

1991 AGRICULTURAL WEED CONTROL GUIDE



Compiled by:
R.K. Zollinger
 NDSU Extension Service

CONTRIBUTORS:

D.R. Berglund, G.K. Dahl NDSU Extension Service
A.G. Dexter NDSU Extension Service and Minnesota Extension Service

W. Ahrens, R.G. Lym, C.G. Messersmith and J.D. Nalewaja, NDSU Agricultural Experiment Station.

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INTRODUCTION

THE WEED CONTROL SUGGESTIONS presented in this guide are based on Federal label clearance and on information obtained from the North Dakota Agricultural Experiment Station and the Research Reports 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.**

RESTRICTED USE HERBICIDES. Certification is required for purchase and use of restricted use herbicides, picloram (Tordon), diclofop (Hoelon), paraquat (Gramoxone Extra, Cyclone), sulfuric acid, amitrole (Amitrol-T, Cytrol), atrazine, cyanazine (Bladex) alachlor (Lasso), bromoxynil (Buctril, Bronate), and pronamide (Kerb). All combinations containing the above herbicides are also restricted.

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 amount of active ingredient. For example, a pint of 4-pound acid equivalent per gallon 2,4-D contains 0.5 pound while a pint of 6-pound acid equivalent per gallon contains 0.75 pound. Three pounds of atrazine (AAtrex 80W) powder contains 2.4 pounds active ingredient ($3 \times 0.80 = 2.4$), or 3 pounds active ingredient is 3.75 pounds of product ($3 / 0.80 = 3.75$).

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

GENERAL INFORMATION

POSTEMERGENCE HERBICIDES:

Effectiveness of postemergence herbicides is influenced by crop tolerance, weed species and climatic conditions and these factors should be considered in determining the herbicide rate. A range of rates is given for most of the herbicides in this circular. The lowest rate of postemergence herbicides will be effective 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 on the label.

Ideal temperatures for applying most postemergence herbicides are between 65 to 85F. Below 60 F weeds are killed very slowly or not at all; above 85F 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 broad-leaf crops, shelterbelts, or farmsteads.

Rainfall shortly after postemergence herbicide application often reduces weed control because the herbicide is washed off the leaves before absorption is complete. Herbicides vary in rate of absorption and in case 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.

MINIMUM INTERVAL BETWEEN APPLICATION AND RAIN FOR MAXIMUM POSTEMERGENCE WEED CONTROL.

Herbicide	Time Interval	Herbicide	Time Interval
acifluorfen (Blazer)	6 hours	fenoxaprop (Whip/Option)	1 hour
atrazine + oil (Aatrex)	4 hours	fluazifop-P (Fusilade 2000)	1 hour
barban (Carbyne)	5 minutes	glyphosate (Roundup, Ranger)	6 hours
bentazon + oil (Basagran)	8 hours	imazamethabenz (Assert)	3 hours
bromoxynil (Buctril)	1 hour	lactofen (Cobra)	0.5 hour
chlorsulfuron (Glean)	4 hours	2,4-D or MCPA amine	4 hours
cyanazine (Bladex)	2 hours	2,4-D or MCPA ester	1 hour
desmedipham (Betanex)	6 hours	metsulfuron (Ally)	4 hours
(Betamix)	6 hours	nicosulfuron (Accent)	4-6 hours
dicamba (Banvel)	6-8 hours	paraquat (Gramoxone Extra)	0.5 hour
diclofop (Hoelon)	1 hour	primisulfuron (Beacon)	4 hours
difenzoquat (Avenge)	6 hours	propanil + MCPA (Stampede CM)	4 hours
sethoxydim (Poast)	1 hour	thifensulfuron (Pinnacle)	1 hour
Harmony Extra	4 hours	tribenuron (Express)	4 hours
quizalofop (Assure)	1 hour		

SPRAY ADDITIVES:

Spray additives consist of oils, surfactants, and fertilizers. The most effective additive often will vary with different herbicides and the need for an additive will vary with environment, weeds present, and herbicide. Additives should be used only when indicated on the herbicide label as they may increase injury to crops or reduce weed control. Oils generally are used at 1% v/v (1 gal/100 gal of spray solution) or at 1 pt to 1 qt/A depending upon herbicide and oil. Oil additives function to increase herbicide absorption and spray retention. Surfactants are used at 0.12 to 0.5% v/v (1 to 4 pt/100 gal 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.

Ammonium sulfate at 17 lbs per 100 gal spray volume has enhanced weed control with glyphosate. The enhancement is most pronounced when spray water contains relatively large quantities of certain ions, such as calcium, sodium, carbonates or bicarbonates. Diammonium sulfate may contain contaminants which may not dissolve and plug nozzles. Ammonium sulfate may need to be dissolved in a small amount of water and filtered to prevent nozzle plugging. Commercial solutions of ammonium sulfate are available. Ammonium sulfate also will overcome antagonism of sethoxydim and 2,4-D amine by salts in water. 28% nitrogen also is effective in enhancing weed control from many postemergence herbicides and overcoming sodium but not calcium antagonism of glyphosate. Sodium bicarbonate antagonism of sethoxydim is overcome by 28% N. Ammonium sulfate or 28% N does not overcome the need for a surfactant. Many adjuvants are available to enhance herbicide action, but information on their effectiveness is limited. The precise salt concentration in water which causes antagonism is difficult to establish because antagonism also is influenced by many other factors. Thus comparisons of treatment without adjuvants should be made to determine the effectiveness of adjuvants for specific herbicides, sprays, water and weeds. Effective adjuvants may allow use of herbicides at reduced rates or provide consistent results with adverse conditions. However, use of rates below the direction label exempts herbicide manufacturers from liability for nonperformance.

SPRAY AND VAPOR DRIFT:

Movement of herbicides off target 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 potential for drift to occur.

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. 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 to 90 F. Amine formulations are essentially non-volatile even at high temperatures. Temperature on the soil surface often is several degrees warmer than air temperature. Thus 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. Dicamba (Banvel) also is 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 than droplets from conventional hydraulic nozzles. Nalco-Trol and other additives to spray mixtures cause larger droplets which may reduce drift. Drift control techniques that produce large spray droplets should not be used with postemergence herbicides that require small droplets for optimum performance such as barban (Carbyne 2EC), desmedipham (Betanex), bentazon (Basagran), sethoxydim, (Poast), fluazifop-P (Fusilade 2000), fenoxaprop (Whip/Option), and quizalofop (Assure).

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

GROUNDWATER CONTAMINATION

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

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

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

1. Select herbicides with short residual and limited mobility in soil.
2. Properly calibrate sprayers to prevent application of excessive rates of herbicide.

3. Apply herbicides only when necessary and follow all herbicide label recommendations and guidelines.
4. Use good agronomic practices that minimize weed competition and maximize herbicide performance such as crop rotation, herbicide rotation, timely cultivation, and cover crops.
5. Use band applications rather than broadcast applications to reduce the amount of pesticide used per acre.
6. Do not apply herbicides near open water.
7. Avoid use of persistent and/or mobile herbicides on soil with a shallow water table.

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

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 herbicides 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 may be controlled by rotary hoeing or harrowing without reducing the effect of the herbicide.

INCORPORATION OF HERBICIDES:

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

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

PESTICIDE COMBINATIONS:

The recommended sequence for addition of various herbicide formulations to a tank is: a) water, b) wettable powders or dry flowables plus agitation, c) liquid flowables, d) emulsifiable concentrates, and e) solutions. Compatibility testing as described in the next section can be used to determine if tank mixes of pesticides will form a uniform mixture in the spray tank. The effect of postemergence herbicides often is increased when applied to areas already treated with a preemergence or preplant herbicide. Combinations of certain herbicides may give better weed control than use of the individual herbicide alone. However, loss of weed control or increased crop damage may result from the use of certain other herbicides in combination. Herbicide combinations should be used with caution until experience or research has shown that the combination is effective and safe. See the discussion on individual crops for more specific information.

Several herbicide-insecticide combinations have been shown to increase crop injury compared to either pesticide applied alone. For example, crop injury has increased from combination of bentazon plus malathion, sulfonylurea herbicides plus organophosphate insecticides, and propanil plus organophosphate or carbamate insecticides. Increased crop injury even has occurred with sequential applications. Efficacy data on herbicide-insecticide mixtures are limited because of the number of potential combinations. Non-registered tank-mixtures should be used with caution until experience or research has shown that the combination is effective and safe.

Agricultural pesticides that are tank mixed often are 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.

SAFETY PRECAUTIONS

Follow the Label. It is a violation of federal pesticide laws to use a herbicide in a manner inconsistent with its labeling. Read the entire label before using the herbicide.

Operator Safety. The most serious risk of exposure from chemicals is during handling and mixing operations with the concentrated product. Use protective equipment specified on the label. Use chemical resistant gloves, eye shield, long sleeved clothing, rubber boots, and appropriate respirator as required. In case of emergency, contact the Poison Control Center via 24 hour phone line:

North Dakota Poison Information Center
Fargo Area (701) 234-5575
State Wide 1-800 732-2200

Minnesota Poison Control Center
State Wide 1-800 222-1222

WEED CONTROL GUIDE INFORMATION AND SUGGESTIONS

The information in this guide provides a summary of herbicide uses for many of the crops grown in North Dakota and does not imply a guarantee. The label is the final guide and should be followed strictly. Users are responsible for following label directions and precautions. The following is a brief explanation of many points within the guide.

Herbicides. Herbicides which are given within each crop are listed by common name. Trade names are usually given except in cases where many brands are available. The common name is given first followed by the trade name in parentheses.

Rates. 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 amount of active ingredient. For example, a pint of 4-pound acid equivalent per gallon 2,4-D contains 0.5 pound while a pint of 6-pound acid equivalent per gallon contains 0.75 pound. Three pounds of atrazine (AAtrex 80W) powder contains 2.4 pounds active ingredient ($3 \times 0.80 = 2.4$), or 3 pounds active ingredient is 3.75 pounds of product ($3 / 0.80 = 3.75$).

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

Time To Apply. The best time to apply most herbicides are based on crop and/or weed growth stage. Herbicides can be applied through various methods, such as: preplant incorporated, postplant

incorporated, preemergence, postemergence, postemergence directed, etc.

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

Abbreviations Used

in.	= inches	pt	= pint
qt	= quart	gal	= gallon
fl oz	= fluid ounce	oz	= ounce
lb	= pound	act	= active ingredient
ae	= acid equivalent	lb/gal	= pounds per gallon
v/v	= volume per volume	gpa	= gallons per acre
PPI	= preplant incorporated	PoPI	= postplant incorporated
PRE	= preemergence	Post	= postemergence
BL	= broadleaf	conc.	= concentration
HRSW	= Hard red spring wheat	WW	= Winter wheat
DF	= dry flowable formulation	L	= liquid formulation
F	= flowable formulation	DS	= dry soluble formulation
W	= wettable powder formulation		
E, EC	= emulsifiable concentrate formulation		
MT	= Micro-Tech (i.e. micro-encapsulated formulation)		
G	= granular formulation		
S	= solution		

DO NOT USE THIS PUBLICATION AFTER DECEMBER 31, 1991

CHEMICAL WEED CONTROL FOR FIELD CROPS

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of 3 lb a.e./gal conc.)	Emerged grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	A nonselective, translocated post-emergence herbicide. No soil activity. Apply with a nonionic surfactant at 0.5% v/v. Combinations of 2,4-D or dicamba with glyphosate have increased the spectrum of weeds controlled. Commercial mixtures of 2,4-D + glyphosate (Landmaster II, Landmaster BW) and dicamba + glyphosate (Fallow Master) are available.	145, 146
Paraquat (Gramoxone Extra)	0.47 to 0.94 (1.5 to 3.0 pt)	Emerged annual grass and broadleaf weeds		A nonselective, postemergence herbicide. No soil activity. Apply with nonionic surfactant at 0.12 to 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Triallate (Far-Go, Showdown)	WINTER WHEAT 1.25 (1.25 qt Far-Go, 12.5 lb Far-Go 10 G,)	Wild oats	Fall: For winter wheat. Applied just before to soon after seeding.	Incorporate immediately after application no deeper than 3 to 4 inches. Do not incorporate with a disk implement. When applied after seeding, shallow incorporate with spike or spring tooth harrows set not to disturb seed.	5, 36
	HRSW & DURUM: 1 as liquid or 1.25 as granular (1 qt, 12.5 lb Far-Go 10G, 6.25 lb Showdown) BARLEY: 1.25 as liquid or 1.25 to 2.5 as granular (1.25 qt, 12.5 to 15 lb 10G, 6.3 to 7.5 lb Showdown)		Fall: For HRSW, durum and barley. Applied within 3 weeks of freeze-up.	Apply and incorporate with recommended equipment in the fall. Second incorporation should be done in fall or spring. Granules can be surface applied in the fall with a delayed two-pass incorporation performed in the spring prior to planting. Delayed incorporation may not provide wild oat control equivalent to fall incorporation. For most reliable wild oat control incorporate within 48 hours after application.	
	HRSW & DURUM: 1 (1 qt Far-Go, 10 lb Far-Go 10G) BARLEY: 1.25 (1.25 qt Far-Go (12.5 lb Far-Go 10G)		Spring: For HRSW, durum and barley. Applied before or after planting. Preplant treatments 3 days or more before seeding HRSW or durum.	Preplant incorporate with field cultivator set 4 inches deep. Two pass incorporation is recommended. For application after seeding, apply before kernal sprouts exceed 0.5 inches in length. Postplant incorporate with harrows set shallower than seed.	5, 12
Triallate + Trifluralin (Buckle)	DURUM & BARLEY: 1 to 1.25 + 0.3 to 0.4 (10 to 12.5 lb G)	Wild oats and foxtails	Fall: For durum and barley. Apply within 3 weeks of freeze up. Spring: For Barley Prior to planting or after planting.	Do not apply to HRSW. Incorporate within 24 hours after application. Keep spring or subsequent incorporation depth shallower than first. Stand reduction may occur. Do not apply on soil treated with trifluralin the previous year.	5, 36

* Refer to page 5 for explanation.

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph	
Triallate (Far-Go) Trifluralin NOT FOR WINTER WHEAT	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtail	SPRING: immediately after planting. Plant 2 to 2.5 in. deep.	Incorporate herbicide shallowly twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches and above crop seed.	5, 36	
Trifluralin NOT FOR WINTER WHEAT	0.5 (1 pt 4E, 5 lb 10G)	Foxtail	SPRING: Preplant incorporated.	Incorporate twice 2 to 3 inches deep. FOR BARLEY ONLY.	1, 2, 4, 12, 16, 47	
	0.5 to 0.75 (1 to 1.5 pt)		SPRING: After planting.	Plant 2 to 2.5 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow 1 to 1.5 inches deep.		
	0.5 to 0.75 (1 to 1.5 pt 4E, 5 to 7.5 lb 10G)		FALL: After September 1.	Incorporate once in fall within 24 hours after application. Keep spring incorporation depth shallower than fall. Stand reduction may occur.		2, 12, 16, 47
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buckwheat, vol. sunflower, and most broad- leaf weeds.	Crop emergence until prior to boot.	Apply when weeds are in early seedling stage for best results. Weak on wild mustard. Restricted use herbicide.	29, 49, 50, 51	
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.38 + 0.19 to 0.38 (0.75 to 1.5 pt)	Wild buckwheat, vol. sunflower, and most broadleaf weeds	Crop from 3-leaf until prior to boot.	Apply when weeds are in early seedling stage for best results. Volunteer sunflower control better than 0.5 lb/A 2,4-D. Restricted use herbicide.	29, 49, 50, 51	
Picloram (Tordon 22K) + 2,4-D or MCPA NOT FOR DURUM WHEAT	1/64 to 1/43 + 0.25 to 0.38 (1 to 1.5 fl oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buckwheat, volunteer and wild sunflower and most broadleaf weeds.	HRSW & Barley: 3rd - 5th leaf stage. Winter Wheat: In spring during active crop growth and before early boot stage.	Use only on land to be planted the following year to grass, small grains, or flax. Picloram is a restricted use herbicide.	18, 28, 49, 50, 51	
			HRSW & Durum: 4-leaf stage only. Winter Wheat: 4 leaf to jointing in spring.	Proper timing of application is important to avoid crop injury. Barley is relatively susceptible to injury from dicamba.		27
			HRSW & Durum: 2nd through 4th leaf stage. Winter Wheat: In spring after dormancy but before jointing.	Use low dicamba rate and high MCPA rate on 4-leaf HRSW or durum. Barley is relatively susceptible to injury from dicamba.		27, 49, 50, 51

*Refer to page 5 for explanation.

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)	Broadleaf weeds	HRSW, Durum and Barley: Emergence until prior to boot. WW: In spring from 4-leaf until 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 high rate for large or perennial weeds.	25, 30, 49, 50, 51
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.)		HRSW & Barley: 5-leaf until prior to boot. WW: Well tillered until prior to boot.	Do not apply from early boot to dough stage. Do not apply in fall.	
Clopyralid + 2,4-D (Curtail)	0.09 to 0.5 (2 pt)	Canada thistle and other broadleaf weeds.	Crop: 4-leaf stage through jointing.	Do not rotate to any crop except small grains, grass, corn or sugarbeets within one year of application.	23, 26, 138
Clopyralid + MCPA (Curtail M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)		Crop: 3-leaf stage through jointing.		
Chlorsulfuron (Glean)	1/128 (1/6 oz)	Most broadleaf weeds.	In spring: 2-leaf stage until prior to boot. Vic durum: 4- leaf stage until prior to boot. Weeds: small, less than 2 in. tall or 2 in. diameter.	Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 24 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH of 7.8. See paragraph 21 for rotational restrictions.	21, 24, 30
Metsulfuron (Ally) + 2,4-D (or other broadleaf tankmix herbicide)	1/267 + 0.25 (0.1 oz + 0.5 pt of 4 lb/gal conc.)		Crop: Not prior to 2-leaf stage. Durum: Not prior to 4-leaf stage. ALSO, follow crop stage restrictions on label of tankmix herbicide.	Apply with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron or chlor- sulfuron treatment. See paragraph 24 about resistant weeds and 22 for rotation restrictions. Apply with a non- ionic surfactant (See label for rates). Do not apply to soils above pH 7.9.	32, 33
Thifensulfuron + Tribenuron (Harmony Extra) + 2,4-D (or other broadleaf tankmix herbicide)	1/111 to 1/53 + 1/200 to 1/111 (0.3 to 0.6 oz) + 0.25 (0.5 pt of 4 lb/gal conc.)	Most broadleaf weeds including wild buckwheat.	Crop: Between 2- leaf stage to jointing BUT ALSO follow crop stage restrictions on label of tankmix herbicide.	The addition of 2,4-D enhances weed control and crop safety. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not tank mix with diclofop. See paragraph 24 about weed resistance. No rotational restrictions for the following year.	32, 33
Tribenuron (Express) + 2,4-D (or other broadleaf tankmix herbicide)	1/128 to 1/64 (1/6 to 1/3 oz) + 0.25 (0.5 pt of 4 lb/gal conc.)	Most broadleaf weeds. Weak on wild buckwheat	Crop: Between 2- leaf stage until prior to flag leaf emergence BUT ALSO follow crop stage restrictions on label of tankmix herbicide.		
Propanil + MCPA (Stampede CM) NOT FOR WINTER WHEAT	0.94 + 0.25 (2.5 pt)	Green and yellow foxtail and some annual broadleaf weeds.	Weeds: 2 to 4 leaves Crop: 2 through 4- leaf.	Application to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased risk of crop injury.	45

*Refer to page 5 for explanation.

Hard Red Spring and Durum Wheat, Winter Wheat and Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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 oat 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 oat stage increases.	37, 38, 39
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5 leaf stage		
Diclofop (Hoelon)	0.75 to 1.0 (2 to 2.7 pt.)	Wild oats and foxtails	Grass weeds: 1 to 4 leaves. HRSW & Barley: Up to 4-leaf stage. WW: Before jointing.	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves. Oil adjuvant enhances weed control under dry conditions. Only mix with bromoxynil or bromoxynil plus 1.5 fl oz/A of MCPA ester. Restricted use herbicide.	41, 44
Diclofop (Hoelon) + Bromoxynil (Buctril)	0.75 to 1.0 + 0.25 to 0.37 (2 to 2.7 pt + 1.0 to 1.5 pt)	Wild oats, foxtails and broadleaf weeds	Grass weeds: 2 to 3 leaves. Broadleaf weeds: small.	Use the higher rate for dry conditions. Oil adjuvant at 1 to 2 pt/A may increase weed control but also increase risk of crop injury. Do not add oil adjuvant to this mixture when applying to barley. Diclofop and bromoxynil are restricted use herbicides.	29, 34, 41, 43, 44
Diclofop (Hoelon) + Bromoxynil (Buctril) + MCPA ester	1.0 + 0.25 to 0.38 + 0.05 (2.7 pt + 1.0 pt to 1.5 pt + 1.5 fl oz)		Grass weeds: 1 to 3 leaves Broadleaf weeds: small		
Difenoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	Wild oats: 3- to 5-leaf stage. Crop: prior to flag leaf emergence.	Use high rate on 3-leaf wild oats. Refer to narrative for herbicides which can be tankmixed with difenzoquat. Injury may occur when crop is under environmental stress. See paragraph 40 for registered wheat varieties. Cleared on all barley varieties.	25, 40
Imazamethabenz (Assert)	0.38 to 0.47 (1.2 to 1.5 pt)	Wild oats, wild mustard, and winter annual mustards	Crop: 2-leaf to jointing. Wild oats: 1- to 4-leaf stage.	See narrative for rotational restrictions. Do not tank-mix with propanil plus MCPA, dicamba, picloram, or the amine formulations of 2,4-D or MCPA.	42

*Refer to page 5 for explanation.

OATS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of 3 lb a.e./gal conc.)	Emerged grass and broadleaf weeds.	Preplant or any time prior to crop emergence.	A nonselective, translocated post-emergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v. Combinations of 2,4-D or dicamba with glyphosate have increased the spectrum of weeds controlled. Commercial mixtures of 2,4-D + glyphosate (Landmaster BW) and dicamba + glyphosate (Fallow Master) are available.	145, 146
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1.0 pt of 4 lb/gal conc.)	Broadleaf weeds	Oats: emergence to boot stage.	Early jointing stage most susceptible. Possible oats injury at any stage. Use 0.5 lb/A for sunflower and kochia.	25, 34, 49, 50,
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buckwheat, volunteer sunflower, and most broad-leaf weeds.	Crop emergence until prior to boot.	Apply when weeds are in early seedling stage for best results. Weak on wild mustard. Restricted use herbicide.	25, 34, 49, 50,
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.38 + 0.19 to 0.38 (0.75 to 1.5 pt)		Oats: 3-leaf to boot stage.	Apply when weeds are in early seedling stage for best results. Volunteer sunflower control better than from 0.5 lb/A of 2,4-D. Restricted use herbicide.	29, 49, 50, 51
Chlorsulfuron (Glean)	1/128 (1/6 oz)	Most broadleaf weeds	Crop: 2-leaf stage until prior to boot. Weeds: small, less than 2 in. tall or 2 in. diameter.	Do not apply within 48 months of the last chlorsulfuron treatment. See paragraph 24 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 21 for rotational restrictions.	21, 24, 30, 49, 50, 51, 52
Picloram (Tordon 22K) + MCPA	1/64 to 1/43 + 0.25 to 0.38 (1 to 1.5 fl oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buckwheat and most broadleaf 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.	18, 28, 49, 50, 51
Dicamba (Banvel, Banvel SGF) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt Banvel, 0.25 to 0.5 pt SGF + 0.5 to 0.75 pt 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, 49, 50, 51
Clopyralid + MCPA (Curtail M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)	Canada thistle and other broadleaf weeds.	Oats: 3-leaf stage through jointing.	Do not rotate to any crop except small grains, corn, grass, or sugarbeets within 12 months after application.	23, 26, 138
Propanil + MCPA (Stampede CM)	0.94 + 0.25 (2.5 pt)	Green and yellow foxtail and some annual broadleaf weeds	Weeds: 1 to 4 leaves. Crop: 2 through 4-leaf stage.	Application to foxtail larger than 3 leaves or oats larger than 4 leaves may result in reduced weed control or increased risk of crop injury.	45

*Refer to page 5 for explanation.

RYE

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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, 34, 49, 50, 51
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.		
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Wild buckwheat and other broadleaf 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. Addition of MCPA improves wild mustard control. Restricted use herbicide.	29, 49, 50, 51
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.38 + 0.19 to 0.38 (0.75 to 1.5 pt)				

*Refer to page 5 for explanation.

SMALL GRAIN PRE-HARVEST

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
2,4-D 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 the weeds will interfere with harvest operations. Do not feed straw to livestock. CAUTION: Drift to broadleaf crops is hazardous at this time.	138
Dicamba (Banvel) + 2,4-D	0.25 + 0.5 to 1 (0.5 pt + 1 to 2 pt of 4 lb/gal conc.)		Wheat: hard dough stage and green color is gone from the nodes of the stem.	A waiting period of 10 to 14 days is required before harvest. Do not feed treated straw to livestock. CAUTION: Drift to broadleaf crops is hazardous at this time. Special North Dakota label.	

*Refer to page 5 for explanation.

FLAX

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
EPTC (Eptam, Genep)	4 (4.5 pts 7E, 40 lb 10G)	Grass and some broadleaf weeds	Fall incorporated after October 15 until freeze-up.	Flax safety is marginal. Weak on wild mustard.	2, 10, 55
Trifluralin	0.5 to 1.0 (1 to 2 pt 4E or 5 to 10 lb 10G)		Fall incorporated	Use higher rates on fine textured soils. Incorporate once in the fall within 24 hours after application. Keep spring tillage depth shallower than fall.	1, 2, 16, 34, 54, 56
Propachlor (Ramrod)	4 (4 qt)	Grass and certain broadleaf weeds	Preemergence	Weak on wild mustard and wild oats.	57
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Grass weeds: 2 to 8 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.	61
Diclofop (Hoelon)	0.75 to 1.0 (2 to 2.67 pt)	Wild oats and foxtails.	Grass weeds: 1 to 4 leaves.	Do not mix with oil additives or any herbicide except bromoxynil. Restricted use herbicide.	60
Diclofop (Hoelon) + Bromoxynil (Buctril)	0.75 to 1.0 + 0.25 (2 to 2.67 pt + 1 pt)	Wild oats, foxtail and broadleaf weeds.	Grass weeds: 1 to 4 leaves and small broadleaf weeds.	Do not mix with oil additive. Restricted use herbicides.	59, 60
Bromoxynil (Buctril)	0.25 (1 pt)	Wild buckwheat, and certain broadleaf weeds	Flax: 2 to 6 inches tall.	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible. Restricted use herbicide.	59
MCPA	0.25 (0.5 pt of a 4 lb/gal conc.)	Broadleaf weeds		Use MCPA ester or the higher rates of MCPA amine for hard-to-kill weeds. Early application less injurious to flax.	
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 herbicides.	18, 58
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 is essential. Do not graze or feed treated straw. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

*Refer to page 5 for explanation.

CORN

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Allyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ae/gal conc.)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Extra)	0.47 to 0.94 (1.5 to 3 pt)	Emerged annual grass and broadleaf weeds.		A nonselective, postemergence herbicide. No soil activity. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Atrazine + Butylate & Safener (Sutan +, Genate +)	1 + 3 (3.5 pt)	Most grass and broadleaf weeds.	Preplant incorporated.	Immediate incorporation is required for best results. Safener protects corn from injury. Atrazine is a restricted use herbicide.	1, 2, 15, 65, 63
EPTC & Safener (Eradicane)	4 to 6 (4.75 to 7 pt)	Grass and some broadleaf weeds.		Safener protects corn from injury and Extender extends EPTC soil life under certain conditions. Immediate incorporation is required for best results. Use high rate for wild proso millet control. Weak on wild mustard.	1, 2, 71
EPTC & Safener & Extender (Eradicane Extra)					
EPTC & Safener & Extender + Cyanazine (Eradicane Extra Bladex)	3.2 to 6 + 0.6 to 3 (4 to 7 pt + 0.7 to 3.3 lb 90DF, 0.6 to 3 qt 4L)	Most grass and broadleaf weeds.	Preplant incorporated.	Use higher rates on fine-textured soils. Immediate incorporation is required for best results. Cyanazine at the high rate may injure corn in cool, wet conditions. Cyanazine is a restricted use herbicide.	1, 2, 69, 71
Alachlor	1.75 to 4 (2 to 4 qt 4EC, 10 to 26 lb 15G, 1.75 to 3.5 qt MT)	Grass and some broadleaf weeds.	Preplant incorporated or preemergence.	Weak on wild mustard. Usually less effective preemergence than propachlor in North Dakota. Preplant incorporation gives more consistent weed control. Alachlor is a restricted use herbicide.	1, 68
Metolachlor (Dual, Dual 25G)	1.5 to 3 (1.5 to 3 pt 8E or 6 to 12 lb 25G)				
Atrazine	2 to 3 (2 to 3 qt 4L, 2.5 to 3.75 lb 80 W, 2.2 to 3.3 lb 90DF)	Broadleaf and some grass control.	Preplant incorporated or preemergence.	Use higher rate on fine-textured soils for quackgrass and Canada thistle control. Provides partial control of foxtails. Restricted use herbicide.	15, 65
Cyanazine (Bladex)	1.2 to 4.75 (1.3 to 5.3 lb 90DF, 1.25 to 4.75 qt 4F)			Soil residues unlikely the year after application. Weak on redroot pigweed. Use higher rate on fine-textured, high organic matter soil. Cyanazine at higher rates may injure corn in cool, wet conditions. DO NOT USE ON SANDS, LOAMY SANDS OR SOIL WITH LESS THAN 1% ORGANIC MATTER. Restricted use herbicide.	69

Refer to page 5 for explanation.

CORN

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Cyanazine (Bladex) + Atrazine	0.75 to 3.75 + 0.4 to 1.6 (0.8 to 4.0 lb 90DF, 0.75 to 3.75 qt 4L + 0.5 to 2.0 lb 80W, 0.4 to 1.8 lb 90DF, 0.4 to 1.6 qt 4L)	Broadleaf and some grass control.	Preplant incorporated or preemergence.	Atrazine rates used reduces the potential for carryover. Commercial mixture (Extrazine II) is available. Do not use on sands, loamy sands or soil with less than 1% organic matter. Both are restricted use herbicides.	15, 69
Cyanazine (Bladex) + Alachlor	0.6 to 3 + 2 (0.7 to 3.3 lb 90DF, 0.6 to 3 qt 4L + 2 qt 4E)	Most grass and broadleaf weeds		Use lower rates of cyanazine on course-textured soils. Cyanazine at the high rate may injure corn in cool, wet conditions. Cyanazine and alachlor are restricted use herbicides. Commercial mixture (Cycle) available.	66, 69
Cyanazine (Bladex) + Metolachlor (Dual)	0.6 to 3 + 2 (0.7 to 3.3 lb 90DF, 0.6 to 3 qt 4L + 2 pt 8E)				
Atrazine + Alachlor	1 + 2 (1.25 lb 80W, 1.1 lb 90DF, 1 qt 4F + 2 qt 4E)			Atrazine soil residue may injure subsequent crops. Commercial mixtures (Lariat, Bullet) are available. Both are restricted use herbicides.	1, 15, 65, 66
Atrazine + Metolachlor (Dual)	1 to 2.4 + 1.5 to 2 (1.25 to 3 lb 80W, 1.1 to 2.6 90DF + 1.5 to 2 pt)			Atrazine soil residue may injure subsequent crops. Commercial mixtures (Bicep) available. Atrazine is a restricted use herbicide.	15, 65, 66
Atrazine + Pendimethalin (Prowl)	1 to 2 + 1 to 1.5 (1.25 to 2.5 lb 80W, 1.1 to 2.2 lb 90DF, 1 to 2 qt 4F + 2 to 3 pt 4F)	Most grass and broadleaf weeds	Preemergence	Atrazine soil residue may injure subsequent crops. Do not incorporate. Atrazine is a restricted use herbicide.	15, 65, 72
Atrazine + Propachlor (Ramrod)	1 + 3 (1.25 lb 80W, 1.1 lb 90DF, 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.	15, 65, 67
Dicamba (Banvel) + Alachlor or Metolachlor (Dual)	0.25 to 0.5 + 2 (0.5 to 1 pt + 2 qt alachlor or 1 qt metolachlor)			Preemergence or before corn is 3 in. tall.	Use lower rate of dicamba on course-textured soils. Do not incorporate. Early postemergence probably will not control emerged grasses.
Pendimethalin (Prowl)	1.5 to 2 (3 to 4 pt)	Grass and some broadleaf weeds	Preemergence	Do not use on sands or loamy sands. Use the high rate on fine textured soils high in OM. Do not incorporate.	72
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.	67
Pendimethalin (Prowl) + Cyanazine (Bladex)	1 to 1.5 + 1.2 to 2 (2 to 3 pt + 1.3 to 2.2 lb 90DF)	Most grasses and broadleaf weeds	Preemergence or 1 to 2-leaf stage of corn.	No soil residue to next crop. Use lower rate of cyanazine on course-textured soils. Do not incorporate. Cyanazine is a restricted use herbicide.	69, 72
Dicamba (Banvel) + Atrazine	0.25 to 0.5 + 0.50 to 2.0 (0.5 to 1 pt + 0.6 to 2.5 lb 80W, 0.55 to 2.2 lb 90DF, 0.5 to 2 qt 4L)	Most broadleaf weeds	Preplant, preemergence, or postemergence before corn exceeds 5-leaf stage.	Use lower rate on sandy soils with low organic matter. Do not apply to stressed corn. Atrazine soil residue may injure subsequent crops. Restricted use herbicide.	15, 65, 70, 73

* Refer to page 5 for explanation.

CORN

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Atrazine + oil additive	1 to 2 (1.25 to 1.5 lb 80W, 1.1 to 2.2 90DF, 1 to 2 qt 4L) + oil additive	Broadleaf weeds and some grasses	Early postemergence Weeds: less than 1.5 in. tall.	Apply with an oil additive at 1 qt/A. Provides partial control of foxtail. Atrazine soil residue may injure subsequent crops. Restricted use.	15, 73
Cyanazine (Bladex)	1.2 to 2.0 (1.3 to 2.2 lb 90DF)	Grass and some broadleaf weeds.	Weeds: less than 1.5 in. tall Corn: 4-leaf stage or smaller.	Vegetable oil additive increases weed control and risk of crop damage. Use only 90DF for postemergence applications. Avoid application under cool, wet conditions or to stressed corn. Restricted use herbicide.	69
Cyanazine (Bladex) + Atrazine	0.8 + 0.5 + 1 qt veg. oil (0.9 lb 90DF + 0.6 lb 90DF)	Grass and some broadleaf weeds	Grasses: less than 1.5 in. Broadleaf: up to 4 in. Corn: up to 4-leaf stage.	Apply with an emulsifiable vegetable oil additive at 1 qt/A. Cyanazine and atrazine are restricted use herbicides.	15, 73, 74
Dicamba (Banvel)	0.25 to 0.5 (0.5 to 1.0 pt 4S)	Broadleaf weeds including buckwheat, Canada thistle, perennial sowthistle	Early post-emergence Corn: up to 5 in. tall.	Use drop nozzles after corn is 8 inches tall to reduce drift. Use low rate on coarse textured or low organic matter soil.	76
Dicamba (Banvel)	0.25 (0.5 pt 4S)		Corn: before 36 in. tall or 15 days prior to tassel.		
2,4-D	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Corn: postemergence, 3-leaf to 30 in. tall.	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.	75
Bromoxynil (Buctril)	0.25 to 0.37 (1 to 1.5 pt)	Wild buckwheat, vol. sunflower and most annual broadleaf weeds.	Corn: postemergence, 3-leaf to tasseling	Apply when weeds are in seedling stage. Weak on wild mustard. Could be used when drift of dicamba or 2,4-D may injure sensitive broadleaf crops. Restricted use herbicide.	77
Bromoxynil (Buctril) + atrazine	0.19 to 0.38 + 0.5 to 1 (0.75 to 1.5 pt + 0.6 to 1.25 80W, 0.55 to 1.1 lb 90 DF, 0.5 to 1 qt 4L)	Broadleaf weeds	Corn: postemergence, 3-leaf to 30 in. tall	Atrazine soil residual may injure subsequent crops. Commercial mixture (Buctril + Atrazine) available. Bromoxynil and atrazine are restricted use herbicides.	15, 73, 77
Bentazon	0.75 to 1.0 (1.5 to 2.0)	Wild mustard, cocklebur, Canada thistle, wild and vol. sunflower.	Postemergence, Mustard: 4 to 6-leaf Thistle: 6 in. to 8 in. Corn: tolerant at all stages.	Could be used when drift of dicamba or 2,4-D may injure sensitive crops. Thorough coverage is essential. Avoid application to stressed plants. Split applications needed for Canada thistle.	78
Bentazon + atrazine (Laddok)	0.4 to 0.7 + 0.4 to 0.7 (2 to 3.5 pt)	Broadleaf weeds	Postemergence Corn: tolerant at all stages. Broadleaf weeds: up to 6-8 in. tall.	Corn is tolerant at all growth stages. Add 1 qt oil additive/A or 1 gal 28% UAN /A. Commercial mixture (Laddok) available. Atrazine is a restricted use herbicide.	15, 78

Refer to page 5 for explanation.

CORN

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Clopyralid (Stinger)	0.12 to 0.25 (0.33 to 0.67 pt)	Canada thistle and other broadleaf weeds	Corn: emergence to 24 in. tall Thistle: 4 in. in diameter but before bud stage Other weeds: before 5-leaf stage.	Apply only to field corn. Majority of thistle shoots should be emerged at time of application. Wait 14 to 20 days after application before cultivating. Restrict livestock grazing or harvest treated corn within 40 days after last application.	23
Nicosulfuron (Accent)	1/32 (0.9 oz) <i>0.67</i>	Emerged annual grasses and some broadleaf weeds.	Corn: 2 to 10-leaf stage.	Apply with crop oil concentrate. Do not apply to corn previously treated with Counter insecticide. See narrative for information on rotational restrictions.	79
Primisulfuron (Beacon)	1/28 (0.9 oz) <i>0.76</i>	Emerged broadleaf and some grass weeds	Corn: 4 to 20 in. tall.	Apply with nonionic surfactant or crop oil concentrate. Do not apply to corn previously treated with Counter insecticide. See narrative for additional information.	80
Ametryn (Evik)	2 to 2.5 (2.5 to 3 lb 80W)	Broadleaf and grass weeds.	Postemergence directed to weeds less than 4 in. tall. Corn: more than 12 in. tall.	Apply as postemergence directed spray. Do not spray over the top of corn or injury will occur. Do not spray within three weeks of tasseling. Apply with nonionic surfactant at 0.5% v/v. Use the higher rate for taller weeds. See label for rotational restrictions.	81
Paraquat (Gramoxone Extra)	0.25 (12.8 fl oz)			Apply as postemergence directed spray. Treat no more than lower 3 inches of corn stalk. Apply with nonionic surfactant at 0.25% v/v. May be tank-mixed with atrazine. Both are restricted use herbicides.	81

* Refer to page 5 for explanation.

SOYBEAN

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Extra)	0.47 to 0.94 (1.5 to 3 pt)	Emerged annual grass and broadleaf weeds		A nonselective, nonresidual, contact, postemergence herbicide. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Some grass and broadleaf weeds	Preplant incorporated only.	Preplant incorporation provides more consistent results. Weak on wild mustard. Pendimethalin and ethalfluralin provide poor wild mustard control and trifluralin provides no wild mustard control.	1, 2, 87
Ethalfluralin (Sonalan)	0.5 to 1.3 (1.3 to 3.5 pt)				
Trifluralin	0.5 to 1 (1 to 2 pt 4E 5 to 10 lb 10G)		Preplant incorporated fall or spring.		1, 2, 12, 16, 85
Clomazone (Command)	0.75 to 1 (1.5 to 2 pt)	Annual grass and broadleaf weeds including velvetleaf.	Preplant incorporated	Vaporization and off-site movement possible. Weak on wild mustard and pigweed. Refer to narrative for additional restrictions. May be applied with trifluralin (prepackage mix available as Commence).	92
Chloramben (Amiben) + dinitroanilines	1.8 to 2.7 (2.4 to 3.6 lb DS) + appropriate rate for soil type	Grass and broadleaf weeds	Dinitroanilines: PPI Chloramben: PRE Both together: PPI	Dinitroanilines include trifluralin, ethalfluralin, and pendimethalin. Incorporation of chloramben improves consistency of wild mustard control.	1, 2, 16, 85, 86, 87, 90
Metribuzin (Lexone/Sencor) + dinitroanilines	0.25 to 0.37 + appropriate rate for soil type	Grass and broadleaf weeds including wild mustard	Preplant incorporated	Dinitroanilines include trifluralin, ethalfluralin, and pendimethalin. May be used on soils with pH 7.5 or lower.	19, 85, 86, 87, 88, 90
	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	1.75 to 4 (2 to 4 qt 4EC, 16 to 26 lb 15G, or 1.75 to 3.75 qt MT)	Grass and some broadleaf weeds including eastern black nightshade.	Preplant incorporated or preemergence	Weak on wild mustard. Preplant incorporation gives more consistent control. Use higher rates on fine textured soils high in organic matter. May be applied as a tank mixture with trifluralin.	1, 84, 89, 102
Metolachlor (Dual, Dual 25G)	2 to 4 (2 to 4 pt or 8 to 16 lb of 25G)				
Alachlor or Metolachlor (Dual) + Metribuzin (Lexone/Sencor)	2 + 0.25 to 0.37 (2 qt 4E or 1 qt 8E + 0.33 to 0.5 lb DF or 0.5 to 0.75 pt 4L)			Broadleaf weeds including wild mustard, black nightshade and annual grasses.	
Alachlor or Metolachlor (Dual) + Metribuzin (Lexone/Sencor)	2 + 0.19 (2 qt 4E or 1 qt 8E + 0.25 lb DF, or 0.38 pt 4L)	Use 0.19 lb/A metribuzin on soils with pH greater than 7.5. This rate applied to Sencor only. Alachlor is a restricted use herbicide.			

Refer to page 5 for explanation.

SOYBEANS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Alachlor or Metolachlor (Dual) + Chloramben (Amiben)	2 + 2 (2 qt 4E or 1 qt 8E + 2.7 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, 84, 90, 102
Chloramben (Amiben)	1.8 to 2.7 (2.4 to 3.6 DS, 20 to 30 lb 9G)	Grass and broadleaf weeds		Weak on wild oats.	93, 102
Acifluorfen (Blazer)	0.25 to 0.5 (1 to 2 pt)	Wild mustard, redroot pigweed, eastern black nightshade, wild buckwheat and ragweed.	Postemergence, Soybeans: 1 to 2 trifoliate leaf stage. Weeds: 1 to 4 inches tall.	Weak on volunteer sunflower. Low rate will control wild mustard and pigweed. The higher rates are needed for larger weeds. Herbicide performance is greater if applied when daytime air temperature exceeds 70 F.	93, 102
Bentazon	0.75 to 1.5 (0.75 to 1.5 qt)	Wild mustard, cocklebur, Canada thistle, volunteer sunflower	Postemergence, Mustard: 4 to 6-leaf Thistle: 6 in. to 8 in. tall See label for more information on weeds controlled.	Good control requires thoroughly coverage. Do not apply during unfavorable conditions. Repeat applications necessary for Canada thistle. An oil additive at 1 qt/A improves control. Good crop tolerance.	94
Bentazon (Basagran) + Acifluorfen (Blazer)	0.75 + 0.25 (1.5 pt + 1 pt)	Broadleaf weeds	Postemergence, Crop: 1 to 2 tri- foliate leaf stage. Weeds: up to 4 in.	Controls most seedling annual broadleaf weeds. Increase acifluorfen rate for eastern black nightshade. See label for additive recommendations.	93, 94
Thifensulfuron (Pinnacle)	1/256 (0.25 oz)	Wild mustard, pigweed and suppression of other BL weeds.	Postemergence, Soybeans: after 1st trifoliate leaf has fully expanded.	Apply with a nonionic surfactant at 0.25% v/v. Avoid spray drift to susceptible crops and clean sprayer thoroughly after application.	96
Thifensulfuron (Pinnacle) + Bentazon	1/256 + 0.75 (0.25 oz + 1.5 pt)	Broadleaf weeds	Postemergence, Soybeans: after first trifoliate has expanded. Weeds: up to 4 in.	Apply with nonionic surfactant at 0.125% v/v and 28% nitrogen at 0.25% v/v.	94, 96
Lactofen (Cobra)	0.20 (12.5 fl oz)	Wild mustard, pigweed, eastern black nightshade, and other broadleaf weeds.	Postemergence, Soybeans: 1 to 2 trifoliate leaf stage. Weeds: 2-6 leaves	Weak on volunteer sunflower. Use of an approved adjuvant is required, petroleum oil is preferred. Addition of oil additive increases control, but also increases risk of crop injury. Refer to narrative for environmental response.	95, 102
Fluazifop-P (Fusilade 2000)	0.09 to 0.19 (0.75 to 1.5 pt)	Annual and perennial grasses	Crop: before bloom Grass weeds :2 to 4 in.	Apply with oil additive at 1% v/v or 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weeds. Treat volunteer corn from 6 to 18 inches tall. Do not apply quizalofop with unmodified vegetable oil.	98
Fenoxaprop (Whip/Option)	0.1 to 0.15 (0.8 to 1.2 pt)	Foxtails, vol. corn, wild oats, wild proso millet	Crop: before bloom Grasses: 3 to 6 in.		97
Quizalofop (Assure)	0.06 to 0.1 (0.63 to 1.25)	Annual and perennial grasses	Crop: up to pod set Grasses: 2 to 6 in.		100
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Crop: before bloom Grass: 2 to 4 inches		99

* Refer to page 5 for explanation.

SOYBEANS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Naptalam + 2,4-DB (Rescue)	1 to 1.5 + 0.03 to 0.045 (2 to 3 qt)	Cocklebur, giant ragweeds, volunteer sunflower	Crop: after first bloom, Weeds: 10 inches or taller.	Salvage treatment for control of tall weeds. Apply with nonionic surfactant or oil additive. Avoid drift to susceptible crops.	101
Paraquat (Gramoxone Extra)	0.25 (12.8 fl oz)	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 (2 gal of 3 lb/gal conc.)		7 to 10 days prior to harvest, after pods are brown.	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

* Refer to page 5 for explanation.

LENTILS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, nonresidual, trans- located, postemergence herbicide. Apply with nonionic surfactant.	145
Triallate (Far-Go)	1.25 (1.25 qt)	Wild oats	Preplant or preemergence incorporated.	Incorporation tool can be operated 4 inches deep without reducing wild oat control.	1, 5, 11, 36, 110
Sethoxydim (Poast)	0.3 to 0.5 (1.5 to 2.5 pt)	Annual and perennial grasses	Crop: before bloom Grass: 2 to 4 inches Vol. corn: 6 to 18".	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weeds.	99

* Refer to page 5 for explanation.

SAFFLOWER

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
EPTC (Eptam, Genep)	3 (3.4 pt)	Grass and some broadleaf weeds.	Preplant incorporated.	See incorporation discussion in narrative for details. Weak on wild mustard.	1, 2, 3, 7, 13, 14
Trifluralin	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incorporat- ed, fall or spring.	No wild mustard control	
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb 25G)		Preplant incorporated or preemergence.	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.	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	37
Sodium chlorate (Leafex-3, Defol)	6 (2 gal of 3 lb/gal conc.)	Desiccant	After physiological maturity and 7 to 14 days prior to harvest.	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground. Most active with warm, sunny conditions.	

Refer to page 5 for explanation.

DRY EDIBLE BEANS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ae/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
EPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broadleaf weeds	Preplant incorporated	Weak on wild mustard. Incorporate immediately after application. Often applied as a tank-mix with trifluralin, ethalfuralin, pendimethalin, chloramben, alachlor, or metolachlor.	1, 2, 3, 9, 10, 102, 105
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up.		
Trifluralin	0.5 to 1 (1 to 2 pt 4E 5 to 10 lb 10G)	Grass and some broadleaf weeds	Preplant incorporated in fall or spring.	No wild mustard control. Incorporate within 24 hours after application.	1, 2, 3, 12, 13, 16,
Ethalfuralin (Sonalan)	0.5 to 1.7 (1.3 to 4.5 pt EC) (5.5 to 11.5 10G)		Preplant incorporated 2 to 3 inches deep.	The low rate should be used on coarse textured, sandy soils. The high rate should be used on fine textured soils for black nightshade control. No wild mustard control.	1, 2, 16, 85
Pendimethalin (Prowl)	0.5 to 1.5 (1 to 3 pt)		Preplant incorporated only.	Use higher rates on fine textured soils. Preplant incorporation is required to provide more consistent results. Refer to label for rotational restrictions.	1, 104
Alachlor	2 to 3 (2 to 3 qt)	Grass and some broadleaf weeds including eastern black nightshade.	Preplant incorporated	Weak on wild mustard. Use higher rate on fine textured soils high in organic matter. Incorporation improves consistency of weed control. Alachlor is a restricted use herbicide.	1, 102, 104
Metolachlor (Dual)	2 to 3 (2 to 3 pt)		Preplant incorporated or preemergence		
Chloramben (Amiben)	1.8 to 2.7 (2.4 to 3.6 lb DS, 20 to 30 lb 9G)	Annual grasses and broadleaf weeds	Preplant incorporated or preemergence	Often applied as a tank mixture with alachlor, metolachlor, trifluralin, ethalfuralin, or EPTC.	102, 104
Bentazon	0.75 to 1 (0.75 to 1 qt)	Wild mustard, cocklebur, Canada thistle, wild and vol. sunflower	Postemergence, Crop: 1st trifoliolate stage or larger Broadleaf weeds: small seedlings.	Thorough spray coverage is essential. Addition of oil concentrate improves weed control but increases risk of crop injury. Canada thistle control requires a second application 7 to 10 days later.	94, 104
Sethoxydim (Poast)	0.1 to 0.3 (0.5 to 1.5 pt)	Annual and perennial grasses	Crop: anytime before 30 days prior to harvest Grass: 2 to 4 inches	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weeds. Apply to volunteer corn when 6 to 18 inches tall.	99, 107
Paraquat (Gramoxone Extra)	0.31 to 0.47 (1 to 1.5 pt)	Desiccant	Prior to harvest.	Apply when at least 80% of the pods are yellowing and mostly ripe with no more than 40% (bush type beans) or 30% (vine type) of the leaves still green. Restricted use herbicide.	
Sodium chlorate (Leafex-3, Defol)	6 (2 gal of 3 lb/gal conc.)		7 to 10 days prior to harvest, after pods are brown.	Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

* Refer to page 5 for explanation.

SUNFLOWER

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Paraquat (Gramoxone Extra)	0.63 to 0.94 (2 to 3 pt)	Emerged annual grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, nonresidual, post- emergence herbicide. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Good coverage is essential. A re- sidual herbicide may be tank mixed with paraquat. Restricted use herbicide.	145
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Grass and some broadleaf weeds	Preplant incorporated.	Weak on wild mustard.	1, 2, 3, 7, 10, 115
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15.		
Ethalfuralin (Sonalan)	0.55 to 1.13 (1.5 to 3 pt EC) (5.5 to 11.5 10G)		Preplant incorporated.	Use lower rate of ethalfuralin on coarse textures soils.	1, 2, 3, 16, 115
Ethalfuralin (Sonalan) + EPTC (Eptam, Genep)	0.5 to 1.13 + 2.2 to 3 (1.25 to 3 + 2.5 to 3.5 pt)				
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broadleaf weeds	Preplant incorporated.	Use higher rate on fine-textured soils.	17, 112
	1.25 to 1.5 (2.5 to 3 pt)		Surface applied from 30 days prior to planting to immediately after planting.	Use the lower rate only on coarse textured soil. This treatment is for no- till sunflowers only.	
	1 to 1.75 (2 to 3.5 pt)		Fall preplant incorporated when soil temperature is less than 45 F.	Keep spring tillage depth shallower than fall tillage. May be tank mixed with EPTC.	
Trifluralin	0.5 to 1 (1 to 2 pt 4E)		Preplant incorporated.	No wild mustard control.	1,2,3, 16,115
	0.5 to 1 (5 to 10 lb 10G)		Preplant incorp- orated, fall after Sept. 1 or spring.		
Trifluralin + EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 to 2.3 pt)	Grass and some broadleaf weeds	Preplant incorporated.	Enhances wild oat control and reduces potential carryover of trifluralin.	1-3, 7, 13, 14, 16,115 116
Alachlor	3 to 4 (3 to 4 qt 4L, 20 to 27 lb 15G)		Preplant incorporated or preemergence.	Weak on wild mustard. Preplant incorporation gives more consistent control.	
Chloramben (Amiben) + other herbicides	1.8 (2.4 lb DS) + appropriate rate for soil type	Annual grass and broadleaf weeds	Preplant incorporated.	Other herbicides include trifluralin, ethalfuralin, and pendimethalin, EPTC and alachlor.	1, 2, 16, 85, 86, 88, 90
Chloramben (Amiben) + Pendimethalin (Prowl)	1.8 to 2.7 + 1.25 to 1.5 (2.4 to 3.6 lb DS + 2.5 to 3 pt)		Surface applied from 7 days before planting until immediately after.	Do not use chloramben on coarse textured soils. For use in no-till sunflowers.	90, 117

Refer to page 5 for explanation

SUNFLOWER

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Crop: 70 days prior to harvest Grass: 2 to 4 in.	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weeds.	99
Imazamethabenz (Assert)	0.19 to 0.38 (0.6 to 1.2 pt)	Wild oats and wild mustard.	Crop: up to 15 in. Wild oats: 1 to 4 leaf Wild mustard: prior to bloom.	The low rates are for wild mustard control. The high rate for wild oat control. Injury may occur when applied at high temperatures. See narrative for rotational restrictions.	119
Paraquat (Gramoxone Extra)	0.3 to 0.47 (1 to 1.5 pt)	Desiccant	Backside of sunflower heads yellow and bracts turning brown. Seed moisture content under 35%.	Registered for oilseed varieties only. Apply with nonionic surfactant at 0.12 to 0.25% v/v. Randomly sample 10 average heads for moisture. Restricted use herbicide.	
Sodium chlorate (Leafex-3, Defol)	4.5 to 6 (1.5 to 2 gal of 3 lb/gal conc.)			For use on confectionery and oilseed varieties. Thorough coverage of plant is essential. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

* Refer to page 5 for explanation.

TAME MUSTARD AND RAPESEED (CANOLA)

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Trifluralin	0.5 to 0.75 (1 to 1.5 pt 4E)	Grass and broadleaf weeds	Preplant incorporated.	Use lower rate on coarse textured, low organic matter soils.	1, 2, 3, 13, 14, 16
Barban (Carbyne) Tame Mustard Only	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats: 2-leaf and within 30 days of crop emergence	Do not apply to rapeseed. Wild oats usually develop to the 2-leaf stage 9 days after emergence.	37

* Refer to page 5 for explanation.

SUGARBEETS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ae/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Extra)	0.62 to 0.94 (2 to 3 pt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence.	A non-selective, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant at 0.25% v/v. Good coverage is essential. Restricted use herbicide.	144
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Annual grasses and some broadleaf weeds	Preplant incorporated.	Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.	1, 2, 3, 6, 7, 9, 10, 122
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 to freeze-up.		
EPTC (Eptam, Genep) + cycloate (Ro-Neet)	1 to 2 + 2 to 2.5 (1.1 to 2.3 + 2.7 to 3.3 pt)	Grass and some broadleaf weeds	Preplant incorporated.	Less sugarbeet injury than from EPTC alone and less expensive than cycloate alone. See narrative for suggested rates for various soil textures and organic matter content.	1, 2, 3, 6, 7, 9, 10, 122, 123
	1 to 2.5 + 2 to 3 (1.1 to 2.9 + 2.7 to 4 pt)		Fall incorporated after October 15 until freeze-up.		
Cycloate (Ro-Neet)	3 to 4 (4 to 5.3 pt 6E)	Annual grasses and some broadleaf weeds	Preplant incorporated.	Sugarbeets have better tolerance to cycloate than to EPTC. Weak on wild mustard. Weed control poor on fine textured, high organic matter soils.	1, 2, 3, 122
	4 (5.3 pt 6E)		Fall incorporated after October 15 until freeze-up.		
Ethofumesate (Nortron)	1.9 to 3.75 (1.25 to 2.5 gal E)	Some annual grasses and broadleaf weeds. Especially good on redroot pigweed	Preemergence or preplant incorporated.	Incorporation generally improves weed control. Band application reduces cost and risk of carryover into the next year.	1, 2, 3, 20, 124
Diethatyl (Antor)	4 to 6 (1 to 1.5 gal)	Redroot and prostrate pigweed and some annual grasses	Preemergence or preplant incorporated.	Shallow (1 to 2 inch) incorporation generally gives better weed control than preemergence or deep incorporation.	125
Pyrazon (Pyramin)	3.1 to 7.6 (3 to 7.25 qt F)	Most broadleaf weeds	Preemergence.	Has been less effective on soils with more than 5% organic matter. Incorporation improves weed control from pyrazon.	8, 121
Clopyralid (Stinger)	0.09 to 0.25 (0.25 to 0.66 pt)	Canada thistle, common cocklebur, sunflower, marshelder, wild buckwheat	Postemergence to sugarbeets with 2 to 8 leaves.	See narrative for rates and treatment sizes for various species. Clopyralid may be tank mixed with desmedipham or phenmedipham.	23, 130

Refer to page 5 for explanation.

SUGARBEETS

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Desmedipham + Phenmedipham (Betamix)	0.06 to 0.6 + 0.06 to 0.6 (0.75 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 0.12 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. Rates should be reduced by 25 to 33% if aerial or high pressure (> 100 psi) application is used or if the field was treated with a soil-applied herbicide.	128
Desmedipham (Betanex)	0.12 to 1.2 (0.75 to 7.5 pt)				
Endothall (Herbicide 273)	0.75 to 1.5 (2 to 4 pt)	Wild buckwheat, smartweed	Sugarbeets should have 2 to 4 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. Endothall is ineffective at temperatures below 60 F or when weeds are drought stressed.	126
Ethofumesate (Nortron EC) + Desmedipham (Betanex)	0.56 to 1.5 + 0.25 to 1 (3 to 8 pt E + 1.5 to 6.1 pt)	Most annual broadleaf weeds	Postemergence to sugarbeets with 6 or more leaves. Reduced rate may be applied to 4-leaf sugarbeets.	Improved weed control but increased risk of sugarbeet injury compared to desmedipham or desmedipham + phenmedipham. Split application at reduced rates has reduced sugarbeet injury and increased weed control compared to single full dose application.	124, 128
Ethofumesate (Nortron EC) + Desmedipham + Phenmedipham (Betamix)	0.56 to 1.5 + 0.12 to 0.5 + 0.12 to 0.5 (3 to 8 pt E + 1.5 to 6.1 pt)				
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Annual and perennial grasses	Wild oats: 1 to 4 in. Foxtail: 3 to 8 in. Vol. wheat or barley: 1 to 6 in. Wild proso millet: 4 to 10 in.	Apply with an oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different grass species.	99, 127
Trifluralin	0.75 (1.5 pt 4E)	Grass and some broadleaf weeds	Sugarbeets 2 to 6 inches tall and well- rooted to withstand incorporation.	Must be incorporated. Exposed beet roots must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugarbeets.	1,2,3 12,16, 129

* Refer to page 5 for explanation.

POTATOES

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
Paraquat (Gramoxone Extra)	0.47 (1.5 pt)	Emerged annual grass and broadleaf weeds		A nonselective, contact, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant at 0.12 to 0.25% v/v. Restricted use herbicide.	144
EPTC (Eptam, Genep)	3 to 6 (3.5 to 6.75 pt)	Grass and some broadleaf weeds	Preplant, dragoff, or directed spray at layby.	Weak on wild mustard.	1, 2, 3, 6, 7, 10
	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 incorporated or preemergence.	Weak on wild mustard. Incorporation improves consistency of weed control. Use the higher rate on fine-textured soils.	1
Linuron (Lorox)	0.75 to 2 (1.5 to 4 lb DF, 1.5 to 4 pt L)	Most annual grasses and broadleaf weeds	Preemergence to crop, before grasses are 2 inches tall and broadleaves are 6 inches tall.	Apply to crop planted 2 inches deep or after dragoff or hilling. Do not plant to other crops within 4 months after treatment. Use the higher rates on fine-textured soils. Apply with surfactant at 1 pt/25 gal. solution when emerged weeds are present.	8
Metribuzin (Lexone, Sencor)	0.5 to 1 (0.67 to 1.33 lb DF, 1 to 2 pt F)	Annual broadleaf weeds and some grasses	Preemergence to crop.	Use the lower rate on coarse textured soil. Soil residual may injure susceptible crops the following year.	13, 14, 19
	0.25 to 0.5 (0.5 to 1 pt, 0.33 to 0.67 lb DF)		Postemergence, before weeds are 1 inch tall.	Apply only to russeted or white skinned varieties that are not early maturing. Do not apply within 60 days of harvest.	
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broadleaf weeds	Preemergence, pre-emergence incorporated, or early postemergence before potatoes are 6 inches tall.	Incorporation increases the consistency of control. Can be tank mixed with EPTC (Eptam, Genep), metribuzin (Sencor, Lexone) or linuron (Lorox).	2, 16
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E)		Preemergence incorporated		
Sethoxydim (Poast)	0.09 to 0.28 (0.5 to 1.5 pt)	Annual and perennial grasses	Weeds-2 to 4 inches tall, volunteer corn up to 18 inches tall, potatoes-before 30 days prior to harvest	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weeds. Do not tank-mix with other chemicals.	99

Refer to page 5 for explanation.

POTATO VINE KILLING

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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 Extra)	0.25 to 0.47 (13 to 24 fl oz)		More than 3 days prior to harvest.	Do not use for potatoes to be stored or used for seed. Apply with a nonionic surfactant at 0.12 to 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. Restricted use herbicide. Use 0.5 lb rate on Russet Burbank potatoes only.	
	0.50 (2 pt)				
Sulfuric acid	20 gal	5 days prior to harvest.	Extremely corrosive. Restricted use herbicide. Do not harvest within 5 days of application.		

* Refer to page 5 for explanation.

MILLET

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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 in 5 gallons or more water per acre with ground sprayer. Do not graze dairy animals or meat animals being finished for slaughter on treated fields within 2 weeks after treatment. Only certain brands of 2,4-D have a label for application to millet (i.e. Rhone-Poulenc "Formula 40").	

* Refer to page 5 for explanation.

ANNUAL CANARYGRASS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Triallate (Far-Go)	1 (1 qt)	Wild oats	Preplant incorporated fall or spring.	Incorporation tool can be operated at 4 inches without reducing wild oat control.	1, 5, 36
Bromoxynil (Buctril) + MCPA	0.25 to 0.38 + 0.25 to 0.38 (1 to 1.5 pt + 0.5 to 0.75 pt)	Broadleaf weeds	Postemergence, weeds small and actively growing.	Apply when weeds are in the early seedling stage for best results. Restricted use herbicide.	
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)		Crop: Minimum of 3 leaves Weeds: 4 leaves or less.	Apply to susceptible broadleaf weeds before they exceed the 4-leaf stage, attain 2 inches in height or reach 1 inch in diameter. Do not harvest within 75 days following treatment. Do not graze livestock in treated fields. Do not apply to canarygrass when stressed or crop forms a canopy over the weeds.	

* Refer to page 5 for explanation.

LEGUME FORAGES

Alfalfa and Clover Establishment With Companion Crop

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
MCPA amine	0.12 to 0.25 (0.25 to 0.5 pt of 4 lb/gal conc.)	Broadleaf weeds	Legumes: 2 to 3 inches tall. Companion crop: 8- leaf to early boot.	Not registered for use on sweetclover. NOTE: POSSIBLE INJURY TO ALFALFA AND CLOVER. Use only when weed problem is severe.	34, 131
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Broadleaf weeds	Alfalfa: at least 4 trifoliolate leaves, Weeds: 4 leaves or less and before rosettes are 1.5 inches in diameter.	Alfalfa injury can occur, especially if warm weather follows treatment. Refer to narrative for information regarding temperatures at application and grazing and harvesting restrictions. Restricted use herbicide.	134
For Alfalfa Only					

* Refer to page 5 for explanation.

LEGUME FORAGES

Alfalfa or Trefoil Establishment, No Companion Crop

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Preplant or prior to crop emergence.	Nonselective, translocated, postemergence herbicides. No soil residual activity. Apply glyphosate with a nonionic surfactant at 0.5 % v/v. Apply paraquat with a nonionic surfactant at 0.12 to 0.25% v/v. Paraquat is a restricted use herbicide.	145
Paraquat (Gramoxone Extra)	0.63 to 0.94 (2 to 3 pt)	Emerged grass and broadleaf weeds.	Preplant or prior to crop emergence.		144
EPTC (Eptam, Genep)	2 to 4 (2.25 to 4.5 pt)	Grass and some broadleaf weeds.	Preplant incorporated.	Weak on wild mustard. Incorporate immediately after application. Use the low rate for grass control only.	1, 2, 3
Benefin (Balan)	1.12 to 1.5 (3 to 4 qt)	Annual grasses and some broadleaf weeds.		No wild mustard control.	
Trifluralin Set Aside Acreage Only	0.50 to 0.75 (1 to 1.5 pt)			Some legume injury may occur. Rate is dependent on soil type. No wild mustard control.	1,2,3, 13, 14, 16,132
2,4-DB ester	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Broadleaf weeds.	Weeds: less than 3 inches tall. Alfalfa: more than 2 trifoliolate leaves.	Sweetclover may be killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied at least 60 days before hay harvest or grazing.	131
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Sethoxydim (Poast)	0.19 to 0.5 (1 to 2.5 pt)	Annual and perennial grasses.	Grass 2 to 4 inches tall.	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weed species.	99, 133
For Alfalfa Only					
Bromoxynil (Buctril) For Alfalfa Only	0.25 to 0.38 (1 to 1.5 pt)	Broadleaf weeds	Refer to "Legume Forages - with companion crop".	Refer to "Legume Forages - with companion crop" for comments.	134

Refer to page 5 for explanation.

LEGUME FORAGES

Established Alfalfa

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Metribuzin (Lexone, Sencor)	0.37 to 1 (0.75 to 2 pt F, 0.5 to 1.25 lb DF)	Annual grass and broadleaf weeds	Early spring to dormant alfalfa.	May be applied on frozen soil. Do not apply to alfalfa during the first growing season after seeding.	135
Terbacil (Sinbar)	0.4 to 1.2 (0.5 to 1.5 lb)		Fall or spring when alfalfa is dormant.	Do not apply to frozen or snow covered soil. Do not rotate to any other crop within 2 years after application. Do not apply to alfalfa stands established less than 1 year.	135
Pronamide (Kerb)	0.5 to 2.0 (1 to 4 lb 50 W)	Foxtail barley, quackgrass, wild oats, volunteer grains, and wild mustard.	Fall - after last cutting and before soil freeze-up.	Apply when soil temperatures are less than 55 F. Do not graze or harvest alfalfa within 25 days (less than 1.5 lb/A) to 45 days (1.5 to 2 lb/A).	135
2,4-DB ester	0.5 to 1.0 (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.	131
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Sethoxydim (Poast)	0.19 to 0.5 (1 to 2.5 pt)	Annual and perennial grasses.	Grass: 2 to 4 inches tall.	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates to control different weed species.	99, 133

* Refer to page 5 for explanation.

GRASS ESTABLISHMENT

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ae/gal conc.)	Emerged grass and broadleaf weeds.	Preplant or anytime prior to crop emergence.	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant at 0.5% v/v.	145
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 establishing grasses. (See section below after tillering of seedling.)	141
Bromoxynil (Buctril)	0.25 to 0.38 (1.0 to 1.5 pt)		Anytime after grass emerges	Grass tolerance is excellent. Can be applied to grass-alfalfa mixtures. Restricted use herbicide.	134

* Refer to page 5 for explanation.

ESTABLISHED GRASS AND RANGELAND

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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; preferably 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 annuals and gumweed and 2 lb/A on sages and other perennials.	141
Dicamba (Banvel) + MCPP + 2,4-D	(See remarks section)			Various commercial formulations available. See individual label for usage rates. Provides a broader spectrum of broadleaf weed control than 2,4-D alone.	141, 142
Dicamba (Banvel) + 2,4-DP + 2,4-D					
MCPA amine or ester	0.25 to 2 (0.5 to 4 pt)	Annual and perennial broadleaf weeds.	Weeds: emergence to bud stage, preferably when young and actively growing.	Do not graze dairy animals for 7 days after treatment. Do not apply after boot stage on grasses for seed production. Use the higher rates for perennial weed control.	
Dicamba (Banvel)	0.25 to 2 (0.5 to 4 pt)			Spray drift from dicamba may injure nearby susceptible crops and trees. Consult the label for grazing restrictions.	142
Picloram (Tordon)	0.5 to 2 (1 to 4 qt)	Annual and perennial broadleaf weeds.	Weeds: emergence to bud stage, preferably when young and actively growing.	See paragraph 137 for grazing and use restrictions. Often applied as a tank mixture with 2,4-D to provide the most cost-effective control. Restricted use herbicide.	140
Triclopyr + 2,4-D (Crossbow)	0.5 to 3.0 + 0.25 to 1.5 (1 to 6 qt)	Brush and broadleaf weeds		Provides more consistent musk thistle and brush control (except buckbrush and western snowberry) than 2,4-D alone. Refer to paragraph 140 for grazing and haying restrictions.	143
Metsulfuron (Ally)	1/267 to 2/267 (1/10 to 2/10 oz)	Pigweed, marestail and other broadleaf weeds	Late spring/early summer.	Apply in late spring or early summer but before weeds are 4 inches tall. Apply when weeds are actively growing.	
	2/267 to 3/267 (2/10 to 3/10 oz)	Musk thistle, Canada thistle, western snowberry or buckbrush		Apply to musk thistle in spring or early summer before plants bolt. Buckbrush will be controlled or suppressed depending on herbicide rate used, size of weeds, and environmental conditions following treatment. Canada thistle will only be suppressed.	

* Refer to page 5 for explanation.

CONSERVATION RESERVE PROGRAM (CRP)

Grass-Legume Seedings

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	0.28 to 1.5 (0.75 to 4 pt of a 3 lb ae/gal conc.)	Emerged grass and broadleaf weeds	Prior to emergence of desired vegetation.	Apply with a nonionic surfactant at 0.5% v/v. Delay tillage 3 days or more after application.	145
Paraquat (Gramoxone Extra) (Cyclone)	0.63 to 0.94 (2 to 3 pt) 0.38 to 0.5 (1.5 to 2 pt)	Emerged annual grass and broadleaf weeds.	Prior to emergence of desired vegetation.	Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Use a minimum of 10 gpa by ground or 3 gpa by air. Restricted use herbicide.	144
2,4-D	0.5 to 2 (1 to 4 pt of 4 lb/gal conc.)	Broadleaf weeds.	Prior to seeding. Small weeds more susceptible than large weeds.	Allow 3 to 4 weeks between application and seeding. May be applied with glyphosate (available as prepackage mixture Landmaster II or Landmaster BW)	
Sethoxydim (Poast)	0.09 to 0.28 (0.5 to 1.5 pt.)	Annual and perennial grasses and volunteer cereals grains.	Grass: 3 to 8 in. Wild oat: 2 to 4 in. Vol. corn: 6 to 20 in. Vol. cereals: before tillering - 2 to 6 in.	For control of annual grasses in CRP or set-aside lands. Broadleaf cover crops such as alfalfa, clover, lespedeza, trefoils, and vetches will be unaffected. Shrubs and trees also have high tolerance. MOST SEEDED GRASS CROPS SUCH AS OATS, SUDANGRASS, TALL FESCUE, ORCHARDGRASS, BROMEGRASSES, RYEGRASS OR TIMOTHY WILL BE KILLED. Apply with oil additive at 1 qt/A. Apply to actively growing grasses. Do not harvest or graze cover crops other than alfalfa. Do not plant any other crop to be harvested for 120 days after application unless labeled for that crop.	133

* Refer to page 5 for explanation.

CRP

Grass - Alfalfa Seedings

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Bromoxynil (Buctril)	0.38 to 0.5 (1.5 to 2 pt)	Annual broadleaf weeds.	After grasses have 2 to 3 leaves and alfalfa has 3 trifoliolate leaves. Weeds should be small.	Listed species include crested wheatgrass, tall wheatgrass, western wheatgrass, bluebunch wheatgrass, intermediate wheatgrass, perennial ryegrass, fescue, bentgrasses, Kentucky bluegrass, Canby bluegrass, bahiagrass, Russian wildrye, and alfalfa. Use a minimum of 10 gpa for ground or 5 gpa for aerial application.	
Chlorsulfuron (Glean)	1/128 (1/6 oz)	Broadleaf weeds.	After stands have been established for at least 1 year.	Alfalfa may be stunted. Apply with nonionic surfactant at 0.25 to 0.5% v/v. See narrative for listed species of grasses.	150

* Refer to page 5 for explanation.

CRP
Pure Grass Seedings

Herbicide	Act. Ingre. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Chlorsulfuron (Glean)	1/128 (1/16 oz)	Broadleaf weeds	Postemergence to small actively growing weeds up to 2 inches tall or 2 inches in diameter. 1 to 2 inches of rainfall will help to control subsequent flushes of weeds.	See narrative for listed varieties and conditions for application. Can be applied early postemergence to new plantings of certain varieties, postemergence to stands planted the previous season, late postemergence to tillered stands, and postemergence to established stands of grass/alfalfa mixtures. All applications should include another broadleaf herbicide (2,4-D ester is recommended). All applications should contain nonionic surfactant at 0.25 to 0.5% v/v.	150
Metsulfuron (Ally)	1/267 (1/10 oz)	Broadleaf weeds.	After new grass seedlings have 3 to 4 leaves or after established stands have 1 leaf.	Apply with a nonionic surfactant at 0.25 to 0.5% v/v. 2,4-D can be tank mixed with metsulfuron on 5 leaf or larger seedling grass or on fully tillered stands. Refer to narrative for registered species..	151
MCPA, 2,4-D	0.25 to 2 (0.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds.	Postemergence.	Use a maximum of 0.5 lb/A on 3 leaf of larger seedling grass. Higher rates may be used the year after seeding when the stand is fully established.	
Dicamba (Banvel)	0.125 to 2 (0.25 to 4 pt)				
Buctril + MCPA (Bronate)	0.25 to 0.38 + 0.25 to 0.38 (1.0 to 1.5 pt)	Broadleaf weeds.	Postemergence to 3 leaf or larger seedling grass.	Use a minimum of 10 gpa by ground or 5 gpa by aerial application. Registered species include crested wheatgrass, tall wheatgrass, western wheatgrass, bluebunch wheatgrass, intermediate wheatgrass, sheep fescue, Russian wildrye, and Canby bluegrass.	
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)		Crop: after emergence Weeds: 4 leaves or less.		
Clopyralid + 2,4-D (Curtail)	0.19 to 0.75 + 0.64 to 2.5 (2 to 5 qt)	Broadleaf weeds including perennial thistles and knapweeds.	Postemergence after grass is tillered and has a good secondary root system.	Use lower rate for most annual broadleaf weeds and musk thistle rosettes. Use higher rate for Canada thistle, knapweeds and bolted musk thistle. Thistles and knapweeds should be treated prior to the bud stage.	
Picloram (Tordon)	0.06 to 2 (0.25 to 8 pt)				

Refer to page 5 for explanation.

CHEMICAL WEED CONTROL FOR FALLOW

For Future Planting to Wheat, Durum, Barley, Oats, Corn or Sorghum

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Cyanazine (Bladex 90DF) + Atrazine	2 to 2.8 (2.2 to 3.1 lb) + 0.5	Annual broadleaf 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. Restricted use herbicides.	15, 147
	2 to 2.8 (2.2 to 3.1 lb) + 0.4		Early spring before weeds emerge.		
Dicamba (Banvel, Banvel SGF)	0.25 to 0.5 (0.5 to 1 pt Banvel, 1 to 2 pt Banvel SGF)	Wild buckwheat, kochia, and other broadleaf weeds.	Postemergence	Residue from fall application may damage broadleaf crops seeded the next year.	146
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ac/gal conc.)	Emerged grass and broadleaf weeds	Weeds less than 6 inches tall.	A nonselective, nonresidual, contact, postemergence herbicide. See narrative for rates. Use the lower rate for annual grasses.	145, 146
Paraquat (Cyclone)	0.5 (2 pt)			A nonselective, contact, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant. Restricted use herbicide.	144
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence	Use the higher rate for perennial weeds.	139
Clopyralid + 2,4-D (Curtail)	0.19 (4 pt)	Canada thistle	After majority has emerged but prior to bud stage.	Do not rotate to any crop except small grains, grass, corn, or sugarbeets within one year after application.	23, 26, 138
Picloram (Tordon 22K)	0.063 to 0.125 (0.25 to 0.5 pt)	Annual weeds	Weeds actively growing	Refer to label for grazing and rotational restrictions. Do not rotate to corn or sorghum the following year. Restricted use herbicide.	139, 140
Picloram (Tordon 22K + 2,4-D)	0.125 to 0.25 + 0.5 to 1 (0.5 to 1 pt + 1 to 2 pt)	Perennial weeds	Canada thistle: prior to bloom		
Glyphosate + dicamba (Fallow Master)	0.19 to 0.38 + 0.08 to 0.17 (22 to 44 fl oz)	Emerged annual grass and broadleaf weeds.	Weeds less than 6 inches tall	The low rate is primarily for green foxtail control. Provides better control of kochia and wild buckwheat than glyphosate + 2,4-D. Delay planting of wheat, barley, oats, or sorghum for 15 days and all other crops for 3 months after application.	145, 146
Glyphosate + 2,4-D (Landmaster II)	0.19 to 0.38 + 0.17 to 0.34 (27 to 54 fl oz)			The low rates are primarily for green foxtail control. The high rate of Landmaster BW provides better perennial broadleaf suppression than the high rate of Landmaster II.	
Glyphosate + 2,4-D (Landmaster BW)	0.19 to 0.38 + 0.32 to 0.63 (27 to 54 fl oz)				
Trifluralin	0.6 to 1.0 (6 to 10 lb 10G)	Grass and some broadleaf 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 application. See narrative for rate information.	13, 14, 16, 149

* Refer to page 5 for explanation.

CHEMICAL WEED CONTROL FOR FALLOW

For Future Planting of Wheat and Durum

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Atrazine	0.5 to 1 (0.6 to 1.25 lb 80W)	Annual broadleaf 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 planting. 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.	15, 144
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.		
Clomazone (Command)	0.75 to 1.0 (1.5 to 2 pt)	Volunteer wheat, downy brome, kochia, wild buckwheat and tansy mustard.	Fall - August 15 to October 31	Not approved for aerial application. Apply with a drift control agent and do not apply near susceptible sites such as towns or winter wheat fields. Do not plant spring wheat until 18 months after a fall treatment. Carryover injury possible.	148

* Refer to page 5 for explanation.

SPECIAL ANNUAL WEED PROBLEMS

False Chamomile

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
Bromoxynil + MCPA ester (Bronate)	0.37 + 0.37 (1.5 pt)	Wheat, barley and oats.	Chamomile less than 4 inches tall.	Control of fall germinated plants will be less than those germinating in the spring. Restricted use herbicide.	52
Chlorsulfuron (Glean)	1/128 (1/6 oz)		Postemergence-crop in 2 leaf stage until just prior to boot.	Do not apply chlorsulfuron within 22 months of the last treatment. See paragraph 24 about resistant weeds. Apply with a nonionic surfactant at 0.12% to 0.25% v/v. Do not apply to soils above pH 7.9. See paragraph 22 for rotational restrictions.	21, 24, 31
Metsulfuron (Ally + a broadleaf herbicide)	1/267 (1/10 oz) + appropriate rate	Wheat and barley	HRSW & Barley: 2-leaf stage until prior to boot. Durum: 4-leaf until prior to boot.	Should be applied with another broadleaf herbicide. Do not apply within 48 months of last metsulfuron treatment. See paragraph 24 about resistant weeds and 22 for rotational restrictions. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9	22, 24, 31
Thifensulfuron + Tribenuron (Harmony Extra)	1/111 to 1/53 + 1/200 to 1/111 (0.3 to 0.6 oz)	Wheat and barley	Chamomile less than 4 inches tall.	Should be applied as a tank mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See paragraph 24 about resistant weeds.	24, 32
Tribenuron (Express)	1/128 to 1/64 (1/6 to 1/3 oz)				
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 to sensitive plants. Restricted use herbicide.	52, 139, 140

* Refer to page 5 for explanation.

FALSE CHAMOMILE

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Paraquat (Gramoxone Extra)	0.47 (1.5 pt)	Tree rows or potholes	Chamomile less than 6 inches tall.	Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Avoid contact with non-target plants. Restricted use herbicide.	52, 144
Glyphosate	0.75 (1 qt of a 3 lb ae/gal conc.)			A nonselective, translocated postemergence herbicide. Avoid contact with non-target plants.	52
Amitrole (Amitrole T)	1.5 (3 qt)			Avoid contact with non-target plants. Restricted use herbicide.	

* Refer to page 5 for explanation.

CHEMICAL CONTROL OF PERENNIAL WEEDS

Absinth Wormwood

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

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D L.V. ester or amine	2 (2 qt of 4 lb/gal conc.)	Pastures and rangeland, noncropland, trees, fallow, or post-harvest	Application should be made when the majority of shoots have emerged and are large enough for maximum spray interception. Plants should be actively growing.	Plants are controlled slowly. Avoid spraying tree foliage. Do not graze dairy cows for 7 days after treatment. Use only the amine formulation in trees.	141
Dicamba (Banvel)	0.5 to 1 (1 to 2 pt)	Pasture and rangeland, noncropland, fallow or post-harvest.		Plants are controlled slowly. Consult label for grazing restrictions. Surfactant at 0.5% v/v may improve consistency of control.	142
Picloram (Tordon 22K)	0.125 to 0.25 (0.5 to 1 pt)	Pasture and rangeland, noncropland.		Consult reference paragraph for grazing restriction. Use high rate for dense stands. Restricted use herbicide.	139, 140
Glyphosate	0.25 to 1.0 (0.33 to 1.33 qt of a 3 lb ae/gal conc.)	Trees, noncropland, fallow or post-harvest.		Avoid spraying tree foliage. Use a nonionic surfactant at 0.5 % v/v for rates less than 0.5 lb/A. Use the high rate for dense stands.	136, 138, 145
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.62 (3.38 pt/A)	Noncropland, pasture		Some grass injury and stunting may occur. Grass injury is greater with spring rather than fall treatments. Grass should not be grazed for 8 weeks after treatment.	

* Refer to page 5 for explanation.

CANADA THISTLE AND SOWTHISTLE

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

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Paragraph
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Wheat and barley	Crop: 4-leaf through jointing Weeds: rosette until prior to bloom.	Do not rotate to any crop except small grains, grass, corn or sugarbeets within one year of application.	23, 26, 138
	0.09 to 0.19 + 0.5 to 1.0 (2 to 4 pt)	Fallow, CRP			
Clopyralid + MCPA (Curtail M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)	Wheat, barley and oats	Crop: 3-leaf through jointing Weeds: rosette until prior to bloom.		
MCPA amine	0.75 (1.5 pt)	Wheat and barley	Tiller stage of crop.	Higher rates than listed may injure crop but be beneficial especially in small areas to achieve thistle control. Small grains are more tolerant to MCPA than 2,4-D.	138
MCPA ester	0.66 (1.33 pt)				
2,4-D amine	0.75 (1.5 pt)				
2,4-D ester	0.66 (1.33 pt)				
Metsulfuron (Ally) + broadleaf herbicide	1/267 (1/10 oz) + appropriate rate	Wheat, barley and pasture	HRSW and Barley: 2-leaf stage until prior to boot. Durum: 4-leaf stage until prior to boot. Thistle: rosette to pre-bud stage.	Provides suppression during the year of application. Do not apply within 22 months of last metsulfuron or chlor-sulfuron application. See paragraph 24 about resistant weeds. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils with pH above 7.9. See paragraph 22 for rotational restrictions.	13, 22, 24, 31, 138
Thifensulfuron + Tribenuron (Harmony Extra) + 2,4-D (or other broadleaf herbicide)	1/53 + 1/111 (0.6 oz) + 0.25 (0.5 pt of 4 lb/gal conc.)	Wheat and barley	Crop: 2-leaf to jointing.	Should be applied as a tank mixture with another broadleaf herbicide in areas of known weed resistance. Apply with a nonionic surfactant at 0.12 to 0.25 % v/v. See paragraph 24 about weed resistance.	24
Tribenuron (Express) + 2,4-D (or other broadleaf herbicide)	1/64 (1/3 oz) + 0.25 (0.5 pt of 4 lb/gal conc.)		Crop: 2-leaf to flag leaf emergence.		
Atrazine	3 (3 qt 4L, 3.75 lb 80W)	Corn	Preemergence or postemergence.	Maximum rate in corn is 3 lb/A. No fall application. Apply postemergence to corn up to 12 inches tall. Do not load within 50 feet of wells or drainage areas. Restricted use herbicide.	15, 65
Bentazon	1.0 (2 pt) applied twice	Soybeans, corn and dry beans.	Canada thistle 8 in. tall to bud stage.	Apply second treatment at 1.0 lb/A 7 to 10 days later.	94
Glyphosate	1.5 to 2.25 (2 to 3 qt of a 3 lb ae/gal conc.)	Patches in corn, wheat, oats or soybeans.	Crop: prior to heading, flowering. Thistles: at or beyond bud stage.	Crop in treated area will be killed. Avoid drift.	136, 138
	0.75 to 2.25 (1 to 3 qt of a 3 lb ae/gal conc.)	Fallow or post-harvest	Thistles at or beyond the bud stage of growth.	Wait 3 or more days after application before tillage. Use the low rate for fall treatment.	136, 139, 146
Trees			Avoid spraying tree foliage. A nonselective herbicide.	136, 145	

Refer to page 5 for explanation.

CANADA THISTLE AND SOWTHISTLE

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para- graph
Dicamba (Banvel, Banvel SGF)	0.25 to 0.5 (0.5 to 1 pt Banvel)	Corn	Corn: early postemergence up to 5 inches tall.	Use low rate on coarse textured or low organic matter soils.	76
	0.25 (0.5 pt Banvel)		Corn: up to 36 in. 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 Banvel or 2 to 4 qt SGF)	Fall or post- harvest	Weeds at least 6 inches tall and actively growing.	Rotate to wheat, corn, soybeans, or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen. May be tank mixed at a lower rate with 2,4-D or glyphosate to reduce soil residue. Surfactant may improve the consistency of control.	142
	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 consistency of control.	
	4 (1 gal)	Patches of plants in pastures	When thistles are actively growing.		
2,4-D ester or amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post- harvest	12 inches tall and actively growing	Cultivate fallow until early July. Spray in late August or September. Retreatment will be necessary.	136, 141
		Pasture and rangeland or trees (with amine only).		Do not graze dairy cows for 7 days after treatment and beef cows for 3 days after treatment. Provides suppression only.	
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.62 (3.38 pt/A)	Noncropland, pasture		Some grass injury and stunting may occur. Grass injury is greater with spring than with fall treatments. Grass should not be grazed for 8 weeks after treatment.	
Clopyralid (Stinger)	0.19 to 0.25 (0.5 to 0.67 pt)	Sugarbeets, wheat, barley and oats	Thistles in the rosette to pre-bud stage.	Do not rotate to any crop except small grains, grass, corn, or sugarbeets within one year of treatment.	23, 26, 130, 138
	0.25 to 0.50 (0.67 to 1.3 pt)	Rangeland and grass pastures.			
Picloram (Tordon 22K)	0.25 to 0.5 (1 to 2 pt)	Pasture, rangeland and fallow	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.	139, 140
	1 (2 qt)	Patches of plants in pastures.	When thistles are actively growing.	Consult reference for grazing restrictions. Restricted use herbicide.	

* Refer to page 5 for explanation.

COMMON MILKWEED

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	2.25 (3 qt of a 3 lb ae/gal conc.)	Stubble or patches in barley, corn, oats, soybeans, or wheat.	Milkweed late bud to flower stage. Crop: prior to heading or flowering.	Apply to milkweed when actively growing. Allow 3 or more days after application before tillage. Crop in treated area will be killed. Avoid drift. Generally will not give complete control.	136, 137
Dicamba (Banvel, Banvel SGF)	0.5 to 2 (1 to 4 pt Banvel or 2 to 8 pt SGF)	Fallow or post-harvest.	Actively growing.	Rotate to wheat, corn, soybeans or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen. Surfactant may improve consistency of control. Generally will not give complete control.	17, 136
2,4-D + Dicamba (Banvel, Banvel SGF)	1 + 0.25 (2 pt + 0.5 pt Banvel or 2 pt SGF)			Provides suppression of milkweed growth for one year. Retreatment at the same rate usually will be necessary the following year.	17, 136, 146
Picloram (Tordon 22K) + 2,4-D	0.5 + 0.5 to 1 (2 pt + 1 to 2 pt)	Pasture, rangeland, and noncropland.		Retreatment at the same rate usually will be necessary the following year. 2,4-D can be added to lower rates of picloram to improve control. Consult reference for grazing restrictions. Restricted use herbicide.	139, 140
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt)	Patches or individual plants in pastures.			

Refer to page 5 for explanation.

FIELD BINDWEED

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

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D amine 2,4-D L.V. ester	0.75 to 1.0 (1.5 to 2 pt) 0.66 to 1.0 (1.33 to 2 pt)	Wheat and barley	Tiller stage of crop.	The higher rate listed may injure crop but may be beneficial, especially in small areas, to control bindweed.	136, 137
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post-harvest	Regrowth 12 inches to bud.	Cultivate fallow until early July. Spray in late August or September. Respray in following crop.	
Dicamba (Banvel, Banvel SGF)	1 to 2 (1 to 2 qt Banvel or 2 to 4 qt SGF)			Mid to late fall treatments have been more effective than summer treatments. Rotate to wheat, corn soybeans or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen. Surfactant improves consistency of control.	136, 142, 146
Dicamba (Banvel, Banvel SGF) + Glyphosate	0.5 (1 pt Banvel or 2 pt SGF) + 1.5 (2 qt)			Less potential for soil residual than higher rates of dicamba.	

Refer to page 5 for explanation.

FIELD BINDWEED

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate	3 to 3.75 (4 to 5 qt of a 3 lb ae/gal conc.)	Patches in barley, oats, soybeans, wheat or trees.	Crop: prior to heading or flowering Bindweed: Bud to flowering stage.	Crop killed in treated area. Avoid drift or spraying tree foliage. Repeat applications are required for complete control. Treat when actively growing.	136, 137, 138
Picloram (Tordon 22K) + 2,4-D	0.5 to 1.0 (1 to 2 qt) + 0.5 to 1 (1 to 2 pt)	Patches or individual plants in pastures, fallow or noncropland.	Bindweed actively growing.	Often applied with 2,4-D to provide most cost-effective control. Consult reference for grazing restrictions. Restricted use herbicide.	139, 140
Dicamba (Banvel)	2 to 8 (0.5 to 2 gal)			Apply to foliage and/or treated soil. Consult label for grazing restrictions. Use low rate only in fall. Use higher rate in dense or old stands.	139

* Refer to page 5 for explanation.

QUACKGRASS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
Atrazine	3 (3 qt 4L, 3.75 lb 80W)	Corn: up to 12 inches tall.	Spring	Maximum rate in corn is 3 lb/A. No fall application. Do not load within 50 feet of wells or drainage areas. Restricted use herbicide.	15, 65
Fluazifop-P (Fusilade 2000)	0.19 (1.5 pt)	Soybeans and trees	Quackgrass: 4-leaves to 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.	98
Sethoxydim (Poast)	0.5 (2.5 pt)	Soybeans, dry edible beans, lentils, sun-flowers, flax, alfalfa, potatoes, sugarbeets and trees.	Quackgrass: 6 to 8 inches tall.	Apply with oil additive at 1 qt/A. If regrowth occurs, make a second application at 0.2 lb/A when quackgrass regrowth is 6 to 8 inches tall.	99
Quizalofop (Assure)	0.125 (1.25 pt)	Soybeans	Quackgrass: 6 to 10 inches tall.	Apply with a oil additive at 1% v/v. If regrowth occurs make a second application at 0.09 lb/A when quackgrass is 4 to 8 inches tall.	100
Glyphosate	1.5 to 2.25 (2 to 3 qt of a 3 lb ae/gal conc.)	Patches in barley, corn oats, soybeans or wheat	Crop: prior to heading or flowering Quackgrass: 8 in. tall or more and actively growing.	Crop in treated area will be killed. Avoid drift.	137, 138
	0.75 (2 pt of a 3 lb ae/gal conc.)	Preplant, fallow or post-harvest.	Fall or spring, Quackgrass: 8 in. tall and actively growing.	Apply with 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.	136, 145

* Refer to page 5 for explanation.

LEAFY SPURGE

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

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D L.V. ester	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow	Plant actively growing.	Cultivate or respray whenever regrowth is 4 to 6 inches high. Retreat in next years crop.	136, 141
Dicamba (Banvel, Banvel SGF)	1 to 2 (1 to 2 qt Banvel or 2 to 4 qt SGF)	Fallow or post-harvest	Plants flowering in spring or 4 to 12 inches regrowth in fall.	Rotate to wheat, corn, soybeans, or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen.	142
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 or beef cows for 3 days after treatment.	136, 141
Picloram (Tordon 22K) + 2,4-D ester or amine	0.25 to 0.5 + 1 (1 to 2 pt + 1 qt of a 4 lb/gal conc.)	Pasture, rangeland and roadsides	Leafy spurge in true flower growth stage or fall regrowth.	Picloram + 2,4-D at 0.25 + 1 lb/A was the most cost effective treatment in NDSU data. Retreatment at the same rate will be necessary for several years regardless of herbicide or rate. Annual control was greater and years of retreatment needed were less with the 0.5 lb/A picloram rate. Use 0.5 lb/A rate for fall application. Dicamba will give good control when applied in the fall for 3 to 5 years. Picloram is a restricted use herbicide.	139, 134
Dicamba (Banvel)	2 (2 qt)				
Dicamba (Banvel)	4 to 8 (1 to 2 gal)	Patches or individual plants in pastures or noncropland.	Leafy spurge in true flower growth stage or fall regrowth.	Consult label for grazing restrictions.	140
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt S)				
Glyphosate	0.75 (1 qt of a 3 lb ae/gal conc.)	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.	137, 138
2,4-D amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)				
Dichlobenil (Norosac 10G)	6 to 8 (60 to 80 lb 10G)		Late November to early March before spurge emergence.	Season long suppression only. Must be applied before leafy spurge emerges. No postemergence control.	
Fosamine (Krenite)	6 to 8 (1.5 to 2 gal)	Noncropland, adjacent to water and trees.	Leafy spurge in true flower growth stage or early fall.	Inconsistent control. Best control with high humidity and good soil moisture. Do not allow to contaminate water.	
Glyphosate (Rodeo formulation only)	0.75 (1 qt of 4 lb/gal conc.)	Adjacent to water	Mid-July to mid-September.	Apply with a nonionic surfactant approved for use near water, such as X-77. Treatment to control seedlings with a 2,4-D formulation near water will be needed in sub-sequent years.	136, 141

* Refer to page 5 for explanation.

LEAFY SPURGE

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

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Adjacent to water	Plants actively growing.	Use only 2,4-D formulations labeled for use in or near water, such as PBI Gordon Amine 400.	136, 141
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.62 (3.38 pt/A)	Noncropland and pasture	True flower stage or actively growing in fall.	Some grass injury and stunting may occur. Injury is greater with spring than fall treatments. Grass should not be grazed for 8 weeks after treatment.	

* Refer to page 5 for explanation.

RUSSIAN KNAPWEED

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	In wheat and barley	Tiller stage of crop.	Prevents seed formation only.	138, 141
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post-harvest, pasture, and rangeland.	Rosette stage preferred. Bud to bloom is second best.	Several years of annual treatments are necessary.	
Dicamba (Banvel, Banvel SGF)	1 to 2 (1 to 2 qt Banvel or 2 to 4 qt SGF)			Banvel SGF is not labeled for pasture and rangeland. 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.	142
Clopyralid + 2,4-D (Curtail)	0.09 + 0.5 (2 pt)	Wheat and barley	Wheat: 4-leaf through jointing.	Do not rotate to any crop except small grains, corn, grass, or sugarbeets within 1 year after application.	23, 26, 138
	0.09 to 0.19 + 0.5 to 1 (2 to 4 pt)	Fallow, CRP	Weeds: Bud to bloom stage or fall.		
Clopyralid + MCPA (Curtail M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)	Wheat, barley and oats	Crop: 3-leaf through jointing. Weeds: rosette until prior to bloom.		
Dicamba (Banvel)	2 to 6 (2 to 6 qt)	Pasture, rangeland, and noncropland.	Spring or fall.	Consult label for grazing restrictions. Plants are controlled slowly.	142
Picloram (Tordon 22K)	1 to 2 (2 to 4 qt)		Any time during growing season.	Consult label for grazing restrictions. Restricted use herbicide.	139, 140
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. Bud to bloom is second best.	Several years of annual treatment is necessary. Picloram is a restricted use herbicide.	136, 139, 140
Clopyralid (Stinger)	0.25 to 0.5 (1 to 2 pt)	Pasture and rangeland	Bud to bloom stage or fall.	Spot treatment.	23, 26, 138

* Refer to page 5 for explanation.

SPOTTED KNAPWEED

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para-graph
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	In wheat and barley	Tiller stage of crop.	Repeat treatment may be necessary for control.	136, 141
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or post-harvest, pasture, and rangeland.	Rosette stage preferred. Bud to bloom stage is second best.	Several years of annual treatments are necessary.	142
Dicamba (Banvel, Banvel SGF)	1 to 2 (1 to 2 qt Banvel or 2 to 4 qt SGF)				
Clopyralid + 2,4-D (Curtil)	0.09 + 0.5 (2 pt)	Wheat and barley	Wheat: 4-leaf through jointing.	Do not rotate to any crop except small grains, corn, grass, or sugarbeets within 1 year after application.	23, 26, 138
	0.09 to 0.19 + 0.5 to 1 (2 to 4 pt)	Fallow, CRP	Bud to bloom stage or fall.		
Clopyralid + MCPA (Curtil M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)	Wheat, barley and oats	Crop: 3-leaf through jointing. Weeds: rosette until prior to bloom		
Picloram (Tordon 22K)	0.25 (1 pt)	Pasture, rangeland, and noncropland.	Rosette stage preferred. Bud to bloom is second best.	Consult label for grazing restrictions. Picloram is a restricted use herbicide. 2,4-D amine or ester at 1 lb/A may be added to improve control.	139, 140
Clopyralid (Stinger)	0.25 to 0.5 (1 to 2 pt)	Pasture and rangeland	Bud to bloom stage or fall	Spot treatment.	23, 26, 138
Cultivation		Cropland	Repeat whenever plants are 3 to 6 inches tall	Spotted knapweed is not generally a problem in cultivated land.	

* Refer to page 5 for explanation.

CATTAILS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Glyphosate (Rodeo)	2.25 (4.5 pt of 4 lb/gal conc.)	Drainage and aquatic sites	At or beyond the early to full bloom stage and actively growing.	Add a nonionic surfactant approved for use in water at 0.5% v/v; see the label for approved surfactants. Apply at 0.75 % v/v solution (1 fl oz/gal) with hand held sprayer equipment.	145
Glyphosate	2.25 (3 qt of a 3 lb ac/gal conc.)	Agricultural and noncropland sites other than listed above.		Add a nonionic surfactant at 0.5% v/v. The Roundup formulations are not approved for use in drainage and aquatic sites because of environmental concerns.	

* Refer to page 5 for explanation.

HERBICIDE USE INFORMATION

INCORPORATION OF HERBICIDES:

1. Butylate, cycloate, EPTC, and triallate should be incorporated immediately (within minutes) after application. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Ethalfluralin incorporation may be delayed up to 48 hours. Pendimethalin must be used preemergence on corn but may be incorporated for soybeans. Incorporation often improves the performance of pendimethalin and may be delayed up to 7 days after application. Alachlor, ethofumesate, and metolachlor may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor, ethofumesate and metolachlor may be delayed several days.

2. Butylate, cycloate, EPTC, ethalfluralin, pendimethalin, 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 blades spaced 8 inches or less and a disk blade diameter of 20 inches or less have given good herbicide incorporation. Larger disks often have given streaked incorporation and poor weed control.

b) Field cultivators of various types may be used. These should have overlapping sweep shovels arranged in at least 3 rows of shovels. The cultivator should be operated at a depth of 3 to 4 inches for 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 is needed 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 gives less effective weed control than deep incorporation, but fair to good control of shallow germinating weeds such as green and yellow foxtail (pigeongrass) can be obtained.

5. Triallate (Far-Go, Showdown) will adequately control wild oats with a shallow incorporation. Two spike tooth harrowings at right

angles will give sufficient incorporation if the soil is loose and free of trash.

Experiments at North Dakota State University have shown that deeper incorporation generally enhances wild oats control from triallate. Triallate applied after seeding should be incorporated less deeply than the placement of the crop seed (**Preemergence Incorporation**). Triallate applied before seeding should be incorporated with a field cultivator plus harrow operated 3 to 4 inches deep. Delay HRSW or durum seeding for 3 days. Triallate applied before seeding may injure certain wheat varieties. Spring preplant incorporated triallate has greater potential for injury to wheat than application at other times. Refer to the label for information on varieties that may be susceptible to preplant incorporated triallate.

THE SOIL ORGANIC MATTER TEST:

6. Many herbicides are partially adsorbed and inactivated by soil organic matter, so knowledge of the organic matter level will serve as a guide in selecting an effective herbicide and rate of application. Herbicides such as atrazine, cycloate (Ro-Neet), EPTC (Eptam, Genep, Eradicane), linuron (Lorox) and pyrazon (Pyramin) require higher rates to be effective in high organic matter soils but crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, 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, corn, flax and potatoes. Sugarbeets have marginal tolerance to EPTC, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussion on selecting an EPTC rate only gives guidelines. Other factors such as method of incorporation affect EPTC performance (immediate and thorough incorporation gives best performance). The suggested spring-applied EPTC rate is 2 to 3 lb/A. The 3 lb/A rate should give good weed control without crop injury on a soil with a silty clay texture and more than 7 percent organic matter. The minimum rate of 2 lb/A may injure sugarbeets on a sandy loam or coarse-textured soil with less than 4 percent organic matter. The EPTC rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes.

8. Some herbicides give good weed control only when organic matter levels are low. Linuron (Lorox) and pyrazon (Pyramin) have not been effective in the Red River Valley, except on the coarse-textured soils with less than 5 percent organic matter. The lower the organic matter, the more effective they become. Atrazine rate must be adjusted according to organic matter levels. Apply the high labeled rates on higher organic matter soils. Many herbicides such as propachlor (Ramrod), triallate (Far-Go, Showdown), trifluralin (Treflan) and most postemergence herbicides are affected only slightly by organic matter levels. Organic matter levels should be determined on each field where organic matter sensitive herbicides are to be used. Organic matter levels change very slowly and testing once every 5 years should be adequate.

FALL APPLICATION OF HERBICIDES:

9. Several herbicides may be applied in the fall for weed control the following spring. Included in this group are EPTC (Eptam, Genep), triallate (Far-Go, Showdown), and trifluralin (Treflan). Fall treatments of trifluralin should be applied after September 1 and until soil freezeup. Fall treatments of EPTC (Eptam, Genep), and triallate (Far-Go, Showdown) should be applied after October 15 and until soil freeze-up. Application of herbicides after October 15 when soil temperature has cooled minimizes herbicide loss by volatilization, and microbial and chemical degradation. Both granular and liquid formulations of the herbicides 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. 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.

11. Triallate (Far-Go, Showdown) is applied at 1 to 1.5 lb/A in the fall. See tables for specific rates of liquid and granules for each crop. 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.

12. Trifluralin (Treflan) fall applied at 0.5 to 1 lb/A (depending on crop) gives good control of annual grasses and broadleaf weeds except wild mustard. Incorporation may be delayed 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. The liquid or granular formulations may be applied in the fall for weed control in soybeans, safflower, dry beans, sunflowers, flax, wheat, and barley.

HERBICIDE RESIDUE:

13. The persistence of phytotoxic levels of a herbicide for more than 1 year can be a problem with some of the herbicides used in North Dakota. Herbicide residues are most likely to occur following years with unusually low rainfall because chemical and microbial activity needed to degrade herbicides are limited in dry soil. Crop damage from herbicide residues can be minimized by application of the lowest herbicide rate required for good weed control, by using band rather than broadcast applications, and by moldboard plowing before planting the next crop. Moldboard plowing reduces phytotoxicity by diluting the herbicide residue in a large volume of soil. Moldboard plowing is ineffective to reduce the residual effects of picloram (Tordon), chlorsulfuron (Glean), metsulfuron (Ally).

14. Herbicide residues often can be detected by bioassay. A soil sample representative of the whole field must be obtained by sampling at many places to the depth of the tillage layer. Also, a sample of soil known to be free of herbicide residues must be obtained from near the treated field to serve as the untreated check. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare at least two samples each of the untreated check soil and the test soil in pots or other containers with holes in the bottom for water drainage. The crop to be grown in the field should be used as one bioassay species. Preparing extra pots and testing a more susceptible species may be helpful in detecting residues. Plant in each pot 12 seeds of large-seeded crops like corn or soybeans, or 20 seeds of small-seeded crops like cereals or flax. Water the soil for germination and plant growth as needed, but do not over-water. When the plants are about 2 inches tall, thin to about 6 large-seeded or 12 small-seeded uniform seedlings in each container. The containers should be placed in a warm place at about 70 to 75 F, and in direct sunlight. Observe the plants in the untreated check and test samples for 2 to 3 weeks after emergence. Some tangible measurements such as plant height and leaf length can be taken for evaluation, along with visual observation of abnormalities. Symptoms of some herbicides, like atrazine and metribuzin (Lexone/Sencor) do not develop until

several days after emergence. The soil should be washed from the roots to observe root growth, especially for dinitroaniline herbicides such as pendimethalin (Prowl) trifluralin (Treflan) and ethalfluralin (Sonalan). Window bioassays do not provide accurate information on chlorsulfuron (Glean) or metsulfuron (Ally) carryover. However, DuPont provides a Laboratory Recrop Bioassay (LRB) service to customers to provide accurate information on rotation options following chlorsulfuron or metsulfuron use. Consult the local DuPont representative for additional information on the LRB service.

15. Atrazine generally has a residue the year following application to corn at 2 to 3 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.

16. Ethalfluralin (Sonalan), pendimethalin (Prowl), and trifluralin (Treflan) are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than 1 year.

Ethalfluralin has less soil residue than trifluralin and pendimethalin. Land treated with ethalfluralin in the spring may be planted to any crop the next year except sugarbeets. Sunflower, soybeans, potatoes, and dry edible beans are quite tolerant of dinitroaniline herbicides. The approximate ranking of other crops from most to least tolerant is flax, barley, wheat, corn, oats, and sugarbeets.

17. Dicamba (Banvel) at 1 to 2 lb/A applied for perennial weed control may remain as a residue 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 lb/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.

18. Picloram (Tordon) at 1/64 lb/A active ingredient (1 oz/A of formulated product) may carryover in the soil for more than 1 crop year. Only grass or grain crops such as small grains, corn, sorghum, or flax should be planted on fields treated with picloram the previous year. Sunflower, soybeans, dry edible beans, and potatoes are especially susceptible to picloram.

19. Metribuzin (Lexone, Sencor) generally is used on soybeans in combination with other herbicides or is used alone on potatoes. No harmful metribuzin carryover would be expected from 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.

20. 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.

21. Chlorsulfuron (Glean) at 1/128 lb/A active ingredient (1/6 oz/A of formulated product) 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 de-

creases as soil pH increases. Chlorsulfuron should not be applied on soils with a pH above 7.9. The minimum recropping intervals are 0 months for wheat, 10 months for spring oats, and 16 months for barley. Land previously treated with chlorsulfuron should not be rotated to crops other than those listed above until a field bioassay confirms that residues of chlorsulfuron are not present. The approximate ranking of other crops from most to least tolerant is safflower, dry beans, sunflower, flax, corn, soybeans and sugarbeets. A Laboratory Recrop Bioassay (LRB) service is available through DuPont to provide customers with accurate information on rotational options following chlorsulfuron use. Consult your local DuPont representative for additional information on the LRB service.

22. 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 7.9. The minimum recropping intervals are 1 month for spring and winter wheat, and 10 months for durum wheat, barley and oats. A 22 month recropping interval should be observed before planting proso millet, sorghum, corn, flax, safflower, or sunflower on fields west of Highway 1, while a 34 month recropping interval should be observed east of Highway 1. Land previously treated with metsulfuron should not be rotated to crops other than those listed above until a field bioassay confirms that residues of metsulfuron are not present. A Laboratory Recrop Bioassay (LRB) service is available through DuPont to provide customers with accurate information on rotational options following metsulfuron use. Consult your local DuPont representative for additional information on the LRB service.

23. Clopyralid (Stinger) and clopyralid + 2,4-D or MCPA (Curtail, Curtail M) may have a herbicidally active residual in the soil following postemergence application. Wheat, barley, oats, corn, other grasses, and sugarbeets have good tolerance to clopyralid and can be planted any time following application. Other crops usually can be planted 12 months after treatment. Extreme conditions where top soil remained cold or dry for extended periods after application may cause herbicidally active residues to persist for more than 12 months. In this case, small areas of lentils or peas should be planted as bioassay species prior to planting more extensive areas of lentils, peas, safflower, potatoes, alfalfa, sunflowers, edible beans, or soybeans. Time of clopyralid application during a season may influence the time of crop seeding the following year. For example, clopyralid applied June 15 would prevent seeding soybeans or edible beans until June 15 or later the following year.

HERBICIDE RESISTANCE:

24. A shift in weed spectrum results from the repeated use of a selective herbicide that eliminates susceptible weed species and allows tolerant weed species to increase in the absence of competition from the susceptible plants. Likewise, individual plant species also may have different plant types or biotypes in the population that vary in susceptibility to certain herbicides. Weed species that are very susceptible to certain herbicides may contain a small percentage of plants which are tolerant or resistant to a herbicide. Continuous exposure of that weed population to the herbicide may gradually result in a buildup of the resistant biotypes until they dominate the population and the herbicide no longer is effective on that weed species. Various weed species have developed resistance to different herbicides. The most common incidence of herbicide resistant weeds has occurred with the triazine herbicides, atrazine and simazine. More recently, several weed species have developed resistance to chlorsulfuron (Glean) and all other herbicides with the same mode of action. Herbicide resistant weeds are most likely to develop with the repeated use of effective, long residual, herbicides

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

SMALL GRAINS - WINTER AND 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 semi-dwarf wheat. Herbicides generally are more effective in more competitive crops. All small grains are sensitive to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until just prior to the boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from the 5th leaf until just prior to the boot stage, are more tolerant than oats to 2,4-D applications. Oats are more tolerant to MCPA than to 2,4-D, but injury to oats is possible with either chemical at any growth stage. Use 2,4-D on oats only for such hard-to-kill weeds as Russian thistle, kochia, common ragweed, and redroot pigweed and when the crop is in the 3rd to 4th leaf stage. While some injury to the oats can be expected, the better control of these weeds with 2,4-D usually will compensate for any yield loss caused by the chemical. Oat varieties vary in their tolerance to 2,4-D, MCPA, bromoxynil, or chlorsulfuron, but wheat and barley varieties differ little in tolerance.

26. Clopyralid + 2,4-D (Curtail) at 0.09 plus 0.5 lb/A or clopyralid + MCPA (Curtail M) at 0.09 to 0.12 plus 0.51 to 0.68 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 Curtail to oats or prior to the 4 leaf stage of wheat or barley. Curtail M can be used on oats, wheat and barley after crop is in the 3 leaf stage through jointing. Do not rotate to any crop except wheat, barley, oats, corn, grass, or sugarbeets within 12 months after treatment.

27. Dicamba (Banvel, Banvel SGF) at 0.06 to 0.12 lb/A controls wild buckwheat, smartweed and certain other broadleaf weeds in wheat, barley and oats. Dicamba can be applied alone but usually is applied with MCPA to increase control of wild mustard and other broadleaf weeds. Oats are more tolerant to dicamba than wheat. Both crops must be treated during the 2nd through 4th leaf stage. Barley can be treated during the 2nd through 3rd leaf stage but barley toler-

ance 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 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 18.

29. Bromoxynil (Buctril) controls wild buckwheat, fumitory and most annual broadleaf weeds in wheat, barley and oats from emergence of the crop to early boot. Mixtures of bromoxynil plus MCPA ester (Bronate) are applied from the 3 leaf to early boot stage to improve wild mustard control. In general a minimum spray volume of 10 gpa is recommended for optimum spray coverage. A minimum of 5 gpa with a minimum spray pressure of 50 psi may be used with higher speed, low volume ground application if ground terrain, crop and weed density allow effective spray distribution. No more than 10 mph is suggested to avoid poor spray coverage. Buctril and Bronate can be tank-mixed with MCPA, Glean, Ally, Finesse, Harmony Extra, Express, Curtail, Curtail M, and Avenge. Buctril only can be tank-mixed with 2,4-D, banvel, and Hoelon. Bronate only can be tank-mixed with Assert.

30. Chlorsulfuron (Glean) at 1/128 lb/A applied postemergence controls broadleaf weeds in wheat, barley and oats. Chlorsulfuron should not be applied until 48 months have elapsed since the last application. Tankmixtures with other broadleaf herbicides and use interval restrictions help minimize the potential buildup of resistant weed biotypes (Refer to paragraph 24). Chlorsulfuron should be tank-mixed with MCPA, 2,4-D, bromoxynil, bromoxynil plus MCPA or Dicamba. Chlorsulfuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank-mix herbicide and rate (Consult the label for further details). Do not apply chlorsulfuron to soils with a pH greater than 7.9. Tankmixing chlorsulfuron with organophosphate insecticides increases crop injury potential. Chlorsulfuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sugarbeets and sunflowers. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. Chlorsulfuron may persist in the soil for 3 years or more. Refer to the herbicide residue section, paragraph 21, on chlorsulfuron carryover and recropping restrictions.

31. Metsulfuron (Ally) at 1/267 lb/A applied as a tank mixture with another broadleaf herbicide provides postemergence control of broadleaf weeds in wheat and barley. Metsulfuron should not be applied until 22 months have elapsed since the last metsulfuron or chlorsulfuron treatment and should always be applied as a tank-mixture with another broadleaf herbicide to minimize the potential buildup of resistant weeds (Refer to paragraph 24). Metsulfuron can be mixed with MCPA, 2,4-D, bromoxynil or bromoxynil plus MCPA. Metsulfuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank-mix herbicide and rate (Consult the label for further details). Tank mixing metsulfuron with organophosphate insecticides increases crop injury potential. Do not apply metsulfuron to soils with a pH greater than 7.9. Metsulfuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sunflowers or sugarbeets. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops. Metsulfuron may persist in the soil for 3 years or more. Refer to the herbicide residue section, paragraph 22, on metsulfuron carryover and recropping restrictions.

32. Thifensulfuron plus tribenuron (Harmony Extra) at 1/72 to 1/36 lb/A applied postemergence controls annual broadleaf weeds and

provides partial control of Canada thistle in wheat and barley. Apply 2,4-D in combination with thifensulfuron plus tribenuron to improve Canada thistle control. Thifensulfuron plus tribenuron always should be applied as a tank mixture with another broadleaf herbicide in areas of known weed resistance to minimize the potential buildup of sulfonylurea resistant weeds (refer to paragraph 24). Thifensulfuron plus tribenuron can be tank mixed with 2,4-D, MCPA, bromoxynil, bromoxynil plus MCPA, difenzoquat or imazamethabenz. Do not tank mix diclofop with thifensulfuron plus tribenuron as grass control may be reduced. Thifensulfuron plus tribenuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank mix herbicide and rate (consult the label for more details). Tank mixing thifensulfuron and tribenuron with organophosphate insecticides increases potential for crop injury. Thifensulfuron and tribenuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sugarbeets and sunflowers. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops.

33. Tribenuron (Express) at 1/128 to 1/64 lb/A applied post-emergence controls several broadleaf weeds in wheat and barley. tribenuron always should be applied as a tank mixture with another broadleaf herbicide in areas of known weed resistance to minimize the potential buildup of sulfonylurea resistant weeds (refer to paragraph 24). Tribenuron can be mixed with MCPA, 2,4-D, bromoxynil, bromoxynil plus MCPA, difenzoquat or Imazamethabenz. Do not tank mix diclofop with thifensulfuron plus tribenuron as grass control may be reduced. Tribenuron should be applied with a nonionic surfactant at 0.12 to 0.25% v/v depending on the tank mix herbicide and rate (consult the label for more details). Tank mixing tribenuron with organophosphate insecticides increases potential for crop injury. Tribenuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sugarbeets and sunflowers. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops.

34. Small grains underseeded to sweetclover, alfalfa or other legumes should not be treated with 2,4-D, MCPA, bromoxynil, dicamba, chlorsulfuron, metsulfuron, tribenuron, thifensulfuron + tribenuron, clopyralid plus 2,4-D, or picloram at rates required to control most broadleaf weeds because serious injury or death of the legumes may result. However, MCPA, 2,4-D, and bromoxynil are registered for use on certain small grain-legume mixtures even though some injury to the legume may occur.

WILD OATS:

35. Wild oats are difficult to control because the plants shatter their seeds before crops are harvested and because seed dormancy causes delayed germination. Wild oats is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist.

36. Triallate (Far-Go, Showdown) at 1 to 1.5 lb/A is applied pre-plant or preemergence incorporated (depending on formulation) for wild oats control in wheat, durum, barley, peas, lentils or annual canarygrass. See tables for specific rates. Triallate is volatile and the liquid formulation must be incorporated immediately after application. The liquid formulation has given more consistent wild oats control with less crop thinning than the granular formulation when spring applied. See paragraph 11 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 or spring applied treatment in barley and durum. Buckle is not labeled for use in Hard Red Spring wheat.

37. Barban (Carbyne 2EC) should be applied for postemergence wild oats control when the majority of wild oats are in the 1.5 to 2 leaf stage, which generally occurs 9 days after emergence. Barban at 0.25 to 0.5 lb/A can be applied to spring and winter wheat, barley and oats; at 0.25 to 0.37 lb/A to durum wheat, and at 0.37 lb/A to safflower, and mustard grown for oil. 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 mustard within 30 days of crop emergence. Barban should not be mixed with or applied within 4 days of 2,4-D, MCPA or dicamba because wild oats control will be reduced. Bromoxynil mixed with barban has at times reduced wild oats control.

38. Barban (Carbyne 2EC) may be mixed with 1 gallon per acre aqueous nitrogen for control of wild oats in wheat and barley. This treatment has increased wild oats control in North Dakota tests especially when the plants were growing under low fertility or drought stress. The barban aqueous nitrogen solution must be mixed with water for application. Addition of a surfactant at 0.5 percent v/v may prevent compatibility problems. A compatibility test should be conducted prior to addition of a barban/fertilizer mixture to the spray tank. Barban at 0.25 lb/A can be tank mixed with diclofop at 0.25 to 0.50 lb/A or difenzoquat at 0.25 to 0.50 lb/A for control of larger wild oats.

39. To reduce possible injury to wheat and barley, barban should be applied when the daytime temperature will exceed 50 F for at least several hours during each of the first 3 days following application. Barban is different from most herbicides since phytotoxicity is greater at lower temperatures. The higher rate should be used at temperatures above 85 F with low fertility soil, or drouthy conditions. Frost prior to barban application does not increase barban injury to wheat and barley or reduce wild oats control if the wild oats leaves are not damaged by the frost and temperatures after application are greater than 50 F.

40. Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the 3 to 5 leaf stage. Difenzoquat is cleared for use in barley, durum wheat (except Vic, Fjord, Edmore, Lakota and Wascana), and winter wheat. Difenzoquat is cleared for application to the following hard red spring wheat varieties: Amidon, Apex, Baart, Benito, Buckshot, Butte, Butte 86, Centa, Chester, Columbus, Copper, Coteau, Courtney, Era, Erik, Federation, Fjeld, Fortuna, Germain 444, Glenlea, Glenman, HY320, Katpwa, Leader, Leif, Marberg, Marshall, McKay, Minnpro, Neepewa, Newana, NK3751, Norak, Norana, Olaf, Oslo, Owens, Penawana, Pioneer 2369, Pioneer 2385, Pondera, ProBrand 711, Pro-Brand 715, Prodax, Rambo, Selkirk, Solar, Stoa, Success, Telemark, Vance, Victory, W 2502, Walera and Wheaton. 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 also has indicated that Vic and Edmore durum wheat varieties may be injured by difenzoquat. Wild oats are more susceptible at the 5 leaf than the 3 leaf stage of growth and control also is improved by good crop competition. The high rate should be used on high populations of 3 leaf wild oats. Wheat injury may occur at temperatures above 80 F. Difenzoquat may be mixed with bromoxynil (Buctril), MCPA, MCPA plus bromoxynil, 2,4-D, metsulfuron (Ally), chlorsulfuron (Glean), thifensulfuron + tribenuron (Harmony Extra), tribenuron (Express), clopyralid plus 2,4-D (Curtail), or clopyralid plus MCPA (Curtail M) for broadleaf weed control without loss of wild oats control.

41. Diclofop (Hoelon) can be applied at 0.75 to 1.25 lb/A in wheat and soybeans and 0.75 to 1 lb/A in barley and flax for the control of 1 to 4 leaf wild oats. The higher rate of diclofop should be used to control wild oats in the 3 to 4 leaf stage or when plants are growing under moisture stress. Oil additive at 1 pt to 1 qt/A will provide more consistent control, especially under moisture stress. Do not use oil additive with diclofop on barley or flax. Wild oats control with diclofop generally is better when cool rather than warm temperatures follow application. Diclofop should not be mixed with any broadleaf herbicide other than bromoxynil in flax and small grains or bromoxynil plus a low rate of MCPA ester (1.5 fl oz) in small grains. Research at North Dakota State University indicated that application of diclofop and herbicides not registered for tank mixing should be separated by 4 days to avoid reduction in wild oats control.

42. Imazamethabenz (Assert) at 0.31 to 0.38 lb/A provides post-emergence wild mustard and wild oats control in wheat and barley. Imazamethabenz should be applied to wild oats in the 1 to 4 leaf stage when wheat and barley are in the 2 leaf to jointing stage of growth. Imazamethabenz also gives good winter annual mustard control and suppresses wild buckwheat with 3 leaves or less. Imazamethabenz has provided more consistent wild oats control with environmental stress than other postemergence wild oats herbicides in wheat and barley. Do not rotate to crops except barley, corn, potatoes, sunflowers, wheat, soybean, dry beans, or safflower for at least 15 months after imazamethabenz application. Imazamethabenz can be tank mixed with metsulfuron (Ally), chlorsulfuron (Glean), clopyralid plus MCPA (Curtail), MCPA plus 2,4-D ester, bromoxynil plus MCPA (Bronate), thifensulfuron plus tribenuron (Harmony Extra), tribenuron (Express), chlorsulfuron plus metsulfuron (Finesse) herbicides.

GREEN AND YELLOW FOXTAIL (PIGEONGRASS):

43. Foxtails commonly infest small grains in North Dakota. Foxtails usually are most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields which have been chisel plowed generally have more foxtails than moldboard plowed fields. Moldboard plowing buries the foxtail seed which prevents emergence and reduces viable seed for subsequent years.

44. Diclofop (Hoelon) at 0.75 to 1.0 lb/A in wheat, soybeans, barley, or flax applied postemergence controls foxtails in addition to wild oats. The lower rate is for green foxtail and yellow foxtail with 1 to 3 leaves. The higher rates are for foxtails growing in dry conditions or for foxtails with 3 to 4 leaves. Research at NDSU has indicated green foxtail is more susceptible than yellow foxtail to diclofop. (See wild oats section for information on diclofop mixtures with other herbicides).

45. Propanil + MCPA ester (Stampede CM) at 0.94 + 0.25 lb/A (2.5 pts product) controls wild buckwheat, redroot pigweed and many other annual broadleaf weeds in Hard Red Spring wheat, durum wheat, barley and oats. 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 only should be applied when temperatures at or after application are between 65 and 85 F and plants are actively growing with adequate soil moisture within 2 inches of the surface. Propanil should not be applied to wheat treated with carbamate or organophosphate insecticides or wheat grown on soil treated the previous year with organophosphate insecticides.

46. Trifluralin at 0.5 to 0.75 lb/A and harrow incorporated shallow after seeding is labeled for control of foxtails in wheat and barley. The lower rate is for use on coarse textured soils and the higher rate on fine textured soils. Incorporation should be by harrowing twice at

right angles and the depth of incorporation of the herbicide must be above the wheat seed. The wheat should be seeded 2 to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semi-dwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trifluralin applied in this manner does not control wild oats. (See wild oats section for discussion on trifluralin-triallate combination, paragraph 35).

47. Trifluralin (Treflan) at 0.5 to 0.75 lb/A may be fall applied for control of foxtails on ground to be planted to wheat or barley the following spring. Some stand reduction may occur from fall applied trifluralin but wheat will usually tiller and compensate so no yield loss occurs. Trifluralin is available in both liquid and granular formulations. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue is at a manageable level that will not interfere with incorporation. Seed wheat or barley no more than 2 inches deep into a moist seedbed. See paragraph 149 for trifluralin applications in the fallow year for foxtail control in small grains the next year.

VOLUNTEER SUNFLOWER:

48. Volunteer sunflower often is a problem in small grains seeded in 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. Judgement may be needed in determining the time of herbicide application. Early herbicide application would not control late emerging sunflower and late application would allow competition from the early emerged sunflower. Generally application should be before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.

Bromoxynil at 0.25 lb/A plus MCPA ester at 0.25 lb/A (Bronate) gives excellent control of volunteer sunflower. Treated sunflower appear severely burned within several days and die about 1 week after treatment. Chlorsulfuron (Glean) at 1/128 lb/A, Metsulfuron (Ally) at 1/267 lb/A, thifensulfuron + tribenuron (Harmony Extra) at 1/78 lb/A, dicamba (Banvel) at 0.12 lb/A plus MCPA amine at 0.25 lb/A, clopyralid + MCPA (Curtail M) at 0.09 + 0.51 lb/A, Clopyralid + 2,4-D (Curtail) at 0.09 + 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 that is superior to 2,4-D or MCPA. 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.

KOCHIA:

50. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. The proper rates of herbicides and spray volumes for thorough coverage should be used to maximize control. Chlorsulfuron (Glean) at 1/64 lb/A, metsulfuron (Ally) at 1/267 lb/A, thifensulfuron + tribenuron (Harmony Extra) at 1/70 lb/A or tribenuron (Express) at 1/128 lb/A provide good kochia control unless resistant populations have developed (See paragraph 24). Tank mixing these herbicides with another broadleaf herbicide is recommended to prevent a buildup of resistant kochia. Addition of a nonionic surfactant at 0.12 to 0.25% v/v is essential for postemergence kochia control with chlorsulfuron, metsulfuron, tribenuron and thifensulfuron + tribenuron. Dicamba (Banvel) at 0.125 lb/A plus MCPA amine at 0.25 lb/A gives good kochia control. Bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A also gives good control of kochia, but plants should be small and

spray coverage good. 2,4-D at 0.5 lb/A gives good kochia control, but good spray coverage is essential because 2,4-D does not translocate readily in kochia. Treatment should be to small plants (less than 3 inches tall) or large spray volumes should be used to penetrate the kochia foliage. MCPA is less effective for kochia control than 2,4-D. However, MCPA at 0.5 lb/A will control small kochia. Picloram (Tordon) is not effective on kochia, but when combined with 2,4-D at 0.37 lb/A, especially the ester, control is good.

RUSSIAN THISTLE AND REDROOT PIGWEED:

51. 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, thifensulfuron + tribenuron (Harmony Extra) at 1/70 lb/A or tribenuron (Express) at 1/128 lb/A give good redroot pigweed and Russian thistle control unless resistant populations have developed (See paragraph 24). Dicamba (Banvel) at 0.12 lb/A, 2,4-D at 0.5 lb/A, bromoxynil at 0.25 lb/A, and picloram (Tordon) at 1/64 to 1/43 lb/A plus 2,4-D at 0.37 lb/A also give good Russian thistle and redroot pigweed control. MCPA is not as effective in controlling either weed. The esters of 2,4-D generally are more effective than the amines for both weeds.

FALSE CHAMOMILE:

52. False chamomile is an important weed in small grains in north central and northeastern North Dakota. False chamomile is resistant to many of the herbicides used in small grains. However, chlorsulfuron at 1/64 lb/A, metsulfuron at 1/267 lb/A, thifensulfuron + tribenuron (Harmony Extra) at 1/70 lb/A or tribenuron (Express) at 1/128 lb/A control false chamomile. Refer to paragraphs 21 and 22 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 usually are 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 Extra) at 0.5 lb/A with a nonionic surfactant at 0.25% v/v. Glyphosate (Roundup) at 0.75 lb/A and amitrole (Amitrole T, Cytrol) at 1.5 lb/A control false chamomile less than 6 inches tall and can be used in tree rows and around potholes. Avoid drift to tree foliage when applying glyphosate or amitrole.

HARROWING FOR WEED CONTROL:

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

FLAX

54. Flax is less competitive with weeds than are small grains, and should be grown on relatively weed-free fields. Early post-harvest tillage of small grain stubble will prevent weed seed production, suppress perennial weeds and encourage annual weed seed germination prior to freeze-up. Weed problems will be reduced when weeds are controlled in the preceding crop. Flax may be seeded directly or

with shallow spring tillage in fields which did not have weed seed produced the previous year. Deep tillage on such fields could bring dormant seeds to the surface, increasing weed problems. If fields are weedy, moldboard plowing after a year of weed seed production will bury the weed seeds, reducing the weed infestation in the following crop season. Moldboard plowing is especially effective in reducing infestation of small seeded weeds like foxtails and kochia which have short seed survival. Delayed seeding of flax with tillage prior to seeding will control wild oats and reduce infestations of other early germinating weeds. However, delayed seeding generally reduces flax yields. Early maturing flax varieties should be used with late seeding. Flax is a poor competitor with weeds so control is needed before or soon after emergence to reduce flax yield losses. Preemergence herbicides control weeds before emergence which eliminates early weed competition and maximizes flax yields. Postemergence herbicides applied soon after weed emergence to small weeds and flax usually give better control and allow more time for flax recovery from possible herbicide injury than applications to larger weeds and flax.

55. EPTC (Eptam, Genep) fall applied at 4 lb/A controls annual grass weeds, including foxtails and wild oats, and some broadleaf weeds in flax. Fall applied EPTC at 3 lb/A in coarse textured soils generally has given good control with less flax injury than 4 lb/A. Incorporate EPTC immediately (within minutes) and thoroughly after application. (See paragraph 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.

56. Trifluralin 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.

57. The flowable formulation of propachlor (Ramrod 4L) can be applied preemergence to control certain annual grasses and broadleaf weeds but is ineffective against wild oats, wild mustard and perennial weeds. Flax tolerance to preemergence propachlor is excellent but incorporation will injure flax and reduce weed control.

58. MCPA at 0.25 lb/A on 2 to 6-inch flax controls many broadleaf weeds. MCPA amine rates higher than 0.25 lb/A or MCPA ester should be used in flax for improved kochia and Russian thistle control. Picloram (Tordon) + MCPA amine gives better redroot pigweed and wild buckwheat control than MCPA alone.

59. Bromoxynil (Buctril) at 0.25 lb/A on 2 to 6-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some leaf burn may be observed at the higher rates or if high temperatures follow application. Mixtures of bromoxynil + MCPA may cause flax injury if applied under hot, humid conditions.

60. 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.

61. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses. See sethoxydim section under soybeans for application rates and stages to control different weed

species. Apply sethoxydim to actively growing grasses and do not apply to grasses under stress. Apply 75 days or more 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 delay maturity of the crop. Grass control from sethoxydim may be reduced when applied as a tank mixture with bromoxynil or MCPA, especially the amine formulation of MCPA.

CORN

62. 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.

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

Package Mixtures Available For Corn:

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

64. 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 90W), or pendimethalin (Prowl) plus cyanazine (corn at 2-leaf stage or smaller). Nicosulfuron (Accent) at 0.5 oz/A with adjuvant has given excellent postemergence control of wild proso millet. See paragraph 79 for additional information.

65. Atrazine (AAtrax, Atrazine) at 2 to 3 lb/A gives good control of annual weeds without corn injury. Fine textured soils with high organic matter require a 3 lb/A application. Atrazine residues injurious to susceptible crops may remain in soils longer than one growing season. (See paragraph 15 in herbicide residue section for additional discussion). Atrazine is registered as a tank mixture with alachlor (Lasso), bromoxynil (Buctril), butylate (Sutan +, Genate +), cyanazine (Bladex), dicamba (Banvel), metolachlor (Dual), propachlor (Ramrod), simazine (Princep), and simazine plus paraquat (Gramoxone Extra). Atrazine also is available as a prepackage mix with several herbicides. See table on package mixtures.

66. Alachlor (Lasso) at 2 to 4 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A are used preplant incorporated or preemergence for control of annual grasses and certain broadleaf weeds such as redroot pigweed, common lambsquarters and common ragweed. Use the higher rate on clay soils high in organic matter. Incorporation improves weed control with alachlor and metolachlor. Alachlor is registered as a tank mixture with atrazine, dicamba, cyanazine, glyphosate, paraquat, and simazine. Metolachlor is registered as a tank mixture with atrazine, cyanazine, dicamba or with atrazine plus paraquat or glyphosate. Metolachlor may be applied up to 45 days before planting.

67. 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.

68. 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.

69. Cyanazine (Bladex) at 1.2 to 4.75 lb/A preemergence controls annual grasses and broadleaf weeds in corn. Use the higher rates on fine textured, high organic matter soils, and the lower rates on coarse textured soils with low organic matter. Do not use on sandy or loamy sand soils, or on soils with less than 1% organic matter. Cyanazine requires 0.5 inch or more rain for activation, especially on fine textured soils. Cyanazine has a short soil residual permitting normal crop rotations. Mixtures of cyanazine with metolachlor, propachlor, alachlor and EPTC improve grassy weed control. Cyanazine alone gives poor to fair redroot pigweed control. Cyanazine is difficult to tank-mix with other herbicides. For best results, premix the cyanazine as a slurry, fill the spray tank at least half full of water and while the pump and agitator are running, add the cyanazine. Once the cyanazine is completely suspended in the water, add the other herbicide while filling the tank with water to the desired level.

70. 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 recommended on coarse-textured sandy soils. Use the lower rate of dicamba on medium silt loams with 2 percent or less organic matter.

71. 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 tillth 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.

72. 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.

73. 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 emulsifiable vegetable oil. Vegetable oils at 1 qt/A with atrazine give weed control equal to petroleum oil concentrate at 1 qt/A with atrazine. Surfactants and wetting agents are less effective with atrazine than any of the oil additives. Refer to herbicide residue section, paragraph 15, for carryover precautions.

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

75. 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.

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

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

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

78. See discussion under soybeans for use of bentazon (Basagran) on corn.

79. Nicosulfuron (Accent) can be applied at 0.5 oz/A to corn from the 2-leaf through 6-leaf stage of field corn. Do not use on popcorn, sweet corn, or corn grown for seed production. A second application may be made to corn through the 10-leaf stage. To avoid crop canopy spray interception and possible crop injury from late treatments, apply with drop nozzles to direct spray to weeds. Always add an oil adjuvant at 1 to 3% v/v or nonionic surfactant at 0.25% v/v. Research results at NDSU have indicated that adjuvant enhancement of weed control from nicosulfuron was greatest with Sun-It, followed by petroleum oil, and least with nonionic surfactant. Liquid 28% N fertilizer at 1 gal/100 gal spray volume has enhanced weed control when nicosulfuron was applied with nonionic surfactant. The nonionic surfactant is required when nicosulfuron is applied in tank mixtures with dicamba because the dicamba label restricts usage with oil adjuvants. Limited research at NDSU indicated that that nicosulfuron tank mixed with 2,4-D amine, according to the 2,4-D label, plus Sun-It gave control of common cocklebur, venice mallow, common lambsquarters in addition to the species indicated below. Nicosulfuron may be used postemergence to control foxtails spp., fall panicum, barnyardgrass, field sandbur, woolly cupgrass, quackgrass, pigweed spp., and smartweed spp. NDSU results show that nicosulfuron provides good control of kochia, wild proso millet and wild oats. Bentazon and organophosphate insecticides, such as Lorsban, malathion, or parathion, should not be applied less than 7 days before or 3 days after nicosulfuron to reduce the risk of crop injury. Do not apply to corn previously treated with Counter insecticide. Corn treated with organophosphate insecticides, such as, Lorsban, Dyfonate, and Thimet applied at planting or over-the-row at cultivation may result in temporary crop injury. Alfalfa can be planted 12 months after application. Soybeans, dry edible beans, wheat, barley, oats, pop corn, and sweet corn can be planted 10 months after application. All other crops can be planted 10 month after application if soil pH is less than or equal to 6.5, otherwise, 18 months must elapse. Field corn can be planted anytime after application.

80. Primisulfuron (Beacon) should be applied at 0.56 oz/A to corn between 4 and 20 inches in height. Crop injury may result from the application of Beacon to certain corn varieties (consult label for susceptible varieties). Primisulfuron should be applied with a non-ionic surfactant at 1 qt/100 gal water, or crop oil concentrate at 1 to 4 pt/A as specified on the oil adjuvant label. Liquid nitrogen fertilizer may be added at 1 to 2 pt/A. Primisulfuron may be tank mixed with Banvel, Buctril, or 2,4-D to improve broadleaf weed control. Do not use crop oil concentrate or liquid fertilizer solution when tank mixing with broadleaf herbicides. Primisulfuron controls quackgrass, fall panicum, cocklebur, nightshade, kochia, smartweed, pigweed, sunflower, and may suppress lambsquarters and Canada thistle. Do not apply primisulfuron if the insecticide Counter is applied at any time during the season. Do not apply a foliar postemergence organophosphate insecticide within 10 days before or after primisulfuron application. Winter wheat may be planted 3 months after application. Alfalfa, corn, dry edible beans, soybeans, sunflowers, and spring seeded small grains may be planted 8 months after application. All other crops can be planted 18 months after application.

81. Emergency control of broadleaf and grass weeds in corn can be obtained with directed applications of ametryn (Evik) or paraquat (Gramoxone Extra). Ametryn at 2 to 2.5 lb/A or paraquat at 0.25 lb/A should be applied as a directed spray to the weeds. A nonionic surfactant should be used with both herbicides. Application over the top of

corn will cause severe injury and contact with the leaves will cause burning. Do not apply ametryn before corn is 12 inches high or paraquat before corn is 10 inches high. Weeds should be less than 4 inches tall.

SOYBEANS

82. Soybeans are poor competitors with weeds when cool soil temperatures cause slow germination and growth, but are good competitors in warm soils when germination and growth are rapid. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to a soybean crop that will compete with weeds. Soybean production requires good cultural practices. Prepare the 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.

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

PACKAGE MIXTURES AVAILABLE FOR SOYBEANS:

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

84. Wild proso millet is an aggressive, competitive annual weed that is becoming a serious problem in some areas in eastern North Dakota. In soybeans, trifluralin, pendimethalin (Prowl) or ethalfluralin (Sonalan) will suppress wild proso millet. For long term control, however, a preplant incorporated treatment of any of these herbicides should be followed with a delayed preemergence application of alachlor (Lasso), metolachlor (Dual), or chloramben (Amiben), or a postemergence application of fluazifop-P (Fusilade 2000), sethoxydim (Poast), fenoxaprop (Whip), or quizalofop (Assure) (see tables for rates). Preplant incorporated treatments of alachlor or metolachlor applied alone or in combination with chloramben (Amiben) at the full label rate for the soil type have also given acceptable wild proso millet control in some experiments.

85. Ethalfluralin (Sonalan), pendimethalin (Prowl) and trifluralin (Trelan) are dinitroaniline herbicides applied preplant incorporated for control of annual grasses and broadleaf weeds except wild mustard,

common cocklebur and sunflower. Proper timing and depth of incorporation for each herbicide are essential as requirements differ.

86. Ethalfuralin (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. Ethalfuralin is registered as a tank mixture with chloramben, alachlor, metolachlor, metribuzin or clomazone. Ethalfuralin has less soil residue than trifluralin.

87. Pendimethalin (Prowl) at 1.0 to 1.5 lb/A is applied preplant incorporated or preemergence to control annual grasses and certain broadleaf weeds. The high rate should be used on heavy clay soils. Incorporation improves weed control if rainfall does not occur within 7 days after application. Pendimethalin is registered as a tank mixture with alachlor, chloramben, clomazone, linuron, metolachlor, and metribuzin. See herbicide residue section, paragraph 16.

88. Trifluralin at 0.5 to 1 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. Set the implement at a 4 to 6 inch depth to uniformly mix trifluralin in the soil. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Do not plant soybeans deeper than 2 inches. Trifluralin is registered as a tank mixture with alachlor, chloramben, clomazone, metolachlor, and metribuzin. See herbicide residue section, paragraph 16.

89. Alachlor at 2 to 4 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A give good preemergence control of annual grasses and some broadleaf weeds, including redroot pigweed, black nightshade, and common lambsquarters, but are ineffective against wild mustard. Apply the higher rate on clay soils high in organic matter. Soybeans have good tolerance to metolachlor and alachlor and incorporation improves the consistency of weed control. Alachlor and metolachlor are registered as a tank mixture with several herbicides.

90. Chloramben (Amiben) at 2 to 3 lb/A is applied preemergence to control most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at NDSU indicates that incorporation of chloramben improves the consistency of wild mustard control. Chloramben is registered as a tank mixture with alachlor, clomazone, ethalfuralin, linuron, metolachlor, metribuzin, pendimethalin and trifluralin.

91. Metribuzin (Sencor, Lexone) at 0.19 to 0.37 lb/A controls annual broadleaf weeds, especially wild mustard. The rate is critical. Consult the label for the proper rate based on soil type, pH, and percent organic matter. Maple Amber soybeans are susceptible to metribuzin. Seed soybeans 2 inches deep to reduce possible injury. Soybean injury also can be reduced by using herbicide combinations with lower rates of metribuzin. Metribuzin is registered as a tank mixture with alachlor, chloramben, clomazone, ethalfuralin, metolachlor, pendimethalin and trifluralin.

92. Clomazone (Command) at 0.75 to 1.0 lb/A applied preplant incorporated controls certain annual grass and broadleaf weeds. Clomazone should be incorporated within 3 hours of application to avoid vaporization and off-site movement. Clomazone effectively controls velvetleaf and common lambsquarters, but does not adequately control redroot pigweed or wild mustard. Do not rotate to small grains, sunflowers, or flax the year following clomazone application. Clomazone is registered as a tank mixture with trifluralin, ethalfuralin, pendimethalin, alachlor, metolachlor, and metribuzin.

93. Acifluorfen (Blazer) at 0.25 to 0.5 lb/A postemergence controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the higher rates are needed for nightshade, smartweed and common cocklebur. Acifluorfen will not adequately control volunteer sunflower. Acifluorfen kills primarily by contact action, thus for effective control, applications should be made to actively growing 1 to 4 inch weeds and first to second trifoliolate soybeans. Soybeans beyond the third 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 4 hours after application as weed control is reduced. A nonionic surfactant (80 percent active ingredient) generally should be added to the tank at the rate of 0.12 percent. See the label for additional information on spray additives. Do not apply within 50 days of harvest or use treated plants for feed or forage.

94. Bentazon at 0.75 to 1.5 lb/A postemergence controls many broadleaf weeds. In North Dakota good wild mustard control has been obtained with bentazon at 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 Canada is 8 inches tall to bud stage and make a second application 7 to 10 days later at 1.0 lb/A.

95. Lactofen (Cobra) at 0.20 lb/A postemergence controls many broadleaf weeds. Lactofen kills primarily by contact action, and thorough spray coverage of the weeds is essential for good control. Soybeans beyond the third trifoliolate leaf stage may interfere with the spray pattern and reduce coverage of the weeds. Application should be made by ground sprayer delivering 15 to 30 gpa at 40 psi. Do not make application during periods of moisture stress, frost, flooding, wind damage, or unseasonably cool or hot temperatures as weed control may be reduced or crop injury increased. Best results are obtained at maximum daytime temperatures of 70 to 85 F. Addition of an oil additive at 0.5 to 1 pt/A generally increases weed control, but also may increase crop injury. Do not apply within 90 days of harvest or use treated plants for feed or forage.

96. Thifensulfuron (Pinnacle) at 1/256 lb/A applied postemergence controls wild mustard and pigweed species, and suppresses several other broadleaf weeds. Thifensulfuron should be applied in combination with a nonionic surfactant at 0.125% v/v or oil concentrate at 1 qt/A. Further addition of 28% UAN liquid fertilizer at 1 gal/A may improve weed control. Thifensulfuron can be tank mixed with bentazon to increase the spectrum of weeds controlled. Thifensulfuron spray drift or sprayer contamination causes severe injury to susceptible crops such as sugarbeets and sunflowers. Thorough cleaning of a sprayer is required to prevent contamination of subsequent sprays and injury to susceptible crops.

97. Fenoxaprop (Whip/Option) at 0.1 to 0.15 lb/A plus oil additive at 1 qt/A can be applied in soybeans for postemergence annual grass control. Fenoxaprop at 0.10 lb/A will control green foxtail, volunteer corn and wild proso millet. Yellow foxtail, wild oats, barnyardgrass, and crabgrass can be controlled with fenoxaprop at 0.15 lb/A. Fenoxaprop generally will not provide good volunteer small grain control. Tank mixing acifluorfen, bentazon, or lactofen with fenoxaprop 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.

98. Fluzifop-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. Fluzifop-P at 0.09 lb/A will control volunteer corn and wild proso millet. Fluzifop-P at 0.12 lb/A will control wild oats and volunteer grains. Fluzifop-P at 0.19 lb/A will control foxtails. Quackgrass with at least 4 leaves but less than 10 inches tall can be suppressed with fluzifop-P at 0.19 lb/A. If regrowth occurs, a second application of 0.19 lb/A should be applied when quackgrass regrowth has 3 to 5 leaves. Mixing fluzifop-P with other herbicides may reduce weed control and increase crop injury. Reduced grass control can be avoided by applying fluzifop-P at least 1 day before or 5 days after application of a broadleaf herbicide.

99. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive at 1 qt/A will control annual and perennial grasses. Methylated vegetable oil (Sun-It by Agsco) and Dash (BASF) additives have enhanced grass control with sethoxydim more than petroleum oil or unmodified vegetable oil additives. Application rates for several grass species are 0.1 lb/A for wild proso millet, 0.2 lb/A for volunteer corn, green foxtail, yellow foxtail, and barnyardgrass, and 0.3 lb/A for wild oats and volunteer cereals. Quackgrass 6 to 8 inches tall can be suppressed with sethoxydim at 0.3 lb/A. Quackgrass regrowth should be treated with 0.2 lb/A. Cultivation between 14 to 21 days after application will improve quackgrass control. Mixing desmedipham (Betanex), desmedipham + phenmedipham (Betamix), endothall (H-273), acifluorfen or bentazon with sethoxydim has generally reduced wild oats control and occasionally reduced foxtail control compared to sethoxydim plus oil additive alone. Also, oil additives frequently have 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. The addition of 2 to 4 qt/A of liquid nitrogen solution or 2.5 lb/A of ammonium sulfate in addition to the oil additive may increase activity on volunteer corn, cereal grains and quackgrass.

100. Quizalofop (Assure) at 0.06 to 0.12 lb/A plus crop oil concentrate at 1% v/v will provide postemergence control of annual and perennial grasses in soybeans. Quizalofop at 0.06 lb/A will control volunteer corn and wild proso millet. Foxtails, volunteer small grains, and wild oats can be controlled with quizalofop at 0.09 lb/A. Quizalofop should be applied at 0.12 lb/A for quackgrass control. If quackgrass regrowth occurs, make a second application at 0.09 lb/A. Tank-mixing acifluorfen, bentazon, or lactofen with quizalofop often has reduced grass control compared to quizalofop alone. Reduced grass control can be avoided by applying quizalofop at least 1 day before or 5 days after application of a broadleaf herbicide. Quizalofop should not be applied with vegetable oil additives due to reduced grass control. However, methylated vegetable oils (Sun-It) have performed equal to petroleum based oil additives with quizalofop.

101. Naptalam + 2,4-DB (Rescue) at 1 to 1.5 + 0.03 to 0.045 lb/A may be applied for salvage control of common cocklebur, giant ragweed, and volunteer sunflower 10 inches or taller in soybeans. Apply after 1st bloom of soybeans because earlier application may cause soybean injury. Apply with a nonionic surfactant or oil additive at 0.5 percent v/v (2 qt/100 gal spray solution). Applications should be made in 10 to 25 gallons per acre water (by ground) with 40-50 psi spray pressure and nozzles 18 to 24 inches above the weeds. Avoid drift to susceptible crops like sunflowers.

EASTERN BLACK NIGHTSHADE:

102. Eastern 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 nightshade can interfere with bean harvest because the nightshade berries are sticky and cause clogging of combines as well as stained beans and reduced quality. Metolachlor (Dual), alachlor (Lasso), and chloramben (Amiben) preemergence or preplant incorporated provide good 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 nightshade control in dry beans. Acifluorfen (Blazer) and lactofen (Cobra) postemergence provide good control of nightshade with less than four leaves in soybeans, but can not be used in dry beans. Bentazon (Basagran) is weak on nightshade.

DRY EDIBLE BEANS

103. 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.

104. See discussion under soybeans for use of bentazon (Basagran), chloramben (Amiben), pendimethalin (Prowl), and trifluralin (Treflan). See paragraph 102 for eastern black nightshade control. The rate of bentazon in dry beans should not exceed 1.0 lb/A. The use of oil with bentazon may increase dry bean injury. Alachlor (Lasso) at 2 to 3 lb/A preplant incorporated or metolachlor (Dual) at 2 to 3 lb/A preplant incorporated or preemergence controls annual grasses and some broadleaf weeds, including nightshade. Metolachlor may be tank mixed with EPTC (Eptam, Genep) for wild oats control.

105. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus pendimethalin (Prowl) at 0.5 to 1.5 lb/A controls a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats, common lambsquarters, and eastern black nightshade. The EPTC plus pendimethalin mixture must be incorporated thoroughly immediately after application by setting the implement at a 4 to 6 inch depth. Do not use on flat podded beans such as soybeans.

106. 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 eastern 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.

107. See discussion under soybeans for use of sethoxydim (Poast) on dry edible beans.

108. 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

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.

110. Triallate (Far-Go) at 1.25 lb/A can be applied for wild oats control before or after seeding lentils. Triallate is volatile and must be incorporated into the soil immediately after application.

111. Propham (ChemHoe) applied preplant incorporated at 4 lb/A will control wild oats and volunteer grains. Lentils should be planted not later than 1 to 2 days after propham incorporation with an implement set 4 inches deep.

112. 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.

113. See discussion under soybeans for use of sethoxydim (Poast) in lentils.

SUNFLOWER

114. Weeds usually are a problem as sunflower does not develop ground cover rapidly enough to prevent weeds from becoming established. Since weeds generally emerge before the sunflower, cultivating with a spike-tooth or coil spring harrow about 1 week after sowing but prior to emergence of the crop will kill many weeds. After sunflower reaches the 4 to 6 leaf stage, weeds may be controlled in the row by using a harrow or rotary hoe. Cultivation will control weeds between the rows.

115. EPTC (Eptam, Genep), ethalfuralin (Sonalan), pendimethalin (Prowl) and trifluralin (Treflan) are preplant incorporated herbicides. See paragraphs 1 to 5 for discussion on herbicide incorporation. Ethalfuralin and trifluralin are applied on sandy soil at 0.56 to 0.75 and 0.5 lb/A, respectively. EPTC must be applied and incorporated immediately to prevent herbicide loss. EPTC is registered at 3 lb/A for sunflower but this rate occasionally has caused sunflower injury on coarse-textured, low organic matter soils. The risk of sunflower injury from EPTC can be reduced on these soils by using 2 to 2.5 lb/A. EPTC may be applied in late fall before soil freeze-up at 4.0 lb/A on coarse textured soil and 4.5 lb/A on fine and medium textured soil. EPTC has given more effective control of wild oats in sunflower than pendimethalin and trifluralin. EPTC, pendimethalin, and trifluralin are labeled for tank mixing with chloramben (Amiben) to improve wild mustard control. Ethalfuralin is labeled for tank mixing with chloramben and EPTC (Eptam only). Rainfall after application is needed for weed control with surface applied pendimethalin. Pendimethalin applied up to 30 days before planting is more likely to receive adequate rainfall for activation than pendimethalin applied at planting.

116. Alachlor (Lasso) at 3.0 lb/A controls annual grasses and some broadleaf weeds including redroot pigweed and common lambsquarters, but is ineffective against wild mustard. Research at NDSU has shown that, on coarse textured soils, alachlor at 2 lb/A has given adequate annual grass control. Sunflowers have good tolerance to alachlor. Incorporation improves consistency of weed control. Alachlor is registered as a tank mixture with chloramben.

117. Chloramben (Amiben) at 2 to 3 lb/A preemergence controls most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the levels of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at NDSU indicates that incorporation of chloramben improves the consistency of wild mustard control.

118. 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.

119. Imazamethabenz (Assert) at 0.19 to 0.38 lb/A provides postemergence wild mustard and wild oats control in sunflowers. The lower rates are for wild mustard control, the high rate is for wild oats control. Assert should be applied to sunflowers before they exceed the 8 leaf stage or 15 inches in height. Sunflower injury may occur with high temperatures at application.

SUGARBEETS

120. 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.

121. Herbicides are commonly used as tank mixtures on sugarbeets. Some herbicide combinations such as desmedipham plus phenmedipham (Betamix) are registered for use as tank mix combinations, but many other tank mixes are not registered. Herbicides may be tank mixed legally if all herbicides in the mixture are registered for use on sugarbeets. However, the user must assume liability for any resulting crop injury, inadequate weed control, or illegal and/or harmful residues.

122. EPTC (Eptam, Genep) preplant incorporated in the spring at 2 to 3 lb/A or in the fall at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC sometimes causes a sugarbeet stand reduction and temporary stunting. However, if enough sugarbeets remain to obtain an adequate plant population after thinning, no yield reduction will result. Use EPTC with extreme caution on sugarbeets grown in sandy loam or lighter soils with low organic matter levels because predicting a safe rate on such soils is difficult. See paragraph 7 on the soil organic matter test. Herbicides such as cycloate (Ro-Neet), ethofumesate (Nortron) or pyrazon (Pyramin) cause less sugarbeet injury on the low organic matter soils where EPTC injury may be excessive.

123. EPTC (Eptam, Genep) plus cycloate (Ro-Neet) has less potential for sugarbeet injury than EPTC alone and is less expensive per acre than cycloate alone. The rate of application of the mixture must be adjusted for soil texture and organic matter. Suggested fall applied rates are: cycloate alone on soils with less than 3 percent organic matter, EPTC + cycloate at 1 + 3 lb/A on loam or coarser soils with 3 percent organic matter, 1.5 + 2.5 lb/A on loam to clay loam soils with 3 to 4 percent organic matter, 2 + 2 lb/A on clay loam soils with 3.5 to 4.5 percent organic matter, and 2.5 + 2.5 lb/A on clay or clay loam soils with over 4.5 percent organic matter. Suggested spring applied rates are: cycloate alone at 3 lb/A on loam or coarser soils with 3 percent or less organic matter, EPTC + cycloate at 1 + 2.5 lb/A on loam or coarser soils with 3 to 3.5 percent organic matter, 1.5 + 2.5 lb/A on loam to clay loam soils with 3.5 to 4.5 percent organic matter, and 2 + 2 lb/A on clay loam or finer soils with 4 percent or more organic matter. These rates may need to be adjusted on certain fields or with certain incorporation tools based on individual experience. EPTC, cycloate, or EPTC + cycloate require immediate incorporation for best weed control.

124. 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. Ethofumesate may be applied preemergence but research results in North Dakota and Minnesota indicate that incorporation generally improves weed control. Operating the incorporation tool 2 to 4 inches deep gave slightly better weed control compared to 1 inch. Band application of ethofumesate reduces cost and soil residue, thus band incorporation equipment is needed. See paragraph 20 on ethofumesate residue. Ethofumesate has been relatively safe on sugarbeets but use of ethofumesate with cycloate or fall-applied EPTC can cause sugarbeet injury especially on coarse-textured soils. Ethofumesate plus spring-applied EPTC has been especially injurious to sugarbeets and should only be used on silty clay soils with over 6 percent organic matter.

125. Diethatyl (Antor) spring applied at 4 to 6 lb/A gives good to excellent control of redroot pigweed and prostrate pigweed. Diethatyl may be applied preemergence but tests in North Dakota and Minnesota showed that incorporation generally improved weed control. Operating the incorporation tool 2 inches deep often gave better weed control than operating the incorporation tool 4 inches deep. Thus, deep incorporation of diethatyl should be avoided unless diethatyl is combined with EPTC or cycloate. Operating the incorporation tool 4 inches deep did not reduce weed control from diethatyl + EPTC or diethatyl + cycloate combinations. Preemergence diethatyl will give good weed control if adequate rain follows application.

126. Endothall (Herbicide 273) at 0.75 to 1.5 lb/A gives good post-emergence 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.

127. 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.

128. 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.

129. Trifluralin 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.

130. Clopyralid (Stinger) at 0.09 to 0.25 lb/A postemergence controls several broadleaf weeds and volunteer crops. Clopyralid at 0.09 to 0.19 lb/A is most effective when applied to common cocklebur, giant ragweed, volunteer sunflower, wild sunflower, volunteer alfalfa, and

volunteer soybeans up to the six-leaf stage, common ragweed up to the five-leaf stage, and wild buckwheat in the three to five-leaf stage before vining begins. Clopyralid at 0.19 to 0.25 lb/A is most effective on Canada thistle in the rosette to pre-bud growth stage, but rosette application often gives better control than later application. Clopyralid must be applied to sugarbeets in the two to eight-leaf stage and at least 105 days prior to harvest. Clopyralid is not registered for application by aircraft.

LEGUMES

131. Seedling legumes usually are poor competitors with weeds. Good management practices in preceding crops are recommended such as clean cultivation in row crops and post-harvest tillage to reduce the amount of weed seeds in the soil. Weed control for establishment of legumes when sown alone can be aided by mowing (except sweetclover), herbicides, or by seeding a companion crop.

132. Trifluralin at 0.50 to 0.75 lb/A can be applied preplant incorporated for annual grass and some annual broadleaf weed control only in legumes established on acres enrolled in the government set-aside program. Do not use on acres not in a government program. Some legume injury may occur.

133. 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.

134. Bromoxynil (Buctril) at 0.25 to 0.38 lb/A can be applied to seedling alfalfa for postemergence broadleaf weed control. Bromoxynil should be applied to alfalfa with a minimum of 4 trifoliolate leaves and to weeds with 4 leaves or less, or before rosettes are 1.5 inches in diameter. Alfalfa leaf burn can occur with bromoxynil, especially if warm weather follows treatment. Do not apply bromoxynil to alfalfa if the temperature at or within 3 days after treatment is expected to exceed 80 F in the western half of North Dakota or 70 F in the eastern half of North Dakota. Do not graze or harvest treated alfalfa within 30 days of spring treatment or 60 days of fall treatments.

135. Metribuzin (Sencor, Lexone) at 0.38 to 1 lb/A, terbacil (Sinbar) at 0.4 to 1.2 lb/A and pronamide (Kerb) at 1 to 2 lb/A can be applied to dormant alfalfa in the fall for grass and broadleaf weed control in alfalfa. Metribuzin and terbacil also can be applied to dormant alfalfa in early spring. All three herbicides can injure alfalfa. Do not apply until alfalfa has been established at least one year. Do not graze or harvest alfalfa treated with metribuzin for 28 days after treatment. Do not graze or harvest alfalfa treated with pronamide within 25 days (below 1.5 lb/A) to 45 days (1.5 to 2 lb/A) after application. Do not rotate to any other crop within 2 years after treatment of terbacil.

PERENNIAL WEED CONTROL

136. Fall herbicide treatments are effective 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. Good leafy spurge control can be expected through mid-October even after several light

frosts if the leaves are green or red but still firmly attached to the stem. Glyphosate should be applied to Canada thistle prior to frost for best results. Mowing or tillage is a good means of reducing perennial weed seed production but should be discontinued in mid-July to allow adequate plant regrowth by herbicide treatment time. Post-harvest treatment can be used when weed growth has reached about 1 foot of stem inside. 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.

137. Glyphosate 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. Ester as well as amine 2,4-D may be used with Roundup RT. See the perennial weed control section of the tables for application stages and rates.

PERENNIAL WEEDS IN SMALL GRAINS

138. Perennial weed control systems in small grains should include herbicide application in the crop followed by post-harvest treatment for several years. Canada thistle and perennial sowthistle can be controlled in wheat and barley with metsulfuron (Ally) or clopyralid plus 2,4-D or MCPA (Curtail, Curtail M). Canada thistle can be controlled with tribenuron (Express) at 1/64 lb/A or thifensulfuron + tribenuron (Symphony Extra) at 0.019 + 0.009. 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 good 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. 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

139. Picloram (Tordon) controls broadleaf perennial weeds such as leafy spurge, common milkweed, field bindweed, Canada thistle and Russian knapweed on rangelands and permanent grass pastures. Rates of 1 to 2 lb/A give good control of these weeds and are economical for spot treatment. Picloram at 0.25 to 0.5 lb/A postemergence will suppress the growth of perennial broadleaf weeds. Retreatment at the same rates may be necessary the following year. The most cost effective broadcast treatment for leafy spurge control in the spring is picloram at 0.25 lb/A + 2,4-D at 1 lb/A applied annually in the spring or fall for 3 to 5 years.

Picloram (Tordon) is toxic to most broadleaf plants. Spray drift in small amounts may cause damage to sensitive plants. Alfalfa, dry beans, soybeans, potatoes, safflower, sunflower, sugarbeets and vegetable crops are highly susceptible to picloram. Picloram is water soluble

and may leach in the soil; consequently, do not apply in areas where a sandy porous surface and substrata overlay ground water 10 feet or less below the surface. Do not apply or allow picloram spray drift into running water (including wells), irrigation ditches for drainage or near shelterbelts, shrubs or trees. When picloram has been applied at 0.5 lb/A or more, do not cut grass for feed within 2 weeks after treatment. Meat animals grazing for up to 2 weeks after treatment should be removed from treated areas 3 days prior to slaughter. Do not graze dairy animals on treated areas within 2 weeks after treatment. Picloram is excreted in the urine, so do not transfer livestock from treated grass areas onto sensitive broadleaf crop areas for 12 months after application without first allowing 7 days of grazing on untreated grass. The total area treated should not exceed 25% of a land owners acreage found in any particular watershed for rates exceeding 1 qt/A.

141. 2,4-D low volatile ester or amine 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. Beef animals cannot be grazed for 3 days after treatment. Some formulations of 2,4-D are cleared for use near water. See individual labels for further details.

142. Dicamba (Banvel) at 0.5 to 8 lb/A can be used to control some perennial weeds, especially field bindweed and 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.

143. Triclopyr plus 2,4-D (Crossbow) at 0.5 to 3 lb/A plus 0.25 to 1.5 lb/A can be applied to grass pastures for broadleaf weed and brush control. Triclopyr plus 2,4-D generally provides better musk thistle and brush control than 2,4-D alone. Do not graze lactating dairy animals or harvest hay from treated areas for 1 year after application. Do not graze beef animals within 3 days of slaughter during the first year after treatment.

CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

144. Paraquat (Gramoxone Extra, Cyclone), a nonselective contact herbicide, can be used at 0.47 to 0.94 lb/A alone or 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 nonionic 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, sunflower and wheat. Paraquat is corrosive to exposed aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is toxic so avoid contact with the skin; small amounts could be fatal if swallowed. Paraquat is a restricted use herbicide.

145. Glyphosate 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 should 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 9 to 17 pounds per 100 gallons of water improves the consistency of weed control with glyphosate especially if environmental stress or water quality is a concern. Add ammonium sulfate to the water slowly and make sure it is completely dissolved before adding herbicides or surfactant. Additives are not needed with the Ranger formulation of glyphosate. Glyphosate at 0.19 lb/A controls foxtails, 0.29 lb/A controls volunteer small grains, and 0.38 lb/A controls wild oats and downy brome when applied to plants less than 4 inches tall. Use a higher rate on larger weeds, more resistant weeds, or if plants are under moisture stress. When low rates of glyphosate are used, apply in 3 to 10 gallons of water per acre by ground or 3 to 5 gallon per acre by air. Delay tillage for at least 3 days after treatment. Apply glyphosate at 0.75 lb/A when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing. Apply glyphosate at 1.5 to 2.25 lb/A when Canada thistle is actively growing and at or before the bud stage. Fall treatment of Canada thistle must be applied before frost for best results. Do not till until 3 or more days after treatment. Glyphosate can be used in the spring before or after planting but before emergence of barley, corn, oats, soybeans, dry beans, forages, potatoes, sugarbeets, wheat, and sorghum (milo), or in the fall when these crops will be planted the next growing season. Potential crop injury exists when glyphosate + 2,4-D or dicamba mixtures are applied immediately before or after planting due to the preemergence soil activity of 2,4-D and dicamba. Fall planted rye or wheat may be killed with 1 lb/A of glyphosate prior to planting sugarbeets and other crops in the spring.

146. For postharvest or fallow weed control in minimum till situations dicamba (Banvel) at 0.08 to 0.25 lb/A or 2,4-D at 0.17 to 0.6 lb/A can be tank mixed with glyphosate at 0.19 to 0.38 lb/A. Commercial mixtures of dicamba plus glyphosate (Fallow Master) and 2,4-D plus glyphosate (Landmaster II, Landmaster BW) are available. Add a nonionic surfactant at 0.5 percent v/v to the spray solution. Further addition of ammonium sulfate at 9 to 17 lb per 100 gallons of spray solution improves consistency of control. For general use, 9 lbs per 100 gal water is adequate, but 17 lbs per 100 gal water would provide more consistent results, especially if environmental stress or water quality is a concern. Delay planting of wheat, barley, oats, or sorghum for 15 days and all other crops for 3 months after Fallow Master application. Low rates of dicamba or 2,4-D plus glyphosate should be used only when weeds are less than 4 inches tall and actively growing. Use glyphosate at 0.38 lb/A if weeds are drought stressed or greater than 4 inches tall.

147. A tank mixture of cyanazine at 2 to 2.8 lb/A plus atrazine at 0.4 to 0.5 lb/A is labeled in North Dakota for annual weed control in fallow. Soils with 3 to 4 percent organic matter require the high rate of cyanazine. The cyanazine plus atrazine combination gives increased residual weed control compared to cyanazine alone. The tank mix combination must be applied before November 15 of the year preceding the planting of winter wheat. Atrazine preemergence at 0.5 to 1 lb/A will control annual weeds including downy brome (cheatgrass) during the fallow period of a wheat-fallow-wheat rotation. See tables for restrictions on atrazine use. Allow 12 or more months between application and planting. If weeds are emerged but less than 6 inches tall at application, a tank mixture of atrazine with paraquat should be applied. A nonionic surfactant should be added to both mixtures.

148. Clomazone will control volunteer wheat and kochia but often may be unsatisfactory on Russian thistle and will not give adequate control of redroot pigweed, foxtails (pigeongrass), and wild mustard. Dry conditions during weed emergence in early spring and summer may give unsatisfactory performance. Carryover injury in wheat is possible following clomazone applications and can be recognized as yellowing

or bleaching (whitening) of seedling plants. Do not apply clomazone within 1000 ft. of emerged winter wheat, towns, and subdivisions, or commercial nurseries, greenhouses, fruit, or vegetable production sites due to drift injury potential.

149. Trifluralin (Treflan TR-10) granules at 0.5 to 1.0 lb/A may be applied and incorporated on fallow land that has manageable trash levels to control foxtails (pigeongrass) and certain broadleaf weeds. Rates depend upon time of application and local rainfall conditions.

Trifluralin (Treflan TR-10) Rates Per Acre

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

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

CONSERVATION RESERVE PROGRAM (CRP)

150. Chlorsulfuron (Glean) can be apply early postemergence to all labeled grasses that were planted the previous season having one or more leaves (except for Plains and WW Spar bluestems). Apply late postemergence to tillered stands of all labeled grasses with stands one year old. Apply postemergence to established grass/alfalfa mixtures with stands one year old (grass=all labeled varieties). Alfalfa injury may occur. Registered grass species include Plains and WW Spar bluestems, blue grama, big and little bluestem, buffalograss, galleta, green needlegrass, green sprangletop, Indian grass, Indian ryegrass, lovegrass, prairie sandreed, sand dropseed, sidecoats grama, switchgrass, wheatgrass, and wildrye grasses.

151. Metsulfuron (Ally) may be applied to the following registered grass species: blue grama, bluestems, buffalograss, green sprangletop, klein-grass, lovegrass, orchardgrass, sidecoats grama, switchgrass, wheat-grasses, and Russian wild rye.

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

SOIL APPLIED HERBICIDES	Barnyardgrass	E. Black Nightshade	Cocklebur, C	Field Bindweed	Perennial Thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters, C	Pigweed, Redroot	Russian Thistle	Sunflower, Volunteer	Wild Buckwheat	Wild Mustard	Wild oats	Herbicide Persistence After 12 months
Alachlor PPI	G-E	G	N	N	N	G-E	F	F	G-E	F	N	F	P	F-G	N
Alachlor PRE	F-G	G	N	N	N	G	P-F	P-F	F-G	P-F	N	P-F	P	P	N
Atrazine PPI	G	E	G	F	F	F-G	E	E	E	E	G-E	E	E	E	O
Atrazine PRE	G	G-E	F-G	P-F	P-F	F-G	G-E	G-E	G-E	G-E	F-G	G-E	E	G-E	O
Butylate (Sutan, Genate) PPI	G-E	F	P	N	N	E	-	P	F	P	N	P	P	G	N
Chloramben (Amiben) PPI	G	G	P	N	N	G	F	E	E	G	N	G	G	F	N
Chloramben (Amiben) PRE	G	G	P	N	N	G	F	E	E	G	N	G	F-E	F	N
Clomazone (Command) PPI	F-G	P	F	N	N	F-G	G-E	F-G	P	F-G	F-G	F-G	F	G	O
Cyanazine (Bladex) PPI	F	F	F	N	N	G	G-E	G-E	F	E	F-E	G	E	F	S
Cyanazine (Bladex) PRE	P-F	P-F	F	N	N	F-G	G	G-E	P-F	G-E	P-F	F-G	G-E	P-F	S
Cycloate (Ro-Neet) PPI	E	F-G	P	N	N	E	P	F-G	G	P	N	P-F	P	G	N
Diethatyl (Antor) PPI	G	G	P	N	N	G	P	P	G-E	P	N	P	P	F-G	N
Diethatyl (Antor) PRE	F-G	F-G	P	N	N	F-G	P	P	G	P	N	P	P	F-G	N
EPTC (Eptam, Genep) PPI	E	F-G	P	N	N	E	F	F	G	P	N	F	P	G	N
Ethalfuralin (Sonalan) PPI	E	F-G	P	N	N	E	G-E	E	E	G-E	N	F	N	G	S
Ethofumesate (Nortron) PPI	P	F-G	P	N	N	F-G	F-G	P-F	G-E	F-G	P	F-G	F	G	O
Ethofumesate (Nortron) PRE	P	F	P	N	N	F	F	P-F	G	F	P	F	P-F	F-G	O
Metolachlor (Dual) PPI	G-E	G	N	N	N	G-E	F	F	G-E	F	N	F	P	P	N
Metolachlor (Dual) PRE	F	G	N	N	N	G	P-F	P-F	F-G	P-F	N	P-F	P	N	N
Metribuzin (Lex/Sen) PPI	F	P	F	N	N	F	G	F	E	E	P-F	F	E	P	S
Metribuzin (Lex/Sen) PRE	P-F	P	P-F	N	N	P-F	F-G	P-F	G-E	G-E	P	F	G-E	P	S
Pendimethalin (Prowl) PPI	E	N	N	N	N	E	G	G	G-E	F	N	N	N	F-G	S
Pendimethalin (Prowl) PRE	E	N	N	N	N	G-E	F-G	G	G	F	N	N	N	P-F	S
Propachlor (Ramrod) PRE	E	-	P	N	N	G-E	G	F	E	P	N	F	P	P	N
Triallate (Far-Go, Showdown) PPI	N	N	N	N	N	N-P	N	N	N	N	N	N	N	E	N
Triallate (Far-Go, Showdown) PEI	N	N	N	N	N	N-P	N	N	N	N	N	N	N	G-E	N
Trifluralin PPI	E	N	P	N	N	E	G	G	G-E	G	N	F	N	F-G	S
Trifluralin PEI	E	N	N	N	N	E	F-G	F-G	F-G	F-G	N	N	N	P	S
POSTEMERGENCE															
Imazamethabenz (Assert)	P	-	P	N	N	P	P-F	P	P	P-F	N	F-G	E	E	S
Aciflufen (Blazer)	N	G	F	F	F	P-F	F-G	G	E	F	P	G	E	N	N
Atrazine + oil	G	G	G	F	F	G	E	E	E	E	G	G	E	G-E	S
Barban (Carbyne)	N	N	N	-	N	N	N	N	N	N	N	F	N	F-G	N
Bentazon	N	F	G	F	F-G	N	F-G	G	F	F	E	F	E	N	N
Bromoxynil (Buctril)	N	E	E	F	F	N	F	G	F-G	E	G-E	E	F-G	N	N

POSTEMERGENCE (cont.)	Barnyardgrass	E. Black Nightshade	Cocklebur, C	Field Bindweed	Perennial Thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters, C	Pigweed, Redroot	Russian Thistle	Sunflower, Volunteer	Wild Buckwheat	Wild Mustard	Wild oats	Herbicide Persistence After 12 Weeks
Bromoxynil + MCPA (Bronate)	N	G-E	G	F	F-G	N	E	E	G	E	E	E	E	N	N
Chlorsulfuron (Glean)	-	N	G	P	F	P	E*	G	E	E*	E	F-G	E	N	O
Clopyralid (Stinger)	N	F-G	E	P	G-E	N	N	P-F	P	P-F	G-E	F-G	P	N	S
Clopyralid + 2,4-D or MCPA (Curtail, Curtail M)	N	F	E	G	G-E	N	F-G	G	G	G	E	G	E	N	S
Cyanazine + oil (Bladex)	G	G	G	P	P	G	G	G	F-G	G	E	G	E	F-G	N
Desmedipham + Phenmedipham (Betamix)	P	G	F-G	N	N	F	F	G	F-G	P	P	F-G	G	N	N
Desmedipham (Betanex)	P	G	P-F	N	N	P	P-F	G	G	P	P	F	G	N	N
Dicamba (Banvel)	N	E	E	G-E	G-E	N	E	G	G	G	G-E	E	G	N	S
Dicamba + MCPA	N	E	E	G	G	N	G-E	E	G	G	E	G-E	E	N	N
Diclofop (Hoelon)	F	N	N	N	N	G-E	N	N	N	N	N	N	N	G-E	N
Difenzoquat (Avenge)	N	N	N	N	N	N	N	N	N	N	N	N	N	G-E	N
Endothall (Herbicide 273)	N	-	P-F	N	N	N	P	P	P-F	P	F-G	G	P-F	N	N
Fenoxaprop (Whip/Option)	E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
Fluazifop (Fusliade 2000)	E	N	N	N	N	G-E	N	N	N	N	N	N	N	E	N
Glyphosate	E	-	-	F	G	E	F-G	G	G	F-G	G	F	G	E	N
Lactofen (Cobra)	N	G	G	F	F	P-F	G	F	E	P	F	G	E	N	N
MCPA	N	G	G	F-G	F-G	N	F	E	F	P	G	N	E	N	N
Metsulfuron (Ally) + MCPA, 2,4 D	N	F-G	F	F	G	N	E*	E	E	E*	G-E	F	E	N	O
Nicosulfuron (Accent)	E	N	P	N	P	E	G	P	E	P	P	P-F	E	E	O
Paraquat (Gramoxone Extra)	G	-	-	P	P	G	G-E	E	E	E	E	F	E	G	N
Picloram (Tordon 22K) + 2,4-D	N	E	E	G-E	G-E	N	F-G	E	E	G-E	E	E	E	N	O
Primisulfuron (Beacon)	P	G	-	-	-	P	F-G	F	E	-	-	-	G	-	O
Propanil + MCPA (Stampede CM)	G	-	G	F	F	G	G	E	E	F	G	G-E	E	N	N
Quizalofop (Assure)	E	N	N	N	N	E	N	N	N	N	N	N	N	E	N
Sethoxydim (Poast)	G-E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
Thifensulfuron (Pinnacle)	N	P	F	N	N	P	F-G	G	E	G	F-G	P-F	E	N	N
Thifensulfuron + Tribenuron (Harmony Extra)	N	P	G	P	F-G	P	E*	E	E	E*	G-E	G-E	E	N	N
Tribenuron + (Express) 2,4-D or MCPA	N	F-G	G	F	G	P	E*	E	G	E*	G	F	E	N	N
2,4-D	N	F-G	G-E	F-G	F-G	N	F-G	E	E	G	E	P-F	E	N	N

E = Excellent, G = Good, F = Fair, P = Poor, N = None, S = Seldom, O = Often
PPI = Preplant Incorporated, PEI = Preemergence Incorporated, PRE = Preemergence with no incorporation, Lex/Sen = Lexone, Sencor.

*Except where resistant populations have developed.

This table is a general 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.

Herbicide Names, Formulations, and Prices

Trade Name ¹	Common Name	Concentration and Formulation ²	Cost/Unit ³
Accent (DuPont)	Nicosulfuron	75% DF	\$27.60 oz
Ally (DuPont)	Metsulfuron	60% DF	\$27.05 oz
Amitrol-T (Rhone-Poulenc)	Amitrole	2 lb/gal S	\$23.50 gal
Antor (Nor-Am)	Diethatyl	4 lb/gal E	\$38.50 gal
Assert (American Cyanamid)	Imazamethabenz	2.5 lb/gal S	\$105.00 gal
Assure (DuPont)	Quizalofop	0.8 lb/gal E	\$105.00 gal
Atrazine (Various)	Atrazine	80% WP, 90% DF, 4 lb/gal F	\$3.00 lb, \$2.50 lb, \$8.60 gal
Avenge (American Cyanamid)	Difenzoquat	2 lb/gal S	\$38.00 gal
Balan (DowElanco)	Benefin	1.5 lb/gal E	\$16.19 gal
Banvel (Sandoz)	Dicamba	4 lb/gal S, 2 lb/gal SGF	\$58.00 gal \$28.50 gal
Basagran (BASF)	Bentazon	4 lb/gal S	\$58.00 gal
Beacon (Ciba Geigy)	Primisulfuron	75% DF	\$24.21 oz
Betamix (Nor-Am)	Desmedipham + Phenmedipham	0.65 + 0.65 lb/gal E	\$68.50 gal
Betanex (Nor-Am)	Desmedipham	1.3 lb/gal E	\$68.50 gal
Bicep (Ciba-Geigy)	Atrazine + Metolachlor	2.7 + 3.4 lb/gal F	\$32.40 gal
Bladex (DuPont)	Cyanazine	90% DF, 4 lb/gal F	\$4.85 lb, \$21.00 gal
Blazer (BASF)	Acifluorfen	2 lb/gal E	\$58.00 gal
Bronate (Rhone-Poulenc)	Bromoxynil + MCPA	2 + 2 lb/gal	\$45.00 gal
Bronco (Monsanto)	Alachlor + Glyphosate	2.6 + 1.4 lb/gal E	\$26.40 gal
Buckle (Monsanto)	Triallate + Trifluralin	10% + 3% G	0.95 lb
Buctril (Rhone-Poulenc)	Bromoxynil	2 lb/gal E	\$41.00 gal
Bullet (Monsanto)	Alachlor + Atrazine	2.5 + 1.5 lb/gal F	NA
Butyrac ester & 200 (Rhone-Poulenc)	2,4-DB	2 lb/gal E, S	\$28.00 gal
Cannon (Monsanto)	Alachlor + Trifluralin	2.5 + 0.5 lb/gal E	\$12.00 gal
Carbyne (Sandoz)	Barban	2 lb/gal E	\$32.60 gal
Cobra (Valent)	Lactofen	2 lb/gal S	\$95.00 gal
Command (FMC)	Clomazone	4 lb/gal E	\$66.56 gal
Commence (DowElanco/FMC)	Trifluralin + Clomazone	3 + 2.25 lb/gal E	\$55.86 gal
Crossbow (DowElanco)	Triclopyr + 2,4-D	2 + 1 lb/gal S	\$38.00 gal
Curtail (DowElanco)	Clopyralid + 2,4-D	0.38 + 2 lb/gal S	\$24.50 gal
Curtail M (DowElanco)	Clopyralid + MCPA	0.42 + 2.35 lb/gal S	\$29.50 gal
Cyclone (ICI)	Paraquat	2 lb/gal S	\$32.00 gal

Defol (Drexel)	Sodium chlorate	6 lb/gal S, 3 lb/gal S	\$7.00 gal \$3.50 gal
Des-i-cate (Pennwalt)	Endothall	0.52 lb/gal S	\$10.50 gal
Dual (Ciba-Geigy)	Metolachlor	8 lb/gal E	\$54.00 gal
Eptam (ICI)	EPTC	7 lb/gal E, 10% G	\$22.00 gal, \$0.48 lb
Eradicane (ICI)	EPTC + Safener	6.7 lb/gal E	\$22.50 gal
Eradicane Extra (ICI)	EPTC+ Safener+ Extender	6 lb/gal E	\$28.00 gal
Evik (Ciba-Geigy)	Ametryn	80% WP	\$4.50 lb
Express (DuPont)	Tribenuron	75% DF	\$17.50 oz
Extrazine II (DuPont)	Cyanazine + Atrazine	3 + 1 lb/gal F 67.5% + 22.5% DF	\$15.52 gal \$3.49 lb
Fallow Master (Monsanto)	Glyphosate + Dicamba	1.1 + 0.5 lb/gal S	\$22.00 gal
Far-Go (Monsanto)	Triallate	4 lb/gal E, 10% G	\$34.16 gal \$0.72 lb
Fusilade 2000 (ICI)	Fluazifop-p	1 lb/gal E	\$88.00 gal
Galaxy (BASF)	Acifluorfen + Bentazon	0.67 + 3 lb/gal S	\$58.00 gal
Genate (Valent)	Butylate + Safener	6.7 lb/gal E	\$20.90 gal
Genep (Valent)	EPTC	7 lb/gal E	\$22.19 gal
Glean (DuPont)	Chlorsulfuron	75% DF	\$12.20 oz
Gramoxone Extra (ICI)	paraquat	2.5 lb/gal S	\$49.95 gal
Harmony Extra (DuPont)	Thifensulfuron + Tribenuron	75% DF	\$11.50 oz
Herbicide 273 (Pennwalt)	Endothall	3 lb/gal S	\$34.00 gal
Hoelon (Hoechst-Roussel)	Diclofop	3 lb/gal E	\$49.50 gal
Kerb (Rohm and Haas)	Pronamide	50% WP	\$14.70 lb
Krenite (DuPont)	Fosamine	4 lb/gal S	NA
Laddok (BASF)	Bentazon + Atrazine	1.7 + 1.7 lb/gal F	\$18.26 gal
Landmaster BW (Monsanto)	Glyphosate + 2,4-D	0.9 + 1.5 lb/gal S	\$18.50 gal
Landmaster II (Monsanto)	Glyphosate + 2,4-D	0.9 + 0.8 lb/gal S	\$19.00 gal
Lariat (Monsanto)	Alachlor + Atrazine	2.5 + 1.5 lb/gal F	\$20.50 gal
Lasso (Monsanto)	Alachlor	4 lb/gal E, MT 15% G	\$22.50 gal, \$0.85 lb
Leafex-3 (J.R. Simplot)	Sodium chlorate	3 lb/gal S	NA
Lexone (DuPont)	Metribuzin	75% DF, 4 lb/gal F	\$21.00 gal \$102.00 gal
Lorox (DuPont)	Linuron	50% WP, 4 lb/gal F	\$7.19 lb \$57.52 gal
MCPA (Various)	MCPA	Amine: S Ester: E	\$13.00 gal \$16.00 gal
Marksman (Sandoz)	Dicamba + Atrazine	1.1 + 2.1 lb/gal F	\$20.50 gal
Nortron (Nor-Am)	Ethofumesate	1.5 lb/gal E	\$49.00 gal

Option (FMC)	Fenoxypop	1 lb/gal E	\$90.00 gal
Pinnacle (DuPont)	Thifensulfuron	25% DF	\$24.00 oz
Roast (BASF)	Sethoxydim	1.5 lb/gal E	\$101.00 gal
Princep (Ciba-Geigy)	Simazine	80% WP 4 lb/gal F 4% G 90% DF	\$4.00 lb \$14.40 gal \$1.30 lb \$3.67 lb
Prowl (American Cyanamid)	Pendimethalin	4 lb/gal E	\$24.00 gal
Pyramin (BASF)	Pyrazon	4.2 lb/gal F	\$69.00 gal
Ramrod (Monsanto)	Propachlor	4 lb/gal F 20% G	\$16.00 gal \$15.25 gal
Ranger (Monsanto)	Glyphosate	2 lb/gal S	\$33.00 gal
Rescue (Uniroyal Chemical)	Naptalam + 2,4-DB	2 + 0.06 lb/gal	\$14.17 gal
Rodeo (Monsanto)	Glyphosate	4 lb/gal S	\$100.00 gal
Ro-Neet (ICI)	Cycloate	6 lb/gal E	\$47.40 gal
Roundup (Monsanto)	Glyphosate	3 lb/gal S 3 lb/gal RT	\$59.00 gal \$36.00 gal
Salute (Mobay)	Trifluralin + Metribuzin	2.7 + 1.3 lb/gal F	\$53.44 gal
Sencor (Mobay)	Metribuzin	4 lb/gal F 75% DF	\$102.00 gal \$21.00 gal
Showdown (Monsanto)	Triallate	20% G	\$1.32 lb
Sonalan (DowElanco)	Ethalfluralin	3 lb/gal E	\$26.50 gal
Stampede CM (Rohm and Haas)	Propanil + MCPA	3.0 + 0.85 lb/gal E	\$24.00 gal
Stinger (DowElanco)	Clopyralid	3 lb/gal S	\$423.00 gal
Sutan + (ICI)	Butylate + Safener	6.7 lb/gal L 10% G	\$23.00 gal \$0.31 lb
Sutazine + (ICI)	Butylate + Safener + Atrazine	4.8 + 1.2 lb/gal F	\$19.00 gal
Tordon 22K (DowElanco)	Picloram	2 lb/gal S	\$89.70 gal
Trifluralin (Various)	Trifluralin	4 lb/gal E, MTF 10% G	\$26.24 gal \$0.80 lb
Turbo (Mobay)	Metribuzin + Metolachlor	1.5 + 6.5 lb/gal F	\$80.40 gal
Whip (Hoechst-Roussel)	Fenoxaprop	1.5 lb/gal E	\$93.50 gal
2,4-D amine (Various)	2,4-D	4 lb/gal S	\$9.00 gal
2,4-D ester (Various)	2,4-D	4 lb/gal E	\$12.50 gal

¹ Reference to commercial products or trade names does not imply that the North Dakota Extension Service recommends or endorses these products over those of similar nature not listed. "Various" means there are numerous trade names and manufactures for the chemical.

² DF=Dry Flowable, E=Emulsifiable, F=Flowable, G=Granular, MT=Micro Tech (encapsulated), S=Solution, SP=Soluble Powder, WP=Wettable Powder.

³ Herbicide prices generally represent average retail prices from dealers throughout the state during 1990. Prices do not include cost of additives such as oils or surfactants or machinery costs. These prices are subject to change over time. Consult your local dealer for actual prices.

NA=Cost information not available at this time.

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