pattern.

2. Rotate herbicides with different modes of action in consecutive years.

3. Apply herbicides in tank-mix, prepackage, or sequential mixtures that include multiple modes of action. Two or more herbicides in the tank-mix must have substantial activity against potentially resistant weeds. Most commercial premixes do not contain herbicides that target the same weed species.

4. Rotate crops, particularly those with different life cycles, e.g. winter annual crops (winter wheat), perennial crops (alfalfa), and summer annual crops (spring wheat, corn or beans). Do not use herbicides with the same mode of action in the different crops unless other effective control practices are also included.

Weed resistance to herbicides cannot be prevented, but can be delayed. Herbicide and tillage rotations will only delay resistance by the length of time that the selection pressure for a given herbicide is removed by an alternative control method. The gene pool does not revert back in absence of the original selection, except when the resistant plants are poorly fit. Fitness has not been greatly different for resistant and susceptible biotypes and should not be relied on for resistance management.

There are two options relative to resistance management: one is to use the desired herbicide until resistance occurs and then change to an alternative, and the other is to rotate control methods to delay the on-set of resistance.

Method 1. Continued Herbicide Use - This approach allows for the use of the preferred treatment but will require more intense monitoring for resistance. The best resistance management strategy is early identification of resistant plants and then complete control (eradication) of the resistant plants while the infestation is small. Hand weeding, non-selective herbicides, cultivation, or combinations of methods can be used for eradication. Identification can be best accomplished with highly effective herbicide rates so that uncontrolled plants are obvious for early eradication. Elimination of the resistant plants will allow for continuous use of the herbicide.

Advantages:

1. Allow use of preferred herbicide.
2. Allow for use of the herbicide best suited for weeds in a given field.
3. The above may save costs as a herbicide with a second mode of action may not be needed for the weeds present before resistance develops.

Disadvantages:

1. Resistance will occur sooner and require earlier monitoring for resistance.
2. Does not save the herbicide for use in crops without alternatives.

Method #2. Rotate Herbicides - This system will delay resistance, but may use unnecessary or less desirable herbicides in rotation or in mixture. Delaying resistance by alternative herbicides in the crop rotation is a means of keeping a herbicide for use in a crop that does not have an effective alternative.

Advantages:

1. Monitoring for resistance probably can be delayed.
2. Herbicide mixtures may give control of more weed species and reduce the need for scouting to choose the appropriate herbicide for the field.

Disadvantages:

1. May need to use herbicides other than the most desired.
2. Will select for multiple resistance.
3. Fewer herbicide options saved for future use.

Testing weeds for herbicide resistance:

Plant samples can be sent to Ag-Quest to test for weed resistance. Contact before sending to determine cost and packaging instructions.

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ACCase or ALS (Group 1) herbicides = \$80 CAN/sample

Dinitroaniline (Group 3) herbicides = \$45 CAN/sample

On-line study course on herbicide mode of action can be found at:
<http://www.wsweedscience.org/Lessons/lessons.asp>

X1 - Herbicide Classification and Mechanism of Action for Resistant Weed Management

Mechanism of Action	Common Name	Herbicide Tradename	Premix or Co-pack Tradenames
ACC-ase Inhibitor (1) Aryloxyphenoxy propionic acids "Fops"	clodinafop-P	Discover	Fusion Fusion
	fenoxaprop-P fluzifop-P quizalofop	Puma Fusilade DX Assure II = Targa.	
Cyclohexanediones "Dims"	clethodim	Select = Trigger = Volunteer = Intensity. Arrow, Clethodim, Envoy, Section, Select Max, Shadow.	Rezult
	sethoxydim tralkoxydim	Poast Achieve	
Phenylpyrazolin "Dens"	pinoxaden	Axial/XL	
ALS Enzyme inhibitor (2)	imazamethabenz imazamox imazapic	Assert Beyond = Raptor. Plateau	ClearMax
Imidazolinones "Imi"	imazapyr imazaquin imazethapyr	Arsenal = Habitat. Scepter Pursuit	Lightning, OneStep, Sahara Squadron Authority Assist, Extreme, Lightning, Pursuit Plus
Sulfonylureas "SU"	chlorimuron	Classic	Canopy, Canopy EX, Synchrony STS/XP
	chlorsulfuron	Glean = Report = Telar.	Chisum, Cimarron X-tra, Finesse/G&B, Report Extra
	foramsulfuron	Option	Equip
	halosulfuron	Permit = Sandea.	Priority
	iodosulfuron	Autumn	Equip
	mesosulfuron	Silverado	Olympus Flex, Rimfire
	metsulfuron	Accurate = Ally = Cimarron = Escort = Metgard = Metsulfuron = Valuron.	Accurate Extra, Agility, Ally Extra, Chisum, Cimarron Max, Cimarron X-tra, Finesse, Report Extra
	nicosulfuron	Accent	Celebrity Plus, Clarion, Steadfast
	primisulfuron	Beacon	
	prosulfuron	Peak	Exceed, NorthStar, Spirit
rimsulfuron	Matrix = Resolve.	Exceed, Spirit	
sulfometuron	Oust	Basis, Clarion, Steadfast, Stout	
sulfosulfuron	Certainty (turf), Maverick	Accurate Extra, Agility, Affinity BroadSpec/Tankmix, Ally Extra, Basis, Harmony Extra, Nimble, Stout	
thifensulfuron	Harass = Harmony GT = Unity		
Triasulfuron	triasulfuron	Amber	Fuego, Rave
	tribenuron	Express = Nuance	Accurate Extra, Agility, Affinity Broadspec/Tankmix, Ally Extra, Canopy EX, Harmony Extra, Nimble
	trifloxysulfuron triflusulfuron	Monument UpBeet	
Triazolopyrimidines "TPS"	cloransulam	FirstRate	Authority First, FrontRow, Gangster
	florasulam		Orion
	flumetsulam	Python	FrontRow, Hornet, SureStart
	pyroxulam	PowerFlex	
Sulfonylamino-carbonyltriazolinone "SACT"	flucarbazone	Everest	Finesse Grass and Broadleaf
	propoxycarbazone	Olympus	Olympus Flex, Rimfire
Mitotic Inhibitor (3) Dinitroanilines (DNA)	ethalfuralin	Sonalan	Pursuit Plus Buckle, Freedom
	pendimethalin	Prowl/H20 = Acumen = Pendimax=Pendant.	
	trifluralin	Trifluralin = Treflan = Triflurex = Trust.	
Growth Regulators (4) Phenoxy	2,4-D	2,4-D, others	See bromoxynil, Crossbow, Curtail = Commando, ForeFront, Grazone P+D = Gun Slinger, Landmaster BW = Campaign = Credit Master, Rage D-Tech, Recoil, Shotgun, Starane+Salvo, Weedmaster = see dicamba.
	2,4-DB MCPA amine MCPA ester	Butyrac MCPA Amine, Rhomene, others Daggar, MCPA E, Rhonox, Sword, Wildcard	See bromoxynil, ClearMax, Curtail M=Commando M, Starane+Sword.
Benzoic acids	dicamba	Banvel = Dicamba = Oracle = Rifle = Sterling. Clarity. Vision.	Agility, Distinct+Overdrive, Fuego, NorthStar, Rave, Status. Fallow Master = Fallow Star = GlyKamba, Status. Marksman = BanvelK+Atrazine = Dicambazine = Rifle Plus = Stratos = Sterling Plus. Weedmaster = Banvel + 2,4-D = Brash = Kamba Master = Outlaw = Range Star = Rifle D.
Pyridines	aminopyralid	Milestone	CleanWave, ForeFront
	clopyralid	Clopyr Ag = Spur = Stinger = Reclaim = Transline.	Commando/M = Curtail/M, Confront = Redeem, WideMatch = Colt, Hornet, SureStart.
	fluroxypyr	Starane = Vista.	CleanWave, PastureGard, Surmount, Starane + Salvo, Starane NXT, Starane + Sword, WideMatch = Colt.
	picloram triclopyr	Tordon 22K = Triumph 22K. Garlon = Remedy. Pathfinder II.	Grazone P+D = Gun Slinger, Surmount. PastureGard, Redeem, Vengeance Plus
Quinolines	quinclorac (dicots)	Drive = Facet = Paramount.	

Mechanism of Action	Common Name	Herbicide Tradename	Premix or Co-pack Tradenames
Photosystem II Inhibitor (5) - Site A Triazines Triazinones Phenyl-carbamates	atrazine	Atrazine, others	See 2,4-D, dicamba, bentazon, bromoxynil, glyphosate, acetochlor, dimethenamid-P, s-metolachlor + or - safener. Derby
	simazine	Princep	
	metribuzin	Metri DF = Metribuzin = Sencor.	Authority MTZ, Canopy, Domain
Photosystem II Inhibitor (6) - Site B	desmedipham phenmedipham	Alphanex = Betanex/β.	Des + Phen = Betamix/β = BNB Plus = D P Mix. Des Phen Etho = Phen Des 8+8 = Progress.
	bentazon	Basagran	Galaxy, Laddok S-12, Rezult
Photosystem II Inhibitor (6) - Site B	bromoxynil	BroClean = Bromox = Brox = Bucril = Moxy.	Bronate = Bison = Bromac = Bromox MCPA = Maestro MA = Wild Card Xtra, Brox M, Huskie. Bronate Advanced = B-5 = Bison Advanced = Bromac Advanced = Brox M Ultra = Wolfpack Advanced. Bromoxynil + 2,4-D(2 lb+2 lb), B-4, Double Up, Maestro D. Bromoxynil + 2,4-D (2 lb+2.5 lb) = WECO Max.
	diuron linuron tebuthiuron	Diuron = Direx = Karmex. Lorox = Linex = Linuron. Spike	Krovar, Sahara, WeedBlast
Photosystem II Inhibitor (7) - Site A - different than 5			
Lipid Synthesis Inhibition (8) Thiocarbamates	cycloate EPTC triallate	Ro-Neet Eptam = Eptek = Eradicane = Razencane. Far-Go	Powerplay, Imperium. Buckle
EPSP Synthase Inhibitor (9)	glyphosate-ipa	Roundup, several generics - see page 69.	Expert, Extreme, Fallow Master, Landmaster BW, others. See 2,4-D, atrazine, dicamba, s-metolachlor, and page 69.
	glyphosate-K	Roundup UltraMax II, several - see page 69.	Sequence
	gly- (NH ₄) ₂	Touchdown iQ - see page 69.	
Glutamine Synthetase Inhibitor (10)	glufosinate	Liberty = Finale = Ignite = Rely.	
Bleaching: Carotenoid Inhibitor - (11)	aclonifen amitrole	Challenge, Bandur Amitrol T	Nikyl
Bleaching: Phytoene Desaturase Inhibitor (PDS) (12)	beflubutamid flurochloridone flurtamone	UBH-820 Racer	Nikyl
Bleaching: DOXP Synthase Inhib. (13)	clomazone	Command = Commit.	Command Xtra, Commence
PPO (Protox) Inhibitor (14)	acifluorfen fomesafen lactofen oxyfluorfen	Ultra Blazer Flexstar, Reflex Cobra, Phoenix Goal	Galaxy Prefix Stellar
Diphenylethers N-phenylphthalimides	flumiclorac flumioxazin	Resource Valor = Broadstar = Chateau = Encompass = Payload = Suregard.	Stellar Gangster
Oxadiazoles	oxadiargyl	Raft, Topstar	
Phenylpyrazoles	pyraflufen	ET	
Triazolinones	carfentrazone sulfentrazone	Aim = Avalanche = Quicksilver = Teamwork. Spartan=Blanket=Crossing=Portfolio	Priority, Rage D-Tech Authority Assist/First=Sonic/MTZ, Spartan Advance
Very Long Chain Fatty Acid Inhibitor (15)	acetochlor	Harness = Confidence. Surpass = Breakfree = Volley. Degree, TopNotch.	Harness Xtra/5.6L=Confidence Xtra/5.6L. Imperium. Breakfree ATZ Lite=Keystn LA=Volley ATZ Lite. SureStart. Powerplay.
	alachlor dimethenamid-P metolachlor meto + safener s-metolachlor s-meto + safener	Alachlor, Intro, Lasso, others. Establish, Outlook, Propel. Dual 8E, Parallel PCS, Stalwart. Dual II, Me-Too-Lachlor, Parallel, Stalwart C. Dual Magnum, Brawl, Charger Max. Dual II Magnum, Brawl II, Cinch.	Establish Lite = G-Max Lite = Propel ATZ Lite. GuardsmanMax = Stalwart Xtra = Parallel Plus. Parallel Plus, Stalwart Extra. Prefix, Sequence. Bicep Lite II Magnum, Brawl II ATZ, Camix, Charger Max ATZ Lite, Cinch ATZ Lite, Halex GT, Lumax.
Oxyacetamides	flufenacet	Define	Domain, Epic, Radius
Unknown (16)	ethofumesate	Nortron	BNB Plus = Des Phen Etho = Progress.
Auxin Inhibitor (19)	diflufenzopyr		Celebrity Plus, Distinct, Status
Photosystem I Inhibitor (22)	diquat paraquat	Reglone Firestorm, Gramoxone Inteon, Parazone	
Unknown (26)	difenzoquat quinclorac(grass)	Avenge Drive = Facet = Paramount.	
Bleaching: HPPD Inhibition (27)	isoxaflutole	Balance Pro	Epic, Radius
	mesotrione	Callisto	Camix, Halex GT, Lumax
	pyrasulfatole		Huskie
	tembotrione	Laudis	
	topramezone	Impact	

Cold, Hard STEEL (28): Plow, cultivator, rotary-hoe, etc.

Adapted from WSSA Herbicide Classification System For Resistant Weed Management. Weed Technol. 17:606-608.

HERBICIDE CARRYOVER

Y1. Herbicide persistence into the next growing season restricts rotational crops. The following information explains herbicide degradation for chemistries known to carryover.

General Rules For Herbicide Breakdown

1. Many herbicides are broken down in soil by microbial decomposition. In addition, SUs and triazines are broken down by chemical reactions like acid hydrolysis.
2. Herbicide molecules must be free from binding to soil particles or organic matter for soil microorganisms to degrade.
3. Most herbicide molecules are more tightly adsorbed to soil particles in dry soils than moist soils.
4. Chemical degradation of herbicides in soil is affected by soil pH. Acid hydrolysis nearly ceases at soil pH above 6.8.

Effect of pH on Herbicide Activity and Persistence

Negative charges on soil particles and organic matter adsorb positive-charged compounds or substances. Soil pH influences adsorption and availability of the following herbicides by determining the electrical charge of the herbicide molecules: Imidazolinones, SUs, Triazines, and Triazolopyrimidines (TPS).

Molecules become (-) charged when a proton is removed or become (+) charged when a proton is added. Most herbicides become positively charged in acid (H⁺) pH conditions. Positively charged herbicide molecules are adsorbed to soil particles due to the attraction between (-) charges on soil particles and (+) charges on the herbicide molecule.

Y2. Breakdown of Imidazolinone (Imi) Herbicides and TPS Herbicides. In general, breakdown occurs by soil microbes and breakdown occurs more rapidly and herbicide activity increases as soil pH increases. Rate of breakdown decreases in dry conditions. Imi and TPS herbicides are:

1. Broken down by microbes - not broken down by hydrolysis.
 2. Not degraded in anaerobic (waterlogged soil) conditions.
 3. Not volatile nor photodegraded by sunlight.
 4. Not leached beyond 12 inches.
 5. Weakly bound to soil but strongly bound to OM.
 6. Adsorbed more strongly as soil dries and through time.
- For Imi herbicides applied in dry conditions, herbicide molecules adsorb to OM. The next spring, winter moisture can displace herbicide molecules from soil and OM allowing the molecules to become free for plant uptake and microbial breakdown. For sensitive crops like sugarbeet, the adsorption and desorption process may occur over several years causing crop injury from herbicide residues that become available after moisture events.
7. Negatively (-) charged, not adsorbed, and free for plant uptake and microbial degradation at soil pH >6.5 for Imi herbicides and pH >7 for TPS herbicides.
 8. Strongly bound to OM at pH <6.5 for Imi herbicides and pH <7 for TPS herbicides. For Imi herbicides: Amount adsorbed changes little from 6.5 to 8. At soil pH <6.5, pH reduction as small as 0.2 pH units can **DOUBLE** the amount adsorbed.

Large variation in pH can exist in the same field. In low pH, residues of Imi herbicides can injure sensitive plants for many years.

In summary, activity and degradation of Imi and TPS herbicides increase as soil pH increases. Herbicide adsorption increases as OM matter increases and as soil pH decreases. All factors increasing microbial activity also increase herbicide degradation (warm, moist soils). Degradation increases in soils with pH above 6.5 (Imi) or 7 (TPS) because herbicide molecules are not adsorbed and are free in soil solution for plant uptake and microbial breakdown.

Y3. Breakdown of SU Herbicides (with exceptions):

In general, most SU herbicides are broken down by acid hydrolysis and can leave a residue in soil for more than one year. The chemical reaction ceases at soil pH above 6.8.

Exceptions: Thifensulfuron, tribenuron, foramsulfuron (Option), and triflurosulfuron (UpBeet) are rapidly broken down by soil microbes. Halosulfuron (Pemit), and rimsulfuron are broken down faster by hydrolysis as pH moves above and below pH of 7.0. Herbicide breakdown is slowest in neutral soil pH of 7.0.

Most SU herbicides are:

1. Not leached, nor volatile, nor broken down by photodegradation.
 2. Affected by pH. Water solubility increases as pH increases.
 3. Broken down primarily by acid hydrolysis. Microbial degradation is very slow.
 4. Non-microbial hydrolysis for most residual SU herbicides ceases at soil pH above 6.8.
 5. SU herbicides are undissociated (neutral charge) at pH less than 7.0 and are adsorbed to soil and OM. As soil pH increases above 7.0 molecules are (-) charged, are in a free form, do not bind with (-) charged soil particles, and are available for plant uptake.
- Even at low pH ranges, SU herbicides are so biologically active at low concentrations that plant response may still occur.**

SU herbicides carryover more in high pH soils (above 6.8) because acid hydrolysis ceases above that level. Hydrolysis is minimally affected by soil moisture, organic matter, soil texture, soil microbes, and soil compaction or aeration. Hydrolysis is affected by soil temperature and soil pH. As temperature increases and pH decreases below 6.8, hydrolysis increases.

Y4. Breakdown of Triazine Herbicides

Triazines are degraded by hydrolysis similar to SU herbicides. Therefore, the same factors affecting SU breakdown also affect breakdown of triazine herbicides - See Y3. Some slight differences are noted below. Triazine herbicides are:

1. More active in high pH soils.
2. Broken down by photodegradation only when herbicide remains on soil surface for extended periods..

Triazine molecules are (+) charged at soil pH < 7.5. Positive charged triazine molecules bind to (-) charges on soil and OM making them unavailable for plant uptake and microbial breakdown. This is why pH sensitive herbicides like atrazine and Sencor can be used with less risk of crop injury in low pH soils. However, as pH fluctuates across the field, herbicide availability may be radically altered ranging from complete crop safety and erratic weed control at low pH to crop injury and adequate weed control at high pH.

At high soil pH, the opposite reaction occurs. At soil pH > 7.5, triazine herbicide molecules donate protons (H⁺) resulting in (H + OH = H₂O) so the molecules have a net neutral charge, which do not bind to soil particles and OM, and are free for plant uptake and microbial decomposition.

Y5. Persistence of phytotoxic levels of a herbicide for more than 1 year can be a problem with some herbicides. Herbicide residues are most likely to occur following years with low rainfall because chemical and microbial activity needed to degrade herbicides are limited in dry soil. Crop damage from herbicide residues can be minimized by applying the lowest herbicide rate required for good weed control, by using band rather than broadcast applications, and by moldboard plowing before planting the next crop. Moldboard plowing reduces phytotoxicity of some herbicides by diluting the herbicide residue in a large volume of soil. Moldboard plowing is effective in reducing the residual effects of trifluralin, Sonalan, Prowl, Nortron SC, atrazine, and Sencor.

Y6. Herbicide residues often can be detected by bioassay.

Representative soil samples of the whole field are obtained by sampling many places to the depth of the tillage layer. A soil sample free of herbicide residues can serve as the untreated check. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare two or more samples of untreated check soil and the test soil in pots or other containers with holes in the bottom for water drainage.

The crop to be grown in the field should be used as one bioassay species. Alfalfa and canola also should be planted as an additional bioassay species because of their relative sensitivity to many residual herbicides. Plant seeds of large-seeded crops like corn or soybean at 1 seed per 1 to 2 square inches, or seeds of small-seeded crops like cereals or flax at about 1 seed/sq inch. Water as needed but do not over-water. Thin plant stands when seedlings are 2 to 3 inches tall to allow sufficient space for adequate growth. Position containers in direct sunlight and maintain temperature at 70 to 75 F. Observe the plants 2 to 3 weeks after emergence. Record visible and physical measurements such as plant height and leaf length for abnormalities.

Symptoms of some herbicides, like atrazine and Sencor, do not develop until 2 to 3 weeks after emergence so do not evaluate the treatment effect too soon after emergence. Plants grown in root inhibiting herbicides, such as dinitroanilines, should be washed to observe root growth. Window bioassay does not provide accurate information for ALS herbicide carryover.

Field Bioassay Instructions: Plant several strips of desired crops across the field perpendicular to the direction the suspect herbicide was applied. Strips should be spaced to represent different field conditions (texture, pH, and drainage). If no visible signs of injury, stand reduction, or yield reduction occur, then the field can be seeded with the desired crop the next growing season. Do not plant if injury occurs and the bioassay must be repeated the next growing season to determine the safety of the crop to existing residues.

Y7. Atrazine at rates over 0.38 lb ai/A generally has residue the year following application to corn in North Dakota. If soil moisture is deficient, atrazine may cause injury to susceptible crops the following year. Corn and millet are tolerant to atrazine while other crops vary in susceptibility. The approximate ranking of crops from most to least tolerant is corn, sorghum, millet, flax, soybean, barley, wheat, oat, sunflower, canola/mustard, alfalfa, and sugarbeet.

Y8. Balance Pro (isoxaflutole) at 1.5 to 3 fl oz/A may have a residue the following year. Breakdown is primarily by microbial activity. Risk of Balance Pro carryover increases as precipitation occurring during the growing season decreases. Balance Pro becomes more active as soil texture becomes more coarse and organic matter decreases. Rotation restrictions are found in the table at the end of this section.

Y9. Callisto (mesotrione) at 3 fl oz/A may have a residue the following year. Risk of Callisto carryover increases as organic matter increases and soil pH decreases. Callisto is degraded by soil microbes. Factors affecting Callisto breakdown are similar to Imi herbicides. See paragraph Y2 for additional information. Rotation restrictions for Callisto are found in the table at the end of this section.

Y10. Celebrity Plus (nicosulfuron & dicamba & diflufenzopyr) at 6.67 oz WDG/A may have a residue the following year from nicosulfuron but not dicamba. Refer to paragraphs on Accent and dicamba for additional information.

Y11. Dicamba at rates greater than 1.5 pt/A may remain as a residue in soil. Most grass and broadleaf crops can be planted 4 months or more after application at 1.5 pt/A. Allow 45 days/pt/A of dicamba, excluding days when ground is frozen to rotate to any crop. NDSU research indicates dicamba at 1 qt/A applied in late September caused visible injury to wheat and barley planted the following spring, but effect on yield was minimal. Dicamba at 1 pt/A applied the previous fall prevented seed production in sunflower. The approximate ranking of crops from most to least tolerant is corn, barley, wheat, oat, potato, buckwheat, soybean, dry edible bean, sunflower, flax, and sugarbeet. Rotational crop restrictions for dicamba are found in the table at the end of this section.

Y12. Flexstar/Reflex (fomesafen) at 0.75 to 1 pt/A may have a residue the year following application to soybean or dry bean. Most crops can be planted the next growing season except canola, crame, flax, potato, safflower, sugarbeet, and sunflower. Fomesafen is weakly adsorbed by OM but mobility and amount available for plant uptake increases as soil pH increases above 6.5. Degradation is through soil microbes and under anaerobic conditions. Conditions that inhibit microbial activity also reduce fomesafen breakdown. Cold or dry conditions after application reduce rate of breakdown. Northern production areas, like ND, have a shorter growing season and the soil temperature is colder for longer periods of time, which limits breakdown. Late applications in beans decreases the amount of time that breakdown can occur.

Ways to reduce potential for fomesafen carryover include lower application rates, banded herbicide applications, and tillage to dilute herbicide residues. The approximate ranking of non-labeled crops from most to least tolerant is cereals, potato, oil-seed rape/canola, field corn, sunflower, sugarbeet, sorghum, and alfalfa. Rotational crop restrictions for Flexstar/Reflex are found in the table at the end of this section.

Y13. Hornet (flumetsulam & clopyralid-K salt) at 2 to 6 oz WDG/A contain is 1 to 3 oz ai/A clopyralid. Clopyralid is labeled for use in corn at 1.5 to 4 oz ai/A. Therefore, precautions in crop rotation would apply as if clopyralid was applied alone at 1 to 3 oz ai/A. Rotational crop restrictions for Hornet are found in the table at the end of this section. Consult the clopyralid labels and paragraph in this section for residue information.

Y14. Nortron SC (ethofumesate) often has a residue the year following use on sugarbeet. The approximate ranking of crops from most to least tolerant is sunflower, dry beans, soybean, corn, barley, and wheat. Moldboard plowing usually will eliminate crop injury. Nortron should be applied in a band to reduce cost and reduce potential crop injury from residues the following year.

Y15. Paramount (quinclorac) at 0.17 to 0.33 lb WDG/A may carryover in soil for more than 1 year. Seeding of flax, chick pea, dry pea, and sugarbeet must be delayed until at least 24 months after application. Rotational crop restrictions for Paramount are found in the table at the end of this section.

Y16. Peak (prosulfuron) at 0.25 to 0.5 oz 57DF/A may carryover in soil for more than 3 crop years. Peak is safe on corn safety which is different as compared to other SU herbicides labeled in small grains. Peak is labeled on corn through the prepackaged mixture Exceed.

Y17. Metribuzin may not have residue the following year at 0.25 lb ai/A, but rates over 0.5 lb ai/A may damage susceptible crops the next year. Rotational crop restrictions for metribuzin are found in the table at the end of this section. The approximate ranking of crops from most to least tolerant is potato, soybean, dry edible bean, corn, barley, wheat, oat, sunflower, flax, and sugarbeet.

Y18-22 - HERBICIDE CARRYOVER

Y18. Sonalan (ethalfuralin), Prowl/Prowl H₂O (pendimethalin), and trifluralin are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in soil for more than 1 year. Sonalan has less soil residue than trifluralin and Prowl. Land treated with Sonalan in the spring may be planted to any crop the next year except sugarbeet. Sunflower, soybean, potato, and dry edible bean are quite tolerant of dinitroaniline herbicides. Rotational crop restrictions for Prowl, Sonalan, and trifluralin are found in the table at the end of this section. The approximate ranking of other crops from most to least tolerant is soybean, flax, alfalfa, barley, wheat, corn, oat, and sugarbeet.

Y19. Spartan (sulfentrazone) residue may remain in soil the following season. Most grass and broadleaf crops can be planted the following year except canola, crambe, lentil, and sugarbeet. Sulfentrazone is degraded by soil microbes, is not affected by sunlight, and is not volatile. Sulfentrazone applied PRE does not degrade on the soil surface. Precipitation activates the herbicide by moving it into the soil. Sulfentrazone solubility increases as soil pH increases above 6.5, as soil texture changes from fine to coarse, and as OM decreases. As sulfentrazone solubility increases availability for plant uptake increases, weed control increases, and risk of crop injury increases. The approximate ranking of crops from most to least tolerant is soybean, flax, chickpea, mint, sunflower, potato, field pea, dry edible beans, safflower, crambe, canola, lentil, and sugarbeet. Rotational crop restrictions are found in the table at the end of this section.

Y20. Clopyralid, including premixes may have a residue in soil following POST application. Pea, lentil, potato, and broadleaf crops grown for seed can be planted 18 months after clopyralid (including premixes) application. Potential for injury from soil residue of clopyralid can be reduced by burning, removal, or incorporation of treated crop residues.

Y21. Tordon (picloram) at rates of 1 fl oz/A or higher may carryover in soil for more than 1 crop year. Only grass or grain crops, such as grass, small grains, or flax, can be planted the year following application. Sunflower, soybean, dry edible bean, and potato are especially susceptible to Tordon.

Y22. Susceptibility of certain crops from most to least tolerant:

Chlorimuron: soybean, wheat, oat, corn, sorghum, sunflower, alfalfa, canola.

Clomazone: soybean, corn = sorghum = sunflower, alfalfa, wheat.

Imazaquin: soybean, wheat, oat, sorghum, sunflower, corn, alfalfa, canola.

Imazethapyr: soybean, alfalfa, corn, wheat, oat, sunflower, sorghum, canola.

See Y7 - Atrazine and Y18 - Trifluralin for crop sensitivity.

General guidelines for laboratory analysis: Safe level*

Herbicide	Parts per billion (ppb)	Parts per million (ppm)	Crop
Chlorimuron	1-2	0.001-0.002	Corn
	2-5	0.002-0.005	Wheat
Clomazone	50-200	0.05-0.2	Corn
	15-100	0.015-0.1	Wheat/Alfalfa
Dintroaniline	100-200	0.1-0.2	Corn
	200-300	0.2-0.3	Wheat
	50-100	0.05-0.1	Sugarbeet
Imazaquin	2-10	0.002-0.01	Corn
	10-30	0.01-0.03	Wheat
Imazethapyr	1-30	0.01-0.03	Corn
	4-15	0.004-0.015	Sorghum
Triazine	150-250	0.15-0.25	Soybean
	40-100	0.04-0.1	Alfalfa
	60-150	0.06-0.15	Oat
	75-180	0.075-0.18	Wheat
	25-50	0.025-0.05	Sugarbeet

*"Safe" values for herbicide residues differ according to soil type and pH because of differences in availability from soil. Low-range value are for coarse textured soils with low levels of organic matter, higher values are for fine textured soils with high organic matter.

1 ppm = 1,000 ppb

"Safe" Triazine Residue Level

3 inch sample (No-till)	6 inch sample (moldboard plow)	Crop
<0.17 ppm	<0.08 ppm	Oat, alfalfa
0.17 to 0.35 ppm	0.08 to 0.17 ppm	Soybean
>0.35 ppm	>0.17 ppm	Corn

Y23. Laboratories That Analyze For Pesticide Residue in soil, water, and plant samples.

For links to labs in each state see AGLABS website:
<http://aglabs.sdstate.org>

For specific category testing of labs see:
<http://www.findtesting.com>

The following list shows laboratories that can analyze for pesticide residues.

A & L Great Lakes Lab
 3505 Conestoga Drive, Fort Wayne, IN 46808
 (219) 483-4759, <http://www.algreatlakes.com>

Agvise Laboratories
 Northwood, ND
 (701) 587-6010, johntlee@polarcomm.com

Analytical Laboratory
 McCall Hall, PO Box 173620
 Montana State University, Bozeman, MT 59717
 406 994-3383, Heidi Hickers
 Developed the most sensitive test available for Oust.

Animal Disease Lab,
 9732 Shattuck Road, Centralia, IL 62801-5858
 (618) 532-6701,
<http://agr.state.il.us/animalHW/labs/centralialab.html>

APT Labs Inc.
 1050 Spring Str., Wyomissing, PA 19610
 610 375-3888

Harris Laboratories
 621 Rose Street, P.O. Box 80837, Lincoln, NE 68501
 (402) 476-2811, <http://www.mdsharris.com>

Hazleton Environmental Services
 525 Science Drive, Madison, WI 53711
 (608) 232-3300

Midwest Laboratories
 13611 B Street, Omaha, NE 68144
 (402) 334-7770, <http://www.midwestlabs.com>

Minnesota Valley Testing Laboratories, Inc.,
 326 Center Street, New Ulm, MN 56073
 (507) 354-8517, (800) 782-3557

Minnesota Valley Testing Laboratories, Inc.,
 1411 South 12th Street, Bismarck, ND 58504
 (701) 258-9720, (800) 782-3557

Olson Biochem Labs, Duane Matthees
 PO Box 2170
 152 ASC, Brookings, SD 57007-1217
 (605) 688-6171, Fax (605) 688-6295,
<http://anserv.sdstate.edu>

Professional Service Industries
 4820 West 15th Street, Lawrence, KS 66049
 (800) 548-7901

Publications on herbicide injury symptoms:

W-1141 Herbicide and Nonherbicide Injury Symptoms on Spring Wheat and Barley, NDSU Extension Service.

A-1085 Herbicide Mode of Action and Sugarbeet Injury Symptoms NDSU Extension Service

PNW-498 Herbicide Drift and Carryover Injury in Potatoes Ag Publications, U of ID, 208 885-7982, ckink@uidaho.edu

CD-ROM:

Herbicide Mode of Action and Crop Injury Symptoms (U of MN)
 To order go to: <http://shop.extension.umn.edu/>
 In the "Search " window type: 06893
 Cost is \$20.00 per CD-ROM

Web sites:

Herbicide Mode of Action Symptoms (U of WI):
http://ipcm.wisc.edu/pubs/PestMngmt_ref.htm

Herbicide Injury Diagnostic Key:
http://ipcm.wisc.edu/uw_weeds/herbinjkey/

Dicamba Injury to Soybean (U of WI):
http://ipcm.wisc.edu/pubs/PestMngmt_ref.htm

Recognizing Residue and Drift Injury in Canola - Alberta Res. Council:
www.canola-council.org/PDF/toolbook.pdf#zoom=100

Y24. Crop Rotation Restrictions for North Dakota

Herbicide	Alf- alfa	Bar- ley	Can- ola	Corn	Cra- mbe	CRP grss	Dry bean	Field pea	Flax	Oat	Edibl Leg.*	Pot- ato	Saff lowr	Soy- bean	Sgr- beet	Sun- flwr	HRS/ Drm
	(months after application)																
DO NOT USE IN ND = Beacon, chlorimuron, Exceed, Scepter, Spirit, Steel																	
Accent (<0.68 oz DF/A) acetochlor	10j 9	8 NCS	18 NCS	0 0	18 NCS	18 NCS	10j NCS	10j NCS	18 NCS	8 NCS	10 NCS	18j NCS	18 NCS	0.5 NCS	18a NCS	10j NCS	8 4
Ally Extra (0.2 oz) e Amber	22 4b	10 18c	22 B	22 22b	22 B	6 B	22 B	22 B	22 B	10 18c	22 B	22 B	22 B	22 36b	22b B	22 24b	1/10 0
Assert atrazine (0.38 lb ai)	15 NCS	NCS NCS	12/15f NCS	NCS 0	12/15 NCS	4 NCS	NCS NCS	15 NCS	15 NCS	15 NCS	15 NCS	15 NCS	NCS NCS	NCS 12	20 NCSb	NCS NCS	NCS NCS
atrazine (0.38-0.5 lb ai) atrazine (0.5-1 lb ai)	2CS 2CS	NCS 2CS	2CS 2CS	0 0	2CS 2CS	2CS 2CS	2CS 2CS	2CS 2CS	NCS 2CS	2CS 2CS	2CS 2CS	NCS 2CS	2CS 2CS	12 12	2CSb 2CSb	2CS 2CS	2CS 2CS
Authority Assist Authority First/Sonic	12 12	9.5 12	40b 24	10 18	40b 30b	12 30b	4 12	4 12	26 30b	18 12	4/12* 12	26 18	18 30b	0 0	40b 30b	18 30b	4 4
Authority MTZ Balance Pro (j)	12 10	4 6	24 18	10 0	18 18	12 18	12 18	18 18	18 18	18 6	18 18	12 6	18 6	4 6	36 18	12 10	4 6
Basis Beacon (r)	10 8	8 8	18 18	0 0.5	18 18	18 18	8 8	8 8	18 18	8 8	18 8	0 2CS	18 18	0.5 8	10 B	10 8	8 8
Beyond/ClearMax Callisto	9 10	18t 4	18 NCS	8.5 0	18 18	9 18	9 18	9 18	18 10	9 4	9 18	18t 10	18 18	0 10	18t 18	9 10	3 4
Camix Celebrity Plus	18 12	4.5 8	18 18	0 0.25	18 18	18 18	18 10	18 10	18 18	NCS 8	18 10	NCS 18a	18 18	NCS 4	18 18a	18 10/18a	NCS 8
clopyralid clopyralid&2,4-D/MCPA	10.5 10.5m	0 1	0 5	0 1	0 5	0 1	10.5m 10.5m	18 18	0 5	0 1	18 18	18 18	10.5m 10.5m	10.5m 10.5m	0 5	10.5m 10.5m	0 1
dicamba (<1.5 pt) h Everest	4 NCS	4h 9	4 9	0h NCS	4h NCS	4 NCS	4 9	4 11	4 9	4 18	4 24	4 9	4 9	4 9	4 9	4 9	0h 0/4
Extreme Far-Go	4 NCS	9.5 0	40b NCS	8.5 NCS	40b NCS	4 NCS	4 NCS	4 NCS	26 NCS	18 18	4 NCS	26 NCS	18 NCS	0 NCS	40b NCS	18 NCS	4 0
Glean/Finesse FirstRate	B 9	16 30b	B 30b	B 9	B B	4 9	B 9	B 9	B 30b	10 9	B 9	B 18	B B	B 0	B 30b	B 30b	0 3
Flexstar Gangster	18 12	4 B	18 B	10 9	18 B	4 9	10 9	10 B	18 9	4 9	10 9	18 18	18 B	0 0	18 30b	18 30b	4 3
Halex GT Hornet	10 10.5m	4 4	10 26b	0 0	18 B	18 12	18 10.5m	18 10.5m	10 26b	18 4	18 10.5m	10 18	18 B	10 10.5m	18 26b	10 18	4 4
Impact Laudis	9 10	3 4	18 10	0 0	18 18	18 18	18 18	9 10	18 18	3 4	18 18	9 10	18 18	18 8	18 18	9 18	3 4
Lightning Lumax (<3 pt/A)	9.5 18	9.5 4.5	40b 18	8.5 0	40b 18	40 18	9.5 18	9.5 18	40b 18	18 NCS	9.5 18	26 18	18 18	9.5 NCS	40b 18	18b 18	4 NCS
Matrix Maverick	12 B	9/18p B	18 B	0 B	18 B	18 B	10 B	18 B	18 B	9 B	18 B	0 B	18 B	4 B	18 B	10 B	9 0
metribuzin (u) metsulfuron (c)	4 34d	8u 10	12 34d	4 34e	12 34d	4 6	12 34e	8 34d	12 34e	12 10	8 34d	4 34d	12 34e	4 34d	18 34d	12 34e	8u 1/10
Milestone (b) Olympus	36b B	B 18k	24b 22k	12b B	B B	B B	B B	B 12k	B B	B B	B 22k	B B	B B	B B	B B	B 18k	B 0
Option	Corn is 7 days, soybean is 14 days, and all other crops are 60 days.																
Paramount Peak (r)	10 22	10 0	10 22	10 1	10 22	10 10	10 22	24 10	24 22	10 0	24 10	10 22r	10 22	10 22	24 22r	10 22	0 0
Permit/Sandea Plateau	9 36	2 24	15 48b	1 36	B 36	2 0	9 36	9 36	B 36	2 24	9 36	9 48b	B 36	9 18	36 48b	18 36	2 12

Herbicide	Alf- alfa	Bar- ley	Can- ola	Corn	Cra- mbe	CRP grss	Dry bean	Field pea	Flax	Oat	Edibl Leg.*	Pot- ato	Saff- lowr	Soy- bean	Sgr- beet	Sun- flwr	HRS/ Durm
	----- (months after application) -----																
Prowl/H ₂ O	NCS	NCS	NCS	0s	NCS	NCS	0	0	NCS	NCS	0	0	NCS	0	2CS	0	NCS
Pursuit	4	9.5	40b	8.5	40b	4	4	4	26	18	4	26	18	0	40b	18	4
Pursuit Plus	9.5	9.5	40b	8.5	40b	NCS	4	4	26	18	4	26	18	0	40b	18	4
Python	4	4	26b	0	26b	12	4	4	26b	4	4	12	26b	0	26b	18	4
Radius	12	12	18	0	18	18	18	18	18	18	18	6	18	6	18	18	12
Raptor	9	18t	18	8.5	18	9	9	9	18	9	9	18t	18	0	18t	9	3
Rave	B	18c	B	22	B	B	B	B	B	18c	B	B	B	36b	B	24b	0
Reflex	18	4	18	10	18	4	10	10	18	4	10	18	18	0	18	18	4
Resolve (<1.1 oz DF/A)	10j	9	10j	0	18	18	10	18	18	9	18	0	18	10	10j	10	9
Rimfire	10	10	10	12	12	12	10	10	10	10	10	12	10	10	12	10	0
Silverado	10	1	10	12	10	10	3	3	10	10	10	10	10	3	10	1	0.25
Sonalan	NCS	NCS	0	NCS	0	13w	0	0	NCS	NCS	0	NCS	NCS	0	2CS	0	NCS
Spartan/Advance	12	4	24	10	24	12	0	0	10	12	0/12*	12	10	0	36	0	4
Status/Distinct (h)	1	1	1	1h	1	1	1	1	1	1	1	1	1	1	1	1	0
Steadfast (<0.76 oz/A)	10j	8	18	0	18	18	10j	10j	18	8	10j	18j	18	0.5	18a	10j	8
Stout (<0.76 oz DF/A)	10j	8	18	0	18	18	10j	10j	18	8	10	10j	18	0.5	18a	10j	8
SureStart	18	NCS	26b	0	26b	26b	18	NCS	26b	NCS	NCS	18	26b	18	26b	18	4
Tordon (1.5 oz)	2CS	NCS	2CS	2CSx	2CS	1	2CS	2CS	NCS	NCS	2CS	2CS	2CS	2CS	2CS	2CS	NCS
trifluralin (y)	0	NCS	0	NCS	0	18/21	0	0	0	18	0	0	0	0	2CS	0	NCS
Valor/Chateau	8b	4	8b	1	8b	8b	4	4	8b	8b	4	8b	8b	0	8b	1	1
WideMatch	10.5	0	4	0	4	0	10.5	10.5z	4	0	18	18	10.5	10.5	0	10.5	0

*Edible legumes = chickpea (garbanzo bean) and lentils.

NCS = Next cropping season after herbicide application.

2CS = Second cropping season after herbicide application.

MAA = months after application.

Field Bioassay Instructions - Refer to label or paragraph Y7 in the Narrative Section.

- a Soil pH <7.5 = 10 MAA for sorghum and 11 MAA for sunflower.
Soil pH >7.5 = 18 MAA for sorghum and sunflower
Soil pH <6.5 = 10 MAA for sugarbeet and all other crops not listed.
Soil pH >6.5 = 18 MAA for sugarbeet, potato, and all other crops not listed and cumulative precipitation in the 18 MAA period must exceed 28 inches.
- B or b = Bioassay. Do not plant until field bioassay indicates it is safe. Crop rotation after atrazine is rate and soil pH dependant.
Python and Hornet require a 26 month rotation and a successful field bioassay.
FirstRate requires a 30 month rotation and a successful field bioassay.
Lightning, Pursuit, and Pursuit Plus requires a 40 month rotation and a successful field bioassay.
- c Do not use on soil with pH greater than 7.9. Barley and oat can be planted 6 months after Ally application west of highway 83.
- d Requires soil pH of 7.9 or less and a 34 month minimum rotation interval and 28 inches of cumulative precipitation.
- e Requires soil pH of 7.9 or less, 22 months and 22 inches of precipitation west of Hwy 1 or 34 months and 34 inches of precipitation east of Hwy 1. These restrictions also apply to Ally Extra at rates greater than 0.2 oz DF/A.
- f Imi resistant canola varieties may be planted the season after application.
Conventional canola varieties may be planted the following season after application at 1 pt/A in ND counties of Cavalier, Pembina, Ramsey, Rolette, Towner, and Walsh and MN counties of Kittson, Marshall, Pennington, Red Lake, and Roseau.
- h Any rotational crop may be planted 120 days following application of dicamba at 1.5 pt/A or less, excluding days when ground is frozen.
For wheat, barley, oat, and grass seedings, allow 45 days per pint/A of dicamba after application before planting.
For all crops and for rates greater than 1.5 pt/A allow 45 days per 1 pt/A of dicamba used excluding days when ground is frozen.

- j Requires 15 inches of cumulative precipitation during the growing season following application. An 18 month restriction applies to Accent, Resolve, and Steadfast applied above rates indicated or if drought follows application. Refer to label for crop rotation restrictions if rates greater than those indicated are used.
- k Requires 24 inches of accumulated precipitation.
- m Do not plant dry bean, dry pea, soybean or sunflower for 18 months on soil with less than 2% OM and rainfall less than 15 inches during the 12 MAA OR may be planted 12 MAA if risk of injury is acceptable. Perform a field bioassay prior to planting for areas that receive less than 15 inches of rainfall and have less than 2% OM. Do not plant lentil, potato or any other broadleaf crop grown for seed for 18 months unless risk of injury is acceptable.
- p Barley can be planted 9 months after application in Cass, Grand Forks, Pembina, Towner, Traill, and Walsh counties of ND. In all other counties of ND allow an 18 month rotation restriction before planting barley.
- r Do not apply Beacon, NorthStar, Peak, or Spirit in the Red River Valley of ND and MN or on soil with pH greater than 7.8. User must follow crop rotation restrictions as given on labels. Refer to label for additional information on soil pH, rotation intervals, maximum use rates, application timing and other restrictions. The number of months after application given in the previous table are applicable only on soil with a pH less than 7.8, only using less than maximum rates allowed, only using approved application timings, and only on approved locations (inside or outside Red River Valley) as indicated on the label.
Do not replant to any broadleaf crop if less than 10 inches of precipitation has occurred since Peak application.
For situations not covered on the label or in the previous table, conduct a soil bioassay to determine if Peak soil residue will allow successful planting of desired rotational crop.
- s Corn can be planted only if Prowl/Prowl H₂O is applied PRE. DO NOT APPLY PPI.
- t Rotation to barley is: 9 months east of Hwy 83 and 18 months west of Hwy 83.
Rotation to potato is: 9 months if soil pH is >6.2 and rainfall is >18 inches/year or 18 months if soil pH is <6.2 and rainfall is < 18 inches/year
Rotation to sugarbeet: 18 months if the soil pH is >6.2 or 26 months if soil pH is less than 6.2.
- u Must add 2 months if soil pH is 7.5 or above. Wheat and barley can be planted 4 MAA following lentil or soybean.
- w CRP grasses may be planted 13 MAA under the following conditions:
 1. By label this is deemed as a non-standard rotation.
 2. Dow assumes no liability for injury.
 3. Fall is recommended as the best time to plant CRP grasses.
 4. A field bioassay is recommended prior to planting CRP grasses.
- x Do not plant corn or sorghum until soil samples analyzed for Tordon residue indicates no detectable levels present. Restriction is based on non-legal herbicide residue that may be found in corn and sorghum and not on crop safety.
- y Oats, sorghum, and annual or perennial grass crops may be planted at least 12 MAA in areas that received 20 inches or more of precipitation during the growing season. CRP grasses may be planted 18 MAA if trifluralin is spring-applied or 21 MAA if fall-applied.
- z For rotation to field pea in 10.5 months, precipitation must be greater than 7 inches during the 10.5 months following application and greater than 5.5 inches of precipitation from June 1 to August 31 following application. Otherwise allow 18 months.

Z1. Restrictions on Grazing/Feeding/Haying of Crops Treated with Herbicides

Herbicide	Crop	Time interval
DAA = days after application		WAA = Weeks after appl.
Accent	Corn	30 DAA
Acetochlor	Corn	No restriction
Achieve	Small grain	30 DAA
Aim	Corn, small grain	No restriction
Amber	CRP, small grain	No restriction
Assert	Sunflower, small grain	Not allowed
Assure II	Canola/mustards, chickpea, dry bean, dry pea, lentil, soybean, sugarbeet	Not allowed
Atrazine	Corn	21 DAA
Authority Assist	Soybean	Not allowed
Authority First	Soybean	Not allowed
Authority MTZ	Soybean	Not allowed
Axial XL	Barley Wheat	Not allowed 50 DAA
Balance Pro	Corn	No restriction
Basagran	Corn Dry edible bean, dry pea Soybean	12 DAA No restriction 30 DAA
Basis	Corn	30 DAA
Beyond	Clearfield canola, CF wheat Clearfield sunflower	No restriction Not allowed
Bromoxynil	Alfalfa Corn, small grain CRP, Grass establishment Flax	30 DAA 45 DAA Not allowed No restriction
Bromox&MCPA	Small grain	45 DAA
Callisto	Corn	45 DAA
Camix	Corn	45 DAA
Celebrity Plus	Corn	32 DAA
Chlorsulfuron	Small grain	No restriction
Chlor&Metslfrn	Small grain	No restriction
ClearMax	Clearfield wheat	7 DAA
Clethodim	Alfalfa Canola, chickpea, dry bean, flax, potato, soybean, sunflower, sugarbeet	15 DAA Not allowed
Clopyralid	Canola/mustards, sugarbeet	7 DAA
Clopyralid& 2,4-D/MCPA	CRP, small grain - graze/feed - hay	7 DAA Not allowed
Dicamba	Corn CRP - non-lactating animals - lactating - see label Small grain - non-lactating - lactating - see label - haying forage	> milk stage No restriction < 70 DAA No restriction 7 DAA 37 DAA
Discover	Small grain	30 DAA
Distinct	Corn	32 DAA
Eptam	Alfalfa, sunflower	No restriction
Everest	Small grain	60 DAA
Extreme	RUR soybean	Not allowed

Far-Go	Chickpea, small grain Field pea Lentil	Not allowed 120 DAA No restriction
Finesse	Small grain	No restriction
FirstRate	Soybean	14 DAA
Flexstar	Soybean	Not allowed
Fusilade DX	Soybean	Not allowed
Fusion	Soybean	Not allowed
Gangster	Soybean	Not allowed
Glyphosate labels indicate that for all registered crops and applications unless otherwise noted there is an 8 week after application (WAA) restriction for grazing, feeding and haying.		
Glyphosate	Alfalfa - Preharvest	1.5 DAA
	Spot - Monsanto - Generics	3 DAA 14 DAA
	Renovate - < 1.5 lb ae/A - > 1.5 lb ae/A	3 DAA Not allowed
	Renovation - Generics	8 WAA
	Alfalfa - Roundup Ready	5 DAA
	Barley - Preharvest	After harvest
	Postharvest - Monsanto - Generics	7 DAA 8 WAA
	Canola	Not allowed
	Canola - RR	8 WAA
	Chickpea - Preharvest	8 WAA
	Corn - Preharvest	8 WAA
	Postharvest - Monsanto - Generics	7 DAA 8 WAA
	Corn RUR - Preharvest	7 DAA
	Postharvest	7 DAA
	Dry bean - Preharvest	Not allowed
	Dry pea - Preharvest	8 WAA
	Flax	8 WAA
	Lentil	8 WAA
	Potato - Preharvest	8 WAA
	Soybean - Preharvest	
	Monsanto - < 22 fl oz/A - > 22 fl oz/A	14 DAA 25 DAA
	Generics - < 6 qt/A Postharvest	25 DAA 8 WAA
	Soybean - RR - Preharvest	
	Monsanto - Generics - Postharvest	14 DAA Not allowed 8 WAA
	Sugarbeet	8 WAA
	Sunflower	Not allowed
	Wheat - preharvest	After harvest
	Postharvest - Monsanto - Generics	7 DAA 8 WAA
Halex GT	Corn	45 DAA
Hornet	Corn	No restriction
Huskie	Wheat, barley	25 DAA
Impact	Corn	45 DAA
Laudis	Corn	45 DAA
Liberty	Liberty Link canola or corn	Not allowed
Lightning	Clearfield corn	45 DAA
Lumax	Corn	45 DAA
Maverick	Small grain - Feed, graze - Hay	No restriction 30 DAA

MCPA	CRP, small grain - hay - graze dairy animal - graze meat animal Flax, grass establishment	30 DAA 7 DAA 7 DAA 7 DAA
Metolachlor	Chickpea, soybean Corn Dry bean, field pea Potato, safflower, sunflower	No restriction 30 DAA 120 DAA Not allowed
Metribuzin	Field pea, lentil, soybean	40 DAA
Metsulfuron	CRP Small grain	No restriction No restriction
Met & Chlorsfrn	Small grain	Not allowed
NorthStar	Corn	30 DAA
Olympus	Small grain	No restriction
Option	Corn	45 DAA
Outlook	Corn Soybean	45 DAA Not allowed
Paramount	CRP Small grain	309 DAA Not allowed
Paraquat (PRE)	Corn, dry bean, field pea sunflower (desiccant), small grain	7 DAA
Peak	Small grain	30 DAA
Permit	Corn	30 DAA
Plateau	CRP Grass establishment	No restriction Not allowed
Poast	Alfalfa Canola, dry bean, dry pea, flax, lentil, flax, potato, sunflower sugarbeet Soybean	7 DAA No restriction Not allowed
Prowl	Wheat Corn Soybean Chickpea, dry bean, dry pea, lentil, potato, sunflower	28 DAA 21 DAA No restriction Not allowed
Puma	Small grain	No restriction
Pursuit	Alfalfa Chickpea, soybean Dry edible bean Field pea Lentil	30 DAA Not allowed 7 DAA 120 DAA No restriction
Pursuit Plus	Soybean	Not allowed
Python	Corn Soybean	No restriction Not allowed
Rage D-Tech	Corn and grass forage Small grains	7 DAA 14 DAA
Raptor	Alfalfa, dry bean, field pea, soybean	No restriction
Reflex	Dry edible bean	7 DAA
Rezult	Soybean Dry bean, dry pea	Not allowed No restriction
Rimfire	Wheat	30 DAA
Rimsulfuron	Corn Potato	30 DAA Not allowed
Sequence	Pod crops Soybean	120 DAA 30 DAA

Silverado	Wheat/Durum - hay forage grain straw	50 DAA 30 DAA 55 DAA
Sonalan	Canola/mustard, dry bean soybean, sunflower Field pea	Not allowed No restriction
Sonic	Soybean	Not allowed
Spartan	Dry pea, chickpea, soybean sunflower	No restriction
Starane	Corn Small grain - graze/feed - hay	47 DAA 7 DAA 14 DAA
Starane NXT	Small grain	45 DAA
Status	Corn	32 DAA
Steadfast	Corn	30 DAA
Thistrol	Field pea	Not allowed
Thifensulfuron	Soybean, small grain	Not allowed
Thifn&Tribenrn	Small grain	Not allowed
Tribenuron	Small grain	Not allowed
Trifluralin	Canola/mustard, dry bean pea, lentil, potato, safflower, sunflower, sugarbeet Chickpea, flax, soybean, small grain	Not allowed No restriction
Ultra Blazer	Soybean	Not allowed
Valor	Soybean	Not allowed
WideMatch	Corn Small grain - graze/forage - hay	47 DAA 7 DAA 14 DAA
2,4-D	CRP, grass - hay - graze/feed dairy animal - graze/feed meat animal Small grain - graze/feed/hay dairy animal - graze/feed/hay meat animal	30 DAA 7 DAA 3 DAA 14 DAA No restriction
2,4-DB	Alfalfa Soybean	30 DAA 60 DAA

Z1. Grazing and Haying Restrictions for Herbicides Used in Pasture and Rangeland

Herbicide ¹	Lactating dairy animals		All animals except lactating dairy animals		
	Before grazing	Before hay harvest	Before grazing	Before hay harvest	Removal before slaughter
	days after application		days after application		
Cimarron/Extra	0	0	0	0	0
Cimarron Max/Extra	7	-	0	0	30
Amber	0	30	0	30	0
Clopyralid	0	0	0	0	0
Clopyralid + 2,4-D	14	30	0	30	7 ³
Crossbow	1 year	1 year	0 ²	1 year	3
Dicamba ¹					
Up to 1 pt	7	37	0	0	30
Up to 2 pt	21	51	0	0	30
Up to 4 pt	40	70	0	0	30
Up to 16 pt	60	90	0	0	30
FallowMaster	8 weeks	8 weeks	8 weeks	8 weeks	8 weeks
Fuego	7	30	0	30	30
Glyphosate ¹					
Pre/Renovation - < 1.5 lb ae/A	No restriction	No restriction	No restriction	No restriction	No restriction
- > 1.5 lb ae/A	8 weeks	8 weeks	8 weeks	8 weeks	8 weeks
Spot Spray - Monsanto ⁶	7	7	7	7	7
- Generics	14	14	14	14	14
Broadcast	8 weeks	8 weeks	8 weeks	8 weeks	8 weeks
Glyphosate + 2,4-D premix ⁵	7	30	3	30	3
Grazone P + D	7	30	7	30	3
Metsulfuron	0	0	0	0	0
Milestone	0	0	0	0	0
Paramount	No grazing allowed. Do not hay for 309 days after application.				
Paraquat ⁴	1 month	1 month	1 month	1 month	0
Plateau	0	7	0	7	0
Rave	7	0	0	0	0
Redeem	1 year	1 year	0	1 year	3
Spike ⁷	0	1 year	0	1 year	0
Tordon 22K ⁸	14	14	0	14	3
2,4-D/MCPA ¹	7	30	0	30	3

¹ Check individual product labels containing the same active ingredients for restrictions and use rates.

² One year if more than 1.5 gallons/A is used.

³ Withdrawal not needed if 2 weeks or more time elapsed since application.

⁴ Restrictions based on degree of new seedling establishment before grazing. Suggested at least 6 inches of grass or legume growth.

⁵ No restrictions if 10% or less of the area is treated.

⁶ Do not treat more than one-tenth of any given acre at one time with spot or wiper applications. Remove livestock before application.

⁷ If no more than 20 lb/A used.

⁸ Remove livestock to untreated grass pasture for 7 days before transferring livestock to broadleaf or pasture areas. Removal before slaughter statement only applies to animals grazing treated forage for 2 weeks immediately after application.

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

The following ratings give relative herbicide effectiveness at labeled rates. Under favorable conditions control may be better than indicated and under unfavorable conditions herbicides may give erratic results. Dry and cool weather increases herbicide persistence while wet and/or warm weather reduces herbicide persistence.

SOIL- APPLIED HERBICIDES	Mode of Action**	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Kochia	Lambsquarters, C.
Acetochlor (PPI)	15	E	G-E	G-E	G-E	N	G	F	F-G	P	P	F	G-E
Acetochlor (PRE)	15	E	G	G-E	G-E	N	G	P	F-G	P	P	P-F	G
Atrazine (0.38 lb ai/A)	5	P	P	P	P	N	F-G	F-G	N	G-E	F	G-E	G-E
Atrazine (0.5 - 0.75 lb ai/A)	5	F	P	P	P-F	P	G-E	G-E	P	E	G	E	E
Authority Assist (PRE)	2,14	P	N	P	P	N	N	N	N	F-G	P	E	E
Authority First/Sonic (PRE)	2,14	N	N	P	P	N	N	N	N	P-F	E	E	E
Authority MTZ (PRE)	5,14	P-F	P-F	P-F	P-F	N	P	P	P	F-G	P-F	E	E
Balance Pro (PRE)	27	E	G	E	F-G	P	N	N	E	N	P	E	E
EPTC (PPI)	8	E	G-E	E	E	F-G	G-E	G-E	F-G	F	P	P	F
Far-Go (PPI)	8	N	N	N-P	N-P	N	N	E	N	N	N	N	N
Gangster (PRE)	2,14	N	N	P	P	N	N	N	N	P-F	E	G	E
Lorox	7	F	-	G	G	P	-	-	-	E	E	-	E
Matrix (PRE)	2	G	-	G	F-G	N	G	F	P	P	F	G ¹	F
Metolachlor/s-Metolclr.* (PPI)	15	F-E	F-P	F-E	F-E	N	P-G	P-F	N-P	N-P	N	N-P	P-F
Metolachlor/s-Metolclr.* (PRE)	15	P-G	F-P	F-G	F-G	N	P-F	P	N	N-P	N	N-P	P-F
Metribuzin (PPI)	5	F	F	F	F	P	G	N	P	F	F	G	F
Metribuzin (PRE)	5	P-F	P-F	P-F	P-F	N	P	P	P	F	P-F	F-G	P-F
Nortron/generics (PPI)	-	P	F	F-G	F-G	P	E	G	-	F-G	P	F-G	P-F
Nortron/generics (PRE)	-	P	P-F	F	F	P	G-E	F-G	-	F	P	F	P-F
Outlook/generics (PPI)	15	G-E	G	G-E	G-E	N	G	P	F	P	N	P	F
Outlook/generics(PRE)	15	F-G	G	G-E	G-E	N	F	P	F	P	N	P	F
Paramount	4	G-E	N	E	G	N	N	N	N	N	N	F	F
Prowl/generics (PPI)	3	E	G	E ¹	E	N	G	F	P-F	P	N	P	E
Prowl/generics (PRE)	3	E	F	G-E ¹	G-E	N	F-G	P	P	N	N	P	G
Pursuit (PPI) (0.72 oz DG)	2	P	N	P	P	N	N	N	N	G	N	E ¹	P-F
Pursuit (PRE) (0.72 oz DG)	2	P	N	P	N	N	N	N	N	F-G	N	E ¹	P
Pursuit Plus (PPI)	2,3	E	G	E ¹	E	N	G	F	P-F	E	N	E ¹	E
Python (PPI/PRE)	2	N	N	N	N	N	N	N	N	F-G	P	E ¹	E
Resolve (PRE)	2	P	-	F-G	F-G	N	F	P	-	N	P	F ¹	F
Ro-Neet (PPI)	8	E	G	E	E	P	G-E	G	-	P-F	P	P	F-G
Sonalan (PPI)	3	E	G	E ¹	E	N	P	P	P-F	P	P	P-F	E
Spartan (PRE)	14	N	N	P	P	N	N	N	N	F-G	P	E	E
SureStart (PRE)	2, 4,15	E	G	E	E	N	G	P	F	E	E	F-G	E
Trifluralin (PPI)	3	E	G	E ¹	E	N	N	P-F	P-F	P	N	P	G-E
Valor/Chateau (PRE)	14	N	N	P	P	N	N	N	N	P-F	N	G-E	E

PPI = Preplant Incorporated, PRE = Preemergence, POPI = Post plant incorporated.

¹Except where resistant populations have developed.

*Ratings are based on equivalent product rates as S-Metolachlor.

**Numbers represent herbicide mechanism of action from a numerical classification system found on page 108-109.

Weed control ratings in this section are based on the following scale:

E = Excellent = 90 to 99% control P = Poor = 40 to 65% control
 G = Good = 80 to 90% control N = None = No control
 F = Fair = 65 to 80% control

Herbicide persistence ratings are for residues present 12 months after application:

O = Often S = Seldom N = None

SOIL- APPLIED HERBICIDES	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Mustard, W. Annual	Nightshade, E/Black	Nightshade, Hairy	Pigweed, Redroot	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herb. Persistence
Acetochlor (PPI)	N	-	-	P	F	-	G-E	G-E	E	-	F-G	P	P	F	N	N	N
Acetochlor (PRE)	N	-	-	P	F	-	G	G	G-E	-	F	P	N	F	N	N	N
Atrazine (0.38 lb ai/A)	G	-	F	F	G	G	G	G	G	G	F	F	F	G	G	N	N
Atrazine (0.5 - 0.75 lb ai)	E	-	G	E	E	E	E	E	E	E	E	E	G	E	E	N	S
Authority Assist (PRE)	-	F	G	P-G	E	E	E	E	E	P	P	E	P	G-E	G-E	N	O
Auth. First/Sonic (PRE)	E	-	E	E	E	E	E	E	E	-	E	E	E	G-E	G	N	O
Authority MTZ (PRE)	F-G	F-G	G	E	G-E	G-E	E	F-G	E	E	G-E	E	P-F	G-E	G-E	N	S
Balance Pro (PRE)	-	-	G-E	G	E	G-E	G-E	G-E	E	G-E	G-E	G	P	G	G-E	N	S
EPTC (PPI)	N	F-G	N	P	P	P	F	F	G	P	F	P	N	P	N	N	N
Far-Go (PPI)	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Gangster (PPI/PRE)	E	-	E	E	E	E	E	E	E	-	E	E	E	G-E	G	N	O
Lorox (PRE)	E	-	-	-	G	G	-	-	E	-	E	E	-	-	-	N	N
Matrix (PRE)	N	-	-	N	F	-	P	P	E	-	F	P	F	P	N	N	S
Metolachlr/s-Meto.*(PPI)	N	-	N	N	N	-	N	N	G	N	P	N	N	P	N	N	N
Metolachlr/s-Meto.*(PRE)	N	-	N	N	N	-	N	N	F	N	P	N	N	P	N	N	N
Metribuzin (PPI)	F-G	F-G	F	E	E	E	P	P	E	E	E	G	P-F	E	G-E	N	S
Metribuzin (PRE)	F-G	F-G	P	E	G-E	G-E	P	P	G-E	E	G-E	G	P	G-E	G-E	N	S
Nortron/generics (PPI)	-	P	F	P	F	-	F-G	F-G	G-E	-	P	G-E	P	F-G	-	N	O
Nortron/generics (PRE)	-	P	F	P	P-F	-	F	F	G	-	P	G	P	F	-	N	O
Outlook/generics (PPI)	N	-	-	N	P-F	-	F-G	G	E	-	P	P	N	P-F	N	N	N
Outlook/generics (PRE)	N	-	-	N	P-F	-	F-G	F-G	G-E	-	N	P	N	P	N	N	N
Paramount	N	-	N	N	N	N	N	N	F	E	F	N	F	F	-	P	S
Prowl/generics (PPI)	N	-	F-G	N	N	P	N	N	E	N	P	P	N	G	N	N	S
Prowl/generics (PRE)	N	-	F	N	N	P	N	N	G	N	P	P	N	F-G	N	N	S
Pursuit (PPI) (0.72 oz DG)	-	F	N	P	E	E	E	E	E	-	N	F	P	P	N	N	O
Pursuit (PRE) (0.72 oz DG)	-	F	N	P	E	E	E	E	E	-	N	F	P	P	N	N	O
Pursuit Plus (PPI)	E	-	F-G	G-E	E	E	E	E	E	E	F	G	P	G-E	P	N	O
Python (PPI/PRE)	G-E	-	E	P-F	E	E	G-E	G-E	E	-	P	G-E	P	E	G-E	N	S
Resolve (PRE)	-	-	-	-	-	-	P	P	F-E	-	F	-	-	P	-	N	S
Ro-Neet (PPI)	N	F-G	F	P	P	P	F-G	F-G	G	P	P	P	N	P	-	N	N
Sonalan (PPI)	N	-	F-G	N	N	P	P	P	E	P	P	P	N	G-E	N	N	S
Spartan (PRE)	N	-	G	P-G	P	P	E	F-G	E	P	P	E	N	G-E	G-E	N	S
SureStart (PRE)	G	-	G-E	E	E	E	E	E	E	G-E	E	E	E	F-G	E	F	O
Trifluralin (PPI)	N	-	F-G	N	N	P	N	N	E	N	P	P	N	G	N	N	S
Valor/Chateau (PRE)	N	-	E	P	G	N	E	E	E	G	F	F	P	F	G	N	N

PPI = Preplant Incorporated, PRE = Preemergence, PoPI = Post plant incorporated.

¹Except where resistant populations have developed.

*Ratings are based on equivalent product rates as s-metolachlor.

**POST- APPLIED
HERBICIDES**

	Mode of Action	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Kochia	Lambsquarters, C.
Accent	2	E	G-E	E	F-G	G-E	G-E	E	G-E	P	P	F ²	P
Achieve	1	F	G	G-E	G	N	N	E ²	E	N	N	N	N
Aim/generics	14	N	N	N	N	N	N	N	N	P	P	F-E	F-E
Amber + 2,4-D	2,4	N	N	N	N	N	N	N	N	F-G	F-G	E ²	F-G
Assert	2	P	N	P	P	N	N	F-G ²	N	F-G	P	N	P
Assure II	1	E	E	E	G-E	G-E	E	G-E ²	E	N	N	N	N
Atrazine (0.38 lb ai/A)	5	F	P	F	F	N	F	F	P	G-E	F	E	E
Atrazine (0.5 - 0.75 lb ai/A)	5	F-G	F	F	F-G	P	F-G	F-G	P-F	E	G	E	E
Axial XL	1	G-E	-	E	G-E	N	N	E ²	E	N	N	N	N
Basagran/generics	6	N	N	N	N	N	N	N	N	P	G-E	P-F	F-G
Betamix/generics	5	P	N	F	F	N	N	N	P	F	P-F	F-G	G
Betanex/generics	5	P	N	P-F	P-F	N	N	N	P	P-F	P	F	G
Beyond	2	E	F-G	E	G-E	F	G-E	E ²	G-E	P	G-E	E ²	F
Bromoxynil	6	N	N	N	N	N	N	N	N	E	E	G-E	G
Bromoxynil&MCPA	4,6	N	N	N	N	N	N	N	N	E	E	G-E	E
Callisto	27	N	N	N	F	N	N	N	N	F	E	P-F	E
Callisto + Atrazine(3/8 lb ai)	5,27	N	N	N	F	N	N	N	N	G-E	E	E	E
Celebrity Plus	2,4,19	E	G-E	E	G-E	G-E	G-E	E	G-E	E	E	E ²	G
Chlorsulfuron + 2,4-D	2,4	N	N	P-F	N	N	N	N	N	E	G	E ²	E
ClearMax	2,4	E	F-G	E	G-E	F	G-E	E ²	G-E	P	E	E ²	E
Clethodim	1	E	E	E	E	G	E	E	E	N	N	N	N
Clopyralid	4	N	N	N	N	N	N	N	N	F-G	E	N	P-F
Clopyralid & 2,4-D/MCPA	4	N	N	N	N	N	N	N	N	G	E	P	G
Cobra	14	N	P	P-F	P-F	N	N	N	P	P	G	P-F	F
Dicamba ¹	4	N	N	N	N	N	N	N	N	E	E	E	G
Dicamba + MCPA	4	N	N	N	N	N	N	N	N	G-E	E	E	E
Discover	1	E	-	E	G-E	P	N	E ²	-	N	N	N	N
ET	14	N	N	N	N	N	N	N	N	P	P	P-G	F-G
Everest	2	F-G	N	E	P-G	P	N	G-E	-	F	N	N	N
Extreme	2,9	E	E	E	E	E	E	E	E	G-E	E	E	G-E
FirstRate	2	N	N	N	N	N	N	N	N	F	E	P ²	P
Flexstar	14	N	N	P-F	P-F	N	N	N	N	P	G-E	G-E	P-F
Fusilade DX	1	E	E	G-E	G-E	G	E	E ²	E	N	N	N	N
Fusion	1	E	E	E	E	G	E	E ²	E	N	N	N	N
Glyphosate ³	9	E	E	E	E	E	E	G-E	E	P-G	E	F-E	P-E
Goal	14	P	N	P	P	P	P	F-G	N	G-E	E	G-E	G
Halex GT	27	E	E	E	E	E	E	E	E	P-G	E	E	E
Hornet	2,4	N	N	N	N	N	N	N	N	F-G	E	F-G ²	P-F
Huskie	6,27	F-G	N	N	N	N	N	N	N	E	E	G-E	E
Impact	27	E	-	G-E	G-E	-	-	-	G-E	P	E	E	E
Impact + Atrazine (3/8 lb ai)	5,27	E	-	G-E	G-E	-	-	-	E	E	E	E	E
Laudis	27	G-E	P-F	P-F	G	-	-	P	G-E	P-F	E	G-E	E
Laudis + Atrazine (3/8 lb ai)	5,27	E	F	F	G-E	-	-	P-F	E	E	E	E	E
Liberty/Finale	10	E	G	E	G	P	F-G	G-E	E	E	E	E	F-G
Lightning	2	E	E	E	E	F	G-E	G-E	G-E	E	G	E ²	E
Lumax (3 pt)	5,15,27	N	N	N	F	N	N	N	N	E	G	E	E
Maverick	2	-	N	P-F	P-F	G	N	E	-	N	-	P ²	P
MCPA	4	N	N	N	N	N	N	N	N	N	G	P	E
Metribuzin	5	F	-	F	F	P	P	-	-	G	P	F-G	E
Metsulfuron + 2,4-D	2,4	N	N	P	P	N	N	N	N	F-G	F	E ²	E
Met & Chlorsulfuron + 2,4-D	2,4	N	N	F-G	F	N	N	N	N	E	G-E	E ²	E

**POST- APPLIED
HERBICIDES**

	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Mustard, W. Annual	Nightshade, E/Black	Nightshade, Hairy	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herbicide Persistence
Accent	P	-	P	P	E	E	N	N	E	-	P	G-E	P	P	P	N	O
Achieve	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Aim/generics	-	-	N	P	P	P	G	G	G-E	P-F	N	N	P	F	-	N	N
Amber + 2,4-D ¹	F-G	F	-	E	E	E	F	F	E	E	E	F	E	E ²	F-G	F-G	O
Assert	N	N	N	N	E	G-E	N	N	P	N	N	P	N	P-F	N	N	S
Assure II	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Atrazine (0.38 lb ai)	E	-	-	G-E	E	E	G-E	G-E	E	E	F-E	G-E	F-E	E	-	N	S
Atrazine (0.5 - 0.75 lb ai)	E	-	-	E	E	E	E	E	E	E	E	E	G	E	-	P	S
Axial XL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Basagran/generics	P	P	E	G-E	E	E	N	F-G	F	G	P-F	E	E	G	G-E	F-G	N
Betamix/generics	P	P	F	G	G-E	-	F-G	F-G	G	-	F	F	P	P	P	N	N
Betanex/generics	P	P	F	G	G-E	-	F-G	F-G	G-E	-	F	F	P	P	P	N	N
Beyond	E	P	P	G-E	E	E	E	E	E	E ²	P	G-E	E	G-E	P	N-P	S
Bromoxynil	E	P	G-E	E	F-G	F-G	E	E	F	F-G	E	G-E	G-E	E	P-F	P	N
Bromoxynil + MCPA	E	P	G-E	E	E	G-E	E	E	G	F-G	E	G	E	E	F	P-F	N
Callisto	-	-	N	E	E	E	E	E	E	-	P-F	E	E	-	-	N	S
Callisto + Atrazine	E	G-E	G-E	E	E	E	E	E	E	E	E	E	E	E	E	P	S
Celebrity Plus	F	G	F	E	E	E	G-E	G-E	E	E	E	E	E	G	E	F-G	O
Chlorsulfuron + 2,4-D ¹	F-G	F	-	E	E	E	F	F	E	E	E	E	E	E ²	F-G	G	O
ClearMax	E	P	F	E	E	E	E	E	E	E ²	G	G-E	E	G-E	F-G	P-F	S
Clethodim	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Clopyralid	F	F-G	P	E	N	N	E	E	P	E	G-E	G-E	G-E	P-F	E	E	S
Clopyralid&2,4-D/MCPA	F-G	G-E	G	E	E	E	E	E	P	E	E	E	E	G	E	G-E	S
Cobra	E	G-E	F-G	G	E	-	G	G	E	-	G-E	G	P-F	P	P	N	N
Dicamba ¹	P-F	P	F-G	E	P	P	E	E	G	G-E	E	E	G-E	G	G-E	F-G	S
Dicamba + MCPA ¹	G-E	P	G	G-E	E	F-G	E	E	G	E	E	E	E	G	G-E	F	S
Discover	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ET	-	-	N	P	P	-	P	P	G	P	N	N	P	P	-	N	N
Everest	N	N	N	N	E	E	E	-	G-E	P	N	E	P-F	N	-	N	S
Extreme	E	G-E	E	E	E	E	E	E	E	E	E	E	E	E	G-E	G	O
FirstRate	P	-	G-E	E	G-E	P	N	N	P	-	E	E	E	-	P	N	O
Flexstar	E	G-E	G-E	G-E	E	E	G-E	F-G	E	-	E	G-E	F	-	P	N	O
Fusilade DX	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fusion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Glyphosate ³	E	P-G	E	G-E	G-E	G-E	P-G	P-G	E	P-G	G-E	P-E	G-E	G	F-E	G-E	N
Goal	E	-	-	-	F	F	G-E	G-E	E	G-E	G	F	F-E	G-E	G	N	N
Halex GT	E	P-G	E	E	E	E	E	E	E	F-G	E	E	E	G	E	G-E	S
Hornet	E	-	E	E	E	E	G-E	G-E	P-F	E	E	F-G	E	F-G	E	G-E	O
Huskie	E	G	G-E	E	E	G-E	E	E	E	F-G	E	G-E	E	E	G	F-G	S
Impact	-	E	E	E	E	E	E	E	E	-	E	E	E	-	-	F	S
Impact + Atrazine	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	G	S
Laudis	-	-	F	-	E	E	E	E	E	-	E	E	E	E	-	F	S
Laudis + Atrazine	-	-	G-E	-	E	E	E	E	E	-	E	E	E	E	F-G	G	S
Liberty/Finale	E	G	E	E	E	G-E	G-E	G-E	E	G-E	E	E	E	G-E	E	P	N
Lightning	E	G	G	E	E	E	E	E	E	E	G	E	G	E	P	F	O
Lumax (3 pt)	E	-	E	E	E	E	E	E	E	E	E	E	E	E	E	P	S
Maverick	-	N	N	-	E	E	-	-	P	-	-	-	E	-	P	N	O
MCPA	G-E	P	F	G	E	G-E	P-F	P-F	P-F	G	G	F	G	P	F-G	P-F	N
Metribuzin	-	-	-	-	E	E	P	P	G	G-E	E	E	F	-	-	N	O
Metsulfuron + 2,4-D	F-G	F	G-E	G-E	E	E	F	F	E	E	E	F	G-E	E ²	F-G	G	O
Met&Chlorsulfon+2,4-D ¹	F-G	F	E	E	E	E	F	F	E	E	E	E	E	E ²	F-G	G	O

**POST- APPLIED
HERBICIDES (cont.)**

	Mode of Action	Barryardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Kochia	Lambsquarters, C.
NorthStar	2,4	-	G-E	G-E	G-E	G-E	-	-	-	E	E	E	E
Olympus	2	P	N	P-F	P-F	F-G	N	G-E	-	-	-	-	-
Option	2	E	G-E	E	F-E	G-E	E	E	G-E	N	G	E ²	G
Paramount	4	G-E	N	E	G	N	N	N	N	N	N	F	F
Paraquat	22	G	G	G	G	P	F-G	G	F-G	F	F-G	G-E	E
Peak + 2,4-D	2,4	N	N	N	N	N	N	N	N	F-G	G-E	G-E ²	G
Permit	2	N	N	N	N	N	N	N	N	P	E	P ²	N
Poast	1	E	E	E	E	F	G-E	G-E ²	E	N	N	N	N
Progress/generics	5	P	N	F-G	F-G	N	N	N	P	F-G	F	F-G	G-E
Puma	1	E	E	E	E	N	N	E ²	E	N	N	N	N
Pursuit	2	G	P-F	G	F-G	N	G	F ²	P-F	P	G-E	E ²	P-F
Rage D-Tech	4	N	N	N	N	N	N	N	N	P-F	G-E	P-F	E
Raptor	2	E	F-G	E	G-E	F	G-E	E ²	G-E	P	G-E	E ²	F
Rave	2,4	N	N	N	N	N	N	N	N	E	E	E	G-E
Reflex	14	N	N	N	N	N	N	N	N	P	G	G-E	P
Rezult	1,6	E	E	E	E	F-G	E	G-E ²	E	P	G-E	P	F-G
Rimfire	2	F-G	N	P-F	P-F	F	N	G-E	-	-	-	-	-
Rimsulfuron	2	G-E	F	G-E	G-E	G-E	G-E	G-E	F	P	N	E ²	F
Select Max	1	E	E	E	E	G-E	E	E	E	N	N	N	N
Silverado	2	P	N	P	P	N	N	G	N	-	-	-	-
Starane	4	N	N	N	N	N	N	N	N	P	E	E	N
Starane & 2,4-D	4	N	N	N	N	N	N	N	N	G	E	E	E
Starane & MCPAe	4	N	N	N	N	N	N	N	N	F	G	E	E
Starane NXT	4,6	N	N	N	N	N	N	N	N	E	E	E	E
Status/Distinct	2,19	P-F	P	P-F	P-F	N	P	P	P	E	E	E	E
Steadfast	2	E	G-E	E	G-E	G-E	E	E	E	P	P	P ²	P
Stout	2,2	E	G-E	E	F-G	G-E	G-E	E	G-E	P	P	G ²	F-G
Thifensulfuron (1/12 oz)	2	N	N	N	N	N	N	N	N	P	N	F-G ²	G
Thifensulfuron (0.3 to 0.6 oz)	2	N	N	N	N	N	N	N	N	E	P	G-E ²	E
Thifensulfuron & Rimsulfuron	2	G-E	F-G	G-E	G	F-G	F-G	F-G	F	P	P	F ²	G
Thifen&Tribenurn(1:1)+ 2,4-D	2,4	N	N	N	N	N	N	N	N	F	G	E ²	E
Thifen&Tribenurn(2:1)+ 2,4-D	2,4	N	N	P	P	N	N	N	N	G-E	E	E ²	E
Thifen&Tribenurn(4:1)+ 2,4-D	2,4	N	N	P	P	N	N	N	N	G-E	E	E ²	E
Tribenuron	2	N	N	N	N	N	N	N	N	P-F	F	E ²	F-G
Tribenuron + 2,4-D	2,4	N	N	N	N	N	N	N	N	F	G	E ²	E
Ultra Blazer	14	N	P	P-F	P-F	N	N	N	P	P	F-G	P-F	G
UpBeet + Betanex/Betamix/ Progress	2,5	P	P	F-G	F-G	N	P	N	P	F-G	F-G	E ²	G-E
WideMatch/generics	4	N	N	N	N	N	N	N	N	E	E	E	P-F
2,4-D	4	N	N	N	N	N	N	N	N	P-F	G-E	P-F	E
2,4-DB/Butyrac	4	N	N	N	N	N	N	N	N	P	E	P	G-E

²Herbicides will not control resistant biotypes.

POST- APPLIED HERBICIDES (cont.)	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Mustard, W. Annual	Nightshade, E/Black	Nightshade, Hairy	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herbicide Persistence
NorthStar	F	G	F	E	E	E	E	E	E	G-E	E	E	E	E	G-E	G	O
Olympus	-	-	-	-	E	E	-	-	P-F	-	-	-	-	-	-	-	O
Option	N	-	-	G-E	E	E	E	E	E	-	G	P	G	-	-	P	N
Paramount	N	-	N	N	N	N	N	N	F	N	F	N	F	F	-	P	S
Paraquat	E	G	G	G	E	G	G-E	G-E	E	F-G	G-E	E	E	E	-	P	N
Peak + 2,4-D	F-G	F	-	-	E	E	-	-	E	E	E	-	E	E ²	F-G	F-G	O
Permit	P	-	E	G-E	E	E	P	P	F-G	-	G-E	F-G	E	-	P	N	O
Poast	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Progress/generics	P-F	N	F	G	G-E	-	G	G	G	-	F-G	F-G	P	P	P	N	S
Puma	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	E	P	P	E	E	E	E	E	E	E ²	P	G	G-E	G-E	P	N	O
Rage D-Tech	P-F	P	G-E	E	E	F-G	P-F	P-F	G	E	G-E	F-G	E	G	F-G	F	N
Raptor	E	P	P	G-E	E	E	E	E	E	G ²	P	G-E	E	G-E	P	N-P	N
Rave	F-G	G	G	E	E	E	E	E	E	E	E	E	E	E	F-G	G	O
Reflex	E	-	G	G	E	E	G	P	G-E	-	G-E	G	P-F	-	P	N	O
Rezult	P	P	E	G-E	E	E	N	F-G	F	G	P-F	E	E	F-G	G-E	F-G	N
Rimfire	-	-	-	-	E	E	-	-	P-F	-	-	-	-	-	-	-	S
Rimsulfuron	-	-	-	-	E	E	G/N	P-F	E	-	P	F	P	P	N	N	S
Select Max	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Silverado	-	-	-	-	E	-	-	-	P-F	-	-	-	-	-	-	-	N
Starane/generics	-	F-G	P	P	P	P	P	P	N	E	E	N	E	P	N	N	N
Starane & 2,4-D	P-F	F-G	G-E	E	E	G	F-G	F-G	G-E	E	E	G	E	G	F-G	F	N
Starane & MCPA	G-E	F-G	F	G	E	G	F	F	F	E	G	F	G	P	G	P-F	N
Starane NXT	E	F-G	G	E	E	E	E	G-E	P	G	E	E	E	G-E	P-F	P	N
Status/Distinct	G	G	E	E	E	G	G	G	E	E	E	E	E	E	E	G	S
Steadfast	P	-	N	P	E	E	N	N	E	-	N	F	P	P	P	N	O
Stout	P	N	P	P	E	E	N	N	E	-	P	G-E	P	P	P	N	O
Thifensulfuron (1/12 oz)	N	N	N	N	E	P	N	N	E	P ²	N	G-E	P	P	N	N	N
Thifensulfuron (0.3-0.6oz)	N	G-E	N	G-E	E	G-E	N	N	E	G-E ²	G	E	G-E	G-E	N	N	N
Thifensulf & Rimsulfuron	P	N	F	G	E	-	P	P	E	-	P	E	F-G	G ²	P	P	S
Thifen&Trib(1:1)+ 2,4-D ¹	F-G	G-E	G-E	E	E	E	F-G	F-G	G	G-E	G	G	F-G	E ²	F-G	G-E	N
Thifen&Trib(2:1)+ 2,4-D ¹	G-E	G-E	-	E	E	E	F-G	F-G	E	E ²	E	E	G-E	E ²	F-G	G	N
Thifen&Trib(4:1)+ 2,4-D ¹	G-E	G-E	-	E	E	E	F-G	F-G	E	E	E	E	G-E	E ²	F-G	G	N
Tribenuron	N	P	F-G	E	E	E	F-G	-	F-G	E ²	P	F-G	F	E	N	G	N
Tribenuron + 2,4-D ¹	F-G	G-E	G-E	E	E	E	F-G	F-G	G	G-E	G	G	F-G	E ²	F-G	G-E	N
Ultra Blazer	P-F	N	F	F	E	-	F-G	F-G	E	-	F-G	E	P-F	G	P	N	N
UpBeet + Betanex/ Betamix/Progress	P-F	G-E	F-G	G	E	-	G	G	G-E	-	F-G	G	G	P	P	N	N
WideMatch/generics	P-F	F-G	G-E	E	P	P	G-E	G-E	P	E	E	G	E	P	E	E	S
2,4-D	P-F	P	G-E	E	E	F-G	P-F	P-F	G	E	G-E	F-G	E	G	F-G	F	N
2,4-DB/Butyrac	-	-	-	-	P	P	-	-	P	-	P	P	-	P	-	N	N

¹ALS herbicides tank-mixed with 2,4-D and dicamba controls most broadleaf weeds and reduce risk of developing resistant kochia.

²Herbicides will not control resistant biotypes.

³Weed control from glyphosate is dependant on rate used, size of weed, environmental conditions, and number of applications.

**CONTROL OF
VOLUNTEER
ROUNDUP READY
CROPS**

	Rate	Canola - Pre	Canola - 3-leaf	Canola - 6-leaf	Corn - 10-18 inches	Corn - 18-24 inches	Corn - 24-40 inches	Soybean - V2-V3	Soybean - V4-V6
POST Grass Herbicides									
Assure II	4 fl oz	N	N	N	E	E	G-E	N	N
Fusilade DX	4 fl oz	N	N	N	E	E	G-E	N	N
	6 fl oz	N	N	N	E	E	E	N	N
Clethodim	3 fl oz	N	N	N	G	P	P	N	N
	4 fl oz	N	N	N	E	F	P	N	N
	6 fl oz	N	N	N	E	G	F	N	N
Select Max	4 fl oz	N	N	N	F	P	N	N	N
	6 fl oz	N	N	N	G	P	P	N	N
	8 fl oz	N	N	N	E	F	P	N	N
Broadleaf Herbicides									
Aim	0.5 fl oz	-	P	N	N	N	N	P	P
Atrazine	0.38 lb ai	E	N-P	N	N	N	N	E	P
	0.5 lb ai	E	P	N	N	N	N	E	F
Balance Pro	3 fl oz	E	-	-	N	N	N	-	-
Basagran	0.5 pt	-	G-E	F	N	N	N	N	N
Bromox & MCPA	0.8 pt	-	E	F-G	N	N	N	E	E
Callisto	3 fl oz	E	E	G	N	N	N	P	P
Clopyralid & 2,4-D	0.25 pt	-	G-E	F-G	N	N	N	F	P
	0.5 pt	-	G-E	F-G	N	N	N	G	F
Dicamba	2 fl oz	-	P	N	N	N	N	G	G
	4 fl oz	-	P	P	N	N	N	E	E
	5 fl oz	-	P	P	N	N	N	E	E
Extreme	1.5 pt	E	E	G-E	F-G	F	P	N	N
Flexstar	0.375 pt	-	E	E	N	N	N	N	N
	0.5 pt	-	E	E	N	N	N	N	N
	0.75 pt	-	E	E	N	N	N	N	N
FirstRate	0.1 oz	E	E	F-G	-	-	-	N	N
	0.2 oz	E	E	E	-	-	-	N	N
	0.3 oz	E	E	E	-	-	-	N	N
Hornet	1 oz	P-F	G	F	N	N	N	E	F
	2 oz	F	E	E	N	N	N	E	F-G
Huskie	11 fl oz	-	E	G-E	N	N	N	G	G
MCPA	0.5 pt	P	G-E	P	N	N	N	P	P
Laudis	3 fl oz	-	E	G-E	N	N	N	G	G
Option	1.5 oz	-	E	E	N	N	N	P	P
Pursuit	0.72 oz	G-E	E	G-E	G	F	P	N	N
Python	1 oz	F-G	-	-	N	N	N	N	N
Raptor	1 fl oz	-	E	G-E	P	P	N	N	N
	2 fl oz	-	E	E	F	P	P	N	N
	4 fl oz	-	E	E	G-E	F	P	N	N
Sencor	0.25 lb	E	G-E	F	N	N	N	P-F	P-F
Spartan	4 oz	P-F	-	-	-	-	-	-	-
Starane	0.5 pt	-	P	P	N	N	N	P	P
Status	1 oz	-	F	P	N	N	N	E	G
	2 oz	-	F-G	P-F	N	N	N	E	E
	4 oz	-	G	F	N	N	N	E	E
Steadfast	0.75 oz	-	E	E	N	N	N	P	P
Thifensulfuron	1/12 oz	-	P-F	P	N	N	N	N	N
	0.33 oz	-	E	G-E	N	N	N	N	N
Tribenuron	0.167 oz	P	E	G-E	P	P	P	P	P
Ultra Blazer	0.75 pt	-	F-G	P	P	N	N	N	N
Valor	2.5 oz	E	-	-	-	-	-	-	-
WideMatch	0.125 pt	-	P	P	N	N	N	F	P
	0.25 pt	-	P	P	N	N	N	E	G
2,4-D	0.25 pt	-	G	P	N	P	P	P	P
	0.5 pt	-	G	P	N	P	P	P	P

2008 North Dakota Herbicide Compendium

The listings are approximate retail prices for small quantities. Herbicide prices do not include cost of such additives as surfactants, oils, fertilizer or application costs. Prices may vary depending on area of the state, wholesaler, bulk discounts, seasonal changes, quantities purchased and particular programs the manufacturing company offers. Prices are averages based on statewide dealer survey for small quantities. Producers should consult local agricultural product suppliers for exact price of each product in their area.

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Accent Dupont	nicosulfuron	75DF	35.00 oz	0.33 oz	0.5 oz	0.67 oz	11.55	17.50	23.45
Acclaim Extra Bayer	fenoxaprop-P	0.57EC	525.00 gal	13 fl oz	20 fl oz	28 fl oz	53.35	82.05	114.85
Achieve Liquid Syngta	tralkoxydim & oil adjuvant	3.33 SC	500.00 case	-	6.9 fl oz	-	-	12.50	-
Acumen Tenkoz	pendimethalin	3.3EC	25.00 gal	2.4 pt	3 pt	3.64 pt	7.50	9.40	11.40
Affinity BroadSpec DuP	thifensulfuron & tribenuron	25 + 25SG	9.00 oz	0.4 oz	0.6 oz	1 oz	3.60	5.40	9.00
Affinity TankMix Dpnt	thifensulfuron & tribenuron	40 + 10SG	6.50 oz	0.6 oz	0.75 oz	1 oz	3.90	4.90	6.50
Agility Dupont	dicamba&thifen&triben&metsulfm	57.8+4.7+2.4+1.9SG	- oz	1.6 oz	2.4 oz	3.2 oz	-	-	-
Aim EW FMC	carfentrazone ethyl	1.9EW	180.00 qt	1/4 fl oz	-	1/2 fl oz	1.40	-	2.80
Alachlor Microflo	alachlor	4EC	23.00 oz	2 qt	2.5 qt	3 qt	11.50	14.40	17.25
Ally Dupont	metsulfuron methyl	60XP	14.00 oz	0.05 oz	0.1 oz	0.3 oz	0.70	1.40	4.20
Ally Extra Dupont	thifensulfm&tribenrn&metsulfurn	37.50 + 18.75 +15DF	10.00 oz	10 A/pk	-	5 A/pk	2.00	-	4.00
Ally Extra SG Dupont	thifensulfm&tribenrn&metsulfurn	27.3 + 13.6 +10.9SG	11.00 oz	0.3 oz	-	0.5 oz	3.30	-	5.50
Alphanex UPI	desmedipham	1.3EC	90.00 gal	4.62 pt	6 pt	7.7 pt	52.00	67.50	86.65
Amber Syngenta	triasulfuron	75DF	9.00 oz	0.14 oz	0.28 oz	0.56 oz	1.25	2.50	5.05
Aquamaster Monsanto	glyphosate-ipa salt	4SL	50.00 gal	0.75 pt	1.5 pt	3 pt	4.70	9.40	18.75
Aquathol Super K	endothall	45G	20.00 lb	8.8 lb	13.2 lb	22 lb	176.00	264.00	440.00
Arrow MANA	ciethodim	2EC	150.00 gal	4 fl oz	6 fl oz	8 fl oz	4.70	7.05	9.40
Arsenal BASF	imazapyr-ipa salt	2SL	300.00 gal	1 qt	2 qt	3 qt	75.00	150.00	225.00
Assert Nufarm	imazamethabenz methyl	2.5SL	86.00 gal	0.6 pt	1 pt	1.2 pt	6.45	10.75	12.90
Assure II Dupont	quizalofop ethyl	0.88EC	132.00 gal	4 fl oz	8 fl oz	10 fl oz	4.15	8.25	10.30
Atrazine 4L Several	atrazine	4F	10.00 gal	0.75 pt	1.5 pt	2 pt	0.95	1.90	2.50
Atrazine 90DF Several	atrazine	90DF	2.25 lb	0.42 lb	0.83 lb	1.11 lb	0.95	1.90	2.50
Authority Assist FMC	imazethapyr & sulfentrazone	-	- fl oz	-	-	-	-	-	-
Authority First FMC	cloransulam & sulfentrazone	7.9 + 62.1WDG	4.00 oz	3.2 oz	6.45 oz	8 oz	12.80	25.80	32.00
Authority MTZ FMC	metribuzin & sulfentrazone	0.27 + 0.18WDG	16.50 lb	8 oz	10 oz	12 oz	8.25	10.30	12.40
Avalanche Winfield	carfentrazone ethyl	1.9EW	165.00 qt	1/2 fl oz	-	1/2 fl oz	0.65	-	0.65
Avenge AMVAC	difenzoquat	2SL	34.00 gal	2.5 pt	3 pt	4 pt	10.65	12.75	17.00
Axial Syngenta	pinoxaden & cloquintocet safener	0.83EC	510.00 case	8.2 fl oz	-	8.2 fl oz	12.75	-	12.75
Axial XL Syngenta	pinoxaden & cloquintocet safener	0.42EC	- gal	16.4 fl oz	-	16.4 fl oz	-	-	-
Balance Pro Bayer	isoxaflutole	4L	8.00 fl oz	1.5 fl oz	2.25 floz	3 fl oz	12.00	18.00	24.00
Banvel Arysta	dicamba-dma salt	4SL	55.00 gal	2 fl oz	4 fl oz	8 fl oz	0.86	1.75	3.45
Banvel&2,4-D Arysta	2,4-D-dea & dicamba-dea	2.87 + 1SL	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Banvel-K+Atra Arysta	atrazine & dicamba-K salt	2.1 + 1.1L	30.00 gal	2 pt	3 pt	3.5 pt	7.50	11.25	13.15
Barrage HF Helena	2,4-D ethylhexyl ester	4.7SL	30.00 gal	6 fl oz	9 fl oz	13 fl oz	1.40	2.10	3.05
Basagran Arysta	bentazon-Na salt	4SL	80.00 gal	1 pt	1.5 pt	2 pt	10.00	15.00	20.00
Basis Dupont	rimsulfuron & thifensulfuron	50 + 25DF	16.00 oz	0.33 oz	0.67 oz	1 oz	5.30	10.70	16.00
Beacon Syngenta	primisulfuron-methyl	75DF	30.00 oz	0.38 oz	0.5 oz	0.76 oz	11.40	15.00	22.80
Betamix Bayer	desmedipham & phenmedipham	0.65 + 0.65EC	85.00 gal	4.62 pt	6 pt	7.7 pt	49.10	63.75	81.80
Betanex Bayer	desmedipham	1.3EC	90.00 gal	4.62 pt	6 pt	7.7 pt	52.00	67.50	86.65
Beyond BASF	imazamox-NH ₄	1SL	525.00 gal	2 fl oz	3 fl oz	4 fl oz	8.20	12.30	16.40
Bicep II Magnum Syng	atrazine & s-metolachlor	3.1 + 2.4L	45.00 gal	2.1 qt	2.35 qt	2.6 qt	23.65	26.45	29.25
Bicep Lite II Magnum	atrazine & s-metolachlor	2.67 + 3.23L	58.00 gal	1.5 qt	1.9 qt	2.2 qt	21.75	27.55	31.90
Bison Winfield	bromoxynil ester & MCPA ester	2 + 2EC	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Bison Advanced Winf	bromoxynil ester & MCPA ester	2.5 + 2.5EC	57.00 gal	0.8 pt	1.2 pt	1.6 pt	5.70	8.55	11.40
BNB Plus UPI	desmed & phenmed & ethofum	0.6 + 0.6 + 0.6EC	95.00 gal	0.8 pt	2 pt	3.3 pt	9.50	23.75	39.20
Boundary Syngenta	s-metolachlor & metribuzin	5.25 + 1.25L	78.00 gal	1.5 pt	2.25 pt	3 pt	14.65	21.94	29.25
Brash Winfield	2,4-D-dma & dicamba-dma	2.87 + 1SL	26.00 gal	0.5 pt	2 pt	4 pt	1.65	6.50	13.00
Brawl Tenkoz	s-metolachlor	7.62EC	100.00 gal	1.33 pt	1.67 pt	2 pt	16.65	20.90	25.00
Brawl II Tenkoz	s-metolachlor & benoxacor safen	7.64EC	105.00 gal	1.33 pt	1.67 pt	2 pt	18.30	23.00	27.50
Breakfree Dupont	acetochlor & dichlorimid safener	6.4EC	75.00 gal	1.5 pt	2 pt	2.25 pt	14.10	18.75	21.10
Breakfree ATZ Lite "	acetochlor & atrazine	4 + 1.5L	48.00 gal	1.5 qt	1.8 qt	2.1 qt	18.00	21.60	25.20
Broclean UAP	bromoxynil ester	2EC	60.00 gal	1 pt	1.5 pt	2 pt	7.50	11.25	15.00
Bromac UAP	bromoxynil ester & MCPA ester	2 + 2EC	40.00 gal	0.75 pt	1 pt	1.5 pt	3.75	5.00	7.50
Bromac AdvancedUAP	bromoxynil ester & MCPA ester	2.5 + 2.5EC	50.00 gal	0.8 pt	1.2 pt	1.6 pt	5.00	7.50	10.00
Bromox MCPA Albgh	bromoxynil ester & MCPA ester	2 + 2EC	50.00 gal	0.75 pt	1 pt	1.5 pt	4.70	6.25	9.40
Bronate Advanccd Bayr	bromoxynil ester & MCPA ester	2.5 + 2.5EC	55.00 gal	0.8 pt	1.2 pt	1.6 pt	5.50	8.25	11.00
Brox Albaugh	bromoxynil ester	2EC	55.00 gal	1 pt	1.5 pt	2 pt	6.90	10.30	13.75

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A			
				Low	Med	High	Low	Med	High	
Brox M	Albaugh	bromoxynil ester & MCPA ester	2 + 2EC	50.00 gal	0.75 pt	1 pt	1.5 pt	4.70	6.25	9.40
Brox M Ultra	Albaugh	bromoxynil ester & MCPA ester	2.5 + 2.5EC	55.00 gal	0.8 pt	1.2 pt	1.6 pt	5.50	8.25	11.00
Buccaneer/Plus	Tenkos	glyphosate-ipa salt	3SL	13.00 gal	1 pt	2 pt	3 pt	1.65	3.25	4.90
Buckle	Gowan	triallate & trifluralin	10 + 3G	1.12 lb	10 lb	11 lb	12.7 lb	11.20	12.30	14.20
Buctril	Bayer	bromoxynil ester	2EC	70.00 gal	1 pt	1.5 pt	2 pt	8.75	13.15	17.50
Butyrac 200	Albaugh	2,4-DB-dma salt	2SL	37.00 gal	2 pt	3 pt	4 pt	9.25	13.90	18.50
Cadence	UAP	acetochlor & dichlormid safener	6.4EC	85.00 gal	1.5 pt	2 pt	2.25 pt	12.20	16.25	18.30
Callisto	Syngenta	mesotrione	4SE	580.00 gal	2 fl oz	2.5 fl oz	3 fl oz	9.05	11.35	13.60
Camix	Syngenta	mesotrione & s-metolachlor	0.334 + 3.34L	60.00 gal	2 qt	2.2 qt	2.4 qt	30.00	33.00	36.00
Casoron 4G	Uniroyal	dichlobenil	4G	2.25 lb	100 lb	150 lb	200 lb	225.00	337.50	450.00
Casoron 10G	Uniroyal	dichlobenil	10G	5.15 lb	40 lb	60 lb	80 lb	206.00	309.00	412.00
Celebrity Plus	BASF	dic-Na & diflufenzopyr & nicosulf	42.4 + 17 + 10.6WG	5.30 oz	2.34 oz	3.50 oz	4.67 oz	12.40	18.55	24.75
Charger Basic	Winfield	s-metolachlor	7.62EC	105.00 gal	1.33 pt	1.67 pt	2 pt	17.45	21.90	26.25
Charger Max	Winfield	s-metolachlor & benoxacor safen	7.64EC	105.00 gal	1.33 pt	1.67 pt	2 pt	17.45	21.90	26.25
Chateau	Valent	flumioxazin	51WDG	7.00 oz	1.5 oz	2 oz	2.5 oz	10.50	14.00	17.50
Cimarron	Dupont	metsulfuron-methyl	60DF	25.00 oz	0.05 oz	0.1 oz	0.3 oz	1.25	2.50	7.50
Cimarron Max	Dupont	Ally+Weed Master (2,4-D & dica)	60DF + 2.87 & 1SL	150.00 case	.25oz+1	0.5+2pt	1oz+4pt	3.75	7.50	15.00
Cimarron X-tra	Dupont	chlorsulfon & metsulfon	37.5 + 30DF	15.00 oz	.25oz+1	0.5+2pt	1oz_4pt	7.50	-	15.00
Cinch	Dupont	s-metolachlor & benoxacor safen	7.64EC	110.00 gal	1.33 pt	1.67 pt	2 pt	18.30	22.95	27.50
Cinch ATZ Lite	Dupont	atrazine & metolachlor	2.67 + 3.23L	58.20 gal	1 qt	1.5 qt	1.9 qt	14.55	21.85	27.65
Cinco	UAP	glyphosate-ipa salt	3SL	13.00 gal	1 pt	2 pt	4 pt	1.63	3.25	6.50
Clarity	BASF	dicamba-dga salt	4SL	95.00 gal	2 fl oz	4 fl oz	8 fl oz	1.50	3.00	5.95
CleanWave	Dow	aminopyralid & fluroxypyr	0.08 + 1.12EC	50.00 gal	10 fl oz	12 fl oz	14 fl oz	3.90	4.70	5.50
ClearMax	BASF	imazamox / MCPAe copack	1SL / 3.7EC	180.00 gal	12 fl oz	16 fl oz	18 fl oz	16.90	22.50	25.30
Clethodim	Arysta	clethodim	2EC	125.00 gal	4 fl oz	6 fl oz	8 fl oz	3.90	5.85	7.80
Clopyr Ag	UPI	clopyralid-monoea salt	3SL	410.00 gal	0.25 pt	0.5 pt	0.67 pt	12.80	25.65	34.35
Cobra	Valent	lactofen	2EC	155.00 gal	6 fl oz	8 fl oz	12.8 fl oz	7.75	10.30	16.50
Colt AS	UAP	clopyralid-MEA salt & fluroxypyr-e	0.75 + 0.75EC	62.00 gal	1 pt	1.25 pt	1.33 pt	7.75	9.70	10.30
Commando	Tenkos	clopyralid-aka & 2,4-D-aka salt	0.38 + 2SL	40.00 gal	2 pt	2.67 pt	4 pt	10.00	13.35	20.00
Commando M	Tenkos	clopyralid acid & MCPAioe	0.42 + 2.35SL	43.00 gal	1.75 pt	2 pt	2.33 pt	9.85	11.25	13.10
Confidence	Winfield	acetochlor & safener	7EC	85.00 gal	1.25 pt	1.75 pt	2.25 pt	13.30	18.60	23.90
Cornerstn/Plus		glyphosate-ipa salt	3SL	14.00 gal	1 pt	2 pt	4 pt	1.75	3.50	7.00
Credit/Extra	Nufarm	glyphosate-ipa salt	3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
CreditDuo/Extra	Nufarm	glyt-ipa salt & glyt-NH4	2.7 + 0.3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
Credit Master	Nufarm	glyphosate-ipa & 2,4-D-ipa	0.9 + 1.5SL	14.00 gal	27 fl oz	40 fl oz	54 fl oz	2.95	4.40	5.90
Crossbow	Dow/UAP	triclopyr-bee & 2,4-D-bee	1 + 2SL	60.00 gal	1 qt	3 qt	6 qt	15.00	45.00	90.00
Crossing 4L	W-Ellis	sulfentrazone	4L	- gal	3 fl oz	4.5 fl oz	6 fl oz	-	-	-
Curtail	Dow	clopyralid-aka & 2,4-D-aka salt	0.38 + 2SL	40.00 gal	2 pt	2.67 pt	4 pt	10.00	13.35	20.00
Curtail M	Dow	clopyralid acid & MCPAioe	0.42 + 2.35SL	45.00 gal	1.75 pt	2 pt	2.33 pt	9.85	11.25	13.10
Dacthall	Amvac	DCPA	6F	144.00 gal	8 pt	10 pt	14 pt	144.00	180.75	252.00
Dacthall	Amvac	DCPA	75WDG	18.00 lb	8 lb	10 lb	14 lb	144.00	180.75	252.00
Define SC	Bayer	flufenacet	4SC	131.00 gal	9 fl oz	20 fl oz	24 fl oz	9.20	20.50	24.55
Degree	Monsanto	acetochlor	3.8ME	45.00 gal	3 pt	4 pt	4.25 pt	16.90	22.50	23.90
Degree Xtra	Monsanto	acetochlor & atrazine	2.7 + 1.34ME	32.00 gal	2 qt	3 qt	3.7 qt	16.00	24.00	29.60
Des	UPI	desmedipham	1.3EC	85.00 gal	4.62 pt	6 pt	7.7 pt	49.10	63.75	81.80
Des-i-cate II	UPI	endothall	2SL	40.00 gal	1.5 qt	-	2 qt	15.00	-	20.00
Des-Phen-Etho	UPI	desmed & phenmed & ethofum	0.6 + 0.6 + 0.6EC	85.00 gal	0.8 pt	2 pt	3.3 pt	8.50	21.25	35.05
Dicamba	Albaugh	dicamba-dma salt	4SL	80.00 gal	2 fl oz	4 fl oz	8 fl oz	1.25	2.50	5.00
Dicambazine	Albaugh	atrazine & dicamba-K salt	2.1 + 1.1L	35.00 gal	2 pt	3 pt	3.5 pt	8.75	13.15	15.30
Dimetric	Winfield	metribuzin	75DF	16.50 lb	1.6 oz	0.25 lb	0.67 lb	1.85	4.15	11.05
Discover	Syngenta	clodinafop-propargyl + DSV adj.	2EC	650.00 gal	3.2 fl oz	3.6 fl oz	4 fl oz	16.25	18.30	20.30
Discover NG	Syngenta	clodinafop-propargyl + DSV adj.	0.5EC	135.00 gal	12.8 fl oz	14.5 fl oz	16 fl oz	13.50	15.30	16.90
Distinct	BASF	dicamba-Na & diflufenzopyr-Na	50 + 20WDG	3.00 oz	2 oz	4 oz	6 oz	6.00	12.00	18.00
Diuron	Several	diuron	80WDG	4.50 lb	0.75 lb	2 lb	6 lb	3.40	9.00	27.00
DoubleUp B&G	Helena	bromoxynil ester & 2,4-D ester	2 + 1.9EC	44.00 gal	0.5 pt	0.75 pt	1 pt	2.75	4.15	5.50
Domain	Rosens	flufenacet & metribuzin	24 + 36WDG	0.85 oz	9 oz	12 oz	14 oz	7.65	10.20	11.90
D-P Mix	UPI	desmedipham & phenmedipham	0.65 + 0.65EC	85.00 gal	4.62 pt	6 pt	7.7 pt	49.10	63.75	81.80
Dual Magnum	Syng	s-metolachlor	7.62EC	110.00 gal	1.33 pt	1.67 pt	2 pt	18.30	22.95	27.50
Dual II Magnum	Syng	s-metolachlor & benoxacor safen	7.64EC	110.00 gal	1.33 pt	1.67 pt	2 pt	18.30	22.95	27.50
Duramax	Dow	glyphosate-dma salt	4SL	36.00 gal	12 fl oz	24 fl oz	48 fl oz	3.40	6.75	13.50
Durango DMA	Dow	glyphosate-dma salt	4SL	26.00 gal	12 fl oz	24 fl oz	48 fl oz	2.45	4.90	9.75
E-99	Winfield	2,4-Dbec	6.1EC	25.00 gal	0.33 pt	0.67 pt	1.33 pt	1.05	2.10	4.15

Product	Active Ingredient	Formulation	Cost \$/Unit	Product/A			Cost \$/A			
				Low	Med	High	Low	Med	High	
Encompass	Tenkos	flumioxazin	51WDG	4.40 oz	2 oz	2.5 oz	3 oz	8.80	11.00	13.20
Epic	Rosens	flufenacet & isoxaflutole	48 + 10DF	2.25 oz	5 oz	6 oz	8 oz	11.25	13.50	18.00
Eptam	Gowan	EPTC	7EC	33.00 gal	2.3 pt	4 pt	6.75 pt	9.50	16.50	27.85
Eptek	Drexel	EPTC	7EC	33.00 gal	2.3 pt	4 pt	6.75 pt	9.50	16.50	27.84
Eradicane	Gowan	EPTC & dichlormid safener	6.7EC	32.00 gal	4.75 pt	6 pt	7.33 pt	19.00	24.00	29.30
Escort	Dupont	metsulfuron methyl	60XP	21.00 oz	0.33 oz	1 oz	2 oz	6.95	21.00	42.00
Establish	Tenkos	dimethenamid-P	6EC	135.00 gal	16 fl oz	18 fl oz	21 fl oz	16.90	19.00	22.15
ET	Nichino	pyraflufen ethyl	0.208EC	345.00 gal	0.5 fl oz	2 fl oz	5.5 fl oz	1.35	5.40	14.80
Etho SC	UPI	ethofumesate	4EC	95.00 gal	6 pt	7 pt	7.5 pt	71.25	83.15	89.05
Ethotron SC	UPI	ethofumesate	4EC	100.00 gal	6 pt	7 pt	7.5 pt	75.00	87.50	93.75
Everest	Arysta	flucarbazone-Na	70WDG	24.00 oz	0.4 oz	0.5 oz	0.6 oz	9.60	12.00	14.40
Expert	Syngenta	s-met & atra & glyphosate-ipa salt	1.74 + 2.14 + 0.75SC	35.00 gal	2.5 qt	3 qt	3.75 qt	21.90	26.25	32.80
Express	Dupont	tribenuron methyl	75XP	22.00 oz	1/8 oz	1/6 oz	1/3 oz	2.75	3.70	6.60
Express	Dupont	tribenuron methyl	50SG	15.00 oz	1/4 oz	1/3 oz	1/2 oz	3.75	4.95	7.50
Extra Credit	Nufarm	glyphosate-ipa salt	3.75SL	20.00 gal	0.8 pt	1.6 pt	3.2 pt	2.00	4.00	8.00
Extreme	BASF	imazethapyr acid & glyph-ipa	0.17 + 2SL	32.00 gal	1.5 pt	2.25 pt	3 pt	6.00	9.00	12.00
Fallow Master	Monsnt	glyphosate-ipa & dicamba-ipa	1.6 + 0.4SL	20.00 gal	22 fl oz	32 fl oz	44 fl oz	3.45	4.50	6.90
Fallow Star	Albaugh	glyphosate-ipa & dicamba-ipa	1.1 + 0.5SL	18.00 gal	22 fl oz	32 fl oz	44 fl oz	3.10	4.50	6.20
Far-Go EC	Gowan	trallate	4EC	40.00 gal	1 qt	1.25 qt	1.5 qt	10.00	12.50	15.00
Far-Go G	Gowan	trallate	10G	0.90 lb	10 lb	12.5 lb	15 lb	9.00	11.25	13.50
Field Master	Monanto	acet & atra & glyphosate-ipa salt	2 + 1.5 + 0.56SC	28.00 gal	3.5 qt	4 qt	5 qt	24.50	28.00	35.00
Finesse	Dupont	chlorsulfuron & metsulfuron-CH ₃	62.5 + 12.5DF	15.00 oz	0.2 oz	0.25 oz	0.3 oz	3.00	3.75	4.50
Finesse G&B	Dupont	chlorsulfuron & flucarbazone-Na	25 + 46.7DF	20.00 oz	0.6 oz	0.72 oz	0.9 oz	12.00	14.40	18.00
Firestorm	Chemtura	paraquat dichloride	3SL	32.00 gal	0.7 pt	1 pt	1.35 pt	2.80	4.00	5.40
FirstRate	Dow	cloransulam methyl	84WDG	29.00 oz	0.3 oz	0.6 oz	0.75	8.70	17.40	21.75
Flexstar	Syngenta	fomesafen-Na + adjuvants	1.88EC	110.00 gal	0.5 pt	0.75 pt	1 pt	6.90	10.30	13.75
Forefront R&P	Dow	aminopyralid & 2,4-D	0.33 + 2.67EC	55.00 gal	1.5 pt	2 pt	2.6 pt	10.30	13.75	17.90
FulTime	Dow	acetochlor-ME & atrazine	2.4 + 1.6L	30.00 gal	2.5 qt	2.7 qt	3 qt	18.75	20.25	22.50
Fusilade DX	Syng	fluazifop-P butyl	2EC	155.00 gal	6 fl oz	10 fl oz	12 fl oz	7.30	12.10	14.55
Fusion	Syngenta	fluazifop-P & fenoxaprop	2 + 0.66EC	170.00 gal	6 fl oz	10 fl oz	12 fl oz	8.00	13.30	15.95
Gangster	Valent	Copack:flumioxazin&cloransulm	51WDG / 84WDG	600.00 cont	2.4 oz	3 oz	3.6 oz	16.65	20.80	22.30
Parazone	MANA	paraquat dichloride	3SL	32.00 gal	0.7 pt	1 pt	1.35 pt	2.80	4.00	5.40
Garlon EC	Dow	triclopyr ester	4EC	120.00 gal	1 qt	2 qt	4 qt	30.00	60.00	120.00
Garlon SL	Dow	triclopyr ester	3SL	90.00 gal	2 qt	1 gal	2 gal	45.00	90.00	180.00
Glean	Dupont	chlorsulfuron	75DF	17.00 oz	1/6 oz	-	1/3 oz	2.85	-	5.60
Glyfos/Extra	Chemnva	glyphosate-ipa salt	3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
GlyKamba	Nufarm	glyphosate-ipa & dicamba-ipa	1.6 + 0.4SL	30.00 gal	22 fl oz	32 fl oz	44 fl oz	5.15	7.50	10.30
Glyphomax XRT	Dow	glyphosate-ipa salt	4SL	36.00 gal	12 fl oz	24 fl oz	48 fl oz	3.40	6.75	13.50
Gly Star/Plus	Albaugh	glyphosate-ipa salt	3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
G-Max Lite	BASF	atrazine & dimethenamid-P	2.75 + 2.25L	60.00 gal	2 pt	2.5 pt	3 pt	15.00	18.75	22.50
Goal	Dow	oxyfluorfen	2EC	90.00 gal	4 pt	6 pt	8 pt	45.00	67.50	90.00
Gramoxone	Inteon	paraquat dichloride	2SL	32.00 gal	2 pt	3 pt	4 pt	8.00	12.00	16.00
Grazon P+D	Dow	picloram-3ipa & 2,4-D-3ipa	0.54 + 2 S	35.00 gal	2 qt	3 qt	4 qt	17.50	26.25	35.00
Guardsman Max	BASF	atrazine & dimethenamid-P	3.3 + 1.7L	48.00 gal	2.8 pt	3.6 pt	4.2 pt	16.80	21.60	25.20
Gun Slinger	Albaugh	picloram-3ipa & 2,4-D-3ipa	0.54 + 2 S	35.00 gal	2 qt	3 qt	4 qt	17.50	26.25	35.00
Habitat	BASF	imazapyr-ipa salt	2SL	300.00 gal	1 qt	2 qt	3 qt	75.00	150.00	225.00
Halex GT	Syngenta	glyt-K & mesotrione & s-metolchlr	- SC	- gal	3 pt	3.6 pt	4 pt	-	-	-
Harmony Extra	Dupont	thifensulfuron & tribenuron	50 + 25XP	15.00 oz	0.15 oz	0.3 oz	0.6 oz	2.25	4.50	9.00
Harmony Extra	Dupont	thifensulfuron & tribenuron	33.33 + 16.67SG	- oz	0.45 oz	0.7 oz	0.9 oz	-	-	-
Harmony GT	Dupont	thifensulfuron methyl	75XP	15.00 oz	1/12 oz	0.3 oz	0.6 oz	1.20	4.50	9.00
Harmony SG	Dupont	thifensulfuron methyl	50SG	11.00 oz	0.45 oz	0.7 oz	0.9 oz	4.95	7.70	9.90
Harness	Monsanto	acetochlor & safener	7EC	90.00 gal	1.25 pt	1.75 pt	2.25 pt	14.10	19.70	25.30
Harness Xtra	Monsnt	acet & dichlormid & atra	4.3 + 1.7F	55.00 gal	1.2 qt	1.5 qt	1.8 qt	16.50	20.65	24.75
Harness Xtra 5.6L	"	acet & dichlormid & atra	3.1 + 2.5F	45.00 gal	1.5 qt	1.7 qt	2.3 qt	16.90	19.15	25.90
HM 0335A	Helena	2,4-D acid & dicamba acid	- SL	- gal	-	6 fl oz	-	-	-	-
Hornet	Dow	flumetsulam & clopyralid-K salt	18.5 + 60WDG	4.00 oz	2 oz	3 oz	4 oz	8.00	12.00	16.00
Huskie	Bayer	bromoxynil & pyrasulfotole	2.08EC-26.3%+3.3%	85.00 gal	11 fl oz	12.8 fl oz	13.5 fl oz	7.30	8.50	9.00
Hyvar X-L	Dupont	bromacil	2L	65.00 gal	1.5 gal	3 gal	6 gal	97.50	195.00	390.00
Impact	Amvac	topramezone	2.8SC	19.00 oz	0.33 oz	0.5 oz	0.75 oz	6.30	9.50	14.25
Imperium	Gowan	acetochlor & safener & EPTC	1.4 + 5.6EC	31.00 gal	4.5 pt	6 pt	7 pt	17.45	23.25	27.15
Intensity	UAP	clethodim	2EC	125.00 gal	4 fl oz	6 fl oz	8 fl oz	3.90	5.90	7.80
Intensity One	UAP	clethodim	1EC	- gal	6 fl oz	8 fl oz	12 fl oz	-	-	-

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Intrro Monsanto	alachlor	4EC	25.00 gal	2 qt	2.5 qt	3 qt	12.50	15.65	18.75
Journey BASF	imazapic acid & glyphosate-ipa	2.25SL	125.00 gal	10.7 fl oz	21.3 fl oz	32 fl oz	10.45	20.80	31.25
KambaMaster Nufarm	2,4-D-dea & dicamba-dea	2.87 + 1SL	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Karmex Griffin	diuron	80XP	4.50 lb	2 lb	6 lb	8 lb	9.00	27.00	36.00
Keystone LA Dow	acetochlor & atrazine	4 + 1.5L	48.00 gal	1.5 qt	1.8 qt	2.1 qt	18.00	21.60	25.00
Krovar I Dupont	bromacil & diuron	40 + 40DF	12.50 lb	6 lb	12 lb	16 lb	75.00	150.00	200.00
Landmark MP Dupont	chlorsulfuron & sulfometuron	25 + 50DF	15.00 oz	2.25 oz	4.5 oz	9 oz	33.75	67.50	135.00
Landmark II MP Dpnt	chlorsulfuron & sulfometuron	18.75 + 56.25DF	16.00 oz	2.66 oz	6.33 oz	10 oz	42.55	101.30	160.00
Landmaster BW Albgh	glyphosate-ipa & 2,4-D-ipa	0.9 + 1.5SL	15.00 gal	27 fl oz	40 fl oz	54 fl oz	3.16	4.70	6.35
Laudis Bayer	tembotrione & isoxadifen safener	3.5 + 1.75SC	4.00 oz	2 fl oz	2.5 fl oz	3 fl oz	8.00	10.00	12.00
Liberty Bayer	glufosinate-NH4	1.67SL	69.00 gal	28 fl oz	31 fl oz	34 fl oz	15.10	16.70	18.35
Lightning BASF	imazethapyr acid & imazapyr	52.5+17.5WDG	13.00 oz	0.75 oz	1.00 oz	1.28 oz	9.75	13.00	16.65
Lorox Griffin	linuron	50DF	17.00 lb	1 lb	3 lb	6 lb	17.00	51.00	102.00
Lumax Syngenta	atrazine & mesotrione & s-metol	1 + 0.268 + 2.68	53.00 gal	2 pt	2.5 pt	3 pt	13.25	16.55	19.90
Mad Dog UAP	glyphosate-ipa	3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
Mad Dog Plus UAP	glyphosate-ipa	3SL	- gal	1 pt	2 pt	4 pt	-	-	-
Maestro D Nufarm	bromoxynil ester & 2,4-D ester	2 + 1.9EC	45.00 gal	0.75 pt	1.33 pt	2 pt	4.22	7.50	11.25
Maestro MA Nufarm	bromoxynil ester & MCPA ester	2 + 2EC	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Makaze UAP	glyphosate-ipa	3SL	17.00 gal	1 pt	2 pt	4 pt	2.15	4.25	8.50
Marksman BASF	atrazine & dicamba-K salt	2.1 + 1.1L	35.00 gal	2 pt	3 pt	3.5 pt	8.75	13.15	15.30
Matrix Dupont	rimsulfuron	25DF	13.00 oz	1 oz	-	1.5 oz	13.00	-	19.50
Maverick Monsanto	sulfosulfuron	75DF	16.00 oz	0.33 oz	0.5 oz	0.67 oz	5.30	8.00	10.70
MCPA amine Several	MCPA amine	4SL	16.00 gal	0.4 pt	1 pt	2 pt	0.80	2.00	4.00
MCPA ester Several	MCPA ester	4EC	18.00 gal	0.5 pt	1 pt	2 pt	1.15	2.25	4.50
Metgard MANA	metsulfuron methyl	60DF	14.00 oz	0.05 oz	0.1 oz	0.3 oz	0.70	1.40	4.20
Me-too-lachlor Drexel	metolachlor & dichlormid safener	7.82EC	100.00 gal	1.67 pt	1.75 pt	2 pt	20.90	21.90	25.00
Metri UPI	metribuzin	75DF	20.00 lb	1.6 oz	0.25 lb	0.67 lb	2.00	5.00	13.40
Metribuzin MANA	metribuzin	75DF	20.00 lb	1.6 oz	0.25 lb	0.67 lb	2.00	5.00	13.40
Metsulfuron Arysta	metsulfuron methyl	60XP	12.00 oz	0.05 oz	0.1 oz	0.3 oz	0.60	1.20	3.60
Milestone Dow	aminopyralid-3ipNH4 salt	2EC	340.00 gal	3 fl oz	5 fl oz	7 fl oz	8.00	13.30	18.60
Mirage Plus UAP	glyphosate-ipa	3SL	13.00 gal	1 pt	2 pt	4 pt	1.65	3.25	6.50
Moxy Winfield	bromoxynil ester	2EC	60.00 gal	1 pt	1.5 pt	2 pt	7.50	11.25	15.00
NorthStar Syngenta	dicamba-Na & primisulfuron	39.9 + 7.5WDG	2.20 oz	5 oz	-	5 oz	11.00	-	11.00
Norton SC Bayer	ethofumesate	4EC	100.00 gal	6 pt	7 pt	7.5 pt	75.00	87.50	93.75
Olympus Bayer	propoxycarbazone-Na	70WDG	13.00 oz	0.4 oz	0.5 oz	0.6 oz	5.20	6.50	7.80
Option Bayer	foramsulfuron & isoxadifen safen	35DF + 35DF	10.50 oz	1.25 oz	1.33 oz	1.5 oz	13.15	14.00	15.75
Oracle Gharda	dicamba-dma salt	4SL	82.00 gal	2 fl oz	4 fl oz	8 fl oz	1.30	2.55	5.15
Oust Dupont	sulfometuron methyl	75XP	12.00 oz	2 oz	6 oz	8 oz	24.00	72.00	96.00
Oust Extra Dupont	sulfometuron & metsulfuron	56.25 + 15DF	10.50 oz	3 oz	4 oz	5 oz	31.50	42.00	52.50
Outlaw Albaugh	2,4-D-ehe & dicamba-acid	1.45 + 1.09SL	32.00 gal	1.5 pt	1.75 pt	2.75 pt	6.00	7.00	11.00
Outlook BASF	dimethenamid-P	6EC	150.00 gal	10 fl oz	14 fl oz	18 fl oz	11.75	16.40	21.10
Overdrive BASF	dicamba-Na & diflufenzopyr-Na	50 + 20WDG	3.20 oz	4 oz	6 oz	8 oz	12.80	19.20	25.60
Parallel MANA	metolachlor & benoxacor safener	7.82EC	60.00 gal	1.67 pt	1.75 pt	2 pt	12.55	13.15	15.00
Parallel Plus MANA	meto & atra & benoxacor safener	2.7 + 2.8L	45.00 gal	1.4 pt	1.9 pt	2.3 pt	7.90	9.55	12.95
Paramount BASF	quinclorac	75DF	55.00 lb	5.3 oz	6.5 oz	8 oz	18.21	22.35	27.50
Pathway Dow	picloram-triipa & 2,4-D-triipa	3% + 11.2%	35.00 gal	2 gal	3 gal	4 gal	70.00	105.00	140.00
Payload Valent	flumioxazin	51WDG	7.00 oz	2 oz	2.5 oz	3 oz	14.00	17.50	21.00
Peak Syngenta	prosulfuron	57DF	13.00 oz	0.25 oz	0.38 oz	0.5 oz	3.25	4.95	6.50
Pendant Winfield	pendimethalin	3.3EC	25.00 gal	2.4 pt	3 pt	3.64 pt	7.50	9.40	11.40
Pendimax Dow	pendimethalin	3.3EC	25.00 gal	2.4 pt	3 pt	3.64 pt	7.50	9.40	11.40
Permit Monsanto	halosulfuron methyl	75DF	19.00 oz	0.67 oz	1 oz	1.33 oz	12.75	19.00	25.30
PhenDes UPI	desmedipham & phenmedipham	0.65 + 0.65EC	85.00 gal	4.62 pt	6 pt	7.7 pt	49.10	63.75	81.80
Phoenix Valent	lactofen & adjuvants	2EC	160.00 gal	6 fl oz	8 fl oz	12.8 fl oz	7.50	10.00	16.00
Plateau BASF	imazapic acid	2SL	277.00 gal	4 fl oz	8 fl oz	12 fl oz	8.65	17.30	26.00
Poast BASF	sethoxydim	1.5EC	75.00 gal	0.5 pt	1 pt	1.5 pt	4.70	9.40	14.05
Portfolio 4L W-Ellis	sulfentrazone	4L	- gal	3 fl oz	4.5 fl oz	6 fl oz	-	-	-
Powerplay Drexel	acetochlor & safener & EPTC	1.4 + 5.6EC	33.00 gal	4.5 pt	6 pt	7 pt	18.55	24.75	28.90
Pramitol EC Several	prometon	25EC	35.00 gal	5 gal	7.5 gal	10 gal	175.00	262.50	350.00
Pramitol 5S Several	prometon	5PS	2.50 lb	150 lb	200 lb	400 lb	375.00	500.00	1000.00
Prefix Syngenta	s-metolachlor & fomesafen	4.34 + 0.95EC	- gal	1 pt	1.5 pt	2 pt	-	-	-
Pre-Pare Arysta	flucarbazone-Na	70WDG	24.00 oz	0.4 oz	0.5 oz	0.6 oz	9.60	12.00	14.40
Princep 4L Syngenta	simazine	4L	20.00 gal	2 qt	3 qt	4 qt	10.00	15.00	20.00

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Princep Caliber 90 "	simazine	90DF	4.50 lb	1.8 lb	3 lb	4.4 lb	8.10	13.50	19.80
Priority Tenkoz	carfentrazone & halosulfuron	12.5+50WDG	10.00 oz	0.5 oz	-	1 oz	5.00	-	10.00
Progress Bayer	desmed & phenmed & ethofum	0.6 + 0.6 + 0.6EC	95.00 gal	0.8 pt	2 pt	3.3 pt	9.50	23.75	39.20
Propel Rosens	dimethenamid-P	6EC	145.00 gal	10 fl oz	14 fl oz	18 fl oz	11.35	15.85	20.40
Prowl BASF	pendimethalin	3.3EC	26.00 gal	2.4 pt	3 pt	3.64 pt	7.80	9.75	11.85
Prowl H2O BASF	pendimethalin	3.8ACS	32.00 gal	2.1 pt	2.6 pt	3 pt	8.40	10.40	12.00
Puma Bayer	fenoxaprop-P ethyl	1EC	185.00 gal	0.33 pt	0.4 pt	0.67 pt	7.65	9.25	15.50
Pursuit BASF	imazethapyr-NH4	2AS	520.00 gal	2 fl oz	2.5 fl oz	3 fl oz	8.15	10.15	12.20
Pursuit Plus BASF	pendimethalin & imazethapyr	2.7 + 0.2EC	55.00 gal	20 fl oz	1.8 pt	2.5 pt	8.60	12.40	19.20
Python Dow	flumetsulam	80WDG	10.00 oz	0.8 oz	1 oz	1.33 oz	8.00	10.00	13.30
Quicksilver FMC	carfentrazone ethyl	1.9EW	200.00 qt	8 fl oz	13 fl oz	18 fl oz	11.25	16.90	25.30
Radius Bayer	flufenacet & isoxaflutole	3.57 + 0.43SC	180.00 gal	8 fl oz	13 fl oz	18 fl oz	11.25	16.90	25.30
Rage D-Tech FMC	carfentrazone ethyl & 2,4-D	0.13 + 3/93EW	53.00 gal	8 fl oz	12 fl oz	16 fl oz	3.35	5.00	6.65
Range Star Albaugh	2,4-D-dea & dicamba-dea	2.87 + 1SL	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Raptor BASF	imazamox-NH ₄	1SL	520.00 gal	2 fl oz	3 fl oz	4 fl oz	8.15	12.20	16.25
Rave Syngenta	triasulfuron & dicamba-Na salt	8.8 & 50WDG	1.60 oz	2 oz	4 oz	5 oz	3.20	6.40	8.00
Razencane Drexel	EPTC & dichlormid safener	6.7EC	32.00 gal	4.75 pt	6 pt	7.33 pt	19.00	24.00	29.30
Recoil Nufarm	glyphosate-ipa & 2,4-D-acid	1.58 & 1.07SL	20.00 gal	20 fl oz	28 fl oz	40 fl oz	3.15	4.40	6.25
Redeem Dow	clopyralid-tea & triclopyr-tea	0.75 & 2.25EC	110.00 gal	1.5 pt	2.5 pt	4 pt	20.65	34.40	55.00
Reflex Syngenta	fomesafen-Na	2EC	110.00 gal	0.5 pt	0.75 pt	1 pt	6.90	10.30	13.75
Reglone Syngenta	diquat	2SL	95.00 gal	1 pt	1.5 pt	2 pt	11.90	17.80	23.75
Rely Bayer	glufosinate-NH4	1SL	48.00 gal	3 pt	6 pt	8 pt	18.00	36.00	48.00
Remedy Dow	triclopyr ester	4EC	100.00 gal	1 qt	1.5 qt	2 qt	25.00	37.50	50.00
Resolve Dupont	rimsulfuron	25DF	7.00 oz	0.75 oz	-	1 oz	5.25	-	7.00
Resource Valent	flumiclorac ester	0.86SL	180.00 gal	1 fl oz	2 fl oz	3 oz	1.40	2.80	4.20
Rezult Copack BASF	bentazon-Na / sethoxydim	5SL / 1EC	55.00 gal		1.6 & 1.6 pt			22.00	
Rifle UAP	dicamba-dma salt	4SL	68.00 gal	2 fl oz	4 fl oz	8 fl oz	1.05	2.15	4.25
Rifle D UAP	2,4-D-dea & dicamba-dea	2.87 + 1SL	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Rifle Plus UAP	atrazine & dicamba-K salt	2.1 + 1.1L	30.00 gal	2 pt	3 pt	3.5 pt	7.50	11.25	13.15
Rimfire Bayer	mesosifrn & propoxycarbazon-Na	8.14 + 2.03WDG	5.50 oz	1.75 oz	2 oz	2.25 oz	9.65	11.00	12.40
Rodeo Dow	glyphosate-ipa salt	4SL	50.00 gal	0.75 pt	1.5 pt	3 pt	4.70	9.40	18.75
Ro-Neet Helm Agro	cycloate	6EC	80.00 gal	4 pt	4.5 pt	5.33 pt	40.00	45.00	53.30
RU Original Max Mons	glyphosate-K salt	4.5SL	35.00 gal	11 fl oz	22 fl oz	32 fl oz	3.00	6.00	8.75
RU WeatherMaxMons	glyphosate-K salt	4.5SL	45.00 gal	11 fl oz	22 fl oz	32 fl oz	3.85	7.75	11.25
RU PowerMax Mons	glyphosate-K salt	4.5SL	41.00 gal	11 fl oz	22 fl oz	32 fl oz	3.55	7.05	10.25
RT 3 Monsanto	glyphosate-K salt	4.5SL	28.00 gal	11 fl oz	22 fl oz	32 fl oz	2.40	4.80	7.00
Saber UAP	2,4-D dma salt	3.8SL	20.00 gal	0.5 pt	1 pt	2 pt	1.25	2.50	5.00
Sahara BASF	imazapyr acid & diuron	7.78 + 62.2WDG	19.00 lb	5 lb	10 lb	15 lb	95.00	190.00	285.00
Salvo UAP	2,4-D ester	5EC	30.00 gal	6.4 fl oz	9.6 fl oz	12.8 fl oz	1.50	2.25	3.00
Sandea Gowan	halosulfuron methyl	75DF	45.00 oz	0.67 oz	1 oz	1.33 oz	30.15	45.00	59.85
Section Winfield	clethodim	2EC	155.00 gal	4 fl oz	6 fl oz	8 fl oz	4.85	7.25	9.70
Shadow Arysta	clethodim	2EC	185.00 gal	4 fl oz	6 fl oz	8 fl oz	5.80	8.70	11.55
Select Max Valent	clethodim	1EC	120.00 gal	6 fl oz	9 fl oz	12 fl oz	5.65	8.45	11.25
Sencor Bayer	metribuzin	75DF	16.50 lb	1.6 oz	0.25 lb	0.67 lb	1.65	4.15	11.05
Sequence Syngenta	glyphosate-K & s-metolachlor	2.25 + 3SC	55.00 gal	2.5 pt	3 pt	3.5 pt	17.20	20.65	24.05
Shotgun UAP	atrazine & 2,4-D acid	2.25 + 1L	28.00 gal	1.5 pt	2 pt	3 pt	5.25	7.00	10.50
Silverado Bayer	mesosulfuron & safener	2WDG	5.25 oz	1.75 oz	2 oz	2.25 oz	9.20	10.50	11.80
Simazine L Several	simazine	4L	16.00 gal	2 qt	3 qt	4 qt	8.00	12.00	16.00
Simazine DF Several	simazine	90DF	3.50 lb	1.8 lb	3 lb	4.4 lb	6.30	10.50	15.40
Sinbar Dupont	terbacil	80WP	38.00 lb	0.5 lb	2 lb	4 lb	19.00	76.00	152.00
Sonalan HFP Dow	ethalfuralin	3EC	32.00 gal	1.5 pt	3 pt	4.5 pt	6.55	13.15	19.70
Sonalan 10G Dow	ethalfuralin	10G	1.10 lb	6 lb	11.5 lb	17 lb	6.80	12.65	18.70
Sonic Dow	cloransulam & sulfentrazone	7.9 + 62.1WDG	2.00 oz	3.2 oz	6.45 oz	8 oz	6.40	12.90	16.00
Spartan FMC	sulfentrazone	4L	425.00 gal	3 fl oz	4.5 fl oz	6 fl oz	9.95	14.95	19.90
Spartan Advance FMC	glyphosate & sulfentrazone	3 + 0.56SC	- gal	16 fl oz	24 fl oz	32 fl oz	-	-	-
Spike Dow	tebuthiuron	20P	15.00 lb	2.5 lb	5 lb	10 lb	37.50	75.00	150.00
Spirit Syngenta	prosulfuron & primisulfuron	14.2 + 42.8DF	12.00 lb	1 oz	-	1 oz	12.00	-	12.00
Spur Albaugh	clopyralid-monoea salt	3SL	430.00 gal	0.25 pt	0.5 pt	0.67 pt	13.45	26.90	36.00
Stalwart SipCam	metolachlor	8EC	70.00 gal	1.67 pt	1.75 pt	2 pt	14.60	15.30	17.50
Stalwart C SipCam	metolachlor & dichlormid safener	7.8EC	70.00 gal	1.67 pt	1.75 pt	2 pt	14.60	15.30	17.50
Starane Dow	fluroxypyr ester	1.5EC	120.00 gal	0.5 pt	0.67 pt	1 pt	7.50	10.05	15.00
Starane NXT Dow	bromoxynil / fluroxypyr-ester	2.33 + 0.583EC	80.00 gal	14 fl oz	21 fl oz	27.4 fl oz	8.75	13.15	15.45

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Starane & Salvo UAP	fluroxypyr ester & 2,4-D ester	0.75 + 3EC	60.00 gal	1 pt	1.33 pt	1.67 pt	7.50	10.00	12.55
Starane & Sword UAP	fluroxypyr ester & MCPA ester	0.71 + 2.84EC	60.00 gal	1.125 pt	1.5 pt	2 pt	8.45	11.25	15.00
Status BASF	dic-Na&diflufenzpr-Na&isoxadifen	44 + 17.1WDG	2.50 oz	2.5 oz	4 oz	5 oz	6.25	10.00	12.50
Stratos Gharda	atrazine & dicamba-K salt	2.1 + 1.1L	35.00 gal	2 pt	3 pt	3.5 pt	8.75	13.15	15.30
Steadfast Dupont	nicosulfuron & rimsulfuron	50 + 25DF	23.00 oz	0.5 oz	0.6 oz	0.75 oz	11.50	13.85	17.25
Stealth UAP	pendimethalin	3.3EC	21.00 gal	2.4 pt	3 pt	3.64 pt	6.30	7.90	10.50
Sterling Winfield	dicamba-dma salt	4SL	70.00 gal	2 fl oz	1 pt	4 pt	1.10	8.75	35.00
Sterling Blue Winfield	dicamba-dga salt	4SL	95.00 gal	2 fl oz	4 fl oz	8 fl oz	1.50	3.00	5.95
Sterling Plus Winfield	atrazine & dicamba-K salt	2.1 + 1.1L	28.00 gal	2 pt	3 pt	3.5 pt	7.00	10.50	12.25
Stinger Dow	clopyralid-monoeca salt	3SL	450.00 gal	0.25 pt	0.5 pt	0.67 pt	14.05	28.15	37.70
Stout Dupont	nicosulfuron & thifensulfuron	67.5 + 5DF	20.00 oz	0.5 oz	-	0.75 oz	10.00	-	15.00
SureStart Dow	aceto&cloprld&flumet&dichlormid	3.75 + 0.29 + 0.12SC	75.00 gal	1.5 pt	1.75 pt	2 pt	14.10	16.40	18.75
Surflan PHI	oryzalin	4EC	100.00 gal	2 qt	3 qt	4 qt	50.00	75.00	100.00
Surpass EC Dow	acetochlor & dichlormid safener	6.4EC	80.00 gal	1.5 pt	2 pt	2.25 pt	15.00	20.00	22.50
Surpass 20G Dow	acetochlor & dichlormid safener	20G	3.75 lb	4 lb	6 lb	8 lb	15.00	22.50	30.00
Sword UAP	MCPA ester	5.2EC	30.00 gal	3 fl oz	1 pt	2 pt	.70	3.75	7.50
Targa Gowan	quizalofop ethyl	0.88EC	140.00 gal	7 fl oz	8 fl oz	10 fl oz	7.65	8.75	10.95
Telar Dupont	chlorsulfuron	75DF	25.00 oz	½ oz	1 oz	3 oz	12.50	25.00	75.00
Thistrol Nufarm	MCPB	2EC	45.00 gal	2 pt	4 pt	6 pt	11.25	22.50	33.75
TopNotch Dow	acetochlor (ME) & dichlormid saf.	3.2ME	38.00 gal	1.5 qt	2 qt	2.5 qt	14.25	19.00	23.75
Tordon 22K Dow	picloram - K salt	2SL	102.00 gal	1 pt	2 pt	4 pt	12.75	25.50	51.00
Touchdown CT Syng	glyphosate - K salt	4.17SL	25.00 gal	0.75 pt	1.5 pt	3 pt	2.35	4.70	9.40
Touchdown HiTech "	glyphosate - K salt	5SL	35.00 gal	10 fl oz	20 fl oz	30 fl oz	2.75	5.50	8.20
Touchdown Total "	glyphosate - K salt	4.17SL	40.00 gal	12 fl oz	24 fl oz	48 fl oz	3.75	7.50	15.00
Transline Dow	clopyralid-monoeca salt	3SL	- gal	0.67 pt	1 pt	1.33 pt	-	-	-
Treflan HFP Dow	trifluralin	4EC	26.00 gal	1 pt	2 pt	4 pt	3.25	6.50	13.00
Treflan TR-10 Dow	trifluralin	10G	0.85 lb	5 lb	10 lb	20 lb	4.25	8.50	17.00
Trifluralin EC Several	trifluralin	4EC	20.00 gal	1 pt	2 pt	4 pt	2.50	5.00	10.00
Trifluralin G Several	trifluralin	10G	0.85 lb	5 lb	10 lb	20 lb	4.25	8.50	17.00
Triflurex EC MANA	trifluralin	4EC	18.00 gal	1 pt	2 pt	4 pt	2.25	4.50	9.00
Trigger Albaugh	clethodim	2EC	160.00 gal	4 fl oz	6 fl oz	8 fl oz	5.00	7.50	10.00
Trimec ClassicPBI Gdn	2,4-D amine & MCPP & dicamba	3.32EC	- gal	3.25 pt	3.8 pt	4.33 pt	-	-	-
Trimec Plus PBI Grdn	MSMA & 2,4-Da & MCPPa	2.88EC	- gal	2 qt	3 qt	4 qt	-	-	-
Trimec SuperPBI Grdn	2,4-De & 2,4DPe & dicamba	4.5EC	- gal	2 pt	2.5 pt	3 pt	-	-	-
Triumph 22K Albaugh	picloram - K salt	2SL	95.00 gal	1 pt	2 pt	4 pt	11.90	23.75	47.50
Trust EC Winfield	trifluralin	4EC	20.00 gal	1 pt	2 pt	4 pt	2.50	5.00	10.00
Ultra Blazer UPI	acifluorfen-Na	2SL	75.00 gal	1 pt	1.5 pt	2 pt	9.40	14.05	18.75
Unison Helena	2,4-D acid	1.74SL	30.00 gal	1 pt	1.75 pt	2.5 pt	3.75	6.55	9.40
Unity Gowan	thifensulfuron methyl	75XP	15.00 oz	1/12 oz	0.3 oz	0.6 oz	1.20	4.50	9.00
UpBeet Dupont	triflusulfuron methyl	50DF	52.00 oz	0.25 oz	0.3 oz	0.5 oz	13.00	15.60	26.00
Valor Valent	flumioxazin	51WDG	4.70 oz	2 oz	2.5 oz	3 oz	9.40	11.75	14.10
Valuron MANA	metsulfuron methyl	60XP	14.00 oz	0.05 oz	0.1 oz	0.3 oz	0.70	1.40	4.20
Velpar Dupont	hexazinone	2L	65.00 gal	2 pt	4 pt	6 pt	16.25	32.50	48.75
Vengeance Plus WECO	MCPA & triclopyr & dichlorprop-p	3.72 + 0.75 + 0.75EC	- gal	2 pt	2.5 pt	3 pt	-	-	-
Vision Albaugh	dicamba acid	3.8SL	94.00 gal	2 fl oz	4 fl oz	8 fl oz	1.45	2.95	5.90
Vista Dow	fluroxypyr ester	1.5EC	100.00 gal	0.5 pt	0.67 pt	1 pt	6.25	8.40	12.50
Volley Tenkoz	acetochlor & dichlormid safener	6.4EC	70.00 gal	1.5 pt	2 pt	2.25 pt	13.15	17.50	19.70
Volunteer Tenkoz	clethodim	2EC	155.00 gal	4 fl oz	6 fl oz	8 fl oz	4.85	7.25	9.70
Weco Max Wilbur-Ellis	bromoxynil ester & 2,4-D ester	2 + 2.5EC	42.00 gal	1 pt	1.25 pt	1.5 pt	5.25	6.55	7.90
Weed Blast UAP	bromacil & diuron	4 + 4G	3.25 lb	40 lb	50 lb	60 lb	130.00	162.50	195.00
Weedone 638 Nufarm	2,4-D acid & 2,4-D ester	2.8EC	25.00 gal	0.67 pt	2 pt	3 pt	2.10	6.25	9.40
Weedmaster BASF	2,4-D-dea & dicamba-dea	2.87 + 1SL	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
WideMatch Dow	clopyralid-MEAsalt & fluroxypyr-e	0.75 + 0.75EC	65.00 gal	0.75 pt	1 pt	1.33 pt	6.10	8.15	10.80
Wildcard Helena	MCPA ester	4EC	30.00 gal	0.5 pt	1 pt	2 pt	1.90	3.75	7.50
Wildcard Xtra Helena	bromoxynil ester & MCPA ester	2 + 2EC	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Wolfpack Adv. Tenkoz	bromoxynil ester & MCPA ester	2.5 + 2.5EC	50.00 gal	0.8 pt	1.2 pt	1.6 pt	5.00	7.50	10.00
Yukon Gowan	dicamba-Na & halosulfuron-CH3	55 + 12.5 WDG	2.50 oz	4 oz	6 oz	8 oz	10.00	15.00	20.00
2,4-D Products	2,4-D								
2,4-D amine		3.8SL	12.00 gal	0.5 pt	2 pt	4 pt	0.75	3.00	6.00
2,4-D ester		3.8EC	15.00 gal	0.4 pt	2 pt	4 pt	0.75	3.75	7.50
LV ester		5.7EC	19.00 gal	0.33 pt	2 pt	4 pt	0.80	4.75	9.50

Herbicide Spray Adjuvants

Surfactants				Basic pH Blend			
Activate Plus	Winfield	\$19.50 gal	0.25 to 0.5% v/v	Linkage	West Central	\$16.50 gal	1% v/v
Activator 90	Loveland	\$17.00 gal	0.25 to 0.5% v/v	Mycrimix Plus	J.R. Simplot	\$18.00 gal	1% v/v
APSA-80	Amway	\$26.00 gal	0.25 to 0.5% v/v	Quad 7	Loveland	\$17.00 gal	1% v/v
ChemSurf 90	Unit. Suppliers	\$20.00 gal	0.25 to 0.5% v/v	Transactive	Helena	\$15.75 gal	1% v/v
Crnblt Premier 90	West Central	\$19.00 gal	0.25 to 0.5% v/v				
Liberate LechiTech	Loveland	\$26.50 gal	0.25 to 0.5% v/v				
Nutryx	Precision Labs	\$79.95 gal	0.25% v/v				
Pen-A-trate II	Precision Labs	\$19.25 gal	0.25 to 0.5% v/v				
Preference	Winfield	\$19.50 gal	0.25 to 0.5% v/v				
Purity 100	Rosens	\$21.00 gal	0.25 to 0.5% v/v				
R-11	Wilbur-Ellis	\$19.00 gal	0.25 to 0.5% v/v				
Tradition 93	Rosens	\$19.00 gal	0.25 to 0.5% v/v				
Translate	Unit. Suppliers	\$24.95 gal	0.25 to 0.5% v/v				
Wet-Sol 99	Schaeffers	\$24.75 gal	0.25 to 0.5% v/v				

NIS Approved for use in Water

Surfactants approved for use in bodies of water are:

Activate Plus	AgriDex	Class Act NG	
Induce	Liberate L-Tech	LI-700 Lechi-Tech	
Preference	R-11	Widespread	X-77

Surfactants & Silicone

Kinetic	Helena	\$95.00 gal	0.75 to 2 pt/100 gal
Silkin	Winfield	\$95.50 gal	0.75 to 2 pt/100 gal
Silwet L-77	Loveland	\$41.50 qt	0.38 to 1 pt/100 gal
Speed	Precision Labs	\$90.95 gal	0.25 to 2 pt/100 gal
Sur-Plus	Unit. Suppliers	\$80.00 gal	0.5 to 2 pt/100 gal
Sylgard 309	Wilbur-Ellis	\$90.00 gal	0.75 to 2 pt/100 gal

Surfactants & Fertilizer

AMSurf	Unit. Suppliers	\$0.75 lb	20 lb/100 gal
Bronc PlusDryEDT	Wilbur-Ellis	\$0.50 lb	10 lb/100 gal
Class Act NG	Winfield	\$7.25 gal	2.5% v/v
Deliver	Precision Labs	\$8.40 gal	2.5% v/v
Impressive DB	Rosens	\$0.70 lb	2.25 lb/A
Powerhouse	Rosens	\$6.70 gal	5 to 10 qt/100 gal
Solis	Precision Labs	\$0.56 lb	20 to 22 lb/100 gal
Surfate	Loveland	\$16.00 gal	1% v/v
Ultra Surf AMS	Unit. Suppliers	\$6.90 gal	2.5% v/v

Surfactants & Water Conditioning Agents

Bronc Total	Wilbur-Ellis	\$21.20 gal	0.75% v/v
Enact	Rosens	\$18.00 gal	0.25 to 0.5% v/v
Fastrack	Unit. Suppliers	\$17.25 gal	0.75% v/v
Flame	Loveland	\$33.00 gal	0.25 to 0.5% v/v
N-Tense	West Central	\$24.00 gal	0.25 to 0.75% v/v

AMS Replacements / Water Conditioning Agents

Alliance	Winfield	\$9.00 gal	1.25% v/v
Bronc Max	Wilbur-Ellis	\$17.95 gal	0.5% v/v
Choice W-master	Loveland	\$17.50 gal	0.5% v/v
Citron	Farm Direct	\$2.25 lb	2.2 lb/100 gal
Cut-Rate	Wilbur-Ellis	\$1.25 lb	4 lb/100 gal
Quest/Request	Helena	\$20.00 gal	0.5% v/v
Speedway	Unit. Suppliers	\$17.25 gal	0.5% v/v
Transport	Precision Labs	\$19.50 gal	0.5% v/v

Oil Based Surfactants

Trophy Gold	West Central	\$28.00 gal	1 qt/100 gal
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Petroleum Oil Concentrates

Agri-Dex	Helena	\$7.00 gal	2 to 4 pt/A
Exchange	Precision Labs	\$12.50 gal	2 to 4 pt/A
Herbimax	Loveland	\$8.50 gal	2 to 4 pt/A
Ortech	Rosens	\$7.00 gal	2 to 4 pt/A
Premium Crop Oil	Unit. Suppliers	\$7.00 gal	2 to 4 pt/A
Premium COC	West Central	\$7.00 gal	2 to 4 pt/A
Prime Oil	Winfield	\$7.50 gal	2 to 4 pt/A
ROC Crop Oil	Wilbur-Ellis	\$8.00 gal	2 to 4 pt/A
R-Way	Rosens	\$7.00 gal	2 to 4 pt/A
Vigor	Precision Labs	\$7.25 gal	2 to 4 pt/A

High Surfactant Oil Concentrates

Between (PO)	Unit. Suppliers	\$ - gal	1 to 2 pt/A
Diplomat	Rosens	\$11.50 gal	3 to 4 pt/100
Superb HC (PO)	Winfield	\$12.00 gal	1 to 2 pt/A
Destiny HC (MSO)	Winfield	\$ - gal	0.75 to 2 pt/A

Methylated Seed Oils (MSO)

Adigor	Syngenta	w/Axial	9.6 fl oz/A
Destiny	Winfield	\$15.00 gal	1 to 2 pt/A
MSO Lechi-Tech	Loveland	\$15.00 gal	1 to 2 pt/A
Persist Ultra	J.R. Simplot	\$18.00 gal	1 to 2 pt/A
Scoil	AGSCO	\$16.00 gal	1 to 2 pt/A
Soy-Stik	West Central	\$16.00 gal	1 to 2 pt/A
Succeed	United Suppl.	\$16.00 gal	1 to 2 pt/A
Sundance II	Rosens	\$16.00 gal	1 to 2 pt/A
Superspread MSO	Wilbur-Ellis	\$15.00 gal	1 to 2 pt/A

MSO Basic pH Blend

Base	West Central	\$17.00 gal	1 to 2 pt/A
Entro	Winfield	\$17.00 gal	1 to 2 pt/A
Renegade	Wilbur-Ellis	\$19.00 gal	1 to 2 pt/A
Z-64	AGSCO	\$17.00 gal	1 to 2 pt/A

MSO & Water Conditioning Agent

SuperCharge	Syngenta	w/Achieve	0.5% v/v
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MSO & Organosilicone Surfactant

Air Force	Unit. Suppliers	\$33.00 gal	4 to 6 fl oz/A
Dyne-Amic	Helena	\$43.00 gal	4 to 6 fl oz/A
Rivet	Winfield	\$44.00 gal	4 to 6 fl oz/A
Syl-tac	Wilbur-Ellis	\$49.50 gal	4 to 6 fl oz/A

Fertilizer

AMS (Dry)	Various	\$0.25 lb	2 to 4 lb/A
AMS (liquid)	Various	\$3.50 gal	2 to 4 qt/A
28% UAN	Various	\$3.50 gal	2 to 4 qt/A
28% UAN (bulk)	Various	\$3.50 gal	2 to 4 qt/A

AMS & Drift Retardant

AMS 20/10	Unit. Suppliers	\$0.90 lb	10 lb/100 gal
Corral AMS Dry	Winfield	\$1.50 lb	10 to 17 lb/100 gal

AMS & Defoamer

Am-Stik	West Central	\$4.00 gal	2 to 4 qt/100 gal
Omnix LDF	Precision Labs	\$4.60 gal	2.5 to 5% v/v

AMS & Deposition & Water Conditioner

Bronc Max EDT	Wilbur-Ellis	\$28.25 gal	2 to 4 qt/100 gal
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AMS & Deposition & Defoamer

AMS 2000	Unit. Suppliers	\$0.75 lb	10 to 17 lb/100 gal
AmSol Plus	Unit. Suppliers	\$5.00 gal	2.5 gal/100 gal
Arrow Four	Winfield	\$16.50 gal	2 to 4 qt/100 gal
Cornbelt Dri-Gard	West Central	\$1.25 lb	9 lb/100 gal
Cornbelt Gardian Plus	West Central	\$5.50 gal	2.5 gal/100 gal
Double Down	Unit. Suppliers	\$6.00 gal	2.5 gal/100 gal
Drift Guard	Rosens	\$1.32 lb	9 lb/100 gal

AMS & Deposition & Retention & Defoamer

Array	Rosens	\$1.60 lb	9 to 14 lbs/100 gal
Border Xtra DF	Precision Labs	\$1.10 lb	18 lb/100 gal
Border Xtra 4L	Precision Labs	\$4.70 gal	5% v/v
Border Xtra 8L	Precision Labs	\$7.25 gal	2.5% v/v

AMS & Surfactant & Deposition & Retention & Defoamer

One-Ap XL	West Central	\$1.50 lb	9 to 15 lbs/100 gal
Pay Off Plus	Unit. Suppliers	\$1.10 lb	10 to 13 lb/100 gal
Zenith	Rosens	\$1.25 lb	1.5 to 2.25 lbs/A

Water Conditioning & Deposition & Defoamer

Cornbelt Gardian	West Central	\$22.00 gal	1 to 3 qt/100 gal
Formula 1	Unit. Suppliers	\$22.00 gal	1 to 3 qt/100 gal
Transport Plus	Precision Labs	\$21.90 gal	1 to 3 qt/A

Water Conditioning & Deposition & Defoamer & Surfactant

Weather-Gard Complete	Loveland	\$30.00 gal	1 to 2 qt/100 gal
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Deposition - Drift Retardants

Affect GC	Unit. Suppliers	\$24.00 qt	1 to 2 fl oz/100 gal
Border EG 250	Precision Labs	8.80/10 oz	10 oz/100 gal
Corral Poly	Winfield	\$25.00 qt	4 to 12 fl oz/100 gal
Direct	Precision Labs	\$19.25 qt	1 to 4 oz/100 gal
Drift Down	Rosens	\$13.00 qt	4 to 8 fl oz/100 gal
In-Place	Wilbur-Ellis	\$32.00 gal	4 fl oz/pt-lb herbicide
InterLock	Winfield	\$42.00 gal	4 to 6 fl oz/A
Placement	Winfield	\$36.00 gal	4 fl oz/pt-lb herbicide
Shroud II	Unit. Suppliers	\$9.00 qt	10 to 12 oz/100 gal
Syndetic	West Central	\$13.00 qt	2 to 8 oz/100 gal

Deposition & Drift Retardant & Surfactant

Powerlock	Winfield	\$36.00 gal	5 to 8 oz/AI
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Drift Retardant & Defoamer

Compadre	Loveland	\$45.00 gal	1 pt/100 gal
Sedate	West Central	\$45.00 gal	1 pt/100 gal

Acidifying Agents

Complete	Winfield	\$35.00 gal	1 to 3 pt/100 gal
Indicate 5	Unit. Supplier	\$28.00 gal	2 to 4 pt/100 gal
LI-700 Lechi-Tech	Loveland	\$24.00 gal	2 to 4 pt/100 gal
New Balance	Precision Lab	\$28.00 gal	2 to 4 pt/100 gal

Compatibility Agents

CompatibilityAgent	West Central	\$30.00 gal	1 to 3 pt/100 gal
Complete	Winfield	\$35.00 gal	1 to 3 pt/100 gal
Convert	Precision Labs	\$31.50 gal	1 to 6 pt/100 gal
Embrace	Wilbur-Ellis	\$32.00 gal	1 to 4 pt/100 gal
EZ-Mix	Loveland	\$30.00 gal	1 to 4 pt/100 gal
Mix-All	Rosens	\$33.00 gal	1 to 4 pt/100 gal
U.S. Compat. Plus	Unit. Suppliers	\$30.00 gal	1 to 2 pt/100 gal

Spray Tank Cleaners

Tank Cleaner	Various	\$22-35 gal	1 to 2 qt/100 gal
Tank Cleaner	Various	\$5-7.00 lb	to 2 lb/100 gal

Summary of new information in the 2008 Weed Control Guide:

NDSU Weed Science home page address at: www.ag.ndsu.edu/weeds - Web version of ND Weed Control Guide.

By 2010, ~90% of herbicide ais will be off patent resulting in several generic formulations. See pages 106-107.

clethodim, clopyralid, thifensulfuron, tribenuron, others.

Company changes:

AgriLiance now Winfield Solutions

AGSCO now under UAP = Agrium (Canada)

Ayrsta + Microflo sold to Industrial Equity Investments (Ireland)

Cerexagri now under UPI

Rage D-Tech (FMC) - Premix of Aim & 2,4-D - apply POST in small grains and corn; preplant in soybean with planting at least 14 days after application.

Small Grains:

Everest/Pre-Pare (Ayrsta) - Registered preplant in wheat.

Prowl (BASF) - Registered POST in wheat - 1- to 3-leaf.

Sulfonyleureas (DuPont)

- SG (Soluble Granule) formulation of several SU herbicides = Ally Extra, Agility, Harmony, Harmony Extra, and Express.

- Many generic formulations of chlorsulfuron, metsulfuron, thifensulfuron, and tribenuron available.

Agility (Dupont) = dicamba, Harmony GT, Express, and Ally.

Axial XL (Syngenta) - Adigor adjuvant included in the formulation.

Avenge (Gowan) - Added back into the weed guide.

Huskie (Bayer) - premix of bromoxynil & pyrasulfatole. Labeled on wheat and barley up to flag-leaf emergence. Controls most annual broadleaf weeds, no grass control. Mix with most POST grass herbicides. Most crops can be planted the year after application.

New page for Herbicides Registered for Small Acreage Crops (buckwheat, juneberry, lawn, millet, mint, onion, rye, sorghum, and triticale) - See page 15.

Corn:

Select Max (Valent) - For EPP application to control unwanted grasses at planting and emergence.

Acetochlor (Dow/Monsanto) - reregistration allows most all crops to be planted the following application (see label).

SureStart (Dow) - Premix of acetochlor plus Hornet applied PRE.

Laudis (tembotrione) (Bayer) - Same chemistry as Callisto and Impact. With atrazine at 0.38 lb ai/A controls most all broadleaf weeds including yellow foxtail and suppression of green foxtail. Broadleaf weed control comparable to Callisto but greater grass control. Carryover to some crops.

Halex GT (Syngenta) - Premix of Dual II Magnum & Callisto & glyphosate for POST application.

RR Corn - Weed management expanded. Tank-mix options with glyphosate included - see page 20-21.

Soybean:

Authority Assist (FMC) (Dow) - Premix of Spartan & Pursuit - registration pending.

Authority MTZ (FMC) - Premix of Spartan & metribuzin.

RR Soybean - Weed management expanded. Tank-mix options with glyphosate included - see page 26-27.

Dry bean:

Valor (FMC) - Registration pending for dry bean desiccation.

Field Pea/Chickpea/Lentil:

Clethodim - Most all formulations registered for use.

Sunflower:

Assure II / Targa (Dupont / Gowan) - Registered for use.

Spartan Advance - Premix of Spartan & glyphosate for preplant application. EPP also registered in field pea.

Express Sun sunflower (Dupont/Pioneer). Non GM sunflower. Broadleaf weeds and season-long suppression of Canada thistle. **Glyphosate** - Registered for preharvest use.

Safflower:

Glyphosate - Preplant and preharvest application.

Clethodim - Registered for use.

Flax:

Assure II / Targa (Dupont / Gowan) - Reg. approved in 12/06.

Spartan 4F = Removed from Flax section.

Glyphosate:

Prices are increasing due less production of glyt-acid in China. Several new formulations available.

Roundup PowerMax (Monsanto) will replace RU OriginalMax - has different adjuvant system to provide greater common lambsquarters control. Contains CropShield to protect RR crops.

Durango DMA and Duramax (Dow) - glyphosate formulated with dimethyl amine salt (dma). Will replace existing formulations

Emerging New Active ingredients:

			Projected launch
Isoxadifen safener	Several	Corn	2006+
Laudis	Bayer	Corn	2008
New ai	Bayer	Corn	2009
Raft	Bayer	Sunflower	???
New ai	BASF	Corn/soybean	2010
Florasulam	Dow/Syng	Small grains	2009
Pyroxulam	Dow	Small grains	2009
New ai	DuPont	Pasture/range	2010?
Pyroxasulfone	Kumiai	Wht, corn, soy, snfl, pea, others	2010

Emerging Weed Management Traits:

		Projected launch
RR sugarbeet	Monsanto	2008
Roundup Ready2Yield soybean	Monsanto	2009
Liberty Link soybean	Bayer	2009
Optimum GAT soybean	DuPont	2009
Optimum GAT corn	DuPont	2010
Dow Herbicide Tolerant (DHT) corn	Dow	2012
DHT soybean	Dow	2013
Dicamba resistant soybean	Mon/U of NE	2013
SmartStax (8 GM traits)	Mon/Dow	????
Atrazine resistant sunflower?	Kansas St U.	????

Potential Section 18 exemptions:

None anticipated.

IR-4 Residue Studies to be Conducted in 2008:

Dry bean	propaonazole -	Fargo (3) Minot (2)
Sorghum	nico & rimsulfuron -	Fargo (2) Minot (1)
Corn	metalddehyde	Fargo (1)

Possible Future IR-4 Studies:

Millet	thifensulfuron
Safflower	sulfentrazone
Sunflower	thifensulfuron (Express resistant)

Double and Triple Stack Weed Resistance Update:

Horseweed:	Glyt (2000), Glyt + ALS (2003)
C. ragweed:	Glyt (2006), Glyt + PPO (2006), Glyt + PPO + ALS (2006)
Waterhemp:	Glyt (2005), Glyt + PPO + ALS (2006)
C. Lambsqt:	Glyt (2006)

Quick reference information:

1. NDSU Weed Science Home Page:
<http://www.ag.ndsu.edu/weeds/>

2. <agdakota> list serve: Timely updates in pesticide registration and crop production information. To subscribe, send email to r.zollinger@ndsu.edu

3. U.S. registered pesticide labels:
<http://www.cdms.net/manuf/manuf.asp>

4. North Dakota Department of Ag registered pesticide database:
<http://www.kellysolutions.com/nd/>

5. North Dakota Pesticide Training and Certification Program:
<http://www.ag.ndsu.nodak.edu/aginfo/pesticid/pesticid.htm>

6. SAFETY AND EMERGENCY PHONE NUMBERS:

ND Poison Control Line: 800 222-1222

ND Emergency Assistance Line: 800 472-2121

Report pesticide incident to NDDA: 701 328-2232