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1988 AGRICULTURAL WEED CONTROL GUIDE

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NDSU EXTENSION SERVICE

North Dakota State University, Fargo, ND 58105

INTRODUCTION

THE WEED CONTROL SUGGESTIONS presented in this guide are based on Federal label clearances 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), diallate (Avadex), diclofop (Hoelon), paraquat (Gramoxone Super, Cyclone) sulfuric acid, amitrole (Amitrol-T, Cytrol), and cyanazine (Bladex).

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 ($3 \div 0.80 = 3.75$).

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.

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 are used at 1% v/v (1 gallon per 100 gallons of spray solution) or at 1 to 2 pt/A depending upon herbicide. 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.

Ideal temperatures for applying most postemergence herbicides are between 65 and 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	4 hours	difenzoquat (Avenge)	6 hours
barban (Carbyne)	5 minutes	fenoxaprop (Whip)	1 hour
bentazon + oil (Basagran)	8 hours	fluazifop-P (Fusilade 2000)	1 hour
bromoxynil (ME4 Brominal, Buctril)	1 hour	glyphosate (Roundup)	6 hours
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 + phenmedi- pham (Betamix)	6 hours	propanil + MCPA (Stampede CM)	4 hours
dicamba (Banvel)	6-8 hours	sethoxydim (Poast)	1 hour

SPRAY AND VAPOR DRIFT:

Offtarget 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 reduce drift. Drift control techniques should not be used with postemergence herbicides that require small droplets for optimum performance such as barban (Carbyne 2EC), desmedipham (Betanex), and bentazon (Basagran).

f) Drift injury from herbicides: Damaging drift to non-target plants is primarily a problem with 2,4-D, MCPA, dicamba, paraquat (Gramoxone), glyphosate (Roundup), and picloram (Tordon) in North Dakota. Other herbicides may drift but generally do not cause significant damage.

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. The 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 which are 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), diallate (Avadex), EPTC (Eptam, Genep, Eradicane, Eradicane Extra), ethalfluralin (Sonalan), triallate (Far-go) 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.

HERBICIDE 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 following 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.

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 with glyphosate have in- creased spectrum of weeds controlled. Commercial formu- lation of 2,4-D + Roundup (0.8 lb + 0.9 lb) mixture (Land- master II) available.	137
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 her- bicide.	136

* 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. Ingre. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Triallate (Far-go)	1 (1 qt 4E, 10 lb 10G)	Wild oats	Three days or more prior to seeding or immediately after seeding.	Preplant incorpo- rate with field cultivator set to cut 4 inches deep. Postplant incor- porate with harrow set shallower than seed depth.	5, 121
	1 liquid (1 qt) 1.25 granule (12.5 lb10G)		Fall-after October 15 and until freeze-up.	Keep spring tillage depth to minimum. Triallate granules may be surface ap- plied without incor- poration in the fall.	5,13
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.	5,121
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, 121
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Foxtails (pigeongrass)			4,36
	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, 14,18, 37
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broadleaf weeds and suppression of foxtails (pigeongrass)	Preemergence	See narrative for ro- tational restrictions. Do not apply on soils above pH 7.5. Shallow tillage may be used after application.	23,30, 38
	1/64 (1/3 oz)		Fall		10,23 30,38
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (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.	29,40, 41,42
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril or 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	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. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sun- flower control better than 0.5 lb/A of 2,4-D.	29,40 41,42

* 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.

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 th 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.	20,28, 40,41, 42
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.	27
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.	27,40, 41,42
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.	25,32, 40,41, 42
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.	25,32, 40,41, 42
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Canada thistle and other broadleaf weeds.	Crop-4 leaf stage to jointing	Do not rotate to any crop except small grains within one year of applicaton.	26,130
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 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	Apply with nonionic surfactant at 0.25 to 0.50% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	23,30
Metsulfuron (Ally)	1/267 (0.1 oz)	Wild mustard and certain annual broad-leaf weeds	Postemergence; crop in 2 leaf stage until just prior to boot	Apply with surfactant of at least 80% active ingredient at 0.25 to 0.5% v/v. May be tank mixed with 2,4-D to improve control. See narrative for rotational restrictions.	31
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.	35

* 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	Refer-ence**
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.	122, 123, 124
	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 fox-tails (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 and MCPA ester. Restricted use herbicide.	34, 126
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril)	0.75 to 1.25 + 0.37 (2 to 3.3 pt + 0.75 pt ME4 or 1.5 pt Buctril)	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.	29,32, 33,34, 126
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.8 to 1.25 + 0.25 + 0.05 (2.1 to 3.3 pt + 0.5 pt ME4 or 1.0 pt Buctril + 1.5 oz MCPA ester		Grass weeds-1 to 3 leaves and small broadleaf weeds	Commercial mixture available (One Shot); provides 0.8 lb/A diclofop. Do not use oil additive with this mixture.	
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	Wild oats in 3 to 5 leaf stage. Crop-prior to flag leaf emergence.	Use high rate on high populations of 3-leaf wild oats. Can be applied with 2,4-D, MCPA amine, bromoxynil, chlor-sulfuron, metsulfuron or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress. See paragraph 125 for varieties registered.	25,125

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**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 formulation of 2,4-D + Roundup (0.8 + 0.9 lb/gal) mixture (Landmaster II) available.	137
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.	136
Triallate (Far-go)	1.25 (1.25 qt) (12.5 lb 10G)	Wild oats	Before or after seeding	Preplant incorporate with field cultivator set to cut 4 inches deep. Postplant incorporate with harrow set shallower than seed depth.	13
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt, 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.	29,40, 41,42
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril, 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)		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. Commercial mixtures (3 + 3 Brominal & Bronate) are available.	
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.	20,28, 40,41, 42
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.) 0.5 (2 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2-leaf stage Wild oats in 2.5 to 3.5 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.	122, 123, 124
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 higher rates for dry conditions or grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil, MCPA ester or chlorsulfuron. Restricted use herbicide.	126

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

Winter Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril)	0.75 to 1.25 + 0.25 (2 to 3.3 pt + 0.5 pt ME4 or 1 pt Buctril)	Wild oats, foxtail (pigeongrass) broadleaf weeds	Grass weeds— 2 to 3 leaves; small broadleaf weeds; before jointing of wheat	Use the higher rate for dry conditions.	29,32, 33,34, 126
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	1 to 1.25 + 0.25 + 0.05 (2.7 to 3.3 pt + 0.5 pt ME4 or 1 pt Buctril + 1.5 oz MCPA ester)				
Diclofop (Hoelon) + Chlorsulfuron (Glean)	1.0 to 1.25 + 1/86 (2.7 to 3.3 pt + 1/4 oz)				23,30, 126
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 populations of 3-leaf stage wild oats. Can be applied with chlorsulfuron, 2,4-D, MCPA, metsulfuron, bromoxynil or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	125
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broad-leaf weeds and suppression of foxtails (pigeongrass)	Preemergence	See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	23,30, 38
	1/128 to 1/43 (1/6 to 1/2 oz)		In spring, crop in 2 leaf stage and until just prior to boot; weeds-small, less than 2 inches tall or 2 inches in diameter	Apply with nonionic surfactant at 0.25% to 0.50% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	10,23, 30,38
	1/128 to 1/43 (1/6 to 1/2 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)	1/267 (0.1 oz.)	Wild mustard and certain annual broad-leaf weeds	Postemergence, crop in 2 leaf stage until just prior to boot	Apply with a surfactant of at least 80% active ingredient at 0.25 to 0.50% v/v. May be tank mixed with 2,4-D. See narrative for rotational restrictions.	24,31
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 within 1 year of application.	26,130

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

Winter Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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.	25,32, 40,41, 42
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.	27,40, 41,42
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		27

Barley

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 nonionic surfactant at 0.5% v/v. Combinations of 2,4-D with glyphosate have increased spectrum of weeds controlled. Commercial formulation of 2,4-D + Roundup (0.8 + 0.9 lb/gal) mixture (Landmaster II) available.	137
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.	136

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Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer-ence**
Triallate (Far-go)	1.25 (1.25 qt, 12.5 lb 10G)	Wild oats	Before or after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation.	1,5, 121
	1.25 liquid (1.25 qt) 1.25 to 1.5 granule (12.5 to 15 lb 10G)		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, 13
Diallate (Avadex)	1.25 (1.25 qt)		After planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation. Restricted use herbicide.	1,5, 119, 120
			Fall-after October 15 and until freeze-up	Keep spring tillage depth to minimum. Restricted use herbicide.	5,11
Triallate (Far-go)+ Trifluralin (Treflan)	1 (1 qt)+ 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	In spring-immediately after planting	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow to depth of 1 to 1.5 inches.	5,121
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	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Barley stand reduction may occur.	5,121
Trifluralin (Treflan)	0.5 (1 pt 4E)	Foxtails (pigeongrass)	Preplant incorporated	Incorporate twice to a depth of 2 to 3 inches. Seed barley 2 inches deep.	36
			After planting	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow to depth of 1 to 1.5 inches.	36
			Fall-after September 1	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Stand reduction may occur.	2,14, 18,36
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 1.5 pt)	Wild buck-wheat, volunteer 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.	29,40, 41,42
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 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	Apply with nonionic surfactant at 0.25% to 0.50% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	23,30, 38

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Barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Metsulfuron (Ally)	1/267 (0.1 oz)	Wild mustard and certain annual broad- leaf weeds	Postemergence, crop in 2 leaf stage until just prior to boot	Apply with a surfactant of at least 80% active ingredient at 0.25 to 0.50% v/v. May be tank mixed with 2,4-D. See nar- rative for rotational restric- tions.	24
Propanil + MCPA (Stampede CM)	0.94 + 0.25 (2.5 pt)	Foxtails (pigeongrass), and some broadleaf weeds	Weeds 2 to 4- leaf stage, crop 2 to 4-leaf	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.	35
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril, 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	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. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	29,40, 41,42
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.	20,28, 40,41, 42
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 within 1 year of application.	26, 130
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.	25,32, 40,41, 42
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.	122, 123, 124
	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. Ingrid. 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 and MCPA. Restricted use her- bicide.	126
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril)	0.75 to 1.25 + 0.37 (2 to 3.3 pt + 0.75 pt ME4 Brominal or 1.5 pt Buctril)	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.	29,32, 33,34, 126
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.8 to 1.25 + 0.25 + 0.05 (2.1 to 3.3 pt + 0.5 pt ME4 or 1.0 pt Buctril + 1.5 oz MCPA ester)			Commercial mixture available (One Shot); provides 0.8 lb/A diclofop. Do not use oil ad- ditive with this mixture.	
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, 2,4-D, MCPA, bromoxynil, or MCPA plus bromoxynil.	125

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Oats

Herbicide	Act. Ingred. 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 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 with glyphosate have increased spectrum of weeds controlled. Commercial formulation of 2,4-D + Roundup mixture (Landmaster II, 0.8 + 0.9 lb/gal) available.	137
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.	25,32, 40,41, 42
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (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.	29,40, 41,42
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (0.5 pt ME4 or 1 pt Buctril plus 0.5 pt of 4 lb/gal MCPA)		Oats-3 leaf to boot stage	Apply when weeds are in early seedling stage for best results. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	29,40, 41,42
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 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	Apply with nonionic surfactant at 0.25 to 0.50% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	23,30 38
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.	20,28, 40,41, 42
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.	27,40, 41,42

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DRY, EDIBLE BEANS

Rye

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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.	25,32, 40,41, 42
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 (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 2 pt)	Wild buckwheat 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.	29,40, 41,42
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (0.5 pt ME4 or 1 pt Buctril + 0.5 pt of 4 lb/gal MCPA)	Wild buckwheat 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. Commercial mixtures (3 + 3 Brominal & Bronate) are available.	29,40, 41,42

Small Grain Pre-Harvest

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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.	130

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Flax

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant incorporated, fall or spring	Incorporation tool can be operated down to 4 inches deep without reducing wild oats control. Restricted use herbicide.	5,11 119, 120
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.	2,12, 46
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, 14,18, 45,47
Propachlor	4 (4 qt)	Grass and certain broad-leaf weeds	Preemergence	Weak on wild mustard and wild oats.	48
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Wild oats, foxtails (pigeongrass), volunteer grain, wild proso millet, quackgrass	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.	53
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.	52
Diclofop (Hoelon) + bromoxynil (ME4 Brominal, Buctril)	0.75 to 1.0 + 0.37 to 0.5 (2 to 2.67 pt + 0.75 to 1 pt ME 4 or 1.5 to 2 pt Buctril)	Wild oats, foxtail (pigeongrass) and broadleaf weeds	Grass weeds 1 to 4 leaves and small broadleaf weeds	Do not use oil additive with this mixture.	52,50
Bromoxynil (Buctril, ME4 Brominal)	0.25 to 0.5 (1 pt Buctril 0.5 to 1 pt ME4)	Wild buckwheat and certain broad-leaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible.	50
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.	49
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.	20,49
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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Corn

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 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.	137
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.	136
Atrazine + Butylate: Safener (Sutan +, Genate +)	1 + 3	Most grasses and broad- leaf weeds	Preplant incorpo- rated	Immediate incorporation is needed for best results. Safener protects corn from injury.	1,2, 17,57, 60
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 incorpo- ration is necessary. Use high rate of EPTC for wild proso millet control. Weak on wild mustard.	1,2,63
EPTC:Safener: Extender (Eradicane Extra)					
EPTC:Safener or EPTC: Safener: Extender + Cyanazine (Eradicane + Bladex) (Eradicane Extra + Bladex)	4 to 6 + 1 to 3	Most grass and broad- leaf weeds	Preplant incorporated	Use the higher rates on fine- textured soils. Immediate in- corporation is needed for best results. Cyanazine at the high rate may injure corn in a cool, wet environment.	1,2, 61,63
Alachlor (Lasso, Lasso II)	2 to 3 (2 to 3 qt 4EC) (15 to 20 lb 15G)	Grass and some broad- leaf weeds	Preplant incorpo- rated or preemer- gence	Weak on wild mustard. Usually less effec- tive preemergence than pro- pachlor in North Dakota. Preplant incorporation gives more consistent weed control.	1,58
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 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 incorpo- rated or preemer- gence	Use higher rate on fine-tex- tured soils for quackgrass and Canada thistle control. Provides only partial control of foxtails.	17,57

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Cyanazine (Bladex)	2.2 to 5.5 (2.8 to 6.8 lb 80W, 2.4 to 6.1 lb 90DF, 2.2 to 5.5 qt 4F)	Broadleaf weeds and some grasses	Preplant or pre- emergence incorpo- rated	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.	61
Cyanazine (Bladex) + Atrazine	1 to 3 + 1 to 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90DF + 1.25 to 2.5 lb 80W, 1.1 to 2.2 lb 90 DF or 1 to 3 qt 4L + 1 to 2 qt 4L)			The tank mix allows lower rates of atrazine to be used, reducing the potential for atrazine carryover. Prepackage mixture available as Conquest. Cyanazine is a restricted use herbicide.	17,61
Cyanazine (Bladex) + Alachlor (Lasso)	1 to 3 + 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90DF, 1 to 3 qt 4F + 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. DO NOT USE ON SANDS, LOAMY SANDS OR SOILS WITH LESS THAN 1% ORGANIC MATTER. Cyanazine is a restricted use herbicide.	58,61
Cyanazine (Bladex) + Metolachlor (Dual)	1 to 3 + 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90 DF, 1 to 3 qt 4F + 2 pt 8E)				
Diallate (Avadex)	1.5 (1.5 qt)	Wild oats	Preplant or pre- emergence incorpo- rated	Incorporation tool can be operated down to 4 inches deep without reducing wild oats control.	1,5, 119
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	Do not harvest for silage within 12 weeks of applica- tion.	1,17, 57,58
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. Available in a prepackage mixture as Bicep (3.4 lb metolachlor + 2.4 lb atrazine/gal).	17,57, 58

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Corn

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer-ence**
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.	17,57, 64
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.	17,57, 59
Dicamba (Banvel) + Alachlor (Lasso)	0.25 to 0.5 + 2 (0.5 to 1 pt 4S + 2 qt 4E)		Preemergence or before corn is 3 inches tall and grass in 2 leaf stage.	Use lower rate of dicamba on coarse-textured soils. Do not incorporate.	58,62
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.	64
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	59
Pendimethalin (Prowl) + Cyanazine (Bladex)	1 to 1.5 + 1.6 to 2 (2 to 3 pt + 2 to 2.5 lb 80W or 1.8 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.	61,64
Dicamba + Atrazine (Marksman)	0.28 to 0.48 + 0.53 to 0.92 (2 to 3.5 pt)	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 (pigeon-grass).	17,62 65
Atrazine + oil additive	1 to 2 + an oil additive	Broadleaf weeds and some grasses	Early postemer-gence—weeds less than 1.5 inches tall	Apply with an oil additive at 1 qt/A. Provides only partial control of foxtail (pigeongrass).	17,65
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	Crop origin oil (linseed or soybean) additive at 1 qt/A generally increases weed control, but may also increase injury. Use only 80W or 90DF for postemergence applications. Avoid application under cool, wet conditions, or to stressed corn. Restricted use herbicide.	66

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Cyanazine (Bladex)+ Atrazine	0.8 + 0.5 + 1 qt crop origin 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.	17,65, 66
Tridiphane (Tandem)+ Cyanazine (Bladex 80W)	0.5 to 0.75 + 1.2 to 2.0 (1 to 1.5 pt + 1.5 to 2.5 lb 80W)	Annual grasses 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 and 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.	67
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 1.8 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 thistle, p. sow-thistle	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.	69
Dicamba (Banvel)	0.25 (0.5 pt 4S)		Postemergence, before corn is 36 inches tall or 15 days prior to tasselling		
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.	68
Bromoxynil (Buctril, ME4 Brominal)	0.25 (1 pt) (0.5 pt)	Wild buck-wheat, volun-teer sun-flower and most annual broadleaf weeds.	Postemergence—corn 3 to 20 inches	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.	70
Bentazon (Basagran)	0.75 to 1.0 (1.5 to 2.0 pt)	Wild mustard, cocklebur, Canada this-tle, 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 details. 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. Thoroughly cover weeds with spray. Do not apply during unfavorable conditions such as drought, cold, or hail damage. Repeat application needed for Canada thistle control.	71

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Corn

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Ametryn (Evik)	2 to 2.5 (2.5 to 3 lb 80W)	Broadleaf weeds and grasses	Postemergence, directed, 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. Use non- ionic surfactant at 0.5% v/v. Use higher rate for taller weeds. See label for rotational restrictions.	72

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 grass 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 surfac- tant at 0.5% v/v.	137
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.	136
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant or preemergence incorporated	Incorporation tool can be operated down to 4 inches deep without reducing wild oats control. Restricted use herbicide.	1,5, 118, 119
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, 78
Ethalfuralin (Sonalan)	0.5 to 1.3 lb/A (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, 18,76, 77,127
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, 14,18 79,127
Clomazone (Command)	0.75 to 1	Annual grass and broad- leaf weeds	Preplant incorporated	Vaporization and off-site move- ment possible. Weak on wild mustard and pigweed. Refer to narrative for rotational restric- tions. May be applied with trifluralin (pre-package mix available as Commence).	83

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Soybeans

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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	Dinitroanilines include ethalfluralin, pendimethalin, and trifluralin. Incorporation of chloramben improves the consistency of wild mustard control.	1,2 18,76, 77,78, 79,81
			Preplant incorporated		
Metribuzin (Sencor, Lexone) + dinitroanilines	0.25 to 0.37 + 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.	21,77, 78,79, 76,82
	0.19 + appropriate rate for soil type			Use 0.19 lb/A metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only.	
Alachlor (Lasso, Lasso Micro Tech, Lasso II)	2 to 3 (2 to 3 qt or 15 to 20 lb 15G)	Grass and some broadleaf weeds	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. Metolachlor at 4 lb/A is used on soils having 6% organic matter or more.	1,80 127
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	Broadleaf weeds including wild mustard 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.	1,21, 80,82
Alachlor (Lasso) or Metolachlor (Dual) + Metribuzin (Sencor, Lexone)	2 + 0.19			Use 0.19 lb/A metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only.	
Alachlor (Lasso) or Metolachlor (Dual) + Chloramben (Amiben)	2 + 2 (2 qt 4E or 2 pt + 8E + 4 qt 2L or 2.4 lb DS)	Broadleaf weeds including wild mustard and annual grasses	Preplant incorporated or preemergence	Incorporation of chloramben improves consistency of wild mustard control. Soybean tolerance is good.	1,80, 81,127
Chloramben (Amiben)	2 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.	81, 127

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Soybeans

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	*Refer- ence**
Acifluorfen (Blazer, Tackle)	0.37 to 0.5 (1.5 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 wild mustard and redroot pigweed, high rate needed for other weeds. Apply when daytime temperatures exceed 70 F.	84, 127
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.	85
Lactofen (Cobra)	0.16 to 0.20 (10 to 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. Low rate will control wild mustard, redroot pigweed, and small weeds. High rate required for larger or hard to control weeds. Surfactant or oil additive increases activity. Refer to narrative for en- vironmental response.	86, 127
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.	84,85
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.	34,126
Fluazifop-P (Fusilade 2000)	0.09 to 0.19 (0.75 to 1.5 pt)	Wild oats, fox- tails (pigeon- grass), vol- unteer grain, wild proso millet, quack- grass	Grass weeds 2 to 4 inches; volunteer corn 6 to 18 inches but before soy- beans bloom	Apply to actively growing grasses. See narrative for rates for different weed species. Apply with oil additive at 1% v/v.	88
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 to actively growing grasses. See narrative for rates for different weed species. Apply with oil additive at 1 qt/A.	89
Fenoxaprop (Whip)	0.1 to 0.15 (0.8 to 1.2 pt)	Foxtails (pigeongrass) volunteer corn, wild proso millet, wild oats	Grass weeds-2 to 4 inches; vol. corn 6 to 18 inches. Soybeans-before bloom	Apply to actively growing grasses. See narrative for rates to control different species. Apply with oil additive at 1 qt/A.	87

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Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	*Refer- ence**
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.	122
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.	90
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.	137
EPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broad- leaf weeds	Preplant incor- porated	Weak on wild mustard	1 to 3, 9,12, 93,127
	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 to 3, 14,15, 18,92
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 to 3, 18,95, 127
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 to 3, 7,15, 16,18 92
Chloramben (Amiben) + other herbicides	2 (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.	92, 127
Alachlor (Lasso, Lasso Micro Tech)	2 to 3 (2 to 3 qt)	Grass and some broad- leaf weeds		Weak on wild mustard. Use the higher rate on fine textured soils high in organic matter.	92, 127
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.	1,92, 127
Pendimethalin (Prowl)	0.5 to 1.5 (1 to 3 pt)		Preplant incor- porated	Use higher rates on fine- textured soils. Weak on wild mustard. Refer to label for rotational restrictions.	1,92,
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, 92
Chloramben (Amiben)	2 (4 qt, 20 lb 10G 2.4 lb DS)	Annual grasses and broadleaf weeds	Preemergence	Weak on wild oats.	92,127

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Dry Edible Beans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
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.	92

Lentils

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Diallate (Avadex)	1.5 (1.5 qt)	Wild oats	Preplant or preemergence incorporated	Incorporation tool can be operated 4 inches deep without reducing wild oats control. Restricted use herbicide.	1,5, 96, 119,
Triallate (Far-go)	1.25 (1.25 qt)				1,5, 11,97, 121
Propham (Chem Hoe FL4)	4 (1 gal)	Wild oats, volunteer grain	Preplant incorporated	Operate incorporation imple- ment 4 inches deep.	96, 98
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.	96, 99

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Safflower

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
EPTC (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 to 3, 7
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incorporated, fall or spring	No wild mustard control.	1 to 3, 15,16, 18
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb 25G)		Preplant incorporated or pre-emergence	Weak on wild mustard. Preplant incorporation 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 within 30 days after emergence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	122
Sodium chlorate (Leafex-3) (Defol)	6 (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	Reference**
Paraquat (Gramoxone Super)	0.5 (2.7 pt)	Emerged annual grasses and broadleaf weeds	Preplant or any-time prior to crop emergence	A nonselective, postemergence 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.	136
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 to 3, 7,12, 101
	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 lower rate of ethalfuralin on coarse textured soils.	1 to 3, 18, 101
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)		Preplant incorporated	Use the higher rate for fine textured soils.	18,101
	1.25 to 1.5 (2.5 to 3 pt)		Surface applied from 30 days before planting until immediately after planting.	Use 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 to 3, 18,101
	0.5 to 1 (5 to 10 lb 10G)		Preplant incorporated, fall after September 1		16,18, 101
Trifluralin (Treflan) + EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 to 2.25 pt)		Preplant incorporated	Enhances wild oats control and reduces potential carry-over of trifluralin.	1 to 3, 7,15, 16,18, 101
Alachlor (Lasso)	3 (3 qt, 20 lb 15G)		Preplant incorporated or preemergence	Weak on wild mustard. Preplant incorporation gives more consistent weed control.	1,102

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Sunflower

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Chloramben (Amiben) + other herbicides	2 + appropriate rate for soil type	Annual grass and broadleaf weeds	Preplant incorporated	Other herbicides include ethalfuralin, EPTC, pendimethalin, trifluralin, and alachlor.	1 to 3, 7, 12, 18, 100, 101, 103
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.	103
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.	122
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Foxtails (pigeongrass) volunteer grains, wild proso millet	Weeds-2 to 4 inches tall. Apply 70 days prior to harvest	Apply to actively growing grasses. See narrative for rates to control different weed species. Apply with oil additive at 1 qt/A.	104
Paraquat (Gramoxone)	0.25 to 0.5 (1 to 2 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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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.	137
Paraquat (Gramoxone Super)	0.5 (2.7 pt)			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.	136
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Annual grasses and some broad- leaf weeds	Preplant incor- porated	Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.	1 to 3, 6,7, 9,12, 107
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Cycloate (Ro-Neet)	3 to 4 (4 to 5.3 pt 6E, 30 to 40 lb 10G)		Preplant incorporated	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 to 3
	4 (5.3 pt 6E, 40 lb 10G)		Fall incorpor- ated after October 15 until freeze-up		
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.	5,9, 11,119
Ethofumesate (Nortron)	2 to 3.75 (1.25 to 2.5 gal E)	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 to 3, 22,109
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.	110
TCA	4.7 to 7.1 (8 to 12 pt)	Most annual grasses	Preemergence	Weak on wild oats. Do not use sugarbeet tops for livestock feed.	108
Pyrazon (Pyramlin)	3.1 to 7.6 (3 to 7.25 qt F)	Most broadleaf weeds		Has been less effective on soils with more than 5% organic matter. Incorporation improves weed control from pyrazon.	106, 108

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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**
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 0.25 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.	113
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.	111
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.	109, 113
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)				
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Wild oats, foxtail (pigeon- grass), volun- teer grain, wild proso millet	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.	Apply to actively growing grasses. See narrative for rates for different grass species. Always apply with oil additive at 1 qt/A.	112
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.	114

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Tame Mustard and Rapeseed (Canola)

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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 to 3 15,16, 18
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Do not apply to rapeseed. Wild oats usually develop to the 2-leaf stage 9 days after emergence.	122

Tame Mustard only

Millet

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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 incorporated or preemergence	Only registered on Proso millet.	16,17

Annual Canarygrass

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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, 121
Bromoxynil + MCPA	0.25 to 0.38 + 0.25 to 0.38	Broadleaf weeds	Postemergence, weeds small and actively growing	Commercial formulation of bromoxynil + MCPA mixtures available. (3 + 3 Brominal & Bronate).	

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

Potatoes

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 a nonionic surfactant at 0.5% v/v.	137
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 her- bicide. Apply with X-77 sur- factant at 0.25% v/v. Restricted use herbicide.	136
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant incorporated	Incorporate immediately. Incorporation tool can be operated down to 4 inches without reducing wild oats control. Restricted use herbicide.	1 to 3, 11,119
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 to 3 6,7, 12
	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.	
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 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.	15,16, 21
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).	
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).	

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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 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.	
Sulfuric acid	20 gal		5 days prior to harvest	Extremely corrosive. Restricted use herbicide. Do not harvest within 5 days of application.	

Grass — Seedling

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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 established grasses. (See section below after tillering of seedling grass.)	
Bromoxynil (Brominal ME4)	0.38 to 0.5 (0.75 to 1 pt)		Anytime after grass emerges	Grass tolerance is excellent.	
Chlorsulfuron (Glean)	1/128 to 1/43 (0.12 to 0.5 oz/A)		Preplant, Preemergence, or postemergence to 3 to 4 leaf grasses	CRP acreage only. Add a nonionic surfactant at 0.25% v/v for postemergence treatments. Do not apply to soils with a pH greater than 7.5. Refer to narrative for labelled grass species and application restrictions. CRP acres can not be grazed or harvested for hay.	115

**CRP acreage
only**

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Grass — Established

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
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.	
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.	

Legumes

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 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.	137
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 CLOVER AND ALFALFA. Use only when weed problem is severe.	116

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Legumes

Alfalfa or trefoil establishment, no companion crop

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 emer- gence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	137
Diallate (Avadex)	1.5 to 2.0 (1.5 to 2.0 qt)	Wild oats	Preplant incor- porated	Incorporation tool can be operated down to 4 inches deep without reducing wild oats control. Restricted use herbicide.	1,5, 120
EPTC (Eptam, Genep)	2 to 4 (2.25 to 4.5 pt)	Grass and some broad- leaf weeds		Weak on wild mustard. Incorporate immediately after application. Use the low rate for grass control only.	1 to 3
Benefin (Balan)	1.12 to 1.5 (3 to 4 qt)	Annual grasses and some broad- leaf weeds		No wild mustard control.	
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. Weak on wild mustard. 2,4-DB must be applied at least 60 days before hay harvest or grazing.	116
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)	Foxtails (pigeongrass) volunteer grains, quackgrass	Grass-2 to 4 inches tall	Apply to actively growing grasses. See narrative for rates to control different weed species. Apply with oil additive at 1 qt/A.	117
Alfalfa only					

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Legumes

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)	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.	
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.	116
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)	Foxtails (pigeongrass) volunteer grains, quackgrass	Grasses-2 to 4 inches tall	Apply to actively growing grasses. See narrative for rates to control different weed species. Apply with oil additive at 1 qt/A.	117

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 within 10 days after application, under-cutting with sweeps may be desirable to destroy weeds until cyanazine is activated.	139
	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.	140
	2 to 2.8 +0.4		Early spring before weeds emerge		

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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 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 is a restricted use herbicides.	136, 139
	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.	141
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.	138
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged grasses and broad- leaf weeds	Weeds less than 6 inches tall	A nonselective, translocated, postemergence herbicide. No soil residual activity. See paragraph 137 for rates. Use lower rate for annual grasses.	137, 138
Paraquat (Cyclone)	0.5 (1 qt)	Emerged an- nual grass and broad- leaf weeds		A nonselective, contact, postemergence herbicide. No soil residual activity. Apply with X-77 surfactant at 0.25% v/v. Restricted use herbicide.	136
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.	
Glyphosate (Roundup) + dicamba (Banvel)	0.19 to 0.375 + 0.125 to 0.25 (0.5 pt to 1 pt + 0.25 to 0.5 pt)	Emerged an- nual grasses and broad- leaf weeds	Weeds less than 6 inches tall	Low rates of dicamba should only be used when weeds are small and actively growing. Refer to paragraph 137 for glyphosate use rates.	137, 138
Glyphosate (Roundup) + 2,4-D	0.28 to 0.50 + 0.21 to 0.42 (0.67 pt to 1.3 pt + 0.42 to 0.84 pt)			Commercial mixture avail- able (Landmaster II, 0.9 lb glyphosate + 0.8 lb 2,4-D per gallon).	137, 138

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For future planting to wheat, durum and barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	Reference**
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 144 for rate information.	15,16, 18, 144
Metsulfuron (Ally)	1/267 (1/10 oz)	Annual broad- leaf weeds	Weeds small and actively growing post harvest or in spring of fallow year	For best results apply when temperatures exceed 70 F. Use surfactant of at least 80% a.i. at 0.25 to 0.50% v/v. See narrative for suggested tank mixtures.	143

For future planting to wheat and durum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Chlorsulfuron (Glean)	1/64 to 1/43 (1/3 to 1/2 oz)	Most broad- leaf weeds and suppres- sion of foxtails (pigeongrass)	Fall-postharvest Spring-early post- emergence	Apply with nonionic sur- factant at 0.25 to 0.50% v/v. Use only on land to be planted to wheat. Do not use on soils with pH 7.5 or higher.	23,142
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.	17, 136, 140
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		
Atrazine + terbutryn (Igran)	0.5 to 1 + 1.6 to 2				
Chlorsulfuron + glyphosate (Glean + Roundup)	1/64 to 1/43 + 0.28 to 0.38 (1/3 to 1/2 oz + 0.75 to 1 pt)	Most emerged grass and broadleaf weeds	Before crop emer- gence, broad- leaf weeds less than 2 inches tall or across, grassy weeds 6 inches tall or less	Use 0.5% v/v of surfactants containing at least 50% active ingredient, use 1.0% v/v of surfactants containing less than 50% active ingredient. Do not use on soils with pH 7.5 or higher.	23,30, 137, 142
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.	
	0.67 to 1.0 (0.67 to 1 qt)		Early spring before weed emergence		

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For future planting to wheat and durum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Metribuzin + terbutryn (Lexone + Igran)	0.5 to 1 + 1.6 to 2 (1 to 2 pt + 2.0 to 2.5 lb 80W)	Annual broad-leaf and grass weeds	Spring-weeds emerged but less than 6 inches tall	Do not plant winter wheat within 4 months of application. Apply with a nonionic surfactant at 0.12 to 0.25% v/v.	
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 application. Use the higher rate of metribuzin on fine-textured soils. Do not plant spring wheat following fall applications or winter wheat within 4 months of treatment. Apply with X-77 surfactant at 0.25% v/v. Paraquat is a restricted use herbicide.	21,136
	0.67 to 1.0 + 0.25 to 0.5 (0.67 to 1 qt + 1 to 2 pt)		Spring after weeds have emerged		

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

For future planting to wheat and durum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Metribuzin + terbutryn (Lexone + Igran)	0.5 to 1 + 1.6 to 2 (1 to 2 pt + 2.0 to 2.5 lb 80W)	Annual broad-leaf and grass weeds	Spring-weeds emerged but less than 6 inches tall	Do not plant winter wheat within 4 months of application. Apply with a nonionic surfactant at 0.12 to 0.25% v/v.	
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 application. Use the higher rate of metribuzin on fine-textured soils. Do not plant spring wheat following fall applications or winter wheat within 4 months of treatment. Apply with X-77 surfactant at 0.25% v/v. Paraquat is a restricted use herbicide.	21,136
	0.67 to 1.0 + 0.25 to 0.5 (0.67 to 1 qt + 1 to 2 pt)		Spring after weeds have emerged		

Special Annual Weed Problems

False Chamomile

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer-ence**
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.37 + 0.37	Wheat, barley and oats	Chamomile less than 4 inches tall	Control of fall germinated plants will be less than those germinating in the spring.	43
Chlorsulfuron (Glean)	1/128 (1/6 oz)		Postemergence-crop in 2-leaf stage and until just prior to boot	Apply with nonionic surfactant at 0.25% to 0.50% v/v. Use only on land to be planted to wheat, barley or oats for two years following application. Do not apply on soils above pH 7.5.	23,39, 43
Metsulfuron (Ally)	1/267 (1/10 oz)			Apply with surfactant of at least 80% active ingredient at 0.25 to 0.5% v/v. See narrative for rotational restrictions.	24,31
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.	132
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.	136
Glyphosate (Roundup)	0.75 (1 qt)			A nonselective, translocated postemergence herbicide. Avoid contact with non-target plants.	43
Amitrole (Amitrole T, Cytrol)	1.5 (3 qt)			Avoid contact with non-target plants. Restricted use herbicide.	

Fumitory

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer-ence**
Triallate (Far-go)	1.25 (1.25 qt)	Barley	Immediately after planting	Incorporate in top 2 inches of soil by cultivation. Seed the crop below the incorporation depth.	1
	1 (1 qt)	Wheat and durum			
Diallate (Avadex)	1.5 (1.5 qt)	Flax	Preplant incorporated	Restricted use herbicide.	1
Bromoxynil (ME4 Brominal, Buctril) + MCPA	0.25 to 0.37 + 0.25 to 0.37	Wheat, barley and oats	After fumitory is established to boot stage of crop	Other broadleaf weeds also will be controlled. Commercial mixtures (3+3 Brominal and Bronate are available.)	29

* 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.

CHEMICAL WEED CONTROL FOR PERENNIAL WEEDS

Absinth Wormwood

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

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D L.V. ester or amine	2 (2 qt of 4 lb/gal conc.)	Pastures and rangeland, noncropland, trees	12 inches tall and actively growing.	Plants are controlled slowly. Avoid spraying tree foliage. Do not graze dairy cows for 7 days after treatment.	133
Dicamba (Banvel)	0.5 to 1 (1 to 2 pt)	Pasture and rangeland, noncropland, fallow or postharvest		Plants are controlled slowly. Consult label for grazing re- strictions. Surfactant 0.5% v/v may improve consistency of control.	134
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.	131, 132
Glyphosate (Roundup)	0.25 to 1.0 (0.33 to 1.33 qt)	Trees, noncrop- land, fallow or postharvest		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.	128, 130 137

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	Refer- ence**
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Wheat and barley	Crop-4 leaf until jointing, Weeds-1 to 6 inches tall	Do not rotate to any crop except small grains within one year of application.	26, 130
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 con- trol. Small grains are more tolerant to MCPA than 2,4-D.	130
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.	130
Chlorsulfuron (Glean)	1/64 to 1/43 (1/3 to 1/2 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.	16,23, 30,130

* 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.

Canada Thistle and Sowthistle

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Metsulfuron (Ally)	1/267 (1/10 oz)	Wheat, oats, and barley	Crop at 2 leaf stage or larger, thistle less than 6 inches tall	Provides suppression of Canada thistle and perennial sowthistle during the year or application.	24,31, 130
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.	17,57
Bentazon (Basagran)	1.0 (2 pt) applied twice	Soybeans, corn	Canada thistle 8 inches tall to bud stage.	Make second application at 1.0 lb/A 7 to 10 days later.	85
	1.0 (2 pt) applied once	Dry edible beans		Apply only once due to injury potential.	
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.	128, 129
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.	69
	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 postharvest	Weeds at least 6 inches tall and actively growing	Rotate to wheat, corn, 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. May be tank mixed at a lower rate with 2,4-D or glyphosate to reduce soil residue. Surfactant may improve consistency of control.	134
2,4-D ester or amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or postharvest	12 inches tall and actively growing	Cultivate fallow until early July. Spray in late August or September. Retreatment will be necessary.	128, 133
Glyphosate (Roundup)	0.75 to 2.25 (1 to 3 qt)	Fallow or postharvest	Thistles at or beyond the bud stage of growth	Wait 3 or more days after application before tillage. Use low rate for fall treatment.	128, 137
		Trees		Avoid spraying tree foliage. A nonselective herbicide.	129

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

Canada Thistle and Sowthistle

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer-ence**
Picloram (Tordon 22K)	0.25 to 0.5 (1 to 2 pt)	Pasture and rangeland	12 inches tall and actively growing. For fall treatment, mid-summer mowing promotes active growth	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide.	131, 132
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.	131, 132
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.	134
	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	12 inches tall and actively growing.	Do not graze dairy cows for 7 days after treatment. Provides suppression only.	128, 133

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

Common Milkweed

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Glyphosate (Roundup)	2.25 (3 qt)	Stubble or patches in barley, corn, oats, soybeans 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.	128, 129
Dicamba (Banvel)	0.5 to 2 (1 to 4 pt)	Fallow or postharvest	Actively growing	Rotate to wheat, corn, 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. Surfactant may improve the consistency of control. Generally will not give complete control.	19, 128
2,4-D + dicamba (Banvel)	1 + 0.25 (2 pt + 0.5 pt)	Fallow or postharvest	Actively growing	Provides suppression of milkweed growth for one year. Retreatment at the same rate usually will be necessary the following year.	19, 128, 138
Picloram (Tordon 22K)	0.5 (2 pt S)	Pasture, rangeland, and noncropland	Actively growing	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide.	131, 132
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt S)	Patches or individual plants in pastures	Actively growing	Consult reference for grazing restrictions. Restricted use herbicide.	131, 132

* 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.

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	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	Rates higher than listed may injure crop but may be benefi- cial, especially in small areas, to control bindweed.	130, 133
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or postharvest	Regrowth 12 inches to bud	Cultivate fallow until early July. Spray in late August or September. Respray in follow- ing year's crop.	128, 133
Dicamba (Banvel)	1 to 2 (1 to 2 qt)	Fallow or postharvest	Regrowth 12 inches to bud	Mid to late fall treatments have been more effective than summer treatments. Rotate to wheat, corn, or sorghum. Crop injury may occur if the interval between application and plant- ing is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen. Surfactant may improve the consistency of control.	128, 134, 138
Dicamba (Banvel) + Glyphosate (Roundup)	0.5 (1 pt) + 1.5 (2 qt)			Less potential for soil residual than higher rates of dicamba.	128, 130 134
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.	129, 130
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.	131, 132
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.	134
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. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer-ence**
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 following year's crop.	128, 134
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, or sorghum. 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.	134
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.	128, 133
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 at 0.25 + 1 lb/A was the most cost effective treatment in NDSU trials. 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.	131, 132, 134
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 a 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.	131, 132
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.	134
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt S)			Consult narrative for grazing restrictions. Restricted use herbicide.	131, 132

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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**
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.	129, 130
2,4-D amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)				
Fosamine (Krenite)	6 to 8 (1.5 to 2 gal)	Noncropland, and adjacent to water	Leafy spurge in true flower growth stage or early fall	Partial control and growth suppression only. Do not allow to contaminate water. Can be used under trees.	

Quackgrass

Herbicide	Act. Ingrid. 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. A total of 3 lb/A is adequate for plowdown on sandy soils.	17, 57
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.	88
Sethoxydim (Poast)	0.5 (2.5 pt)	Soybeans, sunflower, 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.	89
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.	129, 130
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.	128, 137

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Russian Knapweed

Herbicide	Act. Incred. 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	Prevents seed formation only.	130, 133
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.	130, 133
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.	134
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.	134
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.	131, 132
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.	128, 131, 132

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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.	128, 133
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.	134
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.	128, 130
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.	131, 132
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.	

* 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.

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HERBICIDE USE INFORMATION

INCORPORATION OF HERBICIDES

1. Butylate, cycloate, diallate, 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 seven 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.

2. Butylate, cycloate, EPTC, ethalfluralin, pendamethalin and trifluralin require a thorough incorporation and should be incorporated by one of the following methods or a method which will incorporate similarly.

a) A tandem disk should be set at a depth of 3 to 4 inches for pendimethalin and a depth of 4 to 6 inches for other herbicides. Operating speed should be 4 to 6 mph. Tandem disks with disk 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 three 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. Diallate (Avadex) and triallate (Far-go) 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 diallate or 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 varieties. Spring preplant incorporated triallate has greater potential for injury to wheat than application at other times. Refer to label for information on varieties that may be susceptible to preplant incorporated triallate.

THE SOIL ORGANIC MATTER TEST:

6. Many herbicides are partially absorbed 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. The Atrazine rate must be adjusted according to organic matter levels. Apply the high labeled rates on higher organic matter soils. Many herbicides such as diallate (Avadex), propachlor (Ramrod), triallate (Far-go) and 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 can change very slowly and testing once every five years would 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), diallate (Avadex), EPTC (Eptam, Genep), triallate (Far-go) and trifluralin (Treflan). Treatment of Chlorsulfuron and trifluralin should be applied after September 1 and until soil freeze-up. Fall treatments of diallate (Avadex), EPTC (Eptam, Genep) and triallate (Far-go) 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. Diallate (Avadex) applied at 1.25 to 2 lb/A in the fall controls wild oats. Diallate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent loss by evaporation.

The liquid formulation of diallate may be applied in the fall for wild oats control in flax, barley and sugarbeets. The granular formulation of diallate is registered for use on sugarbeets only.

12. 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.
13. Triallate (Far-go) is applied at 1 to 1.25 lb/A in the fall. The liquid formulation may be applied at 1 lb/A (1 qt/A) and the granules at 1.25 lb/A (12.5 lb/A) 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.
14. 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, sunflower, flax, and wheat.

HERBICIDE RESIDUE:

15. The persistence of phytotoxic levels of a herbicide for more than one 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).
16. 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 two to three 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) and trifluralin (Treflan).

17. 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.
18. Ethalfuralin (Sonalan), pendimethalin and trifluralin are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than one year. Ethalfuralin has less soil residue than trifluralin or pendimethalin. Land treated with ethalfuralin in the spring may be planted to any crop the next year. However, ethalfuralin treated land should be moldboard plowed at least 6 inches deep before planting 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.
19. 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.
20. Picloram (Tordon) at 1/64 lb/A active ingredient (1 oz/A of formulated product) may carryover in the soil for more than one 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.
21. 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.

22. 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.
23. 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 7.5. Land previously treated with chlorsulfuron cannot be rotated to crops other than wheat, barley or oats until a field bioassay confirms that residues of chlorsulfuron are not present. The minimum recropping intervals are 0 months for wheat, 10 months for spring oats and 16 months for barley. The approximate ranking of other crops from most to least tolerant is wheat, barley, oats, safflower, dry beans, sunflower, flax, corn, soybeans and sugarbeets.
24. 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 metsulfuron carryover in soil is pH. The rate of metsulfuron breakdown decreases as soil pH increases. Metsulfuron should not be applied to soils with a pH above 8.0. The minimum recropping intervals are 1 month for spring and winter wheat, 10 months for durum wheat, barley and oats, 22 months for proso millet, dryland sorghum, dryland corn, flax, safflower, and sunflower, and 34 months or more for all other crops. Land previously treated with metsulfuron should not be rotated to crops other than those listed above until a field bioassay confirms that residues of metsulfuron are not present.

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

25. 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 fifth 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 third to fourth 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.
26. 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 or barley for one year after treatment.
27. 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 second through fourth 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.
28. 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 20.
29. Bromoxynil (Buctril, ME4 Brominal) 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, 3+3 Brominal) are applied from the 3 leaf to early boot stage to improve wild mustard control.
30. Chlorsulfuron (Glean) controls false chamomile, wild mustard, and many annual broadleaf weeds in wheat preemergence or in wheat, barley and oats postemergence. Chlorsulfuron also suppresses growth of green and yellow foxtail when applied preemergence or early postemergence (less than 2 inches tall). See herbicide effectiveness table or herbicide label for more information on species controlled. Postemergence applications of chlorsulfuron should be applied with surfactant WK or X-77 at 0.25 to 0.50% v/v (1 to 2 qt/100 gal of spray). Fall applications of chlorsulfuron may be made to undisturbed stubble where straw is evenly spread, or after cultivation to a uniform soil surface. Do not moldboard plow. Tillage

after application must be shallow. NOTE: See herbicide residue section, paragraph 23.

31. Metsulfuron (Ally) controls false chamomile, wild mustard and many annual broadleaf weeds in wheat and barley postemergence. Postemergence metsulfuron should be applied with surfactant of at least 80 percent active ingredient at 0.25 to 0.5 percent v/v (1 to 2 qt/100 gal of spray). A tank mixture of metsulfuron plus 2,4-D may improve control of larger weeds and provide a broader spectrum of weed control than metsulfuron alone. Do not tank mix metsulfuron with diclofop (Hoelon), dicamba (Banvel), or malathion. See herbicide effectiveness table or herbicide label for more information on species controlled. Note: See herbicide residue section, paragraph 24.
32. Small grains underseeded to sweetclover, alfalfa or other legumes cannot be treated with 2,4-D, MCPA, bromoxynil, dicamba, chlorsulfuron, metsulfuron or picloram at rates required to control most broadleaf weeds without seriously injuring or killing the legumes.

GREEN AND YELLOW FOXTAIL (PIGEONGRASS) CONTROL:

33. 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.
34. Diclofop (Hoelon) at 0.75 to 1.25 lb/A in wheat or soybeans or 0.75 to 1 lb/A in barley applied postemergence controls foxtails in addition to wild oats. The lower rate is for green foxtail and yellow foxtail with one to three leaves. The higher rates are for foxtails growing in dry conditions or for foxtails with three to four 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 126.)
35. 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.
36. 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 har-

rowing 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 121.)

37. 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 144 for trifluralin applications in the fallow year for foxtail control in small grains the next year.
38. 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 spring wheat. Fall treatments generally provide better foxtail suppression than spring or postemergence treatments. Postemergence treatments should be applied with 0.25% nonionic surfactant to foxtail with two leaves or less.

VOLUNTEER SUNFLOWER:

39. Volunteer sunflower is often a problem in small grains seeded in the rotation the year after sunflower and occasionally the second year. Tillage practices distribute the sunflower seeds to various depths in the soil causing emergence over several days or weeks depending on climatic conditions. Judgment 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.
40. Bromoxynil at 0.25 lb/A plus MCPA ester at 0.25 lb/A (3 + 3 Brominal, Bronate) give excellent control of volunteer sunflower. Treated sunflower appear severely burned within several days and die within about one week after treatment. Chlorsulfuron (Glean) at 1/128 lb/A, Metsulfuron (Ally) at 1/267 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 ap-

proximate order of effectiveness on volunteer sunflower from most to least effective is chlorsulfuron, metsulfuron, bromoxynil + MCPA, dicamba + MCPA, 2,4-D + picloram, 2,4-D, and MCPA.

KOCHIA:

41. 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 and metsulfuron (Ally) at 1/267 lb/A provide good kochia control. Addition of a nonionic surfactant at 0.25% v/v is essential for postemergence kochia control with chlorsulfuron and metsulfuron. Dicamba (Banvel) at 0.125 lb/A plus MCPA amine at 0.25 lb/A gives good kochia control. 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. 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. 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:

42. 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, 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 all give good Russian thistle and redroot pigweed control. MCPA is not effective in controlling either weed. The esters of 2,4-D are generally more effective than the amines for both weeds.

FALSE CHAMOMILE:

43. 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) and metsulfuron (Ally). Fall or spring applications of chlorsulfuron at 1/64 to 1/43 lb/A or metsulfuron at 1/267 lb/A control false chamomile. Refer to paragraph 23 and 24 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) at 0.5 lb/A with X-77 or other nonionic surfactant at 1 quart per 100 gallons of water. 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:

44. 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 two or three 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

45. Flax is less competitive with weeds than are small grains, and should be grown on relatively weed-free fields. Early after-harvest tillage of small grain stubble will prevent weed seed production, control 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 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.
46. EPTC (Eptam, Genep) fall applied at 4 lb/A controls annual grass weeds, including 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 1 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. Spring applied EPTC for flax was removed from registration.

47. 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.
48. The flowable formulation of propachlor (Ramrod 4L) controls certain annual grasses and broadleaf weeds but is ineffective against wild oats, wild mustard and perennial weeds. Flax tolerance to propachlor is excellent. Propachlor incorporation will injure flax and reduce weed control.
49. MCPA at 0.25 lb/A on 2 to 6-inch flax controls most 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.
50. Bromoxynil (ME4 Brominal, Buctril) at 0.25 to 0.5 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.
51. Dalapon (Dowpon) will control green and yellow foxtail in young flax. Apply dalapon as soon as possible after flax is 1 inch tall and the weeds are less than 2 inches tall for best results. CAUTION: Spraying must be completed prior to 6 inches tall or the early bud stage, whichever is earlier, to minimize flax injury. Generally, dalapon is applied in a mixture with MCPA amine to control both the susceptible grass and broadleaf weeds with one application.
52. 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.
53. 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 89. 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.
54. 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.
55. Most herbicides used in corn are labeled for tank mixing with other herbicides for broad spectrum weed control. 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.
56. 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 plus atrazine and/or cyanazine, or pendimethalin (Prowl) plus cyanazine (Bladex 80W) (corn at 2-leaf stage or smaller).

PREEMERGENCE:

57. 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 17 in herbicide residue section for additional discussion). Atrazine is registered as a tank mixture with alachlor (Lasso), bromoxynil (Buctril, ME4 Brominal), 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.
58. Alachlor (Lasso) and metolachlor (Dual) at 2 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 mix-

ture with atrazine, cyanazine, dicamba or with atrazine plus paraquat or glyphosate. Metolachlor may be applied up to 45 days before planting.

59. Propachlor (Propachlor, Ramrod) applied preemergence 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.

60. 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.

61. Cyanazine (Bladex) at 2 to 3.2 lb/A preemergence controls annual grasses and broadleaf weeds in corn. Cyanazine requires 0.5 inch or more of 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. Alachlor and cyanazine are difficult to mix. 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 alachlor while filling the tank with water to the desired level. Cyanazine is registered as a tank mixture with alachlor, atrazine, butylate, metolachlor and paraquat.

62. 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.

63. 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 tilth 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.

64. 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.

POSTEMERGENCE:

65. 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 crop origin oil. Crop origin oils at 1 quart/A with atrazine give weed control equal to petroleum oil concentrate at 1 quart/A with atrazine. Surfactants and wetting agents are less effective with atrazine than any of the oil additives. Refer to herbicide residue section, paragraph 17, for carryover precautions.

66. Cyanazine (Bladex 80W or 90DF) is labeled at 1.2 to 2 lb/A as an early postemergence treatment for grass and broadleaf weed control (including volunteer sunflower). Addition of an emulsifiable crop origin 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 quart per acre of crop origin 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.

67. Tridiphane (Tandem) + atrazine or cyanazine provides optimum control of annual grasses 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.

68. 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.

69. 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 1/8 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.

70. Bromoxynil (Buctril, ME4 Brominal) at 0.25 lb/A on 3 to 20 inch 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.
71. See discussion under soybeans for the use of bentazon (Basagran) on corn.
72. Emergency control of broadleaf and grass weeds in corn can be obtained with directed applications of ametryn (Evik) or linuron (Lorox). Ametryn at 2 to 2.5 lb/A or linuron at 0.6 to 1.5 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 and linuron before corn is 15 inches high. The weeds should be less than 6 inches tall.

Package Mixtures Available for Corn

Trade Name	Common Name	Act. Ingrid. lb/gal
Atrabute + Bicep	(butylate + atrazine)	4.8 + 1.2
Bronco	(metolachlor + atrazine)	3.5 + 2.7
Buctril + Atrazine	(alachlor + glyphosate)	2.6 + 1.4
Conquest	(bromoxynil + atrazine)	1.0 + 2.0
Extrazine	(cyanazine + atrazine)	3.0 + 1.0
Laddok	(cyanazine + atrazine)	2.0 + 1.0
Lasso /atrazine	(bentazon + atrazine)	1.7 + 1.7
Marksman	(alachlor + atrazine)	2.5 + 1.5
Prozine	(dicamba + atrazine)	1.1 + 2.2
Ramrod/ atrazine	(pendimethalin + atrazine)	1.5 + 1.5
Rhino	(propachlor + atrazine)	3.0 + 1.0
Sutazine + Torch	(butylate + atrazine)	4.3 + 1.7
	(butylate + safener + atrazine)	4.8 + 1.2
	(bromoxynil + atrazine)	1.8 + 2.5
	twin pack	

SOYBEANS

73. 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 seedbed 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.

74. Most herbicides used in soybeans are labeled for tank mixing with other herbicides for broad spectrum weed control. 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.
75. 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) or pendimethalin (Prowl) 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 fluazifop-P (Fusilade 2000), sethoxydim (Poast), or fenoxaprop (Whip) (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.
76. 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.
77. 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, or metribuzin. Ethalfluralin has less soil residue than trifluralin.
78. Pendimethalin (Prowl) at 1 to 1.5 lb/A is applied preplant incorporated or preemergence to control annual grass and certain broadleaf weeds. The high rate should be used on heavy clay soils. Incorporation if rainfall does not occur within seven days after application improves control. Pendimethalin is registered as a tank mixture with chloramben, linuron, and metribuzin.
79. 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 metribuzin.
80. Alachlor (Lasso) and metolachlor (Dual) at 2 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 chloramben, linuron plus paraquat (Gramoxone Super), linuron plus glyphosate (Roundup), and metribuzin plus glyphosate.
 81. 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, linuron, metolachlor, metribuzin, pendimethalin and trifluralin.
 82. 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, metolachlor, alachlor plus paraquat, paraquat, pendimethalin and trifluralin.
 83. 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 available in a prepackage mixture with trifluralin as Commence.
 84. Acifluorfen (Blazer, Tackle) at 0.37 to 0.5 lb/A postemergence controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the high rate is needed for nightshade, smartweed and common cocklebur. Acifluorfen will not adequately control volunteer sunflower. Acifluorfen kills primarily by contact action, thus for effective control, application 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 six hours after application as weed control is reduced. Drift control agents, liquid fertilizers, and other pesticides should not be mixed with acifluorfen. Surfactants should be used with acifluorfen except under conditions outlined on the label. A nonionic surfactant (80% 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.
 85. Bentazon (Basagran) at 0.75 to 1.5 lb/A post-emergence 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 lb/A 7 to 10 days later.
 86. Lactofen (Cobra) at 0.16 to 0.20 lb/A postemergence controls many broadleaf weeds. The low rate should be applied to weeds in the 2 to 4 leaf stage, and the high rate should be used when weeds are in the 4 to 6 leaf stage. 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 a nonionic surfactant at 0.12% v/v or oil additive at 0.5 to 1 pt/A generally increases herbicide activity, but may intensify the temporary crop response. Do not apply within 90 days of harvest or use treated plants for feed or forage.
 87. 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 volunteer corn and wild proso millet. 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.
 88. 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 0.19 lb/A will control wild oats, foxtail and volunteer small grains. 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 can 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.

89. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses. Methylated seed oil (SUN-IT by Agsco) and Dash (BASF) additives have enhanced grass control with sethoxydim more than petroleum oil or seed 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 and 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.

90. 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 first 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.

DRY, EDIBLE BEANS

91. 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.

92. See discussion under soybeans for use of bentazon (Basagran), paragraph 85; chloramben (Amiben), paragraph 81; pendimethalin (Prowl), paragraph 78; and trifluralin (Treflan), paragraph 79. 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 controls annual grasses and some broadleaf weeds. Metolachlor (Dual) at 2 to 3 lb/A preplant incorporated or preemergence controls annual grasses and some broadleaf weeds. Metolachlor may be tank mixed with EPTC (Eptam, Genep) for wild oats control.

93. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus pendimethalin 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 - 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.

94. 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.

95. Ethalfluralin (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. Ethalfluralin is registered as a tank mixture with chloramben, alachlor, metolachlor, and EPTC. Ethalfluralin has less soil residue than trifluralin.

LENTILS

96. 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.

97. Triallate (Far-go) at 1.25 lb/A or diallate (Avadex) at 1.5 lb/A can be applied for wild oats control before or after seeding lentils. Diallate and triallate are both volatile and must be incorporated into the soil immediately after application.

98. Protham (ChemHoe) applied preplant incorporated at 4 lb/A will control wild oats and volunteer grains. Lentils should be planted no later than 1 to 2 days after protham incorporation with an implement set 4 inches deep.

99. 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

100. 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 spiketooth 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.
101. EPTC (Eptam, Genep), ethalfluralin (Sonalan), pendimethalin (Prowl) and trifluralin (Treflan) are preplant incorporated herbicides. See paragraphs 1 to 5 for discussion on herbicide incorporation. Ethalfluralin 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. Ethalfluralin 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.
102. Alachlor (Lasso, Lasso II) 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.
103. 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 North Dakota State University indicated that incorporation of chloramben improved the consistency of wild mustard control.
104. 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 89.

SUGARBEETS

105. 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.
106. Herbicides are commonly used as tank mixtures on sugarbeets. Some herbicide combinations such as pyrazon (Pyramin) plus TCA and 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.
107. 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 TCA, diallate (Avadex), cycloate (Ro-Neet), ethofumesate (Nortron) or pyrazon (Pyramin) plus TCA cause less sugarbeet injury on the low organic matter soils where EPTC injury may be excessive.
108. TCA at 4.7 to 7.1 lb/A gives good control of green and yellow foxtail. Research has indicated that shallow incorporation generally will not reduce the weed control from TCA and under low rainfall conditions will improve weed control. TCA and diallate as a tank mixture can be applied with shallow incorporation for wild oats and foxtail control. Incorporation may reduce grass control from TCA if excessive rain follows application especially on the more coarse-textured soils. TCA should not be incorporated on low organic matter, coarse-textured soils where injury to sugarbeets is possible. Research results have demonstrated that TCA used in combination with or over the top of EPTC often gives improved grass and broadleaf control compared to either herbicide alone. TCA plus EPTC should only be used on higher organic matter, fine-textured soils since the combination has greater injury potential than either herbicide alone.
109. 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 a herbicide like TCA, 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 improved 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 22 on ethofumesate residue. Ethofumesate plus TCA 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.

110. Diethatyl (Antor) spring applied at 4 to 6 lbs/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 diethatyl + cycloate combinations. Preemergence diethatyl will give good weed control if adequate rain follows application.
111. Endothall (Herbicide 273) at 0.75 to 1.5 lb/A gives good postemergence control of wild buckwheat, smartweed, and sunflower. Endothall should be applied when temperatures are between 60 and 80 F and soil moisture is good to excellent. Endothall generally gives poor weed control when weeds are drought stressed.
112. 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 89.
113. 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 four 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 four 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.
114. 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.

GRASSES

115. 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, smooth and meadow brome grass, buffalograss, galleta, green needlegrass, Indian ricegrass, prairie sandreed, sand dropseed, sand lovegrass, side oats grama, switch grass, 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. Do not use on soils with a pH greater than 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 23 for chlorsulfuron persistence and rotational guidelines.

LEGUMES

116. Seedling legumes usually are poor competitors with weeds. Good management practices in preceding crops are recommended such as clean cultivation in row crops and postharvest 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.
117. 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 89.

WILD OATS CONTROL

118. 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.
119. Diallate (Avadex) at 1.25 to 2 lb/A is applied preplant for wild oats control in flax, sugarbeets, potatoes, soybeans, forage legumes, corn, lentils or peas and after planting barley, flax, soybeans, corn, lentils or peas. Diallate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent losses by evaporation. See paragraph 11 for fall application of diallate.
120. Diallate (Avadex) at 1.25 lb/A applied preplant incorporated in the spring will control wild oats in newly seeded alfalfa. Wild oats in flax or barley underseeded with alfalfa can be controlled with preemergence incorporated diallate at 1.25 lb/A in the spring.
121. Triallate (Far-go) at 1 to 1.5 lb/A is applied preplant or preemergence incorporated for wild oats control in wheat, durum, barley, peas, lentils or annual canarygrass. Triallate is volatile and 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 13 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 for wild oats and foxtail control in barley and durum. Buckle is not labeled for use in Hard Red Spring wheat or as a spring applied treatment.
122. Barban (Carbyne 2EC) for postemergence control should be applied when the majority of the wild oats are in the 1.5 to 2-leaf stage, which generally occurs nine 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 nor 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.
123. 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.
124. 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 three 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.
125. Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the three to five-leaf stage. Difenzoquat is cleared for use in barley, durum wheat (except Vic, Edmore, Lakota and Wascana), winter wheat and Apex, Benito, Buckshot, Butte, Centa, Chester, Columbus, Coteau, Courtney, Era, Erik, Fortuna, Glenlea, Glenman, HY320, Katepwa, Leader, 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. 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 three-leaf wild oats. Wheat injury may occur at temperatures above 80 F. 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. Difenzoquat may be mixed with bromoxynil, (ME4 Brominal, Buctril), MCPA, MCPA plus bromoxynil, 2,4-D, metsulfuron (Ally) or chlor-sulfuron (Glean) for broadleaf weed control without loss of wild oats control.
126. 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 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 the 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 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 or bromoxynil or 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.

BLACK NIGHTSHADE CONTROL

127. 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 ethalfluralin (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. Black nightshade can be controlled in sugarbeets with a soil applied treatment of cycloate (Ro-Neet), EPTC, ethofumesate (Nortron), or diethatyl (Antor); or postemergence with desmedipham (Betanex) or desmedipham plus phenmedipham (Betamix).

PERENNIAL WEED CONTROL

128. 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. Postharvest treatments can be used when weed growth has reached approximately one foot of stem tissue. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment and swathing should be separated by at least 5 days to allow adequate herbicide translocation.
129. 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:

130. Perennial weed control systems in small grains should include herbicide application in the crop followed by postharvest 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:

131. Picloram (Tordon) controls broadleaf perennial weeds such as leafy spurge, 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 is picloram at 0.25 lb/A + 2,4-D at 1 lb/A applied annually in the spring for three to five years.
132. 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.

CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

133. 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.
134. 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.
135. The wiper-type applicators are a new method of applying 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.
136. 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.
137. 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 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 gallons 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 0.75 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 mixtures are applied immediately before or after planting due to the preemergence soil activity of 2,4-D.
138. For postharvest or fallow weed control in minimum till situations, dicamba (Banvel) at 0.125 to 0.25 lb/A or 2,4-D at 0.5 lb/A can be tank mixed with glyphosate at 0.19 to 0.38 lb/A. Add a nonionic surfactant at 0.5 percent v/v to the spray solution. The low rate of dicamba should be used if winter wheat will be planted in the fall following treatment. 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.
139. 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.

140. 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 or terbutryn (Igran) should be applied. A nonionic surfactant should be added to both mixtures.

141. 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.

142. Chlorsulfuron (Glean) can be applied post-harvest in the fall or in the spring at 1/64 to 1/43 lb/A (1/3 to 1/2 oz/A formulated product), depending on soil pH, to control annual weeds (except wild oats and volunteer grains) on fallow to be planted to wheat. If weeds are emerged at the time of application, apply with surfactant WK or X-77 at 0.25 to 0.50 percent v/v (1 to 2 qt/100 gal spray solution). Fall applications of chlorsulfuron have generally given better weed control than spring applications. See paragraph 23 for crop rotational restrictions.

143. Ally (Metsulfuron) can be tank mixed with glyphosate, glyphosate plus 2,4-D amine, 2,4-D, dicamba, cyanazine, terbutryn or atrazine. Use surfactant of at least 80 percent active ingredient at 0.25 to 0.50 percent v/v unless otherwise directed. Surfactant should not be used when applying metsulfuron in liquid fertilizer. See paragraph 24 for crop rotational restrictions.

144. 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	lb/A (Act. Ingrid.)	Trifluralin (granular)
Apr. 15 to Apr. 30	1.0	10
May 1 to May 31	1.0 to 0.875	10 to 8.75
June 1 to June 30	0.875 to 0.75	8.75 to 7.5
July 1 to July 31	0.75 to 0.625	7.5 to 6.25
Aug. 1 to Aug. 31	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/}
Ally (DuPont)	Metsulfuron	60% DF
Amiben (Rhône-Poulenc, Union Carbide)	Chloramben	10% G, 75% SP 2 lb/gal S
Amitrole T (Rhône-Poulenc, Union Carbide)	Amitrole	2 lb/gal S
Antor (Nor-Am)	Diethatyl	4 lb/gal E
Atrabute + (PPG)	Atrazine + Butylate	1.2 + 4.8 lb/gal F
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 (Banvel), 10% G (Banvel 10G)
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, 15% G 4 lb/gal F
Blazer (BASF)	Acifluorfen	2 lb/gal E, S
Brominal ME4 (Rhône-Poulenc, Union Carbide)	Bromoxynil	4 lb/gal E
3 + 3 Brominal (Rhône-Poulenc, Union Carbide)	Bromoxynil and MCPA	3 + 3 lb/gal
Bronate (Rhône-Poulenc)	Bromoxynil and MCPA	2 + 2 lb/gal E
Bronco (Monsanto)	Alachlor + Glyphosate	2.6 + 1.4 lb/gal E
Buckle (Monsanto)	Triallate and Trifluralin	10% triallate + 3% trifluralin G
Buctril (Rhône-Poulenc)	Bromoxynil	2 lb/gal E
Butyrac Ester & 200 (Rhône-Poulenc, Union Carbide)	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

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/}
Chem-Hoe 135 (PPG)	Propham	3 lb/gal F
Chem-Hoe FL4 (PPG)	Propham	4 lb/gal F
Cobra (PPG)	Lactofen	2 lb/gal S
Commence (Elanco and FMC)	Trifluralin and Clomazone	3 + 3 lb/gal E
Conquest (Dupont)	Cyanazine and Atrazine	3 + 1 lb/gal
Curtail (Dow)	Clopyralid and 2,4-D	0.38 + 2 lb/gal S
Cyclone (ICI Americas)	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, Stauffer)	EPTC	7 lb/gal E 10% G
Eradicane (ICI, Stauffer)	EPTC plus Safener	6.7 lb/gal E
Eradicane Extra (ICI, Stauffer)	EPTC plus Safener + Extender	6.0 lb/gal E
Evik (Ciba-Geigy)	Ametryn	80% WP
Extrazine (Dupont)	Cyanazine + Atrazine	2.0 lb/gal + 1.0 lb/gal
Far-go (Monsanto)	Triallate	4 lb/gal E 10% G
Fusilade 2000 (ICI Americas)	Fluazifop-P	1 lb/gal E
Genate (PPG)	Butylate + Safener	6.7 lb/gal E
Genep (PPG)	EPTC	7 lb/gal E
Glean (DuPont)	Chlorsulfuron	75% DF
Gramoxone Super (ICI Americas)	Paraquat	1.5 lb/gal S
Herbicide 273 (Pennwalt)	Endothall	3 lb/gal S
Hoelon (Hoechst-Roussel)	Diclofop	3 lb/gal E
Igran (Ciba-Geigy)	Terbutryn	80% WP
Krenite (Dupont)	Fosamine	4 lb/gal S

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/}
Laddok (BASF)	Bentazon + Atrazine	1.7 + 1.7 lb/gal F
Landmaster II (Monsanto)	Glyphosate + 2,4-D	0.9 + 0.8 lb/gal S
Lasso (Monsanto)	Alachlor	4 lb/gal E (Lasso) 4 lb/gal Encapsulated (Micro Tech) 15% G (Lasso II)
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 plus 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	3.0 + 2.5 0.45 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 (Uniroyal)	Naptalam + 2,4-DB	2 + 0.06 lb/gal E
Rhino (PPG)	Butylate + Atrazine	4.3 + 1.7 lb/gal /F
Ro-Neet (ICI, Stauffer)	Cycloate	6 lb/gal E 10% G
Roundup (Monsanto)	Glyphosate	3 lb/gal S
Sencor (Mobay)	Metribuzin	4 lb/gal F, 75% DF 50% WP
Sonalan (Elanco)	Ethalfuralin	3 lb/gal E
Stampede CM (Rohm & Haas)	Propanil + MCPA	3.0 + 1.4 lb E
Sutan + (ICI, Stauffer)	Butylate + Safener	6.7 lb/gal L 10% G
Sutazine + (ICI, Stauffer)	Butylate + Safener + Atrazine	4.8 + 1.2 lb/gal F
Tackle (Rhône Poulenc)	Acifluorfen	2 lb gal S
Whip (Hoechst)	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 = wetttable powder.

TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Tandem (Dow)	Tridiphane	4 lb/gal E
TCA (Hopkins)	TCA	4.76 lb/gal S
Torch Twin Pack (Rhône Poulenc)	Bromoxynil + Atrazine	1.8 lb/gal E and 2.5 lb/gal F
Tordon (Dow)	Picloram	2 lb/gal S (Tordon 22K)
Treflan (Elanco)	Trifluralin	4 lb/gal E, 5 lb/gal E 10% G
2,4-D (Various)	2,4-D	Various E, S

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 & per. 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	I	I	N	G	I	P	F	P	N	P	P	F-G	N
Cycloate (Ro-Neet)	G	F-G	P	N	G	P	F-G	F-G	P	N	P-F	P	F-G	N
EPTC (Eptam, Genep)	G	F-G	P	N	G	F	F	F-G	P	N	F	P	F-G	N
Ethalfluralin (Sonalan)	G	G	P	N	G	G	G	G	G	N	F	N	F-G	S
Ethofumesate (Nortron)	P	F-G	P	N	F-G	F-G	P	G	F-G	P	F-G	F	F-G	O
Pendimethalin (Prowl)	G	N	N	N	G	F-G	G	G	F	N	N	N	F	S
Trifluralin (Treflan)	G	N	P	N	G	G	G	G	G	N	F	N	F	S
PREEMERGENCE INCORPORATED														
Di- & Triallate (Avadex, Far-go)	N	N	N	N	N-F	N	N	N	N	N	N	N	G	N
Trifluralin (Treflan)	G	N	N	N	G	F	F	F	F	N	N	N	P-N	S

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

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 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 & per. 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	G	N	N	G	F	F	G	F	N	F	P	P	N
Atrazine (AAtrex)	G	G	F	P	G	G	G	G	G	F	G	G	G	O
Chloramben (Amiben)	G	F	P	N	G	F	G	G	G	N	G	F-G	F	N
Cyanazine (Bladex)	F	F	F	N	G	F	G	F	G	F	G	G	P	N
Diethatyl (Antor)	F-G	F-G	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-G	O
Metolachlor (Dual)	G	G	N	N	G	F	F	G	F	N	F	P	N	N
Metribuzin (Lexone, Sencor)	G	P	F	N	G	G	F	G	G	N	F	G	P	S
Pendimethalin (Prowl)	G	N	N	N	G	F-G	G	G	F	N	N	N	F	S
Propachlor (Bexton, Ramrod)	G	—	P	N	G	G	F	G	P	N	F	P	P	N
Simazine (Princep)	G	G	F	P	G	G	G	G	G	F	G	G	G	O
TCA	G	N	N	N	G	N	N	N	N	P	N	N	P	N
POSTEMERGENCE														
Acifluorfen (Blazer/Tackle)	N	F-G	F	F	P	F-G	P-F	G	P	P	G	G	N	N
Atrazine + oil	G	G	G	P	G	G	G	G	G	G	G	G	G	S
Barban (Carbyne 2EC)	N	N	N	N	N	N	N	N	N	N	P	N	F-G	N
Bentazon (Basagran)	N	F	G	P-F	N	F	P	P	P	G	P	G	N	N
Bromoxynil (ME4 Brominal, Bucril)	N	G	G	P-F	N	F-G	G	F-G	G	G	G	F	N	N
Bromoxynil + MCPA (3 + 3 Brominal, & Bronate)	N	G	G	F	N	G	G	G	G	G	G	G	N	N
Chlorsulfuron (Glean)	—	N	G	P-G	G	G	G	G	G	G	G	G	N	O
Clopyralid + 2,4-D (Curtail)	N	F	G	G	N	F	G	G	G	G	P	G	N	S
Cyanazine + oil (Bladex)	G	F-G	G	P	G	G	G	F-G	G	G	G	G	F	N
Desmedipham + Phenmedipham (Betamix)	P	G	F-G	N	F	F	G	F-G	P	P	F-G	G	N	N
Desmedipham (Betanex)	P	G	P-F	N	P	P-F	G	G	P	P	F	G	N	N
Dicamba (Banvel)	N	G	G	G	N	G	G	G	F-G	G	G	F	N	S
Dicamba + MCPA	N	G	G	F-G	N	G	G	G	F-G	G	G	G	N	N
Diclofop (Hoeon)	F	N	N	N	G	N	N	N	N	N	N	N	G	N
Difenzoquat (Avenge)	N	N	N	N	N	N	N	N	N	N	N	N	G	N
Endothall (Herbicide 273)	N	—	P-F	N	N	P	P	F	P	F-G	G	F	N	N
Fenoxaprop (Whip)	G	N	N	N	G	N	N	N	N	N	N	N	G	N
Fluazifop-P (Fusilade 2000)	G	N	N	N	G	N	N	N	N	N	N	N	G	N
Glyphosate (Roundup)	F	—	—	P-G	G	F	G	G	F	G	P-F	G	G	N
MCPA	N	G	G	F	N	F	G	P-F	N	F-G	N	G	N	N
Paraquat	G	—	—	N	G	F	G	G	F	G	P	G	F	N
Picloram (Tordon 22K) + 2,4-D	N	G	G	G	N	F	G	G	G	G	G	G	N	O
Propanil + MCPA (Stampede CM)	F	—	G	F	G	G	G	G	P	F-G	G	G	N	N
Sethoxydim (Poast)	G	N	N	N	G	N	N	N	N	N	N	N	G	N
2,4-D	N	F	G	F	N	F	G	G	F-G	G	P	G	N	N

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

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.

Year	Month	Day	Event	Location	Time	Admission
1914	Jan	1
1914	Jan	2
1914	Jan	3
1914	Jan	4
1914	Jan	5
1914	Jan	6
1914	Jan	7
1914	Jan	8
1914	Jan	9
1914	Jan	10
1914	Jan	11
1914	Jan	12
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1914	Jan	14
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1914	Jan	16
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1914	Jan	24
1914	Jan	25
1914	Jan	26
1914	Jan	27
1914	Jan	28
1914	Jan	29
1914	Jan	30
1914	Jan	31
1914	Feb	1
1914	Feb	2
1914	Feb	3
1914	Feb	4
1914	Feb	5
1914	Feb	6
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1914	Feb	8
1914	Feb	9
1914	Feb	10
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1914	Feb	25
1914	Feb	26
1914	Feb	27
1914	Feb	28
1914	Feb	29
1914	Feb	30
1914	Mar	1
1914	Mar	2
1914	Mar	3
1914	Mar	4
1914	Mar	5
1914	Mar	6
1914	Mar	7
1914	Mar	8
1914	Mar	9
1914	Mar	10
1914	Mar	11
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1914	Mar	24
1914	Mar	25
1914	Mar	26
1914	Mar	27
1914	Mar	28
1914	Mar	29
1914	Mar	30
1914	Mar	31
1914	Apr	1
1914	Apr	2
1914	Apr	3
1914	Apr	4
1914	Apr	5
1914	Apr	6
1914	Apr	7
1914	Apr	8
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1914	Apr	10
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1914	Apr	27
1914	Apr	28
1914	Apr	29
1914	Apr	30
1914	Apr	30

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