

# 1992 AGRICULTURAL WEED CONTROL GUIDE



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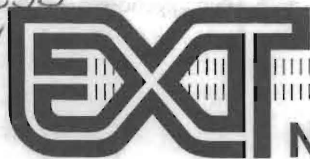
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**NDSU EXTENSION SERVICE**

North Dakota State University, Fargo, ND 58105

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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 ease of being washed from leaves; therefore, herbicides vary in response to rainfall. The amount and intensity of rainfall influence the washing of herbicide from leaves.

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

Herbicide	Time Interval	Herbicide	Time Interval
Accent (nicosulfuron)	4-6 hours	Curtil M (clopyralid + MCPA)	6-8 hours
Ally (metsulfuron)	4 hours	Dakota TP (fenoxaprop + MCPA)	1 hour
atrazine + oil	4 hours	Express (tribenuron)	4 hours
Assert (imazamethabenz)	3 hours	Fusilade 2000 (fluazifop-p)	1 hours
Assure II (quizalofop-p)	1 hour	glyphosate	6 hours
Avenge (difenzoquat)	6 hours	Gramoxone Extra (paraquat)	0.5 hour
Banvel (dicamba)	6-8 hours	Harmony Extra	4 hours
Beacon (primisulfuron)	4 hours	Hoelon (diclofop)	1 hour
bentazon	4 hours	MCPA or 2,4-D amine	4 hours
Betanex (desmedipham)	6 hours	MCPA or 2,4-D ester	1 hour
Betamix	6 hours	Option II (fenoxaprop)	1 hour
Bladex (cyanazine)	2 hours	Pinnacle (thifensulfuron)	1 hour
Blazer (acifluorfen)	6 hours	Poast/Poast Plus (sethoxydim)	1 hour
Buctril (bromoxynil)	1 hour	Stampede CM (propanil + MCPA)	4 hours
Carbyne (barban)	5 minutes	Stinger (clopyralid)	6-8 hours
Cobra (lactofen)	0.5 hour	Tiller (fenoxaprop + 2,4-D + MCPA)	1 hour
Curtil (clopyralid + 2,4-D)	6-8 hours	Tordon 22K (picloram)	6-8 hours

### SPRAY ADDITIVES:

Spray additives consist of oils, surfactants, and fertilizers. The most effective additive 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 to 2 pt/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. 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 manufactures from liability for nonperformance.

#### SPRAY CARRIER WATER QUALITY

Minerals, clay, and organic matter in spray carrier water can reduce the effectiveness of herbicides. Clay inactivates paraquat and glyphosate, organic matter inactivates many herbicides, and minerals of various types inactivate 2,4-D amine, MCPA amine, sethoxydim (Poast), glyphosate, and dicamba (Banvel).

Water in many parts of North Dakota is high in sodium bicarbonate which reduces the effectiveness of 2,4-D and MCPA amines (not esters), sethoxydim, glyphosate, and dicamba. Water samples with 1600 ppm sodium bicarbonate have been observed, but antagonism of the above herbicides is noticeable at only 300 ppm. The antagonism is related to the salt concentration. At low salt levels, loss in weed control may not be noticeable under normal environmental conditions. However, the antagonism from low salt levels will cause inadequate weed control when weed control is marginal because of drought or for marginally tolerant weeds.

High salt levels can cause reduced weed control in nearly all situations. Calcium and, to a lesser degree, magnesium are antagonistic to 2,4-D and MCPA amine, dicamba, and glyphosate. Calcium antagonism may become noticeable at 150 ppm. Sulfate ions in the solution have reduced the antagonism from calcium and magnesium, but the sulfate concentration must be three times the calcium concentration to overcome antagonism. So, for practical purposes, the sulfate that occurs naturally in water can be disregarded.

An analysis of spray sources will provide a guide for determining possible effects on herbicide efficacy. Water with more than 150 ppm calcium or 300 ppm sodium or magnesium may inhibit herbicide phytotoxicity. Iron also is antagonistic to many herbicides, but usually is not abundant in North Dakota water.

Water often contains a combination of sodium, calcium, and magnesium and these cations generally are additive in the antagonism of herbicides. Many adjuvants are marketed to modify spray water pH, but low pH does not appear essential to the action

of most herbicides. Ammonium sulfate, granular or liquid, and 28% liquid nitrogen fertilizer help overcome antagonistic salts in spray carrier water. Ammonium sulfate at 2% (17 lb/100 gallons spray) will overcome the antagonism from the highest calcium and/or sodium concentrations in North Dakota waters for glyphosate, sethoxydim, 2,4-D amine, MCPA amine, and dicamba. Ammonium sulfate at 1% is effective with most North Dakota waters. The 28% nitrogen fertilizer overcomes mineral antagonism of most herbicides, but not glyphosate. Research results with amounts of 28% nitrogen fertilizer is limited, but four gallons/100 gallons of spray has generally been adequate. The ammonium sulfate and 28% nitrogen adjuvants have enhanced herbicide control of certain weeds even in water without salts. This is especially true for glyphosate, sulfonyleureas (Harmony Extra, Express, Ally, Pinnacle) acifluorfen (Blazer), and bentazon. However, ammonium sulfate, 28% nitrogen, or other adjuvants should be used with caution as their benefit often is limited to specific herbicides or weeds and may be antagonistic to other herbicides or weeds.

#### 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), desmedipham (Betanex), bentazon, sethoxydim (Poast), fluazifop-P (Fusilade 2000), fenoxaprop (Option II), and quizalofop-P (Assure II).

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, 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.

### SPRAYER CLEANOUT

Crop injury from a contaminated sprayer may occur when a herbicide not registered on the crop was used previously in the sprayer. The risk of damage is greatest when spraying crops highly susceptible to the previous herbicide and when the previous herbicide is very active in small amounts. Rinsing with water is not adequate to remove all herbicides. Some herbicides have remained tightly adsorbed in sprayers through water rinsing and even through several tank-loads of other herbicides. Then, when a tank-load of solution including an oil adjuvant or nitrogen solution was put in the sprayer, the herbicide was desorbed, moved into the spray solution, and damaged susceptible crops. Highly active herbicides that have been difficult to wash from sprayers and have caused crop injury include dicamba (Banvel) and sulfonylureas (Harmony Extra, Express, Pinnacle, Ally, Accent, Beacon, and other related herbicides).

Herbicides which are difficult to remove from sprayers are thought to be attaching to residues remaining from spray solutions that deposit in a sprayer. The herbicide must be desorbed from the residue or the residue removed in a cleaning process so the herbicide can be removed from the sprayer. Sprayer cleanout procedures are given on many herbicide labels and the procedure on the label should be followed for specific herbicides. The following procedure is given as an illustration of a thorough sprayer cleanup procedure that would be effective for most herbicides.

- Step 1.** Drain tank and thoroughly rinse interior surfaces of tank with clean water. Spray rinse water through the spray boom. Sufficient rinse water should be used for 5 minutes or more of spraying through the boom.
- Step 2.** Fill the sprayer tank with clean water and add a cleaning solution (many labels suggest a cleaning solution). Fill the boom, hoses, and nozzles and allow the agitator to operate for 15 minutes.
- Step 3.** Allow the sprayer to sit for 8 hours while full of cleaning solution. The cleaning solution should stay in the sprayer for 8 hours so that the herbicide can be fully desorbed from the residues inside the sprayer.
- Step 4.** Spray the cleaning solution out through the booms.

- Step 5.** Remove nozzles, screens, and filters and clean thoroughly. Rinse the sprayer to remove cleaning solution and spray rinsate through the booms.

Common types of cleaning solutions are chlorine bleach, ammonia, and commercially formulated tank cleaners. Chlorine lowers the pH of the solution which speeds the degradation of some herbicides. Ammonia increases the pH of the solution which increases the solubility of some herbicides. Commercially formulated tank cleaners generally raise pH and act as detergents to assist in removal of herbicides. Read the herbicide label for recommended tank cleaning solutions and procedures. **WARNING: Never mix chlorine bleach and ammonia as a dangerous and irritating gas will be released.**

Sprayers should be cleaned as soon as possible after use to prevent the deposit of dried spray residues. If a sprayer remains empty over night without cleaning, fill the tank with water to prevent dried spray deposits from forming. A sprayer kept clean is essential to prevention of damage from herbicide contamination.

### 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+), cycloate (Ro-Neet), EPTC (Eptam, Eradicane), ethalfuralin (Sonalan), triallate (Far-Go), and trifluralin. Incorporation of alachlor, ethofumesate (Norton), 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 post-emergence 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 Complex or Unite. Different batches of fertilizer may differ in their mixing properties and should be tested separately.

#### HERBICIDE+DRY-FERTILIZER COMBINATIONS:

Some herbicides are registered for impregnation on dry bulk fertilizer. Read the label for use directions. Ammonium sulfate, ammonium phosphate-sulfate, diammonium phosphate, potassium chloride, superphosphate, treble superphosphate, and urea are 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.

**Applicator 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

North Dakota Chemical Spill  
    State Wide      (701) 472-2121

## 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.** A heading at the top of each table shows, Act. Ingrid. lb/A (Formulation/A) which means that the rate of each herbicide is given as the amount of active ingredient labeled for that crop followed in parenthesis by the amount of formulated product. 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  
oz        = ounce

fl oz     = fluid ounce  
pt        = pint  
qt        = quart  
gal       = gallon

Act       = active ingredient  
ai        = active ingredient  
ae        = acid equivalent  
conc.    = concentration  
v/v      = volume/volume

lb        = pound  
lb/gal   = pounds/gallon  
gpa      = gallons per acre

PPI      = preplant incorporated  
PoPI     = postplant incorporated  
PRE      = preemergence

BL       = broadleaf  
HRSW    = Hard red spring wheat  
WW      = Winter wheat

E, EC    = emulsifiable concentrate formulation  
DC       = dry concentrate  
DF       = dry flowable formulation  
F        = flowable formulation  
G        = granular formulation  
MT      = Micro-Tech (i.e. micro-encapsulated formulation)  
S        = solution  
W        = wettable powder formulation

**DO NOT USE THIS PUBLICATION AFTER DECEMBER 31, 1992**

# 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	Paragraph
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of 3 lb ae/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 BW) and dicamba + glyphosate (Fallow Master) are available.	S2, S3
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.	S1
Triallate (Far-Go)	<b>WINTER WHEAT</b> 1.25 (1.25 qt Far-Go, 12.5 lb Far-Go 10 G.)	Wild oats	Fall: For winter wheat.  Apply 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.	A5, G2
	<b>HRSW &amp; DURUM:</b> 1 as liquid or 1.25 as granular (1 qt, 12.5 lb Far-Go 10G) <b>BARLEY:</b> 1.25 as liquid or 1.25 to 2.5 as granular (1.25 qt, 12.5 to 15 lb 10G)		Fall: For HRSW, Durum and Barley.  Apply within 3 weeks of freeze-up.	Apply and incorporate with recom- mended 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.	
	<b>HRSW &amp; DURUM:</b> 1 (1 qt Far-Go, 10 lb Far-Go 10G) <b>BARLEY:</b> 1.25 (1.25 qt Far-Go 12.5 lb Far-Go 10G)		Spring: For HRSW, Durum and Barley. Apply 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 inch in length. Postplant incorporate with harrows set shallower than seed.	
Triallate + Trifluralin (Buckle)	<b>DURUM &amp; BARLEY:</b> 1 to 1.25 + 0.3 to 0.4 (10 to 12.5 lb G)  <b>Spring: For Durum</b> (10 lb G)	Wild oats and foxtails	Fall: Apply within 3 weeks of freeze up.  Spring: For Barley Prior to or after planting.  Spring: For Durum preplant incorporation only	<b>Do not apply to HRSW.</b> 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.	A5, G2

## 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  <b>NOT FOR WINTER WHEAT</b>	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-tine or diamond harrows to depth of 1 to 1.5 inches and above crop seed.	A5, G2
Trifluralin  <b>NOT FOR WINTER WHEAT</b>	0.5 (1 pt 4E, 5 lb 10G)	Foxtail	SPRING: Preplant incorporated.	Incorporate twice 2 to 3 inches deep. <b>FOR BARLEY ONLY.</b>	A1, A2, A4, C4, D4, G13
	0.4 (4 lb 10G)			Incorporate twice 2 to 3 inches deep. For foxtail suppression only. <b>FOR DURUM WHEAT ONLY.</b>	
	0.5 to 0.75 (1 to 1.5 pt, 10 to 15 oz 80DC)		SPRING: After planting.	Plant 2 to 2.5 inches deep. Incorporate shallowly twice with flex-tine 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, 10 to 15 oz 80DC)		FALL: After September 1 until freeze-up.	Incorporate once in fall within 24 hours after application. Keep spring incorporation depth shallower than fall. Stand reduction may occur.	
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.	F6, G15, G16, G17
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.	F6, G15, G16, G17
Picloram (Tordon 22K) + 2,4-D or MCPA  <b>NOT FOR DURUM WHEAT</b>	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: 3- through 5-leaf stage.	Use only on land to be planted the following year to grass, small grains, or flax. Picloram is a restricted use herbicide.	D6, F5, G15, G16, G17
Dicamba (Banvel, Banvel SGF) + 2,4-D amine	0.06 + 0.25 (0.12 pt Banvel or 0.25 pt SGF + 0.5 pt of 4 lb/gal conc.)		Winter Wheat: In spring before early boot stage.		
			HRSW & Durum: 4-leaf stage only.		
Dicamba (Banvel, Banvel SGF) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt Banvel or 0.25 to 0.5 pt SGF + 0.5 to 0.75 pt of 4 lb/gal MCPA)		HRSW & Durum: 2- through 4-leaf stage.	Use low dicamba rate and high MCPA rate on 4-leaf HRSW or durum. Barley is relatively susceptible to injury from dicamba.	F4, G15, G16, G17
			Winter Wheat: In spring after dormancy but before jointing.		



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

Herbicide	Act. Incred. 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	Emergence until prior to boot.  Winter wheat: 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.	F2, F10, G15, G16, G17
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.)		5-leaf until prior to boot.  Winter wheat: Well tillered until prior to boot.	Do not apply from early boot to dough stage. Do not apply in fall.	
Clopyralid + 2,4-D (Curtall)	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.	D13, F3, T3
Clopyralid + MCPA (Curtall M)	0.09 to 0.12 + 0.51 to 0.68 (1.75 to 2.33 pt)		Crop: 3-leaf stage through jointing.		
Metsulfuron (Ally) + 2,4-D (or other broadleaf herbicide)	1/267 + 0.25 (0.1 oz + 0.5 pt of 4 lb/gal conc.)	Most broadleaf weeds including wild buckwheat.	Crop: Not prior to the 2-leaf stage.  DURUM: Not prior to 4-leaf stage. Also, follow crop stage restrictions on label of tank-mix herbicide.	Apply with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron or chlorsulfuron treatment. See sections on herbicide resistant and rotation restrictions. Apply with a non-ionic surfactant except when adding phenoxy type herbicide at 0.75 pt/A. Do not apply to soils above pH 7.9.	D9, F8, F9
Thifensulfuron + Tribenuron (Harmony Extra) + 2,4-D (or other broadleaf herbicide)	1/111 to 1/53 + 1/200 to 1/111 (0.3 to 0.6 oz) + 0.25 to 0.38 (0.5 to 0.75 pt of 4 lb/gal conc.)		Crop: 2-leaf stage to before jointing BUT ALSO follow crop stage restrictions on the label of tank-mix herbicide.	Apply with another broadleaf herbicide. The addition of 2,4-D enhances weed control and crop safety. Apply with a nonionic surfactant except when adding phenoxy type herbicide at 0.75 pt/A. Do not tank-mix with diclofop. See section on weed herbicide resistance. No rotational restrictions for the following year.	F8, F9
Tribenuron (Express) + 2,4-D (or other broadleaf herbicide)	1/128 to 1/64 (1/6 to 1/3 oz) + 0.25 to 0.38 (0.5 to 0.75 pt of 4 lb/gal conc.)	Most broadleaf weeds. Weak on wild buckwheat	Crop: 2-leaf stage until prior to flag leaf emergence BUT ALSO follow crop stage restrictions on label of tank-mix herbicide.		
Propanil + MCPA (Stampede CM) NOT FOR WINTER WHEAT	0.94 + 0.25 (2.5 pt)	Foxtails and some annual broadleaf weeds.	Crop: 2- through 4-leaf.  Weeds: 2 to 4 leaves.	Treatment of foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased risk of crop injury.	G12

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

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Barban (Carbyne)	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 size increases.	G3
	0.5 (2 pt)		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.  Crop: Up to 4-leaf stage.  Winter wheat: Before jointing.	Use higher rate for dry conditions or grass weeds with 3 to 4 leaves. Oil adjuvant enhances weed control under dry conditions. Only mix with brom- oxynil or bromoxynil plus 1.5 fl oz/A of MCPA ester. Restricted use herbicide.	G5, G9
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 increases risk of crop injury. Do not add oil adjuvant to this mixture when applying to barley. Diclofop and bromoxynil are restricted use herbicides.	F6, F10, G5, G8, G9
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		
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	Crop: Prior to flag leaf emergence.  Wild oats: 3- to 5-leaf stage.	Use high rate on 3-leaf wild oats. Refer to narrative for herbicide tank-mix options and registered wheat varieties. Injury may occur when crop is under environmental stress. Cleared on all barley varieties.	F2, G4
Imazamethabenz (Assert)	0.31 to 0.38 (1.0 to 1.2 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 restric-tions. Do not tank-mix with propanil plus MCPA, dicamba, picloram, or amine formulations of 2,4-D or MCPA.	G7
Fenoxaprop + MCPA (Dakota TP)	0.037 to 0.047 + 0.38 to 0.5 (0.38 to 0.5 pt of Green Fox and 0.75 to 1 pt of MCPA)	Green foxtail, foxtail millets and several broadleaf weeds	Crop: 3-leaf to end of tillering  Grass: 2-leaf to 2-tiller  Broadleaf weeds: Up to 4 inches	Do not apply to wheat after jointing begins. Contents of each container must be tank-mixed in the proper ratio to insure crop safety and weed control. Refer to narrative for tank-mix information. Restricted use herbicide	G10
<b>Hard Red Spring Wheat Only</b>					
Fenoxaprop + 2,4-D + MCPA (Tiller)	0.056 to 0.094 + 0.073 to 0.12 + 0.22 to 0.37 (1 to 1.7 pt)	Foxtails, millet, wild oats, barnyardgrass and several broadleaf weeds	Crop: 3- to 4-leaf stage to end of tillering  Grass: 2-leaf to 2-tiller  Broadleaf weeds: Up to 4 inches	Do not apply to spring or winter wheat after jointing begins. Tank-mixing with some broadleaf herbicides will reduce yellow foxtail and wild oat control. Refer to narrative for additional rates with specific weeds. Do not apply to durum, barley or oats.	G6, G11
<b>Hard Red Spring Wheat Only</b>					

## 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.	S2, S3
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.	F2, F10, G15, G16
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.	F2, F10, G15, G16
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.	F6, G15, G16, G17
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.	D6, F5, G15, G16, G17
Dicamba (Banvel, Banvel SGF) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt Banvel, or 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.	F4, G15, G16, G17
Clpyralid + 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.	D13, F3, T4
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.	Treatment of foxtail larger than 3 leaves or oats larger than 4 leaves may result in reduced weed control or increased risk of crop injury.	G12



## 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.	F2, F10, G15, G16, G17
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.	F6, G15, G16, G17
Bromoxynil + MCPA ester (Bronate)	0.19 to 0.38 + 0.19 to 0.38 (0.75 to 1.5 pt)				

## 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. <b>CAUTION: Drift to broadleaf crops is hazardous at this time.</b>	T3
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. <b>CAUTION: Drift to broadleaf crops is hazardous at this time.</b> Special North Dakota label.	T3

## FLAX

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
EPTC (Eptam)	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.	A2, C2, H2
Trifluralin	0.5 to 1.0 (1 to 2 pt 4E, 5 to 10 lb 10G or 10 to 20 oz 80DC)		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.	A1, A2, D4, F10, H1, H3
Propachlor (Ramrod)	4 (4 qt)	Grass and certain broadleaf weeds	Preemergence	Weak on wild mustard and wild oats.	H4
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 ester for broad spectrum weed control.	H7
Bromoxynil (Buctril)	0.25 (1 pt)	Wild buckwheat, and certain broadleaf weeds	Flax: 2 to 8 inches tall.	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible. Restricted use herbicide.	H6
MCPA	0.25 (0.5 pt of a 4 lb/gal conc.)	Broadleaf weeds	Flax: 2 to 6 inches tall.	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, or flax. Picloram is a restricted use herbicide.	D6, H5
Sodium chlorate (Leafex-3, Defol)	6 (2 gal of 3 lb/gal conc.)	Desiccant	7 to 10 days prior to harvest. 70 to 80% of the bolls should be brown.	Thorough spray coverage of vegetation is essential. Do not graze or feed treated straw. Apply in 5 to 10 gpa by air or 20 to 30 gpa by ground.	

## CORN

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 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.	S2
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.	S1
Atrazine + Butylate & Safener (Sutan+)	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.	A1, A2, D3, J2, J4
EPTC & Safener (Eradicane)	4 to 6 (4.75 to 7 pt, 16 to 24 lb 25G)	Grass and some broadleaf weeds.		Safener protects corn from injury. Immediate incorporation is required for best results. Use high rate for wild- proso millet control. Weak on wild mustard.	A1, A2, J10
EPTC & Safener + Cyanazine (Eradicane + 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.	A1, A2, J8, J10
Alachlor	2 to 4 (2 to 4 qt 4EC, 13 to 26 lb 15G, 2 to 4 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.	A1, J7
Metolachlor (Dual, Dual 25G)	1.5 to 3 (1.5 to 3 pt 8E, 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.	D3, J4
Cyanazine (Bladex)	1.2 to 4.75 (1.3 to 5.3 lb 90DF, 1.2 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.	J8



## CORN

Herbicide	Act.Ingred.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+ 0.4 to 1.8 lb 90DF, 0.4 to 1.6 qt 4L)	Broadleaf and some grass control.	Preplant incorporated or preemergence.	Atrazine rates used reduce 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.	D3, J4, J8
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.	J5, J8
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 (1.1 lb 90DF, 1 qt 4F + 2 qt 4E)				
Atrazine + Metolachlor (Dual)	1 to 2.4 + 1.5 to 2 (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.	D3, J4, J5
Atrazine + Pendimethalin (Prowl)	1 to 2 + 1 to 1.5 (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.	D3, J4, J11
Atrazine + Propachlor (Ramrod)	1 + 3 (1.1 lb 90DF, 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.	D3, J4, J6
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.	J5, J9
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.	J11
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.	J6
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.	J8, J11
Dicamba (Banvel) + Atrazine	0.25 to 0.5 + 0.50 to 2.0 (0.5 to 1 pt + 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.	D3, J4, J9, J12

## CORN

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Atrazine + oil additive	1 to 2 (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.	D3, J12
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.	J8
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 weeds: 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.	D3, J12, J13
Dicamba (Banvel)	0.25 to 0.5 (0.5 to 1.0 pt 4S)	Broadleaf weeds including wild 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.	J15
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.	J14
Bromoxynil (Buctril)	0.25 to 0.37 (1 to 1.5 pt)	Wild buckwheat, vol. sunflower and most annual broadleaf weeds.	Corn: Emergence to prior 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.	J16
Bromoxynil (Buctril) + atrazine	0.19 to 0.38 + 0.5 to 1 (0.75 to 1.5 pt + 0.55 to 1.1 lb 90 DF, 0.5 to 1 qt 4L)	Broadleaf weeds	Corn: Emergence to 12 inches tall	Atrazine soil residual may injure subsequent crops. Commercial mixture (Buctril + Atrazine) available. Bromoxynil and atrazine are restricted use herbicides.	D3, J12, J16
Bentazon	0.75 to 1.0 (1.5 to 2.0 pt 4S)	Wild mustard, cocklebur, Canada thistle, wild and vol. sunflower.	Postemergence, Mustard: 4 to 6-leaf Thistle: 6 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.	J17
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.	D3, J17

## 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.	D13
Nicosulfuron (Accent)	1/32 (0.67 oz)	Emerged grasses including wild- proso millet and quackgrass plus pigweed and smartweed	Corn: 2-leaf to 36 inches.  Drop nozzles must be used from 24 to 36 inches	Apply with crop oil concentrate. Do not apply to corn previously treated with Counter insecticide. See narrative for information on rotational restrictions and registered tank-mix options.	J18
Primisulfuron (Beacon)	1/28 (0.76 oz)	Emerged broadleaf weeds and quackgrass	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.	J19
Sethoxydim (Poast)	0.19 (1 pt)	Emerged annual and perennial grasses	Corn: At least 30 inches tall.	Apply only as postemergence directed spray. Spray must contact not more than the lowest 10 inches of stalk. Refer to label for additional information on equipment setup, nozzle selection and orientation, and application information.	J20
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 only 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.	J20
Paraquat (Gramoxone Extra)	0.25 (12.8 fl oz)			Apply only 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.	J20



## SOYBEANS

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 activity. Apply with a nonionic surfactant at 0.5% v/v.	S2
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.	S1
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt 4EC, 1.2 to 3.6 pt 3.3EC)	Some grass and broadleaf weeds	Preplant incorporated only.	Preplant incorporation provides more consistent results. Weak on wild mustard. Pendimethalin and ethafluralin provide poor wild mustard control and trifluralin provides no wild mustard control.	A1, A2, K6
Ethafluralin (Sonalan)	0.5 to 1.3 (1.3 to 3.5 pt)				A1, A2, 86
Trifluralin	0.5 to 1 (1 to 2 pt 4E 5 to 10 lb 10G 10 to 20 oz 80DC)		Preplant incorporated fall or spring.		A1, A2, C4, D4, K7
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).	K10
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, ethafluralin, and pendimethalin. May be used on soils with pH 7.5 or lower.	D7, K4, K5, K6, K7
	0.19 + appropriate rate for soil type.				
Alachlor	2 to 3.5 (2 to 3.5 qt 4EC, 13 to 23 lb 15G, 2 to 3.5 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 (prepackaged mix available as Freedom or Cannon).	A1, K3, K8, K19
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.		Use 0.25 lb/A of metribuzin on coarse textured soils and for incorporation. Not recommended on soil with pH higher than 7.5. Alachlor is a restricted use herbicide.	A1, D7, K8, K9
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.	

## SOYBEANS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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 trifoliolate 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.	K11, K19
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 to 8 in. 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.	K12
Bentazon (Basagran) + Acifluorfen (Blazer)	0.75 + 0.25 (1.5 pt + 1 pt)	Broadleaf weeds	Postemergence, Crop: 1 to 2 trifoliolate 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.	K11 K12
Thifensulfuron (Pinnacle)	1/256 (0.25 oz)	Wild mustard, pigweed and suppression of other BL weeds.	Postemergence, Soybeans: After 1st trifoliolate 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.	K14
Thifensulfuron (Pinnacle) + Bentazon	1/512 to 1/256 + 0.5 to 0.75 (0.13 to 0.25 oz + 1 to 1.5 pt)	Broadleaf weeds	Postemergence, Soybeans: After first trifoliolate has expanded. Weeds: Up to 4 in.	Apply with nonionic surfactant or crop oil concentrate (COC) under dry conditions. COC may increase risk of crop injury. 28% nitrogen or ammonium sulfate may be used.	K12 K14
Lactofen (Cobra)	0.20 (12.5 fl oz)	Wild mustard, pigweed, eastern black nightshade, lanceleaf sage and other broadleaf weeds.	Postemergence, Soybeans: 1 to 2 trifoliolate leaf stage. Weeds: 2 to 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.	K13 K19
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 inches	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.	K16
Fenoxaprop (Option II)	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.		K15
Quizalofop-P (Assure II)	0.06 to 0.12 (0.63 to 1.25 pt)	Annual and perennial grasses	Crop: Up to pod set Grasses: 2 to 6 in.		K18
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		K17
Paraquat (Gramoxone Extra)	0.25 (12.8 fl oz)	Desiccant	Prior to harvest		Apply when at least 65% of the seeds 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 a 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.	

## DRY EDIBLE BEANS

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 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.	S2
EPTC (Eptam)	3 (3.4 pt)	Grass and some broadleaf weeds	Preplant incorporated	Weak on wild mustard. Incorporate immediately after application. Often applied as a tank-mix with trifluralin, ethalfluralin, pendimethalin, chloramben, alachlor, or metolachlor.	A1, A2, A3, C1 C2, K19, L3
	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 10 to 20 oz 80 DC)	Grass and some broadleaf weeds	Preplant incorporated in fall or spring.	No wild mustard control. Incorporate within 24 hours after application. May be applied as a tank-mixture with alachlor (prepackaged mix available as Cannon).	A1, A2, A3, C4, D1, D4
Ethalfluralin (Sonalan)	0.55 to 1.7 (1.5 to 4.5 pt EC)		Spring: 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.	A1, A2, D4, K4, L4
	0.55 to 1.7 (5.5 to 17.0 lb 10G)		Fall or Spring: Preplant incorporated 2 to 3 inches deep.		
Pendimethalin (Prowl)	0.5 to 1.5 (1 to 3 pt 4EC, 1.2 to 3.6 pt 3.3EC)		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.	A1, L2
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.	A1, K19, L2
Metolachlor (Dual)	2 to 3 (2 to 3 pt)		Preplant incorporated or preemergence		
Bentazon	0.75 to 1 (0.75 to 1 qt 4S)	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.	K12 L2
Sethoxydim (Poast)	0.1 to 0.3 (0.5 to 1.5 pt)	Annual and perennial grasses	Crop: 30 days or more prior to harvest Grass: 2 to 4 inches Vol. Corn: 6 to 18 inches	Apply with oil additive at 1 qt/A. Apply to actively growing grasses. See narrative for rates for different weeds.	K17 L2
Paraquat (Gramoxone Extra)	0.31 to 0.47 (1 to 1.5 pt)	Desiccant	7 days or more 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.		

## 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 residual herbicide may be tank-mixed with paraquat. Restricted use herbicide.	S2
EPTC (Eptam)	2 to 3 (2.3 to 3.4 pt)	Grass and some broadleaf weeds	Preplant incorporated.	Weak on wild mustard.	A1, A2, A3, B2 C2, N2
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15.		
Ethalfluralin (Sonalan)	0.55 to 1.15 (1.5 to 3 pt EC)	Grass and some broadleaf weeds	Spring: Preplant incorporated.	Use lower rate of ethalfluralin on coarse textures soils.	A1, A2, A3, D4, N2
	0.55 to 1.7 (5.5 to 17.0 10G)		Fall or Spring: Preplant incorporate		
Ethalfluralin (Sonalan) + EPTC (Eptam)	0.5 to 1.13 + 2.2 to 3 (1.25 to 3 + 2.5 to 3.5 pt)		Preplant incorporated		
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt 4EC, 1.2 to 3.6 pt 3.3EC)	Grass and some broadleaf weeds	Preplant incorporated.	Use higher rate on fine-textured soils.	D5, N2
	1.25 to 1.5 (2.5 to 3 pt 4EC, 3 to 3.6 pt 3.3EC)		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 4EC, 1.2 to 4.24 pt 3.3EC)		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 10 to 20 oz 80 DC)	Grass and some broadleaf weeds	Preplant incorporated.	No wild mustard control.	A1, A2, A3, D4, N2
	0.5 to 1 (5 to 10 lb 10G)		Preplant incorp- orated, fall after Sept. 1 or spring.		
Trifluralin + EPTC (Eptam)	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.	A1, A2, A3, B2, D1, D2, D4, N2



## 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.	K17
Imazamethabenz (Assert)	0.19 to 0.25 (0.6 to 0.8 pt)	Wild mustard	Crop: up to 15 in. Wild oats: 1- to 4- leaf Wild mustard: prior to bloom.	Injury may occur when applied at high temperatures. See narrative for rotational restrictions.	N4
	0.31 to 0.38 (1.0 to 1.2 pt)	Wild oats			
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. A 7 day interval must elapse between application and harvest. Restricted use herbicide.	
Sodium chlorate (Leafex-3, Defol)	4.5 to 6 (1.5 to 2 gal of 3 lb/gal conc.)				

## SAFFLOWER

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
EPTC (Eptam)	3 (3.4 pt)	Grass and some broadleaf weeds.	Preplant incorporated.	See incorporation discussion in narrative for details. Weak on wild mustard.	A1, A2, A3, B2, D1, D2
Trifluralin	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G, 10 to 20 oz 80 DC)		Preplant incorporated, 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)	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.	G3
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.	

## RAPESEED, CANOLA AND TAME MUSTARD

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Trifluralin	0.5 to 0.75 (1 to 1.5 pt 4E 10 to 15 oz 80 DC)	Grass and broadleaf weeds	Preplant incorporated.	Use lower rate on coarse textured, low organic matter soils.	A1,A2, A3,D1, D2,D4
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 after crop emergence	Do not apply to rapeseed. Wild oats usually develop to the 2-leaf stage 9 days after emergence.	G3

## 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 ae/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.	S2
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.	A1, A5, C11, G2, M2
Metribuzin (Sencor)	0.25 to 0.38 (0.33 to 0.5 lb DF)	Suppression of lambsquarters, henbit, chick- weed and several mustard spp.	Preemergence	Rate should be adjusted for soil type. Refer to narrative for application and environment information, and special precautions which may affect weed control and crop safety.	M3
	Postemergence				
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.	K17



## 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.	S2
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.	S1
EPTC (Eptam)	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.	A1, A2, A3, B1, B2, C1, C2, P3
	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) + 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.	A1, A2, A3, B1, B2, C1, C2, P3, P4
	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.	A1, A2, A3, P3
	4 (5.3 pt 6E)		Fall incorporated after October 15 until freeze-up.		
Ethofumesate (Nortron)	1.9 to 3.75 (10 to 20 pt E)	Many 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.	A1, A2, A3, D8, P5
Diethatyl (Antor)	4 to 6 (8 to 12 pt)	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.	P6
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.	B3, P2
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.	D13, P11

## SUGARBEETS

Herbicide	Act. Ingređ. 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% with small sugarbeets if aerial or high pressure (>100 psi) application is used or if the field was treated with a soil-applied herbicide.	P9
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 4 to 6 leaves. Do not apply later than 40 days after emergence.	Endothall may cause excessive injury over 80 F especially to 4 leaf or smaller sugarbeets. Endothall is ineffective at temperatures below 60 F or when weeds are drought stressed.	P7
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.	P5, P9
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.	K17, P8
Trifluralin	0.75 (1.5 pt 4E 15 oz 80 DC)	Late emerging annual 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.	A1, A2, A3 C4, D4, P10



## 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 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.	S2
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.	S1
EPTC (Eptam)	3 to 6 (3.4 to 6.75 pt)	Grass and some broadleaf weeds	Preplant, dragoff, or directed spray at layby.	Weak on wild mustard.	A1, A2, A3, B1, B2, C2
	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.	A1
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, Grasses: Up to 2 inches tall  Broadleaf weeds: Up to 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.	B3
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.	D1, D2, D7
	0.25 to 0.5 (0.5 to 1 pt, 0.33 to 0.67 lbDF)		Postemergence, Weeds: Before 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 4EC, 1.2 to 3.6 pt 3.3EC)	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), metribuzin (Sencor, Lexone) or linuron (Lorox).	A2, D4
Trifluralin	0.5 to 1 (1 to 2 pt 4E 10 to 20 oz 80DC)		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.	K17

## POTATO VINE KILLING

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Endothall (Des-l-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	More than 5 days prior to harvest.	Extremely corrosive. Restricted use herbicide. Do not harvest within 5 days of application.		

## LEGUME FORAGES

### Alfalfa or Trefoil Establishment, No Companion Crop

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 ae/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.	S2
Paraquat (Gramoxone Extra)	0.63 to 0.94 (2 to 3 pt)	Emerged grass and broadleaf weeds.	Preplant or prior to crop emergence.		S1
EPTC (Eptam)	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.	A1, A2, A3
Benfen (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.	A1,A2 A3,D1 D2,D4 Q2
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 trifoliate 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.	Q1
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Sethoxydim (Poast) For Alfalfa or Sainfoin	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.	K12, Q3
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.	Q4

## 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 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.	S2
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.	F10, Q1
Bromoxynil (Buctril)  For Alfalfa Only	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.	Q4

## LEGUME FORAGES

### Established Alfalfa

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Paraquat (Gramoxone Extra)	0.47 to 0.62 (1.5 to 2 pt)	Winter grasses and annual broadleaf weeds and early germinating spring annuals	Alfalfa stands at least 1 year old.	Apply to well established stands (at least 1 year old) after dormancy, but before spring regrowth reaches 1 inch. Apply 60 days prior to harvest.	
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.	Q5
Terbacil (Sinbar)	0.4 to 1.2 (0.5 to 1.5 lb)		Fall or spring when alfalfa is dormant.		
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).	
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.	Q1
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.	K17 Q3



## FORAGE SORGHUM

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
Atrazine	1.66 to 2.38 (3.25 to 4.75 pt 4L, 2 to 3 lb 80W, 1.8 to 2.7 90DF)	Annual broadleaf and grass weeds.	Early preplant	Surface application up to 45 days before planting in no-till or minimum till. Refer to label.	R1
			Shallow preplant incorporated	Most consistent control method. Apply within 2 weeks before planting and incorporate during final seedbed preparation into top 2 inches of soil.	
			Preemergence	Less consistent than preplant. Requires rainfall within one week after application for adequate weed control. Harrow or rotary hoe if weeds emerge before rainfall.	
	2 to 3 (4 to 6 pt 4L, 2.5 to 3.75 lb 80W, 2.25 to 3.33 90 DF)		Early postemergence without oil. Crop: Up to 12 inches tall. Weeds: Less than 1.5 inches tall.	Slightly better crop tolerance but less weed control than other methods listed unless rainfall occurs. Postemergence application using lower rate of 1.25 lb/A with oil is preferred.	
1.25 (2.5 pt 4L, 1.5 lb 80W, 1.33 lb 90 DF)	Early postemergence with oil. Crop: After 3-leaf stage Broadleaf weeds: Less than 4 inches	Intended for annual broadleaf weeds only; rate is too low for grasses. Fair crop tolerance. Stands can be reduced. Do not use on sandy soil. Use 1 gal/A crop oil or 1 qt/A crop oil concentrate. Do not use liquid fertilizer carrier.			
Metolachlor (Dual)	1.5 to 2.5 (1.5 to 2.5 pt)	Annual grass weeds and partial control of broadleaf weeds	Early preplant, shallow preplant incorporated, or preemergence.	Sorghum must be treated with Concep safener by seed company. Incorporation improves control when rainfall is limited but gives less control than preemergence application with adequate rainfall. Use harrow or rotary hoe if weeds emerge before rainfall is received.	R2
Metolachlor (Dual) + atrazine	1.5 to 2 + 1 to 1.5 (1.5 to 2 pt + 2 to 3 pt 4L, 1.1 to 1.7 lb 90DF)	Annual grass and broadleaf weeds	Early preplant, shallow preplant incorporated, or preemergence.	All precautions with metolachlor and atrazine applied alone are in effect here. Sorghum seed must be treated with Concep safener by the seed company. Good control of many annual grass and broadleaf weeds. Limited control of large seeded annual broadleaf weeds such as sunflower.	R3
Metolachlor (Dual) + atrazine (Bicep)	1.5 to 2 + 1 to 1.5 (1.8 to 2.4 qt)				
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Annual broadleaf weeds	Anytime prior to crop emergence and postemergence when sorghum is at the 3-leaf to boot stage.	Most effective on small weeds. Does not cause lodging. Some leaf burn may occur under warm, humid conditions. Thorough coverage is essential. Restricted use herbicide.	R4



## FORAGE SORGHUM

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Bromoxynil (Buctril) + atrazine	0.25 to 0.38 + 0.5 to 1.2 (1 to 1.5 pt + 1 to 2.4 pt 4L, 0.6 to 1.3 90DF)	Annual broadleaf weeds and grass weeds.	Anytime prior to crop emergence and postemergence when sorghum is at the 3-leaf to boot stage.	Can tank-mix or use commercial product. Atrazine improves control of some broadleaf weeds. Refer to label for rate based on weed size. Follow crop rotation restrictions as for atrazine alone. Do not add crop oil concentrate. Restricted use herbicide.	R5
Bromoxynil (Buctril) + atrazine (Buctril/Atrazine)	0.25 to 0.38 + 0.5 to 1.2 (1.5 to 3 pt)				
2,4-D	0.25 to 0.5 (1 pt amine or 0.5 pt ester)	Annual and perennial broadleaf weeds.	Postemergence when crop is 5 to 12 inches tall.	Tolerance is best at earlier crop stages. Early treatments may inhibit root development and cause lodging; later application may cause poor seed development. Use drop nozzles after 8 inches to minimize injury. Labels for 2,4-D vary in use information. Refer to narrative for use information.	R6

## MILLET

Herbicide	Act.Ingred.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").	

## ANNUAL CANARYGRASS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
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: At least 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.	

## ESTABLISHED GRASS AND RANGELAND

Herbicide	Act.ingred.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.	T5
Dicamba (Banvel) + MCP + 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. A prepackaged mixture of dicamba and 2,4-D is available as Weedmaster.	T5, T6
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.	T6
Picloram (Tordon)	0.06 to 0.13 (0.25 to 0.5 pt)	Annual broadleaf weeds.	Weeds: Emergence to bud stage, preferably when young and actively growing.	See narrative 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.	T4
	0.25 to 2 (1 to 8 pt)	Perennial broadleaf weeds			
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 narrative for grazing and haying restrictions .	T7
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 snow- berry 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. Apply with a nonionic surfactant.	
Clopyralid + 2,4-D (Curtail)	0.18 to 0.36 + 1 to 2 (2 to 4 qt)	Canada thistle and knapweeds	When weeds are actively growing	Apply when majority of basal leaves have emerged but before bud stage. Do not apply to new seedlings of grass. Do not cut treated grass for hay within 30 days after application.	

## 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.	S2
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. Refer to Established Grass and rangeland section for restrictions and use information.	T5
Bromoxynil (Buctril)	0.25 to 0.38 (1.0 to 1.5 pt)		Anytime after grass emerges		

## 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.	S2
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.	S1
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 inches  Wild oat: 2 to 4 inches  Vol. corn: 6 to 20 inches  Vol. cereals: before tillering - 2 to 6 inches	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, BROME GRASSES, 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.	Q3

**CRP**  
**Pure Grass Seedings**

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para-graph
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 for 5 leaf or larger seedling grass or for fully tillered stands. Metsulfuron can be applied to blue grama, bluestems, buffalograss, green sprangletop, kleingrass, lovegrass, orchardgrass, sideoats grama, switchgrass, wheatgrasses, and Russian wildrye.	
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 or 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)				
Bromoxynil + 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 + MCPA ester (Curtall M)	0.18 to 0.5 + 1 to 2.8 (1.75 to 4.75 qt)	Canada thistle, musk thistle and knapweeds	Apply to actively growing weeds after the majority of the basal leaves have emerged, but before bud stage.	Apply when perennial grasses have become established (tillering with at least 1.5 inches secondary roots, and good vigor). After CRP, do not plant broadleaf crop until after a bioassay shows no detectable clopyralid in soil.	
Clopyralid + 2,4-D (Curtall)	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. Thistles and knapweeds should be treated prior to bud stage	Use lower rate for most annual broadleaf weeds and musk thistle rosettes. Use higher rate for Canada thistle, knapweeds and bolted musk thistle.	
Picloram (Tordon)	0.06 to 2 (0.25 to 8 pt)	Annual and perennial broadleaf weeds.		Use 0.06 to 0.12 lb/A for small annual weeds. Use 0.5 lb/A for suppression of perennial weeds. Spot treatment at 1 to 2 lb/A can be used for control of deep rooted perennial weeds. Rates over 0.5 lb/A may suppress perennial grasses. Restricted use herbicide.	



**CRP**  
**Grass - Alfalfa Seedings**

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Bromoxynil (Buctril)	0.25 to 0.38 (1 to 1.5 pt)	Annual broadleaf weeds.	Grass: 2 to 3 leaves  Alfalfa: At least 4 trifoliolate leaves.	Use a minimum of 10 gpa for ground or 5 gpa for aerial application. 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.	

**CHEMICAL WEED CONTROL FOR FALLOW**  
**For Future Planting of Wheat and Durum**

Herbicide	Act.Ingred.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 and grass weeds 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.	D3, S1
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.	S5

## 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.	D3, S4
	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 SGF)	Wild buckwheat, kochia, and other broadleaf weeds.	Postemergence	Residue from fall application may damage broadleaf crops seeded the next year.	S3
Glyphosate	0.19 to 0.75 (0.5 to 2 pt of a 3 lb ae/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.	S2, S3
Paraquat (Cyclone)	0.25 to 0.5 (1 to 2 pt)			A nonselective, contact, post-emergence herbicide. No soil residual activity. Apply with a nonionic surfactant. Effective as a post harvest treatment to grain stubble after harvest. Restricted use herbicide.	S1
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.	T4
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.	D13, F3, T3
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.	T4, T4
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.	S2, S3
	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.	D1, D2, D4, S6

## SPECIAL WEED PROBLEMS

### Absinth Wormwood

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

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para- graph
2,4-D LV ester or amine	2 (4 pt of 4 lb/gal conc.)	Pastures and rangeland, non-cropland, trees, fallow, or post-harvest	Application should be made when plants are at least 12 inches tall and actively growing.	Plants are controlled slowly. Avoid spraying tree foliage. Do not graze dairy cows for 7 days after treatment. Use only the amine formulation in trees.	T5
Dicamba (Banvel)	0.5 to 1 (1 to 2 pt)	Pasture and rangeland, non-cropland, fallow or post-harvest.	Herbicides applied in late-June to mid-August have given greater residual control than fall or spring applications.	Plants are controlled slowly. Consult label for grazing restrictions. Surfactant at 0.5% v/v may improve consistency of control.	T6
Picloram (Tordon 22K)	0.125 to 0.25 (0.5 to 1 pt)	Pasture and rangeland, non-cropland.	Plants can be mowed in early to mid-summer to promote active regrowth prior to fall treatment.	Consult reference paragraph for grazing restriction. Use high rate for dense stands. Restricted use herbicide.	T4,
Clopyralid + 2,4-D (Curtail)	0.18 to 0.36 + 1 to 2 (4 to 8 qt)	Pasture and rangeland and non-cropland		When clopyralid is used in cropland do not rotate to any crop except small grains, grass, corn, or sugarbeets within 1 year of application. Do not apply to new seedings of grass. Do not cut treated grass for hay within 30 days after application. Consult label for grazing restrictions.	
Glyphosate	0.25 to 1.0 (0.66 to 2.66 pt 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.	T1, T3, S2
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.63 (3.38 pt)	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.	

# 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	Para-graph
Clopyralid + 2,4-D (Curtall)	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.	D13, F3, T4
	0.19 + 1 (4 pt)	Fallow			
	0.19 to 0.28 + 1 to 1.5 (4 to 6 pt)	CRP, pasture			
Clopyralid + MCPA (Curtall 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.	T4
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.	Should be applied as a tank-mixture with another broadleaf herbicide. Provides suppression during the year of application. Do not apply Ally within 22 months of last metsulfuron application or to soils with pH above 7.9. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See narrative about resistant weeds and rotational restrictions.	D1, D9, E1, F7, T3
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.	At application, MUST follow crop stage restriction on the label of tank-mix herbicide.	E1
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 (6 pt 4L, 3.75 lb 80W)	Corn	Preemergence or postemergence.	Maximum rate is 3 lb/A to corn up to 12 inches tall. Refer to narrative for restrictions and application information. Restricted use herbicide.	D3, J4
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.	K12
Glyphosate	1.5 to 2.25 (4 to 6 pt 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.	T1, T3
		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.	T1, T4, S3
	Trees		Avoid spraying tree foliage. A nonselective herbicide.	T1, S2	



## 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.	J15
	0.25 (0.5 pt Banvel)		Corn: Up to 36 in. tall or 15 days prior to tasseling.		
	1 to 2 (2 to 4 pt Banvel or 4 to 8 pt 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.	T6
	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. Refer to narrative for additional information.	T1, T6
2,4-D ester or amine	1 to 2 (2 to 4 pt 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.	T1, T5
		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 + 0.63 (3.38 pt)	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.	T1
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.	D13, F3, P11, T3
	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. Refer to narrative for additional information. Restricted use herbicide.	T1, T4
	1 (4 pt)	Patches of plants in pastures.	When thistles are actively growing.	Consult reference for grazing restrictions. Restricted use herbicide.	

## CATTAILS

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weed Location	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.	S2
Glyphosate	2.25 (6 pt of a 3 lb ae/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.	

## FALSE CHAMOMILE

Herbicide	Act.Ingred.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.	G18
Metsulfuron (Ally + a broadleaf herbicide)	1/267 (1/10 oz) + appropriate rate	Wheat and barley	<b>HRSW &amp; Barley:</b> 2- leaf stage until prior to boot.  <b>Durum:</b> 4-leaf until prior to boot.	Should be applied with another broadleaf herbicide. Do not apply within 22 months of last metsulfuron treatment. See narrative for information on resistant weeds and rotational restrictions. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. Do not apply to soils above pH 7.9	D9, E1, F7
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. Apply with a nonionic surfactant at 0.12 to 0.25% v/v. See narrative for information on resistant weeds.	E1, F8
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.	G18 T4,
Paraquat (Gramoxone Extra, Cyclone)	0.47 (1.5 pt)	Tree rows or potholes	Chamomile less than 6 inches tall.	Apply with a surfactant at 0.12 to 0.25% v/v. Avoid contact with non-target plants. Restricted use herbicide.	
Glyphosate	0.75 (2 pt of a 3 lb ae gal/conc.)			A nonselective, translocated herbicide. Avoid contact with non-target plants.	
Amitrole (Amitrole-T)	1.5 (6 pt)			Avoid contact with non-target plants. Restricted use herbicide.	

## 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 LV. 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.	T1, T2
2,4-D LV ester	1 to 2 (2 to 4 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 (2 to 4 pt Banvel or 4 to 8 pt 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. A prepackaged mixture of dicamba and 2,4-D is available as Weedmaster.	T1, T6, S3
Glyphosate + Dicamba (Banvel, Banvel SGF)	1.5 + 0.5 (4 pt + 1 pt Banvel or 2 pt SGF)			Less potential for soil residual than higher rates of dicamba. A prepackaged mixture is available as Fallowmaster	
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.63 (3.38 pt)	Preplant, fallow or post-harvest	Vines 6 to 18 inches	For suppression of field bindweed in patches or individual plants. Allow at least 7 days after application before tillage is performed. Control may be reduced during dry conditions. Ammonium sulfate will improve control of weeds under stress.	
Glyphosate	3 to 3.75 (8 to 10 pt of a 3 lb ae/gal conc.)	Patches in wheat, barley, oats, soybeans 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.	T1, T2, T3
Picloram (Tordon 22K) + 2,4-D	0.5 to 1 (2 to 4 pt) + 0.5 to 1 (1 to 2 pt)	Patches or individual plants in pastures, fallow or non-cropland	Bindweed actively growing.	Often applied with 2,4-D to provide most cost-effective control. Consult reference for grazing restrictions. Restricted use herbicide.	T1, T4
Dicamba (Banvel)	2 to 8 (1 to 16 pt)			Apply to foliage and/or soil. Consult label for grazing restrictions. Use low rate only in fall. Use higher rate in dense or old stands.	T1, T4



## 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 LV ester	1 to 2 (2 to 4 pt 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.	T1, T5
Dicamba (Banvel, Banvel SGF)	1 to 2 (2 to 4 pt Banvel or 4 to 8 pt 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.	T1, T6
2,4-D LV ester	1 to 2 (2 to 4 pt 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.	T1, T4
Picloram (Tordon 22K) + 2,4-D ester or amine	0.25 to 0.5 + 1 (1 to 2 pt + 2 pt 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.	Q4, T4
Dicamba (Banvel)	2 (4 pt)				
Dicamba (Banvel)	4 to 8 (8 to 16 pt)	Patches or individual plants in pastures or noncropland.	Leafy spurge in true flower growth stage or fall regrowth.	Consult label for grazing restrictions.	T1, T4
Picloram (Tordon 22K)	1 to 2 (4 to 8 pt S)			Consult narrative for grazing restrictions. Restricted use herbicide.	T1, T4
Glyphosate	0.75 (2 pt 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.	T1, T2, T3
2,4-D amine	1 to 2 (2 to 4 pt of a 4 lb/gal conc.)				
Dichlobenil (Norosac 10G)	6 to 8 (60 to 80 lb 10G)				
Fosamine (Krenite)	6 to 8 (12 to 16 pt)	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 (2 pt of a 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 subsequent years.	T1, T5



## LEAFY SPURGE

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

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para- graph
2,4-D amine	1 to 2 (2 to 4 pt of a 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.	T1, T5
Glyphosate + 2,4-D (Landmaster BW)	0.38 + 0.63 (3.38 pt)	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.	

## COMMON MILKWEED

Herbicide	Act.Ingred.lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Para- graph
Glyphosate	2.25 (6 pt 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.	T1, T2
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.	D5, T1
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.	D5, T1, S3
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.	T4
Picloram (Tordon 22K)	1 to 2 (4 to 8 pt)	Patches or individual plants in pastures.		Restricted use herbicide.	

## QUACKGRASS

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Para- graph
Atrazine	3 (6 pt 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.	D3, J4
Nicosulfuron (Accent)	1/32 (0.67 oz)	Corn: 2-leaf stage to 36 inches tall  Drop nozzles must be used from 24 to 36 inches	Postemergence	Apply with crop oil concentrate. Do not apply to corn previously treated with Counter insecticide. Do not apply as a broadcast application to corn over 24 inches tall. See narrative for information on rotational restrictions and registered tank-mix options.	J18
Primisulfuron (Beacon)	1/28 (0.76 oz)	Corn: 4 to 20 inches tall	Postemergence	Apply with nonionic surfactant or crop oil concentrate. Do not apply to corn previously treated with Counter insecticide. See narrative for additional information.	J19
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.	K16
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.	K17
Quizalofop-P (Assure II)	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.	K18
Glyphosate	1.5 to 2.25 (4 to 6 pt 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.	T2, T3
	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 nonioic 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.	T1, S2

## RUSSIAN KNAPWEED

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Paragraph
2,4-D amine 2,4-D LV ester	0.75 (1.5 pt) 0.66 (1.33 pt)	In wheat and barley	Tiller stage of crop.	Prevents seed formation only.	T3, T5
2,4-D LV ester	1 to 2 (2 to 4 pt of a 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 (2 to 4 pt Banvel or 4 to 8 pt 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.	T6
Clopyralid + 2,4-D (Curtall)	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.	D13, F3, T3
	0.19 + 1 (4 pt)	Fallow	Weeds: Bud to bloom stage or fall.		
	0.28 to 0.38 + 1.5 to 2 (6 to 8 pt)	CRP and pasture			
Clopyralid + MCPA (Curtall 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 (4 to 12 pt)	Pasture, rangeland, and noncropland.	Spring or fall.	Consult label for grazing restrictions. Plants are controlled slowly.	T6
Picloram (Tordon 22K)	1 to 2 (4 to 8 pt)		Any time during growing season.	Consult label for grazing restrictions. Restricted use herbicide.	T4
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.	T1, T4



## SPOTTED KNAPWEED

Herbicide	Act. Ingrid. 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.	T1, T5
2,4-D L.V. ester or oil soluble amine	1 to 2 (2 to 4 pt of a 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.	T6
Dicamba (Banvel, Banvel SGF)	1 to 2 (2 to 4 pt Banvel or 4 to 8 pt SGF)			Banvel SGF is not labelled for 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.	
Clopyralid + 2,4-D (Curtall)	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.	D13, F3, T3
	0.19 + 1 (4 pt)	Fallow	Bud to bloom stage or fall.		
	0.19 to 0.28 + 1 to 1.5 (4 to 6 pt)	CRP and pasture			
Clopyralid + MCPA (Curtall 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.	T4
Cultivation		Cropland	Repeat whenever plants are 3 to 6 inches tall	Spotted knapweed is not generally a problem in cultivated land.	



## HERBICIDE USE INFORMATION

### INCORPORATION OF HERBICIDES:

**A1.** Butylate (Sutan+), cycloate (Ro-Neet), EPTC (Eptam), and triallate (Far-Go) 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 (Sonalan) incorporation may be delayed up to 48 hours. Pendimethalin (Prowl) must be used preemergence on corn but must be incorporated for soybeans. Incorporation may be delayed up to 7 days after application. Alachlor, ethofumesate (Nortron), and metolachlor (Dual) may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor, Nortron and Dual may be delayed several days.

**A2.** Butylate (Sutan+), cycloate (Ro-Neet), EPTC (Eptam), ethalfluralin (Sonalan), pendimethalin (Prowl), 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 Prowl 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 Prowl and 4 to 6 inches for the other herbicides. A harrow should follow the field cultivator. The operating speed necessary to achieve a satisfactory incorporation will vary somewhat depending on the type of field cultivator but usually will be 6 to 8 mph.

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

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

**A3.** A single incorporation with a power driven tiller is sufficient for Sutan+, Ro-Neet, Eptam, 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.

**A4.** Trifluralin 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.

**A5.** Triallate (Far-Go) will adequately control wild oats with a shallow incorporation. Two spike tooth harrowings at right angles will give sufficient incorporation if the soil is loose and free of trash.

Experiments at North Dakota State University have shown that deeper incorporation generally enhances wild oats control from Far-Go. Far-Go applied after seeding should be incorporated **less deeply** than the placement of the crop seed (**Preemergence Incorporation**). Far-Go applied before seeding should be incorporated with a field cultivator plus harrow operated 3 to 4 inches deep. Delay hard red spring wheat or durum seeding for 3 days. Far-Go applied before seeding may injure certain wheat varieties. Spring preplant incorporated Far-Go 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 Far-Go.

### THE SOIL ORGANIC MATTER TEST:

**B1.** 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, 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.

**B2.** Eptam is used on safflower, sugarbeets, sunflower, dry beans, corn, flax and potatoes. Sugarbeets have marginal tolerance to Eptam, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussion on selecting an Eptam rate only gives guidelines. Other factors such as method of incorporation affect Eptam performance (immediate and thorough incorporation gives best performance). The suggested spring-applied Eptam 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% organic matter. The minimum rate of 2 lb/A may injure sugarbeets on a sandy loam or coarse-textured soil with less than 4% organic matter. The Eptam rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes.

**B3.** 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% 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), trifluralin 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:

**C1.** Several herbicides may be applied in the fall for weed control the following spring. Included in this group are EPTC (Eptam), triallate (Far-Go), and trifluralin. Fall treatments of trifluralin should be applied after September 1 and until soil freezeup. Fall treatments of Eptam, and Far-Go should be applied after October 15 and until soil freeze-up. Application of herbicides after October 15 when soil temperature has cooled minimizes herbicide loss by volatilization, and microbial and chemical degradation. Both granular and liquid

formulations of the herbicides are registered for use in the fall. Granular formulated herbicides, fall applied, generally have given more effective weed control than the liquid formulations, especially under heavy crop residue situations.

**C2.** EPTC (Eptam) fall applied at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. Eptam must be incorporated into the soil immediately after application to prevent loss of herbicide. The liquid and granular formulations of Eptam may be applied in the fall for weed control in dry beans, flax, potatoes, sugarbeets, and sunflower.

**C3.** Triallate (Far-Go) is applied at 1 to 1.5 lb/A in the fall. See tables for specific rates of liquid and granules for each crop. Far-Go performs best when incorporated immediately after application; however, Far-Go granules may be surface applied in the fall and incorporated with normal tillage operations the following spring. Research at North Dakota State University with Far-Go fall applied indicated that, at similar rates, the granular formulation performed more effectively than the liquid formulation and fall surface applied Far-Go gave less consistent weed control than fall incorporated Far-Go.

**C4.** Trifluralin 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:**

**D1.** 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 of some herbicides by diluting the herbicide residue in a large volume of soil. Moldboard plowing is ineffective to reduce the residual effects of Tordon and Ally.

**D2.** 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 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 Prowl, trifluralin and Sonalan. Window bioassays do not provide accurate information on Glean or Ally carryover. However, DuPont provides a Laboratory Recrop Bioassay (LRB) service to customers to provide accurate information on rotation options following Glean or Ally use. Consult the local DuPont representative for additional information on the LRB service.

**D3.** 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.

**D4.** Ethafluralin (Sonalan), pendimethalin (Prowl), and trifluralin are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than 1 year. Sonalan has less soil residue than trifluralin and Prowl. Land treated with Sonalan in the spring may be planted to any crop the next year except 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.

**D5.** 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 Banvel used, excluding days when ground is frozen. Research at North Dakota State University indicated that Banvel 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. Banvel at 0.5 lb/A applied the previous fall prevented seed production by sunflower. The approximate ranking of crops from most to least is corn, barley, wheat, oats, potatoes, buckwheat, soybeans, dry edible beans, sunflowers, flax and sugarbeets.

**D6.** 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 grass, small grains 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.

**D7.** 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.

**D8.** 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. Nortron should be applied in a band to reduce cost and reduce potential crop injury from residues the following year.

**D9.** 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 Ally carryover in soil is pH. The rate of Ally breakdown decreases as soil pH increases. Ally 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 recropping interval of 22 months and 22 inches of cumulative precipitation should be observed before planting proso millet, sorghum, corn, dry edible beans, flax, safflower, or sunflower on fields west of Highway 1. A recropping interval of 34 months and 34 inches of cumulative precipitation should be observed east of Highway 1.

These crop rotation intervals must be followed unless a Laboratory Recrop Bioassay (LRB) indicates a shorter planting interval. A LRB bioassay service is available through DuPont to provide customers with accurate information on rotational options following Ally use. Consult your local DuPont representative or call toll free 1-800-782-3557 for additional information on the LRB service.

**D10.** Imazamethabenz (Assert) may have a residue the year following application to wheat, barley or sunflower. However, wheat, barley, sunflower, soybean, corn, dry edible beans, and safflower may be seeded the next cropping season following Assert application. Potatoes can be planted in the next cropping season after Assert application if 12 inches of rain plus irrigation water were received between Assert application and November 1. If moisture on the field was less than 12 inches, then potatoes should not be planted until 15 or more months after application. Other rotational crops can be seeded 15 or more months after application.

**D11.** Nicosulfuron (Accent) may have a residue the year following application to corn. Field corn can be seeded anytime after Accent application but 10 months should elapse before seeding popcorn or sweet corn. Alfalfa can be seeded 12 months or more after application; dry edible bean and soybean after 10 months; spring wheat, oats and barley after 8 months; and winter wheat and winter rye after 4 months. All other rotational crops may be seeded 18 months or more after Accent application on soils with pH 6.5 or greater and after 10 months on soils with pH less than 6.5.

**D12.** Primsulfuron (Beacon) often will have a residue the year following application to field corn. Field corn can be seeded 14 days after Beacon application but 8 months should elapse before seeding popcorn or sweet corn. Winter wheat can be seeded 3 months or more after application. Alfalfa, dry edible beans, sorghum, soybean, sunflower, spring wheat, barley, and oats can be seeded 8 months or more after application. A minimum of 18 months after application should elapse prior to seeding any other rotational crop. However, Beacon damaged sugarbeet seeded 23 months after Beacon application in a North Dakota State University experiment near Fargo on a silty clay soil with pH 8.0.

**D13.** Clopyralid (Stinger) and clopyralid plus 2,4-D or MCPA (Curtail, Curtail M) may have a herbicidally active residue 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. Cold or dry top-soil 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 influences the time the crop can be seeded 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:

**E1.** 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 herbicide resistant biotypes until they dominate the population.

The most common incidence of herbicide resistant weeds has occurred with the triazine herbicides, atrazine and simazine (Princep). More recently, several weed species have developed resistance to herbicides of the sulfonyleurea chemistry, such as, chlorsulfuron (Glean), metsulfuron (Ally), thifensulfuron (Pinnacle), tribenuron (Express, Harmony Extra), trisulfuron (Amber), nicosulfuron (Accent), and primisulfuron (Beacon). Weeds have developed resistance to other classes of herbicides. 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. 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 sulfonyleurea herbicides.

Resistant weed development can be reduced 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, Spring and Durum Wheat, Barley and Oats

### HARROWING FOR WEED CONTROL:

**F1.** Harrowing a few days after a spring sown crop has sprouted but before emergence 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. Also, 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.

## HERBICIDE USE IN SMALL GRAINS

**F2.** Weed control in small grains is important to maximize yields. Broadleaf weeds, foxtails (pigeongrass), and wild oats infest small grains statewide. Several 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 susceptible 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. Oat varieties vary in their tolerance to 2,4-D, MCPA, or bromoxynil, but wheat and barley varieties differ little in tolerance. 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.

Several brands of 2,4-D are available with some differences on application information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

**F3.** Clopyralid plus 2,4-D (Curtail) or clopyralid plus MCPA (Curtail M) 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. Apply Curtail to wheat and barley from the 4-leaf stage through jointing. Do not apply Curtail to oats. Curtail M can be used on wheat, barley and oats from 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.

**F4.** 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. Banvel 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 Banvel than wheat. Both crops must be treated during the 2nd through 4th leaf stage. Barley can be treated during the 2nd through 3rd leaf stage but barley tolerance is marginal. Banvel and Banvel SGF can be applied with 2,4-D, MCPA, Ally, or Buctril to wheat. Banvel SGF can be applied with Curtail or Curtail M.

**F5.** Picloram (Tordon) at 1/64 to 1/43 lb/A with 0.25 to 0.37 lb/A of 2,4-D or MCPA is labeled for broadleaf weed control in hard red spring wheat, barley and oats. Picloram may be applied during the 3 through 5 leaf stage of crop growth. **NOTE:** Picloram should be used only on land that will be planted the following year to grass, small grains, or flax. See herbicide residue section.

**F6.** Bromoxynil (Buctril) controls wild buckwheat, fumitory and most annual broadleaf weeds in wheat, barley and oats from crop emergence to early boot. For broader spectrum weed control Bronate (Buctril plus MCPA ester) should be applied from the 3-leaf to early boot stage. Buctril and Bronate can be tank-mixed with MCPA, Ally, Banvel, Banvel SGF, Harmony Extra, Express, Curtail, Curtail M, Avenge and Assert. Also, Buctril can be tank-mixed with 2,4-D and Hoelon.

**F7.** Metsulfuron (Ally) at 1/267 lb/A provides postemergence control of broadleaf weeds in wheat and barley, and should always be applied as a tank-mixture with another broadleaf herbicide to minimize the potential buildup of resistant weeds. Ally can be mixed with MCPA, 2,4-D, Buctril, Bronate, and Banvel SGF. Ally 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 additional details). Tank-mixing Ally with organophosphate insecticides increases crop injury potential. Do not apply Ally to soils with a pH greater than 7.9. Ally spray drift or sprayer contamination causes severe injury to 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. Ally may persist in the soil for 3 years or more. Refer to the herbicide residue section on Ally carryover and recropping restrictions.

**F8.** 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 Harmony Extra to improve Canada thistle control. Harmony Extra 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. Harmony Extra can be tank-mixed with 2,4-D, MCPA, Buctril, Bronate, Curtail, Curtail M, Banvel, Banvel SGF, Avenge or Assert. Do not tank-mix Hoelon with Harmony Extra as grass control may be reduced. Harmony Extra 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 Harmony Extra with organophosphate insecticides increases potential for crop injury. Harmony Extra 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.

**F9.** Tribenuron (Express) at 1/128 to 1/64 lb/A applied postemergence controls several broadleaf weeds in wheat and barley. Express always should be applied as a tank-mixture with another broadleaf herbicide to minimize the potential buildup of sulfonylurea resistant weeds. Express can be mixed with MCPA, 2,4-D, Buctril, Bronate, Curtail, Curtail M, Banvel, Banvel SGF, difenzoquat or Assert. Do not tank-mix Hoelon with Express as grass control may be reduced. Express 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 Express with organophosphate insecticides increases potential for crop injury. Express 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.

**F10.** Small grains underseeded to sweetclover, alfalfa or other legumes should not be treated with 2,4-D, MCPA, Buctril, Banvel, Ally, Express, Harmony Extra, Curtail, or Tordon at rates required to control most broadleaf weeds because serious injury or death of the legumes may result. However, MCPA, 2,4-D, and Buctril are registered for use on certain small grain-legume mixtures even though some injury to the legume may occur.



## WEEDS IN SMALL GRAINS

### WILD OATS:

**G1.** Wild oats are difficult to eradicate 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.

**G2.** Triallate (Far-Go) at 1 to 1.5 lb/A is applied preplant or pre-emergence incorporated (depending on formulation) for wild oats control in wheat, durum, barley, lentils or peas. See tables for specific rates. Far-Go is volatile and the liquid formulation must be incorporated immediately after application. The liquid formulation has given more consistent wild oats control with less crop thinning than the granular formulation when spring applied. See section on fall application of Far-Go. Far-Go at 1 lb/A also may be applied in combination with trifluralin 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 Far-Go and trifluralin (Buckle) is available as a fall or spring applied treatment in barley and durum.

**G3.** Barban (Carbyne) 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. Carbyne at 0.25 to 0.5 lb/A can be applied to spring and winter wheat, and barley; at 0.25 to 0.37 lb/A to durum wheat, and at 0.37 lb/A to safflower, canola, rapeseed and mustard grown for oil. Thick, vigorous stands of crop plants help suppress wild oats and enhance the control obtained with Carbyne. Crop competition is important for wild oats control; therefore, control may not be satisfactory in thin crop stands. Carbyne should be applied according to wild oat stage. Treat canola, rapeseed and mustard within 30 days after crop emergence. Carbyne should not be mixed with or applied within 4 days after 2,4-D, MCPA or Banvel because wild oats control will be reduced. Buctril mixed with Carbyne has at times reduced wild oats control.

Barban may be mixed with 1 gpa 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 Carbyne aqueous nitrogen solution must be mixed with water for application. Addition of a surfactant at 0.5% v/v may prevent compatibility problems. A compatibility test should be conducted prior to addition of a Carbyne/fertilizer mixture to the spray tank. Carbyne at 0.25 lb/A can be tank-mixed with Hoelon at 0.25 to 0.50 lb/A or Avenge at 0.25 to 0.50 lb/A for control of larger wild oats.

To reduce possible injury to wheat and barley, Carbyne 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. Carbyne 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 droughty conditions. Frost prior to Carbyne application does not increase Carbyne 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.

**G4.** Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the 3 to 5 leaf stage. Avenge is cleared for use in barley, durum wheat (except Vic, Fjord, Edmore, Lakota and Wascana), and winter wheat. Avenge 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, Katepwa, 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, Produx, 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 Avenge as wild oats, including Len, Waldron, Alex, James, and Aim, so use Avenge 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 Avenge.

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. Avenge may be mixed with Buctril, Bronate, MCPA, 2,4-D, Ally, Harmony Extra, Express, Curtail, or Curtail M for broadleaf weed control without loss of wild oats control.

**G5.** 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 for the control of 1 to 4 leaf wild oats. The higher rate of Hoelon 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 Hoelon on barley. Wild oats control with Hoelon generally is better when cool rather than warm temperatures follow application. Hoelon should not be mixed with any broadleaf herbicide other than Buctril or Buctril plus a low rate of MCPA ester (1.5 fl oz) in small grains. Research at North Dakota State University indicated that application of Hoelon and herbicides not registered for tank-mixing should be separated by 4 days or more to avoid reduction in wild oats control.

**G6.** Fenoxaprop plus 2,4-D plus MCPA (Tiller) at 1 pt/A controls green foxtail, foxtail millets, common lambsquarters and wild mustard. Tiller at the 1.2 pt/A rate controls all weeds listed above plus yellow foxtail, volunteer and wild-proso millet. Tiller at the 1.7 pt/A rate controls all weeds listed above plus wild oats, bardyardgrass and several broadleaf weeds. Tiller can be applied to winter and spring wheat when wheat begins to tiller (3-4 leaf stage) up to the 6-leaf stage. Winter wheat should have a minimum of three or more tillers before application is made. Do not apply to wheat after jointing begins. Tiller will control grasses in the 2-leaf to 2-tiller stage. Wild oats should not exceed 6 inches in height and annual broadleaf weeds should be less than 4 inches tall. Tiller should be applied to young, vigorously growing weeds. Conditions which may reduce wild oat control are low soil moisture, low humidity, and high temperature. Foxtail can be controlled over a wide range of soil moisture conditions but severe drought stress may result in reduced control.

The following herbicides can be tank-mixed with Tiller for control of all weeds listed on the label: Banvel, Banvel SGF, MCPA ester, Stinger, and Tordon. Other broadleaf herbicides listed for tank-mix applications with Tiller antagonize wild oat and yellow foxtail control. A Buctril and Tiller tank-mix will control green foxtail and foxtail millets; but not yellow foxtail and wild oats. Tiller at 1.2 pt/A can be tank-mixed with Ally, Harmony Extra, and Express for green foxtail and foxtail millet control only.

Tiller cannot be applied to durum, barley, tame oats, or rye; cannot be applied aerially, cannot be applied within 70 days of harvest; or cannot be applied with other herbicides, liquid fertilizers or surfactants except as indicated on the label. Rainfall within 1 hour after application may reduce weed control. Drift of this product may injury sensitive plants and trees.

**G7. Imazamethabenz (Assert)** at 0.31 to 0.38 lb/A provides post-emergence wild mustard and wild oats control in wheat and barley. Assert 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. Assert also gives good winter annual-mustard control and suppresses wild buckwheat that have 3 leaves or less. Assert has provided more consistent wild oats control with environmental stress than other postemergence wild oats herbicides in wheat and barley. Refer to herbicide residue section for information on rotational crop restrictions. Assert can be tank-mixed with Ally, Curtail, MCPA plus 2,4-D ester, Bronate, Harmony Extra, or Express.

#### **GREEN AND YELLOW FOXTAIL (PIGEONGRASS):**

**G8. 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.

**G9. Diclofop (Hoelon)** at 0.75 to 1.0 lb/A in wheat, soybeans or barley 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 Hoelon. (See wild oats section for information on Hoelon mixtures with other herbicides).

**G10. Fenoxaprop plus MCPA (Dakota TP)** at 0.38 to 0.5 pt of Green Fox and 0.75 to 1 pt of MCPA controls green foxtail, foxtail millets, wild mustard and other broadleaf weeds in winter and spring wheat. Each box of Dakota TP contains three 2-gallon containers. All components should be tank-mixed for adequate weed control and crop safety. Dakota TP should be applied at the rate of 30 or 40 acres per box depending on tank-mix herbicides used. At the 40 acre per box rate, Banvel at 0.063 lb/A (2 fl oz) or Banvel SGF at 0.125 lb/A (4 fl oz) can be tank-mixed with Dakota TP. At the 30 acre per box rate, Harmony Extra, Express, Ally, Buctril, Tordon, or Stinger may be tank-mixed with Dakota TP. Refer to label for the maximum rate of each herbicide that can be used.

Dakota TP should be applied to spring wheat from the 3-leaf stage to the end of tillering (up to 6-leaf stage). Do not apply to spring wheat after jointing begins. Dakota TP will control grasses in the 2-leaf to 2-tiller stage and annual broadleaf weeds up to 4 inches tall. Poor green foxtail control may occur if Dakota TP is applied to plants under drought stress.

Dakota TP cannot be applied to durum, barley, tame oats, or rye; cannot be applied aerially, cannot be applied within 70 days of harvest; cannot be applied with other herbicides, liquid fertilizers or surfactants except as indicated on the label; and is not labeled in the state of Minnesota. Rainfall within 1 hour after application may reduce weed control. Drift of Dakota TP may injury susceptible plants and trees.

**G11. Fenoxaprop + 2,4-D + MCPA (Tiller).** Refer to G6 for discussion on foxtail control from Tiller herbicide.

**G12. Propanil plus MCPA ester (Stampede CM)** at 0.94 plus 0.25 lb/A (2.5 pt 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 shortly 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.

**G13. Trifluralin** at 0.5 to 0.75 lb/A, applied after seeding and harrow incorporated shallowly after seeding, is labeled for control of foxtails in wheat and barley. The lower rate is for use on coarse textured soils and the higher rate on fine textured soils. Incorporation should be by harrowing twice at right angles and the depth of incorporation of the herbicide must be above the wheat seed. The wheat should be seeded 2 to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semi-dwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trifluralin applied in this manner does not control wild oats. (See wild oats section for discussion on trifluralin-triallate combination).

Trifluralin 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 will not interfere with incorporation. Seed wheat or barley no more than 2 inches deep into a moist seedbed. Refer to the chemical fallow section for information on trifluralin applications in the fallow year for foxtail control in small grains the next year.

#### **VOLUNTEER SUNFLOWER:**

**G14. 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. Herbicides when applied early will not control late emerging sunflower and when applied late will allow competition from the early emerged sunflower. Generally herbicides should be applied before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.

**G15. Broxomynil (Buctril)** 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. Ally, Harmony Extra, Banvel plus MCPA amine, Curtail, Curtail M, and Tordon plus 2,4-D or MCPA 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:**

**G16. 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. Ally, Harmony Extra or Express provide good kochia control unless resistant populations have developed. Tank-mixing these sulfonylurea herbicides with another broadleaf herbicide is strongly recommended to prevent a buildup of resistant kochia. A nonionic surfactant at 0.12 to 0.25% v/v is essential for



postemergence kochia control with Ally, Express and Harmony Extra. Banvel plus MCPA amine at 0.25 lb/A gives good kochia control. Buctril plus MCPA 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. Tordon is not effective on kochia; but when Tordon is combined with 2,4-D ester at 0.37 lb/A control is good.

#### **RUSSIAN THISTLE AND REDROOT PIGWEED:**

**G17.** Rates of most herbicides need to be higher for control of these weeds than for control of wild mustard. Ally, Harmony Extra or Express give good redroot pigweed and Russian thistle control unless resistant populations have developed. Banvel, 2,4-D, Buctril, and Tordon plus 2,4-D at 0.37 lb/A also give good Russian thistle and redroot pigweed control. MCPA is not as effective as 2,4-D in controlling either weed. The esters of 2,4-D generally are more effective than the amines for both weeds.

#### **FALSE CHAMOMILE:**

**G18.** 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, Ally, Harmony Extra, Express, Stinger, Curtail, or Curtail M control false chamomile. Buctril 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 at 0.5 lb/A with a nonionic surfactant at 0.25% v/v. Glyphosate at 0.75 lb/A and amitrole (Amitrole T) 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.

## **FLAX**

**H1.** Flax is less competitive with weeds than small grains and should be grown on relatively weed-free fields. Early post-harvest tillage of small grain stubble will prevent weed seed production, suppress perennial weeds and encourage annual weed seed germination prior to freeze-up. Weed problems will be reduced when weeds are controlled in the preceding crop. Flax should be seeded directly or with shallow spring tillage in fields which were not weedy the previous year. Deep tillage on such fields could bring dormant seeds to the surface, increasing weed problems. If fields are weedy, moldboard plowing after a year of weed seed production will bury the weed seeds, reducing the weed infestation in the following crop season. Moldboard plowing is especially effective in reducing infestation of small-seeded weeds like foxtails and kochia which have short seed survival.

Delayed seeding of flax with tillage prior to seeding will control wild 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 or shortly after emergence which

minimizes 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.

**H2.** EPTC (Eptam) fall applied at 4 lb/A controls annual grass weeds, including foxtails and wild oats, and some broadleaf weeds in flax. Fall applied Eptam at 3 lb/A in coarse textured soils generally has given good control with less flax injury than 4 lb/A. Incorporate Eptam immediately (within minutes) and thoroughly after application (See incorporation section). Flax stunting and stand loss may occur from Eptam. Usually flax yields will not be reduced because plants will produce branches to compensate for a thin stand.

**H3.** Trifluralin at 0.5 to 1.0 lb/A may be fall applied for control of foxtails and some broadleaf weeds on fields to be planted to flax. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue will not interfere with incorporation. Seed flax less than 1.5 inches deep into a moist seedbed.

**H4.** The flowable formulation of propachlor (Ramrod 4L) can be applied preemergence to control certain annual grass and broadleaf weeds but is ineffective against wild oats, wild mustard and perennial weeds. Flax tolerance to preemergence propachlor is excellent but, when incorporated, will injure flax and reduce weed control.

**H5.** 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. Tordon plus MCPA amine gives better redroot pigweed and wild buckwheat control than MCPA alone.

**H6.** Bromoxynil (Buctril) at 0.25 lb/A on 2- to 8-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some flax-leaf burn may occur at the higher rates or if high temperatures follow application. Mixtures of Buctril plus MCPA may cause flax injury if applied during hot, humid conditions.

**H7.** Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive will control annual and perennial grasses. See Poast section under soybeans for application rates and stages to control different weed species. Poast is less effective when applied to grasses under stress. Poast must be applied 75 days or more before flax harvest. Poast plus oil additive can be tank-mixed with Buctril at 0.25 lb/A or MCPA ester at 0.25 lb/A for broadspectrum weed control. Buctril or MCPA ester applied with Poast may cause leaf burn, retarded growth, and delayed maturity of the crop. Grass control from Poast may be reduced when applied as a tank-mixture with Buctril.

## **CORN**

**J1.** 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.

**J2.** Most herbicides used in corn are labeled for tank-mixing with other herbicides for broadspectrum weed control. Several commercial herbicide mixtures are available for use in corn. 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
Marksmen	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

**J3.** Wild-proso millet is a competitive annual weed in some areas of eastern North Dakota. EPTC plus safener (Eradicane), alachlor or metolachlor (Dual) applied preplant incorporated at the high label rate for the soil type will control early germinating wild-proso millet. However, these herbicides usually do not give season long control. For full season control of wild-proso millet, a preplant incorporated treatment of Eradicane can be followed with a delayed pre-emergence application of cyanazine (Bladex), Bladex plus alachlor or Dual, or an early postemergence application of Bladex 90W, or pendimethalin (Prowl) plus Bladex (corn up to 2-leaf stage). Nicosulfuron (Accent) at 0.5 oz/A with Scoil adjuvant has given excellent postemergence control of wild-proso millet.

**J4.** 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 herbicide residue section for additional discussion). Atrazine is registered as a tank-mixture with alachlor, Buctril, Sutan+, Bladex, Banvel, Dual, Ramrod, Princep, and Princep plus paraquat. Atrazine is available as a prepackage mix with several herbicides; see table on package mixtures. Atrazine is a restricted use herbicide.

**J5.** Alachlor at 2 to 4 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A are used preplant incorporated or preemergence to 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 Dual. Alachlor is registered as a tank-mixture with atrazine, Banvel, Bladex, glyphosate, paraquat, and Princep. Dual is registered as a tank-mixture with atrazine, Bladex, Banvel or with atrazine plus paraquat or glyphosate. Dual may be applied up to 45 days before planting. Alachlor is a restricted use herbicide.

**J6.** 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 Dual in North Dakota State University experiments. Ramrod is registered as a tank-mixture with atrazine.

**J7.** Butylate plus safener (Sutan+) at 3 to 6 lb/A preplant incorporated, controls annual grasses and some broadleaf weeds. Sutan+ is a volatile herbicide and must be incorporated immediately following application. Sutan+ generally is tank-mixed with other herbicides to provide broadspectrum weed control. Sutan+ is registered as a tank-mixture with atrazine and Bladex.

**J8.** Cyanazine (Bladex) at 1.2 to 4.75 lb/A applied preemergence controls annual grass and broadleaf weeds in corn. Use the higher rates on fine textured, high organic matter soils, and the lower rates on coarse textured soils with low organic matter. Do not use on sandy or loamy sand soils, or on soils with less than 1% organic matter. Bladex requires 0.5 inch or more rain for activation, especially on fine textured soils. Bladex is a restricted use herbicide.

**J9.** Dicamba (Banvel) at 0.25 to 0.5 lb/A applied preemergence in tank-mixtures with alachlor, atrazine, Bladex, Dual, Prowl, or Princep gives broadspectrum weed control. The mixture is not recommended on coarse-textured sandy soils. Use the lower rate of Banvel on medium silt loams with 2% or less organic matter.

**J10.** EPTC plus safener (Eradicane) at 4 to 6 lb/A controls grass and certain broadleaf weeds. Eradicane at 6 lb/A gives fair to good quackgrass control. Soil should be dry enough and in good tith to permit immediate and thorough incorporation. Eradicane is registered as a tank-mixture with atrazine and Bladex.

**J11.** Pendimethalin (Prowl) at 1.5 to 2 lb/A controls annual grasses and certain broadleaf weeds such as redroot pigweed. Prowl must be used only preemergence in corn and not preplant incorporated. Do not use Prowl on sands or loamy sands or on soils with less than 1.5% organic matter. Prowl is registered as a tank-mixture with atrazine, Bladex and Banvel.

**J12.** Atrazine at 1 lb/A should be applied to broadleaf weeds less than 4 inches tall or at 2 lb/A applied to grass weeds less than 1 inch tall. Atrazine gives good wild oat control, partial foxtail (pigeon-grass) control, and excellent control of broadleaved weeds (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 are less effective with atrazine than any of the oil additives. Refer to herbicide residue section for carryover precautions. Recent atrazine label changes include: 1) atrazine is a restricted use herbicide, 2) protective clothing is required, 3) do not load or mix within 50 feet of well, drainage areas, etc, 4) postemergence applications must be made before corn is 12 inches tall, 5) the maximum rate in corn and sorghum is 3 lb/A, 6) no fall application for quackgrass control, 7) the maximum non-crop rate is 10 lb/A, 8) cannot be applied through irrigation equipment, and 9) cannot be applied to rangeland, switchgrass, or proso millet.

**J13.** Cyanazine (Bladex 90DF) at 1.2 to 2 lb/A applied as an early postemergence treatment for grass and broadleaf weed control (including volunteer sunflower). Emulsifiable vegetable oil (Bio-Veg or Midland EV) at 1 qt/A enhances weed control but may increase the risk of crop injury. Only the 90DF formulation is registered for post-emergence weed control. Bladex 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 corn is under stress, or during extended cold, wet conditions. Bladex 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. Bladex is a restricted use herbicide.



**J14.** 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 apply MCPA to corn, 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 corn injury by directing the spray away from the upper leaves and whorl. Corn sprayed with 2,4-D may develop brittle stalks that may lodge or break. Several brands of 2,4-D are available with some differences on application information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

**J15.** Dicamba (Banvel) at 0.25 to 0.5 lb/A may be applied alone as an early postemergence treatment to corn from emergence to 5 inches tall. Banvel gives better control of Canada thistle, smartweed, wild buckwheat and volunteer sunflower than 2,4-D with less injury to corn. Banvel 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. Banvel can be applied before corn is 3 feet tall or until 15 days before tassel emergence. Drop nozzles should be used after corn is 8 inches tall to reduce injury if Banvel is applied with 2,4-D and to reduce drift potential. Banvel can be mixed with Bladex and atrazine.

**J16.** Bromoxynil (Buctril) at 0.25 lb/A applied to corn from 3 leaf but before tasselling controls seedling wild buckwheat, volunteer sunflower, and most annual broadleaf weeds. Some corn leaf burn may occur when high temperatures follow application. Buctril is a contact herbicide so thorough spray coverage is essential for adequate weed control. Buctril can be mixed with atrazine to increase the spectrum of weed control. A commercial mixture of Buctril plus atrazine is available. Buctril can be tank-mixed with atrazine, Bladex, Extrazine (atrazine + Bladex), glyphosate, Stinger, 2,4-D, Banvel, Accent, and Beacon. The premix Buctril + atrazine can be tank-mixed with Banvel, 2,4-D, Stinger, and Accent.

**J17.** Bentazon at 0.74 to 1 lb/A applied postemergence in corn controls many broadleaf weeds from 2 to 10 inches tall. Bentazon will control common cocklebur, common lambsquarters, giant and common ragweed, smartweed, venice mallow, wild buckwheat, wild mustard, and sunflower. Bentazon can control Canada thistle with sequential applications. Corn is tolerant to bentazon at all stages. Liquid fertilizer can be used with bentazon in place of oil concentrate for improved control of several weeds. Bentazon can be applied in corn when drift of Banvel or 2,4-D may injure sensitive crops. A premix of bentazon and atrazine (Laddok) is available. Atrazine is a restricted use herbicide

**J18.** Nicosulfuron (Accent) at 1/32 lb/A can be applied to corn from 2-leaf stage through 36 inches tall. For corn 24 to 36 inches tall (free standing) Accent should be applied with drop nozzles. Do not apply to field corn taller than 36 inches or with 10 collars, whichever is most restrictive. A sequential application may be made 14 to 28 days following the first application. However, the total dosage applied cannot exceed 1.33 oz product/A. When banding Accent over the row with a three-nozzle-per-row-system, remove or plug the center nozzle to reduce corn injury from Accent intercepted by the crop canopy.

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 Accent was greatest with Scoil, followed by Sun-It II, petroleum oil, and least with nonionic surfactant. Liquid 28% N fertilizer at 4 gal/100 gal spray volume has enhanced weed control when Accent was applied with a nonionic surfactant.

Herbicides that can be tank-mixed with Accent are atrazine, Buctril, Buctril + atrazine, Banvel and Marksman. The nonionic surfactant is required when Accent is tank-mixed with Banvel because the Banvel label restricts usage with oil adjuvants. Limited research at NDSU indicated that Accent tank-mixed with 2,4-D amine, according to the 2,4-D label, plus Scoil controlled common cocklebur, venice mallow, and common lambsquarters in addition to the species indicated below. Accent may be used postemergence to control foxtails spp., fall panicum, barnyardgrass, field sandbur, woolly cupgrass, wild-proso millet, wild oats, quackgrass, pigweed spp., smartweed, jimsonweed, and burcucumber. NDSU results show that Accent provides good control of kochia and wild mustard and fair control of Russian thistle.

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

See the herbicide residue section for information on crop rotation intervals.

**J19.** Primisulfuron (Beacon) at 1/28 lb/A should be applied to corn from 4 to 20 inches tall. Beacon can injure certain corn varieties; consult label for susceptible varieties. Beacon should be applied with a nonionic 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. Beacon 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.

Beacon controls quackgrass, fall panicum, common and giant ragweed, common cocklebur, black nightshade, kochia, smartweed, pigweed, Russian thistle, sunflower, and may suppress common lambsquarters and Canada thistle. Do not apply Beacon 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 Beacon application. See the herbicide residue section for information on crop rotation intervals.

**J20.** Emergency control of broadleaf and grass weeds in corn can be obtained with ametryn (Evik) or paraquat applied postemergence directed. Evik 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 must be used with both herbicides. These herbicides applied over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply Evik before corn is 12 inches high or paraquat before corn is 10 inches high. Weeds should be less than 4 inches tall.

Sethoxydim (Poast) can be applied to corn only as a directed spray for emergency grass control. Poast should be applied to corn 30 inches tall with the spray not contacting more than the lowest 10 inches of the stalk. The use of preemergence herbicides and/or timely cultivations should establish a height differential between corn and grass weeds targeted for control. Improper application will result in severe corn injury. Poast can be applied with 2,4-D amine or ester for grass and broadleaf weed control. Refer to label for application information and specific directions on nozzle selection, position and orientation.

## SOYBEANS

**K1.** 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.

**K2.** Most herbicides used in soybeans are labeled for tank-mixing with other herbicides for broadspectrum weed control. Several 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
Freedom	alachlor + trifluralin	2.67 + 0.33
Galaxy	aciflourfen + bentazon	0.67 + 3.0
Salute	metribuzin + trifluralin	1.1 + 2.9
Turbo	metolachlor + metribuzin	6.55 + 1.45

**K3.** Wild-proso millet is a competitive annual weed in some areas in eastern North Dakota. In soybeans, trifluralin, pendimethalin (Prowl) or ethalfluralin (Sonalan) will suppress wild-proso millet. For long term control a preplant incorporated treatment of any of these herbicides should be followed with a delayed preemergence application of alachlor or Dual, or a postemergence application of fluazifop-P (Fusilade 2000), sethoxydim (Poast), fenoxaprop (Option II), or quizalofop-P (Assure II) (See tables for rates).

**K4.** Ethalfluralin (Sonalan), pendimethalin (Prowl) and trifluralin are dinitroaniline herbicides applied preplant incorporated for control of annual grasses and broadleaf weeds except wild mustard, common cocklebur and sunflower. Requirements for proper timing and depth of incorporation differ for each herbicide.

**K5.** Ethalfluralin (Sonalan) at 0.5 to 1.3 lb/A applied preplant incorporated controls annual grass 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. Sonalan is registered as a tank-mixture with alachlor, Dual,

metribuzin or Command. Sonalan has less soil residue than trifluralin but is more active at comparable rates than trifluralin.

**K6.** Pendimethalin (Prowl) at 1.0 to 1.5 lb/A is applied preplant incorporated or preemergence to control annual grass and certain broadleaf weeds. The high rate should be used on heavy clay soils. Incorporation improves weed control if rainfall does not occur within 7 days after application. Prowl is registered as a tank-mixture with alachlor, Command, Lorox, Dual, and metribuzin. See herbicide residue section.

**K7.** Trifluralin at 0.5 to 1 lb/A applied preplant incorporated controls annual grass and certain broadleaf weeds. Set the implement 4 to 6 inches deep to uniformly mix trifluralin in soil. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil 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, Command, Dual, and metribuzin. See herbicide residue section.

**K8.** Alachlor at 2 to 3 lb/A and metolachlor (Dual) at 1.5 to 3 lb/A applied preemergence controls annual grass 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 alachlor and Dual and incorporation improves the consistency of weed control. Alachlor and Dual each are registered for tank-mixing with several herbicides.

**K9.** Metribuzin (Sencor, Lexone) at 0.19 to 0.37 lb/A controls annual broadleaf weeds, especially wild mustard. The rate applied is important. Consult the label for the proper rate based on soil type, pH, and % organic matter. Some soybean varieties are susceptible to metribuzin; consult label for list of susceptible varieties. Soybean injury can be reduced by using herbicide combinations with lower rates of metribuzin. Metribuzin is registered as a tank-mixture with alachlor, Command, Sonalan, Dual, Prowl and trifluralin.

**K10.** Clomazone (Command) at 0.75 to 1.0 lb/A applied preplant incorporated controls certain annual grass and broadleaf weeds. Command 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 Command application. Command is registered as a tank-mixture with trifluralin, Sonalan, Prowl, alachlor, Dual, and metribuzin.

**K11.** Aciflourfen (Blazer) applied postemergence at 0.25 to 0.5 lb/A controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the higher rates are needed for nightshade, smartweed and common cocklebur. Blazer will not adequately control volunteer sunflower. Blazer kills primarily by contact action; for effective control, it should be applied 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 which prevents coverage of the weeds. Blazer should be applied by ground sprayer delivering a minimum of 20 gpa at 40 psi. Avoid 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 Blazer applied 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% active ingredient) generally should be added to the tank at the rate of 0.12% v/v. See the label for additional information on spray additives. Do not apply within 50 days of harvest or use treated plants for feed or forage.



**K12.** Bentazon at 0.75 to 1.5 lb/A applied postemergence controls many broadleaf weeds. In North Dakota good wild mustard control has been obtained with bentazon at 0.5 lb/A plus an oil adjuvant when wild mustard was less than 4 inches tall. 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 bentazon at 1 lb/A when Canada thistle is 8 inches tall to bud stage and make a second application at 1 lb/A 7 to 10 days later.

**K13.** Lactofen (Cobra) at 0.20 lb/A applied postemergence controls many broadleaf weeds, including lanceleaf sage. Cobra kills primarily by contact action so thorough spray coverage of weeds is essential for good control. Soybeans beyond the third trifoliolate leaf stage may interfere the spray pattern which reduces the weed coverage. Cobra should be applied by ground sprayer delivering 15 to 30 gpa at 40 psi. Do not apply 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. A oil additive at 0.5 to 1 pt/A increases weed control but may increase crop injury. Do not apply within 90 days of harvest or use treated plants for feed or forage.

**K14.** Thifensulfuron (Pinnacle) at 1/256 lb/A applied postemergence controls wild mustard and pigweed species, and suppresses several other broadleaf weeds. Pinnacle should be applied in combination with a nonionic surfactant at 0.125 to 0.25% v/v or oil concentrate at 0.5 % v/v. Further addition of 28% UAN liquid fertilizer at 4% v/v may improve weed control. Pinnacle can be tank-mixed with bentazon to increase the spectrum of weeds controlled. Pinnacle as 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. See section on sprayer cleanout for additional information.

**K15.** Fenoxaprop (Option II) at 0.1 to 0.15 lb/A plus oil additive at 1 qt/A applied postemergence controls annual grass weeds. Option II at 0.10 lb/A controls green foxtail, volunteer corn and wild-proso millet. Yellow foxtail, wild oats, barnyardgrass, and crabgrass are controlled with Option II at 0.15 lb/A. Option II generally will not provide good volunteer small grain control. Tank-mixing Blazer, bentazon, or Cobra with Option II often reduces grass control compared to Option II plus oil additive alone. Reduced grass control can be avoided by applying Option II at least 1 day before or 5 days after application of a broadleaf herbicide.

**K16.** Fluazifop-P (Fusilade 2000) at 0.09 to 0.19 lb/A plus oil additive at 1% v/v applied postemergence controls annual and perennial grass weeds. Fusilade 2000 at 0.09 lb/A controls volunteer corn and wild-proso millet, at 0.12 lb/A controls wild oats and volunteer grains, and at 0.19 lb/A controls foxtails. Fusilade 2000 at 0.19 lb/A suppresses quackgrass with at least 4 leaves but less than 10 inches tall. If regrowth occurs, Fusilade 2000 at 0.19 lb/A should be applied when quackgrass regrowth has 3 to 5 leaves. Fusilade 2000 tank-mixed with other herbicides may provide less grass weed control or increase crop injury. Reduced grass control can be avoided by applying Fusilade 2000 at least 1 day before or 5 days after application of a broadleaf herbicide.

**K17.** Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive at 1 qt/A controls annual and perennial grasses. Methylated vegetable oil (Scoil and Sun-It II) and Dash additives have enhanced grass

control with Poast more than petroleum oil or unmodified vegetable oil additives. Poast at 0.1 lb/A controls wild-proso millet, at 0.2 lb/A controls volunteer corn, green foxtail, yellow foxtail, and barnyardgrass, and at 0.3 lb/A controls wild oats and volunteer cereals. Quackgrass 6 to 8 inches tall can be suppressed with Poast at 0.3 lb/A. Quackgrass regrowth 6 to 8 inches tall should be treated with 0.2 lb/A. Cultivation between 14 to 21 days after application will improve quackgrass control. Poast mixed with Betanex, Betamix, Herbicide 273, Blazer or bentazon has generally reduced wild oats control and occasionally reduced foxtail control compared to Poast plus oil additive alone. Poast with oil additives frequently have increased crop injury when combined with Betanex, Betamix, Herbicide 273, Blazer or Cobra. Reduced grass control and crop injury can be avoided by applying Poast at least 1 day before or 5 days after application of a broadleaf herbicide. 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 control of volunteer corn, cereal grains and quackgrass.

**K18.** Quizalofop-P (Assure II) at 0.06 to 0.12 lb/A plus petroleum oil adjuvant at 1% v/v applied postemergence controls annual and perennial grasses. Assure II at 0.06 lb/A controls volunteer corn and wild-proso millet, at 0.09 lb/A controls foxtails, volunteer small grains, and wild oats, and at 0.12 lb/A controls quackgrass 6 to 10 inches tall. Quackgrass 4 to 8 inches tall should be retreated with Assure II at 0.09 lb/A. Blazer, bentazon, or Cobra tank-mixed with Assure II often has reduced grass control compared to Assure II alone. Reduced grass control can be avoided by applying Assure II at least 1 day before or 5 days after application of a broadleaf herbicide. Assure II should not be applied with vegetable oil additives due to reduced grass control. However, methylated vegetable oils (Scoil and Sun-It II) have performed equal to petroleum based oil additives with Assure II.

**K19.** Eastern black nightshade is an annual weed that is difficult to control and causes harvest problems in soybeans. Even low populations of nightshade can interfere with soybean harvest because the nightshade berries are sticky which clog combines and can stain soybeans, thereby reducing quality. Dual or alachlor applied preemergence or preplant incorporated provide good nightshade control in soybeans. Incorporation generally improves the consistency of control in North Dakota. High rates of Sonalan preplant incorporated give fair to good nightshade control. Cannon and Freedom which are premixes of alachlor and trifluralin have given fair to good control of nightshade. Cannon cannot be used in dry edible beans. Blazer and Cobra applied postemergence provide good control of nightshade with less than four leaves in soybeans, but they cannot be used in dry beans. Bentazon is weak on nightshade.

## DRY EDIBLE BEANS

**L1.** 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.

**L2.** Bentazon, pendimethalin (Prowl), trifluralin, ethalfluralin (Sonalan), and sethoxydim (Poast) are discussed under the soybeans section. The rate of bentazon in dry beans should not exceed 1.0 lb/A. An oil with bentazon may increase dry bean injury. Alachlor at 2 to 3 lb/A preplant incorporated or Dual at 2 to 3 lb/A preplant incorporated or preemergence controls annual grasses and some broadleaf weeds, including nightshade. Dual may be tank-mixed with Eptam for wild oats control. Trifluralin, Prowl and Sonalan applied preplant incorporated controls annual grasses and certain broadleaf weeds except wild mustard, common cocklebur, and sunflower. The



low rates should be used on coarse textured, sandy soils. The high rates should be used for control of eastern black nightshade. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Trifluralin, Prowl and Sonalan are each registered as a tank-mixture with alachlor, Dual, and Eptam. Sonalan has less soil residue but is more active than trifluralin.

**L3.** EPTC (Eptam) at 2.0 to 3.0 lb/A plus either pendimethalin (Prowl) at 0.5 to 1.5 lb/A, trifluralin at 0.5 lb/A or Sonalan at 0.5 to 1.7 lb/A controls a broader spectrum of weeds than either herbicide used separately, especially wild oats, common lambsquarters, and eastern black nightshade. Eptam plus Prowl must be incorporated thoroughly immediately after application by setting the implement at a 4 to 6 inch depth. The mixture reduces the chance of carryover from any dinitroaniline herbicide. Do not use Eptam on soybeans.

**L4.** For information on Eastern black nightshade control see discussion under soybeans.

## LENTILS

**M1.** Lentils, in the early seedling stage, are poor competitors with weeds. Small weeds can be controlled by harrowing before crop emergence and when lentils are 3 to 7 inches tall.

**M2.** Triallate (Far-Go) at 1.25 lb/A can be applied for wild oats control before or after seeding lentils. Far-Go is volatile and must be incorporated into the soil immediately after application.

**M3.** Metribuzin applied preemergence at 0.25 to 0.375 lb/A or post-emergence at 0.125 to 0.19 lb/A in lentils will suppress common lambsquarters, wild mustard, field pennycress, shepherdspurse, henbit, and common chickweed. Metribuzin can be applied before or after planting but must be applied before crop germinates. Thorough incorporation by rainfall or mechanical methods are essential for weed suppression. Metribuzin should be applied postemergence to weeds less than 2 inches tall and to lentils less than 6 inches tall.

Special precautions include: 1) do not apply on wet soil or crop foliage, 2) do not apply postemergence within 3 days after cool, wet, or cloudy conditions, 3) do not use on coarse-textured or sandy soil, or soil with less than 1.5% organic matter, 4) do not apply to Estin lentils, 5) do not seed less than 2 inches deep if metribuzin is to be applied preemergence, 6) do not apply within 75 days of harvest, and 7) do not graze or feed treated vines to livestock within 40 days after application.

**M4.** See discussion under soybeans for use of Poast in lentils.

## SUNFLOWER

**N1.** Weeds usually are a problem because sunflower do not develop ground cover rapidly enough to prevent weeds from becoming established. Weeds that emerge before sunflower can be controlled by cultivating with a spike-tooth or coil spring harrow about 1 week after sowing but before sunflower emergence. Weeds may be controlled with a harrow or rotary hoe when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

**N2.** EPTC (Eptam), ethalfuralin (Sonalan), pendimethalin (Prowl) and trifluralin are preplant incorporated herbicides. See discussion on herbicide incorporation. Sonalan and trifluralin are applied on

sandy soil at 0.56 to 0.75 lb/A and 0.5 lb/A, respectively. Eptam must be applied and incorporated immediately to prevent herbicide loss. Eptam 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. Eptam controlled wild oats in sunflower better than Prowl and trifluralin. Sonalan is labeled for tank-mixing with Eptam. Rainfall after application is needed for weed control with surface applied Prowl. Prowl applied up to 30 days before planting no-till sunflowers is more likely to receive adequate rainfall for activation than Prowl applied at planting.

**N3.** Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive controls annual and perennial grass weeds. Do not apply Poast at least 70 days before sunflower harvest or do not feed treated sunflower forage to livestock. See discussion under soybeans for use of Poast.

**N4.** Imazamethabenz (Assert) at 0.19 to 0.38 lb/A applied postemergence controls wild mustard and wild oats. The rates from 0.19 to 0.25 lb/A are for wild mustard control, and the rates from 0.31 to 0.38 are 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

**P1.** 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.

**P2.** Herbicides are commonly used as tank-mixtures on sugarbeets. Some herbicide combinations such as Betanex plus Nortron 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.

**P3.** EPTC (Eptam) 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. Eptam 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 Eptam 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. Refer to section on the soil organic matter test. Herbicides such as Ro-Neet, Nortron, or pyrazon (Pyramin) cause less sugarbeet injury on the low organic matter soils where Eptam injury may be excessive.

**P4.** EPTC (Eptam) plus cycloate (Ro-Neet) has less potential for sugarbeet injury than Eptam alone and is less expensive per acre than Ro-Neet alone. The rate of the mixture must be adjusted for soil texture and organic matter. Suggested fall applied rates are: Ro-Neet alone on soils with less than 3 percent organic matter, Eptam plus Ro-Neet at 1 plus 3 lb/A on loam or coarser soils with 3% organic matter, 1.5 plus 2.5 lb/A on loam to clay loam soils with 3 to 4% organic matter, 2 plus 2 lb/A on clay loam soils with 3.5 to 4.5% organic matter, and 2.5 plus 2.5 lb/A on clay or clay loam soils with over 4.5% organic matter.

Suggested spring applied rates are: Ro-Neet alone at 3 lb/A on loam or coarser soils with 3% or less organic matter, Eptam plus Ro-Neet at 1 plus 2.5 lb/A on loam or coarser soils with 3 to 3.5% organic matter, 1.5 plus 2.5 lb/A on loam to clay loam soils with 3.5 to 4.5%



organic matter, and 2 plus 2 lb/A on clay loam or finer soils with 4% or more organic matter. These rates may need to be adjusted on certain fields or with certain incorporation tools based on individual experience. Eptam, Ro-Neet, or Eptam plus Ro-Neet require immediate incorporation for best weed control.

**P5.** Ethofumesate (Nortron) at 2 to 3.75 lb/A controls several broadleaf and grass weeds. Nortron is particularly effective on redroot pigweed and wild buckwheat but is weak on yellow foxtail. Nortron may be applied preemergence but research results in North Dakota and Minnesota indicate that incorporation generally improves weed control. Nortron incorporated by operating the incorporation tool 2 to 4 inches deep gave slightly better weed control than 1 inch. Band application of Nortron reduces cost and soil residue. Nortron has been relatively safe on sugarbeets but use of Nortron with Ro-Neet or fall-applied Eptam can cause sugarbeet injury especially on coarse-textured soils. Nortron plus spring-applied Eptam has been especially injurious to sugarbeets and should only be used on silty clay soils with over 6% organic matter.

**P6.** Diethatyl (Antor) at 4 to 6 lb/A spring applied controls redroot pigweed and prostrate pigweed. Antor may be applied preemergence but tests in North Dakota and Minnesota show that incorporation generally improves weed control. Antor incorporated by operating the incorporation tool 2 inches deep often gave better weed control than operating 4 inches deep. Thus, deep incorporation of Antor should be avoided unless Antor is combined with Eptam or Ro-Neet. Operating the incorporation tool 4 inches deep did not reduce weed control from Antor plus Eptam or Antor plus Ro-Neet combinations. Antor applied preemergence will give good weed control if adequate rain follows application.

**P7.** Endothall (Herbicide 273) at 0.75 to 1.5 lb/A applied post-emergence controls wild buckwheat, smartweed and sunflower. Herbicide 273 should be applied when temperatures are between 60 and 80 F. Herbicide 273 generally gives poor weed control when weeds are drought stressed.

**P8.** Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil additive controls annual and perennial grass weeds in sugarbeets. See discussion under soybeans for use of Poast.

**P9.** Desmedipham (Betanex) and desmedipham plus phenmedipham (Betamix) are postemergence herbicides for control of annual broadleaf weeds. Sugarbeet injury occasionally occurs from Betanex and Betamix. Sugarbeets with four true leaves are significantly less susceptible to injury than smaller sugarbeets and they gain additional tolerance with increased size. Betanex at 0.25 to 0.5 lb/A or Betamix at 0.12 to 0.25 plus 0.12 to 0.25 lb/A may be applied to sugarbeets with less than four leaves. Application rates 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 one full-rate application. Risk of sugarbeet injury is reduced by starting application in late afternoon so cooler temperatures follow application. 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.

**P10.** Trifluralin at 0.75 lb/A or EPTC (Eptam) 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 Eptam will control late germinating weeds

that may become a problem when good moisture conditions prevail well into the season.

**P11.** Clopyralid (Stinger) at 0.09 to 0.25 lb/A applied 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 6-leaf stage, common ragweed up to the 5-leaf stage, and wild buckwheat in the 3- to 5-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 2- to 8-leaf stage and at least 105 days prior to harvest. Clopyralid is not registered for application by aircraft.

## LEGUMES

**Q1.** Seedling legumes 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 weed seeds in the soil. Weed control for establishment of legumes when sown alone can be aided by mowing (except sweet-clover), herbicides, or by seeding a companion crop.

**Q2.** Trifluralin at 0.5 to 0.75 lb/A can be applied preplant incorporated for annual grass and some annual broadleaf weeds. Only use on acres in a government set-aside program. Some legume injury may occur.

**Q3.** Sethoxydim (Poast) at 0.19 to 0.5 lb/A plus oil additive at 1 qt/A applied postemergence controls grass in seedling and established alfalfa. Alfalfa is tolerant at all growth stages. Apply Poast to actively growing grass weeds. Allow grass to produce new regrowth after clipping before treating with Poast. Do not feed, graze, or harvest forage for 7 days, or feed or harvest hay for 20 days after application. See discussion under soybeans for rates and stages to control different weed species.

**Q4.** Bromoxynil (Buctril) at 0.25 to 0.38 lb/A applied postemergence to seedling alfalfa controls many annual broadleaf weeds. Buctril should be applied when alfalfa has at least 4 trifoliate leaves and weeds have 4 leaves or less, or before rosettes are 1.5 inches in diameter. Alfalfa injury may occur if the temperature within 3 days after application 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 after spring treatment or 60 days after fall treatments. Buctril can be tank-mixed with 2,4-DB for improved control of pigweed, kochia, and tansymustard.

**Q5.** 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 Sinbar also can be applied to dormant alfalfa in early spring. All three herbicides can injure alfalfa. Do not apply metribuzin and Sinbar until alfalfa has been established at least one year. Do not graze or harvest alfalfa treated with metribuzin for 28 days after treatment. Do not graze or harvest alfalfa treated with Kerb within 25 days (below 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 Sinbar application.

## FORAGE SORGHUMS

**R1.** Atrazine applied at 1.25 to 3 lb/A controls many small-seeded annual broadleaf weeds and partially controls large-seeded broadleaf weeds. Atrazine only provides poor to fair control of grasses. Risk of crop injury is greatest on light, low-organic-matter soil and under cool, wet conditions. Crop tolerance is fair on heavy soils. Do not use on sandy soil. The high rate is to be used on heavy, clay, high-organic-matter soil.

Preplant or preemergence applications may be made in liquid fertilizer. Corn or sorghum may be planted the following year. Lower rates of atrazine used in combination with other herbicides reduces carryover, but will still cause damage to susceptible rotation crops. Do not plant soybeans, sunflowers, small grains, or grass/legumes the following year. Do not graze or feed forage from treated area for 21 days following application.

**R2.** Metolachlor (Dual) applied at 1.5 to 2.5 lb/A provides good control of several annual grass weeds and partial control of some annual broadleaf weeds. Rainfall is necessary for adequate weed control. Sorghum seed must be treated with Concep safener by the seed company or severe crop injury will result. Use low Dual rates for light, low-organic-matter soils. May be applied in liquid fertilizer. Dual, shallow preplant incorporated, gives more consistent weed control than with other application methods.

**R3.** Dual plus atrazine applied as a tank-mix or commercial premix (Bicep) provides very good control of several annual broadleaf and grass weeds. These herbicides provide partial control of large-seeded broadleaf weeds, such as sunflower and cocklebur. Precautions for Dual and atrazine used separately must be followed.

**R4.** Bromoxynil (Buctril) applied at 0.25 to 0.38 lb/A controls several annual broadleaf weeds. Apply Buctril before weeds exceed the most susceptible stage: common cocklebur (8 inches), sunflower or wild buckwheat (6 inches). Higher Buctril rates are required to control less susceptible weeds and Buctril must be applied when weeds are at a smaller growth stage. Do not cut for feed or graze treated area for 30 days following application. Restricted use herbicide.

**R5.** Buctril plus atrazine applied as a tank-mix or commercial premix (Buctril/Atrazine) provides very good control of several annual broadleaf and some grass weeds. Follow crop limitations as for each herbicide alone. Low atrazine rates reduce risk of carryover and may allow rotating to crops with intermediate tolerance, however, small grains and other sensitive crops are not recommended. Restricted use herbicide.

**R6.** 2,4-D applied at 0.25 to 0.5 lb/A control many annual and perennial broadleaf weeds. Crop tolerance is marginal and growing conditions often affect relative sensitivity of sorghum to 2,4-D. Lower rates will control small, susceptible weeds and reduce risk of crop injury. Labels for 2,4-D vary in use information. Few products include forage sorghum, however, products listing "sorghum" are being interpreted by some labelers to include all forage types. Some 2,4-D labels allow higher rates to be used to improve perennial weed (field bindweed) control; however, the user must assume increased risk of crop injury. Some labels include applications of 1 lb/A after the dough stage as a harvest aid for sorghum. Consult the label.

## CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

**S1.** Paraquat (Gramoxone Extra, Cyclone) applied at 0.47 to 0.94 lb/A is a nonselective contact herbicide that can be used alone or in combination with a residual herbicide as a substitute for tillage. Paraquat may be applied until crop emergence. Apply paraquat in 5 to 10 gpa of water by air or in 10 to 20 gpa of water by ground. Add nonionic surfactant 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 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.

**S2.** Glyphosate at 0.19 to 0.75 lb/A applied postemergence will control annual weeds in reduced tillage situations. Glyphosate at 0.19 to 0.37 lb/A should be applied at 0.5% v/v with a nonionic surfactant of at least 50% active ingredient. Ammonium sulfate at 9 to 17 pounds per 100 gallons of water improves consistency of weed control with glyphosate especially if environmental stress or water quality is a concern. Add ammonium sulfate to the water slowly and make sure it is completely dissolved before adding herbicides or surfactant.

Glyphosate at 0.19 lb/A controls foxtails, at 0.29 lb/A controls volunteer small grains, and at 0.38 lb/A controls wild oats and downy brome less than 4 inches tall. Use a higher rate on larger weeds, more resistant weeds, or if plants are under moisture stress. When glyphosate is applied at low rates, use 3 to 10 gpa by ground or 3 to 5 gpa by air. Delay tillage for at least 3 days after treatment. Glyphosate at 0.75 lb/A should be applied when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing; at 1.5 to 2.25 lb/A when Canada thistle is actively growing and at or just before the bud stage. 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 for crop injury exists when glyphosate plus 2,4-D or Banvel mixtures are applied immediately before or after planting due to the preemergence soil activity of 2,4-D and Banvel. Fall planted rye or wheat may be killed with 1 lb/A of glyphosate prior to planting sugarbeets and other crops in the spring.

Recently, several wholesale companies are marketing glyphosate under different names; for example, some names are Silhouette, Mirage, Jury, Ruler, Rattler, Show-off, etc. The major difference with these products is that no surfactant is included in the formulation. Surfactant at 1 to 2% must be added when these products are used. Monsanto will continue to market glyphosate under names other than Roundup, some examples are Ranger, Accord, Rascal, Honcho, and Protocol. Refer to each individual label for application information.

**S3.** For postharvest or fallow weed control in minimum till situations, 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 Banvel plus glyphosate (Fallow Master) and 2,4-D plus glyphosate (Landmaster BW) are available. Add a nonionic surfactant at 0.5% v/v to the spray solution. 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 Banvel 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.

**S4.** A tank-mixture of cyanazine (Bladex) 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% organic matter require the high rate of Bladex. The Bladex plus atrazine combination gives increased residual weed control compared to Bladex 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.

**S5.** Command 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. Tank-mixing with 0.4 to 0.5 lb/A atrazine controls most broadleaf weeds missed by clomazone alone, but is weak on foxtails. Dry conditions during weed emergence in early spring and summer may result in unsatisfactory performance. Carryover injury in wheat is possible following Command application and can be recognized as yellowing or bleaching (whitening) of seedling plants. Do not apply Command within 1000 ft. of emerged winter wheat, towns, and subdivisions, or commercial nurseries, greenhouses, fruit, or vegetable production sites due to drift injury potential.

**S6.** 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.

### PERENNIAL WEED CONTROL

**T1.** Fall applied herbicides can be effective for controlling perennial weeds provided most weed stem and leaf tissue has not been killed by frost. Weeds such as field bindweed, leafy spurge and Canada thistle should have 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.

Mowing or tillage is a good means of reducing perennial weed seed production. If fall herbicide applications are planned, mowing or tillage should be discontinued in mid-July to allow adequate plant regrowth. Post-harvest treatments can be applied when weed growth is about 1 foot tall. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment should be separated from harvest at least 5 days to allow adequate herbicide translocation in the perennial weeds.

**T2.** 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. See the perennial weed control section of the tables for application stages and rates.

### PERENNIAL WEEDS IN SMALL GRAINS

**T3.** Perennial weed control systems in small grains should include herbicide applied in the crop followed by post-harvest treatment for several years. Canada thistle and perennial sowthistle can be controlled in wheat and barley with Curtail, Curtail M, Express, Harmony Extra, MCPA and 2,4-D. Canada thistle control is generally better with Curtail and Curtail M than other herbicides. Perennial sowthistle, and field bindweed can be controlled in tolerant crops with MCPA or 2,4-D. When controlling thistles in small grains, except oats, apply the maximum rate of 2,4-D or MCPA that 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 than 2,4-D. MCPA can be used to suppress thistles in oats and flax, but, these crops do not tolerate rates of MCPA necessary to control thistle. For control of perennial broadleaf weeds after harvest or during fallow, Banvel can be tank-mixed with 2,4-D or glyphosate. Tank-mix Banvel at 0.5 to 2 lb/A with glyphosate at 0.75 to 1.5 lb/A. When a crop rotation restriction requires the lower rate of Banvel, tank-mix with the higher rates of glyphosate.

### PERENNIAL WEEDS IN PASTURE

**T4.** 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. Tordon at 1 to 2 lb/A controls of these weeds and is economical for spot treatment. Tordon at 0.25 to 0.5 lb/A applied 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 Tordon at 0.25 lb/A plus 2,4-D at 1 lb/A applied annually for 3 to 5 years. Tordon cannot be applied with dry fertilizers.

Tordon is toxic to most broadleaf plants. Spray drift in small amounts may damage susceptible plants, such as, alfalfa, dry beans, soybeans, potatoes, safflower, sunflower, sugarbeets and vegetable crops. Tordon is water soluble and may leach in the soil; consequently, do not apply in areas where a sandy porous surface and substrata overlay ground water 10 feet or less below the surface. Tordon must not be allowed to drift into surface water (including wells), irrigation and drainage ditches or near shelterbelts, shrubs or trees. When Tordon has been applied at 0.5 lb/A or more, do not cut grass for feed within 2 weeks after treatment. Meat animals grazing within 2 weeks after application should be removed from treated areas 3 days prior to slaughter. Do not graze dairy animals on treated areas within 2 weeks after treatment. Tordon is excreted in the urine, so do not transfer livestock from treated grass areas onto sensitive broadleaf crop areas for 12 months after application without first allowing 7 days of grazing on untreated grass. The total area treated should not exceed 25% of a land owners acreage found in any particular watershed for rates exceeding 1 qt/A.

**T5.** 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 Tordon cannot, but drift onto susceptible 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. Several brands of 2,4-D with various application limitations are available, for example, Hi-Dep, allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air. Some formulations of 2,4-D are labeled for use near water. See individual labels for further details.

**T6.** Dicamba (Banvel) at 0.5 to 1 lb/A will suppress some perennials, especially field bindweed and weeds resistant to 2,4-D. When applying Banvel at 1 lb/A or less, use 0.5% 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. Banvel has a shorter soil residual than Tordon, but should not be applied where desirable broadleaf plants or trees may be damaged by Banvel 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 read the label for this information.

**T7.** 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. Crossbow plus 2,4-D generally provides better musk thistle and brush control than 2,4-D alone. Do not graze lactating dairy animals or harvest hay from treated areas for 1 year after application. Do not graze beef animals within 3 days of slaughter during the first year after treatment.



## 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
Antor (diethatyl) PPI	G	G	P	N	N	G	P	P	G-E	P	N	P	P	F-G	N
Antor (diethatyl) PRE	F-G	F-G	P	N	N	F-G	P	P	G	P	N	P	P	F-G	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
Bladex (cyanazine) PPI	F	F	F	N	N	G	G-E	G-E	F	E	F-E	G	E	F	S
Bladex (cyanazine) PRE	P-F	P-F	F	N	N	F-G	G	G-E	P-F	G-F	P-F	F-G	G-E	P-F	S
Command (clomazone) PPI	F-G	P	F	N	N	F-G	G-E	F-G	P	F-G	F-G	F-G	F	G	O
Dual (metolachlor) PPI	G-E	G	N	N	N	G-E	F	F	G-E	F	N	F	P	P	N
Dual (metolachlor) PRE	F-G	G	N	N	N	G	P-F	P-F	F-G	P-F	N	P-F	P	N	N
Eptam (EPTC) PPI	E	F-G	P	N	N	E	F	F	G	P	N	F	P	G	N
Far-Go (trallate) PPI	N	N	N	N	N	N-P	N	N	N	N	N	N	N	E	N
Far-Go (trallate) PEI	N	N	N	N	N	N-P	N	N	N	N	N	N	N	G-E	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
Nortron (ethofumesate) PPI	P	F-G	P	N	N	F-G	F-G	P-F	G-E	F-G	P	F-G	F	G	O
Nortron (ethofumesate) PRE	P	F	P	N	N	F	F	P-F	G	F	P	F	P-F	F-G	O
Prowl (pendimethalin) PPI	E	N	N	N	N	E	G	G	G-E	F	N	N	N	F-G	S
Prowl (pendimethalin) PRE	E	N	N	N	N	G-E	F-G	G	G	G	N	N	N	P-F	S
Ramrod (propachlor) PRE	E	-	P	N	N	G-E	G	F	E	P	N	F	P	P	N
Ro-Neet (cycloate) PPI	E	F-G	P	N	N	E	P	F-G	G	P	N	P-F	P	G	N
Sonalan (ethalfuralin) PPI	E	F-G	P	N	N	E	G-E	E	E	G-E	N	F	N	G	S
Sutan (butylate) PPI	G-E	F	P	N	N	E	-	P	F	P	N	P	P	G	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

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.

POSTEMERGENCE 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
Accent (nicosulfuron)	E	N	P	N	P	E	G	P	E	P	P	P-F	E	E	O
Ally (metsulfuron) + 2,4-D	N	F-G	F	F	G	N	E*	E	E	E*	G-E	F	E	N	O
Assert (imazamethabenz)	P	-	P	N	N	P	P-F	P	P	P-F	N	F-G	E	E	S
Assure II (quizalofop-P)	E	N	N	N	N	E	N	N	N	N	N	N	N	E	N
atrazine + oil	G	G	G	F	F	G	E	E	E	E	G	G	E	G-E	S
Avenge (difenzoquat)	N	N	N	N	N	N	N	N	N	N	N	N	N	G-E	N
Banvel (dicamba)	N	E	E	G-E	G-E	N	E	G	G	G	G-E	E	G	N	S
Banvel (dicamba) + MCPA	N	E	E	G	G	N	G-E	E	G	G	E	G-E	E	N	N
bentazon	N	F	G	F	F-G	N	F-G	G	F	F	E	F	E	N	N
Beacon (primisulfuron)	P	G	-	-	-	P	F-G	F	E	-	-	-	G	-	O
Betamix	P	G	P-F	N	N	F	F	G	F-G	P	P	F-G	G	N	N
Betanex (desmedipham)	P	G	P	N	N	P	P-F	G	G	P	P	F	G	N	N
Bladex (cyanazine) + oil	G	G	G	P	P	G	G	G	F-G	G	E	G	E	F-G	N
Blazer (acifluorfen)	N	G	F	F	F	P-F	F-G	G	E	F	P	G	E	N	N
Bronate	N	E	E	F	F-G	N	E	E	G	E	E	E	E	N	N
Buctril (bromoxynil)	N	E	E	F	F	N	G-E	G	F-G	E	G-E	E	F-G	N	N
Carbyne (barban)	N	N	N	-	N	N	N	N	N	N	N	F	N	F-G	N
Cobra (lactofen)	N	G	G	F	F	P-F	G	F	E	P	F	G	E	N	N
Curtail, Curtail M	N	F	E	G	G-E	N	F-G	G	G	G	E	G	E	N	S
Dakota TP	-	-	-	-	-	G-E	F	E	P	P	-	P	E	G	N
Express (tribenuron) + 2,4-D	N	F-G	G	F	G	P	E*	E	G	E*	G	F	E	N	N
Fusilade 2000 (fluzifop-P)	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
Gramoxone Extra (paraquat)	G	-	-	P	P	G	G-E	E	E	E	E	F	E	G	N
Harmony Extra + 2,4-D	N	P	G	P	F-G	P	E*	E	E	E*	G-E	G-E	E	N	N
Herbicide 273 (endothall)	N	P	P-F	N	N	N	P	P	P-F	P	F-G	G	P-F	N	N
Hoelon (diclofop)	F	N	N	N	N	G-E	N	N	N	N	N	N	N	G-E	N
MCPA	N	G	G	F-G	F-G	N	F	E	F	P	G	N	E	N	N
Option II (fenoxaprop)	E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
Pinnacle (thifensulfuron)	N	P	F	N	N	P	F-G	G	E	G	F-G	P-F	E	N	N
Poast (sethoxydim)	G-E	N	N	N	N	E	N	N	N	N	N	N	N	G-E	N
Stampede CM	G	-	G	F	F	G	G	E	E	F	G	G-E	E	N	N
Stinger (clopyralid)	N	F-G	E	P	G-E	N	N	P-F	P	P-F	G-E	F-G	P	N	S
Tiller	-	-	-	-	-	E	F	E	F	F	-	P	E	G-E	N
Tordon 22K (picloram)	N	E	E	G-E	G-E	N	F-G	E	E	G-E	E	E	E	N	O
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 <sup>1</sup>	Common Name	Concentration and Formulation <sup>2</sup>	Cost/Unit <sup>3</sup>
Accent (Dupont)	Nicosulfuron	75% DF	\$25.50 oz
Alachlor (Various)	Alachlor	4 lb/gal E, MT 15% G	\$24.00 gal, \$0.93 lb
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	\$41.10 gal
Assert (American Cyanamid)	Imazamethabenz	2.5 lb/gal S	\$105.00 gal
Assure II (DuPont)	Quizalofop-P	0.8 lb/gal E	\$111.50 gal
Atrazine (Various)	Atrazine	80% WP, 90% DF, 4 lb/gal F	\$3.00 lb, \$2.50 lb, \$11.65 gal
Avenge (American Cyanamid)	Difenzoquat	2 lb/gal S	\$38.50 gal
Balan (DowElanco)	Benefin	1.5 lb/gal E	\$16.19 gal
Banvel (Sandoz)	Dicamba	4 lb/gal S, 2 lb/gal SGF	\$64.40 gal \$31.50 gal
Bentazon (Various)	Bentazon	4 lb/gal S	\$59.90 gal
Beacon (Ciba Geigy)	Primisulfuron	75% DF	\$23.75 oz
Betamix (Nor-Am)	Desmedipham+Phenmedipham	0.65 + 0.65 lb/gal E	\$75.00 gal
Betanex (Nor-Am)	Desmedipham	1.3 lb/gal E	\$75.00 gal
Bicep (Ciba-Geigy)	Atrazine + Metolachlor	2.7 + 3.4 lb/gal F	\$28.50 gal
Bladex (DuPont)	Cyanazine	90% DF, 4 lb/gal F	\$4.80 lb, \$21.50 gal
Blazer (BASF)	Acifluorfen	2 lb/gal E	\$55.40 gal
Bronate (Rhone-Poulenc)	Bromoxynil + MCPA	2 + 2 lb/gal	\$46.20 gal
Bronco (Monsanto)	Alachlor + Glyphosate	2.6 + 1.4 lb/gal E	\$26.40 gal
Buckle (Monsanto)	Triallate + Trifluralin	10% + 3% G	0.99 lb
Buctril (Rhone-Poulenc)	Bromoxynil	2 lb/gal E	\$45.50 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	\$31.00 gal
Cannon (Monsanto)	Alachlor + Trifluralin	2.5 + 0.5 lb/gal E	\$12.40 gal
Carbyne (Sandoz)	Barban	2 lb/gal E	\$34.00 gal
Cobra (Valent)	Lactofen	2 lb/gal S	\$99.50 gal
Command (FMC)	Clomazone	4 lb/gal E	\$72.40 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	\$26.25 gal
Curtail M (DowElanco)	Clopyralid + MCPA	0.42 + 2.35 lb/gal S	\$31.60 gal
Cyclone (ICI)	Paraquat	2 lb/gal S	\$31.00 gal
Dakota (Hoechst-Roussel)	Fenoxaprop + MCPA	1.85 gal of fenoxaprop + 3.78 gal of MCPA	\$240 Box - Treat 40 Acre
Defol (Drexel)	Sodium chlorate	6 lb/gal S, 3 lb/gal S	\$7.25 gal \$3.65 gal
Des-i-cate (Pennwalt)	Endothall	0.52 lb/gal S	\$11.00 gal
Dual (Ciba-Geigy)	Metolachlor	8 lb/gal E	\$57.80 gal
Eptam (ICI)	EPTC	7 lb/gal E, 10% G	\$24.00 gal, \$0.48 lb
Eradicane (ICI)	EPTC + Safener	6.7 lb/gal E	\$24.25 gal
Evik (Ciba-Geigy)	Ametryn	80% WP	\$4.50 lb
Express (DuPont)	Tribenuron	75% DF	\$18.90 oz
Extrazine II (DuPont)	Cyanazine + Atrazine	3 + 1 lb/gal F 67.5% + 22.5% DF	\$15.50 gal \$3.90 lb
Fallow Master (Monsanto)	Glyphosate + Dicamba	1.1 + 0.5 lb/gal S	\$23.80 gal
Far-Go (Monsanto)	Triallate	4 lb/gal E, 10% G	\$36.50 gal \$0.77 lb
Freedom (Monsanto)	Alachlor + trifluralin	2.67 + 0.33 lb/gal E	\$10.50 gal
Fusilade 2000 (ICI)	Fluazifop-P	1 lb/gal E	\$92.50 gal
Galaxy (BASF)	Acifluorfen + Bentazon	0.67 + 3 lb/gal S	\$52.50 gal
Glyphosate (Various)	Glyphosate	3 lb/gal S 3 lb/gal RT	\$46.98 gal \$34.00 gal
Gramoxone Extra (ICI)	Paraquat	2.5 lb/gal S	\$33.00 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	\$50.50 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	\$17.25 gal
Lariat (Monsanto)	Alachlor + Atrazine	2.5 + 1.5 lb/gal F	\$17.50 gal
Leafex-3 (J.R. Simplot)	Sodium chlorate	3 lb/gal S	NA
Lexone (DuPont)	Metribuzin	75% DF, 4 lb/gal F	\$23.00 gal \$102.00 gal
Lorox (DuPont)	Linuron	50% WP, 4 lb/gal F	\$7.19 lb \$64.50 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	\$21.90 gal
Nortron (Nor-Am)	Ethofumesate	1.5 lb/gal E	\$54.00 gal
Option II (Hoechst-Roussel)	Fenoxaprop	1 lb/gal E	\$90.00 gal
Pinnacle (DuPont)	Thifensulfuron	25% DF	\$26.00 oz
Poast (BASF)	Sethoxydim	1.5 lb/gal E	\$111.00 gal
Princep (Ciba-Geigy)	Simazine	80% WP 4 lb/gal F 4% G 90% DF	\$3.50 lb \$14.40 gal \$1.45 lb \$3.67 lb
Prowl (American Cyanamid)	Pendimethalin	4 lb/gal E	\$26.90 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
Rodeo (Monsanto)	Glyphosate	4 lb/gal S	\$110.00 gal
Ro-Neet (ICI)	Cycloate	6 lb/gal E	\$49.50 gal
Salute (Mobay)	Trifluralin + Metribuzin	2.7 + 1.3 lb/gal F	\$58.50 gal
Sencor (Mobay)	Metribuzin	4 lb/gal F 75% DF	\$102.00 gal \$23.00 gal
Sonalan (DowElanco)	Ethalfuralin	3 lb/gal E	\$26.50 gal
Stampede CM (Rohm and Haas)	Propanil + MCPA	3.0 + 0.85 lb/gal E	\$25.10 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
Tiller (Hoechst-Roussel)	Fenoxaprop + 2,4-D + MCPA	2.71 lb/gal L	\$70.00 gal
Tordon 22K (DowElanco)	Picloram	2 lb/gal S	\$82.00 gal
Trifluralin (Various)	Trifluralin	4 lb/gal E, MTF 10% G, 80% DC	\$29.50 gal \$0.89 lb
Turbo (Mobay)	Metribuzin + Metolachlor	1.5 + 6.5 lb/gal F	\$85.50 gal
2,4-D amine (Various)	2,4-D	4 lb/gal S	\$9.50 gal
2,4-D ester (Various)	2,4-D	4 lb/gal E	\$12.75 gal

<sup>1</sup> 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 manufacturers for the chemical.

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

<sup>3</sup> 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.

# NOTES



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