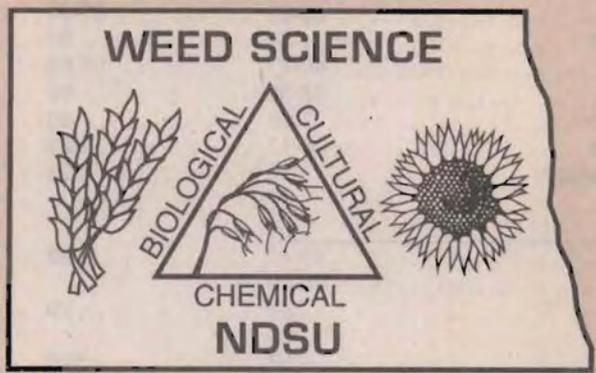


**2003**



# **NORTH DAKOTA WEED CONTROL GUIDE**

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[www.ag.ndsu.nodak.edu/weeds/](http://www.ag.ndsu.nodak.edu/weeds/)

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**NDSU EXTENSION SERVICE**

North Dakota State University, Fargo, ND 58105

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## Table of Contents

<b>Crops</b>	<b>Table</b>		<b>Narrative</b>	
	<b>(Pages)</b>	<b>(Pages)</b>	<b>(Paragraph)</b>	
Alfalfa, Legume forages	44-45	97	P1-5	
Barley	6-11	78-81	B1-23	
Canola, Rapeseed	38	94	L1-3	
Canola, Herbicide Resistant	39	94	L4-6	
Crambe	38	94	L1-3	
Chick Pea/Garbanzo bean	32-33	93	G1-3	
Corn	16-21	83-86	C1-25	
Corn, Herbicide Resistant	22	86	C26-28	
Dry bean	28-29	92	E1-8	
Flax	37	94	K1-6	
Lentil	32-33	93	H1-3	
Millet	14			
Mustard, tame	38			
Oat	13			
Pea, Field	30-31	92-93	F1-5	
Potato/Vine kill	42-43	97	N1-3	
Rye	14			
Safflower	36			
Soybean	23-26	87-91	D1-22	
Soybean, Herbicide Resistant	27	91	D23	
Sugarbeet	40-41	95-96	M1-17	
Sunflower	34-35	93	J1-4	
Sunflower, Herbicide Resistant	35	93	J5	
Wheat, Spring, Durum, Winter	6-12	78-81	B1-23	
Wheat, Barley PRE/POST-Harvest	15	823	B24-29	
<b>Noncrop/Other</b>				
Chemical fallow	46-47	98	Q1-8	
CRP	48-49			
CRP breakout	50	99	R1	
Grass establishment	50			
Noncropland	64	105	V1	
Pasture/Rangeland	48-49			
Shelterbelt	63	105	U1	
Total Vegetation Control	65	105	V2	
<b>Special Weed Problems</b>				
Absinth wormwood	52			
Annual weed control		99-102	S1-13	
Bindweed, Field	54-55	102	T1	
Canada thistle	56-57	102	T2	
Cattail	59			
Flax, volunteer		99	S3	
Foxtails (pigeongrass)		99	S4	
Fringed sage	52			
Knapweed, Diffuse, Spotted, Russian	60			
Kochia		99-100	S5	
Leafy spurge	58-59	104-105	T16	
Mallow, Common		100	S6	
Milkweed, Common	53	102	T3	
Nightshades		100	S7	
Noxious weeds	51			
Perennial weed control	51-62	102-105	T1-17	
Pigweed species		101	S8	
Purple loosestrife	62	105	T17	
Quackgrass	61			
Wild buckwheat		99	S1	
Wild oat		101	S11	
Wormwood, Biennial		101	S12	
Yellow starthistle	60			
Other Weeds = alfalfa, buffalobur, cleavers, curly dock, hemp, hemp dogbane, horsetail, horseweed (maretail), nightflowering catchfly, perennial smartweed, poison ivy, common purslane, waterpod, wild cucumber, wild rose, and yellow nutsedge		101-102	S13	

## Table of Contents (cont.)

<u>General</u>	<u>Table</u> (Pages)	<u>Narrative</u> (Pages)(Pargrph)	<u>General</u>	<u>Table</u> (Pages)	<u>Narrative</u> (Pages)(Pargrph)
Abbreviations Used		4	Incorporation of Herbicides	66	A1
Adjuvants	131	69-71 A5	Laboratories test for residue	112	Y23
AMS Adjuvants	131	69-71 A5	Laboratories test water quality	72	A6
Annual Weed Control		99-102 S1-13	Mode of Action, Herbicides	108-109	
Backpack Sprayer Calibration		77 A17	MSO Adjuvants	131	69-71 A5
Basic pH Blend Adjuvants	131	69-71 A5	Names, Herbicide	126-130	
Bioassay Instructions		118 Y7	Nozzles, Drift Reducing	73-74	A9
Biological Weed Control		104-105 T16-17	Noxious Weeds of ND	51	
Breakdown Imi/TPS Herbicides		110 Y2	Oil Adjuvants	131	69-71 A5
Breakdown SU Herbicides		110 Y3	Organic Matter Test	66	A2
Breakdown Triazine Herbicides		110 Y4	Perennial Weed Control	51-62	102-105 T1-17
Calibrating sprayers		77 A17-18	POST-Applied Herbicides	67-69	A4
Carryover and Residues	114-116	110-112 Y1-24	POST Grass Herbicide Table	91	D24
Combinations, Herb/Pesticide		76 A12-15	Premixes, Herbicide - Corn	83	C2
Corn Herbicide Premixes		83 C2	- Soybean	87	D2
Crop Rotation Restrictions	114-116	110-112 Y1-24	Prices, Herbicide	126-130	
Crop Injury Investigation		74-75 A10	Rain-Free Interval	69	A4
Degradation Imi/TPS Herbicides	110	Y2	Ratings, Weed Control	120-125	
Degradation SU Herbicides	110	Y3	Soil Applied	120-121	
Degradation Triazine Herbicides	110	Y4	POST Applied	122-125	
Drift, Spray and Vapor	74	A9	Reduced Herbicide Rates	72	A7
Drift Reducing Nozzles	74-75	A9	Resistant Weeds	108-109	106-107 X1
Emergency Information	126-130		Residues, Herbicide	114-116	110-112 Y1-24
Environ., Effect on Herbicides	67-68	A4	Residue Laboratories	112	Y23
Fall Herbicide Application	67	A3	Restricted Use Herbicides	5	
Feeding Restrictions	117-119		Rotation Restrictions	114-116	110-112 Y1-24
Field Bioassay Instructions		118 Y7	Soybean Herbicide Premixes	87	D2
Formulation, Herbicide	126-130		Spray Drift	74	A9
Glyphosate	68-69	A4	Sprayer Calibration	77	A17-18
Grasses, POST Herbicide Chart	91	D24	Sprayer Cleanout	72-73	A8
Grazing Restrictions	117-119		Sprayer Water Quality	71-72	A6
Groundwater Contamination	75-76	A11	Storage Temperatures	77	A16
Hand-held Sprayer Calibration	77	A18	Surfactants	131	69-71 A5
Hard Water Antagonism	71-72	A6	Surfactants allowed in water	67-68	A4
Haying Restrictions	117-119		Water Quality	71-72	A6
Herbicide Breakdown, Factors	110-111	Y1-6	Weed Control, Ann. Weeds	99-102	S1-13
Herbicide Carryover	114-116	110-112 Y1-24	Weed Control, Per. Weeds	51-62	102-105 T1-17
Herbicide Formulations	126-130		Weed Control Ratings	120-125	
Herbicide Incorporation	66	A1	Soil Applied	120-121	
Herbicide Mode of Action	108-109		POST Applied	122-125	
Herbicide Names	126-130		Weed Resistance	108-109	106-107 X1
Herb+Pesticide Combinations	76	A12-15	Weed Guide - How To Use	4	
Herbicide, POST Grass Chart	91	D24	Weed Guide - Gen. Information	5,66	
Herbicide Premixes - Corn	83	C2	2003 Updates	132	
- Soybean	87	D2			
Herbicide Prices	126-130				
Herbicide Storage Temps	77	A16			
Herbicide Rain-Free Interval	69	A4			
Herbicide Resistant Weeds	108-109	106-107 X1			

# 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 Atrazine 90DF 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

### Types of Formulation

DF	= Dry flowable
DS	= Dispersible solution

EC	= Emulsifiable concentrate
EDF	= Extruded dry flowable
EW	= Emulsion in water
F	= Flowable
G	= Granular
HFP	= High Flash Point
ME	= Micro-encapsulated
MFC	= Micro-emulsion forming conc.
MTF	= Multi-temperature formulation
S	= Solution
SE	= Suspension emulsion
SG	= Soluble granule
SP	= Soluble powder
WP	= Wettable powder
WDG	= Water dispersible granule
XP	= Extruded paste (granules)

### Miscellaneous

AMS	= Ammonium sulfate
CEC	= Cation exchange capacity
DAA	= Days after application
MSO	= Methylated seed oil
NIS	= Nonionic surfactant
NDDA	= ND Dept of Ag
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 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 or found on the web at: <http://www.cdms.net/manuf/manuf.asp>.

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 and approved the product use and the labeling. Canadian and other foreign labeled pesticides may not be used in the United States until registered by the EPA.

#### TYPES OF PESTICIDE REGISTRATIONS

**Federal EPA Registrations**, also known as 3e and 2ee labels, are the most common and widely used type of pesticide registration.

**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:

All products and premixes containing the active ingredients listed below are restricted use pesticides.

**Acetochlor** = See Mode of Action #15 at X1-Herbicide Classification

**Alachlor** = See Mode of Action #15 at X1-Herbicide Classification

**Atrazine** = See Mode of Action #5 at X1-Herbicide Classification

**Isoxaflutole** = See Mode of Action #28 at X1-Herbicide Classification

**Paraquat** = See Mode of Action #22 at X1-Herbicide Classification

**Picloram** = See Mode of Action #4 at X1-Herbicide Classification

#### Brand names of other RUP:

Amitrole-T, Cytrole  
Kerb 50W (pronamide)  
Sulfuric acid

#### SAFETY AND EMERGENCY PHONE NUMBERS:

ND Poison Control Line:	800 222-1222
ND Emergency Assistance Line:	800 472-2121
Report pesticide incident to NDDA:	701 328-2232

# CHEMICAL WEED CONTROL FOR FIELD CROPS

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (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. (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: glyphosate + 2,4-D = Landmaster BW glyphosate + 2,4-D = RT Master, GlyMix MT glyphosate + dicamba = Fallow Master A4-6 B1-2 Q1 Q3
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 herbicides. Apply with NIS at 0.25% v/v. Good plant coverage is essential. Q5
Aim (carfentrazone)	1/3 oz DF 1/2 fl oz EW (0.128 oz)	Small broadleaf weeds.		May be tank-mixed with glyphosate. Improves broadleaf weed control. B4 S1 S3 S7-8 X1
Harmony GT/XP (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat.		May be tank-mixed with glyphosate. Improves broadleaf weed control including wild buckwheat. Add NIS at 0.25 to 0.5% v/v. B14 S1 S5 X1
Harmony Extra/XP (thifensulfuron + tribenuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)			
Far-Go (triallate)	<b>WINTER WHEAT</b> 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 A3 B15 S11
Far-Go EC 	<b>HRSW &amp; DURUM:</b> 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. A1 A3 B15 B23 S11
	<b>BARLEY:</b> 1.25 qt 12.5 to 15 lb 10G (1.25 as liquid or 1.25 to 1.5 as granular)			
	<b>HRSW &amp; DURUM:</b> 1 qt 10 lb 10G (1) <b>BARLEY:</b> 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 B15 S11

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs	
<b>Buckle</b> (trilalate + trifluralin)  	<b>DURUM &amp; BARLEY:</b> <b>10 to 12.5 lb G</b> (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.	<b>Do not apply to HRSW.</b> 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 B15 B23 S4 S11 Y20 Y24 X1	
	<b>Spring: For HRSW and Durum</b> <b>10 lb G</b> (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. B15 B23 S11	
<b>Far-Go (trilalate) + trifluralin</b> <b>NOT FOR WINTER WHEAT</b>	<b>1 qt + 1 pt 4E</b> (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 B15 S11 X1 Y20 Y24	
Trifluralin  <b>NOT FOR WINTER WHEAT</b>	<b>1 pt 4E</b> <b>5 lb 10G</b> <b>0.83 lb 60DF (0.5)</b>	Foxtail.	Spring: PPI.	<b>FOR BARLEY ONLY.</b> Incorporate twice 2 to 3 inches deep.	
	<b>4 lb 10G</b> (0.4)			<b>FOR DURUM WHEAT ONLY.</b> For foxtail suppression only. A1 B23 S4 Y20 Y24	
	<b>3.5 to 4 lb 10G</b> (0.35 to 0.4)			<b>FOR HRSW ONLY.</b> For suppression of foxtail only. Use west of Hwy 3 only. S4	
	<b>1 pt 4E</b> (0.5)			Spring: After seeding.	Plant 2 to 2.5 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow 1 to 1.5 inches deep. B23 S4 Y1 Y20 Y24
	<b>1 pt 4E</b> <b>5 lb 10G</b> <b>0.83 lb 60DF</b> (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 B23 S4 X1 Y1 Y20 Y24
	<b>3.5 to 5 lb 10G</b> (0.35 to 0.5)			<b>FOR HRSW AND DURUM ONLY.</b> For foxtail suppression only. S4	
MCPA amine or MCPA ester	<b>0.5 to 1.33 pt of 4 lb/gal conc.</b> (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. Several commercial mixtures available: Bronate Advanced, Bromac, Bison B1 B2 S5 S8 S9 S10	
2,4-D amine or 2,4-D ester	<b>0.5 to 1 pt of 4 lb/gal conc.</b> (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 S5 S7-10	
Dicamba + MCPA	<b>0.125 to 0.25 pt + 0.5 to 0.75 pt of 4 lb/gal conc.</b> (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. B2 B11 S1 S5 S7-10 X1 Y13 Y24	
Dicamba + 2,4-D	<b>0.125 pt + 0.5 pt</b> (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. B2 B11 S1 S5 S8-10 X1 Y13 Y24	

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Curtail M</b> (clopyralid + MCPAe)	<b>1.75 to 2.33 pt</b> (0.09 to 0.12 + 0.5 to 0.68)	Broadleaf weeds and Canada thistle.	Crop: 3-leaf until prior to boot.	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. B10 T2 T6 Y21 Y24
<b>Curtail</b> (clopyralid + 2,4-D)	<b>2 to 2.33 pt</b> (0.09 to 0.11 + 0.5 to 0.58)		Crop: 4-leaf until prior to boot.	
<b>Starane</b> (fluroxypyr)	<b>0.5 to 0.67 pt</b> (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 label 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 B22 S5-6
Bromoxynil	<b>1 to 2 pt</b> (0.25 to 0.5)	Broadleaf weeds including buckwheat, sunflower, Russian thistle and ALS resistant kochia.	Crop: Emergence until prior to boot.	Contact herbicide. Apply to small weeds. Controls ALS resistant kochia. See label for tank-mix options. Commercial mixtures with MCPA available: Bison, Bromac, Bronate Advanced B1 B2 B9 S1 S5 S7 S9-10 X1
<b>Aim</b> (carfentrazone)	<b>1/3 oz DF</b> <b>1/2 fl oz EW</b> (0.128 oz)	Broadleaf weeds including pigweed and kochia.	Crop: Up to jointing stage. Weeds: Small. Up to 2 inches tall.	Contact, non-residual herbicide. May cause cosmetic speckling/spotting on wheat leaves. Apply with NIS at 0.25% v/v. Refer to label or narrative for tank-mix options, and application information. B4 S1 S5 S8 X1

### Short Residual Sulfonylurea (SU) Herbicides

<b>Express/XP</b> (tribenuron)	<b>1/6 to 1/3 oz DF</b> (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 e or 2,4-D e enhances broadleaf weed control and crop safety. Apply with a NIS at 0.125% v/v except when adding 2,4-D or MCPA at 0.75 pt/A. See narrative for list of registered tank-mixes. Apply with another broadleaf herbicide to reduce weed resistance. No crop rotation restrictions the following year. B14 S1-2 S5 X1
<b>Harmony GT/XP</b> (thifensulfuron)	<b>3/10 to 6/10 oz DF</b> (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat and common mallow.		
<b>Harmony Extra/XP</b> (thifensulfuron + tribenuron)	<b>3/10 to 6/10 oz DF</b> (0.225 to 0.45 oz)	Harmony Extra controls cocklebur, and lanceleaf sage.		

### Long Residual SU Herbicides

<b>Ally/XP</b> (metsulfuron)	<b>1/10 oz DF</b> (0.06 oz)	Broadleaf weeds including perennial sowthistle. Partial control of wild buckwheat.	Crop: 2-leaf until prior to boot.	Apply with another broadleaf herbicide to reduce weed resistance. Addition of 2,4-De or MCPAe improves broadleaf weed control and crop safety. Apply with a NIS at 0.125% except when adding 2,4-D or MCPA at 0.75 pt/A. See label for crop rotation restrictions.
<b>Ally Extra</b> (metsulfuron + thifensulfuron + tribenuron)	<b>2/10 to 4/10 oz DF</b> (0.03 to 0.06 oz metsulfuron + 0.113 to 0.225 oz thifensulfuron + tribenuron)	Broadleaf weeds including perennial sowthistle. Improved control of wild buckwheat.	Crop: 2-leaf stage until prior to flag leaf emergence.	Ally extra at 2/10 oz/A contains 1/20 oz Ally + 1/6 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 S1-2 X1 Y3 Y6 Y24
<b>Peak</b> (prosulfuron)	<b>0.38 to 0.5 oz DF</b> (0.22 to 0.29 oz)	Broadleaf weeds.	Crop: 3-leaf until 2nd node is detectable.	See label for application information, herbicide and crop rotation restrictions. B19 S2 X1 Y6 Y18 Y24

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Very Long Residual SU Herbicides</b>				
<b>Amber</b> (triasulfuron)	<b>0.28 to 0.56 oz DF</b> (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 Y6 Y24
<b>Rave</b> (triasulfuron + dicamba)	<b>HRSW = 4 oz DF</b> (0.352 to 2 oz) <b>Barley = 2 oz DF</b> (0.176 to 1 oz)		HRSW : Up to 5-leaf stage. Barley: Up to 4-leaf stage.	
<b>Glean</b> (chlorsulfuron )	<b>1/6 to 1/3 oz DF</b> (0.125 to 0.25 oz)	Broadleaf weeds and suppression of foxtail and Canada thistle.	Crop: 2-leaf until prior to flag leaf emergence.	Apply with a NIS at 0.125% except when adding 2,4-De or MCPAe at 0.75 pt/A. See label for application timings, tank-mix options, weeds controlled, soil pH restrictions, resistance weeds, and crop rotation restrictions. B16 X1 Y3 Y6 Y24
<b>Finesse</b> (chlorsulfuron + metsulfuron)	<b>2/10 to 4/10 oz DF</b> (0.15 to 0.3 oz)			
<b>Maverick</b> (sulfosulfuron)	<b>2/3 oz DF</b> (0.5 oz)	Downy brome, quackgrass, mustard species and volunteer sunflower.	Crop: Emergence to prior to jointing.	Add NIS at 0.5%v/v. 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. B17 X1 Y4 Y6 Y24
<b>HRSW and Winter Wheat Only</b>			Brome: 2 to 3 tillers.	
<b>Not For Barley</b>			Wild oat: 1- to 4-leaf stage.	
<b>Herbicides that can be tankmixed with SU herbicides.</b>				
MCPA or 2,4-D	<b>0.5 to 0.75 pt of 4 lb/gal conc.</b> (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.
MCPA or 2,4-D + Dicamba	<b>0.5 pt + 3 to 4 fl oz</b> (0.25 + 0.09 to 0.125 )	Broadleaf weeds including ALS resistant weeds and season long control of Canada thistle.	Crop: Tillering through 5-leaf stage.	<b>Do not use 2,4-D + dicamba on barley.</b> Apply when ALS resistance is suspected. Express/XP rate can be reduced to 1/12 oz DF/A. Tank-mixes with AllyXP gives season long control of field bindweed. B2 B5-6 B14 B16-17 S5 X1 Y24
<b>Starane</b> (fluroxypyr)	<b>0.5 to 0.67 pt</b> (1.5 to 2 oz)	Kochia including ALS resistant and volunteer flax. Partial control of common mallow	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. Allow a 40 day PHI. Refer to label for 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 A7 B22 S3-6 X1
Bromoxynil	<b>0.75 to 1.5 pt</b> (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. Apply with NIS at 0.25% v/v. Express rate can be reduced to 1/12 oz DF/A. Commercial mixtures with MCPA available: Bison, Bromac, Bronate Advanced B9 S1 S5 S7-10 X1
<b>Aim</b> (carfentrazone)	<b>1/3 oz DF</b> <b>1/2 fl oz EW</b> (0.128 oz)	Broadleaf weeds including pigweed and kochia.	Crop: Up to jointing stage. Weeds: Small. Up to 2 inches tall.	Contact, non-residual herbicide. May cause cosmetic speckling/spotting on wheat leaves. Apply with NIS at 0.25% v/v. Refer to label or narrative for tank-mix options, and application information. B4 S1 S5 S8 X1

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>POST Grass Herbicides</b>				
<b>Assert</b> (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, MCPA amine, or 2,4-D amine. Use MSO type adjuvants or use NIS + petroleum oil adjuvant. See label for additional adjuvant information. B7 S11 Y2 Y6 Y24
<b>Avenge</b> (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.	Labeled on all barley varieties. Use high rate on 3-leaf wild oat. Injury may occur when crop is under stress. Refer to narrative for herbicide tank-mix options and registered wheat varieties. B8 S11
<b>Avenge</b> (difenzoquat) + <b>Assert</b> (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. B7 B8 S11 Y2 Y6 Y24
<b>Achieve</b> <b>Achieve Liquid</b> (tralkoxydim)	7 oz WDG 6.9 fl oz (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. 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 S4 S11 X1
<b>Discover</b> (clodinafop + cloquintocet-mexyl safener) <b>HRS, Durum and Winter Wheat Only</b>	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 <sup>th</sup> tiller. Wild oat: 1- to 6-leaf. Foxtails: 1- to 5-leaf.	Packaged 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. B12 S4 S11 X1
<b>Everest</b> (flucarbazone) <b>HRS, Durum and Winter Wheat Only</b> 	0.4 to 0.6 oz WDG (0.28 to 0.42 oz)	Wild oat, green foxtail and mustards. Partial control of yellow foxtail.	Crop: 1- to 6-leaf (4 leaves + 2 tillers). Prior to jointing. Grass weeds: Up to 4 leaves.	Add NIS up to 0.25% v/v. Apply 0.4 oz for green foxtail and 0.6 oz for wild oat and suppression of yellow foxtail. Must add 2,4-D ester or amine when tank-mixing with an SU herbicide. B13 S4 S11 X1 Y24
<b>Puma</b> (fenoxaprop-P + mefenpyr safener)	0.33 to 0.66 pt (0.04 to 0.08)	Wild oat, green and yellow foxtail, millets, corn, barnyardgrass.	HRSW/Durum: 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. B20 S4 S11 X1
<b>Dakota</b> (fenoxaprop-P + MCPA) <b>HRS and Winter Wheat Only</b>	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.	<b>Do not apply to durum wheat, barley or oat.</b> 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. B20 S4 S11 X1
<b>Cheyenne</b> (fenoxaprop-P + MCPA + <b>X-tra</b> (thifensulfuron + tribenuron)) <b>HRS or Winter Wheat Only</b> 	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.	<b>Do not apply to durum wheat, barley or oat.</b> 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, or Starane at 0.33 pt/A. B20 S4 S11 X1

## Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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.	Maybe applied with 0.25 to 0.38 pt/A bromoxynil, bromoxynil + MCPA or 0.2 to 0.3 pt/A of Bronate Advanced. 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. B21 S1 S4

### Identifying Leaf Stages of Small Grain

The plant leaf stage is determined by the number of leaves present on the main stem. Leaves arise on opposite sides of the stem and develop a collar at the junction of the leaf sheath and leaf blade. The first leaf has a blunt tip.

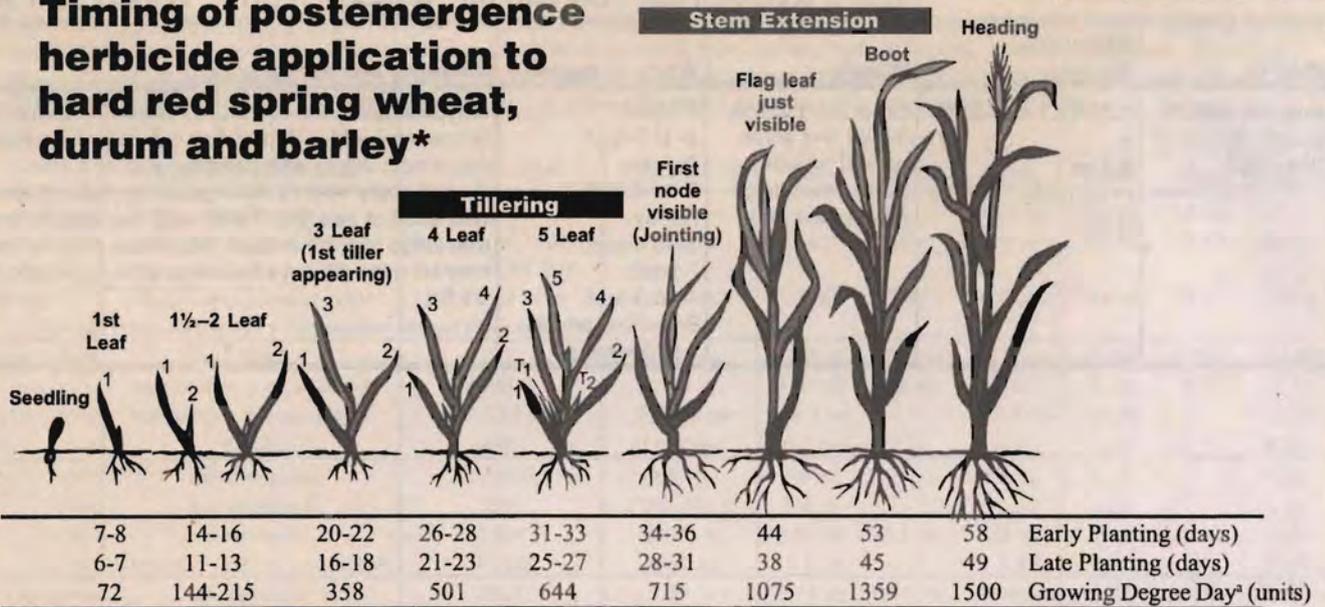
Position the small grain plant with the first leaf pointing to the left. All leaves on the left side of the main stem are designated with an odd number and on the right side with an even number. Count the youngest leaf when it is at least one-half the length of the leaf below it. Follow this procedure to properly stage small grain.

Tillers (stooling) usually start to appear at the third to fifth leaf stage. Most tillers arise between the main axis (stem) and leaf. A coleoptilar tiller may also be present. The coleoptilar tiller originates below the soil (near the seed) and is located on the opposite side of the stem from the first leaf. Frequently, tiller leaves are confused with the leaves of the main stem when determining correct leaf

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

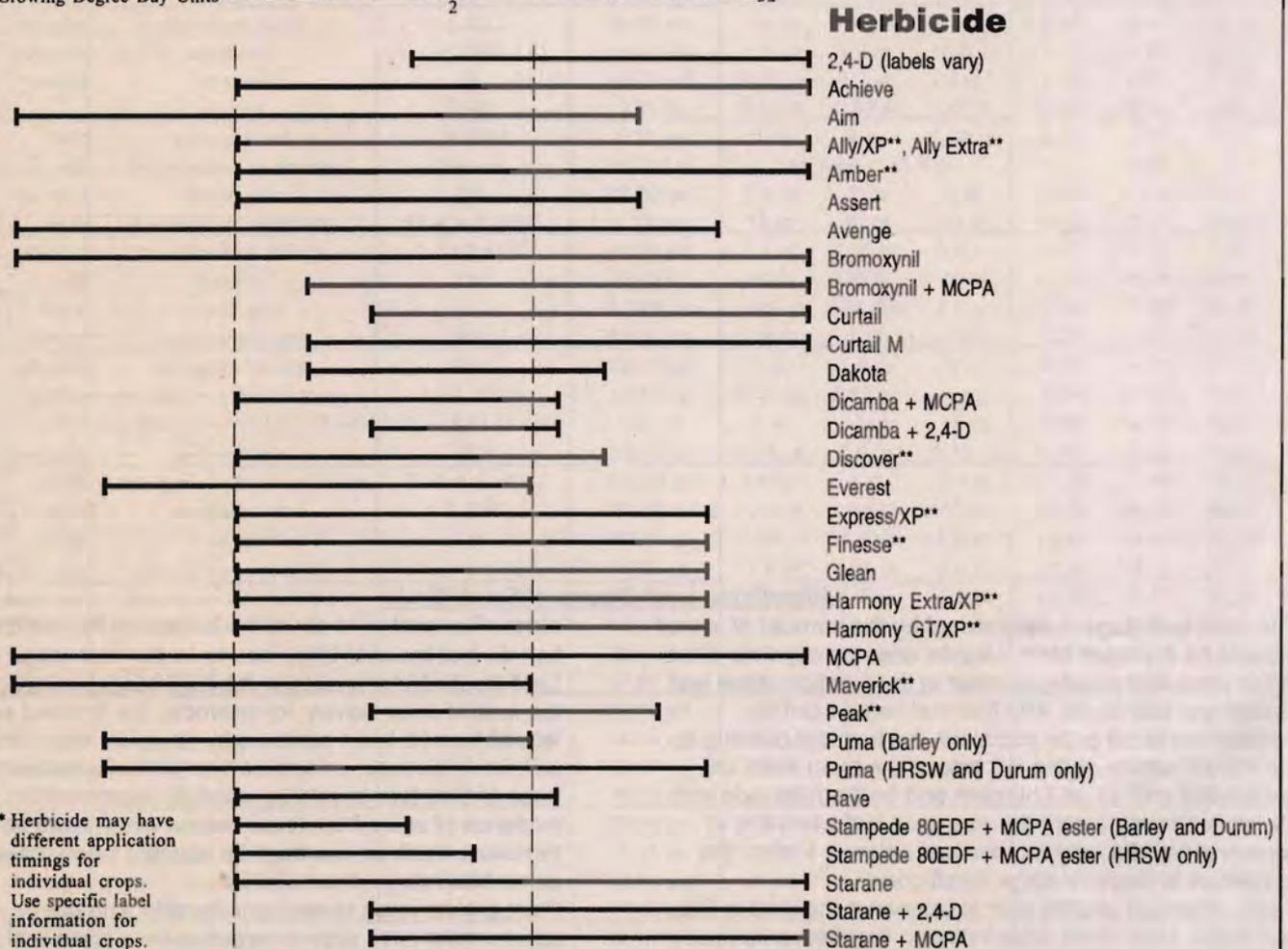
Plant growth rates varies considerably, and the approximate days after emergence for a given leaf stage to appear is influenced by most by temperature. Daytime highs less than 55 F delay development, while daytime highs greater than 55 F advance development. Days to emerge can vary greatly depending on soil temperature and moisture.

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



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

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



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

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

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

Herbicide	Product/A (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. (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. Refer to label for adjuvant use. Apply with AMS fertilizer. Commercial mixtures available: 2,4-D + glyphosate = Landmaster BW 2,4-D + glyphosate = RT Master, GlyMix MT Dicamba + glyphosate = Fallow Master A4-6 Q3 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. B1-2 S5 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. May not control wild mustard and redroot pigweed. Commercial mixtures with MCPA available: Bison, Bromac, Bronate Advanced B9 S5 S7 S9-10 X1
Aim (carfentrazone)	1/3 oz DF 1/2 fl oz EW (0.128 oz)	Broadleaf weeds including pigweed and kochia.	Crop: Up to jointing stage. Weeds: Up to 2 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 S5 S7-8 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. B10 T2 T6 Y21 Y24
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. B2 B11 S3 S5-6 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 B22 S3 S5-6
Harmony GT/XP (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 MCPAe at 0.75 pt/A enhances broadleaf weed control and oat safety. Apply with a NIS at 0.125% v/v except when adding MCPA at 0.75 pt/A. B14 S1-2 S5-6 X1
Harmony Extra/XP (thifensulfuron + tribenuron)	3/10 to 4/10 oz DF (0.225 to 0.3 oz)			
Peak (prosulfuron)	0.38 to 0.5 oz DF (0.22 to 0.29 oz)	Broadleaf weeds.	Oat: 3-leaf until 2nd node is detectable.	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. B19 S2 X1 Y3 Y18 Y24
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 adjuvant at 1 pt/A. B21 S1 S4 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. (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. Commercial mixtures available: 2,4-D + glyphosate = Landmaster BW 2,4-D + glyphosate = RT Master, GlyMix MT Dicamba + glyphosate = Fallow Master A4-6 Q3
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. B1-2 S5 S8-9 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. Addition of MCPA improves broadleaf weed control including wild mustard. Commercial mixtures with MCPA available: Bison, Bromac, Bronate Advanced B9 S4 S7 S9-10
Peak (prosulfuron)	½ oz DF (0.29 oz)	Broadleaf weeds.	<b>Peak + MCPA:</b> 3-leaf until 2 <sup>nd</sup> node. <b>Peak + 2,4-D:</b> After tillering until prior to jointing. <b>Peak + 2,4-D + dicamba:</b> 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. Apply with a NIS. B11 B19 S5 X1 Y3 Y13 Y18 Y24

## 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. B11 X1 Y13 Y24
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. B11 X1 Y24
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.
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.	Only certain formulations of 2,4-D are registered. B2 B19 X1 Y18 Y24

## SMALL GRAIN PRE/POST-HARVEST

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
2,4-D ester  For HRS, Durum, and Winter 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. CAUTION: Drift to broadleaf crops is especially hazardous at this time. B25 Q1 T5-6 X1 Z1
Dicamba + 2,4-D For HRS, Durum, and Winter 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. B11 B27 Q1 T5-6 X1 Y13 Y24 Z1
Ally/XP (metsulfuron) + 2,4-D For HRS, Durum, and Winter Wheat and Barley Only	1/10 oz DF (0.06 oz) + 1.5 to 3 pt of a 4 lb/gal conc. (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. B5 B26 Y3 Y24
Glyphosate  For HRS, Durum and Winter Wheat and Feed Barley 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. (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 14 day PHI.	Do not apply more than 2 pt/A/season. <b>Do not apply on wheat or barley grown for seed because reduced germination/vigor may occur.</b> 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. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 B28-29 Q3 T2 T6 Z1
Glyphosate + 2,4-D  For HRS, Durum and Winter Wheat and Feed Barley Only.	Landmaster BW = 3.38 to 5.25 pt (0.38 to 0.53 + 0.63 to 1)  RT Master Glymix MT = 0.75 to 2 pt (0.28 to 0.75 + 0.03 to 0.08)		Apply with NIS at 0.5% v/v. Apply with AMS. <b>Do not apply on wheat grown for seed because reduced germination/vigor may occur.</b> Do not graze or harvest for forage or straw for 7 days after application. A4-6 B28 B29 Q1 Q3 T2 T6 Z1	
<b>Post-Harvest Only</b>				
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. B18 T1 T6 Y17 Y24

# 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. (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. Apply with AMS fertilizer. See label for adjuvant use. Commercial mixtures available: glyphosate + 2,4-D = RT Master, GlyMix MT A4-6 Q3
Paraquat <b>RUP</b>	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
Harmony GT/XP (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat.		Maybe tank-mixed with glyphosate. Improves broadleaf weed control including wild buckwheat. Add NIS at 0.25 to 0.5% v/v. S1 X1

## 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. Do not tank-mix DoublePlay with DF formulation of atrazine or spray solution may solidify. Refer to label for registered tank-mix products and mixing order. A1-3 C3 C15		
DoublePlay (EPTC+acetochlor + safener)  <b>RUP</b>	5 to 8 pt/A (3.5 to 5.6 + 0.88 to 1.4)					
Axiom (flufenacet + metribuzin) 	15 to 23 oz DF (0.51 to 0.98 + 2 to 3.1 oz)				PPI or PRE.	Poor wild oat and wild mustard control (except Axiom). Adjust rate according to soil type. Less effective PRE than acetochlor products. PPI gives more consistent weed control. May be tank-mixed with most residual soil-applied herbicides registered in corn. See label.
Dual Magnum Dual II Magnum Cinch (metolachlor)	1 to 2 pt (1 to 2) 6 to 12 lb IIG/25G (1.5 to 3)				PPI or PRE. Fall: After Sept 30 but before ground freezes.	Commercial mixture available: Dual + atrazine = Bicep Lite II Magnum, Cinch ATZ Lite Dual + Callisto = Camix Dual + Callisto + atrazine = Lumax Lasso + Atrazine = Lariat, Bullet Balance + flufenacet = Epic A1 C2-3 C17
Lasso (alachlor) <b>RUP</b>	2 to 3.5 qt 4EC/MT 13 to 26 lb 15G (2 to 3.5)				PPI, PRE. Corn: Up to 5 inches tall.	
Outlook (dimethenamid-P)	16 to 21 fl oz 6E (0.75 to 1)				EPP, PPI or PRE.	Commercial mixtures available: Outlook + Atrazine = Guardman Max, G-Max Lite, LeadOff C2 C17 S7
Harness (acetochlor + safener)  <b>RUP</b>	1.25 to 2.75 pt (1.1 to 2.4) 6 to 15 lb 20G (1.2 to 3)				PPI, PRE, EPOST and Fall.	Provides equal or greater weed control compared to Axiom, Dual, Lasso or Outlook. 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. Can be applied with most PPI or PRE residual broadleaf herbicides labeled in corn. Commercial mixture available: Surpass + EPTC = DoublePlay Harness + Atrazine = Harness Xtra Keystone LA A1 C2-3 C16
Surpass (acetochlor + safener)  <b>RUP</b>	1.5 to 3.75 pt 6 to 15 20G (1.2 to 3)					
Ramrod (propachlor) 	4 to 6 qt 20 to 30 lb 20G (4 to 6)				PRE.	More effective PRE and requires less rainfall for activation than other soil applied herbicides. PPI decreases control. C2 C17

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>TopNotch</b> (microencapsulated acetochlor + safener)  RUP	<b>4 to 7.25 pt</b> (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 = FullTime
<b>Degree</b> (microencapsulated acetochlor + safener) RUP 	<b>3.25 to 4.25 qt</b> (1.54 to 2)		Fall: After October 15 but before ground freezes.	Commercial mixture available: Degree + Atrazine = Degree Xtra  A1 C2 C16 S7
<b>Prowl</b> <b>Pendimax</b> (pendimethalin)	<b>2.4 to 3.6 pt EC</b> <b>1.7 to 3.3 lb DG</b> (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. C21 Y1 Y20 Y24
Atrazine  RUP	<b>1.1 to 2.2 lb DF</b> (1 to 2 lb)	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 S7 Y1 Y4 Y8 Y24
<b>Basis</b> (rimsulfuron + thifensulfuron)	<b>1/3 to 1 oz DF</b> (0.165 to 0.5 oz + 0.083 to 0.25 oz)	Some annual broadleaf weeds.	EPP or PRE in no-till.	Apply to soil with 1% to 3.5% OM. Application in conventional or minimum tillage systems may result in reduced weed control. Do not apply Basis, Basis Gold, Accent, Accent Gold, or Steadfast to fields previously treated with more than 0.62 oz/A of Basis. Use higher rates for greater residual control. See label or narrative for tank-mix options. C2 C10 Y18
<b>Python</b> (flumetsulam)	<b>0.8 to 1.33 oz DG</b> (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. Do not apply to soil greater than 7.8 pH. See label for tank-mix options. Python and Hornet has no grass activity. C2 C22 S7 S12 X1 Y2 Y15 Y24
<b>Hornet</b> <b>Hornet WDG</b> (flumetsulam + cloprralid - acid = Hornet K salt = WDG)	<b>3.2 to 4.8 oz or</b> <b>4 to 6 oz WDG</b> (0.74 to 1.1 oz + 2 to 3 oz)	Annual broadleaf weeds.	EPP, PPI, or PRE.	
<b>Balance Pro</b> (isoxaflutole)  RUP 	<b>1.5 to 3 fl oz</b> (0.047 to 0.094)	Annual grass and broadleaf weeds including foxtails, wild proso millet, field sandbur, pigweeds, kochia, lambsquarters, nightshade, and mustards.	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.	<b>Adjust rate according to soil texture and pH.</b> 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 mixture available: Balance + flufenacet = Epic A1 C2-3 C8 S7 Y24

# CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>POST Herbicides</b>				
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. Commercial mixtures with atrazine available: Buctril + Atrazine, Brozine, or Moxy AT C2 C11
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. A sequential applications needed for Canada thistle control. C9
Atrazine + oil adjuvant <b>RUP</b>	Appropriate rate + oil adjuvant (0.38 to 1 lb ai/A)	Broadleaf weeds and some grasses.	POST. Weeds: Less than 1.5 inches tall.	Apply with other POST broadleaf and or grass herbicides before corn is 12 inches tall. Apply with oil adjuvant at 1 qt/A. Improves control of many grass and broadleaf weeds. Atrazine soil residue may injure crops planted the following year. Several mixtures available. C2 C7 Y4 Y5 Y6 Y24
Sencor (metribuzin) + broadleaf herbicide	1.6 to 2 oz DF + brdlf herbicide (1.2 to 1.5 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. <b>Do not add oil adjuvant with any tank-mix.</b> Y4 Y24
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. C24 X1
Shotgun (atrazine + 2,4-D) <b>RUP</b>	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 C23 Y8 Y24
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 or Steadfast for grass control. Commercial mixture available: Marksman. C4 C14 X1 Y13 Y24
	0.5 pt (0.25)		POST Directed. See Remarks.	
Distinct (dicamba + diflufenzopyr)	4 to 6 oz WDG (2 to 3 oz + 0.8 to 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. Use 6 oz/A for grass and perennial weed suppression. Refer to label for tank-mix options. Distinct at 6 oz 70WDG/A = 6 fl oz Clarity. C14 S5 S7 S12 Y13 Y24
Stinger (clopralid) 	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 Hornet WDG (flumetsulam + cloprialid-acid = Hornet or cloprialid-K salt = Hornet WDG)	1.6 to 4 oz or 2 to 5 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. C22 T2 X1 Y15 Y24

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Curtail</b> (clopyralid + 2,4-D)	<b>2 pt</b> (0.09 + 0.5)	Broadleaf weeds including Canada thistle.	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. Refer to label 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. C13 T2 Y21 Y24
<b>Aim</b> (carfentrazone)	<b>1/3 oz WDG</b> <b>1/2 fl oz EW</b> (0.128 oz)	Redroot pigweed, waterhemp, lambsquarters, nightshade. Partial kochia control.	EPOST. Corn: Up to 12 inches tall or 8 collars. Weeds: SMALL - Up to 2 inches.	Aim may cause speckling/spotting on corn leaves intercepting spray. May tank-mix with most registered herbicides except bromoxynil. Do not apply either 8 hours before or after a rain event to avoid crop injury. Commercial mixture available: Aim DF + atrazine DF = Teamwork + Atrazine Aim 2EW + atrazine 4L = Avalanche + Atrazine C6 S5 S7-8 X1
<b>Callisto</b> (mesotrione) + atrazine  atrazine = RUP	<b>3 fl oz</b> (0.094) + 0.375 lb ai/A	Broadleaf weeds including pigweed lambsquarters, giant ragweed, sunflower, smartweed and nightshade.	POST. Corn: Up to 12 inches tall.  Weeds: Small.	Apply with oil adjuvant at 1% v/v + UAN at 2.5% v/v. Must apply with Steadfast or Accent to control green and yellow foxtail control. Refer to label or narrative for tank-mix options, crop rotation restrictions, insecticide interactions, and other restrictions. Growers assume all liability for weed control and corn injury if Lumax is applied at rates lower than labeled. Commercial mixture available: Callisto + Dual II Magnum = Camix C4 C12 X1 Y4 Y11 Y24
<b>Lumax</b> (mesotrione + s-metolachlor + atrazine)  RUP	<b>3 pt</b> (0.1 + 1 + 0.375)	Atrazine improves control of kochia, common ragweed, and common cocklebur.	EPOST. Corn: Up to 5 inches tall.  Weeds: Small.	
<b>Permit</b> (halosulfuron)  	<b>2/3 to 1.33 oz DF</b> (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. Refer to label or narrative for tank-mix options, crop rotation restrictions, insecticide interactions, and other restrictions. Commercial mixture with dicamba available: Yukon. C20 Y3 Y24
<b>NorthStar</b> (dicamba + primisulfuron)	<b>5 oz DF</b> (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. Refer to label or narrative for tank-mix options, crop rotation restrictions, insecticide interactions, and other restrictions. Primisulfuron will carryover for more than 1 year. C19 Y3 Y6 Y24
<b>Basis</b> (rimsulfuron + thifensulfuron)	<b>1/3 oz DF</b> (0.165 oz + 0.083 oz)	Barnyardgrass, foxtails, wild oat, redroot pigweed, wild mustard, lambsquarters, and annual smartweed.	Early POST. Corn: Up to 6 inches tall. Spike to 4-leaf (2 collar) stage. Weeds: 1 to 2 inches tall.	Apply with oil + nitrogen fertilizer or with basic blend adjuvant. 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 Y3 Y24
<b>Basis Gold</b> (nicosulfuron + rimsulfuron + atrazine) RUP	<b>14 oz DF</b> (0.188 oz + 0.188 oz + 0.76)	Annual grasses, quackgrass, and some broadleaf weeds.	POST.	Apply with oil adjuvant at 1 to 2% v/v + nitrogen fertilizer. Basis Gold at 14 oz/A contains 0.76 lb ai/A atrazine. Follow crop rotation restrictions. A8 C2 C5 C10 Y3 Y8-9 Y24
<b>Option</b> (foramsulfuron + isoxadifen safener)	<b>1.5 to 1.75 oz WG</b> (0.525 to 0.613 oz + 0.525 to 0.613 oz)	Annual grass and broadleaf weeds. Controls quackgrass and partial control of Canada thistle.	POST. Corn: Up to 16 inches tall with 5 or fewer collars. Weeds: 1 to 3 inches tall.	Apply with MSO type adjuvants at 1 qt/A + liquid nitrogen fertilizer at 1 qt/A. All crops can be planted the following year. See label or narrative for tank-mix options and crop rotation restrictions and additional information. C3 C18 X1 Y3 Y24

# CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Accent</b> (nicosulfuron)	<b>2/3 oz DF</b> (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 + nitrogen fertilizer or with basic blend adjuvant. Do not apply to corn previously treated with Counter 15G insecticide. May be applied with dicamba, atrazine, and Hornet. See label or narrative for other tank-mix options, crop rotation restrictions, and additional information. A7 C3-5 X1 Y3 Y24
<b>Steadfast</b> (nicosulfuron + rimsulfuron)	<b>3/4 oz DF</b> (0.375 + 0.188 oz)	Annual grasses, quackgrass, and some broadleaf weeds.	POST. Corn: Up to 12 inches tall with 6 or fewer collars.	Apply with oil adjuvant + nitrogen fertilizer or with basic blend adjuvant. See Accent above for insecticide use restrictions. Use caution on corn hybrids less than 88 day maturity. See label or narrative for tank-mix restrictions and crop rotation restrictions. A7 C2-5 X1 Y3 Y24
<b>Steadfast</b> (nicosulfuron + rimsulfuron) + dicamba + atrazine + adjuvant <b>RUP</b> <b>NDSU</b> <b>MICRORATE</b> <b>PROGRAM 1.</b>	<b>3/8 to 3/4 oz DF + 4 fl oz + 0.42 lb DF</b> (0.25 to 0.375 oz + 0.125 to 0.188 oz + 0.125 + 0.375)	Grass and most broadleaf weeds.  Steadfast rates less than 0.75 oz/A will not control yellow foxtail, wild proso millet, volunteer cereals, and quackgrass	POST. Corn: Up to 12 inches tall.  Weeds: Small	<b>User assumes all risk of inadequate weed control and/or corn injury if Steadfast, Accent, or Lumax is used at less than labeled rate.</b> Accent at 0.33 to 0.67 oz DF/A can be substituted for Steadfast. Apply Micro-rate 1 with basic blend or MSO type oil adjuvant. Apply Micro-rate 2 with PO adjuvant. Steadfast at 0.38 to 0.75 oz DF/A or Accent at 0.33 to 0.67 oz DF/A will control green foxtail and wild oat. Atrazine at 0.42 lb/A DF will allow most crops to be planted the following year, including sugarbeet, sunflower, and canola. See Accent and Steadfast above for other precautions. See label or narrative for tank-mix options, crop rotation restrictions, and additional information. A7 C2-5 X1 Y3 Y24
<b>Steadfast</b> (nicosulfuron + rimsulfuron) + <b>Lumax</b> (mesotrione + s-metolachlor + atrazine) + adjuvant <b>RUP</b> <b>NDSU</b> <b>MICRORATE</b> <b>PROGRAM 2.</b>	<b>3/8 to 3/4 oz DF + 3 pt</b> (0.25 to 0.375 oz + 0.125 to 0.188 oz + 0.1 + 1 + 0.375)	Lumax and atrazine improves yellow foxtail control.	EPOST. Corn: Up to 5 inches tall.  Weeds: Small.	A7 C2-5 C7 C12 C14 X1 Y3 Y4 Y8 Y11 Y13 Y24
<b>Steadfast</b> (nicosulfuron + rimsulfuron) + dicamba	<b>3/4 oz DF + 0.5 to 1 pt</b> (0.375 + 0.188 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.	Accent can be substituted for Steadfast if corn is greater than 12 inches tall. 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. A7 C4-5 C14 X1 Y3 Y13 Y24
<b>Celebrity Plus</b> (nicosulfuron + dicamba + diflufenzopyr)	<b>4.67 oz DF</b> (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 1.5% v/v. Celebrity at 4.67 oz WDG/A = Accent at 0.67 oz 75DF/A + the dicamba in Distinct at 4 fl oz/A. A7 C2 C4-5 C14 X1 Y12-13 Y24
<b>Steadfast</b> (nicosulfuron + rimsulfuron) + <b>Hornet DF or Hornet WDG</b> (flumetsulam + clopyralid - acid = Hornet or clopyralid-K salt = Hornet WDG)	<b>3/4 oz DF + 1.6 to 4 oz DF or 2 to 5 oz WDG</b> (0.375 + 0.188 oz + 0.37 to 0.9 oz + 1 to 2.5 oz)	Grass and broadleaf weeds including ragweed, nightshade, cocklebur, and sunflower.	POST.	Accent can be substituted for Steadfast if corn is greater than 12 inches tall. 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. A7 C2 C4-5 C22 T2 X1 Y3-4 Y7 Y15 Y21 Y24

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Accent Gold Accent Gold WDG (nicosulfuron + rimsulfuron + flumetsulam + clopyralid acid or clopyralid-K salt)	2.9 oz Accent Gold or 3.5 oz Accent Gold-WDG (0.188 oz + 0.188 oz + 1.5 oz + 0.56 oz)	Suppression of Canada thistle.	Corn: Up to 20 inches tall with 6 or fewer collars. Use drop nozzles on 20 to 24 inch corn.	Accent Gold at 2.9 oz/A = DPX 79406 at 0.5 oz/A + Hornet (clopyralid acid) at 2.4 oz DF/A Accent Gold at 3.5 oz/A = DPX 79406 at 0.5 oz/A + Hornet WDG (clopyralid-K salt) at 3 oz/A. Both products contain the same amount of active ingredient. Apply with oil adjuvant at 1 to 2% v/v. Use caution on corn hybrids less than 88 days maturity. See label for tank-mix options and crop rotation restrictions. C2 C5 C22 T2 X1 Y3 Y8 Y24

### 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. C24 Y19 Y24
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. C24
Aim (carfentrazone)  Registration Pending	1/3 oz WDG 1.2 fl oz EW (0.13 oz)	Redroot pigweed, lambquarters, nightshade. Partial kochia control.	Registration up to 48 inch tall corn pending.  Weeds: Small.	Aim may cause cosmetic speckling/spotting on corn leaves intercepting spray. Refer to label or narrative for adjuvant and tank-mix options to increase spectrum of broadleaf weeds controlled. C6 C24 X1

### 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. (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. Apply with AMS fertilizer. Refer to label for adjuvant use. Commercial mixtures available: glyphosate + 2,4-D = RT Master, GlyMix MT at up to 3 qt/A for ground and up to 1 qt/A for aerial application. A4-6 Q3
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## 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. Use with herbicides of a different mode of action and use complimentary weed control strategies. C25 Y2 Y24

### LIBERTY (Glufosinate) RESISTANT CORN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Liberty (glufosinate)	28 to 34 fl oz (0.37 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. C26 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. C7 C26 X1 Y4 Y8 Y24

### 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. 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. A4-7 C27 Q3 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 carry over into the following growing season. See label for application information and tank-mix options. A4-7 X1 Y4 Y8 Y24

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. (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 label for adjuvant use. Commercial mixtures available: glyphosate + 2,4-D = RT Master, GlyMix MT A4 Q3
Paraquat RUP	1 to 2.7 pt (0.375 to 1)			Non-selective, non-residual, contact, foliar herbicide. Apply with a NIS. Q5
Harmony GT/XP (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)	Broadleaf weeds including wild buckwheat.		Maybe tank-mixed with glyphosate. Improves broadleaf weed control including wild buckwheat. Add NIS at 0.25 to 0.5% v/v. S1 X1
2,4-D	1 to 2 pt of a 4 lb/gal conc. (0.5 to 1)	Preplant burndown of emerged annual broadleaf weeds. Days before seeding: 1 pt amine = 15 days 1 pt ester = 7 days 2 pt amine or ester = 30 days		A preplant application for use only in reduced tillage. Soybean injury may occur. Seed at least 1.5 to 2 inches deep to ensure seed is separated from the herbicide. D3 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. No wild mustard and poor wild oat control. Green foxtail has become resistant to DNA herbicides in North Dakota.
Sonalan Sonalan 10G (ethalfuralin)	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.	Commercial mixtures available: Trifluralin + alachlor = Freedom Prowl + Pursuit = Pursuit Plus A1-3 D2 D20 X1 Y20 Y24
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.	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 D15 Y2 Y20 Y24
Sencor (metribuzin)	0.25 lb DF Soil pH >7.5. 0.33 to 0.5 lb DF Soil pH <7.5.			Apply with soil-applied grass herbicide. Sencor may injure certain soybean varieties. D2 D19 S12 Y4 Y19 Y24
Dual Magnum Dual II Magnum (metolachlor)	1 to 2 pt (1 to 2)	Grass and some broadleaf weeds.	PPI or PRE.	Poor wild oat control. Dual, Lasso, and Outlook gives poor wild mustard control. PPI gives more consistent control than PRE. PRE requires precipitation for herbicide activation. Adjust rate according to soil type and OM. Outlook gives greater nightshade control. Refer to label for tank-mix options and grazing or feeding restrictions.
Lasso (alachlor) RUP	2 to 3 qt EC/MT 13 to 23 lb 15G (2 to 3)			Commercial mixtures available: Define (flufenacet) + metribuzin = Axiom, Domain Lasso + trifluralin = Freedom Dual + metribuzin = Boundary A1 D2 D13
Outlook (dimethenamid-P)	16 to 21 fl oz (0.75 to 1)		PPI, PRE or EPOST.	
Valor (flumioxazin) 	2 to 3 oz WDG (1 to 1.5 oz)	Broadleaf weeds including pigweed, nightshade, lambsquarters, pigweed, ragweed, cocklebur, kochia, sunflower, and some grass suppression.	EPP and PRE.	Adjust rate according to weed spectrum, soil texture and OM. Requires precipitation to activate herbicide. EPP provides burndown of some broadleaf weeds. Allow a 65 day PHI. See label or narrative for tank-mix options, application information, rate structure, and crop rotation restrictions. D22 S5 S12 Y24
Gangster (flumioxazin + cloransulam) 	Copack: 2.5 to 3 oz WDG + 0.5 to 0.6 oz WDG (1.25 to 1.5 oz + 0.42 to 0.5 oz)			

# SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Authority</b> (sulfentrazone) 	<b>4 to 5.33 oz WDG</b> (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. Requires precipitation to activate herbicide. EPP provides burndown of some broadleaf weeds. Allow a 65 day PHI.
<b>Guantlet</b> (sulfentrazone + cloransulam) 	<b>Copack: 5.33 to 6.67 oz + 0.6 to 0.75 oz WG</b> (0.25 to 0.31 lb + 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 S5 S7 S8 S9 S12 Y24
<b>Python</b> (flumetsulam) 	<b>0.8 to 1.33 oz WDG or 5 to 3 A/pack</b> (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. Allow an 85 days PHI. D2 D16 S7 S12 Y2 Y10 Y24

## POST Herbicides

<b>Basagran</b> (bentazon)	<b>1 to 2 pt</b> (0.5 to 1)	Mustard, cocklebur, vol. sunflower. Suppression of biennial wormwood and Canada thistle.	POST. Soybean: Any stage. Mustard: 4- to 6-leaf. Canada thistle: 6 to 8 inches.	Contact herbicide, non-residual herbicide. Thorough coverage required. Apply with oil additive at 1 qt/A. <b>Rosette technique:</b> 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 S12 T2
<b>Rezult</b> (Co-pack of bentazon + sethoxydim)	<b>1.6 + 1.6 pt</b> (1+ 0.2)	Grass and broadleaf weeds.	POST. Soybean: Emergence to 30 days PHI.	Apply with oil adjuvants at 1 to 2 pt/A. Provides economical weed control. Refer to Basagran and Poast sections for additional information. D7 D14
<b>Ultra Blazer</b> (acifluorfen)	<b>0.5 to 1.5 pt</b> (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. D21 S7
<b>Cobra</b> <b>Phoenix</b> (lactofen)	<b>6 to 12.5 fl oz Cobra 8 to 12.5 fl oz Phoenix</b> (1.5 to 3.2 oz)	Broadleaf weeds including wild mustard, waterhemp, ragweed, and lanceleaf sage.	POST. Soybean: 1 trifoliolate to 45 days before harvest. Weeds: 2 to 6 inches.	Contact herbicide. Thorough coverage required. Apply Cobra with oil adjuvant at 1 to 2 pt/A. Apply Phoenix with NIS at 0.125 to 0.25% v/v. Refer to narrative for environmental response, tank-mix options, and for white mold suppression. D8
<b>Flexstar</b> (fomesafen + adjuvants)	<b>0.75 to 1 pt</b> (0.176 to 0.24)	Broadleaf weeds including pigweed cocklebur, Venice mallow, mustard, ragweed, smartweed, black nightshade, kochia including resistant. Poor hairy nightshade control.	POST. Soybean: Prior to flowering. Weeds: 2- to 4-leaf stage.	Contact herbicide. 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 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. A7 D10 S5 S7 S8 Y14 Y24
<b>Aim</b> (carfentrazone) + broadleaf herbicide	<b>1/6 oz DF 1/4 fl oz EW</b> (0.067 oz)	Redroot pigweed, lambsquarters, nightshade, and waterhemp.	POST. Soybean: Up to 3 <sup>rd</sup> trifoliolate. Weeds: Small.	Apply with NIS at 0.25% v/v. May cause speckling on soybean leaves. Do not apply to wet soil or foliage. Refer to label tank mix options and additional information. D4 S5 S7 S8 X1

# SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Amplify FirstRate</b> (cloransulam)	<b>0.3 oz WDG or 10 A/pack</b> (0.25 oz)	Venice mallow, cocklebur, marestail, ragweed, sunflower, and wild mustard.	POST. Soybean: Up to 50% flowering (1 of 2 plants are flowering). Weeds: Up to 10 inches tall.	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. D9 X1 Y2 Y24
<b>Harmony GT/XP</b> (thifensulfuron)	<b>1/12 oz 75DF</b> (0.062 oz)	Wild mustard, pigweed, and lambsquarters. No ALS kochia control.	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. D12 S1 S8 X1
<b>Pursuit Pursuit DG</b> (imazethapyr)	<b>3 fl oz 1.08 oz WDG</b> (0.75 oz)	Annual broadleaf weeds including black nightshade, kochia, pigweed, and mustard.	POST. Soybean: Fully expanded first trifoliolate leaf but <b>prior to flowering.</b>  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. A7 D15 S7 X1 Y2 Y6 Y24
<b>Pursuit Pursuit DG</b> (imazethapyr) + <b>Harmony GT/XP</b> (thifensulfuron)	<b>3 fl oz 1.08 oz WDG + 1/12 oz</b> (0.75 oz + 0.062 oz)	For improved common lambsquarters 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. Allow a 85 PHI. A7 D8 D15 S7 Y2 Y6 Y24
<b>Pursuit Pursuit DG</b> (imazethapyr) + <b>Flexstar</b> (fomesafen & adjuvants)	<b>3 fl oz 1.08 oz WDG + 0.75 pt/A</b> (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. A7 D10 D15 S5 S7 Y6 Y24
<b>Pursuit Pursuit DG</b> (imazethapyr) + <b>Cobra</b> (lactofen)	<b>3 fl oz 1.08 oz WDG + 4 fl oz</b> (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. A7 D8 D15 S7 Y2 Y6 Y24
<b>Raptor</b> (imazamox)	<b>4 fl oz (0.5 oz) if following a soil - applied grass herbicide or 5 fl oz if applied alone.</b> (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 <b>prior to flowering.</b>  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. A7 D17 S7 X1 Y2 Y24
<b>Raptor</b> (imazamox) + <b>Flexstar</b> (fomesafen & adjuvants)	<b>4 to 5 fl oz + 0.75 pt/A</b> (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. A7 D10 D17 S5 S7 Y24
<b>Raptor</b> (imazamox) + <b>Cobra</b> (lactofen)	<b>4 to 5 fl oz + 4 fl oz</b> (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. D8 D17 S7 Y2 Y24
<b>Raptor</b> (imazamox) + <b>Ultra Blazer</b> (acifluorifen)	<b>4 to 5 fl oz + 12 to 16 fl oz</b> (0.5 to 0.625 oz + 3 to 4 oz)	For improved broadleaf weed control.		Apply with NIS and 28% UAN. Addition of oil adjuvant may increase weed control but may increase risk of soybean injury. Refer to label for application and use information and risk of crop injury. See narrative for rotational restrictions. D8 D17 S7 Y2 Y24

# SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Assure II</b> (quizalofop)	<b>7 to 10 fl oz</b> (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 adjuvant at 1 qt/A. Fusilade with oil adjuvant at 1% v/v. Fusion with oil adjuvant at 1% v/v. Poast with oil adjuvant at 1 qt/A. Select with oil adjuvant at 1 qt/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 D11 D14 D18 D24 X1
<b>Fusilade DX</b> (fluazifop-P)	<b>5 to 12 fl oz</b> (1.25 to 3 oz)		POST. Soybean: Before bloom. Grass weeds: 2 to 4 inches.	
<b>Fusion</b> (fluazifop-P + fenoxaprop)	<b>4 to 12 fl oz</b> (1 to 3 oz + 0.32 to 0.96 oz)		POST. Soybean: Before bloom. Grass weeds: 2 to 6 inches tall.	
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt</b> (0.09 to 0.28)	Annual grasses.	POST. Soybean: All stages. Grass: Up to 8 inches tall.	
<b>Select Prism</b> (clethodim)	<b>4 to 16 fl oz</b> <b>8.5 to 34 fl oz</b> (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	<b>1 to 2 qt 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. (0.75 to 1.5)</b>	Preharvest weed control.	Prior to harvest.	Apply after pods have set and lost all green color. Allow a 7 day PHI. Apply with AMS fertilizer. Refer to narrative for adjuvant use. <b>Do not apply on soybean grown for seed because reduced germination/vigor may occur.</b> A4-6 Q3
<b>Gramoxone Max</b> (paraquat)  RUP	<b>5.5 to 11 fl oz</b> (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. Q5
<b>Drexel Defol</b> (sodium chlorate)	<b>1 gal of a 6 lb/gal conc. (6)</b>		7 to 10 days prior to harvest and after pods are brown.	Thorough coverage of plant foliage is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.

# HERBICIDE RESISTANT SOYBEAN

## ROUNDUP (Glyphosate) RESISTANT SOYBEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Glyphosate	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. (0.38 to 2.25)	Annual and perennial grass and broadleaf weeds.	POST. Soybean: Emergence through full flowering.  Allow a 14 day PHI.  Apply as single or multiple applications.	<b>Apply only to glyphosate resistant soybean varieties.</b> Apply with AMS fertilizer. Do not apply more than 1.5 lb ae/A (4 pt/A of a 3 lb ae/gal or 1.6 qt of 3.7 lb ae/gal product) for each single in-crop application or an application made during flowering. Do not exceed 2.22 lb ae/A (6 pt/A of a 3 lb ae/gal or 2.4 qt of a 3.7 lb ae/gal product) for the total multiple in-crop applications from emergence through flowering. Multiple applications may be necessary for weed flushes. Drift and off-site movement may cause injury or death to other plants and crops. Refer to label for weeds controlled, application information, adjuvant use, tank-mix options with residual herbicides and restrictions. <b>Cannot save harvested seed.</b> A4-6 A7 D23 S7 Q3 X1
<b>Extreme</b> (imazethapyr + glyphosate)	<b>2.25 pt</b> (0.75 oz + 0.56)	For improved nightshade control.	POST. Soybean: Fully expanded first trifoliolate leaf but <b>prior to flowering.</b>  Allow a 14 day PHI.	<b>Apply only to glyphosate resistant soybean varieties.</b> Apply with NIS at 0.25% v/v and AMS fertilizer. 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. <b>Harvested soybean cannot be used for seed.</b> A4 A7 D15 D23 S7 Q3 X1 Y2 Y24

# 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. (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. A4-6 Q3
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, Prowl, Outlook, Sonalan, or trifluralin to increase spectrum of weeds controlled. Consult label for rate range for specific tank mix. A1 A2 A3 E4 S7
	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.	No wild mustard and poor wild oat control. PPI within 24 hours after application. May be tank-mixed with Dual, Eptam, Lasso, and Outlook. Refer to narrative for rotational restrictions. A1 A3 E5 X1 Y1 Y20 Y24
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.	No wild mustard and poor wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. E5 Y20 Y24
	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. E5 Y20 Y24
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.	No wild mustard and poor wild oat control. 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 products, Eptam, Lasso, and Outlook. E5 Y20 Y24
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 E4 E5 S7 Y20 Y24
Dual Magnum Dual II Magnum (metolachlor)	1 to 2 pt Magnum or Cinch  (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.
Outlook (dimethenamid-P)	16 to 21 fl oz (0.75 to 1)		PPI, PRE, or POST to third trifoliolate.	Do not use Lasso on coarse-textured soils. Outlook provides greater nightshade control. Outlook can be applied EPOST with Basagran and Pursuit.
Lasso (alachlor) RUP	4 to 6 pt (2 to 3)		PPI.	A1 E3 S7

## DRY EDIBLE BEAN

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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. Apply with oil adjuvant at 1 qt/A. Partial control of biennial wormwood.
	1 pt / 1 pt (0.5/0.5)		POST. Apply twice.  Make second application 7 to 10 days after first.	Two applications at a 7 to 10 day interval improves overall weed control and controls biennial wormwood and Canada thistle. Apply the first treatment to small weeds and unifoliolate to first trifoliolate dry bean. D7 E2 S12 T2
Rezult (Co-pack of bentazon + sethoxydim)	1.6 + 1.6 pt (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 D14
Pursuit Pursuit DG (imazethapyr)	2 fl oz 0.72 oz WDG (0.5 oz)	Annual broadleaf weeds including wild mustard and black nightshade.	POST. Dry bean: After first trifoliolate but prior to flowering.	User assumes all risk of crop injury. Apply only with NIS at 0.25% v/v. Allow a 60 day PHI. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply under stress conditions. Refer to narrative or label for weeds controlled, risk of crop injury, crop rotation restrictions and additional information. Addition of a reduced rate of Basagran or Rezult may safely Pursuit or Raptor on dry beans. A7 E6 E7 S5 S7 Y1 Y2 Y6 Y24
Raptor (imazamox)	4 fl oz (0.5 oz)			
Reflex (fomesafen)	0.75 pt (0.19)	Annual broadleaf weeds including ragweed and ALS susceptible and ALS resistant nightshade.	POST. Dry bean: Prior to bloom.  Weeds: 1 to 4 inches.	Apply with NIS at 0.125 to 0.25% v/v or oil adjuvant at 0.5 to 1% v/v. Allow a 30 day PHI. Oil adjuvant may increase risk of crop injury. Refer to label for weeds controlled, application information, risk of crop injury, and crop rotation restrictions. A7 E8 S5 S7 S8 Y14 Y24
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 adjuvant at 1 qt/A Poast with oil adjuvant at 1 qt/A Select with oil adjuvant 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 D14 D18 D24 X1
Select Prism (clethodim)	4 to 8 fl oz 8.5 to 17 fl oz (1 to 2 oz)	Annual grasses and quackgrass.		
<b>Preharvest Application</b>				
Gramoxone Max (paraquat)	0.75 to 1.3 pt (0.28 to 0.49)	Desiccant.	POST. Dry bean: 7 or more days 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. Q5
RUP				7 to 10 days prior to harvest and after pods are brown.
Drexel Defol (sodium chlorate)	1 gal of a 6 lb/gal conc. (6)			

# 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. (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. A4-6 Q3
Paraquat RUP	1 to 2.7 pt (0.375 to 1)			Non-selective, non-residual, foliar herbicide. Apply with NIS. Q5
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. Commercial mixture available = trifluralin + triallate = Buckle. A1 A3 B158 F1
Trifluralin	1 to 1.5 pt 5 to 7.5 lb 10G (0.5 to 0.75)	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 E5 F1 Y1 Y6 Y20 Y24
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 Magnum Dual II Magnum (metolachlor)	1 to 2 pt (1 to 2)		PPI or PRE.	Poor wild mustard and wild oat control. Adjust rate according to soil type and OM. PPI improves consistency of weed control. A1 E3 F1
Spartan (sulfentrazone)  Section 18 Registration Pending  	2.67 to 5.33 oz WDG (0.125 to 0.25)	Annual small- seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, PPI, or PRE.	Adjust rate to soil type. Requires precipitation for activation. Temporary sunflower injury may occur in coarse, low organic matter soils with pH greater than 8.0. May give 6 to 8 weeks residual weed control. Refer to narrative for application information, crop rotation restrictions, and other information. D6 F1 J4 S1 S5 S7 S8 S12 Y24
Sencor (metribuzin)	0.25 to 0.5 lb DF (0.19 to 0.38)  0.16 to 0.33 lb DF (0.125 to 0.25)	Suppression of lambsquarters, henbit, mustard, and chickweed.	PRE.  POST.	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. Allow a 50 day PHI. F1 F5 S12 Y19 Y24
Thistrol (MCPB)	2 to 6 pt (0.5 to 1.5)	Broadleaf weeds: Small.	POST. Pea: 3 nodes until prior to flowering.	Slight, temporary injury may occur. Do not apply when temperature exceeds 90 F or when peas are stressed. Suppresses Canada thistle. F1 F3
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 Basagran rate per season is 4 pt/A. Rezult provides economical weed control. Refer to Poast sections for additional information. F1 F2 S12
Rezult (Co-pack of bentazon + sethoxydim)	1.6 + 1.6 pt (1+ 0.2)	Grass and broadleaf weeds.		

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Pursuit Pursuit DG (imazethapyr)	2 fl oz 0.72 oz DG (0.5 oz)	Annual broadleaf weeds.  No control of ALS resistant kochia.	POST. Pea: At least 3 inches in height but prior to 5 nodes and <b>prior to flowering.</b>	User assumes all risk of crop injury. Apply only with NIS at 0.25% v/v. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply during stress conditions (cold/wet) or when stress conditions are predicted within one week of application. Allow a 60 day PHI. Refer to label for application information, weed size, crop rotation restrictions, and other use information. Raptor has a reduced risk of herbicide carryover as compared to Pursuit. Always add Basagran or Rezult to Raptor to safen Raptor and reduce risk of injury to field pea. A7 E6 E7 F1 S7 X1 Y2 Y24
Raptor + Basagran or Result (imazamox + bentazon/ sethoxydim)	4 fl oz + 6 to 16 fl oz (0.5 oz + 3 to 8 oz bentazon)	Annual grass and broadleaf weeds. No control of ALS resistant kochia.	Weeds: 2 to 6 inches.	
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Pea: Refer to PHI. 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 60 day PHI following Assure II. Allow a 30 day PHI following Poast. D5 D14 D24
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.		

**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. (0.19 to 0.75)	Emerged grass and broadleaf weeds. (0.19 to 0.75)	Harvest aid and desiccant.	Apply with AMS fertilizer. Refer to label for adjuvant use. For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will be killed in treated areas. Allow a 7 day PHI for broadcast and 14 day PHI for spot treatment. <b>Do not apply on field pea grown for seed because reduced germination/vigor may occur.</b> A4-6 A7 Q3
		Perennial weeds. (1.5 to 2.25)	Spot treatment.	
Gramoxone Max (paraquat)  RUP	0.83 to 1.25 pt (0.31 to 0.47)	Desiccant.	Harvest aid and desiccant.	Apply with NIS at 0.25% v/v. Allow a 7 day PHI. No not graze or feed treated plants. Refer to label for application information, weed size, crop rotation restrictions, and other use information. Q5

## CHICK PEA/GARBANZO BEAN AND LENTIL

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. (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. A4-6 G1 Q3
Far-Go (triallate) 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 mixture available: triallate + trifluralin = Buckle. A1 A3 B15 G1 G2 H1 Y24
Trifluralin (trifluralin)	Chickpea - 1 to 2 pt 5 to 10 lb 10G (0.5 to 1) Lentil - 1 to 1.5 pt 5 to 7.5 lb 10G (0.5 to 0.75)	Grass and some broadleaf weeds.	PPI.	Lentil tolerance to trifluralin is marginal. Injury may occur under stress conditions. Adjust rate according to soil type. No wild mustard and poor wild oat control. Refer to label for application and environment information. A1 G1 H1 H3 X1 Y20 Y24
Sonalan (ethalfluralin)  Chickpea Only	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 Magnum, Dual II Magnum (metolachlor) Chickpea Only	1 to 2 pt (1 to 2)		PPI or PRE.	PPI improves consistency of weed control. Refer to label for application information. A1 G1
Outlook (dimethenamid-P)  Lentils Only	16 to 21 fl oz (0.75 to 1)		PPI, PRE, or EPOST to third leaf 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 H1 S7
Pursuit Pursuit DG (imazethapyr)	2 fl oz 0.72 oz WDG (0.5 oz)	Annual broadleaf weeds.  No control of ALS resistant kochia.	PPI within one week of planting or PRE after planting until 3 days following planting.	User assumes all risk of crop injury. May tank-mix with registered grass herbicide. Reduced crop growth, quality, yield and/or delayed maturity may result. Do not apply during stress conditions (cold/wet) or when stress conditions are predicted within one week of application. Allow a 60 day PHI. Refer to label for application information, weed size, crop rotation restrictions, and other use information. A7 E6 G1 H1 S7 X1 Y2 Y24
Spartan (sulfentrazone) Section 18 Registration Pending  	2.67 to 5.33 oz WDG (0.125 to 0.25)	Annual small- seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, PPI, or PRE.	Adjust rate to soil type. Requires precipitation for activation. Temporary sunflower injury may occur in coarse, low organic matter soils with pH greater than 8.0. May give 6 to 8 weeks residual weed control. Refer to narrative for application information, crop rotation restrictions, and other information. D6 J4 G1 H1 S1 S5 S7 S8 S12 Y24

## CHICKPEA/GARBANZO BEAN AND LENTIL

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Sencor</b> (metribuzin)	<b>0.25 to 0.5 lb DF</b> (0.19 to 0.38)	Suppression of lambquarters, 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. Allow a 75 day PHI. H1 H2 S12 Y19 Y24
<b>Lentil Only</b>	<b>0.16 to 0.33 lb DF</b> (0.12 to 0.25)		POST.	
<b>Tough</b> (pyridate)	<b>1.5 pt</b> (0.94)	Pigweed, kochia, cocklebur, lambquarters, 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. Does not control wild buckwheat. G1 G3
<b>Chickpea Only</b>				
<b>Assure II</b> (quizalofop)	<b>8 to 10 fl oz</b> (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Crop: Refer to PHI. Grass: 2 to 6 inches tall.	Apply with oil adjuvant to actively growing weeds. Apply: Assure II with oil adjuvant at 1qt/A Poast with oil adjuvant at 1 qt/A Select with oil adjuvant at 1% v/v 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. Allow a 60 day PHI for Assure II. Allow a 50 day PHI for Poast. Allow a 30 day PHI for Select. D5 D14 D18 D24 G1 H1 X1
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt</b> (0.1 to 0.3)	Annual grasses.		
<b>Select</b> <b>Prism</b> (clethodim)	<b>4 to 8 fl oz</b> <b>8.5 to 17 fl oz</b> (1 to 2 oz)	Annual grasses and quackgrass.		
<b>Chickpea Only</b>				
<b>Preharvest Application</b>				
Glyphosate	<b>0.5 to 6 pt of a</b> <b>3 lb ae/gal conc.</b> or <b>0.4 to 4.8 pt of a</b> <b>3.7 lb ae/gal conc</b> or <b>0.38 to 4.56 pt</b> of a <b>4 lb ae/gal conc.</b> (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. Refer to label for adjuvant use. <b>Do not apply on field pea grown for seed because reduced germination/vigor may occur.</b> For spot treatment: Use a 2% solution, apply to perennial broadleaf weeds at or beyond the bud stage, and crop will be killed in treated areas. A4-6 A7 F4 Q3
		Perennial weeds.	Spot treatment.	
<b>Gramoxone Max</b> (Paraquat)	<b>1 to 1.3 pt</b> (0.375 to 0.49)	Desiccant.	POST. Allow a 7 days PHI.	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. Q5
<b>RUP</b>				

# 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. (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. A4-6 Q3
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. Q5
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. A1-3 J1 J3
	4.5 to 5.25 pt 20 to 22.55 lb 20G (4 to 4.5)		Fall PPI after October 15.	
Sonalan (ethalfluralin)	1.5 to 4.5 pt 5.5 to 17 lb 10G (0.55 to 1.7)	Foxtail suppression.	PPI. Spring. Fall: From October 1 to December 31.	No wild mustard and poor wild oat control. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. A1 E5 J1 J3 X1 Y20 Y24
	7.5 to 12.5 lb 10G (0.75 to 1.25)			For use in reduced or conservation tillage. Incorporate twice at 2 to 3 inches deep using a V-blade under-cutter or rotary hoe. For fall applications, incorporate once in the fall and once in the spring before seeding. A3 J1 J3 Y20 Y24
Sonalan (ethalfluralin) + 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 J1 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 Y6-7 Y22 Y24
	3 to 3.6 pt 2.1 to 2.5 lb DG (1.25 to 1.5)		EPP 30 days until 2 days prior to seeding.	For use in no-till sunflowers only.
	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. A1 A3 J1 J3 X1 Y1 Y20 Y24
Trifluralin	1 to 2 pt 5 to 10 lb 10G 0.83 to 1.67 lb 60DF (0.5 to 1)		PPI.	No wild mustard and poor wild oat control. PPI within 24 hours after application. May be tank-mixed with Eptam. Refer to narrative for rotational restrictions. A1 E5 J1 J3 X1 Y1 Y20 Y24
	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 E5 J1 J3

# SUNFLOWER

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Spartan</b> (sulfentrazone)  <b>Section 18 Registration Pending</b>  	<b>2.67 to 5.33 oz WDG</b> (0.125 to 0.25)	Annual small-seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, PPI, or PRE.	Make EPP application up to 30 days prior to planting. Adjust rate to soil type. Requires precipitation for activation. Provide adequate furrow closure at planting. Temporary sunflower injury may occur in coarse, low organic matter soils with pH greater than 8.0. May give 6 to 8 weeks residual weed control. Refer to narrative for application information, crop rotation restrictions, and other information. D6 J1 J4 S1 S5 S7-8 S12 Y24
<b>Assert</b> (imazamethabenz)	<b>0.6 to 0.8 pt</b> (0.19 to 0.25)	Wild mustard.	POST. Sunflower: Less than 8 leaves or 15 inches. Wild mustard: Prior to bloom.	Sunflower injury may occur when applied at high temperature and humidity. See narrative for rotational restrictions. Apply with NIS at 0.25% v/v. J1-2 Y2 Y6 Y24
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt</b> (0.1 to 0.3)	Annual grasses.	POST. Sunflower: Refer to PHI. Grass: Up to 6 inches tall.	Apply with oil adjuvant at 1 qt/A. Allow a 70 day PHI. See narrative for rates for different weeds. D14 D18 D24 J1 X1
<b>Select Prism</b> (clethodim)	<b>6 to 8 fl oz 12.8 to 17 fl oz</b> (1.5 to 2 oz)	Annual grasses and quackgrass.		
Glyphosate	<b>1 to 4 pt of a 3 lb ae/gal conc. or 0.8 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.</b> (0.19 to 0.75)	Annual and perennial grass and broadleaf weeds.	<b>Shielded Application ONLY.</b> Sunflower: Emergence through lay-by.	Apply only as a shielded application with pressure and volume to prevent contact with sunflower and minimize drift and off-site movement. Glyphosate will injure or kill all green plants except Glyphosate resistant crops. Refer to label for adjuvant use. Avoid drift. A4-6 Q3

## Preharvest Application

<b>Gramoxone Max</b> (paraquat)  <b>RUP</b>	<b>1 to 1.3 pt</b> (0.375 to 0.49)	Desiccant.	Backside of sunflower heads yellow and bracts turning brown. Seed moisture content under 35%.	For use on confectionery and oilseed varieties. Apply with NIS. Randomly sample 10 average heads for seed moisture. Allow a 7 day PHI. Q5
<b>Drexel Defol</b> (sodium chlorate)	<b>1 to 2 gal of a 6 lb/gal conc.</b> (6 to 12)			For use on confectionery and oilseed varieties. Thorough coverage of plant is essential. Apply aurally at 5 to 10 gpa or 20 to 30 gpa by ground sprayer.

## HERBICIDE RESISTANT SUNFLOWER

### CLEARFIELD (Imidazolinone Resistant) Sunflower

<b>Beyond</b> (imazamox)  <b>Section 18 Registration Pending</b>	<b>4 fl oz</b> (0.5 oz)	Annual broadleaf weeds including wild mustard and black nightshade.	POST. Sunflower: Refer to label.  Weeds: Small.	<b>Apply only to Clearfield (imidazolinone resistant) sunflower varieties.</b> Refer to label for weeds controlled, adjuvant use, tank-mix options, crop rotation restrictions and additional information. A7 J1 J5 S5 S7 Y1-2 Y24
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## 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. Q5
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. A1-2 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. Adjust rate according to soil type. Use highest rate allowed for nightshade control. Refer to narrative for rotational restrictions. A1 J3 X1 Y20 Y24
Sonalan (ethalfuralin)	1.5 to 3 pt 5.5 to 17 lb 10G (0.55 to 1.7)		PPI. Fall or Spring.	
Dual Magnum Dual II Magnum (metolachlor)	1 to 2 pt (1 to 2) 8 to 12 lb 25G (2 to 3)		PPI or PRE.	Poor wild mustard and wild oat control. PPI gives more consistent weed control. A1 E3
Poast (sethoxydim) Section 3 and Section 18 Registration Pending	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Safflower: Refer to PHI. Grass: Up to 8 inches tall.	Apply with oil adjuvant at 1 qt/A to actively growing weeds. Allow a 70 day PHI. See narrative for rates for different weeds. D14 D24 J1

### 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.
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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. (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. A4-6 Q3
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 K6 X1 Y20 Y24
Spartan (sulfentrazone)  Section 18 Registration Pending 	2.67 to 5.33 oz WDG (0.125 to 0.25)	Annual small-seeded broadleaf weeds including kochia, pigweed, lambsquarters, nightshade, and biennial wormwood.	EPP, PPI, or PRE.	Make EPP application up to 30 days prior to planting. Adjust rate to soil type. Requires precipitation for activation. Close furrow at planting. Temporary flax injury may occur in coarse, low organic matter soils with pH greater than 8.0. May give 6 to 8 weeks residual weed control. Refer to narrative for application information, crop rotation restrictions, and other information. D6 J4 K1 K5 S1 S5 S7-9 S12 Y24
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 on hard-to-kill weeds. Early application is less injurious to flax. K1 K4
Bromoxynil + MCPA	0.9 pt of a 4 lb/gal conc. or 0.8 pt of a 5 lb/gal conc. (0.23 + 0.23)			Apply to small weeds prior to bud stage of flax. Risk of flax injury. Commercial mixtures available: Bison, Bromac, Bronate Advanced K1-2 K4
Curtail M (clopyralid + MCPA)	1.33 to 1.75 pt (1.1 to 1.5 oz + 6.25 to 8.25 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. K1 K3 T2 Y21 Y24
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Flax: Refer to PHI. Grass weeds: Up to 6 inches tall.	Apply Poast at 1 qt/A or Select at 1% v/v 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. Allow a 75 day PHI. D14 D18 D24 K1 X1
Select Prism (clethodim)	4 to 5 fl oz 8.5 to 11 fl oz (1 to 1.25 oz)	Annual grasses.		

**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. (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 at least 10 to 14 days are allowed between application and harvest. Allow a minimum 7 day PHI. Apply with AMS fertilizer. Refer to label for adjuvant use. <b>Do not apply to flax grown for seed because reduced germination/vigor may occur.</b> A4-6 A7 Q1 Q3
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, AND CRAMBE

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. (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. A4-6 Q3
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. D20 K6 L1 Y1 Y20 Y24
Sonalan (ethalfuralin)	1.5 to 2.5 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. D20 K6 L1 Y20 Y24
Muster (ethametsulfuron)	0.3 oz (0.225 oz)	Broadleaf weeds including smartweed, wild mustard.	POST. Crop: 2- leaf until begin bolting. Weeds: Up to 6-leaf stage.	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. L1 L2 Y3 Y24
Stinger (clopyralid)	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. L1 L3 T2 Y21 Y24
Assure II (quizalofop)	8 to 10 fl oz (0.88 to 1.1 oz)	Annual grasses and quackgrass.	POST. Crop: Refer to PHI. Grass weeds: Less than 5 inches tall and actively growing.  Select/Prism: Crop: Prior to bolting.	See label or paragraph 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. Allow a 60 day PHI for Assure II and Poast. Allow a 75 day PHI for Select. Apply Assure II with oil adjuvant at 1% v/v. Apply Poast with oil adjuvant at 1 qt/A. Apply Select with oil adjuvant at 1% v/v. Do not apply Select at more than 5 fl oz/A/season. L1 D5 D14 D18 D24 X1
Poast (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)			
Select Prism (clethodim)	4 to 5 fl oz/ 8.5 to 11 fl oz (1 to 1.28 oz)			

## TAME MUSTARD

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. D20 K6 L1 Y1 Y20 Y24
Select Prism (clethodim)	4 to 5 fl oz/ 8.5 to 11 fl oz (1 to 1.28 oz)	Annual grasses and quackgrass.	POST. Crop: Prior to bolting and allow a 75 day PHI. Grass weeds: Up to 5 inches tall.	See label or paragraph for rates for different weeds. Avoid drift to small grain and desirable grass species. Allow a 75 day PHI. Apply Select with oil adjuvant at 1% v/v. Do not apply Select at more than 5 fl oz/A/season. L1 D18 D24 X1

## HERBICIDE RESISTANT CANOLA

### CLEARFIELD (Imidazolinone Resistant) CANOLA

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Beyond (imazamox)	4 fl oz (0.5 oz)	Annual grass and broadleaf weeds.	POST. Canola: Prior to bloom.  Grass and broadleaf weeds: Small.	<b>Apply only to Clearfield canola varieties.</b> Apply with NIS at 0.25% v/v plus UAN at 1 to 2 qt/A. Apply with Stinger for improved Canada thistle control. Refer to label for weeds controlled, application information, and crop rotation restrictions. Will not control ALS resistant kochia. Allow a 60 day PHI. A7 L1 L4 X1 Y2 Y24

### LIBERTY (Glufosinate) RESISTANT CANOLA

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs																																				
Liberty (glufosinate)	28 to 34 fl oz (0.37 to 0.44)	Annual broadleaf weeds and control or suppression of grasses.	POST. Canola: Cotyledon up to early bolting stage. Broadleaf weeds: Up to 3 inches tall. Grass weeds: See Remarks.	<b>Apply only to Glufosinate resistant canola varieties.</b> Allow a 65 day PHI. Apply with AMS fertilizer at 3 lb/A. Growth stage of grass weeds at application: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Grass weed</th> <th># leaves</th> <th>Inches tall</th> <th># tillers</th> </tr> </thead> <tbody> <tr> <td>Green foxtail</td> <td>1 to 6</td> <td>&lt;4</td> <td>2 or less</td> </tr> <tr> <td>Yellow foxtail</td> <td>1 to 4</td> <td>&lt;2</td> <td>prior to tillering</td> </tr> <tr> <td>Wild oat*</td> <td>1 to 4</td> <td>&lt;4</td> <td>1 or less</td> </tr> <tr> <td>Barnyardgrass</td> <td>1 to 6</td> <td>&lt;3</td> <td>1 or less</td> </tr> <tr> <td>Proso millet</td> <td>1 to 6</td> <td>&lt;3</td> <td>1 or less</td> </tr> <tr> <td>Vol. wheat*</td> <td>1 to 4</td> <td>&lt;4</td> <td>1 or less</td> </tr> <tr> <td>Vol. barley*</td> <td>1 to 3</td> <td>&lt;3</td> <td>---</td> </tr> <tr> <td>Vol. corn</td> <td>1 to 4</td> <td>&lt;6</td> <td>—</td> </tr> </tbody> </table> * = A second application may be required. Refer to label for additional information . Liberty is a non-residual, contact herbicide. Will control weeds resistant to other herbicides. A7 L1 L5 X1	Grass weed	# leaves	Inches tall	# tillers	Green foxtail	1 to 6	<4	2 or less	Yellow foxtail	1 to 4	<2	prior to tillering	Wild oat*	1 to 4	<4	1 or less	Barnyardgrass	1 to 6	<3	1 or less	Proso millet	1 to 6	<3	1 or less	Vol. wheat*	1 to 4	<4	1 or less	Vol. barley*	1 to 3	<3	---	Vol. corn	1 to 4	<6	—
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Vol. wheat*	1 to 4	<4	1 or less																																					
Vol. barley*	1 to 3	<3	---																																					
Vol. corn	1 to 4	<6	—																																					

### ROUNDUP (Glyphosate) RESISTANT CANOLA

Herbicide	Product/A (lb ae/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. (0.375 to 0.56)	Annual and perennial grass and broadleaf weeds.	POST. Canola: Emergence to bolting (5- to 6-leaf).  Do not apply after the 6-leaf stage or once bolting has begun or canola injury may occur.  Apply once or twice as needed.	<b>Apply only to glyphosate resistant canola varieties.</b> Apply with AMS fertilizer. Sprayer overlap may result in yellowing , delayed flowering , and growth reduction. Refer to label for adjuvant use. Do not apply more than 0.56 lb ae/A for each single in-crop application. Do not exceed 0.75 lb ae/A for the total multiple in-crop application. Allow a minimum interval of 10 days between applications. Allow an 8 week PHI. Avoid drift. May require multiple applications for weed flushes. 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. A4-6 L6 Q3 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. or 0.38 to 1.5 pt of a 4 lb ae/gal (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. A4-6 Q3
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 Q5
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 M7
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. A1-3 M1-2 M5-7 M15
	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. A1-3 M1-2 M5-7
	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. A1-3 M1-2 M5-6
	5.3 pt (4)		Fall incorporated after October 15 until freeze-up.	
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 M1-2
Nortron SC/ Etho SC (ethofumesate)	6 to 7.5 pt (3 to 3.75)	Good redroot pigweed and fair to good kochia control.	PPI or PRE.	Incorporation generally improves weed control. Band application reduces cost and risk of carryover into the next year. A1 M1-2 M9 Y16 Y24
	4 fl oz (0.125)	Improves broadleaf weed control, including kochia, pigweed, lambsquarters.	POST in combination with Progress, Betanex, or Betamix.	Crop rotation restrictions allow no more than two applications at 4 fl oz/A in combination with the micro-rate of Progress or no more than three applications at 4 fl oz/A in combination with any labeled rate or Betanex or Betamix. A1 M1-2 M9 Y16 Y24
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. Allow a 45 day PHI. M1-2 M13 M16 Y21 Y24
UpBeet (triflurosulfuron)	0.5 oz DF (0.25 oz)	Annual broadleaf weeds.	POST. Weeds: Cotyledon to 2- leaf.	Apply two or more times in combination with Betanex, Betamix, 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. Allow a 60 day PHI. M1-2 M14 M16

# SUGARBEET

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Betamix</b> (desmedipham + phenmedipham)	<b>0.75 to 7.5 pt</b> (0.06 to 0.6 + 0.06 to 0.6)	Annual broadleaf weeds.	POST. Sugarbeet: Cotyledon up to 8-leaf stage.  Broadleaf weeds: Cotyledon up to 4-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. Allow a 75 day PHI. M1-2 M4 M16
<b>Betanex</b> (desmedipham)	<b>0.75 to 7.5 pt</b> (0.12 to 1.2)			
<b>Progress</b> (desmedipham + phenmedipham + ethofumesate)	<b>0.56 to 5 pt</b> (0.04 to 0.38 + 0.04 to 0.38 + 0.04 to 0.38)			
<b>Betanex/ Betamix/ Progress + UpBeet + Stinger + MSO type oil adjuvant</b> (desm/desm&phen/ desm&phen&etho + triflurosulfuron + clopypalid)	<b>8 / 8 / 5.7 fl oz + 0.125 oz + 1.3 fl oz + 1.5% v/v</b> (0.08 + 0.004 + 0.03) <b>MICRO-RATE PROGRAM</b> The Betanex/ Betamix/Progress rate can be increased to 12/12/8.7 fl oz after sugarbeet has four leaves.	Annual broadleaf weeds.  Fair to good annual grass control.  Will not control 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 day intervals.	<b>Micro-rate Program</b> - Timely application is critical for success. A grass control herbicide at 1/3 normal rate can be added. Increasing the Stinger rate from 1.3 to 2.6 fl oz/A will improve lanceleaf sage control but may increase sugarbeet injury. 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. Allow a 75 day PHI. M1-2 M4 M8-9 M11 M13-14 M16
<b>Assure II</b> (quizalofop)	<b>8 to 10 fl oz</b> (0.88 to 1.1 oz) <b>10 fl oz</b> (1.1 oz)	Annual grasses.  Quackgrass.	POST. Sugarbeet: Refer to PHI. Annual grass weeds and vol. wheat or barley: 2 to 6 inches tall. Quackgrass: 6 to 10 inches tall.	Apply Assure II with oil adjuvant at 1% v/v. Apply Poast with oil adjuvant at 1 qt/A. Apply Select/Prism with oil adjuvant at 1qt/A. Treat quackgrass regrowth 4 to 10 inches tall. Apply with AMS or UAN fertilizer for greater control of certain grass species. See narrative for rates for different grass species. Allow a 45 day PHI for Assure II. Allow a 60 day PHI for Poast. Allow a 40 day PHI for Select. D5 D14 D18 D24 M1-3 M10 M16
<b>Poast</b> (sethoxydim)	<b>0.5 to 1.5 pt</b> (0.1 to 0.3)	Annual grasses.		
<b>Select Prism</b> (clethodim)	<b>6 to 8 fl oz 12.8 to 17 fl oz</b> (1.5 to 2 oz) <b>8 to 16 fl oz 17 to 34 fl oz</b> (2 to 4 oz)	Annual grasses.  Quackgrass.		
Trifluralin	<b>1.5 pt</b> (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 M1-2 M15 X1 Y20 Y24

# 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. (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. A4-6 Q3
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 Q5
Eptam (EPTC)	3.5 to 7 pt 15 to 30 lb 20G (3 to 6)  5.25 to 7 pt 22.5 to 30 lb 20G (4.5 to 6)	Grass and some broadleaf weeds.	PPI, Dragoff, or Directed spray at layby.  Fall: Incorporate after October 15 until freeze-up.	Incorporate immediately after application with tool set 4 to 6 inches deep. Weak on wild mustard. 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. A1-3 N1
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 Magnum Dual II Magnum Cinch (metolachlor)	1 to 2 pt (1 to 2)		PPI or PRE.	Allow a 40 day PHI. A1 N1 X1 Y1 Y20 Y24
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
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 N3 Y1 Y4 Y19 Y24
	0.33 to 0.67 lb DF (0.25 to 0.5)		POST. Weeds: Up to 1 inch tall.	<b>Only for russet type or white skinned varieties that are not early maturing.</b> 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 N3 Y19 Y24

# POTATO

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Matrix</b> (rimsulfuron)	1.5 oz DF (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 for activation. 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.
	1 to 1.5 oz DF (0.25 to 0.375 oz)	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. N1-3 X1 Y3 Y24
<b>Matrix + Sencor</b> (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.
			POST. Potato: Up to 14 inches tall. Annual weeds: Less than 1 inch tall.	Use the low rate of Sencor for PRE applications to coarse textured soil. Soil residual may injure susceptible crops the following year. N1-3 Y1 Y3-4 Y19 Y24
<b>Poast</b> (sethoxydim)	0.5 to 1.5 pt (0.1 to 0.3)	Annual grasses.	POST. Potato: Refer to PHI.	Apply with oil adjuvant at 1 qt/A. See narrative for rates to control different weeds. May be tank-mixed with Sencor. Allow a 30 day PHI.
<b>Select/Prism</b> (clethodim)	6 to 16 fl oz/ 12.8 to 34 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: 2 to 6 inches tall.	Allow a 30 day PHI. D14 D18 D24 N1 X1

## POTATO VINE DESICCATION

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
<b>Desiccate II</b> (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.
<b>Reglone</b> (diquat)	1 to 2 pt (0.25 to 0.5)		Allow a 7 day PHI.	Apply with a NIS. Diquat at 2 pt/A can be applied to all potatoes varieties and seed potato. Sequential application may be made up to a total of 3 pt/A. Allow at least 5 days between applications.
<b>Gramoxone Max</b> (paraquat) RUP	0.6 to 1 pt (0.23 to 0.375)		Allow a 3 day PHI.	<b>Paraquat use is for fresh market potatoes ONLY. Do not use paraquat on potatoes that will be stored or used a seed pieces.</b>
<b>Rely</b> (glufosinate)	48 fl oz (0.375)		Allow a 9 day PHI.	<b>Do not apply to potato grown for seed pieces.</b> Best results when applied at the beginning of natural potato vine senescence. Requires thorough coverage. Apply in 20 to 100 gpa by ground and 5 to 10 by air. Use higher spray volumes on dense potato vines.
Sulfuric acid RUP	20 gal		Allow a 5 day PHI.	Extremely corrosive.

# 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. (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. A4-5 Q3
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 Q5
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.
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 (0.25 to 0.38)		Refer to "Legume Forages - with companion crop".	Sweet clover may be killed. 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 (0.75 to 1 oz)	Annual broadleaf and grass weeds.	POST. Alfalfa: At least 2 trifoliolates. Weeds: 1- to 3-inches tall.	Excellent alfalfa safety. 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. A7 P3 Y2 Y24
Raptor (imazamox) For Alfalfa Only	4 to 6 fl oz (0.5 to 0.75 oz)			
Poast (sethoxydim)	0.5 to 1.5 pt (0.19 to 0.28)	Annual grasses.	POST. Alfalfa: Refer to PHI.	May be applied to alfalfa and sainfoin. Apply with oil adjuvant at 1 qt/A. See narrative for rates to control different weed species. Allow a 15 day PHI.
Select Prism (clethodim)	6 to 16 fl oz 13 to 34 fl oz (1.5 to 4 oz)	Annual grasses and quackgrass.	Grass weeds: 2 to 6 inches tall.	D14 D18 D24 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. A4-6 Q3
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 Q5
	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 Q5
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. P5
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. P4
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) For Alfalfa Only	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 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. A7 P3 Y2 Y24
Raptor (imazamox) For Alfalfa Only	4 to 6 fl oz (0.5 to 0.75 oz)			
Poast (sethoxydim)	0.5 to 1.5 pt (0.2 to 0.3)	Annual grasses.	Grass. Alfalfa: Refer to PHI.	Apply with oil adjuvant at 1 qt/A to actively growing grasses. Apply Select in two sequential applications sequential applications each at 8 fl oz/A for quackgrass control. Allow a 15 day PHI. D14 D18 D24 X1
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.	Grass weeds: 2 to 6 inches tall.	
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. (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 or longer after treatment. Non-selective, non-residual, systemic, foliar herbicide. Apply with AMS fertilizer. Refer to label for adjuvant use. A4 Q3

# 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. Q8 X1 Y1 Y20 Y24
Spartan (sulfentrazone)	2 to 5.33 oz DF (0.094 to 0.25)	Most small seeded broadleaf weeds.	Post harvest in fall until 4 month prior to planting.	Adjust rate according to soil type. Apply in fall prior to registered rotational crop (soybean and crops included in Section 18 registrations). May be applied in spring with glyphosate or 2,4-D for control of emerged vegetation. Apply with NIS at 0.125% v/v or PO at 1 to 2 pt/A for burndown applications. Refer to label for additional information. Q6 V1 Y24
Valor (flumioxazin) Future Planting of Wheat and Durum	2 to 3 oz WDG (0.063 to 0.094)		Post harvest in fall until 30 days prior to planting.	
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 V1 Y4 Y8 Y24
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. Q5
Aim (carfentrazone)	1/3 to 2/3 oz WDG 0.5 to 1 fl oz EW (0.128 to 0.24 oz)	Broadleaf weeds including pigweed and ALS kochia.	Weeds: Less than 2 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 S5 Q2 S7 X1
Ally/XP/Cimarron (metsulfuron)	1/10 oz DF (0.06 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. Cimarron Max = Ally/Cimarron + Weedmaster (2,4-D + dicamba) Refer to narrative for tank-mix herbicides and restrictions on preceding and follow-crop herbicides and rotation crops. A7 X1 Y3 Y24
Ally Extra (metsulfuron + thifensulf+tribenrn)	2/10 oz DF (0.075 oz met + 0.225 oz thif+trib)	Products containing tribenuron (Express Ally Extra and Harmony Extra) give season-long Canada thistle control.		
Cimarron Max (metsulfuron + 2,4-D + dicamba)	1/4 oz DF + 1 pt (0.15 oz + 0.36 + 0.125)			
Express/XP (tribenuron)	1/6 to 1/3 oz DF (0.125 to 0.25 oz)	Ally, Ally Extra, Cimarron/Max give season-long control of perennial sowthistle.		
Harmony GT/XP (thifensulfuron)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)			
Harmony Extra/XP (thifensulf+tribenrn)	3/10 to 6/10 oz DF (0.225 to 0.45 oz)			
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 Q1
Dicamba	0.5 to 1 pt (0.25 to 0.5)			Soil residual from fall application may damage broadleaf crops seeded the next year.
Weedmaster (dicamba + 2,4-D)	0.5 to 4 pt (0.25 to 2)			B2 B8 X1 Y13 Y24
Distinct (dicamba + diflufenzopyr)	6 oz WDG (3 oz + 1.2 oz)			Add NIS at 0.25% v/v + 28% UAN at 1.25 qt/A or AMS at 17 lb/100 gallons. 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. C14 Y13 Y24

# CHEMICAL FALLOW

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

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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. (0.19 to 1.5)	Annual and perennial grass and broadleaf weeds.	Weeds: Less than 12 inches tall. See label.	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. A4-6 A7 Q1 Q3 X1
RT Master GlyMix MT (glyphosate + 2,4-D)	0.75 to 4 pt (0.28 to 1.5 + 0.03 to 0.16)			Apply with NIS at 0.5% v/v and AMS fertilizer. Provides no residual weed control. Fallow Master provides greater control of kochia and wild buckwheat than glyphosate + 2,4-D products. Following Fallow Master, delay planting wheat, barley, oat, or sorghum for 15 days and 3 months for all other crops. Allow 1 day between application and tillage. A4-6 A7 Q1 Q3 X1 Y13 Y24
Landmaster BW (glyphosate + 2,4-D)	27 to 54 fl oz (0.19 to 0.38 + 0.32 to 0.63)			
Fallow Master (glyphosate + dicamba)	22 to 44 fl oz (0.19 to 0.38 + 0.08 to 0.17)			
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. B10 T2 T6 X1 Y21 Y24
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 T2-3 T6 T14 X1 Y1 Y22 Y24
Tordon 22K (picloram) + 2,4-D  RUP	0.5 to 1 pt + 1 to 2 pt (0.125 to 0.25 + 0.5 to 1)	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 gal/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested to use in a 3-year program with 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. May control foxtails, barnyardgrass, and volunteer flax. Q5 T1 Y17 Y24
Starane (fluroxypyr)	0.67 pt (2 oz)	Kochia including resistant biotypes.	Weeds: 4- to 8-inches tall.	No residual weed control. Controls ALS resistant and dicamba resistant kochia. Do not plant any crop for 120 days after application. B22 S5 X1

## PASTURE, RANGELAND AND CRP

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
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. (0.19 to 1.5)	Annual and perennial grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	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. Commercial mixtures available: glyphosate + 2,4-D = RT Master, GlyMix MT A4-6 Q1 Q3 X1
Cimarron (metsulfuron)	1/10 to 1 oz DF (0.06 to 0.6 oz)	Annual broadleaf weeds and suppression of some perennial species. Season- long control of per. sowthistle.	Fall or spring to early summer to weeds less than 4 inches tall.	Apply with phenoxy type herbicide to small annual weeds or before thistle plants bolt. Apply with NIS at 0.25 to 0.5 % v/v. Add 2,4-D for Russian thistle control. Use Cimarron Max for control of buckbrush and perennial species. T2 T11 X1 Y3 Y24 Z1
Cimarron Max (metsulfuron + 2,4-D + dicamba)	1/4 oz DF + 1 pt (0.15 oz + 0.36 + 0.125)	Annual, perennial weeds, and brush species including Canada thistle, per. sowthistle, other thistles, snow-berry or buckbrush.		Cimarron Max = Ally/Cimarron + Weedmaster (2,4-D + dicamba). The 0.25 oz + 1 pt rate will treat 20 acres. Apply with NIS at 0.25 to 0.5% v/v. Safe to most grass but refer to label for NIS rates for certain grass species. T2 T11 X1 Y3 Y24 Z1
Amber (triasulfuron)	0.28 to 0.56 oz DF (0.21 to 0.42 oz)	Annual broadleaf weeds including musk and Russian thistle.	Weeds: 2 to 6 inches tall.	Apply with NIS at 0.25 to 0.5% v/v. Control only above ground growth of Canada thistle, curly dock, musk thistle, and many other noxious weeds. May tank-mix with many other herbicides registered on pasture and rangeland. No grazing restrictions except for lactating animals. Do not cut hay for 30 days following application. Fuego = copack containing Amber 75DF + Clarity 4S. Y3 Y13 Y24 Z1
Fuego (triasulfuron + dicamba )	8 to 12 A/container 0.39 oz + 8.3 fl oz to 0.59 oz + 12.5 fl oz (0.29 to 0.44 oz + 0.25 to 0.39)	Partial control of perennial broadleaf weeds.		
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.	<b>DO NOT use on pasture and rangeland areas to be grazed or cut for hay.</b> Use an MSO type adjuvant at 2 pt/A. Provides only suppression of perennial broadleaf weeds. Q4 S1 S4 T1 Z1
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. Apply in mid-September for optimum control.	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. Rates above 8 fl oz/A can cause reduced grass production, especially cool-season grasses. Use lower rates in areas of low rainfall. High risk of injury to switchgrass. No grazing restrictions specified. Does not control absinth wormwood, Canada thistle, or spotted knapweed. T16 Y24 Z1
	4 to 8 fl oz for pasture, rangeland native prairie restoration and wildflower establishment. (1 to 2 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 NIS. 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 Z1
Stinger Transline (clopyralid)	1/3 to 2/3 pt (2 to 4 oz)	Broadleaf weeds including Canada thistle and knapweeds.	Weeds: Actively growing and prior to bud stage for thistles and knapweeds.	Apply after most thistle shoots have emerged but before bud stage. Do not apply Curtail to new grass seedings. Use lower rate for annual broadleaf weeds and higher rate for perennial thistles and knapweeds. Do not cut treated grass for hay within 30 days after application. T2 Z1
Curtail (clopyralid + 2,4-D)	4 to 8 pt (0.19 to 0.38 + 1 to 2 oz)			
Redeem (triclopyr + clopyralid)	Annual weeds = 1.5 to 2.5 pt Perennial weeds = 2.5 to 4 pt (0.4 to 1.1 + 0.15 to 0.4)	Annual and perennial weeds, brush, and trees.	Spring: Prior to bud stage for thistles and knapweed. Fall: To rosettes.	Apply with NIS at 0.25% v/v. 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 T13 Z1
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
Tordon (picloram)  RUP	0.25 to 0.5 pt (0.06 to 0.13)	Annual broadleaf weeds.	Weeds:	Use 0.25 to 0.5 pt/A for small annual weeds. Use 2 pt/A for suppression and 4 pt/A as spot treatment to control perennial weeds. Rates over 2 pt/A may suppress perennial grasses. Observe grazing restrictions.
	1 to 4 pt (0.25 to 1)	Perennial broadleaf weeds and trees.	Emergence to bud stage.	Apply with 2,4-D to provide cost-effective weed control. Commercial premix with 2,4-D is available = Grazon P+D. T2 T3 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. A4-6 T2 T3 Z1
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. Q5 Z1

## 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. (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. Commercial mixtures available; glyphosate + 2,4-D = RT Master, GlyMix MT A4-6 Q3
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 of a 4 lb/gal conc. or 0.8 to 1.6 pt of 5 lb/gal conc. (0.25 to 0.5 + 0.25 to 0.5)		POST: Grasses: 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. (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 bromegrass requires at least fall plus preplant spring applications of glyphosate and in-crop chemical and/or mechanical control for adequate season-long control. Always add AMS for improved weed control. Refer to label for adjuvant use. Allow 14 to 21 days prior to tillage. 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 <b>decrease grass control</b> . A4-6 Q3 R1
Glyphosate + 2,4-D	Landmaster BW = 54 fl oz (0.375 + 0.63)  RT Master GlyMix MT = 4 pt (1.5 + 0.16)			Always use AMS to overcome antagonism of 2,4-D on grass control. Will control perennial weeds, such as leafy spurge and Canada thistle. Formulated products are better than glyphosate applied alone but grass species are more tolerant. CRP grasses and forbs may become a problem in the planted crop. A1 A4-6 Q3 R1

# SPECIAL WEED PROBLEMS

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## 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. Dalmatian Toadflax
5. Musk thistle  
Extension Circular W-799, "Perennial and Biennial Thistle Control"  
Extension Circular W-1120, "Thistles of North Dakota"
6. 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"
7. Diffuse knapweed
8. Spotted knapweed
9. Russian knapweed  
Extension Circular W-1146, "Know your Knapweeds"
10. Purple loosestrife  
Extension Circular W-1132, "Identification and Control of Purple Loosestrife"
11. Saltcedar  
Extension Circular W-1223, "Saltcedar Identification and Control"
10. Yellow starthistle  
Extension Circular W-1222, "Yellow Starthistle Identification and Control"

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, noncropland, 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 Z1
Dicamba	1 to 2 pt (0.5 to 1)			DO NOT apply near trees. Apply with NIS. Observe grazing restrictions. T10 Y13 Y24 Z1
Tordon 22K (picloram) RUP	0.5 to 1 pt (0.125 to 0.25)	Pasture, rangeland, noncropland.		Tordon at 0.5 pt/A is the most cost effective. Refer to paragraph for grazing restriction. Use high rate for dense stands. T14 Y24 Z1
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. B10 Y21 Y24 Z1
	4 to 8 pt (0.19 to 0.38 + 1 to 2)	Pasture, rangeland and noncropland.		
Redeem (clopyralid + triclopyr)	1.5 to 2 pt (0.14 to 0.188 + 0.42 to 0.56)	Pasture, rangeland, and noncropland including CRP.		More cost-effective than Curtail at the same ai use rate. Apply with NIS. Observe grazing restrictions. T13 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. (0.19 - 0.75)	Trees, noncropland, 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 Q3 T7	
Landmaster BW (glyphosate + 2,4-D)	3.38 pt (0.38 + 0.63)	Noncropland 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 Q3 Z1	

## 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, noncropland, 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 Z1
Dicamba	1 to 2 pt (0.5 to 1)	Pasture, rangeland, noncropland, fallow or post-harvest.		Less effective than 2,4-D. Surfactant at 0.5% v/v may improve consistency of control. T10 Z1
Curtail (clopyralid + 2,4-D)	2.6 to 4 pt (0.125 to 0.19 + 0.75 to 1)			Good long-term control. Y21 Y24 Z1
Redeem (clopyralid + triclopyr)	2.5 to 4 pt (0.23 to 0.38 + 0.7 to 1.10.4)	Pasture, rangeland, and noncropland including CRP.		More cost-effective than Curtail at the same rate of clopyralid. Apply with NIS. Observe grazing restrictions. T13 Z1
Tordon 22K (picloram) RUP	2 to 4 pt (0.5 to 1)	Pasture, rangeland, and noncropland.		Observe grazing restriction. High rate will provide nearly 100% control for several years. Applying Tordon at lower rates with 2,4-D is more cost effective. T14 Y24 Z1
Tordon 22K + (picloram) 2,4-D ester RUP	1 + 2 pt (0.25 + 1)			Applying with 2,4-D ester with Tordon improves weed control rather than applying 2,4-D amine. T8 T14 Y24 Z1

## 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. (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 with AMS fertilizer. Refer to label for adjuvant use. 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. Apply at 2% concentration for patch spray. Refer to paragraph for additional information . A4-6 A18 Q3 T2-7 Z1
Express/XP (tribenuron) + 2,4-D + dicamba	1/3 oz DF + 0.75 pt + 2 fl oz (0.25 oz + 0.38 + 1 oz)	Wheat: Control of milkweed top-growth only.	Wheat: 2-leaf until prior to flag leaf emergence.	Do not apply with NIS. No crop rotation restrictions the following year. B14 S1 S5 T3 X1 Z1
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. T3-4 T6 T10 X1 Y13 Y24 Z1
Distinct (dicamba + diflufenzopyr)	4 to 6 oz WDG (2 to 3 oz + 0.8 to 1.2 oz)			Will not give complete control and will require retreatment. Q1 T3-5 Y13 Y24
2,4-D + Dicamba	2 pt + 0.5 pt (1 + 0.25)			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. Q7 T3 T14 Y24 Z1
Tordon 22K (picloram) + 2,4-D RUP	2 pt + 1 to 2 pt (0.5 + 0.5 to 1)	Pasture, rangeland, and noncropland.		Very long soil residual. Suppression only and retreatment is required. Avoid drift and contact with desirable plants. Apply with NIS at 0.25% v/v. T3
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.		

## CATTAIL

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks and Paragraphs
Rodeo Pondmaster (glyphosate)	4.5 pt of a 4 lb ae/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 an approved NIS for use in water - see the end of paragraph A4. Apply NIS at 0.75% v/v - 1 fl oz/gal for hand-held sprayer equipment. A4-6 Q3
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. (2.25)	Agricultural and noncropland sites other than those listed above.		Refer to label for adjuvant use. Apply with AMS fertilizer. Only the Rodeo formulation of glyphosate is approved for use in drainage and aquatic sites because the surfactants in other formulations injure or kill aquatic life. A4-6 Q3

# 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. or 3 pt of a 4 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 with higher rates of dicamba. A prepackaged mixture is available as Fallow Master. Apply with AMS fertilizer. Refer to label for adjuvant use. A4-6 Q1 Q3 Z1
Landmaster BW (glyphosate + 2,4-D)	3.38 pt (0.38 + 0.63)		Vines: 6 to 18 inches.	Suppression in patches or individual plants. Allow at least 7 days between application and tillage. Control is reduced under dry conditions. Add AMS to improve weed control. A4-6 Q1 Q3 Z1
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. T6 Z1
Express/XP (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. See section on herbicide resistance. No crop rotation restrictions the following year for Express/XP 3-way mix. Do not apply metsulfuron within 22 months from last metsulfuron treatment or on soils above a pH of 7.9. Refer to Ally/XP label for additional restrictions. B5 B11 B26 T6 Y3 Y13 Y24 Z1
Ally/XP (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)			
Aim (carfentrazone)	1/3 oz WDG 1/2 fl oz EW (0.128 oz)	HRS wheat, durum, barley, oat, and corn.	Small grains: Up to jointing stage. Corn: Up to 48 inches tall.	Contact, non-residual, foliar herbicide. Controls only bindweed top-growth. May cause cosmetic speckling/spotting on small grain and corn leaves. Apply with NIS at 0.25% v/v. Refer to label or narrative for tank-mix options, and application information. B4 C6 S5 S7 T6 X1 Z1
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. C24 T1 Z1
Dicamba	0.5 to 1 pt (0.25)		Corn: See remarks.	Apply 0.5 to 1 pt/A up to 8 inches tall. Apply 0.5 pt/A post-direct from 8 inches to 36 inches tall or 15 days prior to tassel. C11 T6 Z1
Glyphosate	8 to 10 pt of a 3 lb ae/gal conc. (3 to 3.75) 6 to 7.5 pt of a 4 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. A4-6 Q3 T4-6 Z1

**FIELD BINDWEED cont.**

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 gal/A may also be added to improve control but do not substitute for MSO. Apply after harvest but prior to frost. Suggested to use a 3-year program with 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. May control foxtails, barnyardgrass, and volunteer flax. Q4 T1 Y17 Y24 Z1
	0.5 lb DF (0.375)	Pasture, rangeland, and CRP.	Fall: Prior to frost Bindweed: At least 4 inches long and actively growing.	<b>DO NOT use on pasture and rangeland areas to grazed or cut for hay.</b> Use an MSO type adjuvant at 2 pt/A. Provides only suppression of perennial broadleaf weeds. T1 Z1
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. T4-6 T8 Z1
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. T4-6 T10 Z1
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 Y22 Y24 Z1
Dicamba	4 to 16 pt (2 to 8)	Patches or individual plants in pastures, fallow or noncropland.		Apply to foliage and/or soil. Consult label for grazing restrictions. Use low rate only in fall and high rates in dense or old stands. Addition of NIS improves consistency of control. Q1 T4-5 T10 Y13 Y24 Z1
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. T4-5 T14 Y22 Y24 Z1	
Paramount + (quinclorac) Distinct (dicamba + diflufenzopyr)	8 oz DF + 6 oz WDG (6 oz + 3 oz + 1.2 oz)	Noncropland.	Fall prior to a killing frost with at least 4 inches of stem.	<b>Do not hay or graze for 309 days following application.</b> Use an MSO type adjuvant at 2 pt/A. Q5 T1 T10 Z1

# 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/XP Ally Extra Harmony Extra/XP Express/XP Finesse Amber	1/10 oz DF 2/10 to 4/10 oz DF 1/2 to 6/10 oz DF 1/6 to 1/3 oz DF 2/10 to 3/10 oz DF 0.56 oz DF	Wheat, barley and pasture.	Thistle: Rosette to pre-bud stage. Wheat and barley.	Apply with 2,4-De + dicamba - refer to the herbicide listing in the "Hard Red Spring and Durum Wheat, Winter Wheat and Barley" section of this guide. Apply with NIS except when adding 2,4-D or MCPA ester at 0.75 pt/A. Express/XP and Harmony Extra/XP provide season-long Canada thistle control. Ally/XP and Ally Extra provide season-long perennial sowthistle control. See narrative for rotational restrictions. B5-6 B14 B16 T2 T6 Y1 Y3 Y24 Z1
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. B2 T6
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 Z1
	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 T6 T8 Z1
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.	<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 stems. Refer to narrative for control of Canada thistle using the rosette technique. See narrative for rotational restrictions. B10 T2 T6 T8 T16 Y21 Y24
Curtail (clopyralid + 2,4-D)	2 pt (0.09 + 0.5)	Fallow.	Crop: 4-leaf through jointing.	
	4 pt (0.19 + 1)		Thistle: Rosette until prior to bloom.	
Stinger (clopyralid)	0.25 to 0.67 pt (0.09 to 0.25)	Sugarbeet, wheat, barley, oat, corn.	Thistles: Rosette to pre-bud stage.	See narrative for rotational restrictions. High rates in pasture is very expensive but very effective. B10 M14 T2 Y21 Y24 Z1
	0.67 to 1.3 pt (0.25 to 0.5)	Pasture and rangeland.		
Hornet Hornet WDG (flumetsulam + clopyralid)	1.6 to 4 oz WDG 2 to 5 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. C22 T2 Y2 Y21 Y24
Accent Gold Accent Gold WDG (nicosulf + rimsulf + clopyralid + flumet)	2.9 oz DF 3.5 oz WDG (0.188 oz + 0.188 + 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. C5 T2 Y2-3 Y24
Dicamba	0.5 to 1 pt (0.25 to 0.5)	Corn.	Corn: EPOST up to 5 inches tall.	Do not apply more than 0.5 pt/A after corn is more than 5 inches tall. Can be applied 15 days prior to tasseling. C14 T2 Y13 Y24
Distinct (dicamba + diflufenzopyr)	6 oz WDG (3 oz + 1.2 oz)	Corn, fallow, and noncropland.	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. C14 T2 Y13 Y24
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 to 1.5 pt/A + liquid fertilizer. C19 T2
Basagran (bentazon)	1 to 2 pt (0.5 to 1)	Soybean, dry bean: Any stage. Field pea: More than 3 leaf pairs or 4 nodes.	Canada thistle: 6 to 8 inches tall.	Thorough coverage required. Apply with oil additive at 1 qt/A in two sequential applications. <u>Rosette technique</u> : Repeated in-crop applications control Canada thistle during the growing season but allow fall rosette growth. Refer to narrative for control of Canada thistle using the rosette technique. D7 E2 F2 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. (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.  Refer to label for adjuvant use. Apply with AMS fertilizer. Avoid drift to non-target plants. Crop will be killed in treated area. A4-6 Q3 T2 T4 T5 T7
	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. (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. (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 A4-6 Q3 T2 T4 T5 T7  Avoid spraying tree foliage. A4-6 Q3 T2 T4 U1 V1
Dicamba	2 to 4 pt (1 to 2)	Fall or post- harvest.	Thistle: At least 6 inches tall. Most effective when thistle is in the rosette stage.	Rotate to wheat, corn, soybean, or sorghum only. Residue may injure sensitive crops the following year. May be tank-mixed at a lower rate with 2,4-D or glyphosate to reduce soil residual. NIS improves consistency of control. C14 T2 T4-6 T10
	1 pt (0.5)	Pasture and rangeland.	Thistle: Rosette 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, noncropland, and fallow.	Thistle: Rosette to prebud stage. In fall to rosette following light frost but prior to a killing frost.	Refer to narrative for additional information. T2 T10 Z1
Transline (clopyralid)	0.67 to 1.3 pt (0.25 to 0.5)	Pasture, rangeland, CRP, and noncropland.		Redeem is more cost effective than Curtail at the same active ingredient use rate. Apply with NIS. Observe grazing restriction for lactating animals. T2 T13 T15 Z1  Apply with NIS at 0.25 to 0.5% v/v. Safe to most grass but refer to label for NIS rates for certain grass species. T2 T11 X1 Y3 Y24 Z1
Redeem (clopyralid + triclopyr)	2.5 to 4 pt (0.25 to 0.4 + 0.7 to 1.1)			
Cimarron Max (metsulfuron + 2,4-D + dicamba)	1/4 oz DF + 1 pt (0.15 oz + 0.36 + 0.125)			
Paramount (quinclorac)	0.5 lb DF (0.375)			
Tordon 22K (picloram)	0.5 to 2 pt (0.125 to 0.5)	Pasture, rangeland and fallow.	Thistle: 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. T2 T14 Y24 Z1
<b>RUP</b>	4 pt (1)	Patches of plants in pastures.	Thistle: Actively growing.	Consult reference for grazing restrictions. T2 T14 Z1

# 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 T10 Y13 Y24
Paramount (quinclorac)	0.5 lb DF (0.375)	Pasture, rangeland, and CRP.	Fall: Prior to frost Leafy spurge: actively growing.	<b>DO NOT graze or hay pasture and rangeland.</b> Use an MSO type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q4 T4 T5 T16 Z1
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 Z1
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. T4 T14 Z1
Tordon 22K + Plateau + 2,4-D + MSO type adjuvant (picloram + imazapic)	1 pt + 4 fl oz + 1 qt + 1 qt (4 oz + 1 oz + 16 oz)		Leafy spurge: True flower growth in spring. <b>Do not apply in fall.</b>	Addition of Plateau improves leafy spurge control. NDSU data: % control at 3 12 15 months after appl. Tordon + 2,4-D = 75 48 0 Tordon+Plateau+2,4-D = 92 83 75 Follow labels of all three herbicides used. Must apply only in spring when plants are in true flower. Some grasses may show temporary stunting mainly from Plateau. T5 T12 T14 Z1
Dicamba	4 pt (2)			Consecutive fall application for 3 to 5 years give good control. Surfactant improves consistency of control. T10
	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. Re-treatment necessary. Q1 Z1
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. T14 Z1
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. (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. Refer to label for adjuvant use. Add AMS fertilizer. A4-6 Q3 T4 T7
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.

## LEAFY SPURGE cont.

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
<b>Paramount +</b> (quinclorac) <b>Distinct</b> (dicamba + diflufenzopyr)	<b>8 oz DF +</b> <b>6 oz WDG</b> (6 oz + 3 oz + 1.2 oz)	Noncropland.	True flower of fall prior to frost.	<b>Allow 309 days before grazing and haying.</b> Use an MSO type adjuvant at 2 pt/A. Provides only suppression of leafy spurge. Q4
<b>Krenite</b> (fosamine)	<b>12 to 16 pt</b> (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.
<b>Rodeo</b> <b>Pondmaster</b> (glyphosate) (Listed Formulations Only)	<b>2 pt of a</b> <b>4 lb/gal conc.</b> (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. A4-6 Q3 T8
2,4-D amine	<b>2 to 4 pt of a</b> <b>4 lb/gal conc.</b> (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
<b>Landmaster BW</b> (glyphosate + 2,4-D)	<b>54 fl oz or</b> <b>3.38 pt</b> (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. A4-6 Q1 T8 Z1
<b>Plateau</b> (imazapic)	<b>8 to 12 fl oz</b> (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. 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 Z1
Cultivation		Cropland.	Leafy spurge: 2 to 4 inches tall.	Leafy spurge will not survive intensive tillage. Repeat when plants are 2 to 4 inches tall. T5
			Late fall.	Cultivate when plants are 3 to 6 inches tall on fallow or post-harvest in Sept. and again in Oct.
<b>Biological Control</b>	<b>Insects and Grazing</b>	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. T16 Z1

## 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
<b>Glypro, Rodeo</b> <b>Pondmaster</b> (glyphosate)	<b>1 to 1.5 gal/100 gal</b> <b>water or</b> <b>1.3 to 1.9 fl oz/gal</b> (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. A4-6 A17 Q3 T17
<b>Garlon 4</b> (triclopyr)	<b>1 to 2 gal/100 gal</b> <b>water (4 to 8)</b>			<b>Apply up to water edge. Do not allow herbicide to</b> <b>enter any body of water.</b> Does not affect cattail or desirable grass species. T17

# DIFFUSE, SPOTTED AND RUSSIAN KNAPWEED, AND YELLOW STARHISTLE

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

Extension Bulletin W-1222, "Yellow Starthistle Identification and Control" 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. B2 T6 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. B2 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 (clopyralid + 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. B10 T6 T15 Y20 Y24
	4 pt (0.19 + 1)	Fallow.	Weeds: Bud to bloom stage or fall.	
	6 to 8 pt (0.29 to 0.38 + 1.5 to 2)	CRP and pasture.		
Redeem (triclopyr + clopyralid)	1.5 to 2 pt (0.4 to 0.6 + 0.14 to 0.19) 2.5 to 4 pt (0.7 to 1.1 + 0.23 to 0.38)	Pasture, rangeland, CRP, and noncropland.	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. T13 T15 Z1  <b>Use high rates for Russian knapweed.</b>
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 Z1
Tordon 22K (picloram)  RUP	4 to 8 pt (1 to 2)		Any time during growing season.	Consult label for grazing restriction. <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. <u>For Russian knapweed:</u>
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.	Several years of annual treatment is necessary. Consult label for grazing restrictions. Commercial mixture of Tordon + 2,4-D = Grazon P+D. T8 T14 Y22 Y24
Plateau (imazapic)	8 fl oz (2 to 3 oz)	New or existing grass plantings in CRP or noncropland.	Rosette to bloom. Rosettes in the fall.	<u>For Russian knapweed and yellow starthistle only.</u> 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. See label for additional information. T12 T15
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. (1.5 to 2.25)	Fallow and noncropland.	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. Refer to label for adjuvant use. Add AMS fertilizer. A4-6 Q3 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)	2/3 oz DF (0.5)	Corn: Up to 36 inches tall. Drop nozzles must be used from 24 to 36 inches.	POST.	Apply with oil + nitrogen fertilizer or with basic blend adjuvant. Do not apply to corn previously treated with Counter 15G insecticide. May be applied with dicamba, atrazine, Hornet. See label or narrative for other tank-mix options, crop rotation restrictions, and additional information. A7 C3-5 X1 Y3 Y24
Steadfast (nicosulfuron + rimsulfuron)	3/4 oz DF (0.375 + 0.188 oz)	Corn: Up to 12 inches tall with 6 or fewer collars.		Apply with oil + nitrogen fertilizer or with basic blend adjuvant. See Accent above for insecticide use restrictions. Use caution on corn hybrids less than 88 day maturity. See label or narrative for tank-mix restrictions and crop rotation restrictions. A7 C2-5 X1 Y3 Y24
Assure II (quizalofop)	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: 4 to 10 inches tall.	Apply with oil adjuvant at 1qt/A. Make second application at 7 fl oz when quackgrass is 4 to 8 inches tall. D5 D24
Fusilade DX (fluazifop-P)	Split: 12 fl oz then 8 fl oz (3 oz/2 oz)	Soybean and trees.		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. D11 D24
Fusion (fluazifop-P + fenoxaprop-P)	Split: 12 fl oz then 8 fl oz (3 + 0.96 oz/ 1.92 to 0.64 oz)	Soybean.		
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. D14 D24
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 fl oz/A Select or 17 fl oz/A Prism then make second application at the same rate to new growth 2 to 3 weeks after emergence. D18 D24
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. (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. Refer to label for adjuvant use. Apply with AMS fertilizer. A4-6 Q3 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. (0.75)	Preharvest only in wheat and barley grown for seed and soybean.	Wheat: Hard-dough stage.	Refer to label for adjuvant use. Do not apply on wheat or barley grown for seed because reduced germination/vigor may occur. May be tank-mixed with 2,4-D. A4-6 Q3 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. A4-6 Q3 T4 T5 T7

## 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 of plants germinating in the spring. B2 B10 S2
Ally/XP Ally Extra Finesse Maverick Harmony GT/XP Harmony Extra/XP Express/XP	1/10 oz DF 2 to 4 oz DF 2/10 to 3/10 oz DF 2/3 oz DF 3/10 to 6/10 oz DF 3/10 to 6/10 oz DF 1/6 to 1/3 oz DF	Wheat and barley.	Refer to "HRS and Durum Wheat, and barley" section in this guide.	For information on 3-way tank-mixes 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. See narrative for information on resistant weeds and rotational restrictions. Apply with NIS at 1 pt/100 gallon water. B2 B5 B6 B14 B17 S2 X1 Y3 Y24
Cimarron Cimarron Max (Co-pack)	1/3 to 1/2 oz DF 0.25 oz DF + 1 pt	Pasture, rangeland, and noncropland.	Chamomile: Less than 6 inches tall.	Apply with NIS at 1 pt/100 gallon water. Cimarron Max is a co-pack of Ally/Cimarron + Weedmaster (2,4-D + dicamba) S2
Tordon 22K (picloram) RUP	1 to 1.5 pt (0.25 to 0.37)	Roadsides.		Use the higher rate on plants over 4 inches tall. Avoid drift to susceptible plants. S2 T14
Paraquat RUP	1.75 to 2.7 pt (0.66 to 1)	Tree rows or potholes.		Apply with a NIS. Avoid drift to non-target plants. S2
Glyphosate	2 pt of a 3 lb ae/gal conc. (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. A4-6 Q3 S2

## SALT CEDAR

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

Herbicide	Product/A (lb ai/A)	Weed Location	When to Apply	Remarks and Paragraphs
Arsenal (imazapyr)	1% solution to foliage or 2 qt/A aerial foliar application or 12 oz/gal as a cut stump treatment immediately after cutting	Wildlife openings and wildlands.	August or September but apply anytime saltcedar is found. Plants should have green leaves (foliar application).	Thoroughly wet foliage. Do not cut down and remove for at least three years following foliar treatment or regrowth will occur. Apply with MSO type adjuvant at 1 qt/A for foliar application or 0.5 to 1% for backpack sprayer or 0.25% v/v NIS. Avoid drift and contact with desirable plants. Do not contaminate surface water. T3

## YELLOW AND DALMATIAN TOADFLAX

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

# 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 is 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 (fluzifop-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. Apply with AMS. Avoid contact to 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 Q3	
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 weeds including kochia 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)	Apply with MSO at 2 qt/A. Controls many broadleaf weeds including leafy spurge. Can spray in and around tree species. Do not use on new plantings or seedling trees. Fall treatment will kill lilac and will cause temporary yellowing of spruce candles. Higher rates will reduce grass stands. Refer to label for list of tolerant tree species. Use 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 Transline (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 (0.5 to 1) 80 lb 5G (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. <b>Short residual.</b>	
Dicamba)	0.5 to 6 pt of a 4 lb/gal conc. (0.06 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. <b>Long residual.</b>	
Weedmaster (dicamba + 2,4-D)	0.5 to 4 pt (0.06 to 0.5 + 0.18 to 1.4)	Controls broadleaf weeds and woody plants. Apply when weeds are actively growing. Adjuvants may be used for wetting, penetration, or drift control. <b>Moderate residual.</b>	
Crossbow (triclopyr + 2,4-D)	2 qt to 4 gal/A (0.5 to 4 + 1 to 8)	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. <b>Moderate residual.</b> 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 NIS and another herbicide of a different mode of action. <b>Long residual.</b>	
Cimarron Max (metsulfuron + 2,4-D + dicamba)	0.25 to 1 oz DF + 1 to 4 pt (0.15 to 0.6 + 0.36 to 1.42 + 0.125 to 0.5)	Controls annual and perennial broadleaf weeds and brush. Apply with NIS. Cimarron Max is a co-pack of Ally + Weedmaster. The low rate (0.25 oz DF + 1 pt) will cover 20 acres, medium rate (0.5 oz DF + 2 pt) will cover 10 acres and high rate (1 oz DF + 4 pt) will cover 5 acres. Will not injure most grasses. No grazing restrictions for beef cattle. <b>Long residual.</b>	
Fuego (triasulfuron + dicamba )	8 to 12 A/container 0.39 oz + 8.3 fl oz to 0.59 oz + 12.5 fl oz (0.29 to 0.44 oz + 0.25 to 0.39)	Gives partial control of perennial broadleaf weeds. Apply with NIS at 0.25 to 0.5% v/v. No grazing restrictions except for lactating animals. Do not cut hay for 30 days following application. Fuego is a copack containing Amber 75DF + Clarity 4S. Y3 Z1	
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. (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, <b>non-residual</b> , systemic, foliar herbicide. Effective on annual and perennial grass and broadleaf plants. Avoid contact with desirable species. Refer to label for adjuvant use. Apply with AMS fertilizer. Commercial mixtures available: glyphosate + 2,4-D = Landmaster BW, RT Master, GlyMix MT glyphosate + dicamba = Fallow Master A4-6 Q3	
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. Q4	
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. <b>Long residual.</b>	
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. <b>Long residual.</b>	
Starane (fluroxypyr)	0.67 to 1.13 pt (0.125 to 0.25)	<b>Non-residual</b> 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. <b>Long residual.</b>	

## TOTAL VEGETATION WEED CONTROL

Herbicide	Product/A (lb ai/A)	Remarks	Refer to Paragraph V2
<b>Diuron/Direx</b> Karmex (diuron)	<b>1 to 8 gal</b> <b>5 to 15 lb</b> (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 retreatment. <b>Long residual.</b>	
<b>Hyvar X, Hyvar DF</b> (bromacil)	<b>3 to 15 lb DF</b> (2.4 to 9.6)	Use 3 to 6 lb DF for annual grass and broadleaf weeds or 7 to 15 lb for perennial weeds. Non-corrosive, nonvolatile, nonflammable. Refer to label for tank-mixes. <b>Long residual.</b>	
<b>Finale</b> (glufosinate)	<b>3 to 6 qt</b> (0.75 to 1.5)	Non-selective, <b>non-residual</b> 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.	
<b>Glyphosate</b>	<b>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.</b> (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, <b>non-residual</b> , systemic herbicide. Effective on annual and perennial grass and broadleaf plants. Commercial mixtures available: glyphosate + 2,4-D = Landmaster BW, RT Master, GlyMix MT glyphosate + dicamba = Fallow Master A4-6	
<b>Paraquat</b> <b>RUP</b>	<b>2 to 2.7 pt</b> (0.75 to 1)	Non-selective, <b>non-residual</b> , contact. Controls top-growth only of perennial species. Add NIS and repeat application as necessary. Avoid drift and contact with desirable species.	
<b>Krovar</b> (bromacil + diuron)	<b>4 to 30 lb DF</b> (3.2 to 24)	Control of annual grass and broadleaf weeds. Apply PRE or early POST. Refer to label for registered tank-mixes. <b>Long residual.</b>	
<b>Oust/XP</b> (sulfometuron)	<b>2 to 4 oz DF</b> (1.5 to 3 oz)	Use high rate in high moisture areas except in residential properties. Will control leafy spurge at 3 oz/A. Do not spray near water. <b>Long residual.</b>	
<b>Plateau</b> (imazapic)	<b>8 to 12 fl oz</b> (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	
<b>Pramitol 25E</b> (prometon)	<b>5 to 10 gal</b> (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. <b>Long residual.</b>	
<b>Total</b> (bromacil + diuron + Na-chlorate + Na-borate)	<b>0.5 to 2 lb/100 sq. ft.</b> (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. <b>Long residual.</b>	
<b>Sahara</b> (imazapyr + diuron)	<b>3 to 4 A/copack or 6.5 to 13 lb DF</b> (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. Apply Topside 2.5G prior to weed emergence at 0.5 to 0.7 lb 2.5G/100 sq. ft. Can be tank-mixed with Roundup, Finale, Krovar, Hyvar X, Oust, Garlon, and Clarity.	
<b>Topside</b> (imazapyr + diuron)	<b>200 to 300 lb 2.5G</b> (1 to 1.5 + 4 to 6)	Do not apply with 2,4-D due to reduced weed control. <b>Long residual.</b>	

## 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 that 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 products, Lasso, Nortron SC, Outlook 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 products 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 herbicides 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 products, 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 products, Eptam, Far-Go, and Ro-Neet, Surpass 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 (trilalate) 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

Rainfall shortly after POST herbicide application reduces weed control because herbicide is washed off the leaves before absorption is complete. The amount and intensity of rainfall influence the amount of herbicide washed off 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.

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 range. The lowest rate of POST herbicides will be effective under favorable growing conditions and when weeds are small and actively growing. Use the highest labeled rate under adverse conditions and 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. Glyphosate is not sensitive to UV light but research has shown reduced weed control if glyphosate is applied after 4:00 pm or before 10:00 am.

Ideal temperatures for applying most POST herbicides are between 65 and 85 F. Weeds may be 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 may influence crop safety and weed control from herbicides. 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. Herbicides may be sprayed following cold night-time temperatures if day-time temperatures warm to at least 60 degrees.

Wild oat is more sensitive to fenoxaprop (Puma) during cool rather than warm/hot conditions. Green and yellow foxtail are warm season grasses and may shutdown under cold conditions resulting in reduced control. Grass and broadleaf weeds are controlled more effectively when plants are actively growing. Cool or cold conditions at and following application of Achieve and products containing fenoxaprop give greater grass weed control but also may cause crop injury. Other ACCase herbicides of Assure II, Poast, Fusilade DX, and Select provide better grass control in warm weather when grasses are actively growing.

Cold temperatures, including freezing conditions following application of ALS herbicides, Sencor, and bromoxynil may increase crop injury of respective crops with little effect on weed control.

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 is slowed when cold temperatures follow application.

## A4 - POST APPLIED HERBICIDES

Recommendations for applying products containing fenoxaprop, ALS herbicides, 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. 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 products at 8.5 lbs/100 gal water or 1 lb/A if less than 12 GPA. Addition of AMS increased weed control even under good growing conditions and/or lack of salts in water. Allow sufficient time for AMS to dissolve before application.

### NIS Approved for use in Water:

Only the Glypro, Pondmaster, and Rodeo formulations of glyphosate can be applied on water because their adjuvants are not toxic to fish and aquatic life. For any herbicide used in and around water, add only approved surfactants for effective weed control.

Some surfactants labeled for use in and around water are: Activate Plus, Agridex, Class Act NG, Induce, Liberate, LI-700, Preference, R-11, Widespread, and X-77.

### Registered Glyphosate Products:

Trade Name	Manufacturer	Active ingredients	lb ai or ae/gal	Adjuvant Load*
Acquire	BASF	glyphosate-ipa	3	Partial
Aquamaster	Monsanto	glyphosate-ipa	4	None
Backdraft	BASF	imazaquin+gly-ipa	.25+1.25	None
Campaign	Monsanto	gly-ipa + 2,4-D-ipa	1.2 + 1.9	None
Cornerstone	Agrillance	glyphosate-ipa	3	Partial
Credit System	NuFarm	glyphosate-ipa	3	Partial
Debit TMF	NuFarm	glyphosate-ipa	4	None
Engame	UAP	gly-acid +AMADS**	1.23+9.1	Partial
Expert	Syngenta	s-meto+atra+gly		None
Extreme	BASF	imazethapr+gly-ipa	0.17 + 2	None
Fallowmaster	Monsanto	gly-ipa+dicmb-acid	1.1 + 0.5	None
Fallow Star	Albaugh	gly-ipa+dicmb-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
GlyMix MT	Dow	gly-ipa + 2,4-D-ipa	3+ 0.32	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
Glyphosate VMF	DuPont	glyphosate-ipa	4	None
Glypro	Dow	glyphosate-ipa	4	None
Glypro Plus	Dow	glyphosate-ipa	3	Partial
Gly Star 5	Albaugh	glyphosate-ipa	3.7	Partial
Gly Star Original	Albaugh	glyphosate-ipa	3	Partial
Gly Star Plus	Albaugh	glyphosate-ipa	3	Full
Landmaster BW	Monsanto	gly-ipa+2,4-D-ipa	0.9 + 1.5	None
Land Star	Albaugh	gly-ipa+2,4-D-ipa	0.9 + 1.5	None
Mad Dog	AGSCO	glyphosate-ipa	3	Partial
Mirage	UAP	glyphosate-ipa	3	Partial
Protocol	Monsanto	glyphosate-ipa	3	Partial
Rattler	Helena	glyphosate-ipa	3	Partial
ReadyMaster ATZ	Monsanto	atrazine + glyphosa	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
RU UltraDry	Monsanto	glyphosate-NH3	65%	Full
RU UltraMax	Monsanto	glyphosate-ipa	3.7	Full
RU WeatherMax	Monsanto	glyphosate-K	4.5	Full
RT Master	Monsanto	gly-ipa + 2,4-D-ipa	3 + 0.32	Partial
Silhouette	Various	glyphosate-ipa	3	Partial
Touchdown	Syngenta	glyphosate(2)(NH3)	3	Full

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

\*\*AMADS = 1-aminomethanamide dihydrogen tetraoxosulfate (Monocarbamide dihydrogen sulfate)

Many other products containing glyphosate are registered in North Dakota. Refer to the following web site for a list: <http://www.kellysolutions.com/nd/>.

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

SPRAY ADJUVANTS - A5

Herbicide	Time Interval	Herbicide	Time Interval
Accent	4-6 hr	Liberty ATZ	4 hr
Accent Gold/WDG	6 hr	Lightning	1 hr
Achieve/Liquid	1 hr	Lorox	6-8 hr
Aim DF/EW	1 hr	Lumax	4 hr
Ally/XP / Cimarron	4 hr	MCPA amine	4 hr
Ally Extra	6 hr	MCPA ester	1 hr
Amber	4 hr	Marksman	4 hr
Assert	3 hr	Matrix	4 hr
Assure II	1 hr	Maverick	4 hr
Atrazine	4 hr	Muster	4-6 hr
Avenge	6 hr	Northstar	4 hr
Basagran	4 hr	Option	2 hr
Basis	4 hr	Paramount	6 hr
Basis Gold	4-6 hr	Peak	1 hr
Betamix/Betanex	6 hr	Permit	4 hr
Beyond	1 hr	Phoenix	2 hr
Bromoxynil	1 hr	Plateau	1 hr
Bronate Advanced	1 hr	Poast	1 hr
Butyrac 200	6 hr	Prism	1 hr
Callisto	1 hr	Progress	6 hr
Celebrity Plus	4-6 hr	Pursuit	1 hr
Cimarron Max	4 hr	Puma	1 hr
Clarity	6-8 hr	Raptor	1 hr
Cobra	0.5 hr	Rave	4 hr
Curtail/M	6 hr	ReadyMaster ATZ	4 hr
Dakota	1 hr	Redeem	2 hr
Desiccate II	5 hr	Reflex	1 hr
Dicamba	6-8 hr	Reglone	0.5 hr
Distinct	4 hr	Rely	4 hr
Discover	1 hr	Remedy	6-8 hr
Diquat	0.5 hr	Rezult	4 hr
Engame	4-6 hr	RT Master/GlyMixMT	4-6 hr
Everest	1 hr	RU Custom	4-6 hr
Express/XP	4 hr	RU Original/RT	4 hr
Extreme	1 hr	RU Private Labels	4-6
Finesse	4 hr	Roundup Ultra Max	1 hr
FirstRate	4 hr	RU Weather Max	0.5 hr
Flexstar	1 hr	Select	1 hr
Fuego	4 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
Glean	4 hr	Stinger	6 hr
Glyphosate (Full adj.)	1 hr	Storm	6 hr
Glyphosate (Part adj.)	4 hr	Teamwork	1 hr
Glyphosate (No adj.)	4-6 hr	Tordon 22K	6-8 hr
Goal	1 hr	Touchdown 3	1 hr
Gramoxone Max	0.5 hr	Ultra Blazer	6 hr
Harmony Extra/XP	4 hr	UpBeet	6 hr
Harmony GT/XP	4 hr	Weedmaster	6-8 hr
Hornet/WDG	6 hr	2,4-D amine	4 hr
Landmaster BW	6-12 hr	2,4-D ester	1 hr

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.

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. An adjuvant may increase weed control from one herbicide but not from another. Comparisons of adjuvants should be made at marginal control levels to determine the effectiveness of adjuvants for specific herbicides, sprays, water 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.

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 an effective adjuvants from the list.

Commercial adjuvant effect on Roundup/Honcho (glyphosate) phytotoxicity to selected grass and broadleaf plants<sup>a,b</sup>.

Adjuvants	1992-1995 <sup>a</sup>		1993-1995 <sup>a</sup>		
	Grass	Brdlf	Grass	Brdlf	Grass (range)
----- % control -----					
<b>Surfactants</b>					
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
<b>Surfactant + Fertilizer</b>					
Cayuse+R-11	--	--	82	66	66-94
Class Act	--	--	90	75	80-98
Dispatch	--	--	85	69	73-91
Surfate	--	--	89	75	71-97

## A5 - SPRAY ADJUVANTS

<sup>a</sup>Data 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.

<sup>b</sup>In 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.

**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.

**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, 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.

AMS at 8.5 to 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. Use at least 1 lb/A of AMS when spray volume is less than 12 gpa. Ammonium ions also are involved in herbicide absorption and have enhanced phytotoxicity of many herbicides in 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.

**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 pH 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 pH blend adjuvants also reduce precipitation problems with Betamix/Betanex/Betamix Progress plus UpBeet at low rates by increasing water pH. They contain nitrogen fertilizer to overcome antagonistic salts; a surfactant to aid in spray retention, spray deposition, and herbicide absorption; and a buffer to increase pH.

Research has shown that basic pH 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.

**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. Water with 1600 ppm sodium bicarbonate occur, but antagonism of above herbicides was noticeable at or above 300 ppm. The antagonism is related to the salt concentration. At low salt levels, loss in weed control may not be noticeable under normal environmental conditions. However, antagonism from low salt levels will cause inadequate weed control when weed control is marginal because of drought or partially susceptible weeds.

High salt levels in spray water can reduce weed control in nearly all situations. Calcium and, 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).

Analysis of spray water sources will determine 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% (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.

## A7 - USING HERBICIDES AT REDUCED RATES

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. Generally, 4 gal of 28% UAN/100 gal of spray has been adequate. The 28% UAN fertilizer overcomes mineral antagonism of most herbicides, but not glyphosate.

AMS and 28% UAN enhance herbicide control of certain weeds even in water without salts. This is especially true for glyphosate, sulfonylurea (SU) herbicides, 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.

Water samples can be tested at the following laboratory: NDSU Soil and Water Environmental Laboratory, 701 231-7864, Waldron 202, NDSU, Fargo, ND 58105-5575. Complete analysis approximately \$25.00.

## A7. USING HERBICIDES AT REDUCED RATES

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

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

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

**Adjuvants.** Most POST herbicides require addition adjuvants such as surfactants, crop oils, methylated seed oils or fertilizer. See section on spray adjuvants for more information. Adjuvant information is fairly general on labels to cover adequate weed under most situations. 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.** Special knowledge of the best application method for a specific herbicide and situation may allow a reduction in herbicide rate.

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

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

**Are Low Rates Legal?** A herbicide user can legally choose a rate lower than listed on the herbicide label unless the label specifically prohibits low rates. However, the company has no obligation to support 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 sulfonylurea 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:**

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

**Kerosene or diesel fuel followed by ammonia + water:**

2,4-D ester

**Ammonia or commercial tank cleaner + water:**

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

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

**Detergent + water:** Aim, Atrazine, and Sencor.

**Commercial tank cleaner + water:**

Alexstar, Liberty, Liberty ATZ, Shotgun, and Touchdown

**Detergent or commercial tank cleaner + water:**

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

**Ammonia, commercial tank cleaner, or detergent + water:**

Poast.

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

**A9. SPRAY AND VAPOR DRIFT**

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

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

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

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

**Spray shields:** Small plastic cones that fit around individual nozzles reduce drift by approximately 25 to 50% and spray shields 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.

**Drift control:** Spray drift can be reduced by increasing droplet size and 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.

**Drift-Reducing Nozzles:** Several sprayer nozzles designed to reduce spray drift are available. These nozzles increase spray droplet size and reduce the number of small droplets. These drift-reducing nozzles are flat-fan types and are adapted for conventional spray equipment. The two primary types of drift-reducing nozzles are pre-orifice and veturi designs.

## A9 - SPRAY AND VAPOR DRIFT

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

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

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

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

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

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

**Herbicide performance.** NDSU research has demonstrated weed control from Roundup Ultra, Raptor, Pursuit, Distinct, Assure II, and Poast to be similar when applied through drift-reducing nozzles or standard flat-fan nozzles. The same results

were observed with fast acting contact herbicides of Gramoxone Extra and Aim. Reflex applied with drift-reducing nozzles was the only herbicide examined in which weed control was found to be slightly less as compared to a standard nozzle. All other herbicides gave similar control regardless of nozzle.

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

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

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

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

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

### A10. FIELD INVESTIGATION OF CROP INJURY:

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

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

North Dakota law requires that a "Report of Loss" form and a "Proof of Service" form must be completed and filed with the ND Dept of Ag, the applicator, within 60 days from the occurrence of the herbicide damage and prior to the time when 50% of the crop is harvested. Failure to file the forms can result in loss of the right to pursue court action to recover damages. Forms can be obtained from the ND Dept. of Agriculture, 600 E. Boulevard, Bismarck, ND 58505-20020. (800) 242-7535 or (701) 328-2231.

The Plant Diagnostic Lab at NDSU will analyze samples and evaluate injury symptoms to provide an opinion on the cause of the problem. The PDL can test soil for Pursuit and Raptor residues. Also, glyphosate residue in plant tissue can be analyzed. Fee for the glyphosate test is \$325/sample, with a \$50/sample discount for multiple samples submitted at one time. Glyphosate residues can be detected to 0.05 ppm which is lower than the 0.1 ppm threshold.

Analysis of plant tissues or soil by a testing laboratory may not provide a definitive answer to the cause of the problem. Each active ingredient must be tested individually which increases expense. A positive detection can be useful but the detected herbicide may not have caused the symptoms. A negative test does not prove that the herbicide did not cause the problem 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. Refer to "Herbicide Carryover" section for list of testing labs.

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

Drift is nearly always worse near the source of the drift with damage becoming less as the distance becomes greater. Lessening of injury with distance may not be evident shortly after the drift has occurred but the differences should become more visible with time since 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.

## A11. GROUNDWATER CONTAMINATION:

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**mulsifiable 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, bromoxynil+MCPA, 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.

**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		
	Mancozeb	Mancozeb	Tilt
Aim, Ally/XP, Ally Extra, Amber, Assert, Avenge, Curtail/M, dicamba, Discover, Express/XP, Finesse, Glean, Harmony Extra/XP, Harmony GT/XP, MCPA, Peak, Puma, Starane =			
	Not Prohibited	Yes, if required	Not Prohibited
Achieve	PROHIBITED	PROHIBITED	PROHIBITED
Bromoxynil + MCPA	See Product Bulletin 2ee	Not needed	Not Prohibited
Bromoxynil	See Product	Not needed	Not Prohibited
Cheyenne	PROHIBITED	PROHIBITED	PROHIBITED
Dakota	See Dakota label	PROHIBITED	Not Prohibited
Stampede	See current label	Oil additive only	PROHIBITED
2,4-D	Not Prohibited	Not Prohibited	Yes, if required

**A15. HERBICIDE + LIQUID-FERTILIZER COMBINATIONS**

require thorough mixing and continuous, vigorous agitation to obtain even application. Some herbicide + fertilizer combinations will not form a uniform mixture even with thorough agitation. 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. Shake after mixing.

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

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

Dual products, EPTC, Surpass, Achieve, Maverick. Most dry formulated herbicides in DF or WDG formulations.

**Do not store below 40 F**

Assert, Avenge, Campaign, Command, Discover, Extreme, FallowMaster, Galaxy, Landmaster BW, Lariat, LI-700, Nortron, Prowl, Pursuit Plus, Pyramin, Sonalan HFP, Treflan, Tri-4.

**Do not store below 32 F**

Agri-Dex, Basagran, Confront, Far-Go EC, Flexstar, Freedom, Goal, paraquat, Grazone P+D, Hyvar, Kerb, Lasso, Liberty, Liberty ATZ, Lorox DF, Poast, Pramitol, Progress, Puma, Pursuit, Quest, Raptor, Redeem, Reflex, Reglone, Stampede 80EDF, Stinger, Thistrol, Ultra Blazer, Velpar.

**Do not store below 20 F**

DoublePlay, Fusilade DX, Plateau, Ro-Neet, Weedar 64

**Do not store below 16 F**

Camix and Lumax

**Do not store below 10 F**

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

**Do not store below 3 F**

Atrazine 4L, Low Vol ester, Bronate Advanced, bromoxynil, bromoxynil + Atrazine, Shotgun.

**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:  $3 \text{ pt/A} / 65 \text{ gpa} = 0.046 \text{ pt}$  or 0.73 fl oz or 1.5 Tbsp/gal of spray solution (16 fl oz = 1 pt, 2 Tbsp = 1 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 Tbls = 1 cup				
1 Tbls = 3 tsp	1 fl oz = 30 mls				
1 Tbls = 15 ml	1 fl oz = 2 Tbls				

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

### 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/Liquid** (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 or 6.9 fl oz Liquid applied POST controls green and yellow foxtail, wild and volunteer tame oat, Persian damel, 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 damel, and 1- to 6-leaf wild oat. Forage grasses have good tolerance to Achieve. Grass weed control may be poor and retillering may occur if plants are stressed at application.

Apply Achieve at 10 to 15 gpa by ground or 3 to 5 gpa by air. Use of water volumes higher than listed may result in reduced grass weed control. Achieve 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/XP, 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 five or more days before the broadleaf herbicide.

**B4.** **Aim** (carfentrazone) at 0.33 oz 75DF/A or 0.5 fl oz 2EW applied POST controls small (1 to 2 inch) 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. Aim may be tank-mixed with most herbicides registered in wheat. See label of tank-mix partner for tank-mixing instructions. 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 primarily by humidity and moisture. Higher humidity and moisture at application increase risk of leaf burn but usually the crop quickly recovers. Data shows that Aim may be safened when tank-mixed with SU herbicides. Aim may provide top-growth control of field bindweed.

**B5.** **Ally/XP** (metsulfuron) at 0.1 oz 75DF/A or **Ally Extra** (metsulfuron + thifensulfuron + tribenuron) at 5 to 10 A/pack applied POST controls broadleaf weeds in wheat and barley and should be applied with another broadleaf herbicide to reduce development of resistant weeds. Burndown or speed at which weeds are killed is faster with Ally/XP and Ally Extra than other SU herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Tank-mixing with organophosphate insecticides increases crop injury potential. Do not apply to soils with a pH greater than 7.9. 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. Metsulfuron residue may persist in the soil for 3 years or more. Refer to the herbicide residue section and carryover and re-cropping restrictions. See section on Harmony Extra/XP for additional information.

**B6.** **Amber** (triasulfuron) at 0.28 to 0.35 oz 75DF/A or **Rave** (triasulfuron + dicamba-Na) applied POST at 2 oz WDG/A in barley and 4 oz WDG/A in wheat applied POST controls several broadleaf weeds plus 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. Apply Amber with other broadleaf herbicides to prevent resistant weeds. Do not apply Amber or other similar mode of action herbicides within a 12 month period after application. Apply with a NIS at 0.12 to 0.25% v/v to Amber depending on the tank-mix herbicide and rate. Amber can be tank-mixed with all OP insecticides except malathion. 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 and Rave 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 applied POST controls wild mustard and wild oat control in wheat and barley. Apply Assert to 1- to 4-leaf wild oat to wheat and barley in the 2-leaf to jointing stage. Assert also suppresses wild buckwheat that have 3 leaves or fewer. Assert has provided more consistent wild oat control in hot, droughty than other POST wild oat herbicides. Apply with MSO type oil for greater and more consistent weed control. Refer to herbicide residue section for information on rotational crop restrictions.

Spray solution incompatibility (thickening) may develop if Assert is tank-mixed with dicamba or amine formulations of 2,4-D or MCPA. Thickening results from using hard water, or additives that increase spray solution pH. To reverse thickening, lower water pH by add an acid, preferably muriatic acid. 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 for a 10% HCl conc.).

**B8. Avenge** (difenzoquat) applied POST at 2.5 to 4 pt/A controls 3- to 5-leaf wild oat. Wild oat is more susceptible to Avenge at the 5-leaf than the 3-leaf stage and crop competition improves control. High rates should be used on high populations of 3-leaf wild oat. Wheat injury may occur at temperatures above 80 F. 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: Belzer, Edmore, Fjord, Kari, Lakota, Lebsock., Mountrail, Regold, Renville, Vic, 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, Produx, 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, Aurora, Bacup, Dandy, Ember, Ernest, Forge, Hamer, Hi-Line, HJ 98, Ingot, Ivan, Kulm, Lars, McKenzie, McNeal, McVey, Mercury, ND 2375, Norlander, Oxen, Russ, Sharpshooter.

**Hard Red Spring Wheat varieties injured by Avenge:**

NDSU research conducts testing of new and experimental HRS wheat varieties to Avenge. Use caution with non-labeled varieties to Avenge and use Avenge only on wheat varieties listed on the label. Consult the Avenge label for a list.

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

**B10. 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 controls Canada thistle and annual broadleaf weeds in barley, durum, and hard red spring wheat. Canada thistle is most susceptible at rosette to early bolting stages. Curtail will not provide long-term control of Canada thistle with one application but will reduce populations with repeated use.

Curtail contains 2,4-D and should be applied to wheat and barley from 4-leaf through jointing only. Only Curtail M is allowed on oat. See herbicide residue section for recropping restrictions.

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

**B12. 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 darnel 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 in at least 5 gpa by ground or 3 gpa by air to wheat from 2-leaf to emergence of 4<sup>th</sup> 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.

**B13. 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 controls wild oat and suppresses yellow foxtail in wheat, including durum. 28% nitrogen is not recommended. Everest controls mustard species, annual smartweed and suppresses redroot pigweed. Uptake is primarily foliar but soil residue absorbed by roots may give 2 to 3 weeks residual green foxtail control. Always apply Everest with a broadleaf herbicide. Everest must be applied with 2,4-D when tank-mixing with a SU herbicide (Express, Harmony Extra, Harmony GT, others). Data has shown that 2,4-D safens Everest to wheat under stress without antagonizing wild oat control. Most crops (except oat) can be planted the year following application. See label for crop rotation restrictions. Apply Everest in at least 5 gpa by ground to actively growing wheat and grass weeds with 1 to 6 total leaves (1 to 4 total leaves on main stem plus 2 tillers) but prior to jointing. Refer to label for herbicide tank-mix options. Everest safens Aim on wheat. Application with dicamba will result in reduced grass control. See label for additional information.

**B14. Express/XP** (tribenuron) at 0.17 to 0.33 oz DF/A, **Harmony Extra/XP** (thifensulfuron +tribenuron) at 3/10 to 6/10 oz 75DF/A or **Harmony GT/XP** (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 provides season-long (top growth) control of Canada thistle in wheat and barley and oat (Express/XP and Harmony Extra/XP only). Burndown or speed at which weeds are killed is the most rapid with Express/XP and average with Harmony Extra/XP as compared with other SU herbicides. Apply with NIS at 0.125% v/v depending on broadleaf herbicide and rate. Tank-mixing with organophosphate insecticides increases potential for crop injury. 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.

## SMALL GRAINS - B15-20

**B15. Far-Go** (triallate) at 1 to 1.5 qt/A or 10 to 15 lb 10G applied preplant or PRE incorporated (depending on formulation) controls wild oat in wheat, durum, barley, lentil or pea. See tables for specific rates. Far-Go is volatile and the liquid formulation must be incorporated immediately after application. 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.

**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.

**B16. Glean** (chlorsulfuron) at 1/6 to 1/3 oz 75DF/A or **Finesse** (chlorsulfuron + metsulfuron) applied 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 and tank-mix herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Finesse can be applied only once every 24 months in North Dakota. Speed at which weeds are killed is relatively slow as compared with other SU herbicides.

**B17. Maverick** (sulfosulfuron) at 0.67 oz DF/A applied fall POST controls cheat, downy brome, and Japanese brome at 2- to 3-leaf stage in winter wheat, or applied spring POST suppresses annual bromes with less than 5-tillers. Maverick at 0.67 oz DF/A applied spring POST controls wild oat in the 1- to 4-leaf stage and may also control cleavers, false chamomile, flixweed, annual smartweed species, mustard species, quackgrass, and sunflower. Apply Maverick with NIS at 0.5% v/v. Maverick may be applied with most herbicides labeled in wheat. Maverick should be applied with another broadleaf herbicide 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 section for recropping restrictions.

**B18. 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 controls some 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. Paramount at 0.17 to 0.33 lb DF/A controls 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.

**B19. Peak** (prosulfuron) at 0.25 to 0.5 oz 57DF/A applied POST controls 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 should be applied with a NIS. Do not apply a foliar or soil organophosphate insecticide within 15 days before or 10 days after Peak. Corn is tolerant to Peak which is different than other long residue SU herbicides labeled in small grains (Finesse, Ally, Amber). 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.

**B20. 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 at 5 to 10 gpa by ground or 5 gpa by air. Use 5 gpa only on light infestations, small weeds, and during good growing conditions. Apply Puma to wheat and durum from 1-leaf until 60 days prior to harvest and to barley from 1-leaf until prior to jointing. Puma will control grass weeds in the 1-leaf to 2-tiller stage. Low humidity and high temperature can influence foxtail and wild oat control. Puma can be applied with Furadan, Sevin XLR Plus, Stratego, 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/XP, Amber, bromoxynil, bromoxynil + MCPA, Curtail M, dicamba, Express/XP, Harmony Extra/XP, Harmony GT/XP, 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/XP, MCPA ester, Peak, Starane, or Stinger. For barnyardgrass and wild oat control apply Puma at 0.66 pt/A with bromoxynil, Bronate Advanced, Curtail, Curtail M, Harmony Extra/XP, Harmony GT/XP, 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.

**Cheyenne** (fenoxaprop-P plus MCPA plus Harmony Extra (thifensulfuron plus tribenuron)) at 40 acres/case controls most annual grasses, suppresses yellow foxtail, and controls several broadleaf weeds. 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. 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 additives.

**Dakota** (fenoxaprop-P plus MCPA) at 16 to 21.3 fl oz/A controls green foxtail, foxtail millets, wild mustard and some broadleaf weeds in winter and spring wheat. 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. Do not apply Dakota to durum, barley, tame oat, or rye or with other herbicides or additives except as indicated on the label.

**B21. 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 is a contact herbicide and requires good spray coverage. 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.

**B22. 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, and Puma. 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 is labeled with most POST grass herbicides registered in wheat. Refer to label of tank-mix partner for mixing options.

Commercial premix formulations of Starane are available:

Starane + Salvo (2,4-D) at 1 to 1.33 pt/A

Starane + Saber (2,4-D) at 1.5 to 2 pt/A

Starane + Sword (MCPA) at 1.125 to 1.5 pt/A.

Starane is systemic with no soil residual or carryover and controls only emerged weeds. Dew at application may decrease control. Starane is very safe on small grains. Apply to small weeds that are actively growing. 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.

**B23. Trifluralin** at 1 pt/A of a 4 lb/gal concentrate or 5 lb/A 10G applied after spring seeding and harrow incorporated shallowly 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.

## B24-29 - SMALL GRAIN PREHARVEST

**B24. 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.**

### B25. 2,4-D as a Harvest Aid

Apply 2,4-D at 1.5 to 3 pt/A to dough stage to harvest spring wheat, durum, barley, and rye. Labels vary in crop use. Follow the label. Not all 2,4-D formulations are labeled for preharvest applications. Some 2,4-D labels only allow use on wheat, others allow use on wheat and barley and others allow use on wheat, barley and rye. Ester formulations will give better control and quicker burndown than an amine formulation. Use only low volatile formulations to reduce vapor drift potential. Use at least 2 pt/A of amine formulation 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.

### B26. Ally/XP + 2,4-D as a Harvest Aid

Ally/XP 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/XP has a long residue so use only in a continuous wheat or wheat-fallow rotation. Must follow crop rotation restrictions. Apply Ally/XP 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/XP + 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.

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

Dicamba can be applied alone or with 2,4-D in wheat and durum. 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.**

### B28. Glyphosate as a Harvest Aid

Glyphosate is labeled as a harvest aid only in spring wheat and durum, and feed barley only. 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. Apply ONLY to feed 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. 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 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.

### B29. Glyphosate + 2,4-D as a Harvest Aid

Glyphosate + 2,4-D applied at 3.38 pt/A (54 fl oz/A) to 5.25 pt/A as Landmaster BW or 0.75 to 2 pt of RT Master or Glymix MT (others) controls annual grass and broadleaf weeds, quackgrass, and suppresses Canada thistle in hard red spring wheat and durum, and feed barley only. DO NOT apply more than 5.25 pt/A of Landmaster BW or 2 pt/A of RT Master/GlyMix MT as a harvest aid. See paragraph above on glyphosate for application information.

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

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

**C2. Package Mixtures Available For Corn:**

Trade Name	Common Name	Product/A
Accent Gold/WDG	nicosulfuron+rimsulfuron+clopyralid+flumetsulam	2.9 oz DF or 3.5 oz WDG
Avalanche + Atrazine	atrazine + carfentrazone	0.5 fl oz + 24 fl oz
Axiom	flufenacet + metribuzin	15 to 23 fl oz
Basis	rimsulfuron + thifensulfuron	0.33 oz DF
Basis Gold	nicosulfuron+rimsulfuron+atrazine	14 oz DF
Bicep Lite II Magnum	atrazine + s-metolachlor	1.5 to 1.9 qt
Buctril + Atrazine Brozine, Moxy AT	atrazine + bromoxynil	1.5 to 3 pt
Bullet	atrazine + alachlor	2.5 to 4.5 qt
Camix	s-metolachlor + mesotrione	4 to 4.8 pt
Celebrity Plus	nicosulfuron + dicamba	4.67 oz WDG
Cinch ATZ Lite	atrazine + s-metolachlor	1.5 to 1.9 qt
Curtail	clopyralid + 2,4-D	2 pt
Degree Xtra	atrazine + acetochlor	2.9 to 3.7 qt
Distinct	dicamba + diflufenzopyr	4 to 6 oz WDG
DoublePlay	acetochlor + EPTC	4.5 to 8 pt
Epic	flufenacet + isoxaflutole	7 to 17 oz DF
FulTime	atrazine + acetochlor	2.5 to 3 qt
G-Max Lite	atrazine + dimethenamid-P	2 to 3.5 pt
Guardsman	atrazine+dimethenamid	2.5 to 5 pt
Guardsman Max	atrazine + dimethenamid-P	2.8 to 4.6 pt
Harness Xtra	atrazine + acetochlor	1.8 to 2.3 qt
Hornet/WDG	flumetsulam + clopyralid/K	1.6 to 4 1/2 to 6 oz
Keystone LA	atrazine + acetochlor	1.6 to 3 qt
LeadOff	atrazine + dimethenamid	2.5 to 5 pt
Liberty ATZ	atrazine + glufosinate	32 to 40 fl oz
Lightning (CL corn)	imazethapyr + imazapyr	1.28 oz WDG
Lumax	atrazine+ s-meto+mesotrione	3 to 6 pt
Marksman	atrazine + dicamba	3.5 pt
NorthStar	dicamba + primisulfuron	5 oz DF/A
Ramrod + Atrazine	atrazine + propachlor	3.5 to 5.5 qt
ReadyMaster ATZ	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
Teamwork+Atrazine	carfentrazone + atrazine	0.33 oz + 0.25 lb
Yukon	dicamba-Na + halosulfuron	4 to 8 oz DF

**C3.** Wild-proso millet is a competitive annual weed in eastern North Dakota. Eradicane, Harness, or Surpass PPI at the maximum rate for the soil type will only suppress millet for 2 to 3 weeks. Dual and Outlook give poor control. For a foundation soil program, apply Balance PPI or PRE or Harness/Surpass at maximum rate. For POST control apply Accent at 0.67 oz DF/A or Steadfast at 0.75 oz DF/A, or Option at 1.75 oz DF/A with an MSO type adjuvant.

**C4. NDSU MICRO-RATE PROGRAMS:**

Steadfast is 65% the cost of Accent but cannot be applied beyond 12 inch tall corn. Early application to small weeds avoid weed competition with corn and gives greater weed control from reduced herbicide rates. NDSU research has shown Steadfast at 0.5 to 0.75 oz DF/A or 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 pH blend adjuvants or Lumax at 3 pt/A + PO adjuvants control most annual grass and broadleaf weeds. Accent at 0.67 oz/A or Steadfast at 0.75 oz DF/A is required to control yellow foxtail, wild proso millet, volunteer cereals, field sandbur, and quackgrass. Atrazine at 0.38 lb ai/A will allow all crops to be planted the following year unless severe drought occurs in the year of application. MSO adjuvants should be used, when allowed by label, to provide maximum enhancement of weed control. Yellow foxtail has replaced green foxtail as the dominant foxtail species in ND. Dicamba and especially Distinct antagonizes yellow foxtail control from Steadfast and Accent. In some cases MSO adjuvant has overcome yellow foxtail antagonism from dicamba. Steadfast gives greater yellow foxtail control than Accent but inadequate control may result even when labeled rates are used. Refer to C5 below for additional information. NDSU research has shown enhancement of yellow foxtail control when Steadfast and Accent are applied with Callisto at 3 fl oz/A + atrazine at 0.38 lb ai/A + MSO or Lumax at 3 pt/A + oil adjuvant.

**C5. Accent** (nicosulfuron) at 0.67 oz 75DF/A applied POST to corn up to 20 inches tall with 6 collars or less or with drop nozzles to corn 20 to 36 inches tall (free standing). Do not apply to field corn taller than 36 inches or with 10 collars, whichever is most restrictive.

**Steadfast** (nicosulfuron + rimsulfuron) 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. Always add an oil adjuvant at 1.5 pt/A plus nitrogen fertilizer at 1 to 2% v/v or basic pH blend adjuvants at 1% v/v. NDSU research has shown that adjuvant enhancement of Steadfast or Accent was greatest with an MSO type oil or basic pH blend adjuvant, followed by petroleum oil, and least with NIS + 28%. Weeds controlled are green foxtail, fall panicum, barnyard-grass, field sandbur, woolly cupgrass, wild-proso millet, wild oat, quackgrass, pigweed species, smartweed, wild mustard, jimsonweed, and burcucumber. Steadfast gives greater yellow foxtail control than Accent but inadequate control may result even when labeled rates are used. Poor yellow foxtail control will result if Steadfast or Accent are applied at reduced rates, if applied with dicamba, if yellow foxtail is larger than recommended, or if growing in adverse conditions. NDSU research has shown enhancement of yellow foxtail control when Steadfast is tank-mixed with Callisto + atrazine + oil adjuvant at labeled rates or tank-mixed with Lumax at 3 pt/A. Use caution when applying Steadfast to corn hybrids of 88 or less days maturity. See label for herbicide tank-mix options. Do not tank-mix organophosphate insecticides. A soil residue will be present for more than one year. Refer to the label or herbicide residue section for crop rotation restrictions.

**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. Lack of yellow foxtail control has been observed. Celebrity at 4.67 oz WDG/A is equivalent to Accent at 0.67 oz 75DF/A plus dicamba at 4 oz 70WDG or dicamba at 4 fl oz/A (dicamba at 0.188 lb ai/A). Refer to sections on Accent and dicamba for use information. 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.

## C5-11 - CORN

**Accent Gold/WDG** (nicosulfuron + rimsulfuron + clopyralid + flumetsulam) applied POST at 2.9 oz DF/A or 3.5 oz WDG/A 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 oil adjuvant at 1 to 2% v/v with liquid nitrogen or with basic blend adjuvants. 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 or ½ oz 2EW applied POST controls kochia, lambsquarters, nightshade, pigweed spp. and waterhemp. Apply Aim to corn up to 8 collar growth stage and to weeds from 1 to 4 inches tall. Registration is pending for application to corn up to 48 inches tall as a post-directed application. Application to weeds 2 inches tall or less will result in much greater weed control. Apply Aim with NIS at 0.25% v/v and liquid fertilizer. Petroleum oil adjuvants may increase weed control but also may increase risk of corn injury. Aim should be applied with another broadleaf herbicide to broaden spectrum of weeds controls. Aim may be tank-mixed with most herbicides registered in corn except Liberty. Refer to label of tank-mix herbicide for tank-mixing options and adjuvant restrictions. Aim is a non-residual, contact herbicide and may produce cosmetic injury symptoms of speckling and spotting on leaves receiving spray. Symptoms should disappear after new growth appears. Do not apply Aim either 8 hours before or after a rain event and maintain an 18 inch boom height over corn canopy to minimize exposure to the whorl of the plant. A commercial copack of Aim + atrazine is available as Teamwork + Atrazine at 0.33 oz DF + 13.3 fl oz 4L.

**C7. Atrazine** applied PPI or PRE or applying at rates greater than 0.75 lb ai/A is not recommend in ND. PPI or PRE atrazine require rates greater than 1 lb/A for consistency in weed control but also causes carryover concerns for more than two years. Atrazine is available as a prepackage mix with several herbicides. Most atrazine premixes contains excessive atrazine rates for normal crop rotation in ND. Atrazine is a restricted use herbicide.

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

**C8. Balance Pro** at 1.5 to 3 fl oz/A applied EPP or PRE controls foxtails, wild proso millet, field sandbur, and woolly cupgrass and annual small-seeded broadleaf weeds including nightshade, kochia, pigweed, lambsquarters, common ragweed, wild mustard, annual smartweed, seedling dandelion, and horseweed (mare's tail). Balance may yellow corn after emergence but yellowing may disappear after 3 to 5 days with no effect on subsequent growth or yield. Use exact rates based on soil type, pH, and organic matter to insure adequate corn safety. Rates even slightly greater than labeled for intended soil type, soil pH, and organic matter can cause slight to serious corn injury. Uneven application, variable ground speed, lack of good agitation, sprayers not properly calibrated, improper incorporation and especially spray overlaps may increase risk of

corn injury. Always preslurry Balance with water prior to adding to the tank. Allow time for Balance to dissolve in tank afterward providing thorough agitation. If tank mixing, add Balance Pro first and ensure thorough dispersment before adding other products. 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.

Balance is labeled with most PRE herbicides. Applying with acetochlor controls of most annual grass and broadleaf weeds. Balance is weak on yellow foxtail, wild oat, volunteer grain, and large-seeded broadleaf weeds like wild buckwheat, cocklebur, sunflower, giant ragweed. Research indicates Balance PRE provides greater weed control than other PRE corn herbicides especially under limited rainfall but 0.5 to 0.75 inches of rainfall after application is required for optimum weed control. Balance may 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 controls 2 to 10 inch tall common cocklebur, giant and common ragweed, smartweed, Venice mallow, wild mustard, sunflower and suppression of yellow nutsedge. Basagran controls Canada thistle only with sequential applications. Corn is tolerant to Basagran at all stages. 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 applied POST in corn up to 4-leaf (2 collar) controls small foxtail, barnyardgrass, redroot pigweed, wild mustard, common lambsquarters, and annual smartweed. Apply when grasses are 1 to 2 inches tall and broadleaf weeds are 1 to 3 inches tall. Sequential application of Accent may be needed for complete weed control. Always apply Basis with an oil adjuvant at 1 to 2% v/v and nitrogen fertilizer or with basic blend adjuvant. Corn varieties of 88 day maturity or less are more susceptible to injury from Basis than varieties greater than 88 days. See label for tank-mix options.

**Basis Gold** (nicosulfuron + rimsulfuron + atrazine) at 14 oz DF/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 + liquid nitrogen or with basic blend adjuvant. NDSU research has shown greater herbicide enhancement from Basis Gold 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 DF/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 DF/A) would be equivalent to atrazine at 0.38 lb ai/A. If a half rate of Basis Gold is used, additional Accent may be required to achieve adequate weed control. Applying herbicides at lower than labeled rates makes the user liable for product performance and crop injury on crops planted at a shorter interval than directed on the label.

**C11. Bromoxynil** at 1 to 1.5 pt/A applied to corn from emergence but before tasseling controls seedling wild buckwheat, volunteer sunflower, and other 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. Commercial mixtures of bromoxynil plus atrazine are available.

**C12. Callisto** (mesotrione) at 3 fl oz/A applied POST to corn up to 30 inches tall controls pigweed species, waterhemp, and other pigweed species, common lambsquarters, common sunflower, giant ragweed, annual smartweed, nightshade and suppresses Canada thistle. Always apply Callisto with atrazine at 0.38 lb ai/A. Atrazine improves weeds listed above plus common cocklebur, common ragweed and kochia. Callisto can be tank-mixed with atrazine, Accent, Steadfast, dicamba, and Distinct. Callisto symptoms on weeds are bleaching followed by death. Apply with petroleum oil adjuvant at 1% v/v + UAN at 2.5% v/v. DuPont has issued 2(ee) labels allowing Accent at 0.67 oz DF/A or Steadfast at 0.75 ozDF/A + Callisto at 1.5 to 3 fl oz/A. Do not tank-mix with organophosphate insecticides. NDSU research has shown improved control of yellow foxtail when tank-mixed with Accent and Steadfast. Refer to label for crop rotation restrictions.

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

**C13. Curtail** (cloprialid + 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 5<sup>th</sup> leaf collar visible to corn 24 inches tall. The exact staging of corn is required because Curtail contains 2,4-D which can cause stem brittleness and corn injury. Corn treated with 2,4-D may become temporarily brittle causing stalk breakage. Application during the window described above may 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 for sugarbeet.

**C14. Dicamba** at 0.25 to 0.5 pt/A applied POST to corn from emergence to 8 inches tall controls many broadleaf weeds including kochia, smartweed, wild buckwheat and volunteer sunflower, and suppresses Canada thistle. Dicamba can be applied before corn is 3 feet tall or until 15 days before tassel emergence. Drop nozzles should be used after corn is 8 inches tall to reduce injury if dicamba is applied with 2,4-D and to reduce drift potential. Yellow foxtail control may be reduced when dicamba is tank-mixed with Accent, Steadfast, and Option.

**Distinct** (dicamba + diflufenzopyr) at 6 oz WDG/A applied EPOST or POST to corn up to 24 inches tall (preferred timing when corn is 4 to 10 inches tall) controls annual and perennial broadleaf weeds and will suppress foxtail. Apply with NIS at 0.25% v/v + UAN at 2 qt/A. Refer to paragraph on dicamba for use information and restrictions. Distinct controls a wider spectrum of weeds and gives 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, or immediately after application; when Distinct is

applied to corn less than 4 inches tall; by using an oil adjuvant instead of NIS + UAN; when a less tolerant variety is treated; and by not allowing the dry product added to the spray solution to totally dissolve. See label for mixing order and mixing instructions. Yellow foxtail control may be reduced when tank-mixed with Accent, Steadfast, and Option.

**C15. 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 can be tank-mixed with Surpass to improve performance over a wider range of environmental conditions.

**C16. 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 including pigweed species, common lambsquarters. Use the higher rate on clay soils high in organic matter. Do not apply acetochlor on sands with less than 3% OM, loamy sands with less than 2% OM, or sandy loams with 1% OM if ground water is within 30 feet of soil surface. Incorporation may improve weed control under dry conditions. Acetochlor may be applied up to 45 days before planting and applied POST to corn up to 11 inches tall. Acetochlor applied PPI or PRE provides greater and more consistent grass and broadleaf weed control than other soil applied grass herbicides. Greater control has been observed across variable climates and conditions in North Dakota.

**C17. Lasso** (alachlor) at 2 to 4 qt 4E/A, **Dual II Magnum** (s-metolachlor) at 1 to 2 pt/A, **Outlook** (dimethenamid-P) at 16 to 21 fl oz/A, and **Axiom** (flufenacet + metribuzin) at 15 to 23 fl oz/A applied PPI or PRE 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. Dual products may be surface applied or incorporated in the fall after September 30 but before ground freezes or applied in the spring. Dual products may be applied up to 45 days before planting. Lasso is a restricted use herbicide. **Ramrod** (propachlor) applied PRE at 4 to 6 qt/A controls annual grasses and some broadleaf weeds but is ineffective PPI or against wild mustard and perennial weeds. Ramrod applied PRE gives greater foxtail control than Lasso and Dual.

**C18. Option** (foramsulfuron + safener) at 1.5 to 1.75 oz WG/A applied POST controls grass and broadleaf weeds, quackgrass, and top-growth of Canada thistle in corn up to 16 inches tall with no more than 5 collars. Always apply with MSO type adjuvants only plus nitrogen fertilizer each at 1 qt/A. Option applied with atrazine will antagonize yellow foxtail control if applied to plants greater than 3 inches tall. All crops can be planted the following year. See label or narrative for tank-mix options and crop rotation restrictions and additional information.

**C19. NorthStar** (dicamba-Na + primisulfuron) at 5 oz WDG/A applied POST controls broadleaf weeds and some grasses in corn 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 used with NIS or oil additive. Northstar contains dicamba and will control ALS resistant weeds. Northstar will leave a residue 3 or more years. See label or herbicide residue section for information on crop rotation restrictions.

## CORN - C20-27

**C20. Permit** (halosulfuron) at 0.67 to 1.33 oz 75DF/A applied POST in corn controls nutsedge and some broadleaf weeds including sunflower, ragweeds, and cocklebur. Apply with NIS or oil additive. 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.

**C21. 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.

**C22. Python** (flumetsulam) at 0.8 to 1.33 oz 80WDG applied EPP, PPI, or PRE will control nightshade, pigweed, ALS susceptible kochia, lambsquarters, mustards, annual smartweed, Russian thistle, Venice mallow and lanceleaf sage. Python does not control grasses. As with all soil applied herbicides, Python requires rain to activate the herbicide for adequate weed control and dry weather following PPI and PRE applications will reduce weed control. High soil pH increases Python activity and increases rate of herbicide degradation. Some stunting of corn may occur under poor growing conditions on soils with pH greater than 8.0. Use the higher rate on fine textured soils with greater than 3% OM and the lower rates on coarse textured soils with less than 3% OM. Incorporate into the top 2 inches for PPI applications. Soil insecticides should be applied in a T-band to avoid corn injury. Refer to label for tank-mix options. See Herbicide Residue section for information on crop rotation restrictions.

**Hornet** (flumetsulam + clopyralid acid) at 3.2 to 4.8 oz DF or **Hornet WDG** (flumetsulam + clopyralid - K salt) at 4 to 6 oz is equivalent to 0.05 to 0.07 lb/A of flumetsulam + 0.13 to 0.19 lb/A of clopyralid and can be applied EPP, PPI, or PRE. Adjust rate according to soil type.

**Hornet** (flumetsulam + clopyralid acid) at 1.6 to 4 oz DF/A or **Hornet WDG** (flumetsulam + clopyralid - K salt) at 2 to 5 oz WDG/A applied POST controls most annual broadleaf weeds and Canada thistle in corn from emergence up to 24 inches tall. Apply with NIS at 0.25% v/v or oil adjuvant at 1% v/v. Apply with UAN at 2.5% v/v under dry conditions. Hornet controls a wide spectrum of broadleaf weeds including nightshade, ALS susceptible 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 cocklebur and sunflower. Hornet does not control grasses. 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.

**C23. 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 controls 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 applica-

tion information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

**C24. Emergency control** of broadleaf and grass weeds in corn can be obtained with paraquat applied at 0.75 to 1.3 pt applied POST directed only. Apply with NIS. Paraquat applied over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply paraquat before corn is 10 inches high and weeds should be less than 4 inches tall.

**Sencor** (metribuzin) at 2 to 3 oz 75DF/A 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.

## HERBICIDE TOLERANT CORN

### CLEARFIELD (imidazolinone resistant) CORN

**C25. Lightning** (imazethapyr + imazapyr) at 1.28 oz WDG/A (0.64 oz imazethapyr + 0.15 oz imazapyr) controls nearly all annual grass and broadleaf weeds (except ALS resistant kochia) and suppresses quackgrass and Canada thistle. Apply Lightning only to IMI-corn varieties and to weeds 1 to 3 inches tall. Apply with oil adjuvant and liquid fertilizer. Lightning contains Pursuit and Arsenal, both imidazolinone herbicides. The rate of Pursuit in Lightning is approximately 1.08 oz WDG/A and Arsenal 1% the rate of Arsenal that is registered on noncropland. Refer to the rotational crop restriction section of this guide. Use herbicides with a different mode of action or use other weed control strategies that will slow development of resistant weeds throughout the rotation.

### LIBERTY (Glufosinate) RESISTANT CORN

**C26. Liberty** (glufosinate) at 24 to 34 fl oz/A applied POST to Liberty tolerant corn varieties up to 24 inches with 7 or less collars controls most annual broadleaf weeds, controls or suppresses grasses, and suppress some perennial weeds. Liberty is a non-selective, non-residual, contact type herbicide with limited translocation. Apply to small weeds because of limited translocation. Liberty does not control large or well tillered grasses like yellow foxtail, wild oat, or volunteer cereals. Liberty is non-residual which may require multiple applications or applying with a residual herbicide to control multiple weed flushes. Apply with AMS fertilizer. Refer to label for weeds controlled, application information and timing, tank-mix options, application information, and other restrictions. Liberty can be used to control weeds resistant 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

**C27. 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 controls 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 controlled by glyphosate applied alone or after one application.

## SOYBEAN

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

**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.

**D1. Soybean** is a poor competitor with weeds when cool soil temperatures cause slow germination and growth but competes effectively in warm soils when germination and growth are rapid. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to conditions allowing good competition with weeds. Soybean production requires good cultural practices. Prepare the seedbed prior to planting to kill germinating weeds. A rotary hoe or harrow may be used to control weeds after planting but before the soybean emerge or after emergence when soybean are in the 1 to 2 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
Boundary	s-metolachlor + metribuzin	1.5 to 2.5 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
Gangster(Co-pack)	cloransulam+flumioxazin	0.5-0.6+2.5-3 oz
Gauntlet (Co-pack)	cloransulam+sulfentrazone	.6-.75+5.3-6.7oz
Pursuit Plus	imazethapyr+pendimethln	1.75 pt
Rezult (Co-pack)	bentazon + sethoxydim	1.6 + 1.6 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.

#### D4-10 - SOYBEAN

**D4. Aim** (carfentrazone) at 1/6 oz 75DF/A or 0.25 fl oz 2EW applied POST controls small (1 to 2 inch tall) 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 label for tank-mix options. 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. Higher humidity and rainfall at application increase risk of leaf burn but usually the crop quickly recovers. Research has shown that Aim may provide control of field bindweed top-growth.

**D5. Assure II** (quizalofop) at 7 to 10 fl oz/A plus petroleum oil adjuvant at 1qt/A 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. Most broadleaf herbicides 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 including kochia, pigweed species, lambsquarters, nightshade, smartweed, Russian thistle 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 control, and has 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 be 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, at least 0.5 to 0.75 inch rainfall prior to weed emergence is required for partial grass control and for acceptable control of marginally susceptible broadleaf weeds. Herbicide solubility and phytotoxicity 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.

**Gauntlet** 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.

**D7. Basagran** (bentazon) at 0.5 to 1 qt/A applied POST controls 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 is safe to soybean at all stages. 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.

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

**D8. Cobra** (lactofen) at 4 to 12.5 fl oz/A applied POST controls some broadleaf weeds, including lanceleaf sage. Apply with oil additive at 0.5 to 1 pt/A. Cobra is a contact herbicide and requires thorough spray coverage for good weed control. Soybean beyond the third trifoliolate leaf stage may interfere with spray interception and reduce weed control. Cobra will burn soybean leaves but usually recover. Apply between daytime temperatures of 70 to 85 F. See label to suppress white mold.

**Phoenix** (lactofen + adjuvant) at 8 to 12.5 fl oz/A applied POST with other registered herbicides will control some broadleaf weeds. Apply with NIS at 0.125% to 0.25% v/v. AMS or liquid nitrogen can be included. The adjuvant system included in the formulation enhances weed control of the tank-mix partner with minimal crop response. Do not apply with oil adjuvants. Apply Phoenix at 6 to 8 fl oz/A for white mold suppression.

**D9. FirstRate/Amplify** (cloransulam) applied at 0.6 to 0.75 oz WDG/A PPI or PRE controls common cocklebur, common lambsquarters, horseweed (maretail), pigweed species, annual smartweeds, common and giant ragweed, sunflower, and velvetleaf or at 0.3 oz 80WDG/A applied POST to soybean prior to flowering controls cocklebur, Venice mallow, horseweed (maretail), common ragweed, annual smartweed, sunflower, and velvetleaf and suppresses giant ragweed. Apply to broadleaf weeds less than 10 inches tall. These herbicides give no nightshade control. Apply with NIS at 0.125 to 0.25% v/v + 28% UAN at 2.5% v/v. Oil additive can be used with or without fertilizer. Cloransulam 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, and may increase iron chlorosis symptoms on soils where symptoms have been observed earlier. Do not apply to soils with a pH greater than 7.8 as crop injury may result. See label for tank-mix options. See FirstRate under the herbicide residue section for crop rotation restrictions.

**D10. Flexstar** (fomesafen + adjuvants) applied POST at 0.75 to 1 pt/A controls common cocklebur, annual smartweed, wild mustard, nightshade, pigweed, waterhemp, common and giant ragweed, Venice mallow and small kochia (including ALS resistant). Apply to broadleaf weeds 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 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. Soybean injury may result when Flexstar is tank-mixing 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 has been registered for use in on dry bean through Section 18 registration. Flexstar contains adjuvants lacking in the Reflex formulation. Reflex may give less consistent weed control than Flexstar and will require better management strategies to achieve adequate weed control. See label or crop rotation restriction section for additional information.

**D11. Fusilade DX** (fluazifop-P) at 5 to 12 fl oz/A or **Fusion** (fluazifop-P + fenoxaprop-P) at 4 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 according to weed species and weed size. Fusilade DX and Fusion 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. Reduced grass control may result if applied with broadleaf herbicides. Reduced grass control can be avoided by applying Fusilade DX or Fusion at least 1 day before or 5 days after application of a broadleaf herbicide.

**D12. Harmony GT/XP** (thifensulfuron) at 1/12 oz 75DF/A applied POST controls wild mustard, common lambsquarters, and pigweed and suppresses other broadleaf weeds. Apply with NIS at 0.125 to 0.25% v/v or oil adjuvants at 0.5% v/v plus liquid fertilizer at 4% v/v. DO NOT apply with oil adjuvants when tank-mixing with any other herbicide or severe crop injury may occur. See label or Pursuit paragraph for precautions when tank-mixing with Pursuit and other herbicides. 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.

**D13. 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, **Outlook** at 12 to 21 fl oz/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 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.

**D14. 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. Apply with oil adjuvants. See table in the soybean section for rates according to weed species and weed size. Poast only suppresses quackgrass. Poast mixed with most broadleaf herbicides reduce 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.

**D15. 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, ALS susceptible 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 may 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/XP 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/XP is greater than with either product alone OR the tank-mix of Pursuit plus Harmony GT/XP. In sequential application, the herbicide applied first reduces the ability of the soybean plant to metabolize the second herbicide. Pursuit and Harmony GT/XP 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.

**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.

## SOYBEAN - D16-21

**D16. 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 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.

**D17. Raptor (imazamox)** at 4 fl oz/A POST plus a soil applied grass herbicide or Raptor alone at 5 fl oz/A alone POST controls nearly all annual grass and broadleaf weeds in soybean. Grass weeds controlled are barnyardgrass, crabgrass, foxtail, wild proso millet, field sandbur, volunteer corn and small grains. Broadleaf weeds controlled are cocklebur, ALS susceptible 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 trials, 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 (marestail), 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 common lambsquarters control, 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/XP or other POST herbicides. Crop rotation restrictions are less with Raptor than Pursuit. However, like Pursuit, Raptor carryover is affected by soil pH. As soil pH increases, rate of Raptor degradation

increases. At soil pH less than 6.5, rate of breakdown is slow and injury to sugarbeet and other sensitive crops may occur if planted before allowed time interval. See label or Raptor under the herbicide residue section for information on crop rotation restrictions.

**D18. 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, 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.

**D19. Sencor (metribuzin)** at 0.25 to 0.5 lb 75DF/A controls annual broadleaf weeds, including wild mustard. Adjust rate according to soil type, pH, and % organic matter. Some soybean varieties are susceptible to metribuzin; consult label for list of susceptible varieties. Soybean injury can be reduced by using herbicide combinations with lower rates of metribuzin.

**D20. Sonalan (ethalfuralin)** at 1.3 to 3.5 pt/A, trifluralin at 1 to 2 pt 4E/A, or Prowl at 2 to 3 pt/A EC or 0.83 to 2.5 lb DG applied PPI controls most annual grasses and some small-seeded broadleaf weeds. They give no wild mustard, common cocklebur and sunflower control. Requirements for proper timing and depth of incorporation differ for each herbicide. Adjust rate according to soil type. Trifluralin must be incorporate in the top 2 to 3 inches of soil within 2 days of application. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil. Incorporation of Sonalan 10G can delayed 3 to 5 days after application. Herbicides can be applied with most soil PPI herbicides labeled in soybean. Sonalan has less soil residue than trifluralin or Prowl and is more active at comparable rates.

**D21. Ultra Blazer (acifluorfen)** applied POST at 0.5 to 1.5 pt/A controls many broadleaf weeds. Low rates control wild mustard and redroot pigweed but higher rates are needed for nightshade and smartweed. Ultra Blazer will not adequately control volunteer sunflower. Ultra Blazer is a contact herbicide and requires thorough coverage. Apply to weeds 1 to 4 inches tall that are actively growing and first to second trifoliate soybean. Soybean beyond the third trifoliate 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. Allow a 50 day PHI and do not use treated plants for feed or forage.

**D22. Valor** (flumioxazin) at 2 to 3 oz/A applied EPP or PRE controls most small-seeded broadleaf weeds including kochia (including ALS resistant), nightshade, pigweed species, lambsquarters, and Venice mallow and may suppress common and giant ragweed, annual smartweed, Russian thistle, and foxtail. Valor control wild buckwheat applied early preplant burndown. 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 applied EPP with glyphosate in early burndown programs. Valor requires a minimum of 0.25 inch of rain for activation and requires a bioassay prior to planting sensitive crops. See label for additional information.

**Gangster** (flumioxazin + cloransulam) a copack of Valor and FirstRate/Amplify at 2.5 to 3 + 0.5 to 0.6 oz/A applied EPP or PRE controls most small-seeded broadleaf weeds including ALS resistant kochia, nightshade, pigweed species, lambsquarters, ragweed, sunflower, smartweed, and Venice mallow, and suppress foxtail. Gangster does not control perennial weeds. Apply from 14 days prior to seeding to just before soybean emergence. Gangster can be applied with glyphosate in EPP burndown programs. Refer to label weeds controlled, rates, and crop rotation restrictions.

**ROUNDUP (Glyphosate) RESISTANT SOYBEAN**

**D23. 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. Refer to label for adjuvant use. Apply with AMS. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, 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 (maretail), 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.

**D24. POST Grass Herbicides:**

Herbicide	Weed Size (inches)	Rate
<b>Green and Yellow Foxtail</b>		
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
<b>Wild Oat</b>		
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
<b>Field Sandbur</b>		
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
<b>Wild Proso Millet</b>		
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
<b>Volunteer Small Grains</b>		
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
<b>Volunteer Corn</b>		
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
<b>Quackgrass (First treatment/Regrowth)</b>		
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 12	17/17 fl oz
Select	4 to 12	8/8 fl oz

## DRY EDIBLE BEAN

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

**E2. Basagran** (bentazon) applied in sequential treatments provides improved broadleaf weed control compared to a single application. Basagran at 1 pt/A plus petroleum oil applied before weeds are 0.5 to 4 inches tall with repeat application 7 to 10 days later will control cocklebur, lambsquarters, annual smartweed, Venice mallow, and wild mustard. Common ragweed, kochia, pigweed, and sunflower may be partially controlled. Refer to label for information on weed sizes at application. 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.

**E3. Dual Magnum, Dual II Magnum** (s-metolachlor) PPI or PRE at 1 to 2 pt/A, **Outlook** (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. **Outlook** can be applied in sequential treatments for improved nightshade control in dry bean. Outlook PPI or PRE provides greater nightshade control than Dual or Lasso but may degrade in the soil before nightshade emergence ceases. Apply Outlook EPOST alone or with Basagran up to third trifoliolate dry beans to reduce late nightshade emergence.

**E4. 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.

**E5. Prowl/Pendimax** (pendimethalin), **Sonalan** (ethalfuralin), and **trifluralin** are discussed under the soybean section. Trifluralin, Prowl and Sonalan applied PPI controls annual grasses, redroot pigweed, and common lambsquarters. Adjust rate for soil type and incorporate in the top 2 to 3 inches of soil within 2 days of application.

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. 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 should be used in high crop residues and heavy weed populations.

**E6. 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 most dry bean types, field pea. Pursuit can be applied ONLY PPI within 1 week of planting or PRE up to 3 three days following

planting to chickpea/ garbanzo bean and lentil at rates listed above. DO NOT apply POST to chickpea/ garbanzo bean or lentil. Do not apply after crop has begun flowering. 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 with NIS at 0.25% v/v to dry beans with 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. **User assume all risk of liability for injury.**

**E7. 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.

**E8. Reflex** (fomesafen) may be labeled through ND Section 18 emergency labeling for control of several broadleaf weeds including nightshade and common ragweed. Apply Reflex POST at 0.75 pt/A 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 increases risk of dry bean injury. Refer to the Flexstar paragraph in the soybean section for information on application and adjuvant use and restrictions.

## 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. Basagran** (bentazon) at 1 to 1.5 pt/A controls some annual broadleaf weeds and suppresses Canada thistle. Apply Basagran in 15 to 20 gpa 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 2 to 4 inches tall field pea. A second application can be made to pea greater than 6 inches tall. Allow a 30 days PHI. See paragraph under Basagran in soybean section for additional information.

**F3. Thistrol** (MCPB) at 0.5 to 1 pint/A controls some broadleaf weeds including wild mustard and redroot pigweed. Apply to 4 to 6 inch pea vines. Slight pea injury may occur but will usually recover. Injury potential increases when pea is taller than 6 inches and when temperatures exceed 85 F or when the pea is under heat/drought stress. Apply MCPB prior to flowering.

**F4. Glyphosate** at up to 1 qt/A applied preharvest at the hard dough stage of pea grain with 30% or less moisture controls most annual and perennial weeds. Allow a 7 day PHI. Greater perennial weed control may be obtained by allowing a 10 to 14 day PHI. Do not apply to crop grown for seed.

## SUNFLOWER

**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.

**F5. Sencor** (metribuzin) at 0.167 to 0.33 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 caused by cold weather. Apply when weeds are less than 2 inches in height or diameter and before the crop is 6 inches tall. Apply Sencor no later than 50 days before harvest.

## 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. Far-Go** (triallate) at 1.25 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.

**G3. 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. 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. Sencor** (metribuzin) applied PRE at 0.25 to 0.5 lb 75DF/A or POST at 0.167 to 0.33 lb 75DF/A in lentil will suppress common lambsquarters, mustard species, henbit, and common chickweed. Apply Sencor PRE before or after planting but before crop emerges. Thorough incorporation by rainfall or mechanical methods is essential for weed suppression. Apply Sencor POST to weeds less than 2 inches tall and lentil less than 6 inches tall. See label for special precautions.

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

**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. Harrow or rotary hoe when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

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

**J4. Spartan** (sulfentrazone) may be registered in sunflower through Section 18 emergency registration. Spartan applied PRE at 2.67 to 5.33 oz WDG/A controls most annual small-seeded broadleaf weeds, such as kochia, pigweed species, lambsquarters, nightshade, smartweed, Russian thistle and biennial wormwood and may suppress buckwheat, mustard, ragweed, and Russian thistle. Spartan may provide some grass but no perennial weed control. Adjust rate for OM. Use higher rates if applied up to 30 days prior to planting. Sunflower has 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. Close furrow at planting to avoid 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 susceptible 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 in which no weed resistance has been documented.

### **Clearfield (imidazolinone) Resistant Sunflower**

**J5. Beyond** (imazamox) may be labeled through ND Section 18 emergency labeling for control of kochia, nightshade and several other broadleaf weeds, including common cocklebur and marshelder with limited crop rotation restrictions. Apply Raptor applied at 4 fl oz/A only with registered adjuvants. Refer to the Raptor paragraph in the soybean section for information on Raptor application and adjuvant use and restrictions.

## FLAX

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

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

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

**K3. Curtail M** at 1.33 to 1.75 pt/A control Canada thistle and at 1.75 pt/A suppresses perennial sowthistle. Apply when flax is 2 to 6 inches tall. Extreme growing conditions prior to, at, and following application may reduce weed control and increase risk of flax injury.

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

**K5. Spartan** (sulfentrazone) may be registered in flax through Section 18 emergency registration. Spartan applied PRE at 2.67 to 5.33 oz WDG/A controls most annual small-seeded broadleaf weeds. Refer to Sunflower section for additional information.

**K6. 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. Incorporate shallow and seed deep or seed shallow with deep incorporation to maximize crop safety.

## 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. Muster** (ethametsulfuron) at 0.3 oz DF/A controls wild mustard, hemp nettle, smartweed, and flaxweed and may suppress field pennycress and redroot pigweed in canola, rapeseed, and crambe. 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.

**L3. Stinger** (clopyralid) at 0.33 to 0.5 pt/A applied POST controls several broadleaf weeds and volunteer crops in canola, rapeseed, and crambe. 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.

### HERBICIDE TOLERANT CANOLA

#### CLEARFIELD (Imidazolinone) RESISTANT CANOLA

**L4. Beyond** (imazamox) at 4 fl oz/A applied POST to Clearfield canola varieties (45A71) from emergence until prior to flowering controls most annual grass and broadleaf weeds. Apply with NIS at 0.25% v/v alone or with UAN liquid fertilizer at 1 to 2 qt/A. Raptor will not control ALS resistant weeds. Clearfield canola can be planted on land previously treated with Assert or Pursuit and may reduce or eliminate injury from long residual SU herbicides. See label or information on Raptor in the soybean section for use, weed control, carryover, crop rotation restrictions and other use information.

#### LIBERTY (Glufosinate) RESISTANT CANOLA

**L5. Liberty** (glufosinate) at 34 fl oz/A applied POST to Liberty tolerant canola from cotyledon to bolting stage controls most annual broadleaf weeds, controls or suppresses grasses, and may suppress perennial weeds. Always apply with AMS at 3 lb/A. If tank mixing with Assure II, Poast, or Select then AMS at 1.5 lb/A. Liberty is a non-selective, non-residual, contact type herbicide with limited translocation and should be applied to small weeds. Refer to label for weeds controlled, application information and timing, tank-mix options, and other restrictions. Liberty has a unique mode of action and may be used as another tool in weed resistance management.

#### ROUNDUP (Glyphosate) RESISTANT CANOLA

**L6. Glyphosate** applied at a maximum of 1 pt/A with no more than two applications to glyphosate resistant canola from emergence to bolting controls most annual and perennial weeds. Apply with AMS. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a non-selective, non-residual, systemic herbicide. Full labeled rates are required for broadleaf weed control. Glyphosate will control weeds resistant to other herbicides. Refer to label or paragraphs on glyphosate under herbicide resistant corn or soybean sections for weeds controlled, application information and timing, tank-mix options, and other restrictions.

## SUGARBEET

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

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

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

**M4. Betanex** (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. Allow a 75 day PHI for Betanex and Betamix.

### Betanex, Betamix, Broadcast Rate.

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

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

**M5. Eptam** (EPTC) PPI in the spring at 2.3 to 3.4 pt 7E/A or in the fall at 4 to 5 pt 7E/A or 17 to 22 lb 20G/A controls annual grasses and certain broadleaf weeds but may 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 OM matter because choosing a safe rate is difficult. Herbicides such as Ro-Neet, Nortron, or Pyramin cause less sugarbeet injury on the low OM soils where Eptam injury may be excessive.

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

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

### Suggested Eptam + Ro-Neet rates.

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

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

**M7. Far-Go** (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.

**M8. 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 Stinger plus an methylated seed oil (MSO) adjuvant at 8 or 8 or 5.7 fl oz/A plus 0.125 oz/A plus 1.3 fl oz/A plus 1.5% v/v. The MSO is essential to increase weed control from low herbicide rates used. The rate of Betanex/Betamix/Progress can be increased to 12 / 12 / 8.7 fl oz/A after sugarbeet has four leaves. Add Assure II at 4 fl oz/A or Select at 2 fl oz/A or Poast at 5.3 fl oz/A to the micro-rate to improve grass control. The micro-rate will not control lanceleaf sage or ALS resistant kochia.

The micro-rate should be applied a minimum of three times. Three applications of the micro-rate generally has given better weed control than two applications of conventional rates. Three applications of conventional rates gave better weed control than three applications of the micro-rate but the difference was 5% or less. Four micro-rate applications frequently have given better weed control than three applications.

## SUGARBEET - M8-17

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) 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. 3) Pre-mix the UpBeet in hot water or water with pH 8 to 9. Put UpBeet in the tank first and be sure it is dissolved before adding, in order, Betanex/Betamix/Progress, Stinger, and MSO type oil adjuvant. A 2% solution of household ammonia at 1 gal/100 gal of water will give about pH 9. Add ammonia slowly as the tank fills so water pH does not go much over pH 9. 4) Add a grass herbicide. Tests using a single nozzle and a small volume of spray solution indicated that Assure II reduced precipitation more than Poast and Select but all had an effect. 5) Gentle agitation resulted in less precipitation than vigorous agitation.

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

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

**M11. Progress (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. Adjust the rate of Progress so the total lb/A of the active ingredients is equal to the lb/A of Betamix if the Betamix were applied alone. For example, if the normal rate of Betamix was 0.3 lb/A then Progress also should be applied at 0.3 lb/A. Risk factors are the same as for Betamix alone. Allow a 75 day PHI.

**M12. Select (clethodim)** at 6 to 8 or **Prism** at 12.8 to 17 fl oz/A plus oil adjuvant at 1qt/A controls annual grasses and quackgrass. See table in the soybean section for rates of Select/Prism according to weed species and weed size. Quackgrass control requires 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, NDSU research indicates less antagonism of grass control with Select/Prism tank-mixed with Betanex or Betamix than Poast or Assure II. Allow a 40 day PHI.

**M13. Stinger (clopyralid)** 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 allow a 45 day PHI.

**M14. UpBeet (triflurosulfuron)** at 0.25 to 0.5 oz/A should be used with an adjuvant when applied with 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. 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.

**M16. 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 except ALS resistant kochia.

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

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

**N3. Sencor** (metribuzin) applied PRE at 0.33 to 0.67 lb DF/A or 0.5 to 1 pt/A or POST at 0.33 to 1.33 lb DF/A or 0.5 to 2 pt/A controls many broadleaf weeds and suppresses some grasses. 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 trifoliate leaves and weeds have 4 leaves or less, or before rosette weeds are 1.5 inches in diameter. Alfalfa injury may occur if the temperature within 3 days after application exceeds 80 F in the western half of ND or 70 F in the eastern half of ND. Bromoxynil can be tank-mixed with 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 or Raptor at 4 to 6 fl oz/A applied POST in the fall or spring controls many annual grass and broadleaf weeds in seedling or established alfalfa, or dormant, semi-dormant alfalfa, or between cuttings. Apply when alfalfa has at least 2 trifoliate leaves and weeds are 1 to 3 inches tall. Alfalfa has excellent safety. Apply with NIS at 0.25% v/v or oil additive at 1.5 to 2 pt/A. UAN at 1 to 2 qt/A can be added.

NDSU research has shown excellent weed control of over 22 annual grass and broadleaf weed species when applied with MSO type oil adjuvant at 1.5 pt/A to establishing alfalfa. Perennial weeds are not controlled. Yellow foxtail, common lambsquarters, common ragweed, wild buckwheat control or perennial weed control, including quackgrass, dandelion, Canada thistle, perennial sowthistle, or field bindweed may not be controlled. Herbicides plus strong alfalfa competition may control weeds not controlled by herbicides alone.

**P4. 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. Apply metribuzin and Sinbar 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 rotate to any other crop within 2 years after Sinbar application.

**P5. 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 show excellent alfalfa safety and grass and broadleaf weed control of over 20 weed species with Velpar DF. Velpar controls quackgrass, dandelion, and smooth bromegrass 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.

## CHEMICAL FALLOW

**Q1. Postharvest or fallow weed control in minimum-till situations.** Dicamba at 0.25 to 0.5 pt/A, or 2,4-D at 0.34 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. Aim (carfentrazone)** at 0.33 to 0.67 oz DF/A or 0.5 to 1 fl oz 2EW + other registered herbicides will control many weeds. Apply with NIS at 0.25% v/v. All labeled crops (soybean, corn, small grains) can be planted immediately following application. All non-labeled crops can be planted 30 days following application. Aim applied after glyphosate offers economical burn-down of several weeds. Aim may provide top-growth control of field bindweed.

**Q3. 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. 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.

**Q4. Paramount (quinclorac)** at 0.33 lb DF controls field bindweed in fallow, postharvest or preplant in spring prior to seeding wheat including durum. Apply to bindweed at least 4 inches long. Apply with MSO adjuvant at 1.5 pt/A with AMS at 2.5 lb/A or UAN at 1 ga/A may be added. Apply after harvest but prior to frost. Use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. Paramount also control foxtails, barnyardgrass, and flax.

**Q5. Paraquat** applied at 1.5 to 3 pt/A is a non-selective, contact herbicide that can be used as a crop desiccant or as a substitute for tillage applied alone or with residual herbicides. Apply paraquat before crop emergence. Apply in 5 to 10 gpa of water by air or in 10 to 20 gpa of water by ground. Add NIS at 0.25% v/v. Paraquat is corrosive to aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is toxic so avoid contact with 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.

**Q6. Spartan (sulfentrazone)** applied at 2.67 to 5.33 oz/A in the fall prior to planting of registered crops (soybean and any crop with Section 18 label) or in spring with glyphosate or 2,4-D for control of emerged vegetation. Plant small grains 4 months or more after application. Spartan requires moisture for activation.

**Q7. Tordon (picloram)** can be applied post-harvest or on fallow in a continuous small grain or small grain/fallow rotation. Sensitive crops 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 field bindweed with 8 to 12 inches vines and Canada thistle after most shoots have emerged but before the bud stage.

To avoid injury to small grains, allow a minimum of 45 days for rates up to 0.5 pint/A with soil temperature above 40 degrees F. Allow 90 days before seeding for applications of 0.5 to 1 pint/A. These intervals can reduce but eliminate potential of crop injury. Soil moisture and OM influence the rate of picloram breakdown. Under dry conditions, crop injury may occur even if the preplant interval is followed. Growers should consider the benefits of weed control against the risk of crop damage using picloram.

### Q8. Trifluralin Rates Per Acre

Application Date	An. Rainfall - <10 inches		Other Areas	
	lb/A (Act. Ingrid.)	Trifluralin (granular)	lb/A (Act. Ingrid.)	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.

NDSU research found that 1 qt/A of glyphosate applied fall or spring gave less than 70% alfalfa and smooth bromegrass 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.

## ANNUAL WEED CONTROL

**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 Ally Extra, Bronate Advanced, Clarity, Curtail, dicamba, Harmony Extra/XP, Harmony GT/XP, Python, 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, most ALS herbicides, Stinger, and 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. Flax, volunteer** can infest follow crops. Express/XP + 2,4-D, Flexstar/Reflex, Paramount, Starane products, and Ultra Blazer will control volunteer flax in registered crops.

**S4. Foxtail** is most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields regularly chisel plowed generally have more 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 at the elevator. Herbicide treatment for foxtail may not be warranted when foxtail infestations are light - less than 30 plants/sq. ft and when foxtail emerges after the crop is in the 3- to 4-leaf stage. This is especially true for barley. Once the small grain is in the 3- to 4-leaf stage, it can usually out compete emerging foxtail. Chemical control is warranted when the foxtail population is heavy (100 plants/sq ft or more). Foxtail may also contribute to moisture stress and cause greater yield loss under drought conditions. Foxtail emerging at the same time or before small grain is more competitive than when emerging after small grain. Some options to consider for foxtail control are:

1. If the foxtail infestation is heavy, and just emerging with the crop, consider harrowing or rotary hoeing as soon as possible. Harrowing or rotary hoeing is not effective once foxtail has 2 to 3 leaves. Small grains can be harrowed or rotary hoed until the 3- to 4-leaf stage with little effect on yield. If a harrow or rotary hoe is not an option, then consider a herbicide.
2. If the foxtail infestation is light to moderate, wait to determine if the crop will out compete the foxtail. Herbicides can still be used if foxtail is a problem after small grain is in the 5- to 6-leaf stage.

**S5. Kochia** is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. Use 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.

## ANNUAL WEED CONTROL - S5-7

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, Sonalan may improve control compared to trifluralin. 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.

**S6. Common mallow (cheeseweed)** is an annual, winter annual, biennial, or short-lived perennial and is traditionally found along roadsides and in lawns, gardens, and waste places and is becoming a problem weed in cultivated fields, especially in no-till conditions. Although tillage helps reduce infestations, common mallow can thrive in less competitive crops such as flax and chickpea. NDSU research at Minot with no crop competition showed Liberty, Roundup, or a three-way mix of Starane + Harmony Extra/XP + 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 Advanced, Tough, Basagran, Clarity, or dicamba was poor. Combinations of herbicides including UpBeet gave good to excellent mallow control in sugarbeet.

**S7. Nightshades** have become a serious weed problem in North Dakota. 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. Also, birds and wildlife consume nightshade and can transport seed through droppings.

Four nightshade species are found in North Dakota: black, eastern black nightshade, hairy nightshade, and cutleaf nightshade. Hairy nightshade is the only species densely covered with small hairs and along with cutleaf nightshade the 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. E. black nightshade is very difficult to distinguish from black nightshade before berry formation. E. 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. It has been reported that leaves from eastern black nightshade plants are translucent and leaves from black nightshade are opaque when held to sunlight.

Nightshade emergence may continue from June through September and is strongly influenced by moisture. Rain events cause multiple flushes of nightshade and plants can emerge even 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 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 prevention of 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.

Nightshade biotypes are tolerant to many classes of herbicide including SUs (except Express). 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 residual soil herbicides, e.g. Authority/Spartan, Balance Pro, Pursuit, and Python, can help control 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, Aim, bromoxynil, bromoxynil + MCPA, Curtail, Curtail M, and dicamba.

### **Nightshade control in corn:**

PPI, PRE herbicides: Products containing acetochlor (DoublePlay, Harness, Surpass, others), Atrazine, Balance Pro, Hornet, Outlook, and Python.

POST herbicides: Aim, Accent Gold, Basis Gold, Callisto, dicamba, Distinct, Hornet, bromoxynil, Liberty (Liberty resistant corn), Lightning (Clearfield corn), and Roundup (RUR Corn).

### **Nightshade control in soybean/dry bean:**

PPI and PRE herbicides:

Soybean: Authority, Outlook, Python, Sonalan (suppression).

Drybean: Outlook, Sonalan (suppression)

POST herbicides:

Soybean: Cobra, Flexstar, Pursuit, Raptor, Ultra Blazer, Liberty (Liberty resistant Soybean), glyphosate and Extreme (Roundup Ready Soybeans).

Dry bean: Pursuit, Raptor, Reflex.

Notes: Basagran may control hairy nightshade but not eastern black nightshade. Basagran, Cobra, and Ultra Blazer control only small nightshade. Flexstar/Reflex gives poor hairy nightshade control. Only Authority, Python, Extreme and Pursuit gives residual control of multiple flushes but these herbicides may restrict seeding of some crops one or more years after application

### **Nightshade control in sugarbeet:**

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

POST herbicides: Single or multiple applications of Stinger alone or in combination with Betanex/Betamix/Progress + Upbeet. Alternative control: inter-row cultivation, and hand weeding.

### **Nightshade Control in potato:**

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

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

**S8. Pigweed** control requires higher rates of most herbicides than rates for control of wild mustard. Ally/XP, Amber, Express/XP, Harmony Extra/XP, Harmony GT/XP, 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, has biotypes that are 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).

**S9. Russian thistle** requires higher herbicide rates than 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.

**S10. Volunteer sunflower** is a common 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 and not be controlled after POST herbicides are normally applied. 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/XP, Harmony Extra/XP, Harmony GT/XP, bromoxynil, bromoxynil + MCPA, dicamba plus MCPA amine, and Curtail all give good control of volunteer sunflower that is superior to 2,4-D or MCPA. Sunflower 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.

**S11. Wild oat** is difficult to eradicate because the plants shatter their seeds before crops are harvested and because seed dormancy causes delayed germination. Wild oat is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist. Cultural approaches available for wild oat control in small grains include delayed small grain seeding, post seeding cultivation and competitive crops. The most practical cultural method of wild oat control is delayed small grain seeding which involves early soil cultivation to stimulate wild oat germination then tillage or chemical control to kill emerged wild oat prior to crop seeding. Delayed seeding may cause a significant wheat yield reduction when compared to early seeding.

Other cultural control practices are planting competitive crops like barley and rye, or broadleaf row crops such as sunflower, soybean should be considered in fields with heavy wild oat infestations. Wild oat eradication is not practical or economically sound, therefore, a combination of cultural and chemical control methods should be used to manage wild oat populations and prevent yield losses.

POST wild oat herbicides require application to wild oats and crops at precise leaf stages. Refer to tables in the small grain section determined the correct way to stage small and wild oat plants. Timing of POST herbicides should be considered. Early application may mean better yields because of less competition with the crop but a late flush of wild oat will require a second application, or some wild oats might escape treatment. In general, any population warrants chemical control to prevent 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%

**S12. 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 survives most PPI, PRE, and POST herbicides, is then detected and misidentified as common ragweed when plants are larger. 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.

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 products) and POST (e.g. most ALS herbicides and Ultra Blazer) herbicides used in row crops. Also, biennial wormwood can emerge late after most POST herbicides have been applied and is often confused with common ragweed. However, biennial wormwood is controlled by growth regulator herbicides of 2,4-D, Curtail/M, dicamba, Distinct, Hornet, Stinger and by non-selective herbicides, Liberty and glyphosate. Other herbicides that control wormwood are soil applied Authority/Spartan, Python, Sencor, and Valor.

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. Compared to a single treatment. Wormwood apparently rapidly becomes tolerant to herbicides as plant size increases.

**S13. Other Weeds:** The following information has been gathered from limited observations in NDSU research and from research reports from NCWSS, WSWSS, and WSSA. Additional observations on these or other unusual species would be welcome. Contact any NDSU weed scientist.

**Alfalfa:** E = Curtail at 4 pt/A, 2,4-D + dicamba (1qt + 0.5pt), Stinger (2/3 pt). G-E = 2,4-D (1-2 qt/A), Landmaster BW. G = glyphosate (1.5 -2 qt), Fallowmaster. F = dicamba (0.5 pt). P-F = glyphosate (1qt).  
**Buffalobur:** E = Betanex/Betamix+Stinger. G = Betanex/Betamix, Cobra. P-F = 2,4-D. P = MCPA, Banvel, Pursuit.  
**Cleavers:** E = Paramount, Starane. F-G = Liberty.  
**Curly dock:** E = Stinger. G = Harmony Extra/XP.  
**Equisetum (horsetail):** G = Amitrole T, Casoron, Telar (Glean), Oust/XP, glyphosate + Garlon. P = glyphosate.  
**Hemp:** E = 2,4-D, ALS herbicides, atrazine, Basagran, Callisto, Lorox, Sencor.

## S-13-T3 - ANNUAL WEEDS/PERENNIAL WEEDS

**Hemp Dogbane:** G = 2,4-D, dicamba or glyphosate.  
**Horseweed (marestail):** E = Callisto, FirstRate, Peak, Python, Valor. G-E = glyphosate.  
G = atrazine + Sencor, paraquat, 2,4-D. P = Pursuit.  
**Nightflowering catchfly:** E = Reflex + MSO adjuvant.  
**Per. Smartweed:** E = glyphosate (2 lb). G-E = glyphosate + dicamba (1qt + 1pt). G = Stinger. F-G = dicamba (1qt).  
**Per. Sowthistle:** G-E = glyphosate, Ally, Cimarron Max.  
**Poison Ivy:** E = Crossbow. G = glyphosate, Garlon, Trimec, Arsenal, Oust/XP. P-G = 2,4-D.  
**Purslane, Common:** G = 2,4-D + Stinger, Betanx + Stinger.  
**Waterpod:** G = 2,4-D, Pursuit, SU herbicides.  
**Wild cucumber:** G = Accent, dicamba, Harmony Extra + 2,4-D + dicamba, glyphosate (2 qt).  
**Wild Rose:** G = dicamba, glyphosate, Tordon. P = 2,4-D.  
**Yellow Nutsedge:** Permit = E. G = Basagran (splits), Pursuit. F = Dual/Lasso (PPI), EPTC, glyphosate. O = Grass herbs.

### PERENNIAL WEED CONTROL

**T1. Field bindweed.** Paramount (quinclorac) at 0.33 lb DF controls field bindweed in fallow, postharvest or preplant in spring prior to seeding wheat, including durum. Apply with MSO adjuvant at 1.5 pt/A to bindweed least 4 inches long. Apply after harvest but prior to frost. Use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. Paramount may also control foxtails, barnyardgrass, and volunteer flax. Field research in other states show Paramount gives 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** is a major problem in ND due to reduced tillage, wet weather, lack of persistence and expense of control. NDSU research has shown Stinger/Transline, and Curtail provide the best long-term Canada thistle control. Glyphosate alone or with 2,4-D gives good control applied pre- and post-harvest. However, control is reduced under dry conditions. Several herbicides give good but temporary season-long control: dicamba, Express and products containing Express (Ally Extra, Harmony Extra/XP and Cimarron Max). Applying Express containing products with 2,4-D + dicamba enhances control. 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 infestations increase. Timing is a critical factor. Herbicide application after a light frost may enhance control but application when leaf tissue has been destroyed by frost may result in less control due to lack of herbicide uptake. Tillage can be a critical factor. Tillage in late fall after spraying increases control and may add an additional 30 to 40% control for herbicide treatments that gave 30 to 50% control without control. If lower herbicide rates or less effective herbicides are used, tillage is very important. If tillage is not planned, then implement a program of multiple applications of the most effective herbicides at the high rates practical. Spray rosettes of actively growing plants using the rosette technique.

**Rosette Technique.** 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. Greater control occurs when herbicides are applied in the fall to new growth and to Canada thistle in the rosette stage. Periodic tillage in fallow controls Canada thistle shoots and other weeds until mid July when the day-length is less than 15 hours. Canada thistle shoots that emerge when day-length is less than 15 hours do not bolt but remain in the rosette growth stage. Apply glyphosate, Curtail/M, Stinger, or Redeem to rosettes in late September or early October. For in-crop control, use herbicides and between-row tillage to prevent bolting. Continue cultivation until canopy closure in soybean and until early July in corn. Effective herbicides can be applied post-harvest until early October. Herbicides fall-applied to rosette Canada thistle provide greater control and root kill compared 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 treatment. Preventing establishment and spread of milkweed patches requires continuous scouting and persistent control efforts. Prevent seed production. Milkweed seed is highly viable and will germinate readily. Pappus on seeds allows long-distance travel and is responsible for establishment in fields. Common milkweed becomes perennial (capable of reproducing from underground roots) approximately 3 weeks after emergence. New shoots developing from established roots begin emerging in late April and grow more rapidly than spring seeded crops. Milkweed control is expensive. Individual plants and small patches are easier and less expensive to treat than entire fields. Patch spraying covers only a fraction of the area of a broadcast application. Patch spraying allows use of higher herbicide rates with less expense than broadcast spraying.

Common milkweed control and management.  
NDSU Research. Herbicides applied June, 1988.

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

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

Apply herbicides when milkweed is in the late-bud to flowering stage and actively growing. Control patches when small. Patch-spray glyphosate at 6 to 8 pt/A (up to 10 pt/A is allowed). Apply glyphosate with AMS at 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.

**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 with auxin herbicides even after several light frosts if the leaves are green or red and still firmly attached to the stem.

**T5. Mowing or tillage** is a good means of reducing perennial weed seed production. If fall herbicide applications are planned, mowing or tillage should be discontinued early enough to allow adequate plant regrowth. Post-harvest treatments can be applied when weed growth is about 1 foot tall. 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 crops** should include in-crop (conventional and particularly Roundup Ready crops if available), preharvest, and postharvest herbicide applications. Regardless of application, retreatment, once or twice per year will be required for successful control of perennial weeds. Once large patches are controlled, seedlings will require treatment annually with registered in-crop herbicides. Roundup Ready corn, soybean, canola, and wheat (future registration) is very effective in controlling perennial weeds. Decreasing cost of glyphosate enables economic control. NDSU research has shown control of established Canada thistle patches with preharvest applications of glyphosate. For postharvest applications to be effective, treatment to new plant growth is required. Tillage in combination with any herbicide treatment enhances control. Tables for each crop or perennial weed listed in this guide gives most effective herbicide choices, rates, and application information.

**T7. Glyphosate** at 2 to 6 pt/A of a 3 lb ae/gal concentrate applied as a spot treatment will give season-long control of perennial weeds in wheat, barley, oat, corn and soybean. Glyphosate is non-selective so the crop in the treated area will be killed. Avoid drift outside the target area. Glyphosate is non-residual so plants may emerge after treatment and unaffected rhizomes or roots from perennials will continue to grow. See label or tables for application stage and rates. Preharvest applications of glyphosate at 2 pt/A gives 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

(See Z1 for haying and grazing restrictions)

**T8. 2,4-D ester or amine** at 2 to 4 pt/A controls many perennial weeds in pastures. Some perennials such as fringed sagebrush and western snowberry (buckbrush) are controlled with one application and perennials such as Canada thistle, field bindweed and leafy spurge require retreatment annually. 2,4-D can be used in many locations where Tordon cannot, but avoid drift onto susceptible plants. Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air. PBI Gordon "Amine 400," Combelt 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 Cimarron (metsulfuron) at 0.1 to 0.3 oz 75DF/A or Cimarron Max at 0.5 to 1 oz DF/A Part A + 1 to 4 pt Part B can be applied in rangeland, grass pastures and non-cropland for control of noxious and troublesome weeds. Spot treatment at higher rates when practical. Spray foliage for thorough coverage but not to run-off. Add a NIS at 0.25 to 0.5% v/v. Use of NIS may cause temporary yellowing, stunting and suppression of head development in annual and perennial grasses. To avoid grass injury, do not apply to desirable grasses under stress, nor to grasses grown for seed. No grazing restrictions are given. Products with 2,4-D, dicamba and many other herbicides increase control and reduce risk of resistant weeds. Products 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 with MSO adjuvant and UAN at 1 qt/A each from early September to mid-October controls many grass and broadleaf weeds including foxtail and leafy spurge in right-of-ways, pasture, rangeland, and CRP. Warm season grasses are more tolerant than cool-season grasses. Highest rate provides longer control but increases grass injury. Plateau does not control absinth wormwood. Plateau does not injure desirable forage grasses or some broadleaf species including lead plant (*Amorpha canescens*), purple prairie clover (*Dalea purpurea*), prairie wild rose (*Rosa arkansana*), willow, (*Salix species*), and wild raspberry (*Rubus species*).

**T13. 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.

## T14-16 - PERENNIAL WEED CONTROL

**T14. 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 is 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 will damage broadleaf crops and plants. Tordon is water soluble and may leach in the soil; consequently, do not apply in areas where a sandy porous surface and substrata overlay ground water 10 feet or less below the surface. Tordon must not be allowed to drift into surface water (including wells), irrigation 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.

### T15. NRCS Policy on Noxious Weed Control in CRP.

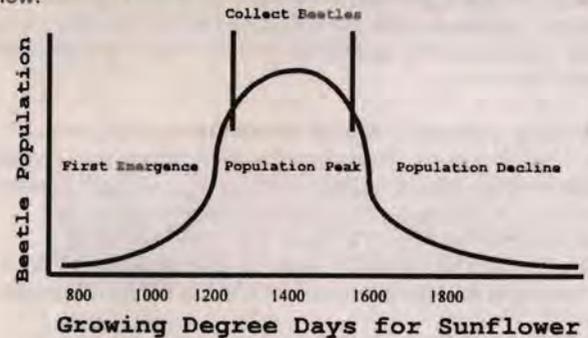
Taken from ND NRCS Exhibit 3, 2-CRP Manual, para. 210. **Established CRP Stands:** Policy requires that no clipping or spraying of entire fields should be done during the primary nesting period (April 15 to August 1) for normal weed control. If noxious weeds are present and the critical control period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

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

## BIOLOGICAL CONTROL OF PERENNIAL WEEDS

**T16. 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 ND Biological Control Program. Contact your county weed officer or board member for information. Release flea beetles on a well-drained south-facing slope with a moderate density of leafy spurge (60 to 90 plants/square yard) with minimal grass cover. Do not collect or move flea beetles, 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 m<sup>2</sup> 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. 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 ft<sup>2</sup> 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 to reduce leafy spurge stem density and increase establishment.

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

**Leafy spurge gall midge** (*Spurgia esulae*) prevents galled stems from flowering, 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.

**T17. Purple loosestrife.** Six species of insects have been identified as having potential for biological control of purple loosestrife. Three species have been released into North Dakota. The insects and plant parts attacked are:  
*Galerucella pusilla* - a leaf-feeding beetle  
*Galerucella californiensis* - a leaf-feeding beetle  
*Hylobius transversovittatus* - a root-mining weevil  
Biological agents hold promise for large infestations, thereby reducing the spread from neighboring states. However, purple loosestrife infestations in North Dakota are very small and isolated and should be controlled by chemical and/or mechanical methods. Biological control agents for purple loosestrife may not work well in urban areas because mosquito spraying severely reduces populations of biocontrol agents.

## SHELTERBELT WEED CONTROL

**U1.** Herbicides listed in the table can be used for weed control in shelterbelts and tree plantings in farm shelterbelts. Read and follow label directions. Eliminate perennial weeds with repeated tillage or with non-residual herbicides before trees are planted. Many herbicides are NOT labeled for over-the-top application to trees and must be applied through directed application. Some herbicides (Stinger) can be applied over-the-top to coniferous (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. 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.

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

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

### Types of Resistance

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

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

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

### Cross and Multiple Resistance

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

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

### Herbicide resistant weed species in ND:

1. Green foxtail to the DNA herbicides.
2. Wild oat to ACCase inhibitor herbicides.
3. Wild oat to ALS (Assert) herbicides.
4. Wild oat resistant to Avenge
5. Wild oat resistant to Far-Go
6. Kochia to ALS herbicides.
7. Kochia to 2,4-D and dicamba.
8. Kochia to atrazine
9. Redroot pigweed to IMI herbicides.
10. Waterhemp to ALS herbicides.
11. Wild mustard to ALS herbicides.
12. Eastern black nightshade to imidazolinone herbicides.
13. Marshelder resistance to ALS herbicides (suspected)
14. C. ragweed resistance to ALS herbicides (suspected)

**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.

**ACCase resistant wild oat** is found within ND and MN. Hoelon and fenoxaprop (Puma, Dakota, Tiller, and Cheyenne) resistance has been documented in nearly every county in ND. Resistance to Achieve and Discover has also been documented. Resistance has varied from complete resistance to recovery from near death and all possible responses in between. Wild oat resistance to Assure II and Poast has been documented in the RRV of ND and MN. Wild oat resistance to Select has not been documented in ND or MN.

**Assert (ALS) resistant wild oat** has been documented in MN and eastern ND. 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.

**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. Generally, all kochia biotypes tested were tolerant to 2,4-D and MCPA.

**IMI resistant redroot pigweed** has been documented at one location in Cass county. Continued use of Pursuit and Raptor selected for this resistant biotype.

**ALS resistant waterhemp** has been documented in the RRV of ND and MN. 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 selected for this resistant biotype.

**ALS resistant wild mustard** has been documented in the RRV of MN and 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 selected for this resistant biotype.

**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 Pursuit and Raptor in soybean and dry bean have selected for the resistant biotype.

Other weeds that have developed resistance to herbicides in other areas of the nation are listed below. This shows that resistance to these weed species could also occur in ND:

**ALS Mode of action:**

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

**ACCase Mode of Action:**

Green foxtail and giant foxtail.

**Growth regulator mode of action:**

Wild mustard

**Triazines:**

Kochia

Genetically engineered crops resistant to glyphosate, Liberty, and Raptor (Imi herbicides) 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, kochia (button size), wild buckwheat, nightshade, common lambsquarters, waterhemp, smartweed, horseweed (maretail), common mallow, velvetleaf, dandelion, and nutsedge. Weeds expressing some natural tolerance to Liberty include lambsquarters and yellow nutsedge.

For a comprehensive list of resistant weeds in North Dakota, U.S., and world see web site: [www.weedscience.com](http://www.weedscience.com)

**STRATEGIES TO MINIMIZE HERBICIDE RESISTANT WEEDS**

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

**General Guidelines:**

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

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

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

**4. Rotate crops**, particularly those with different life cycles, e.g., winter annual crops (winter wheat), perennial crops (alfalfa), 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.

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

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

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

**Advantages:**

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

**Disadvantages:**

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

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

**Advantages:**

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

**Disadvantages:**

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

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

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

Mechanism of Action	Common Name	Herbicide Tradename	Premix or Co-pack Tradenames
Photosystem II Inhibitors (6) - Site C	bromoxynil	Buctril/Connect/others	Bison, Bromac, Bronate/Advanced/others, Buctril+Atrazine, Brozine, Moxy AT
	bentazon	Basagran	Galaxy, Rezult
	pyridate	Tough	
Photosystem II Inhibitors (7) - Site B	diuron	Diuron/Direx/Karmex	Krovar, Sahara, WeedBlast
	linuron	Lorox, Linex, Linuron	
	tebuthiuron	Spike	
Amide	propanil	Stampede	Stampede CM
Lipid Synthesis Inhibition (8)	cycloate	Ro-Neet	DoublePlay
	EPTC	Eptam/Eradicane	
	thiocarbamates	Far-Go	
Difenoquat	difenoquat	Avenge	Buckle
EPSP Synthase Inhibitors (9)	glyphosate-ipa	Roundup/Severol	Backdraft, Bronco, Campaign, Extreme, FieldMaster, GlyMix MT, Landmaster BW, FallowMaster, ReadyMaster ATZ, RT Master
	glyphosate-NH3	Roundup UltraDry	
	gly- (NH4)2	Touchdown 3	
	gly-acid+AMADS	Engame	
Glutamine Synthetase Inhibitors (10)	glufosinate	Liberty/Finale/Rely	Liberty ATZ
Bleaching: Carotenoid Inhibition - Unknown (11)	amitrole	Amitrol T	
Bleaching: Carotenoid Inhibition - Phytoene Desaturase Inhibitor (12)	beflubutamid	UBH-820 Sonar	Nikyl
	fluridone		
	flurochloridone		
Nicotinilide	diflufenican		
Bleaching: Diterpene Inhibition (13)	acolonifen clomazone	Challenge/Bandur Command	Nikyl Command Xtra, Commence
PPO Inhibitors (14)	acifluorfen	Ultra Blazer	Galaxy
	fomesafen	Flexstar/Reflex	
Diphenylethers	lactofen	Cobra/Phoenix	Stellar
	oxyfluorfen	Goal	
N-phenylthalamides	flumiclorac	Resource	Stellar
	flumioxazin	Valor	
Oxadiazoles	oxadiargyl	Raft/Topstar	
	oxadiazon	Ronstar	
Phenylpyrazoles	pyraflufen	Ecopart	
Thiadiazole	fluthiacet	Action	
Triazolinones	carfentrazone	Aim	Teamwork + Atrazine Canopy XL, Command Xtra, Gauntlet
	sulfentrazone	Authority/Spartan	
Other	flufenpyr		
Very Long Chain Fatty Acid Inhibitors (15)	acetochlor	Degree/Harness/Surpass/ TopNotch	Degree Xtra, DoublePlay, FieldMaster, FulTime, Harness Xtra
	alachlor	Lasso/others	Bronco, Bullet, Freedom, Lariat G-Max Lite, Guardsman Max, LeadOff Axiom, Domain, Epic Bicep Lite II Magnum, Camix, Cinch ATZ Lite, Lumax Ramrod + Atrazine
	dimethenamid	Outlook	
	flufenacet	Define	
	metolachlor	Dual/Dual II/Magnum	
propachlor	Ramrod		
Acetamides			
Auxin Inhibitor (19)	diflufenzopyr		Celebrity Plus, Distinct
Photosystem I Inhibitors (22)	diquat	Diquat, Reglone	
	paraquat	Gramoxone Max	
Bleaching: HPPD Inhibition (28)	isoxaflutole	Balance/Pro	Epic
	mesotrione	Callisto	Camix, Lumax
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 explain herbicide degradation for chemistries known to carryover.

### General Rules For Herbicide Breakdown

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

### Effect of pH on Herbicide Activity and Persistence

Negative charges on soil particles and organic matter adsorb positive charged compounds or substances. Soil pH influences adsorption and availability of the following herbicides by determining the electrical charge of the herbicide chemistries: Imidazolinones, SUs, 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) and Breakdown of TPS Herbicides (FirstRate/Amplify and Python).

In general, breakdown occurs by soil microbes and **breakdown occurs more rapidly and herbicide activity increases as soil pH increases**. Rate of breakdown decrease in dry conditions. Imi and TPS herbicides are:

1. Broken down by microbes - not broken down by hydrolysis.
2. Not degraded in anaerobic (waterlogged soil) conditions.
3. Not volatile nor photodegraded by sunlight.
4. Not leached beyond 12 inches.
5. Weakly bound to soil but strongly bound to OM.
6. Adsorbed more strongly as soil dries and through time.

For Imi herbicides applied in dry conditions, herbicide molecules adsorb to OM. The next spring, winter moisture can displace herbicide molecules from soil and OM allowing the molecules to become free for plant uptake and microbial breakdown. For sensitive crops like sugarbeet, the adsorption and desorption process may occur over several years causing crop injury from herbicide residues that become available after moisture events.

7. Negatively (-) charged, not adsorbed, and free for plant uptake and microbial degradation at soil pH >6.5 for Imi herbicides and pH >7 for TPS herbicides.
8. Strongly bound to OM at pH <6.5 for Imi herbicides and pH <7 for TPS herbicides. For Imi herbicides: Amount adsorbed changes little from 6.5 to 8. At soil pH <6.5, pH reduction as small as 0.2 pH units can **DOUBLE** amount adsorbed.

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

In summary, activity and degradation of Imi and TPS herbicides increase as soil pH increases. Herbicide adsorption increases as OM matter increases and as soil pH decreases. All factors increasing microbial activity also increase herbicide degradation (warm, moist soils). Degradation increases in soils with pH above

6.5 (Imi) or 7 (TPS) because herbicide molecules are not absorbed and are in a free state in soil solution for plant uptake and microbial breakdown.

### Y3. Breakdown of Sulfonylurea (SU) Herbicides:

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

Short residual herbicides of Express/XP, Harmony Extra/XP, Harmony GT/XP, Option, and UpBeet are rapidly broken down by soil microbes

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

Exception: Permit (halosulfuron) and Matrix (rimsulfuron) are 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.

Most SU herbicides are:

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

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

### Y4. Breakdown of Triazine Herbicides (Atrazine, Sencor, and Princep)

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

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

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

At high soil pH, the opposite reaction occurs. At soil pH > 7.5, triazine herbicide molecules donate protons (H<sup>+</sup>) (H + OH = H<sub>2</sub>O) causing molecules to have a net neutral charge which do not bind to soil particles and OM and are free for plant uptake and microbial decomposition.

**Y5.** 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.

**Y6.** Herbicide residues can often be detected by bioassay. Representative soil samples of the whole field are obtained by sampling many places to the depth of the tillage layer. A soil sample free of herbicide residues can serve as the untreated check. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare two or more samples of untreated check soil and the test soil in pots or other containers with holes in the bottom for water drainage.

The crop to be grown in the field should be used as one bioassay species. Alfalfa and canola 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. Window bioassay do not provide accurate information for ALS herbicide carryover.

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

**Y7. Accent Gold/WDG** (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.

**Y8. 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.

**Y9. 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.

**Y10. 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.

**Y11. Callisto** (mesotrione) at 3 fl oz/A may have a residue the following year. Risk of Callisto carryover increases as organic matter increases and soil pH decreases. Callisto is degraded by soil microbes. Factors affecting Callisto breakdown are similar to Imi herbicides. See paragraph Y2 for additional information. Rotation restrictions for Callisto are found in the table at the end of this section.

**Y12. Celebrity Plus** (nicosulfuron + 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.

**Y13. 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.

**Y14. 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 rate of breakdown. Northern production areas, like ND, have a shorter growing season and the soil temperature is colder for longer periods of time which limits breakdown. Late applications in beans decreases the amount of time that breakdown can occur.

Ways to reduce potential for fomesafen carryover include lower application rates, banded herbicide applications, and tillage to dilute herbicide residues. The approximate ranking of 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.

## Y15-23 - HERBICIDE CARRYOVER

**Y15. Hornet** (flumetsulam + clopyralid-acid) applied 1.6 to 4.8 oz/A or **Hornet WDG** (flumetsulam + clopyralid-K salt) at 2 to 6 oz WDG/A contains 1 to 3 oz ai/A clopyralid. **Stinger** is labeled for use in corn at 1.5 to 4 oz ai/A. Therefore, precautions in crop rotation would apply as if clopyralid was applied alone at 1 to 3 oz ai/A. Rotational crop restrictions for **Hornet** are found in the table at the end of this section. Consult the **Stinger** label and paragraph in this section for residue information for clopyralid.

**Y16. 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.

**Y17. 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.

**Y18. 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**.

**Y19. Sencor** (metribuzin) is used on corn, 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.

**Y20. Sonalan** (ethalfuralin), **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, potato, 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.

**Y21. 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.

**Y22. 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**.

### Y23. 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, <http://www.algreatlakes.com>

Agvise Laboratories  
Northwood, ND  
(701) 587-6010, [johnhlee@polarcomm.com](mailto:johnhlee@polarcomm.com)

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

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

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

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

Hazelton 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](http://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 12<sup>th</sup> Street, Bismarck, ND 58504  
(800) 279-6885, (701) 258-9720

NDSU Diagnostic Lab  
206 Waldron Hall, NDSU 58105  
(701) 231-7854, [diaglab@ndsuxext.nodak.edu](mailto:diaglab@ndsuxext.nodak.edu)  
For Pursuit (soil) and glyphosate (foliage) only.  
For glyphosate residue, fee is \$325/sample, with a \$50/sample discount for multiple samples submitted at one time. Glyphosate residues can be detected to 0.05 ppm which is lower than the 0.1 ppm threshold.

Olson Biochem Labs  
PO Box 2170  
134 ASC, Brookings, SD 57007-1217  
(605) 688-6171, Fax (605) 688-6295

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

**Y24.** Table on crop rotation restrictions is on the next page.



Y24. 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	Field pea	Flax	Oat	Edibl Leg.*	Pot- ato	Saff- lowr	Soy- bean	Sgr- beet	Sun- flwr	HRS Drm
----- (months after application) -----																	
<b>DO NOT USE IN ND = Beacon, Canopy, Canopy XL, Classic, Concert, Exceed, Scepter, Spirit, Steel, Synchrony</b>																	
Accent (a)	12	8	18	0	18	18	10	10	18	8	10	18a	18	0.5	18a	11/18a	8
Accent Gold	10.5	8	26b	0	B	26	10.5	18	26b	8	18	18	B	10.5	26b	18	8
Ally/XP (c)	34d	10	34d	34e	34d	4	34e	34d	34e	10	34d	34d	34e	34d	34d	34e	1/10
Ally Extra (0.2oz) e	22	10	22	22	22	2-4	22	22	22	10	22	22	22	22	22b	22	1/10
Amber	4b	18c	B	22b	B	B	B	B	B	18c	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 (0.38 lb ai)	NCS	NCS	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	NCS	12	NCSb	NCS	NCS
Atrazine (0.38-0.5 lb ai)	2CS	NCS	2CS	0	2CS	2CS	2CS	2CS	NCS	2CS	2CS	NCS	2CS	12	2CSb	2CS	2CS
Atrazine (0.5-1 lb ai)	2CS	2CS	2CS	0	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	12	2CSb	2CS	2CS
Authority	12	4	30	10	30	12	12	12	18	4	12	30	30	0	30	12	4
Axiom	12	12	12	0	18	12	12	1	12	12	1	1	12	0	18	12	12
Balance Pro (j)	10	6	18	0	18	18	18	18	18	6	18	6	6	6	18	10	6
Basis	10	8	18	0	18	18	8	8	18	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	8	18	0.5	18	18	8	8	18	8	8	2CS	18	8	B	8	8
Boundary	4.5	8	18	8	18	12	18	8	18	8	12	8	18	0	18	-	8
Brdstrk+Treflan	4	4	26b	8	26b	12	4	4	26b	18	4	12	26	0	26b	18	4
Buckle	NCS	0	NCS	16	NCS	18	NCS	NCS	NCS	16	NCS	NCS	NCS	NCS	14g	NCS	NCS
Callisto	18	4	NCS	0	18	18	18	18	18	4	18	NCS	18	NCS	18	NCS	4
Celebrity Plus	12	8	18	0.25	18	18	10	10	18	8	10	18a	18	4	18a	10/18a	8
Curtail/M	10.5m	1	10.5m	1	10.5m	1	10.5m	18	10.5m	1	18	18	10.5m	10.5m	5	10.5m	1
Degree (n)	2CS	2CS	2CS	0	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	4
Dicamba (<1.5 pt) h	4	4h	4	0h	4h	4	4	4	4	4h	4	4	4	4	4	4	0h
Domain	12	12	18	1	18	12	12	12	12	12	12	1	12	0	18	12	12
Distinct (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	9	9	NCS	NCS	NCS	NCS	11	NCS	18	24	9	NCS	9	9	NCS	4
Extreme	4	9.5	40b	8.5	40b	4	4	4	26	18	4	26	18	0	40b	18	4
Far-Go	NCS	0	NCS	NCS	NCS	NCS	NCS	NCS	NCS	18	NCS	NCS	NCS	NCS	NCS	NCS	0
Finesse	B	16	B	B	B	4	B	B	B	10	B	B	B	B	B	B	0
FirstRate/Amplify	9	30b	30b	9	B	9	9	9	30b	9	9	18	B	0	30b	30b	3
Flexstar	18	4	18	10	18	4	10	10	18	4	10	18	18	0	18	18	4
Gangster	12	B	B	9	B	9	9	B	9	9	9	18	B	0	30b	30b	3
Gauntlet	12	12	24	10	24	12	12	12	B	12	12	B	B	0	30	30	4
Glean	B	16	B	B	B	4	B	B	B	10	B	B	B	B	B	B	0
Harness (n)	2CS	2CS	2CS	0	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	4

Herbicide	Alf- alfa	Bar- ley	Can- ola	Corn	Cra- mbe	CRP grss	Dry bean	Field pea	Flax	Oat	Edibl Leg.*	Pot- ato	Saff- lowr	Soy- bean	Sgr- beet	Sun- flwr	HRS/ Durm
	----- (months after application) -----																
Hornet/WDG	10.5m	4	26b	0	B	12	10.5m	10.5m	26b	4	10.5m	18	B	10.5m	26b	18	4
Lightning	9.5	9.5	40b	8.5	40b	40	9.5	9.5	40b	18	9.5	26	18	9.5	40b	18b	4
Lumax (<3 pt/A)	18	4	NCS	0	18	18	18	18	18	4	18	NCS	18	NCS	18	NCS	4
Matrix	12	9/18p	18	0	18	18	10	18	18	9	18	0	18	4	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	22	10	10	22	22b	22b	22b	22b	22b	10
NorthStar (r)	8	8	18	0.5	18	18	8	8	18	8	8	8r	18	8	36r	8	8
Option	No crop rotation restrictions - Refer to label.																
Paramount	10	10	10	10	10	10	10	24	24	10	24	10	10	10	24	10	0
Peak (r)	22	0	22	1	22	10	22	10	22	0	10	22r	22	22	22r	22	0
Permit	9	2	15	1	B	2	9	9	B	2	9	9	B	9	36	18	2
Plateau	36	24	48b	36	36	0	36	36	36	24	36	48b	36	18	48b	36	12
Prowl/Pendimax	NCS	NCS	NCS	0s	NCS	NCS	0	0	NCS	NCS	0	0	NCS	0	2CS	0	NCS
Pursuit	4	9.5	40b	8.5	40b	4	4	4	26	18	4	26	18	0	40b	18	4
Pursuit Plus	9.5	9.5	40b	8.5	40b	NCS	4	4	26	18	4	26	18	0	40b	18	4
Python	4	4	26b	0	26b	12	4	4	26b	4	4	12	26b	0	26b	18	4
Raptor/Beyond	9	4	18	8.5	18	9	9	9	18	9	9	9	18	0	18t	9	3
Rave	B	18c	B	22	B	B	B	B	B	18c	B	B	B	36b	B	24b	0
Reflex	18	4	18	10	18	4	10	10	18	4	10	18	18	0	18	18	4
Sencor (u)	4	8u	12	4	12	4	12	8	12	12	8	4	12	4	18	12	8u
Sonalan	NCS	NCS	NCS	NCS	NCS	13w	0	0	NCS	NCS	0	NCS	NCS	0	2CS	0	NCS
Spartan	12	4	24	10	24	12	10	10	24	4	10	10	10	0	24	-	4
Spirit (r)	18	3	18	1	18	10	18	10	18	3	10	18	18	18	18r	18r	3
Steadfast	12	8	18	0	18	18	10	10	18	8	10	18a	18	0.5	18a	11a	8
Stinger	10.5	0	0	0	0	0	10.5m	18	0	0	18	18	10.5	10.5m	0	10.5m	0
Surpass (n)	2CS	2CS	2CS	0	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	4
Tordon (1.5 oz)	2CS	NCS	2CS	2CSx	2CS	1	2CS	2CS	NCS	NCS	2CS	2CS	2CS	2CS	2CS	2CS	NCS
TopNotch (n)	2CS	2CS	2CS	0	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	2CS	4
Trifluralin (y)	0	NCS	0	NCS	0	18/21	0	0	0	18	0	0	0	0	2CS	0	NCS
Valor	12b	4	12b	1	12b	12b	4	4	12b	12b	4	12b	12b	0	12b	1	1

\*Edible legumes = chickpea/garbanzo bean and lentils.

NCS = Next cropping season after herbicide application.

2CS = Second cropping season after herbicide application.

MAA = months after application.

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

- a Soil pH <7.5 = 10 MAA for sorghum and 11 MAA for sunflower.  
 Soil pH >7.5 = 18 MAA for sorghum and sunflower  
 Soil pH <6.5 = 10 MAA for sugarbeet and all other crops not listed.  
 Soil pH >6.5 = 18 MAA for sugarbeet, potato, and all other crops not listed and cumulative precipitation in the 18 MAA period must exceed 28 inches.

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

- Crop rotation after atrazine is rate and soil pH dependant. Accent Gold/WDG, Python, and Hornet/WDG require a 26 month rotation and a successful field bioassay.  
FirstRate requires a 30 month rotation and a successful field bioassay. Lightning, Pursuit, and Pursuit Plus requires a 40 month rotation and a successful field bioassay.
- c** Do not use on soil with pH greater than 7.9. Barley and oat can be planted 6 months after Ally/XP application west of highway 83.
- d** Requires soil pH of 7.9 or less and a 34 month minimum rotation interval and 28 inches of cumulative precipitation.
- e** Requires soil pH of 7.9 or less, 22 months and 22 inches of precipitation west of Hwy 1 or 34 months and 34 inches of precipitation east of Hwy 1. The previous restriction also applies to Ally Extra at rates greater than 0.2 oz DF/A.
- f** Imi resistant canola varieties may be planted the season after application.  
Conventional canola varieties may be planted the following season after application at 1 pt/A in ND counties of Cavalier, Pembina, Ramsey, Rolette, Towner, and Walsh and MN counties of Kittson, Marshall, Pennington, Red Lake, and Roseau.
- 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 Degree, 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.

**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, Raptor: 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.  
Ally Extra, Express/XP, 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, Glyphosate (preharvest), Select:  
Do not graze or feed.

### Corn

Aim, Axiom, Balance Pro, DoublePlay, Dual products, Epic, Eradicane, FulTime, 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 products, 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, Outlook, G-Max Lite, Guardsman Max, LeadOff, Stinger:  
Do not graze or feed until 40 DAA.  
Poast, Pursuit: 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/WDG, Homet/WDG:  
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

Amber, Cimarron Max, bromoxynil, Plateau:  
No restrictions for grazing and feeding.  
Ally/XP, Landmaster BW, paraquat:  
Do not graze, feed, or hay.  
2,4-D, MCPA: Do not cut for hay for 30 DAA, graze dairy animals for 7 DAA or meat animals for 3 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, Far-Go, glyphosate (preharvest), Pursuit, Raptor, 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, Select: 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.

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### Lentil

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

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### 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.

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### Potato

Paraquat (PRE), glyphosate, Rely, and Sencor: No restrictions.  
Desiccate, Diquat, Dual products, Matrix, 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.

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### Safflower

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

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### Soybean

Dual products, Lasso, paraquat (PRE), Prowl, glyphosate (preplant), Treflan: No restrictions.  
Aim, Assure II, Authority, Axiom, Classic, Cobra, Command, Domain, Flexstar, Freedom, Fusilade DX, Fusion, Galaxy, Gangster, Gauntlet, Harmony GT/XP, Liberty, Linex, Lorox, Outlook, paraquat, Pursuit, Pursuit Plus, Python, Raptor, Reflex, 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: 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.

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### 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.

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### 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.

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

Aim, Ally/XP, Amber, Dakota, Everest, Finesse, Maverick, Paramount, Puma, or trifluralin: No restrictions.  
Ally Extra, Assert, Avenge, Buckle, Cheyenne, Express/XP, Far-Go, Harmony GT/XP, Harmony Extra/XP, 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 = 8 WAA  
Spot treatment = 8 WAA, Preharvest = 7 DAA.  
Curtail/M: Do not graze dairy animals or meat animals for slaughter until 14 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, Bronate Advanced, 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.

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

Herbicide <sup>1</sup>	Lactating dairy animals		All animals except lactating dairy animals		
	Before grazing	Before hay harvest	Before grazing	Before hay harvest	Removal before slaughter
Ally/Cimarron/Escort	0	0	0	0	0
Cimarron Max	7	37	0	0	30
Amber	0	30	0	30	0
Crossbow	1 year	1 year	0 <sup>2</sup>	1 year	3 days
Curtail	14 days	30 days	0	30 days	7 days <sup>3</sup>
Dicamba <sup>1</sup>					
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
Fuego	7 days	30 days	0	30 days	30 days
Glyphosate <sup>1</sup>					
Spot Spray <sup>6</sup>	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 <sup>5</sup> /Campaign	7 days	30 days	3 days	30 days	3 days
Paramount	No grazing or haying restrictions.				
Paraquat <sup>4</sup>	1 month	1 month	1 month	1 month	0
Plateau	0	7 days	0	7 days	0
Rave	7 days	0	0	0	0
Redeem	14 days	365 days	0	7 days	0
Spike <sup>7</sup>	0	1 year	0	1 year	0
Stinger/Transline	0	0	0	0	0
Tordon 22K <sup>8</sup>	14 days	14 days	0	14 days	3 days
2,4-D/MCPA <sup>1</sup>	7 days	30 days	3 days	30 days	0

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

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

<sup>3</sup>Withdrawal not needed if 2 weeks or more time elapsed since application.

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

<sup>5</sup>No restrictions if 10% or less of the area is treated.

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

<sup>7</sup>If no more than 20 lb/A used.

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

## RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

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

SOIL APPLIED HERBICIDES	Mode of Action	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Flixweed	Kochia
Atrazine (PPI)	5	G	F	F-G	G	P-F	E	E	P-F	E	G	E	E
Atrazine (PRE)	5	G	F	F-G	G	P	E	G-E	P	G-E	F-G	E	G-E
Axiom (PPI)	5+	G-E	P	G-E	G-E	N	P	P	P	P	N	-	F
Axiom (PRE)	5+	F-G	P	G-E	G-E	N	P	P	N	P	N	-	P-F
Authority/Spartan (PRE)	14	N	N	P	P	N	N	N	N	F-G	P	F-G	E
Balance Pro (PRE)	28	E	G	E	F-G	P	N	N	E	N	P	G-E	E
DoublePlay (PPI)	8+	E	G-E	E	E	F-G	G-E	G-E	F-G	F	P	P	G-E
Eptam/Eradicane (PPI)	8	E	G-E	E	E	F-G	G-E	G-E	F-G	F	P	P	F
Dual Products (PPI)	15	G-E	P	G-E	G-E	N	F-G	P-F	P	P	N	-	P
Dual Products (PRE)	15	F-G	P	G	G	N	F	P	N	P	N	-	P
Far-Go (PPI)	8	N	N	N-P	N-P	N	N	E	N	N	N	N	N
Far-Go (PoPI)	8	N	N	N-P	N-P	N	N	G	N	N	N	N	N
Gangster (PPI/PRE)	14+	N	N	P	P	N	N	N	N	P-F	E	N	G
Gauntlet (PPI/PRE)	14+	N	N	P	P	N	N	N	N	F-G	E	F-G	E
Harness/Surpass (PPI)	15	E	G-E	G-E	G-E	N	G	F	F-G	P	P	-	G-E
Harness/Surpass (PRE)	15	E	G	G-E	G-E	N	G	P	F-G	P	P	-	G
Hornet (PPI)	2.4	N	N	N	N	N	N	N	N	E	G-E	E	E
Hornet (PRE)	2.4	N	N	N	N	N	N	N	N	E	G	E	G-E
Lasso/generics (PPI)	15	G-E	F	G-E	G-E	N	F-G	P-F	P-F	P	N	-	P
Lasso/generics PRE	15	F-G	P	G	G	N	F-G	P	P	P	N	-	P
Nortron SC (PPI)	-	P	F	F-G	F-G	P	E	G	-	F-G	P	-	F-G
Nortron SC (PRE)	-	P	P-F	F	F	P	G-E	F-G	-	F	P	-	F
Outlook (PPI)	15	G-E	G	G-E	G-E	N	G	P	F	P	N	-	P
Outlook (PRE)	15	F-G	G	G-E	G-E	N	F	P	F	P	N	-	P
Matrix (PRE)	2	G	-	G	F-G	N	G	F	P	P	F	-	G <sup>1</sup>
Paramount	4	G-E	N	E	G	N	N	N	N	N	N	N	F
Prowl (PPI)	3	E	G	E <sup>1</sup>	E	N	G	F	P-F	P-F	N	P	F
Prowl (PRE)	3	E	F	G-E <sup>1</sup>	G-E	N	F-G	P-F	P	P	N	P	F
Pursuit (PPI) (0.72 oz DG)	2	P	N	P	P	N	N	N	N	N	N	E	E <sup>1</sup>
Pursuit (PRE) (0.72 oz DG)	2	P	N	P <sup>1</sup>	N	N	N	N	N	N	N	E	E <sup>1</sup>
Pursuit Plus (PPI)	2,3	E	G	E <sup>1</sup>	E	N	G	F	P-F	F-G	G	E	E
Python (PPI/PRE)	2	N	N	N	N	N	N	N	N	F-G	P	E	E <sup>1</sup>
Ro-Neet (PPI)	8	E	G	E	E	P	G-E	G	-	P-F	P	P	P
Sonalan (PPI)	3	E	G	E <sup>1</sup>	E	N	G	F	P-F	P-F	P	P	F-G
Sencor (PPI)	5	F	F-G	F	F	F	G	N	P	F	F	E	G
Sencor (PRE)	5	P-F	F	P-F	P-F	N	F-G	P	P	F	P-F	G-E	F-G
Trifluralin (PPI)	3	E	G	E <sup>1</sup>	E	N	N	P-F	P-F	P-F	N	P	F
Trifluralin (PoPI)	3	E	F-G	E <sup>1</sup>	E	N	N	P	P	P	N	P	F
Valor (PPI/PRE)	14	N	N	P	P	N	N	N	N	P-F	N	N	G-E

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

<sup>1</sup>Except 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	Lambsquarters, C	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, E/Black	Nightshade, Hairy	Pigweed, Redroot	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herb. Persistence
Atrazine (PPI)	E	E	-	G	E	E	E	E	E	E	E	E	G-E	E	-	N	O
Atrazine (PRE)	G-E	E	-	G	E	E	G-E	G-E	G-E	E	E	E	F-G	G-E	-	N	O
Axiom (PPI)	F	N	-	N	N	F	P	P	G-E	P	P	P	N	F	N	N	N
Axiom (PRE)	F-P	N	-	N	N	P	P	P	F-G	P	P	P	N	P-F	N	N	N
Authority/Spartan (PRE)	E	N	-	G	P-G	F	E	F-G	E	P-F	P	E	N	G-E	G-E	N	S
Balance Pro (PRE)	E	-	-	G-E	G	E	G-E	G-E	E	-	G-E	G	P	G	G-E	N	S
DoublePlay (PPI)	E	N	F-G	N	P	F	G-E	G-E	E	P	G-E	P	P	F	P	N	N
Eptam/Eradicane (PPI)	F	N	F-G	N	P	P	F	F	G	P	F	P	N	P	N	N	N
Dual Products (PPI)	F	N	-	N	N	P	P	P	G-E	P	P-F	P	N	F	P	N	N
Dual Products (PRE)	P-F	N	-	N	N	P	P	P	F-G	P	P-F	P	N	P-F	P	N	N
Far-Go (PPI)	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
Gangster (PPI/PRE)	E	E	-	E	E	E	E	E	E	-	E	E	E	G-E	G	N	O
Gauntlet (PPI/PRE)	E	E	-	E	E	E	E	G	E	E	E	E	E	G-E	G-E	N	O
Harness/Surpass (PPI)	G-E	N	-	-	P	F	G-E	G-E	E	-	F-G	P	P	F	N	N	N
Harness/Surpass (PRE)	G	N	-	-	P	F	G	G	G-E	-	F	P	N	F	N	N	N
Hornet (PPI)	E	G-E	-	E	E	E	E	E	E	E	E	E	E	E <sup>1</sup>	E	F-G	O
Hornet (PRE)	G-E	G-E	-	E	E	E	E	E	E	E	E	E	E	E	E	F	O
Lasso/generics (PPI)	F	N	-	N	N	P	P	P	G-E	P	P	P	N	F	N	N	N
Lasso/generics (PRE)	P-F	N	-	N	N	P	P	P	F-G	P	P	P	N	P-F	N	N	N
Nortron/Etho (PPI)	P-F	-	P	F	P	F	F-G	F-G	G-E	-	P	G-E	P	F-G	-	N	O
Nortron/Etho (PRE)	P-F	-	P	F	P	P-F	F	F	G	-	P	G	P	F	-	N	O
Outlook (PPI)	F	N	-	-	N	P-F	F-G	G	E	-	P	P	N	P-F	N	N	N
Outlook (PRE)	F	N	-	-	N	P-F	F-G	F-G	G-E	-	N	P	N	P	N	N	N
Matrix (PRE)	F	N	-	-	N	F	P	P	E	-	F	P	F	P	N	N	S
Paramount	F	N	-	N	N	N	N	N	F	N	F	N	F	F	-	P	S
Prowl (PPI)	E	N	-	F-G	N	N	N	N	E	N	P	P	N	G	P	N	S
Prowl (PRE)	G	N	-	F	N	N	N	N	G	N	P	P	N	F-G	P	N	S
Pursuit (PPI) (0.72 oz DG)	P-F	-	F	N	P	E	E	E	E	-	N	F	P	P	N	N	O
Pursuit (PRE) (0.72 oz DG)	P	-	F	N	P	E	E	E	E	-	N	F	P	P	N	N	O
Pursuit Plus (PPI)	E	E	-	F-G	G-E	E	E	E	E	E	F	G	G-E	G-E	P	N	O
Python (PPI/PRE)	E	G-E	-	E	P-F	E	G-E	G-E	E	-	P	G-E	P	E	G-E	N	S
Ro-Neet (PPI)	F-G	N	F-G	F	P	P	F-G	F-G	G	P	P	P	N	P	-	N	N
Sonalan (PPI)	E	N	-	F-G	N	N	P	P	E	P	P	P	N	G-E	P	N	S
Sencor (PPI)	F	F-G	F-G	F	E	E	P	P	E	E	E	G	P-F	E	G-E	N	S
Sencor (PRE)	P-F	F-G	F-G	P	E	G-E	P	P	G-E	E	G-E	G	P	G-E	G-E	N	S
Trifluralin (PPI)	G-E	N	-	F-G	N	N	N	N	E	N	P	P	N	G	P	N	S
Trifluralin (PoPI)	F-G	N	-	P	N	N	N	N	F-G	N	P	P	N	F-G	P	N	S
Valor (PPI/PRE)	E	N	-	E	P	G	E	E	E	-	F	F	N	G	G	N	N

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

<sup>1</sup>Except where resistant populations have developed.

POST APPLIED HERBICIDES	Mode of Action	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Flixweed	Kochia
Accent	2	E	G-E	E	F-G	G-E	G-E	E	G-E	P	P	E	F <sup>2</sup>
Accent Gold	2,4	E	G	E	E	G-E	G	G-E	G-E	F	E	E	F <sup>2</sup>
Achieve	1	F	G	G-E	G	N	N	E	E	N	N	N	N
Aim/Teamwork	14	N	N	N	N	N	N	N	N	P	P	E	F-E
Ally + 2,4-D	2,4	N	N	P	P	N	N	N	N	F-G	F	E	E <sup>2</sup>
Ally Extra 2,4-D	2,4	N	N	N	N	N	N	N	N	G	F-G	E	E <sup>2</sup>
Amber + 2,4-D	2,4	N	N	N	N	N	N	N	N	F-G	F-G	E	E <sup>2</sup>
Assert	2	P	N	P	P	N	N	G-E <sup>2</sup>	N	F-G	P	G-E	N
Assure II	1	E	E	E	G-E	G-E	E	G-E <sup>2</sup>	E	N	N	N	N
Atrazine + oil	5	G	F	G	G-E	P-F	F-G	G-E	F	G	G	E	E
Avenge	8	N	N	N	N	N	N	G-E	N	N	N	P	N
Basagran	6	N	N	N	N	N	N	N	N	P	G-E	E	P
Basis	2	G-E	F-G	G-E	G	F-G	F-G	F-G	F	P	P	-	F <sup>2</sup>
Basis Gold	2,5	E	G	E	E	E	G	E	G-E	G-E	F-G	E	E <sup>2</sup>
Betamix	5	P	N	F	F	N	N	N	P	F	P-F	-	F-G
Betanex	5	P	N	P-F	P-F	N	N	N	P	P-F	P	-	F
Bromoxynil	6	N	N	N	N	N	N	N	N	E	E	F-G	G-E
Bromoxynil + MCPA	4,6	N	N	N	N	N	N	N	N	E	E	G-E	G-E
Callisto + Atrazine	5,28	N	N	N	F	N	N	N	N	G-E	E	E	E
Celebrity Plus	2,4,19	E	G-E	E	G-E	G-E	G-E	E	G-E	E	E	E	E <sup>2</sup>
Cheyenne	1,2,4	G-E	F	E	G-E	P	N	E <sup>1</sup>	E	F-G	G	E	E <sup>2</sup>
Cobra	14	N	P	P-F	P-F	N	N	N	P	P	G	-	P-F
Curtail/M	4	N	N	N	N	N	N	N	N	G	E	E	P
Dakota	1,2	G	P-F	G-E	G	P	N	G <sup>2</sup>	E	P	G	G	P
Dicamba <sup>1</sup>	4	N	N	N	N	N	N	N	N	E	E	P-F	E
Dicamba + MCPA	4	N	N	N	N	N	N	N	N	G-E	E	F-G	E
Discover	1	E	-	E	G-E	P	N	E <sup>2</sup>	-	N	N	N	N
Distinct	2,19	P-F	P	P-F	P-F	N	P	P	P	E	E	G	E
Everest	2	N	N	E	F-G	N	N	E	-	F	N	E	N
Express	2	N	N	N	N	N	N	N	N	P-F	F	E	E <sup>2</sup>
Express + 2,4-D	2,4	N	N	N	N	N	N	N	N	F	G	E	E <sup>2</sup>
Extreme	2,9	E	E	E	E	E	E	E	E	F-G	E	E	E
Finesse + 2,4-D	2,4	N	N	F-G	F	N	N	N	N	E	G-E	E	E <sup>2</sup>
FirstRate	2	N	N	N	N	N	N	N	N	P	E	P	P <sup>2</sup>
Flexstar	14	N	N	P-F	P-F	N	N	N	N	P	G-E	E	G-E
Fusilade DX	1	E	E	G-E	G-E	G	E	E <sup>2</sup>	E	N	N	N	N
Fusion	1	E	E	E	E	G	E	E <sup>2</sup>	E	N	N	N	N
Glean + 2,4-D	2,4	N	N	P-F	N	N	N	N	N	E	G	E	E <sup>2</sup>
Glyphosate	9	E	E	E	E	E	E	G-E	E	P-F	E	G-E	F-E
Goal	14	P	N	P	P	P	P	F-G	N	G-E	E	F	G-E
Harmony Extra + 2,4-D	2,4	N	N	P	P	N	N	N	N	G-E	E	E	E <sup>2</sup>
Harmony GT (0.3 to 0.6 oz)	2	N	N	N	N	N	N	N	N	E	P	G-E	G-E <sup>2</sup>
Harmony GT (1/12 oz)	2	N	N	N	N	N	N	N	N	P	N	P	F-G <sup>2</sup>
Hornet	2,4	N	N	N	N	N	N	N	N	F-G	E	E	F-G <sup>2</sup>
Liberty	10	E	G	E	G	P	F-G	G-E	E	E	E	G-E	E
Lightning	2	E	E	E	E	F	G-E	G-E	G-E	E	G	E	E <sup>2</sup>
Lorox	7	F	-	G	G	P	-	-	-	E	E	G	-
Lumax (3 pt)	5,15,28	E	E	E	E	F	G-E	G-E	G-E	E	G	E	E <sup>2</sup>

POST APPLIED HERBICIDES	Lambsquarters, C.	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, E/Black	Nightshade, Hairy	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herbicide Persistence
Accent	P	P	-	P	P	E	N	N	E	-	P	G-E	P	P	P	N	O
Accent Gold	G	E	-	E	E	E	G-E	G-E	E	-	E	E	E	F	E	G-E	O
Achieve	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Aim/Teamwork	F-E	-	-	N	P	P	G	G	G-E	N	N	N	N	F	-	N	N
Ally + 2,4-D <sup>1</sup>	E	F-G	F	G-E	G-E	E	F	F	E	E	E	F	G-E	E <sup>2</sup>	F-G	G	O
Ally Extra + 2,4-D	E	F-G	F	G-E	E	E	F	F	E	E	E	F-G	G-E	E <sup>2</sup>	F-G	G	O
Amber + 2,4-D <sup>1</sup>	F-G	F-G	F	-	E	E	F	F	E	E	E	F	E	E <sup>2</sup>	F-G	F-G	O
Assert	P	N	N	N	N	E	N	N	P	N	N	P	N	P-F	N	N	S
Assure II	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Atrazine + oil	E	E	-	-	E	E	G	G	E	E	E	E	G	E	-	P	S
Avenge	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Basagran	F-G	P	P	E	G-E	E	N	F-G	F	E	F-G	E	E	G	G-E	F-G	N
Basis	G	P	N	F	G	E	P	P	E	-	P	E	F-G	G <sup>2</sup>	P	P	S
Basis Gold	E	E	-	E	E	E	F	F	E	E	G-E	E	G	E	-	N	O
Betamix	G	P	P	F	G	G-E	F-G	F-G	G	-	F	F	P	P	P	N	N
Betanex	G	P	P	F	G	G-E	F-G	F-G	G-E	-	F	F	P	P	P	N	N
Bromoxynil	G	E	P	G-E	E	F-G	E	E	F	E	E	G-E	G-E	E	F	P	N
Bromoxynil + MCPA	E	E	P	G-E	E	E	E	E	G	E	E	G	E	E	F	P-F	N
Callisto + Atrazine	E	E	-	-	E	E	E	E	E	-	E	E	E	-	-	P	S
Celebrity Plus	G	F	G	F	E	E	G-E	G-E	E	E	E	E	E	G	E	F-G	O
Cheyenne	E	F-G	-	G	E	E	F-G	F-G	E	E	E	E	E	G-E <sup>2</sup>	P-F	P	N
Cobra	F	E	-	F-G	G	E	G	G	E	-	G-E	G	P-F	P	P	N	N
Curial/M	G	F-G	F	G	E	E	E	E	P	E	E	E	E	G	E	G-E	S
Dakota	E	F-G	N	F	G	E	P-F	P-F	P	G-E	G	G	G	P	P	P	N
Dicamba <sup>1</sup>	G	P-F	G	F-G	E	G	E	E	G	G-E	E	E	G-E	G	G-E	F-G	S
Dicamba + MCPA <sup>1</sup>	E	G-E	G	G	G-E	E	E	E	G	E	E	E	E	G	G-E	F	S
Discover	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Distinct	E	G	G	E	E	E	G	G	E	E	E	E	E	E	E	G	S
Everest	N	N	N	N	N	E	N	N	F	N	N	N	N	N	-	N	S
Express	F-G	N	-	-	E	E	F-G	-	F-G	-	P	F-G	F	E	N	G	N
Express + 2,4-D <sup>1</sup>	E	F-G	G-E	-	E	E	F-G	F-G	G	G-E	G	G	F-G	E <sup>2</sup>	F-G	G	N
Extreme	G-E	E	G-E	E	E	E	E	E	E	E	E	E	E	E	G-E	G	O
Finesse + 2,4-D <sup>1</sup>	E	F-G	F	E	E	E	F	F	E	E	E	E	E	E <sup>2</sup>	F-G	G	O
FirstRate	P	P	-	G-E	E	P-F	N	N	P	-	E	E	E	-	P	N	O
Flexstar	P-F	E	-	G-E	G-E	E	G-E	F-G	E	-	E	G-E	F	-	P	N	O
Fusilade DX	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fusion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Glean + 2,4-D <sup>1</sup>	E	F-G	F	-	E	E	F	F	E	E	E	E	E	E <sup>2</sup>	F-G	G	O
Glyphosate <sup>3</sup>	P-E	E	F-G	E	G-E	G-E	F-G	F-G	E	E	E	E	G-E	G	G-E	G-E	N
Goal	G	E	-	-	-	F	G-E	G-E	E	G-E	G	F	F-E	G-E	G	N	N
Harmony Extra + 2,4-D <sup>1</sup>	E	G-E	F	-	E	E	F-G	F-G	E	E	E	E	G-E	E <sup>2</sup>	F-G	G	N
Harmony GT (0.3-0.6oz)	E	N	F	N	G-E	E	N	N	E	E	G	E	G-E	G-E	N	N	N
Harmony GT (1/12 oz)	G	N	N	N	N	E	N	N	E	N	N	G-E	P	P	N	N	N
Hornet	P-F	E	-	E	E	E	G-E	G-E	P-F	-	E	F-G	E	F-G	E	G-E	O
Liberty	F-G	E	E	E	E	E	E	E	E	G-E	E	E	E	G-E	E	P	N
Lightning	E	-	G	G	E	E	E	E	E	-	G	E	G	E	P	F	O
Lorox	E	-	-	-	-	G	-	-	E	-	E	E	-	-	-	N	N
Lumax (3 pt)	E	E	-	E	E	E	E	E	E	E	E	E	E	E	E	P	S

POST APPLIED HERBICIDES (cont.)	Mode of Action	Barnyardgrass	Field Sandbur	Foxtail, Green	Foxtail, Yellow	Quackgrass	Volunteer Cereals	Wild Oat	Wild Proso Millet	Buckwheat, Wild	Cocklebur, Common	Flixweed	Kochia
Matrix	2	G	-	E	G-E	G	E	G	F	P	F	-	P <sup>2</sup>
Maverick	2	-	N	P-F	P-F	G-E	N	E	-	N	-	E	P <sup>2</sup>
MCPA	4	N	N	N	N	N	N	N	N	N	G	G-E	P
Muster	2	N	N	N	N	N	N	P	N	P	P	E	P <sup>2</sup>
NorthStar	2,4	-	G-E	G-E	G-E	G-E	-	-	-	E	E	E	E
Option	2	E	G-E	E	F-E	G-E	-	E	G-E	N	G	E	E <sup>2</sup>
Paramount	4	G-E	N	E	G	N	N	N	N	N	N	N	F
Paraquat	22	G	G	G	G	P	F-G	G	F-G	F	F-G	G	G-E
Peak + 2,4-D	2,4	N	N	N	N	N	N	N	N	F-G	G-E	E	G-E <sup>2</sup>
Permit	2	N	N	N	N	N	N	N	N	P	E	E	P <sup>2</sup>
Phoenix	14	N	N	N	N	N	N	N	N	P	F-G	-	P-F
Poast	1	E	E	E	E	F	E	G-E <sup>2</sup>	E	N	N	N	N
Prism	1	E	E	E	E	G	E	E	E	N	N	N	N
Progress	5	P	N	F-G	F-G	N	N	N	P	F-G	F	-	F-G
Puma	1	E	E	E	E	N	N	E <sup>2</sup>	E	N	N	N	N
Pursuit	2	G	P-F	G	F-G	N	G	F <sup>2</sup>	P-F	P	G-E	E	E <sup>2</sup>
Raptor/Beyond	2	E	F-G	E	G-E	F	G-E	E <sup>2</sup>	G-E	P	G-E	E	E <sup>2</sup>
Rave	2,4	N	N	N	N	N	N	N	N	E	E	E	E
ReadyMaster	5,9	E	E	E	E	E	E	E	E	E	E	E	E
Reflex	14	N	N	N	N	N	N	N	N	P	G	E	G-E
Resource	14	N	N	N	N	N	N	N	N	P	N	P	P
Rezult	2,6	E	E	E	E	F-G	E	G-E <sup>2</sup>	E	P	G-E	E	P
Select	2	E	E	E	E	G	E	E	E	N	N	N	N
Sencor	5	F	-	F	F	P	P	-	-	G	P	E	F-G
Stampede EDF + MCPAe	4,7	G	P	G	G	N	N	N	P	G-E	G	P	G
Starane + 2,4-D	4	N	N	N	N	N	N	N	N	G	E	G	E
Starane + MCPAe	4	N	N	N	N	N	N	N	N	F	G	G	E
Steadfast	2	E	G-E	E	G-E	G-E	E	E	E	P	P	E	P <sup>2</sup>
Stellar	14	N	N	N	N	N	N	N	N	P	F	P	P
Stinger	4	N	N	N	N	N	N	N	N	F-G	E	P	N
Tough	6	N	N	N	N	N	N	N	N	P	G	P	E
Ultra Blazer	14	N	P	P-F	P-F	N	N	N	P	P	F-G	-	P-F
UpBeet + Betanex/Betamix/Progress	2,5	P	P	F-G	F-G	N	P	N	P	F-G	F-G	-	E <sup>2</sup>
2,4-D	4	N	N	N	N	N	N	N	N	P-F	G-E	F-G	P-F

<sup>2</sup>Herbicides will not control resistant biotypes.

POST APPLIED HERBICIDES (cont.)	Lambsquarters, C.	Lanceleaf Sage	Mallow, Common	Mallow, Venice	Marshelder	Mustard, Wild	Nightshade, E/Black	Nightshade, Hairy	Redroot Pigweed	Prickly Lettuce	Ragweed, Common	Smartweed, Annual	Sunflower	Thistle, Russian	Wormwood, Biennial	Thistle, Canada	Herbicide Persistence
Matrix	F	-	-	-	-	E	G/N	P-F	E	-	F	F	P	P	N	N	S
Maverick	P	-	N	N	-	E	-	-	P	-	-	-	E	-	P	N	O
MCPA	E	G-E	-	F	G	E	P-F	P-F	P-F	F	G	F	G	P	F-G	P-F	N
Muster	P-F	P	N	P	P	E	P	P	P-F	P	P	G	F	P	N	N	N
NorthStar	E	F	G	F	E	E	E	E	E	G-E	E	E	E	E	G-E	G	O
Option	G	N	-	-	-	E	E	E	E	-	G	P	G	-	-	P	N
Paramount	F	N	-	N	N	N	N	N	F	N	F	N	F	F	-	P	S
Paraquat	E	E	G	G	G	E	G-E	G-E	E	E	G-E	E	E	E	-	P	N
Peak + 2,4-D	G	F-G	F	-	-	E	-	-	E	E	E	-	E	E <sup>2</sup>	F-G	F-G	O
Permit	N	P	-	E	G-E	E	P	P	F-G	-	G-E	F-G	E	-	P	N	O
Phoenix	P	G	N	F	F	E	G	G	E	-	G	F	P	P	P	N	N
Poast	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
Progress	G-E	P-F	N	F	G	G-E	G	G	G	-	F-G	F-G	P	P	P	N	S
Puma	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	P	E	G	P	E	E	E	E	E	E	P	G	G-E	G-E	P	N	O
Raptor/Beyond	G	E	G	P	G-E	E	E	E	E	-	P	G-E	E	G-E	P	N-P	N
Rave	G-E	F-G	G	G	E	E	E	E	E	E	E	E	E	E	F-G	G	O
ReadyMaster	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	O
Reflex	P	E	-	G	G	E	G	P	G-E	-	G-E	G	P-F	-	P	N	O
Resource	G	-	N	N	-	P-F	P	P	G	-	G	N	N	-	P	N	N
Rezult	F-G	P	P	E	G-E	E	N	F-G	F	E	F-G	E	E	F-G	G-E	F-G	N
Select	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sencor	E	-	-	-	-	E	P	P	G	-	E	E	F	-	-	N	O
Stampede + MCPAe	E	N	-	-	F	E	-	-	E	-	P	F	G	F	F	P-F	N
Starane + 2,4-D	E	P-F	E	G-E	E	E	F-G	F-G	G-E	E	E	G	E	G	F-G	F	N
Starane + MCPAe	E	F	E	G-E	G	E	F	F	F	E	G	F	G	P	G	P-F	N
Steadfast	P	P	-	N	P	E	N	N	E	-	N	F	P	P	P	N	O
Stellar	F-G	F-G	N	N	-	P	P	P	G-E	-	G-E	-	-	-	P-F	N	N
Stinger	P-F	F	P	G	E	P	E	E	P	E	G-E	G-E	G-E	P-F	E	E	S
Tough	E	P-F	P	P-F	-	P	E	E	E	P	P	P	F-G	E	G-E	N	N
Ultra Blazer	G	P-F	N	F	F	E	F-G	F-G	E	-	F-G	E	P-F	G	P	N	N
UpBeet + Betanex/ Betamix/Progress	G-E	P-F	G-E	F-G	G	E	G	G	G-E	-	F-G	G	G	P	P	N	N
2,4-D	E	P-F	P	G-E	E	E	P-F	P-F	G	E	G-E	F-G	E	G	F-G	F	N

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

<sup>2</sup>Herbicides will not control resistant biotypes.

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

## 2002 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	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A			
				Low	Med	High	Low	Med	High	
Accent	DuPont	nicosulfuron	75DF	32.00 oz	0.33 oz	0.5 oz	0.67 oz	10.55	16.00	21.15
Accent Gold	DuPont	nicosulfuron + rimsulfuron + clopyralid acid + flumetsulam	1:1 ratio of 75DF + Hornet = 85.6DF	7.25 oz	2 oz	2.5 oz	2.9 oz	14.50	18.15	21.00
Accent Gold WDG	DuPont	nicosulfuron + rimsulfuron + clopyralid-K salt + flumetsulam	1:1 ratio of 75DF + Hornet WDG = 85.6DF	6.00 oz	2.5 oz	3 oz	3.5 oz	14.50	18.15	21.00
Acclaim Extra	Aventis	fenoxaprop-P	1EC	380 gal	15 fl oz	30 fl oz	45 fl oz	45.00	90.00	135.00
Achieve	Syngenta	tralkoxydim + oil adjuvant	40WDG	1.75 oz	4.67 oz	5.6 oz	7 oz	8.15	9.80	12.25
Achieve Liquid	Syng	tralkoxydim + oil adjuvant	3.33 EC	227.25 gal	6.9 fl oz		6.9 fl oz	12.25	-	12.25
AGSCO 400		2,4-De	4EC	19.00 gal	0.5 pt	2 pt	4 pt	1.20	4.75	9.50
Aim WDG	FMC	carfentrazone	40WDG	7.50 oz	1/6 oz	-	1/3 oz	1.25	-	2.50
Aim EW	FMC	carfentrazone	2EW	160.00 qt	1/4 oz	-	1/2 oz	1.25	-	2.50
Ally/XP	DuPont	metsulfuron	60DF	22.00 oz	0.05 oz	0.1 oz	0.3 oz	1.10	2.20	6.60
Ally Extra	DuPont	thifensulfur + tribenn + metsulfur	71.25DF	9.00 oz	10 A/pk	-	5 A/pk	1.80	-	3.60
Amber	Syngenta	triasulfuron	75DF	8.75 oz	0.14 oz	0.28 oz	0.56 oz	1.25	2.45	4.90
Amplify	Monsanto	cloransulam	84WDG	24.00 oz	0.3 oz	0.6 oz	0.75 oz	7.20	14.40	18.00
Aquathol Super K		endothall	45G	17.50 lb	8.8 lb	13.2 lb	22 lb	154.00	231.00	472.50
Arsenal	BASF	imazapyr	2SL	300.00 gal	1 qt	2 qt	3 qt	75.00	150.00	225.00
Assert	MicroFlo	imazamethabenz	2.5SL	85.00 gal	0.6 pt	1 pt	1.2 pt	6.40	10.65	12.75
Assure II	DuPont	quizalofop	0.88EC	130.00 gal	7 fl oz	8 fl oz	10 fl oz	7.10	8.15	10.15
Atrazine 4L	Several	atrazine	4L	11.00 gal	0.75 pt	1.5 pt	2 pt	1.05	2.05	2.75
Atrazine 90DF		atrazine	90DF	2.50 lb	0.42 lb	0.83 lb	1.11 lb	1.05	2.10	2.80
Authority	FMC	sulfentrazone	75WDG	1.70 oz	3 oz	4 oz	5.33 oz	5.10	6.80	9.00
Avalanche + Atrazine		carfentrazone + atrazine	2EW + 4L	152.00 qt	0.5 fl oz + 24 fl oz			4.85		
Avenge	MicroFlo	difenzoquat	2SL	32.00 gal	2.5 pt	3 pt	4 pt	10.00	12.00	16.00
Axiom	Bayer	flufenacet + metribuzin	54.4 + 13.6DF	1.10 oz	15 oz	20 oz	23 oz	16.50	22.00	25.30
B-4	AGSCO	bromoxynil + 2,4-De	1.3 + 2.69EC	40.00 gal	1.1 pt	1.25 pt	1.5 pt	5.50	6.25	7.50
Balan	UAP	benfenin	2.5G	0.70 lb	60 lb	70 lb	80 lb	42.00	49.00	56.00
Balanca Pro	Bayer	isoxaflutole	4L	6.00 fl oz	1.5 fl oz	2.25 fl oz	3 fl oz	9.00	13.50	18.00
Banvel	Several	dicamba-dma salt	4SL	82.00 gal	2 fl oz	1 pt	4 pt	1.28	10.25	40.95
Basagran	MicroFlo	bentazon-Na salt	4SL	78.00 gal	1 pt	1.5 pt	2 pt	9.75	14.65	19.50
Basis	DuPont	rimsulfuron + thifensulfuron	50 + 25DF	16.50 oz	0.33 oz	0.67 oz	1 oz	5.45	11.05	16.50
Basis Gold	DuPont	nicosulfuron + rimsulfuron + atrazine	1.34 + 1.34 + 86.78DF	1.20 oz	7 oz	10 oz	14 oz	8.40	12.00	16.80
Beacon	Syngenta	primisulfuron	75DF	25.00 oz	0.38 oz	0.5 oz	0.76 oz	9.50	12.50	19.00
Betamix	Bayer	desmedipham + phenmedipham	0.65 + 0.65EC	100.00 gal	4.62 pt	6 pt	7.7 pt	57.75	75.00	96.25
Betanex	Bayer	desmedipham	1.3EC	100.00 gal	4.62 pt	6 pt	7.7 pt	57.75	75.00	96.25
Beyond	BASF	imazamox	1SL	490.00 gal	3 fl	4 fl oz	5 fl oz	11.50	15.30	19.15
Bicep II Magnum	Syn	atrazine + s-metolachlor	3.1 + 2.4L	41.00 gal	2.1 qt	2.35 qt	2.6 qt	21.50	24.10	26.65
Bicep Lite II Magnum		atrazine + s-metolachlor	2.67 + 3.23L	55.00 gal	1.5 qt	1.9 qt	2.2 qt	20.65	26.15	30.25
Bison	Agrilience	bromoxynil + MCPAe	2 + 2EC	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Boundary	Syngenta	s-metolachlor + metribuzin	6.3 + 1.5L	76.00 gal	1.5 pt	2 pt	2.5 pt	14.25	19.00	23.75
Brash	Agrilience	2,4-D-dma + dicamba-dma	2.87 + 1SL	27.00 gal	0.5 pt	2 pt	4 pt	1.70	6.75	13.50
Broclean	UAP	bromoxynil	2EC	57.00 gal	1 pt	1.5 pt	2 pt	7.15	10.70	14.25
Bromac	UAP	bromoxynil + MCPAe	2 + 2EC	44.00 gal	0.75 pt	1 pt	1.5 pt	4.15	5.50	8.25
Bromox + Atrazine		atrazine + bromoxynil	2 + 1L	37.00 gal	1.5 pt	2 pt	3 pt	6.95	9.25	13.90
Bronate Advanced		bromoxynil ester + MCPAe	2.5 + 2.5	55.00 gal	0.8 pt	1.2 pt	1.6 pt	5.50	8.25	11.00
Brozine	UAP	atrazine + bromoxynil	2 + 1L	37.00 gal	1.5 pt	2 pt	3 pt	6.95	9.25	13.90
Buckle	Monsanto	triallate + trifluralin	10 + 3G	1.13 lb	10 lb	11 lb	12.7 lb	11.30	12.45	14.35
Buctril	Bayer	bromoxynil	2EC	57.00 gal	1 pt	1.5 pt	2 pt	7.15	10.70	14.25
Buctril + Atrazine	Bayer	atrazine + bromoxynil	2 + 1L	37.00 gal	1.5 pt	2 pt	3 pt	6.95	9.25	13.90
Bullet	Monsanto	alachlor + atrazine	2.5 + 1.5L	18.50 gal	2.5 qt	3 qt	3.75 qt	11.60	13.90	17.35
Butyrac 200	Albaugh	2,4-DB	2SL	42.00 gal	2 pt	3 pt	4 pt	10.50	15.75	21.00
Callisto	Syngenta	mesotrione	4SE	500.00 gal	2 fl oz	2.5 fl oz	3 fl oz	7.80	9.75	11.75
Camix	Syngenta	mesotrione + s-metolachlor	0.334 + 3.34L	41.00 gal	2.1 qt	2.35 qt	2.6 qt	21.50	24.10	26.65
Casoron 4G	Uniroyal	dichlobenil	4G	2.05 lb	100 lb	150 lb	200 lb	205.00	307.50	410.00
Casoron 10G	Uniroyal	dichlobenil	10G	5.15 lb	40 lb	60 lb	80 lb	205.00	307.00	410.00
Celebrity Plus	BASF	dic-Na + diflufenzopyr + nicosulf	42.4 + 17 + 10.6WDG	5.00 oz	2.34 oz	3.50 oz	4.67 oz	11.70	17.50	23.35

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Cheyenne Bayer	fenoxaprp-P + MCPAe + HarmXtr	0.467 + 2.16e + 75DF	680.00 case	Each case treats 40 acres			17.00	-	17.00
Cimarron DuPont	metsulfuron	60DF	22.00 oz	0.05 oz	0.1 oz	0.3 oz	1.10	2.20	6.60
Cimarron Max DuPont	Ally + Weed Master(2,4-D + dica)	60DF + 2.87&1SL	260.00 case	.25oz + 1	.5oz + 2pt	1oz + 4pt	6.50	13.00	26.00
Cinch DuPont	s-metolachlor + safener	7.64EC	105.00 gal	1.33 pt	1.67 pt	2 pt	17.45	21.90	26.25
Cinch ATZ DuPont	atrazine + metolachlor	3.1 + 2.4L	41.00 gal	2.1 qt	2.35 qt	2.6 qt	21.50	24.10	26.65
Cinch ATZ Lite DuPt	atrazine + metolachlor	2.67 + 3.23L	55.00 gal	1.5 qt	1.9 qt	2.2 qt	20.65	26.15	30.25
Clarity BASF	dicamba - dga salt	4SL	85.00 gal	0.5 pt	0.75 pt	1 pt	5.45	8.15	10.90
Classic DuPont	chlorimuron	25DF	12.00 oz	0.5 oz	0.67 oz	0.75 oz	6.00	8.05	9.00
Cobra Valent	lactofen	2EC	132.00 gal	6 fl oz	8 fl oz	12.8 fl oz	6.20	8.25	13.20
Command FMC	clomazone	3ME	90.00 gal	1.33 pt	2 pt	2.67 pt	15.00	22.50	30.00
Command Xtra FMC	clomazone / sulfentrazone	Copack: 3EC/4EC	215.00 cont.	21.3 floz/8 floz - 32 floz/12 floz			17.90	-	26.90
Confront Dow	clopyralid-tea + triclopyr-tea	0.75 + 2.25EC	105.00 gal	1 pt	1.5 pt	2 pt	13.15	19.70	26.25
Connect Bayer	bromoxynil	20WSP	6.50 lb	1.25 lb	1.88 lb	2.5 lb	8.15	12.25	16.25
Cornerstone Agrilinc	glyphosate-ipa salt	3SL	32.00 gal	0.5 pt	2 pt	4 pt	2.00	8.00	16.00
Crossbow Dow	triclopyr-bee + 2,4-D-bee	1 + 2SL	48.00 gal	1 qt	3 qt	6 qt	12.00	36.00	72.00
Curtail Dow	clopyralid-aka + 2,4-D-aka salt	0.38 + 2SL	37.00 gal	2 pt	4 pt	8 pt	9.25	18.00	37.00
Curtail M Dow	clopyralid acid + MCPAioe	0.42 + 2.35SL	43.00 gal	1.75 pt	2 pt	2.33 pt	9.40	10.75	12.55
Dacthal Amvac	DCPA	75WDG	15.50 lb	8 lb	10 lb	14 lb	124.00	155.00	217.00
Dakota UAP	fenoxaprop-P + MCPAe	0.234 + 2.84EC	44.00 gal	16 fl oz	-	21.3 fl oz	5.50	-	7.35
Define Bayer	flufenacet	60WDG	1.15 oz	14 oz	18 oz	21 oz	16.10	20.70	24.15
Defol Drexel	sodium chlorate	6SL	6.50 gal	0.5 gal	-	1 gal	3.25	-	6.50
Degree Monsanto	acetochlor-ME	3.8ME	42.00 gal	3.25 pt	4 pt	4.25 pt	17.05	21.00	22.30
Degree Xtra Monsanto	atrazine + acetochlor-ME	1.34 + 2.7L	30.00 gal	2.4 qt	2.9 qt	3.7 qt	18.00	21.75	27.75
Desiccate II Cerexagri	endothall	2SL	40.00 gal	1.5 qt	-	2 qt	15.00	-	20.00
Dimension Dow	dithiopyr	1EC	130.00 gal	1 qt	1.5 qt	2 qt	32.50	48.75	68.00
Dimension Ultra Dow	dithiopyr	40WSP	55.00 lb	0.5 lb	0.75 lb	1 lb	27.50 lb	41.25	55.00
Diquat Syngenta	diquat	2SL	79.00 gal	1 pt	2 pt	4 pt	9.90	19.75	39.50
Discover Syngenta	clodinafop + DSV adjuvant	2EC	610.00 case	3.2 fl oz	-	4 fl oz	15.25	-	19.10
Distinct BASF	dicamba-Na + diflufenzopyr-Na	50 + 20WDG	2.20 oz	4 oz	6 oz	8 oz	8.80	13.20	17.60
Diuron Several	diuron	80WDG	3.85 lb	0.75 lb	2 lb	6 lb	2.90	7.70	23.10
Domain Bayer	flufenacet + metribuzin	24 + 36WDG	0.78 oz	9 oz	13 oz	16 oz	7.00	10.14	12.50
DoublePlay Syngenta	acetochlor + EPTC	1.4 + 5.6EC	31.00 gal	4.5 pt	6 pt	7 pt	17.45	23.25	27.15
Drive BASF	quinclorac	75DF	90.00 lb	1 lb	-	1 lb	90.00	-	90.00
Dual Magnum Syng	s-metolachlor	7.62EC	100.00 gal	1.33 pt	1.67 pt	2 pt	16.65	20.90	25.00
Dual II Magnum Syng	s-metolachlor + safener	7.64EC	105.00 gal	1.33 pt	1.67 pt	2 pt	17.45	21.90	26.25
Engame UAP	glyphosate acid + AMADS	1.23 + 9.1SL	18.00 gal	1.22 pt	2.44 pt	4.88 pt	2.75	5.50	11.00
Epic Bayer	flufenacet + isoxaflutole	48 + 10DF	2.00 oz	8 oz	14 oz	20 oz	16.00	28.00	40.00
Eptam EC Syngenta	EPTC	7EC	32.00 gal	2.3 pt	4 pt	6.75 pt	9.20	16.00	27.00
Eptam G Syngenta	EPTC	20G	1.05 lb	15 lb	18 lb	22.5 lb	15.75	18.90	23.65
Eradicane EC Syng	EPTC + safener	6.7EC	27.00 gal	4.75 pt	6 pt	7 pt	16.00	20.30	23.65
Escort/XP DuPont	metsulfuron	60DF	20.00 oz	0.33 oz	1 oz	2 oz	6.60	20.00	40.00
Everest Arvesta	flucarbazone	70WDG	20.00 oz	0.4 oz	0.5 oz	0.6 oz	8.00	10.00	12.00
Exceed Syngenta	prosulfuron + primisulfuron	32.3 + 32.3WDG	11.20 oz	0.88 oz	-	0.88 oz	9.85	-	9.85
Express/XP DuPont	tribenuron	75DF	17.50 oz	1/8 oz	1/6 oz	1/3 oz	2.20	2.90	5.80
Extreme BASF	imazethapyr + glyphosate	0.17 + 2SL	35.00 gal	1.5 pt	2.25 pt	3 pt	6.55	9.85	13.15
Fallow Master Mnsnto	glyphosate-ipa + dicamba acid	1.1 + 0.5SL	21.00 gal	22 fl oz	33 fl oz	44 fl oz	3.60	5.40	7.20
Fallow Master BrdSpc	glyphosate-ipa + dicamba acid	1.6 + 0.4SL	22.00 gal	22 fl oz	33 fl oz	44 fl oz	3.80	5.70	7.60
Fallow Star Albaugh	glyphosate-ipa + dicamba acid	1.1 + 0.5SL	21.00 gal	22 fl oz	33 fl oz	44 fl oz	3.60	5.40	7.20
Far-Go EC Monsanto	triallate	4EC	40.00 gal	1 qt	1.25 qt	1.5 qt	10.00	12.50	15.00
Far-Go G Monsanto	triallate	10G	0.95 lb	10 lb	12.5 lb	15 lb	9.50	11.90	14.25
FieldMaster Mnsnto	acetochlor + atrazn + glyphosate	2 + 1.5 + 0.56L	25.00 gal	3.5 qt	4 qt	5 qt	21.90	25.00	31.25
Finesse DuPont	chlorsulfuron + metsulfuron	62.5 + 12.5DF	13.50 oz	0.2 oz	0.25 oz	0.3 oz	2.70	3.40	4.05
FirstRate Dow	cloransulam	84WDG	24.00 oz	0.3 oz	0.6 oz	0.75	7.20	14.40	18.00
Flexstar Syngenta	fomesafen + adjuvants	1.88EC	94.00 gal	0.5 pt	0.75 pt	1 pt	5.90	8.80	11.75
Freedom Monsanto	alachlor + trifluralin	2.67 + 0.33EC	12.25 gal	2.75 qt	3.25 qt	4.5 qt	8.40	9.90	13.80
Fuego Syngenta	Amber + Clarity	Co-pack: 75DF + 4S	235.00 case	12 A/Box	10A/Box	8 A/Box	17.50	18.90	21.60
FulTime Dow	acetochlor-ME + atrazine	2.4 + 1.6L	28.00 gal	2.5 qt	2.7 qt	3 qt	17.50	18.90	21.00
Fusilade DX Syng	fluzifop-P	2EC	130.00 gal	6 fl oz	10 fl oz	12 fl oz	6.10	10.15	12.20
Fusion Syngenta	fluazifop-P + fenoxaprop	2 + 0.66EC	140.00 gal	6 fl oz	10 fl oz	12 fl oz	6.60	10.95	13.15
Galaxy BASF	bentazon + acifluorfen	3 + 0.67SL	60.00 gal	2 pt	-	2 pt	15.00	-	15.00
Gallery Dow	isoxaben	75DF	115.00 lb	0.66 lb	1 lb	1.33 lb	75.90	115.00	152.95
Gangster Valent	Copack: flumioxazin + cloransulm	51WDG/84WDG	571.00 cont.	3 oz	3.3	3.6	17.85	19.50	21.15

Product	Active Ingredient	Formulation	Cost \$/Unit	Product/A			Cost \$/A			
				Low	Med	High	Low	Med	High	
Garlon EC	Dow	triclopyr	4EC	100.00 gal	1 qt	2 qt	4 qt	25.00	50.00	100.00
Garlon SL	Dow	triclopyr	3SL	78.00	2 qt	1 gal	2 gal	39.00	78.00	156.00
Gauntlet	FMC	Copack:sulfentrazn + cloransulm	75WDG/84WDG	88.00 cont.	5.33oz/0.6oz - 6.67oz/0.75oz			18.20		22.80
Glean	DuPont	clorsulfuron	75DF	15.00 oz	1/6 oz	1/3 oz	1/3 oz	2.75	--	5.50
Gly-Flo	MicroFlo	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
Glyfos	Cheminova	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
Glyfos X-tra	Cheminv	glyphosate-ipa salt	3SL	36.00 gal	1 pt	2 pt	4 pt	4.50	9.00	18.00
GlyMix MT	Dow	glyphosate-ipa + 2,4-D ipa	3 + 0.32SL	24.00 gal	0.75 pt	2 pt	4 pt	2.25	6.00	12.00
Glyphomax	Dow	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	9.00	18.00
Glyphomax Plus	Dow	glyphosate-ipa salt	3SL	36.00 gal	1 pt	2 pt	4 pt	4.50	9.00	18.00
Glyphosate Herb.	DuP	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
Glyphosate Original		glyphosate-ipa salt	3SL	28.00 gal	1 pt	2 pt	4 pt	3.50	7.00	14.00
Glypro	Dow	glyphosate-ipa salt	4SL	45.00 gal	1 pt	2 pt	4 pt	4.25	8.45	16.90
Glypro Plus	Dow	glyphosate-ipa salt	3SL	39.00 gal	1 pt	2 pt	4 pt	4.90	9.75	19.50
Gly Star	Albaugh	glyphosate-ipa salt	4SL	45.00 gal	0.75 pt	1.5 pt	4 pt	4.25	8.45	16.90
Gly Star Original	"	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
Gly Star Plus	Albaugh	glyphosate-ipa salt	3SL	38.00 gal	1 pt	2 pt	4 pt	4.75	9.50	19.00
G-Max Lite	BASF	atrazine + dimethenamid-P	2.75 + 2.25L	52.00 gal	2 pt	2.5 pt	3 pt	13.00	16.25	19.50
Goal	Dow	oxyfluorfen	2EC	95.00 gal	4 pt	6 pt	8 pt	47.50	71.25	95.00
Gramoxone Max Syng		paraquat	3SL	36.00 gal	1.5 pt	2 pt	2.7 pt	6.75	9.00	12.15
Grazon P+D	Dow	picloram-3ipa + 2,4-D-3ipa	0.54 + 2 S	28.00 gal	2 qt	3 qt	4 qt	14.00	21.00	28.00
Guardsman	BASF	atrazine + dimethenamid	2.67 + 2.33L	36.00 gal	2.5 pt	3.75 pt	5 pt	11.25	16.90	22.50
Guardsman Max	BASF	atrazine + dimethenamid-P	3.3 + 1.7L	40.00 gal	2.8 pt	3.6 pt	4.2 pt	14.00	18.00	21.00
Harmony GT/XP	DuP	thifensulfuron	75DF	11.00 oz	1/12 oz	0.3 oz	0.6 oz	0.92	3.30	6.60
Harmony Extra/XP	DP	thifensulfuron + tribenuron	50 + 25DF	12.00 oz	0.15 oz	0.3 oz	0.6 oz	1.80	3.60	7.20
Harness EC	Monsanto	acetochlor + safener	7EC	70.00 gal	1.25 pt	2 pt	3 pt	10.95	17.50	26.25
Harness G	Monsanto	acetochlor + safener	20G	2.05 lb	8 lb	10 lb	12 lb	16.40	20.50	24.60
Hi-Dep	PBI Gordon	2,4-Da	4SL	19.00	0.25 pt	2 pt	4 pt	0.60	4.75	9.50
Hornet	Dow	flumetsulam + clopyralid acid	23.1 + 62.5DF	3.80 oz	1.6 oz	2.4 oz	3.2 oz	6.10	9.10	12.15
Hornet WDG	Dow	flumetsulam + clopyralid-K salt	18.5 + 50DF	3.05 oz	2 oz	4 oz	6 oz	6.10	9.10	12.15
Hyvar XL	DuPont	bromacil	2L	65.00 gal	1.5 gal	3 gal	6 gal	97.50	195.00	390.00
Kerb	Dow	pronamide	50WSP	30.00 lb	2 lb	3 lb	4 lb	60.00	90.00	120.00
Keystone LA	Dow	atrazine + acetochlor	1.5 + 4L	- gal	1.8 qt	2.1 qt	3 qt	-	-	-
Krenite	Dupont	fosamine	4L	56.00 gal	1.5 gal	3 gal	6 gal	84.00	168.00	336.00
Krovax I	DuPont	bromacil + diuron	40 + 40DF	11.00 lb	4 lb	15 lb	30 lb	44.00	165.00	330.00
Landmaster BW	Mon	glyphosate-ipa + 2,4-D-ipa	0.9 + 1.5SL	16.00 gal	27 fl oz	40 fl oz	54 fl oz	3.40	5.00	6.75
Land Star	Albaugh	glyphosate-ipa + 2,4-D-ipa	0.9 + 1.5SL	16.00 gal	27 fl oz	40 fl oz	54 fl oz	3.40	5.00	6.75
Lariat	Monsanto	alachlor + atrazine	2.5 + 1.5L	19.00 gal	2.5 qt	3 qt	3.75 qt	11.90	14.25	17.80
Lasso EC	Monsanto	alachlor	4EC	23.00 gal	2 qt	2.5 qt	3 qt	11.50	13.75	16.50
LeadOff	DuPont	atrazine + dimethenamid	2.67 + 2.33L	37.00 gal	2.5 pt	3.75 pt	5 pt	11.55	17.35	23.15
Liberty	Bayer	glufosinate	1.67SL	64.00 gal	24 fl oz	28 fl oz	34 fl oz	12.00	14.00	17.00
Liberty ATZ	Bayer	atrazine + glufosinate	3.3 + 1L	58.00 gal	20 fl oz	32 fl oz	40 fl oz	9.00	14.50	18.15
Lightning	BASF	imazethapyr + imazapyr	52.5+17.5WDG	11.50 oz	0.75 oz	1.00 oz	1.28 oz	8.65	11.50	14.75
Lorox/Linex	Griffin	linuron	50DF	9.00 lb	1 lb	3 lb	6 lb	11.00	33.00	66.00
Lumax	Syngenta	atrazine + mesotrione + s-metol	1 + 0.268 + 2.68	40.00 gal	2 pt	2.5 pt	3 pt	10.00	12.50	15.00
Mad Dog	AGSCO	glyphosate-ipa salt	3SL	24.00 gal	1 pt	2 pt	4 pt	3.00	6.00	12.00
Marksman	BASF	atrazine + dicamba-K salt	2.1 + 1.1L	28.00 gal	2 pt	3 pt	3.5 pt	7.00	10.50	12.25
Matrix	DuPont	rimsulfuron	25DF	12.50 oz	1 oz	-	1.5 oz	12.50	-	18.75
Maverick	Monsanto	sulfosulfuron	75DF	15.50 oz	0.33 oz	0.5 oz	0.67 oz	5.15	7.75	10.40
MEC Amine D	UHS	mecoprop	4SL	26.00 gal	0.5 pt	1 pt	2 pt	1.65	3.25	6.50
Metgard	Makhteshim	metsulfuron	60DF	22.00 oz	0.05 oz	0.1 oz	0.3 oz	1.10	2.20	6.60
MCPAamine	Several	MCPAa	4SL	15.00 gal	0.4 pt	1 pt	2 pt	0.75	1.90	3.75
MCPA ester	Several	MCPAe	4EC	16.50 gal	0.5 pt	1 pt	2 pt	1.00	2.00	4.00
Moxy	Agrilience	bromoxynil	2EC	57.00 gal	1 pt	1.5 pt	2 pt	7.15	10.70	14.25
Moxy AT	Agrilience	atrazine + bromoxynil	2 + 1L	37.00 gal	1.5 pt	2 pt	3 pt	6.95	9.25	13.90
MXL	AGSCO	MCPAe	4EC	23.00 gal	0.5 pt	1 pt	2 pt	1.45	2.90	5.75
MXL - B	AGSCO	MCPAe + bromoxynil	Copack: 4EC / 4EC	42.00 gal	1 pt	1.25 pt	1.5 pt	5.25	6.55	7.90
Muster	DuPont	ethametsulfuron	75DF	28.00 oz	0.25 oz	0.33 oz	0.42 oz	7.00	9.25	11.75
Northstar	Syngenta	dicamba-Na + primisulfuron	39.9 + 7.5WDG	1.80 oz	-	5 oz	-	-	9.00	-
Nortron SC	Bayer	ethofumesate	4EC	100.00 gal	6 pt	7 pt	7.5 pt	75.00	87.50	93.75
Option	Bayer	foramsulfuron + safener	35DF + 35DF	9.25 oz	1.5 oz	-	1.75 oz	9.25	-	13.90
Oracle	Gharda	dicamba-dma salt	4SL	82.00 gal	2 fl oz	1 pt	4 pt	1.28	10.25	40.95

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A			
				Low	Med	High	Low	Med	High	
Oust/XP	DuPont	sulfometuron	75DF	12.00 oz	2 oz	6 oz	8 oz	24.00	72.00	96.00
Outlook	BASF	dimethenamid-P	6EC	135.00 gal	16 fl oz	18 fl oz	21 fl oz	16.90	19.00	22.15
Paramount	BASF	quinclorac	75DF	50.00 lb	0.17 lb	0.25 lb	0.33 lb	8.50	12.50	16.50
Peak	Syngenta	prosulfuron	57DF	11.00 oz	0.25 oz	0.38 oz	0.5 oz	2.75	4.20	5.50
Pendimax	Dow	pendimethalin	3.3EC	22.00 gal	2.4 pt	3 pt	3.64 pt	6.60	8.25	10.00
Permit	Monsanto	halosulfuron	75DF	15.00 oz	0.67 oz	1 oz	1.33 oz	10.00	15.00	20.00
Phenoxy 088	Agrilinc	2,4-D acid + 2,4-De	2.8EC	24.00 gal	0.67 pt	2 pt	3 pt	2.00	6.00	9.00
Phoenix	Valent	lactofen + adjuvants	2EC	140.00 gal	6 fl oz	8 fl oz	12.8 fl oz	6.55	8.85	14.00
Plateau	BASF	imazapic	2SL	2.10 fl oz	4 fl oz	8 fl oz	12 fl oz	8.40	16.80	25.20
Poast	MicroFlo	sethoxydim	1.5EC	65.00 gal	0.5 pt	1 pt	1.5 pt	4.05	8.15	12.20
Pramitol EC	Several	prometon + others	25EC	30.00 gal	5 gal	7.5 gal	10 gal	150.00	225.00	300.00
Pramitol 5S	Several	prometon + others	5PS	2.50 lb	150 lb	200 lb	400 lb	337.50	450.00	900.00
Princep 4L	Syngenta	simazine	4L	18.00 gal	2 qt	3 qt	4 qt	9.00	13.50	18.00
Princep Caliber 90 "		simazine	90DF	3.75 lb	1.8 lb	3 lb	4.4 lb	6.75	11.25	16.50
Prism	AGSCO	clethodim	0.94EC	88.00 gal	8 fl oz	10 fl oz	13 fl oz	5.50	8.80	8.95
Progress	Bayer	desmed + phenmed + ethofum	0.6 + 0.6 + 0.6EC	106.00 gal	0.8 pt	2 pt	3.3 pt	10.6	26.50	43.75
Prowl	BASF	pendimethalin	3.3EC	21.00 gal	2.4 pt	3 pt	3.64 pt	6.30	7.90	9.20
Puma	Bayer	fenoxaprop-P	1EC	165.00 gal	0.33 pt	0.4 pt	0.67 pt	6.80	8.25	13.80
Pursuit WDG	BASF	imazethapyr	70WDG	10.75 oz	0.72 oz	1.07 oz	1.44 oz	7.75	11.50	15.50
Pursuit 2AS	BASF	imazethapyr	2SL	480.00 gal	2 fl oz	3 fl oz	4 fl oz	7.50	11.25	15.00
Pursuit Plus	BASF	pendimethalin + imazethapyr	2.7 + 0.2EC	45.00 gal	1.8 pt	-	2.5 pt	10.15	-	14.05
Pyramin	BASF	pyrazon	67.7DF	14.50 lb	4.58 lb	7.4 lb	11.25 lb	66.40	107.30	163.15
Python	Dow	flumetsulam	80WDG	9.00 oz	0.8 oz	1 oz	1.33 oz	7.20	9.00	12.00
Raptor	BASF	imazamox	1SL	490.00 gal	3 fl oz	4 fl oz	5 fl oz	11.50	15.30	19.15
Rattler	Helena	glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
Rave	Syngenta	triasulfuron + dicamba-Na salt	8.8 + 50WDG	1.30 oz	2 oz	4 oz	5oz	2.60	5.20	6.50
ReadyMaster ATZ		atrazine + glyphosate-ipa salt	2 + 1.5L	28.00 gal	1.5 qt	1.75 qt	2 qt	10.50	12.25	14.00
Redeem	Dow	clopyralid-tea + triclopyr-tea	0.75 + 2.25EC	62.00 gal	1.5 pt	2.5 pt	4 pt	11.65	19.40	31.00
Reflex	Syngenta	fomesafen	2EC	82.00 gal	0.5 pt	0.75 pt	1 pt	5.00	7.50	10.00
Reglone	Syngenta	diquat	2SL	82.00 gal	1 pt	1.5 pt	2 pt	10.25	15.40	20.50
Rely	Bayer	glufosinate	1SL	59.00 gal	3 pt	6 pt	8 pt	22.15	44.25	59.00
Remedy	Dow	triclopyr	4EC	85.00 gal	1 qt	1.5 qt	2 qt	21.25	31.90	42.50
Resource	Valent	flumiclorac	0.86EC	160.00 gal	4 fl oz	6 fl oz	8 fl oz	5.00	7.50	10.00
Rezult Copack	BASF	bentazon / sethoxydim	5SL / 1EC	44.00 gal		1.6 + 1.6 pt			17.60	
Ro-Neet	Monterey	cycloate	6EC	56.00 gal	4 pt	4.5 pt	5.33 pt	28.00	31.50	37.30
Ronstar G	Aventis	oxadiazon	2G	1.50 lb	100 lb	150 lb	200 lb	150.00	225.00	300.00
Ronstar WP	Aventis	oxadiazon	50WP	25.00 lb	4 lb	5 lb	6 lb	100.00	125.00	150.00
Rodeo	Monsanto	glyphosate-ipa salt	4SL	80.00 gal	0.38 pt	2 pt	4 pt	3.80	20.00	40.00
Roundup Custom "		glyphosate-ipa salt	4SL	45.00 gal	0.75 pt	1.5 pt	3 pt	4.25	8.45	16.90
Roundup Original "		glyphosate-ipa salt	3SL	35.00 gal	1 pt	2 pt	4 pt	4.40	8.75	17.50
Roundup Original RT "		glyphosate-ipa salt	3SL	34.00 gal	1 pt	2 pt	4 pt	4.25	8.50	17.00
RT Master	Monsanto	glyphosate-ipa + 2,4-D ipa	3 + 0.32SL	22.00 gal	0.75 pt	2 pt	4 pt	1.40	5.50	11.00
Roundup Ultra Dry "		glyphosate-NH3	65SG	8.00 lb	0.58 lb	1.15 lb	2.3 lb	4.65	9.20	18.40
Roundup Ultra Max "		glyphosate-ipa salt	3.7SL	47.00 gal	0.8 pt	1.62 pt	3.25 pt	4.70	9.40	18.80
RU Weather Max "		glyphosate-K salt	4.5SL	54.00 gal	0.67 pt	1.33 pt	2.67 pt	4.50	9.00	18.00
Saber	UAP	2,4-De	4EC	16.00 gal	0.5 pt	1 pt	1.5 pt	1.00	2.00	3.00
Sahara	BASF	imazapyr + diuron	7.78 + 62.2WDG	10.00 lb	5 lb	10 lb	15 lb	50.00	100.00	150.00
Salvan	West Central	2,4-De	5EC	26.00 gal	6.4 fl oz	9.6 fl oz	12.8 fl oz	1.30	1.95	2.60
Salvo	UAP	2,4-De	5EC	26.00 gal	6.4 fl oz	9.6 fl oz	12.8 fl oz	1.30	1.95	2.60
Savage	UAP	2,4-D acid	79DS	4.00 lb	0.25 lb	0.5 lb	1 lb	1.00	2.00	4.00
Savana	UAP	2,4-D acid	2.5MFC	- gal	0.75 pt	3 pt	6 pt	-	-	-
Scepter	BASF	imazaquin	70DF	5.25 oz	1.4 oz	-	2.8 oz	7.35	-	14.70
Select	Valent	clethodim	2EC	185.00 gal	4 fl oz	6 fl oz	8 fl oz	5.80	8.70	11.55
Sencor	Bayer	metribuzin	75DF	19.00 lb	1.6 oz	0.25 lb	0.67 lb	1.90	4.75	12.75
Shotgun	UAP	atrazine + 2,4-D acid	2.25 + 1L	28.00 gal	1.5 pt	2 pt	3 pt	5.25	7.00	10.50
Silhouette	Agriliance	glyphosate-ipa	3SL	30.00 gal	1 pt	2 pt	4 pt	3.75	7.50	15.00
Simazine L	Several	simazine	4L	18.00 gal	2 qt	3 qt	4 qt	9.00	13.50	18.00
Simazine DF	Several	simazine	90DF	3.50 lb	1.8 lb	3 lb	4.4 lb	6.30	10.50	15.40
Sinbar	DuPont	terbacil	80WP	32.00 lb	0.5 lb	2 lb	4 lb	16.00	64.00	128.00
Sonalan HFP	Dow	ethalfuralin	3EC	25.00 gal	1.5 pt	3 pt	4.5 pt	4.70	9.40	14.05
Sonalan 10G	Dow	ethalfuralin	10G	0.90 lb	6 lb	11.5 lb	17 lb	5.40	10.35	15.30

Product	Active Ingredients	Formulation	Cost \$/Unit	Product/A			Cost \$/A		
				Low	Med	High	Low	Med	High
Spartan FMC	sulfentrazone	75DF	2.60 oz	2.67 oz	4.00 oz	5.33 oz	6.95	10.40	13.85
Spike Dow	tebuthiuron	20WG	12.00 lb	2.5 lb	5 lb	10 lb	30.00	60.00	120.00
Spirit Syngenta	prosulfuron + primisulfuron	14.2 + 42.8DF	9.40 oz	1 oz	-	1 oz	9.40	-	9.40
Stampede Dow	propanil	80EDF	4.50 lb	1.25 lb	1.3 lb	1.4 lb	5.65	5.85	6.30
Starane Dow	fluroxypyr	1.5EC	85.00 gal	0.5 pt	0.67 pt	1 pt	5.32	7.12	10.63
Starane + Esteron "	fluroxypyr + 2,4-De	3.75EC	48.00 gal	1 pt	1.33 pt	1.67 pt	6.00	8.00	10.00
Starane + MCPE "	fluroxypyr + MCPAe	3.55EC	48.00 gal	1.125 pt	1.5 pt	2 pt	6.75	9.00	12.00
Starane + Saber "	fluroxypyr + 2,4-Da	2.5EC	33.00 gal	1.5 pt	2 pt	3 pt	6.20	8.25	12.40
Starane + Salvo "	fluroxypyr + 2,4-De	3.75EC	46.00 gal	1 pt	1.33 pt	1.67 pt	5.75	7.65	9.60
Starane + Sword "	fluroxypyr + MCPAe	3.55EC	46.00 gal	1.125 pt	1.5 pt	2 pt	6.45	8.63	11.50
Steadfast DuPont	nicosulfuron + rimsulfuron	50 + 25DF	18.50 oz	0.25 oz	0.5 oz	0.75 oz	6.95	9.25	13.90
Stellar Valent	flumiclorac + lactofen	0.7 + 2.4EC	200.00 gal	5 fl oz	7 fl oz	10 fl oz	7.80	10.95	15.65
Sterling Agrilience	dicamba-dma salt	4SL	86.00 gal	2 fl oz	1 pt	4 pt	1.35	10.75	43.00
Sterling Plus "	atrazine + dicamba-K salt	2.1 + 1.1L	28.00 gal	2 pt	3 pt	3.5 pt	7.00	10.50	12.25
Stinger Dow	clopyralid-monoea salt	3SL	480.00 gal	0.25 pt	0.5 pt	0.67 pt	15.00	30.00	40.00
Stratos Gharda	atrazine + dicamba-K salt	2.1 + 1.1L	28.00 gal	2 pt	3 pt	3.5 pt	7.00	10.50	12.25
Surpass EC Dow	acetochlor + safener	6.4EC	68.00 gal	1 pt	2 pt	3 pt	8.50	17.00	25.50
Surpass 20G Dow	acetochlor + safener	20G	2.02 lb	4 lb	8 lb	12 lb	8.10	16.15	24.25
Surflan Dow	oryzalin	4EC	95.00 gal	2 qt	3 qt	4 qt	47.50	71.25	95.00
Sword UAP	MCPAe	5.2EC	28.00 gal	3 fl oz	1 pt	2 pt	0.65	3.50	7.05
Teamwork + Atrazine	carfentrazone + atrazine	40DF + 90DF	7.35 oz	0.33 oz + 0.25 lb/A			4.85		
Telar DuPont	chlorsulfuron	75DF	22.00 oz	½ oz	1 oz	3 oz	11.00	22.00	66.00
Thistrol Aventis	MCPB	2EC	35.00 gal	2 pt	4 pt	6 pt	8.75	17.50	26.30
TopNotch Dow	acetochlor (microencapsulated)	3.2ME	35.00 gal	2 qt	2.5 qt	3 qt	17.50	21.90	26.25
TopSite UAP	imazapyr + diuron	0.5 + 2G	3.25 lb	200 lb	250 lb	300 lb	650.00	800.00	960.00
Tordon 22K Dow	picloram	2SL	84.00 gal	1 fl oz	-	1.5 fl oz	0.65	-	1.00
Tordon 22K Dow	picloram	2SL	84.00 gal	1 pt	2 pt	8 pt	10.65	21.25	85.05
Total Agrilience	bromacil + diuron + Na-chlorat + B	94G	2.20 lb	0.5 to 1.37 lb/100 sq ft			1.10 to 3.00/100 sq ft		
Touchdown Syngenta	glyphosate - diammonium	3SL	40.00 gal	0.5 pt	2 pt	4 pt	2.50	10.00	20.00
Tough Syngenta	pyridate	5L	67.00 gal	1 pt	1.5 pt	2 pt	8.40	12.60	16.75
Transline Dow	clopyralid-monoea salt	3SL	300.00 gal	0.67 pt	1 pt	1.33 pt	25.15	37.50	49.85
Treflan HFP Dow	trifluralin	4EC	26.00 gal	1 pt	2 pt	4 pt	3.25	6.50	13.00
Treflan TR-1 O Dow	trifluralin	10G	0.85 lb	5 lb	10 lb	20 lb	4.25	8.50	17.00
Trifluralin EC Several	trifluralin	4EC	21.00	1 pt	2 pt	4 pt	2.65	5.25	10.50
Trifluralin G Several	trifluralin	10G	0.80 lb	5 lb	10 lb	20 lb	4.00	8.00	16.00
Trimec Classic	2,4-Da + MCPP + dicamba	3.32EC	25.00 gal	3.25 pt	3.8 pt	4.33 pt	10.15	11.90	13.55
Trimec Plus	MSMA + 2,4-Da + MCPPa	2.88EC	32.00 gal	2 qt	3 qt	4 qt	16.00	24.00	32.00
Trimec Super	2,4-De + 2,4DPe + dicamba	4.5EC	54.00 gal	2 pt	2.5 pt	3 pt	13.50	16.90	20.25
Ultra Blazer BASF	acifluorfen	2SL	68.00 gal	1 pt	1.5 pt	2 pt	8.50	12.75	17.00
UpBeet DuPont	triflurosulfuron	50DF	46.00 oz	0.25 oz	0.3 oz	0.5 oz	11.50	13.80	23.00
Valor Valent	flumioxazin	51WDG	4.70 oz	2 oz	2.5 oz	3 oz	9.40	13.80	14.10
Velpar DuPont	hexazinone	2L	60.00 gal	2 pt	4 pt	6 pt	15.00	30.00	45.00
Weed Blast UAP	bromacil + diuron	4 + 4G	3.45 lb	40 lb	50 lb	60 lb	138.00	172.50	204.00
Weedone 638 Nufarm	2,4-D acid + 2,4-De	2.8EC	24.00 gal	0.67 pt	2 pt	3 pt	2.00	6.00	9.00
Weed Master BASF	2,4-D-dea + dicamba-dea	2.87 + 1SL	24.00 gal	0.5 pt	2 pt	4 pt	1.50	6.00	12.00
Yukon Monsanto	dicamba-Na + halosulfuron	55 + 12.5 WDG	2.50 oz	4 oz	6 oz	8 oz			
2,4-D Products	2,4-D								
2,4-D amine		3.8SL	12.00 gal	0.5 pt	2 pt	4 pt	0.75	3.00	6.00
2,4-D ester		3.8EC	13.00 gal	0.4 pt	2 pt	4 pt	0.65	3.25	6.50
LV ester		5.7EC	18.00 gal	0.33 pt	2 pt	4 pt	0.75	4.50	9.00

## Herbicide Spray Adjuvants

### Surfactants

Activate Plus	Agrilience	\$17.00 gal	2 to 4 pt/100 gal
Activator 90	Loveland	\$22.00 gal	2 to 4 pt/100 gal
Active-It	AGSCO	\$17.00 gal	2 to 4 pt/100 gal
Crnbt Premier 90	West Central	\$16.50 gal	2 to 4 pt/100 gal
Induce	Helena	\$20.00 gal	2 to 4 pt/100 gal
LJ-700	Loveland	\$25.00 gal	2 to 4 pt/100 gal
Liberate	Loveland	\$28.00 gal	2 to 4 pt/100 gal
Preference	Agrilience	\$18.00 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
Spray Booster S	Agrilience	\$17.00 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	\$22.50 gal	2 to 4 pt/100 gal

### Surfactants with Silicone

Celexone	Agrilience	\$80.00 gal	0.75 to 4 pt/100 gal
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
Silken	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

Bronc Plus	Wilbur-Ellis	\$5.50 gal	3% v/v
Cayuse Plus	Wilbur-Ellis	\$11.00 gal	1 to 2 qt/A
ClassAct NG	Agrilience	\$7.00 gal	2.5% v/v
Dispatch 2N	Loveland	\$5.50 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	\$15.00 gal	1% v/v

### Water Conditioning Agents

AMS Plus	Agrilience	\$14.00 gal	4 to 6 pt/A
Choice	Loveland	\$16.50 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

### Water Conditioning Agents + Surfactants

BlendMaster	Loveland	\$21.50 gal	1 gal/100 gal
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### Basic pH Blend

Dispatch 111	Loveland	\$15.75 gal	1% v/v
Linkage	West Central	\$14.25 gal	1% v/v
Newtone	Agrilience	\$15.25 gal	1% v/v
Quad 7	AGSCO	\$15.75 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	\$11.00 gal	1 to 2 pt/A
Ortech	Rosens	\$7.00 gal	2 to 4 pt/A
Premium COC	West Central	\$6.00 gal	2 to 4 pt/A
Prime Oil	Agrilience	\$7.00 gal	2 to 4 pt/A
Paraspread	Custom Chem	\$6.50 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	Agrilience	\$15.00 gal	1 to 1.5 pt/A
Hasten	Wilbur-Ellis	\$16.00 gal	1 to 1.5 pt/A
MSO	Loveland	\$15.00 gal	1 to 1.5 pt/A
Perform	United Supp.	\$16.00 gal	1 to 1.5 pt/A
Scoil	AGSCO	\$15.75 gal	1 to 1.5 pt/A
Soy-Stik	West Central	\$15.00 gal	1 to 1.5 pt/A
Sundance II	Rosens	\$15.00 gal	1 to 1.5 pt/A
Superspread MSO	Wilbur-Ellis	\$15.00 gal	1 to 1.5 pt/A
Unifilm MSO	Custom Chem	\$16.00 gal	1 to 1.5 pt/A

### MSO 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 Basic Blend + 28% Nitrogen + Surfactant

Z 64	AGSCO	\$15.75 gal	1 to 2% v/v
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### MSO + Water Conditioning Agent

SuperCharge	Syngenta	w/Achieve	0.5% v/v
Vortex	Loveland	\$17.00 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	\$0.25 lb	2 to 4 lb/A
AMS (liquid)	Various	\$3.00 gal	2 to 4 qt/A
28% UAN	Various	\$3.50 gal	2 to 4 qt/A
28% UAN (bulk)	Various	\$3.50 gal	2 to 4 qt/A

### AMS 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
Thrust	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	\$4.25 gal	2.5 to 5 gal/100 gal

### AMS Fertilizer + Defoamer

Am-Stik	West Central	\$4.00 gal	1 to 4 qt/A
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### AMS Fertilizer + Deposition + Defoamer

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

### AMS Fertilizer + Surfactant + Deposition + Defoamer

One-Ap XL	West Central	\$1.60 lb	10 to 20 lbs/100 gal
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### Drift Retardants

Chem-trol	Loveland	\$16.25 gal	2 qt /100 gal
Corral Poly	Agrilience	\$13.00 gal	4 to 12 fl oz/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 herbicid 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
Valid	Loveland	\$48.00 gal	1 pt/100 gal

### Drift Retardant + Defoamer

Valid	Loveland	\$48.00 gal	1 pt/100 gal
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### Drift Retardant+Defoamer+Water Conditioning Agent

Cornbelt Gardian	West Central	\$25.00 gal	1 to 3 qt/100 gal
Ultra-Gard	Loveland	\$44.00 gal	1 qt/100 gal

### Compatibility Agents

CompatibilityAgent	West Central	\$30.00 gal	1 to 3 pt/100 gal
Complete	Agrilience	\$29.00 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

## Summary of New Information Added to the 2003 Weed Control Guide:

**NDSU Weed Science home page at:** [www.ag.ndsu.nodak.edu/weeds](http://www.ag.ndsu.nodak.edu/weeds).

- ~ Web version of 2003 ND Weed Control Guide In development:
- ~ Link to NDSU Extension Weed/Herbicide Pubs ~ Weed Control Data base
- ~ Link to NDSU Extension Crop Production Pubs ~ Herbicide Selection Software Program
- ~ Link to 2003 Section 18 - Status
- ~ CDMS Herbicide Label Search
- ~ Resistant Weed Web Site

**Glyphosate: Master list of Commercial Brands available - see Paragraph A4:**

**Roundup Weather Max** = glyphosate 4.5 lb ae/gal - Not registered in ND

**Herbicides deleted** Tiller. Dakota will be sold by UAP.

### **Cereal Herbicides:**

- SUs** = New XP (extruded paste (granule)) formulation.  
**Achieve Liquid** = Achieve 40DG phased out and replace with Achieve Liquid 3.33 EC  
**Clearfield wheat** = Beyond = name for Clearfield Crop Systems.  
2002 launch for winter wheat. Spring wheat = still in development.

### **Corn Herbicides:**

- Cinch** (DuPont) – same as Dual II Magnum  
**Atrazine pre-mixtures:**  
Avalanche or Teamwork + Atrazine (Aim 2EW or Aim 40DF + 4L)  
Cinch ATZ/Lite - same as Bicep II Magnum/Lite  
G-Max Lite (Outlook + atrazine (2.25+2.75 lb/gal)  
Keystone LA – LA = less atrazine (acetochlor+atrazine) (4 + 1.5)  
**Yukon** (55% dicamba + 12.5% Permit)  
**Camix** - Callisto + Dual II Magnum - Labeled only in MN, WI, MI  
**Lumax** - Callisto + Dual II Magnum + Atrazine - Labeled in ND

### **Soybean Herbicides:**

- Gangster** = Valor + FirstRate (Similar to Gauntlet = Authority + FirstRate).

### **Pasture, Range, and CRP Herbicides:**

- Cimarron** = same as Ally  
**Cimarron Max** = Ally + Weedmaster (2,4-D + dicamba)  
**Transline** = same a.i. as Stinger  
**Leafy Spurge** = Tordon + Plateau + 2,4-D + MSO - better than Tordon + 2,4-D

**New ND Noxious Weeds** = Saltcedar and dalmatian/yellow toadflax

**Crop Rotation Restrictions** = Added field pea, revised atrazine and several other herbicides.

**Weed Control Ratings** = Added mode of action and common mallow.

### **Federal (Section 3) registrations approved**

**Canola** - Sonalan, Stinger, Beyond (CF canola)  
**Curtail M:** flax  
**Raptor** = alfalfa, dry bean, dry pea, Clearfield winter wheat (Beyond).  
**Plateau** = pasture (allow grazing)

**Chickpea** - Spartan  
**Field pea** - Spartan  
**Dry beans** - Reflex  
**Flax** - Spartan  
**Sugarbeet** - Outlook (if Dual not labeled)  
**Safflower** - Poast  
**Sunflower** - Beyond (CF sunflower), Spartan

### **Section 24c registrations approved**

Section 24c are ND State Local Need (SLN) labels that normally do not expire after approval.

**Glyphosate (preharvest):** crambe, field pea, chickpea, lentil, flax.

**Niger thistle** - Treflan, Select.

### **IR-4 Projects for 2003**

Safflower - Select, zeta-cypermethrin, azoxystrobin  
Oat - glyphosate (preharvest)  
Mustard seed - thiophanate. glyphosate - IR-4 will work with Monsanto to bridge 07210 IR-4 residue project on canola to mustard seed. If so then Monsanto will add to Section 3 label.  
Barley - diflufenzuron, fenpropathrin  
Dry Bean - fluazinam

### **Possible 2002 Section 18 registrations**

**Buckwheat** - Poast



MEMORANDUM FOR THE RECORD

On 10/10/54, the following information was received from the [illegible] regarding the [illegible] of the [illegible] in the [illegible] area.

The [illegible] was observed on [illegible] at [illegible] hours. The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior. The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

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The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

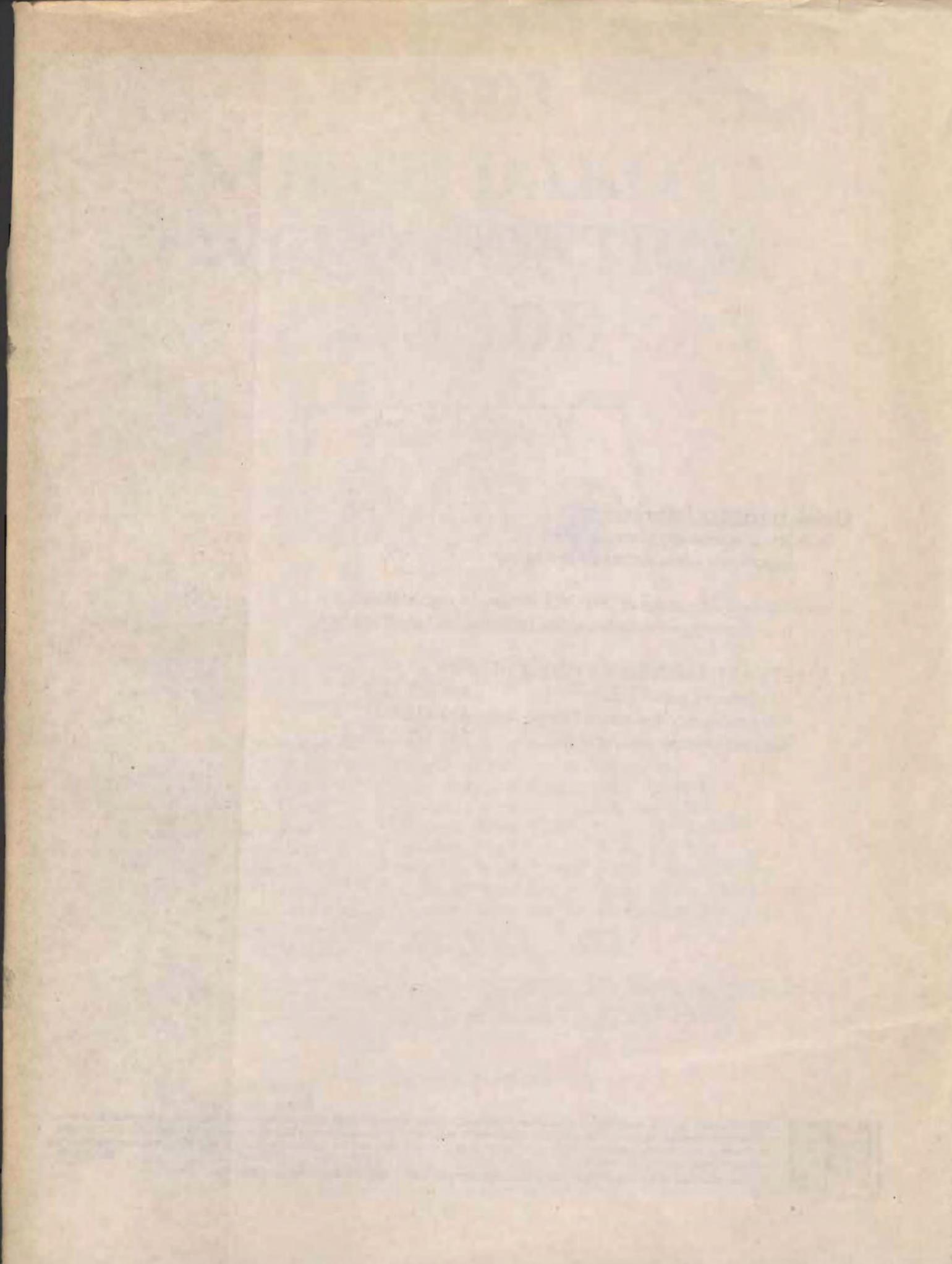
The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

The [illegible] was [illegible] and [illegible] in appearance. The [illegible] was [illegible] and [illegible] in behavior.

Very truly yours,

[Illegible signature and text]

[Illegible signature and text]



**Quick reference information:**

1. Web site to access any pesticide label:

<http://www.cdms.net/manuf/manuf.asp>

2. Web site to access status of 2003 ND Section 18 registrations:

<http://www.ag.ndsu.nodak.edu/aginfo/pesticid/LabelPage.htm>

3. SAFETY AND EMERGENCY PHONE NUMBERS:

ND Poison Control Line: 800 222-1222

ND Emergency Assistance Line: 800 472-2121

Report pesticide incident to NDDA: 701 328-2232



W-253

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