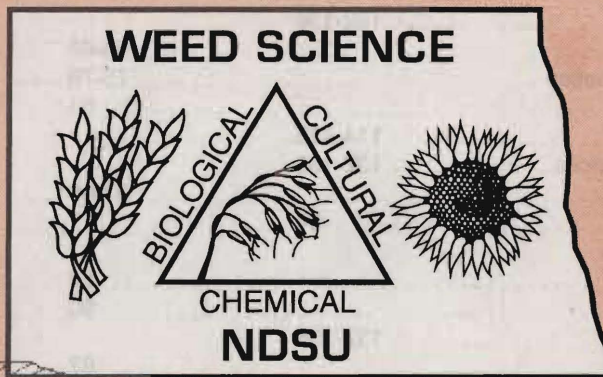


NORTH DAKOTA
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2001

NORTH DAKOTA WEED CONTROL GUIDE



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WEED GUIDE INFORMATION

The information in this guide provides a summary of herbicide uses for many crops grown in North Dakota. The information is based on federal and state herbicide labels, research at North Dakota Agriculture Experiment Stations and other 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 many herbicide uses are allowed only by supplemental or specific labeling for North Dakota. Persons are required to have the necessary supplemental or specific labeling in their possession 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.

Below is information to aid in using this guide:

Herbicides. Herbicides in tables are listed by trade name followed by common name in parentheses. Trade names are usually given except in cases where several brands are available. Restricted use herbicides and combinations are designated by a RUP in the lower right corner of each listing under the Herbicide section. Only those products that cannot be applied by aircraft are designated by a symbol in the Herbicide Section. Some new registrations may become available during the year. New information will be provided to NDSU County Extension Agents as changes occur. New information about label changes can be found also in the NDSU Pest and Crop Report, North Dakota Pesticide Quarterly, the Data Transmission Network (DTN) and on the web.

Rates. Rates in tables are based on broadcast application and are expressed according to formulated commercial listed as product/A with active ingredient/A or acid equivalent /A given in parenthesis. Commercial formulations of the same herbicide may vary in amount of active ingredient.

For example, a pint of 4-pound acid equivalent per gallon 2,4-D contains 0.5 pound while a pint of 6-pound acid equivalent per gallon contains 0.75 pound. Two pounds of Bladex 90DF (cyanazine) contains 1.8 pounds active ingredient ($2 \times 0.90 = 1.8$) or 2 pounds active ingredient is 2.22 pounds of product ($2 / 0.90 = 2.22$).

Weed Spectrum. Weeds in tables are listed individually or combined into major groups (i.e. grass, broadleaf) depending on the spectrum of weeds controlled by individual herbicides or additional weeds controlled through tank mix options.

Time To Apply. The best time to apply most herbicides are based on crop and/or weed growth stage. See 'Abbreviation Used' section below for a list of application methods.

Remarks and Paragraph Sections. Important information about each herbicide or herbicide combination is given in the "Remarks" section. Additional information is given in the narrative section where each paragraph is numbered and corresponds to the herbicide.

Herbicide Effectiveness 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.

Abbreviations Used

Units of Measurement

oz	= ounce (16 oz/lb)
fl oz	= fluid ounce (128 fl oz/gal)
pt	= pint (8 pt/gal)
gal	= gallon
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
PoPi	= Postplant incorporated
PRE	= Preemergence
EPOST	= Early postemergence
POST	= Postemergence
POST Directed	= Postemergence directed



= Aerial application prohibited

Type of Formulation

DF	= Dry flowable
DS	= Dispersible solution
EC	= Emulsifiable concentrate
EDF	= Extruded dry flowable
F	= Flowable
G	= Granular
ME	= Micro-encapsulated
MTF	= Multi-temperature formulation
S	= Solution
SG	= Soluble granule
SP	= Soluble powder
WP	= Wettable powder
WDG	= Water dispersible granule

Miscellaneous

AMS	= Ammonium sulfate
CEC	= Cation exchange capacity
DAA	= Days after application
MSO	= Methylated seed oil
NIS	= Nonionic surfactant
OM	= Organic matter
PHI	= Preharvest interval
RUP	= Restricted Use Pesticide
SU	= Sulfonylurea
UAN	= Urea ammonium nitrate

GENERAL INFORMATION

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. The weed control suggestions in this circular are based on the assumption that all herbicides mentioned in this guide 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 registered as a state label must have a copy of the label in their possession at the time of application. State labels can be obtained from chemical dealers or distributors.

Use herbicides 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 herbicides 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 the product and approved of the 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.

Special Local Needs Registrations, also known as 24C or State Local Needs (SLN) labels, allow states to control pesticide usage in their jurisdiction, including registering additional uses or adding limitations for a federally registered pesticide. SLN registrations involve adding application sites, pests, or alternate control methods to those listed on federally registered labeling. SLN labels are initiated by the ND Dept. of Ag (NDDA) 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 registration are used when an emergency or crisis pest situation arises for which no pesticide is registered. 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. This process takes several months to complete. In rare occasions, when time is critical and the emergency is acute, NDDA has the authority to declare a "Crisis" exemption without the 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 have the federal label and the Section 18 exemption labeling in their possession at application.

CLASSIFICATION OF PESTICIDES

EPA categorizes pesticides as either unclassified (general use) or restricted. **Restricted-Use Pesticides (RUP)** are pesticides that can cause harm to humans or the environment unless applied safely 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:

Atrazine	Gramoxone Extra
Amitrole-T, Cytrole	Judge, Judge MT
Balance	Kerb 50W (pronamide)
Basis Gold	Laddok S-12
Bicep/Bicep II/Bicep Lite	Lariat
Bladex (cyanazine)	Lasso (alachlor)
Bronco	Marksman
Buctril + Atrazine	Micro-Tech (alachlor)
Bullet	Moxy AT
Contour	Paraquat
Cropstar (alachlor)	Pardner (alachlor)
Cy-Pro, Cy-Pro AT	Ramrod+Atrazine
Detail	Readymaster ATZ
Degree (acetochlor)	Saddle
DoublePlay	Shotgun
Epic	Stall, Stall MT
Extrazine II	Starfire
Freedom	Surpass (acetochlor)
FulTime	Surpass 100
Harness (acetochlor)	Sutazine +
Harness Xtra	Sulfuric acid
Hoelon (diclofop)	TopNotch (acetochlor)
Guardsman	Tordon (picloram)

All premixes and/or combinations containing the above herbicides are also restricted use pesticides.

CHEMICAL WEED CONTROL FOR FIELD CROPS

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc. or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds and volunteer crops.	Preplant or any time prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Combinations of 2,4-D or dicamba with glyphosate increase spectrum of broadleaf weeds controlled. Refer to label for adjuvant use. Commercial mixtures available: 2,4-D + glyphosate = Landmaster BW Dicamba + glyphosate = Fallow Master A4 B1 B2 Q1 Q4
Dicamba + Glyphosate	2 fl oz + 0.75 to 1 pt of a 3 lb ae/gal conc. (0.0625 + 0.28 to 0.38)			See glyphosate above for other formulations. Residual activity of dicamba may control or suppress germinating weed flushes. Refer to label for adjuvant use. A4 B1 B2
Paraquat RUP	1 to 2.7 pt of a 3 lb/gal conc. (0.375 to 1)	Emerged annual grass and broadleaf weeds.		Non-selective, non-residual, foliar herbicide. Apply with NIS at 0.12 to 0.25% v/v. Good plant coverage is essential. B1 B2 Q6
Far-Go (triallate)	WINTER WHEAT 1.25 qt 12.5 lb 10G (1.25)	Wild oat.	Fall: Winter wheat. Apply just before or soon after seeding.	Incorporate immediately after application. Shallow incorporate with spike or spring tooth harrows when applied after seeding, A1 B16 S10
Far-Go EC = 	HRSW & DURUM: 1 qt 12.5 lb 10G (1 as liquid or 1.25 as granular)		Fall: HRSW, Durum and Barley. Apply within 3 weeks of freeze-up.	Apply and incorporate with recommended equipment in the fall. Second incorporation should be delayed in fall or performed in spring. Granules can be surface applied in the fall with a delayed two-pass incorporation performed in the spring prior to seeding. However, incorporation in spring may not provide wild oat control equivalent to fall incorporation. For most reliable wild oat control incorporate within 48 hours after application. B18 B19 S10
	HRSW & DURUM: 1 qt 10 lb 10G (1) BARLEY: 1.25 qt 12.5 lb 10G (1.25)		Spring: HRSW, Durum and Barley. Apply before or after seeding.	PPI with field cultivator set at 4 inches deep. PPI 3 or more days before seeding HRSW. Two pass incorporation is recommended. For application after seeding, apply before kernel sprouts exceed 0.5 inch in length and incorporate with harrows set more shallow than seed. A1 A3 B18 B19 S10
Buckle (triallate + trifluralin) 	DURUM & BARLEY: 10 to 12.5 lb G (1 to 1.25 + 0.3 to 0.4)	Wild oat and foxtails.	Fall: Apply within 3 weeks of freeze up. Spring: Barley. Prior to or after seeding.	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 B18 B19 B33 S10 X1 Y22 Y26
	Spring: For HRSW and Durum 10 lb G (1 + 0.3)		Spring: HRSW and Durum: PPI only.	Use in North Dakota only in designated counties. Apply only to fields fallowed the previous year. Do not apply to soil treated with trifluralin the previous year. B18 B19 S10

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Far-Go (trifluralin) + trifluralin NOT FOR WINTER WHEAT	1 qt + 1 pt 4E (1 + 0.5)	Wild oat and foxtail.	Spring: Immediately after seeding.	Shallow incorporate twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches and above crop seed. A1 B18 B33 S10 X1 Y22 Y26
Trifluralin NOT FOR WINTER WHEAT	1 pt 4E 5 lb 10G 0.83 lb 60DF (0.5)	Foxtail.	Spring: PPI.	FOR BARLEY ONLY. Incorporate twice 2 to 3 inches deep. A1 B18 B33 S3 X1 Y22 Y26
	4 lb 10G (0.4)			FOR DURUM WHEAT ONLY. Incorporate twice 2 to 3 inches deep. For foxtail suppression only. A3 B33 S3 Y20 Y24
	3.5 to 4 lb 10G (0.35 to 0.4)			FOR HRSW ONLY. For suppression of foxtail only. Use west of Hwy 3 only. S3
	1 pt 4E (0.5)			Spring: After seeding.
	1 pt 4E 5 lb 10G 0.83 lb 60DF (0.5)		Fall: After September 1 until freeze-up.	Incorporate once in fall within 24 hours after application. Keep spring incorporation depth more shallow than fall. Stand reduction may occur. A1 A3 B18 B33 S3 X1 Y1 Y22 Y26
	3.5 to 5 lb 10G (0.35 to 0.5)			FOR HRSW AND DURUM ONLY. For foxtail suppression only. S3
MCPA amine or MCPA ester	0.5 to 1.33 pt of 4 lb/gal conc. (0.25 to 0.66)	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 and kochia. Use high rate for large or perennial weeds. B1 B2 S4 S7 S8 S9
2,4-D amine or 2,4-D ester	0.5 to 1 pt of 4 lb/gal conc. (0.25 to 0.5)		Crop: 5-leaf until prior to boot. Winter wheat: Well tillered until prior to boot.	Do not apply from early boot to dough stage. Do not apply to winter wheat in fall. B1 B2 S4 S7 S8 S9
Dicamba + MCPA	0.125 to 0.25 pt + 0.5 to 0.75 pt of 4 lb/gal conc. (0.06 to 0.12 + 0.25 to 0.38)	Broadleaf weeds including wild buckwheat, sunflower, Russian thistle and ALS resistant kochia.	HRSW & Durum: Up to 5-leaf stage. Winter Wheat: Spring after dormancy but before jointing.	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. B9 S1 S4 S7 S8 S9 X1 Y15 Y26
Dicamba + 2,4-D	0.125 pt + 0.5 pt (0.06 + 0.25)		HRSW & Durum: 4 to 5-leaf. Winter wheat: In spring from 4-leaf to jointing in spring.	Apply only at the 4 to 5-leaf stage to avoid crop injury. Do not use on barley. Dicamba may give short-term residual weed control and/or weed suppression. B9 S4 S7 S8 S9 X1 Y15 Y26
Curtail M (clopyralid + MCPAe)	1.75 to 2.33 pt (0.09 to 0.12 + 0.5 to 0.68)	Broadleaf weeds and Canada thistle.	3-leaf to jointing or to boot if risk of injury is acceptable.	Apply to Canada thistle at the rosette to early bolting stage. Dew at application may reduce weed control. Do not harvest hay from treated fields. See narrative for crop rotational restrictions. B12 T2 T6 Y23 Y26
Curtail (clopyralid + 2,4-D)	2 to 2.33 pt (0.09 to 0.11+ 0.5 to 0.58)		Crop: 4-leaf to jointing.	

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Starane (fluroxypyr)	0.5 to 0.67 pt (1.5 to 2 oz)	Kochia including ALS resistant and volunteer flax.	Crop: 2-leaf through flag leaf emergence. Weeds: 4 to 8 inches tall.	Refer to Starane label and label of tank-mix partner for registered tank-mix options and rates. Commercial premixes available: Starane + Salvo at 1 to 1.33 pt/A Starane + Sword at 1.125 to 1.5 pt/A Starane + Saber at 1.5 to 2 pt/A B30 S4 S5
Bromoxynil	1 to 2 pt (0.25 to 0.5)	Broadleaf weeds including buckwheat, sunflower,	Crop: Emergence until prior to boot.	Contact herbicide. Apply to small weeds. Controls ALS resistant kochia. See label for tank-mix options. B1 B2 B9 S1 X1
Bromoxynil + MCPA ester	0.75 to 2 pt (0.19 to 0.5 + 0.19 to 0.5)	Russian thistle and ALS resistant kochia.	Crop: 3-leaf until prior to boot.	Apply to small weeds. Sunflower control better than 1 pt/A of 2,4-D. Premixes: Bronate, Bromac, Bison. B1 B2 B9 S1 S4 S7 S8 S9 X1
Aim + (carfentrazone) + 2,4-D amine or MCPA amine	1/3 to 0.67 oz DF+ 0.5 to 0.75 pt of a 4 lb/gal conc. (0.128 to 0.24 oz + 0.25 to 0.38)	Broadleaf weeds including pigweed. Partial control of kochia and buckwheat.	Crop: Up to jointing stage. Weeds: Up to 4 inches tall.	Contact, non-residual herbicide. May cause cosmetic speckling/spotting on wheat leaves. Apply with NIS at 0.25% v/v. B4 S1 S4 S7 X1

Short Residual Sulfonylurea (SU) Herbicides

Express (tribenuron)	1/6 to 1/3 oz DF (0.125 to 0.25 oz)	Broadleaf weeds. Poor control of wild buckwheat.	Crop: 2-leaf until prior to flag leaf emergence.	The addition of MCPA or 2,4-D enhances 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. See narrative for list of registered tank-mixes. Only Harmony GT may be tank-mixed with Hoelon or Hoelon + bromoxynil. Apply with another broadleaf herbicide to reduce weed resistance. See section on herbicide resistance. No crop rotation restrictions the following year. B17 B21 B22 S1 S4 X1
Harmony GT (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	Broadleaf weeds. Good control of wild buckwheat.		
Harmony Extra (thifensulfuron + tribenuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat, cocklebur, and lanceleaf sage.		


Long Residual SU Herbicides

Ally (metsulfuron)	1/10 oz DF (0.06 oz)	Broadleaf weeds. Partial control of wild buckwheat.	Crop: 2-leaf until prior to boot.	Apply with another broadleaf herbicide to reduce weed resistance. The addition of 2,4-D or MCPA enhances 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. See label for crop rotation restrictions. Canvas at 2/10 oz/A contains 1/10 oz Ally + 3/10 oz Harmony Extra. Do not apply within 22 months of last metsulfuron treatment. Do not apply to soils above pH 7.9. See section on herbicide resistance. B5 B10 S1 X1 Y3 Y7 Y26
Canvas (metsulfuron + thifensulfuron + tribenuron)	2/10 to 4/10 oz DF (0.03 to 0.06 oz met + 0.113 to 225 oz thifensulf+tribenuron)	Broadleaf weeds. Improved control of wild buckwheat.	Crop: 2-leaf stage until prior to flag leaf emergence.	
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.	


Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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. See label for application timings, tank-mix options, weeds controlled, soil pH restrictions, resistance weeds, and crop rotation restrictions. B6 X1 Y3 Y26
Rave (triasulfuron + dicamba)	HRSW = 4 oz DF (0.352 oz + 2 oz) Barley = 2 oz DF (0.176 oz + 1 oz)		HRS: Emergence up to 5-leaf stage. Barley: Emergence up to 4-leaf stage.	
Finesse (chlorsulfuron + metsulfuron)	2/10 to 4/10 oz DF (0.15 to 0.3 oz)	Broadleaf weeds and suppression of foxtail and Canada thistle.	Crop: 2-leaf until prior to flag leaf emergence.	Do not apply within 22 months of last treatment. Apply with a NIS at 0.125% except when adding 2,4-D or MCPA at 0.75 pt/A. See sections on herbicide resistance and crop rotation restrictions. Do not apply to soils above pH 7.9. B20 S3 X1Y3 Y26
Maverick (sulfosulfuron)	2/3 oz DF (0.5 oz)	Downy brome, quackgrass, mustard species and volunteer sunflower.	Crop: Emergence to prior to jointing.	Add NIS at 0.5%v/v. Do not add adjuvants that alter spray solution pH below 5. See 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. B24 X1 Y3 Y26
HRSW and Winter Wheat Only Not For Barley			Brome: 2 to 3 tillers. Wild oat: 1- to 4-leaf stage.	
Herbicides that can be tankmixed with SU herbicides.				
MCPA or 2,4-D	0.5 to 0.75 pt of 4 lb/gal conc. (0.25 to 0.38)	Broadleaf weeds.	MCPA: Same as SU herbicides applied alone. 2,4-D: Not prior to tiller but not later than SU herbicide applied alone.	MCPA and 2,4-D enhances crop safety. Ester formulation provides greater SU safening than amine. Apply with NIS except when adding MCPA or 2,4-D at 0.75 pt/A. Do not apply to durum wheat prior to 4-leaf stage. No crop restrictions the following year. Tank-mix with Finesse gives season long Canada thistle control. B5 B6 B17 B21 B25 S4 X1 Y3
MCPA or 2,4-D + Dicamba	0.5 pt + 3 to 4 fl oz (0.25 + 0.09 to 0.125)		Broadleaf weeds including ALS resistant weeds and season long control of Canada thistle.	
Starane (fluroxypyr)	0.5 to 0.67 pt (1.5 to 2 oz)	Kochia including ALS resistant and volunteer flax.	Crop: 2-leaf through flag leaf emergence. Weeds: 4 to 8 inches tall.	Non residual herbicide. May be tank-mixed with most small grain grass and broadleaf herbicides. Refer to Starane label and label of tank-mix partner for registered tank-mix options and rates. Allow a 40 day PHI. B30 S4 S5 X1
Bromoxynil	0.75 to 1.5 pt (0.188 to 0.375)	Broadleaf weeds including wild buckwheat, sunflower, lanceleaf sage, and ALS resistant weeds.	Same as SU herbicides applied alone but not later than SU herbicide applied alone.	Apply to small weeds. Express rate can be reduced to 1/12 oz DF/A. Apply with NIS at 0.25% v/v. B10 S1 S4 S7 S8 S9 X1
Bromoxynil + MCPA			3-leaf but not later than SU herbicide applied alone.	

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST Grass Herbicides				
Assert (imazamethabenz)	1 to 1.5 pt (0.31 to 0.47)	Wild oat, wild mustard, and other mustard species.	Crop: 2-leaf to jointing. Wild oat: 1- to 4-leaf stage.	See narrative for crop rotation restrictions. Do not tank-mix with Stampede, dicamba, Tordon, MCPA amine, or 2,4-D amine. Use an MSO type adjuvant or use NIS + petroleum oil adjuvant. See label for additional adjuvant information. B7 S10 Y2 Y6 Y26
Avenge (difenzoquat)	2.5 to 4 pt (0.62 to 1)	Wild oat.	Crop: Prior to flag leaf emergence. Wild oat: 3- to 5-leaf stage.	Use high rate on 3-leaf wild oat. Refer to narrative for herbicide tank-mix options and registered wheat varieties. Injury may occur when crop is under stress. Labeled on all barley varieties. B8 S10
Avenge (difenzoquat) + Assert (imazamethabenz)	2 pt + 0.75 pt (0.5 + 0.23)	Wild oat, wild mustard and other mustard species.	Crop: 2- to 4-leaf. Wild oat: 2- to 4-leaf.	Apply with NIS. See Avenge label for HRSW variety restrictions. B1 B2 B7 B8 S10 Y2 Y6 Y26
Achieve (tralkoxydim)	7 oz WDG (0.18)	Green and yellow foxtail, wild and volunteer oat, Persian dandel, and annual ryegrass.	Crop: 2-leaf to boot. Foxtail: 1- to 5-leaf. Persian dandel: 1- to 4-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. Apply in 10 to 15 GPA by ground or 3 to 5 GPA by air. See label or narrative for tank-mix information and restrictions. B3 S3 S10 X1
Discover (clodinafop) HRS and Durum Wheat Only	3.2 and 4 fl oz (0.05 to 0.06)	Wild and vol. oat, barnyardgrass, green and yellow foxtail, Persian dandel, and annual ryegrass.	Crop: 2-leaf to emergence of 4 th tiller. Wild oat: 1- to 6-leaf. Foxtails: 1- to 5-leaf.	Packaged as one box containing product and DSV adjuvant in separate containers for 40 to 50 acres/box. Apply 3.2 fl oz/A for wild oat and barnyardgrass and 4 fl oz/A for foxtails, Persian dandel, and ryegrass. See label for tank-mix information. B15 S3 S10 X1
Everest (flucarbazone) HRS and Durum Wheat Only 	0.4 to 0.6 oz WDG (0.28 to 0.42 oz)	Wild oat, green foxtail, and suppression of yellow foxtail.	Crop: 1- to 6-leaf (4 leaves + 2 tillers). Grass weeds: Up to 4 leaves.	Add NIS at 0.25% v.v. Apply 0.4 oz for green foxtail and 0.6 oz for wild oat and suppression of yellow foxtail. Control mustard species. May tank-mix with 2,4-D, Ally, Aim, bromoxynil, Curtail, Express, Harmony Extra, MCPA, Starane, or Stinger. B16 S3 S10 X1Y26
Puma (fenoxaprop-P + safener)	0.33 to 0.66 pt (0.04 to 0.08)	Wild oat, green and yellow foxtail, millets, corn, barnyardgrass.	HRSW: 1-leaf to 60 days before harvest. Barley: 1-leaf up to 5-leaf stage. Grass weeds: 1-leaf to 2-tiller.	Do not apply to barley after jointing begins. Apply 0.33 pt/A for green foxtail, volunteer corn and millet. Apply 0.4 pt/A for yellow foxtail and proso millet. Apply 0.66 pt/A for barnyardgrass and wild oat. See label for tank-mixing information. B27 S3 S10 X1
Dakota (fenoxaprop-P + MCPA) HRS and Winter Wheat Only	16 to 21.3 fl oz or 1 to 1.33 pt (0.029 to 0.039 + 0.36 to 0.47)	Green foxtail, foxtail millets and several broadleaf weeds.	HRSW: 3-leaf to 6-leaf. Grass weeds: 2-leaf to 2-tiller. Broadleaf weeds: Up to 4 inches.	Do not apply to durum wheat, barley or oat. Do not apply after jointing begins. Tank-mixing with dicamba at 2 fl oz/A increases kochia and Russian thistle control. Refer to narrative for tank-mix information. B13 S3 S10 X1
Tiller (fenoxaprop-P + 2,4-D + MCPA) Do Not Apply To Durum Wheat	1 to 1.7 pt (0.047 to 0.08 + 0.073 to 0.12 + 0.22 to 0.37)	Wild oat, green and yellow foxtail, barnyardgrass, millet and several broadleaf weeds.	Crop: 3- to 4-leaf up to 6-leaf. Grass weeds: 2-leaf to 2-tiller. Broadleaf weeds: Up to 4 inches.	Do not apply to durum wheat or oat. Do not apply to spring or winter wheat after jointing begins. Dicamba at 2 fl oz/A increases kochia and Russian thistle control. Tank-mixing with some broadleaf herbicides will reduce yellow foxtail and wild oat control. Refer to narrative for rates and tank-mix options. B31S3 S10 X1

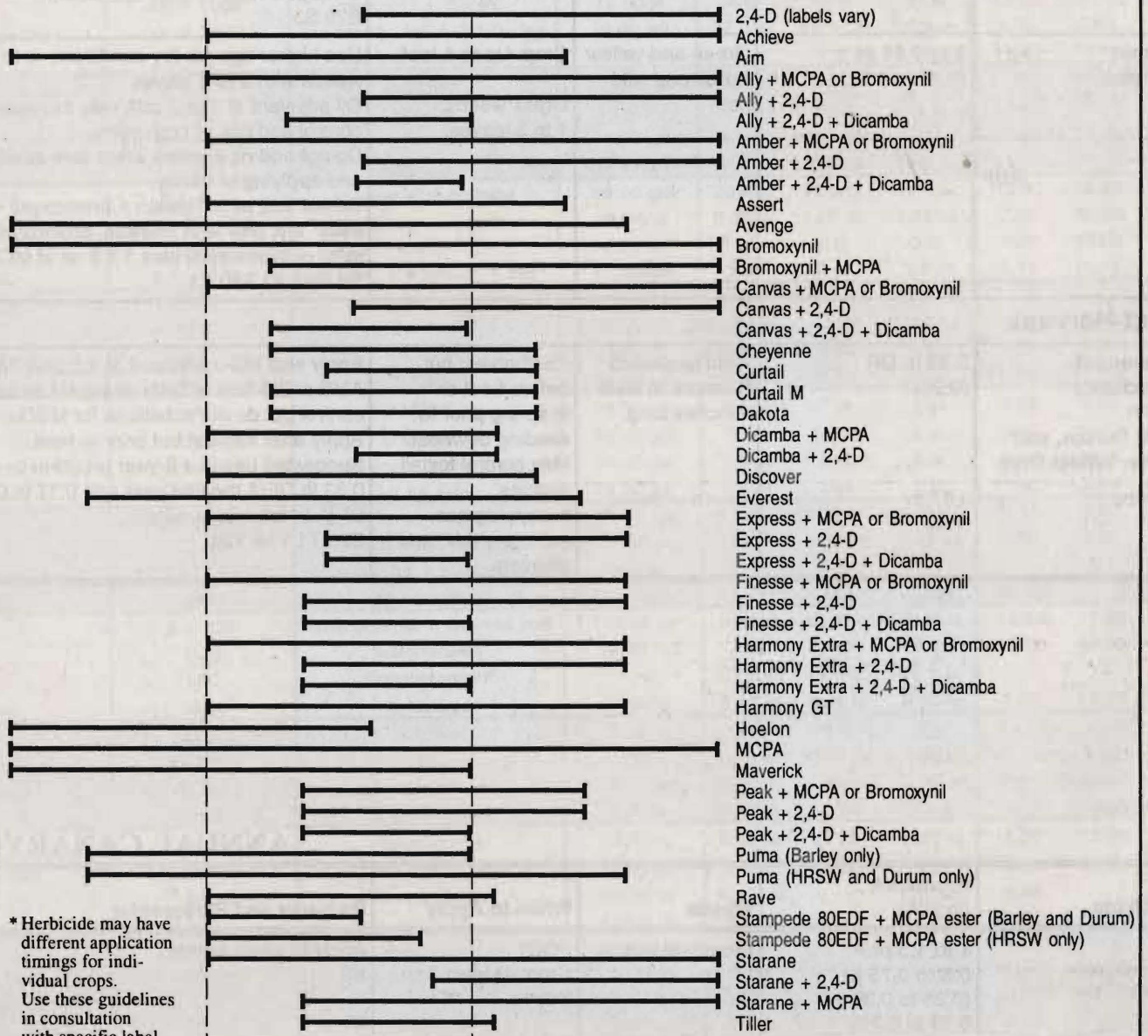
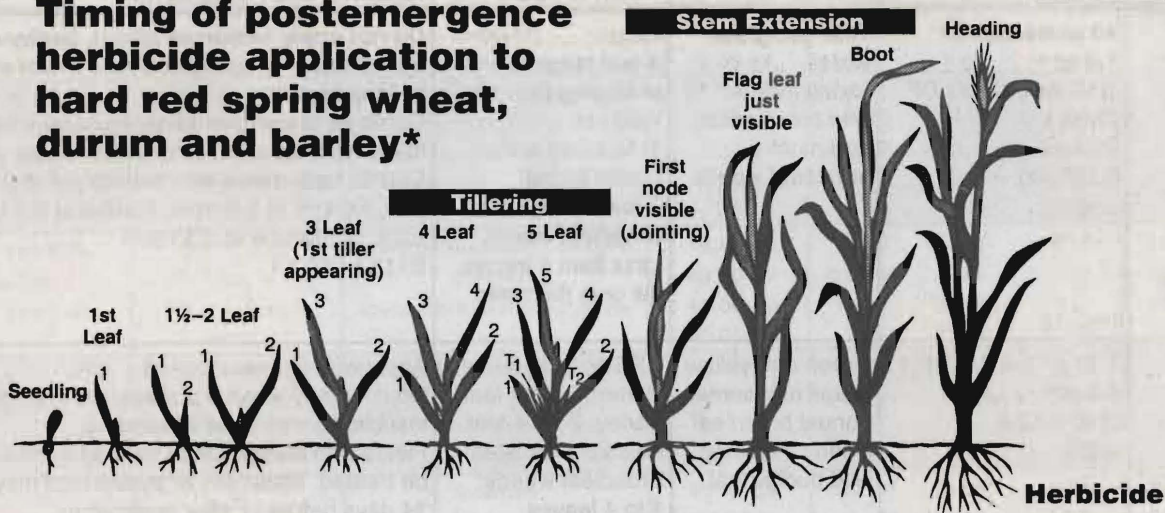
Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Cheyenne (fenoxaprop-P + MCPA + X-tra (thifensulfuron + tribenuron)) HRS or Winter Wheat Only 	40 acres/box or 1.4 pt + 3/10 oz of X-tra DF (0.08 + 0.38 + 0.225 oz)	Wild oat, green foxtail, foxtail millets, wild proso millet, and most broadleaf weeds.	Crop: 3-leaf stage to end of tillering (6-leaf). Wild oat: 1- to 4-leaf stage. Green foxtail: 2-leaf to 2-tiller. Broadleaf weeds: Less than 4 inches tall or in diameter.	Do not apply to durum wheat, barley or oat. Do not apply to spring or winter wheat after jointing begins. Contents of each container must be added to tank to insure crop safety and weed control. Can be tank-mixed with bromoxynil at 0.38 to 0.5 pt/A, Stinger at 2 fl oz/A, Tordon at 0.5 to 0.75 fl oz/A, or Starane at 0.33 pt/A. B11S3 S10 X1
Stampede 80EDF (propanil) + MCPA ester	1.25 to 1.4 lb EDF + 0.5 pt (1 to 1.13 + 0.25)	Green and yellow foxtail and some annual broadleaf weeds including wild buckwheat.	HRSW: 2- to 5-leaf. Durum: 2- to 4-leaf. Barley: 2- to 4-leaf. Foxtail: 1- to 3-leaf. Broadleaf weeds: 1 to 4 leaves.	Apply with petroleum oil at 1 pt/A. Do not apply when a soil applied systemic insecticide was used at seeding. Fields with Maneb/Lindane seed dressings may be treated. Malathion or pyrethroids may be used 14 days before or after application. B29 S3
Hoelon (diclofop) RUP	2 to 2.66 pt (0.75 to 1.0)	Green and yellow foxtail and wild oat.	Crop: Up to 4-leaf. Grass weeds: 1 to 3 leaves.	Use higher rate for dry conditions or to grass weeds with 3 to 4 leaves. Oil adjuvant at 1 to 2 pt/A may increase weed control and risk of crop injury. Do not add oil additive when tank-mixing Hoelon and applying to barley. Do not add oil to Hoelon + bromoxynil + MCPA ester. Mix only with Starane, bromoxynil (1 to 1.5 pt/A) or bromoxynil plus 1.5 fl oz of MCPA ester. B9 B23 S3 S10 X1
Post-Harvest				
Paramount (quinclorac) HRS, Durum, and Winter Wheat Only	0.33 lb DF (0.25)	Field bindweed: Runners at least 4 inches long.	Postharvest but before frost or in spring prior to seeding of wheat. May control foxtail species, barnyardgrass, volunteer flax, and cleavers.	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 but do not substitute for MSO. 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. B26 T1 Y18 Y24

ANNUAL CANARYGRASS

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Bromoxynil + MCPA	1 to 1.5 pt + 0.5 to 0.75 pt (0.25 to 0.38 + 0.25 to 0.38)	Broadleaf weeds.	POST Crop: At least 3 leaves.	Apply to small weeds. B9
Bromoxynil	1 to 1.5 pt (0.25 to 0.38)		Weeds: Small with 4 or less leaves.	Apply to small weeds. Allow a 75 day PHI. Do not graze livestock. Do not apply to canarygrass when stressed. B9 Z1

Timing of postemergence herbicide application to hard red spring wheat, durum and barley*



* Herbicide may have different application timings for individual crops. Use these guidelines in consultation with specific label information for individual crops.

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

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc. or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Commercial mixtures available with 2,4-D as Landmaster or with dicamba as Fallow Master. See narrative for adjuvant use. A4 Q1 Q4
MCPA amine or MCPA ester	0.5 to 1 pt of 4 lb/gal conc. (0.25 to 0.5)	Broadleaf weeds.	Oat: Emergence until prior to boot stage.	Possible oat injury at any stage. Use full rate for sunflower and kochia. B1 B2 S4 X1
Bromoxynil	1 to 1.5 pt EC (0.25 to 0.38)	Broadleaf weeds including wild buckwheat, and volunteer sunflower.		Apply to small weeds. Weak on wild mustard and redroot pigweed. B9 S4 S7 S8 S9 X1
Bromoxynil + MCPA ester	0.75 to 1.5 pt (0.19 to 0.38 + 0.19 to 0.38)		Oat: 3-leaf to boot stage.	Apply to small weeds. Volunteer sunflower control better than from 1 pt/A of 2,4-D. B9 S4 S7 S8 S9 X1
Aim + (carfentrazone) + 2,4-D amine or MCPA amine	1/3 to 0.67 oz DF+ 0.5 to 0.75 pt of a 4 lb/gal conc. (0.128 to 0.24 oz + 0.25 to 0.38)	Broadleaf weeds including pigweed. Partial control of kochia and buckwheat.	Crop: Up to jointing stage. Weeds: Up to 4 inches tall.	Contact, non residual herbicide. May cause cosmetic speckling/spotting on wheat leaves intercepting spray. Apply with NIS at 0.25% v/v. B4 S1 S4 S7 X1
Curtail M (clopyralid + MCPAe)	1.75 to 2.33 pt (0.09 to 0.12 + 0.5 to 0.68)	Broadleaf weeds and Canada thistle.	3-leaf to jointing or to boot if risk of injury is acceptable.	Apply to Canada thistle at the rosette to early bolting stage. See narrative for crop rotational restrictions. B12 T2 T6 Y23 Y26
Dicamba + MCPA	2 to 4 fl oz + 0.5 to 0.75 pt (0.06 to 0.12 + 0.25 to 0.38)	Broadleaf weeds.	Oat: 2- through 5-leaf stage.	Use the low dicamba rate and the high MCPA rate on 5-leaf oat. Early application increases crop safety. B9 S3 S5 S6 X1 Y15 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. Refer to label for tank-mix options. Allow a 40 day PHI. Commercial premixes available: Starane + Salvo at 1.33 pt/A Starane + Sword at 1.5 pt/A Starane + Saber at 1.5 pt/A B30 S4 S5
Harmony GT (thifensulfuron)	3/10 to 4/10 oz DF (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. See label for list of tank-mix herbicides. The addition of MCPA at 0.75 pt/A enhances weed control and oat safety. Apply with a NIS at 0.125% v/v except when adding MCPA at 0.75 pt/A. B17 B21 B22 S1 S5 X1
Harmony Extra (thifensulfuron + tribenuron)	3/10 to 4/10 oz DF (0.225 to 0.3 oz)			
Peak (prosulfuron) + MCPA	0.38 to 0.5 oz DF + 0.5 to 0.75 pt of 4 lb/gal conc. (0.22 to 0.29 oz + 0.25 to 0.38)	Broadleaf weeds.	Oat: 3-leaf until 2nd node is detectable.	See label for list of tank-mix herbicides. Apply with a NIS at 0.25% v/v. See label for application timings, weeds controlled at various rates, and soil pH, herbicide and crop rotation restrictions. B25 X1Y20 Y26
Stampede 80EDF (propanil) + MCPA ester	1.25 to 1.4 lb EDF + 0.5 pt of a 4 lb/gal conc. (1 to 1.13 + 0.25)	Green and yellow foxtail and some annual broadleaf weeds.	Oat: 2- through 4- leaf stage. Weeds: 1 to 4 leaves.	Foxtail larger than 3 leaves may not be controlled Use only isooctyl ester formulation of MCPA. Apply with oil additive at 1 pt/A. B29 S3 X1

RYE

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc. or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. See label for adjuvant use. A4 Q4
2,4-D amine or 2,4-D ester	0.5 to 1 pt of 4 lb/gal conc. (0.25 to 0.5)	Broadleaf weeds.	Spring. Rye: Tillered but prior to boot stage.	Do not apply from early boot to dough stage. Do not apply in the fall. B1 B2 S4 S7 S8 X1
MCPA amine or MCPA ester			Spring: 4-leaf stage and prior to boot.	
Bromoxynil	1 to 1.5 pt (0.25 to 0.38)	Broadleaf weeds including wild buckwheat.	Spring. Rye: Prior to early boot stage.	Apply to small weeds. Do not apply in the fall. Addition of MCPA improves general broadleaf weed control including wild mustard. B9 S4 S7 S8
Bromoxynil + MCPA ester	0.75 to 1.5 pt (0.19 to 0.38 + 0.19 to 0.38)			
Peak (prosulfuron) + MCPA or 2,4-D	½ oz DF + 0.5 to 0.75 pt of 4 lb/gal conc. (0.29 oz + 0.25 to 0.38)	Broadleaf weeds.	Peak + MCPA: 3-leaf until 2 nd node Peak + 2,4-D: After tillering until prior to jointing.	Apply Peak with another herbicide for increased broadleaf control and weed resistance management. See label for application timings, weeds controlled at various rates, soil pH, herbicide and crop rotation restrictions.
Peak (prosulfuron) + 2,4-D + Dicamba	1/4 to 3/8 oz DF + 0.5 pt + 2 to 3 fl oz (0.14 to 0.21 oz + 0.25 + 0.06 to 0.09)	Broadleaf weeds including Russian thistle and ALS resistant kochia.	Rye: After tillering through 5-leaf stage.	Apply with a NIS. B14 B25 S4 S8 X1 Y15 Y20 Y26

MILLET

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
2,4-D amine (Only certain formulations)	0.5 to 1.3 pt of a 4 lb/gal conc. (0.25 to 0.6)	Broadleaf weeds	Millet: 4 to 6 inches tall.	Do not graze dairy animals or meat animals being finished for slaughter on treated fields within 2 weeks after treatment. X1
Dicamba	4 fl oz (0.12)		Millet: 2 to 5-leaf stage.	Early application increases safety. B9 X1 Y15 Y26
Dicamba + 2,4-D amine	3 fl oz + 0.75 pt (0.09 + 0.38)		Millet: 4 to 5-leaf stage.	Hay type millets are more sensitive than other millet types. Do not apply prior to the 3-leaf stage of millet. Only certain formulations of 2,4-D are registered. B14 X1 Y22 Y26
Peak (prosulfuron) + 2,4-D (Only certain formulations)	1/4 to ½ oz DF + 0.5 to 0.75 pt (0.14 to 0.29 oz + 0.25 to 0.38)	Broadleaf weeds.	Millet: After tillering until prior to jointing.	Apply with a herbicide of different mode of action to prevent weed resistance. See section on herbicide resistance. See label for application timings, weeds controlled at various rates, soil pH, herbicide and crop rotation restrictions. Only certain formulations of 2,4-D are registered.
Peak (prosulfuron) + Dicamba	1/4 to 3/8 oz DF + 2 to 4 fl oz (0.14 to 0.21 oz + 0.06 to 0.09)	Broadleaf weeds including Russian thistle and ALS resistant kochia.	Millet: After tillering to the 5-leaf stage.	B25 X1 Y20 Y26






SMALL GRAIN PRE-HARVEST






Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
2,4-D ester For HRS and Durum Wheat, Barley, and Rye	1.5 to 3 pt of 4 lb/gal conc. (0.75 to 1.5)	Broadleaf weeds.	Wheat: Dough stage to harvest.	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, for example, Weedone 64, Weedone 638, Weedone LV4, Weedone LV6. CAUTION: Drift to broadleaf crops is especially hazardous at this time. B34 B35 T6 X1 Z1
Dicamba + 2,4-D For HRS and Durum Wheat Only	0.5 to 1 pt + 1 to 2 pt of 4 lb/gal conc. (0.25 to 0.5 + 0.5 to 1)		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. B34 B36 X1 Y15 Y26 Z1
Ally (metsulfuron) + 2,4-D For HRS and Durum Wheat and Barley Only	1/10 oz DF + 1.5 to 3 pt of a 4 lb/gal conc. (0.075 oz + 0.75 to 1.5 2,4-D)		Wheat or 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. B34 B37 Y3 Y26
Glyphosate For HRS and Durum Wheat Only	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc. or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Annual and perennial grass and broadleaf weeds including Canada thistle.	Wheat: Hard-dough stage, 30% or less grain moisture. Allow a 7 day PHI.	Do not apply more than 2 pt/A/season. Do not apply on wheat grown for seed because reduced germination/vigor may occur. Apply 2 pt/A for Canada thistle control. Apply 1 to 2 pt/A + 2,4-D at 1 to 2 pt/A for field bindweed control. A4 B34 B35 B38 Q4 T1 T2 Z1
Landmaster BW (glyphosate + 2,4-D) For HRS and Durum Wheat Only	3.38 to 5.25 pt (0.38 to 0.53 + 0.63 to 1)			Do not apply more than 5.25 pt/A/season. Do not apply on use on wheat grown for seed because reduced germination/vigor may occur. Do not feed or allow dairy or meat animals to forage for 14 days after application. Do not feed treated straw. A4 B34 B39 Q1 Q4 T1 T2 Z1
Glyphosate + Dicamba For HRS and Durum Only	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc. or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG + 0.25 to 0.5 pt of a 4 lb gal/conc. (0.19 to 0.75 + 0.125 to 0.25)		Wheat: Hard dough stage and green color is gone from the nodes (joints) of stem. Allow a 7 day PHI.	ND state 2(ee) registration. The label must be in the possession of the applicator at the time of application. Use a minimum of 3 gpa by air and 5 to 20 gpa by ground application. A4 B34 B36 B38 Q1 Q4 T1 T2 Z1

CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. May be tank-mixed with residual preemergence herbicides. See label or narrative for adjuvant use. A4 Q4
Paraquat RUP	1 to 2.7 pt of a 3 lb/gal conc. (0.375 to 1)	Emerged annual grass and broadleaf weeds.		Non-selective, foliar herbicide. No soil activity. Apply with a NIS at 0.12 to 0.25% v/v. Good plant coverage is essential. Q5

Soil Applied Herbicides

Eradicane (EPTC & safener)	5 to 7 pt 17 to 24 lb 25G (4.2 to 6)	Grass and some broadleaf weeds.	PPI. Application and incorporation should be performed at the same time.	Immediate incorporation is required. Double incorporation and high rates recommended for wild proso millet, field sandbur, and wild oat. Weak on wild mustard. Can be applied with most PPI or PRE residual broadleaf herbicides labeled in corn. A1 C3 C21 S6
DoublePlay (EPTC + acetochlor + safener)  RUP	5 to 8 pt/A (3.5 to 5.6 + 0.88 to 1.4)		PPI or PRE.	Poor wild oat control. Adjust rate according to soil type. Less effective PRE than Ramrod and Harness /Surpass on many soils. PPI gives more consistent weed control.
Axiom (flufenacet + metribuzin) 	15 to 23 oz DF (0.51 to 0.98 + 2 to 3.1 oz)		PPI or PRE. Fall: After Sept 30 but before ground freezes.	May be tank-mixed with most residual soil- applied herbicides registered in corn. See label. Commercial mixture available: Dual + Atrazine = Bicep Lasso + Atrazine = Lariat, Bullet Balance + flufenacet = Epic A1 A3 C2 C3 C25 S6
Dual, Dual II Dual Magnum Dual II Magnum (metolachlor)	1.5 to 3 pt Dual/II 6 to 12 lb IIG/25G (1.5 to 3) 1 to 2 pt Magnum (1 to 2)		PPI, PRE or EPOST Corn: Up to 5 inches tall.	
Lasso (alachlor) RUP	2 to 3.5 qt 4EC/MT 13 to 26 lb 15G (2 to 3.5)		EPP, PPI or PRE.	Weak on wild mustard and wild oat. Can be applied with most PPI or PRE residual broadleaf herbicides labeled in corn. Commercial mixtures available: Frontier + Atrazine = Guardsman, LeadOff Frontier + dicamba = OpTill C2 C22 S6
Frontier (dimethenamid)	20 to 32 fl oz 6E (0.93 to 1.5)		PPI, PRE, EPOST and Fall.	Weak on wild mustard. Provides equal or greater weed control compared to Axiom, Dual, Lasso or Frontier. Adjust rate according to soil type. Surpass can be applied EPOST at 1.2 to 3 pt/A or in fall at 3 pt/A.
Harness (acetochlor + safener)  RUP	1.25 to 2.75 pt (1.1 to 2.4) 6 to 15 lb 20G (1.2 to 3)		PPI and PRE: 1.5 to 3.75 pt 6 to 15 20G (1.2 to 3)	Can be applied with most PPI or PRE residual broadleaf herbicides labeled in corn. Commercial mixture available: Harness + Atrazine = Harness Xtra A1 C2 C3 C23 S6
Surpass (acetochlor + safener)  RUP	4 to 6 qt 20 to 30 lb 20G (4 to 6)		PRE.	Weak on wild mustard and wild oat. More effective PRE and requires less rainfall for activation than other soil applied herbicides. PPI decreases control. Commercial mixtures: Ramrod + Atrazine C2 C30
Ramrod (propachlor) 				

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
TopNotch (microencapsulated acetochlor + safener)  RUP	4 to 7.25 pt (1.6 to 2.9)	Grass and some broadleaf weeds.	EPP and PRE. Reduced or No-till.	Weak on wild mustard and wild oat. See label for tank-mix option. Commercial mixture available: TopNotch + Atrazine = FulTime
Degree (microencapsulated acetochlor + safener) RUP 	3.25 to 4.25 qt (1.54 to 2)		Fall: After October 15 but before ground freezes.	Commercial mixture available: Degree + Atrazine = Degree Xtra A1 C2 C23
Prowl Pendimax (pendimethalin)	2.4 to 3.6 pt EC 1.7 to 3.3 lb DG (1 to 1.5)		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 from herbicide. C27 Y1 Y22 Y26
Atrazine RUP	1.1 to 2.2 lb DF (1 to 2 lb ai/A)	Broadleaf and some grass weeds.	PPI and PRE. Spring only.	Use higher rate on fine-textured soils. Soil residue may injure some crops planted the following year. Consult label for crop rotation restrictions. Several pre-mixtures available. See paragraph for list. C2 C7 S6 Y1 Y9 Y26
Bladex (cyanazine) RUP	1.3 to 3.3 lb DF (1.2 to 3)		PPI and PRE.	Soil residues unlikely the next year. Weak on redroot pigweed. Use higher rates on fine- textured, high OM soil. Do not use on sands, loamy sands or soil with less than 1% OM. C12
Python (flumetsulam)	0.8 to 1.33 oz DG or (0.64 to 1.06 oz)	Annual broadleaf weeds including nightshade.	EPP, PPI, PRE or POST. Corn: Early spike stage.	Shallow PPI. PRE applications require at least 0.75 inch rain for activation. Adjust rate for soil type.
Broadstrike + Dual (flumetsulam + metolachlor) 	1.75 to 2.75 pt (0.64 to 1 oz + 1.6 to 2.33)	Annual grass and broadleaf weeds.	EPP, PPI or PRE.	Do not apply to soil greater than 7.8 pH. See label for tank-mix options. Python and Hornet has no grass activity. C2 C13 C24 C28 S6 S11 X1 Y4 Y15 Y23 Y26
Hornet (flumetsulam + cloprralid)	3.2 to 4.8 oz DF or (0.74 to 1.1 oz + 2 to 3 oz)	Annual broadleaf weeds.		
Balance (isoxaflutole)  RUP	1 to 2 oz DF (0.047 to 0.094)	Annual grass and broadleaf weeds including foxtails, wild proso millet, field sandbur, pigweeds, kochia, lambquarters,	EPP, PPI or PRE. Corn: Apply alone or in tank-mix up to 21 days before seeding or 30 days in a planned sequential program with a POST herbicide, but prior to corn emergence.	Adjust rate according to soil texture and pH. Pre-slurry or wait 15 minutes after mixing before application. Requires rainfall for activation. Shallow PPI and seed corn 1.5 inches deep. Cover seed completely with soil. See 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 or failing to observe label directions. Apply with acetochlor at 1 to 2.5 pt/A for improved weed control. Commercial premix available: Balance + flufenacet = Epic A1 C2 C3 C12 C23 S6 Y9 Y11 Y26
Balance Pro (isoxaflutole)  RUP	1.5 to 3 fl oz (0.047 to 0.094)	nightshade, and mustards.		

CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST Herbicides				
Bromoxynil	1 to 1.5 pt EC (0.25 to 0.37)	Annual broadleaf weeds.	POST. Corn: Prior to tasseling.	Apply to small weeds. Weak on wild mustard. Could be used when drift of dicamba or 2,4-D may injure susceptible broadleaf crops. C14
Bromoxynil + Atrazine RUP	0.75 to 1.5 pt EC + 0.5 to 1.1 lb DF (0.19 to 0.38 + 0.5 to 1)		POST. Corn: Up to 12 inches tall.	Atrazine soil residual may injure subsequent crops. Commercial mixtures available: Buctril + Atrazine, Brozine, or Moxy AT C2 C7 C14 Y6 Y9 Y26
Basagran (bentazon)	1.5 to 2 pt (0.75 to 1)	Wild mustard, cocklebur, sunflower and suppression of Canada thistle.	POST. Mustard: 4- to 6-leaf Canada thistle: 6 to 8 inches tall.	Contact herbicide. Thorough coverage is essential. Split applications needed for Canada thistle control. C2 C7 C9 Y6 Y9
Atrazine + oil additive RUP	Appropriate rate + oil additive (1 to 2)	Broadleaf weeds and some grasses.	POST. Weeds: Less than 1.5 inches tall.	Apply before corn is 12 inches tall. Apply with an oil additive at 1 qt/A. Provides partial control of foxtail. Atrazine soil residue may injure crops planted the following year. C7 Y9 Y26
Bladex (cyanazine) + NIS or vegetable oil additive RUP	1.3 to 2.2 lb DF (1.2 to 2.0)		POST. Corn: Up to 4-leaf stage. Weeds: Less than 1.5 inches tall.	Do not use petroleum based crop oils. Vegetable oil additive increases weed control and risk of crop damage compared to NIS. Use only 90DF for POST applications. Avoid application during cool, wet conditions. C12
Bladex (cyanazine) + Atrazine + vegetable oil additive RUP	0.9 lb DF + 0.6 lb DF + 1 qt veg. oil (0.8 + 0.5)		POST. Corn: Up to 12 inches tall or 4-leaf stage.	Apply with an vegetable oil additive at 1 qt/A. Apply to small grass and broadleaf weeds. Commercial mixture available: Extrazine II. C2 C7 C12 Y24 Y26
Sencor (metribuzin) + broadleaf herbicide	1.6 to 2 oz DF + BL herbicide (1.2 to 1.44 oz + labeled rate)	Broadleaf weeds.	POST. Corn: Prior to tassel.	See label for tank-mix options. Must follow crop stage restrictions of tank-mix broadleaf herbicide. Do not use oil adjuvant with any tank-mix. C9 Y26
2,4-D	0.5 to 1 pt of a 4 lb/gal conc. (0.25 to 0.5)		POST and POST Directed.	Use drop nozzles when corn is over 8 inches tall but before tasseling. Apply POST directed to corn from 3-leaf to 30 inches tall. C34 X1
Shotgun (atrazine + 2,4-D) RUP	2 to 3 pt (0.56 to 0.84 + 0.25 to 0.375)		EPP, PRE or EPOST.	Lower atrazine rates reduce potential for carryover. Can be tank-mixed with bromoxynil at 0.75 pt/A or dicamba at 2 to 4 fl oz/A. C2 C7 C16 C31 Y9 Y26
Dicamba	0.5 to 1 pt (0.25 to 0.5)		EPOST. Corn: From spike to 8 inches tall.	Apply with drop nozzles when corn is 8 to 36 inches tall or 15 days prior to tassel. Can be applied with Accent for grass control. C16 S4 X1 Y15 Y26
	0.5 pt (0.25)		POST Directed. See Remarks.	
Dicamba + Atrazine RUP	0.5 to 1 pt + 0.55 to 2.2 lb DF (0.25 to 0.5 + 0.5 to 2)		PRE or EPOST. Corn: Up to 5-leaf stage.	Do not apply to stressed corn. Atrazine soil residue may injure subsequent crops. Commercial mixture available: Marksman. C2 C7 C18 X1 Y3 Y9 Y15 Y26

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Distinct (dicamba + diflufenzopyr)	6 oz WDG (3 oz + 1.2 oz)	Broadleaf weeds and grass suppression.	POST. Corn: 4 to 16 inches with 6 or fewer collars. 4 to 10 inch = 6 oz. 10 to 16 inch = 4 oz.	Do not apply to corn less than 4 inches tall. 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. C19 S4 S6 S7 S11 Y15 Y26
Stinger (clopyralid)	1/4 to 2/3 pt (1.5 to 4 oz)	Composite, legume, and polygonum broadleaf weeds including Canada thistle.	POST. Corn: Up to 24 inches tall. Canada thistle: Rosettes: Before bud stage.	Apply after most thistle shoots have emerged. See narrative for crop rotation restrictions and for rosette technique for Canada thistle control. Fall application provides greater control than application to bolting or flowering plants. T2
Hornet (flumetsulam + clopyralid)	1.6 to 4 oz WDG (0.37 to 0.9 oz + 1 to 2.5 oz)	Broadleaf weeds including Canada thistle.	POST. Corn: Up to 24 inches tall.	Use drop nozzles on 20 to 24 inch corn. Add NIS at 0.25% v/v or oil adjuvant at 1% v/v. Refer to label or narrative for tank-mix options. C24 T2 X1 Y23 Y26
Curtail (clopyralid + 2,4-D)	2 pt (0.09 + 0.5)		POST. Corn: Up to 8 inches tall or 4 visible leaf collars showing.	Corn stalks may become brittle due to 2,4-D. Use drop nozzles from 8 to 24 inches tall. See label or narrative for risk of injury, delay in cultivation after application and other restrictions. May be tank-mixed with Stinger at 2 to 6 fl oz/A. C17 T2 Y23 Y26
Tough (pyridate)	12 to 24 fl oz (0.47 to 0.94)	Small seeded broadleaf weeds, kochia including ALS resistant.	POST. Corn: Up to 68 days prior to harvest. Weeds: Small	Contact, non-residual herbicide. Apply at 20 to 30 gpa with NIS or oil adjuvant + 28% UAN. Apply when weeds are small and actively growing. Use an oil additive when weeds are large. Refer to label for tank-mix options. C33
Aim (carfentrazone) + tank-mix herbicide Atrazine is RUP	1/3 oz DF + labeled rate (0.13 oz + labeled rate)	Redroot pigweed, lambsquarters, nightshade and may control or suppress kochia.	EPOST. Corn: Up to 12 inches tall or 8 collars. Weeds: Small.	Aim may cause cosmetic speckling/spotting on corn leaves intercepting spray. See label or narrative for adjuvant and tank-mix options to increase spectrum of broadleaf weeds controlled. C6 S4 S6 S7 X1
Callisto (mesotrione) Registration Pending	3 fl oz (1.5)	Broadleaf weeds including pigweed lambsquarters, ragweed, sunflower, smartweed and nightshade.	POST. Corn: Up to 30 inches tall. Weeds: Small	Apply with oil adjuvant at 1% v/v + UAN at 2.5% v/v. Apply with atrazine at 0.25 lb ai/A for common cocklebur and kochia control. See label or narrative for tank-mix options, crop rotation restrictions, insecticide interactions, and other restrictions. C5 X1 Y26
Permit (halosulfuron)	2/3 to 1.33 oz DF (0.5 to 1 oz)	Pigweeds, cocklebur, Venice mallow, ragweeds, smartweed, sunflower, velvetleaf, and nutsedge.	POST. Corn: Up to 36 inches tall. Use drop nozzles on 24 to 36 inch corn.	Add NIS at 0.25 to 0.5% v/v or oil adjuvant with 28% UAN at 2 to 4 qt/A. Liquid fertilizer increases control of pigweed and other species. No control of common lambsquarters. Can be tank-mixed with atrazine, dicamba, Marksman, 2,4-D, bromoxynil, and Accent. C27 Y3 Y26
NorthStar (dicamba + primisulfuron)	5 oz DF (2.2 oz + 0.375 oz)	Broadleaf weeds and suppression of foxtail, field sandbur, quackgrass, nightshade, and Canada thistle.	POST. Corn: 4 to 20 inches tall with 6 or fewer collars. Use drop nozzles on 20 to 36 inch corn.	Add NIS at 0.25% v/v or oil adjuvant at 1 to 4 pt/A. UAN or AMS may be added with NIS or oil. Oil adjuvants should not be used when corn is greater than 12 inches tall. See label or narrative for tank-mix options, crop rotation restrictions, insecticide interactions, and other restrictions. Primisulfuron will carryover for more than 1 year. C26 Y3 Y26

CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Basis (rimsulfuron + thifensulfuron) + additive	1/3 oz DF (0.165 oz + 0.083 oz)	Barnyardgrass, foxtails, redroot pigweed, wild mustard, lambsquarters, and annual smartweed.	Early POST. Corn: Spike to 4-leaf (2 collar) stage. ½ to 6 inches tall. Weeds: 1 to 2 inches tall.	Apply with oil or basic blend adjuvant plus UAN. Do not use on corn hybrids less than 88 days maturity. Do not apply to corn previously treated with Counter insecticide. See label or narrative for tank-mix options. C2 C10 Y13
Basis Gold (nicosulfuron + rimsulfuron + atrazine) RUP	14 oz DF (0.188 oz + 0.188 oz + 0.76)	Annual grasses, quackgrass, and some broadleaf weeds.	POST. Corn: Up to 12 inches tall and prior to 6 collars.	Apply with oil adjuvant at 1 to 2% v/v with 28% UAN. Basis Gold at 14 oz/A contains 0.76 lb ai/A atrazine. Follow crop rotation restrictions. C2 C4 C11 Y3 Y9 Y12 Y26
Steadfast (nicosulfuron + rimsulfuron) + additive	3/4 oz DF (0.375 + 0.188 oz)			Available only in bulk dispensing systems. Apply with oil or basic blend adjuvant plus UAN. See Accent below for insecticide use restrictions. May tank-mix with atrazine, dicamba, or Hornet. Use caution on corn hybrids less than 88 day maturity. See label or narrative for tank-mix restrictions and crop rotation restrictions. C3 C4 X1 Y3 Y26
Accent (nicosulfuron) + additive	2/3 oz DF (0.5 oz)	Annual grasses, quackgrass and wild mustard, pigweed and smartweed.	POST. Corn: Up to 20 inches with 6 or fewer collars. Use drop nozzles on 20 to 36 inch corn.	Apply with oil or basic blend adjuvant plus UAN. Do not apply to corn previously treated with Counter 15G insecticide. See label or narrative for tank-mix options and crop rotation restrictions and tank-mix options. C3 C4 X1 Y3 Y26
Accent (nicosulfuron) + Atrazine RUP	2/3 oz DF + 0.42 to 1.7 lb DF (0.5 oz + 0.375 to 1.5)	Grass and most small seeded broadleaf weeds.	POST. Corn: Up to 12 inches tall.	Apply with oil adjuvants. May be tank-mixed with dicamba for control of large-seeded broadleaf weeds. C3 C4 C7 X1 Y3 Y9 Y26
Accent (nicosulfuron) + dicamba	2/3 oz DF + 0.5 to 1 pt (0.5 oz + 0.25 to 0.5)	Grass and broadleaf weeds including kochia, cocklebur, and wild buckwheat.	POST. Corn: Up to 8 inches tall. Use drop nozzles on 8 to 24 inch corn.	Apply with basic blend adjuvants. Do not apply the 1 pt/A rate of dicamba to corn greater than 8 inches tall. May be tank-mixed with atrazine. C3 C4 C18 X1 Y4 Y15 Y26
Celebrity Plus (nicosulfuron + dicamba + diflufenzopyr)	4.67 oz DF (0.5 oz + 0.125 + 0.05)		POST. Corn: 4 to 16 inches tall with 6 or fewer collars. Use drop nozzles on 16 to 36 inch corn.	Apply with NIS at 0.25 to 0.5% plus UAN at 1 to 2 qt/A or basic blend adjuvants at 1% v/v. May be tank-mixed with atrazine, dicamba, or Marksman. Celebrity at 4.67 oz WDG/A = Accent at 0.67 oz 75DF/A + the dicamba in Distinct at 4 fl oz/A. C2 C16 X1 Y14 Y26
Accent (nicosulfuron) + bromoxynil	2/3 oz DF + 1 to 1.5 pt (0.5 oz + 0.25 to 0.5)	Grass and annual broadleaf weeds.	Use drop nozzles on 20 to 24 inch corn.	Use of oil adjuvant is not prohibited but substitution of oil or basic blend additives may result in crop injury. Addition of 28% UAN is recommended with NIS. C4 C14 X1 Y3 Y26
Accent (nicosulfuron) + Hornet (flumetsulam + clopyralid)	2/3 oz DF + 1.6 to 4 oz WDG (0.5 oz + 0.37 to 0.9 oz + 1 to 2.5 oz)	Grass and broadleaf weeds including ragweed, nightshade, cocklebur, and sunflower.	POST. Corn: Up to 20 inches tall with 6 or fewer collars. Use drop nozzles on 20 to 24 inch corn.	Apply with NIS at 0.25% v/v or PO at 1% v/v. Add 28% UAN at 2.5% v/v during dry conditions. Do not cultivate within 10 days before or after application. Refer to label for rate range for various weeds and tank-mix options. C2 C4 C24 S6 T2 X1 Y3 Y4 Y7 Y15 Y23 Y26
Accent Gold (nicosulfuron + rimsulfuron + clopyralid + flumetsulam)	2.9 oz DF (0.188 oz + 0.188 oz + 1.5 oz + 0.56 oz)	Suppression of Canada thistle.		Apply with oil adjuvant at 1 to 2% v/v. Do not use on corn hybrids less than 88 days maturity. Accent Gold at 2.9 oz DF/A contains 2.4 oz/A Hornet. See label for tank-mix options and crop rotation restrictions. C5 T2 X1 Y3 Y4 Y8 Y9 Y26

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST-Directed Herbicides				
Sencor (metribuzin) + broadleaf herbicide	2 to 3 oz DF + rate for broadleaf herbicide (1.44 to 2.24 oz)	Annual broadleaf weeds.	POST Directed. Corn: More than 8 inches tall.	Apply with 2,4-D, dicamba or bromoxynil. Refer to label for adjuvant use, application information, range of crop stage at application, cultivation, potential for injury, and other restrictions. C9 C31 Y17 Y26
Paraquat Directed Spray Only RUP	0.75 to 1.3 pt of a 3 lb/gal conc. (0.28 to 0.48)	Broadleaf and grass weeds.		Treat no more than lower 3 inches of corn stalk. Apply with NIS at 0.25% v/v. May be tank-mixed with atrazine. C35
Preharvest Application				
Glyphosate	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc. or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.75)	Annual and perennial grass and broadleaf weeds.	Preharvest.	Apply when grain moisture is 35% or less and corn is physiologically mature (black layer formed). Allow at least 7 days between application and harvest. Do not use on corn grown for seed. A4 Q4

HERBICIDE RESISTANT CORN

CLEARFIELD (Imidazolinone Resistant) CORN




Herbicide	Product/A (lb 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.	EPOST and 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. High risk of developing ALS kochia resistance. Should use with herbicides of a different mode of action and use complimentary weed control strategies. C36 Y2 Y19 Y26

LIBERTY (Glufosinate) RESISTANT CORN




Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Liberty (glufosinate)	24 to 34 fl oz (0.31 to 0.44)	Annual grass and broadleaf weeds.	EPOST and 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, contact herbicide. Apply with AMS at 3 lb/A in a minimum of 15 gpa. See label for tank-mix options. Will control weeds resistant to other herbicides. C37 S6 X1
Liberty ATZ (glufosinate + atrazine) RUP	32 to 40 fl oz (0.25 to 0.31 + 0.83 to 1)		EPOST and POST. Corn: Up to 12 inches tall.	Apply only to glufosinate resistant corn varieties. Liberty ATZ contains atrazine and may carryover into the following growing season. Do not add NIS or oil adjuvants. Apply with AMS at 3 lb/A in a minimum of 15 gpa. See label for application information and tank-mix options. C37 S6 X1 Y9 Y25 Y26

ROUNDUP (Glyphosate) RESISTANT CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	1.5 to 2 pt of a 3 lb ae/gal conc. or 1.2 to 1.6 pt of a 3.7 lb ae/gal conc or 1.12 to 1.5 pt of a 4 lb ae/gal conc. or 5.2 to 18.5 oz of a 65% SG (0.56 to 0.75)	Annual and perennial grass and broadleaf weeds.	EPOST and POST. Corn: Up to 30 inches tall or 8 collars (V8).	Apply only to glyphosate resistant corn varieties. Do not apply more than 1 qt/A per single in-crop application. Do not apply more than 2 qt/A in crop. Apply with AMS fertilizer at 8.5 to 17 lbs/ 100 gal water. Refer to label for tank-mix options, application information, and restrictions. Glyphosate is a foliar, non-selective, non-residual herbicide. Will control weeds resistant to other herbicides. A4 C38 Q4 X1
ReadyMaster ATZ (glyphosate + atrazine) RUP	(1.5 to 2 qt) (0.56 to 0.75 + 0.75 to 1)		EPOST and POST. Corn: Up to 12 inches tall.	Apply only to glyphosate resistant corn varieties. ReadyMaster ATZ contains atrazine and may carryover into the following growing season. See label for application information and tank-mix options. A4 X1 Y5 Y9 Y26

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. See narrative or label for adjuvant use. A4 Q4
Paraquat RUP	1 to 2.7 pt of a 3 lb/gal conc. (0.375 to 1)			Non-selective, non-residual, contact, foliar herbicide. Apply with a NIS. Q6
2,4-D	1 to 2 pt of a 4 lb/gal conc. (0.5 to 1)	Preplant burndown of emerged annual broadleaf weeds.	<u>Days before seeding</u> 1 pt amine: 15 days 1 pt ester: 7 days 2 pt am or es: 30 d	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. D4 X1
Prowl Pendimax (pendimethalin)	2.4 to 3.6 pt 1.67 to 2.5 lb DG (1 to 1.5)	Annual grass and some broadleaf weeds.	PPI or PRE.	Adjust rate according to soil type. Do not apply Sonalan or trifluralin PRE. Poor control of wild mustard and wild oat. DNA resistant green foxtail has been documented in North Dakota. D2 D4 D19 D27 X1 Y26 Y26
Sonalan Sonalan 10G (ethalfluralin)	1.5 to 3.5 pt 5.5 to 13 10G (0.55 to 1.3)		PPI. Fall from Oct 1 to Dec 31 or Spring.	
Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1)		PPI. Fall or spring.	
Pursuit Plus (imazethapyr + pendimethalin)	1.8 pt (0.75 oz + 0.72)	Grass and broadleaf weeds including wild mustard.	PPI.	ND state label allows reduced use rate. 1.8 pt/A is equivalent to 3 fl oz/A Pursuit and 1.75 pt Prowl. Additional Prowl at 1.75 pt/A improves weed control. D2 D21 Y2 Y26
Sencor (metribuzin)	0.33 to 0.5 lb DF Soil pH <7.5. 0.25 lb DF Soil pH >7.5.			Apply with soil-applied grass herbicide. Use 0.33 to 0.5 lb/A on soils with pH < 7.5. Use 0.25 lb/A on soils with pH > 7.5. Sencor may injure certain soybean varieties. D2 D19 D26 D24 S11Y25 Y26
Axiom (flufenacet + metribuzin) 	7 to 13 oz WDG (0.24 to 0.44 + 1 to 1.77 oz)	Grass and some broadleaf weeds.	PPI or PRE.	Poor wild oat control. PPI gives more consistent control than PRE. PRE requires precipitation for herbicide activation. Adjust rate according to soil type and OM. Frontier has given greater nightshade control. Refer to label for tank-mix options and grazing or feeding restrictions.
Domain (flufenacet + metribuzin) 	9 to 16 oz WDG (0.135 to 0.24 + 3.25 to 5.75 oz)		EPP, PPI, and PRE.	Commercial mixtures available: Lasso + trifluralin = Freedom. Dual + metribuzin = Turbo A1 D2 D3 D17 S6
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 4 pt Dual/II 1 to 2 pt Magnum (1 to 2)		Fall: After Sept 30 but before ground freezes. Spring: PPI or PRE.	
Lasso (alachlor) RUP	2 to 3 qt EC/MT 13 to 23 lb 15G (2 to 3)		PPI or PRE.	
Frontier (dimethenamid)	20 to 32 fl oz (0.93 to 1.5)		PPI, PRE or EPOST.	
Valor (flumioxazin) Registration Pending 	2 to 3 oz WDG (1 to 1.5 oz)	Broadleaf weeds including kochia, nightshade, lambsquarters, pigweed.	PPI, and PRE.	Adjust rate according to soil texture and OM. Requires precipitation to activate herbicide. See label or narrative for tank-mix options, application information, rate structure, and crop rotation restrictions. D29 S11 Y26

SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Authority (sulfentrazone) 	4 to 5.33 oz WDG (3 to 4 oz)	Broadleaf weeds including kochia, nightshade, and biennial wormwood	EPP, PPI, and PRE.	Use lower rates on soil with OM <3. Use higher rates on soil with OM >3. Do not use on sand with < 1% OM. Authority may injure certain soybean varieites. Requires precipitation to activate herbicide. Provides excellent weed burndown applied EPP. Allow a 65 day PHI.
Guantlet (sulfentrazone + cloransulam) 	Copack: 5.33 to 6.67 oz WG + 0.6 to 0.75 oz WG (0.25 to 0.31 oz + 0.31 to 0.39 oz)	Controls many large-seeded broadleaf weeds.		See label or narrative for tank-mix options, application information, rate structure, and crop rotation restrictions. D6 S4 S6 S7 S8S11 Y10 Y26
Python (flumetsulam) 	0.8 to 1.33 oz WDG or 5 to 3 A/pack (0.64 to 1.06 oz)	Broadleaf weeds including nightshade and biennial wormwood.	EPP, PPI, or PRE.	Adjust rate according to soil texture and OM. Requires precipitation to activate herbicide. Do not apply to soil with greater than 7.8 pH. See label for tank-mix options. 85 days PHI. Commercial mixtures available: Broadstrike + Dual at 1.75 to 2.5 pt/A Broadstrike + Treflan at 1.5 to 2.25 pt/A D2 D8 D9 D22 S6 S11 Y4 Y13 Y26

POST Herbicides

Basagran (bentazon)	1 to 2 pt (0.5 to 1)	Wild mustard, cocklebur, volunteer sunflower. Suppression of biennial wormwood and Canada thistle.	POST. Soybean: Any stage. Mustard: 4- to 6-leaf. Canada thistle: 6 to 8 inches. See label for more information.	Contact herbicide, non-residual herbicide. Thorough coverage required. Apply with oil additive at 1 qt/A. <u>Rosette technique</u> : Repeated in-crop applications controls Canada thistle during the growing season but allows fall rosette growth. Refer to narrative for control of Canada thistle using the rosette technique. D7 T2 S11
Rezult (bentazon + sethoxydim)	3.2 pt (1+ 0.2)	Grass and broadleaf weeds.	POST. Soybean: Emergence to 30 days prior to harvest.	Apply with oil adjuvants at 1 to 2 pt/A. Provides economical weed control. Refer to Basagran and Poast sections for additional information. D7 D18
Ultra Blazer (acifluorfen)	0.5 to 1.5 pt (0.125 to 0.375)	Wild mustard, redroot pigweed, and volunteer flax.	POST. Soybean: 1 to 2 trifoliates. Weeds: 1 to 4 inches tall.	Contact herbicide. Thorough coverage required. Use low rate on wild mustard, pigweed and volunteer flax. Use higher rate on larger weeds. Apply when temperature exceeds 70 F. D28 S6
Cobra (lactofen)	6 to 12.5 fl oz (1.5 to 3.2 oz)	Broadleaf weeds including wild mustard, ragweed, and lanceleaf sage.	POST. Soybean: 1 to 2 trifoliates. Weeds: 2 to 6 leaves.	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. D11 S6
Flexstar (fomesafen + adjuvants)	0.75 to 1 pt (0.176 to 0.24)	Broadleaf weeds including cocklebur pigweed, mustard, ragweed, Venice mallow, smartweed black nightshade, kochia including ALS resistant. Poor hairy nightshade control.	POST. Weeds: 2- to 4-leaf stage.	Contact herbicide. Thorough coverage required. 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 at 0.75 pt/A in ND east of Hwy 281 and in MN south of US Hwy 2. See 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. D12 S4 S6 S7 Y26

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
FirstRate (cloransulam)	0.3 oz WDG or 10 A/pack (0.25 oz)	Cocklebur, Venice mallow, marestail, ragweed, sunflower, wild mustard.	POST. Soybean: Up to 50% flowering. Weeds: Up to 10 inches tall or 8 leaves.	Apply with NIS at 0.125% v/v + 28% UAN at 2.5% v/v, or oil adjuvant at 1.2% v/v alone or with 28% UAN at 2.5% v/v. See label or narrative or label for weed size, tank-mix options and crop rotation restrictions. 50% flowering = when 1 of 2 plants are flowering. D11 X1 Y4 Y26
Harmony GT (thifensulfuron) Harmony GT Registration Pending.	1/12 oz 75DF (0.062 oz)	Wild mustard, pigweed, and lambsquarters.	POST. Soybean: Fully expanded 1st trifoliolate leaf until 60 days prior to harvest.	Apply with a NIS at 0.25% v/v or oil additive plus 28% UAN or AMS. Refer to label for tank-mix options. No control of ALS resistant kochia. D7 D16 S1 S6 X1
Pursuit Pursuit DG (imazethapyr)	3 fl oz S 1.08 oz WDG (0.75 oz)	Annual broadleaf weeds including black nightshade, kochia, pigweed, and mustard.	POST. Soybean: Fully expanded first trifoliolate leaf but prior to flowering. Weeds: Small and actively growing.	Apply with NIS or oil adjuvant and liquid fertilizer. MSO type oil adjuvants have given greater Pursuit enhancement than petroleum oil or NIS. See narrative for rotational restrictions. Poor common lambsquarters, wild buckwheat and biennial wormwood control. No control of ALS resistant kochia. Avoid drift. D20 S6 X1 Y2 Y26
Pursuit Pursuit DG (imazethapyr) + Harmony GT (thifensulfuron) Supplemental Tank- mix Label Pending.	3 fl oz 1.08 oz WDG + 1/12 oz 75DF (0.75 oz + 0.062)	For improved wild buckwheat and common lambsquarters control.		Apply with basic blend type adjuvants or NIS plus 28% UAN. Do not apply with oil adjuvant. Refer to label for crop safety, adjuvant use, weed size, weed response, stresses that may affect control and crop safety, and rotational restrictions. No control of ALS resistant kochia. D16 D20 S6 X1 Y2 Y26
Pursuit Pursuit DG (imazethapyr) + Flexstar (fomesafen & adjuvants)	3 fl oz 1.08 oz WDG + 0.75 pt/A (0.75 oz + 0.176)	For improved ragweed control and control of kochia including ALS resistant.		See label for geographic region restrictions, adjuvant use, and crop rotation restrictions. Use MSO adjuvants at 1%v/v + AMS at 10 lb/100 gal water. D16 D20 S4 S6 Y26
Pursuit Pursuit DG (imazethapyr) + Cobra (lactofen)	3 fl oz 1.08 oz WDG + 4 fl oz (0.75 oz + 1 oz)	For improved ragweed control.		Apply with NIS and 28% UAN. Do not apply with oil adjuvant. Refer to label for application and use information and risk of crop injury. See narrative for rotational restrictions. D10 D20 S6 Y2 Y26
Raptor (imazamox)	4 fl oz (0.5 oz) if following a soil - applied grass herbicide or 0.5 fl oz (0.625 oz)	Annual grass and broadleaf weeds. Poor common ragweed, wild buckwheat and biennial wormwood control.	POST. Soybean: Fully expanded first trifoliolate leaf but prior to flowering. Weeds: 2 to 6 inches.	Apply with NIS or oil additive with 28% UAN. Do not use oil adjuvant + 28% UAN during high temperature and humidity. See narrative for application information, weed size, crop rotation restrictions, and other use information. Reduced risk of herbicide carryover as compared to Pursuit. No control of ALS resistant kochia. D23 S6 X1 Y2 Y26
Raptor (imazamox) + Flexstar (fomesafen & adjuvants)	4 to 5 fl oz + 0.75 pt/A (0.75 oz + 0.176)	For improved ragweed control and control of kochia including ALS resistant.		See label for geographic region restrictions, crop rotation restrictions. Use MSO adjuvants at 1%v/v + AMS at 10 lb/100 gal water. Refer to Flexstar comments for kochia control. D12 D23 S4 Y26
Raptor (imazamox) + Cobra (lactofen)	4 to 5 fl oz + 4 fl oz (0.5 to 0.625 oz + 1 oz)	For improved common ragweed control.		Apply with NIS and 28% UAN. Do not apply with oil adjuvant. Refer to label for application and use information and risk of crop injury. See narrative for rotational restrictions. D10 D23 S6 Y2 Y26

SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Assure II (quizalofop)	7 to 10 fl oz (0.77 to 1.1 oz)	Annual grasses and quackgrass.	POST. Soybean: Up to pod set. Grass weeds: 2 to 6 inches tall.	Apply with oil adjuvant to actively growing grasses. Apply: Assure II with oil additive at 1% v/v. Fusilade with oil additive at 1% v/v. Fusion with oil additive at 1% v/v. Poast with oil additive at 1 qt/A. Select with oil additive at 1qt/A. Apply Assure II with nitrogen when weeds are drought stressed. See narrative for rates by weed species. Treat volunteer corn from 6 to 18 inches tall. Grass control is reduced by tank mixtures or close interval application of POST broadleaf control herbicides. <u>The 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.</u> Do not cultivate prior to 5 days before or 7 days after application. Reduced yellow foxtail control may result if Assure II is applied at rates lower than 8 fl oz/A, if used with broadleaf herbicides, or applied to stressed or larger yellow foxtail. See label or narrative for tank-mix option allowed. See supplemental labels allowing reduced rates on small grass weeds. D5 D13 D14 D18 D24 D25 D31 X1
Fusilade DX (fluazifop-P)	5 to 12 fl oz (1.25 to 3 oz)		POST. Soybean: Before bloom. Grass weeds: 2 to 4 inches.	
Fusion (fluazifop-P + fenoxaprop)	4 to 12 fl oz (1 to 3 oz + 0.32 to 0.96 oz)		POST. Soybean: Before bloom. Grass weeds: 2 to 6 inches tall.	
Poast (sethoxydim)	0.5 to 1.5 pt (0.09 to 0.28)	Annual grasses.	POST. Soybean: All stages. Grass: Up to 8 inches tall.	
Select Prism (clethodim)	4 to 16 fl oz 8.5 to 34 fl oz (1 to 4 oz)	Annual grasses and quackgrass.	POST. Soybean: All stages. Annual grasses: 2 to 6 inches tall. Quackgrass: 4 to 12 inches tall.	

Preharvest Application

Glyphosate	1 to 2qt of a 3 lb ae/gal conc. or 1.6 to 3.2 pt of a 3.7 lb ae/gal conc. or 1.5 to 3 pt of a 4 lb ae/gal conc. or 18.5 to 37 oz of a 65% SG (0.75 to 1.5)	Preharvest weed control.	Prior to harvest.	Apply after pods have set and lost all green color. Allow a 7 day PHI. Refer to narrative for adjuvant use. A4 Q1 Q4
Paraquat RUP	5.5 to 11 fl oz of a 3 lb/gal conc. (0.13 to 0.25)	Desiccant.	Prior to harvest.	Add a NIS at 0.125% v/v. Do not apply within 15 days of harvest. Apply when at least 65% of the seed pods are a mature brown color or when seed moisture is 30% or less. Q6
Drexel Defol (sodium chlorate)	1 gal of a 6 lb/gal conc. (6)		7 to 10 days prior to harvest and after pods are brown.	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.

ROUNDUP (Glyphosate) RESISTANT SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	<p>1 to 6 pt of a 3 lb ae/gal conc. or 0.8 to 4.8 pt of a 3.7 lb ae/gal conc. or 0.75 to 4.5 pt of a 4 lb ae/gal conc. or 9.4 to 54.4 oz of a 65% SG (0.38 to 2.25)</p>	<p>Annual and perennial grass and broadleaf weeds.</p>	<p>POST. Soybean: Emergence through full flowering.</p> <p>Allow a 14 day PHI.</p> <p>Apply as single or multiple applications.</p>	<p>Apply only to glyphosate resistant soybean varieties. Add AMS at 8.5 to 17 lb/100 gal water. Do not apply more than 4 pt/A for each single in-crop application OR during flowering. Do not exceed 6 pt/A for the total multiple in-crop applications from emergence through flowering. Multiple applications may be necessary for weeds 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 save harvested seed. A4 D30 S6 Q4 X1</p>
<p>Extreme (imazamox + glyphosate)</p>	<p>2.25 pt (0.75 oz + 0.42)</p>		<p>POST. Soybean: Fully expanded first trifoliolate leaf but prior to flowering.</p>	<p>Apply only to glyphosate resistant soybean varieties. Add NIS at 0.25% v/v and AMS at 12 to 15 lb/100 gal water. 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, and restrictions. Allow a 14 day PHI. Cannot save harvested seed. A4 D20 S6 Q4 X1 Y2 Y26</p>

DRY EDIBLE BEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Eptam (EPTC)	3.5 to 4.5 pt 15 to 20 lb 20G (3 to 4)	Grass and some broadleaf weeds.	PPI.	Weak on wild mustard. PPI immediately after application. May be tank-mixed with Dual, Lasso, Frontier, Prowl, Sonalan, or trifluralin to increase spectrum of weeds controlled. Consult label for rate range for specific tank mix. A1 A2 A3 E5 S6
	4.5 to 5.25 pt 20 to 22.5 lb 20G (4 to 4.5)		Fall: Incorporated after October 15 until freeze-up.	
Trifluralin	1 to 2 pt 5 to 10 lb 10G 0.83 to 1.67 lb 60DF (0.5 to 1)		PPI. Fall or spring.	Poor wild mustard and wild oat control. PPI within 24 hours after application. May be tank-mixed with Dual, Eptam, Frontier, and Lasso. Refer to narrative for rotational restrictions. A1 A3 E5 E6 E8 X1 Y1 Y22 Y26
Sonalan (ethalfluralin)	1.5 to 4.5 pt 5.5 to 17 lb 10G (0.55 to 1.7)		PPI. Fall: After October 15 or Spring. Spring: PPI for EC formulation only.	Poor wild mustard and wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. E8 Y22 Y26
	7.5 to 12.5 lb 10G (0.75 to 1.25)		Foxtail suppression.	Fall incorporated between October 1 to December 31 or Spring. Use in reduced or conservation tillage systems. Incorporate twice at 2 to 3 inches deep using a V-blade undercutter or rotary hoe at 5 mph. For fall application, incorporate once in the fall and once in the spring before seeding. E8 Y22 Y26
Prowl Pendimax (pendimethalin)	2.4 to 3.6 pt 1.2 to 2.5 lb DG (0.75 to 1.5)	Grass and some broadleaf weeds.	PPI.	Poor on wild mustard and wild oat. Adjust rate according to soil type. PPI provides more consistent results. Refer to narrative for rotational restrictions. Can be tank-mixed and applied PPI with Dual, Eptam, Frontier, Lasso, Micro-Tech, and Partner. E3 E4 E5 E6 E8 Y22 Y26
Eptam (EPTC) + Sonalan (ethalfluralin)	2.5 to 3.5 pt 11 to 15 lb 20G + 3 to 4.25 pt 11.25 to 16 lb 10G (2.2 to 3 + 1.125 to 1.6)	Grass and some broadleaf weeds. Suppression of nightshade.	PPI.	Adjust rate according to soil type and OM. PPI immediately after application. Poor on wild mustard. Refer to narrative for rotational restrictions. A1 A3 D3 E3 E4 E5 E8 S6 Y22 Y26
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 3 pt Dual/II (2 to 3) 1 to 2 pt Magnum (1 to 2)		Spring: PPI or PRE. Fall: After Sept 30 but before ground freezes.	Poor on wild mustard and wild oat. Adjust rate according to soil type and OM. PPI improves consistency of weed control. Can be tank-mixed with Eptam, Prowl, Sonalan, or trifluralin. Do not use Lasso on coarse- textured soils. Frontier provides greater nightshade control. Frontier can be applied EPOST with Basagran and Pursuit. A1 E4 E6 S6
Frontier (dimethenamid)	20 to 32 fl oz (0.93 to 1.5)		PPI, PRE, or POST to third trifoliolate.	
Lasso (alachlor) RUP	4 to 6 pt (2 to 3)		PPI.	

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
POST Herbicides				
Basagran (bentazon)	1 to 2 pt (0.5 to 1)	Wild mustard, cocklebur, sunflower, ragweed, Venice mallow and suppression of Canada thistle.	POST. Dry bean: After emergence. Broadleaf weeds: Small seedlings.	Thorough spray coverage is essential. Addition of oil adjuvant at 1 qt/A improves weed control. D7 E3 S11 T2
	1 pt/1 pt (0.5/0.5)		POST. Apply twice. Make second application 7 to 10 days after first.	Use two split application for improved weed control. First application to small weeds and unifoliolate to first trifoliolate dry bean. Apply with oil additive at 1 to 2 pt/A. Canada thistle control requires the second application 7 to 10 days later. D7 E3 S11 T2
Rezult (bentazon + sethoxydim)	3.2 pt/A (1+ 0.2)	Grass and broadleaf weeds.	POST. Dry bean: Emergence to 30 days prior to harvest.	Add oil adjuvants at 1 to 2 pt/A. Provides economical weed control. Refer to Basagran and Poast sections for additional information. D7 D19 D24
Pursuit Pursuit DG (imazethapyr)	2 fl oz 0.72 oz WDG or (0.5 oz)	Wild mustard and control or suppression of black nightshade and other weeds.	POST. Dry bean: After first trifoliolate but prior to flowering.	Apply only with NIS. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply under stress conditions. Refer to narrative for additional information. A reduced rate of Basagran in combination will safen Pursuit on dry beans. D21 E9 S4 Y1 Y2 Y6 Y26
Raptor (imazamox) Section 3 and 18 Registration Pending	4 fl oz (0.5 oz)	Annual grass and broadleaf weeds including nightshade.		Apply with NIS at 0.25% v/v. Allow a 60 day PHI. Refer to label for weeds controlled, application information, risk of crop injury, and crop rotation restrictions. E10 S4 S6 S7 Y2 Y26
Reflex (fomesafen) Section 18 Registration Pending	0.75 pt (0.19)	Annual broadleaf weeds including ragweed and nightshade.	POST. Dry bean: Prior to bloom. Weeds: 1 to 4 leaves.	Apply with NIS at 0.125 to 0.25% v/v or oil adjuvant at 0.5 to 1% v/v. Oil adjuvant may increase risk of crop injury. Allow a 30 day PHI. Refer to label for weeds controlled, application information, risk of crop injury, and crop rotation restrictions. E10 S4 S6 S7 Y2 Y26
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Dry bean: 30 days or more prior to harvest	Apply with oil adjuvant to actively growing weeds. Apply: Assure II with oil additive at 1% v/v Poast with oil additive at 1 qt/A Select with oil additive at 1qt/A
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	Grass: 2 to 6 inches tall.	See soybean section, label, or narrative for tank-mix options, possible grass antagonism with broadleaf herbicides, and avoiding reduced grass control. Lack of yellow foxtail control may result if Assure II is applied at reduced rates or with broadleaf herbicides. D5 D18 D24 D25 D31 E2 E7 E12 X1
Select Prism (clethodim)	4 to 8 fl oz 8.5 to 17 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
Preharvest Application				
Paraquat RUP	0.75 to 1.3 pt of a 3 lb/gal conc. (0.28 to 0.49)	Desiccant.	POST. Dry bean: 7 days or more prior to harvest.	Apply when at least 80% of the pods are yellow and mostly ripe with no more than 40% (bush type beans) or 30% (vine type) of the leaves still green. Q6
Drexel Defol (sodium chlorate)	1 gal of a 6 lb/gal conc. (6)		7 to 10 days prior to harvest and after pods are brown.	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.

FIELD PEA



Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Paraquat RUP	1 to 2.7 pt of a 3 lb/gal conc. (0.375 to 1)			Non-selective, non-residual, foliar herbicide. Apply with NIS. Q6
Far-Go (triallate)	1.25 qt 12.5 to 15 lb 10G (1.25 liquid or 1.25 to 1.5 10G)	Wild oat.	PPI.	PPI immediately after application. A two pass incorporation is recommended. A premix of triallate + trifluralin (Buckle) is labeled for use in field pea. A1 A3 B18 B19
Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1)	Grass and some broadleaf weeds.		Adjust rate according to soil type. Poor wild mustard and wild oat control. Some pea varieties may be injured. A1 E8 Y1 Y6 Y22 Y26
Sonalan (ethalfluralin)	1.5 to 2 pt 5.5 to 7.5 lb 10G (0.55 to 0.75)			
Prowl/Pendimax (pendimethalin)	1.2 to 3.6 pt (0.5 to 1.5)			
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 3 pt Dual/II (2 to 3) 1 to 2 pt Magnum (1 to 2)			
Sencor (metribuzin)	0.33 to 0.5 lb DF (0.25 to 0.38)	Suppression of lambquarters, henbit, mustard, and chickweed.	PRE.	Adjust rate according to soil type. Refer to narrative for application and environment information, and special precautions which may affect weed control and crop safety. F10 Y17 Y26
	0.16 to 0.25 lb DF (0.125 to 0.19)		POST.	
Chiptox (MCPA sodium salt)	0.5 to 1.5 pt (0.13 to 0.38)	Broadleaf weeds.	POST. Pea: Vines 4 to 6 inches.	MCPA registration has been discontinued on field pea. Use only products that still have field pea listed on the label. Apply to small broadleaf weeds. Do not apply when peas are in bloom. Slight, temporary injury may occur. Do not apply when temperature exceeds 90 F or when peas are stressed. F4
MCPA amine (certain brands)	0.5 to 0.75 pt (0.25 to 0.38)			
Thistrol (MCPB)	2 to 6 pt (0.5 to 1.5)			
Basagran (bentazon)	1 to 2 pt (0.5 to 1)	Annual broadleaf weeds and suppression of Canada thistle.	POST. Pea: At least 3 pair of leaves or 4 nodes.	Apply with oil adjuvant at 1 to 2 pt/A to small actively growing weeds. Do not harvest within 30 days following application. Maximum rate per season is 4 pt/A. F3 S11
Pursuit Pursuit DG (imazethapyr)	2 fl oz 0.72 oz WDG (0.5 oz)	Annual broadleaf weeds.	POST. Pea: 1 to 2 trifoliates.	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. Apply with NIS only. Refer to label for additional information. F7 Y2 Y26


Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Pea: Up to pod set. Grass: 2- to 4-inches tall.	Apply Assure II with oil adjuvant at 1% v/v and Poast with oil adjuvant at 1 qt/A to actively growing grasses. See label for rates and tank-mix options. Allow a 30 day PHI following Poast application. D18 D31 F2 F6
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST.	

Preharvest Application

Glyphosate	0.5 to 6 pt of a 3 lb ae/gal conc. or 0.4 to 4.8 pt of a 3.7 lb ae/gal conc. or 0.38 to 4.56 pt of a 4 lb ae/gal conc. or 4.7 to 56.4 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds. (0.19 to 0.75)	Harvest aid and desiccant.	Apply with AMS fertilizer. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. Do not apply to crop used for seed the following year. For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will killed in treated areas. A4 Q4
		Perennial weeds. (1.5 to 2.25)	Spot treatment.	

CHICK PEA/GARBANZO BEANS

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Far-Go (trifluralin) Far-Go EC = 	1.25 qt 12.5 to 15 lb 10G (1.25 for liquid or 1.25 to 1.5 10G)	Wild oat.	PPI or PRE incorporated.	PPI immediately after application. A two pass incorporation is recommended. Commercial premix of trifluralin + trifluralin available = Buckle. A1 A3 B18 B19 G3 Y26
Trifluralin (trifluralin)	1 to 1.5 pt (0.5 to 0.75)	Grass and some broadleaf weeds.	PPI.	Adjust rate according to soil type. Poor wild mustard and wild oat control. Rate should be adjusted for soil type. Refer to label for application and environment information. A1 G1 H7 X1 Y22 Y26
Sonalan (ethalfluralin)	1.5 to 2 pt 5.5 to 7.5 lb 10G (0.55 to 0.75)			
Prowl Pendimax (pendimethalin)	1.2 to 3.6 pt 0.83 to 2.5 lb DG (0.5 to 1.5)			
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 3 pt Dual/II (2 to 3) 1 to 2 pt Magnum (1 to 2)			
Tough (pyridate) 	1.5 pt (0.94)	Pigweed, kochia, cocklebur, lambsquarters, nightshade, sunflower, and Russian thistle.	POST. Weeds: Less than 3 inches tall	Do not add adjuvants. Allow a 60 day PHI. Do not make more than two applications and allow 20 days between applications. G7
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Crop: Up to pod set. Grass: 2 to 6 inches tall.	Apply with oil adjuvant to actively growing weeds. Apply: Assure II with oil adjuvant at 1% v/v Poast with oil adjuvant at 1 qt/A Select with oil adjuvant at 1qt/A See narrative for rates for different weeds. See section in soybean for information on broadleaf herbicide tank-mix antagonism and method to avoid reduced grass control. D5 D18 D31 E2 E7 E12 F2 F5 G1 X1
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Grass: 2 to 4 inches tall.	
Select Prism (clethodim)	4 to 8 fl oz 8.5 to 17 fl oz (1 to 2 oz)	Annual grasses and quackgrass.	POST. Grass: 2 to 6 inches tall.	
Preharvest Application				
Glyphosate	0.5 to 6 pt of a 3 lb ae/gal conc. or 0.4 to 4.8 pt of a 3.7 lb ae/gal conc or 0.38 to 4.56 pt of a 4 lb ae/gal conc. or 4.7 to 56.4 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Harvest aid and desiccant.	Apply with AMS fertilizer. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. Do not apply to crop used for seed the following year. For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will killed in treated areas. A4 Q4
		Perennial weeds.	Spot treatment.	
Paraquat RUP	1 to 1.3 pt of a 3 lb/gal conc. (0.375 to 0.49)	Desiccant.	POST. Dry bean: 7 days or more prior to harvest.	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. Q6

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Far-Go (triflalte)  Far-Go EC =	1.25 qt (1.25)	Wild oat	PPI or PRE incorporated.	Incorporation tool can be operated 4 inches deep without reducing wild oat control. A1 A3 B18 B19 H1 H3
Treflan (trifluralin)	1 to 1.5 pt (0.5 to 0.75)	Grass and some broadleaf weeds	PPI.	No wild mustard control and poor wild oat control. A1 H1 H7 X1 Y22 Y26
Trilin (trifluralin)	5 to 7.5 lb 10G - spring 6 to 8.5 lb 10G - Fall (0.5 to 0.85)		PPI. Spring or fall	Lentil tolerance to trifluralin is marginal. Injury may occur under stress conditions. Refer to narrative for additional information. H1 H7
Prowl/Pendimax (pendimethalin)	1.2 to 3.6 pt (0.5 to 1.5)		PPI.	Use lower rate on coarse textured soils and higher rate on fine-textured soils. H7 Y22 Y26
Frontier (dimethenamid)	20 to 32 fl oz (0.93 to 1.5)		PPI, PRE, or EPOST to third trifoliolate lentil.	Poor wild mustard and wild oat control. Adjust rate according to soil type and OM. Incorporation improves consistency of weed control. See label for tank-mix products. A1 E3 E6 S6
Sencor (metribuzin)	0.33 to 0.5 lb DF (0.25 to 0.38)	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 which may affect weed control and crop safety. H1 H6 Y17 Y26
	0.16 to 0.25 lb DF (0.125 to 0.19)		POST.	
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Lentil: Up to pod set. Grass: 2- to 4-inches tall.	Apply with oil adjuvant at 1% v/v to actively growing grasses. See narrative for rates for different weeds. Lack of yellow foxtail control may result if Assure II is applied at reduced rates. D31 H2 X1
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Lentil: Before bloom. Grass: 2 to 4 inches. Volunteer corn: 6 -to 18-inches tall.	Apply with oil adjuvant at 1 qt/A to actively growing grasses. See narrative for rates for different weeds. D18 D31 H4 X1

Preharvest Application

Glyphosate	0.5 to 6 pt of a 3 lb ae/gal conc. or 0.4 to 4.8 pt of a 3.7 lb ae/gal conc or 0.38 to 4.56 pt of a 4 lb ae/gal conc. or 4.7 to 56.4 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Harvest aid and desiccant.	Apply with AMS fertilizer. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. Do not apply to crop used for seed the following year. For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will killed in treated areas. A4 Q4
		Perennial weeds.	Spot treatment.	
Paraquat RUP	1 to 1.3 pt (0.375 to 0.49)	Emerged annual and broadleaf weeds.	Desiccant.	Add NIS at 0.25% v/v. Apply when crop is mature and at least 80% of the pods are yellow and no more than 30% of the leaves still green. Q6

SUNFLOWER

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Paraquat RUP	1.75 to 2.7 pt of a 3 lb/gal conc. (0.66 to 1)	Emerged annual grass and broadleaf weeds.		Non-selective, non-residual, foliar contact herbicide. Apply with a NIS at 0.12 to 0.25% v/v. Good plant coverage is essential. A residual herbicide may be tank-mixed with paraquat. Q6
Eptam (EPTC)	2.5 to 3.5 pt (2 to 3)	Grass and some broadleaf weeds.	PPI.	Weak on wild mustard. PPI immediately after application. May be tank-mixed with Sonalan, or trifluralin to increase spectrum of weeds controlled. Consult label for rate range for specific tank mix. A1 A2 A3 J3
	4.5 to 5.25 pt 20 to 22.55 lb 20G (4 to 4.5)		Fall PPI after October 15.	
Sonalan (ethalfuralin)	1.5 to 4.5 pt 5.5 to 17 lb 10G (0.55 to 1.7)		PPI. Spring. Fall: From October 1 to December 31.	Poor wild mustard and wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. A1 J3 X1 Y22 Y26
	7.5 to 12.5 lb 10G (0.75 to 1.25)	Foxtail suppression.		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 Y22 Y26
Sonalan (ethalfuralin) + Eptam (EPTC)	1.25 to 3 pt + 2.5 to 3.5 pt (0.5 to 1.13 + 2 to 3)	Grass and some broadleaf weeds.	PPI.	Adjust rate according to soil type and OM. PPI immediately after application. Poor on wild mustard. Refer to narrative for rotational restrictions. A2 J3
Prowl Pendimax (pendimethalin)	2.4 to 3.6 pt 1.67 to 2.5 lb DG (1 to 1.5)		PPI.	Poor on wild mustard and wild oat. Adjust rate according to soil type. Refer to narrative for rotational restrictions. May be tank-mixed with Eptam. A1 J3 X1 Y1 Y6 Y7 Y22 Y26
	3 to 3.6 pt 2.1 to 2.5 lb DG (1.25 to 1.5)		Surface applied from 30 days prior to seeding to immediately after seeding.	For use in no-till sunflowers only. Adjust rate according to soil type. Use lower rate only for coarse textured soil. Y1 Y6 Y7 Y22 Y26
	2.4 to 4.24 pt 1.67 to 2.9 lb DG (1 to 1.75)		Fall: PPI when soil temperature is less than 45 F.	Keep spring tillage depth shallower than fall tillage. May be tank-mixed with EPTC. A3
Trifluralin	1 to 2 pt 5 to 10 lb 10G 0.83 to 1.67 lb 60DF (0.5 to 1)		PPI.	Poor wild mustard and wild oat control. PPI within 24 hours after application. May be tank-mixed with Eptam. Refer to narrative for rotational restrictions. A1 J3 X1 Y1 Y6 Y7 Y22 Y26
	5 to 10 lb 10G (0.5 to 1)		Fall: PPI after September 1 or Spring.	
Trifluralin + Eptam (EPTC)	1 pt + 7.5 to 10 lb 20G (0.5 + 1.5 to 2)		PPI.	Enhances wild oat control and reduces potential carryover of trifluralin. A2 J3

SAFFLOWER


Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Paraquat RUP	1.75 to 2.7 pt of a 3 lb/gal conc. (0.66 to 1)	Emerged annual grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, foliar herbicide. Apply with a NIS at 0.12 to 0.25% v/v. Good plant coverage is essential. Q6
Eptam (EPTC)	3.5 pt 15 lb 20G (3)	Grass and some broadleaf weeds.	PPI.	See incorporation discussion in narrative for details. Poor wild mustard and wild oat control. A1 A2 J3
Trifluralin	1 to 2 pt 5 to 10 lb 10G 0.83 to 1.67 lb 60DF (0.5 to 1)		PPI. Fall or spring.	No wild mustard and poor wild oat control. A1 J3 X1 Y1 Y2 Y6 Y26
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 3 pt Dual/II 8 to 12 lb 25G (2 to 3) 1 to 2 pt Magnum (1 to 2)		PPI or PRE.	Poor wild mustard and wild oat control. PPI gives more consistent weed control. A1 E4
Poast (sethoxydim) Registration Pending	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Grass: 2 to 8 inches.	Apply with oil adjuvant at 1 qt/A to actively growing weeds. Allow a 70 day PHI. See narrative for rates for different weeds. D18 D31 J1 J4
Preharvest Application				
Drexel Defol (sodium chlorate)	1 gal of a 6 lb/gal conc. (6)	Desiccant	After physiological maturity and 7 to 14 days prior to harvest.	Thorough coverage of plant is essential. Apply aerially at 5 to 10 gpa or at 20 to 30 gpa by ground sprayer. Most active with warm, sunny conditions.

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1)	Grass and some broadleaf weeds.	Fall: PPI.	Use higher rates on fine textured soils. Incorporate once in the fall within 24 hours after application. Keep spring tillage depth shallower than fall. A1 K1 K7 X1 Y22 Y26
Bromoxynil	1 pt 5 A/pack (0.25)	Broadleaf weeds including wild buckwheat.	Flax: 2- to 8-inches tall.	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible. K1 K2
MCPA	0.5 pt of a 4 lb/gal conc. (0.25)	Broadleaf weeds.		Use MCPA ester hard-to-kill weeds. Early application is less injurious to flax. K1 K5
Bromoxynil + MCPA	0.9 pt (0.23 + 0.23)			Apply to small weeds prior to crop canopy and shading. Risk of crop injury. K1 K2 K3
Curtail M (clopyralid) Section 18 Registration Pending	1.33 to 1.75 pt (2 to 3 oz)	Broadleaf weeds including Canada thistle and perennial 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. K3 T2 Y23 Y26
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Flax: Prior to bloom. Grass weeds: 2 to 8 inches tall.	Apply with 1 qt/A oil adjuvant to actively growing grasses. See narrative for rates to control different weed species. May be tank-mixed with bromoxynil or MCPA ester for broad spectrum weed control. K1 K6

Preharvest Application

Glyphosate Section 18 Registration Pending	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.75)	Emerged grass and broadleaf weeds including Canada thistle and perennial sowthistle.	Preharvest. Flax: Physiologically mature. Seed contains 30% or less moisture.	Greater perennial weed control will result if 10 to 14 days is allowed between application and harvest. Allow a 7 day PHI. Refer to narrative for adjuvant use. A4 Q1 Q4
Drexel Defol (sodium chlorate)	1 gal of a 6 lb/gal conc. (6)	Desiccant	7 to 10 days prior to harvest. 70 to 80% of the bolls should be brown.	Thorough spray coverage of vegetation is essential. Do not graze or feed treated straw. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.

CANOLA, RAPESEED, CRAMBE, AND TAME MUSTARD

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Trifluralin	1 to 2 pt 5 to 10 lb 10G (0.5 to 1)	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. L1 L8 X1 Y1 Y6 Y22 Y26
Sonalan (ethalfluralin) Crambe Only	1.5 to 3 pt 5.5 to 11.5 lb 10G (0.55 to 1.15)	Grass and some broadleaf weeds. May control or suppress ALS resistant kochia.	PPI. Spring or Fall from October 1 to December 31	Adjust rate for soil type. Poor wild mustard and wild oat control. May result in reduced crop stand or early injury. May provide greater broadleaf weed control than trifluralin. L6 Y22 Y26
Stinger (clopyralid) Crambe Only 	0.33 pt (2 oz)	Broadleaf weeds including Canada thistle and perennial sowthistle.	POST. Annual weeds: Small. Thistle: 4- to 6-inches tall.	Apply after most thistle shoots have emerged. Do not graze or harvest treated crambe for livestock forage. Allow a 72 day PHI. Follow rotational crop interval and other precautions on product label. L7 T2 Y23 Y26
Assure II (quizalofop) Canola and Crambe Only	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Canola: 30 days or more prior to harvest Grass weeds: 2- to 6-inches tall.	Apply with oil adjuvant at 1% v/v to actively growing grasses. See label for rates for different weeds. Lack of yellow foxtail control may result if Assure II is applied at reduced rates. Avoid drift to small grain and desirable grass species. L1 L2
Poast (sethoxydim) Canola, Rapeseed and Crambe Only	0.5 to 1.5 pt (0.1 to 0.3)		POST. Crop: All stages. Grass: 2 to 4 inches. Volunteer corn: 6- to 18-inches tall.	Apply with oil adjuvant at 1qt/A to actively growing grasses. Labeled crops are tolerant at all growth stages. Allow a 60 day PHI. See narrative for rates for different weeds. Avoid drift to small grains. D30 L1 L4
Select/Prism (clethodim) Canola Registration Pending	4 to 5 fl oz/ 8.5 to 11 fl oz (1 to 1.28 oz)		POST. Canola: Prior to bolting. Grass: 1- to 5-inches tall.	Apply with oil adjuvant at 1qt/A to actively growing weeds. Do not apply more than 5 fl oz/A/season. See narrative for rates for different weeds. Allow a 60 day PHI. D25 D31 L5 X1

Possible Section 18 Registrations for Canola or Crambe in 2000 - Must have label prior to use!

Sonalan (ethalfluralin) Section 18 Registration Pending on Canola	1.5 to 3 pt 5.5 to 11.5 lb 10G (0.55 to 1.15)	Grass and some broadleaf weeds. May control or suppress ALS resistant kochia.	PPI. Spring. Fall: October 1 to December 31	Adjust rate for soil type. Poor wild mustard and wild oat control. May result in reduced crop stand or early injury. May provide greater broadleaf weed control than trifluralin. L6 Y22 Y26
Muster (ethametsulfuron) Section 18 Registration Pending 	0.3 oz (0.225 oz)	Broadleaf weeds including smartweed, wild mustard.	POST. Canola: 2- leaf to beginning of bolting. Weeds: Up to 6-leaf stage.	Section 18 labeling is for seed canola only. Apply with NIS at 0.25% v/v. May be tank-mixed with Assure II with NIS at 0.25% v/v. Temporary yellowing may occur if canola is stressed at application. Do not feed livestock of graze forage. Allow a 60 day PHI. L3 Y3 Y26
Stinger (clopyralid) Section 18 Registration Pending on Canola 	0.33 to 0.5 pt (2 to 3 oz)	Broadleaf weeds including Canada thistle and perennial sowthistle.	POST. Canada thistle: 4- to 6-inches tall.	Apply after most thistle shoots have emerged. Do not graze or harvest treated canola for livestock forage. Allow a 72 day PHI. Follow rotational crop interval and other precautions on product label. L7 T2 Y23 Y26

HERBICIDE RESISTANT CANOLA

CLEARFIELD (Imidazolinone Resistant) CANOLA

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Raptor (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. Refer to label for weeds controlled, application information, and crop rotation restrictions. Will not control ALS resistant kochia. Should use herbicides of a different mode of action and use complimentary weed control strategies. Allow a 60 day PHI. L10 X1 Y2 Y26
2001 Section 18 Registration Approved				


LIBERTY (Glufosinate) RESISTANT CANOLA

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Liberty (glufosinate)	34 fl oz (0.44)	Annual broadleaf weeds and control or suppression of grasses.	POST. Canola: Cotyledon up to early bolting stage. Grass weeds: Up to 2- to 3-inches and 1-tiller. Broadleaf weeds: Up to 3 inches tall.	Apply only to Glufosinate resistant canola varieties. Apply with AMS fertilizer at 3 lb/A. Refer to label for weeds controlled, application information, and other restrictions. Liberty is a non-residual, contact herbicide. Will control weeds resistant to other herbicides. L10 X1

ROUNDUP (Glyphosate) RESISTANT CANOLA

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	1 to 1.5 pt of a 3 lb ae/gal conc. or 0.8 to 1.2 pt of a 3.7 lb ae/gal conc. or 0.75 to 1.12 pt of a 4 lb ae/gal conc. or 9.4 to 13.8 oz of a 65% SG (0.375 to 0.56) The higher rate of each formulation is pending registration.	Annual and perennial grass and broadleaf weeds.	POST. Canola: Emergence to bolting (5- to 6-leaf). Apply once or twice as needed.	Apply only to Glyphosate resistant canola varieties. Add AMS at 8.5 to 17 lb/100 gal water. Do not apply more than 1 pt/A for each single in-crop application. Do not exceed 2 pt/A for the total multiple in-crop applications from emergence up to 5 to 6-leaf or bolting. May require multiple applications for weed flushes. Avoid drift. Refer to label for application information, adjuvant use, tank-mix options with residual herbicides, and restrictions. Glyphosate is a non-residual, systemic, foliar herbicide. Will control weeds resistant to other herbicides. A4 L11 Q4 X1


SUGARBEET



Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
	0.38 to 1.5 pt of a 4 lb ae/gal (0.19 to 0.75)			
Paraquat RUP	1.25 to 2.7 pt of a 3 lb/gal conc. (0.47 to 1)	Emerged annual grasses and broadleaf weeds.		A contact, non-selective, foliar herbicide. No soil residual activity. Apply with NIS. Good plant coverage is essential. A4 Q6
Far-Go (triallate) Far-Go EC = 	1.5 qt 15 lb 10G (1.5)	Wild oat.	Spring PPI. Fall incorporated after October 15 until freeze-up or snow cover.	Incorporate immediately after application with a tillage tool set 3 to 4 inches deep. A second incorporation at an angle to the first will improve wild oat control. One pass in the fall followed by spring seed-bed preparation is sufficient for fall application. A1 M8
Eptam (EPTC)	2.3 to 3.4 pt (2 to 3)	Annual grasses and some broadleaf weeds.	PPI.	Some stand reduction and temporary stunting may occur from Eptam. Weak on wild mustard. A1 A2 A3 M1 M2 M6 M7 M16
	4 to 5 pt 17 to 22 lb 20G (3.5 to 4.38)		Fall incorporated after October 15 until freeze-up.	
Eptam (EPTC) + Ro-Neet (cycloate)	1.1 to 2.3 pt + 2.7 to 3.3 pt (1 to 2 + 2 to 2.5)		PPI.	Less sugarbeet injury than from Eptam alone and less expensive than Ro-Neet alone. See narrative for suggested rates for various soil textures and organic matter. A1 A2 A3 M1 M2 M6 M7
	1.1 to 2.9 pt + 2.7 to 4 pt (1 to 2.5 + 2 to 3)		Fall incorporated after October 15 until freeze-up.	
Ro-Neet (cycloate)	4 to 5.3 pt (3 to 4)		PPI.	Sugarbeet has better tolerance to Ro-Neet than to Eptam. Weak on wild mustard. Weed control poor on fine textured, high organic matter soils. A1 A3 M1 M2 M6
	5.3 pt (4)		Fall incorporated after October 15 until freeze-up.	
Nortron SC (ethofumesate)	6 to 7.5 pt (3 to 3.75)	Especially good on redroot pigweed.	PPI or PRE.	Incorporation generally improves weed control. Band application reduces cost and risk of carryover into the next year. A1 M1 M2 M9 M10 Y3 Y26
Pyramin SC (pyrazon)	6 to 14.5 pt (3.1 to 7.6)	Broadleaf weeds.	PPI or PRE.	Has been less effective on soils with more than 5% organic matter. Incorporation improves weed control from Pyramin. A2 M1 M2
Stinger (clopyralid)	0.25 to 0.66 pt (0.09 to 0.25)	Cocklebur, sunflower, marshelder, wild buckwheat and Canada thistle.	POST. Sugarbeet:: 2 to 8 leaves.	See narrative for rates and treatment sizes for various species. Stinger may be tank-mixed with Betanex or Betamix. See narrative for rotation restrictions. M1 M2 M15 M17 Y21 Y26
UpBeet (triflusalufuron)	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, Progress, or Stinger. Research in ND/MN has shown that three treatments including 0.25 to 0.3 oz/A of UpBeet generally gave better weed control than two treatments including 0.5 oz/A of UpBeet. Do not exceed 2.5 oz/A/season. M1 M2 M15 M17

SUGARBEET

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Betamix (desmedipham + phenmedipham)	0.75 to 7.5 pt (0.06 to 0.6 + 0.06 to 0.6)	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. See paragraph for rate adjustment information. M1 M2 M4 M17
Betanex (desmedipham)	0.75 to 7.5 pt (0.12 to 1.2)		Broadleaf weeds: Cotyledon up to 4-leaf stage.	
Progress (desmedipham + phenmedipham + ethofumesate)	0.56 to 3.3 pt (0.04 to 0.25 + 0.04 to 0.25 + 0.04 to 0.25)		POST Sugarbeet: Cotyledon up to 8-leaf stage.	
Betanex/ Betamix/ Progress + UpBeet + Stinger + MSO type oil adjuvant (desm/desm&phen/ desm&phenðo + triflusulfuron + clopyralid)	0.5 / 0.5 / 0.4 pt + 0.125 oz + 1.3 fl oz + 1.5% v/v (0.08 + 0.004 + 0.03) Micro-rate Program	Annual broadleaf weeds. Fair to good annual grass control. Will not control lanceleaf sage or ALS resistant kochia.	POST. Sugarbeet: Apply a minimum of three times starting at cotyledon to early 2-leaf stage. Apply subsequent treatments at 5 to 7 days intervals.	Timely application is critical to success of the Micro-rate Program. A grass control herbicide at 1/3 normal rate can be added. Herbicide precipitation in the spray tank and nozzle plugging has been a problem. Nozzle plugging can be reduced by mixing in warm water, raising water pH to 8 or 9, premixing UpBeet, use of a grass herbicide and frequent cleaning of sprayer. M1 M2 M4 M12 M14 M15 M17
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz) 10 fl oz (1.1 oz)	Annual grasses. Quackgrass.	Foxtail: Assure II: 2 to 4 inches tall. Select: 2 to 8 inches tall. Wild oat: 2 to 6 inches tall. Vol. wheat or barley: 2 to 6 inches tall. Quackgrass: 6 to 10 inches tall.	Apply to actively growing grasses. Apply Assure II with oil adjuvant at 1% v/v and treat quackgrass regrowth 4 to 8 inches tall with 6 to 7 fl oz/A. Apply Select/Prism with oil adjuvant at 1qt/A and treat quackgrass regrowth 4 to 12 inches tall with 8 to 16 fl oz/A. D31 M1 M2 M3 M13 M17
Select Prism (clethodim)	6 to 8 fl oz 12.8 to 17 fl oz (1.5 to 2 oz) 8 to 16 fl oz 17 to 34 fl oz (2 to 4 oz)	Annual grasses. Quackgrass	Wild oat: 1 to 4 inches tall. Foxtail: 3 to 8 inches tall. Vol. wheat or barley: 1 to 6 inches tall. Wild-proso millet: 4 to 10 inches tall.	Apply with an oil adjuvant at 1 qt/A to actively growing grasses. Apply with AMS or UAN fertilizer for greater control of certain grass species. See narrative for rates for different grass species. D18 D31 M1 M2 M11
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	Wild oat: 1 to 4 inches tall. Foxtail: 3 to 8 inches tall. Vol. wheat or barley: 1 to 6 inches tall. Wild-proso millet: 4 to 10 inches tall.	Apply with an oil adjuvant at 1 qt/A to actively growing grasses. Apply with AMS or UAN fertilizer for greater control of certain grass species. See narrative for rates for different grass species. D18 D31 M1 M2 M11
Trifluralin	1.5 pt (0.75)	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 M2 M16 M17 X1 Y22 Y26

POTATO

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Paraquat RUP	1.3 pt (0.49)	Emerged annual grass and broadleaf weeds.		A contact, non-selective, foliar herbicide. No soil residual activity. Apply with NIS. A4 Q6
Eptam (EPTC)	3.5 to 7 pt 15 to 30 lb 20G (3 to 6)	Grass and some broadleaf weeds.	PPI, Dragoff, or Directed spray at layby.	Incorporate immediately after application with tool set at 4 to 6 inches deep. Weak on wild mustard. See label for rates depending on use. Do not apply within 45 days of harvest. May be tank-mixed with metribuzin at 0.33 to 0.67 lb/A. A1 A2 A3 N1 N3
	5.25 to 7 pt 22.5 to 30 lb 20G (4.5 to 6)		Fall: Incorporate after October 15 until freeze-up.	
Trifluralin	1 to 2 pt 0.8 to 1.7 lb 60DF (0.5 to 1)		PoPI.	Adjust rates according to soil type. Poor wild mustard and wild oat control. Incorporate above the seed piece after planting or immediately following drag-off or hilling but before potato and weed emergence. Can be tank-mixed with Eptam or Sencor.
Prowl Pendimax (pendimethalin)	1.2 to 3.6 pt 1.67 to 2.5 lb DG (1 to 1.5)		PPI, PRE or EPOST. Potato: Before 6 inches tall.	May be applied PRE. Incorporation improves consistency of weed control.
Dual, Dual II, Dual Magnum, Dual II Magnum (metolachlor)	2 to 3 pt Dual/II 8 to 12 lb 25G (2 to 3) 1 to 2 pt (1 to 2)		PPI or PRE.	Commercial mixture with metribuzin = Turbo A1 N1 N2 N7 X1 Y1 Y6 Y22 Y26
Linuron 	1.5 to 4 lb DF 1.5 to 4 pt L (0.75 to 2)	Annual grass and broadleaf weeds.	PRE to potato: Grasses: Up to 2 inches tall. Broadleaf weeds: Up to 6 inches tall.	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 N4
Sencor (metribuzin)	0.67 to 1.33 lb DF (0.5 to 1)	Annual broadleaf weeds and grass suppression.	PRE to potato.	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 N9 Y1 Y6 Y17 Y26
	0.33 to 0.67 lb DF (0.25 to 0.5)		POST. Weeds: Up to 1 inch tall.	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, Chip Bell, 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 N9 Y17 Y26

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Matrix (rimsulfuron) 	1.5 oz DF (0.375 oz) 1 to 1.5 oz DF (0.25 to 0.375 oz)	Annual grass and broadleaf weeds and suppression of quackgrass.	PRE to potato and weeds. After hilling or drag-off but before potato emerge.	Requires 1 inch water after application. May be tank-mixed with Dual, Eptam, Prowl, and Sencor. Can be applied in two sequential treatments of 1 oz/A PRE followed by 1 oz/A POST. N1 N5 X1
		Poor common lambsquarters control.	POST. Potato: Up to 14 inches tall. Annual weeds: Less than 1 inch tall.	Apply to quackgrass 4 to 6 inches tall. Apply with NIS at 0.25% v/v. Refer to label for application information and restrictions. N1 N5 X1 Y26
Matrix + Sencor (rimsulfuron + metribuzin) 	1 to 1.5 oz DF + 0.25 to 0.33 lb DF (0.25 to 0.375 oz + 0.188 to 0.25)	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 according to metribuzin label. Injury may occur to russet type or white skin potato varieties - use only the low rate of metribuzin and consider benefits of weed control vs risk of potato injury prior to application to "at risk" varieties. Allow a 60 day PHI. Use the low rate of Sencor for PRE applications to coarse textured soil. Soil residual may injure susceptible crops the following year. N1 N5 N9 Y1 Y2 Y17 Y26
			POST. Potato: Up to 14 inches tall. Annual weeds: Less than 1 inch tall.	
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Weeds: 2 to 4 inches.	Apply with oil adjuvant at 1 qt/A to actively growing grasses. See narrative for rates to control different weeds. May be tank-mixed with Sencor. D18 D31 N1 N6
Select/Prism (clethodim) Registration Pending	6 to 16 fl oz/ 12.8 to 34 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	POST. Grass: 2 to 8 inches tall.	Apply with oil adjuvant at 1qt/A to actively growing weeds. See narrative for rates for different weeds. 30 day PHI. D26 D31 N8 X1

POTATO VINE DESICCATION

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Desiccate II (endothall)	2 to 4 pt (0.5 to 1)	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 (diquat)	1 to 2 pt (0.25 to 0.5)		Allow A 7 day PHI.	Diquat at 2 pt/A can be applied to all potatoes varieties. Apply with a NIS. Sequential application may be made up to a total of 3 pt/A. Allow no less than 5 days between applications. Paraquat use is for fresh market potatoes ONLY. Do not use paraquat on potatoes that will be stored or used a seed pieces.
Gramoxone Extra (paraquat) RUP	13 to 24 fl oz of 2.5 lb/gal conc. (0.3 to 0.56)		Allow A 3 day PHI.	
Rely (glufosinate)	48 fl oz (0.375)		Allow A 9 day PHI.	Do not apply to potato grow for seed pieces. Best results when applied a the beginning of natural potato vive senescence. Requires thorough coverage. Apply in 20 to 100 gpa by ground and 5 to 10 by aerial application. Use higher spray volumes to dense potato vines. Allow a 9 day PHI.
Sulfuric acid RUP	20 gal		Allow A 5 day PHI.	Extremely corrosive. Do not harvest for 5 days after application.

LEGUME FORAGES

Alfalfa or Trefoil Establishment, No Companion Crop

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraph
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
Paraquat RUP	1.5 to 2.7 pt of a 3 lb/gal conc. (0.56 to 1)	Emerged annual weeds.		A contact, non-selective, foliar herbicide. No soil residual activity. Apply with NIS. A4 Q6
Eptam (EPTC)	2 to 4.5 pt 10 to 20 lb 20G (1.75 to 4)	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 HFP (trifluralin)	1 to 1.5 pt (0.5 to 0.75)			PPI prior to direct-seeding alfalfa. Adjust rate for soil type. Use 1 pt/A in areas receiving less than 20 inches of rain. Some alfalfa stand reduction and stunting may occur but reduced weed competition will allow alfalfa establishment. P6
Butyrac 200/ others (2,4-DB ester 2,4-DB amine)	2 to 4 pt of a 2 lb/gal conc. (0.5 to 1)	Broadleaf weeds.	Alfalfa: More than 2 trifoliolate leaves. Weeds: Less than 3 inches tall.	Sweet clover may be killed by 2,4-DB. Poor wild mustard control. Allow a 60 day PHI or grazing interval. Maximum rate of 2,4-DB amine is 6 pt/A.
Bromoxynil For Alfalfa Only	1 to 1.5 pt 3.33 to 5 A/pack (0.25 to 0.38)		Refer to "Legume Forages - with companion crop".	Sweet clover may be killed by bromoxynil. Refer to "Legume Forages - with companion crop" for comments. P2
Pursuit Pursuit DG (imazethapyr) For Alfalfa Only	3 to 4 fl oz 1.08 to 1.44 oz WDG or 10 to 6.67 A/pack (0.75 to 1 oz)	Annual broadleaf and grass weeds.	POST. Alfalfa: At least 2 trifoliate. Weeds: 1- to 3-inches tall.	Excellent alfalfa safety. Can be applied to seedling or established alfalfa in the fall or spring to dormant or semi-dormant alfalfa or between cuttings. Apply with oil additive at 1.5 to 2 pt/A alone or with UAN at 1 to 2 qt/A. Can be tank-mixed with 2,4-DB/Butyrac 200/others, bromoxynil, or Poast. P3 Y2 Y26
Poast (sethoxydim) For Alfalfa or Sainfoin	0.5 to 1.5 pt (0.19 to 0.28)	Annual grasses.	POST. Grass: 2- to 4-inches tall.	Apply with oil adjuvant at 1 qt/A to actively growing grasses. See narrative for rates to control different weed species. D31 P4
Select Prism (clethodim)	6 to 16 fl oz 13 to 34 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	POST. Grass: 2- to 8-inches tall.	Apply with oil adjuvant at 1qt/A to actively growing weeds. See narrative for rates for different weeds. Allow a 15 day PHI. D25 D31 X1

Alfalfa with Small Grains as a Companion Crop

Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	See glyphosate above for rates from other formulations Non-selective, non-residual, systemic, foliar herbicide. No soil residual activity. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
MCPA amine For Alfalfa Only	0.25 to 0.5 pt of a 4 lb/gal conc. (0.12 to 0.25)	Broadleaf weeds.	Legumes: 2- to 3-inches tall. Companion crop: 8-leaf to early boot.	Possible injury to alfalfa. Use only when weed problem is severe and legume is protected by canopy. P1 X1
Bromoxynil For Alfalfa Only	1 to 1.5 pt (0.25 to 0.38)		Alfalfa: At least 4 trifoliolate leaves. Weeds: Small	Alfalfa injury can occur, especially if warm weather follows treatment. Refer to narrative for information for additional restrictions. P2

LEGUME FORAGES

Established Alfalfa

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraph
Paraquat RUP	1.5 to 2 pt of a 3 lb/gal conc. (0.56 to 0.75)	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 Q6
	0.75 pt of a 3 lb/gal conc. (0.28)	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 Q6
Velpar (hexazinone)	0.67 to 1.33 lb DF (0.5 to 1)	Annual grass and broadleaf weeds and suppression of some perennial weeds.	Early spring: Alfalfa: Dormant.	Do not apply to snow-covered or frozen ground. Apply to dormant alfalfa before new growth begins in spring. Weed control improves if 0.5 to 1 inch of rainfall occurs within 2 weeks after application, when soil is moist at application, and when weeds have not germinated or are less than 2 inches tall at application. Apply with NIS at 0.25% v/v if weeds have emerged. Apply to alfalfa stands established more than 1 year. P7
Sencor (metribuzin)	0.5 to 1.25 lb DF (0.37 to 1)	Annual grass and broadleaf weeds.		May be applied on frozen soil. Apply only to alfalfa stands established more than 1 year. P5
Trifluralin	1.5 to 2 pt (0.75 to 1)	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)			
Sinbar (terbacil)	0.5 to 1.5 lb W (0.4 to 1.2)	Annual grass and broadleaf weeds.	Fall or spring. Alfalfa: Dormant.	Do not apply to frozen or snow covered soil. Do not rotate to any other crop within 2 years after application. Apply to alfalfa stands established more than 1 year.
Kerb (pronamide) RUP	1 to 4 lb W (0.5 to 2.0)	Foxtail barley, quackgrass, wild oat, volunteer grains, mustards.	Fall. After last cutting and before soil freeze-up.	Apply when soil temperatures are less than 55 F. Do not graze or harvest alfalfa within 25 days after application if apply less than 3 lb 50W/A or 45 days if apply between 3 to 4 lb 50W/A.
Butyrac 200/others 2,4-DB ester 2,4-DB amine	2 to 4 pt (0.5 to 1.0)	Broadleaf weeds.	Weeds: Less than 3 inches tall.	Sweet clover may be killed by 2,4-DB. Poor wild mustard control. Allow a 30 day hay, harvest or grazing interval.
Pursuit Pursuit DG (imazethapyr)	3 to 4 fl oz 1.08 to 1.44 oz WDG (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. Can be applied in the fall or spring to dormant or semi-dormant alfalfa or between cuttings. Apply with NIS at 0.25% v/v or oil additive at 1.5 to 2 pt/A. 28% UAN can be added to NIS or oil additive at 1 to 2 qt/A. Can be tank-mixed with 2,4-DB, Buctril, or Poast. P3
Poast (sethoxydim)	0.5 to 1.5 pt (0.2 to 0.3)	Annual grasses.	Grass. 2 to 4 inches tall.	Requires an oil adjuvant at 1 qt/A to actively growing grasses. D18 D31 P4
Select/ Prism (clethodim)	8 fl oz/17 fl oz or 8 fb 8 fl oz/ 17 fb 17 fl oz (2/4.25 oz)	Annual grasses and quackgrass.	POST. Grass: 4 to 8 inches tall.	Apply with oil adjuvant at 1qt/A to actively growing weeds. Best quackgrass control when two sequential applications are made, each at 8 fl oz/A. Allow a 30 day PHI. D25 D31 X1
Glyphosate	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.19 to 0.75)	Alfalfa and emerged grass and broadleaf weeds.	Apply in spring or fall for quackgrass control.	Apply where crop destruction is acceptable. Treated crop and weeds can be harvested and fed 36 hours after treatment. Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4

CHEMICAL FALLOW

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


Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Trifluralin	6 to 10 lb 10G (0.6 to 1)	Grass and some broadleaf weeds.	PPI in fallow.	Incorporate within 24 hours after application. Delayed second incorporation until weed control is necessary. Q7 X1 Y1 Y6 Y22 Y26
Atrazine Future Planting of Wheat and Durum Only RUP	0.55 to 1.11 lb DF (0.5 to 1)	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. See 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. C7 Q3 V1 Y9 Y26
Paraquat RUP	1 to 2.7 pt of a 3 lb/gal conc. (0.375 to 1)	Emerged annual grass and broadleaf weeds.	Weeds: Less than 6 inches tall.	Contact, non-selective, non-residual, foliar herbicide. Apply with a NIS. Effective as a post-harvest in-crop treatment. Q6
Aim + (carfentrazone) + 2,4-D amine or MCPA amine	1/3 to 0.67 oz DF+ 0.5 to 0.75 pt of a 4 lb/gal conc. (0.128 to 0.24 oz + 0.25 to 0.38)	Broadleaf weeds including pigweed. Partial control of kochia and buckwheat.	Weeds: Up to 4 inches tall.	Aim is a contact, non-residual, foliar herbicide. May cause cosmetic speckling/spotting on wheat. Apply with NIS at 0.25% v/v. B4 S6 S7 X1
Harmony GT (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	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 in areas where weed resistance may occur. Refer to narrative for tank-mix herbicides and restrictions on preceding and follow-crop herbicides and rotation crops. Q2 X1 Y3 Y26
Harmony Extra (thif+tribenuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)			
Express (tribenuron)	1/6 to 1/3 oz DF (0.125 to 0.25 oz)			
Ally (metsulfuron)	1/10 oz DF (0.06 oz)			
Canvas (metsulfuron + thif + tribenuron)	2/10 oz DF (0.075 oz met + 0.225 oz thif+trib)			
Finesse (chlor+metsulfuron)	2/20 to 3/10 oz DF (0.15 to 0.225 oz)			
2,4-D	1.5 to 4 pt of a 4 lb/gal conc. (0.75 to 2)	Broadleaf weeds and suppression of Canada thistle.	POST.	Use the higher rate for perennial weeds. B2 Soil residual from fall application may damage broadleaf crops seeded the next year. B8 R1 X1 Y15 Y26 Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. Provides improved annual and perennial weed control than dicamba. See label for tank-mix options. Distinct at 6 oz 70WDG/A = 6 fl oz Clarity. C19 Y15 Y18 Y26
Dicamba	0.5 to 1 pt (0.25 to 0.5)			
Weedmaster (dicamba + 2,4-D)	0.5 to 4 pt (0.25 to 2)			
Distinct (dicamba + diflufenzopyr)	6 oz WDG (3 oz + 1.2 oz)			
Glyphosate	0.5 to 4 pt of a 3 lb ae/gal conc. or 0.4 to 3.2 pt of a 3.7 lb ae/gal conc or 0.38 to 3 pt of a 4 lb ae/gal conc. or 4.7 to 37 oz of a 65% SG (0.19 to 1.5)	Annual and perennial grass and broadleaf weeds.	Weeds: Less than 6 inches tall.	Non-selective, non-residual, systemic, foliar herbicide. See narrative for rates and adjuvants. Apply with AMS fertilizer. Use the lower rate for annual grasses. Glyphosate will not control glyphosate resistant volunteer crops. A4 Q1 Q4 X1

CHEMICAL FALLOW


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

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Landmaster BW (glyphosate + 2,4-D)	27 to 54 fl oz (0.19 to 0.38 + 0.32 to 0.63)	Emerged grass and broadleaf weeds.	Weeds: Less than 6 inches tall.	Landmaster BW provides no residual weed control. Fallow Master provides greater control of kochia and wild buckwheat than Landmaster BW.
Fallow Master (glyphosate + dicamba)	22 to 44 fl oz (0.19 to 0.38 + 0.08 to 0.17)			Delay planting of wheat, barley, oat, or sorghum for 15 days and all other crops for 3 months after applying Fallow Master. A4 Q1 Q4 X1 Y15 Y26
Curtail (clopyralid + 2,4-D)	4 pt (0.19 + 1)	Broadleaf weeds including Canada thistle.	Canada thistle: Prior to bud stage.	Apply after a majority of rosettes have emerged. See narrative for rotational restrictions. B12 T2 T6 X1 Y23 Y26
Tordon 22K (picloram) RUP	0.25 to 0.5 pt (0.063 to 0.125)	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 fallow the following year. Q7 T1 T2 T3 T15 X1 Y24 Y26
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)	Perennial weeds.	Canada thistle: Prior to bloom. Field bindweed: Actively growing.	
Paramount (quinclorac) Future Planting of Wheat and Durum Only	0.33 lb DF (0.25)	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 ga/A may also be added to improve control but do not substitute for MSO. 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. May control foxtails, barnyardgrass, and volunteer flax. Q5 T1 Y18 Y26
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. B29 S5 X1

PASTURE, RANGELAND AND CRP

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Ally (metsulfuron) 	1/10 to 2/10 oz DF (0.06 to 0.12 oz)	Broadleaf weeds including pigweed and horseweed.	Late spring or early summer.	Apply with phenoxy type herbicide in late spring or early summer to small annual weeds or in spring or early summer before thistle plants bolt. Apply with NIS at 0.25 to 0.5 % v/v. Control or suppression of buckbrush. Suppression of Canada thistle. Add 2,4-D for Russian thistle control. Escort is for control of noxious and troublesome weeds in rangeland, pasture and non-cropland areas. Escort has no grazing restrictions. T2 T11 X1 Y3 Y26
	2/10 to 3/10 oz DF (0.12 to 0.18 oz)	Musk thistle, Canada thistle, snow-berry or buckbrush.		
Escort (metsulfuron) NOT FOR CRP	0.5 to 4 oz DF (0.3 to 2.4 oz)	Annual broadleaf weeds including musk and Russian thistle.	Weeds: Up to bloom or apply to fall rosettes.	Suppression of Canada thistle, curly dock, musk thistle. May tank-mix with Tordon. No grazing restrictions. Do not cut hay for 30 days following application. Apply with NIS at 0.25 to 0.5% v/v. Y3
Amber (triasulfuron)	0.28 to 0.56 oz DF (0.21 to 0.42 oz)		Weeds: 2 to 6 inches tall.	
Rave (triasulfuron + dicamba)	2 to 5 oz DF (0.176 to 0.44 + 1.1 to 2.75)	Annual broadleaf weeds and suppression of Canada thistle.	60 days after grass emergence or sprigging of new grass stands.	Apply with NIS at 0.125 to 0.25% v/v unless restricted by tank-mix herbicide. See label for list of approved grass species. Can be tank-mixed with many broadleaf herbicides including 2,4-D, Crossbow, Weedmaster, Grazon P+D, Stinger, or Tordon. T13 Y3 Y26
Paramount (quinclorac)	0.5 lb DF (0.375)	Field bindweed, leafy spurge, annual sowthistle, and foxtail.	Fall: Perennial broadleaf weeds control. Spring: Annual grass control.	DO NOT use on pasture and rangeland areas to be grazed or cut for hay. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of perennial broadleaf weeds. Q5 S3 T1
Plateau (imazapic)	4 fl oz for establishing or established CRP (1 oz)	Annual broadleaf weeds and suppression of leafy spurge.	Early September to early October.	Section 18 pending to allow grazing and haying otherwise DO NOT use on pasture and rangeland areas to grazed or cut for hay. Safe on alfalfa and sweet clover. 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. 8 fl oz/A controls annual and controls/suppresses leafy spurge and Russian knapweed. 10 to 12 fl oz/A controls annual and perennial weeds. 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. Does not control absinth wormwood, Canada thistle, or spotted knapweed. T2 T12 Y26
	4 to 12 fl oz for pasture, rangeland native prairie restoration and wildflower establishment. (1 to 3 oz)	Annual and perennial grass and broadleaf weeds including foxtail and leafy spurge.	PRE or POST. Grasses: 7 to 10 days after planting. Weeds: Up to 6 inches tall.	

PASTURE, RANGELAND AND CRP

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
MCPA	0.5 to 4 pt of a 4 lb/gal conc. (0.25 to 2)	Annual weeds and suppression of perennial broadleaf weeds.	Weeds: Emergence to bud stage.	Do not graze dairy animals for 7 days after treatment. Do not apply after boot stage on grasses for seed production. High rates are for perennial weed control. X1
2,4-D	1.5 to 4 pt of a 4 lb/gal conc. (0.75 to 2)		Pasture grasses: After 5-leaf stage.	<u>Do not graze animals for 7 days after application or within 3 days of slaughter.</u> 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. Controls buckbrush/western snowberry. Commercial premix with Tordon available = Grazon P+D. T2 T3 T8 X1
Dicamba	0.5 to 4 pt (0.25 to 2)		Grasses: After 3-leaf stage of seedling grasses. Weeds: Prior to bud stage for thistles and knapweeds.	Apply with a surfactant. Spray drift from dicamba may injure nearby susceptible crops and trees. Rates greater than 1 pt/A may injure newly seeded grasses. Consult the label for grazing restrictions and tank mixtures with other herbicides. T2 T3 T10 X1
Curtail (clopyralid + 2,4-D)	4 to 8 pt (0.19 to 0.36 + 1 to 2)	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 to new seedings of grass. 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
Tordon (picloram)	0.25 to 0.5 pt (0.06 to 0.13)	Annual broadleaf weeds.	Weeds: Emergence to bud stage.	Use 0.25 to 0.5 pt/A for small annual weeds. Use 2 pt/A for suppression and 4 to 8 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. Commercial premix with 2,4-D is available = Grazon P+D. T2 T3 T15
	RUP 1 to 8 pt (0.25 to 2)	Perennial broadleaf weeds.		
Crossbow (triclopyr + 2,4-D) NOT FOR CRP	 1 to 6 qt (0.5 to 3.0 + 0.25 to 1.5)	Brush and broadleaf weeds.		Provides more consistent musk thistle and brush control (except buckbrush and western snowberry) than 2,4-D alone. Observe grazing and haying restrictions. T9
Redeem (triclopyr + clopyralid)	1.5 to 4 pt (0.4 to 1.1 + 0.15 to 0.4)	Annual and perennial weeds and brush.	Spring: Prior to bud stage for thistles and knapweed. Fall: To rosettes.	Apply with NIS at 0.25% v/v. Very 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
Landmaster BW (glyphosate + 2,4-D) NOT FOR CRP	54 fl oz or 3.38 pt (0.38 + 0.63)	Annual broadleaf weeds and some perennial weeds including leafy spurge.	Pasture grasses: Seed set stage. Fall: Plants are actively growing.	Some grass injury and stunting may occur. Injury is greater with fall than spring applications. Not to be used in consecutive years. T2 T3
Paraquat	1 to 2.7 pt (0.375 to 1)	Annual broadleaf weeds and suppression of existing sod.	Weeds: Small.	Apply prior to emergence of new seeding. Apply to grazed or mowed pastures no more than 3 inches tall. Q6

GRASS ESTABLISHMENT

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 to 0.75)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	Non-selective, non-residual systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q4
2,4-D MCPA	0.5 to 1 pt of a 4 lb/gal conc. (0.25 to 0.5)	Broadleaf weeds.	Grasses: After 5-leaf stage.	Use rates listed for establishing grasses. Refer to "Pasture, Rangeland and CRP" section for restrictions and use information. T8 X1
Bromoxynil	1.0 to 2 pt (0.25 to 0.5)		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 (0.25 to 0.5 + 0.25 to 0.5)		POST: Grasses: Up to 3- leaf stage or larger.	Use a minimum of 10 gpa by ground and 5 gpa by aircraft. Refer to bromoxynil section above for registered grass species. Consult label for list.

VEGETATION CONTROL FOR CRP BREAKOUT

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	2 to 4 pt of a 3 lb ae/gal conc. or 1.6 to 3.2 pt of a 3.7 lb ae/gal conc or 0.75 to 3 pt of a 4 lb ae/gal conc. or 18.5 to 37 oz of a 65% SG (0.75 to 1.5)	CRP vegetation and weeds.	14 to 21 days prior to tillage.	Wheat grasses may be adequately controlled by applying glyphosate in the spring. However, smooth brome grass require at least fall and 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. Fall applications provide greater Canada thistle control than spring applications. Addition of 2,4-D or use of Landmaster BW will increase alfalfa and sweet clover control but decrease grass control. A4 Q4 R1
Landmaster BW (glyphosate + 2,4-D)	54 fl oz (0.375 + 0.63)			Always use AMS to overcome antagonism of 2,4-D on grass control. Landmaster BW will control perennial weeds, such as leafy spurge and Canada thistle. Landmaster BW is better than glyphosate applied alone but grass species are more tolerant. CRP grasses and forbs may become a problem in the planted crop. A1 A4 Q4 R1

SPECIAL WEED PROBLEMS

North Dakota Noxious Weeds

By North Dakota Law, all property owners must control noxious weeds on their property.

Refer to the following Extension Circulars for additional information:

1. Absinth wormwood
Extension Circular W-838, "Absinth Wormwood Control"
2. Field bindweed
Extension Circular W-802, "Identification and Control of Field Bindweed"
3. Canada thistle
4. Musk thistle
Extension Circular W-799, "Perennial and Biennial Thistle Control"
Extension Circular W-1120, "Thistles of North Dakota"
5. Leafy spurge
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"
6. Diffuse knapweed
7. Spotted knapweed
8. Russian knapweed
Extension Circular W-1146, "Know your Knapweeds"
9. Purple loosestrife
Extension Circular W-1132, "Identification and Control of Purple Loosestrife"
10. Yellow starthistle

Other Extension Circulars that may have additional information:

Extension Publication "Right-of-Way Certification Manual" provides additional information on identification, biology, characteristics, and other information on most North Dakota noxious weeds.

Extension Circular W-1097, "Weed Control in Tree Plantings"

ABSINTH WORMWOOD

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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
2,4-D amine 2,4-D ester	4 pt of a 4 lb/gal conc. (2)	Pasture, rangeland, non-cropland, trees, fallow, or post-harvest.	Application should be made when plants are at least 12 inches tall and actively growing. Herbicides applied in late-June to mid-August have given greater residual control than fall or spring applications. Plants can be mowed in early to mid-summer to promote active regrowth prior to fall treatment.	Plants are controlled slowly. Do not graze dairy cows for 7 days after treatment. Use amine formulation near trees. T8
Dicamba	1 to 2 pt (0.5 to 1)			DO NOT apply near trees. Apply with NIS. Observe grazing restrictions. T9 Y15 Y24
Tordon 22K (picloram) RUP	0.5 to 1 pt (0.125 to 0.25)	Pasture, rangeland, non-cropland.		Consult reference paragraph for grazing restriction. Use high rate for dense stands. T13 Y22 Y24
Curtail (clopyralid + 2,4-D)	2 pt (0.09 + 0.5)	Cropland.		See narrative for rotational restrictions. Do not apply to new seedings of grass. Do not cut treated grass for hay within 30 days after application. Consult label for grazing restrictions. B13 Y23 Y26
	4 to 8 pt (0.18 to 0.36 + 1 to 2)	Pasture, rangeland and non-cropland.		
Redeem (triclopyr + clopyralid)	2.5 to 4 pt (0.7 to 1.1 + 0.25 to 0.4)	Pasture, rangeland, and non-cropland including CRP.		More cost-effective than Curtail at the same ai use rate. Apply with NIS. Observe grazing restrictions. T14 T16 Z1
Glyphosate	0.5 to 2 pt of a 3 lb ae/gal conc. or 0.4 to 1.6 pt of a 3.7 lb ae/gal conc or 0.38 to 1.5 pt of a 4 lb ae/gal conc. or 4.7 to 18.5 oz of a 65% SG (0.19 - 0.75)	Trees, non-cropland, fallow or post- harvest.	Avoid spraying tree foliage. Apply with AMS fertilizer. Refer to label for adjuvant use. Use the high rate for dense stands. A4 Q4 T4 T6	
Landmaster BW (glyphosate + 2,4-D)	3.38 pt (0.38 + 0.63)	Non-cropland and pasture.	Some grass injury and stunting may occur. Grass injury is greater with fall rather than spring treatments. Grass should not be grazed for 8 weeks after treatment. A1 A4 Q4	

FRINGED SAGE

Extension Circular W-985, "Fringed sage" provides additional information.

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
2,4-D ester	1 to 4 pt of a 4 lb/gal conc. (0.5 to 2)	Pastures, rangeland, non-cropland, trees, fallow, or post-harvest.	Fringed sage: Prior to 6- to 8- inches tall, usually late May to mid- June.	Best control if applied when air temperature exceeds 60 degrees. 2,4-D amine formulations provide 50% or less control compared to ester formulations. T8
Dicamba	1 to 2 pt (0.5 to 1)	Pasture, rangeland, non-cropland, fallow or post-harvest.		Less effective than 2,4-D. Surfactant at 0.5% v/v may improve consistency of control. T9
Curtail (clopyralid + 2,4-D)	2.6 to 4 pt (0.125 to 0.19 + 0.75 to 1)			Good long-term control. Y23 Y26
Redeem (triclopyr + clopyralid)	2.5 to 4 pt (0.7 to 1.1 + 0.25 to 0.4)	Pasture, rangeland, and non-cropland including CRP.		More cost-effective than Curtail at the same ai use rate. Apply with NIS. Observe grazing restrictions. T14 T16 Z1
Tordon 22K (picloram) RUP	2 to 4 pt (0.5 to 1)	Pasture, rangeland, and non-cropland.		Observe grazing restriction. High rate will provide nearly 100% control for several years. Apply with 2,4-D is more cost effective. T15 T16 Y24 Y26
Tordon 22K + (picloram) 2,4-D ester RUP	1 + 2 pt (0.25 + 1)			Control is best when 2,4-D ester is used with picloram rather than 2,4-D amine. T5 T13 T16 Y22 Y26

COMMON MILKWEED

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate)	6 pt of a 3 lb ae/gal conc. or 4.8 pt of a 3.7 lb ae/gal conc. or 3 pt of a 4 lb ae/gal conc. or 55.5 oz of a 65% SG (2.25)	Stubble or patches in barley, corn, oat, soybean, or wheat.	Milkweed: Late bud to early flower stage. Crop: prior to heading or flowering.	Apply to actively growing milkweed. Allow 3 or more days after application before tillage. Crop in treated area will be killed. Will not give complete control and will require retreatment. Refer to label for adjuvant use. A4 Q4 T3 T4 T5 T7
Dicamba	1 to 4 pt (0.5 to 2)	Fallow or post-harvest.	Milkweed: Actively growing.	Rotate to wheat, corn, soybean or sorghum. Crop injury may occur if interval between application and planting is less than 45 days per pt/A of dicamba, excluding days when ground is frozen. NIS improves consistency of control. Will not give complete control and will require retreatment. T3 T4 T5 X1 Y15 Y26
2,4-D + Dicamba	2 pt + 0.5 pt (1 + 0.25)			Will not give complete control and will require retreatment. Q1 T3 T4 T5 Y15 Y26
Tordon 22K (picloram) + 2,4-D RUP	2 pt + 1 to 2 pt (0.5 + 0.5 to 1)	Pasture, rangeland, and noncropland.		Will not give complete control and will require retreatment. 2,4-D can be added to lower rates of Tordon to improve control. Follow grazing restrictions. Q6 T3 T13 Y24 Y26
Tordon 22K (picloram) RUP	4 to 8 pt (1 to 2)	Patches or individual plants in pastures.		
Arsenal (imazapyr)	4 to 6 pt (1 to 1.5 lb)	Noncropland.		Very long soil residual. Suppression only and requires retreatment. Avoid drift and contact with desirable plants. Apply with NIS at 0.25% v/v. T3

FIELD BINDWEED


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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Glyphosate + Dicamba	4 pt of a 3 lb ae/gal conc. + 1 pt (1.5 + 0.5)	Preplant, fallow or post-harvest.	Actively growing. Vines: At least 12 inches long. Apply at beyond full bloom.	Less potential for soil residual than higher rates of dicamba. A prepackaged mixture is available as Fallow Master. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q1 Q4 T1
Glyphosate + Dicamba	3 pt of a 4 lb ae/gal conc. + 1 pt (1.5 + 0.5)			
Landmaster BW (glyphosate + 2,4-D)	3.38 pt (0.38 + 0.63)		Vines: 6 to 18 inches.	
2,4-D amine or ester	1.5 to 2 pt amine (0.75 to 1.0) 1.33 to 2 pt ester (0.66 to 1.0)	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. T1
Express (tribenuron) + 2,4-D + Dicamba	1/6 to 1/3 oz DF + 0.5 pt + 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. The addition of 2,4-D enhances weed control and crop safety. Apply with NIS at 0.125% v/v. Do not tank-mix with Hoelon. See section on herbicide resistance. No crop rotation restrictions the following year for Express 3-way mix. Do not apply Ally within 22 months from last Ally treatment or on soils above a pH of 7.9. Refer to Ally label for additional restrictions. B5 B9 B17 B32 T1 Y3 Y15 Y26
Ally (metsulfuron) + 2,4-D + Dicamba	1/20 to 1/10 oz DF + 0.5 pt + 2 to 3 fl oz (0.0375 to 0.075 oz + 0.25 + 1 to 1.44 oz)			
2,4-D	1 pt of a 4 lb/gal conc. (0.5)	Corn.	Corn: 3 to 8 inches tall.	Use drop nozzles after corn is more than 8 inches tall. Provides field bindweed suppression only. C31 T1
Dicamba	0.5 to 1 pt (0.25)		Corn: See remarks.	
Glyphosate	8 to 10 pt of a 3 lb ae/gal conc. (3 to 3.75)	Patches in wheat, barley, oat, corn, soybean or trees.	Crop: Prior to heading or flowering. Bindweed: Bud to flowering stage.	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 Q4 T1 T4 T5 T6 T7
	6 to 7.5 pt of a 4 lb ae/gal conc. (3 to 3.75)			

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Paramount (quinclorac)	0.33 lb DF (0.25)	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 ga/A may also be added to improve control but do not substitute for MSO. 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. May control foxtails, barnyardgrass, and volunteer flax. Q5 T1 Y18 Y26
	0.5 lb DF (0.375)	Pasture, rangeland, and CRP.	Fall: Prior to frost Bindweed: At least 4 inches long and actively growing.	DO NOT use on pasture and rangeland areas to grazed or cut for hay. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of perennial broadleaf weeds. T1
2,4-D ester	2 to 4 pt of 4 lb/gal conc. (1 to 2)	Fallow or post-harvest.	Bindweed: Actively growing and regrowth 12 inches to bud.	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. T1 T4 T5 T6 T8
Dicamba	2 to 4 pt (1 to 2)			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 mixture with 2,4-D available = Weedmaster. T1 T4 T5 T6 T10
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)	Fallow, post-harvest and pasture.		Refer to label for crop rotation and preplant interval recommendations. Primarily for small grain/fallow rotations. Commercial mixture available = Grazon P+D. Q7 T1 Y24 Y26
Dicamba	4 to 16 pt (2 to 8)	Patches or individual plants in pastures, fallow or non-cropland.		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 T1 T4 T5 T10 Y15 Y26
Tordon 22K (picloram) + 2,4-D RUP	2 to 4 pt + 1 to 2 pt (0.5 to 1 + 0.5 to 1)			Application with 2,4-D is more cost effective than picloram alone at higher rates. Consult reference for grazing restrictions. Commercial mixture available = Grazon P+D. T1 T4 T5 T13 Y24 Y26
Paramount + (quinclorac) Distinct (dicamba + diflufenzopyr)	8 oz DF + 6 oz WDG (6 oz + 3 oz + 1.2 oz)	Non-cropland.	Fall prior to a killing frost with at least 4 inches of stem.	Allow a 309 day grazing and haying period. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q5 T1 T10

CANADA THISTLE AND SOWTHISTLE

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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Ally Escort 	1/10 oz DF 1/2 to 2 oz DF	Wheat, barley and pasture.	Thistle: Rosette to pre-bud stage. Wheat and barley:	Apply herbicides with 2,4-D + dicamba. Provides season-long Canada thistle control. Apply with NIS except when adding 2,4-D or MCPA at 0.75 pt/A. See narrative about resistant weeds and rotational restrictions. For information on 3-way tank-mixes for SU herbicides with 2,4-D and dicamba, consult the herbicide listing in the "Hard Red Spring and Durum Wheat, Winter Wheat and Barley" section of this guide. B5 B6 B11 B17 B20 B21 T2 T6 Y1 Y3 Y26
Harmony Extra	1/2 to 6/10 oz DF	Wheat and barley.	Consult "Hard Red Spring and Durum Wheat, Winter Wheat and Barley" section of this guide.	
Express	1/6 to 1/3 oz DF			
Canvas	5 A/pack			
Finesse	2/10 to 3/10 oz DF			
Amber	0.56 oz DF			
MCPA or 2,4-D amine or ester	1.5 pt amine (0.75) 1.33 pt ester (0.66)	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. T2
2,4-D ester or amine	2 to 4 pt of a 4 lb/gal conc. (1 to 2)	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
	3 to 4 pt of a 4 lb/gal conc. (1.5 to 2)	Pasture, and rangeland or trees.		Refer to paragraph for livestock grazing restrictions. Use only amine formulation in trees. Suppression only. Commercial mixture with dicamba available = Weedmaster. T2 T4 T5 T8
Curtail M (clopyralid + MCPAe)	1.75 to 2.33 pt (0.09 to 0.122 + 0.5 to 0.68)	Wheat and barley.	Crop: 3-leaf to jointing.	Possible 2001 Curtail M Section 18 for flax. (See Flax). Rosette technique: Glyphosate or Curtail/Stinger fall-applied to Canada thistle in the rosette stage provides greater control than when applied to bolting or flowering stems. Refer to narrative for control of Canada thistle using the rosette technique. See narrative for rotational restrictions. B13 T2 T8 T16 Y23 Y26
Curtail (clopyralid + 2,4-D)	2 pt (0.09 + 0.5)		Crop: 4-leaf through jointing.	
	4 pt (0.19 + 1)	Fallow.	Thistle: Rosette until prior to bloom.	
	4 to 6 pt (0.19 to 0.25 + 1 to 1.5)	CRP and pasture.		
Stinger (clopyralid)	0.25 to 0.67 pt (0.09 to 0.25)	Sugarbeet, wheat, barley, oat and corn.	Thistles: Rosette to pre-bud stage.	See narrative for rotational restrictions. High rates in pasture is very expensive but very effective. B13 M15 T2 T8 Y23 Y26
	0.67 to 1.3 pt (0.25 to 0.5)	Pasture and rangeland.		
Hornet (flumetsulam + clopyralid)	1.6 to 4 oz WDG (0.37 to 0.09 oz + 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. T2
Accent Gold nicosulfuron + clopyralid + flumetsulam)	2.9 oz DF (0.188 oz + 1.5 oz + 0.56)			Add oil adjuvant at 1 to 2 % v/v. Do not use on corn varieties less than 88 day maturity. Refer to label for tank-mix options and crop rotation restrictions. T2
Dicamba	0.5 to 1 pt (0.25 to 0.5)	Corn.	Corn: EPOST up to 5 inches tall.	Use low rate on coarse textured or low organic matter soils. T2 Y15 Y26
	0.5 pt (0.25)		Corn: Up to 36 inches tall.	Use drop nozzles after corn is 8 inches tall to reduce drift. Can be applied 15 days prior to tasseling. T2 Y26
Distinct (dicamba + diflufenzopyr)	6 oz WDG (3 oz + 1.2 oz)	Corn, fallow, and non-cropland.	Corn: 4 to 24 inches tall.	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. C18 T2 Y15 Y18 Y26
Northstar (dicamba + primisulfuron)	5 oz DF (2.2 oz + 0.375 oz)	Corn.	Corn: 4 to 20 inches tall.	Use drop nozzles on 20 to 36 inch corn. Add NIS at 0.25% v/v or oil adjuvant at 1.5 2 pt/A. Liquid fertilizer may be added. T2

CANADA THISTLE AND SOWTHISTLE cont.

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Glyphosate	4 to 6 pt of a 3 lb ae/gal conc. or 3.2 to 4.8 pt of a 3.7 lb ae/gal conc or 3 to 4.5 pt of a 4 lb ae/gal conc. or 37 to 55.4 oz of a 65% SG (1.5 to 2.25)	Patches in corn, wheat, oat or soybean.	Prior to heading or flowering.	<u>Rosette technique</u> : Glyphosate or Curtail/Stinger fall- applied to Canada thistle in the rosette stage provides greater control than when applied to bolting or flowering plants. Refer to narrative for control of Canada thistle using the rosette technique. Apply with AMS fertilizer. Avoid drift to non-target plants. Crop will be killed in treated area. A4 Q4 T2 T4 T5 T6
	2 to 4 pt of a 3 lb ae/gal conc. or 1.6 to 3.2 pt of a 3.7 lb ae/gal conc or 1.5 to 3 pt of a 4 lb ae/gal conc. or 18.5 to 37 oz of a 65% SG (0.75 to 1.5)	Roundup Ready Corn: Up to 30 inches tall/6 collars. Roundup Ready Soybean: Emergence to 14 day PHI. Roundup Ready canola: Prior to bolting.		
	2 to 6 pt of a 3 lb ae/gal conc. or 1.6 to 4.8 pt of a 3.7 lb ae/gal conc or 1.5 to 4.5 pt of a 4 lb ae/gal conc. or 18.5 to 55.4 oz of a 65% SG (0.75 to 2.25)	Preharvest wheat, corn, soybean, field pea, and lentil.	Crop seed is physiologically mature. Thistle: At or beyond bud stage.	
		Fallow or post- harvest. Noncropland and around trees.	Canada thistle: Rosette or beyond bud stage.	Wait 3 or more days after application before tillage. R1 A4 Q4 T2 T4 T5 T7 Avoid spraying tree foliage. A4 Q4 R4 T2 T4 T5
Dicamba	2 to 4 pt (1 to 2)	Fall or post- harvest.	Canada 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. C16 T2 T2 T4 T5 T10
	1 pt (0.5)	Pasture and rangeland.	Rosettes to 12 inches tall. Fall: Mid-summer mowing promote 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. Spray in late August or September. Retreatment necessary.
	4 to 8 pt (2 to 4)	Thistle patches in pastures, non- cropland, and fallow.	Thistle: Rosette to prebud stage. Fall rosette following light frost but prior to a killing frost.	Refer to narrative for additional information. T2 T16
Redeem (triclopyr + clopyralid)	2.5 to 4 pt (0.7 to 1.1 + 0.25 to 0.4)	Pasture, rangeland, CRP, and non-cropland.		More cost effective than Curtail at the same active ingredient use rate. Apply with NIS. Observe grazing restriction for lactating animals. T2 T14 T16 Z1
Paramount (quinclorac)	0.5 lb DF (0.375)		Fall: Prior to frost. Annual sowthistle: Actively growing.	For annual sowthistle only. DO NOT use on pasture and rangeland areas to be grazed or cut for hay. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of annual sowthistle. Q5 T2 T16
Tordon 22K (picloram) RUP	0.5 to 2 pt (0.125 to 0.5)	Pasture, rangeland and fallow.	Thistles: At least 12 inches tall and actively growing.	Retreat at the same rate the following year. Addition of 2,4-D at 1 qt/A with Tordon at the 1 pt/A rate may improve control. Mid-summer mowing promotes active growth for fall treatment. Refer to narrative for additional information. B29 T2 Y23 Y26
	4 pt (1)	Patches of plants in pastures.	Thistles: Actively growing.	Consult reference for grazing restrictions. B1 T2 T15 T16

LEAFY SPURGE

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 (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
2,4-D amine or ester	2 to 4 pt of 4 lb/gal conc. (1 to 2)	Fallow.	Leafy spurge: Actively growing.	Cultivate or respray whenever regrowth is 4 to 6 inches high. Retreat in next years crop. T4 T5 T8
Dicamba	2 to 4 pt (1 to 2)	Fallow or post-harvest.	Leafy spurge: Flowering in spring or 4 to 12 inches fall regrowth.	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. T4 T5 T10 Y15 Y26
Paramount (quinclorac)	0.5 lb DF (0.375)	Pasture, rangeland, and CRP.	Fall: Prior to frost Leafy spurge: actively growing.	DO NOT use on pasture and rangeland areas to be grazed or cut for hay. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q5 T4 T5 T6 T16
2,4-D amine or ester	2 to 4 pt of 4 lb/gal conc. (1 to 2)	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. T4 T5 T8
Tordon 22K (picloram) + 2,4-D ester or amine RUP	1 to 2 pt + 2 pt of a 4 lb/gal conc. (0.25 to 0.5 + 1)	Pasture, rangeland and roadsides.	Leafy spurge: True flower growth stage or fall 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. Use 2 pt/A rate for fall application. T14
Dicamba	4 pt (2)			Dicamba will give good control when applied in the fall for 3 to 5 years. Surfactant improves consistency of control. T9
	4 to 16 pt (2 to 8)	Patches or individual plants in pastures or noncropland.	Leafy spurge: True flower growth stage or fall regrowth.	Consult label for grazing restrictions. Surfactant improves consistency of control. Retreatment necessary. Q1 Q3 Q4
Tordon 22K (picloram) RUP	4 to 8 pt (1 to 2)			Consult narrative for grazing restrictions. Commercial mixture with 2,4-D available = Grazon P+D. T15
Glyphosate	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.75)	Trees.	Leafy spurge: After July 1 to actively growing plants.	Other vegetation will also be killed. Avoid spraying tree foliage. Non-selective, non-residual herbicide. Retreat the following spring with 2,4-D at 2 to 4 pt/A to control seedlings and escapes. Add AMS fertilizer. A4 Q4 T4 T5 T6 T7 T8
2,4-D amine	2 to 4 pt (1 to 2)			
Casoron 4G Norosac 10G (dichlobenil)	150 to 200 4G 60 to 80 lb 10G (6 to 8)		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 (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Paramount + (quinclorac) Distinct (dicamba + diflufenzopyr)	8 oz DF + 6 oz WDG (6 oz + 3 oz + 1.2 oz)	Non-cropland.	True flower of fall prior to frost.	Allow 309 day before grazing and haying. Use an MSO type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q5
Krenite (fosamine)	12 to 16 pt (6 to 8)	Noncropland, adjacent to water and trees.	True flower growth stage or early fall.	Inconsistent control. Best control with high humidity and good soil moisture. Do not contaminate water during application.
Rodeo Pondmaster (glyphosate) (Listed Formulations Only)	2 pt of a 4 lb/gal conc. (0.75)	Adjacent to water.	Mid-July to mid- September.	Apply with a NIS approved for use near water. Control seedlings with a 2,4-D formulation near water in subsequent years. A4 Q4 T4 T5 T8
2,4-D amine	2 to 4 pt of a 4 lb/gal conc. (1 to 2)		Leafy spurge: Actively growing.	Use only 2,4-D formulations labeled for use in or near water, such as PBI Gordon Amine 400. T4 T5 T8
Landmaster BW (glyphosate + 2,4-D)	54 fl oz or 3.38 pt (0.38 + 0.63)	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 Q1 T8
Plateau (imazapic)	8 to 12 fl oz (2 to 3 oz)	New or existing grass plantings in cropland or noncropland.	Early to mid September.	May be used on CRP, pasture, rangeland, industrial sites, roadside right-of-way or noncropland. Section 18 pending to allow grazing and haying otherwise DO NOT use on pasture and rangeland areas to grazed or cut for hay. Apply with MSO type adjuvant plus 28% UAN each 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. T12 T16
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	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. T17

CATTAILS

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Rodeo, Pondmaster (glyphosate)	4.5 pt of a 4 lb/gal conc. (2.25)	Drainage and aquatic sites.	At or beyond the early to full bloom stage and actively growing - normally late July through mid August.	Add a NIS approved for use in water. Apply at 0.75% v/v solution (1 fl oz/gal) with hand-held sprayer equipment. A4 Q4
Glyphosate	6 pt of a 3 lb ae/gal conc. or 4.8 pt of a 3.7 lb ae/gal conc or 4.5 pt of a 4 lb ae/gal conc. or 55.4 oz of a 65% SG (0.75 to 2.25)	Agricultural and non-cropland sites other than listed above.		Refer to label for adjuvant use. Only the Rodeo formulation of glyphosate is approved for use in drainage and aquatic sites because of environmental concerns. A4 Q4

DIFFUSE, SPOTTED and RUSSIAN KNAPWEED, AND YELLOW STARHISTLE

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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
2,4-D amine or ester	1.5 pt amine (0.75) 1.33 pt ester (0.66)	Wheat and barley.	Crop: Tiller stage.	Prevents seed formation only. X1
2,4-D ester	2 to 4 pt of a 4 lb/gal conc. (1 to 2)	Fallow, post-harvest, pasture, and rangeland.	Rosette stage is preferred.	Several years of annual treatments are necessary. T4 T5 T6 T8
Dicamba	2 to 4 pt (1 to 2)		Bud to bloom is second best.	Crop injury may occur if the interval between application and planting is less than 45 days per pt/A of dicamba used, excluding days when ground is frozen. Plants are controlled slowly. Surfactant improves consistency of control. Retreatment annually required for Russian knapweed. T10
Curtail (cloprialid + 2,4-D)	2 pt (0.09 + 0.5)	Wheat and barley.	Wheat: 4-leaf through jointing.	Maximum rate labeled for spotted and diffuse knapweed, and yellow starthistle in CRP and pasture is 6 pt/A. See narrative for rotational restrictions. B13 T6 T16 Y23 Y26
	4 pt (0.19 + 1)	Fallow.	Weeds: Bud to bloom stage or fall.	
	6 to 8 pt (0.28 to 0.38 + 1.5 to 2)	CRP and pasture.		
Redeem (triclopyr + clopyralid)	1.5 to 2 pt (0.4 to 0.6 + 0.15 to 0.2) 2.5 to 4 pt (0.7 to 1.1 + 0.25 to 0.4)	Pasture, rangeland, CRP, and non-cropland.	Rosette to bloom rosettes in the fall.	Apply with NIS at 0.25% v/v. Very cost effective formulation of clopyralid. Observe grazing and haying restrictions for lactating animals. T14 T16 Z1 Use high rates for Russian knapweed.
Dicamba	4 to 12 pt (2 to 6)	Pasture, rangeland, and noncropland.	Spring or fall.	<u>For Russian knapweed.</u> Consult label for grazing restrictions. Plants are controlled slowly. T4 T5 X1
Tordon 22K (picloram) RUP	4 to 8 pt (1 to 2)		Any time during growing season.	Consult label for grazing restriction. Y24 Y26 <u>For spotted, diffuse knapweed, and yellow starthistle:</u> Use 1 pt/A of Tordon. May be tank-mixed with 2,4-D amine or ester to improve control. T8 Y24 Y26
Tordon 22K (picloram) + 2,4-D amine or ester RUP	1 to 2 pt + 1 qt of a 4 lb/gal conc. (0.25 to 0.5 + 1)		Knapweed: Rosette stage preferred. Bud to bloom is second best.	<u>For Russian knapweed:</u> Several years of annual treatment is necessary. Consult label for grazing restrictions. Commercial mixture of Tordon + 2,4-D = Grazon P+D. T9 T15 Y24 Y26
Glyphosate	4 to 6 pt of a 3 lb ae/gal conc. or 3.2 to 4.8 pt of a 3.7 lb ae/gal conc or 3 to 4.5 pt of a 4 lb ae/gal conc. or 37 to 55.4 oz of a 65% SG (1.5 to 2.25)	Fallow and non-cropland.	Bud to bloom stage - late summer to early fall.	Other vegetation will also be killed. Avoid spraying tree foliage. Non-selective, non-residual herbicide. Retreat the following spring with 2,4-D at 2 to 4 pt/A to control seedlings and escapes. Add AMS fertilizer. A4 Q4 T4 T5 T6 T7 T8
Cultivation		Cropland.	Cultivate when ever plants are 3- to 6-inches tall.	<u>For spotted and diffuse knapweed.</u> Spotted knapweed is generally not a problem in cultivated land.

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Accent (nicosulfuron)	0.67 oz DF (0.5)	Corn: Up to 36 inches tall. Drop nozzles must be used from 24 to 36 inches.	POST.	Apply with oil adjuvant plus 28% UAN. Use of 28% UAN with MSO type adjuvants or NIS enhances control. Do not apply if Counter insecticide was used. Apply as drop nozzle application to corn over 24 inches tall. See narrative for rotational restrictions and registered tank-mix options. C4 X1 Y3 Y26
Assure II (quiazalofop)	Split: 10 fl oz then 7 fl oz (1 oz/0.7 oz)	Soybean, dry bean, canola, crambe, lupin, lentil, field pea, and sugarbeet.	Quackgrass: 6 to 10 inches tall.	Apply with oil adjuvant at 1 % v/v. Make second application at 7 fl oz when quackgrass is 4 to 8 inches tall. D5 D31
Fusilade DX (fluazifop-P)	Split: 12 fl oz then 8 fl oz (3 oz/2 oz)	Soybean and trees.	Quackgrass: 4-leaves to 10 inches tall.	Apply with oil adjuvant. Make second application at 12 fl oz when quackgrass has 3 to 5 leaves. D13 D31
Fusion (fluazifop-P + fenoxaprop-P)	Split: 12 fl oz then 8 fl oz (3 + 0.96 oz/ 1.92 to 0.64 oz)	Soybean.	Quackgrass: 6 to 10 inches tall.	Apply with oil adjuvant. First application should be at 12 fl oz/A. Make a second application at 8 fl oz/A to new growth 2 to 3 weeks after emergence. D14 D31
Poast (sethoxydim)	Split: 1.5 pt then 1 pt (0.28/0.2)	Canola, crambe, rapeseed, dry bean, field pea, flax, lentil, lupin, potato, sunflower, sugarbeet and trees.		Apply with oil adjuvant at 1 qt/A. Make second application at 1 pt when quackgrass regrowth is 6 to 8 inches tall. Maximum rate in dry bean is 1.5 pt/A. D18 D31
Select/ Prism (clethodim)	Split: 8 fl oz fb 8 fl oz/ 17 fl oz fb 17 fl oz (2 oz/2 oz)	Alfalfa, dry bean, soybean, and sugarbeet.	Quackgrass: 4 to 12 inches tall.	Apply with oil adjuvant at 1 qt/A. First application should be at 8 oz/A. Make second application at 8 fl oz/A to new growth 2 to 3 weeks after emergence. D25 D31
Glyphosate	4 to 6 pt of a 3 lb ae/gal conc. or 3.2 to 4.8 pt of a 3.7 lb ae/gal conc or 3 to 4.5 pt of a 4 lb ae/gal conc. or 37 to 55.4 oz of a 65% SG (1.5 to 2.25)	Patches in wheat, barley, oat, corn, or soybean.	Crop: Prior to heading. Quackgrass: At least 8 inches tall.	Crop in treated area will be killed. Avoid drift to non-target plants. Can be mixed with AMS fertilizer and drift retardants. Can be mixed with AMS fertilizer and drift retardants. Refer to label for adjuvant use. A4 Q4 T6 T7
	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.75)	Preharvest in wheat and soybean only.	Wheat: Hard-dough stage.	Refer to label for adjuvant use. Application to wheat grown for seed is not recommended because a reduction in germination or vigor may occur. May be tank-mixed with 2,4-D. A4 Q4 T6 T7
		Preplant, fallow or post-harvest.	Fall or spring Quackgrass: 8 inches tall and actively growing.	Refer to label for adjuvant use. Allow 3 or more days after application before tillage. For established quackgrass sod, use at 4 pt/A. A4 Q4 T4 T5

FALSE CHAMOMILE

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Bromoxynil + MCPA ester	1.5 pt (0.37 + 0.37)	Wheat, barley and oat.	Chamomile less than 4 inches tall.	Control of fall germinated plants will be less than plants germinating in the spring. B2 B10 S1
Ally (metsulfuron)	1/10 oz DF (0.06 oz)	Wheat and barley.	Refer to "HRS and Durum Wheat, and barley" section in this guide.	Do not apply Ally within 22 months after last Ally treatment. See narrative for information on resistant weeds and rotational restrictions. Apply with NIS at 1 pt/100 gallon water. Do not apply to soils above pH 7.9. B2 B5 B11 B20 S1 X1 Y3 Y26
Canvas (metsulfuron+thifensulfuron + tribenuron)	5 A/pack (0.075 oz met + 0.225 oz thif+trib)			
Finesse (chlorsulfuron+metsulfuron)	2/10 to 3/10 oz DF (0.15 to 0.225 oz)			
Maverick (sulfosulfuron)	2/3 oz DF 0.5 oz)			
Harmony Extra (thifensulfuron + tribenuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)			
Express (tribenuron)	1/6 to 1/3 oz DF (0.125 to 0.25 oz)	Chamomile: Less than 4 inches tall.	For information on 3-way tank-mixes for Ally, Harmony Extra or Express with 2,4-D and dicamba consult the herbicide listing in the "Hard Red Spring and Durum Wheat, Winter Wheat and Barley" section of this guide. B2 B17 B21 S1 X1	
Escort (metsulfuron)	1/3 to 1/2 oz DF (0.2 to 0.3 oz)	Pasture, rangeland, and non-cropland.	Weeds: 2 inches or less and actively growing.	Do not apply to CRP. Apply with NIS at 1 pt/100 gallon water.
Tordon 22K (picloram) RUP	1 to 1.5 pt (0.25 to 0.37)	Roadsides.	Chamomile less than 4 inches tall.	Use the higher rate on plants over 4 inches tall. Avoid drift to susceptible plants. B2 S1 T15
Paraquat RUP	1.75 to 2.7 pt of a 3 lb/gall conc. (0.66 to 1)	Tree rows or potholes.	Chamomile less than 6 inches tall.	Apply with a NIS. Avoid drift to non-target plants. B2 S1
Glyphosate	2 pt of a 3 lb ae/gal conc. or 1.6 pt of a 3.7 lb ae/gal conc. or 1.5 pt of a 4 lb ae/gal conc. or 18.5 oz of a 65% SG (0.75)			Non-selective, systemic herbicide. Avoid drift to non-target plants. Can be applied with AMS fertilizer and drift retardants. Refer to label for adjuvant use. A4 Q4 S1
Amitrol-T (amitrole) RUP	6 pt (1.5)			Avoid drift to non-target plants. S1

PURPLE LOOSESTRIFE

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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Glypro, Rodeo Pondmaster (glyphosate)	1 to 1.5 gal/100 gal water or 1.3 to 1.9 fl oz/gal (1 to 1.5% concentration)	Drainage and aquatic sites.	July to early September.	Add a NIS approved for use in water at 0.75% v/v. A 2,4-D formulation labeled for use near water will be needed to control seedlings. Biological control agents have been introduced for control. A4 A15 Q4 T18

SHELTERBELT WEED CONTROL

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

Herbicide	Product/A (lb ai/A)	Remarks	Refer to Paragraph U1
Amitrol T (amitrole) RUP	1 to 4 gal (2 to 8)	Systemic, postemergence herbicide. Directed application only. Keep spray off desired species. Controls many annual and perennial weeds and poison ivy. Apply in combination with preemergence herbicides for residual weed control.	
Casoron (dichlobenil)	100 to 200 lb 4G (4 to 8)	Highly volatile. Preemergence herbicide for control of annual and perennial weeds in new plantings established at least 4 weeks. Application in November or March just before rain or snow are most effective.	
Finale (glufosinate)	2 to 6 qt (0.5 to 1.5)	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, or 5 to 6 qt/A for weeds greater than 6 to 8 inches.	
Fusilade DX (fluazifop-P)	1 to 1.5 pt (0.25 to 0.38)	Systemic, 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	1.33 to 8 pt of a 3 lb ae/gal conc. or 1 to 6 pt of a 4 lb ae/gal conc.	Other glyphosate formulations available. Non-selective, non-residual, systemic, postemergence herbicide. Effective on annual and perennial plants. Directed spray only. Avoid drift and contact with desirable species. Use 1 to 1.5 fl oz/gal for small annual weeds or 2.5 to 3 fl oz/gal for perennial weeds when applying with a hand-held sprayer. Refer to label for adjuvant use. A4 Q4	
Goal (oxyfluorfen)	5 to 10 pt 1.6E 4 to 8 pt 2XL (1 to 2)	Residual, preemergence or contact postemergence herbicide for control of broadleaf and some grass weeds. <u>General:</u> Do not incorporate in soil. Apply POST with NIS at 0.25% v/v. User must possess North Dakota 24C SLN label at the time of application. Can be applied with a residual herbicide or as a split application. <u>Conifers:</u> Apply pre-transplant, POST or POST-directed prior to bud-break or after new foliage has hardened off. <u>Hardwoods:</u> 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)	Add MSO at 2 qt/A. Controls many broadleaf weeds including leafy spurge. Use rates up to 12 fl oz in and around established trees allowed. Do not use on new plantings or seedling trees. Will cause temporary yellowing of spruce candles. Higher rates will reduce grass stands. Refer to label for list of tolerant tree species. Use with 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)	Systemic, 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)	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.	
Stinger (clopyralid)	0.25 to 0.67 pt (0.1 to 0.25)	Systemic, postemergence, broadleaf herbicide. Effective on weeds in the legume, smartweed and aster families. Provides excellent control of Canada thistle and knapweeds. Safe to some conifer species only. Apply to actively growing weeds.	
Stomp, Pendulum (pendimethalin)	2 to 4 qt 3.3 to 6.6 lb WDG (2 to 4)	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 80 lb 5G (0.5 to 1) (4)	Apply PPI for new plantings or established trees. Gives season long control of many annual grass and some broadleaf weeds. Does not control weeds in the aster, 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 (1 to 2)	Systemic, 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.	

NONCROPLAND WEED CONTROL

Herbicide	Product/A (lb ai/A)	Remarks	Refer to Paragraph V1
2,4-D	2 to 8 pt (1 to 4)	Systemic, short residual herbicide. For control of annual and perennial broadleaf plants. Avoid drift to desirable plants and sensitive crops. Short residual.	
Dicamba)	0.5 to 6 pt of a 4 lb/gal conc. (0.25 to 3)	Use 0.5 to 1.5 pt/A to control annual broadleaf plants, 0.5 to 3 pt/A to control biennials, 1 to 6 pt/A to control perennials. Apply when weeds are actively growing. Refer to label for registered tank-mixes. Long residual.	
Weedmaster (dicamba + 2,4-D)	0.5 to 4 pt (0.25 to 2)	Controls broadleaf weeds and woody plants. Apply when weeds are actively growing. Adjuvants may used for wetting, penetration, or drift control. Moderate residual.	
Crossbow (triclopyr + 2,4-D)	1 to 1.5 gal/100 gal, 2 qt to 4 gal/A	Use 1 to 1.5 gal product/100 gal water for spot treatment, 2 to 4 qt/A for broadleaf weeds, 1.5 to 4 gal in sufficient water to deliver 10 to 30 gpa for woody species. Moderate residual. T9	
Distinct (dicamba + diflufenzapyr)	6 oz WDG (3 + 1.2)	Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. Provides a wider spectrum of weeds controlled and greater perennial weed control than Banvel/Clarity. Can be tank-mixed with other herbicides but refer to label or narrative for tank-mix options. Distinct at 6 oz 70WDG/A = 6 fl oz Clarity.	
Escort (metsulfuron)	0.3 to 2 oz DF (0.2 to 1.2 oz)	For annual broadleaf weed control. Can be applied anytime except when ground is frozen. No grazing restrictions up to 0.75 oz/A. Kochia biotypes have developed resistance. Apply with another herbicide of a different mode of action. Long residual.	
Glyphosate	2 to 10 pt of a 3 lb ae/gal conc. or 1.6 to 8 pt of a 3.7 lb ae/gal conc or 1.5 to 7.5 pt of a 4 lb ae/gal conc. or 18.5 to 92.5 oz of a 65% SG (1.5 to 7.5)	Apply 2 to 10 qt of a 3 lb ae/gal concentrate or 1.5 to 7.5 qt of a 4 lb ae/gal concentrate. Non-selective, non-residual , systemic, foliar herbicide. Effective on annual and perennial grass and broadleaf plants. Avoid drift and contact with desirable species. A4 Q4	
Paramount (quinclorac)	0.5 lb DF (0.375)	Use an MSO type adjuvant at 2 pt/A. May control or suppress broadleaf weeds including field bindweed, leafy spurge, and annual sowthistle. Q5	
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 and around established trees, roadsides, prairies, and other non-cropland areas used for wildlife cover, erosion control, etc. Do not use on new plantings or seedling trees. Refer to label for list of tolerant tree species. Use with caution on trees not listed on label. T12	
Spike (tebuthiuron)	5 to 30 lb 20P 2.5 to 15 lb 40P	Controls over 125 grass and broadleaf species and 110 woody species. Rate varies by weed species and duration of control desired. Avoid drift to desirable species. Long residual.	
Telar (chlorsulfuron)	0.25 to 3 oz DF (0.19 to 2.24)	Use higher rate for perennial weed control. Avoid treatment to dry soil that may move off target. Apply with another herbicide for broad spectrum weed control. Long residual.	
Starane (fluroxypyr)	0.67 to 1.13 pt (0.125 to 0.25)	Non-residual herbicide. For kochia control including ALS and dicamba resistant biotypes.	
Tordon 22K (picloram) RUP	0.25 pt to 2 gal (0.06 to 4)	For control of most annual and perennial broadleaf weeds and woody plants. Avoid drift and contact with desirable species. Long residual.	

TOTAL VEGETATION WEED CONTROL

Herbicide	Product/A (lb ai/A)	Remarks	Refer to Paragraph V2
Diuron/Direx Karmex (diuron)	1 to 8 gal 5 to 15 lb (4 to 32)	Refer to label for use in irrigation ditches. Higher rates needed for perennial grasses and broadleaf weeds. Deep rooted perennials will require re-treatment. Long residual.	
Hyvar X, Hyvar DF (bromacil)	3 to 15 lb DF (2.4 to 9.6)	Use 3 to 6 lb for annual grass and broadleaf weeds or 7 to 15 lb for perennial weeds. Non-corrosive, nonvolatile, nonflammable. Refer to label for tank-mixes. Long residual.	
Finale (glufosinate)	3 to 6 qt (0.75 to 1.5)	Non-selective, non-residual 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.	
Glyphosate	2 to 10 pt of a 3 lb ae/gal conc. or 1.6 to 8 pt of a 3.7 lb ae/gal conc or 1.5 to 7.5 pt of a 4 lb ae/gal conc. or 18.5 to 92.5 oz of a 65% SG (1.5 to 7.5)	Apply 2 to 10 qt of a 3 lb ae/gal concentrate or 1.5 to 7.5 qt of a 4 lb ae/gal concentrate. Non-selective, non-residual , systemic herbicide. Effective on annual and perennial grass and broadleaf plants. Avoid drift and contact with desirable species. A4	
Paraquat RUP	2 to 2.7 pt (0.75 to 1)	Non-selective, non-residual , contact. Controls top-growth only of perennial species. Add NIS and repeat application as necessary. Avoid drift and contact with desirable species.	
Krovar (bromacil + diuron)	4 to 30 lb DF (3.2 to 24)	Control of annual grass and broadleaf weeds. Apply PRE or early POST. Refer to label for registered tank-mixes. Long residual.	
Oust (sulfometuron)	2 to 4 oz DF (1.5 to 3 oz)	Use high rate in high moisture areas such as railroad shoulders, under asphalt and concrete, except residential properties. Will control leafy spurge at 3 oz/A. Do not spray near water. 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, Karmex, diuron and other total vegetation control herbicides. T12	
Pramitol 25E (prometon)	5 to 10 gal (10 to 15)	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.	
Total (bromacil + diuron + Na-chlorate + Na-borate)	0.5 to 2 lb/100 sq. ft. (10 to 15)	Use 0.5 to 1 lb/100 sq. ft. for annual weeds and 1 to 2 lb/100 sq. ft. for hard-to-kill perennial weeds. Apply before weeds emerge. Long residual.	
Sahara (imazapyr + diuron)	3 to 4 A/copack or 6.5 to 13 lb DF (0.5 to 1 + 4 to 8)	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. 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.	
Topsite (imazapyr + diuron)	200 to 300 lb 2.5G (1 to 1.5 + 4 to 6)	Apply Topside 2.5G prior to weed emergence at 0.5 to 0.7 lb 2.5G/100 sq. ft. Long residual.	

GENERAL INFORMATION

A1. PPI AND PRE HERBICIDES

Many soil applied herbicides need to be incorporated (PPI) to give optimum weed control. Incorporation is required for Buckle, DoublePlay, Eptam, Eradicane, Far-Go, Ro-Neet, Sonalan, and trifluralin. Incorporation of Axiom, Dual, Frontier, Harness, Lasso, Nortron, Prowl, and Surpass generally improves weed control. Apply Balance PRE rather than PPI due to moderate solubility and possible movement down to the seed zone under wet conditions.

An estimate of the efficiency of an incorporating tool can be obtained by operating the tool through flour or lime which has been spread thickly over the soil. A thorough incorporation should cover most of the flour or lime and mix it uniformly through the soil. Several tillage tools have been used successfully for the incorporation of herbicides. Some herbicides require more thorough incorporation, the incorporation method should be appropriate for the herbicide.

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 which are incorporated into the soil surface usually require less rainfall after application for effective weed control than unincorporated herbicides. Weeds 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, 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.

Eptam, DoublePlay, Far-Go, and Ro-Neet should 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. **Prowl** is labeled only PPI in soybean and dry beans and PRE, not PPI, on corn. **Axiom, Dual, Frontier, Lasso, Nortron SC, and Harness/Surpass** may be used PRE but weed control improves when applied PPI on fine textured soils. Incorporation of **Lasso, Nortron SC** and **Dual** 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.

Eptam, Far-Go, Prowl, Ro-Neet, and Sonalan, and trifluralin require thorough incorporation by one of the following methods or a method which will incorporate similarly.

a) A tandem disk should be set at a depth of 3 to 4 inches for Prowl and a depth of 4 to 6 inches for other herbicides except Far-Go should not be incorporated with a disk. Operating speed should be 4 to 6 mph. Tandem disks with blades spaced 8 inches or less and a disk blade diameter of 20 inches or less have given good herbicide incorporation. Larger disks often have given streaked incorporation and poor weed control.

b) Field cultivators of various types may be used. These should have overlapping sweep shovels arranged in at least 3 rows of shovels. The cultivator should be operated at a depth of 3 to 4 inches for Far-Go or Prowl and 4 to 6 inches for the other herbicides. A harrow should follow the field cultivator. The operating speed necessary to achieve a satisfactory incorporation will vary somewhat depending on the type of field cultivator but usually will be 6 to 8 mph.

c) Field cultivators with Danish tines and rolling crumblers behind have given good herbicide incorporation. These tools should be operated 4 inches deep and 7 to 8 mph or faster. Adequate incorporation with one pass may be possible with these tools if soil conditions are ideal for herbicide incorporation. However, a second incorporation may be good insurance against poor weed control.

d) Power driven rototiller type equipment will give adequate incorporation when set to operate at a depth of 2 to 3 inches at the manufacturer's recommended ground speed.

A single incorporation with a power driven tiller is sufficient for all herbicides. 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, 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. Herbicides such as atrazine, Ro-Neet, Eptam, Eradicane, Lorox and Pyramin 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, 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 and Pyramin have not been effective in the Red River Valley, except on coarse-textured soils with less than 5% organic matter. The lower the organic matter, the more effective they become. The rate of most soil applied herbicide must be adjusted according to organic matter levels. Apply the high labeled rates on higher organic matter soils. Many herbicides such as Ramrod, 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

Dual, Eptam, Far-Go, Ro-Neet, Surpass EC and 20G, TopNotch and trifluralin may be fall applied. Fall treatments of trifluralin should be 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 Dual, Eptam, Far-Go, and Ro-Neet, Supass and TopNotch 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. Both granular and liquid formulations of the herbicides are registered for use in the 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 applied in the fall for weed control in dry bean, potatoes, sugarbeet, and sunflower. Ro-Neet is registered only on sugarbeet.

Far-Go (trallate) 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 and 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 broadleaf weeds except wild mustard. Trifluralin liquid or 10G formulations may be applied in the spring or fall for weed control in soybean, safflower, dry bean, sunflower, flax, wheat, and barley. Sonalan can be applied in the fall or spring but the label does not specify 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 are different 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 active ingredient to release from granule. The first incorporation is to trap the granule and the second is to thoroughly mix the active ingredient. Prowl at 2.4 to 3.6 pt/A fall applied in sunflower gives good control of annual grasses and broadleaf weeds except wild mustard. Incorporation may be delayed 7 days. The liquid may be applied in the fall for weed control in sunflower.

A4. POST APPLIED HERBICIDES

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

Herbicide	Time Interval	Herbicide	Time Interval
Accent	4-6 hr	Landmaster BW	6-12 hr
Accent Gold	6 hr	Liberty/ATZ	4 hr
Achieve	1 hr	Lightning	1 hr
Aim	1 hr	Lorox	6-8 hr
Ally/Escort	4 hr	MCPA amine	4 hr
Amber	4 hr	MCPA ester	1 hr
Assert	3 hr	Marksman	4 hr
Assure II	1 hr	Matrix	4 hr
Atrazine	4 hr	Maverick	4 hr
Avenge	6 hr	Muster	4-6 hr
Basagran	4 hr	Northstar	4 hr
Basis	4 hr	Paramount	6 hr
Basis Gold	4-6 hr	Peak	1 hr
Betamix/Betanex	6 hr	Permit	4 hr
Bladex	2 hr	Plateau	1 hr
Bromoxynil	1 hr	Poast	1 hr
Bronate/Pro	1 hr	Prism	1 hr
Butyrac 200	6 hr	Progress	6 hr
Callisto	1 hr	Pursuit	1 hr
Canvas	6 hr	Puma	1 hr
Celebrity Plus	4-6 hr	Raptor	1 hr
Cheyenne	4 hr	Rave	4 hr
Cobra	0.5 hr	ReadyMaster ATZ	4 hr
Connect	1 hr	Redeem	2 hr
Curtail/M	6 hr	Reflex	1 hr
Dakota	1 hr	Reglone	0.5 hr
Desiccate II	5 hr	Rely	4 hr
Dicamba	6-8 hr	Remedy	6-8 hr
Distinct	4 hr	Resource	1 hr
Discover	1 hr	Rezult	4 hr
Diquat	0.5 hr	RU Custom	4-6 hr
Everest	1hr	RU Original/RT	4 hr
Express	4 hr	RU Private Labels	4-6 hr
Extreme	1 hr	Roundup Ultra/RT	1 hr
Finesse	4 hr	Roundup Ultra Max	1 hr
FirstRate	4 hr	Select	1 hr
Flexstar	1 hr	Sencor	6-8 hr
Fusilade DX	1 hr	Stampede 80EDF	4 hr
Fusion	1 hr	Starane	1 hr
Galaxy	6 hr	Steadfast	4-6 hr
Glyphosate (Part adj.)	1 hr	Stinger	6 hr
Glyphosate (Part adj.)	4 hr	Storm	6 hr
Glyphosate (No adj.)	4-6 hr	Tiller	1 hr
Goal	1 hr	Tordon 22K	6-8 hr
Gramoxone Extra/Max	0.5 hr	Touchdown 3	1 hr
Guardman	4 hr	Touchdown 5	2 hr
Harmony Extra	4 hr	Ultra Blazer	6 hr
Harmony GT	4 hr	UpBeet	6 hr
Hoelon	6 hr	Weedmaster	6-8 hr
Hornet	6 hr	2,4-D amine	4 hr
Landmaster BW	6-12 hr	2,4-D ester	1 hr

A4 - POST APPLIED HERBICIDES

Rainfall shortly after POST herbicide application often reduces weed control because the herbicide washes off the leaves before absorption is complete. Herbicides vary in rate of absorption and in ease of being washed from leaves; therefore, herbicides vary in response to rainfall. The amount and intensity of rainfall influence the washing of herbicide from leaves. 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. Oil adjuvants may help retain and deposit spray droplets on leaf surfaces in the presence of dew.

Weed control from POST herbicides is influenced by crop tolerance, weed species, weed size, and climatic conditions. These factors should be considered in determining the herbicide selection and rate. A range of rates is given for most of the herbicides in this circular. The lowest rate of POST herbicides will be effective under favorable growing conditions when weeds are small and actively growing. Use the highest suggested labeled rate under adverse conditions of drought or prolonged cool weather, or for well established weeds.

Sunlight inactivates some herbicides by ultra violet (UV) light. Trifluralin and Eptam degradation is minimal because incorporation is done soon after application. Achieve, Poast, and Select are highly sensitive 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 Achieve, Poast, and Select soon after mixing, after 4:00 pm, and with superior oil adjuvants.

Ideal temperatures for applying most POST herbicides are between 65 and 85 F. Most weeds are killed slowly below 60 F. Some herbicides may injure crops if applied above 85 F. Avoid applying volatile herbicides such as 2,4-D ester, MCPA ester and dicamba during hot weather, especially near susceptible broadleaf crops, shelterbelts, or farmsteads.

Temperatures following herbicide application determine crop safety or injury. Cold temperatures cause concern for crop safety and possible reduced weed control. Plants degrade herbicides by metabolism, but plant 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. However, cold temperatures during and after herbicide application increases degradation time of the active ingredient and may result in crop injury. Continued cold night and day temperatures cause metabolism to shutdown in plants, preventing herbicide degradation. However, herbicides may be sprayed following cold night-time temperatures if day-time temperatures warm to at least 60 degrees.

Wild oat is a cool season grass and is more sensitive to products containing fenoxaprop (Dakota, Tiller, Cheyenne, and Puma) during cool rather than warm or hot conditions. Green and yellow foxtail are warm season grasses and may shutdown under cold conditions resulting in reduced control. Many broadleaf weeds are warm season plants and are controlled better during warm/hot conditions under active plant growth with sufficient moisture.

ACCase inhibitors, such as Achieve and fenoxaprop (Dakota, Tiller, Cheyenne, Puma), may cause crop injury and give greater weed control when cold temperatures follow application. Fenoxaprop is more active on grass weeds during cold temperatures. Risk of crop injury is much greater from fenoxaprop in cool/cold conditions.

Other herbicides, such as Assure II, Poast, Fusilade DX, and Select provide better grass control in warm weather when grasses are actively growing.

Cold temperatures following application of ALS herbicides may increase crop injury with little effect on weed control. Pursuit and Raptor on beans; Accent, Matrix in Basis, Basis Gold and Accent Gold, and Harmony GT in Basis in corn; Lightning on Clearfield corn; FirstRate on soybeans; Bladex in corn; Sencor in legumes and potatoes; and bromoxynil in grass crops all have shown significant corn and wheat leaf burn when freezing temperatures follow application.

Basagran, Cobra, Flexstar, Liberty, paraquat, Stampede, and Ultra Blazer may not cause crop injury when cold temperatures follow application but less weed control may result.

2,4-D, dicamba, MCPA, Stinger, Starane, glyphosate (resistant crops) have adequate crop safety and provide similar weed control, but weed death may be slowed when cold temperatures follow application.

Recommendation for applying fenoxaprop based herbicides, ALS herbicides, Bladex, and Sencor is to delay application until daytime temperatures exceed 60 degrees F and after active plant growth resumes.

Adjuvants may also affect crop safety and weed control. Oil additives may increase risk of crop injury but may be necessary for greatest weed control. Refer to each herbicide label for specific information on adjuvant use during stress conditions. Use an oil additive if risk of crop injury is acceptable for those herbicides that allow use.

Glyphosate

Glyphosate applied POST will control annual and perennial weeds in preplant, in-crop use on resistant crops, and post-harvest in conventional or reduced-till systems.

Glyphosate at 0.5 pt/A of a 3 lb ae/gal concentration controls foxtails, at 0.75 pt/A controls volunteer small grains and at 1 pt/A controls wild oat and downy brome less than 4 inches tall. Use higher rates on larger weeds, tolerant weeds, or if plants are under moisture stress. Use 3 to 10 gpa by ground or 3 to 5 gpa by air when glyphosate is applied at low rates. Glyphosate at 2 pt/A should be applied when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing; at 4 to 6 pt/A when Canada thistle is actively growing and just before the bud stage. Tillage can be performed the same day as glyphosate application for annual weeds but tillage should be delayed for 3 days following application of all other formulations. Some glyphosate formulations contain adjuvants that enhance uptake allowing less time between application and tillage or application.

Glyphosate can be used in the spring before or after planting but before emergence of several crops. Potential for crop injury exists when glyphosate plus 2,4-D or dicamba mixtures are applied immediately before or after planting due to the PRE soil activity of 2,4-D and dicamba. Glyphosate at the equivalent of 2.66 pt/A of a 3 lb ae/gal concentrate is required to control fall planted rye or wheat prior to seeding crops in spring.

Dew on plant foliage at application may reduce weed control. Glyphosate should be applied in low spray water volumes to produce spray droplets having a higher concentration of glyphosate. Dew on leaves dilutes spray droplets and negates the effect of low spray volumes at application.

ALWAYS add AMS to any glyphosate product at 8.5 to 17 lb/100 gallons of water. Increased weed control results from addition of AMS even under good growing conditions or lack of hard water. Allow sufficient time for AMS to dissolve before adding herbicides or other adjuvants.

Registered Glyphosate Products:

Trade Name	Manu- facturer	Active ingredients	lb ai or ae/gal	Adjuvant Load*
Backdraft	BASF	imazaquin + glyphosate-ipa	0.25 + 1.25	None
Campaign	Monsanto	glyphosate-ipa + 2,4-D-ipa	1.2 + 1.9	None
Expert	Novartis	s-metolachlor + atrazine + gly-ipa		None
Extreme	BASF	imazethapyr + glyphosate-ipa	0.17 + 2	None
Fallowmaster	Monsanto	glyphosate-ipa + dicamba acid	1.1 + 0.5	None
FieldMaster	Monsanto	acetochlor + atrazine + gly-ipa	2 + 1.5 + 0.56	None
Gly-Flo	Micro Flo	glyphosate-ipa	3	Partial
Glyfos	Cheminova	glyphosate-ipa	3	Partial
Glyphos X-tra	Cheminova	glyphosate-ipa	3	Full
Glyphomax	Dow	glyphosate-ipa	3	Partial
Glyphomax Plus	Dow	glyphosate-ipa	3	Full
Glyphosate Herb.	DuPont	glyphosate-ipa	3	Partial
Glyphosate Orig.	Griffin	glyphosate-ipa	3	Partial
Glypro	Dow	glyphosate-ipa	4	None
Landmaster BW	Monsanto	glyphosate-ipa + 2,4-D-ipa	0.9 + 1.5	None
Protocol	Monsanto	glyphosate-ipa	3	Partial
Rattler	Helena	glyphosate-ipa	3	Partial
ReadyMaster ATZ	Monsanto	atrazine + gly	2 + 1.5	None
Rodeo	Monsanto	glyphosate-ipa	4	None
Roundup Custom	Monsanto	glyphosate-ipa	4	None
Roundup Original	Monsanto	glyphosate-ipa	3	Partial
RU Original RT	Monsanto	glyphosate-ipa	3	Partial
RU SoluGran	Monsanto	glyphosate-NH3	86.5%	None
RU/Private labels	Various	glyphosate-ipa	3	Partial
Roundup Ultra	Monsanto	glyphosate-ipa	3	Full
Roundup Ultra RT	Monsanto	glyphosate-ipa	3	Full
RU UltraDry	Monsanto	glyphosate-NH3	65%	Full
RU UltraMax	Monsanto	glyphosate-ipa	3.7	Full
Silhouette	Various	glyphosate-ipa	3	Partial
Touchdown	Zeneca	glyphosate-tms	3.45	Partial
Touchdown	Zeneca	glyphosate	3	Full

*Full = No additional NIS needed.

Partial = Additional NIS needed.

None = Additional NIS at full rate required.

Only the Glypro, Pondmaster, and Rodeo formulation of glyphosate can be applied on water because they do not contain adjuvants toxic to fish and aquatic life. Add only approved surfactants for use in water for effective weed control. Some surfactants labeled for use on water are: Agridex, Aberchem Aquatic surfactant, Side-Kick, Side-Kick II, Induce, Liqua-Wet, X-77, Passage, Prospread Activator, R-11, Spreader Sticker, Super Spread 200, Sure-Fact, Triton Ag 98, and Widespread.

A5. SPRAY ADJUVANTS

Postemergence herbicide effectiveness depends on spray droplet retention and herbicide absorption by weed foliage. Adjuvants and spray water quality influence POST herbicide efficacy. Adjuvants are not important to preemergence herbicides because retention and absorption by foliage does not occur. The advent of postemergence herbicides for weed control in corn and soybean has increased interest in adjuvants.

Weed scientists have made many attempts to relate herbicide efficacy to adjuvant properties that influence spray droplets, like retention, deposition, absorption, and HLB. Adjuvant properties successfully predicts the level of herbicide enhancement or non-enhancement. All adjuvants must be field tested with several different herbicides against many weeds and under different environments. Adjuvants are herbicide and weed specific. An adjuvant may increase weed control from one herbicide but not from another. No single adjuvant is best with all POST herbicides. Adjuvant selection should be based on label recommendations, basic herbicide manufacturer "Approved Adjuvant Lists," and unbiased field research.

Spray adjuvants 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 increase injury to crops or reduce weed control.

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 and herbicide absorption.

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

A5 - SPRAY 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 Accent, Pursuit, Raptor, and Poast 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 Accent, Basagran, Carbyne, glyphosate, Poast, Pursuit, Ultra Blazer, and 2,4-D amine. Fertilizer applied with other herbicides may reduce weed control or cause crop injury. Fertilizers should be used with herbicides only as indicated on the label or where experience has proven acceptability.

Ammonium sulfate (AMS) at 17 lb/100 gal spray volume (2%) has enhanced weed control with glyphosate. Enhancement of glyphosate is most pronounced when spray water contains relatively large quantities of certain ions, such as calcium, sodium, and magnesium. AMS may contain contaminants which may not dissolve and then plug nozzles. AMS should be dissolved in a small amount of water and filtered to prevent nozzle plugging. Commercial solutions of AMS are available.

AMS at 2% is adequate to overcome severe salt antagonism. AMS at 0.5% has adequately overcome antagonism of glyphosate from 300 ppm calcium. Ammonium ions also are involved in herbicide absorption and have enhanced phytotoxicity of many herbicides in the absence of salts in the spray carrier. Herbicide enhancement by nitrogen compounds appears most pronounced to certain species like velvetleaf or sunflower.

AMS enhances phytotoxicity and overcomes antagonism from salts of Poast, glyphosate, 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 which causes a visible loss in weed control is difficult to establish because weed control also is influenced by many other factors. Comparisons of adjuvants should be made at marginal control levels to determine the effectiveness of adjuvants for specific herbicides, sprays, water and weeds. Effective adjuvants will enhance herbicides at reduced rates and provide consistent results under adverse conditions. However, reduced rates exempt herbicide manufacturers from liability for nonperformance.

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. Formation of herbicide acid with pH modifiers may precipitate and plug nozzles when solubility is exceeded, such as with high 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 blend adjuvants are non-oil and are different from additives which lower spray solution pH. These increase water pH which increases water solubility of certain herbicides, such as Accent, Pursuit, Raptor, and UpBeet. For example, Accent solubility at water pH of 5 is 360 mg/L, at 7 is 12,200 mg/L, and at 8 is 39,200 mg/L. Basic blend adjuvants also reduce precipitation problems with Betamix/Betanex/Betamix Progress plus UpBeet at low rates by increasing water pH. They contain nitrogen fertilizer that increases water pH, a surfactant that aids in retention, deposition, and absorption, and a buffer.

Research has shown that basic blend adjuvants enhance weed control from Accent, Pursuit, and Raptor 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. Quad 7 is less expensive at field use rates than MSO type adjuvants. Quad 7 used at 1% v/v (1 gal/100 gal of water) and costs approximately \$0.75/A at 5 GPA or \$1.50/A at 10 GPA. MSO type adjuvants cost approximately \$2.50 to \$3.00/A at the 1.5 pt/A rate.

Antagonism of glyphosate by calcium in a spray solution was overcome by sulfuric but not nitric acid, indicating that the sulfate ion was important, not the acid hydrogen ion. The importance of the sulfate explains the effectiveness of the ammonium sulfate, and not 28% UAN, in overcoming calcium antagonism of glyphosate. Other herbicides which become acid at a higher pH than glyphosate may more 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.

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 in certain highly alkaline waters or in a mixture with other herbicides or fertilizers that raise pH. Thus, precipitate problems have occurred occasionally with Assert in North Dakota. The "solution" to the problem is a lowering of the spray solution pH by a strong acid, like sulfuric or hydrochloric acid. Sulfuric acid is available at most dealers and is sold as a potato vine desiccant. Hydrochloric acid, as muriatic acid, is available in most hardware stores.

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.

Commercial adjuvants differ in effectiveness with herbicides. Data from the table below are from experiments conducted from 1992 through 1995 compared commercial adjuvants with Roundup (glyphosate with surfactant) or Honcho (glyphosate without

surfactant) at various locations in North Dakota. Data was 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. 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 one of the more effective adjuvants from the list.

Commercial adjuvant effect on Roundup/Honcho (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
Amway 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.

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 type additives have often given greater weed control than petroleum oil additives and nonionic surfactants

(NIS) but cost up to 2 to 3 times more. The added cost of MSO's and increased risk of crop injury when used at high temperatures have deterred people from using this class of adjuvants.

Some herbicide labels restrict use of oil adjuvants and recommend only the 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 adjuvant referred to as crop oil concentrates (COC) or methylated seed oil (MSO) adjuvants may be used. The term crop oil concentrate is misleading and incorrect. The base substance in COC is petroleum oil based ingredients, not crop oil based.

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. The following are conditions where MSO type additives may give greater weed control than other adjuvant types:

Conditions that favor use of MSO type adjuvants:

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 weed or 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. Only some herbicides give greater weed control when used with MSO type adjuvants. For example: Accent, Pursuit, Raptor, and UpBeet have shown greater weed control when used with an MSO type adjuvant compared to a NIS. Also, glyphosate should never be used with an oil adjuvant because glyphosate is very water soluble (water + oil don't mix) and the added cost of an MSO is not necessary.

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, some oil adjuvants are applied with Accent, Raptor, Pursuit, Assure II, 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. For example, 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.

Quad 7 applied with Accent, Pursuit, and Raptor may help simplify the confusion. Quad 7 is recommended at 1% v/v regardless of spray volume. Data indicates Quad 7 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 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 2,4-D and MCPA amines (not esters), Poast, glyphosate, and dicamba products. Water samples with 1600 ppm sodium bicarbonate have been observed, but antagonism of the 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, to a lesser degree, magnesium are antagonistic to 2,4-D and MCPA amine, dicamba, and glyphosate. 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:
AMS (lb/100 gal) = 0.005 ppm Na + 0.002 ppm K + 0.009 ppm Ca + 0.014 ppm Mg.

An analysis of spray water sources will provide a guide for determining possible effects on herbicide efficacy. 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% as indicated on many labels (17 lb/100 gallons spray) will overcome the antagonism from the highest calcium and/or sodium concentrations in North Dakota waters for glyphosate, Poast, 2,4-D amine, MCPA amine, and dicamba. However, AMS at 1% 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 does not appear essential to the action of most herbicides. AMS, granular or liquid, and 28% UAN fertilizer help overcome antagonistic salts in spray carrier water. The 28% UAN fertilizer overcomes mineral antagonism of most herbicides, but not Glyphosate. Research with amounts of 28% UAN fertilizer is limited, but 4 gal/100 gal of spray has generally been adequate.

The AMS and 28% UAN adjuvants have enhanced herbicide control of certain weeds even in water without salts. This is especially true for glyphosate, sulfonylurea (SU) herbicides (Ally, Amber, Express, Harmony Extra, and Harmony GT), Ultra Blazer, and Basagran. Nitrogen fertilizer/surfactant blends (e.g. Surfate/ others) may enhance weed control of most herbicides formulated as a salt. However, AMS, 28% UAN, or other adjuvants should be used with caution as their benefit often is limited to specific herbicides or weeds and may be antagonistic to other herbicides or weeds.

A7. USING HERBICIDES AT REDUCED RATES

Applying the lowest herbicide rate for control of target weeds or herbicide application at rates that will provide the greatest return over herbicide and application costs is the goal of many growers. This "best" herbicide rate will be different for every combination of herbicide-environment-weed species-crop-weed growth stage-crop growth stage-adjuvant-weed density-tolerance for risk by user. Sometimes, the "best" herbicide rate will be lower than the lowest rate on the herbicide label. To understand why this is true, we need to understand some of the assumptions and considerations of the companies when they write a label.

Weed Size and Crop Size. Companies must make an assumption about the normal size of weeds and crops when the herbicide will be applied. Generally, small weeds are more susceptible to herbicides than large weeds, but small crop plants also may be more susceptible. Herbicide rate reduction may be possible if the herbicide is applied to weeds that are smaller than the weed size on the herbicide label. The crop also may be smaller than the suggested crop stage at application, so knowledge of safety to the crop would be needed. Herbicide rates can sometimes be reduced by early application but special knowledge is needed.

Environment. Companies can not write a label that anticipates all environments in which a herbicide may be used. Environment has a large influence on the efficacy of herbicides. Herbicide rate reduction may be possible if the specific environment will favor high phytotoxicity from the herbicide but special knowledge is needed on the environment-herbicide interaction.

Adjuvants. The efficacy of some postemergence herbicides is enhanced by adjuvants such as surfactants, crop oils, methylated seed oils or fertilizer. Adjuvants vary considerably in ability to enhance herbicide efficacy even among a class of adjuvants. For example, some surfactants may double percent weed control from a herbicide while other surfactants may have little effect. The number of adjuvants presently sold is so large that testing all adjuvants with all herbicides is not possible. Companies must set label rates for herbicides by assuming that adjuvants will or will not be used and that adjuvants used will be similar to those tested with the herbicides. Herbicide rates can sometimes be reduced by using an adjuvant that is highly effective with the specific herbicide but special knowledge is needed. The herbicide-adjuvant combination must be safe on the crop as well as provide good weed control.

Method of Application. Sprayer pressure-volume-speed-nozzle type-delivery system will influence herbicide efficacy. Companies must assume an average or common application method when writing a herbicide label. Special knowledge of the best application method for a specific herbicide and situation may allow a reduction in herbicide rate.

Weed Species. Weeds may vary considerably in susceptibility to a herbicide. Companies sometimes list weed species separately on the label with different rates for different weeds. Some labels do not vary rates by weed species. Herbicide rates can often be reduced if the field is infested only with weed species that are highly susceptible to the herbicide. Special knowledge of weed response to the herbicides is needed.

Performance Complaints. Chemical companies recommend product use to obtain adequate performance across a wide range of conditions and uses. Herbicide rates on labels are often set to reduce the risk of less than adequate weed control and to reduce numbers of complaints. A herbicide user who is willing to accept a higher risk of poor weed control can reduce herbicide rates below the labeled rate.

This should only be done when conditions favor high efficacy from the herbicide and susceptible weeds are present.

Production Cost of the Product. Companies rarely consider the production cost of the product when they set the labeled rate of a herbicide. Companies that sell herbicides are not selling a product, they are selling a service. The companies would prefer to recommend the least amount of herbicide to control the weeds because the value of the service (the weed control) would be the same regardless of rate of herbicide. So, companies do not deliberately set rates higher than necessary but refinements in rates are possible with special knowledge about specific situations.

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 herbicides 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.

A8. SPRAYER CLEANOUT

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 failing to clean tanks after using non-selective herbicides (glyphosate and Liberty) on herbicide resistant crops. 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 solution including an oil adjuvant or nitrogen solution was put in the sprayer, the herbicide was desorbed, moved into the spray solution, and damaged susceptible crops. Highly active herbicides that have been difficult to wash from sprayers and have caused crop injury include dicamba, Pursuit, Raptor and sulfonyleurea herbicides.

Herbicides difficult to remove from sprayers are thought to be attaching to residues remaining from spray solutions that deposit in a sprayer. 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 cleanup 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:

Accent, Ally, Amber, Assure II, dicamba, Basis, Basis Gold, Beacon, Exceed, Expert, Finesse, FirstRate, Glean, Peak, Permit, Harmony GT, Python, Resolve, Stinger.

Kerosine or diesel fuel followed by ammonia + water:
2,4-D ester

Ammonia or commercial tank cleaner + water:

Action, Basagran, Bladex, Buctril + Atra, bromoxynil, Classic, Cobra, Contour, Dual/II/Magnum, Flexstar, Fusilade DX, Fusion, Gauntlet, Gramoxone, Harness, Harmony Extra, Hornet, Lasso, Lightning, Moxy, Moxynil, Passport, Prowl, Pursuit, Pursuit, Plus, Reflex, Resource, Scepter, Select, Squadron, Status, Steel, Surpass, Treflan, trifluralin, Ultra Blazer.

Water: Command and glyphosate.

Detergent + water: Atrazine and Sencor.

Commercial tank cleaner + water:

Liberty, Marksman, Optill, Shotgun, and Touchdown

Detergent or commercial tank cleaner + water: Turbo

Ammonia, commercial tank cleaner, or detergent + water:
Poast.

A9. SPRAY AND VAPOR DRIFT:

(Refer to NDSU Extension Circular A-657, "Herbicide Spray Drift," for additional information.) Movement of herbicides off target is a problem as herbicides move from target fields into non-target areas containing crops or other susceptible plant species. Drift of all herbicides should be avoided as much as possible. However, the risk of injury to non-target plants varies greatly among herbicides. In general, POST herbicides that are highly phytotoxic at low rates have the greatest potential for damaging non-target plants. Spray drift and injury to plants are affected by several factors.

Wind velocity and direction: To minimize spray drift injury, wind direction should be away from susceptible plants during herbicide application. The wind velocity should be less than 10 miles per hour. However, drift can occur even with lower wind velocities, especially when air is vertically stable. 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 impact plants two miles or more downwind. Herbicide application should be avoided when vertically stable air conditions occur. These conditions can be identified by the presence of fog or by observing smoke bombs or dust from a gravel road.

Distance between nozzle and target (boom height): Droplets should be released as close to the target as possible while maintaining uniform spray coverage. Less distance means less time to fall and therefore less potential for drift to occur.

Herbicide formulation: All herbicides can drift as spray droplets, but some herbicides are sufficiently volatile to cause plant injury from vapor or fume drift. Herbicide volatility and consequent risk of damage to susceptible plants increases with increasing temperature. High volatile esters of 2,4-D or MCPA may produce damaging vapors at temperatures as low as 40 F while low volatile esters 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. Thus, low volatile ester could be exposed to temperatures high enough to cause damaging vapor formation even when the air temperature is below 70 F.

Dicamba is formulated as different salts and have different relative volatility potentials. The dimethyl amine salt has a volatility potential of 10 (10 = high and 0 = low), sodium salt has a volatility potential of 7, and the diglycolamine salt has a volatility potential of 2.

Herbicide vapor drifts further and over a longer time than spray droplets. A 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, 2,4-D ester, dicamba, and MCPA ester should not be used near susceptible plants.

Drift control: Spray drift can be reduced by increasing droplet size since wind will move large droplets less than small droplets. Droplet size can be increased by reducing spray pressure, increasing nozzle orifice size, special drift reduction

nozzles, additives that increase spray viscosity, and rearward nozzle orientation on aircraft.

Techniques that increase droplet size may reduce weed control from herbicides that require small droplets for optimum effectiveness, such as Assure II, Basagran, Betanex, Betamix, bromoxynil, Fusilade DX, Fusion, and Poast. Weed control from systemic herbicides (example: phenoxy type herbicides) are affected little by droplet size within a normal range. Droplet size has minimal effect on glyphosate, but glyphosate is partially inactivated by increased water volume so spray recommendations on the label should be followed.

Spray shields: Shields around spray nozzles or spray booms will partially protect spray droplets from wind and reduce spray drift. Small plastic cones that fit around individual nozzles reduce drift by approximately 25 to 50% and spray shields which 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.

Injury from herbicide drift: Damaging drift to non-target plants is primarily a problem with herbicides that are toxic in small amounts such as dicamba, Express, glyphosate, paraquat, Harmony GT, Harmony Extra, Liberty, MCPA, Pursuit, and Tordon. However, all herbicides may drift and cause significant damage to susceptible non-target plants, so caution must be observed with all herbicide applications.

A10. FIELD INVESTIGATION OF CROP INJURY

Keep an open mind and investigate all possible causes and sources of the observed problem when assessing crop injury. Do not accept, without question, statements of 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.

The Plant Diagnostic Laboratory at North Dakota State University will accept samples and provide an opinion on the cause of the problem. The Plant Diagnostic Laboratory can test soil for Pursuit or Raptor residues or plant tissue for previous exposure to glyphosate. These tests may not always be conclusive. For example, soil containing Pursuit and Raptor residues that are below the detection limit may injure certain highly sensitive crops. A low level of glyphosate injury may not always be detectable. In most situations, opinions on the cause of plant injury will be based on injury symptoms. Refer to Herbicide Carryover for list of testing labs.

Be aware that analysis of plant tissues or soil by a testing laboratory may not provide a definitive answer to the cause of the problem. Each herbicide must be tested individually so testing can be very expensive if numerous herbicides are the possible cause of the problem. A positive detection of a herbicide can be useful but the detected herbicide may not have caused the symptoms. A negative test for a herbicide does not prove that the herbicide did not cause the problem since the herbicide may cause injury at levels 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 will help identify the source of the injury. A sprayer skip in a field will be valuable in diagnosing a herbicide problem, especially if the applicator remembers the reason and the time that the skip occurred. The history of herbicide use on the field 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 the recovery of the damaged plants will be more rapid and more complete as the 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 spray 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 which 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. The damage from spray drift sometimes moves at an angle across nearby fields with a rather distinct line between damaged and undamaged plants at the edge of the line. 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. 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 the 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, rinsing spray cans, rinsing tanks, 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 maintaining 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 the rinsate to the spray 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 of 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. PESTICIDE COMBINATIONS:

The recommended sequence for addition of various herbicide 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**mulsi-fiable concentrates and **S**olutions. Add surfactants, petroleum oils, MSO (methylated seed oil) type and other adjuvants last.

Compatibility testing as described in the next section can be used to determine if tank mixes of pesticides will form a uniform mixture in the spray tank. The effect of POST herbicides often is increased when applied to areas already treated with a PPI or PRE herbicide. Combinations of certain herbicides may give better weed control than use of the individual herbicide alone. However, loss of weed control or increased crop damage may result from the use of certain other herbicides in combination. Herbicide combinations should be used with caution until experience or research has shown that the combination is effective and safe. See the discussion on individual crops for more specific information.

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 must assume 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 been shown to increase 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, Bronate, Curtail mixed with Asana, Cygon, dicamba, 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.

Bladex: Oil-based insecticides increase risk of corn injury.

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

POST Grass Herbicide:

Assure II, Fusilade DX, Fusion, Poast, Prism, Select:

Reduced grass control may result from tank-mixes of Fusilade DX with Lorsban, malathion, Sevin XLR, or Pydrin, 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.

Stampede 80EDF + MCPA e + Oil additive: Do not tank-mix with any organophosphate or carbamate insecticide as serious crop injury will result. Apply Malathion 14 days after application.

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	Adjuvant with		Tilt
	Mancozeb	Mancozeb	
Achieve	PROHIBITED	PROHIBITED	PROHIBITED
Aim	Not Prohibited	Yes, if required	Not Prohibited
Ally	Not Prohibited	Yes, if required	Not Prohibited
Amber	Not Prohibited	Yes, if required	Not Prohibited
Assert	Not Prohibited	Yes, see label	Not Prohibited
Avenge	Not Prohibited	Yes, see label	Not Prohibited
Bromoxynil + MCPA	See Product Bulletin Zee	Not needed	Not Prohibited
Bromoxynil	See Product	Not needed	Not Prohibited
Canvas	Not Prohibited	Yes, if required	Not Prohibited
Cheyenne	PROHIBITED	PROHIBITED	PROHIBITED
Curtail/M	Not Prohibited	Yes, if required	Not Prohibited
Dakota	See Dakota label	PROHIBITED	Not Prohibited
Dicamba	Not Prohibited	Yes, if required	Not Prohibited
Discover	Not Prohibited	Yes, if required	Not Prohibited
Express	Not Prohibited	Yes, if required	Not Prohibited
Finesse	Not Prohibited	Yes, if required	Not Prohibited
Hrmny Extra	Not Prohibited	Yes, if required	Not Prohibited
Hoelon	See Hoelon label	Oil additive	Not Prohibited
	Spring wheat only		
MCPA	Not Prohibited	Yes, if required	Not Prohibited
Peak	Not Prohibited	Yes, if required	Not Prohibited
Puma	Not Prohibited	Yes, if required	Not Prohibited
Stampede	See current label	Oil additive only	PROHIBITED
Starane	Not Prohibited	Yes, if required	Not Prohibited
Tiller	See Tiller label	PROHIBITED	Yes
2,4-D	Not Prohibited	Not Prohibited	Yes, if required

A15. HERBICIDE + LIQUID-FERTILIZER COMBINATIONS

require thorough mixing and continuous, vigorous agitation to obtain an even application. Some herbicide + fertilizer combinations will not form a uniform mixture even with thorough agitation. Herbicide/liquid fertilizer compatibility should be tested before use. To test, combine small quantities of components to be mixed in the same proportions used in the spray 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 the fertilizer. Close the jar and shake well.

Watch the mixture for several seconds and check again 30 minutes later. 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 can be used with on many herbicides that are registered for impregnation on dry bulk fertilizer. 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. Accurate spreader calibration and uniform fertilizer distribution are essential. Consult the herbicide label for minimum amount of fertilizer/A and maximum amounts of herbicide per given weight of fertilizer. Ranges of 200 to 400 lbs/A of dry bulk fertilizer are recommended to maintain uniformity of 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

DoublePlay, Surpass, Achieve, Maverick.
Most dry formulated herbicides in DF or WDG formulations.

Do not store below 40 F

Assert, Avenge, Broadstrike + Treflan, Bronco, Command, FallowMaster, Galaxy, Landmaster BW, Lariat, LI-700, Nortron, Passport, Prowl, Pursuit Plus, Pyramin, Sonalan HFP, Stomp, Treflan, Tri-4.

Do not store below 32 F

Agri-Dex, Basagran, bromoxynil + Atrazine, Conclude, Contour, CropStar, Diquat, Far-Go EC, Flexstar, Freedom, Goal, paraquat, Hyvar, Kerb, Liberty, Liberty AZT, Lasso, Lorox DF, Poast, Pramitol, Progress, Puma, Pursuit, Quest, Raptor, Reflex, Stampede 80EDF, Stinger, Storm, Thistrol, Ultra Blazer, Velpar.

Do not store below 20 F

Fusilade DX, Plateau, Ramrod/+ Atrazine, Ro-Neet, Weedar 64

Do not store below 10 F

Accord, Amitrole T, Arsenal, Cheyenne, Curtail/M, Crossbow, Dakota, Fusion, glyphosate, Rodeo, Roundup, Tiller.

Do not store below 3 F

Bronate, bromoxynil, Bullet, Micro-Tech.

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 and the leaves of the 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 and a standard and 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:

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

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	Concentration of herbicide, %				
	0.5	1.0	1.5	2.0	5.0
gallons	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	5.1	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 Tbsp = 1 cup				
1 Tbsp = 3 tsp	1 fl oz = 30 mls				
1 Tbsp = 15 ml	1 fl oz = 2 Tbsp				

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

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, emerged 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. 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 generally is required to achieve a profitable yield. Broadleaf weeds, foxtails, and wild oat infest small grains statewide. 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 more effective in more competitive crops. Small grains underseeded to sweetclover, alfalfa or other legumes should not be treated with an SU or growth regulator herbicide at rates required to control most broadleaf weeds 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, kochia, common ragweed, and redroot pigweed and when the crop is only 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 with some differences on 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 40DG (tralkoxydim) is labeled for use only in certain geographic areas. Do not apply Achieve 40DG 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 result in injury to spring wheat. Syngenta will not be liable for injury to spring wheat if Achieve is used in these areas.

Achieve at 7 oz WDG/A 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 higher water volumes than listed may result in reduced grass weed control. Achieve is packaged with Supercharge adjuvant and should be added at 0.5% v/v. 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, bromoxynil, bromoxynil + MCPA (maximum of 1 pt/A), 2,4-D ester, Curtail M (maximum of 2 pt/A), Harmony GT, and Starane. Tank-mixing other herbicides, especially dicamba or SU herbicides will result in reduced grass weed control. If other herbicides are used, apply Achieve 5 or more days before the broadleaf herbicide.

B4. Aim (carfentrazone) At 0.33 to 0.67 oz 75DF/A applied POST controls most broadleaf weeds including mustards, nightshade, pigweed, lambsquarters, and may control or suppress kochia (including ALS resistant types) and wild buckwheat in wheat, barley and oat. Add NIS at 0.25% v/v. See labels of POST grass (wild oat) herbicides for tank-mixing instructions. Aim may be tank-mixed with most broadleaf herbicides registered in wheat. Data shows that Aim may be safened when tank-mixed with SU herbicides. Do not tank-mix Aim with 2,4-D ester or MCPA ester. Aim is a contact herbicide, requires application to small weeds, and may produce speckling and spotting on leaves receiving spray. Symptoms should soon disappear after new growth appears. Degree of speckling is determined by temperature, amount of leaf foliage receiving spray, and adjuvants used with tank-mixes.

B5. Ally (metsulfuron) at 0.1 oz 75DF/A provides POST control of broadleaf weeds in wheat and barley and should be applied with another broadleaf herbicide to prevent resistant weeds. Burndown or speed at which weeds are killed is faster with Ally than other SU herbicides. Ally can be mixed with MCPA, 2,4-D, bromoxynil, bromoxynil + MCPA, dicamba, and Starane. Ally should be applied with a NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Tank-mixing Ally with organophosphate insecticides increases crop injury potential. Do not apply Ally to soils with a pH greater than 7.9. Ally spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section. Ally may persist in the soil for 3 years or more. Refer to the herbicide residue section on Ally carry-over and recropping restrictions.

B6. Amber (triasulfuron) at 0.28 to 0.35 oz 75DF/A applied POST controls several broadleaf weeds and provides partial control of Canada thistle, cheat and downy brome in wheat and barley. Burndown or speed at which weeds are killed is slower for Amber than other SU herbicides. Apply 2,4-D in combination with Amber to improve Canada thistle control. Amber must be applied as a tank mixture with another broadleaf herbicide of different mode of action to prevent resistant weeds. Do not apply Amber or other similar mode of action herbicides within a 12 month period after application. Amber can be mixed with MCPA, 2,4-D, Assert, bromoxynil, Bronate, Curtail, dicamba, Fallow Master, or paraquat. Add a NIS at 0.12 to 0.25% v/v to Amber depending on the tank-mix herbicide and rate. Tank-mixing Amber with organophosphate (OP) insecticides increases potential for crop injury, but Amber can be tank-mixed with all OP insecticides except malathion. Amber spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section. Amber may persist in the soil for 4 years or more. Consult label or herbicide carryover/residue section for rotational crop restrictions.

B7. Assert (imazamethabenz) at 1 to 1.5 pt/A provides POST wild mustard and wild oat control in wheat and barley. Assert should be applied to wild oat in the 1- to 4-leaf stage when wheat and barley are in the 2-leaf to jointing stage of growth. Assert also gives good mustard control and suppresses wild buckwheat that have 3 leaves or fewer. Assert has provided more consistent wild oat control with environmental stress than other POST wild oat herbicides in wheat and barley. Apply with a methylated seed oil adjuvant for greater and more consistent weed control. Refer to herbicide residue section for information on rotational crop restrictions. Assert can be tank-mixed with Ally, Amber, Canvas, Curtail M, MCPA or 2,4-D ester, bromoxynil + MCPA, Peak, Harmony Extra, or Express.

Spray solution incompatibility (thickening) may develop if Assert is tank-mixed with dicamba or amine formulations of 2,4-D or MCPA. Thickening may result if spray solution pH is increased. Using hard water, water with high pH, or additives that increase spray solution pH can cause the spray solution to thicken. To reverse thickening, add an acid, preferably muriatic acid to lower water pH. Muriatic acid is available at most agricultural outlets and comes in different concentrations (10% HCl to 100% HCl). Regardless of the concentration add only enough to change the solution to a liquid state (less than 1 gal/100 gal water if using 10% HCl concentration).

B8. Avenge (difenzoquat) is applied at 2.5 to 4 pt/A for control of wild oat at the 3- to 5-leaf stage. Avenge is cleared for use on varieties of the following crops:

Barley: All varieties can be treated.

Durum wheat: All varieties can be treated except:

Vic, Fjord, Edmore, Lakota, Renville and Wascana.

Winter wheat: All varieties can be treated.

Hard Red Spring Wheat: 2.5 to 4 pt/A can be used on:

Amidon, Apex, Buckshot, Butte, Butte 86, Columbus, Coteau, Era, Erik, Fjeld, Fortuna, Glenlea, Glenman, HY320, Katepwa, Leader, Leif, Marshall, Minnpro, Newana, Norak, Norm, Olaf; Oslo, 2369, Pondera, ProBrand 711, Pro-Brand 715, Prodax, Rambo, Selkirk, Sharp, Solar, Sonya, Stoa, Success, Telemark, Vance, and Wheaton.

2.5 to 3 pt/A can be used on:

2375, AC Barrie, AC Domain, AC Majestic, Anvil, Bacup, Ernest, Forge, Hamer, Hi-Line, HJ 98, Ingot, Ivan, Kulm, Lars, McKenzie, McNeal, ND 2375, Norlander, Oxen, Russ, Sharpshooter.

Hard Red Spring Wheat varieties injured by Avenge:

Research is conducted each year to determine tolerance of new and experimental HRS wheat varieties to Avenge. Even though research may show tolerance of a non-labeled variety to Avenge, use Avenge only on wheat varieties listed on the label. Consult the Avenge label for a complete listing of varietal restrictions.

Wild oat is more susceptible to Avenge at the 5-leaf than the 3-leaf stage of growth and control is improved by good crop competition. High rates should be used on high populations of 3-leaf wild oat. Wheat injury may occur at temperatures above 80 F. Avenge may be mixed with bromoxynil, bromoxynil + MCPA, MCPA, 2,4-D, Ally, Harmony Extra, Express, or Curtail, for broadleaf weed control without loss of wild oat control.

B9. Bromoxynil controls kochia, wild buckwheat, fumitory and most annual broadleaf weeds in wheat, barley and oat from crop emergence to early boot. Trade names of some bromoxynil products available are **Buctril**, **Broclean**, and **Moxy**. For broader spectrum weed control, bromoxynil plus MCPA ester should be applied from the 3-leaf to early boot stage. Bromoxynil can be tank-mixed with many herbicides labeled POST in small grains. See label.

Bromoxynil + MCPA (ester) at 0.75 to 2 pt/A gives excellent control of volunteer sunflower. Trade names of some bromoxynil + MCPA products available are **Bison**, **Bromac**, **Bronate**. A commercial copack of Puma and bromoxynil + MCPA is **Bronate Pro**.

B10. Canvas 75DF (metsulfuron + thifensulfuron + tribenuron) at 5 to 10 A/pack provides POST control of broadleaf weeds in wheat and barley and should be applied with another broadleaf herbicide to prevent weed resistance. Burndown or speed at which weeds are killed often is faster with Canvas than with other SU herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. See sections on Ally and Harmony Extra for additional information.

B11. Cheyenne (fenoxaprop-P plus MCPA plus Harmony Extra (thifensulfuron plus tribenuron)) at 40 acres/case controls green foxtail, foxtail millets, barnyardgrass, proso millet, volunteer corn, and wild oat and provides suppression of yellow foxtail. Cheyenne also controls several broadleaf weeds including, kochia, Russian thistle, common lambsquarters, wild mustard, and redroot pigweed. Cheyenne is sold as a twin pack, one container of Cheyenne and one container of X-tra herbicide. One box of Cheyenne contains two 20 acre units. Cheyenne herbicide must always be tank-mixed and applied with the X-tra herbicide to ensure crop safety and control of weeds listed on label.

Apply Cheyenne to spring wheat from the 3-leaf stage to the end of tillering (6-leaf). Winter wheat should have a minimum of 3 tillers before application. **Do not** spray spring or winter wheat after jointing begins. Cheyenne will control wild oat in the 1- to 4-leaf stage of growth and green foxtail in the 2-leaf to 2-tiller stage. Annual broadleaf weeds should be beyond the cotyledon stage but less than 4 inches tall or in diameter. Cheyenne should be applied to vigorous growing weeds within the proper growth stage. Low soil moisture, low humidity, and high temperatures may interact to reduce wild oat control. Green foxtail is controlled over a wide range of soil moisture conditions but stress from severe drought may reduce weed control.

Do not apply Cheyenne to durum wheat, barley, tame oat, or rye. Cheyenne can be tank-mixed with bromoxynil, or Stinger additional control of wild buckwheat. See Cheyenne label for tank-mix rates. **Do not** tank-mix Cheyenne with any other herbicides, surfactants or liquid fertilizers unless recommended on the Cheyenne label. Drift of Cheyenne may injure susceptible plants. Follow sprayer cleanout instructions on the label to avoid subsequent injury to crops other than wheat following application.

B12. Curtail (clopyralid plus 2,4-D) at 2 to 2.33 pt/A or **Curtail M** (clopyralid + MCPA) at 1.75 to 2.33 pt/A provide control of 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. Only Curtail M is allowed on oat. See herbicide residue section for recropping restrictions.

B13-19 - SMALL GRAINS

B13. Dakota (fenoxaprop-P plus MCPA) at 16 to 21.3 fl oz/A controls green foxtail, foxtail millets, wild mustard and other broadleaf weeds in winter and spring wheat. Dakota can be tank-mixed with several broadleaf herbicides, however antagonism of foxtail may occur. Dakota at 16 oz/A can be tank-mixed with dicamba, or Starane. Dakota at the 21.3 fl oz/A rate can be tank-mixed with Ally, Amber, bromoxynil, Express, Harmony GT, Harmony Extra, Peak, Stinger, or Starane. Dakota should be applied to spring wheat from the 3-leaf stage to the end of tillering (up to 6-leaf stage). Winter wheat should have a minimum of 3 tillers before application. Do not apply to winter or spring wheat after jointing begins. Dakota will control grasses in the 2-leaf to 2-tiller stage and annual broadleaf weeds up to 4 inches tall. Poor green foxtail control may occur if plants are drought stressed. Dakota cannot be applied to durum, barley, tame oat, or rye and cannot be applied with other herbicides or other additives except as indicated on the label. Drift of Dakota may injure susceptible plants and trees. Dakota can be applied by air.

B14. Dicamba at 0.125 to 0.25 pt/A controls kochia, wild buckwheat, smartweed and certain 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. Both crops must be treated during the 2-through 4-leaf stage. Barley can be treated during the 2- through 3-leaf stage but barley tolerance is marginal. dicamba can be applied with 2,4-D, MCPA, Ally, Harmony Extra, Express or bromoxynil to wheat. Allow 45 days/pt of dicamba excluding days when ground is frozen for degradation.

B15. Discover (clodinafop + safener) at 3.2 fl oz/A plus DSV adjuvant at 10.2 fl oz/A controls wild and volunteer oat, barnyardgrass, canarygrass, and volunteer corn and at 4 fl oz/A plus DSV adjuvant at 12.8 fl oz/A controls green, yellow, and giant foxtail, Persian dandelion and annual ryegrass in wheat, including durum. Discover and DSV adjuvant are packaged in one box in separate containers. Add both herbicide and adjuvant in spray tank and apply at 40 (4 fl oz/A) or 50 (3.2 fl oz/A) acres per box. Wheat has excellent tolerance to Discover. Apply Discover with at least 5 gpa by ground or 3 gpa by air. Apply Discover to wheat from 2-leaf to emergence of 4th tiller. Discover will control foxtail in the 1- to 5-leaf stage and wild oat in the 1- to 6-leaf stage. Grasses should be actively growing but Discover controls grass weeds over wide environmental conditions. Discover can be applied with many herbicides, insecticides, and fungicides labeled in wheat. Discover is antagonized much less than other grass herbicides labeled in wheat when tank-mixed with other pesticides. See label for approved tank-mix options.

B16. Everest (flucarbazone) at 0.4 oz WDG/A plus basic blend adjuvants at 1% v/v or NIS at 0.25% v/v controls green foxtail and at 0.6 oz WDG/A plus adjuvants controls wild oat and suppresses yellow foxtail in wheat, including durum. Addition of 28% nitrogen is not prohibited and may increase grass control. Increasing surfactant rate to 0.5% v/v may increase yellow foxtail control. Everest controls mustard species, annual smartweed and suppresses redroot pigweed. Uptake is through leaves and soil residue absorbed by roots may give 2 to 3 weeks residual green foxtail and wild oat control. Always apply Everest with a broadleaf herbicide. Data has shown that 2,4-D safens Everest to wheat under stress without antagonizing wild oat control. Puma also provides effective safening (safener in

Puma) and increases yellow foxtail control. Most crops (except oat) can be planted the year following application. See label for crop rotation restrictions. Apply Everest with at least 5 gpa by ground or air. Apply Everest to wheat and grass weeds with 1 to 6 total leaves (1 to 4 total leaves on main stem plus 2 tillers). Grasses should be actively growing. Everest can be applied with 2,4-D, Ally, Aim, bromoxynil, Curtail, Express, Harmony Extra, MCPA, Starane, or Stinger. Everest safens Aim on wheat. Application with dicamba will result in reduced grass control. See label for additional information.

B17. Express (tribenuron) at 0.17 to 0.33 oz DF/A applied POST with 2,4-D or 2,4-D + dicamba controls several broadleaf weeds and provides season-long control of Canada thistle in wheat and barley. Burndown or speed at which weeds are killed is among the fastest with Express as compared to other SU herbicides. Express should be applied with another broadleaf herbicide to prevent weed resistance. Express can be mixed with MCPA, 2,4-D, bromoxynil, bromoxynil + MCPA, Curtail, dicamba, Starane, Avenge or Assert. Apply with NIS at 0.125% v/v depending on broadleaf herbicide and rate. Tank-mixing Express with organophosphate insecticides increases potential for crop injury. Express spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section.

B18. Far-Go (trilalate) at 1 to 1.5 qt/A or 10 to 15 lb 10G applied pre-plant or PRE incorporated (depending on formulation) controls wild oat control 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. The liquid formulation has given more consistent wild oat control with less crop thinning than the granular formulation when spring applied. See section on fall application. Far-Go at 1 qt/A also 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 if the soil is loose and free of trash. Experiments at NDSU have shown that deeper incorporation enhances wild oat control from Far-Go. Far-Go applied after seeding (PoPI) should be incorporated **less deeply** than the placement 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 HRSW or durum 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 application at other times. Refer to label for information on varieties that may be susceptible to PPI Far-Go.

B19. Buckle (prepackage mixture of Far-Go+trifluralin) can be applied in fall or spring in barley and durum or in spring in durum or in HRS wheat in Adams, Billings, Bottineau, Bowman, Burleigh, Burke, Divide, Dunn, Emmons, Grant, Golden Valley, Hettinger, Kidder, McHenry, McKenzie, McLean, Mercer, Morton, Oliver, Renville, Sheridan, Sioux, Slope, Stark, Ward, and Williams counties in North Dakota for foxtail and wild oat control. Apply and incorporate Buckle at 10 lb/A according to directions on the Buckle label.

HRS wheat varieties susceptible to Buckle include:
Alex, Amidon, Ellar, Era, Erik, Lew, Newana.

Seed semi-dwarf varieties no more than 1.5 to 2 inches deep to minimize stress and allow for uniform germination. Stand reduction may occur on hilltops when applied to fields with rolling terrain. Seed treatments are recommended to reduce potential stress to germinating seedlings from disease or insects.

B20. Finesse (chlorsulfuron + metsulfuron) PRE to HRSW only or POST at 2/10 to 4/10 oz 75DF/A with 2,4-D or 2,4-D + dicamba will control most annual weeds and suppress Canada thistle, and at 3/10 to 4/10 oz 75DF/A will suppress and/or control green foxtails in spring wheat (including durum), and barley. Follow label for application window for Finesse 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. Finesse can be used as an additional mode of action to control or suppress green foxtail that has developed resistance to trifluralin (Treflan), Sonalan, and Prowl (See table in herbicide resistance section). Burndown or speed at which weeds are killed is relatively slow as compared with other SU herbicides.

B21. Harmony Extra (thifensulfuron plus tribenuron) at 3/10 to 6/10 oz 75DF/A applied POST with 2,4-D or 2,4-D + dicamba controls annual broadleaf weeds and provides season-long control of Canada thistle in wheat, barley, and oat. Harmony Extra should be applied with another broadleaf herbicide to prevent weed resistance. Burndown or speed at which weeds are killed is relatively average with Harmony Extra as compared with other SU herbicides. Harmony Extra can be tank-mixed with 2,4-D, MCPA, bromoxynil, bromoxynil + MCPA Curtail, dicamba, Starane, Avenge or Assert. Add NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Tank-mixing Harmony Extra with organophosphate insecticides increases potential for crop injury. Harmony Extra spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough sprayer tank cleaning is required to prevent contamination of subsequent sprays and injury to susceptible crops.

B22. Harmony GT (thifensulfuron) at 0.3 to 0.6 oz DF/A applied POST with 2,4-D or 2,4-D + dicamba controls several broadleaf weeds and suppresses Canada thistle in wheat and barley. Harmony GT should be applied with another broadleaf herbicide to prevent weed resistance. Harmony GT can be mixed with MCPA, 2,4-D, Achieve, Assert, Avenge, bromoxynil, bromoxynil + MCPA, dicamba, Curtail, and Starane. Apply with NIS at 0.125% v/v depending on broadleaf herbicide and rate. Tank-mixing Harmony GT with organophosphate insecticides increases potential for crop injury. Harmony GT spray drift or sprayer contamination causes severe injury to some broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section.

B23. 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 less than 5-tiller stage. Maverick at 0.67 oz DF/A applied spring POST in spring wheat controls wild oat in the 1- to 4-leaf stage. Maverick applied spring POST 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 2,4-D ester, bromoxynil, bromoxynil + MCPA, Cheyenne, Curtail, Dakota, MCPA ester, Stinger, Tiller and most SU broadleaf herbicides labeled in wheat. Maverick should be applied with another broadleaf herbicide 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. Thorough cleaning of a sprayer is required to prevent injury to susceptible crops. See sprayer cleanout section. Maverick may persist in the soil for 3 years or more. Refer to label or carryover and and recropping restrictions.

B24. Peak (prosofuron) at 0.25 to 0.5 oz 57DF/A provides POST control of broadleaf weeds in wheat, barley, oat, rye, triticale, proso millet, and sorghum and should be applied with another broadleaf herbicide to prevent weed resistance. Burndown or speed at which weeds are killed is relatively average with Peak as compared with other SU herbicides. Peak can be mixed with MCPA, 2,4-D, bromoxynil, bromoxynil + MCPA, and dicamba. Peak should be applied with a NIS. Do not apply a foliar or soil organophosphate insecticide within 15 days before or 10 days after Peak. Peak may be applied with bromoxynil, bromoxynil + MCPA, and MCPA from 3-leaf to 2nd node. Corn is tolerant to Peak which is different than other long residue SU herbicides labeled in small grains (Finesse, Ally, Amber). Do not rotate to crops other than field corn, grain sorghum, wheat, barley, oat, rye, proso millet, or triticale the year following Peak application. Peak spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section. Peak may persist in the soil for 3 years or more. Refer to label or herbicide carryover section for rotational cropping restrictions.

B25. Paramount (quinclorac) at 0.33 lb 75DF/A with only MSO type adjuvant postharvest to any crop on land to be planted the following year to wheat, including durum for control of broadleaf weeds including field bindweed. Wheat and sorghum have a 0 hour plant back restriction. An in-crop registration of Paramount is pending federal registration. The registration will allow Paramount use at 0.17 to 0.33 lb DF/A for control of green foxtail, yellow foxtail, barnyardgrass, cleavers/ bedstraw, and volunteer flax, and possibly small kochia and Russian thistle. Refer to label for rate for each weed. Paramount will control or suppress field bindweed. Apply Paramount with another broadleaf herbicides, such as 2,4-D, MCPA, or ALS herbicides to broaden spectrum of weeds controlled. Refer to label for application and use directions.

B26. Puma (fenoxaprop-P + 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 contains fenoxaprop-P + safener. Puma does not contain phenoxy type herbicides for broadleaf weed control. Apply Puma with at least 10 gpa by ground or 5 gpa by air. Apply Puma to wheat from 2-leaf until 60 days prior to harvest and to barley from the 2-leaf to 6-leaf stage. Puma will control grass weeds in the 2-leaf to 2-tiller stage and young, vigorously growing weeds are most susceptible. Low humidity, and high temperature may reduce wild oat control. Foxtail can be controlled over a wide range of soil moisture conditions but severe drought stress may reduce weed control. Puma can be applied with Furan, Sevin XLR Plus, and Warrior insecticides; Mancozeb, Tilt, and Benlate fungicides; and Peak, Curtail M, Stinger, Starane, 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 Ally, Amber, bromoxynil, bromoxynil + MCPA, Curtail M, dicamba, Express, Harmony Extra, Harmony GT, MCPA ester, Starane, or Stinger. For yellow foxtail and wild proso millet, apply Puma at 0.4 pt/A with Curtail M, dicamba, Harmony GT, MCPA ester, Peak, Starane, or Stinger. For barnyardgrass and wild oat control apply Puma at 0.66 pt/A with bromoxynil, Bronate, Curtail, Curtail M, Harmony Extra, Harmony GT, MCPA ester, Peak, Starane, and Stinger. 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. A commercial copack of Puma and bromoxynil + MCPA is **Bronate Pro**.

B27. Rave (dicamba-Na + triasulfuron) at 2 oz WDG/A in barley and 4 oz WDG/A in wheat applied POST controls several broadleaf weeds and provides partial control of Canada thistle. Rave can be applied with bromoxynil, bromoxynil + MCPA, MCPA, 2,4-D, or Tilt. Apply with a NIS at 0.125 to 0.25% v/v. Tank-mixing Rave with organophosphate (OP) insecticides increases potential for crop injury. Rave spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section. Rave may persist in the soil for 4 years or more. Consult label or herbicide carryover/residue section for rotational crop restrictions.

B28. Stampede 80EDF (propanil) at 1.25 to 1.4 lb 80EDF + MCPA iso-octyl ester at 0.5 pt/A controls wild buckwheat, redroot pigweed and other annual broadleaf weeds in hard red spring wheat, durum wheat, barley and oat. All ingredients must be applied together. Petroleum oil at 1 pt/A is required with Stampede 80EDF for optimum weed control. The propanil component controls foxtails. See tables for crop and weed stages. Stampede + MCPA ester + bromoxynil or bromoxynil + MCPA ester at 0.25 to 0.38 pt/A can be tank-mixed to provide greater kochia, Russian thistle, and annual smartweed control. Stampede requires good spray coverage because it is not translocated. Apply Stampede when temperature is between 65 and 85 F and plants are actively growing with adequate soil moisture within 2 inches of the surface. Stampede should not be applied to wheat treated with carbamate or organophosphate insecticides or wheat grown on soil treated the previous year with organophosphate insecticides. Stampede can also be tank-mixed with mancozeb fungicide. The recommended mixing order of products is: 1) add Stampede 80EDF, 2) add Mancozeb fungicide (if desired), 3) add MCPA ester, and 4) add oil additive.

B29. 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, and volunteer flax in wheat, barley and oat. Starane is very effective on kochia and has benefits over dicamba by having excellent wheat, barley, and oat safety, a much wider application window in small grains that extends to flag leaf emergence, controls larger kochia at in-crop use rates, and does not antagonize POST grass herbicides like Achieve, Assert, Avenge, Dakota, Puma, and Tiller. Starane at 0.5 pt/A control kochia less than 4 inches tall and 0.67 pt/A controls kochia at least 8 inches tall while bromoxynil only controls small kochia less than 1 to 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 will be labeled with most POST grass herbicides registered in wheat. Refer to label of tank-mix partner for tank-mix options. Commercial premix formulations of Starane + 2,4-D are available as Starane + Salvo at 1 to 1.33 pt/A, or Starane + Saber at 1.5 to 2 pt/A, or Starane + MCPA as Starane + Sword at 1.125 to 1.5 pt/A.

Starane is a systemic herbicide with no soil residual or carryover. Only weeds emerged at time of application will be controlled. Dew at application may decrease control. Starane is very safe on small grains. Apply to small weeds that are actively growing. Do not allow livestock to graze treated fields within 7 days of application. Allow a 40 day PHI. If replanting is required, only plant registered crops within 120 days after application.

Refer to tables or labels for weeds controlled, application timing, and other application information and restrictions.

B30. Tiller (fenoxaprop-P plus 2,4-D plus MCPA) at 1 pt/A controls green foxtail, foxtail millets, volunteer corn, common lambsquarters and wild mustard. Tiller at 1.2 pt/A controls all weeds listed above plus yellow foxtail, volunteer and wild-proso millet. Tiller at 1.7 pt/A controls all weeds listed above plus wild oat, barnyardgrass and several broadleaf weeds. Tiller can be applied to winter and spring wheat when wheat begins to tiller (3- to 4-leaf stage) up to the 6-leaf stage. Winter wheat should have a minimum of three or more tillers before application. **Do not apply to wheat or barley after jointing begins.** Tiller controls actively growing grasses in the 2-leaf to 2-tiller stage and annual broadleaf weeds less than 4 inches tall. Conditions that may reduce wild oat control are low soil moisture, low humidity, and high temperature. Foxtail can be controlled over a wide range of soil moisture conditions but severe drought stress may result in reduced control. Tiller can be tank-mixed with Starane, and Stinger for control of weeds listed on the label. Other broadleaf herbicides listed for tank-mix applications with Tiller may antagonize wild oat and yellow foxtail control. For green foxtail and foxtail millet control, apply Tiller at 1 pint/A and Tiller can be tank-mixed with dicamba, bromoxynil, MCPA ester, Starane, or Stinger; at 1.2 pints/A Tiller can be tank-mixed with Ally, Amber, Express, Harmony GT, Harmony Extra, and Starane. For control of yellow foxtail, wild and volunteer millets, apply Tiller at 1.2 pints/A and Tiller can be tank-mixed with dicamba, MCPA ester, Peak, Starane, or Stinger.

For wild oat control apply Tiller at 1.7 pints/A and Tiller can be tank-mixed with bromoxynil and Stinger. Tank-mixing Tiller with bromoxynil or any sulfonyleurea herbicide will result in reduced yellow foxtail control due to antagonism. Tiller cannot be applied to durum, tame oat, or rye and cannot be applied with other herbicides or additives except as indicated on the label. Tiller can be applied by air ONLY for foxtail control.

B31. Trifluralin at 1 pt/A of a 4 lb/gal concentrate or 5 lb/A 10G applied after spring seeding and harrow incorporated shallowly after seeding, is labeled for control of foxtails in wheat and barley. The lower rate is for use on coarse textured soils and the higher rate on fine textured soils. Incorporation should be by harrowing twice at right angles and the depth of incorporation of the herbicide must be above the wheat seed. The 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 will occur. 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 applications in the fallow year for foxtail control in small grains the next year.

B32. 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 if wet and cool after treatment. All herbicides labeled for preharvest application are systemic 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 use on oats. **Paraquat is NOT labeled as a harvest aid in small grains.**

B33. 2,4-D as a Harvest Aid

2,4-D at 1.5 to 3 pt/A is labeled as a harvest aid in spring wheat, durum, barley, and rye. Labels vary in crop use. Follow the label. Apply at the dough stage of spring wheat, barley or rye. 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. Apply only those products that allow intended use. An ester formulation will give better control and quicker burndown than an amine formulation. If using an ester formulation, use a low volatile formulation to reduce vapor drift potential. If using an amine, at least 2 pt/A is needed for larger weeds. 2,4-D does not control large pigweed, kochia or wild buckwheat. Large kochia and other 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 control and grass control. Follow the glyphosate label. The labels of most formulations of 2,4-D have restrictions of no dairy grazing allowed, a 7-day waiting period for meat animal grazing, and a 30-day waiting period prior to haying. Do not feed straw to livestock.

B34. 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. Must follow crop rotation restrictions. Apply Ally at 0.1 oz product/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.

B35. Dicamba + 2,4-D as a Harvest Aid

Dicamba is labeled only in North Dakota as a preharvest application in wheat and durum applied alone or in a tank-mix combination with 2,4-D. 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. A waiting period of 10 to 14 days is required before harvest. Do not feed treated straw to livestock. **Caution: Drift to broadleaf crops is especially hazardous at this time.**

B36. Glyphosate as a Harvest Aid

Glyphosate is labeled as a harvest aid only in spring wheat and durum - not barley or oats. Glyphosate at 0.5 to 2 pt/A of a 3 lb ae/gal concentrate controls annual grass, broadleaf weeds, and quackgrass and suppresses Canada thistle in hard red spring wheat and durum. **DO NOT** apply to barley. **DO NOT** apply to wheat grown for seed 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 the 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 at 8.5 to 17 lb/100 gallons of water. AMS increases control of annual and perennial weeds and 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 an NIS. Refer to label for addition of other adjuvants

Glyphosate can be tank mixed with 2,4-D for additional broadleaf control. A ND 2(ee) label interpretation has been granted allowing use of glyphosate at 0.75 to 2 pt/A + dicamba at 0.25 to 0.5 pt/A for a preharvest application to wheat and durum at the hard dough stage after green color is gone from stems. Allow a 14 day PHI. The tank-mix can be applied by ground or air.

B37. Landmaster BW as a Harvest Aid

Landmaster BW (glyphosate + 2,4-D isooctyl ester) applied at 3.38 pt/A (54 fl oz/A) to 5.25 pt/A controls annual grass and broadleaf weeds, quackgrass, and suppresses Canada thistle in hard red spring wheat and durum. **DO NOT apply to barley.** **DO NOT** apply more than 5.25 pt/A as a harvest aid. See paragraph above on glyphosate for application information.

Application should be made after the hard dough stage (30% or less grain moisture) of the wheat and at least 7 days prior to harvest. **DO NOT** apply to wheat grown for seed as a reduction in germination or vigor may occur. Be aware of the injury potential of glyphosate drift on sensitive plants. Do not feed or allow dairy or meat animals to forage on treated plants for 2 weeks after application. Do not feed treated straw.

CORN

C1. A combination of cultural, mechanical and chemical methods is necessary for effective weed control in corn. Control early germinating weeds by cultivation 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.

C2. Package Mixtures Available For Corn:

Trade Name	Common Name	Product/A
Accent Gold	nicosulfuron+rimsulfuron+clopyralid+flumetsulam	2.9 oz DF
Axiom	flufenacet + metribuzin	15 to 23 fl oz
Axiom AT	flufenacet+atrazine+metribuzin	2 to 3.75 lb
Basis	rimsulfuron + thifensulfuron	0.33 oz DF
Basis Gold	nicosulf+rimulf+ atrazine	14 oz DF
Bicep, Bicep II	atrazine + metolachlor	1.8 to 3 qt
Bicap Lite	atrazine + metolachlor	1.5 to 3.5 qt
Broadstrike+Dual	flumetsulam + metolachlor	1.75 to 2.75 pt
Bronco	alachlor + glyphosate	3 to 5 qt
Buctril + Atrazine Brozine, Moxy AT	atrazine + bromoxynil	1.5 to 3 pt
Bullet	atrazine +alachlor	2.5 to 4.5 qt
Celebrity Plus	nicosulfuron + dicamba	4.67 oz WDG
Curtail	clopyralid + 2,4-D	2 pt
Degree Xtra	atrazine + acetochlor	2.9 to 3.7 qt
Epic	flufenacet + isoxaflutole	7 to 17 oz DF
Expert	s-metolachlor+atrazine+glyph	3 to 3.75 qt
Extrazine II	atrazine + cyanazine	1.4 to 5.8 lb DF
FulTime	atrazine + acetochlor	2.5 to 3 qt
Distinct	dicamba + diflufenzopyr	4 to 6 oz WDG
DoublePlay	acetochlor + EPTC	4.5 to 8 pt
Guardman	atrazine+dimethenamid	2.5 to 5 pt
Harness Xtra	atrazine + acetochlor	1.8 to 2.3 qt
Hornet	flumetsulam + clopyralid	1.6 to 4 oz
LeadOff	atrazine + dimethenamid	2.5 to 5 pt
Liberty ATZ	atrazine + glufosinate	32 to 40 fl oz
Lightning (CL corn)	imazethapy + imazapyr	1.28 oz WDG
Marksman	atrazine + dicamba	3.5 pt
NorthStar	dicamba + primisulfuron	5 oz DF/A
Ramrod + Atrazine	atrazine + propachlor	3.5 to 5.5 qt
ReadyMaster	atrazine + glyphosate	1.5 to 2 qt
Shotgun	atrazine + 2,4-D acid	2 to 3 pt
Spirit	primisulfuron+prosulfuron	1 oz WDG/A
Steadfast	nicosulfuron + rimsulfuron	0.75 oz DF

C3. Wild-proso millet is a competitive annual weed in eastern North Dakota. Eradicane, Harness, Lasso or Surpass PPI at the maximum rate for the soil type will only suppress millet for 2 to 3 weeks. Dual and Frontier give poor control. For full season control, apply Balance/Pro PPI or PRE at maximum rate with Harness/Surpass, followed by Prowl + Bladex (corn up to 2-leaf stage). Accent at 0.67 oz DF/A with Scoil adjuvant has given excellent POST control of wild-proso millet.

C4. Accent (nicosulfuron) at 0.67 oz 75DF/A can be applied POST to corn up to 20 inches tall with 6 collars or less. Apply Accent to corn 20 to 36 inches tall (free standing) with drop nozzles. Do not apply to field corn taller than 36 inches or with 10 collars, whichever is most restrictive. When banding Accent over the row with a three nozzle-per-row-system, plug the center nozzle to reduce corn injury from Accent concentrating in the whorl of the corn plant.

Always add an oil adjuvant at 1.5 pt/A or NIS at 0.25% v/v. NDSU research has shown that adjuvant enhancement of Accent was greatest with an MSO type oil or basic blend adjuvant, followed by petroleum oil, and least with NIS. 28% UAN at 1% v/v with NIS or petroleum oil increases weed control compared to Accent + NIS. Accent may be used POST to control green and yellow foxtail, fall panicum, barnyardgrass, field sandbur, woolly cupgrass, wild-proso millet, wild oat, quackgrass, pigweed species, smartweed, wild mustard, jimsonweed, and burcucumber. NDSU results show that Accent provides good control of ALS susceptible kochia and fair Russian thistle control with MSO type adjuvant. Poor yellow foxtail control may result if Accent is applied at reduced rates, if yellow foxtail is larger than recommended or growing in stress conditions.

NDSU research has shown Accent at 0.33 to 0.5 oz DF/A + Atrazine at 0.42 lb DF/A + dicamba at 4 fl oz/A + MSO type oil or basic blend adjuvant controlled most annual grass and broadleaf weeds. Accent at 0.67 oz DF/A is required to control yellow foxtail, wild proso millet, volunteer cereals, field sandbur, and quackgrass. Atrazine at 0.42 lb DF/A will not carryover or interfere with rotation crops unless drought occurs the year of application. The Dicamba label restricts using an oil additive with Dicamba alone or in tank-mix combination. However, the low rate of Dicamba in tank-mix helps ensure corn safety if applied early. Do not use additives which lower spray solution pH. Acid hydrolysis degradation of Accent occurs in low water pH. In contrast, basic blend adjuvants increase spray solution pH, prevents acid hydrolysis, but more importantly, greatly increases the solubility of Accent resulting in greater weed control.

Accent can be tank-mixed with atrazine, bromoxynil, Buctril + Atrazine, Dicamba, Harness, Hornet, Marksman, Prowl, Surpass and many other herbicides. Refer to label for adjuvant selection when tank-mixing Accent with other herbicides. Oil additives can be substituted for NIS when tank-mixing Accent with bromoxynil, or Buctril + Atrazine but may increase risk of crop injury. Oil adjuvants should always be used when tank-mixing Accent with atrazine. Follow label for mixing procedure with tank-mix partners.

Basagran and organophosphate insecticides, such as Lorsban, malathion, or parathion, should not be applied less than 7 days before or 3 days after Accent to reduce the risk of crop injury. Significant injury may result if Accent is applied to corn previously treated with Counter insecticide. Corn treated with other organophosphate insecticides, such as Lorsban, Dyfonate, and Thimet applied at planting or over-the-row at cultivation may result in temporary crop injury.

C5. Accent Gold (nicosulfuron + rimsulfuron + clopyralid + flumetsulam) at 2.9 oz DF/A applied POST to corn up to 20 inches tall with less than 6 collars, controls most annual grass and broadleaf weeds and suppresses Canada thistle. Apply with NIS or oil adjuvant at 1 to 2% v/v with 28% UAN. Apply only to corn hybrids of 88 or more days maturity. Accent Gold

at 2.9 oz DF/A contains 0.25 oz 75DF/A Accent, 0.75 oz 25DF/A Matrix, 4 fl oz of Stinger and 0.7 oz Python 80DF. NDSU research has shown good safety from Accent, Matrix, Stinger, and Hornet to corn. Follow label for tank-mix options, weeds controlled, application information, and rotational crop restrictions.

C6. Aim (carfentrazone) at 0.33 oz WDG/A applied POST controls cocklebur, kochia, lambsquarters, nightshade, pigweed, and Venice mallow in corn. Apply Aim to corn up to 8 collar growth stage and to weeds from 1 to 4 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 atrazine at 1 pt/A or 9 oz 90DF/A. Aim + Atrazine may be tank-mixed with Accent, Accent Gold, Basis Gold, Dicamba, and Hornet. 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. Degree of speckling may be determined by temperature, amount of leaf foliage receiving spray, and adjuvants used with tank-mixes.

C7. Atrazine at 1 to 2 lb/A applied PPI or PRE controls annual weeds without corn injury. The rate for fine textured soils with high organic matter is 2 lb/A. Atrazine residues injurious to susceptible crops may remain in soils longer than one growing season. (See herbicide residue section for additional discussion). Atrazine is registered as a tank-mixture with most soil and POST herbicides. Atrazine is available as a prepackage mix with several herbicides; see table on commercial mixtures. Atrazine is a restricted use herbicide.

Atrazine at 0.38 to 2 lb ai/A applied POST to corn less than 12 inches tall controls broadleaf weeds less than 4 inches tall, or grass weeds less than 1 inch tall. Atrazine gives good wild oat control, partial foxtail (pigeongrass) control, and excellent control of broadleaved weeds (including volunteer sunflower) when used in combination with petroleum oil concentrate or emulsifiable vegetable oil adjuvants. Atrazine applied either with vegetable or petroleum oil at 1 qt/A gives similar weed control. Surfactants are less effective with atrazine than any oil additives. Refer to herbicide residue section for carryover precautions. Refer to label for application information and restrictions. Atrazine is a restricted use herbicide.

C8. Balance (isoxaflutole) at 1.25 to 2 oz WDG/A or **Balance Pro** at 1.5 to 3 fl oz/A applied EPP, or PRE controls most annual grasses including foxtails, wild proso millet, field sandbur, and woolly cupgrass and most annual small-seeded broadleaf weeds, including nightshade, kochia, pigweed, lambsquarters, common ragweed, wild mustard, annual smartweed, seedling dandelion, and horseweed (marestail). Balance can control kochia and foxtail resistant to other herbicides. Symptoms of Balance injury to corn under stress or misapplied is exhibited as yellowing or chlorosis after corn emerges. Normally yellowing disappears after 3 to 5 days with no effect on subsequent growth or yield. Balance is applied at low rates. Accurate and precise application and using exact rates based on soil type, pH, and organic matter is required to insure adequate corn safety. Applying Balance at rates slightly greater than those recommended for soil type, soil pH, and organic matter can cause slight to serious corn injury. Uneven application, variable ground speed, lack of good agitation, sprayers not properly calibrated, improper incorporation and especially spray overlaps

may increase corn response. Always preslurry Balance with water prior to adding to the tank. Allow time for Balance to dissolve in tank, afterward providing thorough agitation. Seed corn at least 1.5 inches deep with adequate soil covering the furrow to prevent herbicide contact on seed. DO NOT apply POST to corn or corn will die.

Balance is labeled with most PRE herbicides. A tank-mix with atrazine and/or acetochlor controls of most annual grass and broadleaf weeds. Balance PRE can be followed by all POST herbicides labeled in corn. Balance is weak on yellow foxtail, wild oat, volunteer grain, and large-seeded broadleaf weeds like wild buckwheat, cocklebur, sunflower, giant ragweed. Balance gives no wild buckwheat control. Research indicates Balance PRE provides greater weed control than other PRE corn herbicides. Balance has shown good to excellent weed control under limited rainfall conditions. However, 0.5 to 0.75 inches of rainfall after application is required for optimum weed control. If weeds emerge after application from lack of rainfall, a rain event can activate the herbicide, cause susceptible weeds to turn white and kill emerged weeds up to 2 inches tall. Balance will give 6 to 8 weeks residual weed control after activation. See herbicide residue section for crop rotation restrictions. Precipitation and soil moisture is more critical to breakdown than other factors.

C9. Basagran (bentazon) at 1.5 to 2 pt/A applied POST in corn controls many broadleaf weeds from 2 to 10 inches tall. Basagran will control common cocklebur, giant and common ragweed, smartweed, Venice mallow, wild mustard, sunflower and suppression of yellow nutsedge. Basagran can control Canada thistle only with sequential applications. Corn is tolerant to Basagran at all stages. Liquid fertilizer can be used with Basagran in place of oil concentrate for improved control of several weeds. Basagran can be applied in corn when drift of Dicamba or 2,4-D may injure sensitive crops. Atrazine is a restricted use herbicide.

C10. Basis (rimsulfuron + thifensulfuron) at 0.33 oz 75DF/A controls foxtail, barnyardgrass, redroot pigweed, wild mustard, common lambsquarters, and annual smartweed control to 4-leaf (2 collar) corn. 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 to completely eliminate weeds. Always apply Basis with with an oil additive (petroleum or MSO type oil) at 1 to 2% v/v and nitrogen. Do not use 28% UAN without an oil additive. Corn varieties of 88 day maturity or less are more susceptible to injury from Basis than varieties greater than 88 days. Basis may be tank-mixed with dicamba. See label for tank-mix options.

C11. Basis Gold (nicosulfuron + rimsulfuron + atrazine) at 14 oz 89.46DF/A applied POST to corn up to 12 inches tall and with less than 6 collars control most annual grass and broadleaf weeds plus quackgrass. Apply with oil adjuvant at 1 to 2% v/v. NDSU research has shown greater herbicide enhancement from Accent and atrazine applied with MSO type adjuvants than NIS or petroleum oil adjuvants. Apply only to corn hybrids of 88 or more days maturity.

Basis Gold at 14 oz 89.46DF/A contains 0.25 oz 75DF/A Accent, 0.75 oz 25DF/A Matrix, and 0.76 lb ai atrazine. NDSU research has shown good safety to most crops (including small grains and sugarbeet) planted the year following atrazine applied at 0.38 lb ai/A with normal rainfall the year of application. The atrazine in Basis Gold applied at a half rate (7 oz 89.46DF/A) would be equivalent to 0.38 lb ai/A. If a half rate of Basis Gold is used, additional Accent may need to be added to achieve adequate weed control. Applying herbicides at lower than labeled rates makes user liable for product performance and crop injury on crops planted at a shorter interval than directed on the label.

C12. Bladex (cyanazine) at 1.3 to 5.3 lb 90DF applied PRE controls annual grass and broadleaf weeds in corn. Use the higher rates on fine textured, high organic matter soils, and the lower rates on coarse textured soils with low organic matter. Do not use on sandy or loamy sand soils, or soils with less than 1% organic matter. Bladex requires 0.5 inch or more rain for activation, especially on fine textured soils.

Bladex 90DF at 1.3 to 3.33 lb 90DF applied as an early POST treatment gives grass and broadleaf weed control (including volunteer sunflower). Emulsifiable vegetable oil at 1 qt/A enhances weed control but may increase the risk of crop injury. Use only the 90DF formulation for POST applications. Bladex at 1.3 lb 90DF/A with 1 qt/A of vegetable oil has given good control of small weeds (less than 1.5 inches tall) on fine textured soil. Occasionally corn leaf burn occurs, but recovery is good. Higher rates will give more consistent weed control but also increase risk of corn injury. Corn should not be treated after the 4th leaf stage when corn is under stress, or during extended cold, wet conditions. Bladex is unlikely to carryover and cause crop injury the next year. Bladex is a restricted use herbicide.

C13. Broadstrike + Dual (flumetsulam + metolachlor) at 1.75 to 2.75 pt/A of the premix product or 0.04 to 0.07 lb/A of the Broadstrike (Python) component + 1.6 to 2.6 pt 8E/A of the Dual component applied EPP, PPI, or PRE will control some grass and broadleaf weeds. Broadstrike is also packaged individually as Python. See Python paragraph for additional information on flumetsulam. Python does not control grasses, so grass control is limited to the activity of Dual. Dual has not given adequate weed control PRE and sometimes PPI in NDSU field trials. Adding more Dual or other similar product (Lasso, Frontier, Harness, Surpass, Ramrod) may be necessary to obtain adequate grass control. A higher rate of these herbicides will be required in medium to fine-textured soils. NDSU research has shown that Harness and Surpass gave greater weed control than Lasso, Dual or Frontier. Dual did not enhance broadleaf weed control with Broadstrike as compared to trifluralin in the Broadstrike + Treflan product used in soybean.

C14. Bromoxynil at 1 to 1.5 pt/A applied to corn from emergence but before tasseling controls seedling wild buckwheat, volunteer sunflower, and most annual broadleaf weeds. Some corn leaf burn may occur when high temperatures follow application. Bromoxynil is a contact herbicide so thorough spray coverage is essential for adequate weed control. Bromoxynil can be mixed with atrazine to increase the spectrum

of weed control. A commercial mixture of bromoxynil plus atrazine is available. Bromoxynil can be tank-mixed with Accent, atrazine, Bladex, dicamba, Extrazine II, glyphosate, Stinger, and 2,4-D. The premix Buctril + Atrazine can be tank-mixed with Accent, dicamba, Stinger, and 2,4-D.

C15. Callisto (mesotrione) registration on corn is pending. Callisto at 3 fl oz/A applied PRE controls pigweed species, common lambsquarters, common sunflower, waterhemp, giant ragweed, annual smartweed, and nightshade. Callisto at 3 fl oz/A applied POST to corn up to 30 inches tall controls weeds listed above plus common cocklebur and tank-mixed with atrazine at 0.25 lb ai/A controls common ragweed and kochia. Callisto can be tank-mixed with most PRE and POST herbicides registered in corn. Symptoms on weeds from Callisto are bleaching followed by death. Apply with petroleum oil adjuvant + UAN at 1% v/v + 2.5% v/v. MSO type adjuvant at 1.5 pt/A may increase weed control but increase frequency and level of corn injury. Do not tank-mix with organo-phosphate insecticide.

C16. Celebrity Plus (nicosulfuron + dicamba + diflufenzopyr) at 4.67 oz WDG/A applied EPOST or POST to corn from 4 to 24 inches tall or with 6 (V6) or fewer collars controls most grass and annual broadleaf weeds. Celebrity at 4.67 oz WDG/A is equivalent to Accent at 0.67 oz 75DF/A and dicamba at 4 oz 70WDG or dicamba at 4 fl oz/A (dicamba at 0.188 lb ai/A). Refer to paragraph sections on Accent and dicamba for use information. The Celebrity Plus formulation is significant because dicamba is formulated as a dry granule rather than a liquid. If an oil adjuvant is used then the user assumes all risk and liability of crop injury. Refer to label for additional information on adjuvant use. See label or narrative for crop rotation restrictions.

C17. Curtail (clopyralid + 2,4-D) at 2 pt/A applied EPOST to corn up to 8 inches tall or up to 4 collars controls many broadleaf weeds and controls or suppresses Canada thistle. Do not apply broadcast to corn more than 8 inches tall. Curtail may be applied as a directed spray using drop nozzles to corn from 8 inches tall or the 5th leaf collar visible to corn 24 inches tall. The reason for exact staging of corn is because Curtail contains 2,4-D which can cause stem brittleness and corn injury. Corn treated with 2,4-D may become temporarily brittle. Winds or cultivation may cause stalk breakage while corn is brittle. Application during the window described above will reduce risk of stem brittleness but injury may still occur.

Curtail may be applied with Stinger at 2 to 6 fl oz/A for greater Canada thistle control. NIS may increase weed control but also increases risk of corn injury. If Curtail is applied when corn is growing rapidly under high temperature and good soil moisture, delay cultivation for 7 to 10 days to allow corn to overcome temporary stalk brittleness. Delay cultivation or fertilizing with shank-type applicators for 14 to 20 days after application for optimum weed control. Curtail allows sugarbeet growers to utilize clopyralid in corn and plant sugarbeet the next year. Hornet requires an 18-month waiting period.

C18. Dicamba at 0.5 to 1 pt/A 4S may be applied alone PRE or early POST to corn from emergence to 8 inches tall. Dicamba gives better control of Canada thistle, kochia, smartweed, wild buckwheat and volunteer sunflower than 2,4-D with less injury to corn. 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 if dicamba is applied with 2,4-D and to reduce drift potential. Dicamba can be mixed with Accent, Bladex and atrazine.

C19. Distinct (dicamba + diflufenzopyr) at 6 oz WDG/A applied EPOST or POST to corn up to 24 inches tall (preferred treatment when corn is 4 to 10 inches tall) controls annual and perennial broadleaf weeds and suppress foxtail. Apply with NIS at 0.25% v/v + UAN at 2 qt/A. Refer to paragraph on dicamba for use information and restrictions. Distinct controls a wider spectrum of weeds and greater perennial weed control than dicamba. Diflufenzopyr inhibits auxin transport and acts as a synergist to dicamba and other growth regulator herbicides. Diflufenzopyr aids translocation to metabolic sinks and areas of high metabolic activity, like growing points of shoots and roots. Corn injury can occur when corn is stressed by cold conditions prior to, at, and 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 total dry product added to the spray to dissolve. See label for mixing order and mixing instructions.

C20. Epic (flufenacet + isoxaflutole) at 7 to 17 oz WDG/A applied EPP, PPI or PRE controls most annual grass and broadleaf weeds. Epic contains flufenacet (Axiom) and Balance. See label or sections on Axiom and Balance for additional information.

C21. Eradicane (EPTC plus safener) at 5 to 7.33 pt/A or 17 to 24 lb 25G/A controls grass and certain broadleaf weeds. Soil should be dry enough and in good tilth to permit immediate and thorough incorporation. Eradicane is registered as a tank-mixture with atrazine, Bladex and Surpass. Eradicane can be tank-mixed with Surpass to improve performance over a wider range of environmental conditions.

C22. Frontier (dimethenamid) at 20 to 32 fl oz/A is used EPP up to 45 days before planting, PPI, PRE or early POST. 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. Incorporation may improve weed control in drier conditions. Frontier is registered as a tank-mixture with atrazine, Bladex, dicamba, glyphosate, Marksman, Prowl, 2,4-D, and Princep. Frontier provides equal control of labeled weeds and may provide greater nightshade than Lasso or Dual. Frontier may be applied at 8 to 12 fl oz/A POST in tank-mix combination with Accent at 0.25 to 0.67 oz 75DF/A to corn up to 8 inches tall. A NIS must be added at 0.25% v/v plus 28% UAN at 4% v/v and dicamba may be added to this tank-mixture for burndown and residual control of broadleaf weeds.

C23. Harness (acetochlor + safener) at 1 to 3 pt/A or **Surpass** (acetochlor + dichlormid (safener)) at 1 to 3 pt/A or **Degree** (encapsulated acetochlor + dichlormid (safener)) or **TopNotch** (encapsulated acetochlor + dichlormid (safener)) at 4 to 7.25 pt/A applied PPI or PRE control annual grasses and certain broadleaf weeds such as pigweed species, common lambsquarters, kochia, nightshade, and common ragweed. 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. Harness Xtra can be applied with atrazine, dicamba, Bladex, glyphosate, paraquat and Prowl. Harness Xtra may be applied up to 45 days before planting. Harness/Surpass can be applied POST to corn up to 11 inches tall. Do not apply with fluid fertilizer because severe injury may occur. Harness/Surpass may be applied with Accent, Atrazine, dicamba, Marksman, Permit, and Pursuit. Do not apply to corn over 8 inches tall when tank-mixing with dicamba or Marksman.

Harness/Surpass applied PPI or PRE provides greater and more consistent grass and broadleaf weed control than Axiom, Lasso, Dual or Frontier. Greater control has been observed across variable climates and conditions in North Dakota. Results have shown greater or equal control of certain weed species than Frontier at relative respective use rates. PPI may provide greater weed control than PRE application in dry conditions. However, based on research results, Harness/Surpass applied PRE provides greater weed control under dry conditions than other chloroacetamide herbicides.

C24. Hornet (flumetsulam + clopyralid) at 0.2 to 0.3 lb/A of the premix product or 0.05 to 0.07 lb/A of flumetsulam + 0.13 to 0.19 lb/A of the clopyralid component can be applied EPP, PPI, or PRE. Use 0.2 to 0.25 lb/A on coarse textured soils and 0.25 to 0.3 lb/A on medium and fine textured soils. Hornet controls a wide spectrum of broadleaf weeds including nightshade, kochia, mustards, annual smartweed, wild buckwheat, biennial wormwood, Venice mallow, marshelder, Russian thistle, horseweed (marestail) and common ragweed. Hornet controls large-seeded broadleaf weeds such as common cocklebur and sunflower. Hornet does not control grasses.

As with all soil applied herbicides, Hornet depends on soil moisture for adequate weed control. Hornet applied PRE requires rainfall shortly after application for maximum weed control. Incorporation improves weed control under dry conditions. Flumetsulam (Broadstrike/Python) is strongly affected by soil pH. Higher soil pH increases herbicide activity and also increases risk of crop injury. Some stunting may occur under poor growing conditions on soils with pH greater than 8.0. Soil insecticides should only be band-applied when using Hornet to avoid potential crop injury. See Hornet under the Herbicide Residue section for crop rotation restrictions.

Hornet at 1.6 to 4 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. Under dry conditions, UAN may be also added at 2.5% v.v. Soil applied Hornet provides greater pigweed and lambsquarters control than POST applied. Do not cultivate within 10 days before or after application. Hornet may be tank-mixed with most other POST herbicides labeled in corn including Accent or Basis Gold.

C25. Lasso (alachlor) at 2 to 4 qt 4E/A **Dual**, **Dual II** (metolachlor) at 1.5 to 3 pt 8E/A, **Dual Magnum**, **Dual II Magnum** (s-metolachlor) at 1 to 2 pt/A and **Axiom** (flufenacet + metribuzin) at 15 to 23 fl oz/A applied PPI or PRE to control annual grasses and certain broadleaf weeds such as redroot pigweed, common lambsquarters and common ragweed. Lasso may also be applied POST to corn up to 5 inches tall for PRE control of weeds. Use the higher rate on clay soils high in organic matter. Incorporation improves weed control with Lasso and Dual products. Lasso is registered as a tank-mixture with

atrazine, Bladex, dicamba, glyphosate, and paraquat. Dual Magnum and Dual II Magnum may be surface applied or incorporated in the fall after September 30 but before ground freezes or applied in the spring. Dual is registered as a tank-mixture with atrazine, Bladex, Dicamba or with atrazine plus paraquat or glyphosate. Dual products may be applied up to 45 days before planting. Lasso is a restricted use herbicide.

C26. NorthStar (dicamba-na + primisulfuron) at 5 oz WDG/A applied POST controls broadleaf weeds and some grasses in corn at 4 to 12 inches tall. Direct apply to corn from 20 to 36 inches tall. Apply with NIS at 0.25% v/v or oil additive at 1 to 4 pt/A. Do not use oil additive if corn is greater than 12 inches tall or if tank-mixing with dicamba or Marksman. UAN at 2 to 4 qt/A may be used with NIS or oil additive. Northstar contains dicamba and will control ALS resistant weeds. Northstar can be tank-mixed with other POST herbicides registered in corn. Northstar will leave a residue 3 or more years. See label or herbicide residue section for information on crop rotation restrictions.

C27. Permit (halosulfuron) at 2/3 to 1 1/3 oz 75DF/A applied POST in corn controls nutsedge and some broadleaf weeds including sunflower, ragweeds, and cocklebur. Permit must be tank-mixed with 2,4-D or dicamba for common lambsquarters and pigweed control. Always add NIS or oil additive. Addition of 28% UAN may enhance control of larger pigweed. Breakdown of Permit differs from other sulfonylurea herbicides. Permit degradation occurs most rapidly at pH 7. The rate at which Permit is degraded decreases as soil pH increases above 7 or decreases below 7. Regardless, 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.

C28. Prowl/Pendimax (pendimethalin) at 1.8 to 4.8 pt EC or 1.25 to 3.33 lb DG 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. Prowl can be tank-mixed with atrazine, Bladex and dicamba.

C29. Python (flumetsulam) at 0.8 to 1.33 oz 80WDG applied EPP, PPI, or PRE will control some small-seeded broadleaf weeds like nightshade, pigweed, kochia, lambsquarters, mustards, annual smartweed, marshelder, Russian thistle, and Venice mallow. Python may also provide suppression of common ragweed 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.

C30. Ramrod (propachlor) applied PRE at 4 to 6 qt/A controls annual grasses and some broadleaf weeds but is ineffective against wild mustard or perennial weeds. Ramrod applied PRE gives greater foxtail control than Lasso and Dual. Ramrod is registered as a tank-mixture with atrazine.

C31. Sencor (metribuzin) at 1.6 to 2 oz 75DF/A or 2.4 to 3 fl oz 4F applied POST with another herbicide labeled for tank-mix use with Sencor controls many broadleaf weeds. Sencor can be tank-mixed with atrazine, Basagran, bromoxynil, dicamba, Marksman, and 2,4-D. Consult label for adjuvant use with the different tank-mix options. Do not use oil adjuvants with any Sencor tank-mix.

Sencor at 1.6 to 2 oz 75DF/A or 2.4 to 3 fl oz 4F can be applied POST directed with bromoxynil, dicamba, or 2,4-D. Use drop nozzles and appropriate spacing to direct spray below the corn whorl and upper leaves. The height of the weeds must be sufficiently below the whorl to achieve adequate crop safety. Apply before tassel emergence.

C32. Steadfast (nicosulfuron + rimsulfuron) is available only through a bulk dispensing system. Steadfast at 0.75 oz DF/A applied POST to corn up to 12 inches tall and with less than 6 collars controls most annual grasses, quackgrass, and some broadleaf weeds. Apply with basic blend adjuvant at 1% v/v, oil adjuvant at 1 to 2% v/v or NIS + UAN at 0.25% + 2 qt/A. NDSU research has shown greater herbicide enhancement from nicosulfuron and rimsulfuron applied with basic blend or MSO type adjuvants than NIS or petroleum oil adjuvants. Apply only to corn hybrids of 88 or more days maturity. Rainfall within 5 to 7 days after application will improve residual weed control. Steadfast can be applied with atrazine at 0.25 to 1 lb 90DF/A, dicamba at 0.125 to 0.25 pt/A, dicamba + atrazine premix at 0.5 to 1 pt/A, or Hornet at 1.6 to 2.4 oz/A. See label for additional herbicide tank-mix options. Do not tank-mix with Basagran, Bladex, or 2,4-D herbicides or organophosphate insecticides or severe crop injury or grass antagonism will result. See paragraphs on Accent, Basis, and Basis Gold for additional information. Steadfast will have a soil residue for more than one year. Refer to the label or herbicide residue section for crop rotation restrictions.

C33. Tough (pyridate) at 1 to 2 pt/A can be applied to corn up to 68 days before harvest to control kochia, pigweed, sunflower. Tough is a contact type herbicide and can be tank-mixed with atrazine, Bladex, Guardsman, Accent, Permit, Frontier, dicamba, Marksman, or 2,4-D. Apply with adjuvants as directed on the label. Do not graze or feed treated corn grain, forage, or fodder to livestock within 68 days after application.

C34. 2,4-D amine at 0.5 to 1 pt/A of a 4 lb/gal concentrate applied POST to corn 3 to 8 inches tall will control broadleaf weeds. 2,4-D at 0.5 pt/A will control susceptible weeds like wild mustard and 1 pt/A rate will control less susceptible weeds, including volunteer sunflower, but risk of corn injury is greater. Do not apply MCPA to corn, as it is more injurious to corn than 2,4-D. Apply 2,4-D with drop nozzles when corn is over 8 inches tall to reduce corn injury by directing the spray away from the whorl. 2,4-D may cause brittle stalks that may lodge or break. Several brands of 2,4-D are available with some differences on application information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

C35. Emergency control of broadleaf and grass weeds in corn can be obtained with Evik or paraquat applied POST directed. Paraquat at 0.25 lb/A should be applied as a directed spray to the weeds. A NIS must be used with both herbicides. These herbicides applied over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply Evik before corn is 12 inches high or paraquat before corn is 10 inches high. Weeds should be less than 4 inches tall.

CLEARFIELD (Imidazolinone resistant) CORN

C36. Lightning (imazethapyr + imazapyr) at 1.28 oz 70WDG/A (0.64 oz imazethapyr + 0.15 oz imazapyr) controls nearly all annual grass and broadleaf weeds and provides season-long suppression of perennial weeds including quackgrass and Canada thistle. Apply Lightning EPOST or POST only to IMI-corn varieties and to weeds 1 to 3 inches tall. Apply with oil adjuvant and liquid fertilizer. Can be tank-mixed with Atrazine, Basagran, Bicep, Buctril+Atrazine, Dual products, FullTime, Guardsman, Harness, Harness Xtra, Lasso, Marksman, Surpass, TopNotch, or Tough. Refer to label for weeds controlled, adjuvants, application information and timing, and insecticide interaction.

Lightning contains Pursuit and Arsenal, both imidazolinone herbicides. Pursuit is labeled in several legume crops in ND. The rate of Pursuit in Lightning is slightly below the equivalent of the 3 fl oz/A, 1.08 oz WDG/A or the ND soybean rate. The rate of Arsenal in Lightning is 1/100 the rate of Arsenal that is registered on noncropland and right-of-ways for non-selective burndown and residual weed control. Carryover restrictions of Lightning are the same as Pursuit due to the small amount of Arsenal in Lightning. Refer to the rotational crop restriction section of this guide. Both active ingredients in Lightning are ALS inhibitors resulting in a high risk of developing ALS resistant weeds. Use herbicides with a different mode of action or use other weed control strategies that will slow development of resistant weeds.

LIBERTY (Glufosinate) RESISTANT CORN

C37. Liberty (glufosinate) at 24 to 34 fl oz/A (0.2 to 0.365 lb/A) applied POST to Liberty tolerant corn varieties controls most annual broadleaf weeds, controls or suppresses grasses, and provides suppression of some perennial weeds. Apply Liberty EPOST or POST to Liberty tolerant corn up to 24 inches tall or 7 or less collars.

Liberty is a non-selective, non-residual, contact type herbicide with limited translocation. Liberty should be applied 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. No residue will allow any crop to be planted the following year. Liberty does not require addition of an adjuvant. However, Liberty should always be applied with spray grade 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 other herbicides.

Liberty ATZ (atrazine + glufosinate) at 32 to 40 fl oz/A on corn up to 12 inches tall controls most annual grass and broadleaf weeds. Liberty ATZ at 32 fl oz/A contains 0.25 lb ai/A of glufosinate plus 0.83 lb ai/A atrazine, the equivalent of 1.65 pt/A or 0.92 lb 90DF/A. The atrazine in Liberty ATZ at 32 fl oz/A may carryover and injure crop planted the following year. See section on herbicide carryover and crop rotation.

ROUNDUP (Glyphosate) RESISTANT CORN

C38. Glyphosate at 1.5 to 2 pt/A of a 3 lb ae/gal concentration applied only to glyphosate resistant 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 spray grade AMS at 8.5 to 17 lb/100 gal to ALL glyphosate formulations. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, systemic herbicide that can control grasses at rates as low as 0.25 pt/A. Labeled rates are required for broadleaf weeds. However, some broadleaf weeds like kochia, nightshade, wild buckwheat, horseweed (marestail), dandelion, lambsquarters may not be fully controlled by glyphosate applied alone or from just one application.

Glyphosate is non-residual so multiple applications or combining with a residual herbicide may be needed to control multiple weed flushes. The lack of residue from glyphosate alone will allow any crop to be planted the following year. Refer to label for weeds controlled, application information and timing, tank-mix options, and other restrictions. Glyphosate will control weeds resistant to other herbicides.

ReadyMaster ATZ (atrazine + glyphosate) at 1.5 to 2 qt/A applied EPOST and POST to glyphosate resistant corn up to 12 inches tall controls most annual and perennial grass and broadleaf weeds. ReadyMaster ATZ contains atrazine and may carryover into the following growing season. See label for application information and tank-mix options.

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 a crop that will compete 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 trifoliolate 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 die quickly.

D2. Some combinations best adapted to North Dakota are given in the chemical weed control tables. Several commercial herbicide mixtures are available for use in soybean.

Package Mixtures Available For Soybean:

Trade Name	Common Name	Product/A
Axiom	flufenacet + metribuzin	7 to 13 fl oz
Broadstrike+Dual	flumetsulam+metolachlor	1.75 to 2.75 pt
Broadstrike+Treflan	flumetsulam + trifluralin	1.5 to 2.25 pt
Domain	flufenacet + metribuzin	9 to 16 oz
Extreme	imazethapyr + glyphosate	2.25 pt
Freedom	alachlor + trifluralin	3 to 4.5 qt
Fusion	fenoxaprop-P+fluazifop-P	6 to 12 fl oz
Galaxy	acifluorfen + bentazon	2 pt
Gauntlet	cloransulam+sulfentrazone	0.6-0.75 / 5.3-6.7
Pursuit Plus	imazethapyr+pendimethln	1.75 pt
Rezult	bentazon + sethoxydim	3.2 pt
Salute	metribuzin + trifluralin	1.5 to 3 pt
Stellar	flumiclorac + lactofen	5 fl oz
Storm	acifluorfen + bentazon	1.5 pt

D3. Preplant applications with 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.

D4. Aim (carfentrazone) at 0.33 oz WDG/A applied POST controls cocklebur, kochia, lambsquarters, nightshade, pigweed, and Venice mallow in soybean. Apply Aim to soybean up to the 3rd trifoliolate and to weeds from 1 to 4 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 soybean injury. Aim should be applied with another broadleaf herbicide to broaden spectrum of weeds controlled. 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. Symptoms disappear after new growth appears. Degree of speckling may be affected by temperature, amount of leaf foliage receiving spray, and adjuvants used with tank-mixes.

D5. Assure II (quizalofop) at 7 to 10 fl oz/A plus petroleum oil adjuvant at 1% v/v applied POST controls annual grasses and quackgrass. See table in the soybean section for rates of Assure II according to weed species and weed size. Quackgrass regrowth should be retreated when 4 to 8 inches tall at 8 fl oz/A. Ultra Blazer, Basagran, Betanex, Betamix, or Cobra tank mixed with Assure II often reduce grass control compared to Assure II alone. Reduced grass control can be avoided by applying Assure II at least 1 day before or 5 days after application of a broadleaf herbicide. MSO type oils have performed equal to petroleum based oil additives with Assure II. Assure II may provide excellent green foxtail control but less yellow foxtail control. Lower yellow foxtail 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.

D6. Authority (sulfentrazone) at 4 to 5.33 oz/A applied PPI or PRE controls most annual small-seeded broadleaf weeds, such as, kochia, pigweed species, lambsquarters, nightshade, smartweed, and biennial wormwood and may suppress other weeds like buckwheat, marshelder, mustard, ragweed, Venice mallow, and Russian thistle. Authority controls ALS resistant weeds, provides little grass, and no perennial weed control. Adjust rate for OM. Authority 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. Authority can tank-mixed with most PPI/PRE herbicides registered in soybean. NDSU research has shown excellent weed control in many different environments throughout the Great Plains region. However, consistent control of sensitive broadleaf weeds and control of grass and marginally controlled broadleaf weeds requires at least 0.75 inch rainfall prior to weed emergence. Herbicide solubility and phototoxicity increases as soil pH increases. Authority will leave a residue in soil for more than one year. Refer to label or crop rotation restriction section for additional information.

D7. Basagran (bentazon) at 0.5 to 1 qt/A applied POST controls some broadleaf weeds including wild mustard, common cocklebur, and sunflower. and suppresses biennial wormwood and Canada thistle. Apply with oil additive at 1.25% v/v (1 pt/A by air) or a maximum of 2 pt/A. Basagran at 1 pt/A plus an oil adjuvant has controlled wild mustard less than 4 inches tall. Basagran is safe to soybean at all stages. However, soybean leaf burn occurs occasionally from Basagran but recovery is good. For Canada thistle control, apply 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 which may cause incompatibility problems causing the zinc to precipitate. 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.

D8. Broadstrike + Dual (flumetsulam + metolachlor). See Broadstrike + Dual under the Corn section for additional information.

D9. Broadstrike + Treflan (flumetsulam + trifluralin) at 1.5 to 2.25 pt/A of premix product or 0.05 to 0.07 of the Python component + 0.64 to 0.96 lb/A of the trifluralin component applied PPI will control most grass and broadleaf weeds in soybean. Broadstrike is formulated alone as Python. See Python in this section for more information on flumetsulam. NDSU research has shown excellent weed control from Broadstrike + Treflan on most grass and broadleaf weeds ONLY after receiving adequate rainfall within the first 7 to 10 days after application. Broadstrike + Treflan will not control large-seeded broadleaf weeds. Refer to paragraph on Python for additional information on Broadstrike (flumetsulam). Use the higher rates on medium to fine textured soils and the lower rates on coarse textured soils. PPI applications may be made 30 days before planting. Instructions for incorporating Broadstrike + Treflan are the same as incorporation of Treflan alone. Incorporate uniformly into the top 2 inches for PPI applications. Do not apply to soils with a pH greater than 8.0 as crop injury may result. Broadstrike + Treflan is registered as a tank-mixture with glyphosate, paraquat, and Sencor. See Broadstrike + Treflan under the Herbicide Residue section for information on crop rotation restrictions.

D10. Cobra (lactofen) at 4 to 12.5 fl oz/A applied POST controls many broadleaf weeds, including lanceleaf sage. Cobra is a contact herbicide and requires thorough spray coverage for good weed control. Soybean beyond the third trifoliate leaf stage may interfere with the spray pattern and reduce the weed coverage. Apply Cobra by ground sprayer delivering at least 20 gpa. Do not apply during periods of crop stress or weed control may be reduced or crop injury increased. Best results are obtained at maximum daytime temperatures of 70 to 85 F. An oil additive at 0.5 to 1 pt/A increases weed control but may increase crop injury. Do not apply within 45 days of harvest or use treated plants for feed or forage. Several tank-mix options are available with Cobra at reduced rates. Cobra can be tank-mixed with Assure II, Harmony GT, and Select or Basagran and Harmony GT at reduced rates. See label for use of Cobra to suppress white mold in soybean.

D11. FirstRate (cloransulam) applied at 0.6 to 0.75 oz 80WDG/A PPI or PRE controls common cocklebur, common lambsquarters, horseweed (marestalk), pigweed species, annual smartweeds, common and giant ragweed, sunflower, and velvetleaf. FirstRate gives no nightshade control. As with all soil applied herbicides, FirstRate requires rain to activate the herbicide for adequate weed control. At least 0.5 inch of rain after application must occur to ensure adequate weed control. FirstRate is affected by soil pH. High soil pH increases herbicide activity, increases speed of herbicide degradation, but also increases risk of crop injury. Some soybean stunting may occur under poor growing conditions on soils with pH greater than 7.8. FirstRate may increase iron chlorosis symptoms on soils where symptoms have been observed earlier. Use the higher rates on medium to fine textured soils and the lower rates on coarse textured soils. Incorporate uniformly into the top 2 inches for PPI applications. Do not apply to soils with a pH greater than 7.8 as crop injury may result. See label for tank-mix options.

FirstRate 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. Pigweed and lambsquarters are controlled ONLY with soil applications. Apply

to broadleaf weeds prior to 10 inches. See label for maximum size of each weed. Use 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 but risk of crop injury increases. See FirstRate under the herbicide residue section for crop rotation restrictions.

D12. Flexstar (fomesafen + adjuvants) applied POST at 0.75 to 1 pt/A controls common cocklebur, annual smartweed, wild mustard, nightshade, pigweed species, waterhemp, common and giant ragweed, Venice mallow and small kochia (including ALS resistant). Apply to broadleaf weeds in the 2 to 4 inch stage. 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 may 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 2 inches tall.

Flexstar may be applied with POST herbicides labeled in soybean. Caution should be observed when tank-mixing Flexstar or Reflex with EC formulation herbicides. Emulsifiers in the EC formulations acts as additional adjuvant and may significantly increase crop injury. 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 mid-west. The reduced fomesafen rate reduces carryover and crop rotation restrictions but requires more management for adequate weed control. In ND, Flexstar is labeled only on soybean and Reflex may be labeled on dry bean through Section 18 registration in 2001. Flexstar contains adjuvants which the Reflex formulation does not. Reflex may give less consistent weed control than Flexstar and require better management strategies to achieve adequate weed control. See label or crop rotation restriction section for additional information.

D13. Fusilade DX (fluazifop-P) at 5 to 12 fl oz/A plus oil additive at 1% v/v applied POST controls annual grasses and quackgrass. See table in the soybean section for information on the rate of Fusilade DX according to weed species and weed size. Fusilade DX provides quackgrass suppression with only one application. Quackgrass regrowth should be retreated at 3 to 5 leaves with Fusilade DX at 12 fl oz/A. Fusilade DX tank-mixed with other herbicides may provide less grass weed control or increase crop injury. Reduced grass control can be avoided by applying Fusilade DX at least 1 day before or 5 days after application of a broadleaf herbicide.

D14. Fusion (fluazifop-P + fenoxaprop-P) at 4 to 12 fl oz/A plus 1% v/v crop oil control concentrate or 0.25% v/v NIS applied POST controls annual grasses and quackgrass in soybean. See table in the soybean section for information on the rate of Fusion according to weed species and weed size. Fusion provides in-season quackgrass control. Fusion is currently registered for tank-mix or sequential application with Ultra Blazer, Basagran, Harmony GT, Storm and Galaxy. Reduced grass control may occur with tank-mix combinations with broadleaf herbicides. However, reduced control can be avoided by applying Fusion 1 day prior to or 5 days after broadleaf herbicides. Fusion may be tank-mixed with Pursuit herbicide for control of volunteer corn only. Fusion may be tank-mixed with Orthene insecticide.

D15. Gauntlet (cloransulam + sulfentrazone) is sold as a co-pack of Authority (sulfentrazone) and FirstRate (cloransulam). Gauntlet applied PPI or PRE at 5.33 to 6.67 oz/A of Authority + 0.6 to 0.75 oz/A of FirstRate controls most annual broadleaf weeds. See label or paragraphs on Authority and FirstRate for weed controls, rates, conditions for activity, and crop rotation restrictions. Both Authority and FirstRate will leave a residue in soil for more than one year. See section on Authority and FirstRate in the herbicide residue section for crop rotation restrictions.

D16. Harmony GT (thifensulfuron) at 1/12 oz 75DF/A applied POST controls wild mustard, common lambsquarters, and pigweed and suppresses several other broadleaf weeds. Apply Harmony GT with an 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. DO NOT apply Harmony GT with oil adjuvant 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. Harmony GT 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 sprays and injury to susceptible crops. See section on sprayer cleanout.

D17. Lasso at 2 to 3 qt/A applied PPI or PRE, **Dual, Dual II** at 1.5 to 3 pt applied PPI or PRE (NOT EPOST), **Dual Magnum, Dual II Magnum** at 1 to 2 pt applied PPI or PRE, **Frontier** at 1 to 2 pt/A applied PPI, PRE, or EPOST up to third trifoliolate, or **Axiom** at 7 to 13 fl oz/A or **Domain** at 9 to 16 oz WDG/A applied PPI or PRE control annual grass and some broadleaf weeds, including redroot pigweed, black nightshade, 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 September 30 but before ground freezes or applied in the spring. Herbicides are registered for tank-mixing with several herbicides. Frontier can be applied EPOST with Pursuit. Do not ensilage soybean or feed forage, hay or straw from soybean treated with Lasso.

D18. Poast (sethoxydim) is a 0.5 to 1.5 pt/A plus oil additive at 1 qt/A controls annual grasses in canola, crambe, rapeseed, dry bean, field pea, flax, lentil, lupin, potato, soybean, sugarbeet, and sunflower. MSO type oils (Scoil and Sun-It II, etc) and Dash adjuvants have enhanced grass control with Poast more than petroleum oil or unmodified seed oil additives. See table in the soybean section for rates according to weed species and weed size. Poast provides only suppression of quackgrass. Poast mixed with Betanex, Betamix, Ultra Blazer or Basagran reduces grass control compared to Poast with oil additive. Poast with oil additives frequently has increased crop injury when combined with Betanex, Betamix, Ultra Blazer or Cobra. Reduced grass control and crop injury can be avoided by applying Poast at least 1 day before or 5 days after application of a broadleaf herbicide. 28% UAN at 2 to 4 qt/A or 2.5 lb/A of AMS with the oil additive may increase control of volunteer corn, cereal grains and quackgrass.

D19. Prowl/Pendimax (pendimethalin) at 2 to 3 pt/A EC or 0.83 to 2.5 lb DG applied PPI controls annual grass and certain broadleaf weeds. The high rate should be used on heavy clay soils. Prowl is registered as a tank-mixture with Lasso, Lorox, Dual, and metribuzin. See herbicide residue section.

D20. Pursuit (imazethapyr) at 3 fl oz/A or Pursuit DG at 1.08 oz or 6.67 acres per water soluble packet applied POST controls nightshade, kochia, wild mustard and pigweed species and may control or suppress many other broadleaf weeds not listed on the label. Pursuit has controlled foxtail, marshelder, Russian thistle, common cocklebur, sunflower, smartweed, and lanceleaf sage in NDSU field trials. Pursuit may give poor control of Venice mallow, wild buckwheat, horsetail, common lambsquarters and common ragweed greater than 1 inch tall. Soil residual from POST applications will not control subsequent flushes of these weeds. Poor residual control of eastern black nightshade may result when only a small amount of herbicide reaches the soil surface with POST application. However, even a small amount of Pursuit may give a reduction in number and intensity of flushes of other weeds. Pursuit should be applied with basic blend adjuvants at 1% v/v, or MSO type oil adjuvants at 1.5 pt/A or oil concentrate at 0.5% v/v, or NIS at 0.125 to 0.25% v/v, with 28% UAN liquid fertilizer at 4% v/v control. 28% UAN improves control of common lambsquarters. NDSU research has shown enhanced weed control by using MSO type oil adjuvants or basic blend adjuvants as compared to NIS or some oil additives with or without 28% UAN.

Pursuit at a reduced rate of 2 to 3 fl oz/A can be tank-mixed with Basagran, Cobra or Harmony GT to increase the spectrum of weeds controlled such as, common cocklebur, common lambsquarters, common ragweed, Venice mallow, and wild buckwheat. Crop injury from sequential postemergence applications of Pursuit following Harmony GT is greater than with either product alone OR the tank-mix of Pursuit plus Harmony GT. In sequential application, the herbicide applied first reduces the ability of the soybean plant to metabolize the second herbicide. Pursuit and Harmony GT applied as sequential treatments can result in severe crop injury. Weeds not controlled by the first herbicide may not be controlled after the second herbicide is applied. This is particularly important for common lambsquarters. Weeds that escape control from the first herbicide may be larger than labeled size by the time the soybean can safely be treated with the second herbicide. Cultivation before, during or within 7 days after application may also result in reduced weed control. Cultivation approximately 14 days after application is preferred.

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 or at least 5 days after Pursuit.

D21. Pursuit Plus (imazethapyr + pendimethalin) at 1.8 pt/A applied PPI controls most annual grass and broadleaf weeds. 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 or 1.08 oz WDG/A plus 1.75 pt/A of Prowl. Add additional Prowl 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.

D22. Python (flumetsulam) at 0.8 to 1.33 oz 80WDG/A applied PPI or PRE will control many annual broadleaf weeds in soybean. Python is the Broadstrike component in the commercial premixes available as Broadstrike + Dual or Broadstrike + Treflan, and also a component in corn premixes Hornet, and Accent Gold. Python is active on small-seeded broadleaf weeds like nightshade, pigweed, kochia, biennial

wormwood, common lambsquarters, mustard, annual smartweed, Venice mallow, and Russian thistle. Python gives poor control of large-seeded broadleaf weeds like common and giant ragweed and common cocklebur.

As with all soil applied herbicides, Python requires soil moisture for optimum weed control. Good soil moisture and timely rains shortly after application are needed to ensure adequate herbicide performance. 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 applications may be made 30 days before planting. Incorporate uniformly into the top 2 inches for PPI applications. Do not apply to soils with a pH greater than 8.0 as crop injury may result. Python is registered as a tank-mixture with most soil applied herbicides labeled in soybean. See Python under the Herbicide Residue section for information on crop rotation restrictions.

D23. Raptor (imazamox) at 4 fl oz/A POST plus a soil applied grass herbicide or at 5 fl oz/A alone POST controls nearly all annual grass and broadleaf weeds in soybean. Grass weeds controlled are barnyardgrass, crabgrass, foxtail, wild proso millet, field sandbur, volunteer corn and small grains. Broadleaf weeds controlled are cocklebur, kochia, lambsquarters, mustard species, nightshade species, pigweed species, giant ragweed, annual smartweed, and sunflower. Raptor provides no or poor control of wild buckwheat, large common lambsquarters, common and giant ragweed, Venice mallow, biennial wormwood, and ALS resistant kochia. In NDSU field trails, Raptor has controlled weeds listed above plus marshelder, Russian thistle, and lanceleaf sage less than 1 inch tall. Raptor gives poor control of Venice mallow, wild buckwheat, horsetail (marestalk), large lambsquarters and common ragweed. Low soil residue of Raptor may not control late germinating weeds or weeds flushes later in the growing season after rain events.

Raptor, as compared to Pursuit has greater grass and broadleaf weed control, provides improved control lambsquarters, and has less carryover and crop rotation restrictions.

Apply **Raptor** with basic 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. NDSU research has shown enhanced weed control by using MSO type oil adjuvants or basic blend adjuvants as compared to NIS or some oil additives with or without 28% UAN. However, Raptor applied with MSO + 28% 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 for information and restrictions when applying Raptor before or after Harmony GT or tank-mixing Raptor with Harmony GT or other POST herbicides.

Crop rotation restrictions are less 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 the year or two. See label or Raptor under the herbicide residue section for information on crop rotation restrictions.

D24. Rezult (bentazon + sethoxydim) at 3.2 pt (1.6 pt/A Rezult G and 1.6 pt/A Rezult B) applied POST controls most grass and broadleaf weeds in soybean can be applied from emergence to 30 days prior to harvest. Add oil adjuvants at 1 to 2 pt/A. Refer to label or narrative for tank-mix options. Rezult is priced economically compared to other POST herbicide programs. Refer to Basagran and Poast sections for additional information.

D25. Select (clethodim) at 4 to 16 fl oz/A or **Prism** at 8.5 to 34 fl oz/A plus oil additive at 1 qt/A applied POST controls annual grass weeds and quackgrass. See table in the soybean section for rates of Select according to weed species and weed size. Quackgrass can be controlled with sequential applications at 8 to 16 fl oz/A. Tank-mixing Ultra Blazer, Basagran, Cobra or Pursuit with Select may reduce grass control. Reduced grass control can be avoided by applying Select at least 1 day before or 5 days after application of a broadleaf herbicide.

Select is a ACCase mode of action herbicide, similar to Assure II, fenoxaprop, Fusilade, and Poast. However, research has shown that Select controls many grasses documented resistant to other ACCase herbicides. No grass has been documented resistant to Select. It is recommended that Select be used in rotation with herbicides of different modes of action and in a resistant weed management program.

D26. Sencor (metribuzin) at 0.25 to 0.5 lb 75DF/A controls annual broadleaf weeds, especially wild mustard. The rate applied is important. Consult the label for the proper rate based on 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. Metribuzin is registered as a tank-mixture with Lasso, Sonalan, Dual, Prowl and trifluralin.

D27. Sonalan (ethalfluralin), **Prowl** and **trifluralin** are dinitroaniline herbicides applied PPI for control of annual grasses and broadleaf weeds except wild mustard, common cocklebur and sunflower. Requirements for proper timing and depth of incorporation differ for each herbicide. Sonalan (ethalfluralin) at 1.3 to 3.5 pt/A applied PPI controls annual grass and certain broadleaf weeds. Use the low rate on coarse-textured, sandy soils. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Incorporation of Sonalan 10G can delayed 3 to 5 days after application. Sonalan is registered as a tank-mixture with most soil PPI herbicides labeled in soybean. Sonalan has less soil residue than trifluralin and is more active at comparable rates.

Trifluralin at 1 to 2 pt 4E/A applied PPI controls annual grass and certain broadleaf weeds. Set the implement 4 to 6 inches deep to uniformly mix trifluralin in soil. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil. Do not seed soybean deeper than 2 inches. See herbicide residue section.

D28. Ultra Blazer (acifluorfen) applied POST at 0.5 to 1.5 pt/A controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the higher rates are needed for nightshade, smartweed and common cocklebur. Ultra Blazer will not adequately control volunteer sunflower. Ultra Blazer kills primarily by contact action. Apply to weeds 1 to 4 inches tall that are actively growing and first to second trifoliolate soybean. Soybean beyond the third trifoliolate leaf stage may intercept the spray and prevent thorough coverage of the weeds. Best results are obtained with Ultra Blazer applied at maximum daytime temperatures of 70 to 85 F. A NIS (80% active ingredient) generally should be added to the tank at the rate of 0.12% v/v. See the label for additional information on spray additives. Do not apply within 50 days of harvest or use treated plants for feed or forage.

D29. Valor (flumioxazin) registration in soybean is pending for use in 2001. Valor applied EPP or PRE at 2 to 3 oz/A 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. Valor does not control perennial weeds. Apply Valor from 14 days prior to seeding to just before soybean emergence. Valor can be applied with most PRE herbicides labeled in soybean and can be tank-mixed with glyphosate in early burndown systems. Valor requires 0.25 inch of rain for activation and requires a bioassay prior to planting sensitive crops. See label for additional information.

ROUNDUP (Glyphosate) RESISTANT SOYBEAN

D30. Glyphosate at 1 to 2 pt/A of a 3 lb ae/gal concentrate applied only to glyphosate resistant soybean will control most annual and perennial weeds. Some formulations require no additional NIS, while others require partial or full rates. Add AMS at 8.5 to 17 lb/100 gal to ALL glyphosate formulations. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, systemic herbicide that can control grasses at rates as low as 0.25 pt/A. Labeled rates are required for 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.

D31. POST Grass Herbicides:

Herbicide	Weed Size (inches)	Rate
Green and Yellow Foxtail		
Assure II	2 to 4	8 fl oz
Fusilade DX	2 to 4	10 to 12 fl oz
Fusion	2 to 4	8 fl oz
Poast	1 to 8	1 pt
Prism	2 to 8	8.5 to 12.8 fl oz
Select	2 to 8	4 to 6 fl oz
Wild Oat		
Assure II	2 to 6	8 fl oz
Fusilade DX	2 to 6	8 fl oz
Fusion	2 to 6	8 fl oz
Poast	1 to 4	1 pt
Prism	2 to 6	12.8 fl oz
Select	2 to 6	6 fl oz
Field Sandbur		
Assure II	2 to 6	8 fl oz
Fusilade DX	2 to 4	10 to 12 fl oz
Fusion	2 to 4	8 fl oz
Poast	1 to 3	1.5 pt
Prism	2 to 6	12.8 fl oz
Select	2 to 6	6 fl oz
Wild Proso Millet		
Assure II	2 to 6	8 fl oz
Fusilade DX	4 to 8	6 fl oz
Fusion	4 to 8	6 fl oz
Poast	4 to 10	0.5 pt
Prism	1 to 10	8.5 to 12.8 fl oz
Select	1 to 10	4 to 6 fl oz
Volunteer Small Grains		
Assure II	2 to 6	8 fl oz
Fusilade DX	2 to 6	8 fl oz
Fusion	2 to 6	8 fl oz
Poast	1 to 4	1.5 pt
Prism	2 to 6	12.8 fl oz
Select	2 to 6	6 fl oz
Volunteer Corn		
Assure II	6 to 18	5 fl oz
Fusilade DX	12 to 24	6 to 8 fl oz
Fusion	12 to 24	6 fl oz
Poast	1 to 20	1 pt
Prism	4 to 12	8.5 fl oz
Prism	12 to 24	12.8 fl oz
Select	4 to 12	4 fl oz
Select	12 to 24	6 fl oz
Quackgrass (First treatment/Regrowth)		
Assure II	6 to 10	10/8 fl oz
Fusilade DX	6 to 10	12/8 fl oz
Fusion	6 to 10	12/12 fl oz
Poast	6 to 8	1.5/1 pt
Prism	4 to 8	17/17 fl oz
Select	4 to 8	8/8 fl oz

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

E2. Assure II (quizalofop) at 8 to 10 fl oz/A plus petroleum oil adjuvant at 1% v/v applied POST controls annual grasses and quackgrass. See paragraph and table on Assure II in soybean section for additional information.

E3. Basagran (bentazon) applied in sequential treatments provides improved broadleaf weed control compared to a single application. The first application should be before the weeds are 0.5 to 4 inches tall. Refer to label for information on weed sizes at application. Apply Basagran at 1 pt/A plus petroleum oil and repeat the application 7 to 10 days later. Split applications will control cocklebur, lambsquarters, annual smartweed, Venice mallow, and wild mustard. Common ragweed, kochia, pigweed, and sunflower may be controlled or suppressed. NDSU research has shown greater control of 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.

E4. Dual, Dual II (metolachlor) at 2 to 3 pt/A or **Dual Magnum, Dual II Magnum** (s-metolachlor) PPI or PRE at 1 to 2 pt/A, **Frontier** (dimethenamid) PPI, PRE or EPOST up to the third trifoliolate at 1 to 2 pt/A/A, or **Lasso** (alachlor) only PPI at 2 to 3 qt/A controls annual grasses and some broadleaf weeds. PPI may provide more consistent weed control since rainfall is essential for activation. Dual products may be tank-mixed with Eptam for wild oat control. Frontier can be applied with Basagran and Pursuit EPOST.

E5. 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 at a 4 to 6 inch depth immediately after application. Do not use Eptam on soybean.

E6. Frontier (dimethenamid) can be applied in sequential treatments for improved nightshade control in dry bean. Frontier PPI or PRE provides greater nightshade control than Dual or Lasso but may degrade in the soil before nightshade emergence ceases. Apply Frontier EPOST alone or with Basagran up to third trifoliolate dry beans to prevent late nightshade emergence. Frontier applied in split applications and activated by rainfall will offer improved nightshade control compared to a single application. Split applications may also provide greater control of other weeds.

E7. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus petroleum oil adjuvant at 1qt/A applied POST controls annual grasses and suppresses quackgrass. See paragraph and table on Poast in soybean section for additional information.

E8. Prowl/Pendimax (pendimethalin), **Sonalan** (ethalfuralin), and **trifluralin** are discussed under the soybean section. Trifluralin, Prowl and Sonalan applied PPI controls annual grasses and certain broadleaf weeds except wild mustard, common cocklebur, and sunflower. The low rates should be used on coarse textured, sandy soils. The high rates should be used for suppression of eastern black nightshade. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Trifluralin, Prowl

and Sonalan are each registered as a tank-mixture with Dual, Eptam, Frontier, Lasso, Micro-Tech, and Partner. Sonalan has less soil residual but is more active than trifluralin.

Sonalan 10G at 7.5 to 12.5 lb/A 10G applied in the fall or spring suppresses foxtail in dry edible bean and sunflower grown in reduced tillage systems. Apply in the fall between October 10 and December 31, or spring PPI before planting. Apply to tilled land or standing or chopped stubble. Incorporate twice 2 to 3 inches deep using a V-blade undercutter or other implements such as a rotary hoe that leave a maximum amount of crop residue on the soil surface. Operate implements approximately 5 mph. The first incorporation should be performed within 48 hours after application. The second incorporation should be performed at an angle to the first incorporation and must be delayed at least 14 days after the first incorporation. Sonalan 10G applied in the fall should be incorporated once in the fall and the second time in the spring before planting. Refer to label for application rate according to soil type. The higher rate in the rate range should be used in high crop residues and heavy weed populations.

E9. Pursuit (imazethapyr) at 2 fl oz/A or Pursuit DG at 0.72 oz/A or 10 acres per water soluble packet applied POST controls many broadleaf weeds including wild mustard and nightshade in pinto, navy, great northern, kidney, black turtle, and cranberry type dry beans. Reduced crop growth, yield, and/or delayed maturity may result from application. Do not apply if planting is delayed, or cold and/or wet weather are present or predicted to occur within one week of application. Do not apply to Domino variety black turtle bean. Pinto varieties UI-111 and Olathe are more sensitive to injury than other Pinto varieties. Apply Pursuit with NIS at 0.25% v/v to dry beans having at least one trifoliolate leaf. DO NOT use oil additives, liquid fertilizer or DASH. Refer to the Raptor paragraph in the soybean section for additional information on application use and restrictions. See Pursuit under the herbicide residue section for information on crop rotation restrictions.

E10. Raptor (imazamox) may be labeled through ND Section 18 emergency labeling for control of nightshade with limited crop rotation restrictions. Raptor applied at 4 fl oz/A when preceded by a soil applied grass herbicide registered in dry bean controls many annual grass and broadleaf weeds. Refer to the Raptor paragraph in the soybean section for information on Raptor application and adjuvant use and restrictions.

E11. Reflex (fomesafen) may be labeled through ND Section 18 emergency labeling for control of nightshade and common ragweed. Reflex applied POST at 0.75 pt/A controls many annual broadleaf weeds. Apply with NIS at 0.25 to 0.5% v/v or oil adjuvant at 0.5 to 1% v/v. Oil adjuvant may increase weed control but also increase risk of dry bean injury. Refer to the Flexstar paragraph in the soybean section for information on application and adjuvant use and restrictions.

E12. Select (clethodim) at 4 to 8 fl oz/A or **Prism** at 8.5 to 17 fl oz/A plus petroleum oil adjuvant at 1qt/A applied POST controls annual grasses and quackgrass. See paragraph and table on Select in soybean section for additional information.

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 above 85 F or when the pea or lentil are under heat/drought stress.

F2. Assure II (quizalofop) at 8 fl oz/A plus oil adjuvant at 1% v/v controls annual grasses and quackgrass. See paragraph under Assure II in soybean section for additional information.

F3. Basagran (bentazon) at 1 to 1.5 pt/A controls some annual broadleaf weeds and suppresses Canada thistle. Apply Basagran at 15 to 20 gpa and with MSO type oil additive at 1.5 pt/A. 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. Apply to pea 2 to 4 inches in height. A second application can be applied to pea greater than 6 inches. Allow a 30 days PHI. See paragraph under Basagran in soybean section for additional information.

F4. Chiptox (MCPA sodium salt), **MCPA** (certain brands), or **Thistrol** (MCPB) at 0.5 to 1 pint/A will control many broadleaf weeds including wild mustard and redroot pigweed. Apply to 4 to 6 inch pea vines. Pea might be slightly injured but will usually recover. The potential of injury increases when pea is taller than 6 inches and when temperatures exceed 85 F or when the pea is under heat/drought stress. Apply MCPA before vines are 6 inch long and MCPB prior to flowering.

F5. Glyphosate at up to 1 qt/A applied preharvest at the hard dough stage of pea grain with 30% or less moisture control 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 2 to 3 qt/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.

F6. Poast (sethoxydim) at 0.5 pt/A plus oil adjuvant at 1 pt/A controls annual grasses. See paragraph under Poast in soybean section for additional information.

F7. Pursuit (imazethapyr) at 0.72 oz/A controls many broadleaf weeds and controls or suppresses foxtail and black nightshade. Apply with NIS at 0.25% v/v. Pursuit can be applied to peas from the first trifoliate to prior to bloom. Apply Pursuit before flowering. Pursuit is an ALS inhibitor and will not control ALS resistant kochia. See Pursuit in soybean section for additional information.

F8. Result (bentazon + sethoxydim) at 3.2 pt (1.6 pt/A Result G and 1.6 pt/A Result B) applied POST controls most grass and broadleaf weeds in field pea from emergence to 30 days prior to harvest. Add 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 Basagran and Poast paragraphs in soybean section for additional information.

F9. Select (clethodim) at 6 to 8 fl oz/A or **Prism** at 12.8 to 17 fl oz/A plus petroleum oil adjuvant at 1qt/A applied POST controls annual grasses and quackgrass. See paragraph and table on Select in soybean section for additional information.

F10. Sencor (metribuzin) at 0.167 to 0.25 lb DF/A will control broadleaf weeds including mustard species and lambsquarters. Sencor will provide good control of small wild buckwheat, kochia, and wild sunflower. Crop injury may result if pea is under stress conditions caused by cold weather. Apply when weeds are small (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.

CHICK PEA/GARBANZO BEAN

G1. Chick pea/Garbanzo beans are poor competitors with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence up to 3 to 5 days after chick pea germination and when chick pea is 2 to 4 inches tall. Apply broadleaf herbicides to small weeds and small peas to reduce risk of pea injury. Do not apply POST herbicides above 85 F or when the peas are under heat/drought stress.

G2. Assure II (quizalofop) at 8 fl oz/A plus oil adjuvant at 1% v/v controls annual grasses and quackgrass. See paragraph under Assure II in soybean section for additional information.

G3. Far-Go (trilalate) at 2.5 pt/A can be applied for wild oat control before or just after seeding. Far-Go is volatile and must be incorporated into the soil immediately after application.

G4. Poast (sethoxydim) at 0.5 pt/A plus oil adjuvant at 1 pt/A controls annual grasses. See paragraph under Poast in soybean section for additional information.

G5. Glyphosate can be applied preharvest or as a spot treatment for weed control prior to harvest. See Glyphosate in field pea section for additional information.

G6. Select (clethodim) at 6 to 8 fl oz/A or **Prism** at 12.8 to 17 fl oz/A plus petroleum oil adjuvant at 1qt/A applied POST controls annual grasses and quackgrass. See paragraph and table on Select in soybean section for additional information.

G7. Tough (pyridate) at 1.5 pt/A applied POST controls pigweed species, kochia, cocklebur, lambsquarters, nightshade, sunflower, and Russian thistle less than 3 inches tall in chick pea. Do not add adjuvants. Allow a 60 day PHI. Do not make more than two applications and allow 20 days between applications. Do not apply by air. Do not feed forage or hay from crop.

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. Assure II (sethoxydim) at 8 to 10 fl oz/A plus oil additive at 1% v/v controls annual grasses and quackgrass. See paragraph under Assure II in soybean section for additional information.

H3. Far-Go (trilalate) at 1.25 qt/A can be applied for wild oat control before or just after seeding lentil. Far-Go is volatile and must be incorporated into the soil immediately after application.

H4. Glyphosate can be applied preharvest or as a spot treatment for weed control prior to harvest. See Roundup Ultra in field pea section for additional information.

H5. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil additive at 1 qt/A controls annual grass weeds and suppresses quackgrass in lentil. See paragraph under Poast in soybean section for additional information.

H6. Sencor (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.

H7. Treflan or Trilin 10G (trifluralin) at 5 to 7.5 lb 10G/A or 6 to 8.5 lb 10G/A in the fall or **Prowl/Pendimax** (pendimethalin) at 1.2 to 3.6 pt/A applied in the 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. Spring applications of Treflan/Trilin may cause a stand reduction compared to fall applications. If seeding into cool, dry soil after a spring application of Treflan/Trilin, the seeding rate should be increased by 15% to compensate for injury that may occur. Seeding no deeper than 1.5 inches, will also reduce the potential for lentil injury.

SUNFLOWER

J1. Sunflower competes poorly with weeds because of slow early growth and 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. A harrow or rotary can be used when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

J2. Assert (imazamethabenz) is registered through ND supplemental labeling at 0.6 to 0.8 pt/A for POST control of wild mustard in the rosette stage and prior to bloom and sunflower at the 2- to 8-leaf but before 15 inches tall. Severe sunflower injury may occur with high temperatures and humidity at application. Sunflower variety, growth stage, weather conditions, humidity, spray volume, spray additives, and type of application may affect

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sunflower safety. Risk of injury should be considered when deciding whether treatment is warranted. Do not apply to sunflower under drought or heat stress. Apply Assert only when air temperature plus relative humidity is below 150. Sunflower damage from misapplication may range from plant stunting to head deformation. Do not tank mix Assert with any insecticides or herbicides. After Assert application, wait 4 to 5 days before between-row cultivation. Read and follow the label information.

J3. Eptam (EPTC), **Prowl/Pendimax** (pendimethalin), **Sonalan** (ethalfuralin), and **trifluralin** are PPI herbicides that can be applied spring or fall (See discussion on herbicide incorporation). Sonalan at 1.5 to 2 pt/A or 5.5 lb 10G/A and trifluralin at 1 pt/A or 5 lb 10G/A can be applied on sandy soil. Eptam must be applied and incorporated immediately to prevent herbicide loss. Eptam may be applied in late fall before soil freeze-up at 4.5 pt 7E/A or 20 lb 20G/A on coarse textured soil and 5.25 pt 7E/A or 22.55 lb 20G/A on fine and medium textured soil. Eptam controls wild oat better than Prowl, Sonalan or trifluralin. Sonalan may be tank-mixed with Eptam. Rainfall after Prowl applied PRE is needed for activation.

J4. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil additive control annual grasses. Observe a 70 days PHI and do not feed treated sunflower forage to livestock. See paragraph and table on Poast in soybean section for additional information.

J5. Select (clethodim) at 6 to 8 fl oz/A or **Prism** at 12.8 to 17 fl oz/A plus oil additive controls annual grasses and quackgrass. Observe a 70 days PHI and do not feed treated sunflower forage to livestock. See paragraph and table on Select in soybean section for additional information.

J6. Spartan (sulfentrazone) may be registered in sunflower in 2001 through Section 18 emergency registration. Spartan applied PRE at 2.67 to 5.33oz WDG/A controls most annual small-seeded broadleaf weeds, such as kochia, pigweed species, lambsquarters, nightshade, smartweed, and biennial wormwood. Spartan may suppress other weeds like buckwheat, mustard, ragweed, and Russian thistle. Spartan provides little grass and no perennial weed control. Adjust rate for OM. Spartan may be applied up to 30 days prior to planting but use the higher rate in the appropriate rate range. Sunflower has shown good tolerance to Spartan on medium to fine textured soils with organic matter above 3%. Crop injury may occur on soils with low organic matter and soil pH greater than 8.0, especially on calcareous outcropping. Do not use on coarse textured soils with less than 1% organic matter. Provide adequate furrow closure and soil covering to avoid crop injury. Poor growing conditions at and following sunflower emergence, cold temperatures, soil compaction, or rate too high based on soil type and organic matter may result in sunflower injury. NDSU research has shown excellent weed control in many different environments throughout the Great Plains region. However, consistent control of sensitive broadleaf weeds and control of grass and marginally controlled broadleaf weeds greatly depends on at least 0.75 inch rainfall shortly after application and before weeds emerge. Spartan is a PPO inhibitor mode of action herbicide. No weed resistance has been documented with herbicides of this type. Contact a county, area, or state extension specialist for registration status.

FLAX

K1. Flax is less competitive with weeds than small grains and should be grown on relatively weed-free fields. Early 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. Weed problems will be reduced when weeds are controlled in the preceding crop. Flax should be seeded directly or with shallow spring tillage in fields which were not weedy the previous year. Deep tillage on such fields could bring dormant seeds to the surface, increasing weed problems. If fields are weedy, moldboard plowing after a year of weed seed production will bury the weed seeds, reducing the weed infestation in the following crop season. Moldboard plowing is especially effective in reducing infestation 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. PPI herbicides prevent weed emergence and minimize early weed competition and 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 to larger weeds and flax.

K2. Bromoxynil at 1 pt/A on 2- to 8-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some flax leaf burn may occur at higher rates or if high temperatures follow application. Mixtures of bromoxynil plus MCPA may cause flax injury if applied during hot, humid conditions.

K3. Curtail M may be labeled in flax through Section 18 emergency exemption registration in 2001. Apply Curtail M at 1.33 to 1.75 pt/A for Canada thistle control and 1.75 pt/A for perennial sowthistle control. Apply when flax is 2 to 6 inches tall and weeds are actively growing. Extreme growing conditions prior to, at, and following application may reduce weed control and increase risk of flax injury.

K4. Glyphosate may be labeled in flax as a preharvest application through Section 18 emergency exemption registration in 2001.

K5. MCPA at 0.5 pt/A on 2- to 6-inch flax controls many broadleaf weeds. MCPA amine rates higher than 0.5 pt/A or MCPA ester should be used in flax for improved kochia and Russian thistle control.

K6. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil additive controls annual grass weeds and quackgrass. See section on Poast under soybean for additional information. Poast is less effective when applied to grasses under stress. Allow a 75 day PHI. Poast plus oil additive can be tank-mixed with bromoxynil at 1 pt/A or MCPA ester at 0.5 pt/A for broad-spectrum weed control. Bromoxynil or MCPA ester applied with Poast may cause leaf burn, retarded growth, and delayed maturity of flax. Grass control from Poast may be reduced when applied as a tank-mixture with bromoxynil.

K7. Trifluralin at 1 to 2 pt/A or 10 to 12 lb 10G/A may be fall applied for foxtail and broadleaf weed control on fields to be planted 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. Registration for shallow spring application is being pursued. To maximize crop safety, if incorporate shallow - seed deep or if incorporate deep - seed shallow.

CANOLA AND MUSTARD CROPS

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

L2. Assure II (quizalofop-P) at 8 to 10 fl oz/A plus petroleum oil additive at 1% v/v in canola and crambe controls annual grass weeds and quackgrass. See discussion on Assure II under soybean for additional information.

L3. Muster (ethametsulfuron) may be registered in 2001 for wild mustard control in canola grown for seed. Muster at 0.3 oz DF/A will control wild mustard in canola. Muster may control hemp nettle, smartweed, and flaxweed and suppress field pennycress and redroot pigweed. Apply to 2-leaf to bolting canola with NIS at 0.25% v/v. Apply to small weeds. May be tank-mixed with Assure II. Apply only to canola grown for seed

L4. Poast (sethoxydim) at 10 to 30 fl oz/A plus oil additive at 1 qt/A applied in canola, rapeseed, and crambe at all stages will control annual grasses and suppress quackgrass. Poast must be applied 60 days or more before harvest. See Poast in the soybean section for additional information.

L5. Select (clethodim) at 4 to 5 fl oz/A or **Prism** at 8.5 to 11 fl oz/A plus petroleum oil additive at 1qt/A controls annual grass weeds and quackgrass in canola. Allow a 60 day PHI. See discussion on Select under soybean for additional information.

L6. Sonalan (ethalfluralin) is registered on crambe and may be registered for use in canola in 2000 through Section 18 registration. Sonalan PPI at 1 to 3 pt/A controls annual grass and some small-seeded broadleaf weeds in canola. Sonalan gives poor control of wild mustard, common cocklebur and sunflower. Adjust rate according to soil type. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Sonalan has less soil residue than trifluralin but is more active at comparable rates than trifluralin.

L7. Stinger (clopyralid) is registered on crambe and may be registered for use in canola and crambe in 2001 through Section 18 registration. Stinger at 0.33 to 0.5 pt/A applied POST controls several broadleaf weeds and volunteer crops. Stinger 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. Stinger 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.

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L8. Trifluralin at 1 to 2 pt/A or 10 to 12 lb 10G/A applied PPI in spring or fall to canola, rapeseed, and crambe or at 1 to 1.5 pt/A on tame mustard controls foxtail and some small-seeded broadleaf weeds. Use only those brands of trifluralin that are registered for use on crops listed (Treflan and Tri-4) are registered). Set the incorporation implement 4 to 6 inches deep to uniformly mix trifluralin in soil. Trifluralin incorporation may be delayed up to 24 hours if wind velocity is less than 10 mph. See herbicide residue section.

HERBICIDE TOLERANT CANOLA

LIBERTY (Glufosinate) RESISTANT CANOLA

L9. 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 provides suppression of some perennial weeds. Always apply with AMS at 2 to 4 lb/A. Liberty is a non-selective, non-residual, contact type herbicide with limited translocation and should be applied to small weeds. Lack of translocation may be the cause of poor control of large grass or certain species like yellow foxtail, wild oat, or volunteer cereals. Liberty is non-residual so multiple applications or a residual herbicide may be needed to control multiple weed flushes. Lack of soil residue will allow any crop to be planted the following year. 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 as another tool in weed resistance management.

CLEARFIELD (Imidazolinone) RESISTANT CANOLA

L10. Raptor (imazamox) may be registered for use in Clearfield canola in 2001 through Section 18 registration. Raptor at 4 fl oz/A applied POST to Imi tolerant canola (45A71) from emergence until prior to flowering controls nearly all 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. Allow a 60 day PHI. Raptor is an ALS herbicide and will not control ALS resistant kochia. 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.

ROUNDUP (Glyphosate) RESISTANT CANOLA

L11. Glyphosate may be applied at a maximum of 1 pt/A with a total of two applications allowed to glyphosate resistant canola from emergence to bolting for control of most annual and perennial weeds. Some formulation require no additional adjuvant, while others require part or full NIS rates. Add AMS at 8.5 to 17 lb/100 gal to ALL glyphosate formulations. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, systemic herbicide. Full labeled rates are required for broadleaf weed control. Glyphosate is non-residual so multiple applications or residual herbicide may be needed to control multiple weed flushes. 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.

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-P) at 7 to 10 fl oz/A plus petroleum oil additive controls annual and quackgrass control in sugarbeet. See discussion on Assure II under soybean for additional information.

M4. Betanex (desmedipham) and **Betamix** (desmedipham plus 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.

Table 1. 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

M5. Micro-rate program uses 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 or Betamix or Progress plus UpBeet plus

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Stinger plus an methylated seed oil (MSO) adjuvant at 0.5 or 0.5 or 0.4 pt/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 from low herbicide rates used. Assure II at 4 fl oz/A or Select at 2 fl oz/A or Poast at 5.3 fl oz/A can be added to the micro-rate to improve grass control. The micro-rate will not control lanceleaf sage or ALS resistant kochia.

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 but the difference generally was 5% or less. Broadcast application of the micro-rate is encouraged since precise application is easier with broadcast rather than band application. If banding is done, the band width should be 11 inches or wider and wind velocity should be low.

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 out 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) 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. 3) Allow the spray tank water to warm before mixing and increase the pH of the water to 8 or 9 by using ammonia, Quad 7, or other pH increasing agents. 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.

M6. 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 sometimes cause sugarbeet stand reduction and temporary stunting. However, no yield reduction will occur if an adequate sugarbeet population remains after thinning. Use extreme caution in sandy loam or lighter soils with low organic matter because choosing a safe rate is difficult. Herbicides such as Ro-Neet, Nortron, or Pyramin cause less sugarbeet injury on the low organic matter soils where Eptam injury may be excessive.

Ro-Neet 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 organic matter 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 to use on more coarse-textured, low organic matter soils.

M7. 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 organic matter. Suggested fall applied rates are: Ro-Neet alone at 5.3 pt/A on soils with less than 3 percent organic matter, Eptam plus Ro-Neet at 1.1 pt/A plus 4 pt/A on loam or coarser soils with 3% organic matter, 1.7 pt/A plus 3.3 pt/A on loam to clay loam soils with 3 to 4% organic matter, 2.3 pt/A plus 2.7

pt/A on clay loam soils with 3.5 to 4.5% organic matter, and 2.9 pt/A plus 3.3 pt/A on clay or clay loam soils with over 4.5% organic matter.

Suggested spring applied rates are: Ro-Neet alone at 4 pt/A on loam or coarser soils with 3% or less organic matter, Eptam plus Ro-Neet at 1.1 pt/A plus 3.3 pt/A on loam or coarser soils with 3 to 3.5% organic matter, 1.7 pt/A plus 3.3 pt/A on loam to clay loam soils with 3.5 to 4.5% organic matter, and 2.3 pt/A plus 2.7 pt/A on clay loam or finer soils with 4% or more organic matter. 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.

M8. Far-Go (triallate) spring or fall applied at 1.5 pt/A or 15 lb 10G/A controls wild oat. Far-Go should be incorporated immediately after application with a tillage tool set 3 to 4 inches deep. Deep and thorough incorporation generally will provide the best wild oat control. A second incorporation will often improve wild oat control and a three day or longer delay between the first and second incorporation is recommended. One incorporation in the fall followed by spring seed-bed preparation is sufficient for fall applied Far-Go. Far-Go should be applied in the fall when temperatures are consistently below 50 F. This 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.

M9. Nortron SC (ethofumesate) at 6 to 7.5 pt/A controls several broadleaf and grass weeds. Nortron is particularly effective on redroot pigweed and wild buckwheat but is weak on yellow foxtail. Nortron may be applied PRE but research results in North Dakota and Minnesota indicate that incorporation generally improves weed control. Nortron incorporated by operating the incorporation tool 2 to 4 inches deep gave slightly better weed control than when incorporated 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 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.

M10. Nortron SC (ethofumesate) is registered as a tank-mix combination with **Betanex (desmedipham)**. Nortron SC plus Betanex gives increased weed control and greater risk of sugarbeet injury than Betanex alone. The active ingredients should be used in a 1 part ethofumesate:2 parts desmedipham ratio. The total lb/A of the active ingredients in the tank-mix combination should be equal to the lb/A of Betanex if the Betanex were to be applied without the Nortron SC. For example, if the normal rate of Betanex was 0.3 lb/A, then the suggested Nortron SC plus Betanex rate would be 0.1 + 0.2 lb/A. Risk factors are the same as for Betanex alone.

M11. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil additive controls annual grass weeds and quackgrass in sugarbeet. See discussion on Poast under soybean for additional information.

M12. Progress (desmedipham + phenmedipham + ethofumesate) applied POST gives increased weed control and greater risk of sugarbeet injury than Betamix alone. The active ingredients are in a 1:1:1 ratio. A tank mixture of Betamix plus Nortron SC can substitute for Progress but the ratio of the three

active ingredients should be 1:1:1. Adjust the rate 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.

M13. Select (clethodim) at 6 to 8 or **Prism** at 12.8 to 17 fl oz/A plus oil additive at 1qt/A controls annual and quackgrass in sugarbeet. See table in the soybean section for rates of Select/Prism according to weed species and weed size. Quackgrass can be controlled with two sequential applications, each at 8/17 fl oz/A. Tank-mixing POST sugarbeet herbicides or applying the herbicide within 1 day of Select/Prism may reduce grass control compared to Select/Prism applied alone. Reduced grass control can be avoided by applying Select/Prism at least 1 day before or 5 days after application of a broadleaf herbicide. However, research at NDSU indicated that grass control from Select/Prism was reduced less than from Poast or Assure II tank-mixed with Betanex or Betamix. Do not apply Select/Prism within 100 days of sugarbeet harvest. Do not apply more than 68 fl oz of Select/Prism per season.

M14. UpBeet (triflurosulfuron) at 0.25 to 0.5 oz/A should be used with an adjuvant when applied with Stinger 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 Poast, Prism or Assure II 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. Stinger (clopypalid) at 0.25 to 0.66 pt/A applied POST controls several broadleaf weeds and volunteer crops. Stinger 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. Apply Stinger 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. Stinger must be applied to sugarbeet in the 2- to 8-leaf stage and at least 105 days prior to harvest.

M16. Trifluralin at 1.5 pt/A or **Eptam** (EPTC) at 3.4 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 or Eptam will control late germinating weeds that may become a problem, well into the season with good moisture conditions.

M17. Combinations of postemergence herbicides give more broad spectrum and greater total weed control compared to individual treatments. The risk of sugarbeet injury also increases with combinations so combinations should be used with caution. Stinger + Betanex or Stinger + Betamix have given control of wild buckwheat, eastern black nightshade, common lambsquarters, buffalobur, giant ragweed, ladythumb, lanceleaf

sage, and Russian thistle superior to Stinger 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 + Stinger has given good to excellent control of all common broadleaf weeds in sugarbeet in research conducted in ND and MN.

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 tuber. 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. Dual, Dual III (metolachlor) at 2 to 3 pt/A or **Dual Magnum, Dual II Magnum** at 1 to 2 pt/A can be applied PPI or PRE to control grasses and certain broadleaf weeds. Dual products gives poor wild mustard control. Use the higher rate on clay soils with high OM. Dual products have a 40 day post-harvest interval in potato. Dual products are registered as a tank-mix with Sencor.

N3. Eptam (EPTC) can be applied at 3.5 to 7 pt/A before planting and incorporated immediately after application or apply and incorporate after drag-off before potato and weeds emerge. Do not use on peat or muck soils. Use lower rates on coarse textured soils. Eptam can be tank-mixed with Sencor or Prowl.

N4. Lorox (linuron) at 1.5 to 4 pt/A/lb 50DF/A can be applied PRE after crop is planted. Crop must be planted a minimum of 2 inches deep. Grass weeds should be less than 2 inches tall. Use lower rates on coarse textured soils.

N5. Matrix (rimsulfuron) at 1 to 1.5 oz 25DF/A plus NIS or oil additive can be applied PRE or POST alone or with Sencor at 0.25 to 0.67 lb 75DF/A to control annual grass and broadleaf weeds including common lambsquarters, ALS resistant kochia and wild buckwheat and to suppress quackgrass and Canada thistle. 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, may control or suppress hairy nightshade but gives poor 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 when 0.75 inches of water occur soon after application. If weeds have emerged, add NIS at 0.25% v/v. 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, or Prowl. 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. Do not apply within 60 days of harvest. Refer to label for application information and restrictions.

N6. Poast (sethoxydim) at 0.5 to 1.5 pt/A with oil additive at 1 qt/A applied POST controls annual grasses and suppress quackgrass. Allow a 30 day PHI. See Poast section under soybean for additional information.

N7. Prowl (pendimethalin), at 1.2 to 3.6 pt EC, 1.67 to 2.5 lb DG controls grasses and certain broadleaf weeds. Prowl can be applied post-plant incorporated (PoPI), PRE or early POST before the potato is 6 inches tall. Weed control is better if incorporated. Do not use on muck or peat soils. Can be tank-mixed with Eptam, Sencor, or Lorox.

N8. Select (clethodim) at 6 to 10 fl oz or **Prism** at 12.8 to 21.3 fl oz/A applied POST with oil additive at 1 qt/A controls annual grasses and quackgrass. Allow a 30 day PHI. See Select section under soybean for additional information.

N9. Sencor (metribuzin) at 1 to 2 pt/A or 0.67 to 1.33 lb 75DF/A can be applied PRE before potato or weeds emerge. Use lower rate on coarse textured soils. For POST applications use 0.5 to 1 pt/A or 0.67 to 1.33 lb 75DF/A 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.

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.

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 rosettes 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 2,4-DB for improved control of pigweed, kochia, and tansy mustard.

P3. Pursuit (imazethapyr) at 3 to 4 fl oz/A or **Pursuit DG** (imazethapyr) at 1.08 to 1.44 oz 70WDG/A applied POST controls many annual grass and broadleaf weeds. Pursuit should be applied when alfalfa has at least 2 trifoliolate leaves and weeds are 1 to 3 inches tall. Alfalfa has excellent safety to Pursuit. Pursuit can be applied to seedling or established alfalfa in the fall, spring to dormant, semi-dormant alfalfa, or between cuttings. Apply Pursuit with NIS at 0.25% v/v or oil additive at 1.5 to 2 pt/A. 28% UAN at 1 to 2 qt/A can be added to NIS or oil additive.

NDSU research has shown excellent weed control of over 22 annual grass and broadleaf weed species from Pursuit applied at 2 fl oz/A with MSO type oil adjuvant at 1.5 pt/A to establishing alfalfa. Pursuit does not control perennial weeds. Pursuit can be tank-mixed with Butyrac 200 (2,4-DB), bromoxynil, or Poast. Pursuit may not provide adequate yellow foxtail, common lambsquarters, common ragweed, wild buckwheat control or perennial weed control, including quackgrass, dandelion, Canada thistle, perennial sowthistle, or field bindweed. However, herbicides plus strong alfalfa competition may control weeds not controlled by herbicides alone.

P4. Poast (sethoxydim) at 0.5 to 1.5 pt/A plus oil additive applied POST controls annual grasses and suppresses quackgrass in seedling and established alfalfa. Alfalfa is tolerant at all growth stages. Apply Poast to actively growing grass weeds. Allow grass to produce new regrowth after clipping before treating with Poast. Do not feed, graze, or harvest forage for 7 days, or feed or harvest hay for 20 days after application. Poast can be applied only to alfalfa, sanfoin, trefoil, and clover. See discussion under soybean for rates and stages to control different weed species.

P5. Sencor (metribuzin) at 0.75 to 2 pt/A or 0.5 to 1.25 lb 75DF/A, **Sinbar** (terbacil) at 0.5 to 1.5 lb 80W/A and **Kerb** (pronamide) at 2 to 4 lb 50W/A can be applied to dormant alfalfa in the fall for grass and broadleaf weed control. Metribuzin and Sinbar also can be applied to dormant alfalfa in early spring. All three herbicides can injure alfalfa. Do not apply metribuzin and Sinbar until alfalfa has been established at least one year. Do not graze or harvest alfalfa treated with metribuzin for 28 days after treatment. Do not graze or harvest alfalfa treated with Kerb within 25 days (below 3 lb 50W/A) to 45 days (3 to 4 lb 50W/A) after application. Do not rotate to any other crop within 2 years after Sinbar application.

P6. Trifluralin at 1 to 1.5 pt/A applied PPI controls annual grass and some broadleaf weeds. Only use on acres in a government set-aside program. Some legume injury may occur.

P7. Velpar (hexazinone) at 0.67 to 1.33 lb 75DF/A applied in the spring to dormant alfalfa will control most annual grass and broadleaf weeds and provides suppression of Canada thistle, dandelion, and quackgrass. NDSU field tests showed excellent alfalfa safety and grass and broadleaf weed control of over 20 weed species with Velpar DF. Velpar gave good to excellent quackgrass, dandelion, and smooth brome grass control. Velpar can be used to control weedy alfalfa fields and prolong alfalfa stands.

Velpar is expensive which may limit use. However, research has shown excellent weed control of most weed species normally infesting alfalfa stands. Removing weed infestations may allow alfalfa stands to increase and also increase forage production. Revitalizing alfalfa stands may allow productive harvest for a few more years. Therefore the cost should be calculated over the number of years the stand will be maintained.

Q1. Postharvest or fallow weed control in minimum-till situations. Dicamba at 0.25 to 0.5 pt/A, or 2,4-D at 0.34 to 1.2 pt/A can be tank-mixed with glyphosate. Commercial mixtures of dicamba plus glyphosate (**Fallow Master**) and 2,4-D plus glyphosate (**Landmaster BW**) are available. Refer to the label for additives allowed. Always add AMS at 8.5 to 17 lb/100 gal water. Delay planting of wheat, barley, oat, or sorghum for 15 days and all other crops for 3 months after Fallow Master application. Low rates of dicamba or 2,4-D plus glyphosate should be used when weeds are less than 4 inches tall and actively growing. Use higher rates of glyphosate if weeds are drought stressed or greater than 4 inches tall.

Q2. Ally at 1/10 oz DF/A, **Canvas** at 2/10 to 4/10 oz DF/A or 5 to 10 A/pack, **Express** at 0.167 to 0.33 oz DF/A, or **Harmony GT** at 3/10 to 6/10 oz DF/A, **Harmony Extra** at 3/10 to 6/10 oz DF/A, **Finesse** (tribenuron) at 2/10 to 4/10 oz DF/A controls most annual weeds in fallow cropland. Apply with NIS at 0.25% v/v and may be tank-mixed with other products such as dicamba, glyphosate, 2,4-D or other fallow herbicides.

Q3. Bladex (cyanazine) at 2.2 to 3.1 lb 90DF/A plus **atrazine** at 0.8 to 1 pt 4L/A with NIS controls annual weeds in fallow. Use high rate on soil with high OM. Bladex plus atrazine combination gives greater residual weed control compared to Bladex alone. Apply before November 15 preceding the planting of winter wheat. Atrazine PRE at 1 to 2 pt/A will control annual weeds including downy brome (cheatgrass) during the fallow period of a wheat-fallow-wheat rotation. See herbicide carryover section for atrazine restrictions. Allow 12 or more months between application and planting. Add paraquat if weeds have emerged but are less than 6 inches tall. Atrazine and Bladex are restricted use herbicides.

Q4. Glyphosate applied POST will control annual and perennial weeds in preplant, in-crop use on resistant crops, and post-harvest in conventional or reduced-till systems. ALWAYS add AMS to any glyphosate product at 8.5 to 17 lb/100 gallons of water. Increased weed control results from addition of AMS even under good growing conditions or lack of hard water. Allow AMS to dissolve before adding herbicides or surfactant.

Glyphosate at 0.5 pt/A of a 3 lb ae/gal concentration controls foxtails, at 0.75 pt/A controls volunteer small grains and at 1 pt/A controls wild oat and downy brome less than 4 inches tall. Use a higher rate on larger weeds, tolerant weeds, or if plants are under moisture stress. Use 3 to 10 gpa by ground or 3 to 5 gpa by air when glyphosate is applied at low rates. Glyphosate at 2 pt/A should be applied when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing; at 4 to 6 pt/A when Canada thistle is actively growing and just before the bud stage. Tillage can be performed the same day as glyphosate application for annual weeds but tillage should be delayed for 3 days following application of all other formulations. Some formulations of glyphosate contain an NIS that enhances uptake of glyphosate allowing less time between application and tillage or application of glyphosate to perennial weeds. See label for details.

Glyphosate can be used in the spring before or after planting but before emergence of barley, corn, oat, soybean, dry bean, sunflower, forages, potatoes, sugarbeet, wheat, and sorghum (milo), or in the fall when these crops will be planted the next growing season. Potential for crop injury exists when glyphosate

plus 2,4-D or dicamba mixtures are applied immediately before or after planting due to the PRE soil activity of 2,4-D and dicamba. Glyphosate at the equivalent of 2.66 pt/A of a 3 lb ae/gal concentrate is required to control fall planted rye or wheat prior to seeding crops in spring.

Dew on plant foliage at application may reduce weed control. Glyphosate should be applied in low spray water volumes to produce spray droplets having a higher concentration of glyphosate. Dew on leaves dilutes spray droplets and negates the effect of low spray volumes at application.

Q5. Paramount (quinclorac) at 0.33 lb DF controls field bindweed in fallow, postharvest or preplant in spring prior to seeding wheat including durum. Bindweed should be actively growing with regrowth at least 4 inches long. Apply with MSO adjuvant at 1.5 pt/A. AMS at 2.5 lb/A or UAN at 1 ga/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested for 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 may also control foxtails, barnyardgrass, and volunteer flax.

Q6. Paraquat applied at 1.5 to 3 pt/A is a non-selective, contact herbicide that can be used as a crop desiccant. It can also be used as a substitute for tillage either applied alone or in combination with a residual herbicide. Paraquat can be applied until crop emergence and can be used on land intended for barley, corn, potatoes, soybean, sunflower and wheat. 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 the skin; small amounts could be fatal if 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.

Q7. Tordon (picloram) can be applied post-harvest or on fallow in a continuous small grain or small grain/fallow rotation. Sensitive crops (dry edible bean and sunflower) should not be planted for at least 36 months after application. Apply 0.25 to 0.5 pint/A for annual weeds, and 0.5 to 1 pint/A for perennial weeds. Tank-mix Tordon with 2,4-D at 1 to 2 pt/A for optimum control. Treat actively growing field bindweed with stems 8 to 12 inches long. Treat Canada thistle after most shoots have emerged but before the bud stage.

Small grains can be injured if seeded too soon following Tordon application. For rates up to 0.5 pint/A, allow a minimum of 45 days with soil temperature above 40 degrees F. For applications of 0.5 to 1 pint/A allow a minimum of 90 days. These intervals will reduce but may not eliminate the potential for crop damage. Factors such as soil moisture and soil organic matter content influence the rate of picloram breakdown and crop injury potential. Under extremely dry conditions, crop injury and yield loss may occur even if the preplant interval is followed. Growers should consider the benefits of weed control against the risk of crop damage in using these treatments.

ANNUAL WEED CONTROL

Q8. Trifluralin (Treflan TR-10) Rates Per Acre

Application Date	Less than 10 inches Annual Rainfall		Other Areas	
	lb/A (Act.Ingred.)	Trifluralin (granular)	lb/A (Act.Ingred.)	Trifluralin (granular)
Apr 15 to Apr 30	0.875	8.75	1.0	10
May 1 to May 31	0.875 to 0.75	8.75 to 7.5	1.0 to 0.875	10 to 8.75
June 1 to June 30	0.75 to 0.625	7.5 to 6.25	0.875 to 0.75	8.75 to 7.5
July 1 to July 31	0.625 to 0.5	6.25 to 5.0	0.75 to 0.625	7.5 to 6.25
Aug 1 to Aug 31	0.5	5.0	0.625 to 0.5	6.25 to 5.0

NOTE: Use higher rate at beginning of month and lower rate at end of month.

Trifluralin (Treflan TR-10) granules at 10 to 12 lb 10G/A may be applied and incorporated on fallow land that has manageable trash levels to control foxtails (pigeongrass) and certain broadleaf weeds. Rates depend upon time of application and local rainfall conditions.

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 made 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 seed bed the following year. Fall application allows breakdown of foliage and root plant biomass. Cultivators and some tillage equipment tend to plug during spring tillage if 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.

In NDSU research 1 qt/A of glyphosate applied fall or spring gave less than 70% alfalfa and smooth brome control. Glyphosate at 2 qt/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 1 qt/A or a spring application of Roundup at 2 qt/A was required for greater than 90% control of smooth brome. A spring application of Roundup at 2 qt/A provided over 90% control and gave the best 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 an annual weed that is becoming more troublesome especially in central and western North Dakota. The recent increase in alternative crops where control options are limited may have contributed to the increase in wild buckwheat infestations. 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 Bronate, Clarity, Curtail, Harmony Extra, Harmony GT, Rave, and Finesse. In other crops, Sonalan, Treflan, Prowl, and Sencor will suppress wild buckwheat. Liberty provides excellent wild buckwheat control while Roundup may need two applications for control.

S2. False chamomile has been a troublesome weed in small grains in north central and northeastern North Dakota. False chamomile is tolerant to many herbicides used in small grains. However, Ally, Harmony Extra, Express, Stinger, or Curtail control false chamomile. Bromoxynil at 1.5 pt/A plus MCPA at 0.75 pt/A gives fair to good control of small spring emerging false chamomile. Fall emerging plants that survive spring seedbed preparation usually are too large at treatment for adequate control. Thorough fall and spring tillage will help control fall emerged chamomile. False chamomile less than 6 inches tall in tree rows and around potholes can be controlled with paraquat at 1.6 pt/A with a NIS at 0.25% v/v. Glyphosate at 2 pt/A controls false chamomile less than 6 inches tall in tree rows as a directed application and around potholes.

S3. Green and yellow foxtails commonly infest all crops in North Dakota. Foxtails are 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 foxtails 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 when the grain is delivered to the elevator. Situations where cost of a herbicide treatment for foxtail control is not justified include: 1. When foxtail infestations are light - Less than 30 plants/sq. ft. 2. When the 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 foxtail and make a herbicide treatment unnecessary. However, if the foxtail population is heavy (100 plants/sq ft or more) control is generally needed. Another complication is moisture stress since weeds will generally cause greater yield losses under drought conditions. Foxtail emerging at the same time or before small grain is more competitive than foxtail 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.

2. If a harrow or rotary hoe are not an option, then consider a herbicide. Hoelon needs to be applied to small foxtail (1- to 3-leaf), so the decision to apply Hoelon needs to be made early in the season. If wild oats are not present, then Stampede CM can be considered.

3. If the foxtail infestation is light to moderate it may be best to wait and see if the crop will be able to out compete foxtail. If foxtail is still a problem by the time the small grain is in the 5- to 6-leaf stage, herbicides can still be used for control.

S4. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. Use proper spray volumes for thorough coverage. ALS herbicides provide good kochia control unless resistant populations are present. Tank-mixing ALS herbicides with other effective broadleaf herbicides with differing modes of action is required to slow development of resistant kochia. Starane or dicamba controls susceptible and resistant kochia. Bromoxynil plus MCPA also gives good control of kochia, but plants should be small and spray coverage good. Tordon is not effective on kochia and 2,4-D and MCPA no longer control kochia due to repeated use and near eradication of susceptible kochia biotypes. 2,4-D and MCPA do not translocate readily in kochia. Treat small plants (less than 3 inches tall) and use high spray volumes to thoroughly wet kochia foliage. Kochia seed is short-lived in soil so one or two years of excellent control can greatly reduce kochia populations. Trifluralin does not give consistent kochia control. However, use of Sonalan may improve control. Soil applied Authority in soybean or Spartan in sunflower 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.

S5. Common mallow has been described as an annual, winter annual, biennial, or short-lived perennial. It is sometimes referred to as cheeseweed. Common mallow traditionally has been found along roadsides and in lawns, gardens, and waste places. However, it has slowly become a problem weed in cultivated fields. Round-leaved mallow, which is very similar to common mallow, has been shown to increase under no-till conditions. Although tillage helps reduce infestations compared to no-till, common mallow can be a problem especially in less competitive crops such as flax and chickpea. In NDSU weed control trials at Minot with no crop competition; Liberty, Roundup, or a three-way mix of Starane + Harmony Extra + 2,4-D ester (0.33 pt + 0.3 oz + 1 pt) gave good to excellent mallow control. Control with Starane (0.67 pt) alone or with 2,4-D ester was fair to good. Common mallow control with Curtail was fair while control with Bronate, Tough, Basagran, or Clarity was poor. Combinations of herbicides including UpBeet gave good to excellent mallow control in sugarbeet.

S6. Nightshades have become a serious weed problem in North Dakota crop production. Human activity associated with crop production, like moving tillage and harvesting equipment from field to field or planting crop seed contaminated with nightshade seed is the greatest contributor to nightshade seed dissemination. However, birds and other wildlife consume nightshade and can transport seed through droppings.

Four different nightshades are found in North Dakota: black, eastern black nightshade, hairy nightshade, and cutleaf nightshade. Black, eastern black, and hairy nightshade are found in central and eastern North Dakota. Cutleaf nightshade is

found in northern regions of the state but is found in isolated areas in or near the Red River Valley. Hairy nightshade is the only nightshade densely covered with small hairs and berries remain green at maturity. Only the underneath side of black and eastern black nightshade leaves are black or dark-purple in color and berries turn black or dark purple at maturity. Eastern black nightshade is very difficult to distinguish from black nightshade before reproduction and berry formation. Eastern black nightshade forms berries in umbrella-like clusters with berry stems arising from a common point; the calyx is smallest, 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.

Nightshade emergence is from June through September and is strongly influenced by moisture. Rain events cause multiple flushes of nightshade and late flushes may occur after normal crop spraying is complete. H. nightshade emerging in early fall can produce viable seed before frost while E. B. nightshade requires a longer growing season. Nightshade can compete in most crops even 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 the soil for 15 years when deeply buried. NDSU studies show that one nightshade plant can produce 178,000 seeds under competitive situations or 800,000 in the absence of competition. Therefore, successful nightshade management requires **little or no seed production**.

Nightshade plants remain green through 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 if contaminated seed is used for planting.

Nightshades are tolerant to many classes of herbicide including SUs. Eastern black nightshade resistance to imidazolinone herbicides has been documented in the Red River Valley of North Dakota. Black nightshade is more tolerant to some herbicides (Matrix) than eastern black nightshade. Thus, herbicides may remove competing broadleaf weeds allowing nightshades to proliferate. Only a few herbicides with residual effect e.g. Authority, Balance, Pursuit, and Python can help control continuous nightshade emergence flushes. Other options for nightshade management include: planting of uncontaminated seed, using crop rotations, multiple herbicide applications to control late flushes, and inter-row cultivation.

Nightshade control in small grains:

POST herbicides: 2,4-D, Bromoxynil, Bromoxynil + MCPA, Curtail, Curtail M, dicamba, and Tordon.

Nightshade control in corn:

PPI, PRE herbicides: Atrazine, Balance, Broadstrike + Dual, Doubleplay, Eradicane, Frontier, Harness, Python, and Surpass.

POST herbicides: Accent Gold, Basis Gold, dicamba, Hornet, Bromoxynil, Liberty (Liberty resistant corn), Lightning (Clearfield corn), and glyphosate resistant Corn).

ANNUAL WEED CONTROL - S6-10

Nightshade control in soybean/dry bean:

PPI and PRE herbicides: Authority, Broadstrike + Treflan, Frontier, Python.

POST herbicides: Cobra, Flexstar, Pursuit, Raptor, Reflex, Ultra Blazer, Liberty (Liberty tolerant Soybean), glyphosate and Extreme (Roundup Ready Soybeans).

Notes: Basagran may control H. nightshade but not E. B. nightshade. Basagran, Cobra, and Ultra Blazer control only small nightshade. Flexstar/Reflex gives poor hairy nightshade control. Only Broadstrike/Python, Extreme and Pursuit have residual effects to control multiple flushes but these herbicides may restrict seeding of some crops one or more years after application; Not all herbicides are labeled for dry beans – see dry bean section or labels.

Nightshade control in sugarbeet:

PPI and PRE herbicides: Eptam, Norton, and Ro-Neet.

POST herbicides: Single or multiple applications of Betanex/Betamix/Progress + Upbeet + Stinger to nightshade at the cotyledon to 2-leaf stage. Alternative control: inter-row cultivation, and hand weeding.

Nightshade Control in potato:

PPI and PRE herbicides: Eptam, Dual + Sencor, or Matrix (eastern black and hairy nightshade only).

POST herbicides: Matrix (E. black and hairy nightshade only).

S7. Pigweed control requires higher rates of most herbicides than rates for control of wild mustard. Ally, Amber, Harmony Extra, Express and other ALS herbicides give good control. Dicamba, 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. A redroot pigweed population resistant to imidazolinone herbicides has been documented in Cass county.

Waterhemp, a related pigweed species, is tolerant to ALS herbicides. Geographic distribution has been primarily in the midwest, but waterhemp has been documented in the Red River valley of North Dakota. 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).

S8. Russian thistle requires higher herbicide rates than those for wild mustard control. ALS herbicides, dicamba, 2,4-D, and bromoxynil give good control. 2,4-D gives greater control than MCPA. The esters of 2,4-D are more effective than the amines.

S9. Volunteer sunflower may be a problem in small grains seeded the year after sunflower. Tillage can distribute the sunflower seeds to various depths in the soil causing emergence over several days or weeks depending on climatic conditions. Sunflower plants may emerge after POST herbicides are normally applied. Herbicides applied early will not control late emerging sunflower and late applications allow competition from early emerged sunflower. Apply herbicides before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.

Treated sunflower appear severely affected within a few days and die about 1 to 2 weeks after treatment. Ally, Harmony Extra, dicamba plus MCPA amine, and Curtail all give good control of volunteer sunflower that is superior to 2,4-D or MCPA. Sun-

flower will stop growing shortly after treatment but may remain green for several weeks, depending on weather and crop competition. Good sunflower control will result even though control may take a longer period of time as compared to bromoxynil + MCPA.

S10. 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. Several cultural approaches are available for wild oat control in small grains. They 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. Delayed seeding involves early soil cultivation to stimulate wild oat germination with one or two subsequent cultivations to control emerged wild oat prior to crop seeding. Delayed seeding may control wild oat but may cause up to a 40% wheat yield reduction when compared to early seeding.

Planting competitive crops is another effective cultural control method for wild oat. Barley and rye are more competitive with wild oat than spring wheat. Also, warm season row crops such as sunflowers, soybeans, and corn should be considered in fields with heavy wild oat infestations. Many growers would like to eradicate wild oat from their fields. Research has shown that wild oat eradication may not be practical or economically sound. Therefore, a combination of cultural and chemical control methods should be used to manage wild oat populations and prevent yield losses.

Good wild oat control with any herbicide requires proper timing of applications. POST wild oat herbicides require application to wild oats and crops at precise leaf stages. Leaf number on wild oats is determined by counting the leaves on the main stem and disregarding the tillers. The youngest leaf is counted as a full leaf only when another leaf becomes visible. Lower leaves which may have died from various stresses, such as frost, should also be counted in the total leaf number. An accurate leaf count is important for optimum wild oat control. Climatic conditions must also be considered when choosing a wild oat herbicide. For example, some wild oat herbicides work better under dry conditions than others.

Several tradeoffs should be considered in timing POST herbicide application. Early wild oat control can mean better yields because the weed has less time to compete with the crop. However, when a herbicide treatment is applied early, odds are greater that a late flush of wild oat will require a second application, or that some wild oats might escape treatment. Any uncontrolled wild oats can reduce yields and will produce seed that contribute to next year's wild oat problem. In general, heavy wild oat pressure (over 30 plants/square foot) warrants herbicide treatment to prevent high yield losses. Wheat yield reduction from foxtail and wild oats 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%

S11. Wormwood, annual or biennial, plants emerge throughout the year, behave like an annual species, and produce numerous seed (approx. 1 million per plant). B. wormwood seeds are very small, can be dispersed easily by wind, water, and all human-related operations related to farming. 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 events a new flush of wormwood seedlings may appear.

Biennial wormwood is difficult to control because of an extended emergence period and tolerance to many PPI, PRE (e.g. Treflan, Sonalan, Prowl, Lasso, Dual) and POST (e.g. most ALS herbicides and Ultra Blazer) herbicides used in row crops. Also, b. wormwood can emerge late after most POST herbicides have been applied and is often confused with common ragweed. However, b. wormwood is susceptible to growth regulator herbicides of 2,4-D, Curtail/M, dicamba, Distinct, Hornet, Stinger and to non-selective herbicides, Liberty and glyphosate. Other herbicide that may control or suppress wormwood are soil applied Authority, Broadstrike + Treflan, Python, and Spartan.

Limited research and experience indicates Basagran applied as split applications – first split when wormwood is 1.5 inches tall and second split when wormwood is 3 inches tall will improve control. Additionally, from preliminary research, it appears that small wormwood, 1 to 3 inches tall, may be controlled by some herbicides that were previously thought to be ineffective. Wormwood apparently rapidly becomes tolerant to herbicides as plant size increases.

Commonly, biennial wormwood survives PPI, PRE, and POST herbicides, is then detected and misidentified as common ragweed when plants are large. Rescue treatments are made with herbicides that control common ragweed, such as Ultra Blazer and FirstRate but 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 which impedes grain harvest or can damage harvesting equipment.

PERENNIAL WEEDS

T1. Field bindweed is a problem in the more semi-arid parts of ND. Paramount (quinclorac) at 0.33 lb DF controls field bindweed in fallow, postharvest or preplant in spring prior to seeding wheat, including durum. Bindweed should be actively growing with regrowth at least 4 inches long. Apply with MSO adjuvant at 1.5 pt/A. AMS at 2.5 lb/A or UAN at 1 ga/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested for 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 may also control foxtails, barnyardgrass, and volunteer flax. Field research in ND, SD, KS, NE, CO, and WY showed Paramount gave excellent field bindweed control at rates of 0.33 to 0.5 lb/A. Will require yearly applications at rates less than 0.37 lb ai/A.

T2. Canada thistle has become a major problem in ND due to reduced tillage, wet weather, and lack of persistence in control. NDSU research has shown Curtail provides the best long-term Canada thistle control. Glyphosate alone or with 2,4-D gave better control applied post-harvest than pre-harvest. However, control was reduced under dry conditions. Dicamba gave good in-season control but dropped to 65% the following year.

Express + 2,4-D did not control Canada thistle. 2,4-D at jointing followed by Curtail applied post-harvest to rosette thistle provided the best long-term control. In general, post-harvest treatments gave better thistle control than pre-harvest treatments. Glyphosate applied alone gave control similar to Curtail but less control than glyphosate + 2,4-D.

Curtail, Dicamba, glyphosate, Stinger, Tordon, and 2,4-D have the greatest activity on Canada thistle. Highest rates should be used without interfering with next years cropping pattern. Apply high rates of herbicides to patches before thistle infestation increase. Timing is a critical factor. Herbicide application after a light frosts 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 treatments that gave 30 to 50% control. If lower herbicide rates or less effective herbicides are used, tillage is very important. If tillage is not planned, then use the most effective herbicide at high rates. Spray rosettes of actively growing plants using the rosette technique.

Rosette Technique. Fall-applied herbicides are better absorbed and translocated when Canada thistle is in the rosette compared to bolting or flowering stage. The rosette technique for Canada thistle control in fallow utilizes tillage and fall-applied herbicides, while control in row crops include in-crop and fall-applied herbicide plus tillage. Periodic tillage in fallow controls Canada thistle shoots and other weeds until late 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. A herbicide used for Canada thistle control, such as glyphosate, Curtail/M, or Stinger, is then applied to rosettes in late September or early October. A similar technique can be used in row crops where between-row cultivation can be utilized. Herbicides and tillage are used to control Canada thistle in the crop to prevent bolting. Cultivation should be continued until canopy closure in soybean and until early July in corn. Herbicides recommended for Canada thistle control can be applied post-harvest until early October. The rosette technique controls Canada thistle in both fallow and row-crops during the season and maximizes the number of rosettes for better absorption, translocation and activity of herbicides. Herbicides fall-applied to Canada thistle in the rosette stage provide greater control and root kill compared to 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 chemical, mechanical, and cultural control measures. Common milkweed is tolerant to most labeled herbicides. Control requires multiple herbicide application. Preventing establishment and spread of common 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 developing from established roots begin emerging in late April and grow more rapidly than spring seeded crops.

PERENNIAL WEEDS / PERENNIAL WEED CONTROL- T3-10

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.

NDSU Research. Herbicides applied June, 1988.

Herbicide	Rate pt/A	Fall 88 --- % control ---	Spring 89
2,4-D	4	36	48
Dicamba	2	71	61
Dicamba + 2,4-D	0.5+2	26	15
Curtail	4	13	6
Tordon	2	86	83
Glyphosate	6	56	99

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 at late bud to flowering. Apply glyphosate with AMS at 8.5 to 17 lb/100 gallons of water. Do not apply after small grain is headed and only a maximum of 10% of the field can be treated. After heading, the application is regarded as a preharvest application and maximum use rates are limited to 2 pt/A. 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.

PERENNIAL WEED CONTROL

T4. Fall applied herbicides can be effective for controlling perennial weeds provided most weed 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 even after several light frosts if the leaves are green or red but 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. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment should be separated from harvest by at least 5 days to allow adequate herbicide translocation in the perennial weeds.

PERENNIAL WEEDS IN CROPS

T6. Perennial weed control systems in small grains should include herbicide application in crop followed by post-harvest treatment for several years. Canada thistle and perennial sowthistle can be controlled in wheat and barley with Curtail, Express, Harmony Extra, MCPA and 2,4-D. Canada thistle control is generally better with Curtail than other herbicides. Perennial sowthistle and field bindweed can be controlled in tolerant crops with MCPA or 2,4-D. When controlling thistles in small grains, except oat, apply the maximum rate of 2,4-D or MCPA that the crop will tolerate: 2,4-D or MCPA amine at 1.5

pt/A of a 4 lb/gal concentrate and 2,4-D low volatile ester or MCPA ester at 1.33 pt/A of a 4 lb/gal concentrate. MCPA is less likely to cause injury to small grain than 2,4-D. MCPA can be used to suppress thistles in oat and flax, but these crops do not tolerate rates of MCPA necessary to control thistle. Dicamba can be tank-mixed with 2,4-D or glyphosate for control of perennial broadleaf weeds after harvest or during fallow. Tank-mix dicamba at 1 to 4 pt/A with glyphosate at 2 to 4 pt/A of a 3 lb ae/gal concentrate. When higher dicamba rates restrict crop rotation, use the lower rate of dicamba and higher rates of glyphosate.

T7. Glyphosate at 4 to 10 pt/A of a 3 lb ae/gal concentrate may be applied for spot treatment of perennial weeds in wheat, barley, oat, corn and soybean. Spot treatments must be made prior to the heading stage of small grains, initial pod set on soybean and silking of corn. Glyphosate is a non-selective POST herbicide so the crop in the treated area will be killed, and care must be taken to avoid drift outside the target area. Glyphosate does not have a soil residual, so plants arising from seed after treatment or unaffected underground rhizomes or roots of perennials will continue to grow. See the perennial weed control section of the tables for application stages and rates. Preharvest applications of glyphosate at 2 pt/A have given good Canada thistle and quackgrass control. Preharvest applications will give greater Canada thistle control than post-harvest applications when tillage is used after harvest.

PERENNIAL WEEDS IN PASTURES

T8. 2,4-D ester or amine at 2 to 4 pt/A of a 4 lb/gal concentrate can be used to control 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 in many locations where Tordon cannot, but drift onto susceptible plants such as trees should be avoided. Several brands of 2,4-D with various application limitations are available. For example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air. PBI Gordon "Amine 400," Cornbelt Chemical "Navigate," and Rhone Poulenc "Weedar 64" are labeled for use in water. See individual labels for further details.

T9. Crossbow (triclopyr plus 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 at 1 to 5 gpa in pasture, rangeland, and fallow. When applying dicamba at 2 pt or less, use 0.5% v/v surfactant or AMS at 17 lbs/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. Escort (metsulfuron) at 0.5 to 1.5 oz 75DF/A or **Ally** (metsulfuron) at 0.1 to 0.3 oz 75DF/A can be applied in rangeland, grass pastures and non-cropland for control of noxious and troublesome weeds. For foliar spot treatment, mix 1 oz 75DF/A per 100 gallons of water. Spray foliage for thorough coverage but not to run-off. Add a NIS at 0.25 to 0.5% 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 Escort to desirable grasses under stress, nor to grasses grown for seed. Escort has no grazing restrictions. Escort can be tank-mixed with 2,4-D, dicamba, Garlon, Stinger and Tordon. To reduce the risk of resistant weeds, apply Escort or Ally in a tank-mix with 2,4-D and dicamba. Escort may be applied through air (helicopter and fixed wing) for weed control to utility and pipeline right-of-ways, military installations, and rangeland and pasture.

T12. Plateau (imazapic) applied in the fall through early October controls many grass and broadleaf weeds including foxtail and leafy spurge in right-of-ways, pasture, rangeland, and CRP. **A Section 18 is pending to allow haying and grazing otherwise DO NOT apply to grass areas that will be grazed or hayed.** Warm season grasses are more tolerant than cool-season grasses. Apply with MSO type adjuvant plus 28% UAN each at 1 qt/A. Highest rate provides longer control but increases grass injury. Plateau does not control absinth wormwood. Plateau use in noncropland has two important benefits, no injury to desirable forage grasses and no injury to several desirable 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*). Apply Plateau with MSO for optimum weed control in the fall from early September to mid-October.

T13. Rave (dicamba-Na + triasulfuron) at 2 to 5 oz WDG/A in pasture, rangeland and CRP applied POST controls several annual broadleaf weeds and provides partial control of field bindweed, Canada thistle, and musk thistle. Do not apply to new seedlings of grasses until at least 60 days after emergence. Rave can be applied with 2,4-D, Crossbow, Weedmaster, Grazon P+D, Stinger, and Tordon 22K. Apply with a NIS at 0.125 to 0.25% v/v or oil adjuvant at 1% v/v. Rave can be used on several established rangeland grasses. See label for approved list. Rave spray drift or sprayer contamination causes severe injury to most broadleaf crops. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. See sprayer cleanout section. Rave may persist in the soil for 4 years or more. Consult label or herbicide carryover/residue section for rotational crop restrictions.

T14. Redeem (clopyralid + triclopyr) applied 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 for annual broadleaf weeds and 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 the growth of perennial broadleaf weeds. Retreatment at the same rates may be necessary the following year. The most cost effective broadcast spring 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 toxic to most broadleaf plants. Spray drift in small amounts may damage most 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 and drainage ditches or near shelterbelts, shrubs or trees. Do not cut grass for feed within 2 weeks after treatment at 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. The total area treated should not exceed 25% of a land owner's acreage found in any particular watershed for rates exceeding 2 pt/A.

T16. NRCS Policy on Noxious Weed Control in CRP.
Taken from ND NRCS Exhibit 3, 2-CRP Manual, para. 210.

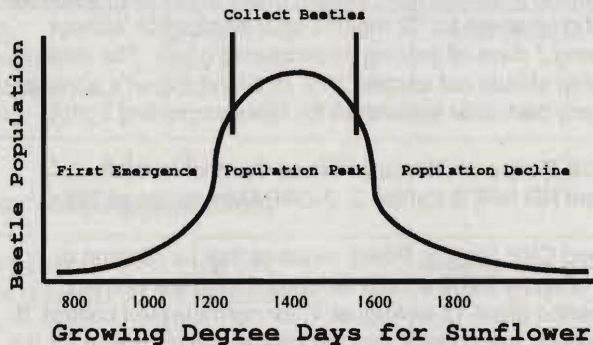
Established CRP Stands: Policy requires that no clipping or spraying of entire fields should be done during the primary nesting period (April 15 to August 1) for normal weed control. If noxious weeds are present and the critical control period for the weed falls in the primary nesting period, spot treatment of weeds is allowed. Herbicides chosen should maintain the grass and legume mixture. If this is not possible, control of the noxious 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

T17. Leafy spurge. Eight insects have been released in North Dakota for biological control of leafy spurge. **Flea beetles** (*Aphthona* spp.) have been the most effective 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 North Dakota 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, or cultivate or burn site, or apply insecticide within a quarter 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 unaffected perimeters with herbicides.

The best time to collect and distribute flea beetles is between 1000 to 1500 accumulated growing degree days (AGDD). 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 then 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. Collect and redistribute flea beetle adults when present. 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 could be treated with Tordon (picloram) plus 2,4-D (2 pt + 2 pt) from early to mid-September.

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, 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* and W-1088 *Leafy Spurge Biology, Ecology, and Management*, W-1183, *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 approximately 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, etc., and prevailing markets at the time. Consult NDSU Extension Service Circular R-1093, *Controlling Leafy Spurge Using Goats and Sheep*, for further details.

T18. 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 by NDSU. 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 have not worked well in urban areas because mosquito spraying has severely reduced populations of biocontrol agents.

SHELTERBELT WEED CONTROL

U1. Herbicides listed in the table, "Shelterbelt Weed Control" can be used for most weed control situations in shelterbelts and tree plantings in farm shelterbelts. Be sure to read and follow label directions and verify that the product of choice can be applied to target tree and shrub species. If possible, cultivation should be used to control weeds between the tree rows, while herbicides can be used in the row. Eliminate perennial weeds with repeated tillage or with non-residual herbicides before trees are planted. Controlling perennial weeds is much more difficult after 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 (pine 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. For example, Finale and glyphosate are non-selective which means that any spray intercepted by plant foliage or green bark, whether from misapplication or drift, may cause injury. 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). Some formulations of herbicides labeled for shelterbelts have the same active ingredient labeled in agricultural crops. Only use herbicide formulations that are labeled in shelterbelts and only as described on the label.

Goal 2E at 4 to 8 pt/A are registered for weed control in shelterbelts and windbreaks in North Dakota under a Special Local Needs (SLN) label that must be in the possession of the user at the time of application.

Goal provides greatest and most consistent weed control applied PRE. Goal should not be incorporated. Goal controls many grass and broadleaf weeds and can be used safely in broadcast applications to conifer tree species and POST-directed applications to deciduous tree species. Goal is strongly adsorbed to soil and has low water solubility characteristics which reduces potential for leaching.

NONCROPLAND WEED CONTROL

V1. Herbicides for control of weeds and other plants in noncropland generally should be applied before emergence or when plants are very small to minimize the risk of drift, improve herbicide performance, and prevent vegetation brownout. Some herbicides in this group are applied PRE but most are applied POST. Listed herbicides can be applied alone or in combination for control of desired plant species. The type of vegetation to be controlled will determine the herbicide to use. For example, perennial grasses can only be controlled with Finale, Fusilade, glyphosate, or Poast/Vantage. Woody perennials can be controlled with dicamba, Crossbow, glyphosate, Spike, Tordon, or Weedmaster. Deep rooted species like field bindweed can be controlled with dicamba, Crossbow, glyphosate, or Tordon. Control of both grass and broadleaf plants, especially for bare ground weed control will require a combination of herbicides or a high rate of a residual herbicide. Do not apply during conditions that will cause drift.

TOTAL VEGETATION WEED CONTROL

V2. Weeds and plants should be controlled before emergence or when very small to minimize the risk of drift, 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. Know 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, use non-volatile formulations, reduce spray pressure, and select 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 (R) occurs from repeated use of a herbicide that eliminates susceptible (S) weed species and allows R weed species to increase in the absence of competition from the S plant species. Genetically diverse weed species may contain a small percentage of plants that are R to herbicides having the same mode of action. Repeated exposure of a weed population to a herbicide may result in a rapid buildup of weed resistance to that class of herbicides. R types may dominate over time due to this selection pressure.

Risk of weed resistance increases by using herbicides that provide near 100% weed control (ALS inhibitors). Growers should not rely on one herbicide class in a crop rotation system, like using an ALS herbicide in both small grains and broadleaf crops. Plants with a wide genetic diversity that have developed herbicide resistance are kochia, pigweeds/water hems, cocklebur, sunflower, green/giant foxtail, and wild oat. Models estimate resistance in kochia and other species to occur at 1 resistant plant in 10,000 to 100,000 plants.

Types of Resistance

Altered site of action - ALS inhibitors and other herbicides act on one specific site in a plant which may allow diverse plant species to be resistant to the herbicide or mutate to express resistance. 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 serious 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 are not affected by herbicide concentration. Plants having altered metabolism resistance are affected by herbicide rate. As herbicide 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 sulfonylurea (SU) often confers cross resistance to other. 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 sulfonylureas, and kochia may be resistant to atrazine. Different resistance mechanisms are involved; therefore, a kochia plant that withstands treatment with sulfonylureas and atrazine has multiple resistance.

Herbicide resistant weed species in ND:

1. Green foxtail to the DNA herbicides.
2. Wild oat to ACCase inhibitor herbicides.
3. Wild oat to ALS (Assert) herbicides.
4. Kochia to ALS herbicides.
5. Kochia to 2,4-D and dicamba.
6. Redroot pigweed to IMI herbicides.
7. Waterhemp to ALS herbicides.

8. Wild mustard to ALS herbicides.

9. Eastern black nightshade to imidazolinone herbicides.

Trifluralin (DNA) resistant green foxtail is found in areas of ND where trifluralin is used consecutively in small grain crops, row crops, and fallow. Continuous small grains, small grain/fallow, or small grain/sunflower rotations allows continuous DNA use. Also, trifluralin is usually applied at high rates in sunflower and residue may partially control green foxtail in the small grain crop planted the next year. Continuous use of and residue from high DNA rates increase selection pressure for DNA resistant green foxtail. DNA resistant foxtail has been documented in the RRV of ND. Resistant green foxtail and be expressed after 8 to 12 herbicide applications.

ACCase resistant wild oat is found within ND and MN. Hoelon and fenoxaprop (Puma, Dakota, Tiller, and Cheyenne) resistance has been documented in every nearly every county in ND. Resistance has varied from complete resistance to recovery from near death and all possible responses in between. Wild oat resistance to Assure II has been documented in the RRV of ND and MN. Resistant wild oat can be expressed after 8 to 12 herbicide applications. Wild oat resistance to Poast or Select has not been documented in ND.

Assert (ALS) resistant wild oat has been documented in MN. No wild oat plants were unaffected but several lines exhibited less than 20% control when evaluated 4 weeks after application. Wild oat biotypes resistant to Assert may or may not be resistant to one or more of the other grass-killing ALS inhibiting herbicides.

ALS resistant kochia can be found across ND and developed originally in northern, western, and southwestern regions where Glean and SU herbicides were used extensively. Wide spread use of SUs in small grains, Pursuit in soybean and dry beans, Accent in corn, and UpBeet in sugarbeet have caused ALS resistant kochia to increase in the eastern ND. Resistant kochia has spread throughout the RRV and has escaped control from those using Raptor for the first time.

ALS herbicides consist of SU, imidazolinones (Imi), and triazolopyrimidines (TPS) chemistries. Repeated use of any ALS herbicide will contribute to kochia resistance. Kochia resistance can be slowed following a resistance management program. Resistant kochia populations can be significant after 3 to 5 herbicide applications.

Plant growth regulator (PGR) resistant kochia was discovered in a survey conducted in 1993. Resistance was evaluated primarily against dicamba. Some kochia types were found resistant up to 0.5 pt/A of dicamba. Even though some plants survived, they were reduced in growth and may not compete well with vigorous growing crops.

IMI resistant redroot pigweed has been documented in Cass county. Continued use of Pursuit and Raptor in soybean and dry bean have caused resistant to occur.

ALS resistant waterhemp has been documented in the RRV of ND. Waterhemp commonly infests the midwest and plains states. Continued use of Accent in corn, Pursuit and Raptor in soybean and dry bean and SUs in small grains have caused resistant waterhemp populations to occur.

ALS resistant wild mustard has been documented in the RRV of ND. This is the first documented case of wild mustard resistance to ALS herbicides in the U.S. Continued use of Accent in corn, Pursuit and Raptor in soybean and dry bean and SUs in small grains have caused resistant wild mustard populations to establish.

ALS resistant eastern black nightshade has been documented in the RRV of ND/MN and in WI. This is the first documented case of eastern black nightshade resistance to ALS herbicides in the U.S. Continued use of Accent in corn, Pursuit and Raptor in soybean and dry bean and SUs in small grains have caused resistant eastern black nightshade populations to occur.

Other weeds that have developed resistance to herbicides are listed below:

ALS Mode of action:

Green foxtail, yellow foxtail, giant foxtail, wild oat, sunflower, common cocklebur, common ragweed, and giant ragweed.

ACCase Mode of Action:

Green foxtail and giant foxtail.

Growth regulator mode of action:

Wild mustard

Triazines:

Kochia

Other:

Wild oat R to Avenue and Far-Go (MT only).

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

Herbicide resistant weeds are most likely to develop by using:

1. Single site of action herbicides.
2. Long residual herbicides.
3. Same mode of action herbicides applied over several consecutive years or multiple times during a growing season.
4. Herbicides used as "stand alone" products without using other weed control options, such as cultivation.

Weeds species most likely to develop resistance are genetically variable and have a rapid life cycle with short seed dormancy such as kochia and Russian thistle.

Genetically engineered crops resistant to glyphosate and Liberty are now available. Glyphosate and Liberty can be used to control weeds resistant to all other herbicides. However, heavy selection pressure from these herbicides may cause resistant biotypes to occur. Weeds expressing some natural tolerance to glyphosate are quackgrass, wild buckwheat, nutsedge, nightshade, smartweed, kochia, dandelion, horseweed (marestail), common mallow, and velvetleaf. Weeds expressing some natural tolerance to Liberty include lambsquarters and yellow nutsedge.

For a thorough discussion on weed resistance and management strategies, refer to the NCR Extension Publication 468, Herbicide Resistant Weeds. Copies are available through the the NDSU Distribution Center.

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.

1. **Use herbicides only when necessary.** Herbicide use should be based on economic thresholds.
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. Many commercial premixes on the market do not contain herbicides that are targeted for the same weed species.
4. **Rotate crops**, particularly those with different life cycles, e.g., winter annual crops (winter wheat), perennial crops (alfalfa), summer annual (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.
5. **Combine mechanical weed control practices** like rotary hoe and cultivation with herbicide treatments. Hand removal of surviving weeds will prevent seed production of resistant plants.
6. **Use pre-crop, in-crop, and post-crop tillage.** No weed has become resistant to steel!
7. **Scout fields regularly** and identify weeds that escape herbicide treatments. Monitor changes in weed populations and restrict spread of potentially resistant weeds that match the field history and a herbicide use pattern.
8. **Clean tillage and harvest equipment** before moving from fields infested with resistant weeds to those that are not.
9. **Non-agricultural organizations (railroads, public utilities, highway departments)** implementing total vegetation control programs should be encouraged to use vegetation management systems that do not lead to resistant weeds. Resistant weeds from total vegetation control areas frequently spread to cropland. Chemical companies, state and federal agencies, and farm organizations can help in this effort.

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

Mechanism of Action	Common Name	Herbicide Tradename	Premix Tradenames
ACC-ase Inhibitors (1) "Fops"	clodinafop-P cyhalofop diclofop	Discover Clincher Hoelon	Bronate Pro, Cheyenne, Dakota, Fusion, Tiller Fusion
	fenoxaprop-P fluazifop-P quizalofop	Puma Fusilade DX Assure II	
"Dims"	clethodim sethoxydim tepraloxymidim tralkoxydim	Select/Prism Poast Equinox Achieve	Rezult
ALS Enzyme Inhibitors (2)	imazamethabenz imazamox imazapic imazapyr imazaquin imazethapyr	Assert Raptor Plateau Arsenal Scepter Pursuit	Lightning, Sahara Backdraft, Detail, Squadron, Steel, Tri-Scept Extreme, Lightning, Pursuit Plus, Resolve, Steel
Imidazolinones			
Sulfonylureas	chlorimuron chlorsulfuron ethametsulfuron foramsulfuron halosulfuron iodosulfuron metsulfuron nicosulfuron oxasulfuron primisulfuron prosulfuron rimsulfuron sulfometuron sulfosulfuron thifensulfuron triasulfuron tribenuron triflusulfuron	Classic Glean/Telar Muster Tribute Permit AE 1715 Ally/Escort Accent Expert Beacon Peak Matrix Oust Maverick Harmony GT Amber Express UpBeet	Canopy XL, Reliance STS, Synchrony STS Finesse Canvas, Finesse Accent Gold, Basis, Basis Gold, Celebrity Plus, Steadfast Exceed, NorthStar, Spirit Exceed, Spirit Accent Gold, Basis Gold, Steadfast Basis, Canvas, Cheyenne, Harmony Extra, Reliance, Synchrony Rave Canvas, Cheyenne, Harmony Extra
Triazolopyrimidines	cloransulam diclosulam flumetsulam	FirstRate StrongArm Python (Broadstrike)	FrontRow, Gauntlet Accent Gold, Broadstrike+Dual/Treflan, FrontRow, Hornet
Sulfonylamino-carbonyltriazolinone	flucarbazone propoxycarbazone	Everest Olympus	
Root Inhibitors (DNA) (3)	ethalfuralin oryzalin pendimethalin trifluralin	Sonalan Surflan Prowl/Pendimax/others Trifluralin/Treflan/others	Rout Pursuit Plus, Squadron, Steel Broadstrike+Treflan, Buckle, Freedom, Passport, Salute, Tri-Scept
Growth Regulators (4)	2,4-D	2,4-D/others	Campaign, Crossbow, Curtail, Grazone P+D, Landmaster BW, Shotgun, Starane + Salvo, Starane + Saber, Tiller, Weedmaster
Phenoxy	2,4-DB MCPA	Butyrac MCPA/others	Bronate, Cheyenne, Curtail M, Dakota, Starane + Sword, Tiller
Benzoic acids	dicamba	Banvel/Clarity/Sterling/others	Celebrity Plus, Distinct, Fallow Master, Marksman, NorthStar, OpTill, Rave, Resolve, Spirit, Weedmaster
Pyridines	clopyralid fluroxypyr picloram triclopyr	Stinger/Reclaim/Transline Starane Tordon 22K Garlon/Remedy	Accent Gold, Curtail, Curtail M, Hornet, Redeem Starane + Salvo, Starane + Saber, Starane + Sword Grazone P+D Redeem
Quinolines	quinclorac	Paramount/Drive	
Photosystem II Inhibitors (5) (different than 6)	atrazine	Atrazine/other	Axiom AT, Basis Gold, Bicep, Buctril+Atrazine, Bullet, Degree Xtra, Expert, Extrazine II, FieldMaster, FullTime, Guardsman, Harness Xtra, Lariat, LeadOff, Liberty ATZ, Marksman, Readymaster ATZ, Shotgun Extrazine II
Triazines	cyanazine simazine	Bladex Princep	Derby
Triazones	amicarbozone hexazinone metribuzin	BAY MKH 3586 Velpar Lexone/Sencor	Axiom DF, Axiom AT, Canopy, Domain, Epic, Salute, Turbo
Uracils	bromacil	Hyvar X	Krovar I, WeedBlast
Phenyl-carbamates	desmedipham phenmedipham	Betanex	Betamix, Progress Betamix, Progress

Mechanism of Action	Common Name	Herbicide Tradename	Premix Tradenames	
Photosystem II Inhibitors (6) - different than 5	bromoxynil	Buctril/Connect/others	Bison, Bromac, Bronate/Pro, Buctril + Atrazine, Brozine, Moxy AT	
	bentazon	Basagran	Galaxy, Rezult, Storm	
	pyridate	Tough		
Photosystem II Inhibitors (7) - different than 5 or 6	diuron	Diuron/Direx/Karmex	Krovar, Sahara, WeedBlast	
	linuron	Lorox, Linex, Linuron		
Amide	tebuthiuron	Spike		
	propanil	Stampede	Stampede CM	
Lipid Synthesis Inhibition (8)	cycloate	Ro-Neet	DoublePlay Buckle	
	EPTC	Eptam/Eradicane		
Thiocarbamates	triallate	Far-Go		
Difenzoquat	difenzoquat	Avenge		
EPSP Synthase Inhibitors (9)	glyphosate-ipa	Several	Backdraft, Bronco, Campaign, Expert, Extreme, FieldMaster, Landmaster BW, FallowMaster, ReadyMaster ATZ	
	glyphosate-NH3	Roundup UltraDry		
	glyphost- (NH4)2	Touchdown 3		
Glutamine Synthetase Inhibitors. (10)	glufosinate	Liberty/Finale/Rely	Liberty ATZ	
Bleaching: Carotenoid Inhibition - Unknown (11)	aclonifen	Challenge/Bandur	Nikyl	
	amitrole	Amitrol T		
Bleaching: Carotenoid Inhibition - Phytoene Desaturase Inhibitor (12)	beflubutamid	UBH-820	Nikyl	
	fluridone	Sonar		
	flurochloridone			
Nicotinanilide	flurtamone			
	diflufenican			
Bleaching: Diterpene Inhibition (13)	clomazone	Command	Command Extra, Commence	
PPO Inhibitors (14)	acifluorfen	Ultra Blazer	Conclude, Galaxy, Scepter OT, Storm Tornado, Twister Stellar	
	fomesafen	Flexstar/Reflex		
Diphenylethers	lactofen	Cobra		
	oxyfluorfen	Goal		
N-phenylthalamides	fluathiacet	Action	Stellar	
	flufenpyr	S-3153		
	flumiclorac	Resource		
	flumioxazin	Valor		
Oxadiazole	pyraflufen	Ecopart		
	oxadiargyl	Raft/Topstar		
Triazolinones	oxadiazon	Ronstar		
	azafenidin	Milestone	Canopy XL, Command Xtra, Gauntlet	
	carfentrazone	Aim		
sulfentrazone	Authority/Spartan			
Action unknown (15)	acetochlor	Harness/Surpass/TopNotch/Degree	Degree Xtra, DoublePlay, FieldMaster, FullTime, Harness Xtra	
	Acetamides	alachlor	Lasso/others	Bronco, Bullet, Freedom, Lariat
		dimethenamid	Frontier/Outlook	Detail, Guardsman, LeadOff, OpTill
		flufenacet	Define	Axiom, Axiom AT, Domain, Epic
		metolachlor	Dual/Dual II/Magnum	Bicep/II/Lite, Broadstrike+Dual, Expert, Turbo
propachlor	Ramrod	Ramrod and Atrazine		
Auxin Inhibitor (19)	diflufenzopyr		Celebrity Plus, Distinct	
Photosystem I Inhibitors (22)	diquat	Diquat, Reglone		
	paraquat	Gramoxone Extra/Max		
Bleaching: HDDP Inhibition (28)	isoxaflutole	Balance/Pro	Epic	
	mesotrione	Callisto		

Cold, Hard STEEL (29): Plow, cultivator, rotary-hoe, etc.

Adapted from Weed Sci. Soc. of Am. (WSSA) Herbicide Classification System For Resistant Weed Management. Weed Technol. 11:384-389.

HERBICIDE CARRYOVER

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

General Rules For Herbicide Breakdown

1. Herbicides are broken down in soil by microbial decomposition and chemical reactions like acid hydrolysis.
2. Soil microorganisms do not degrade herbicide molecules when herbicides are adsorbed to soil particles.
3. Greater herbicide adsorption to soil particles occurs in dry soils than in moist soils.
4. Acid hydrolysis affects primarily triazines and most sulfonylurea herbicides.
5. 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 chemistries: Imidazolinones, SU's, Triazines, and Triazolopyrimidines (TPS).

Molecules become negatively (-) charged when a proton is removed or become positively (+) 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:

Assert, Plateau, Pursuit, Lightning, Raptor, and Scepter.

In general, Imi herbicides leave a residue in soil for more than one year. Breakdown occurs by soil microbes rather than acid hydrolysis which is a chemical reaction. **Breakdown occurs more rapidly and herbicide activity increases as soil pH increases.** Rate of breakdown decrease in dry conditions.

Imi 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.
Sorption is reversible when soil becomes wet. Dry conditions through the year of application will cause Imi herbicide molecules to be adsorbed to soil OM and when adsorbed are NOT available for plant uptake and microbial degradation. Winter and spring precipitation reverses sorption and causes Imi molecules to be 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 each spring and summer.

7. Weakly adsorbed to soil at soil pH greater than 6.5.
8. Bound stronger to OM at soil pH below 6.5 and amount adsorption changes little from 6.5 to 8. At soil pH less than 6.5, small differences or reductions in pH (0.2 to 0.4 pH units) can **DOUBLE** amount adsorbed.

Soil pH is not uniform across fields and may fluctuate greatly. Soil pH may vary by one or even two pH units in a few feet. Crop injury from chemical residue may be expressed in high pH areas of the field. High soil pH can cause crop injury that does not fit a pattern and it can be used to explain injury situations that do not match sprayer application or misapplication.

At soil pH between 6.5 to 8, Imi herbicides are (-) charged and (-) charged molecules are NOT adsorbed by OM that also have (-) charges. Therefore, molecules in a free state are available for plant uptake and microbial degradation.

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

Y3. Breakdown of Sulfonylurea (SU) Herbicides:

Accent, Ally, Amber, Beacon, Classic, Escort, Glean, Maverick, Muster, Peak, and premixes containing active ingredients of the above herbicides: Accent Gold, Basis, Basis Gold, Canvas, Celebrity Plus, Exceed, Finesse, Rave, Spirit, Steadfast and Synchrony.

Short residual herbicides of Express, Harmony Extra, Hamony GT, Upbeet are rapidly broken down by soil microbes

In general, most SU herbicides leave a residue in soil for more than one year and in some cases for several years. Breakdown occurs primarily by hydrolysis, a chemical reaction, rather than by soil microbes. Hydrolytic breakdown ceases at soil pH above 6.8. Rate of breakdown may decrease in dry conditions.

Exception: **Permit** (halosulfuron) and **Matrix** (rimsulfuron) is broken down faster by hydrolysis as pH increases above and below pH of 7.0. Herbicide breakdown is slowest in neutral soil pH of 7.0 for both herbicides.

Most SU herbicides are:

1. Not volatile nor broken down by photodegradation.
2. Not leached.
3. Affected by soil pH. Water solubility greatly increases as pH increases.
4. Broken down primarily by acid hydrolysis. Microbial degradation is very slow with residual SU herbicides. Short residual SU herbicides (Express, Harmony GT, and Harmony Extra) are rapidly broken down by microbes and hydrolysis.
5. Non-microbial hydrolysis for most residual SU herbicides ceases at soil pH above 6.8.
6. SU herbicides are more highly adsorbed to soil particles and OM at low soil pH.

SU herbicides are bound more tightly in the neutral form at low pH than in (-) charge form at high pH. SU herbicides are undissociated (neutral charge) in soil with pH less than 7.0. As soil pH increases above 7.0 more molecules will be (-) charged. The (-) charged molecules are in a free form and do not bind with (-) charged soil particles. In a free form they are available for plant uptake.

However, 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 at pH levels above 6.8. Hydrolysis is a chemical reaction that takes place in the soil and 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, the chemical reaction (hydrolysis) increases at an exponential rate rather than a linear rate. Also, hydrolysis sharply increases at soil pH below 6.8.

Soil pH is not uniform across fields and may fluctuate greatly. Soil pH may vary by one or even two pH units in a few feet. Crop injury from chemical residue may be expressed in high pH areas of the field. High soil pH can cause crop injury that does not fit a pattern and it can be used to explain injury situations that do not match sprayer application or misapplication.

Y4. Breakdown of TPS Herbicides:

Broadstrike, FirstRate, Python and premixes containing the active ingredients in above herbicides: Accent Gold, Broadstrike + Dual, Broadstrike + Treflan, Hornet.

In general, TPS herbicides leave a residue in soil for more than one year. Breakdown occurs by soil microbes rather than acid hydrolysis which is a chemical reaction. Breakdown occurs more rapid and herbicide activity increases as soil pH increases. Rate of breakdown decrease in dry conditions.

TPS herbicides are:

1. Degraded by microbes.
2. Not volatile, nor broken down by hydrolysis.
3. Adsorbed more tightly to OM than clay.
4. Adsorbed more in low pH and less in high pH soils.
5. Lower in activity in low pH, more active in high pH soils.

Soil pH below 7.0 increases binding to OM because more molecules are NOT (-) charged. As soil pH increases beyond 7.0, more molecules are (-) charged, as a result, fewer molecules will be bound to OM and free molecules are available for plant uptake and microbial degradation.

In summary, adsorption of TPS molecules increases as organic matter increases and soil pH decreases. Activity and degradation of TPS herbicides increase as soil pH increases. Degradation increases in soils with high pH because herbicide molecules are not adsorbed and are in a free state in the soil solution and available for plant uptake and microbial breakdown. All factors that increase microbial activity also increase TPS herbicide degradation (warm, moist soils).

Y5. Breakdown of Triazine Herbicides:

Atrazine, Sencor, and Princep and all premixes containing the active ingredients list above.

In general, triazines leave a residue in soil for more than one year and in some cases for several years. Breakdown occurs primarily by hydrolysis, a chemical reaction, rather than by soil microbes. Hydrolytic breakdown slows at soil pH above 6.8. Rate of breakdown may decrease in dry conditions.

Triazine herbicides are:

1. More active and persistent in high pH soils.
2. Not volatile, but broken down by photodegradation only when herbicide remains on soil surface for extended periods..
3. Broken down slowly by microbial degradation.
4. Broken down primarily by hydrolysis at soil pH of 6.8 to 5.5.
5. Hydrolysis ceases at soil pH above 7.5.

Triazines are broken down mainly through hydrolysis, which is a chemical reaction in the soil and is affected little by soil moisture content. Hydrolysis is affected more by soil pH than other factors. Hydrolysis is reduced in high soil pH. An exception is Bladex (cyanazine). Cyanazine contains a nitrile group C-N which is especially prone to microbial deactivation and allows more rapid breakdown than atrazine.

6. Triazines are more active in high pH soils.

More triazine herbicides molecules are (+) charged at soil pH less than 7.5. Positive charged triazine molecules bind to (-) charges on soil and OM making them unavailable for plant uptake and microbial breakdown. At low soil pH, more herbicide molecules are adsorbed on the soil particles and not available for plant uptake. 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 radically fluctuate. Applying one rate across an entire field may result in variability in crop tolerance and weed control in variable soil pH levels. Also, more molecules will be bound to soil and OM in dry conditions. As soil wets, triazine molecules will move into soil solution as water displaces triazine molecules.

At high soil pH, the opposite reaction occurs. At soil pH greater than 7.5, triazine herbicide molecules donate protons (H^+) ($H + OH = H_2O = \text{water}$). At pH greater than 7.5, more triazine molecules have a net neutral charge. More neutral triazine molecules do not bind to soil particles and OM and are free for plant uptake and microbial decomposition.

Y6. The persistence of phytotoxic levels of a herbicide for more than 1 year can be a problem with some herbicides used. 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.

Y7. Herbicide residues often can be detected by bioassay. Soil samples representative of the whole field must be obtained by sampling at many places to the depth of the tillage layer. Also, a sample of soil free of herbicide residues must be obtained from near the treated field to 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 should also be planted as an additional bioassay species because of their relative sensitivity to many residual herbicides and is helpful in detecting residues. 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 less than 1 seed/sq in. 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. Plants grown in root inhibiting herbicides such as dinitroanilines should be washed from the roots to observe root growth, especially Window bioassay does not provide accurate information for ALS herbicide carryover (Ally, Amber, Beacon, Broadstrike, Classic, Expert, Finesse, Peak, Permit, Pursuit, or Python).

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.

Y8. Accent Gold (nicosulfuron + rimsulfuron + clopyralid + flumetsulam) at 2.9 oz DF/A may have a residue the year following application to corn. Accent Gold at the rate 2.9 oz DF/A contains the equivalent of 0.25 oz 75DF/A Accent, 0.75 oz 25DF/A Matrix, 4 fl oz Stinger, and 0.7 oz 80DF Python. Refer to paragraphs in this section under Accent, Python, Stinger, and Hornet for residue information. Rotational crop restrictions for Accent Gold are found in the table at the end of this section.

Y9. Atrazine generally has residue the year following application to corn at rates over 0.38 lb ai/A 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 other crops from most to least tolerant is millet, flax, soybean, barley, wheat, oat, sunflower, canola/mustard, and sugarbeet.

Y10. Authority/Spartan (sulfentrazone) at 4 to 6.67 oz WDG/A may carryover in soil for more than 1 year. Most crops except flax, mustard crops and sugarbeet can be planted 10 months after application. Rotational crop restrictions are found in the table at the end of this section.

Y11. Balance/Pro (isoxaflutole) at 2 oz DF/A may have a residue the year following application to corn. Many crops require an 18 months interval between application and planting. Rotational crop restrictions for Balance/Pro are found in the table at the end of this section.

Y12. Basis Gold (nicosulfuron + rimsulfuron + atrazine) at 14 oz 89.46DF/A may have a residue the year following application to corn. Basis Gold at the rate 14 oz 89.46DF/A contains the equivalent of 0.25 oz/A Accent, 0.75 oz/A Matrix, and 0.76 lb ai/A atrazine. Refer to paragraphs in this section under Accent, Basis, atrazine for residue information. Rotational crop restrictions are found in the table at the end of this section.

Y13. Broadstrike + Treflan (flumetsulam + trifluralin) is available only as a prepackaged product. The amount of trifluralin applied when Broadstrike + Treflan is applied at the labeled rate of 1.5 to 2.25 pt/A is 0.63 to 0.96 lb ai/A, respectively. Therefore, precautions in crop rotation would apply as if trifluralin was applied alone at 0.63 to 0.96 lb ai/A. Refer to the trifluralin paragraph for residue information. Rotational crop restrictions are found in the table at the end of this section.

Y14. Celebrity Plus (dicamba + diflufenzopyr) at 4.67 oz WDG/A - may have a residue the following year from nicosulfuron not dicamba. Celebrity Plus at 6.67 oz WDG/A contains the equivalent of Accent at 0.67 oz DF/A and dicamba at 4 fl oz/A. Refer to paragraphs on Accent and dicamba for additional information. Rotation restrictions for Accent and dicamba are found in the table at the end of this section.

Y15. Dicamba at rates greater than 1.5 pt/A may remain as a residue in the 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.

Y16. 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, crambe, 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 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 other crops from most to least tolerant is: cereals, potato, oil seed rape, field corn, sunflower, sugarbeet, sorghum, and alfalfa. Rotational crop restrictions for Flexstar/Reflex are found in the table at the end of this section.

Y17. Hornet (flumetsulam + clopyralid) applied 0.2 to 0.3 lb/A contains 0.13 to 0.19 lb ai/A clopyralid. Stinger is labeled for use in corn at 0.12 to 0.25 lb ai/A. Therefore, precautions in crop rotation would apply as if clopyralid was applied alone at 0.12 to 0.25 lb ai/A. Rotational crop restrictions for Hornet are found in the table at the end of this section. Consult the Stinger label and paragraph in this section for residue information for clopyralid.

Y18. 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, 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.

Y19. 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.

Y20. Peak (prosulfuron) at 0.25 to 0.5 oz 57DF/A may carryover in soil for more than 3 crop years. The unique feature of Peak as compared to other SU herbicides labeled in small grains is excellent corn safety. Peak is labeled on corn through the prepackaged mixture Exceed.

Y21. Sencor (metribuzin) is used on soybean with other herbicides or is used alone on potatoes. No harmful metribuzin carryover is expected from 0.25 lb ai/A. 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.

Y22. Sonalan (ethalfluralin), **Prowl** (pendimethalin), and **trifluralin** are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the 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, potatoes, and dry edible bean are quite tolerant of dinitroaniline herbicides. Rotational crop restrictions for Prowl, Sonalan, trifluralin are found in the table at the end of this section. The approximate ranking of other crops from most to least tolerant is flax, barley, wheat, corn, oat, and sugarbeet.

Y23. Stinger (clopyralid) and **Curtail M** (clopyralid plus MCPAe), and **Curtail** (clopyralid plus 2,4-D) may have a residue in the soil following POST application. Pea, lentil, potato, and broadleaf crops grown for seed can be planted 18 months after Stinger or Curtail application. Potential for injury from soil residue of Stinger or Curtail can be reduced by burning, removal, or incorporation of treated crop residues.

Y24. Tordon (picloram) at rates of 1 fl oz/A or higher may carryover in the 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.

Y25. Laboratories That Analyze For Pesticide Residue in soil, water, and plant samples.

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

Agvise Laboratories
Northwood, ND
701 587-6010, johtlee@polarcomm.com

Animal Disease Lab,
9732 Shattuck Road, Centralia, IL 62801-5858
(618) 532-6701

Harris Laboratories
621 Rose Street, P.O. Box 80837, Lincoln, NE 68501
(402) 476-2811, 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, www.midwestlabs.com

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

Minnesota Valley Testing Laboratories, Inc.,
1411 South 12th Street, Bismarck, ND 58504
1 800 279-6885, (701) 258-9720

NDSU Diagnostic Lab
Waldron Hall, NDSU 58105
1 701 231-7854, cruby@ndsuct.nodak.edu
For Pursuit (soil) and glyphosate (foliage) only.

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

Y26. Table on crop rotation restrictions is on the next page.

Y26. CROP ROTATION RESTRICTIONS

Rotation Restrictions for Crops Grown in North Dakota																	
Herbicide	Alf-alfa	Bar-ley	Can-ola	Corn	Cra-mbe	CRP grss	Dry bean	Flax	Oat	Chck Pea	Dry Pea	Pot-ato	Saff lowr	Soy-bean	Sgr-beet	Sun-flwr	HRS/Durm
----- (months after application) -----																	
DO NOT USE IN ND = Beacon, Canopy, Canopy XL, Classic, Concert, Exceed, Reliance, Scepter, Spirit, Steel, Synchrony																	
Accent(a)	12	8	18	0	18	18	10	18	8	10	10	18a	18	0.5	18a	11/18a	8
Accent Gold	10.5	8	26b	0	B	26	10.5	B	8	18	18	18	B	10.5	26b	18	8
Ally(c)	34d	10	34d	22e	34d	4	22e	22e	10	34d	34d	34d	22e	34d	34d	22e	1/10
Amber	B	18c	B	22	B	B	B	B	18c	B	B	B	B	36b	B	24b	0
Assert	15	NCS	12/15f	NCS	12/15	4	NCS	15	15	15	15	15	NCS	NCS	20	NCS	NCS
Atrazine/Aatrex	B	B	B	0	B	2CS	B	B	B	2CS	2CS	B	B	B	B	B	B
Atrazine Premixes - Refer to Atrazine.																	
Authority	12	4	30	10	30	12	12	18	4	12	12	30	30	0	30	-	4
Axiom	12	12	18	0	18	12	12	12	12	12	12	1	12	0	18	12	12
Balance/Pro(j)	10	6	18	0	18	18	18	18	6	18	18	6	6	6	18	10	6
Basis	10	8	18	0	18	18	8	18	8	8	8	4	18	0.5	10	10	8
Basis Gold	18	18	18	0	18	8	18	18	18	18	18	18	18	10	18	18	18
Beacon(r)	8	3	18	0.5	18	18	8	18	8	8	8	2CS	18	8	B	8	8
Brdstrike+Dual	4	4.5	26b	0	26b	12	4	26b	4.5	4	4	12	26	0	26b	18	4.5
Brdstrk+Treflan	4	4	B	8	B	12	4	B	18	4	4	12	B	0	26b	18	4
Buckle	NCS	0	NCS	16	NCS	18	NCS	NCS	16	NCS	NCS	NCS	NCS	NCS	14g	NCS	NCSg
Callisto	Refer to label for crop rotation restrictions.																
Canvas(0.2 oz/A)e	22	10	22	22	22	2-4	22	22	10	22	22	22	10	22	22	22	1/10
Celebrity Plus	12	8	18	0.25	18	18	10	18	8	10	10	18a	18	4	18a	10/18a	8
Curtail/M	10.5	1	10.5	1	10.5	1	10.5m	NCS	1	18	18	18	10.5	10.5m	NCS	10.5m	1
Degree(n)	NCS	NCS	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	4
Dicamba(<1.5pt) h	4	4h	4	0h	4h	4	4	4	4h	4	4	4	4	4	4	4	0h
Domain	12	12	18	1	18	18	18	18	18	18	18	1	18	0	18	18	12
Dístinct(h)	4	4	4	4h	4	4	4	4	4	4	4	4	4	4	4	4	0
Epic	12	12	12	0	12	12	18	12	12	12	12	6	12	6	12	12	12
Everest	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	18	NCS	NCS	NCS	NCS	NCS	NCS	NCS	4
Extreme	Same as Pursuit																
Far-Go	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	18	NCS	NCS	NCS	NCS	NCS	NCS	NCS	0
Finesse	B	16	B	B	B	4	B	B	10	B	B	B	B	B	B	B	0
FirstRate	9	B	B	9	B	9	9	B	B	9	9	B	B	0	30b	30b	3
Flexstar	18	4	18	10	18	4	10	18	4	10	10	18	18	0	18	18	4
Harness(n)	NCS	NCS	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	4
Hornet	10.5m	4	B	0	B	12	10.5m	B	4	10.5m	10.5m	18	B	10.5m	B	18	4
Gauntlet	12	12	12	10	12	12	12	B	12	12	12	B	B	0	30	30	4
Liberty ATZ	B	B	B	0	B	2CS	B	B	B	2CS	2CS	B	B	B	B	B	B
Lightning	9.5	9.5	40b	8.5	40b	40	9.5	40b	18	9.5	9.5	26	18	9.5	40b	18b	4

Herbicide	Alf- alfa	Bar- ley	Can- ola	Corn	Cra- mbe	CRP grss	Dry bean	Flax	Oat	Chck Pea	Dry Pea	Pot- ato	Saff lowr	Soy- bean	Sgr- beet	Sun- flwr	HRS/ Durm
	(months after application)																
Matrix	12	9/19p	18	0	18	18	10	18	9	18	18	0	18	10	18	10	9
Maverick	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	0
Muster	22	10	22	22b	22b	22	22	10	10	22	22	22b	22b	22b	22b	22b	10
NorthStar(r)	8	8	36	0.5	36	18	8	18	8	8	8	36	18	8	36r	36	8
Paramount	10	10	10	10	10	10	10	24	10	24	24	10	10	10	24	10	0
Peak(r)	22	0	22	1	22	10	22	22	0	10	10	22	22	22	22	22	0
Permit	10	3	B	0	B	3	10	B	3	B	B	12	B	10	30	26	3
Plateau	9	18	40	9	40	0	9	26	18	9	9	40	26	9	40	26	4
Prowl/Pendimax	NCS	NCS	NCS	0s	NCS	NCS	0	NCS	NCS	0	0	0	NCS	0	2CS	0	NCS
Pursuit	4	18	40b	8.5	40b	4	4	26	18	4	4	26	18	0	40b	18	4
Pursuit Plus	NCS	18	40b	8.5	40b	NCS	4	26	18	4	4	26	18	0	40b	18	NCS
Python	4	4	26b	0	26b	12	4	26b	4	4	4	12	26b	0	26b	18	4
Raptor	9	4	18	9	18	9	9	18	9	9	9	9	18	0	18t	9	3
Rave	B	18c	B	22	B	B	B	B	18c	B	B	B	B	36b	B	24b	0
Reflex	18	4	18	10	18	4	10	18	4	10	10	18	18	0	18	18	4
Sencor(u)	4	8u	18	4	18	12	12	2	12	12	12	4	12	4	18	12	8u
Sonalan	NCS	NCS	NCS	NCS	NCS	3w	0	NCS	NCS	0	0	NCS	NCS	0	2CS	0	NCS
Spartan	10	4	24	10	24	12	10	24	4	10	10	10	10	0	24	-	4
Spirit(r)	18	3	18	1	18	10	18	18	3	10	10	18	18	18	18r	18r	3
Steadfast	12	8	18	0	18	18	10	18	8	10	10	18a	18	0.5	18a	11/18	8
Stinger	10.5	0	10.5	0	10.5	1	10.5m	10.5	0	18	18	18	10.5	10.5m	0	10.5m	0
Surpass(n)	NCS	NCS	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	4
Tordon (1.5 oz)	2CS	NCS	2CS	2CSx	2CS	1	2CS	NCS	NCS	2CS	36	2CS	2CS	2CS	2CS	2CS	NCS
TopNotch(n)	NCS	NCS	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	4
Trifluralin(y)	0	NCS	0	NCS	0	18/21	0	0	18	0	0	0	0	0	2CS	0	NCS
Valor	12b	4	12b	1	12b	12b	4	12b	12b	4	12b	12b	1	0	12b	1	2

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 >7.5 = 18 MAA for sugarbeet and all other crops not listed and cumulative precipitation in the 18 MAA period must exceed 28 inches (includes potatoes).

B or b = Bioassay. Do not plant until field bioassay indicates it is safe.

Crop rotation after Atrazine is rate and soil pH dependant. Accent Gold, Broadstrike/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 Amber application west of highway 83.

- d Requires soil pH to be 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 lower, 22 months and 22 inches of precipitation west of Hwy 1 or 34 months and 34 inches of precipitation east of Hwy 1. The previous restriction also applies to Canvas at rates greater than 0.2 oz DF/A.
- f Iml 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.
- g Sugarbeet requires 20 months in areas that received less than 20 inches of precipitation during the growing season.
Buckle is labeled as a fall treatment in durum wheat and spring PPI application for durum and HRSW (some varieties excluded).
- 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 Balance requires 15 inches of cumulative precipitation from application to planting of rotational crop. Furrow or flood irrigation should not be included in total. No more than 7 inches of overhead irrigation included in total.
- m Do not plant dry bean, 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.
Do not plant lentil, pea, potato or any other broadleaf crop grown for seed for 18 months unless 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.
- n Restriction applies to DoublePlay, FullTime, Harness, Surpass, and TopNotch.
Label restricts crops allowed to be planted the next season as corn, soybean, sorghum, and wheat only.
Restriction to other crops is based on incomplete residue data and not on crop safety.
- 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 is applied PRE. DO NOT APPLY PPI.
- t Rotation to sugarbeet is after 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 lentils or soybeans.
- 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 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.

Z1 Restrictions on Feeding and Grazing of Crops Treated with Herbicides

DAA = days after application, WAA = weeks after application

Alfalfa/Small Seeded Legumes

Balan, Eptam, glyphosate: No restrictions.
MCPA: Do not graze or forage within 7 days of slaughter.
Glyphosate: Do not graze, feed, or harvest established alfalfa for 1.5 DAA.
Trifluralin: Do not graze or feed until 21 DAA.
Kerb: Do not graze or feed until 25 DAA.
Sencor: Do not graze/harvest until 28 DAA.
Bromoxynil, 2,4-DB, Pursuit, Velpar: Do not graze or feed for 30 DAA.
Paraquat: Do not graze or feed until 42 DAA.

Annual Canarygrass

Bromoxynil: Do not graze or feed.
MCPA: Do not graze or feed until 21 DAA.

Canola, Crambe, Rapeseed, and Tame Mustard

Assure II, Liberty, Raptor, Select, Sonalan, Stinger, Trifluralin:
Do not graze or feed.
Stinger: Do not graze or feed until 7 DAA.

Chemical Fallow

Finesse, Paramount: No restrictions.
Canvas, Express, Paraquat: **Do not graze or feed.**
Tordon 22K: Do not graze or feed until 7 DAA.
2, 4-D: Do not graze or feed until 7 DAA.
Do not hay until 30 DAA.
Curtail, Tordon 22K: Do not graze or feed until 14 DAA for dairy cattle.
Dicamba, Distinct: Do not remove animals for slaughter for 30 DAA.
Grazing and feeding = No restrictions for non-lactating animals/70 DAA for lactating animals.
Fallow Master, glyphosate, Landmaster BW: Do not graze or feed until 8 WAA.
Atrazine: Do not graze or feed until 26 WAA.

Chickpea

Dual products, glyphosate, Prowl, Trifluralin: No restrictions.
Assure II, Far-Go, Select: **Do not graze or feed.**

Corn

Aim, Axiom, Axiom AT, Balance/Pro, Bladex, DoublePlay, Dual products, Epic, Eradicane, Extrazine II, FullTime, glyphosate (PRE or in-crop applications in Roundup resistant corn), paraquat (PRE), Harness, Harness Xtra, Lasso, Lorox, Prowl, Ramrod, , Surpass, TopNotch: No restrictions.
Princep, Python: **Do not graze or feed.**
2,4-D, glyphosate, paraquat: Do not graze or feed until 7 DAA.
Basagran: Do not graze or feed until 12 DAA.

Atrazine, Bullet, Lariat, Shotgun: Do not graze or feed until 21 DAA.
Accent, Basis/Gold, Bicep, Bromoxynil, Buctril+Atrazine, Dual/III/ Magnum, Evik, Steadfast: Do not graze or feed until 30 DAA.
Beacon, Exceed, Lightning, Northstar, Permit: Do not graze until 30 DAA or harvest until silage for 45 DAA.
Curtail, Frontier, Guardsman, Stinger: Do not graze or feed until 40 DAA.
Poast, Pursuit, Resolve: Do not graze/feed until 45 DAA.
Sencor: Do not graze or feed until 60 DAA.
Liberty/ATZ: Do not forage until 60 DAA.
Tough: Do not graze or feed until 68 DAA.
Accent Gold, Broadstrike + Dual, Hornet: Do not graze or feed for 85 DAA.
Celebrity Plus, dicamba, Marksman: Do not graze or harvest prior to ensilage (milk) stage of crop.
Glyphosate: Do not graze or feed until 8 WAA.

CRP

2,4-D, Ally, Landmaster BW, paraquat, Plateau: **Do not graze, feed, or hay.**
MCPA: Do not graze or feed until 7 DAA.
Amber: No restrictions for grazing and feeding.
Do not hay until 30 DAA.
Dicamba: Do not remove animals for slaughter for 30 DAA.
Grazing and feeding = No restrictions for non-lactating animals and up to 70 DAA for lactating animals depending on rate (check label).
Curtail: Do not graze or feed until 14 DAA for dairy cattle.
Do not hay for 30 DAA.
Paramount: Do not graze or feed until 309 DAA.
Glyphosate: Do not graze or feed until 8 WAA.

Dry Edible Bean

Lasso, Poast, Prowl, glyphosate (PRE): No restrictions.
Assure II, Basagran, Drexel Defol, Pursuit, Raptor, Reflex, Select, Sonalan, Treflan: **Do not graze or feed.**
Paraquat: Do not graze or feed until 7 DAA.
Eptam: Preplant = no restrictions;
Layby = Do not graze or feed until 45 DAA.
Dual products: Do not cut for hay until 120 DAA.

Field Pea

Basagran, glyphosate, Poast, paraquat, Prowl, Sonalan: No restrictions.
Assure II, Chiptox, Far-Go, MCPA amine, Pursuit, Reflex, Thistrol, Treflan: **Do not graze or feed.**
Sencor: Do not graze or feed until 40 DAA.
Dual products: Do not cut for hay until 120 DAA.

Flax

Bromoxynil, Trifluralin: No restrictions.
MCPA: Do not graze or feed until 7 DAA.
Drexel Defol: Do not graze or feed until 14 DAA.
Poast: Do not graze. Processed meal may be fed.

Grass establishment

Glyphosate: No restrictions.
Bromoxynil, Plateau: **Do not graze, feed, or hay.**
MCPA: Do not graze or feed until 7 DAA.
2,4-D: Do not graze or feed until 7 DAA.
Do not hay until 30 DAA.

Lentil

Glyphosate (PRE), Prowl: No restrictions.
Assure II, Far-Go, paraquat, Poast, Trifluralin:
Do not graze or feed.
Sencor: Do not graze or feed until 40 DAA.

Millet

2,4-D amine: Do not graze until 14 DAA.
Do not feed treated straw.
Dicamba: Do not graze or harvest prior to maturity.
Do not graze or feed until 7 DAA for lactating
animals, or hay for 37 DAA.
No restriction for non-lactating animals.
Peak: Do not graze or feed until 30 DAA or harvest
for silage until 40 DAA.

Potato

Paraquat (PRE), glyphosate, and Sencor:
No restrictions.
Desiccate, Diquat, Dual products, paraquat, Poast, Prowl,
Select, Sulfuric acid, Trifluralin: Do not graze or feed.
Eptam: PRE = No restrictions,
Layby = Do not graze or feed until 45 DAA.

Safflower

Eptam, paraquat: No restrictions.
Drexel Defol, Dual products, Trifluralin: **Do not graze or feed.**

Soybean

Domain, Dual products, Lasso, paraquat (PRE), Prowl,
glyphosate (preplant), Treflan:
No restrictions.
Aim, Assure II, Authority, Axiom, Broadstrike + Dual/Treflan,
Classic, Cobra, Command, Concert, Flexstar, Freedom,
Frontier, Fusilade DX, Fusion, Galaxy, Gauntlet, Harmony GT,
Liberty, Linex, Lorox, paraquat, Pursuit, Pursuit Plus, Python,
Raptor, Reflex, Reliance STS, Resource, Scepter, Select,
Sonalan, Stellar, Ultra Blazer, Valor:
Do not graze or feed.
Glyphosate: Preplant = No restrictions,
Broadcast = 14 DAA, Spot treatment = 8 WAA,
Selective equip. = 7 DAA, Preharvest = 25 DAA
FirstRate: Do not graze or feed for 14 DAA.
Glyphosate (RUR soybeans): Do not graze or feed until 25
DAA.
Basagran: Do not graze or feed until 30 DAA.
Sencor, Turbo: Do not graze or feed until 40 DAA.
2,4-DB: Do not graze or feed until 60 DAA.
Poast: Do not graze or feed until 75 DAA.

Sunflower

Eptam, paraquat (PRE), glyphosate:
No restrictions
Assert, paraquat (desiccant), Poast, Prowl, Select, Sonalan,
Spartan, Trifluralin: **Do not graze or feed.**
Drexel Defol: Do not graze or feed until 14 DAA.

Sugarbeet

Betamix/Progress, Betanex, Eptam, glyphosate (PRE), Nortron SC,
paraquat, Ro-Neet, UpBeet:
No restrictions.
Assure II, Poast, Select, Trifluralin: **Do not graze or feed.**
Stinger: Do not graze or feed until 7 DAA.

Winter, Spring and Durum Wheat, Barley, Oat, and Rye

Aim, Ally, Amber, Dakota, Everest, Finesse, Paramount, Puma,
Tiller, or trifluralin: No restrictions.
Assert, Avenge, Buckle, Canvas, Cheyenne, Express, Far-Go,
Harmony GT, Harmony Extra, Hoelon, paraquat, Stampede:
Do not graze or feed.
Dicamba: Do not graze or harvest for feed prior to maturity.
Do not feed straw after preharvest application.
Dicamba, Rave: Do not graze or feed until 7 DAA for lactating
animals, no restriction for non-lactating animals.
Do not hay for 37 DAA. Do not feed treated straw
after preharvest application.
Glyphosate: Preplant: No restrictions, Broadcast = 14 DAA
Spot treatment. = 8 WAA, Preharvest = 7 DAA.
Curtail/M: Do not graze dairy animals or meat animals for
slaughter until 7 DAA. Do not harvest for hay.
MCPA, Stinger: Do not graze dairy animals or meat animals for
slaughter until 7 DAA.
Starane: Do not graze or feed until 7 DAA and harvest for
hay until 14 DAA.
Tordon 22K: Do not graze or feed until 14 DAA.
Do not harvest for hay.
Bromoxynil, Discover, Maverick:
Do not graze or harvest until 30 DAA.
Achieve: Do not graze, feed, or hay until 45 DAA.
Do not harvest mature straw until 60 DAA.
Peak: Do not graze or feed until 30 DAA or harvest for
silage until 40 DAA.
2,4-D, Landmaster BW: Do not graze until 14 DAA.
Do not feed treated straw.

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
Ally/Escort	0	0	0	0	0
Amber	0	0	0	0	0
Crossbow	1 year	1 year	0 ²	1 year	3 days
Curtail	14 days	30 days	0	30 days	7 days ³
Dicamba ¹					
Up to 1 pt	7 days	37 days	0	0	30 days
Up to 2 pt	21 days	51 days	0	0	30 days
Up to 4 pt	40 days	70 days	0	0	30 days
Up to 16 pt	60 days	90 days	0	0	30 days
FallowMaster	8 weeks	8 weeks	8 weeks	8 weeks	8 weeks
Glyphosate ¹					
Spot Spray ⁶	14 days	14 days	14 days	14 days	0
Broadcast	8 weeks	8 weeks	8 weeks	8 weeks	0
Grazone P + D	7 days	30 days	7 days	30 days	3 days
Landmaster BW ⁵ /Campaign	7 days	30 days	3 days	30 days	3 days
Paramount	DO NOT use on areas to be grazed or hayed.				
Paraquat ⁴	1 month	1 month	1 month	1 month	0
Plateau Section 18 registration pending	0	7 days	0	7 days	0
Rave	7 days	0	0	0	0
Redeem	14 days	365 days	0	7 days	0
Spike ⁷	0	1 year	0	1 year	0
Stinger/Transline	0	0	0	0	0
Tordon 22K ⁸	14 days	14 days	0	14 days	3 days
2,4-D/MCPA ¹	7-14 days	30 days	3 days	0-30 days	0
Weed-Out 2,4-D	7 days	0	0	0	0

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

This table gives a general rating of relative herbicide effectiveness to weeds listed and persistence of herbicides in soil. Under favorable weather conditions, control may be better than indicated. Under unfavorable conditions, some herbicides rated as good or fair may give erratic and unacceptable results. Also, dry and/or cool weather increases herbicide persistence while wet and/or warm weather reduces herbicide persistence.

SOIL APPLIED HERBICIDES	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Herbicide Persistence
Atrazine (PPI)	G	F	F-G	G	P-F	E	E	P-F	O
Atrazine (PRE)	G	F	F-G	G	P	E	G-E	P	O
Axiom (PPI)	G-E	P	G-E	G-E	N	P	P	P	N
Axiom (PRE)	F-G	P	G-E	G-E	N	P	P	N	N
Authority/Spartan (PRE)	N	N	P	P	N	N	N	N	S
Balance/Pro (PRE)	E	G	E	F-G	P	N	N	E	S
Bladex (PPI)	F	F	G	G	P-F	E	F	P-F	S
Bladex (PRE)	P-F	F	F-G	F-G	P	G-E	P-F	P-F	S
Broadstrike + Treflan (PPI)	E	G	E ¹	E	N	N	F-G	P-F	S
DoublePlay (PPI)	E	G-E	E	E	F-G	G-E	G-E	F-G	N
Dual Products (PPI)	G-E	P	G-E	G-E	N	F-G	P-F	P	N
Dual Products (PRE)	F-G	P	G	G	N	F	P	N	N
Eptam/Eradicane (PPI)	E	G-E	E	E	F-G	G-E	G-E	F-G	N
Far-Go (PPI)	N	N	N-P	N-P	N	N	E	N	N
Far-Go (PoPI)	N	N	N-P	N-P	N	N	G	N	N
FirstRate (PPI/PRE)	N	N	N	N	N	N	N	N	O
Gauntlet (PRE)	N	N	P	P	N	N	N	N	O
Frontier (PPI)	G-E	G	G-E	G-E	N	G	P	F	N
Frontier (PRE)	F-G	G	G-E	G-E	N	F	P	F	N
Harness/Surpass (PPI)	E	G-E	G-E	G-E	N	G	F	F-G	N
Harness/Surpass (PRE)	E	G	G-E	G-E	N	G	P	F-G	N
Hornet (PPI)	N	N	N	N	N	N	N	N	O
Hornet (PRE)	N	N	N	N	N	N	N	N	O
Lasso/generics (PPI)	G-E	F	G-E	G-E	N	F-G	P-F	P-F	N
Lasso/generics PRE	F-G	P	G	G	N	F-G	P	P	N
Nortron SC (PPI)	P	F	F-G	F-G	P	E	G	-	O
Nortron SC (PRE)	P	P-F	F	F	P	G-E	F-G	-	O
Matrix (PRE)	G	-	G	F-G	N	G	F	P	S
Paramount	G-E	N	E	G	N	N	N	N	S
Prowl/Pentagon (PPI)	E	G	E ¹	E	N	G	F	P-F	S
Prowl/Pentagon (PRE)	E	F	G-E ¹	G-E	N	F-G	P-F	P	S
Pursuit Plus (PPI)	E	G	E ¹	E	N	G	F	P-F	O
Python (PPI/PRE)	N	N	N	N	N	N	N	N	S
Ramrod (PRE)	E	F-G	G-E	G-E	N	G-E	P	P	N
Ro-Neet (PPI)	E	G	E	E	P	G-E	G	-	N
Sencor (PPI)	F	F-G	F	F	F	G	N	P	S
Sencor (PRE)	P-F	F	P-F	P-F	N	F-G	P	P	S
Sonalan (PPI)	E	G	E ¹	E	N	G	F	P-F	S
Trifluralin (PPI)	E	G	E ¹	E	N	N	F	P-F	S
Trifluralin (PoPI)	E	F-G	E ¹	E	N	N	P	P	S
Valor	N	N	P	P	N	N	N	N	N

PPI = Preplant Incorporated, PRE = Preemergence, PoPI = Post plant incorporated.
¹Except where resistant populations have developed.

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	Buckwheat, Wild	Cocklebur, Common	Flixweed	Kochia	Lambsquarters, C	Lanceleaf Sage	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, Black	Pigweed, Redroot	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada
Atrazine (PPI)	E	G	E	E	E	E	G	E	E	E	E	E	E	E	G-E	E	-	F
Atrazine (PRE)	G-E	F-G	E	G-E	G-E	E	G	E	E	G-E	G-E	E	E	E	F-G	G-E	-	P-F
Axiom (PPI)	P	N	-	F	F	N	N	N	F	P	G-E	P	P	P	N	F	N	N
Axiom (PRE)	P	N	-	P-F	F-P	N	N	N	P	P	F-G	P	P	P	N	P-F	N	N
Authority/Spartan (PRE)	F-G	P	F-G	E	E	N	G	P-G	F-G	E	E	E	F	E	N	G-E	G-E	N
Balance/Pro (PRE)	N	P	G-E	E	E	-	G-E	G	E	G-E	E	-	G-E	G	P	G	-	N
Bladex (PPI)	G	F	E	G-E	G-E	E	G	E	E	F	F	E	E	E	F-E	E	-	N
Bladex (PRE)	F-G	F	E	G	G-E	E	G	E	G-E	P-F	P-F	E	E	E	P-F	G-E	-	N
Brdstrk + Treflan (PPI)	G-E	F-G	E	E ¹	E	G-E	E	E	E	G-E	E	E	G	E	G-E	G-E ¹	G-E	F
DoublePlay (PPI)	F	P	P	G-E	E	N	N	P	F	G-E	E	P	G-E	P	P	F	P	N
Dual Products (PPI)	P	N	-	P	F	N	N	N	P	F	G-E	P	P-F	P	N	F	P	N
Dual Products (PRE)	P	N	-	P	P-F	N	N	N	P	P	F-G	P	P-F	P	N	P-F	P	N
Eptam/Eradicane (PPI)	F	P	P	F	F	N	N	P	P	F-G	G	P	F	P	N	P	N	N
Far-Go (PPI)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Far-Go (PoPI)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FirstRate (PPI/PRE)	P	E	P	P	G	F-G	-	E	P	N	G	-	E	E	E	-	N	N
Gauntlet (PPI/PRE)	F-G	E	F-G	E	E	E	E	E	E	E	E	E	E	E	E	G-E	G-E	N
Frontier (PPI)	P	N	-	P	F	N	-	N	P-F	G-E	E	-	P	P	N	P-F	N	N
Frontier (PRE)	P	N	-	P	F	N	-	N	P-F	G	G-E	-	N	P	N	P	N	N
Harness/Surpass (PPI)	P	P	-	G-E	G-E	N	-	P	F	G-E	E	-	F-G	P	P	F	N	N
Harness/Surpass (PRE)	P	P	-	G	G	N	-	P	F	G	G-E	-	F	P	N	F	N	N
Hornet (PPI)	E	G-E	E	E ¹	E	G-E	E	E	E	E	E	E	E	E	E	E ¹	E	F-G
Hornet (PRE)	E	G	E	G-E	G-E	G-E	E	E	E	E	E	E	E	E	E	E	E	F
Lasso/generics (PPI)	P	N	-	F	F	N	N	N	P	G	G-E	P	P	P	N	F	N	N
Lasso/generics (PRE)	P	N	-	P-F	P-F	N	N	N	P	G	F-G	P	P	P	N	P-F	N	N
Nortron (PPI)	F-G	P	-	F-G	P-F	-	F	P	F	F-G	G-E	-	P	G-E	P	F-G	-	N
Nortron (PRE)	F	P	-	F	P-F	-	F	P	P-F	F	G	-	P	G	P	F	-	N
Matrix (PRE)	P	F	-	G	F	N	-	N	F	P	E	-	F	P	F	P	N	P
Paramount	N	N	N	F	F	N	N	N	N	N	F	N	F	N	F	F	-	P
Prowl/Pentagon (PPI)	P-F	N	P	F-G	E	N	F-G	N	N	P	E	N	P	P	N	G	P	N
Prowl/Pentagon (PRE)	P	N	P	F-G	G	N	F	N	N	N	G	N	P	P	N	F-G	P	N
Pursuit Plus (PPI)	F-G	G	E	E ¹	E	E	F-G	G-E	E	E	E	E	F	G	G-E	G-E	P	N
Python (PPI/PRE)	P	P	E	E ¹	E	G-E	E	P-F	E	G-E	E	-	P	G-E	P	E	G-E	N
Ramrod (PRE)	F	P	P	G	F	N	N	N	P	N	E	P	P	P	N	P	N	N
Ro-Neet (PPI)	P-F	P	P	P	F-G	N	F	P	P	F-G	G	P	P	P	N	P	-	N
Sencor (PPI)	F	F	E	G	F	F-G	G-E	E	E	P	E	E	E	G	P-F	E	G-E	N
Sencor (PRE)	F	P-F	G-E	F-G	P-F	F-G	G	E	G-E	P	G-E	E	G-E	G	P	G-E	G-E	N
Sonalan (PPI)	P-F	P	P	G	E	N	F-G	N	N	F	E	P	P	P	N	G-E	P	N
Trifluralin (PPI)	P-F	N	P	F-G	G-E	N	F-G	N	N	P	E	N	P	P	N	G	P	N
Trifluralin (PoPI)	P	N	P	F-G	F-G	N	P	N	N	N	F-G	N	P	P	N	F-G	P	N
Valor (PPI/PRE)	P	N	N	G	E	N	E	P	P	E	E	-	F	F	N	F	P-F	N

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

¹Except where resistant populations have developed.

POST APPLIED HERBICIDES	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Herbicide Persistence
Accent	E	G-E	E	G-E	G-E	G-E	E	G-E	O
Accent Gold	E	G	E	E	G-E	G	G-E	G-E	O
Achieve	F	G	G-E	G	N	N	E	E	N
Aim	N	N	N	N	N	N	N	N	N
Ally + 2,4-D	N	N	P	P	N	N	N	N	O
Amber + 2,4-D	N	N	N	N	N	N	N	N	O
Assert	P	N	P	P	N	N	G-E ²	N	S
Assure II	E	E	E	G-E	G-E	E	G-E ²	E	N
Atrazine + oil	G	F	G	G-E	P-F	F-G	G-E	F	S
Avenge	N	N	N	N	N	N	G-E	N	N
Basagran	N	N	N	N	N	N	N	N	N
Basis	G-E	F-G	G-E	G	F-G	F-G	F-G	F	S
Basis Gold	E	G	E	E	E	G	E	G-E	O
Betamix	P	N	F	F	N	N	N	P	N
Betanex	P	N	P-F	P-F	N	N	N	P	N
Betamix Progress	P	N	F-G	F-G	N	N	N	P	S
Betanex + Nortron SC	P	N	F	F	N	N	N	P	S
Bladex + oil	G	F-G	G	G	N	G-E	F-G	P-F	N
Bromoxynil	N	N	N	N	N	N	N	N	N
Bromoxynil + MCPA	N	N	N	N	N	N	N	N	N
Callisto	N	N	N	N	N	N	N	N	S
Canvas + 2,4-D	N	N	N	N	N	N	N	N	O
Celebrity Plus	E	G-E	E	G-E	G-E	G-E	E	G-E	O
Cheyenne	G-E	F	E	G-E	P	N	E ¹	E	N
Cobra	N	P	P-F	P-F	N	N	N	P	N
Curtail/M	N	N	N	N	N	N	N	N	S
Dakota	G	P-F	G-E	G	P	N	G ²	E	N
Dicamba	N	N	N	N	N	N	N	N	S
Dicamba + MCPA	N	N	N	N	N	N	N	N	S
Discover	E	-	E	G-E	P	N	E ²	-	N
Distinct	P-F	P	P-F	P-F	N	P	P	P	S
Everest	N	N	E	F-G	N	N	E	-	S
Express + 2,4-D	N	N	P	P	N	N	N	N	N
Extreme	E	E	E	E	E	E	E	E	O
Finesse + 2,4-D	N	N	F-G	F	N	N	N	N	O
FirstRate	N	N	N	N	N	N	N	N	O
Flexstar	N	N	P-F	P-F	N	N	N	N	O
Fusilade DX	E	E	G-E	G-E	G	E	E ²	E	N
Fusion	E	E	E	E	G	E	E ²	E	N
Glyphosate	E	E	E	E	E	E	G-E	E	N
Goal	P	N	P	P	P	P	F-G	N	N
Harmony Extra + 2,4-D	N	N	P	P	N	N	N	N	N
Harmony GT (1/3 to 1/6 oz)	N	N	N	N	N	N	N	N	N
Harmony GT (1/12 oz)	N	N	N	N	N	N	N	N	N
Hoelon	F	P	G-E	G	P	N	G-E ²	P-F	N
Hornet	N	N	N	N	N	N	N	N	O
Liberty	E	G	E	G	P	F-G	G-E	E	N
Liberty ATZ	F	F	E	G-E	P	G-E	E	E	S

POST APPLIED HERBICIDES	Buckheat, Wild	Cocklebur, Common	Flxweed	Kochia	Lambsquarters, C.	Lanceleaf Sage	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, E. Black	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada
Accent	P	P	E	F ²	P	P	P	P	E	N	E	-	P	G-E	P	P	P	N
Accent Gold	F	E	E	F ²	G	E	E	E	E	G-E	E	-	E	E	E	F	E	G-E
Achieve	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Aim	N	N	E	G	G-E	-	N	N	P	G-E	G-E	N	N	N	N	N	-	N
Ally + 2,4-D ¹	F-G	F	E	E ²	E	F-G	G-E	G-E	E	F-G	E	E	E	F	G-E	E ²	F-G	G
Amber + 2,4-D ¹	F-G	F-G	E	E ²	F-G	F-G	-	E	E	F-G	E	E	E	F	E	E ²	F-G	F-G
Assert	F-G	P	G-E	N	P	N	N	N	E	N	P	N	N	P	N	P-F	N	N
Assure II	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Atrazine + oil	G	G	E	E	E	E	-	E	E	G	E	E	E	E	G	E	-	P
Avenge	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Basagran	P	G-E	E	P	F-G	P	E	G-E	E	F	F	E	F-G	E	E	G	F-G	F-G
Basis	P	P	-	F ²	G	P	F	G	E	P	E	-	P	E	F-G	G ²	P	P
Basis Gold	G-E	F-G	E	E ²	E	E	E	E	E	F	E	E	G-E	E	G	E	-	P-F
Betamix	F	P-F	-	F-G	G	P	F	G	G-E	F-G	G	-	F	F	P	P	P	N
Betanex	P-F	P	-	F	G	P	F	G	G-E	F-G	G-E	-	F	F	P	P	P	N
Betanex Progress	F-G	F	-	F-G	G-E	P-F	F	G	G-E	G	G	-	F-G	F-G	P	P	P	N
Betanex + Nortron SC	F	F	-	F	G-E	P-F	F	G	G-E	G	G-E	-	F-G	F	P	P	P	N
Bladex + oil	G-E	G	F-G	G-E	G	E	E	E	E	G	F-G	G	E	E	E	G	-	P
Bromoxynil	E	E	F-G	G-E	G	E	G-E	E	F-G	E	F	E	E	G-E	G-E	E	F	F
Bromoxynil + MCPA	E	E	G-E	G-E	E	E	G-E	E	E	E	G	E	E	G	E	E	F	F
Callisto	N	E	N	G-E	E	-	-	E	N	E	E	-	E	E	E	-	-	N
Canvas + 2,4-D	G	F-G	E	E ²	E	F-G	G-E	E	E	F-G	E	E	E	F-G	G-E	E ²	F-G	G
Celebrity Plus	E	E	E	E	G	F	F	E	E	G-E	E	E	E	E	E	G	E	F-G
Cheyenne	F-G	G	E	E ²	E	F-G	G	E	E	F-G	E	E	E	E	E	G-E ²	P-F	P
Cobra	P	G	-	P-F	F	E	F-G	G	E	G	E	-	G-E	G	P-F	P	P	F
Curtail/M	G	E	E	P	G	F-G	G	E	E	E	P	E	E	E	E	G	E	G-E
Dakota	P	G	G	P	E	F-G	F	G	E	F	P	G-E	G	G	G	P	P	P
Dicamba ¹	E	E	P-F	E	G	P-F	F	E	G	E	G	G-E	E	E	G-E	G	G-E	F-G
Dicamba + MCPA ¹	G-E	E	F-G	E	E	G-E	G	G-E	E	E	G	E	E	E	E	G	G-E	F
Discover	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Distinct	E	E	G	E	E	G	E	E	E	G	E	E	E	E	E	E	E	G-E
Everest	F	N	E	N	N	N	N	N	E	N	F	N	N	E	N	N	-	N
Express + 2,4-D ¹	F	G	E	E ²	E	F-G	-	E	E	F-G	G	G-E	G	G	F-G	E ²	F-G	G
Extreme	P	E	E	E	G-E	E	E	E	E	E	E	E	E	E	E	E	P	G
Finesse + 2,4-D ¹	E	G-E	E	E ²	E	F-G	E	E	E	F-G	E	E	E	E	E	E ²	F-G	G
FirstRate	P	E	P	P ²	P	G-E	G-E	E	P-F	N	P	-	E	E	E	-	P	N
Flexstar	P	G-E	E	G-E	P-F	E	G-E	G-E	E	G-E	E	-	E	G-E	F	-	P	N
Fusilade DX	N	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	N
Glyphosate ³	P-F	E	G-E	F-E	P-E	E	E	G-E	G-E	F-G	E	E	E	E	G-E	G	P-F	G
Goal	G-E	E	F	G-E	G	E	-	-	F	G-E	E	G-E	G	F	F-G	G-E	G	N
Harmony Extra + 2,4-D ¹	G-E	E	E	E ²	E	G-E	-	E	E	F-G	E	E	E	G	G-E	E ²	F-G	G
Harmony GT (0.3-0.6oz)	E	P	G-E	G-E ²	E	N	N	G-E	E	N	E	E	G	E	G-E	G-E	N	N
Harmony GT (1/12 oz)	P	N	N	F-G ²	G	N	N	N	E	N	E	N	N	G-E	P	P	N	N
Hoelon	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Hornet	F-G	E	E	F-G ²	P-F	E	E	E	E	G-E	P-F	-	E	F-G	E	F-G	E	G-E
Liberty	E	E	G-E	E	F-G	E	E	E	E	E	E	G-E	E	E	E	G-E	E	P-F
Liberty ATZ	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F

POST APPLIED HERBICIDES (cont.)	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Herbicide Persistence
Lightning	E	E	E	E	F	G-E	G-E	G-E	O
Lorox	F	-	G	G	P	-	-	-	N
Matrix	G	-	E	G-E	G	E	G	F	S
Maverick	-	-	P-F	P-F	G-E	N	E	-	O
MCPA	N	N	N	N	N	N	N	N	N
Muster	N	N	N	N	N	N	P	N	N
NorthStar	-	G-E	G-E	G-E	G-E	-	-	-	O
Paramount	G-E	N	E	G	N	N	N	N	S
Paraquat	G	G	G	G	P	F-G	G	F-G	N
Peak + 2,4-D	N	N	N	N	N	N	N	N	O
Permit	N	N	N	N	N	N	N	N	O
Plateau	N	N	E	G-E	N	N	N	N	O
Poast	E	E	E	E	F	E	G-E ²	E	N
Prism	E	E	E	E	G	E	E	E	N
Puma	E	E	E	E	N	N	E ²	E	N
Pursuit	G	P-F	G	F-G	N	G	F ²	P-F	O
Raptor	E	F-G	E	G-E	F	G-E	E ²	G-E	N
Rave	N	N	N	N	N	N	N	N	O
ReadyMaster	E	E	E	E	E	E	E	E	O
Reflex	N	N	N	N	N	N	N	N	O
Resource	N	N	N	N	N	N	N	N	N
Rezult	E	E	E	E	F-G	E	G-E ²	E	N
Select	E	E	E	E	G	E	E	E	N
Sencor	F	-	F	F	P	P	-	-	O
Stampede EDF + MCPAe	G	P	G	G	N	N	N	P	N
Starane	N	N	N	N	N	N	N	N	N
Steadfast	E	G-E	E	E	G-E	E	E	E	O
Stellar	N	N	N	N	N	N	N	N	N
Stinger	N	N	N	N	N	N	N	N	S
Tiller	G-E	F	E	G-E	N	N	G-E ²	E	N
Tough	N	N	N	N	N	N	N	N	N
Ultra Blazer	N	P	P-F	P-F	N	N	N	P	N
UpBeet + Betanex/Betamix/ Progress	P	P	F-G	F-G	N	P	N	P	N
2,4-D	N	N	N	N	N	N	N	N	N

²Herbicides will not control resistant biotypes.

POST APPLIED	Buckwheat, Wild	Cocklebur, Common	Flixweed	Kochia	Lambsquarters, C.	Lanceleaf Sage	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, Black	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada
Lightning	E	G	E	E ²	E -	G	E	E	E	E	-	G	E	G	E	P	F	
Lorox	E	E	G	-	E	-	-	-	G	E	E	-	E	E	-	-	-	N
Matrix	P	F	-	P ²	F	-	-	-	E	P	E	-	F	F	P	P	N	N
Maverick	N	-	E	P ²	P	-	N	-	E	-	P	-	-	-	E	-	P	N
MCPA	N	G	G-E	P	E	G-E	F	G	E	F	P-F	F	G	F	G	P	F-G	F-G
Muster	P	P	E	P ²	P-F	P	P	P	E	P	P-F	P	P	G	F	P	N	N
NorthStar	E	E	E	E	E	F	F	E	E	E	E	G-E	E	E	E	E	G-E	G-E
Paramount	N	N	N	F	F	N	N	N	N	N	F	N	F	N	F	F	-	P
Paraquat	F	F-G	G	G-E	E	E	G	G	E	G-E	E	E	G-E	E	E	E	-	P
Peak + 2,4-D	F-G	G-E	E	G-E ²	G	F-G	-	-	E	-	E	E	E	-	E	E ²	F-G	F-G
Permit	P	E	E	P ²	P-F	P	E	G-E	E	P	F-G	-	G-E	F-G	E	-	P	N
Plateau	-	E	E	E ²	E	-	-	E	E	G-E	E	E	E	-	E	-	N	F
Poast	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Prism	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Puma	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	P	G	E	E ²	P	E	P	E	E	E	E	E	P	G	G-E	G-E	P	N
Raptor	P	G-E	E	E ²	G	E	P	G-E	E	E	E	-	P	G-E	E	G-E	P	N-P
Rave	E	E	E	E	G-E	F-G	G	E	E	E	E	E	E	E	E	E	F-G	G
ReadyMaster	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Reflex	P	G	E	G-E	P	E	G	G	E	G	G-E	-	G-E	G	P-F	-	P	N
Resource	P	N	P	P	G	-	N	-	P-F	P-F	G	-	G	N	N	-	P	N
Rezult	P	G-E	E	P	F-G	P	E	G-E	E	F	F	E	F-G	E	E	F	F	F-G
Select	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sencor	G	P	E	F-G	E	-	-	-	E	P	G	-	E	E	F	-	-	P
Stampede + MCPAe	G-E	G	P	G	E	N	-	F	E	-	E	-	P	F	G	F	F	F
Starane	P-F	P	P	E	N	-	P	P	P	F-G	N	E	P	P	P	P	P	N
Steadfast	P	P	E	P ²	P	P	N	P	E	N	E	-	N	F	P	P	P	N
Stellar	P	F	P	P	F-G	F-G	N	-	P	P	G-E	-	G-E	-	-	-	P-F	N
Stinger	F-G	E	P	N	P-F	F	G	E	P	F-G	P	E	G-E	G-E	G-E	P-F	E	G-E
Tiller	P	G-E	G	F	E	G	F-G	F-G	E	F	F	E	F	P	G-E	F	P-F	F
Tough	P	G	P	E	E	P-F	P-F	-	P	E	E	P	P	P	F-G	E	P	N
Ultra Blazer	P	F-G	-	P-F	G	P-F	F	F	E	G	E	-	F-G	E	P-F	G	P	P
UpBeet + Betanex/ Betamix/Progress	F-G	F-G	-	E ²	G-E	P-F	F-G	G	E	G	G-E	-	F-G	G	G	P	P	N
2,4-D	P-F	G-E	F-G	P-F	E	P-F	G-E	E	E	P-F	G	E	G-E	F-G	E	G	F-G	F-G

¹ALS herbicides tank-mixed with 2,4-D and Banvel 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.

2000 North Dakota Herbicide Price List

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	Formulation	Active Ingredients	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Accent	75DF	nicosulfuron	31.00 oz	0.33 oz	0.5 oz	0.67 oz	10.25	15.50	20.50
Accent Gold	nic + rim = 75DF + Hornet = 85.6DF	nicosulfuron + rimsulfuron + clopyralid + flumetsulam	7.25 oz	2 oz	2.5 oz	2.9 oz	14.50	18.15	21.00
Acclaim	1EC	fenoxaprop	380 gal	15 fl oz	30 fl oz	45 fl oz	45.00	90.00	135.00
Achieve + Oil Adj.	40WDG	tralkoxydim	2.30 oz	4.67 oz	5.6 oz	7 oz	10.75	12.90	16.10
Aim	40DF	carfentrazone	7.50 oz	0.33 oz	-	0.33 oz	2.50	-	2.50
Ally	60DF	metsulfuron	22.00 oz	0.05 oz	0.1 oz	0.3 oz	1.10	2.20	6.60
Amber	75DF	triasulfuron	9.75 oz	0.14 oz	0.28 oz	0.56 oz	1.35	2.75	5.45
Aquathol	10G	endothall	2.50 lb	200 lb	300 lb	400 lb	500.00	700.00	1000.00
Arsenal	2SL	imazapyr	270.00 gal	1 qt	2 qt	3 qt	67.50	135.00	202.50
Assert 2.5S	2.5SL	imazamethabenz	100.00 gal	0.6 pt	1 pt	1.2 pt	7.50	12.50	15.00
Assure II	0.88EC	quizalofop	125.00 gal	7 fl oz	8 fl oz	10 fl oz	6.85	7.80	9.75
Atrazine 4L	4L	atrazine	14.00 gal	0.75 pt	1.5 pt	2 pt	1.30	2.65	3.50
Atrazine 90DF	90DF	atrazine	3.15 lb	0.42 lb	0.83 lb	1.11 lb	1.30	2.60	3.50
Authority	75WDG	sulfentrazone	2.55 oz	3 oz	4 oz	5.33 oz	7.65	10.20	13.65
Avenge	2SL	difenzoquat	38.00 gal	2.5 pt	3 pt	4 pt	11.90	14.25	19.00
Axiom	54.4 + 13.6DF	flufenacet + metribuzin	1.10 oz	15 oz	20 oz	23 oz	16.50	22.00	25.30
Axiom AT	50.5 + 19.6 + 4.9DF	atrazine + flufenacet + metribuzin	8.50 lb	2 lb	3 lb	3.75 lb	17.00	25.50	31.90
B-4	1.3 + 2.69EC	bromoxynil + 2,4-D ester	40.00 gal	1.1 pt	1.25 pt	1.5 pt	5.50	6.25	7.50
Balan	2.5G	benefin	0.70 lb	60 lb	70 lb	80 lb	42.00	49.00	56.00
Balance	75DF	isoxaflutole	8.75 oz	1.25 oz	1.5 oz	2 oz	10.95	13.10	17.50
Balance Pro	4SC	isoxaflutole	5.85 fl oz	1.5 fl oz	2.25 fl oz	3 fl oz	8.75	13.15	17.55
Banvel	4SL	dicamba - dma salt	82.00 gal	2 fl oz	1 pt	4 pt	1.28	10.25	40.95
Basagran	4SL	bentazon - Na salt	72.00 gal	1 pt	1.5 pt	2 pt	9.00	13.50	18.00
Basis	50 + 25DF	rimsulfuron + thifensulfuron	16.50 oz	0.33 oz	-	0.33 oz	5.45	-	5.45
Basis Gold	1.34 + 1.34 + 86.78DF	nicosulfuron + rimsulfuron + atrazine	1.20 oz	7 oz	10 oz	14 oz	8.40	12.00	16.80
Beacon	75DF	primisulfuron	25.00 oz	0.38 oz	0.5 oz	0.76 oz	9.50	12.50	19.00
Betamix	0.65 + 0.65EC	desmedipham + phenmedipham	100.00 gal	4.62 pt	6 pt	7.7 pt	57.75	75.00	96.25
Betanex	1.3EC	desmedipham	100.00 gal	4.62 pt	6 pt	7.7 pt	57.75	75.00	96.25
Bicep II Magnum	3.1 + 2.4L	atrazine + metolachlor	41.00 gal	2.4 qt	2.7 qt	3 qt	24.60	27.70	30.75
Bicep Lite II Magnum	2.67 + 3.23	atrazine + metolachlor	55.00 gal	1.5 qt	1.9 qt	2.2 qt	20.65	26.15	30.25
Bison	2 + 2EC	bromoxynil + MCPAe	42.00 gal	0.75 pt	1 pt	1.5 pt	3.95	5.25	7.90
Bladex	4L	cyazazine	30.00 gal	1 qt	2 qt	3 qt	7.50	15.00	22.50
Bladex	90DF	cyazazine	6.25 lb	1.11 lb	2.22 lb	3.33 lb	6.95	13.90	20.80
Boundary	6.3 + 1.5L	metolachlor + metribuzin	70.00 gal	1.5 pt	2 pt	2.5 pt	13.15	17.50	21.90
Brash	2.87 + 1SL	2,4-D + dicamba	27.00 gal	0.5 pt	2 pt	4 pt	1.70	6.75	13.50
Broadstrike + Dual	0.2 + 7.47EC	flumetsulam + metolachlor	65.00 gal	1.75 pt	2 pt	2.5 pt	14.25	16.25	20.35
Broadstrike + Treflan	0.25 + 3.4EC	flumetsulam + trifluralin	82.00 gal	1.5 pt	2 pt	2.25 pt	15.40	20.50	23.05
Broclean	2EC	bromoxynil	55.00 gal	1 pt	1.5 pt	2 pt	6.90	10.30	13.15
Bromac	2 + 2EC	bromoxynil + MCPAe	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Bromox + Atrazine	2 + 1L	bromoxynil + atrazine	35.00 gal	1.5 pt	2 pt	3 pt	6.55	8.75	13.15
Bronate	2 + 2EC	bromoxynil + MCPAe	42.00 gal	0.75 pt	1 pt	1.5 pt	3.95	5.25	7.90
Bronate Pro	1.65 gal/2.5 gal	Copack: Puma + Bronate	385 case	Puma @0.66pt + Bronate @1pt			19.00		
Brozine	2 + 1L	bromoxynil + atrazine	35.00 gal	1.5 pt	2 pt	3 pt	6.55	8.75	13.15
Buckle	10 + 3G	triallate + trifluralin	1.13 lb	10 lb	11 lb	12.7 lb	11.30	12.45	14.35
Buctril	2EC	bromoxynil	55.00 gal	1 pt	1.5 pt	2 pt	6.90	10.30	13.75
Buctril + Atrazine	2 + 1L	bromoxynil + atrazine	35.00 gal	1.5 pt	2 pt	3 pt	6.55	8.75	13.15
Bullet	2.5 + 1.5L	alachlor + atrazine	18.50 gal	2.5 qt	3 qt	3.75 qt	11.60	13.90	17.35
Butyrac 200	2SL	2,4-DB	35.00 gal	2 pt	3 pt	4 pt	8.75	13.15	17.50
Callisto	4SL	mesotrione		3 fl oz		3 fl oz			
Canopy	64.3 + 10.7DF	metribuzin + chlorimuron	2.15 oz	4 oz	5.5 oz	7 oz	8.60	11.85	15.00
Canvas	71.25DF	thifensulfuron + tribenuron + metsulfuron	13.00 oz	10 A/pk	-	5 A/pk	2.60	-	5.20
Casoron	4G	dichlobenil	2.05 lb	100 lb	150 lb	200 lb	205.00	307.50	410.00
Casoron	10G	dichlobenil	5.25 lb	40 lb	60 lb	80 lb	210.00	315.00	420.00
Celebrity	63 + 7.5WDG	dicamba-Na + nicosulfuron	3.10 oz	3.34 oz	5 oz	6.67 oz	10.35	15.50	20.70

Product	Formulation	Active Ingredients	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Celebrity Plus	42.4 + 17 + 10.6WDG	dic-Na + diflufenzopyr + nicosulf	4.40 oz	2.34 oz	3.50 oz	4.67 oz	10.30	15.40	20.55
Cheyenne	fenoxaprop-P + MCPA + thifensulfuron + tribenuron 0.467 + 2.16e + 50DF + 25DF		810.00 case	Each case treats 40 acres			20.25	-	20.25
Clarity	4S	dicamba - dga salt	85.00 gal	0.5 pt	0.75 pt	1 pt	5.45	8.15	10.90
Classic	25DF	chlorimuron	11.00 oz	0.5 oz	0.67 oz	0.75 oz	5.50	7.30	8.25
Cobra	2SL	lactofen	126.00 gal	6 fl oz	8 fl oz	12.8 fl oz	5.90	7.85	12.60
Command	3ME	clomazone	66.00 gal	1.33 pt	2 pt	2.67 pt	11.00	16.50	22.00
Command Extra	Copack: 3EC/4EC	clomazone / sulfentrazone	195.00 cont.	21.3 fl oz/8 fl oz - 32 fl oz/12 fl oz			21.50		
Concert	12.5 + 12.5DF	thifensulfuron + chlorimuron	7.50 oz	0.5 oz	-	0.5 oz	3.75	-	3.75
Confront	0.75 + 2.25EC	clopyralid-tea + triclopyr-tea	105.00 gal	1 pt	1.5 pt	2 pt	13.15	19.70	26.25
Connect	20WSP	bromoxynil	6.16 lb	1.25 lb	1.88 lb	2.5 lb	7.70	11.60	15.40
Crossbow	1 + 2SL	triclopyr + 2,4-D	50.00 gal	1 qt	3 qt	6 qt	12.50	37.50	75.00
Curtail	0.38 + 2SL	clopyralid-aka + 2,4-D-aka salt	35.00 gal	2 pt	4 pt	8 pt	8.75	17.50	35.00
Curtail M	0.42 + 2.35SL	clopyralid acid + MCPA _{ioe}	41.00 gal	1.75 pt	2 pt	2.33 pt	9.00	10.25	11.95
Dakota	0.234 + 2.84EC	fenoxaprop + MCPA _e	57.00 gal	16 fl oz	-	21.3 fl oz	7.20	-	9.60
Degree	3.8ME	acetochlor-ME	46.00 gal	3.25 pt	4 pt	4.25 pt	18.70	23.00	24.45
Degree Xtra	1.34 + 2.7L	atrazine + acetochlor(ME)	34.50 gal	2.4 qt	2.9 qt	3.7 qt	21.30	23.00	31.90
Desiccate II	2SL	endothall	38.00 gal	1.5 qt	-	2 qt	14.25	-	19.00
Dimension	1EC	dithiopyr	130.00 gal	1 qt	1.5 qt	2 qt	32.50	48.75	68.00
Dimension Ultra	40WSP	dithiopyr	55.00 lb	0.5 lb	0.75 lb	1 lb	27.50 lb	41.25	55.00
Diquat	2SL	diquat	79.00 gal	1 pt	2 pt	4 pt	9.90	19.75	39.50
Discover + DSV adj.	2EC	clodinafop + PO adjuvant	600 case	3.2 fl oz	-	4 fl oz	12.75	-	15.75
Distinct	50 + 20WDG	dicamba-Na + diflufenzopyr-Na	2.00 oz	4 oz	6 oz	8 oz	8.00	12.00	16.00
Diuron	80WDG	diuron	5.00 lb	0.75 lb	2 lb	6 lb	3.75	10.00	30.00
Domain	24 + 36WDG	flufenacet + metribuzin	0.88 oz	9 oz	13 oz	16 oz	7.90	11.45	14.10
DoublePlay	1.4 + 5.6EC	acetochlor + EPTC	30.00 gal	4.5 pt	6 pt	7 pt	16.90	22.50	26.25
Drexel Defol	6SL	sodium chlorate	6.50 gal	0.5 gal	-	1 gal	3.25	-	6.50
Drive	75DF	quinclorac	90.00 lb	1 lb	-	1 lb	90.00	-	90.00
Dual II Magnum	7.6EC	metolachlor	105.00 gal	1.33 pt	1.67 pt	2 pt	17.45	21.90	26.25
Epic	48 + 10DF	flufenacet + isoxaflutole	1.90 oz	8 oz	14 oz	20 oz	15.20	26.60	38.00
Eptam 7E	7EC	EPTC	31.00 gal	2.3 pt	4 pt	6.75 pt	8.90	15.50	26.15
Eptam 20G	20G		1.05 lb	15 lb	18 lb	22.5 lb	15.75	18.90	23.65
Eradicane EC	6.7EC	EPTC + safener	27.00 gal	4.75 pt	6 pt	7 pt	16.00	20.30	23.65
Eradicane 25G	25G		1.00 lb	16 lb	20 lb	24 lb	16.00	20.00	24.00
Escort	60DF	metsulfuron	25.00 oz	0.33 oz	1 oz	2 oz	8.25	25.00	50.00
Everest	70WDG	flucarbazone	20.00 oz	0.4 oz	0.5 oz	0.6 oz	8.00	10.00	12.00
Exceed	32.3 + 32.3WDG	prosulfuron + primisulfuron	11.20 oz	0.88 oz	-	0.88 oz	9.85	-	9.85
Expert	1.73 + 2.13 + 1	s-metolachlor + atra + glyphosate	-	2.5 qt	3 qt	3.75 qt	-	-	-
Express	75DF	tribenuron	17.50 oz	0.08 oz	0.25 oz	0.33 oz	1.40	4.40	5.80
Extrazine II	67.5 + 22.5DF	cyanazine + atrazine	4.75 lb	1.4 lb	3 lb	5.3 lb	6.65	14.25	25.20
Extreme	0.17 + 2SL	imazethapyr + glyphosate	35.00 gal	1.5 pt	2.25 pt	3 pt	6.55	9.85	13.15
Fallow Master	1.1 + 0.5SL	glyphosate-ipa + dicamba acid	18.50 gal	22 fl oz	33 fl oz	44 fl oz	3.20	4.75	6.13
Far-Go EC	4EC	triallate	40.00 gal	1 qt	1.25 qt	1.5 qt	10.00	12.50	15.00
Far-Go 10G	10G	triallate	0.92 lb	10 lb	12.5 lb	15 lb	9.20	11.50	13.80
FieldMaster	2 + 1.5 + 0.56	acetochlor + atrazine + glyphosate	24.00 gal	3.5 qt	4 qt	5 qt	21.00	24.00	30.00
Finesse	62.5 + 12.5DF	metsulfuron + chlorsulfuron	13.50 oz	0.2 oz	0.25 oz	0.3 oz	2.70	3.40	4.05
FirstRate	84WDG	cloransulam	23.75 oz	0.3 oz	0.6 oz	0.75	7.15	14.25	17.80
Flexstar	1.88EC	fomesafen + adjuvants	88.00 gal	0.5 pt	0.75 pt	1 pt	5.50	8.25	11.00
Freedom	2.67 + 0.33EC	alachlor + trifluralin	12.25 gal	2.75 qt	3.25 qt	4.5 qt	8.40	9.90	13.80
Frontier	6EC	dimethenamid	80.00 gal	15 fl oz	20 fl oz	32 fl oz	9.45	12.60	20.15
FulTime	2.4 + 1.6L	acetochlor (ME) + atrazine	26.00 gal	2.5 qt	2.7 qt	3 qt	16.25	17.55	19.50
Fusilade DX	2EC	fluazifop-P	120.00 gal	6 fl oz	10 fl oz	12 fl oz	5.65	9.40	11.30
Fusion	2 + 0.66EC	fluazifop + fenoxaprop	132.00 gal	6 fl oz	10 fl oz	12 fl oz	6.20	10.30	12.35
Galaxy	3 + 0.67SL	bentazon + acifluorfen	60.00 gal	2 pt	-	2 pt	15.00	-	15.00
Gallery	75DF	isoxaben	115.00 lb	0.66 lb	1 lb	1.33 lb	75.90	115.00	152.95
Garlon	4EC	triclopyr	100.00 gal	1 qt	2 qt	4 qt	25.00	50.00	100.00
Garlon	3AS	triclopyr	78.00 gal	2 qt	1 gal	2 gal	39.00	78.00	156.00
Gauntlet	75WDG/84WDG	Copack:sulfentrazn + cloransulm	85.50 cont.	5.33 oz/0.6 oz-6.67 oz/0.75 oz			18.50		
Glyfos	3SL	glyphosate - ipa salt	34.00 gal	0.5 pt	2 pt	4 pt	2.15	8.50	17.00
Glyphomax	3AS	glyphosate - ipa salt	36.00 gal	0.5 pt	2 pt	4 pt	2.25	9.00	18.00
Glyphomax Plus	3AS	glyphosate - ipa salt	38.00 gal	0.5 pt	2 pt	4 pt	2.40	9.50	19.00

Product	Formulation	Active Ingredient	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Goal	2EC	oxyfluorfen	95.00 gal	4 pt	6 pt	8 pt	47.50	71.25	95.00
Gramoxone Extra	2.5SL	paraquat	31.00 gal	0.8 pt	2 pt	3 pt	3.10	7.75	11.65
Gramoxone Max	3SL	paraquat	- gal	1.5 pt	2 pt	2.7 pt	-	-	-
Grazon P+D	0.54 + 2 S	picloram + 2,4-D	28.00 gal	2 qt	3 qt	4 qt	14.00	21.00	28.00
Guardzman	2.67 + 2.33L	atrazine + dimethenamid	34.00 gal	2.5 pt	3.75 pt	5 pt	10.65	15.95	21.25
Harmony GT	75DF	thifensulfuron	10.50 oz	1/12 oz	0.3 oz	0.6 oz	0.88	3.15	6.30
Harmony Extra	50 + 25DF	thifensulfuron + tribenuron	11.50 oz	0.15 oz	0.3 oz	0.6 oz	1.75	3.45	6.90
Harness EC	7EC	acetochlor + safener	70.00 gal	1.25 pt	2 pt	3 pt	10.95	17.50	26.25
Harness 20G	20G		2.00 lb	8 lb	10 lb	12 lb	16.00	20.00	24.00
Harness Xtra 5.6L	3.1 + 2.5L	acetochlor&safener + atrazine	43.00 gal	1.4 qt	2.3 qt	3 qt	15.05	24.75	32.25
Herbicide 273	3SL	endothall	43.00 gal	0.67 pt	2 pt	4 pt	3.60	10.75	21.50
Harness Xtra 5.6L	3.1 + 2.5L	acetochlor&safener + atrazine	43.00 gal	1.4 qt	2.3 qt	3 qt	15.05	24.75	32.25
Hoelon	3EC	diclofop	60.00 gal	2 pt	2.5 pt	2.7 pt	15.00	18.50	20.25
Hornet	23.1 + 62.5DF	flumetsulam + clopyralid acid	3.80 oz	1.6 oz	2.4 oz	3.2 oz	6.10	9.10	12.15
Hyvar XL	2L	bromacil	65.00 gal	1.5 gal	3 gal	6 gal	97.50	195.00	390.00
Karmex	80DF	diuron	5.00 lb	1 lb	3 lb	6 lb	5.00	15.00	30.00
Karb	50WSP	pronamide	30.00 lb	2 lb	3 lb	4 lb	60.00	90.00	120.00
Krenite	4L	fosamine	56.00 gal	1.5 gal	3 gal	6 gal	84.00	168.00	336.00
Krovar I	40 + 40DF	bromacil + diuron	12.00 lb	4 lb	15 lb	30 lb	48.00	180.00	360.00
Landmaster BW	0.9 + 1.5SL	glyphosate - ipa + 2,4-D - ipa	20.00 gal	27 fl oz	40 fl oz	54 fl oz	4.30	6.40	8.65
Lariat	2.5 + 1.5L	alachlor + atrazine	18.00 gal	2.5 qt	3 qt	3.75 qt	11.25	13.50	16.90
Lasso EC/Microtech	4EC	alachlor	223.00 gal	2 qt	2.5 qt	3 qt	11.050	13.75	16.50
Lasso II 15G	15G	alachlor	0.90 lb	16 lb	20 lb	26 lb	14.40	18.00	23.40
LeadOff	2.67 + 2.33L	atrazine + dimethenamid	34.00 gal	2.5 pt	3.75 pt	5 pt	10.65	15.95	21.75
Liberty	1.67SL	glufosinate	0.78 fl oz	16 fl oz	20 fl oz	28 fl oz	12.50	15.60	21.85
Liberty ATZ	3.3 + 1L	atrazine + glufosinate	66.00 gal	20 fl oz	32 fl oz	40 fl oz	10.30	16.50	20.60
Lightning	52.5+17.5WDG	imazethapyr + imazapyr	10.50 oz	0.75 oz	1.00 oz	1.28 oz	7.90	10.50	13.45
Lorox	50DF	linuron	9.00 lb	1 lb	3 lb	6 lb	9.00	27.00	54.00
Marksman	2.1 + 1.1L	atrazine + dicamba - K salt	27.00 gal	2 pt	3 pt	3.5 pt	6.75	10.15	11.85
Matrix	25DF	rimsulfuron	15.00 oz	1 oz	-	1.5 oz	15.00	-	22.50
Maverick	75DF	sulfosulfuron	15.00 oz	0.33 oz	0.5 oz	0.67 oz	5.00	7.50	10.00
MEC Amine D	4SL	mecoprop	28.00 gal	0.5 pt	1 pt	2 pt	1.75	3.50	7.00
MCPA amine	4SL	MCPA	14.00 gal	0.4 pt	1 pt	2 pt	0.70	1.75	3.50
MCPA ester	4EC	MCPA	16.50 gal	0.5 pt	1 pt	2 pt	1.00	2.00	4.00
Moxy	2EC	bromoxynil	55.00 gal	1 pt	1.5 pt	2 pt	6.90	10.30	13.75
Moxy AT	1 + 2L	atrazine + bromoxynil	35.00 gal	1.5 pt	2 pt	3 pt	6.55	8.75	13.15
MXL	4EC	MCPA ester	22.50 gal	0.5 pt	1 pt	2 pt	1.40	2.80	5.60
MXL - B	Copack: 4EC / 4EC	MCPA ester + bromoxynil	41.75 gal	1 pt	1.25 pt	1.5 pt	5.15	6.50	7.75
Muster	75DF	ethametsulfuron	27.00 oz	0.25 oz	0.33 oz	0.42 oz	6.75	8.90	11.35
Northstar	39.9 + 7.5WDG	dicamba -Na + primisulfuron	2.20 oz	-	5 oz	-	-	11.00	-
Nortron SC	4EC	ethofumesate	183.00 gal	6 pt	7 pt	7.5 pt	137.30	160.15	171.60
OpTill	5 + 1EC	dimethenamid + dicamba acid	750.00 gal	24 fl oz	30 fl oz	36 fl oz	14.00	17.60	21.10
Oust	75DF	sulfometuron	14.00 oz	2 oz	6 oz	8 oz	28.00	84.00	112.00
Outlook	6EC	dimethenamid-P	- gal	8.3 fl oz	11 fl oz	21 fl oz	-	-	-
Paramount	75DF	quinclorac	45.00 lb	0.17 lb	0.25 lb	0.33 lb	7.65	11.25	14.85
Partner	65WDG	alachlor	3.70 lb	3 lb	4 lb	5 lb	11.10	14.80	18.50
Peak	57DF	prosulfuron	11.00 oz	0.25 oz	0.38 oz	0.5 oz	2.75	4.20	5.50
Pendimax	3.3EC	pendimethalin	22.00 gal	2.4 pt	3 pt	3.64 pt	6.60	8.25	11.00
Pentagon	60WDG	pendimethalin	5.00 lb	0.85 lb	2 lb	3.5 lb	4.25	10.00	17.50
Permit	75DF	halosulfuron	13.00 oz	0.67 oz	1 oz	1.33 oz	8.70	13.00	17.30
Phenoxy 088	2.8EC	2,4-D acid + ester	24.00 gal	0.67 pt	2 pt	3 pt	2.00	6.00	9.00
Pinnacle	25DF	thifensulfuron	37.00 oz	0.125oz	-	0.25 oz	4.65	-	9.25
Plateau	2SL	imazapic	2.25 fl oz	4 fl oz	8 fl oz	12 fl oz	9.00	18.00	27.00
Poast	1.5EC	sethoxydim	65.00 gal	0.5 pt	1 pt	1.5 pt	4.05	8.15	12.20
Pramitol EC	25EC	prometon + others	30.00 gal	5 gal	7.5 gal	10 gal	150.00	225.00	300.00
Pramitol 5S	5PS		2.50 lb	150 lb	200 lb	400 lb	337.50	450.00	900.00
Princep Caliber 90	90DF	simazine	3.75 lb	1.8 lb	3 lb	4.4 lb	6.75	11.25	16.50
Princep 4L	4L	simazine	20.00 gal	2 qt	3 qt	4 qt	10.00	15.00	20.00
Prism	0.94EC	clethodim	88.00 gal	8 fl oz	10 fl oz	13 fl oz	5.50	8.80	8.95
Progress	0.6 + 0.6 + 0.6 EC	desmed + phenmed + ethofum	120.00 gal	0.8 pt	2 pt	3.3 pt	12.00	30.00	49.50
Prowl	3.3EC	pendimethalin	16.00 gal	2.4 pt	3 pt	3.64 pt	4.80	6.00	7.25

Product	Formulation	Active Ingredients	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Puma	1EC	fenoxaprop-P	180.00 gal	0.33 pt	0.4 pt	0.67 pt	7.45	9.00	15.00
Pursuit WDG	70WDG	imazethapyr	10.00 oz	0.72 oz	1.07 oz	1.44 oz	7.20	10.70	14.40
Pursuit 2AS	2SL	imazethapyr	450.00 gal	2 fl oz	3 fl oz	4 fl oz	7.05	10.60	14.10
Pursuit Plus	2.7 + 0.2EC	pendimethalin + imazethapyr	42.00 gal	1.8 pt	-	2.5 pt	9.45	-	13.15
Pyramin	67.7DF	pyrazon	14.50 lb	4.58 lb	7.4 lb	11.25 lb	66.40	107.30	163.15
Python	80WDG	flumetsulam	9.00 oz	0.8 oz	1 oz	1.33 oz	7.20	9.00	12.00
Ramrod 4L	4L	propachlor	17.00 gal	3 qt	4 qt	5 qt	12.75	17.00	21.25
Ramrod 20G	20G		1.10 lb	15 lb	20 lb	25 lb	16.50	22.00	27.50
Raptor	1SL	imazamox	450.00 gal	3 fl oz	4 fl oz	5 fl oz	10.55	14.05	17.60
Rave	8.8 + 50WDG	triasulfuron + dicamba-Na	1.40 oz	2 oz	4 oz	5oz	2.80	5.60	7.00
ReadyMaster	2 + 1.5L	atrazine + glyphosate-ipa	30.00 gal	1.5 qt	1.75 qt	2 qt	11.25	13.15	15.00
Reflex	2EC	fomesafen	82.00 gal	1 pt	1.25 pt	1.5 pt	10.25	12.80	15.40
Reliance STS	25DF	thifensulfuron + chlorimuron	6.00 oz	0.5 oz	-	0.5 oz	3.00	-	3.00
Redeem	0.75 + 2.25EC	clopyralid-tea + triclopyr-tea	65.00 gal	1.5 pt	2.5 pt	4 pt	12.20	20.30	32.50
Reglone	2SL	paraquat	80.00 gal	1 pt	1.5 pt	2 pt	10.00	15.00	20.00
Rely	1SL	glufosinate	55.00 gal	3 pt	6 pt	8 pt	20.65	41.25	55.00
Remedy	4EC	triclopyr	91.00 gal	1 qt	1.5 qt	2 qt	22.75	34.15	45.50
Resource	0.86 EC	flumiclorac	160.00 gal	4 fl oz	6 fl oz	8 fl oz	5.00	7.50	10.00
Rezult Copack	5SL / 1EC	bentazon + sethoxydim	40.00 gal	1.6 + 1.6 pt			16.00		
Ro-Neet	6EC	cycloate	55.00 gal	4 pt	4.5 pt	5.33 pt	22.50	30.95	36.65
Ronstar	2G	oxadiazon	1.50 lb	100 lb	150 lb	200 lb	150.00	225.00	300.00
Ronstar	50WP	oxadiazon	25.00 lb	4 lb	5 lb	6 lb	100.00	125.00	150.00
Rodeo	4SL	glyphosate - ipa salt	80.00 gal	0.38 pt	2 pt	4 pt	3.80	20.00	40.00
Roundup Custom	4SL	glyphosate - ipa salt	45.00 gal	0.5 pt	2 pt	4 pt	2.80	11.25	22.50
Roundup Original	3SL	glyphosate - ipa salt	37.00 gal	0.5 pt	2 pt	4 pt	2.30	9.25	18.50
Roundup Original RT	3SL	glyphosate - ipa salt	34.00 gal	0.5 pt	2 pt	4 pt	2.15	8.50	17.00
Roundup Ultra	3SL	glyphosate - ipa salt	38.00 gal	0.5 pt	2 pt	4 pt	2.40	9.50	19.00
Roundup Ultra RT	3SL	glyphosate - ipa salt	35.00 gal	0.5 pt	2 pt	4 pt	2.20	8.75	17.50
RU Private Labels	3SL	glyphosate - ipa salt	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Roundup Ultra Dry	65SG	glyphosate - NH3	9.00 lb	0.29 lb	1.15 lb	2.3 lb	2.60	10.35	20.70
Roundup Ultra Max	3.7SL	glyphosate - ipa salt	47.50 gal	0.4 pt	1.62 pt	3.24 pt	2.40	9.65	19.25
Sahara	7.78 + 62.2WDG	imazapyr + diuron	19.00 lb	5 lb	10 lb	15 lb	95.00	190.00	285.00
Scepter	70DF	imazaquin	5.00 oz	1.4 oz	-	2.8 oz	7.00	-	14.00
Select	2EC	clethodim	175.00 gal	4 fl oz	6 fl oz	8 fl oz	5.45	8.20	10.95
Sencor	75DF	metribuzin	19.00 lb	1.6 oz	0.25 lb	0.67 lb	1.90	4.75	12.75
Shotgun	2.25 + 1L	atrazine + 2,4-D acid	27.00 gal	1.5 pt	2 pt	3 pt	5.05	6.75	10.15
Silhouette	3SL	glyphosate - ipa	30.00 gal	0.5 pt	2 pt	4 pt	1.90	7.50	15.00
Sinbar	80WP	terbacil	27.00 lb	0.5 lb	2 lb	4 lb	13.50	54.00	108.00
Sonalan HFP	3EC	ethalfluralin	26.00 gal	1.5 pt	3 pt	4.5 pt	4.90	9.75	14.65
Sonalan 10G	10G	ethalfluralin	0.94 lb	6 lb	11.5 lb	17 lb	5.65	10.95	16.00
Spartan	75DF	sulfentrazone	2.50 oz	2.67 oz	4.25 oz	5.33 oz	6.70	10.65	13.35
Spike	20WG	tebuthiuron	11.00 lb	2.5 lb	5 lb	30 lb	27.50	55.00	330.00
Spirit	14.2 + 42.8DF	prosulfuron + primisulfuron	10.50 oz	1 oz	-	1 oz	10.50	-	10.50
Stampede	80EDF	propanil	4.50 lb	1.25 lb	1.3 lb	1.4 lb	5.65	5.85	6.30
Starane	1.5EC	fluroxypyr	85.00 gal	0.5 pt	0.67 pt	1 pt	5.32	7.12	10.63
Starane + Esteron	3.75EC	fluroxypyr + 2,4-De	46.00 gal	1 pt	1.33 pt	1.67 pt	5.75	7.65	9.60
Starane + MCPE	3.55EC	fluroxypyr + MCPAe	46.00 gal	1.125 pt	1.5 pt	2 pt	6.45	8.65	11.50
Starane + Saber	2.5EC	fluroxypyr + 2,4-Da	33.00 gal	1.5 pt	2 pt	3 pt	6.20	8.25	12.40
Starane + Salvo	3.75EC	fluroxypyr + 2,4-D e	46.00 gal	1 pt	1.33 pt	1.67 pt	5.75	7.65	9.60
Starane + Sword	3.55EC	fluroxypyr + MCPA e	46.00 gal	1.125 pt	1.5 pt	2 pt	6.45	8.63	11.50
Steadfast	50 + 25DF	nicosulfuron + rimsulfuron	20.00 oz	0.25 oz	0.5 oz	0.75 oz	5.00	10.00	15.00
Stellar	0.7 + 2.4EC	flumiclorac + lactofen	190.00 gal	5 fl oz	7 fl oz	10 fl oz	7.40	10.35	14.80
Sterling	4SL	dicamba-dma salt	85.00 gal	2 fl oz	1 pt	4 pt	1.30	10.65	42.50
Sterling Plus	2.1 + 1.1L	atrazine + dicamba-K salt	27.00 gal	2 pt	3 pt	3.5 pt	6.75	10.15	11.80
Stinger	3SL	clopyralid - monoea salt	480.00 gal	0.25 pt	0.5 pt	0.67 pt	15.00	30.00	40.00
Storm	1.33 + 2.67SL	acifluorfen + bentazon	75.00 gal	1.5 pt	-	1.5 pt	14.05	-	14.05
Surpass EC	6.4EC	acetochlor + safener	65.00 gal	1 pt	2 pt	3 pt	8.15	16.25	24.40
Surpass 20G	20G	acetochlor + safener	2.02 lb	4 lb	8 lb	12 lb	8.10	16.15	24.25
Surflan	4EC	oryzalin	75.00 gal	2 qt	3 qt	4 qt	37.50	56.25	75.00
Sword	5.2EC	MCPA	28.00 gal	3 fl oz	1 pt	2 pt	0.65	3.50	7.05
Telar	75DF	chlorsulfuron	21.00 oz	1/2 oz	1 oz	3 oz	10.50	21.00	63.00

Product	Formulation	Active Ingredients	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Thistrol	2EC	MCPB	35.00 gal	2 pt	4 pt	6 pt	8.75	17.50	26.30
Tiller	0.37+0.58+1.75E	fenoxaprop-P + MCPA + 2,4-D	87.00 gal	1 pt	1.2 pt	1.7 pt	10.90	13.05	18.50
TopNotch	3.2MC	acetochlor (microencapsulated)	32.00 gal	2 qt	2.5 qt	3 qt	16.00	20.00	24.00
TopSite	0.5 + 2G	imazapyr + diuron	3.25 lb	200 lb	250 lb	300 lb	650.00	800.00	960.00
Tordon 22K	2SL	picloram	84.00 gal	1 fl oz	-	1.5 fl oz	0.65	-	1.00
Tordon 22K	2SL	picloram	84.00 gal	1 pt	2 pt	8 pt	10.65	21.25	85.05
Total	94G	bromacil + diuron + Na-chlorat + B	2.25 lb	0.5 to 1.37 lb/100 sq ft			1.25 to 3.10/100 sq ft		
Touchdown/Pro	3SL	glyphosate - diammonium	40.00 gal	0.5 pt	2 pt	4 pt	2.50	10.00	20.00
Touchdown	5SL	glyphosate - tms salt	50.00 gal	0.8 pt	1.6 pt	3.2 pt	5.00	9.40	20.00
Tough	5L	pyridate	67.00 gal	1 pt	1.5 pt	2 pt	8.40	12.60	16.75
Transline	3SL	clopyralid	325.00 gal	0.67 pt	1 pt	1.33 pt	27.20	40.65	54.05
Treflan HFP	4EC	trifluralin	25.00 gal	1 pt	2 pt	4 pt	3.15	6.25	12.50
Treflan TR-10	TR10G	trifluralin	0.85 lb	5 lb	10 lb	20 lb	4.25	8.50	17.00
Trifluralin/Trust	4EC	trifluralin	21.00 gal	1 pt	2 pt	4 pt	2.65	5.25	10.50
Trilin	10G	trifluralin	0.80 lb	5 lb	10 lb	20 lb	4.00	8.00	16.00
Trimec Classic	3.32EC	2,4-Da + MCPP + dicamba	25.00 gal	3.25 pt	3.8 pt	4.33 pt	10.15	11.90	13.55
Trimec Plus	2.88EC	MSMA + 2,4-Da + MCPPa	31.00 gal	2 qt	3 qt	4 qt	15.50	23.25	31.00
Trimec Super	4.5EC	2,4-De + 2,4DPe + dicamba	52.00 gal	2 pt	2.5 pt	3 pt	13.25	16.60	19.90
Turbo	6.55 + 1.45 L	metolachlor + metribuzin	64.00 gal	2 pt	3 pt	3.5 pt	16.00	24.00	28.00
Turflon Ester	4EC	triclopyr	100.00 gal	1 pt	1.5 pt	2 pt	25.00	37.50	50.00
Ultra Blazer	2SL	acifluorfen	65.00 gal	1 pt	1.5 pt	2 pt	8.15	12.20	16.25
UpBeet	50DF	triflusulfuron	45.00 oz	0.25 oz	0.3 oz	0.5 oz	11.25	13.50	22.50
Valor	50WDG	flumioxazin	- oz	2 oz	2.5 oz	3 oz	-	-	-
Velpar	75DF	hexazinone	22.50 lb	0.67 lb	1.33 lb	2 lb	15.10	29.95	45.00
Weed Blast	4 + 4G	bromacil + diuron	3.25 lb	40 lb	50 lb	60 lb	130.00	162.50	195.00
Weedone 638	2.8EC	2,4-D acid + ester	24.00 gal	0.67 pt	2 pt	3 pt	2.00	6.00	9.00
Weed Master	2.87 + 1SL	2,4-D + dicamba	25.00 gal	0.5 pt	2 pt	4 pt	1.60	6.25	12.50
2,4-D Products		2,4-D							
2,4-D amine	3.8SL		11.00 gal	0.5 pt	2 pt	4 pt	0.70	2.75	5.50
2,4-D ester	3.8EC		12.50 gal	0.4 pt	2 pt	4 pt	0.65	3.15	6.25
LV ester	5.7EC		17.00 gal	0.33 pt	2 pt	4 pt	0.70	4.25	8.50
AGSCO 400	4EC		19.00 gal	0.5 pt	2 pt	4 pt	1.20	4.75	9.50
Formula 40	4SL		15.00 gal	0.5 pt	2 pt	4 pt	0.95	3.75	7.50
Hi-Dep	4SL		19.00 gal	0.25 pt	2 pt	4 pt	0.60	4.75	9.50
Saber	4EC		16.00 gal	0.2 pt	1 pt	2.25 pt	1.60	8.00	18.00
Salvan	5EC		26.00 gal	0.5 pt	2 pt	4 pt	1.65	6.50	13.00
Salvo	5EC		26.00 gal	0.5 pt	2 pt	4 pt	1.65	6.50	13.00
Savage	79DS		3.95 lb	0.5 lb	0.75 lb	1.5 lb	2.00	3.00	6.00

Herbicide Spray Additives

Surfactants

Activate Plus	Agrilience	\$17.00 gal	2 to 4 pt/100 gal
Activator 90	Loveland	\$18.50 gal	2 to 4 pt/100 gal
Activate-It	AGSCO	\$17.00 gal	2 to 4 pt/100 gal
Preference	Agrilience	\$15.70 gal	2 to 4 pt/100 gal
Crnblt Premier 90	West Central	\$16.50 gal	2 to 4 pt/100 gal
Induce	Helena	\$20.00 gal	2 to 4 pt/100 gal
LI-700	Loveland	\$25.00 gal	2 to 4 pt/100 gal
Purity 100	Rosens	\$17.00 gal	2 to 4 pt/100 gal
R-11	Wilbur-Ellis	\$21.00 gal	2 to 4 pt/100 gal
Tradition 93	Rosens	\$19.00 gal	2 to 4 pt/100 gal
Unifilm 707	Custom Chem	\$16.00 gal	2 to 4 pt/100 gal
X-77 Spreader	Loveland	\$18.00 gal	2 to 4 pt/100 gal

Surfactants with Silicone

Galactic	Custom Chem	\$95.00 gal	0.75 to 4 pt/100 gal
Kinetic	Helena	\$93.00 gal	0.75 to 4 pt/100 gal
Silkin	Agrilience	\$80.00 gal	0.75 to 4 pt/100 gal
Silwet L-77	Loveland	\$40.00 qt	0.38 to 1 pt/100 gal
Sylgard 309	Wilbur-Ellis	\$80.00 gal	0.75 to 4 pt/100 gal

Surfactants + Fertilizer

Cayuse Plus	Wilbur-Ellis	\$11.00 gal	1 to 2 qt/A
ClassAct New Gen	Agrilience	\$7.00 gal	2.5% v/v
Cornbelt Combo	West Central	\$5.00 gal	2.25 to 2.5 pt/A
Cornbelt Combo II	West Central	\$4.50 gal	4 to 6 pt/A
Dispatch 2N	Loveland	\$5.00 gal	2.5 qt/A
Impressive DB	Rosens	\$0.70 lb	2.5 to 3 lb/A
Patrol	Helena	\$6.00 gal	2.25 to 2.5 pt/A
Recon	Rosens	\$5.50 gal	2.25 to 2.5 pt/A
Surfate	AGSCO	\$14.50 gal	1% v/v

Water Conditioning Agents

AMS Plus	Agrilience	\$14.00 gal	4 to 6 pt/A
Choice	Loveland	\$17.00 gal	2 to 6 pt/A
Infactant	Custom Chem	\$13.00 gal	2 to 6 pt/A
Quest	Helena	\$20.00 gal	2 to 6 pt/A

Basic Blend

Dispatch 111	Loveland	\$15.25 gal	1% v/v
Linkage	West Central	\$14.25 gal	1% v/v
Newtone	Agrilience	\$15.25 gal	1% v/v
Quad 7	AGSCO	\$15.25 gal	1% v/v
Transactive	Helena	\$15.25 gal	1% v/v

Petroleum Oil Concentrates

Agri-Dex	Helena	\$7.00 gal	2 to 4 pt/A
DSV (Score)	Syngenta	-	Copak w/ Discover
Herbimax	Loveland	\$7.00 gal	2 to 4 pt/A
Hi-Per-Oil	Agrilience	\$9.75 gal	1 to 2 pt/A
Premium COC	West Central	\$5.00 gal	2 to 4 pt/A
Ortech	Rosens	\$7.00 gal	2 to 4 pt/A
Paraspread	Custom Chem	\$6.50 gal	2 to 4 pt/A
Prime Oil	Agrilience	\$6.25 gal	2 to 4 pt/A
ROC Crop Oil	Wilbur-Ellis	\$7.00 gal	2 to 4 pt/A
R-Way	Rosens	\$6.00 gal	2 to 4 pt/A

Vegetable Oil Concentrates

Amigo	Loveland	\$7.50 gal	2 to 4 pt/A
Prime Oil EV	Agrilience	\$6.50 gal	2 to 4 pt/A

Methylated Seed Oils (MSO)

Destiny Next Gen.	Agrilience	\$13.00 gal	1.5 to 2 pt/A
MSO	Helena	\$16.00 gal	1.5 to 2 pt/A
MSO	Loveland	\$15.00 gal	1.5 to 2 pt/A
Perform	United Supp.	\$16.00 gal	1.5 to 2 pt/A
Scoil	AGSCO	\$15.00 gal	1.5 to 2 pt/A
Soy-Stik	West Central	\$16.00 gal	1.5 to 2 pt/A
Sundance II	Rosens	\$15.00 gal	1.5 to 2 pt/A
Unifilm MSO	Custom Chem	\$16.00 gal	1.5 to 2 pt/A

MSO + Basic Blend

FirstMate	Agrilience	\$15.00 gal	1 to 2.5 gal/100 gal
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MSO based Basic Blend

Base	West Central	\$15.25 gal	1 to 2% v/v
Renegade	Wilbur-Ellis	\$15.25 gal	1 to 2% v/v

MSO + Water Conditioning Agent

SuperCharge	Syngenta	w/Achieve	0.5% v/v
Vortex	Loveland	\$43.00 gal	1.5 to 2 pt/A

MSO + Organosilicone Surfactant

Dyne-Amic	Helena	\$43.00 gal	4 pt/100 gal
Pearless	Custom Chem	\$40.00 gal	3 to 5 pt/100 gal
Phase	Loveland	\$40.00 gal	2 pt/100 gal
Rivet	Agrilience	\$42.00 gal	4 pt/100 gal

Fertilizer

AMS (Dry)	Various	\$0.32 lb	2 to 4 lb/A
AMS (liquid)	Various	\$3.00 gal	2 to 4 qt/A
28% UAN	Various	\$4.00 gal	2 to 4 qt/A
28% UAN (bulk)	Various	\$3.50 gal	2 to 4 qt/A

AMS Fertilizer + Drift Retardant

Array	Rosens	\$1.60 lb	9 to 14 lb/100 gal
Corral AMS Liquid	Agrilience	\$5.40 gal	2.5 to 5 gal/100 gal
Corral AMS Dry	Agrilience	\$0.85 lb	10 to 17 lb/100 gal
Dryve	Loveland	\$1.50 lb	7 to 17 lb/100 gal
Placement ProPak	Agrilience	\$15.75 gal	1 to 2 gal/100 gal
Surf Plus	AGSCO	\$3.50 gal	2.5 to 5 gal/100 gal

AMS Fertilizer + Defoamer

Herb-Stik	West Central	\$4.00 gal	2 to 4 qt/A
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AMS Fertilizer + Deposition + Defoamer

Dri-Gard	West Central	\$1.30 lb	9 lb/100 gal
Guardian Plus	West Central	\$5.50 gal	2.5 gal/100 gal

Drift Retardants

Chem-trol	Loveland	\$16.25 gal	2 qt /100 gal
Drift Retardant	AGSCO	\$13.25 qt	2 to 4 fl oz/100 gal
Placement	Agrilience	\$26.00 gal	4 fl oz/pt of L herbicid 2 fl oz/lb DF herbicide 2 oz/qt F herbicide
Sta-Put	Wilbur-Ellis	\$12.00 gal	1 qt/100 gal
Target LC	Loveland	\$14.95 pt	2 to 4 fl oz/100 gal
Windbreak	Agrilience	\$13.00 gal	4 to 12 fl oz/100 gal

Drift Retardant+Defoamer

Guardian	West Central	\$20.00	1 to 3 qt/100 gal
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Drift Retardant+Defoamer+Water Conditioning Agent

Ultra-Gard	Loveland	\$44.00 gal	1 qt/100 gal
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Compatibility Agents

Combine	Agrilience	\$27.00 gal	1 to 3 pt/100 gal
EZ-Mix	Loveland	\$28.00 gal	1 to 2 pt/100 gal
Unite	Loveland	\$37.00 gal	1 to 3 pt/100 gal

Spray Tank Cleaners

Tank Cleaner	Various	\$22.00 gal	1 to 2 qt/100 gal
Tank Cleaner	Various	\$6.00 lb	1 to 2 lb/100 gal

New Weed Control Guide Information for 2001:

2001 Edition of Weed Control Guide on web at: www.ext.nodak.edu/extpubs/plantsci/weeds/w253/w253w.htm

Glyphosate:

Generic name used in place of the many product names

Formulations and brand names - see Paragraph A4:

Touchdown 3 (glyphosate - diammonium salt) registered

Cereal Herbicides:

- Achieve =** Use on wheat restricted in SD, MN, and east of ND Hwy 281. Also, cannot use in ND counties of Dickey, LaMoure, Stutsman, Foster, Eddy, Ramsey, and Towner.
- Aim =** Registration approved on barley and oat.
- Bronate Pro =** Pre-pack of Puma and Bronate.
- Curtail M =** Registration approved on oat.
- Discover =** Wild oat, green and yellow foxtail control.
- Everest =** Wild oat, green foxtail, and suppression of yellow foxtail.
- Puma =** Application window for wheat: 1-leaf to 60 days prior to harvest.
- Starane + Saber =** Starane + 2,4-D amine.
- Tordon =** Use restricted in small grains.

Corn Herbicides:

- Balance Pro =** 4SC formulation of Balance.
- Callisto =** POST broadleaf weed control - Pigment inhibitor mode of action.
- Distinct =** Guidelines to reduce risk of corn injury - See paragraph C19 in corn section.
- Glyphosate =** Some early maturing Roundup Ready Corn varieties available for ND.
- Steadfast =** Accent + Matrix mix.

Soybean Herbicides:

- Extreme =** Pre-mix of glyphosate and Pursuit - 2.25 pt/A = 16 fl oz gly + 3 fl oz Pursuit.
- Gauntlet =** Pre-pack of Authority and FirstRate.
- Harmony GT 75DF =** Replace Pinnacle 25DF.
- Ultra Blazer =** New name for Blazer.
- Valor =** PPI/PRE small seeded broadleaf weed control.

Oil seed Herbicides:

- Sonalan and Stinger:** Section 24(c) registration in crambe.

Sugarbeet Herbicides:

- Far-Go:** Wild oat control - apply PPI.
- Herbicide 273:** Discontinued.

Others:

- Connect =** 20WSP formulation of bromoxynil.
- Dicamba =** Generic name for Banvel/Clarity/others.
- Gramoxone Max =** 3 lb ai/gal paraquat (Registration Pending).
- Harmony GT =** Weed ratings separated for cereals and soybean.
- Reglone =** New name for diquat.

Noxious Weed Control

- Redeem =** Pre-mix of Stinger and Garlon - registered in pasture, rangeland, and CRP. See: Absinth wormwood, Fringed sage, Canada thistle, and Knapweeds.
- CRP =** See T16 for NRCS Policy on Noxious Weed Control in grass + alfalfa CRP stands.
- Yellow Starthistle =** Added to the knapweed section.

Mode of Action Chart =

Expanded to include more modes of action - See X1.

Spray Adjuvants =

Section revised - also include rates - See last page.

Possible 2001 Section 18 registrations

Buckwheat - Poast
Canola - Muster, Sonalan, Stinger
Clearfield canola - Raptor
Dry beans - Raptor, Reflex
Flax - Curtail, Roundup (preharvest)
Field pea - Gramoxone Extra
Safflower - Poast, Sonalan
Sunflower - Spartan
Range, pasture, CRP - Plateau

IR-4 Projects for 2000

Sugarbeet - Methoxyfenozide
Potato - Valor, Spartan
Dry bean - Cyprodinil + Fludioxonil, Valor



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