

**NORTH DAKOTA
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1989 AGRICULTURAL WEED CONTROL GUIDE

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INTRODUCTION

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 Report of the North Central Weed Control Conference.

CAUTION: The weed control suggestions in this circular are based on the assumption that all herbicides mentioned in this guide will continue to have a registered label with the Environmental Protection Agency.

USE PESTICIDES ONLY AS LABELED. Certification is required for purchase and use of restricted use herbicides, picloram (Tordon), diclofop (Hoelon), paraquat (Gramoxone Super, Cyclone), sulfuric acid, amitrole (Amitrol-T, Cytrol), cyanazine (Bladex) and alachlor (Lasso).

RATES ARE BASED on broadcast application and are expressed as active ingredient or acid equivalent, and as the amount of commercial product. Commercial formulations of the same herbicide may vary in their 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. Three pounds of atrazine (AAtrex 80W) powder contains 2.4 pounds active ingredient ($3 \times 0.80 = 2.4$), or 3 pounds active ingredient is 3.75 pounds of product ($3 / 0.80 = 3.75$).

WEED COMPETITION reduces crop yields severely, unless weeds are removed when small. Good cultural practices are one of the many methods of controlling weeds. However, selective herbicides at the recommended rate will control many annual weeds satisfactorily without damaging the crop in which the weeds are growing.

GENERAL INFORMATION

POSTEMERGENCE HERBICIDES:

Effectiveness of postemergence herbicides is influenced by crop tolerance, weed species and climatic conditions and should be considered in determining the rate of herbicide to apply. A range of rates is given for most of the herbicides in this circular. Use the lowest recommended rate of postemergence herbicides under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of drought or prolonged cool weather, or for well established weeds, use the highest suggested rate, unless otherwise directed.

Ideal temperatures for applying most postemergence herbicides are between 65 to 85 F. Below 60 F weeds are killed very slowly or not at all; above 85 F there is danger of herbicide injury to the crop. Avoid applying volatile herbicides such as 2,4-D ester, MCPA ester and dicamba (Banvel) during hot weather, especially near sensitive broadleaf crops, shelterbelts, or farmsteads.

Rainfall shortly after application often reduces weed control from postemergence applications because the herbicide is washed off the leaves before absorption is complete. Herbicides vary in rate of absorption and in ease of being washed from leaves; therefore, herbicides vary in

response to rainfall. The amount and intensity of rainfall influence the washing of herbicide from leaves. The approximate time between application and rainfall needed for maximum weed control from several herbicides follows:

Herbicide	Time Interval	Herbicide	Time Interval
acifluorfen (Blazer, Tackle)	6 hours	diclofop (Hoelon)	1 hour
atrazine + oil (Aatrex)	4 hours	difenzoquat (Avenge)	6 hours
barban (Carbyne)	5 minutes	fenoxaprop (Whip)	1 hours
bentazon + oil (Basagran)	8 hours	fluazifop-P (Fusilade 2000)	1 hour
bromoxynil (Buctril)	1 hour	glyphosate (Roundup)	6 hour
cyanazine (Bladex)	2 hours	lactofen (Cobra)	0.5 hour
dalapon (Dowpon)	8 hours	2,4-D or MCPA amine	4 hours
desmedipham (Betanex)	6 hours	2,4-D or MCPA ester	1 hour
desmedipham + phenmedipham (Betamix)	6 hours	propanil + MCPA (Stampede CM)	4 hours
dicamba (Banvel)	6-8 hours	sethoxydim (Poast)	1 hour
		quizalofop (Assure)	1 hour

SPRAY ADDITIVES:

Spray additives consist of oils, surfactants, and fertilizers. The most effective additive often will vary with different herbicides and the need for an additive will vary with environment, weeds present, and herbicide. Additives should be used only when indicated on the herbicide label as they may increase injury to crops or reduce weed control. Oils generally are used at 1% v/v (1 gallon per 100 gallons of spray solution) or at 1 pt to 1 gal/A depending upon herbicide and oil. Oil additives function to increase herbicide absorption and spray retention. Surfactants are used at 0.12 to 0.5% v/v (1 to 4 pt per 100 gallons of spray solution). Surfactant rate depends on the amount of active ingredient in the surfactant and other factors. The main function of a surfactant is to increase the wetting of plants by the spray. When a range of surfactant rates is given, the high rate is for use with low rates of the herbicide, drought stress, tolerant waxy weeds, or when the surfactant contains a low (less than 50%) percentage active ingredient. X-77 and WK are examples of surfactants with more than 80% active ingredient. Fertilizers containing ammonium nitrogen occasionally have increased the effectiveness of barban, acifluorfen, glyphosate, bentazon, and sethoxydim. Fertilizer with herbicides also 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.

SPRAY AND VAPOR DRIFT:

Off target movement of herbicides is a problem in North Dakota each year as herbicides move from target fields into nontarget fields containing crops susceptible to the herbicide. Spray drift and crop injury are affected by several factors.

a) Spray particle size: Large droplets will drift less than small particles. Low spray pressures (20 to 30 psi) and nozzles which deliver high gallons per acre will increase spray droplet size.

b) Wind velocity and direction: To minimize spray drift injury, wind direction should be away from susceptible crops during herbicide application. The wind velocity should be less than 10 miles per hour; however, drift can occur even with lower wind velocities.

c) Distance between nozzle and target (boom height): Droplets should be released as close to the target as possible since less distance means less time to fall and therefore less drift.

d) Herbicide formulation: All herbicides can drift as spray droplets but some herbicides are sufficiently volatile to cause plant injury from vapor or fume drift. 2,4-D and MCPA are formulated as amines or esters. The ester formulations may form damaging vapors while the amines are essentially non-volatile. Dicamba (Banvel) is also volatile and can drift as droplets or vapor. Herbicide vapor drifts further and over a longer time than spray droplets. A wind blowing away from susceptible plants during application will prevent damage from droplet drift but a later wind shift towards the susceptible plants could move damaging vapors to the plants. Thus, to minimize the risk of drift injury, herbicides such as 2,4-D esters, MCPA esters, and dicamba with high potential to form damaging vapors should not be used near susceptible plants.

e) Drift control: Certain spray nozzles or spray systems such as the Delavan Raindrop nozzle, the Spraying Systems LP nozzle or controlled droplet applicators produce droplets less subject to drift. Nalco-Trol and other additives to spray mixtures cause larger droplets which may reduce drift. Drift control techniques that produce large spray droplets should not be used with postemergence herbicides that require small droplets for optimum performance such as barban (Carbyne 2EC), desmedipham (Betanex), bentazon (Basagran), sethoxydim, (Poast), fluazifop-P (Fusilade 2000), fenoxaprop (Whip), and quizalofop (Assure).

f) Drift injury from herbicides: Damaging drift to non-target plants is primarily a problem with 2,4-D, MCPA, dicamba (Banvel), paraquat (Gramoxone Super, Cyclone), glyphosate (Roundup), DPX-M6316 (Harmony) and picloram (Tordon) in North Dakota. All herbicides may drift and cause significant damage to susceptible nontarget plants, so caution must be observed with all herbicide applications.

Herbicide volatility and consequent risk of damage to susceptible plants increases with increasing temperature. The so-called high volatile esters of 2,4-D or MCPA may produce damaging vapors at temperatures as low as 40 F while low volatile esters may produce damaging vapors between 70 and 90 F. Amine formulations are essentially non-volatile. Temperature on the soil surface often is several degrees warmer than air temperature. Thus an applied low volatile ester could be exposed to temperatures high enough to cause damaging vapor formation even when the air temperature is below 70 F.

PREEMERGENCE HERBICIDES:

Good weed control with preemergence herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature, soil type and weed species. For these reasons, preemergence chemicals applied to the soil surface sometimes fail to give satisfactory

weed control. Herbicides which are incorporated into the soil surface usually require less rainfall after application for effective weed control than unincorporated herbicides. Weeds emerging through a preemergence herbicide treatment may be controlled by rotary hoeing or harrowing without reducing the effect of the herbicide.

INCORPORATION OF HERBICIDES:

Many herbicides applied before crop and weed emergence need to be incorporated to give optimum weed control. Included in this group are butylate (Sutan +, Genate +), cycloate (Ro-Neet), EPTC (Eptam, Genep, Eradicane, Eradicane Extra), ethalfuralin (Sonalan), triallate (Far-Go, Showdown), and trifluralin (Treflan). Incorporation of alachlor (Lasso), ethofumesate (Nortron), metolachlor (Dual), and pendimethalin (Prowl) generally improves weed control.

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 than others and the incorporation method should be appropriate for the herbicide.

PESTICIDE COMBINATIONS:

The recommended sequence of addition of formulations for tank mixes is a) water, b) wettable powders or dry flowables plus agitation, c) liquid flowables, d) emulsifiable concentrates, and e) solutions. 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 postemergence herbicides often is increased when applied to areas already treated with a preemergence or preplant 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.

Several herbicide-insecticide combinations have been shown to increase crop injury compared to either pesticide applied alone. For example, crop injury has increased when bentazon plus malathion, sulfonylurea herbicides plus organophosphate insecticides, and propanil plus organophosphate or carbamate insecticides were applied. Increased crop injury even has occurred with sequential applications. 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.

Agricultural pesticides that are tank mixed are often registered for use as a mixture by the Environmental Protection Agency. Non-registered tank mixes may be applied if all pesticides in the mixture are registered by the Environmental Protection Agency on the crop being treated. However, the user must assume liability for crop injury, inadequate weed control and illegal residues if the combination is not a labelled tank mixture.

HERBICIDE-LIQUID FERTILIZER COMBINATIONS:

Thorough mixing and continuous, vigorous agitation are required to obtain an even application of herbicide-fertilizer combinations. Some herbicide-fertilizer combinations will not form a uniform mixture even with thorough agitation. Compatibility of the herbicide in the liquid fertilizer should be tested before the herbicide is added to the tank. The compatibility test may be conducted by combining small quantities of the components being mixed in the same proportions used in the spray tank. One teaspoon of liquid herbicide in 1.5 pints of fertilizer is equivalent to one quart of herbicide in 35 gallons of fertilizer. One teaspoon of dispersible granules in 1.5 pints of fertilizer is equivalent to 1 pound of granules in 16 gallons of fertilizer. One teaspoon of wettable powder in 1.5 pints of fertilizer is equivalent to 1 pound of wettable powder in 32 gallons of fertilizer. Wettable powders and dispersible granules should be mixed with a small amount of water to form a slurry before adding to the fertilizer. For other fertilizer volumes per acre or herbicide rates, adjust proportions accordingly. Close the jar and shake well. Watch the mixture for several seconds and check again 30 minutes later. If the mixture does not separate, the combination is compatible. If the mixture separates or gets very thick or syrupy, do not

combine for field application. Mixing ability may be improved by adding a compatibility agent such as Compex or Unite. Different batches of fertilizer may differ in their mixing properties and should be tested separately.

HERBICIDE-DRY FERTILIZER COMBINATIONS:

Many preplant incorporated herbicides are registered for impregnation on dry bulk fertilizer. Ammonium sulfate, ammonium phosphate-sulfate, diammonium phosphate, potassium chloride, superphosphate, treble superphosphate, and urea are some of the approved fertilizer materials for impregnation. Impregnated fertilizer should be applied immediately and incorporated according to label instructions. Accurate spreader calibration and uniform fertilizer distribution are essential. Consult the herbicide label for minimum amounts of fertilizer per acre and for maximum amounts of herbicide per given weight of fertilizer. Ranges of 200 to 400 lbs/A of dry bulk fertilizer are recommended to maintain uniformity of herbicide application.

CHEMICAL WEED CONTROL For Field Crops

Hard Red Spring and Durum Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant at 0.5% v/v. Combinations of 2,4-D or dicamba with glyphosate have increased the spectrum of weeds controlled. Commercial mixtures of 2,4-D + glyphosate (Landmaster II, Landmaster BW) and dicam- ba + glyphosate (Fallow Master) are available.	145, 146
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)	Emerged annual grass and broad- leaf weeds		A nonselective, postemer- gence herbicide. No soil resi- dual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.
**Reference paragraph number indicates appropriate paragraph in the narrative.

Hard Red Spring and Durum Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Triallate (Far-Go, Showdown)	1 (1 qt Far-Go, 10 lb Far-Go 10 G)	Wild oats	Three days or more prior to seeding or immediately after seeding.	Preplant incorporate with field cultivator set to cut 4 inches deep. Postplant incorporate with harrow set shallower than seed depth.	5,36
	1 liquid (1 qt Far-Go), 1.25 lb. granule (12.5 lb Far-Go 10G, 6.25 lb Showdown)		Fall-after October 15 and until freeze-up.	Keep spring tillage depth to minimum. Triallate granules may be surface ap- plied without incorporation in the fall.	5,12
Triallate + Trifluralin (Buckle)	1 to 1.25 + 0.3 to 0.4 (10 to 12.5 lb G)	Wild oats and foxtails (pigeongrass)	Fall-within 3 weeks of freezeup	Do not apply to Hard Red Spring wheat. Incorporate once in the fall within 24 hours after application. Keep spring tillage depth shallower than fall. Wheat stand reduc- tion may occur.	5,36
Durum Wheat only					
Triallate (Far-Go) + Trifluralin (Treflan)	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	Immediately after seeding	Plant wheat 2 to 2.5 inches deep. Incorporate herbicide shallowly twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches.	5,36
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Foxtails (pigeongrass)			4,46
	0.5 to 0.75 (1 to 1.5 pt 4E) (5 to 7.5 lb 10G)		Fall - after September 1 and until freeze-up	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Wheat stand reduction may occur.	1,2, 13,17, 47
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broadleaf weeds and suppression of foxtails (pigeongrass)	Preemergence	Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 25 about resistant weeds. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	10,22, 25,31, 48,50, 51,52, 53
	1/64 (1/3 oz)		Fall		
Bromoxynil (Buctrl)	0.25 to 0.38 (1 to 1.5 pt)	Wild buck- wheat, volun- teer sun- flower, and most broadleaf weeds	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best re- sults. Weak on wild mustard.	30,50, 51,52
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.25 + 0.19 to 0.25 (0.75 to 1 pt)	Wild buck- wheat, volunteer sunflower, and most broadleaf weeds	Crop-3rd leaf until just prior to boot	Apply when weeds are in early seedling stage for best re- sults. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	30,50, 51,52

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Hard Red Spring and Durum Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.38 (1 to 1.5 fl oz. + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buck-wheat and most broad-leaf weeds	Crop—3rd through 5th leaf stage	Do not apply to durum wheat. Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted herbicide.	19,29, 50,51, 52
Hard Red Spring Wheat Only					
Dicamba (Banvel) + 2,4-D amine	0.06 + 0.25 (0.12 pt 4S + 0.5 pt of 4 lb/gal conc.)	Wild buck-wheat and most broadleaf weeds	Crop-4 leaf stage only	Proper timing of application is important to avoid crop injury.	28
Dicamba (Banvel) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S + 0.5 to 0.75 pt of 4 lb/gal MCPA)	Wild buck-wheat and most broad-leaf weeds	Crop-2nd through 4th leaf stage	Use the low dicamba rate and the high MCPA rate on 4 leaf wheat.	28,50, 51,52
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)	Broadleaf weeds	Crops-emergence until just prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sunflower and kochia. Use the high rate for control of large weeds or perennial weeds.	26,34, 50,51, 52
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-5th leaf until just prior to boot	Do not apply from early boot to dough stage. Use 0.5 lb/A for volunteer sunflower and kochia.	26,34, 50,51, 52
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Canada thistle and other broadleaf weeds	Crop-4 leaf stage through jointing	Do not rotate to any crop except small grains, grass, or sugarbeets within one year of treatment.	24,27, 136
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broadleaf weeds and suppression of foxtails (pigeongrass)	Crop in 2 leaf stage and prior to boot, weeds-small, less than 2 inches tall or 2 inches in diameter	Do not apply within 48 months of last chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	22,25, 31,48
Metsulfuron (Ally) + a broadleaf herbicide	1/267 (0.1 oz) + appropriate rate	Most broad-leaf weeds	HRS wheat-2 leaf stage until just prior to boot Durum-4 leaf stage until just prior to boot	Should be applied as a tank-mixture with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron or chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 23 for rotational restrictions.	23,25, 32
DPX-M6316 (Harmony)	1/64 to 1/32 (1/3 to 2/3 oz)	Annual broadleaf weeds	Crop-2 leaf to jointing. Weeds-less than 4 inches tall or 4 inches in diameter	Should be applied as a tank-mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See paragraph 25 about resistant weeds.	25,33, 50,51, 52,53

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Hard Red Spring and Durum Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Propanil + MCPA (Stampede CM)	0.94 + 0.25 (2.5 pt)	Green and yellow foxtail (pigeongrass) and annual broadleaf weeds	Weeds-2 to 4 leaf, crop-2nd through 4th leaf	Application to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased wheat injury.	45
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2-leaf stage	Wild oats usually develop to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer. May be tank mixed with diclofop or difenzoquat. Control decreases as wild oats stage increases.	37,38, 39
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5 leaf stage		
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and and foxtails (pigeongrass)	Grass weeds-1 to 4 leaves	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves. Oil improves consistency of weed control under dry conditions. Do not mix with any herbicide except bromoxynil or bromoxynil plus a low rate of MCPA ester (1.5 fl oz/A). Restricted use herbicide.	41,44
Diclofop (Hoelon) + Bromoxynil (Buctril)	0.75 to 1.25 + 0.37 (2 to 3.3 pt + 1.5 pt)	Wild oats, foxtails, (pigeongrass) and broad-leaf weeds	Grass weeds-2 to 3 leaves and small broadleaf weeds	Use the higher rate for dry conditions. Do not use oil additives with this mixture. Diclofop is a restricted use herbicide.	30,34, 41,43, 44
Diclofop + Bromoxynil + MCPA ester (One Shot)	0.8 + 0.25 + 0.05 (3.45 pt)		Grass weeds-1 to 3 leaves and small broadleaf weeds	Do not use oil additive. Diclofop is a restricted use herbicide.	
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	Wild oats in 3 to 5 leaf stage	Use high rate on high populations of 3-leaf wild oats. Can be applied with 2,4-D, MCPA amine, bromoxynil, chlor-sulfuron, metsulfuron, DPX-M6316, MCPA plus bromoxynil or clopyralid plus 2,4-D. Injury may occur when crop is under environmental stress. See paragraph 40 for varieties registered.	26,40
AC-222,293 (Assert)	0.38 to 0.47 (1.2 to 1.5 pt)	Wild oats, wild mustard, and winter annual mustards	Crop-2 leaf to jointing. Wild oats-1 to 4 leaf stage	See narrative for rotational restrictions. Do not tank-mix with propanil plus MCPA, dicamba, picloram, or the amine formulations of 2,4-D or MCPA.	42

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Winter Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or any-time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant at 0.5% v/v. Commercial mixture of 2,4-D + glyphosate (Landmaster II, Landmaster BW) and dicamba + glyphosate (Fallow Master) are available.	145, 146
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)	Emerged annual grass and broadleaf weeds		A nonselective, postemergence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Triallate (Far-Go)	1.25 (1.25 qt) (12.5 lb 10G)	Wild oats	Before or after seeding	Preplant incorporated with field cultivator set to cut 4 inches deep. Postplant incorporate with harrow set shallower than seed depth.	12
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buckwheat, volunteer sunflower and most broadleaf weeds.	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	30,50, 51,52
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.25 + 0.19 to 0.25 (0.75 to 1 pt)		In spring prior to boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall.	
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buckwheat and most broadleaf weeds	In spring after resumption of active crop growth and before early boot stage	Do not apply in the fall. Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	19, 50,51, 52
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2-leaf stage	Wild oats usually develop to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer. Control decreases as wild oats stage increases.	37,38, 39
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5 leaf stage		
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and foxtail (pigeongrass)	Grass weeds- 1 to 4 leaves; before jointing of wheat	Use the higher rates for dry conditions or grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil or bromoxynil plus a low rate of MCPA ester (1.5 fl oz/A). Restricted use herbicide.	41,44

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Winter Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Diclofop (Hoelon) + Bromoxynil (Buctril)	0.75 to 1.25 + 0.25 (2 to 3.3 pt + 1 pt)	Wild oats, foxtail (pigeongrass) and broadleaf weeds	Grass weeds- 2 to 3 leaves; small broadleaf weeds; before jointing of wheat	Use the higher rate for dry conditions. Diclofop is a restricted use herbicide.	30,34, 41,43, 44
Diclofop + Bromoxynil + MCPA ester (One Shot)	0.8 + 0.25 + 0.05 (3.45 pt)				
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	3 to 5-leaf stage of wild oats. Crop prior to flag leaf emergence	Use high rate on high popula- tions of 3-leaf stage wild oats. Can be applied with chlorsulfuron, 2,4-D, MCPA, metsulfuron, DPX-M6316, bromoxynil, MCPA plus bromoxynil, or clopyralid plus 2,4-D. Injury may occur when crop is under environmental stress.	40
AC-222,293 (Assert)	0.38 to 0.47 (1.2 to 1.5 pt)	Wild mustard, wild oats, and winter annual mustards	Crop-2 leaf to jointing. Wild oats- 1 to 4 leaf stage	See narrative for rotational restrictions. Do not tank mix with propanil plus MCPA, dicamba, picloram, or the amine formulations of 2,4-D or MCPA.	42
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broad- leaf weeds and suppres- sion of foxtails (pigeongrass)	Preemergence	Do not apply within 48 months of the last chlorsulfuron treat- ment. See paragraph 25 about resistant weeds. Apply post- emergence treatments with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	22,25, 31,48, 50,51, 52,53
	1/128 to 1/64 (1/6 to 1/3 oz)		In spring, crop in 2 leaf stage and until just prior to boot; weeds- small, less than 2 inches tall or 2 in- ches in diameter		
	1/128 to 1/64 (1/6 to 1/3 oz)		In fall, after the wheat has reached the 2 leaf stage; weeds-small, less than 2 inches tall or 2 inches in diameter		
Metsulfuron (Ally) + a broadleaf	1/267 (0.1 oz) + appropriate rate	Wild mustard and certain annual broad- leaf weeds	Postemergence, crop in 2 leaf stage until just prior to boot	Should be applied as a tank- mixture with another broad- leaf herbicide. Do not apply within 22 months of last metsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 23 for rota- tional restrictions.	23,25, 32,50, 51,52, 53

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Winter Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
DPX-M6316 (Harmony)	1/64 to 1/32 (1/3 to 2/3 oz)	Annual broadleaf weeds	Crop-2 leaf to jointing. Weeds less than 4 inches tall or 4 inches in diameter	Should be applied as a tank- mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See paragraph 25 about resistant weeds.	25,33, 50,51, 52,53
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Canada thistle and other broadleaf weeds	Crop-4 leaf stage until jointing	Do not rotate to any crop except small grains, grass, or sugarbeets within 1 year of application.	24,27, 136
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	In spring when wheat is well tillered but prior to boot stage	Do not apply from early boot to dough stage. Do not apply in the fall.	26,34, 50,51, 52
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/ gal conc.)		In spring from 4-leaf stage and prior to boot stage		
Dicamba (Banvel) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S + 0.5 to 0.75 pt of 4 lb/gal MCPA)	Wild buck- wheat and most broad- leaf weeds	In spring after winter dormancy but before wheat begins to joint	Do not apply in the fall.	28,50, 51,52
Dicamba (Banvel) + 2,4-D amine	0.06 + 0.25 (0.12 pt 4S + 0.5 pt of 4 lb/gal 2,4-D amine)		Crop-4 leaf to jointing		

Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with nonionic surfactant at 0.5% v/v. Combinations of 2,4-D or dicamba with glyphosate have increased the spectrum of weeds controlled. Commercial mixtures of 2,4-D + glyphosate (Land- master II, Landmaster BW) and dicamba + glyphosate (Fallow Master) are available.	145, 146
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)	Emerged an- nual grass and broadleaf weeds		A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144

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Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Triallate (Far-Go, Showdown)	1.25 (1.25 qt Far-Go, 12.5 lb Far-Go 10G)	Wild oats	Before or after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation.	1,5, 36
	1.25 liquid (1.25 qt Far-Go), 1.25 to 1.5 granule (12.5 to 15 lb Far-Go 10G, 6.25 to 7.5 lb Showdown)		Fall-after October 15	Keep spring tillage to a minimum. The lower rate has generally given adequate control. Triallate granules may be surface applied in the fall without incorporation.	1,5, 12
Triallate (Far-Go) + Trifluralin (Treflan)	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	In spring-immedi- ately after plant- ing	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow to depth of 1 to 1.5 inches.	5,36
Triallate + Trifluralin (Buckle)	1 to 1.25 + 0.3 to 0.4 (10 to 12.5 lb G)	Wild oats and foxtails	Fall-within 3 weeks of freeze-up. Spring-prior to planting	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Barley stand reduction may occur.	5,36
Trifluralin (Treflan)	0.5 (1 pt 4E, 5 lb 10G)	Foxtails (pigeongrass)	Preplant incorporated	Incorporate twice to a depth of 2 to 3 inches. Seed barley 2 in- ches deep.	1,2,4, 13,17, 46
	0.5 to 0.75 (1 to 1.5 pt 4E)		After planting	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or dia- mond harrow to depth of 1 to 1.5 inches.	
	0.5 to 0.75 (1 to 1.5 pt 4E, 5 to 7.5 lb 10G)		Fall-after September 1	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Stand reduction may occur.	2,13, 17,47
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buck- wheat, volun- teer sun- flower, and most broadleaf weeds	Crop-emergence and prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	30,50, 51,52
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broad- leaf weeds and suppres- sion of fox- tails (pigeongrass)	Crop in 2 leaf stage and prior to boot, weeds-small, less than 2 inches tall or 2 inches in diameter	Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	22,25, 31,48, 50,51, 52,53

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Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Metsulfuron (Ally) + a broadleaf herbicide	1/267 (0.1 oz) + appropriate rate	Most broad- leaf weeds	Crop in 2 leaf stage until just prior to boot	Should be applied as a tank- mixture with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron or chlorsulfuron treatment. See paragraph 25 about resis- tant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 23 for rotational restrictions.	23,25, 32,50, 51,52, 53
DPX-M6316 (Harmony)	1/64 to 1/32 (1/3 to 2/3 oz)	Annual broadleaf weeds	Crop-2 leaf to jointing. Weeds- less than 4 inches tall or 4 inches in diameter	Should be applied as a tank- mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See paragraph 25 about resistant weeds.	25,33, 50,51, 52,53
Propanil + MCPA (Stampede CM)	0.94 + 0.25 (2.5 pt)	Foxtails (pigeongrass), and some annual broadleaf weeds	Weeds 2 to 4- leaf stage, crop 2 to 4-leaf stage	Application to foxtail larger than 3 leaves or barley larger than 4 leaves may result in re- duced weed control or increas- ed crop injury.	45
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.25 + 0.19 to 0.25 (0.75 to 1 pt)	Wild buck- wheat, volun- teer sun- flower and most broad- leaf weeds	Crop-3rd leaf stage and until just prior to boot	Apply when weeds are in early seedling stage for best results. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	30,50, 51,52
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4lb/ gal conc.)	Wild buck- wheat and most broad- leaf weeds	Crop-3rd through 5th-leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum, or flax. Picloram is a restricted use herbicide.	19,29, 50,51, 52
Clopyralid + 2,4-D (Curtall)	0.09 + 0.5 (2 pt)	Canada thistle and other broadleaf weeds	Crop-4 leaf stage until jointing	Do not rotate to any crops except small grains, grasses, or sugarbeets within 1 year of application.	24,27, 136
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-5th leaf and prior to boot	Do not apply from early boot to dough stage. Barley more susceptible than wheat. Use 0.5 lb/A for volunteer sunflower and kochia.	26,34, 50,51, 52
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)		Crop-emergence and prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sunflower and kochia. Use the high rate for control of large weeds or perennial weeds.	
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2- leaf stage	Wild oats usually develop to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer. Control decreases as wild oats stage increases.	37,38, 39
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5 leaf stage		

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Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Diclofop (Hoelon)	0.75 to 1 (2 to 2.66 pt)	Wild oats and foxtail (pigeongrass)	Grass weeds-1 to 3 leaves. Crop- up to 4 leaf stage	Use the higher rate for dry conditions or grass weeds with 3-4 leaves. Do not mix with oil or any herbicide ex- cept bromoxynil or bromoxynil plus a low rate of MCPA ester (1.5 fl oz/A). Restricted use herbicide.	41,44
Diclofop (Hoelon) + Bromoxynil (Buctril)	0.75 to 1.0 + 0.37 (2 to 2.7 pt + 1.5 pt)	Wild oats, fox- tail (pigeon- grass) and annual broadleaf weeds	Grass weeds in 2 to 3 leaf stage and small broadleaf weeds	Use the higher rate for dry conditions. Do not use oil additive with this mixture. Diclofop is a restricted use herbicide.	30,34, 41,43, 44
Diclofop + Bromoxynil + MCPA ester (One Shot)	0.8 + 0.25 + 0.05 (3.45 pt)			Do not use oil additive with this mixture. Diclofop is a restricted use herbicide.	
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	3 to 5-leaf stage of wild oats. Crop-prior to flag leaf emergence	Cleared on all barley varieties. Use high rate on high popula- tions of 3-leaf wild oats. Can be applied with chlorsulfuron, metsulfuron, DPX-M6316, 2,4-D, MCPA, bromoxynil, MCPA plus bromoxynil, or cloparylid plus 2,4-D.	40
AC-222,293 (Assert)	0.38 to 0.47 (1.2 to 1.5 pt)	Wild mustard, wild oats, and winter annual mustards	Crop-2 leaf to jointing. Wild oats- 1 to 4 leaf stage	See narrative for rotational restrictions. Do not tank-mix with propanil plus MCPA, dicamba, picloram, or the amine formulations of 2,4-D or MCPA.	42

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Oats

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grasses and broad-leaf weeds	Preplant or any-time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v. Combinations of 2,4-D or dicamba with glyphosate have increased the spectrum of weeds controlled. Commercial mixtures of 2,4-D + glyphosate (Landmaster II, Landmaster BW) or dicamba + glyphosate (Fallow Master) are available.	145, 146
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Oats-emergence to boot	Early jointing stage most susceptible. Possible injury to oats at any growth stage. Use 0.5 lb/A for volunteer sunflower.	26,34, 50,51, 52
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buck-wheat, volunteer sunflower, and most broadleaf weeds	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	30,50, 51,52
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.25 + 0.19 to 0.25 (0.75 to 1 pt)		Oats-3 leaf to boot stage	Apply when weeds are in early seedling stage for best results. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	30,50, 51,52
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broadleaf weeds and suppression of foxtails (pigeongrass)	Crop in 2 leaf stage and prior to boot. Weeds-small, less than 2 inches tall or 2 inches in diameter	Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	22,25, 31,48, 50,51, 52,53
Picloram (Tordon 22K) + MCPA amine	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buck-wheat and most broad-leaf weeds	Oats-3 through 5-leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	19,29, 50,51, 52
Dicamba (Banvel) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S + 0.5 to 0.75 pt of 4 lb/gal MCPA)		Oats-2 through 4-leaf stage	Use the low dicamba rate and the high MCPA rate on 4 leaf oats.	28,50, 51,52

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Rye

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer-ence**
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	In spring when rye is well tillered but prior to boot stage	Do not apply from early boot to dough stage. Do not apply in the fall.	26,34, 50,51, 52
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)		In spring from 4-leaf stage and prior to early boot		
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buck-wheat and other broad-leaf weeds	In spring prior to early boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall. Weak on wild mustard.	30,50, 51,52
Bromoxynil + MCPA ester (Bronate)	0.19 + 0.25 + 0.19 + 0.25 (0.75 to 1 pt)	Wild buck-wheat and other broad-leaf weeds	In spring prior to early boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall.	30,50, 51,52

Small Grain Pre-Harvest

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer-ence**
2,4-D L.V. ester	0.75 to 1.5 (1.5 to 3 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-dough stage to harvest	Use only when weeds may interfere with harvest operations. Do not feed straw to livestock. CAUTION: Drift to broadleaf crops is hazardous at this time.	136

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Flax

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
EPTC (Eptam, Genep)	4 (4.5 pt 7E, 40 lb 10G)	Grass and some broad- leaf weeds	Fall incorporated after October 15 until freeze-up	Flax safety is marginal. Weak on wild mustard.	2,11, 56
Trifluralin (Treflan)	0.5 to 1.0 (1 to 2 pt 4E or 5 to 10 lb 10G)	Grass and some broad- leaf weeds	Fall, incorporated	Use higher rates on fine- textured soils. Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall.	1,2, 13,17, 55,57
Propachlor	4 (4 qt)	Grass and certain broad- leaf weeds	Preemergence	Weak on wild mustard and wild oats.	58
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Grass weeds 2 to 4 inches tall, but prior to flax bloom	Apply with 1 qt/A oil additive. Apply to actively growing grasses. See narrative for rates to control different weed species. May be tank mixed with bromoxynil or MCPA for broad spectrum weed control.	62
Diclofop (Hoelon)	0.75 to 1.0 (2 to 2.67 pt)	Wild oats and foxtail (pigeongrass)	Grass weeds-1 to 4 leaves	Do not mix with oil additive. Do not mix with any herbicide except bromoxynil. Restricted use herbicide.	61
Diclofop (Hoelon) + bromoxynil (Buctril)	0.75 to 1.0 + 0.25 (2 to 2.67 pt + 1 pt)	Wild oats, fox- tail (pigeon- grass) and broadleaf weeds	Grass weeds 1 to 4 leaves and small broadleaf weeds	Do not use oil additive with this mixture. Diclofop is a restricted use herbicide.	60,61
Bromoxynil (Buctril)	0.25 (1 pt)	Wild buck- wheat and certain broad- leaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Weak on wild mus- tard. Flax injury is possible.	60
MCPA	0.25 (0.5 pt of a 4 lb/ gal conc.)	Broadleaf weeds	Flax—2 to 6 inches tall	Use MCPA ester or higher rates of MCPA amine for hard- to-kill weeds. Early application less injurious to flax.	59
Picloram (Tordon 22K) + MCPA amine	1/64 + 0.25 (1 fl oz. + 0.5 pt of a 4 lb/gal conc.)			Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	19,59
Sodium chlorate (Leafex-3, Defol)	6 (2 gal of 3 lb/gal conc.)	Desiccant	7 to 10 days prior to harvest	Thorough spray coverage of vegetation essential. Do not graze or feed treated straw. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

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Com

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grasses and broad-leaf weeds	Preplant or any-time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Emerged annual grass and broad-leaf weeds		A nonselective, post-emergence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Atrazine + Butylate & Safener (Sutan +, Genate +)	1 + 3 (3.5 pt)	Most grass and broad-leaf weeds	Preplant incorporated	Immediate incorporation is needed for best results. Safener protects corn from injury.	1,2, 16,66, 69
EPTC & Safener (Eradicane)	4 to 6 (4.75 to 7 pt)	Grass and some broad-leaf weeds.		Safener protects corn from injury and Extender extends EPTC soil life under certain conditions. Immediate incorporation is necessary. Use high rate of EPTC for wild proso millet control. Weak on wild mustard.	1,2,72
EPTC & Safener & Extender (Eradicane Extra)					
EPTC & Safener or EPTC & Safener & Extender + Cyanazine (Eradicane Extra + Bladex)	3.2 to 6 + 0.6 to 3 (4 to 7 pt + 0.75 to 3.75 80W, 0.7 to 3.3 90DF, 0.6 to 3 qt 4L)	Most grass and broad-leaf weeds	Preplant incorporated	Use higher rates on fine-textured soils. Immediate incorporation is needed for best results. Cyanazine at the high rate may injure corn in a cool, wet environment. Cyanazine is a restricted use herbicide.	1,2, 70,72
Alachlor (Lasso, Lasso II, Lasso MT)	1.75 to 4 (2 to 4 qt 4EC) (10 to 26 lb 15G) (1.75 to 3.5 qt MT)	Grass and some broad-leaf weeds	Preplant incorporated or preemergence	Weak on wild mustard. Usually less effective preemergence than propachlor in North Dakota. Preplant incorporation gives more consistent weed control. Alachlor is a restricted use herbicide.	1,67
Metolachlor (Dual, Dual 25G)	1.5 to 3 (1.5 to 3 pt or 6 to 12 lb of 25G)				
Atrazine	2 to 4 (2 to 4 qt 4L, 2.5 to 5 lb 80W, 2.2 to 4.4 lb 90DF)	Broadleaf weeds and some grasses	Preplant incorporated or preemergence	Use higher rate on fine-textured soils for quackgrass and Canada thistle control. Provides only partial control of foxtails.	16,66

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Cyanazine (Bladex)	1.2 to 4.75 (1.5 to 6 lb 80W, 1.3 to 5.3 lb 90DF, 1.25 to 4.75 qt 4F)	Broadleaf weeds and some grasses	Preplant incorp- orated or preemergence	Soil residues unlikely the year after treatment. Weak on red- root pigweed. Use higher rate on fine textured, high organic matter soil. Cyanazine at higher rates may injure corn in cool, wet environment. DO NOT USE ON SANDS, LOAMY SANDS OR SOILS WITH LESS THAN 1% ORGANIC MATTER. Restricted use herbicide.	70
Cyanazine (Bladex)+ Atrazine	0.75 to 3.75 + 0.4 to 1.6 (1.0 to 4.5 lb 80W, 0.9 to 4.0 lb 90F, 0.25 to 3.75 qt 4L + 0.5 to 2.0 lb 80W, 0.4 to 1.8 lb 90DF, 0.5 to 1.5 qt 4L)			The tank mix allows lower rates of atrazine to be used, reducing the potential for atrazine carryover. Commercial mixtures (Conquest, Extrazine, Extrazine II) are available. DO NOT USE ON SANDS, LOAMY SANDS OR SOILS WITH LESS THAN 1% ORGANIC MATTER. Cyanazine is a restricted use herbicide.	16,66, 70
Cyanazine (Bladex)+ Alachlor (Lasso)	0.6 to 3 + 2 (0.75 to 3.75 lb 80W, 0.7 to 3.3 lb 90DF, 0.4 to 3 qt 4L + 2 qt 4EC)	Most grass and broad- leaf weeds		Use lower rate of cyanazine on coarse-textured soils. Cyana- zine at the high rate may in- jure corn in a cool, wet en- vironment. Cyanazine and alachlor are restricted use her- bicides.	67,70
Cyanazine (Bladex)+ Metolachlor (Dual)	0.6 to 3 + 2 (0.75 to 3.75 lb 80W, 0.7 to 3.3 lb 90 DF, 0.4 to 3 qt 4F + 2 pt 8E)				
Atrazine + Alachlor (Lasso)	1 + 2 (1.25 lb 80W, 1.1 lb 90DF, 1 qt 4F + 2 qt 4E)	Most grass and broad- leaf weeds	Preplant incorpo- rated or preemer- gence	Atrazine soil residual may injure subsequent crops. Commercial mixture (Lariat) available. Alachlor is a restricted use herbicide.	1,16, 66,67
Atrazine + Metolachlor (Dual)	1 to 2.4 + 1.5 to 2 (1.25 to 3 lb 80W, 1.1 to 2.6 lb 90DF + 1.5 to 2 pt)			Atrazine soil residual may injure subsequent crops. Commercial mixture (Bicep) available.	16,66, 67

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Atrazine + Pendimethalin (Prowl)	1 to 2 + 1 to 1.5 (1.25 to 2.5 lb 80W or 1.1 to 2.2 lb 90 DF + 2 to 3 pt)	Most grass and broad-leaf weeds	Preemergence	Atrazine soil residual may injure subsequent crops. Do not incorporate. Commercial mixture (Prozine) available.	16,66, 73
Atrazine + Propachlor (Ramrod)	1 + 3 (1.25 lb 80W, 1.1 lb 90 DF, or 1 qt 4F + 3 qt 4F)	Broadleaf and annual grasses		Propachlor requires less rainfall for activation than alachlor or metolachlor; however, duration of weed control may be less.	16,66, 68
Dicamba (Banvel) + Alachlor (Lasso) or Metolachlor (Dual)	0.25 to 0.5 + 2 (0.5 to 1 pt + 2 qt metolachlor)		Preemergence or before corn is 3 inches tall	Use lower rate of dicamba on coarse-textured soils. Do not incorporate. Early postemergence probably will not control emerged grasses.	67,71
Pendimethalin (Prowl)	1.5 to 2 (3 to 4 pt)	Grass and some broad-leaf weeds	Preemergence	Do not use on sands or loamy sands. Use the high rate on fine-textured soils high in organic matter. Do not incorporate.	73
Propachlor (Ramrod)	4 to 5 (6 to 7.7 lb 65W, 4 to 5 qt 4F, 20 to 25 lb 20G)			Weak on wild mustard	68
Pendimethalin (Prowl) + Cyanazine (Bladex)	1 to 1.5 + 1.2 to 2 (2 to 3 pt + 1.5 to 2.5 lb 80W or 1.3 to 2.2 lb 90 DF)	Most grass and broad-leaf weeds	Preemergence or 1 to 2-leaf stage of corn	No soil residue to next crop. Use lower rate of cyanazine on coarse-textured soils. Do not incorporate. Cyanazine is a restricted use herbicide.	70,73
Dicamba (Banvel) + Atrazine	0.25 to 0.50 + 0.50 to 2.0 (0.5 to 1 pt + 0.6 to 2.5 lb 80W, 0.55 to 2.2 lb 90 DF, 0.5 to 2 qt 4L)	Most broadleaf weeds	Preplant, preemergence, or postemergence before corn exceeds 5 leaf stage	Use lower rate on sandy soils with low organic matter. Do not apply to stressed corn. Weak on foxtail (pigeongrass). Commercial mixture (Marksman) available.	16,66, 71,74
Atrazine + oil additive	1 to 2 + oil additive	Broadleaf weeds and some grasses	Early postemergence—weeds less than 1.5 inches tall	Apply with an oil additive at 1 qt/A. Provides only partial control of foxtail (pigeongrass). Atrazine soil residual may injure subsequent crops.	16,74
Cyanazine (Bladex)	1.2 to 2.0 (1.5 to 2.5 lb 80W, 1.3 to 2.2 lb 90 DF)	Grass and some broad-leaf weeds	Weeds less than 1.5 inches and corn 4-leaf stage or smaller	Vegetable oil additive at 1 qt/A generally increases weed control, but may also increase injury. Use only 80W or 90 DF for postemergence applications. Avoid application under cool, wet conditions, or to stressed corn. Restricted use herbicide.	75

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Cyanazine (Bladex) + Atrazine	0.8 + 0.5 + 1 qt vegetable oil (1 lb 80W or 0.9 lb 90DF + 0.63 lb 80W or 0.6 lb 90DF)	Grass and some broad-leaf weeds	Grasses less than 1.5 inches, broadleaf weeds less than 4 inches and corn 4-leaf stage or smaller	Apply with an oil additive at 1 qt/A. Cyanazine is a restricted use herbicide.	16,74 75
Tridiphane (Tandem) + Cyanazine (Bladex 80W)	0.5 to 0.75 + 1.2 to 2.0 (1 to 1.5 pt + 2 to 2.5 lb 80W)	Annual grasses including foxtail, wild oats, and wild proso millet and broadleaf weeds	Grasses-1 to 3 leaf stage, broad-leaf weeds small and actively growing. Follow up treatment may be needed, see narrative.	Apply tridiphane-cyanazine mixtures to corn 4-leaf stage or smaller. Oil additive at 1 qt/A should be used for tridiphane-atrazine mixtures. Do not use an oil additive with tridiphane-cyanazine mixtures. A three way tank mixture of tridiphane, atrazine, and cyanazine is registered for use in areas where atrazine carryover is a concern. Atrazine should be used at 1 lb/A or less to reduce the risk of carryover. Cyanazine is a restricted use herbicide.	76
Tridiphane (Tandem) + Atrazine (Atrazine 80W, 4L or 90DG)	0.5 to 0.75 + 1.5 to 2.0 (1 to 1.5 pt + 2 to 2.5 lb 80W, 3 to 4 pt 4L or 1.7 to 2.2 lb 90DG)				
Dicamba (Banvel)	0.25 to 0.5 (0.5 to 1.0 pt 4S)	Broadleaf weeds including wild buckwheat, Canada this-tle, perennial sowthistle	Early postemer-gence, corn up to 5 inches tall.	Use drop nozzles after corn is 8 inches tall to reduce drift. Use low rate on coarse textured or low organic matter soil.	78
Dicamba (Banvel)	0.25 (0.5 pt 4S)		Postemergence, before corn is 36 in-ches tall or 15 days prior to tasseling		
2,4-D	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence, corn—3 inches to tasseling	Use drop nozzles when corn is over 8 inches tall but before tasseling. Dicamba can be mixed with 0.25 lb/A of 2,4-D.	77
Bromoxynil (Buctril)	0.25 to 0.37 (1 to 1.5 pt)	Wild buck-wheat, volun-tee sun-flower and most annual broadleaf weeds	Postemergence—corn 3 leaf to tasseling	Apply when weeds are in seedling stage. Weak on wild mustard. Could be used when drift of dicamba or 2,4-D may injure sensitive broadleaf crops.	79
Bromoxynil (Buctril) + atrazine	0.19 to 0.38 + 0.5 to 1 (0.75 to 1.5 pt + 0.6 to 1.25 lb 80W, 0.55 to 1.1 lb 90DF, 0.5 to 1 qt + 4L)	Broadleaf weeds	Postemergence, corn—3 leaf to 30 inches tall	Atrazine soil residual may injure subsequent crops. Commercial mixture (Buctril + Atrazine) available.	16,74, 79

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Corn

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Pentazon (Asagran)	0.75 to 1.0 (1.5 to 2.0 pt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sun- flower	Postemergence when mustard is in the 4 to 6-leaf stage and thistles are 6 to 8 inches tall. See label for more de- tails. Corn is tol- erant at all stages of growth.	Could be used when drift of dicamba or 2,4-D may injure soybeans or dry beans. Thor- oughly cover weeds with spray. Do not apply during unfavorable conditions such as drought, cold, or hail damage. Repeat application needed for Canada thistle con- trol.	80
Ametryn (Evik)	2 to 2.5 (2.5 to 3 lb 80W)	Broadleaf and grass weeds	Postemergence, directed to weeds less than 4 inches tall, corn greater than 12 inches tall	Apply as postemergence direc- ted spray. Do not spray over top of corn or injury will occur. Do not apply within three weeks of tasseling. Apply with nonionic surfactant at 0.5% v/v. Use the higher rate for taller weeds. See label for rotational restrictions.	81
Paraquat (Gramoxone Super)	0.28 (1.5 pt)	Broadleaf and grass weeds	Postemergence directed, corn greater than 10 inches tall, weeds less than 4 inches tall	Apply as postemergence directed spray. Do not spray over top of corn or injury will occur. Apply with nonionic surfactant at 0.25% v/v. May be tank-mixed with atrazine. Restricted use herbicide.	81

Soybeans

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfac- tant at 0.5% v/v.	145
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Emerged an- nual grass and broad- leaf weeds.		A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broad- leaf weeds	Preplant incorporated or preemer- gence	Preplant incorporation gives more consistent weed control. Weak on wild mus- tard.	1,2, 87
Ethalfuralin (Sonalan)	0.5 to 1.3 (1.3 to 3.5 pt)		Preplant incorporated 2 to 3 inches deep	The low rate should be used on coarse-textured, sandy soils. No wild mustard control.	1,2, 17,85, 86,101
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incor- porated, fall or spring	No wild mustard control.	1,2, 13,17

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Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Clomazone (Command)	0.75 to 1 (1.5 to 2 pt)	Annual grass and broad-leaf weeds	Preplant incorporated	Vaporization and off-site movement possible. Weak on wild mustard and pigweed. Refer to narrative for rotational restrictions. May be applied with trifluralin (pre-package mix available as Commence).	92
Chloramben (Amiben) + dinitroanilines	1.8 to 2.7 (4 to 6 qt, 2.4 to 3.6 lb DS) + appropriate rate for soil type	Grass and broadleaf weeds	Dinitroanilines preplant incorporated, chloramben preemergence Preplant incorporated	Dinitroanilines include ethalfluralin, pendimethalin, and trifluralin. Incorporation of chloramben improves the consistency of wild mustard control.	1,2 17,85, 86,87, 88,90
Metribuzin (Sencor, Lexone)+ dinitroanilines	0.25 to 0.37 + appropriate rate for soil type 0.19 + appropriate rate for soil type	Grass and broadleaf weeds including wild mustard	Preplant incorporated	Dinitroanilines include ethalfluralin, pendimethalin, and trifluralin. May be used on soils with pH 7.5 or lower. Use 0.19 lb/A metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only.	20,85, 86,87, 88,91
Alachlor (Lasso, Lasso Micro Tech, Lasso II)	1.75 to 4 (2 to 4 qt, 16 to 26 lb 15G, or 1.75 to 3.75 lb MT)	Grass and some broad-leaf weeds including black nightshade	Preplant incorporated or preemergence	Weak on wild mustard. Preplant incorporation gives more consistent weed control. Use higher rate on fine-textured soils high in organic matter. May be applied as a tank-mixture with trifluralin. Alachlor is a restricted use herbicide.	1,89, 101
Metolachlor (Dual, Dual 25G)	2 to 4 (2 to 4 pt or 8 to 16 lb of 25G)				
Alachlor (Lasso) or Metolachlor (Dual) + Metribuzin (Sencor, Lexone)	2 + 0.25 to 0.37 (2 qt 4E or 1 qt 8E + 0.33 to 0.5 lb DF, 0.5 to 0.75 lb WP, or 0.5 to 0.75 pt 4L)	Broadleaf weeds including wild mustard, black nightshade and annual grasses		Use 0.25 lb/A of metribuzin on coarse-textured soils and for incorporation. Not recommended for use on soil with pH 7.5 or higher. Alachlor is a restricted use herbicide.	1,20, 89,91
Alachlor (Lasso) or Metolachlor (Dual) + Metribuzin (Sencor)	2 + 0.19 (2 qt 4E or 1 qt 8E + 0.25 lb DF, or 0.38 pt 4L)			Use 0.19 lb/A metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only. Alachlor is a restricted use herbicide.	
Alachlor (Lasso) or Metolachlor (Dual) + Chloramben (Amiben)	2 + 2 (2 qt 4E or 1 qt 8E + 4 qt 2L or 2.4 lb DS)	Broadleaf weeds including wild mustard and annual grasses	Preplant incorporated or pre-emergence	Incorporation of chloramben improves consistency of wild mustard control. Soybean tolerance is good.	1,89, 90,101
Chloramben (Amiben)	1.8 to 3 (4 to 6 qt, 2.4 to 3.6 lb DS, 20 to 30 lb 10G)	Grass and broadleaf weeds		Weak on wild oats.	90, 101

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Soybeans

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	Refer- ence**
Acifluorfen (Blazer, Tackle)	0.25 to 0.5 (1.0 to 2 pt)	Wild mustard, redroot pig- weed, eastern black night- shade, wild buckwheat	Postemergence. Soybeans-1 to 2 trifoliolate leaf stage. Weeds- 1 to 4 inches tall.	Weak on volunteer sunflower. Low rate will control small wild mustard and redroot pigweed, the higher rates are needed for larger or less susceptible weeds. Apply when daytime temperatures exceed 70 F.	93, 101
Bentazon (Basagran)	0.75 to 1.5 (0.75 to 1.5 qt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sunflower	Postemergence when mustard is in 4 to 6 leaf stage and thistle is 6 to 8 inches tall. See label for more details	Thoroughly cover weeds with spray. Do not apply during un- favorable conditions such as drought, cold or hail damage. Repeat application needed for Canada thistle control. Soy- beans are tolerant at any stage of growth. An oil additive at 1 qt/A with Bentazon improves weed control.	94
Lactofen (Cobra)	0.20 (12.5 fl oz)	Wild mustard, Redroot pig- weed, eastern black night- shade	Postemergence Soybeans-1 to 2 trifoliolate leaf stage. Weeds-2 to 6 leaf stage.	Weak on volunteer sunflower. Addition of an oil additive increases weed control, but also may increase crop injury potential. Refer to nar- rative for environmental response.	95, 101
Bentazon (Basagran) + Acifluorfen (Blazer, Tackle)	0.75 + 0.25 (1.5 pt + 1 pt)	Broadleaf weeds	Postemergence, Soybeans-1 to 2 trifoliolate leaf stage. Weeds-less than 4 inches tall	Controls most seedling annual broadleaf weeds. Increase acifluorfen rate for eastern black nightshade control. Do not use an oil additive.	93,94
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats, fox- tails (pigeon- grass) and vol- unteer corn	Grass weeds in 1 to 4-leaf stage, volunteer corn short enough for good coverage of the whorl. Crop- emergence through 5th trifoliolate.	Do not tank mix with bentazon (Basagran), acifluorfen (Blazer, Tackle) or lactofen (Cobra). Restricted use herbicide.	41,44
Fluazifop-P (Fusilade 2000)	0.09 to 0.19 (0.75 to 1.5 pt)	Annual and perennial grasses	Grass weeds 2 to 4 inches; volunteer corn 6 to 18 inches but before soy- beans bloom	Apply with oil additive at 1% v/v. Apply to actively growing grasses. See narrative for rates for different weed species.	97
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)		Grass weeds 2 to 8 inches; vol. corn 6 to 18 inches but before soybeans bloom	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weed species.	98
Fenoxaprop (Whip)	0.1 to 0.15 (0.8 to 1.2 pt)	Foxtails (pigeongrass) volunteer corn, wild proso millet, wild oats	Grass weeds-3 to 6 inches; vol. corn 6 to 18 inches. Soybeans-before bloom	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different species.	96

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Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	Refer- ence**
Quizalofop (Assure)	0.06 to 0.1 (0.63 to 1 pt)	Annual and perennial grasses	Grass weeds 2 to 6 inches, volunteer corn 6 to 18 inches. Soybeans—before bloom	Apply with oil additive at 1% v/v or nonionic surfactant at 0.25% v/v. Do not apply with unmodified vegetable oil additives. Apply to actively growing grasses. See narrative for rates to control different species.	99
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/ gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days of crop emergence	Wild oats usually develops to the 2-leaf stage 9 days after emergence.	37
Naptalam + 2,4-DB (Rescue)	1 to 1.5 + 0.03 to 0.045 (2 to 3 qt)	Cocklebur, giant ragweed, volunteer sunflower	Weeds 10 inches or taller. Soybeans after first bloom	Salvage treatment for control of weed escapes. Apply with nonionic surfactant or oil add- itive. Avoid drift to susceptible crops.	100
Paraquat (Gramoxone Super)	0.25 (1.3 pt)	Desiccant	Prior to harvest	Apply when at least 65% of the seed pods have reached a mature brown color or when seed moisture is 30% or less. Restricted use herbicide.	
Sodium Chlorate (Leafex-3, Defol)	6 lb (2 gal of 3 lb/gal conc.)		7-10 days prior to harvest, after pods are brown	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air and 20 to 30 gpa by ground.	

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Dry Edible Beans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
EPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broad- leaf weeds	Preplant incor- porated	Weak on wild mustard	1,2,3, 9,11, 101, 104
	4 to 4.5 (4.5 to 5.25 pt 7E, 40-45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incor- porated, fall after September 1, or spring	No wild mustard control.	1,2,3, 13,14, 17,103
Ethalfuralin (Sonalan)	0.5 to 1.7 (1.3 to 4.5 pt)		Preplant incor- porated 2 to 3 inches deep	The low rate should be used on coarse textured, sandy soils. High rate should be used on fine textured soils for black nightshade control. No wild mustard control.	1,2,3, 17,101, 106
Trifluralin (Treflan) + EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 pt to 2.25 pt)		Preplant incorpor- ated	EPTC enhances wild oats control and reduces potential of trifluralin carryover.	1,2,3, 7,14, 15,17, 103
Chloramben (Amiben) + other herbicides	1.8 (8 pt or 2.4 lb DS + appropriate rate for soil type)	Annual grasses and broadleaf weeds		Other herbicides includes alachlor, metolachlor, trifluralin, ethalfuralin, and EPTC.	101, 103
Alachlor (Lasso)	2 to 3 (2 to 3 qt)	Grass and some broad- leaf weeds including black nightshade		Weak on wild mustard. Use the higher rate on fine textured soils high in organic matter.	101, 103
Metolachlor (Dual)	2 to 3 (2 to 3 pt)		Preplant incor- porated or pre- emergence	Weak on wild mustard. Incorporation improves consis- tency of weed control. Use high rate on fine-textured soils.	1,101, 103
Pendimethalin (Prowl)	0.5 to 1.5 (1 to 3 pt)	Grass and some broad- leaf weeds	Preplant incor- porated	Use higher rates on fine- textured soils. Weak on wild mustard. Refer to label for rotational restrictions.	1,103
Pendimethalin (Prowl) + EPTC (Eptam)	0.5 to 1.5 + 2.2 to 3.0 (1 to 3 pt + 2.5 to 3.5 pt)			Use higher rates on fine- textured soils. Do not use on soybeans. Weak on wild mustard. Refer to label for rotational restrictions.	1,2, 103

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Dry Edible Beans

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Chloramben (Amiben)	2 (4 qt, 20 lb 10G 2.4 lb DS)	Annual grasses and broadleaf weeds	Preemergence	Weak on wild oats.	101, 103
Bentazon (Basagran)	0.75 to 1 (0.75 to 1 qt)	Wild mustard, cocklebur, Canada thistle, wild and volun- teer sun- flower	Postemergence wild mustard in 4 to 6-leaf stage and sunflower less than 8 inches tall. Beans in 1st trifoliolate leaf stage or larger.	Thoroughly cover weeds with spray. Do not apply under un- favorable conditions such as drought, cold or hail damage.	103

Lentils

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Triallate (Far-Go)	1.25 (1.25 qt)	Wild oats	Preplant or preemergence incorporated	Incorporation tool can be operated 4 inches deep without reducing wild oats control.	1,5, 12,36, 108
Propham (Chem Hoe FL4)	4 (1 gal)	Wild oats, volunteer grain	Preplant incorporated	Operate incorporation imple- ment 4 inches deep.	107, 109
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/ gal conc.)	Wild oats	Wild oats 2-leaf stage and with- in 30 days after crop emergence	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	107, 110

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Safflower

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
PPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broad- leaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.	1,2,3, 7
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incor- porated, fall or spring	No wild mustard control.	1,2,3, 14,15, 17
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb 25G)		Preplant incor- porated or pre- emergence	Weak on wild mustard. Preplant incor- poration gives more consistent weed control.	
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf stage and with- in 30 days after emergence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	37
Sodium chlorate (Leafex-3) (Defol)	6 lb/A (2 gal of 3 lb/gal conc.)	Desiccant	After safflower has reached physiological maturity, 7 to 14 days prior to harvest	Thorough spray coverage of vegetation essential. Apply in 5 to 10 gpa by air and 20 to 30 gpa by ground. Most active with warm, sunny conditions.	

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Sunflower

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emer- gence	A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. A residual herbicide for sunflowers can be tank mixed with paraquat. Restricted use herbicide.	144
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Grass and some broad- leaf weeds	Preplant incorporated	Weak on wild mustard.	1,2,3, 7,11 112
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Ethalfuralin (Sonalan)	0.56 to 1.13 (1.5 to 3 pt)		Preplant incorporated	Use the lower rate of ethal- fluralin on coarse textured soils.	1,2,3, 17, 112
Ethalfuralin (Sonalan)+ EPTC (Eptam)	0.5 to 1.13 + 2.2 to 3.0 (1.25 to 3 + 2.5 to 3.5 pt)				
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broad- leaf weeds	Preplant incorporated	Use the higher rate for fine textured soils.	17,112
	1.25 to 1.5 (2.5 to 3 pt)		Surface applied from 30 days before planting until immediately after planting.	Use the lower rate only on coarse textured soil. This treatment is for no-till sunflowers only.	
	1 to 1.75 (2 to 3.5 pt)		Fall-Preplant incorporated when soil temperature is less than 45 F and until freeze up	Keep spring tillage depth shallower than fall. May be tank mixed with EPTC.	
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E)		Preplant incorporated	No wild mustard control.	1,2,3, 17,112
	0.5 to 1 (5 to 10 lb 10G)		Preplant incor- porated, fall after September 1		15,17, 112
Trifluralin (Treflan)+ EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 to 2.25 pt)		Preplant incor- porated	Enhances wild oats control and reduces potential carry- over of trifluralin.	1,2,3, 7,14, 15,17, 112
Alachlor (Lasso, Lasso II)	3 to 4 (3 to 4 qt, 20 to 26 lb 15G)		Preplant incorpo- rated or preemer- gence	Weak on wild mustard. Preplant incorpor- ation gives more consistent weed control. Alachlor is a restricted use herbicide.	1,113

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Sunflower

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Chloramben (Amiben) + other herbicides	1.8 (4 qt, 2.4 lb DS) + appropriate rate for soil type	Annual grass and broadleaf weeds	Preplant incorporated	Other herbicides include ethalfluralin, EPTC, pendimethalin, trifluralin, and alachlor.	1,2,3, 7,11, 17, 111, 112, 114
Chloramben (Amiben) + Pendimethalin (Prowl)	1.8 to 2.7 + 1.25 to 1.5 (4 to 6 qt + 2.5 to 3 pt)		Surface applied from 7 days before planting until immediately after planting	Do not use chloramben on coarse textured soils. For use in no-till sunflower.	114
Barban (Carbyne 2EC)	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	37
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Weeds-2 to 4 inches tall. Apply 70 days prior to harvest	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weed species.	115
AC 222,293 (Assert)	0.19 to 0.38 (0.6 to 1.2 pt)	Wild mustard and wild oats	Sunflowers-less than 15 inches tall. Wild oats-1 to 4 leaf, wild mustard-prior to bloom	The low rates are for wild mustard control, the high rate is for wild oats control. Injury has occurred with application at high temperatures and late treatments. See narrative for rotational restrictions.	116
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)	Desiccant	Back side of sunflower heads yellow and bracts turning brown. Seed moisture under 35%.	Registered for oilseed varieties only. Apply with X-77 surfactant at 0.25% v/v. Randomly sample 10 average sized heads for moisture. Restricted use herbicide.	
Sodium chlorate (Leafex-3, Defol)	4.5 to 6 (1.5 to 2 gal)			For use on confectionary and oilseed varieties. Thorough coverage of the plant is essential. Most active with warm, sunny conditions. Apply in 5 to 10 gpa by air and 20 to 30 gpa by ground.	

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Sugarbeets

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grasses and broad- leaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Emerged annual grass and broad- leaf weeds		A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt) 4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)	Annual grasses and some broad- leaf weeds	Preplant incor- porated Fall incorporated after October 15 until freeze-up	Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.	1,2,3, 6,7,9, 11,119
EPTC (Eptam, Genep) + cycloate (Ro-Neet)	1 to 2 + 2 to 2.5 (1.1 to 2.3 + 2.7 to 3.3 pt) 1 to 2.5 + 2 to 3 (1.1 to 2.9 + 2.7 to 4 pt)	Grass and some broad- leaf weeds	Preplant incorporated Fall incorporated after October 15 until freeze-up	Less sugarbeet injury than from EPTC alone and less expensive than cycloate alone. See narrative for suggested rates for various soil textures and organic matter content.	1,2,3, 6,7,9, 11,119, 120
Cycloate (Ro-Neet)	3 to 4 (4 to 5.3 pt 6E, 30 to 40 lb 10G) 4 (5.3 pt 6E, 40 lb 10G)	Annual grasses and some broad- leaf weeds	Preplant incorporated Fall incorpor- ated after October 15 until freeze-up	Sugarbeets have better toler- ance to cycloate than to EPTC. Weak on wild mustard. Weed control poor on fine- textured, high organic matter soils.	1,2,3, 119
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt, 15 to 20 lb 10G)	Wild oats	Spring-preplant incorporated Fall-after October 15 and until freeze-up	Incorporation tool can be operated 4 inches deep without reducing wild oats control. Restricted use herbicide.	
Ethofumesate (Nortron)	2 to 3.75 (1.25 to 2.5 gal E or 2 to 3.75 qt F)	Some annual grasses and broadleaf weeds. Espe- cially good on redroot pig- weed	Preemergence or preplant incor- porated	Incorporation generally improves weed control. Band application reduces cost and risk of carryover into the next year.	1,2,3, 21,121
Diethatyl (Antor)	4 to 6 (1 to 1.5 gal)	Redroot and prostrate pig- weed and some annual grasses	Preemergence or preplant incorporated	Shallow (1 to 2 inch) incorporation generally gives better weed control than preemergence or deep incorporation.	122
Pyrazon (Pyramin)	3.1 to 7.6 (3 to 7.25 qt F)	Most broadleaf weeds	Preemergence	Has been less effective on soils with more than 5% organic matter. Incorporation improves weed control from pyrazon.	8,118

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Sugarbeets

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Desmedipham + Phenmedi- pham (Betamix)	0.12 to 0.6 + 0.12 to 0.6 (1.5 to 7.5 pt)	Most annual broadleaf weeds	Postemergence when broadleaf weeds are from cotyledon to 4-leaf stage. Sugarbeets with less than 4 leaves will tolerate 0.32 to 0.5 lb/A and sugarbeets with 4 leaves or more will tolerate higher rates.	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.	125
Desmedipham (Betanex)	0.25 to 1.2 (1.5 to 7.5 pt)				
Endothall (Herbicide 273)	0.75 to 1.5 (2 to 4 pt)	Wild buck- wheat, smart- weed, volun- teer sun- flower	Sugarbeets should have 4 to 6 leaves. Do not apply later than 40 days after emergence	Endothall may cause excessive injury over 80 F especially to 4 leaf or smaller sugarbeets. Endo- thall is ineffective at tem- peratures below 60 F or when weeds are drought stressed.	123
Ethofumesate (Nortron EC) + Desmedipham (Betanex)	1.12 to 1.5 + 0.73 to 1 (0.75 to 1 gal E + 4.5 to 6.1 pt)	Most annual broadleaf weeds	Postemergence to sugarbeets with 6 or more leaves. Half rate may be applied to 4-leaf sugarbeets	Improved weed control and increased risk of sugarbeet injury compared to desmedi- pham or desmedipham + phenmedipham. Split appli- cation at half rates has reduced sugarbeet injury and increased weed control com- pared to single full dose ap- plication.	121, 125
Ethofumesate (Nortron EC) + Desmedipham + Phenmedi- pham (Betamix)	1.12 to 1.5 + 0.365 to 0.5 + 0.365 to 0.5 (0.75 to 1 gal E + 4.5 to 6.1 pt)				
Clopyralid (Stinger)	0.09 to 0.25 (0.25 to 0.66 pt)	Canada thistle, common cocklebur, sunflower, marshelder, wild buck- wheat	Postemergence to sugarbeets with 2 to 8 leaves	See narrative for rates and treatment sizes for various species. Stinger may be tank mixed with Betanex or Betamix	24,127
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Wild oats 1 to 4 inches, foxtail (pigeongrass) 3 to 8 inches, vol- unteer wheat or barley 1 to 6 inches, wild proso millet 4 to 10 inches.	Always apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different grass species.	124
Trifluralin (Treflan)	0.75 (1.5 pt 4E)	Grass and some broad- leaf weeds	Sugarbeets 2 to 6 inches tall and well-rooted to withstand incorporation	Must be incorporated. Exposed beet roots must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugarbeets.	1,2,3, 13,17, 126

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Tame Mustard and Rapeseed (Canola)

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Grass and broadleaf weeds	Preplant incorporated	Use lower rate on coarse- textured, low organic matter soils.	1,2,3, 14,15, 17
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emer- gence of crop	Do not apply to rapeseed. Wild oats usually develop to the 2-leaf stage 9 days after emergence.	37

**Tame Mustard
only**

Millet

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D amine	0.25 to 0.5 (0.5 to 1 pt of a 4 lb/gal conc.)	Broadleaf weeds	Millet 4 to 6 inches tall	Apply with minimum of 5 gallons water per acre with ground sprayer. Do not permit dairy animals or meat animals being finished for slaughter to forage or graze treated fields within 2 weeks after treatment.	
Atrazine	0.5 to 1 lb/A (0.5 to 1 qt 4L, 0.6 to 1.25 lb 80W, 0.6 to 1.1 lb 90 DF)	Broadleaf weeds and grasses	Preplant incor- porated or preemer- gence	Only registered on proso millet.	15,16

Annual Canarygrass

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Triallate (Far-Go)	1 (1 qt)	Wild oats	Preplant incorporated fall or spring	Incorporation tool can be operated down to 4 inches deep without reducing wild oats control.	1,5, 36
Bromoxynil + MCPA (Bronate)	0.25 to 0.38 + 0.25 to 0.38 (1 to 1.5 pt)	Broadleaf weeds	Postemergence, weeds small and actively growing	Apply when weeds are in the early seedling stage for best results.	

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Potatoes

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)	Emerged annual grass and broad- leaf weeds		A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Restricted use her- bicide.	144
EPTC (Eptam, Genep)	3 to 6 (3.5 to 6.75 pt)	Grass and some broad- leaf weeds	Preplant, dragoff, or directed spray at layby	Weak on wild mustard.	1,2,3, 6,7, 11
	4.5 to 6 (5.25 to 7 pt 7E, 45 to 60 lb 10G)		Fall incorporated after October 15 until freeze-up		
Metolachlor (Dual)	2 to 3 (2 to 3 pt) (8 to 12 lb 25G)		Preplant incorpor- ated or pre- emergence	Weak on wild mustard. Incorporation improves consistency of weed control. Use the higher rate on fine- textured soils.	1
Linuron (Lorox)	0.75 to 2 (1.5 to 4 lb WP)	Most an- nual grasses and broad- leaf weeds	Preemergence to weeds	Apply to crop planted 2 inches deep or after dragoff or hilling. Do not plant to other crops within 4 months after treatment. Use the higher rates on fine-textured soils.	8
Metribuzin (Lexone, Sencor)	0.5 to 1 (1 to 2 lb WP, 1 to 2 pt F, 0.67 to 1.33 lb DF)	Broadleaf weeds includ- ing wild mustard and some grasses	Preemergence or postemergence (on white skinned, late maturing varieties)	Use lower rate on coarse- textured soils. Metribuzin soil residue may injure sus- ceptible crops the fol- lowing year. See label for details.	14,15, 20
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broad- leaf weeds	Preemergence or preemergence incorporated	Incorporation increases the consistency of control. Can be tank mixed with EPTC (Eptam, Genep), metribuzin (Sencor, Lexone) or linuron (Lorox).	2,17
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E)		Preemergence incorporated	Incorporate above the seed piece zone to avoid damage to the seed pieces or elongating sprouts. Can be tank mixed with EPTC (Eptam, Genep).	1,2,3, 14,15, 17
Sethoxydim (Poast)	0.09 to 0.28 (0.5 to 1.5 pt)	Annual and perennial grasses	Weeds—2 to 4 inches tall, volunteer corn— 0 to 18 inches tall, potatoes—before 30 days prior to harvest	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weeds. Do not tank-mix with other chemicals.	98

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Potato Vine Killing

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Endothall (Des-i-Cate)	0.75 to 1 (1.5 to 2 gal)	Desiccant	10 to 14 days prior to harvest	Use the higher rate during cool, cloudy weather and on heavy vine growth.	
Paraquat (Gramoxone Super)	0.25 to 0.5 (1.3 to 2.7 pt)		More than 3 days prior to harvest	Do not use when the potatoes are to be stored or used for seed. Apply with X-77 surfactant at 0.25% v/v. Restricted use herbicide.	
Diquat	0.25 (1 pt)		More than 7 days prior to harvest	Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Make a second application at least 5 days after first treatment if necessary.	
	0.50 (2 pt)			Russet Burbank potatoes only. Apply with nonionic surfactant at 0.12 to 0.25% v/v.	
Sulfuric acid	20 gal		5 days prior to harvest	Extremely corrosive. Restricted use herbicide. Do not harvest within 5 days of application.	

Legume Forages

Alfalfa and clover establishment with companion crop

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence	A. nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
MCPA amine	0.12 to 0.25 (0.25 to 0.5 pt of 4 lb/gal conc.)	Broadleaf weeds	Legumes 2 to 3 inches tall and companion crop 8-leaf to early boot	Not registered for use on sweetclover. NOTE: POSSIBLE INJURY TO ALFALFA AND CLOVER. Use only when weed problem is severe.	34,128
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Broadleaf weeds	Alfalfa—at least 2 trifoliolate leaves, Weeds—4 leaves or less and before rosettes are 1.5 inches in diameter	Alfalfa only. Alfalfa burn injury can occur, especially if warm weather follows treatment. Do not treat when temperatures exceed 70 F at or within 3 days following treatment. Do not graze or harvest within 30 days of spring, or 60 days of fall treatments.	131

Alfalfa Only

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Legume Forages

Alfalfa or trefoil establishment, no companion crop

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grass and broadleaf weeds	Preplant or any- time prior to crop emer- gence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
EPTC (Eptam, Genep)	2 to 4 (2.25 to 4.5 pt)	Grass and some broad- leaf weeds	Preplant incorporated	Weak on wild mustard. Incorporate immediately after application. Use the low rate for grass control only.	1,2,3,
Benfin (Balan)	1.12 + 1.5 (3 to 4 qt)	Annual grasses and some broad- leaf weeds		No wild mustard control.	
Trifluralin (Treflan)	0.50 to 0.75 (1 to 1.5 pt)	Annual grass and some broadleaf weeds	Preplant incorporated	Government set aside programs only. Some legume injury may occur. Rate is dependent on soil type.	1,2,3, 14,15, 17,129
Set Aside Acreage Only					
2,4-DB ester	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Broadleaf weeds	Weeds less than 3 inches tall, alfalfa more than 2 tri- foliolate leaves	Sweetclover may be killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied at least 60 days before hay harvest or grazing.	128
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Sethoxydim (Poast)	0.19 to 0.5 (1 to 2.5 pt)	Annual and perennial grasses	Grass-2 to 4 inches tall	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weed species.	130
Alfalfa Only					
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Broadleaf weeds	Alfalfa—at least 2 trifoliolate leaves, Weeds—4 leaves or less and before rosettes are 1.5 inches in diameter	Alfalfa only. Alfalfa burn injury can occur, especially if warm weather follows treatment. Do not treat when temperatures exceed 70 F at or within 3 days following treatment. Do not graze or harvest within 30 days of spring, or 60 days of fall treatments.	131
Alfalfa Only					

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Legume Forages
Alfalfa established

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Metribuzin (Lexone, Sencor)	0.37 to 1 (0.75 to 2 lb WP, 0.75 to 2 pt F, 0.5 to 1.25 lb DF)	Annual grass and broadleaf weeds	Early spring to dormant alfalfa	May be applied on frozen soil. Do not apply to alfalfa during the first growing season after seeding.	132
Terbacil (Sinbar)	0.4 to 1.2 (0.5 to 1.5 lb)	Annual grass and broad- leaf weeds	Fall or spring when alfalfa is dormant	Do not apply to frozen or snow covered soil. Do not rotate to any other crop within 2 years after application. Do not apply to alfalfa stands established less than 1 year.	132
Pronamide (Kerb)	0.5 to 2.0 (1 to 4 lb)	Foxtail barley, quackgrass, wild oats, volunteer grains, and wild mustard	Fall--after last cutting and before soil freeze-up	Apply when soil temperature are less than 55 F. Do not graze or harvest alfalfa within 25 days (less than 1.5 lb/A) to 45 days (1.5 to 2 lb/A).	132
2,4-DB ester	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Broadleaf weeds	Weeds less than 3 inches tall	Sweetclover may be killed by 2,4-DB. Weak on wild mustard. 2,4-DB must be applied at least 30 days before hay harvest or grazing.	128
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Sethoxydim (Poast)	0.19 to 0.5 (1 to 2.5 pt)	Annual and perennial grasses	Grasses-2 to 4 inches tall	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weed species.	130

Grass Establishment

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D	0.5 to 0.75 (1 to 1.5 pt of 4 lb/gal conc.)	Broadleaf weeds	After 3-leaf stage of grasses	Use rate listed for estab- lishing grasses. (See section below after tillering of seedling grass.)	139
Bromoxynil (Buctril)	0.38 to 0.5 (1.5 to 2 pt)		Anytime after grass emerges	Grass tolerance is excellent. Can be applied to grass-alfalfa mixtures.	
Chlorsulfuron (Glean)	1/128 to 1/43 (0.12 to 0.5 oz/A)	Broadleaf weeds	Preplant, Preemergence, or postemergence to 3 to 4 leaf grasses	CRP acreage only. Apply with a nonionic surfactant at 0.25% v/v for post- emergence treatments. Refer to narrative for labelled grass species and application restrictions. CRP acres should not be grazed or harvested for hay.	133

**CRP acreage
only**

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Established Grass and Rangeland

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Weeds—emergence to bud stage; pre- ferably when young and actively growing	Do not graze dairy cows for 7 days after application. Do not apply after boot stage on grasses for seed production. Use 1 lb/A on an- nuals and gumweed and 2 lb/A on sages and other perennials.	139
Dicamba + MCPP + 2,4-D	(See remarks section)			Various commercial formula- tions available. See individual label for usage rates. Provides a broader spectrum of broad- leaf weed control than 2,4-D alone.	139, 140
Dicamba + 2,4-DP + 2,4-D					
MCPA amine or ester	0.25 to 2 (0.5 to 4 pt)	Annual and perennial broadleaf weeds	Weeds—emerg- ence to bud stage, preferably when young and actively growing	Do not graze dairy animals for 7 days after treatment. Do not apply after boot stage on grasses for seed production. Use the higher rates for peren- nial weed control.	
Dicamba (Banvel)	0.25 to 2 (0.5 to 4 pt)			Spray drift from dicamba may injure nearby susceptible crops and trees. Consult the label for grazing restrictions.	140
Picloram (Tordon)	0.5 to 2 (1 to 4 qt)	Annual and perennial broadleaf weeds	Weeds—emergence to bud stage, preferably when young and actively growing	See paragraph 138 for grazing and use restrictions. Often applied as a tank-mixture with 2,4-D to provide the most cost- effective control. Restricted use herbicide.	138
Triclopyr + 2,4-D (Crossbow)	0.5 to 3.0 + 0.25 to 1.5 (1 to 6 qt)	Brush and broadleaf weeds		Provides more consistant musk thistle and brush control (except buckbrush and western snowberry) than 2,4-D alone. Refer to paragraph 142 for grazing and haying restric- tions.	142

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CHEMICAL WEED CONTROL FOR FALLOW
For future planting to wheat, durum, barley, oats, corn or sorghum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Cyanazine (Bladex)	2.4 to 3.2 (3 to 4 lb)	Annual broad- leaf and grass weeds	Fall—anytime after harvest but before weeds emerge	Use the higher rate on fine- textured soils. If 0.5 inch of rainfall is not received with- in 10 days after application, under-cutting with sweeps may be desirable to destroy weeds until cyanazine is ac- tivated. Restricted use her- bicide.	147
	1.6 to 2.8 (2 to 3.5 lb)		Early spring before weeds emerge		
Cyanazine (Bladex 80W) + Atrazine	2 to 2.8 + 0.5	Annual broad- leaf and grass weeds	Fall—anytime after harvest but before weeds emerge	Mixture must be applied before November 15 for winter wheat the following year and allow 12 or more months between application and sowing of spring-seeded grain. Cyanazine is a restricted use herbicide.	16,148
	2 to 2.8 + 0.4		Early spring before weeds emerge		
Cyanazine (Bladex 80W) + Paraquat (Cyclone)	2.4 to 3.2 (3 to 4 lb) + 0.25 to 0.5 (1 to 2 pt)	Annual broad- leaf and grass weeds	Fall—anytime after harvest if weeds have emerged	Use only if weeds have emerged at time of applica- tion. Use the higher rate of cyanazine on fine-textured soils. Paraquat and cyanazine are restricted use herbicides.	144, 147
	1.6 to 2.8 (2 to 3.5 lb) + 0.5 (1 qt)		Spring—after weeds have emerged		
Propham (Chem Hoe 135)	3 to 4 (4 to 5.3 qt)	Wild oats, downy brome and volunteer grain	Late fall	Apply in late fall after soil temperatures have cooled to 50 F or cooler in upper inch of soil. Use the higher rate on medium to fine-textured soils.	149
Dicamba (Banvel)	0.25 to 0.5 (0.5 to 1.0 pt)	Wild buck- wheat, kochia and other broadleaf weeds	Postemergence	Residue from fall applica- tion may damage broadleaf crops if seeded the next year.	146
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Weeds less than 6 inches tall	A nonselective, translocated, postemergence herbicide. No soil residual activity. See paragraph 145 for rates. Use the lower rate for annual grasses.	145, 146
Paraquat (Cyclone)	0.5 (1 qt)			A nonselective, contact, postemergence herbicide. No soil residual activity. Apply with X-77. Restricted use herbicide.	144
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence	Use the higher rate for perennial weeds.	136
Glyphosate (Roundup) + dicamba (Banvel)	0.19 to 0.38 + 0.08 to 0.25 (0.5 pt to 1 pt + 0.17 to 0.5 pt)	Emerged an- nual grass and broad- leaf weeds	Weeds less than 6 inches tall	Commercial mixture (Fallow Master) available. Delay planting of wheat, barley, oats, or sorghum for 15 days and all other crops for 3 months after application.	145, 146
Glyphosate (Roundup) + 2,4-D	0.19 to 0.38 + 0.17 to 0.6 (0.5 to 1 pt + 0.33 to 1.2 pt)			Commercial mixtures (Landmaster II, Landmaster BW) available.	145, 146

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

For future planting to wheat, durum and barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	Refer- ence**
Trifluralin (Treflan)	0.6 to 1.0 (6 to 10 lb 10G)	Grass and some broad- leaf weeds	Incorporated in fallow	First incorporation required within 24 hours. Second incorporation may be delayed several weeks, until necessary to control weeds. Rates vary depending on time of applica- tion. Refer to paragraph 151 for rate information.	14,15, 17, 151

For future planting to wheat and durum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Atrazine	0.5 to 1 (0.6 to 1.25 lb 80W)	Annual broad- leaf weeds and grasses including downy brome	Apply before weeds emerge	Plant at least 2 inches deep and allow 12 or more months between application and plant- ing. Do not use on sandy soils, eroded hillsides, caliche and rock outcroppings or exposed calcareous subsoil. Apply combinations with nonionic surfactant at 0.12 to 0.25% v/v. Paraquat is a restricted use herbicide.	16, 144, 148
Atrazine + Paraquat (Cyclone)	0.5 to 1 + 0.25 to 0.5 (0.6 to 1.25 lb 80W + 1 to 2 pt)		Weeds emerged but less than 6 inches tall		
Metribuzin (Lexone 4L)	1.0 to 1.5 (1 to 1.5 qt)	Annual broad- leaf and grass weeds	Fall—after harvest before weeds emerge	Use the higher rate on fine- textured soils. Do not plant spring wheat following fall ap- plications or winter wheat within 6 months of treatment.	20
	0.67 to 1.0 (0.67 to 1 qt)		Early spring before weed emergence		
Metribuzin + paraquat (Lexone + Cyclone)	1.0 to 1.5 + 0.25 to 0.5 (1 to 1.5 qt + 1 to 2 pt)	Annual broad- leaf and grass weeds	Fall—after harvest if weeds emerged	Use only if weeds have emerged at time of applica- tion. Use the higher rate of metribuzin on fine-textured soils. Do not plant spring wheat following fall applica- tions or winter wheat within 4 months of treatment. Apply with X-77 surfactant at 0.25% v/v. Paraquat is a restricted use herbicide.	20,144
	0.67 to 1.0 + 0.25 to 0.5 (0.67 to 1 qt + 1 to 2 pt)		Spring after weeds have emerged		
Clomazone (Command)	0.75 to 1.0 (1.5 to 2 pt)	Volunteer wheat, downy brome, kochia, wild buck- wheat, tansy mustard	Fall—August 15 to October 31	Not approved for aerial application. Apply with a drift control agent and do not apply near susceptible sites such as towns or winter wheat fields. Do not plant spring wheat un- til 18 months after a fall treat- ment. Carryover injury possi- ble.	150

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Special Annual Weed Problems

False Chamomile

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Bromoxynil + MCPA ester (Bronate)	0.37 + 0.37 (1.5 pt)	Wheat, barley and oats	Chamomile less than 4 inches tall	Control of fall germinated plants will be less than those germinating in the spring.	53
Chlorsulfuron (Glean)	1/128 (1/6 oz)		Postemergence- crop in 2-leaf stage until just prior to boot	Do not apply Glean within 48 months of the last treat- ment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12% to 0.25% v/v. Do not apply to soils above pH 7.9.	22,25, 31,53
Chlorsulfuron (Telar)	1/128 (1/6 oz)	Roadsides	Chamomile less than 4 inches tall	See paragraph 23 for rotational restrictions.	
Metsulfuron (Ally) + a broadleaf herbicide	1/267 (1/10 oz) + appropriate rate	Wheat and barley	HRS wheat and barley-2 leaf stage until just prior to boot. Durum-4 leaf stage until just prior to boot	Should be applied as a tank- mixture with another broad- leaf herbicide. Do not apply within 22 months of last metsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 23 for rota- tional restrictions.	23,25, 32
DPX-M6316 (Harmony)	1/48 to 1/32 (1/2 to 2/3 oz)	Wheat and barley	Chamomile less than 4 inches tall	Should be applied as a tank- mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See paragraph 25 about resistant weeds.	25,33
Picloram (Tordon 22K)	0.25 to 0.37 (1 to 1.5 pt)	Roadsides	Chamomile less than 4 inches tall	Use the higher rate on plants over 4 inches tall. Avoid drift of picloram to sensitive plants. Restricted use herbicide.	53,130
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Tree rows or potholes	Chamomile less than 6 inches tall	Apply with X-77 surfactant at 0.25% v/v. Avoid contact with non-target plants. Restricted use herbicide.	53,144
Glyphosate (Roundup)	0.75 (1 qt)			A nonselective, translocated postemergence herbicide. Avoid contact with non- target plants.	53
Amitrole (Amitrole T, Cytrol)	1.5 (3 qt)			Avoid contact with non-target plants. Restricted use herbicide.	53

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Fumitory

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Triallate (Far-Go)	1.25 (1.25 qt, 12.5 lb 10G)	Barley	Fall, preplant or preemergence incorporated	Incorporate in top 2 inches of soil by cultivation. Seed the crop below the incorporation depth.	1,5, 12,36
	1 (1 qt, 10 lb 10G)	Wheat and durum			
Bromoxynil + MCPA (Bronate)	0.25 to 0.37 + 0.25 to 0.37 (1 to 1.5 pt)	Wheat, barley and oats	After fumitory is established to boot stage of crop	Other broadleaf weeds also will be controlled.	30

CHEMICAL WEED CONTROL FOR PERENNIAL WEEDS

Absinth Wormwood

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

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
2,4-D L.V. ester or amine	2 (2 qt of 4 lb/gal conc.)	Pastures and rangeland, noncropland, trees, fallow, or post-harvest	12 inches tall and actively growing	Plants are controlled slowly. Avoid spraying tree foliage. Do not graze dairy cows for 7 days after treatment. Use only the amine formulation in trees.	139
Dicamba (Banvel)	0.5 to 1 (1 to 2 pt)	Pasture and rangeland, noncropland, fallow or post-harvest		Plants are controlled slowly. Consult label for grazing restrictions. Surfactant at 0.5% v/v may improve consistency of control.	140
Dicamba (Banvel 10G)	0.5 to 1.0 (5 to 10 lb 10G)				
Picloram (Tordon 22K)	0.125 to 0.25 (0.5 to 1 pt)	Pasture and rangeland, noncropland		Consult reference for grazing restriction. Use high rate for dense stands. Restricted use herbicide.	137, 138
Glyphosate (Roundup)	0.25 to 1.0 (0.33 to 1.33 qt)	Trees, noncropland, fallow or post-harvest		Avoid spraying tree foliage. Use a nonionic surfactant at 0.5% v/v for rates less than 0.5 lb/A. Use the high rate for dense stands.	134, 136, 145

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Canada Thistle and Sowthistle

Extension Bulletin W-799, "Canada Thistle Identification & Control," provides additional information.

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Wheat and barley	Crop-4 leaf through jointing. Weeds-rossette until prior to bloom	Do not rotate to any crop except small grains, grass, or sugarbeets within one year of application.	24,27, 136
	0.09 to 0.19 + 0.5 to 1.0 (2 to 4 pt)	Fallow, CRP			
MCPA amine MCPA ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Higher rates than listed may injure crop but may be beneficial especially in small areas, to achieve thistle control. Small grains are more tolerant to MCPA than 2,4-D.	136
2,4-D amine 2,4-D ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Higher rates than listed may injure crop, but may be beneficial for control of thistle in small areas.	136
Chlorsulfuron (Glean)	1/64 (1/3 oz)	Wheat, oats, and barley	Crop at 2-leaf stage or larger, thistle less than 6 inches tall	Provides suppression of only Canada thistle during the year of application. Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	14,22, 25,31, 136
Metsulfuron (Ally) + broadleaf herbicide	1/267 (1/10 oz) + appropriate rate	Wheat and barley	HRS wheat and barley-2 leaf stage until just prior to boot. Durum-4 leaf stage until just prior to boot. Thistle-rossette to pre-bud stage	Provides suppression of Canada thistle and perennial sowthistle during the year of application. Should be applied as a tank-mixture with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron or chlorsulfuron treatment. See paragraph 25 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 23 for rotational restrictions.	14,23, 25,32, 136
Atrazine	4 (1 gal 4L, 5 lb 80W)	Corn	Preemergence or postemergence	Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting; or 2 postemergence treatments at 2 lb/A with oil additive at 1 qt/A 10 to 20 days apart. Plant only corn the year following treatment.	10,66
Bentazon (Basagran)	1.0 (2 pt) applied twice	Soybeans, corn	Canada thistle 8 inches tall to bud stage	Apply 2nd treatment at 1.0 lb/A 7 to 10 days later.	94
	1.0 (2 pt) applied once	Dry edible beans		Apply only once due to injury potential.	

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Canada Thistle and Sowthistle

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)	Patches in barley, corn, oats, soybeans or wheat	Prior to heading or flowering of crop, thistles at or beyond the bud stage of growth	Crop in treated area will be killed. Avoid drift.	134, 136
Dicamba (Banvel)	0.25 to 0.5 (0.5 to 1 pt)	Corn	Early post- emergence corn up to 5 inches tall	Use low rate on coarse textured or low organic matter soils.	78
	0.25 (0.5 pt)		Before corn is 36 inches tall or 15 days prior to tasseling	Use drop nozzles after corn is 8 inches tall to reduce drift.	
	1 to 2 (1 to 2 qt)	Fallow or post-harvest	Weeds at least 6 inches tall and actively growing	Rotate to wheat, corn, soy- beans, or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, ex- cluding days when ground is frozen. May be tank mixed at a lower rate with 2,4-D or glyphosate to reduce soil residue. Surfactant may improve the consistency of control.	140
2,4-D ester or amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post-harvest	12 inches tall and actively growing.	Cultivate fallow until early July. Spray in late August or September. Retreatment will be necessary.	134, 139
Glyphosate (Roundup)	0.75 to 2.25 (1 to 3 qt)	Fallow or post-harvest	Thistles at or be- yond the bud stage of growth	Wait 3 or more days after application before tillage. Use low rate for fall treatment.	134, 145, 146
		Trees		Avoid spraying tree foliage. A nonselective her- bicide.	134, 145
Clopyralid (Stinger)	0.19 to 0.25 (0.5 to 0.67 pt)	Sugarbeets	Thistles in the rosette to pre-bud stage	Do not rotate to any crop except small grains, grass, or sugarbeets within one year of treatment.	24,27, 127, 136
	0.25 to 0.50 (0.67 to 1.3 pt)	Rangeland and grass pastures			
Picloram (Tordon 22K)	0.25 to 0.5 (1 to 2 pt)	Pasture and rangeland	12 inches tall and actively growing. For fall treat- ment, mid-summer mowing promotes active growth	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide.	137, 138
Picloram (Tordon 22K)	1 (2 qt)	Patches or individual plants in pastures	When thistles are actively growing	Consult reference for grazing restrictions. Restricted use herbicide.	137, 138

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Canada Thistle and Sowthistle

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Dicamba (Banvel)	0.5 (1 pt)	Pasture and rangeland	12 inches tall and actively growing. For fall treatment, mid-summer mowing promotes active growth	Consult label for grazing restrictions. Surfactant may improve the consistency of control.	140
	4 (1 gal)	Patches or individual plants in pastures	When thistle are actively growing		
Dicamba (Banvel 10G)	4 to 6 (40 to 60 lb 10G)				
2,4-D ester or amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Pasture and rangeland or trees (amine only)	12 inches tall and actively growing	Do not graze dairy cows for 7 days after treatment. Provides suppression only.	134, 139

Common Milkweed

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	2.25 (3 qt)	Stubble or patches in barley, corn, oats, soy- beans or wheat	Milkweed late bud to flower stage and actively growing. Prior to heading or flowering of crop	Allow 3 or more days after application before tillage. Crop in treated area will be killed. Avoid drift. Generally will not give complete control.	134, 135
Dicamba (Banvel)	0.5 to 2 (1 to 4 pt)	Fallow or post-harvest	Actively growing	Rotate to wheat, corn, soy- beans, or sorghum only. Crop injury may occur if the in- terval between application and planting is less than 45 days per 0.5 lb dicamba used, ex- cluding days when ground is frozen. Surfactant may improve the consistency of control. Generally will not give com- plete control.	18, 134
2,4-D + dicamba (Banvel)	1 + 0.25 (2 pt + 0.5 pt)	Fallow or post-harvest	Actively growing	Provides suppression of milk- weed growth for one year. Retreatment at the same rate usually will be necessary the following year.	18, 134, 146
Picloram (Tordon 22K)	0.5 (2 pt)	Pasture, rangeland, and noncropland	Actively growing	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide.	137, 138
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt)	Patches or individual plants in pastures	Actively growing	Consult reference for grazing restrictions. Restricted use herbicide.	137, 138

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Field Bindweed

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

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Rates higher than listed may injure crop but may be benefi- cial, especially in small areas, to control bindweed.	134, 136
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post-harvest	Regrowth 12 inches to bud	Cultivate fallow until early July. Spray in late August or September. Respray in follow- ing year's crop.	134, 136
Dicamba (Banvel)	1 to 2 (1 to 2 qt)	Fallow or post-harvest	Regrowth 12 inches to bud	Mid to late fall treatments have been more effective than summer treatments. Rotate to wheat, corn, soybeans, or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicam- ba used, excluding days when ground is frozen. Surfactant may improve the consistency of control.	134, 140, 146
Dicamba (Banvel) + Glyphosate (Roundup)	0.5 (1 pt) + 1.5 (2 qt)			Less potential for soil residual than higher rates of dicamba.	
Glyphosate (Roundup)	3 to 3.75 (4 to 5 qt)	Patches in barley, corn, oats, soybeans wheat, or trees	Prior to heading or flowering of crops, bindweed in bud and/or flowering stage and actively growing	Crop in the treated area will be killed. Avoid drift or spraying tree foliage. Repeat applications are required for complete control.	145, 146
Picloram (Tordon 22K)	1 (2 qt S)	Patches or individual plants in pastures or non- cropland	Bindweed actively growing	Consult references for grazing restrictions. Restricted use herbicide.	137, 138
Dicamba (Banvel)	2 to 8 (0.5 to 2 gal)			Apply to foliage and/or soil. Consult label for grazing restrictions. Use low rate only in fall. Use higher rates in dense or old stands.	140
Dicamba (Banvel 10G)	4 to 6 (40 to 60 lb 10G)				

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Leafy Spurge

Extension Circular W-765, "Leafy Spurge Identification and Control," provides additional information.

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
2,4-D L.V. ester	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow	Plants actively growing	Cultivate or respray whenever regrowth is 4 to 6 inches high. Retreat in next year's crop.	134, 139
Dicamba (Banvel)	1 to 2 (1 to 2 qt)	Fallow or post-harvest	Plants flowering in spring or 4 to 12 inch regrowth in fall	Rotate to wheat, corn, soybeans or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen.	140
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Pasture and rangeland	Early bud stage and fall	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days after treatment.	134, 139
Picloram (Tordon 22K) + 2,4-D ester or amine	0.25 to 0.5 + 1 (1 to 2 pt + 1 qt of 4 lb/gal conc.)	Pasture, rangeland, and roadsides	Leafy spurge in true flower growth stage or fall regrowth	Picloram + 2,4-D at 0.25 + 1 lb/A was 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 0.5 lb/A picloram rate. Use the 0.5 lb/A picloram rate with fall application. Picloram is a restricted use herbicide.	137, 138
Dicamba (Banvel)	2 (2 qt)				
Picloram (Tordon 22K)	Wiper applicator solution 1 part picloram: 3 to 7 parts water		Plants 15 to 20 inches tall until freeze-up	Use the more concentrated solution for higher weed densities. Fall treatments are more effective than spring treatments. Retreatment with 2,4-D at 1 to 2 lb/A may be needed the following year. Restricted use herbicide.	137, 138
Dicamba (Banvel)	4 to 8 (1 to 2 gal, 40 to 80 lb 10G)	Patches or individual plants in pastures or non-cropland	Leafy spurge in true flower growth stage or with fall regrowth	0.5 cup dicamba granules (8 lb/A) treats 100 square feet. Consult label for grazing restrictions. Liquid formulation provides better control than granular formulation in spring.	140
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt S)			Consult narrative for grazing restrictions. Restricted use herbicide.	137, 138

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Leafy Spurge

Extension Circular W-765, "Leafy Spurge Identification and Control," provides additional information.

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Sulfometuron (Oust) + 2,4-D amine	0.07 to 0.12 + 1 lb (1.5 to 2.5 oz + 1 qt)	Industrial- noncropland Conifer trees	Leafy spurge in true flower growth stage through fall regrowth	Grass growth will be suppressed, especially with late season application. Treat- ment after September 1 has given season long leafy spurge control the following year. Avoid spraying tree foliage or bark. Do not use surfactant if desirable grasses are present.	143
Sulfometuron (Oust) + Picloram (Tordon)	0.07 to 0.12 + 0.25 to 0.5 (1.5 to 2.5 oz + 1 to 2 pt)	Industrial- noncropland		Grass growth will be suppres- sed, especially with late season application. Application with picloram is more effective than with 2,4-D. Do not use a surfactant. Picloram is a restricted use herbicide.	143
Glyphosate (Roundup)	0.75 (1 qt)	Trees	After July 1 and plants actively growing	Avoid spraying tree foliage. Glyphosate is a nonselective herbicide. Retreat the following spring with 2,4-D at 1 to 2 lb/A to control seedlings and escapes.	135, 136
2,4-D amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)				
Dichlobenil (Norosac 10G)	6 to 8 (60 to 80 lb 10G)		Late November to early March before spurge emergence	Season long suppression only. Must be applied before leafy spurge emerges. No post- emergence control.	
Fosamine (Krenite)	6 to 8 (1.5 to 2 gal)	Noncropland, adjacent to water, trees	Leafy spurge in true flower growth stage or early fall	Inconsistent control. Best control when applied with high humidity and good soil moisture. Do not allow to con- taminant water.	
Glyphosate (Rodeo)	0.75 (1 qt)	Adjacent to water	Mid-July to mid-September	Rodeo formulation only. Apply with a nonionic surfactant approved for use near water, such as X-77. Treatment with a 2,4-D formulation labelled for use near water will be needed in subsequent years to control emerging seedlings.	135, 145
2,4-D amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)		Plants actively growing	Use only 2,4-D formulations labelled for use near water.	134, 139

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Quackgrass

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Atrazine	4 (5 lb 80W, 4 qt 4L)	Corn	Fall and/or spring	Apply 2 lb/A 10 to 14 days prior plowing in the fall or early spring and an additional 2 lb/A before, at, or after corn planting. Plant only corn the year of application and the year following treatment.	16, 66
Fluazifop-P (Fusilade 2000)	0.19 (1.5 pt)	Soybeans and trees	Quackgrass — 4 leaves but less than 10 inches tall	Apply with oil additive at 1% v/v. If regrowth occurs, make a second application at 0.19 lb/A when quackgrass has 3 to 5 leaves.	97
Sethoxydim (Poast)	0.5 (2.5 pt)	Soybeans, sunflowers, flax, alfalfa and trees	Quackgrass 6 to 8 inches tall	Apply with oil additive at 1 qt/A. If regrowth occurs, make a second application at 0.3 lb/A when quackgrass regrowth is 6 to 8 inches tall.	98
Quizalofop (Assure)	0.125 (1.25 pt)	Soybeans	Quackgrass 6 to 10 inches tall	Apply with oil additive at 1% v/v or nonionic surfactant at 0.25% v/v. If regrowth occurs make a second application at 0.09 lb/A when quackgrass is 4 to 8 inches tall.	99
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)	Patches in barley, corn, oats, soybeans or wheat	Prior to heading or flowering of the crop, quack- grass at least 8 inches tall and actively growing	Crop in treated area will be killed. Avoid drift.	135, 136
Glyphosate (Roundup)	0.75 (1 qt)	Preplant, fallow or post- harvest	Fall or spring, quackgrass 8 inches tall and actively growing	Add a nonionic surfactant at 0.5% v/v. Allow 3 or more days after application before tillage. For established quackgrass sod, use glyphosate at 1.5 lb/A.	134, 145

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Russian Knapweed

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Prevents seed formation only.	136, 139
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qts of 4 lb/gal conc.)	Fallow or post- harvest, pasture and rangeland	Rosette stage pre- ferred. Also bud to bloom stage	Several years of annual treat- ment is necessary.	136, 139
Dicamba (Banvel)	1 to 2 (1 to 2 qt)			Wheat injury may occur if the interval between application and planting is less than 45 days per 0.5 lb of dicamba us- ed, excluding days when the ground is frozen. Plants are controlled slowly.	140
Clopyralid + 2,4-D (Curtail)	0.09 to 0.5 (2 pt)	Wheat and barley	Wheat-4 leaf through jointing	Do not rotate to any crop except small grains, grass, or sugarbeets within 1 year of application.	24,27, 136
	0.09 to 0.19 + 0.5 to 1.0 (2 to 4 pt)	Fallow, CRP	Bud to bloom stage or fall		
Dicamba (Banvel)	2 to 6 (2.0 to 6.0 qt S)	Pasture and rangeland, non- cropland	Spring or fall	Consult label for grazing restrictions. Plants are controlled slowly.	140
Dicamba (Banvel 10G)	4 to 6 (40 to 60 lb 10G)				
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt S)		Anytime during growing season	Consult label for grazing restrictions. Restricted use herbicide.	137, 138
Picloram (Tordon 22K)+ 2,4-D amine or ester	0.25 to 0.5 + 1 (1 to 2 pt + 1 qt of 4 lb/gal conc.)		Rosette stage preferred. Also bud and bloom stage	Several years of annual treatment necessary. Restricted use herbicide.	134, 137, 138

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Spotted Knapweed
Extension Circular W-842, "Spotted Knapweed," provides additional information.

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qts of 4 lb/gal conc.)	Fallow or post-harvest, pasture and rangeland	Rosette stage preferred. Also bud to bloom stage	Annual treatment for several years is necessary.	134, 139
Dicamba (Banvel)	1 to 2 (1 to 2 qt)			Wheat injury may occur if the interval between application and planting is less than 45 days per 0.5 lb of dicamba used, excluding days when ground is frozen. Plants are controlled slowly.	140
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt) (of 4 lb/gal conc.)	Wheat and barley	Tiller stage of crop	Repeat treatments may be required for spotted knapweed control.	134, 136
Clopyralid + 2,4-D (Curtail)	0.09 to 0.5 (2 pt)	Wheat and barley	Wheat-4 leaf through jointing	Do not rotate to any crop except small grains, grass, or sugarbeets within 1 year of application.	24,27, 136
	0.09 to 0.19 + 0.5 to 1.0 (2 to 4 pt)	Fallow, CRP	Bud to bloom stage or fall		
Picloram (Tordon 22K)	0.25 to 0.5 lb (0.5 to 1 qt S)	Pasture and rangeland, non-cropland	Rosette or bud to bloom stage most susceptible	Consult reference for grazing restriction. Picloram is a restricted use herbicide.	137, 138
Picloram (Tordon 22K) + 2,4-D amine or ester	0.25 + 1 (1 pt + 1 qt of 4 lb/gal conc.)				
Cultivation		Cropland	Repeat whenever plants are 3 to 6 inches tall	Spotted knapweed is not generally a problem in cultivated land.	

Cattails

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Glyphosate (Rodeo)	2.25 (4.5 pt)	Drainage and aquatic sites	At or beyond the early to full bloom stage and actively growing	Add a nonionic surfactant approved for use in water at 0.5% v/v; see the label for approved surfactants. Apply at 0.75% v/v solution (1 fl oz per gallon) with hand held equipment.	145
Glyphosate (Roundup)		Agricultural and noncropland sites other than drainage and aquatic sites		Add a nonionic surfactant at 0.5% v/v. The Roundup formulation is not approved for use in drainage and aquatic sites because of environmental concerns.	145

* Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.
 **Reference paragraph number indicates appropriate paragraph in the narrative.

HERBICIDE USE INFORMATION

INCORPORATION OF HERBICIDES:

1. Butylate, cycloate, EPTC, and triallate 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. Ethalfluralin incorporation may be delayed up to 48 hours. Pendimethalin must be used preemergence on corn but may be incorporated for soybeans. Incorporation often improves the performance of pendimethalin and may be delayed up to 7 days after application. Alachlor, ethofumesate, and metolachlor may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor, ethofumesate and metolachlor may be delayed several days.
 - a) A tandem disk should be set at a depth of 3 to 4 inches for pendimethalin and a depth of 4 to 6 inches for other herbicides. 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 have often 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 pendimethalin 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.
3. A single incorporation with a power driven tiller is sufficient for butylate, cycloate, EPTC, and trifluralin. However, a second tillage at right angles to the initial incorporation should be done if a disk or field cultivator is used. The second incorporation has two purposes: a) Incorporate any herbicide remaining on the soil surface, and b) provide more uniform distribution of the herbicide in the soil which will improve weed control and may reduce crop injury.

4. Trifluralin (Treflan) may be applied to wheat and barley after planting and then incorporated above the seed. Shallow incorporation of trifluralin does not give weed control as effective as deep incorporation, but fair to good control of shallow germinating weeds such as green and yellow foxtail (pigeongrass) can be obtained.
5. Triallate (Far-Go, Showdown) will adequately control wild oats with a shallow incorporation. Two spike tooth harrowings at right angles will give sufficient incorporation if the soil is loose and free of trash. Experiments at North Dakota State University have shown that deeper incorporation generally enhances wild oats control from triallate. Triallate applied after seeding should be incorporated **less deeply** than the placement of the crop seed (Preemergence Incorporation). Triallate applied before seeding should be incorporated with a field cultivator plus harrow operated 3 to 4 inches deep. Delay seeding for 3 days. Triallate applied before seeding may injure certain wheat varieties. Spring preplant incorporated triallate has greater potential for injury to wheat than application at other times. Refer to the label for information on varieties that may be susceptible to preplant incorporated triallate.

THE SOIL ORGANIC MATTER TEST:

6. 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, cycloate (Ro-Neet), EPTC (Eptam, Genep), linuron (Lorox) and pyrazon (Pyramin) require higher rates to be effective in high organic matter soils. However, crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, thereby reducing weed control. However, organic matter level generally affects herbicide performance more than clay content.
7. EPTC is used on safflower, sugarbeets, sunflower, dry beans, and potatoes. Sugarbeets have marginal tolerance to EPTC, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussion on selecting an EPTC rate only gives guidelines. Other factors such as method of incorporation affect EPTC performance (immediate and thorough incorporation gives best performance). The suggested spring-applied EPTC rate is 2 to 3 lb/A. The 3 lb/A rate should give good weed control without crop injury on a soil with a silty clay texture and more than 7 percent organic matter. The minimum rate of 2 lb/A may injure sugarbeets on a sandy loam or coarse-textured soil with less than 4 percent organic matter. The EPTC rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes.
8. Some herbicides give good weed control only when organic matter levels are low. Linuron (Lorox) and pyrazon (Pyramin) have not been effective in the Red River Valley, except on the coarse-textured soils with less than 5 percent organic matter. The lower the organic matter, the more effective they become. Atrazine rate must be adjusted according to organic matter levels. Apply the high labeled rates on higher organic matter soils. Many herbicides such as pro-pachlor (Ramrod), triallate (Far-Go, Showdown),

trifluralin (Treflan) and most postemergence 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.

FALL APPLICATION OF HERBICIDES:

9. Several herbicides may be applied in the fall for weed control the following spring. Included in this group are Chlorsulfuron (Glean), EPTC (Eptam, Genep), triallate (Far-Go, Showdown), and trifluralin (Treflan). Fall treatments of chlorsulfuron and trifluralin should be applied after September 1 and until soil freeze-up. Fall treatments of EPTC (Eptam, Genep), and triallate (Far-Go, Showdown) 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 except chlorsulfuron, are registered for use in the fall. Fall applications of granular formulations generally have given more effective weed control than the liquid formulations, especially under heavy crop residue situations.
10. Chlorsulfuron (Glean) applied at 1/64 lb/A in the fall will control a number of annual weed species in spring wheat. Chlorsulfuron should be applied to undisturbed stubble where straw is spread evenly, or after cultivation to a uniform soil surface. Shallow tillage, not more than 4 inches deep, may be done after application. Spring tillage should be shallow. Do not moldboard plow.
11. EPTC (Eptam, Genep) fall applied at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC must be incorporated into the soil immediately after application to prevent loss of herbicide. The liquid and granular formulations of EPTC may be applied in the fall for weed control in dry beans, flax, potatoes, sugarbeets, and sunflower.
12. Triallate (Far-Go, Showdown) is applied at 1 to 1.50 lb/A in the fall. The liquid formulation may be applied at 1 lb/A (1 qt/A) and the granules at 1.25 to 1.5 lb/A (12.5 to 15 lb/A Far-Go 10G, 6.25 to 7.5 lb/A Showdown) for wild oats control in barley, wheat, and durum. Triallate performs best when incorporated immediately after application; however, triallate granules may be surface applied in the fall and incorporated with normal tillage operations the following spring. Fall surface applied triallate may perform less consistently than fall incorporated triallate. Research at North Dakota State University with fall applications indicates that at similar rates, the granular formulation performs more effectively than the liquid formulation.
13. Trifluralin (Treflan) fall applied at 0.5 to 1 lb/A (depending on crop) gives good control of annual grasses and broadleaf weeds except wild mustard. Incorporation may be delayed 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. The liquid or granular formulations may be applied in the fall for weed control in soybeans, safflower, dry beans, sunflowers, flax, wheat, and barley.

HERBICIDE RESIDUE:

14. The persistence of phytotoxic levels of a herbicide for more than 1 year can be a problem with some of the herbicides used in North Dakota. Herbicide residues are most likely to occur following years with unusually 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 application of 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 by diluting the herbicide residue in a large volume of soil. Moldboard plowing is ineffective to reduce the residual effects of picloram (Tordon), chlorsulfuron (Glean), and metsulfuron (Ally).
15. Herbicide residues often can be detected by bioassay. A soil sample representative of the whole field must be obtained by sampling at many places to the depth of the tillage layer. Also, a sample of soil known to be free of herbicide residues must be obtained from near the treated field to serve as the untreated check. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare at least two samples each of the 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. Preparing extra pots and testing a more susceptible species may be helpful in detecting residues. Plant in each pot 12 seeds of large-seeded crops like corn or soybeans, or 20 seeds of small-seeded crops like cereals or flax. Water the soil for germination and plant growth as needed, but do not over-water. When the plants are about 2 inches tall, thin to about 6 large-seeded or 12 small-seeded uniform seedlings in each container. The containers should be placed in a warm place at about 70 to 75 F, and in direct sunlight. Observe the plants in the untreated check and test samples for 2 to 3 weeks after emergence. Some tangible measurements such as plant height and leaf length can be taken for evaluation, along with visual observation of abnormalities. Symptoms of some herbicides, like atrazine and metribuzin (Lexone/Sencor) do not develop until several days after emergence. The soil should be washed from the roots to observe root growth, especially for dinitroaniline herbicides such as pendimethalin (Prowl), trifluralin (Treflan) and ethalfuralin (Sonalan). Window bioassays do not provide accurate information on chlorsulfuron (Glean) or metsulfuron (Ally) carryover. However, DuPont provides a Laboratory Recrop Bioassay (LRB) service to customers to provide accurate information on rotation options following chlorsulfuron or metsulfuron use. Consult the local DuPont representative for additional information on the LRB service.
16. Atrazine generally has a residue the year following application to corn at 2 to 4 lb/A in North Dakota. If soil moisture is deficient, 1 lb/A of 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 flax, soybeans, barley, wheat, oats, sunflower and sugarbeets.

17. Ethalfluralin (Sonalan), pendimethalin (Prowl), and trifluralin (Treflan) are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than 1 year. Ethalfluralin has less soil residue than trifluralin and pendimethalin. Land treated with ethalfluralin in the spring may be planted to any crop the next year except sugarbeets. Sunflower, soybeans, potatoes, and dry edible beans are quite tolerant to dinitroaniline herbicides. The approximate ranking of other crops from most to least tolerant is flax, barley, wheat, corn, oats, and sugarbeets.
18. Dicamba (Banvel) at 1 to 2 lb/A applied for perennial weed control may carryover in the soil. Corn, sorghum and soybeans may be planted in the spring following applications made during the previous year. Wheat may be planted in the fall or spring following applications. For all these crops injury may occur if the interval between application and planting is less than 45 days per 0.5 lb/A of dicamba used, excluding days when ground is frozen. Research at North Dakota State University indicated that dicamba at 1 qt/A applied in late September caused some visible injury to wheat and barley planted the following spring, but the effect on yield was minimal. Dicamba at 0.5 lb/A applied the previous fall prevented seed production by sunflower.
19. Picloram (Tordon) at 1/64 lb/A active ingredient (1 oz/A of formulated product) may carryover in the soil for more than 1 crop year. Only grass or grain crops such as small grains, corn, sorghum, or flax should be planted on fields treated with picloram the previous year. Sunflower, soybeans, dry edible beans, and potatoes are especially susceptible to picloram.
20. Metribuzin (Lexone, Sencor) generally is used on soybeans in combination with other herbicides or is used alone on potatoes. No harmful metribuzin residues would be expected when used at 0.25 lb/A active ingredient. Rates over 0.5 lb/A may damage susceptible crops the next year. The approximate ranking of crops from most to least tolerant is potatoes, soybeans, dry edible beans, corn, barley, wheat, oats, sunflower, flax, and sugarbeets.
21. Ethofumesate (Nortron) often has a residue the year following use on sugarbeets. The approximate ranking of crops from most to least tolerant is sunflower, soybean, corn, barley, and wheat. Moldboard plowing usually will eliminate crop injury. Ethofumesate should be applied in a band to reduce cost and reduce potential crop injury from residues the following year.
22. Chlorsulfuron (Glean) at 1/128 lb/A active ingredient (1/6 oz/A of formulated product) or higher may carryover in the soil for more than 3 crop years. The most important factor influencing chlorsulfuron carryover in soil is pH. The rate of chlorsulfuron breakdown decreases as soil pH increases. Chlorsulfuron should not be applied on soils with a pH above 7.9. The minimum recropping intervals are 0 months for wheat, 10 months for spring oats, and 16 months for barley. Land previously treated with chlorsulfuron should not be rotated to crops other than those listed above until a field bioassay confirms that residues of chlorsulfuron are not present. The approximate ranking of other crops from most to least tolerant is saflower, dry beans, sunflower, flax, corn, soybeans and sugarbeets. A Laboratory Recrop Bioassay (LRB) service is available through DuPont to provide customers with accurate information on rotational options following chlorsulfuron use. Consult your local DuPont representative for additional information on the LRB service.
23. Metsulfuron (Ally) at 1/267 lb/A (0.1 oz/A of formulated product) may carryover in soil for more than 3 crop years. The most important factor affecting met-sulfuron carryover in soil is pH. The rate of met-sulfuron breakdown decreases as soil pH increases. Metsulfuron should not be applied to soils with a pH above 7.9. The minimum recropping intervals are 1 month for spring and winter wheat, and 10 months for durum wheat, barley and oats. A 22 month recropping interval should be observed before planting proso millet, sorghum, corn, flax, safflower, or sunflower on fields west of Highway 1, while a 34 month recropping interval should be observed east of Highway 1. Land previously treated with metsulfuron should not be rotated to crops other than those listed above until a field bioassay confirms that residues of met-sulfuron are not present. A Laboratory Recrop Bioassay (LRB) service is available through DuPont to provide customers with accurate information on rotational options following metsulfuron use. Consult your local DuPont representative for additional information on the LRB service.
24. Clopyralid (Stinger) or clopyralid + 2,4-D (Curtail) may have a herbicidally active residual in the soil following postemergence application. Wheat, barley, oats, other grasses, and sugarbeets have good tolerance to clopyralid and can be planted any time following application. Other crops usually can be planted 12 months after treatment. Extreme conditions where topsoil remained cold or dry for extended periods after application may cause herbicidally active residues to persist for more than 12 months. In this case, small areas of lentils or peas should be planted as bioassay species prior to planting more extensive areas of lentils, peas, safflower, potatoes, alfalfa, sunflowers, edible beans, or soybeans. Time of clopyralid application during a season may influence the time of crop seeding the following year. For example, clopyralid applied June 15 would prevent seeding soybeans or edible beans until June 15 or later the following year.

HERBICIDE RESISTANCE:

25. A shift in weed spectrum results from the repeated use of a selective herbicide that eliminates susceptible weed species and allows tolerant weed species to increase in the absence of competition from the susceptible plants. Likewise, individual plant species may also have different plant types or biotypes in the population that vary in susceptibility to certain herbicides. Weed species that are very susceptible to certain herbicides may contain a small percentage of plants which are tolerant or resistant to a herbicide. Continuous exposure of that weed population to the herbicide may gradually result in a buildup of the resistant biotypes until they dominate the population and the herbicide is no longer effective on that weed

species. Various weed species have developed resistance to different herbicides. The most common incidence of herbicide resistant weeds has occurred with the triazine herbicides atrazine and simazine. More recently, several weed species have developed resistance to chlorsulfuron (Glean) and all other herbicides with the same mode of action. Herbicide resistant weeds are most likely to develop with the repeated use of effective, long residual herbicides that kill susceptible plants by affecting a specific process in the plant. Both the triazines and chlorsulfuron exhibit these characteristics. The weeds most likely to develop resistance are those that are highly variable and have a rapid life cycle with short seed dormancy such as kochia and Russian thistle. Both kochia and Russian thistle have developed populations resistant to chlorsulfuron and other herbicides with the same mode of action, including metsulfuron (Ally) and DPX-M6316 (Harmony). Resistant weed population development can be prevented by using crop rotations, herbicide rotations, herbicide mixtures of chemicals with different modes of action, and integrated pest management (IPM) practices. All of these techniques are sound agronomic practices which help minimize continuous exposure to a herbicide and reduce the selective pressure for specific resistant biotypes. Failure to practice these techniques and follow label guidelines on herbicides where resistance has occurred may eventually lead to loss of effectiveness of otherwise useful herbicides.

**SMALL GRAINS-WHEAT
(INCLUDING DURUM),
BARLEY AND OATS**

26. Weed control in small grains is important to maximize yields. Broadleaf weeds, foxtails (pigeongrass), and wild oats infest small grains statewide. Several applications of different herbicides or mixtures may be required to control all weeds. Normal height wheat varieties, rye, and winter wheat are more competitive than semidwarf wheat and thus will increase the effectiveness of herbicides. All small grains are sensitive to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until just prior to the boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from the 5th leaf until just prior to the boot stage, are more tolerant than oats to 2,4-D applications. Oats are more tolerant to MCPA than to 2,4-D, but injury to oats is possible with either chemical at any growth stage. Use 2,4-D on oats only for such hard-to-kill weeds as Russian thistle, kochia, common ragweed, and redroot pigweed and when the crop is in the 3rd to 4th leaf stage. While some injury to the oats can be expected, the better control of these weeds with 2,4-D usually will compensate for any yield loss caused by the chemical. Oat varieties vary in their tolerance to 2,4-D, MCPA, bromoxynil, or chlorsulfuron, but wheat and barley varieties differ little in tolerance.
27. Clopyralid + 2,4-D (Curtail) at 0.09 plus 0.5 lb/A provides control of Canada thistle and annual broadleaf weeds in barley, durum, and Hard Red Spring wheat. Canada thistle is most susceptible at the rosette or early bolting stages. This treatment will not provide long-term control of Canada thistle with one application, but will reduce populations with repeated use. Do not apply to oats or prior to the 4 leaf stage of wheat or barley. Do not rotate to any crop except wheat, barley, oats, grass, or sugarbeets for one year after treatment.
28. Dicamba (Banvel) at 0.06 to 0.12 lb/A controls wild buckwheat, smartweed and certain other broadleaf weeds in wheat, barley and oats. Dicamba can be applied alone but usually is applied with MCPA to increase control of wild mustard and other broadleaf weeds. Oats are more tolerant to dicamba than wheat. Both crops must be treated during the 2nd through 4th leaf stage. Barley can be treated during the 2nd through 3rd leaf stage but barley tolerance is marginal. Dicamba also can be applied in combination with 2,4-D, bromoxynil or chlorsulfuron to wheat.
29. Picloram (Tordon) at 1/64 to 1/43 lb/A with 0.25 to 0.37 lb/A of 2,4-D or MCPA is labeled for broadleaf weed control in hard red spring wheat, barley and oats. Picloram may be applied during the 3 through 5 leaf stage of crop growth. NOTE: Picloram should be used only on land that will be planted the following year to grass or grain crops including small grains, corn, sorghum, and flax. See herbicide residue section, paragraph 19.
30. Bromoxynil (Buctril) controls wild buckwheat, fumitory and most annual broadleaf weeds in wheat, barley and oats from emergence of the crop to early boot. Mixtures of bromoxynil plus MCPA ester (Bronate) are applied from the 3 leaf to early boot stage to improve wild mustard control.
31. Chlorsulfuron (Glean) at 1/128 to 1/64 lb/A can be applied preemergence in wheat or postemergence in wheat, barley and oats for broadleaf weed control and foxtail suppression. Chlorsulfuron should not be applied until 48 months have elapsed since the last application. Tank-mixtures with other broadleaf herbicides and use interval restrictions help minimize the potential buildup of resistant weed biotypes (Refer to paragraph 25). Chlorsulfuron can be tank-mixed with MCPA, 2,4-D, bromoxynil, or bromoxynil plus MCPA. Chlorsulfuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank-mix herbicide and rate (Consult the label for further details). Do not apply chlorsulfuron to soils with a pH greater than 7.9. Tank-mixing chlorsulfuron with organophosphate insecticides increases crop injury potential. Chlorsulfuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sugarbeets and sunflowers. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. Chlorsulfuron may persist in the soil for 3 years or more. Refer to the herbicide residue section, paragraph 22, on chlorsulfuron carryover and recropping restrictions.
32. Metsulfuron (Ally) at 1/267 lb/A applied as a tank-mixture with another broadleaf herbicide provides good postemergence control of broadleaf weeds in wheat and barley. Metsulfuron should not be applied until 22 months have elapsed since the last metsulfuron or chlorsulfuron treatment and should always be applied as a tank-mixture with another broadleaf herbicide to minimize the potential buildup

of resistant weeds (Refer to paragraph 25). Metsulfuron can be mixed with MCPA, 2,4-D, bromoxynil or bromoxynil plus MCPA. Metsulfuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank-mix herbicide and rate (Consult the label for further details). Tank-mixing metsulfuron with organophosphate insecticides increases crop injury potential. Do not apply metsulfuron to soils with a pH greater than 7.9. Metsulfuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sunflowers or sugarbeets. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. Metsulfuron may persist in the soil for 3 years or more. Refer to the herbicide residue section, paragraph 23, on metsulfuron carryover and recropping restrictions.

33. DPX-M6316 (Harmony) at 1/64 to 1/32 lb/A applied postemergence provides good annual broadleaf weed control in wheat and barley. DPX-M6316 should always be applied as a tank-mixture with another broadleaf herbicide in areas of known weed resistance to minimize the potential buildup of resistant weeds (Refer to paragraph 25). DPX-M6316 can be mixed with MCPA, 2,4-D, bromoxynil, or bromoxynil plus MCPA. DPX-M6316 should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank-mix herbicide and rate (consult the label for more details). Tank-mixing DPX-M6316 with organophosphate insecticides increases crop injury potential. DPX-M6316 spray drift or sprayer contamination causes severe injury to susceptible crops such as sunflowers and sugarbeets. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops.
34. Small grains underseeded to sweetclover, alfalfa or other legumes cannot be treated with 2,4-D, MCPA, bromoxynil, dicamba, chlorsulfuron, metsulfuron, DPX-M6316, clopyralid plus 2,4-D, or picloram at rates required to control most broadleaf weeds without seriously injuring or killing the legumes. However, MCPA, 2,4-D, and bromoxynil are registered for use on certain small grain-legume mixtures even though some injury to the legume may occur.

WILD OATS:

35. Wild oats are difficult to control because the plants shatter their seeds before crops are harvested and because seed dormancy causes delayed germination. Wild oats is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist.
36. Triallate (Far-Go, Showdown) at 1 to 1.5 lb/A is applied preplant or preemergence incorporated (depending on formulation) for wild oats control in wheat, durum, barley, peas, lentils or annual canarygrass. Triallate is volatile and the liquid formulation must be incorporated immediately after application. The liquid formulation has given more consistent wild oats control with less crop thinning than the granular formulation when spring applied. See paragraph 12 for fall application of triallate. Triallate at 1 lb/A also may be applied in combination with trifluralin (Treflan) at 0.5 to 0.75 lb/A for both wild oats and foxtail control in wheat, durum and barley after seeding. A prepackage mixture of triallate and trifluralin (Buckle) is available as a fall applied treatment in barley and durum or a spring treatment in barley for wild oats and foxtail control. Buckle is not labeled for use in Hard Red Spring wheat or as a spring applied treatment on durum.
37. Barban (Carbyne 2EC) should be applied for postemergence wild oats control when the majority of wild oats are in the 1.5 to 2 leaf stage, which generally occurs 9 days after emergence. Barban at 0.25 to 0.5 lb/A can be applied to spring and winter wheat, and barley; at 0.25 to 0.37 lb/A to durum wheat, flax and peas; at 0.37 lb/A to safflower, lentils, soybeans and mustard grown for oil; at 0.5 to 1 lb/A to sunflower and at 0.75 to 1 lb/A to sugarbeets. Thick, vigorous stands of crop plants help suppress wild oats and enhance the control obtained with barban. Crop competition is important for wild oats control; therefore, control may not be satisfactory in thin crop stands. Barban application is not affected by barley and wheat crop stage. Treat flax before the 12 leaf stage, and soybeans, lentils, mustard, sunflower, and sugarbeets within 30 days of crop emergence. Barban should not be mixed with or applied within 4 days of 2,4-D, MCPA or dicamba because wild oats control will be reduced. Bromoxynil mixed with barban has at times reduced wild oats control.
38. Barban (Carbyne 2EC) may be mixed with 1 gallon per acre aqueous nitrogen for control of wild oats in wheat and barley. This treatment has increased wild oats control in North Dakota tests especially when the plants were growing under low fertility or drought stress. The barban-aqueous nitrogen solution must be mixed with water for application. Addition of a surfactant at 0.5 percent v/v may prevent compatibility problems. A compatibility test should be conducted prior to addition of a barban/fertilizer mixture to the spray tank. Barban at 0.25 lb/A can be tank mixed with diclofop at 0.25 to 0.50 lb/A or difenzoquat at 0.25 to 0.50 lb/A for control of larger wild oats.
39. To reduce possible injury to wheat and barley, barban should be applied when the daytime temperature will exceed 50 F for at least several hours during each of the first 3 days following application. Barban is different from most herbicides since phytotoxicity is greater at lower temperatures. The higher rate should be used at temperatures above 85 F with low fertility soil, or drouthy conditions. Frost prior to barban application does not increase barban injury to wheat and barley or reduce wild oats control if the wild oats leaves are not damaged by the frost and temperatures after application are greater than 50 F.
40. Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the 3 to 5 leaf stage. Difenzoquat is cleared for use in barley, durum wheat (except Vic, Fjord, Edmore, Lakota and Wascana), winter wheat and Apex, Benito, Buckshot, Butte, Butte 86, Centa, Chester, Columbus, Coteau, Courtney, Era, Erik, Fortuna, Glenlea, Glenman, HY320, Katepwa, Leader, Leif, Marberg, Marshall, McKay, Neepewa, Newana, NK3751, Norak, Norana, Oslo, Pioneer 2369, Pondera, Pro-Brand 711, Pro-Brand 715, Prodax, Selkirk, Solar, Stoa, Success, Victory and Wheaton hard red spring wheat. Certain hard red spring wheat varieties have been nearly as susceptible to difenzoquat as wild oats, including Len, Waldron, Alex,

James, and Aim, so use difenzoquat only on wheat varieties listed on the label. Research at NDSU has also indicated that Vic and Edmore durum wheat varieties may be injured by difenzoquat. Wild oats are more susceptible at the 5 leaf than the 3 leaf stage of growth and control also is improved by good crop competition. The high rate should be used on high populations of 3 leaf wild oats. Wheat injury may occur at temperatures above 80 F. Difenzoquat may be mixed with bromoxynil (Buctril), MCPA, MCPA plus bromoxynil, 2,4-D, metsulfuron (Ally), chlorsulfuron (Glean), DPX-M3616 (Harmony), or clopyralid plus 2,4-D (Curtail) for broadleaf weed control without loss of wild oats control.

41. Diclofop (Hoelon) can be applied at 0.75 to 1.25 lb/A in wheat and soybeans and 0.75 to 1 lb/A in barley and flax for the control of 1 to 4 leaf wild oats. The higher rate of diclofop should be used to control wild oats in the 3 to 4 leaf stage or when plants are growing under moisture stress. Oil additive at 1 pt to 1 qt/A will provide more consistent control, especially under moisture stress conditions. Do not use oil additive with diclofop on barley or flax. Wild oats control with diclofop generally is better when cool rather than warm temperatures follow application. Diclofop should not be mixed with any broadleaf herbicide other than bromoxynil in flax and small grains or bromoxynil plus a low rate of MCPA ester (1.5 fl oz) in small grains. Research results at North Dakota State University indicate that application of diclofop and herbicides not registered for tank mixing should be separated by 4 days to avoid reduction in wild oats control.
42. AC 222,293 (Assert) at 0.38 to 0.47 lb/A provides postemergence wild mustard and wild oats control in wheat and barley. AC 222, 293 should be applied to wild oats in the 1 to 4 leaf stage when wheat and barley are in the 2 leaf to jointing stage of growth. AC 222,293 also gives good winter annual mustard control and suppresses wild buckwheat with 3 leaves or less. AC 222,293 has provided more consistent wild oats control with environmental stress than other postemergence wild oats herbicides in wheat and barley. Do not rotate to any crops except barley, corn, potatoes, sunflowers or wheat for at least 15 months after AC 222,293 application.

GREEN AND YELLOW FOXTAIL (PIGEONGRASS):

43. Foxtails commonly infest small grains in North Dakota. Foxtails usually are most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields which have been 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.
44. Diclofop (Hoelon) at 0.75 to 1.25 lb/A in wheat or soybeans or 0.75 to 1 lb/A in barley or flax applied postemergence controls foxtails in addition to wild oats. The lower rate is for green foxtail and yellow foxtail with 1 to 3 leaves. The higher rates are for foxtails growing in dry conditions or for foxtails with 3 to 4 leaves. Research at NDSU has indicated green foxtail is more susceptible than yellow foxtail to diclofop. (See wild oats section for information on diclofop mixtures with other herbicides, paragraph 41).

45. Propanil + MCPA ester (Stampede CM) at 0.94 + 0.25 lb/A (2.5 pts product) controls wild buckwheat, redroot pigweed and many other annual broadleaf weeds in Hard Red Spring wheat, durum wheat and barley. The propanil component of this mixture also controls foxtails. See tables for crop and weed stages. Propanil is not translocated, so good weed coverage by the spray is essential. Propanil should only be applied when temperatures at or after application are between 65 and 85 F and plants are actively growing with adequate soil moisture within 2 inches of the surface. Propanil should not be applied to wheat treated with carbamate or organophosphate insecticides or wheat grown on soil treated the previous year with organophosphate insecticides.

46. Trifluralin (Treflan) at 0.5 to 0.75 lb/A 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 oats. (See wild oats section for discussion on trifluralin-triallate combination, paragraph 36).

47. Trifluralin (Treflan) at 0.5 to 0.75 lb/A may be fall applied for control of foxtails on ground to be planted to wheat or barley the following spring. Some stand reduction may occur from fall applied trifluralin but wheat will usually tiller and compensate so no yield loss occurs. Trifluralin is available in both liquid and granular formulations. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue is at a manageable level that will not interfere with incorporation. Seed wheat or barley no more than 2 inches deep into a moist seedbed. See paragraph 151 for trifluralin applications in the fallow year for foxtail control in small grains the next year.

48. Chlorsulfuron (Glean) applied preemergence or early postemergence suppresses green and yellow foxtail. Glean can be applied preemergence in the fall or spring in wheat and durum, but not in barley and oats. Chlorsulfuron can be applied postemergence to oats, barley, durum, and hard wheat. Fall treatments generally provide better foxtail suppression than spring or postemergence treatments. Postemergence treatments should be applied with a nonionic surfactant at 0.12 to 0.25% v/v to foxtail with two leaves or less.

VOLUNTEER SUNFLOWER:

49. Volunteer sunflower is often a problem in small grains seeded in the rotation the year after sunflower and occasionally the 2nd year. Tillage practices distribute the sunflower seeds to various depths in the soil causing emergence over several days or weeks depending on climatic conditions. Judgement may be needed in determining the time of herbicide application. Early herbicide application would not

control late emerging sunflower and late application would allow competition from the early emerged sunflower. Generally application should be before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.

50. Bromoxynil at 0.25 lb/A plus MCPA ester at 0.25 lb/A (Bronate) give excellent control of volunteer sunflower. Treated sunflower appear severely burned within several days and die about 1 week after treatment. Chlorsulfuron (Glean) at 1/128 lb/A, Metsulfuron (Ally) at 1/267 lb/A, DPX-M6316 (Harmony) at 1/48 lb/A, dicamba (Banvel) at 0.12 lb/A plus MCPA amine at 0.25 lb/A, 2,4-D or MCPA at 0.5 lb/A, and picloram (Tordon) at 1/64 to 1/43 lb/A plus 2,4-D or MCPA at 0.37 lb/A all give good control of volunteer sunflower. These treatments will cause the sunflower to stop growing shortly after treatment, but they may remain green and alive for several weeks or more, depending on climatic conditions and crop competition. The approximate order of effectiveness on volunteer sunflower from most to least effective is chlorsulfuron, metsulfuron, DPX-M6316, bromoxynil + MCPA, dicamba + MCPA, 2,4-D + picloram, 2,4-D and MCPA.

KOCHIA:

51. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. The proper rates of herbicides and spray volumes for thorough coverage should be used to maximize control. Chlorsulfuron (Glean) at 1/64 lb/A, metsulfuron (Ally) at 1/267 lb/A and DPX-M6316 (Harmony) at 1/48 lb/A provide good kochia control unless resistant populations have developed (See paragraph 25). Addition of a nonionic surfactant at 0.12 to 0.25% v/v is essential for postemergence kochia control with chlorsulfuron, metsulfuron, and DPX-M6316. Dicamba (Banvel) at 0.125 lb/A plus MCPA amine at 0.25 lb/A gives good kochia control. Bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A also gives good control of kochia, but plants should be small and spray coverage good. 2,4-D at 0.5 lb/A gives good kochia control, but good spray coverage is essential because 2,4-D does not translocate readily in kochia. Treatment should be to small plants (less than 3 inches tall) or large spray volumes should be used to penetrate the kochia foliage. MCPA is less effective for kochia control than 2,4-D. However, MCPA at 0.5 lb/A will control small kochia. Picloram (Tordon) is not effective on kochia, but when combined with 2,4-D at 0.37 lb/A, especially the ester, control is good.

RUSSIAN THISTLE AND REDROOT PIGWEED:

52. Russian thistle and redroot pigweed are important weeds in small grains. Rates of most herbicides need to be higher for control of these weeds than for control of wild mustard. Chlorsulfuron (Glean) at 1/64 lb/A, metsulfuron (Ally) at 1/267 lb/A, and DPX-M6316 (Harmony) at 1/48 lb/A give good redroot pigweed and Russian thistle control unless resistant populations have developed (See paragraph 25). Dicamba (Banvel) at 0.12 lb/A, 2,4-D at 0.5 lb/A, bromoxynil at 0.25 lb/A, and picloram (Tordon) at 1/64 to 1/43 lb/A plus 2,4-D at 0.37 lb/A also give good Russian thistle and redroot pigweed control. MCPA is not as effective in controlling either weed. The esters of 2,4-D are generally more effective than the amines for both weeds.

FALSE CHAMOMILE:

53. False chamomile is an important weed in small grains in north central and northeastern North Dakota. False chamomile is resistant to most of the herbicides used in small grains except chlorsulfuron (Glean), metsulfuron (Ally) and DPX-M6316 (Harmony). Chlorsulfuron at 1/64 lb/A, metsulfuron at 1/267 lb/A, or DPX-M6316 at 1/48 to 1/32 lb/A control false chamomile. Refer to paragraphs 22 and 23 for information on chlorsulfuron and metsulfuron use and residues. Bromoxynil at 0.37 lb/A plus MCPA at 0.37 lb/A gives fair to good control of small spring emerging false chamomile. The fall emerging plants which survive spring seedbed preparation are usually too large at treatment for adequate control. Thorough fall and spring tillage is essential to control fall emerged chamomile. False chamomile less than 6 inches tall in tree rows and around potholes can be controlled with paraquat (Gramoxone Super) at 0.5 lb/A with a nonionic surfactant at 0.25% v/v. Glyphosate (Roundup) at 0.75 lb/A and amitrole (Amitrole T, Cytrol) at 1.5 lb/A control false chamomile less than 6 inches tall and can be used in tree rows and around potholes. Avoid drift to tree foliage when applying glyphosate or amitrole.

HARROWING FOR WEED CONTROL:

54. Harrowing a few days after a spring sown crop has sprouted but before it has emerged is effective in reducing stands of foxtails, wild oats and other weeds. The weeds must be emerging. Since foxtails are shallow rooted and easily controlled, set the teeth back on the harrow to minimize crop injury. Small grains can be harrowed after they have emerged and have 2 or 3 leaves but before tillering. Soil moisture should be good but with a dry solid surface. Wheat can be harrowed one to three times, but barley only once. Oats normally are not harrowed because it is injured more easily than wheat and barley.

FLAX

55. Flax is less competitive with weeds than are small grains, and should be grown on relatively weed-free fields. Early post-harvest tillage of small grain stubble will prevent weed seed production, suppress perennial weeds and encourage annual weed seed germination prior to freeze-up. Weed problems will be reduced when weeds are controlled in the preceding crop. Flax may be seeded directly or with shallow spring tillage in fields which did not have weed seed produced the previous year. Deep tillage on such fields could bring dormant seeds to the surface, increasing weed problems. If fields are weedy, moldboard plowing after a year of weed seed production will bury the weed seeds, reducing the weed infestation in the following crop season. Moldboard plowing is especially effective in reducing infestation of small seeded weeds like foxtails and kochia which have short seed survival. Delayed seeding of flax with tillage prior to seeding will control wild oats 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. Flax is a poor competitor with weeds so control is needed before or soon after emergence to reduce flax yield losses. Preemergence herbicides control weeds before emergence which eliminates early weed competition and maximizes flax yields. Postemergence 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 applications to larger weeds and flax.

56. EPTC (Eptam, Genep) fall applied at 4 lb/A controls annual grass weeds, including foxtails and wild oats, and some broadleaf weeds in flax. Fall applied EPTC at 3 lb/A in coarse textured soils generally has given good control with less flax injury than 4 lb/A. Incorporate EPTC immediately (within minutes) and thoroughly after application. (See paragraph 11 for incorporation discussion). Flax stunting and stand loss may occur from EPTC application. Usually flax yields will not be reduced because the remaining plants will recover, branch out and compensate for a thin stand.
57. Trifluralin (Treflan) at 0.5 to 1.0 lb/A may be fall applied for control of foxtails and some broadleaf weeds on ground to be planted to flax. 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 is at a manageable level that will not interfere with incorporation. Seed flax less than 1.5 inches deep into a moist seedbed.
58. The flowable formulation of propachlor (Ramrod 4L) can be applied preemergence to control certain annual grasses and broadleaf weeds but is ineffective against wild oats, wild mustard and perennial weeds. Flax tolerance to preemergence propachlor is excellent but incorporation will injure flax and reduce weed control.
59. MCPA at 0.25 lb/A on 2 to 6-inch flax controls many broadleaf weeds. MCPA amine rates higher than 0.25 lb/A and MCPA ester should be used in flax for improved kochia and Russian thistle control. Picloram (Tordon) + MCPA amine enhances redroot pigweed and wild buckwheat control.

60. Bromoxynil (Buctril) at 0.25 lb/A on 2 to 6-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some leaf burn may be observed at the higher rates or if high temperatures follow application. Mixtures of bromoxynil + MCPA may cause flax injury if applied under hot, humid conditions.
61. Diclofop (Hoelon) at 0.75 to 1.0 lb/A will control foxtail and wild oats in flax. Apply diclofop at the 1 to 4 leaf stage of foxtail and wild oats. Diclofop can be tank mixed with bromoxynil for broadleaf weed control. Do not use oil additive with diclofop in flax. Broadleaf herbicides other than bromoxynil should not be applied within 4 days of diclofop application.
62. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses. See discussion under soybeans for application rates and stages to control different weed species, Paragraph 98. Apply sethoxydim to actively growing grasses and do not apply to grasses under stress. Do not apply after 75 days before flax harvest. Sethoxydim plus oil additive can be tank mixed with bromoxynil at 0.25 lb/A or MCPA at 0.25 lb/A for broad spectrum weed control. Apply the tank mixtures at the optimum time for weed control with the broadleaf herbicide. Bromoxynil or MCPA applied with sethoxydim may cause leaf burn, retarded growth, and delayed maturity of the crop. Grass control from sethoxydim may be reduced when applied as a tank mixture with bromoxynil or MCPA, especially the amine formulation of MCPA.

CORN

63. A combination of cultural, mechanical and chemical methods is necessary for consistently effective weed control in corn. Control early germinating weeds by cultivation before planting if conventional tillage is used. A rotary hoe can be used to control emerging weeds when the corn is beyond the spike stage. Cultivation between the rows should be done soon after weeds emerge.

Package Mixtures Available For Corn:

Trade Name	Common Name	Act. Ingrid. lb/gal
Atrabute +	(butylate + atrazine)	4.8 + 1.2
Bicep	(metolachlor + atrazine)	3.3 + 2.7
Bronco	(alachlor + glyphosate)	2.6 + 1.4
Buctril + Atrazine	(bromoxynil + atrazine)	1.0 + 2.0
Conquest	(cyanazine + atrazine)	3.0 + 1.0
Extrazine	(cyanazine + atrazine)	2.0 + 1.0
Extrazine II	(cyanazine + atrazine)	3.0 + 1.0
Laddok	(bentazon + atrazine)	1.7 + 1.7
Lariat	(alachlor + atrazine)	2.5 + 1.5
Lasso/atrazine	(alachlor + atrazine)	2.5 + 1.5
Marksman	(dicamba + atrazine)	1.1 + 2.2
Prozine	(pendimethalin + atrazine)	1.5 + 1.5
Ramrod/atrazine	(propachlor + atrazine)	3.0 + 1.0
Rhino	(butylate + atrazine)	4.3 + 1.7
Sutazine +	(butylate + safener + atrazine)	4.8 + 1.2
Torch	(bromoxynil + atrazine) twin pack	1.8 + 2.5

64. Most herbicides used in corn are labeled for tank mixing with other herbicides for broad spectrum weed control. A number of commercial herbicide mixtures also are available for use in corn. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete list of all possible registered combinations.
65. Wild proso millet is an aggressive, competitive annual weed that is becoming a serious problem in some areas of eastern North Dakota. EPTC + Safener (Eradicane), EPTC + Safener + Extender (Eradicane Extra), alachlor (Lasso) or metolachlor (Dual) applied preplant incorporated at the high label rate for the soil type will give control of early germinating wild proso millet. However, these herbicides usually do not give season long millet control. EPTC + Safener + Extender may give slightly better control than EPTC + Safener since it is formulated with an extender which increases the soil life of the herbicide. For full season control of wild proso millet, a preplant incorporated treatment of EPTC + Safener or EPTC + Safener + Extender can be followed with a delayed preemergence application of cyanazine (Bladex), cyanazine plus alachlor (Lasso) or metolachlor (Dual), or an early post application of cyanazine (Bladex 80W), tridiphane (Tandem) plus atrazine and/or cyanazine, or pendimethalin (Prowl) plus cyanazine (corn at 2-leaf stage or smaller).
66. Atrazine (AAtrex, Atrazine) at 2 to 4 lb/A gives good control of annual weeds without corn injury. Fine textured soils with high organic matter require a 4 lb/A application. Atrazine residues injurious to susceptible crops may remain in soils longer than one growing season. (See paragraph 16 in herbicide residue section for additional discussion). Atrazine is registered as a tank mixture with alachlor (Lasso), bromoxynil (Buctril), butylate (Sutan +, Genate +), cyanazine (Bladex), dicamba (Banvel), metolachlor (Dual), propachlor (Propachlor, Ramrod), simazine (Princep), and simazine plus paraquat (Gramoxone Super). Atrazine is also available as a prepackage mix with several chemicals. See table on Package mixtures.
67. Alachlor (Lasso) at 2 to 4 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A are used preplant incorporated or preemergence for control of annual grasses and certain broadleaf weeds such as redroot pigweed, common lambsquarters and common ragweed. Use the higher rate on clay soils high in organic matter. Incorporation improves weed control with alachlor and metolachlor. Alachlor is registered as a tank mixture with atrazine, dicamba, cyanazine, glyphosate (Roundup), paraquat, and simazine. Metolachlor is registered as a tank mixture with atrazine, cyanazine, dicamba or with atrazine plus paraquat or glyphosate. Metolachlor may be applied up to 45 days before planting.
68. Propachlor (Propachlor, Ramrod) applied pre-emergence at 4 to 5 lb/A controls annual grasses and some broadleaf weeds but is ineffective against wild mustard or perennial weeds. Propachlor generally has given weed control superior to alachlor and metolachlor in North Dakota State University experiments. Propachlor is registered as a tank mixture with atrazine.
69. Butylate plus Safener (Sutan +, Genate +) at 3 to 6 lb/A preplant incorporated, controls annual grasses and some broadleaf weeds. Butylate is a volatile herbicide and must be incorporated immediately following application. Safener increases the tolerance of corn to butylate. Butylate generally is tank mixed with another herbicide to provide broad spectrum weed control. Butylate is registered as a tank mixture with atrazine and cyanazine.
70. Cyanazine (Bladex) at 1.2 to 4.75 lb/A preemergence controls annual grasses and broadleaf weeds in corn. Use the higher rates on fine textured, high organic matter soils, and the lower rates on coarse textured soils with low organic matter. Do not use on sandy or loamy sand soils, or on soils with less than 1% organic matter. Cyanazine requires 0.5 inch or more rain for activation, especially on fine textured soils. Cyanazine has a short soil residual permitting normal crop rotations. Mixtures of cyanazine with metolachlor, propachlor, alachlor and EPTC improve grassy weed control. Cyanazine alone gives poor to fair redroot pigweed control. Cyanazine is difficult to tank-mix with other herbicides. For best results, premix the cyanazine as a slurry, fill the spray tank at least half full of water and while the pump and agitator are running, add the cyanazine. Once the cyanazine is completely suspended in the water, add the other herbicide while filling the tank with water to the desired level.
71. Dicamba (Banvel) at 0.25 to 0.5 lb/A applied preemergence in tank mixtures with alachlor, atrazine, cyanazine, metolachlor, pendimethalin, or simazine gives broad spectrum weed control. The mixture is not recommended on coarse-textured sandy soils. Use the lower rate of dicamba on medium silt loams with 2 percent or less organic matter.
72. EPTC plus Safener (Eradicane) and EPTC plus Safener plus Extender (Eradicane Extra) at 4 to 6 lb/A control grasses and certain broadleaf weeds. EPTC at 6 lb/A gives fair to good quackgrass control. Safener increases the tolerance of corn to EPTC. The Extender extends EPTC soil life under certain conditions. Soil should be dry enough and in good till to permit immediate and thorough incorporation. EPTC + Safener and EPTC + Safener + Extender are registered as a tank mixture with atrazine and cyanazine. EPTC + Safener + Extender is more effective on wild proso millet than EPTC + Safener when soils have been conditioned for rapid EPTC breakdown.
73. Pendimethalin (Prowl) at 1.5 to 2 lb/A controls annual grasses and certain broadleaf weeds such as redroot pigweed. Pendimethalin should be used only preemergence in corn and not preplant incorporated. Do not use pendimethalin on sands or loamy sands or on soils with less than 1.5 percent organic matter. Pendimethalin is registered as a tank mixture with atrazine, cyanazine and dicamba.
74. Atrazine at 1 lb/A applied to broadleaf weeds less than 4 inches tall or at 2 lb/A applied to grasses less than 1 inch tall gives good wild oats control, partial foxtail (pigeongrass) control, and excellent control of broadleaves (including volunteer sunflower) when used in combination with petroleum oil concentrate or vegetable oil. Vegetable oils at 1 qt/A with atrazine

give weed control equal to petroleum oil concentrate at 1 qt/A with atrazine. Surfactants and wetting agents are less effective with atrazine than any of the oil additives. Refer to herbicide residue section, paragraph 16, for carryover precautions.

75. Cyanazine (Bladex 80W or 90DF) is labeled at 1.2 to 2 lb/A as an early post-emergence treatment for grass and broadleaf weed control (including volunteer sunflower). Addition of an emulsifiable vegetable oil (Bio-Veg or Midland EV) at 1 qt/A enhances weed control, but may also increase the risk of crop injury. Only the 80W or 90DF formulations are registered for postemergence weed control. Cyanazine at 1.2 lb/A with 1 qt/A of vegetable oil has given good control of small weeds (less than 1.5 inches tall). Occasionally corn leaf burn occurs, but recovery is good. Higher rates will give more consistent weed control but also increase the possibility of corn injury. Corn should not be treated after the 4th leaf stage, when under stress, or during extended cold, wet conditions. Cyanazine is unlikely to carryover and cause crop injury the next year. The 1.2 lb/A rate in fine-textured soils only controls emerged weeds.

76. Tridiphane (Tandem) + atrazine or cyanazine provides optimum control of annual grasses including foxtail, wild oats, and wild proso millet when applied after the 1st flush of annual grass is in the 1 to 3 leaf stage. Application to larger grass or those not actively growing may result in reduced weed control. Cultivation 7 to 14 days after application or a follow-up treatment of atrazine or cyanazine may improve control. A three way tank mixture of tridiphane, atrazine, and cyanazine is registered for use in areas where atrazine carryover is a concern. See the label for further details. Use lower rates on coarse textured soils and higher rates on fine textured soils.

77. 2,4-D amine at 0.25 to 0.5 lb/A applied postemergence to corn 3 to 8 inches tall will control broadleaf weeds. 2,4-D at 0.25 lb/A will control susceptible weeds like wild mustard. The 0.5 lb/A rate will control the more resistant weeds (including volunteer sunflower) but corn may be injured. Do not use MCPA, as it is more injurious to corn than 2,4-D. When corn is over 8 inches tall, application of 2,4-D with drop nozzles reduces crop injury by avoiding treatment of upper leaves and whorl. Corn sprayed with 2,4-D may become brittle, with the result that stalks may lodge or break.

78. Dicamba (Banvel) may be applied alone at 0.5 lb/A as an early postemergence treatment in corn from emergence to 5 inches tall. Dicamba gives better control of Canada thistle, smartweed, wild buckwheat and volunteer sunflower than 2,4-D with less injury to corn. Dicamba alone at 0.25 lb/A should be applied if corn is greater than 5 inches tall or at 0.12 to 0.25 lb/A when combined with 2,4-D. Dicamba can be applied until corn is 3 feet tall or until 15 days before tassel emergence. Drop nozzles should be used after corn is 8 inches tall to reduce injury if dicamba is applied with 2,4-D and to reduce drift potential. Dicamba also can be mixed with cyanazine and atrazine.

79. Bromoxynil (Buctril) at 0.25 lb/A on 3 leaf to tasselling corn controls seedling wild buckwheat, volunteer sunflower, and most annual broadleaf weeds. Some corn leaf burn may occur when high temperatures

follow application of bromoxynil. Bromoxynil is a contact herbicide so thorough spray coverage is essential for adequate weed control. Bromoxynil can be mixed with atrazine to increase the spectrum of weed control. A commercial mixture of bromoxynil plus atrazine (Buctril + atrazine) is available.

80. See discussion under soybeans for the use of bentazon (Basagran) on corn, paragraph 94.

81. Emergency control of broadleaf and grass weeds in corn can be obtained with directed applications of ametryn (Evik) or paraquat (Gramoxone Super). Ametryn at 2 to 2.5 lb/A or paraquat at 0.28 lb/A should be applied as a directed spray to the weeds. A nonionic surfactant should be used with both herbicides. Application over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply ametryn before corn is 12 inches high or paraquat before corn is 10 inches high. Weeds should be less than 4 inches tall.

SOYBEANS

82. Soybeans are poor competitors with weeds when cool soil temperatures cause slow germination and growth, but are good competitors in warm soils when germination and growth are rapid. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to a soybean crop that will compete with weeds. Soybean production requires good cultural practices. Prepare the seed-bed immediately prior to planting the crop to kill germinating weeds. A rotary hoe or harrow may be used to control weeds after planting but before the soybeans emerge or after emergence when soybeans are in the 1 to 2 trifoliolate leaf stage. Preemergence herbicides will not be inactivated by the rotary hoe or harrow. The rotary hoe is an effective and economical weed control method when the ground is not trashy, lumpy or wet and when weeds are emerging, not more than 0.25 inch tall. Cultivation is most effective when the soybeans are slightly wilted during the warm part of the day, because the crop is less susceptible to breakage and the weeds will die quickly.

83. Most herbicides used in soybeans are labeled for tank mixing with other herbicides for broad spectrum weed control. A number of commercial herbicide mixtures also are available for use in soybeans. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete listing of registered combinations.

Package Mixtures Available For Soybeans:

Trade Name	Common Name	Act. Ingrid. lb/gal
Cannon	(alachlor + trifluralin)	2.5 + 0.5
Commence	(clomazone + trifluralin)	3.0 + 3.0
Galaxy	(acifluorfen + bentazon)	0.67 + 3.0
Rescue	(naptalam + 2,4-D)	2.0 + 0.06
Salute	(metribuzin + trifluralin)	1.1 + 2.9
Turbo	(metolachlor + metribuzin)	6.55 + 1.45

84. Wild proso millet is an aggressive, competitive annual weed that is becoming a serious problem in some areas in eastern North Dakota. In soybeans, trifluralin (Treflan), pendimethalin (Prowl) or ethalfluralin (Sonalan) will suppress wild proso millet. For long term control, however, a preplant incorporated treatment of any of these herbicides should be followed with a delayed preemergence application of alachlor (Lasso), metolachlor (Dual), or chloramben (Amiben), or a postemergence application of fluzifop-P (Fusilade 2000), sethoxydim (Poast), fenoxaprop (Whip), or quizalofop (Assure) (see tables for rates). Preplant incorporated treatments of alachlor or metolachlor applied alone or in combination with chloramben (Amiben) at the full label rate for the soil type have also given acceptable wild proso millet control in some experiments.
85. Ethalfluralin (Sonalan), pendimethalin (Prowl) and trifluralin (Treflan) are dinitroaniline herbicides applied preplant incorporated for control of annual grasses and broadleaf weeds except wild mustard, common cocklebur and sunflower. Proper timing and depth of incorporation for each herbicide are essential as requirements differ.
86. Ethalfluralin (Sonalan) at 0.5 to 1.3 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. The low rate should be used on coarse-textured, sandy soils. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Ethalfluralin is registered as a tank mixture with chloramben, alachlor, metolachlor, metribuzin or clomazone. Ethalfluralin has less soil residue than trifluralin.
87. Pendimethalin (Prowl) at 1.0 to 1.5 lb/A is applied preplant incorporated or preemergence to control annual grasses and certain broadleaf weeds. The high rate should be used on heavy clay soils. Incorporation if rainfall does not occur within 7 days after application improves control. Pendimethalin is registered as a tank mixture with alachlor, chloramben, clomazone, linuron, metolachlor, and metribuzin. See herbicide residue section, Paragraph 17.
88. Trifluralin (Treflan) at 0.5 to 1 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. Set the implement at a 4 to 6 inch depth to uniformly mix trifluralin in the soil. 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. Do not plant soybeans deeper than 2 inches. Trifluralin is registered as a tank mixture with alachlor, chloramben, clomazone, metolachlor, and metribuzin. See herbicide residue section, Paragraph 17.
89. Alachlor (Lasso) at 2 to 4 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A give good preemergence control of annual grasses and some broadleaf weeds, including redroot pigweed, black nightshade, and common lambsquarters, but are ineffective against wild mustard. Apply the higher rate on clay soils high in organic matter. Soybeans have good tolerance to metolachlor and alachlor and incorporation improves the consistency of weed control. Alachlor and metolachlor are registered as a tank mixture with several herbicides.
90. Chloramben (Amiben) at 2 to 3 lb/A is applied preemergence to control most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at NDSU indicates that incorporation of chloramben improves the consistency of wild mustard control. Chloramben is registered as a tank mixture with alachlor, clomazone, ethalfluralin, linuron, metolachlor, metribuzin, pendimethalin and trifluralin.
91. Metribuzin (Sencor, Lexone) at 0.19 to 0.37 lb/A controls annual broadleaf weeds, especially wild mustard. The rate is critical. Consult the label for the proper rate based on soil type, pH, and percent organic matter. Maple Amber soybeans are susceptible to metribuzin. Seed soybeans 2 inches below the soil surface to reduce possible injury. Soybean injury also can be reduced by using herbicide combinations with lower rates of metribuzin. Metribuzin is registered as a tank mixture with alachlor, chloramben, clomazone, ethalfluralin, metolachlor, pendimethalin and trifluralin.
92. Clomazone (Command) at 0.75 to 1.0 lb/A applied preplant incorporated controls certain annual grass and broadleaf weeds. Clomazone should be incorporated within 3 hours of application to avoid vaporization and off-site movement. Clomazone effectively controls velvetleaf and common lambsquarters, but does not adequately control redroot pigweed or wild mustard. Do not rotate to small grains, sunflowers, or flax the year following clomazone application. Clomazone is registered as a tank mixture with trifluralin, ethalfluralin, pendimethalin, alachlor, metolachlor, and metribuzin.
93. Acifluorfen (Blazer, Tackle) at 0.25 to 0.5 lb/A postemergence controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the higher rates are needed for nightshade, smartweed and common cocklebur. Acifluorfen will not adequately control volunteer sunflower. Acifluorfen kills primarily by contact action, thus for effective control, applications should be made to actively growing 1 to 4 inch weeds and 1st to 2nd trifoliolate soybeans. Soybeans beyond the 3rd trifoliolate leaf stage may intercept the spray pattern and prevent spray coverage of the weeds. Application should be made by ground sprayer delivering a minimum of 20 gallons per acre at 40 psi. Do not make application during periods of moisture stress, frost, flooding, wind damage or unseasonably cool or hot temperatures as weed control may be reduced or crop injury increased. Best results are obtained with applications at maximum daytime temperatures of 70 to 85 F. Do not apply if rain is expected within 6 hours after application as weed control is reduced. Surfactants should be used with acifluorfen except under conditions outlined on the label. A nonionic surfactant (80 percent active ingredient) should be added to the tank at the rate of 0.12 percent. Do not apply within 50 days of harvest or use treated plants for feed or forage.

94. Bentazon (Basagran) at 0.75 to 1.5 lb/A postemergence controls many broadleaf weeds. In North Dakota good wild mustard control has been obtained with a 0.5 lb/A when wild mustard is small (less than 4 inches tall) and when used with an oil additive. For volunteer sunflower control, apply 0.75 lb/A to plants less than 5 inches and 1 lb/A to plants 5 to 8 inches tall. An oil additive with bentazon improves weed control. Bentazon at 1 lb/A with oil additive gives good control of common lambsquarters less than 1.5 inches tall and fair to good control of redroot pigweed less than 1.5 inches tall. Soybean leaf burn occurs occasionally from bentazon application, but recovery is good. For Canada thistle control apply 1 lb/A when the plants are 8 inches tall to bud stage and make a second application at 1.0 lb/A 7 to 10 days later.
95. Lactofen (Cobra) at 0.20 lb/A postemergence controls many broadleaf weeds. Lactofen kills primarily by contact action, and thus thorough spray coverage of the weeds is essential for good control. Soybeans beyond the 3rd trifoliolate leaf stage may interfere with the spray pattern and reduce coverage of the weeds. Application should be made by ground sprayer delivering 15 to 30 gpa at 40 psi. Do not make application during periods of moisture stress, frost, flooding, wind damage, or unseasonably cool or hot temperatures as weed control may be reduced or crop injury increased. Best results are obtained at maximum daytime temperatures of 70 to 85 F. Addition of an oil additive at 0.5 to 1 pt/A generally increases weed control, but also may increase crop injury. Do not apply within 90 days of harvest or use treated plants for feed or forage.
96. Fenoxaprop (Whip) at 0.1 to 0.15 lb/A plus oil additive at 1 qt/A can be applied in soybeans for postemergence annual grass control. Fenoxaprop at 0.10 lb/A will control green foxtail, volunteer corn and wild proso millet. Yellow foxtail, wild oats, barnyardgrass, and crabgrass can be controlled with fenoxaprop at 0.15 lb/A. Fenoxaprop generally will not provide good volunteer small grain control. Tank mixing acifluorfen, bentazon, or lactofen with fenoxaprop has often reduced grass control compared to fenoxaprop plus oil additive alone. Reduced grass control can be avoided by applying fenoxaprop at least 1 day before or 5 days after application of a broadleaf herbicide.
97. Fluazifop-P (Fusilade 2000) at 0.09 to 0.19 lb/A + oil additive at 1 percent v/v can be applied in soybeans for annual and perennial grass control. Fluazifop-P at 0.09 lb/A will control volunteer corn and wild proso millet. Fluazifop-P at 0.12 lb/A will control wild oats and volunteer grains. Fluazifop-P at 0.19 lb/A will control foxtails. Quackgrass with at least 4 leaves but less than 10 inches tall can be suppressed with fluazifop-P at 0.19 lb/A. If regrowth occurs, a second application of 0.19 lb/A should be applied when quackgrass regrowth has 3 to 5 leaves. Mixing fluazifop-P with other herbicides may reduce weed control and increase crop injury. Reduced grass control can be avoided by applying fluazifop-P at least 1 day before or 5 days after application of a broadleaf herbicide.
98. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive at 1 qt/A will control annual and perennial grasses. Methylated vegetable oil (SUN-IT by Agsco) and Dash (BASF) additives have enhanced grass control with sethoxydim more than petroleum oil or unmodified vegetable oil additives. Application rates for several grass species are 0.1 lb/A for wild proso millet, 0.2 lb/A for volunteer corn, green foxtail, yellow foxtail, and barnyardgrass, and 0.3 lb/A for wild oats and volunteer cereals. Quackgrass 6 to 8 inches tall can be suppressed with sethoxydim at 0.5 lb/A. Quackgrass regrowth should be treated with 0.3 lb/A. Cultivation between 14 to 21 days after application will improve quackgrass control. Mixing desmedipham (Betanex), desmedipham + phenmedipham (Betamix), endothall (H-273), acifluorfen or bentazon with sethoxydim has generally reduced wild oats control and occasionally reduced foxtail control compared to sethoxydim plus oil additive alone. Also, oil additives have frequently increased crop injury when combined with desmedipham, desmedipham + phenmedipham, endothall, or acifluorfen. Reduced grass control can be avoided by applying sethoxydim at least 1 day before or 5 days after application of a broadleaf herbicide.
99. Quizalofop (Assure) at 0.06 to 0.12 lb/A plus crop oil concentrate at 1% v/v will provide postemergence control of annual and perennial grasses in soybeans. Quizalofop at 0.06 lb/A will control volunteer corn and wild proso millet. Foxtails, volunteer small grains, and wild oats can be controlled with quizalofop at 0.09 lb/A. Quizalofop should be applied at 0.12 lb/A for quackgrass control. If quackgrass regrowth occurs, make a second application at 0.09 lb/A. Tank-mixing acifluorfen, bentazon, or lactofen with quizalofop has often reduced grass control compared to quizalofop alone. Reduced grass control can be avoided by applying quizalofop at least 1 day before or 5 days after application of a broadleaf herbicide. Quizalofop should not be applied with vegetable oil additives due to reduced grass control. However, methylated vegetable oils (Sun-It) have performed equal to petroleum based oil additives with quizalofop.
100. Naptalam + 2,4-DB (Rescue) at 1 to 1.5 + 0.03 to 0.045 lb/A may be applied for salvage control of common cocklebur, giant ragweed, and volunteer sunflower 10 inches or taller in soybeans. Apply after 1st bloom of soybeans because earlier application may cause soybean injury. Apply with a nonionic surfactant or oil additive at 0.5 percent v/v (2 qt/100 gal spray solution). Applications should be made in 10 to 25 gallons per acre water (by ground) with 40-50 psi spray pressure and nozzles 18 to 24 inches above the weeds. Avoid drift to susceptible crops like sunflowers.

BLACK NIGHTSHADE:

101. Black nightshade is an annual weed which is difficult to control in most row crops and causes harvest problems in soybeans and dry beans. Even low populations of black nightshade can interfere with bean harvest because the nightshade berries are sticky and cause clogging of combines as well as staining the beans and lowering quality. Metolachlor (Dual), alachlor (Lasso), and chloramben (Amiben) preemergence or preplant incorporated provide good black nightshade control in soybeans, dry beans, and sunflowers. Incorporation generally improves the consistency of control in North Dakota. High rates of

ethalfuralin (Sonalan) or EPTC preplant incorporated give fair to good black nightshade control in dry beans. Acifluorfen (Blazer, Tackle), and lactofen (Cobra) postemergence provide good control of black nightshade with less than 4 leaves in soybeans, but can not be used in dry beans. Bentazon (Basagran) is weak on black nightshade.

DRY, EDIBLE BEANS

102. Navy beans generally have less tolerance to herbicides than other dry beans or soybeans. CAUTION: Use lower rates of herbicides on navy beans than other beans unless prior experience or research has shown the higher rates to be safe.
103. See discussion under soybeans for use of bentazon (Basagran), paragraph 94; chloramben (Amiben), paragraph 90; pendimethalin (Prowl), paragraph 87; and trifluralin (Treflan), paragraph 88. See paragraph 101 for black nightshade control. The rate of bentazon in dry beans should not exceed 1.0 lb/A. The use of oil with bentazon may increase dry bean injury. Alachlor (Lasso) at 2 to 3 lb/A preplant incorporated or metolachlor (Dual) at 2 to 3 lb/A preplant incorporated or pre-emergence controls annual grasses and some broadleaf weeds, including black nightshade. Metolachlor may be tank mixed with EPTC (Eptam, Genep) for wild oats control.
104. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus pendimethalin (Prowl) at 0.5 to 1.5 lb/A controls a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats, lambsquarters, and black nightshade. The EPTC plus pendimethalin mixture must be incorporated thoroughly immediately after application by setting the implement at a 4 to 6 inch depth. Do not use on flat podded beans such as soybeans.
105. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus trifluralin (Treflan) at 0.5 lb/A is a tank mixture to control a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats and black nightshade and reduces the chance of trifluralin carryover. The EPTC-trifluralin mixture must be incorporated thoroughly immediately after application by setting the implement at a 4 to 6 inch depth. Do not use this combination in soybeans.
106. Ethalfuralin (Sonalan) at 0.5 to 1.7 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds except wild mustard, common cocklebur, and sunflower. The low rate should be used on coarse-textured, sandy soils. The high rate should be used for control of eastern black nightshade. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Ethalfuralin is registered as a tank mixture with chloramben, alachlor, metolachlor, and EPTC. Ethalfuralin has less soil residue than trifluralin.

LENTILS

107. Lentils are poor competitors with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when plants are 3 to 7 inches high.
108. Triallate (Far-Go) at 1.25 lb/A can be applied for wild oats control before or after seeding lentils. Triallate is volatile and must be incorporated into the soil immediately after application.
109. Propham (ChemHoe) applied preplant incorporated at 4 lb/A will control wild oats and volunteer grains. Lentils should be planted not later than 1 to 2 days after propham incorporation with an implement set 4 inches deep.
110. Barban (Carbyne 2EC) applied postemergence to lentils at 0.37 lb/A will control wild oats. Application should be made when wild oats seedlings are in the 1.5 to 2 leaf stage and within 30 days after lentil emergence. Do not allow livestock to graze treated fields until after harvest.

SUNFLOWER

111. Weeds usually are a problem as sunflower does not develop ground cover rapidly enough to prevent weeds from becoming established. Since weeds generally emerge before the sunflower, cultivating with a spike-tooth or coil spring harrow about 1 week after sowing but prior to emergence of the crop will kill many weeds. After sunflower reaches the 4 to 6 leaf stage, weeds may be controlled in the row by using a harrow or rotary hoe. Cultivation will control weeds between the rows.
112. EPTC (Eptam, Genep), ethalfuralin (Sonalan), pendimethalin (Prowl) and trifluralin (Treflan) are preplant incorporated herbicides. See paragraphs 1 to 5 for discussion on herbicide incorporation. Ethalfuralin and trifluralin are applied on sandy soil at 0.56 to 0.75 and 0.5 lb/A respectively. EPTC must be applied and incorporated immediately to prevent herbicide loss. EPTC is registered at 3 lb/A for sunflower but this rate occasionally has caused sunflower injury on coarse-textured, low organic matter soils. The risk of sunflower injury from EPTC can be reduced on these soils by using 2 to 2.5 lb/A. EPTC may be applied in late fall before soil freeze-up at 4.0 lb/A on coarse textured soil and 4.5 lb/A on fine and medium textured soil. EPTC has given more effective control of wild oats in sunflower than pendimethalin and trifluralin. EPTC, pendimethalin, and trifluralin are labeled for tank mixing with chloramben (Amiben) to improve wild mustard control. Ethalfuralin is labeled for tank mixing with chloramben and EPTC (EPTAM only). Rainfall after application is needed for weed control with surface applied pendimethalin. Pendimethalin applied up to 30 days before planting is more likely to receive adequate rainfall for activation than pendimethalin applied at planting.
113. Alachlor (Lasso) at 3.0 lb/A controls annual grasses and some broadleaf weeds including redroot

pigweed and common lambsquarters, but is ineffective against wild mustard. Research at NDSU has shown that, on coarse textured soils, alachlor at 2 lb/A has given adequate annual grass control. Sunflowers have good tolerance to alachlor. Incorporation improves consistency of weed control. Alachlor is registered as a tank mixture with chloramben.

114. Chloramben (Amiben) at 2 to 3 lb/A preemergence controls most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the levels of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at NDSU indicates that incorporation of chloramben improves the consistency of wild mustard control.
115. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses in sunflowers. Do not apply sethoxydim within 70 days of harvest or feed treated sunflower forage to livestock. See discussion under soybeans for use of sethoxydim (Poast), Paragraph 98.
116. AC 222,293 (Assert) at 0.19 to 0.38 lb/A provides postemergence wild mustard and wild oats control in sunflowers. The lower rates are for wild mustard control, the high rate is for wild oats control. AC 222,293 should be applied to sunflowers before they exceed the 8 leaf stage or 15 inches in height. Sunflower injury has occurred with late treatments and applications with high temperatures.

SUGARBEETS

117. Herbicides may be used in sugarbeets 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. Herbicides not in the sugarbeet narrative are discussed in the table.
118. Herbicides are commonly used as tank mixtures on sugarbeets. Some herbicide combinations such as desmedipham plus phenmedipham (Betamix) 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 sugarbeets. However, the user must assume liability for any resulting crop injury, inadequate weed control, or illegal and/or harmful residues.
119. EPTC (Eptam, Genep) preplant incorporated in the spring at 2 to 3 lb/A or in the fall at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC sometimes causes a sugarbeet stand reduction and temporary stunting. However, if enough sugarbeets remain to obtain an adequate plant population after thinning, no yield reduction will result. Use EPTC with extreme caution on sugarbeets grown in sandy loam or lighter soils with low organic matter levels because predicting a safe

rate on such soils is difficult. See paragraph 7 on the soil organic matter test. Herbicides such as cycloate (Ro-Neet), ethofumesate (Nortron) or pyrazon (Pyramin) cause less sugarbeet injury on the low organic matter soils where EPTC injury may be excessive.

120. EPTC (Eptam, Genep) plus cycloate (Ro-Neet) has less potential for sugarbeet injury than EPTC alone and is less expensive per acre than cycloate alone. The rate of application of the mixture must be adjusted for soil texture and organic matter. Suggested fall applied rates are: cycloate alone on soils with less than 3 percent organic matter, EPTC + cycloate at 1 + 3 lb/A on loam or coarser soils with 3 percent organic matter, 1.5 to 2.5 lb/A on loam to clay loam soils with 3 to 4 percent organic matter, 2 + 2 lb/A on clay loam soils with 3.5 to 4.5 percent organic matter, and 2.5 + 2.5 lb/A on clay or clay loam soils with over 4.5 percent organic matter. Suggested spring applied rates are: cycloate alone at 3 lb/A on loam or coarser soils with 3 percent or less organic matter, EPTC + cycloate at 1 + 2.5 lb/A on loam or coarser soils with 3 to 3.5 percent organic matter, 1.5 + 2.5 lb/A on loam to clay loam soils with 3.5 to 4.5 percent organic matter, and 2 + 2 lb/A on clay loam or finer soils with 4 percent or more organic matter. These rates may need to be adjusted on certain fields or with certain incorporation tools based on individual experience. EPTC, cycloate, or EPTC + cycloate require immediate incorporation for best weed control.
121. Ethofumesate (Nortron) at 2 to 3.75 lb/A gives good control of several broadleaf and grass weeds. Ethofumesate is particularly effective on redroot pigweed and wild buckwheat but is weak on yellow foxtail. Generally, ethofumesate should be used with herbicides like cycloate (Ro-Neet) or fall-applied EPTC for improved grass control. Ethofumesate is not registered for fall application so ethofumesate would be used as a spring overlay to fall-applied EPTC. Ethofumesate may be applied preemergence but research results in North Dakota and Minnesota indicate that incorporation generally improves weed control. Operating the incorporation tool 2 to 4 inches deep gave slightly better weed control compared to 1 inch. Band application of ethofumesate reduces cost and soil residue, thus band incorporation equipment is needed. See paragraph 21 on ethofumesate residue. Ethofumesate has been relatively safe on sugarbeets but use of ethofumesate with cycloate or fall-applied EPTC can cause sugarbeet injury especially on coarse-textured soils. Ethofumesate plus spring-applied EPTC has been especially injurious to sugarbeets and should only be used on silty clay soils with over 6 percent organic matter.
122. Diethatyl (Antor) spring applied at 4 to 6 lb/A gives good to excellent control of redroot pigweed and prostrate pigweed. Diethatyl may be applied preemergence but tests in North Dakota and Minnesota showed that incorporation generally improved weed control. Operating the incorporation tool 2 inches deep often gave better weed control than operating the incorporation tool 4 inches deep. Thus, deep incorporation of diethatyl should be avoided unless diethatyl is combined with EPTC or cycloate. Operating the incorporation tool 4 inches deep did not reduce weed control from diethatyl + EPTC or

diethyl + cycloate combinations. Preemergence diethyl will give good weed control if adequate rain follows application.

LEGUMES

123. Endothal (Herbicide 273) at 0.75 to 1.5 lb/A gives good postemergence control of wild buckwheat, smartweed and sunflower. Endothal should be applied when temperatures are between 60 and 80 F and soil moisture is good to excellent. Endothal generally gives poor weed control when weeds are drought stressed.
124. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses in sugarbeets. See discussion under soybeans for use of sethoxydim (Poast), paragraph 98.
125. Desmedipham (Betanex) and desmedipham plus phenmedipham (Betamix) are postemergence herbicides for the control of annual broadleaf weeds. Sugarbeet injury occasionally occurs from desmedipham and phenmedipham. Sugarbeets with 4 true leaves are significantly less susceptible to injury than smaller sugarbeets and they gain additional tolerance with increased size. Desmedipham at 0.25 to 0.5 lb/A or desmedipham plus phenmedipham at 0.12 to 0.25 plus 0.12 to 0.25 lb/A may be applied to sugarbeets with less than 4 leaves. Applications totalling 0.5 lb/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 a single full dose application. Risk of sugarbeet injury is reduced by starting application in late afternoon so cooler temperatures follow application while risk is increased by factors such as recent flooding, high temperature, and especially a sudden change from a cool, cloudy environment to a hot, sunny environment.
126. Trifluralin (Treflan) at 0.75 lb/A or EPTC (Eptam, Genep) at 3 lb/A can be used on sugarbeets after thinning for annual grass and broadleaf weed control. Broadcast and incorporate immediately with cultivators or tillage tools adjusted to mix the herbicides thoroughly with soil in the row without damaging the sugarbeets. The crop should be clean cultivated before application since established weeds are not controlled. Trifluralin or EPTC will control late germinating weeds that become a problem in sugarbeets with early seeding or when good moisture conditions prevail well into the season.
127. Clopyralid (Stinger) at 0.09 to 0.25 lb/A postemergence controls several broadleaf weeds and volunteer crops. Clopyralid at 0.09 to 0.19 lb/A is most effective when applied to common cocklebur, giant ragweed, volunteer sunflower, wild sunflower, volunteer alfalfa, and volunteer soybeans up to the six-leaf stage, common ragweed up to the five-leaf stage, and wild buckwheat in the three to five-leaf stage before vining begins. Clopyralid at 0.19 to 0.25 lb/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. Clopyralid must be applied to sugarbeets in the two to eight-leaf stage and at least 105 days prior to harvest. Clopyralid is not registered for application by aircraft.
128. Seedling legumes usually are poor competitors with weeds. Good management practices in preceding crops are recommended such as clean cultivation in row crops and post-harvest tillage to reduce the amount of weed seeds in the soil. Weed control for establishment of legumes when sown alone can be aided by mowing (except sweetclover), herbicides, or by seeding a companion crop.
129. Trifluralin (Treflan) at 0.50 to 0.75 lb/A can be applied preplant incorporated for annual grass and some annual broadleaf weed control only in legumes established on acres enrolled in the government set-aside program. Do not use on acres not in a government program. Some legume injury may occur.
130. Sethoxydim (Poast) at 0.19 to 0.5 lb/A plus oil additive at 1 qt/A can be applied postemergence for grass control in seedling and established alfalfa. Alfalfa is tolerant at all growth stages. Apply sethoxydim to actively growing grasses and do not apply to grasses under stress. Allow grass to produce new regrowth after clipping before treating with sethoxydim. Do not feed, graze, or harvest forage for 7 days, or feed or harvest hay for 20 days after application. See discussion under soybeans for application rates and stages to control different weed species, Paragraph 98.
131. Bromoxynil (Buctril) at 0.25 to 0.38 lb/A can be applied to seedling alfalfa for postemergence broadleaf weed control. Bromoxynil should be applied to alfalfa with a minimum of 2 trifoliolate leaves and to weeds with 4 leaves or less, or before rosettes are 1.5 inches in diameter. Alfalfa leaf burn can occur with bromoxynil, especially if warm weather follows treatment. Do not apply bromoxynil to alfalfa if the temperature at or within 3 days after treatment is expected to exceed 70 F. Do not graze or harvest treated alfalfa within 30 days of spring treatment or 60 days of fall treatments.
132. Metribuzin (Sencor, Lexone) at 0.38 to 1 lb/A, terbacil (Sinbar) at 0.4 to 1.2 lb/A and pronamide (Kerb) at 1 to 2 lb/A can be applied to dormant alfalfa in the fall for grass and broadleaf weed control in alfalfa. Metribuzin and terbacil also can be applied to dormant alfalfa in early spring. All three herbicides can injure alfalfa. Do not apply until alfalfa has been established at least one year. Do not graze or harvest alfalfa treated with metribuzin for 28 days after treatment. Do not graze or harvest alfalfa treated with pronamide within 25 days (below 1.5 lb/A) to 45 days (1.5 to 2 lb/A) after application. Do not rotate to any other crop within 2 years after treatment of terbacil.

GRASSES AND RANGELAND

133. Chlorsulfuron (Glean) can be applied preemergence at not more than 1/64 lb/A or postemergence at not more than 1/43 lb/A for broadleaf weed control in CRP acreage seeded to blue grama, bluestem, meadow bromegrass, buffalograss, galleta, green needlegrass, Indian ricegrass, prairie sandreed, sand

dropseed, sand lovegrass, side oats grama, switchgrass, wheatgrass, and Russian or beardless wild-rye. Postemergence treatments should be applied in combination with 0.25% v/v nonionic surfactant to 3 to 4 leaf grasses. Chlorsulfuron may be applied postemergence only, at not more than 1/43 lb/A, to tillered stands of bentgrass and orchardgrass. The maximum use rate is 1/43 lb/A on soils having a pH less than 6.5 and 1/64 lb/A on soils having a pH of 6.6 to 7.5. Legumes in the seeding mixture may be severely injured or killed following an application of chlorsulfuron. Grass grown on CRP acres can not be grazed or used for hay. Refer to Paragraph 22 for chlorsulfuron persistence and rotational guidelines.

PERENNIAL WEED CONTROL

134. Fall herbicide treatments are more effective than spring or summer treatments for controlling perennial weeds. The optimum time of treatment for many perennial weeds usually is between August 20 and September 10, but treatments later in September can be successful if most weed stem and leaf tissue has not been killed by frost. Weeds such as field bindweed, leafy spurge and Canada thistle should have 12 inches or more of stem tissue before treatment for adequate leaf area to absorb the herbicide. Mowing or tillage is a good means of reducing perennial weed seed production but should be discontinued in mid-July to allow adequate plant regrowth by herbicide treatment time. Post-harvest treatments can be used when weed growth has reached approximately 1 foot of stem tissue. A pre-harvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment and swathing should be separated by at least 5 days to allow adequate herbicide translocation.
135. Glyphosate (Roundup) at 1.5 to 3.75 lb/A may be applied for spot treatment of perennial weeds in wheat, barley, oats, corn and soybeans. Spot treatments must be made prior to the heading stage of small grains, initial pod set on soybeans and silking of corn. Glyphosate is a nonselective postemergence herbicide so the crop in the treated area will be killed, and care must be taken to avoid drift outside the target area. Glyphosate does not have a soil residual, so plants arising from seed after treatment or unaffected underground rhizomes or roots of perennials will continue to grow. See the perennial weed control section of the tables for application stages and rates.

PERENNIAL WEEDS IN SMALL GRAINS:

136. Perennial weed control systems in small grains should include herbicide application in the crop followed by post-harvest treatment for several years. Canada thistle can be controlled in small grains with chlorsulfuron (Glean) at 1/43 lb/A. Canada thistle and perennial sowthistle can be controlled in wheat and barley with metsulfuron (Ally) or clopyralid plus 2,4-D (Curtail). Canada thistle, perennial sowthistle, and field bindweed can be controlled in tolerant crops with MCPA or 2,4-D. When controlling thistles in small grains, except oats, apply the maximum rate of 2,4-D or MCPA the crop will tolerate: 0.75 lb/A of 2,4-D or MCPA amine and 0.66 lb/A of 2,4-D low volatile

ester or MCPA ester. MCPA is less likely to cause injury to small grain crops than 2,4-D. MCPA can be used to suppress thistles in oats and flax. However, these crops do not tolerate rates of MCPA necessary to give adequate thistle control. For control of perennial broadleaf weeds after harvest or during fallow dicamba (Banvel) can be tank mixed with 2,4-D or glyphosate (Roundup). Tank mix dicamba at 0.5 to 2 lb/A with glyphosate at 0.75 to 1.5 lb/A. In situations where a short waiting period requires the lower rate of dicamba, tank mix with the higher rates of glyphosate.

PERENNIAL WEEDS IN PASTURE:

137. Picloram (Tordon) controls broadleaf perennial weeds such as leafy spurge, common milkweed, field bindweed, Canada thistle and Russian knapweed on rangelands and permanent grass pastures. Rates of 1 to 2 lb/A give good control of these weeds and are economical for spot treatment. Picloram at 0.25 to 0.5 lb/A postemergence will suppress the growth of perennial broadleaf weeds. Retreatment at the same rates may be necessary the following year. The most cost effective broadcast treatment for leafy spurge control in the spring is picloram at 0.25 lb/A + 2,4-D at 1 lb/A applied annually in the spring for 3 to 5 years.
138. Picloram (Tordon) is toxic to most broadleaf plants. Spray drift in small amounts may cause damage to sensitive plants. Alfalfa, dry beans, soybeans, potatoes, safflower, sunflower, sugarbeets and vegetable crops are highly susceptible to picloram. Picloram 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. Do not apply or allow picloram spray drift into running water (including wells), irrigation ditches for drainage or near shelterbelts, shrubs or trees. When picloram has been applied at 0.5 lb/A or more, do not cut grass for feed within 2 weeks after treatment. Meat animals grazing for up to 2 weeks after treatment should be removed from treated areas 3 days prior to slaughter. Do not graze dairy animals on treated areas within 2 weeks after treatment. Picloram 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 owners acreage found in any particular watershed for rates exceeding 1 qt/A.
139. 2,4-D low volatile ester at 1 to 2 lb/A can be used to control many perennial weeds in pastures. Some perennials such as fringed sagebrush and western snowberry (buckbrush) can be controlled with one application, but many perennials such as Canada thistle, field bindweed and leafy spurge require retreatment annually. 2,4-D can be used in many locations where picloram cannot be used. However, 2,4-D drift onto sensitive plants such as trees should be avoided. Dairy cows cannot be grazed on treated areas for 7 days after treatment. Some formulations of 2,4-D are cleared for use near water. See individual labels for further details.

CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

140. Dicamba (Banvel) at 0.5 to 8 lb/A can be used to control some perennial weeds, especially weeds that are resistant to 2,4-D, or for some areas where soil residual of picloram may cause problems. Dicamba at 0.5 to 1 lb/A will suppress some perennials. When applying dicamba at 1 lb/A or less, use 0.5 percent v/v surfactant or ammonium sulfate at 17 lb/100 gal of spray solution. Long-term control generally is achieved with 2 to 8 lb/A but the high rates are economical only for spot treatment. Dicamba has a shorter soil residual than picloram, but should not be applied where desirable broadleaf plants or trees may be damaged by dicamba leached to the root system. Do not graze meat animals in treated fields within 30 days of slaughter. The required delay between treatment and grazing of dairy animals or cutting for hay varies with rate from 7 to 90 days, so the label should be consulted for this information.
141. The wiper-type applicators can be used to apply picloram for leafy spurge control in pastures. The wiper-type applicators include carpet-wick, canvas-wick and roller applicators but not rope-wick applicators. Research at NDSU has shown that leafy spurge control with picloram applied with a wiper applicator was similar to picloram broadcast at 1.0 lb/A. The solution concentration applied with the wiper applicator should be 1 part picloram (Tordon 22K): 3 to 7 parts water. The more concentrated solution has been more effective when leafy spurge densities are high. The wiper height should be adjusted to contact most of the leafy spurge stems. Application can be made any time after the leafy spurge is 15 to 20 inches tall until freezing temperatures occur in the fall. The amount of picloram applied has been reduced 50 to 70 percent when using the wiper applicator in dense infestations as compared to picloram broadcast at 2 lb/A. Retreatment with 2,4-D at 1 to 2 lb/A may be necessary the following year to control seedlings.
142. Triclopyr plus 2,4-D (Crossbow) at 0.5 to 3 lb/A plus 0.25 to 1.5 lb/A can be applied to grass pastures for broadleaf weed and brush control. Triclopyr 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.
143. Sulfometuron (Oust) is labelled for NON-CROPLAND use only. Sulfometuron must be applied with 2,4-D or picloram for satisfactory leafy spurge control. Application should be made during the true flower growth stage or from mid-August to late September. **NOTE** Sulfometuron will cause some grass suppression or injury and injury will increase from 20 to 100 percent when application is delayed to late in the growing season, if a surfactant is used or if sulfometuron is applied for two consecutive years. Application after September 1 has given season-long leafy spurge control the following season, when applied with picloram, but not 2,4-D. A follow-up treatment will be needed to maintain satisfactory leafy spurge control.
144. Paraquat (Gramoxone Super, Cyclone), a nonselective contact herbicide, can be used at 0.5 lb/A alone or at 0.25 to 0.5 lb/A in combination with a residual herbicide as a substitute for tillage. Paraquat may be applied before or after planting until just before crop emergence. Apply paraquat in 5 to 10 gallons per acre of water by air or in 20 to 60 gallons per acre of water by ground. Add X-77 surfactant to the spray solution at 0.12 to 0.25% v/v. Paraquat can be used on land intended for barley, corn, potatoes, soybeans, sugarbeets, sunflower and wheat. Paraquat is corrosive to exposed 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.
145. Glyphosate (Roundup) is applied postemergence for annual weed control in reduced tillage situations at 0.19 to 0.75 lb/A. Glyphosate at 0.19 to 0.37 lb/A must be used in combination with a nonionic surfactant of at least 50 percent active ingredient at 0.5 percent v/v. Addition of ammonium sulfate at 17 pounds per 100 gallons of water improves the consistency of weed control with glyphosate, especially if environmental stress or water quality is a concern. Add ammonium sulfate to the water slowly and make sure it is completely dissolved before adding herbicides or surfactant. Glyphosate at 0.19 lb/A controls foxtails, 0.29 lb/A controls volunteer small grains, and 0.38 lb/A controls wild oats and downy brome when applied to plants less than 4 inches tall. Use a higher rate on larger weeds, more resistant weeds, or if plants are under moisture stress. When low rates of glyphosate are used, apply in 3 to 10 gallons of water per acre by ground or 3 to 5 gallon per acre by air. Delay tillage for at least 3 days after treatment. Apply glyphosate at 0.75 lb/A when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing. Apply glyphosate at 1.5 to 2.25 lb/A when Canada thistle is actively growing and at or before the bud stage. Fall treatment of Canada thistle must be applied before frost for best results. Do not till until 3 or more days after treatment. Glyphosate can be used in the spring before or after planting but before emergence of barley, corn, oats, soybeans, dry beans, forages, potatoes, sugarbeets, wheat, and sorghum (milo), or in the fall when these crops will be planted the next growing season. Potential crop injury exists when glyphosate + 2,4-D or dicamba mixtures are applied immediately before or after planting due to the preemergence soil activity of 2,4-D and dicamba.
146. For postharvest or fallow weed control in minimum till situations dicamba (Banvel) at 0.08 to 0.25 lb/A or 2,4-D at 0.17 to 0.6 lb/A can be tank mixed with glyphosate at 0.19 to 0.38 lb/A. Commercial mixtures of dicamba plus glyphosate (Fallow Master) and 2,4-D plus glyphosate (Landmaster II, Landmaster BW) are available. Add a nonionic surfactant at 0.5 percent v/v to the spray solution. Further addition of ammonium sulfate at 17 lb per 100 gallons of spray solution improves consistency of control, especially if environmental stress or water quality is a concern. Delay planting of wheat, barley, oats, 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 only when weeds are less than 4 inches tall and actively growing. Use glyphosate at 0.38 lb/A if weeds are drought stressed or greater than 4 inches tall.

147. Cyanazine (Bladex 80W) is applied preemergence at 2.4 to 3.2 lb/A to control annual weeds on fallow for future planting to wheat, barley, oats, sorghum or corn. Bladex 4L is ineffective because of adsorption to plant residues. Cyanazine is a short residual herbicide so carryover to succeeding crops is unlikely. Rainfall is required for activation of cyanazine. Generally 0.5 inch will be adequate if the soil is wet to a depth of 1.5 to 2 inches. Whenever possible, cyanazine should be applied at a time when rainfall can be expected within about 10 days. A late fall application about 2 weeks ahead of expected soil freeze-up will result in adequate control of early germinating weeds the following spring and generally has been more effective than spring applications. Spring applications of cyanazine should be made as soon as practical after the soil thaws to take advantage of early spring rains for activation and to move the herbicide into the soil before weeds germinate. If winter annual or annual weeds have emerged, a tank mix of paraquat and cyanazine should be applied because cyanazine does not adequately control emerged weeds.
148. A tank mixture of cyanazine at 2 to 2.8 lb/A plus atrazine at 0.4 to 0.5 lb/A is labeled in North Dakota for annual weed control in fallow. Soils with 3 to 4 percent organic matter require the high rate of cyanazine. The cyanazine plus atrazine combination gives increased residual weed control compared to cyanazine alone. The tank mix combination must be applied before November 15 of the year preceding the planting of winter wheat. Atrazine preemergence at

0.5 to 1 lb/A will control annual weeds including downy brome (cheatgrass) during the fallow period of a wheat-fallow-wheat rotation. See tables for restrictions on atrazine use. Allow 12 or more months between application and planting. If weeds are emerged but less than 6 inches tall at application, a tank mixture of atrazine with paraquat should be applied. A nonionic surfactant should be added to both mixtures.

149. Propham (ChemHoe 135) can be applied at 3 to 4 lb/A for control of downy brome, wild oats and volunteer grain in fallow. The higher rate of application is for use on medium and fine-textured soils. Propham should be applied in the fall after soil temperatures have cooled to 50 F or cooler in the upper inch of soil. The lower temperature reduces herbicide loss by volatility and degradation by soil microbes. Precipitation after propham application is necessary for effective weed control.
150. Clomazone will control volunteer wheat and kochia but often may be unsatisfactory on Russian thistle and will not give adequate control of redroot pigweed, foxtails (pigeongrass), and wild mustard. Dry conditions during weed emergence in early spring and summer may give unsatisfactory performance. Carryover injury in wheat is possible following clomazone applications and can be recognized as yellowing or bleaching (whitening) of seedling plants. Do not apply clomazone within 1000 ft. of emerged winter wheat, towns, and subdivisions, or commercial nurseries, greenhouses, fruit, or vegetable production sites due to drift injury potential.
151. Trifluralin (Treflan TR-10) granules at 0.5 to 1.0 lb/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.

Trifluralin (Treflan TR-10) Rates Per Acre

Application Date	Areas with Less than 10" Annual Rainfall		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.

GLOSSARY OF CHEMICAL NAMES

TRADE NAME^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS^{2/}
Amibon (DuPont)	Metsulfuron	60% DF
Amiben (Rhône-Poulenc)	Chloramben	10% G, 75% SP, 1.8 lb/gal S
Amitrole T (Rhône-Poulenc)	Amitrole	2 lb/gal S
Antor (Nor-Am)	Diethatyl	4 lb/gal E
Assert (American Cyanamid)	AC 222,293	2.5 lb/gal S
Assure (DuPont)	Quizalofop	0.8 lb/gal E
Atrazine (Various)	Atrazine	80% WP, 90% DF 4 lb/gal F
Avadex (Monsanto)	Diallate	4 lb/gal E 10% G
Avenge (American Cyanamid)	Difenzoquat	2 lb/gal S
Balan (Elanco)	Benefin	1.5 lb/gal E
Banvel (Sandoz)	Dicamba	4 lb/gal S, 10% G
Basagran (BASF)	Bentazon	4 lb/gal S
Betamix (Nor-Am)	Desmedipham + Phenmedipham	0.65 + 0.65 lb/gal E
Betanex (Nor-Am)	Desmedipham	1.3 lb/gal E
Bicep (Ciba-Geigy)	Atrazine + Metolachlor	2.7 + 3.4 lb/gal F
Bladex (DuPont)	Cyanazine	80% WP, 90% DF 4 lb/gal F
Blazer (BASF)	Acifluorfen	2 lb/gal E, S
Bronate (Rhône-Poulenc)	Bromoxynil + MCPA	2 + 2 lb/gal E
Bronco (Monsanto)	Alachlor + Glyphosate	2.6 + 1.4 lb/gal E
Buckle (Monsanto)	Triallate + Trifluralin	10% + 3% G
Buctril (Rhône-Poulenc)	Bromoxynil	2 lb/gal E
Butyrac Ester & 200 (Rhône-Poulenc)	2,4-DB	2 lb/gal E, S
Butoxone (Vertac)	2,4-DB	1.75 lb/gal amine S 2 lb/gal E
Carbyne 2EC (Sandoz)	Barban	2 lb/gal E
Cobra (Valent)	Lactofen	2 lb/gal S
Command (FMC)	Clomazone	4 lb/gal E

^{1/} "Various" means there are numerous trade names and manufacturers for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

^{2/} G = Granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wettable powder.

TRADE NAME^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS^{2/}
Commence (Elanco and FMC)	Trifluralin + Clomazone	3 + 3 lb/gal E
Conquest (DuPont)	Cyanazine + Atrazine	3 + 1 lb/gal
Crossbow (Dow)	Triclopyr + 2,4-D	2 + 1 lb/gal S
Curtail (Dow)	Clopyralid + 2,4-D	0.38 + 2 lb/gal S
Cyclone (ICI)	Paraquat	2 lb/gal S
Cytrol (American Cyanamid)	Amitrole	2 lb/gal S
Defol (6) (Drexel)	Sodium chlorate	3 or (6) lb/gal S
Des-i-cate (Pennwalt)	Endothall (As a desiccant)	0.52 lb/gal S
Dual (Ciba-Geigy)	Metolachlor	25% G, 8 lb/gal E
Eptam (ICI)	EPTC	7 lb/gal E 10% G
Eradicane (ICI)	EPTC + Safener	6.7 lb/gal E
Eradicane Extra (ICI)	EPTC + Safener + Extender	6.0 lb/gal E
Evik (Ciba-Geigy)	Ametryn	80% WP
Extrazine (Dupont)	Cyanazine + Atrazine	2 + 1 lb/gal F
Extrazine II (DuPont)	Cyanazine + Atrazine	3 + 1 lb/gal F
Fallow Master (Monsanto)	Glyphosate + Dicamba	1.1 + 0.5 lb/gal S
Far-Go (Monsanto)	Triallate	4 lb/gal E 10% G
Fusilade 2000 (ICI)	Fluazifop-P	1 lb/gal E
Galaxy (BASF)	Acifluorfen + Bentazon	0.67 + 3 lb/gal S
Genate (Valent)	Butylate + Safener	6.7 lb/gal E
Genep (Valent)	EPTC	7 lb/gal E
Glean (DuPont)	Chlorsulfuron	75% DF
Gramoxone Super (ICI)	Paraquat	1.5 lb/gal S
Harmony (DuPont)	DPX-M6316	75% DF
Herbicide 273 (Pennwalt)	Endothall	3 lb/gal S
Hoelon (Hoechst-Roussel)	Diclofop	3 lb/gal E
Krenite (Dupont)	Fosamine	4 lb/gal S

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2/ G = Granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wetttable powder.

TRADE NAME^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS^{2/}
Laddok (BASF)	Bentazon + Atrazine	1.7 + 1.7 lb/gal F
Landmaster BW (Monsanto)	Glyphosate + 2,4-D	0.9 + 1.5 lb/gal S
Landmaster II (Monsanto)	Glyphosate + 2,4-D	0.9 + 0.8 lb/gal S
Lariat (Monsanto)	Alachlor + Atrazine	2.5 + 1.5 lb/gal F
Lasso (Monsanto)	Alachlor	4 lb/gal E, 4 lb/gal MT, 15% G
Leafex-3 (J.R. Simplot)	Sodium chlorate	3 lb/gal S
Lexone (DuPont)	Metribuzin	75% DF, 4 lb/gal F
Lorox (DuPont)	Linuron	50% WP 4 lb/gal F
MCPA (Various)	MCPA	Various E, S
Marksman (Sandoz)	Dicamba + atrazine	1.1 + 2.1 lb/gal
Nortron (Nor-Am)	Ethofumesate	4 lb/gal F, 1.5 lb/gal E
One Shot (Hoechst-Roussel)	Diclofop + Bromoxynil + MCPA	1.88 + 0.58 + 0.12 lb/gal E
Poast (BASF)	Sethoxydim	1.5 lb/gal E
Princep (Ciba-Geigy)	Simazine	80% WP, 4 lb/gal F, 4% G, 90% DF
Prowl (American Cyanamid)	Pendimethalin	4 lb/gal E
Prozine (American Cyanamid)	Pendimethalin + Atrazine	1.5 + 1.5 lb/gal
Pyramin (BASF)	Pyrazon	4.2 lb/gal F,
Ramrod (Monsanto)	Propachlor	65% WP, 4 lb/gal F 20% G
Rescue (Unlroyal)	Naptalam + 2,4-DB	2 + 0.06 lb/gal
Ro-Neet (ICI)	Cycloate	6 lb/gal E 10% G
Roundup (Monsanto)	Glyphosate	3 lb/gal S
Salute (Mobay)	Trifluralin + Metribuzin	2.7 + 1.3 lb/gal F
Sencor (Mobay)	Metribuzin	4 lb/gal F, 75% DF, 50% WP
Showdown (Monsanto)	Triallate	20% G
Sonalan (Elanco)	Ethalfuralin	3 lb/gal E
Stampede CM (Rohm & Haas)	Propanil + MCPA	3.0 + 1.4 lb E
Stinger (Monsanto)	Clopyralid	3 lb/gal S

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^{2/} G = Granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wettable powder.

TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Sutan + (ICI)	Butylate + Safener	6.7 lb/gal E, 10% G
Sutazine + (ICI)	Butylate + Safener + Atrazine	4.8 + 1.2 lb/gal F
Tackle (Rhone Poulenc)	Acifluorfen	2 lb gal S
Tandem (Dow)	Tridiphane	4 lb/gal E
Tordon 22K (Dow)	Picloram	2 lb/gal S
Treflan (Elanco)	Trifluralin	4 lb/gal E, 10% G
Turbo (Mobay)	Metribuzin + Metolachlor	1.5 + 6.5 F
2,4-D (Various)	2,4-D	Various E, S
Weedmaster (Sandoz)	Dicamba + 2,4-D	1 + 2.9 lb/gal S
Whip (Hoechst-Roussel)	Fenoxaprop	1.5 lb/gal E

1/ "Various" means there are numerous trade names and manufacturers for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

2/ G = Granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wettable powder.

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

	Barnyardgrass	E. Black nightshade	Cocklebur	Field bindweed	Perennial thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oats	Herbicide Persistence After 12 Months
PREPLANT INCORPORATED															
Butylate (Sutan, Genate)	G-E	F	P	N	N	E	—	P	F	P	N	P	P	G	N
Cycloate (Ro-Neet)	E	F-G	P	N	N	E	P	F-G	G	P	N	P-F	P	G	N
EPTC (Eptam, Genep)	E	F-G	P	N	N	E	F	F	G	P	N	F	P	G	N
Ethalfuralin (Sonalan)	E	G	P	N	N	E	G-E	E	E	G-E	N	F	N	G	S
Ethofumesate (Nortron)	P	F-G	P	N	N	F-G	F-G	P-F	G-E	F-G	P	F-G	F	G	O
Pendimethalin (Prowl)	E	N	N	N	N	E	G	G	G-E	F	N	N	N	F-G	S
Trifluralin (Treflan)	E	N	P	N	N	E	G	G	G-E	G	N	F	N	F-G	S
PREEMERGENCE INCORPORATED															
Di- & Triallate (Avadex, Far-Go)	N	N	N	N	N	N-F	N	N	N	N	N	N	N	G-E	N
Trifluralin (Treflan)	E	N	N	N	N	E	F-G	F-G	F-G	F-G	N	N	N	P	S

E = Excellent; G = Good; F = Fair; P = Poor; N = None; S = Seldom; O = Often

*Except where resistant populations have developed

This table is a general comparative rating of the relative effectiveness of herbicides to certain weeds and persistence of herbicides in soil. Under very favorable weather conditions, control might be better than indicated. Under unfavorable conditions, some herbicides rated good or fair might give erratic or unfavorable results. Also, relatively dry and/or cool weather increases herbicide persistence while wet and/or warm weather reduces herbicide persistence.

	Barnyardgrass	E. Black nightshade	Cocklebur	Field bindweed	Perennial thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oats	Herbicide Persistence After 12 Months
PREEMERGENCE															
Alachlor (Lasso)	G-E	G	N	N	N	E	F	F	G	F	N	F	P	P	N
Atrazine (AAtrex)	G	E	F-G	F	F	F-G	E	E	E	E	G	E	E	E	O
Chloramben (Amiben)	G	G	P	N	N	G	F	E	E	G	N	G	G	F	N
Cyanazine (Bladex)	F	F	F	N	N	G	G-F	E	F-G	E	F	G	E	F	N
Diethatyl (Antor)	F-G	F-G	P	P	P	F-G	P	P	G	P	P	P	P	F-G	N
Hexazinone (Velpar)	G	—	—	—	—	G	P	F	F	P	—	P	F	F	O
Metolachlor (Dual)	G-E	G	N	N	N	E	F	F	G	F	N	F	P	N	N
Metribuzin (Lexone, Sencor)	F	P	F	N	N	F	G	F	E	E	P	F	E	P	S
Pendimethalin (Prowl)	E	N	N	N	N	E	G	G	G	F	N	N	N	F	S
Propachlor (Ramrod)	E	—	P	N	N	G-E	G	F	E	P	N	F	P	P	N
POSTEMERGENCE															
AC 222,293 (Assert)	P	—	P	N	N	P	P-F	P	P	P-F	N	F-G	E	E	S
Acifluorfen (Blazer/Tackle)	N	G	F	F	F	P-F	F-G	F	E	P	P	G	E	N	N
Atrazine + oil	G	G	G	F	F	G	E	E	E	E	G	G	E	G-E	S
Barban (Carbyne)	N	N	N	N	N	N	N	N	N	N	N	F	N	F-G	N
Bentazon (Basagran)	N	F	G	F	F-G	N	F-G	F	F	P	E	P	E	N	N
Bromoxynil (Buctril)	N	G	G	F	F	N	F	G	F-G	E	G-E	E	F-G	N	N
Bromoxynil + MCPA (Bronate)	N	G-E	G	F	F-G	N	E	E	G	E	E	E	E	N	N
Chlorsulfuron (Glean)	—	N	G	P	G	F-G	E*	G	E	E*	E	G	E	N	O
Clomazone (Command)	F-G	P	F	N	N	F-G	G-E	F-G	P	F-G	F-G	F-G	F	G	O
Clopyralid (Stinger)	N	P	E	P	G-E	N	N	P	P	N	G-E	F-G	P	N	S
Clopyralid + 2,4-D (Curtail)	N	F	E	G	G-E	N	F-G	G	G	G	E	G	E	N	S
Cyanazine + oil (Bladex)	G	G	G	P	P	G	G	G	F-G	G	E	G	E	F-G	N
Desmedipham + Phenmedipham (Betamix)	P	G	F-G	N	N	F	F	G	F-G	P	P	F-G	G	N	N
Desmedipham (Betanex)	P	G	P-F	N	N	P	P-F	G	G	P	P	F	G	N	N
Dicamba (Banvel)	N	E	E	G-E	G-E	N	E	G	G	G	E	E	E	N	S
Dicamba + MCPA	N	E	E	G	G	N	G-E	E	G	E	E	G-E	E	N	N
Diclofop (Hoelon)	F	N	N	N	N	G-E	N	N	N	N	N	N	N	G-E	N
Difenzoquat (Avenge)	N	N	N	N	N	N	N	N	N	N	N	N	N	G-E	N
DPX-M6316 (Harmony)	P	P	G	N	N	P	E*	G	E	E*	E	G-E	E	N	N
Endothall (Herbicide 273)	N	—	P-F	N	N	N	P	P	F	P	F-G	G	F	N	N
Fenoxaprop (Whip)	E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
Fluazifop-P (Fusilade 2000)	E	N	N	N	N	G-E	N	N	N	N	N	N	N	E	N
Glyphosate (Roundup)	E	—	—	F	G	E	F-G	G	G	F-G	G	F	G	E	N
Lactofen (Cobra)	N	G	G	F	F	P-F	G	F	E	P	F	G	E	N	N
MCPA	N	G	G	F-G	F-G	N	F	E	F	P	G	N	E	N	N
Metsulfuron (Ally)	N	P	E	P	G	N	E*	E	E	E*	E	F	E	N	O
Paraquat	G	—	—	N	N	G	G	E	E	F	E	F	E	G	N
Picloram (Tordon 22K) + 2,4-D	N	E	E	G-E	G-E	N	F-G	E	E	G-E	E	E	E	N	O
Propanil + MCPA (Stampede CM)	G	—	G	F	F	G	G	E	E	F	G	G-E	E	N	N
Quizalofop (Assure)	E	N	N	N	N	E	N	N	N	N	N	N	N	E	N
Sethoxydim (Poast)	G-E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
2,4-D	N	F-G	G-E	F-G	F-G	N	F-G	E	E	G	E	P-F	E	N	N

E = Excellent; G = Good; F = Fair; P = Poor; N = None; S = Seldom; O = Often

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This table is a general comparative rating of the relative effectiveness of herbicides to certain weeds and persistence of herbicides in soil. Under very favorable weather conditions, control might be better than indicated. Under unfavorable conditions, some herbicides rated good or fair might give erratic or unfavorable results. Also, relatively dry and/or cool weather increases herbicide persistence while wet and/or warm weather reduces herbicide persistence.

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