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1985 AGRICULTURAL WEED CONTROL GUIDE

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INTRODUCTION

THE WEED CONTROL SUGGESTIONS are based on Federal label clearances and on information obtained from the North Dakota Agricultural Experiment Station and the Research Report of the North Central Weed Control Conference.

CAUTION:

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

USE PESTICIDES ONLY AS LABELED. Certification is required for purchase and use of restricted use herbicides, picloram (Tordon), diallate (Avadex), diclofop (Hoelon), paraquat (Paraquat, Gramoxone) and sulfuric acid.

RATES ARE BASED on broadcast application and are expressed as active ingredient or acid equivalent, and as the amount of commercial product. Commercial formulations of the same herbicide may vary in their amount of active ingredient. For example, a pint of 3.3-pound acid equivalent per gallon contains 0.4 pound, and a pint of 6-pound acid equivalent per gallon contains 0.75 pound. Three pounds of atrazine (AAtrex 80W) powder contains 2.4 pounds active ingredient ($3 \times 0.80 = 2.4$), or 3 pounds active ingredient is 3.75 pounds of product ($3 \div 0.80 = 3.75$).

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

HERBICIDE USE INFORMATION

POSTEMERGENCE HERBICIDES:

1. Effectiveness of postemergence herbicides is influenced by crop tolerance, weed species and climatic conditions and should be considered in determining the rate of herbicide to apply. A range of rates is given for most of the herbicides in this circular. Use the lowest recommended rate of postemergence herbicides under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of drought or prolonged cool weather, or for well established weeds, use the highest suggested rate, except for barban (Carbyne 2EC). (See paragraph 125.)
2. Ideal temperatures for applying most postemergence herbicides are between 65 and 85 F. Below 60 F weeds are killed very slowly or not at all; above 85 F there is danger of herbicide injury to the crop. Avoid applying volatile herbicides such as 2,4-D ester, MCPA ester and dicamba (Banvel) during hot weather, especially near sensitive broadleaf crops, shelterbelts or farmsteads.
3. Rainfall shortly after application often reduces weed control from postemergence applications because the herbicide is washed off the leaves before absorp-

tion is complete. Herbicides vary in rate of absorption and in ease of being washed from leaves; therefore, herbicides vary in response to rainfall. The amount and intensity of rainfall influence the washing of herbicide from leaves. The approximate time between application and rainfall needed for maximum weed control from several herbicides follows:

<u>Herbicide</u>	<u>Time Interval</u>	<u>Herbicide</u>	<u>Time Interval</u>
acifluorfen (Blazer)	6 hours	diclofop (Hoelon)	1 hour
atrazine + oil	4 hours	difenzoquat (Avenge)	6 hours
barban (Carbyne)	5 minutes	dinoseb + naptalam (Dyanap)	6 hours
bentazon (Basagran)	24 hours	fluazifop (Fusilade)	1 hour
bromoxynil (Brominal, Buctril)	1 hour	glyphosate (Roundup)	6 hours
dalapon (Dowpon)	8 hours	2,4-D or MCPA amine	4 hours
desmedipham (Betanex)	6 hours	2,4-D or MCPA ester	1 hour
desmedipham + phenmedipham (Betamix)	6 hours	sethoxydim (Poast)	1 hour

SPRAY DRIFT:

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

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

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

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

d) Herbicide formulation: All herbicides can drift as spray droplets but some herbicides are sufficiently volatile to cause plant injury from vapor or fume drift. 2,4-D and MCPA are formulated as amines or esters. The ester formulations may form damaging vapors while the amines are essentially non-volatile. Dicamba (Banvel) is also volatile and can drift as droplets or vapor. A less volatile formulation of dicamba (Banvel II) is available. 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 with high potential to form damaging vapors such as 2,4-D esters, MCPA esters, and dicamba should not be used near susceptible plants.

e) Drift control: Certain spray nozzles or spray systems such as the Delavan Raindrop nozzle, the Spraying Systems LP nozzle or controlled droplet applicators produce droplets less subject to drift. Nalco-Trol and other additives to spray mixtures cause larger droplets which reduce drift.

f) Drift injury from herbicides: Damaging drift to non-target plants is primarily a problem with 2,4-D, MCPA, dicamba (Banvel, Banvel II), paraquat, glyphosate (Roundup), picloram (Tordon) and dinoseb + naptalam (Dyanap) in North Dakota. Other herbicides may drift but generally do not cause significant damage. Drift control techniques should not be used with postemergence herbicides that require small droplets for optimum performance such as barban (Carbyne 2EC), desmedipham (Betanex), bentazon (Basagran), and dinoseb + naptalam (Dyanap).

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

PREEMERGENCE HERBICIDES:

6. Good weed control with preemergence herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature, soil type and weed species. For these reasons, preemergence chemicals applied to the soil surface sometimes fail to give satisfactory weed control. Herbicides which are incorporated into the soil surface usually require less rainfall after application for effective weed control than unincorporated herbicides. Weeds emerging through a preemergence herbicide treatment may be controlled by rotary hoeing without reducing the effect of the herbicide.

INCORPORATION OF HERBICIDES:

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

8. Butylate, cycloate, diallate, EPTC and triallate should be incorporated immediately (within minutes) after application. Incorporate fluchloralin within eight hours of application. Trifluralin incorporation may be

delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Ethalfluralin incorporation may be delayed up to 48 hours. Pendimethalin must be used preemergence on corn but may be incorporated for soybeans. Incorporation often improves the performance of pendimethalin and may be delayed up to seven days after application. Alachlor, ethofumesate and metolachlor may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor, ethofumesate and metolachlor may be delayed several days.

9. 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.

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

a) A tandem disk should be set at a depth of 3 to 4 inches for fluchloralin and pendimethalin and a depth of 4 to 6 inches for other herbicides. Operating speed should be 4 to 6 mph. Tandem disks with disk blades spaced 8 inches or less and a disk blade diameter of 20 inches or less have given good herbicide incorporation. Larger disks have often given streaked incorporation and poor weed control.

b) Field cultivators of various types may be used. These should have overlapping sweep shovels with at least three rows of gangs and the operating depth should be 3 to 4 inches for fluchloralin and pendimethalin and 4 to 6 inches for the other herbicides. A harrow should follow the field cultivator. The operating speed necessary to achieve a satisfactory incorporation will vary somewhat depending on the type of field cultivator but the speed 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.

11. A single incorporation with a power driven tiller is sufficient for butylate, cycloate, EPTC, fluchloralin and trifluralin. However, a second tillage at right angles to the initial incorporation should be done if the disk or field cultivator is used. The second incorporation has two purposes: a) Most of the herbicide left on the surface after the first incorporation will be

mixed into the soil with the second tillage, and b) the second tillage will give more uniform distribution of the herbicide in the soil which will improve weed control and may reduce crop injury.

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

THE SOIL ORGANIC MATTER TEST:

14. Certain 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 an effective herbicide rate. Herbicides such as atrazine, cycloate (Ro-Neet), EPTC (Eptam, Genep), linuron (Lorox) and pyrazon (Pyramin) require higher rates to be effective in high organic matter soils. However, crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, thereby reducing weed control. However, organic matter level generally affects herbicide performance more than clay content.
15. EPTC is used on sugarbeets, sunflower, dry beans and potatoes. Sugarbeets have marginal tolerance to EPTC, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussion on selecting an EPTC rate only gives guidelines. Other factors such as method of incorporation affect EPTC performance (immediate and thorough incorporation gives best performance). Rates must be adapted for individual conditions. The suggested spring-applied EPTC rate is 2 to 3 lb/A. The 3 lb/A rate should give good weed control without crop injury on a soil with a silty clay texture and more than 7 percent organic matter. The minimum rate of 2 lb/A may injure sugarbeets on a sandy loam or coarse-textured soil with less than 4 percent organic matter. The EPTC rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes. EPTC at 2.5 lb/A should give good weed control and little crop injury on clay loams or fine-textured soils with more than 5 percent organic matter.

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

FALL APPLICATION OF HERBICIDES:

17. Several herbicides may be applied in the fall for weed control the following spring. Included in this group are diallate (Avadex), EPTC (Eptam, Genep), triallate (Far-go) and trifluralin (Treflan). Trifluralin may be applied after September 1 and until soil freeze-up. Fall treatments of diallate (Avadex), EPTC (Eptam, Genep) and triallate (Far-go) should be applied after October 15 and until soil freeze-up. Application of herbicides after October 15 when soil temperature has cooled minimizes herbicide loss by volatilization, and microbial and chemical degradation. Both granular and liquid formulations of the herbicides are registered for use in the fall. Fall applications of granular formulations generally have given more effective weed control than the liquid formulations, especially under heavy crop residue situations.
18. Diallate (Avadex) applied at 1.25 to 2 lb/A in the fall controls wild oats. Diallate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent loss by evaporation. The liquid formulation of diallate may be applied in the fall for wild oats control in flax, barley and sugarbeets. The granular formulation of diallate is registered for use on sugarbeets only.
19. EPTC (Eptam, Genep) fall applied at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC must be incorporated into the soil immediately after application to prevent loss of herbicide. The liquid and granular formulations of EPTC may be applied in the fall for weed control in dry beans, flax, potatoes, sugarbeets and sunflower.
20. Triallate (Far-go) is applied at 1 to 1.25 lb/A in the fall. The liquid formulation may be applied at 1 lb/A and the granules at 1.25 lb/A for wild oat control in barley, wheat, and durum. Triallate performs best when incorporated immediately after application; however, triallate granules may be surface applied in the fall and incorporated with normal tillage operations the following spring. Fall surface applied triallate may perform less consistently than fall incorporated triallate. Research at North Dakota State University with fall applications indicates that at similar rates the granular formulation performs more effectively than the liquid formulation.
21. Trifluralin (Treflan) fall applied at 0.5 to 1 lb/A (depending on crop) gives good control of annual grasses

and broadleaf weeds except wild mustard. Incorporation may be delayed 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. The liquid or granular formulations may be applied in the fall for weed control in soybeans, safflower, dry beans, sunflower, flax, and wheat.

HERBICIDE COMBINATIONS:

22. The effect of postemergence herbicides often is increased when applied to areas already treated with a preemergence or preplant herbicide. Combinations of certain postemergence herbicides or preemergence 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.
23. All agricultural pesticides which are tank mixed should be registered for use as a mixture by the Environmental Protection Agency. Agricultural pesticides may be tank mixed if all pesticides in the mixture are registered by the Environmental Protection Agency on the crop being treated. However, users must assume liability for crop injury, inadequate weed control and illegal residues.

HERBICIDE-LIQUID FERTILIZER COMBINATIONS:

24. 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. Generally, mix 1 pint of fertilizer and 2 teaspoons of the liquid herbicide. For wettable powders, mix 2 teaspoons of powder with a small quantity of water to form a slurry, and add the slurry to the fertilizer. Close the jar and shake well. Watch the mixture for several seconds and check again 30 minutes later. If the mixture does not separate, the combination is compatible. If the mixture separates or gets very thick or syrupy, do not combine for field application. Mixing ability may be improved by adding a compatibility agent such as Compex or Unite. Different batches of fertilizer may differ in their mixing properties so should be tested separately.

HERBICIDE-DRY FERTILIZER COMBINATIONS:

25. Many preplant incorporated herbicides are registered for impregnation on dry bulk fertilizer. Ammonium sulfate, ammonium phosphate-sulfate, diammonium phosphate, potassium chloride, superphosphate, treble superphosphate, and urea are some of the approved fertilizer materials for impregnation. Impregnated fertilizer should be applied immediately and incorporated according to label instructions. Accurate spreader calibration and uniform fertilizer distribution are essential. Consult the herbicide label for

minimum amounts of fertilizer per acre and for maximum amounts of herbicide per given weight of fertilizer. Ranges of 200 to 400 lbs/A of dry bulk fertilizer are recommended to maintain uniformity of herbicide application.

HERBICIDE RESIDUE:

26. 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 which will give good weed control, by using band rather than broadcast applications, and by moldboard plowing before planting the next crop. Moldboard plowing reduces phytotoxicity by diluting the herbicide residue in a large volume of soil.
27. Herbicide residues 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 six large-seeded or 12 small-seeded uniform seedlings in each container. The containers should be placed in a warm place at about 70 to 75 F, and in direct sunlight. Observe the plants in the untreated check and test samples for two to three weeks after emergence. Some tangible measurements such as plant height and leaf length can be taken for evaluation, along with visual observation of abnormalities. Symptoms of some herbicides, like atrazine and metribuzin develop slowly after food reserves in the seed have been depleted so symptoms may not be apparent soon after emergence. The soil should be washed from the roots to observe root growth, especially for dinitroaniline herbicides such as fluchloralin (Basalin), pendimethalin (Prowl) and trifluralin (Treflan).
28. Atrazine generally has a residue the year following application to corn at 2 to 4 lb/A in North Dakota. If soil moisture is deficient, 1 lb/A of atrazine may cause injury to susceptible crops the following year. Corn and millet are tolerant to atrazine while other crops vary in susceptibility. The approximate ranking of other crops from most to least tolerant is flax, soybeans, barley, wheat, oats, sunflower and sugarbeets.
29. Fluchloralin (Basalin), pendimethalin (Prowl), benfen (Balan), and trifluralin (Treflan) are similar herbicides

called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than one year. Sunflower, soybeans, potatoes and dry edible beans are quite tolerant to dinitroaniline herbicides. The approximate ranking of other crops from most to least tolerant is flax, barley, wheat, corn, oats and sugarbeets.

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

30. Dicamba (Banvel) at 1 to 2 lb/A applied for perennial weed control may carryover in the soil. Corn and sorghum may be planted in the spring following applications made during the previous year. Wheat may be planted in the fall or spring following applications, but crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb/A of dicamba used, excluding days when ground is frozen. Research at North Dakota State University indicated that dicamba at 1 lb/A applied in late September caused some visible injury to wheat and barley planted the following spring, but the effect on yield was minimal. Barley generally is more susceptible than wheat to dicamba. Dicamba at 0.5 lb/A applied the previous fall prevented seed production by sunflower.
31. Picloram (Tordon) at 1/64 lb/A active ingredient (1 oz/A of formulated product) may carryover in the soil for more than 1 crop year. Only grass or grain crops such as small grains, corn, sorghum, or flax should be planted on fields treated with picloram the previous year. Sunflower, soybeans, dry edible beans and potatoes are especially susceptible to picloram.
32. Metribuzin (Lexone, Sencor) generally is used on soybeans in combination with other herbicides or is used on potatoes alone. No harmful metribuzin residues would be expected when used at 0.25 lb/A active ingredient. Rates over 0.5 lb/A may damage susceptible crops the next year. The approximate ranking of crops from most to least tolerant is potatoes, soybeans, dry edible beans, corn, barley, wheat, oats, sunflower, flax and sugarbeets.
33. Ethofumesate (Nortron) often has a residue the year following use on sugarbeets. The approximate ranking of crops from most to least tolerant is sunflower, soybean, corn, barley and wheat. Moldboard plowing usually will eliminate crop injury. Ethofumesate should be applied in a band to reduce cost and reduce potential crop injury from residues the following year.
34. Chlorsulfuron (Glean) at 1/128 lb/A active ingredient (1/6 oz/A of formulated product) or higher may carryover in the soil for more than three crop years. The most important factor influencing chlorsulfuron carryover in soil is pH. As soil pH increases, the rate of chlorsulfuron breakdown decreases. Chlorsulfuron should not be applied on soils with a pH above 7.5. Land previously treated with chlorsulfuron cannot be rotated to crops other than wheat, barley or oats until a field bioassay confirms that residues of chlorsulfuron are not present. The minimum recropping intervals are 0 months for wheat and 16 months for barley and spring oats. The approximate ranking of other crops from most to least tolerant is wheat, barley, oats, safflower, dry beans, sunflower, flax, corn, soybeans and sugarbeets.
35. Weed control in small grains is important to maximize yields. Broadleaf weeds, foxtails (pigeongrass), and wild oats infest small grains statewide. Several applications of different herbicides or mixtures may be required to control all weeds. Normal height wheat varieties, rye, and winter wheat are more competitive than semidwarf wheat and will increase the effectiveness of herbicides. All small grains are sensitive to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until the early boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from the fifth leaf to the early boot stage, are more tolerant than oats to 2,4-D applications. Oats are more tolerant to MCPA than to 2,4-D, but injury to oats is possible with either chemical at any growth stage. Use 2,4-D on oats only for such hard-to-kill weeds as Russian thistle, kochia, common ragweed, and redroot pigweed and when the crop is in the third to fourth leaf stage. While some injury to the oats can be expected, the better control of these weeds with 2,4-D usually will compensate for any yield loss caused by the chemical. Oat varieties vary in their tolerance to 2,4-D but wheat and barley varieties differ little in tolerance.
36. Dicamba (Banvel, Banvel II) at 0.06 to 0.12 lb/A controls wild buckwheat, smartweed and certain other broadleaf weeds in wheat and oats. Banvel is a 4 lb/gallon formulation and Banvel II a 2 lb/gallon formulation. Banvel at 0.12 to 0.25 pint = 0.06 to 0.12 lb/A and Banvel II at 0.24 to 0.5 pint = 0.06 to 0.12 lb/A. Dicamba can be applied alone but usually is applied with MCPA to increase control of wild mustard and other broadleaf weeds. Oats are more tolerant to dicamba than wheat. Both crops must be treated during the second through fourth leaf stage. Barley is more susceptible to injury from dicamba than wheat or oats. Dicamba can be applied in combination with 2,4-D to wheat in the 4 leaf stage.
37. 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 three through five leaf stage of crop growth. NOTE: Picloram should be used only on land that will be planted the following year to grass or grain crops including small grains, corn, sorghum, and flax. See herbicide residue section, paragraph 31.
38. Bromoxynil (Buctril, ME4 Brominal) controls wild buckwheat, fumitory and most annual broadleaf weeds in wheat, barley and oats from emergence of the crop to early boot. Mixtures of bromoxynil plus MCPA ester (Bronate, 3+3 Brominal) are applied from the 3 leaf to early boot stage to improve wild mustard control.
39. Chlorsulfuron (Glean) controls wild mustard, wild buckwheat, false chamomile, kochia and most annual broadleaf weeds in wheat preemergence or in wheat, barley and oats postemergence. Chlorsulfuron also suppresses growth of green and yellow foxtail when applied preemergence or early

postemergence (less than 2 inches tall). Postemergence applications of chlorsulfuron should be applied with surfactant WK or X-77 at 0.25% v/v (1 qt/100 gal of spray). Fall applications of chlorsulfuron (Glean) may be made to undisturbed stubble where straw is evenly spread, or after cultivation to a uniform soil surface. Do not moldboard plow. Tillage after application must be shallow. NOTE: See herbicide residue section, paragraph 34.

40. Small grains underseeded to sweetclover, alfalfa or other legumes cannot be treated with 2,4-D, MCPA, bromoxynil, dicamba or picloram at rates required to control most broadleaf weeds without seriously injuring or killing the legumes.

FOXTAIL CONTROL:

41. Foxtail commonly infests small grains in North Dakota. Foxtail usually is 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 foxtail than moldboard plowed fields. Moldboard plowing buries the foxtail seed which prevents emergence and reduces viable seed for subsequent years.
42. Diclofop (Hoelon) at 0.75 to 1.25 lb/A in wheat or soybeans or 0.75 to 1 lb/A in barley applied postemergence controls foxtail in addition to wild oats. The lower rate is for green foxtail and yellow foxtail with one to three leaves. The higher rates are for foxtail growing in dry conditions or for foxtail with three to four leaves. Research at NDSU has indicated green foxtail is more susceptible than yellow foxtail to diclofop. (See wild oats section for information on diclofop mixtures with other herbicides, paragraph 129.)
43. Propanil (Stampede 3E) at 1.5 lb/A should be applied to foxtail at the two to four leaf stage in four leaf or smaller hard red spring wheat. Applications to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased wheat injury. Propanil is not translocated, so good weed coverage by the spray is essential. Propanil should only be applied when temperatures at or after application are between 65 and 85 F and plants are in active growth with adequate soil moisture within 2 inches of the surface. Propanil also controls wild buckwheat, redroot pigweed, prostrate pigweed, common lambsquarters, wild mustard and kochia in the 2 to 4 leaf stage. 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. Propanil can be used in combination with MCPA for control of foxtail and broadleaf weeds in hard red spring wheat, durum and barley. See tables for rates and crop stages.
44. Trifluralin (Treflan) at 0.5 to 0.75 lb/A and harrow incorporated shallowly after seeding is labeled for foxtail (pigeongrass) control in wheat and barley. The lower rate is for use on coarse textured soils and the higher rate on fine textured soils. Incorporation should be by harrowing twice at right angles and the depth of incorporation of the herbicide must be above the wheat seed. The wheat should be seeded 2

to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semi-dwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trifluralin applied in this manner does not control wild oats. (See wild oats section for discussion on trifluralin-triallate combination, paragraph 124.)

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

VOLUNTEER SUNFLOWER:

46. Volunteer sunflower is often a problem in small grains seeded in the rotation the year after sunflower and occasionally the second year. Tillage practices distribute the sunflower seeds to various depths in the soil causing emergence over several days or weeks depending on climatic conditions. Judgment may be needed in determining the time of herbicide application. Early herbicide application would not control late emerging sunflower and late application would allow competition from the early emerged sunflower. Generally application should be before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.
47. Bromoxynil at 0.25 lb/A plus MCPA ester at 0.25 lb/A (3+3 Brominal, Bronate) give excellent control of volunteer sunflower. Treated sunflower appear severely burned within several days and die within about one week. Dicamba (Banvel, Banvel II) at 0.12 lb/A plus MCPA amine at 0.25 lb/A, 2,4-D or MCPA at 0.5 lb/A, and picloram (Tordon) at 1/64 to 1/43 lb/A plus 2,4-D or MCPA at 0.37 lb/A all give good control of volunteer sunflower. These treatments will cause the sunflower to stop growing shortly after treatment, but they may remain green and alive for several weeks or more, depending on climatic conditions and crop competition. The approximate order of effectiveness on volunteer sunflower from most to least effective is bromoxynil + MCPA, dicamba + MCPA, 2,4-D + picloram, 2,4-D and MCPA.

KOCHIA:

48. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. The proper rates and spray volumes of herbicides should be used to maximize control. Dicamba (Banvel, Banvel II) at 0.125 lb/A plus MCPA amine at 0.25 lb/A gives good kochia control. 2,4-D at 0.5 lb/A gives good kochia control, but good spray coverage is essential because 2,4-D does not translocate readily in kochia. Treatment should be to small plants (less than 3 inches tall) or large spray volumes should be used to penetrate the kochia foliage. MCPA is less effective for kochia control than 2,4-D. However,

MCPA at 0.5 lb/A will control small kochia. Bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A also gives good control of kochia, but plants should be small and spray coverage good. Picloram (Tordon) is not effective on kochia, but when combined with 2,4-D at 0.37 lb/A, especially the ester, control is good.

REDROOT PIGWEED:

49. Redroot pigweed is another important weed in small grains. Rates of most herbicides need to be higher for redroot pigweed control than for control of wild mustard. Dicamba at 0.12 lb/A plus MCPA at 0.25 lb/A, 2,4-D at 0.5 lb/A, bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A, and picloram at 1/64 to 1/43 lb/A plus 2,4-D at 0.37 lb/A all give good redroot pigweed control. MCPA is less effective than 2,4-D for redroot pigweed control. The esters of 2,4-D or MCPA are generally more effective than the amines for redroot pigweed control.

FALSE CHAMOMILE:

50. False chamomile is an important weed in small grains in north central and northeastern North Dakota. False chamomile is resistant to most of the herbicides used in small grains except chlorsulfuron (Glean). Fall or spring applications of chlorsulfuron at 1/128 lb/A give excellent control of false chamomile. Refer to paragraph 34 for information on chlorsulfuron use and residues. Bromoxynil at 0.37 lb/A plus MCPA at 0.37 lb/A gives fair to good control of small spring emerging false chamomile. The fall emerging plants which survive spring seedbed preparation are usually too large at treatment for adequate control. Thorough fall and spring tillage is essential to control fall emerged chamomile. False chamomile less than 6 inches tall in tree rows and around potholes can be controlled with paraquat at 0.5 lb/A with X-77 or other nonionic surfactant at 1 quart per 100 gallons of water. Glyphosate (Roundup) at 0.75 lb/A and amitrole (Amitrole T, Cytrol) at 1.5 lb/A control false chamomile less than 6 inches tall and can be used in tree rows and around potholes. Avoid drift to tree foliage when applying glyphosate or amitrole.

HARROWING FOR WEED CONTROL:

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

FLAX

52. Flax is less competitive with weeds than are small grains, and should be grown on relatively weed-free fields. Early after-harvest tillage of small grain stub-

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

53. EPTC (Eptam, Genep) fall applied at 4 lb/A controls annual grass weeds, including wild oats, and some broadleaf weeds in flax. Fall applied EPTC at 3 lb/A generally has given good control with less flax injury than 4 lb/A in coarse-textured soils. Incorporate EPTC immediately (within minutes) and thoroughly after application. (See paragraph 19 for incorporation discussion.) EPTC is the only soil applied herbicide for general weed control in flax. However, flax tolerance to EPTC is marginal. Stunted plants and stand reduction are symptoms of flax injury from EPTC. Usually flax yields will not be reduced because the remaining plants will recover, branch out and compensate for a thin stand. However, with severe injury the stand may be thinned to the point where yield is reduced. Each grower should try EPTC on a small acreage of flax on the lighter soils to determine if the benefits from the EPTC offset possible injury. Spring applied EPTC for flax was removed from registration.
54. Trifluralin (Treflan) at 0.5 to 1.0 lb/A may be fall applied for control of foxtails (pigeongrass) and some broadleaf weeds on ground to be planted to flax. Trifluralin is available in both liquid and granular formulations. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue is at a manageable level that will not interfere with incorporation. Seed flax less than 1.5 inches deep into a moist seedbed.
55. The flowable formulation of propachlor (Ramrod 4L) controls certain annual grasses and broadleaf weeds but is ineffective against wild oats, wild mustard and perennial weeds. Flax tolerance to propachlor is excellent. Propachlor incorporation will injure flax and reduce weed control.
56. MCPA at 0.25 lb/A on 2 to 6-inch flax controls most broadleaf weeds. MCPA amine rates higher than 0.25 lb/A and MCPA ester should be used in flax for im-

proved kochia and Russian thistle control. Picloram + MCPA amine enhances redroot pigweed and wild buckwheat control.

57. Bromoxynil (ME4 Brominal, Buctril) at 0.25 to 0.5 lb/A on 2 to 6-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some leaf burn may be observed at the higher rates or if high temperatures follow application. Mixtures of bromoxynil + MCPA may cause flax injury if applied under hot, humid conditions.
58. Dalapon (Dowpon) will control green and yellow fox-tail (pigeongrass) in young flax. Apply dalapon as soon as possible after flax is 1 inch tall and the weeds are less than 2 inches tall for best results. CAUTION: Spraying must be completed prior to 6 inches tall or the early bud stage, whichever is earlier, to minimize flax injury. Generally, dalapon is applied in a mixture with MCPA amine to control both the susceptible grass and broadleaf weeds with one application.

CORN

59. 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.
60. Most herbicides used in corn are labeled for tank mixing with other herbicides for broad spectrum weed control. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete list of all possible registered combinations.
61. Wild proso millet is an aggressive, competitive annual weed that is becoming a serious problem in some areas of eastern North Dakota. EPTC + Safener (Eradicane), EPTC + Safener + Extender (Eradicane Extra), alachlor (Lasso) or metolachlor (Dual) applied preplant incorporated at the full label rate for the soil type will give control of early germinating wild proso millet. However, these herbicides usually do not give season long millet control. EPTC + Safener + Extender may give slightly better control than EPTC + Safener since it is formulated with an extender which increases the soil life of the herbicide. For full season control of wild proso millet, a preplant incorporated treatment of EPTC + Safener or EPTC + Safener + Extender can be followed with a delayed preemergence application of cyanazine (Bladex), cyanazine (Bladex) plus alachlor (Lasso) or metolachlor (Dual), or an early post application of cyanazine (Bladex 80W) or pendimethalin (Prowl) plus cyanazine (Bladex 80W) (corn at 2-leaf stage or smaller).

PREEMERGENCE:

62. Atrazine (AAtrex, Atrazine) at 2 to 4 lb/A gives good control of annual weeds without crop injury. Fine textured soils with high organic matter require a 4 lb/A

application. Atrazine residues injurious to susceptible crops may remain in soils longer than one growing season. (See paragraph 28 in herbicide residue section for additional discussion). Atrazine is registered as a tank mixture with alachlor (Lasso), cyanazine (Bladex), metolachlor (Dual), propachlor (Propachlor, Ramrod), simazine (Princep) and simazine plus paraquat.

63. Alachlor (Lasso) and metolachlor (Dual) at 2 to 3 lb/A are used preplant incorporated or preemergence for control of annual grasses and certain broadleaf weeds such as redroot pigweed, common lambsquarters and common ragweed. Use the higher rate on clay soils high in organic matter. Incorporation improves weed control with alachlor and metolachlor. Alachlor is registered as a tank mixture with atrazine, dicamba (Banvel, Banvel II), cyanazine (Bladex), glyphosate (Roundup), paraquat and simazine. Metolachlor is registered as a tank mixture with atrazine, cyanazine, dicamba or with atrazine plus paraquat or glyphosate. Metolachlor may be applied up to 45 days before planting.
64. Propachlor (Propachlor, Ramrod) applied preemergence at 4 to 5 lb/A controls annual grasses and some broadleaf weeds but is ineffective against wild mustard or perennial weeds. Propachlor generally has given weed control superior to alachlor and metolachlor in North Dakota State University experiments. Propachlor is registered as a tank mixture with atrazine.
65. Butylate plus Safener (Sutan +, Genate +) at 3 to 6 lb/A preplant incorporated, controls annual grasses and some broadleaf weeds. Butylate is a volatile herbicide and must be incorporated immediately following application. Safener increases the tolerance of corn to butylate. Butylate generally is tank mixed with another herbicide to provide broad spectrum weed control. Butylate is registered as a tank mixture with atrazine (AAtrex, Atrazine) and cyanazine (Bladex).
66. Cyanazine (Bladex) at 2 to 3.2 lb/A preemergence controls annual grasses and broadleaf weeds in corn. Cyanazine requires more than 0.5 inch of rain for activation, especially on fine textured soils. Cyanazine has a short soil residual permitting normal crop rotations. Mixtures of cyanazine with metolachlor, propachlor, alachlor and EPTC improve grassy weed control. Cyanazine alone gives poor to fair redroot pigweed control. Alachlor and cyanazine are difficult to mix. For best results, premix the cyanazine as a slurry, fill the spray tank at least half full of water and while the pump and agitator are running, add the cyanazine. Once the cyanazine is completely suspended in the water, add the alachlor while filling the tank with water to the desired level. Cyanazine is registered as a tank mixture with alachlor (Lasso), atrazine (AAtrex, Atrazine), butylate (Sutan +, Genate +), metolachlor (Dual) and paraquat.
67. Dicamba (Banvel, Banvel II) at 0.25 to 0.5 lb/A applied preemergence in tank mixtures with alachlor, metolachlor or pendimethalin gives broad spectrum weed control. Banvel is a 4 lb/gal formulation and Banvel II is a 2 lb/gal formulation. Banvel at 0.5 to 1.0 pint = 0.25 to 0.5 lb/A and Banvel II at 1.0 to 2.0 pints = 0.25 to 0.5 lb/A. The mixture is not recommended on coarse-textured sandy soils. Use the lower rate of

dicamba on medium silt loams with 2 percent or less organic matter.

68. EPTC plus Safener (Eradicane) and EPTC plus Sagener plus Extender (Eradicane Extra) at 4 to 6 lb/A control grasses and certain broadleaf weeds. EPTC at 6 lb/A gives fair to good quackgrass control. Safener increases the tolerance of corn to EPTC. The Extender extends EPTC soil life under certain conditions. Soil should be dry enough and in good tilth to permit immediate and thorough incorporation. EPTC + Safener and EPTC + Safener + Extender are registered as a tank mixture with atrazine and cyanazine. EPTC + Safener + Extender is more effective on wild proso millet than EPTC + Safener when soils have been conditioned for rapid EPTC breakdown.
69. Linuron (Lorox) at 0.75 to 1.5 lb/A applied preemergence controls annual broadleaf weeds and some annual grasses. Rates of linuron are dependent upon soil texture and percent organic matter. Use the low rate on sandy or low organic matter soils. Linuron is registered as a tank mixture with alachlor, atrazine and propachlor.
70. Pendimethalin (Prowl) at 1.5 to 2 lb/A controls annual grasses and certain broadleaf weeds such as redroot pigweed. Do not use pendimethalin on sands or loamy sands or on soils with less than 1.5 percent organic matter. Pendimethalin is registered as a tank mixture with atrazine, cyanazine and dicamba.

POSTEMERGENCE:

71. Atrazine at 1 lb/A applied to broadleaf weeds less than 4 inches tall or at 2 lb/A applied to grasses less than 1 inch tall gives good annual grass control (including wild oats) and excellent control of broadleaves (including volunteer sunflower) when used in combination with petroleum oil concentrate or crop origin oil. Crop origin oils at 1 quart/A with atrazine give weed control equal to petroleum oil concentrate at 1 quart/A with atrazine. Surfactants and wetting agents are less effective with atrazine than any of the oil additives. Refer to herbicide residue section, paragraph 28, for carryover precautions.
72. Cyanazine (Bladex 80W or 90DF) is labeled at 1.2 to 2 lb/A with 1 qt/A of an emulsifiable crop origin oil (Bio-Veg or Midland EV) as an early postemergence treatment for grass and broadleaf weed control (including volunteer sunflower). Only the 80W or 90DF formulations are registered for postemergence weed control. Cyanazine at 1.2 lb/A with 1 quart per acre of crop origin oil has given good control of small weeds (less than 1.5 inches tall). Higher rates will give more consistent weed control but also increase the possibility of corn injury. Occasionally corn leaf burn occurs, but recovery is good. Corn should not be treated after the four-leaf stage or during extended cold, wet conditions. Cyanazine is unlikely to carryover and cause crop injury the next year. The 1.2 lb/A rate in fine-textured soils only controls emerged weeds.
73. 2,4-D amine at 0.25 to 0.5 lb/A applied postemergence to corn 3 to 8 inches tall will control broadleaf weeds. 2,4-D at 0.25 lb/A will control susceptible weeds like wild mustard. The 0.5 lb/A rate will control the more resistant weeds (including volunteer sunflower) but corn may be injured. Do not use MCPA, as it is more

injurious to corn than 2,4-D. When corn is over 8 inches tall, application of 2,4-D with drop nozzles reduces crop injury by avoiding treatment of upper leaves and whorl. Corn sprayed with 2,4-D may become brittle, with the result that stalks may bend or break.

74. Dicamba (Banvel, Banvel II) at 0.12 to 0.25 lb/A, either alone or in a mixture with 2,4-D amine at 0.25 lb/A, can be applied postemergence in corn. Dicamba gives better control of Canada thistle, smartweed, wild buckwheat and volunteer sunflower than 2,4-D with less injury to corn. Dicamba can be applied until corn is 3 feet tall or until 15 days before tassel emergence, whichever comes first. Drop nozzles should be used after corn is 8 inches tall to reduce dicamba drift and to reduce injury if dicamba is applied with 2,4-D.
75. Bromoxynil (Buctril, ME4 Brominal) at 0.25 lb/A on 3 to 20 inch corn controls seedling wild buckwheat, volunteer sunflower, and most annual broadleaf weeds. Some leaf burn may occur when high temperatures follow application of bromoxynil. Bromoxynil is a contact herbicide so thorough spray coverage is essential for adequate weed control.
76. See discussion under soybeans for the use of bentazon (Basagran) on corn.
77. Emergency control of broadleaf and grass weeds in corn can be obtained with directed applications of ametryn (Evik) or linuron (Lorox). Ametryn at 2 to 2.5 lb/A or linuron at 0.6 to 1.5 lb/A should be applied as a directed spray to the weeds. A nonionic surfactant should be used with both herbicides. Application over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply ametryn before corn is 12 inches high and linuron before corn is 15 inches high. The weeds should not be more than 6 inches tall.

SOYBEANS

78. 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.
79. Most herbicides used in soybeans are labeled for tank mixing with other herbicides for broad spectrum

weed control. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete listing of registered combinations.

80. Wild proso millet is an aggressive, competitive annual weed that is becoming a serious problem in some areas in eastern North Dakota. In soybeans, trifluralin (Treflan), fluchloralin (Basalin), or pendimethalin (Prowl) will suppress wild proso millet. For long term control, however, a preplant incorporated treatment of any of these herbicides should be followed with a delayed preemergence application of alachlor (Lasso), metolachlor (Dual), or chloramben (Amiben), or a postemergence application of fluzifop (Fusilade) or sethoxydim (Poast) (see tables for rates). Preplant incorporated treatments of alachlor (Lasso) or metolachlor (Dual) applied alone or in combination with chloramben (Amiben) at the full label rate for the soil type have also given acceptable wild proso millet control in some trials.
81. Fluchloralin (Basalin), ethalfluralin (Sonalan), pendimethalin (Prowl) and trifluralin (Treflan) are dinitroaniline herbicides applied preplant incorporated for control of annual grasses and broadleaf weeds except wild mustard, common cocklebur and sunflower. Proper timing and depth of incorporation for each herbicide are essential as requirements differ.
82. Fluchloralin (Basalin) at 0.5 to 1.5 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. The low rate should be used on coarse-textured, sandy soils. Incorporate in the top 1.5 to 3 inches of soil within 8 hours of application. Fluchloralin is registered as a tank mixture with metribuzin.
83. Ethalfluralin (Sonalan) at 0.5 to 1.3 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. The low rate should be used on coarse-textured, sandy soils. Incorporate in the top 2 to 3 inches of soil within 2 days of application. Ethalfluralin is registered as a tank mixture with chloramben, alachlor, metolachlor, or metribuzin. No rotational restrictions apply to ethalfluralin up to the 1.3 lb/A rate. Ethalfluralin has less soil residue than trifluralin.
84. 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 if rainfall does not occur within seven days after application improves control. Pendimethalin is registered as a tank mixture with chloramben, linuron, and metribuzin.
85. Trifluralin (Treflan) at 0.5 to 1 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. Set the implement at a 4 to 6-inch depth to uniformly disperse trifluralin into the top 2 to 3 inches. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Do not plant soybeans deeper than 2 inches. Trifluralin is registered as a tank mixture with metribuzin and bifenox.
86. Alachlor (Lasso) and metolachlor (Dual) at 2 to 3 lb/A give good preemergence control of annual grasses and some broadleaf weeds, including redroot pigweed and common lambsquarters but are ineffective against wild mustard. Apply the higher rate on clay soils high in organic matter. Soybeans have good tolerance to metolachlor and alachlor and incorporation improves the consistency of weed control. Alachlor and metolachlor are registered as a tank mixture with chloramben, linuron plus paraquat, linuron plus glyphosate, metribuzin plus glyphosate and naptalam plus dinoseb. Alachlor is also registered as a tank mixture with dinoseb (Premerge).
87. Chloramben (Amiben) at 2 to 3 lb/A is applied preemergence to control most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at North Dakota State University indicates that incorporation of chloramben improves the consistency of wild mustard control. Chloramben is registered as a tank mixture with alachlor, dinoseb, linuron, metolachlor, metribuzin, pendimethalin and trifluralin.
88. Linuron (Lorox) at 0.5 to 1.5 lb/A applied preemergence controls most annual broadleaf weeds. Weed control and crop injury with linuron are greatly influenced by soil texture and organic matter. Linuron is most effective on coarse-textured low organic matter soils. Use rates recommended on the label for various soil types. Linuron should be used in combination because rates of linuron needed for grass control often cause soybean injury. Linuron is registered as a tank mixture with alachlor, chloramben, pendimethalin, and propachlor (only on soybeans grown for seed).
89. Metribuzin (Sencor, Lexone) at 0.19 to 0.37 lb/A controls annual broadleaf weeds, especially wild mustard. **The rate is critical.** Consult the label for the proper rate based on soil type, pH, and percent organic matter. Maple Amber soybeans are susceptible to metribuzin. Seed soybeans 2 inches below the soil surface to reduce possible injury. Soybean injury also can be reduced by using herbicide combinations with lower rates of metribuzin. Metribuzin is registered as a tank mixture with alachlor, fluchloralin, metolachlor, alachlor plus paraquat, paraquat, pendimethalin and trifluralin.
90. Acifluorfen (Blazer) at 0.37 to 0.5 lb/A postemergence controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the high rate is needed for nightshade, smartweed and common cocklebur. Acifluorfen will not adequately control volunteer sunflower. Acifluorfen kills primarily by contact action, thus for effective control, applications should be to actively growing 1 to 4-inch weeds and first to second trifoliolate soybeans. Soybeans beyond the 3rd trifoliolate leaf stage may intercept the spray pattern and prevent spray coverage of the weeds. Application should be made by ground sprayer delivering a minimum of 20 gallons per acre at 40 psi. Do not make application during periods of moisture stress, frost, flooding, wind damage or unseasonably cool or hot temperatures as weed control may be reduced or crop injury increased. Best

results are obtained with applications at maximum daytime temperatures of 70 to 85 F. Do not apply if rain is expected within six hours after application as weed control is reduced. Drift control agents, liquid fertilizers, and other pesticides should not be mixed with acifluorfen. Surfactants should be used with acifluorfen except under conditions outlined on the label. A nonionic surfactant (80% active ingredient) should be added to the tank at the rate of 1/8 percent. Do not apply within 50 days of harvest or use treated plants for feed or forage.

91. Bentazon (Basagran) at 0.75 to 1.5 lb/A postemergence controls many broadleaf weeds. In North Dakota good wild mustard control has been obtained with a 0.5 lb/A when wild mustard is small (less than 4 inches tall) and when used with an oil additive. For volunteer sunflower control, apply 0.75 lb/A to plants less than 5 inches and 1.0 lb/A to plants 5 to 8 inches tall. Addition of oil to bentazon improves weed control. Bentazon at 1 lb/A with oil additive gives good control of common lambsquarters less than 1½ inches tall and fair to good control of redroot pigweed less than 1½ inches tall. Soybean leaf burn occurs occasionally from bentazon application, but recovery is good. For Canada thistle control apply 1 lb/A when the plants are 8 inches tall to bud stage and make a second application at 1.0 lb/A 7 to 10 days later.
92. Dinoseb (Premerge) at 1.5 lb/A applied early postemergence to soybeans in the cracking to crook stage has controlled wild mustard. Dinoseb has been an effective supplement to preemergence herbicides which give poor wild mustard control. Application at the cracking stage kills emerged weeds and may provide some residual control of wild mustard that emerges shortly thereafter. Dinoseb kills weeds rapidly and is more effective at temperatures above 75 F.
93. Dinoseb plus naptalam (Dyanap) at 0.38 to 1 + 0.75 to 2 lb/A may be applied before soybeans are 20 inches tall. Use only 0.38 to 0.5 + 0.75 to 1 lb/A when soybeans are at the first trifoliolate leaf stage. Weeds 3 inches tall or less are most susceptible. However, weeds 3 to 6 inches tall may be controlled with the maximum rate. Research at North Dakota State University has indicated that volunteer sunflower 10 to 12 inches tall has been controlled. Applications should be made in 8 to 10 gallons per acre water by ground with 60 to 70 psi spray pressure and in at least 5 gallons per acre water by air. A ground spray boom should be 3 feet above the soybean tops and an airplane boom should be 10 to 15 feet high. Application should not be made to wet foliage. Do not use a surfactant or oil additive.
94. Fluazifop (Fusilade) at 0.125 to 0.25 lb/A + oil concentrate at 1 qt/A or nonionic surfactant at 0.25% v/v can be applied in soybeans for annual and perennial grass control. Fluazifop at 0.125 lb/A will control volunteer corn and wild proso millet. Fluazifop at 0.25 lb/A will control wild oats, foxtail and volunteer small grains. Quackgrass with at least 4 leaves but less than 10 inches tall can be suppressed with fluazifop at 0.25 lb/A. If regrowth occurs, a second application of 0.25 lb/A can be applied when quackgrass regrowth has 3 to 5 leaves. Do not mix fluazifop with herbicides, other pesticides, or liquid fertilizers.

95. Sethoxydim (Poast) at 0.1 to 0.5 lb/A plus oil concentrate will control annual and perennial grasses. Application rates for several grass species are 0.1 lb/A for wild proso millet, 0.2 lb/A for volunteer corn, green foxtail, yellow foxtail, and barnyardgrass, and 0.3 lb/A for wild oats and volunteer cereals. Quackgrass 6 to 8 inches tall can be suppressed with sethoxydim at 0.5 lb/A. Quackgrass regrowth should be treated with 0.3 lb/A. Cultivation between 14 and 21 days after application will improve quackgrass control. Mixing desmedipham (Betanex) desmedipham + phenmedipham (Betamix), endothall (H-273), acifluorfen (Blazer) or bentazon (Basagran) with sethoxydim has generally reduced wild oats control and occasionally reduced foxtail control compared to sethoxydim plus oil concentrate alone. Also, oil concentrate has frequently increased crop injury when combined with desmedipham, desmedipham + phenmedipham, endothall, or acifluorfen. Bentazon is registered for combination with sethoxydim + oil but the sethoxydim rate must be increased by 50%.
96. Naptalam + 2,4-DB at 1 to 1.5 + 0.03 to 0.045 lb/A may be applied for salvage control of common cocklebur, giant ragweed, and volunteer sunflower 10 inches or taller in soybeans. Apply after first bloom of soybeans because earlier application may cause soybean injury. Apply with a nonionic surfactant or oil concentrate at 0.5% v/v (2 qt/100 gal spray solution). Applications should be made in 10 to 25 gallons per acre water (by ground) with 40-50 psi spray pressure and nozzles 18 to 24 inches above the weeds. Avoid drift to susceptible crops like sunflowers.

DRY, EDIBLE BEANS

97. See discussion under soybeans for use of bentazon (Basagran), paragraph 91; chloramben (Amiben), paragraph 87; dinoseb (Premerge), paragraph 92; ethalfuralin (Sonalan), paragraph 83; pendimethalin (Prowl), paragraph 84; and trifluralin (Treflan), paragraph 84. The rate of bentazon in dry beans should not exceed 1.0 lb/A. The use of oil with bentazon may increase dry bean injury. Alachlor at 2 to 3 lb/A preplant incorporated controls annual grasses and some broadleaf weeds. Metolachlor at 2 to 3 lb/A preplant incorporated or preemergence controls annual grasses and some broadleaf weeds. Metolachlor may be tank mixed with EPTC for wild oats control.
98. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus pendimethalin at 0.5 to 1.5 lb/A controls a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats, lambsquarters, and black nightshade. The EPTC - pendimethalin mixture must be incorporated thoroughly into the top 2 to 3 inches of soil immediately after application by setting the implement at a 4 to 6 inch depth. Do not use on flat podded beans such as soybeans.
99. EPTC (Eptam, Genep) at 2.0 to 3.0 lb/A plus trifluralin (Treflan) at 0.5 lb/A is a tank mixture to control a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats and black nightshade and reduces the chance of trifluralin carryover. The EPTC-trifluralin mixture must be incorporated thoroughly into the top 2 to 3 inches of soil immediately after ap-

plication by setting the implement at a 4 to 6 inch depth. Do not use this combination in soybeans.

100. 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.

LENTILS

101. Lentils are poor competitors with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when plants are 3 to 7 inches high.
102. Triallate (Far-go) at 1.25 lb/A or diallate (Avadex) at 1.5 lb/A can be applied for wild oats control before or after seeding lentils. Diallate and triallate are both volatile and must be incorporated into the soil immediately after application.
103. Propham (ChemHoe) applied preplant incorporated at 4 lb/A will control wild oats and volunteer grains. Lentils should be planted not later than 1 to 2 days after propham incorporation with an implement set 4 inches deep.
104. Barban (Carbyne 2EC) applied postemergence to lentils at 0.37 lb/A will control wild oats. Application should be made when wild oats seedlings are in the 1½ to 2 leaf stage and within 30 days after lentil emergence. Do not allow livestock to graze treated fields until after harvest.

SUNFLOWER

105. See discussion under soybeans for use of fluchloralin (Basalin) (paragraph 82).
106. Weeds usually are a problem as sunflower does not develop ground cover rapidly enough to prevent weeds from becoming established. Since weeds generally emerge before the sunflower, cultivating with a spiketooth or coil spring harrow about 1 week after sowing but prior to germination of the crop will kill many weeds. After sunflower reaches the four to six-leaf stage, weeds may be controlled in the row by using a harrow or rotary hoe. Cultivation will control weeds between the rows.
107. EPTC (Eptam, Genep), fluchloralin (Basalin), pendimethalin (Prowl) and trifluralin (Treflan) are preplant incorporated herbicides. See paragraphs 7 to 12 for discussion on herbicide incorporation. Fluchloralin and trifluralin are applied on sandy soil at 0.5 lb/A. EPTC should be applied and incorporated immediately to prevent herbicide loss. EPTC is registered at 3 lb/A for sunflower but this rate occasionally has caused sunflower injury on coarse-textured, low organic matter soils. The risk of sunflower injury from EPTC can be reduced on these soils by using 2 to 2.5 lb/A. EPTC has given more effective control of wild oats in sunflower than fluchloralin, pendimethalin and trifluralin. EPTC, pendimethalin, and trifluralin are labeled for tank mixing with chloramben (Amiben) to improve wild mustard control.

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

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

SUGARBEETS

110. See discussion under soybeans for use of sethoxydim (Poast), paragraph 95.
111. Herbicides may be used in sugarbeets to supplement cultural practices. Hand labor, mostly hoeing, may be needed for optimum weed control but can be reduced or eliminated by timely cultivations and herbicide applications. Herbicides not in the sugarbeet narrative are discussed in the table.
112. Herbicides are commonly used as tank mixtures on sugarbeets. Some herbicide combinations such as pyrazon (Pyramin) plus TCA and desmedipham plus phenmedipham (Betamix) are registered for use as tank mix combinations, but many other tank mixes are not registered. Herbicides may be tank mixed legally if all herbicides in the mixture are registered for use on sugarbeets. However, the user must assume liability for any resulting crop injury, inadequate weed control, or illegal and/or harmful residues.
113. EPTC (Eptam, Genep) preplant incorporated in the spring at 2 to 3 lb/A or in the fall at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC sometimes causes a sugarbeet stand reduction and temporary stunting. However, if enough sugarbeets remain to obtain an adequate plant population after thinning, no yield reduction will result. Use EPTC with extreme caution on sugarbeets grown in sandy loam or lighter soils with low organic matter levels because predicting a safe rate on such soils is difficult. See paragraph 15 on the soil organic matter test. Herbicides such as TCA, diallate (Avadex), cycloate (Ro-Neet), ethofumesate (Nortron) or pyrazon (Pyramin) plus TCA cause less sugarbeet injury on the low organic matter soils where EPTC injury may be excessive.
114. TCA at 4.7 to 7.1 lb/A gives good control of green and yellow foxtail. Research has indicated that shallow incorporation generally will not reduce the weed control from TCA and under low rainfall conditions will improve weed control. TCA and diallate as a tank mix-

ture can be applied with shallow incorporation for wild oats and foxtail control. Incorporation may reduce grass control from TCA if excessive rain follows application especially on the more coarse-textured soils. TCA should not be incorporated on low organic matter, coarse-textured soils where injury to sugarbeets is possible. Research results have demonstrated that TCA used in combination with or over the top of EPTC often gives improved grass and broadleaf control compared to either herbicide alone. TCA plus EPTC should only be used on higher organic matter, fine-textured soils since the combination has greater injury potential than either herbicide alone.

115. Endothall (Herbicide 273) at 0.75 to 1.5 lb/A gives good postemergence control of wild buckwheat, smartweed and sunflower. Endothall should be applied when temperatures are between 60 and 80 F and soil moisture is good to excellent. Endothall generally gives poor weed control when weeds are drought stressed.
116. Ethofumesate (Nortron) at 2 to 3.75 lb/A gives good control of several broadleaf and grass weeds. Ethofumesate is particularly effective on redroot pigweed and wild buckwheat but is weak on yellow foxtail. Generally, ethofumesate should be used with a herbicide like TCA, cycloate (Ro-Neet), or fall-applied EPTC for improved grass control. Ethofumesate is not registered for fall application so ethofumesate would be used as a spring overlay to fall-applied EPTC. Ethofumesate may be applied preemergence but research results in North Dakota and Minnesota have shown incorporation improved weed control. Tillage at 2 to 4 inches gave slightly better weed control compared to 1 inch. Band application of ethofumesate reduces cost and soil residue, thus a tool for band incorporation is needed. See paragraph 33 on ethofumesate residue. Ethofumesate plus TCA has been relatively safe on sugarbeets but use of ethofumesate with cycloate or fall-applied EPTC can cause sugarbeet injury especially on coarse-textured soils. Ethofumesate plus spring-applied EPTC has been especially injurious to sugarbeets and should only be used on silty clay soils with over 6 percent organic matter.
117. Diethatyl (Antor) spring applied at 4 to 6 lbs/A gives good to excellent control of redroot pigweed and prostrate pigweed. Diethatyl may be applied preemergence but tests in North Dakota and Minnesota showed that incorporation generally improved weed control. Operating the tillage tool 2 inches deep often gave better weed control than operating the tillage tool 4 inches deep. Thus, deep incorporation of diethatyl should be avoided unless diethatyl is combined with EPTC or cycloate. Operating the tillage tool 4 inches deep did not reduce weed control from diethatyl + EPTC or diethatyl + cycloate combinations. Preemergence diethatyl will give good weed control if adequate rain follows application.
118. Desmedipham (Betanex) and desmedipham plus phenmedipham (Betamix) are postemergence herbicides for the control of annual broadleaf weeds. Sugarbeet injury occasionally occurs from desmedipham and phenmedipham. Sugarbeets with four true leaves are significantly less susceptible to injury than smaller sugarbeets and they gain additional tolerance with increased size. Desmedipham at

0.32 to 0.5 lb/A or desmedipham plus phenmedipham at 0.16 to 0.25 plus 0.16 to 0.25 may be applied to sugarbeets with less than four leaves. Applications totalling 0.5 lb/A or less should be followed by a second application in 5 to 7 days if living weeds are present after 5 days. Split application with reduced rates has reduced sugarbeet injury and increased weed control compared to a single full dose application. Risk of sugarbeet injury is reduced by starting application in late afternoon so cooler temperatures follow application while risk is increased by factors such as recent flooding, high temperature, and especially a sudden change from a cool, cloudy environment to a hot, sunny environment.

119. Trifluralin (Treflan) at 0.75 lb/A or EPTC (Eptam, Genep) at 3 lb/A can be used on sugarbeets after thinning for annual grass and broadleaf weed control. Broadcast and incorporate immediately with cultivators or tillage tools adjusted to mix the herbicides thoroughly with soil in the row without damaging the sugarbeets. The crop should be clean cultivated before application since established weeds are not controlled. Late germinating weeds can become a problem in sugarbeets with early seeding or when good moisture conditions prevail well into the season.

LEGUME ESTABLISHMENT

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

WILD OAT CONTROL

121. Wild oats are difficult to control because the plants shatter their seeds before crops are harvested and because seed dormancy causes delayed germination. Wild oats is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist.
122. Diallylate (Avadex) at 1.25 to 2 lb/A is applied preplant for wild oats control in flax, sugarbeets, potatoes, soybeans, forage legumes, corn, lentils or peas and after planting barley, flax, soybeans, corn, lentils or peas. Diallylate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent losses by evaporation. See paragraph 18 for fall application of diallylate.
123. Diallylate (Avadex) at 1.25 lb/A applied preplant incorporated in the spring will control wild oats in newly seeded alfalfa. Wild oats in flax or barley underseeded with alfalfa can be controlled with preemergence incorporated diallylate at 1.25 lb/A in the spring.
124. Triallylate (Far-go) at 1 to 1.5 lb/A is applied preplant or preemergence incorporated for wild oats control in wheat, durum, barley, peas, lentils or annual canarygrass. Triallylate is volatile and must be incor-

porated immediately after application. The liquid formulation has given more consistent wild oats control with less crop thinning than the granular formulation when spring applied. See paragraph 20 for fall application of triallate. Triallate at 1 lb/A also may be applied in combination with trifluralin (Treflan) at 0.5 to 0.75 lb/A for both wild oats and foxtail control in wheat, durum and barley after seeding.

125. Barban (Carbyne 2EC) for postemergence control should be applied when the majority of the wild oats are in the 1.5 to 2-leaf stage, which generally occurs nine days after emergence. Barban at 0.25 to 0.5 lb/A can be applied to spring and winter wheat, and barley; at 0.25 to 0.37 lb/A to durum wheat, flax and peas; at 0.37 lb/A to safflower, lentils, soybeans and mustard grown for oil; at 0.5 to 1 lb/A to sunflower and at 0.75 to 1 lb/A to sugarbeets. Thick, vigorous stands of crop plants help suppress wild oats and enhance the control obtained with barban. Crop competition is important for wild oats control; therefore, control may not be satisfactory in thin crop stands. Barban application is not affected by barley and wheat crop stage. Treat flax before the 12-leaf stage, and soybeans, lentils, mustard, sunflower, and sugarbeets within 30 days of crop emergence. Barban should not be mixed with nor applied within 4 days of 2,4-D, MCPA or dicamba because wild oats control will be reduced. Bromoxynil mixed with barban has at times reduced wild oats control.

126. Barban may be mixed with 1 gallon per acre aqueous nitrogen for control of wild oats in wheat and barley. This treatment has increased wild oats control in North Dakota tests especially when the plants were growing under low fertility or drought stress. The barban-aqueous nitrogen solution must be mixed with water for application. Addition of a surfactant at 0.5% v/v may prevent compatibility problems. Consult the herbicide/fertilizer combination narrative in paragraphs 24 to 25 regarding compatibility tests.

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

128. Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the 3 to 5-leaf stage. Difenzoquat is cleared for use in barley, durum wheat (except Vic, Edmore, Lakota and Wascana), winter wheat and Butte, Era, Kitt, Olaf, Solar, Coteau, Walera, Pro-Brand 711, Pro-Brand 715, Marshall, Wheaton, Oslo, Pioneer 2369, Pondera, Marberg, Fortuna and Stoa hard red spring wheat. Wild oats are more susceptible at the 5-leaf than the 3-leaf stage of growth and control also is improved by good crop competition. The high rate should be used on high populations of 3-leaf wild oats. Wheat injury may occur at temperatures above 80 F. Certain hard red spring wheat varieties have been nearly as susceptible to difenzoquat as wild oats, including Len, Waldron, Alex, James, and Aim, so use difenzoquat only on

wheat varieties listed on the label. Research at North Dakota State University has also indicated that Vic and Edmore durum wheat varieties may be injured by difenzoquat. Difenzoquat may be mixed with bromoxynil, MCPA, MCPA plus bromoxynil, 2,4-D, or chlor-sulfuron for broadleaf weed control without loss of wild oats control.

129. 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 control of 1 to 4-leaf wild oats. The higher rate of diclofop should be used to control wild oats in the 3 to 4-leaf stage or when the plants are growing under moisture stress. Oil additive at 1 qt/A will provide more consistent control, especially under moisture stress conditions. Wild oats control with diclofop generally is better when cool rather than warm temperatures follow application. Diclofop should not be mixed with any herbicide other than bromoxynil. Research results at North Dakota State University indicate that application of diclofop and herbicides other than bromoxynil should be separated by four days or wild oats control will be reduced. For additional information on control of foxtail in small grains, see paragraphs 41-42.

PERENNIAL WEED CONTROL

130. Fall herbicide treatments are more effective than spring or summer treatments for controlling perennial weeds. The optimum time of treatment usually is between August 20 and September 10, but treatments later in September can be successful if most weed stem and leaf tissue has not been killed by frost. Weeds such as field bindweed, leafy spurge and Canada thistle should have 12 inches or more of stem tissue before treatment for adequate leaf area to absorb the herbicide. Mowing or tillage is a good means of reducing perennial weed seed production but should be discontinued in mid-July to allow adequate plant regrowth by herbicide treatment time. Postharvest treatments can be used when weed growth has reached approximately one foot of stem tissue. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment and swathing should be separated by at least 5 days for adequate herbicide translocation.

PERENNIAL WEEDS IN SMALL GRAINS:

131. Canada thistle, perennial sowthistle and field bindweed can be controlled in tolerant crops with MCPA or 2,4-D. Perennial weed control systems should include herbicide application in the crop followed by postharvest treatment for several years. When controlling thistles in small grains except oats, apply the maximum rate of 2,4-D or MCPA the crop will tolerate: 0.75 lb/A of 2,4-D or MCPA amine and 0.66 lb/A of 2,4-D low volatile ester or MCPA ester. MCPA is as effective on Canada thistle as 2,4-D but MCPA is less likely to cause injury to small grain crops than 2,4-D. Cereals more tolerant to 2,4-D such as rye, wheat and barley should be grown if high herbicide rates are planned for controlling hard-to-kill annual or perennial weeds in crops. MCPA can be used to suppress thistles in oats and flax. However, these crops do not tolerate rates of MCPA necessary to give adequate thistle control.

132. Glyphosate (Roundup) at 1.5 to 3.75 lb/A may be applied for spot treatment of perennial weeds in wheat, barley, oats, corn and soybeans. Spot treatments must be made prior to the heading stage of small grains, initial pod set on soybeans and silking of corn. Glyphosate is a nonselective postemergence herbicide so the crop in the treated area will be killed, and care must be taken to avoid drift outside the target area. Glyphosate does not have a soil residual, so plants arising from seed after treatment or unaffected underground rhizomes or roots of perennials will continue to grow. See the perennial weed control section of the tables for application stages and rates.

PERENNIAL WEEDS IN PASTURE:

133. Picloram (Tordon) controls broadleaf perennial weeds such as leafy spurge, field bindweed, Canada thistle and Russian knapweed on rangelands and permanent grass pastures. Rates of 1 to 2 lb/A give good control of these weeds and are economical for spot treatment. Picloram at 0.25 to 0.5 lb/A postemergence will suppress the growth of perennial broadleaf weeds. Retreatment at the same rates may be necessary the following year. The most cost effective broadcast treatment for leafy spurge control is picloram at 0.25 lb/A + 2,4-D at 1 lb/A applied annually for three to five years.
134. Picloram is toxic to most broadleaf plants. Spray drift in small amounts may cause damage to sensitive plants. Alfalfa, dry beans, soybeans, potatoes, safflower, sunflower, sugarbeets and vegetable crops are highly susceptible to picloram. Picloram is water soluble and may leach in the soil; consequently, do not apply in areas where a sandy porous surface and substrata overlay ground water 10 feet or less below the surface. Do not apply or allow picloram spray drift into running water (including wells) irrigation ditches for drainage or near shelterbelts, shrubs or trees. When picloram has been applied at 0.5 lbs/A or more, do not cut grass for feed within two weeks after treatment. Meat animals grazing for up to two weeks after treatment should be removed from treated areas three days prior to slaughter. Do not graze dairy animals on treated areas within two weeks after treatment. Picloram is excreted in the urine, so do not transfer livestock from treated grass areas onto sensitive broadleaf crop areas for 12 months after application without first allowing 7 days of grazing on untreated grass.
135. 2,4-D low volatile ester at 1 to 2 lb/A can be used to control many perennial weeds in pastures. Some perennials such as fringed sagebrush and western snowberry (buckbrush) can be controlled with one application, but many perennials such as Canada thistle, field bindweed and leafy spurge require retreatment annually. 2,4-D can be used in many locations where picloram cannot be used, except 2,4-D drift onto sensitive plants such as trees should be avoided. Dairy cows cannot be grazed on treated areas for 7 days after treatment.
136. Dicamba at 0.5 to 8 lb/A can be used to control some perennial weeds, especially weeds that are resistant to 2,4-D, or for some areas where soil residual of picloram may cause problems. Dicamba at 0.5 to 1 lb/A will control some perennials but annual retreatment is required for many perennial weeds. Long term control generally is achieved with 4 to 8 lb/A but the high rates are economical only for spot treatment. Dicamba has a shorter soil residual than picloram, but should not be applied where desirable broadleaf plants or trees may be damaged by dicamba leached to the root system. Do not graze meat animals in treated fields within 30 days of slaughter. The required delay between treatment and grazing of dairy animals or cutting for hay varies with rate from 7 to 90 days, so the label should be consulted for this information. For control of perennial broadleaf weeds after harvest or during fallow, dicamba can be tank mixed with 2,4-D or glyphosate. Tank mix dicamba at 0.5 to 2 lb/A with glyphosate at 0.75 to 1.5 lb/A. In situations where a short waiting period requires the lower rate of dicamba, tank mix with the higher rates of glyphosate.
137. The wiper-type applicators are a new method of applying picloram for leafy spurge control in pastures. The wiper-type applicators include carpet-wick, canvas-wick and roller applicators but not rope-wick applicators. Research at North Dakota State University has shown that leafy spurge control with picloram applied with a wiper applicator was similar to picloram broadcast at 1.0 lb/A. The solution concentration applied with the wiper applicator should be 1 part picloram (Tordon 22K):3 to 7 parts water. The more concentrated solution has been more effective when leafy spurge densities are high. The wiper height should be adjusted to contact most of the leafy spurge stems. Application can be made any time after the leafy spurge is 15 to 20 inches tall until freezing temperatures occur in the fall. The amount of picloram applied has been reduced 50 to 70% when using the wiper applicator in dense infestations as compared to picloram broadcast at 2 lb/A. Retreatment with 2,4-D at 1 to 2 lb/A may be necessary the following year to control seedlings.

CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

138. Paraquat, a nonselective contact herbicide, can be used at 0.5 lb/A alone or at 0.25 to 0.5 lb/A in combination with a residual herbicide as a substitute for tillage. Paraquat may be applied before or after planting until just before crop emergence. Apply paraquat in 5 to 10 gallons per acre of water by air or in 20 to 60 gallons per acre of water by ground. Add Ortho X-77 to the spray solution at 0.5 to 1 pint per 100 gallons. Paraquat can be used on land intended for barley, corn, potatoes, soybeans, sugarbeets, sunflower and wheat. Paraquat is corrosive to exposed aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is toxic so avoid contact with the skin; small amounts could be fatal if swallowed.
139. Glyphosate (Roundup) is applied postemergence for annual weed control in reduced tillage situations at 0.19 to 0.75 lb/A. Glyphosate at 0.19 to 0.37 lb/A must be used in combination with a nonionic surfactant of at least 50% active ingredient at 0.5% v/v. Glyphosate at 0.19 lb/A controls foxtails, 0.29 lb/A controls volunteer small grains, and 0.38 lb/A controls wild oats and downy brome when applied to

plants less than 4 inches tall. Use a higher rate on larger weeds, more resistant weeds, or if plants are under moisture stress. When low rates of glyphosate are used, apply in 3 to 10 gallons of water per acre by ground or 3 to 5 gpa by air. Delay tillage for at least three days after treatment. Apply glyphosate at 0.75 lb/A when quackgrass is at least 8 inches tall (3 to 4-leaf stage) and actively growing. Apply glyphosate at 1.5 to 2.25 lb/A when Canada thistle is actively growing and at or before the bud stage. Fall treatment of Canada thistle must be applied before frost for best results. Do not till until three 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, beets, wheat, and sorghum (milo), or in the fall when these crops will be planted the next growing season.

140. For postharvest or fallow weed control in minimum till situations research at North Dakota State University has shown that dicamba at 0.125 to 0.25 lb/A or 2,4-D at 0.5 lb/A can be tank mixed with glyphosate at 0.19 to 0.38 lb/A. Add a nonionic surfactant at 0.5% v/v to the spray solution. The low rate of dicamba should be used if winter wheat will be planted the fall following treatment. Low rates of dicamba or 2,4-D plus glyphosate should be used only when weeds are less than 4 inches tall and actively growing. Use glyphosate at 0.38 lb/A if weeds are drought stressed or greater than 4 inches tall.

141. Cyanazine (Bladex 80W) is applied preemergence at 2.4 to 3.2 lb/A to control annual weeds on fallow for future planting to wheat, barley, oats, sorghum or corn. Bladex 4L is ineffective because of adsorption to plant residues. Cyanazine is a short residual herbicide so carryover to succeeding crops is unlikely. Rainfall is required for activation of cyanazine. Generally 0.5 inch will be adequate if the soil is wet to a depth of 1.5 to 2 inches. Whenever possible, cyanazine should be applied at a time when rainfall can be expected within about 10 days. A late fall application about two weeks ahead of expected soil freeze-up will result in adequate control of early germinating weeds the following spring and generally has been more effective than spring applications. Spring applications of cyanazine should be made as soon as practical after the soil thaws to take advantage of early spring rains for activation and to move the herbicide into the soil before weeds germinate. If winter annual or annual weeds have emerged, a tank mix of paraquat and cyanazine should be applied because cyanazine does not adequately control emerged weeds.

142. A tank mixture of cyanazine at 2 to 2.8 lb/A plus atrazine at 0.4 to 0.5 lb/A is labeled in North Dakota

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

143. Protham (ChemHoe 135) can be applied at 3 to 4 lb/A for control of downy brome, wild oats and volunteer grain in fallow. The higher rate of application is for use on medium and fine-textured soils. Protham should be applied in the fall after soil temperatures have cooled to 50 F or cooler in the upper inch of soil. The lower temperature reduces herbicide loss by volatility and degradation by soil microbes. Precipitation after protham application is necessary for effective weed control.

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

145. Trifluralin (Treflan) granules at 0.75 to 1.0 lb/A may be applied to ground that has manageable trash levels to control foxtails (pigeongrass) and certain broadleaf weeds. Rates depend upon time of application.

Trifluralin (Treflan) Rates Per Acre

Application Date	lb/A	
	(Active Ingredient)	Trifluralin (granular)
April 15 to May 31	1.0	10
June 1 to June 30	0.9	9
July 1 to July 31	0.8	8
August 1 to August 31	0.6	6

The first incorporation is required within 24 hours after application. The second incorporation and subsequent tillage may be done whenever necessary to destroy uncontrolled weeds during the remainder of the fallow year.

CHEMICAL WEED CONTROL For Field Crops

Hard Red Spring Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged an- nual grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant.	139
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)			A nonselective, postemer- gence herbicide. No soil resi- dual activity. Apply with X-77. Good coverage is essential. Restricted use herbicide.	138
Triallate (Far-go)	1 (1 qt)	Wild oats	Three days or more prior to seeding or immediately after seeding.	Preplant incorpo- rated with field cultivator set to cut 4 inches deep. Postplant incor- porate with harrow set shallower than seed depth.	13, 124
	1 liquid (1 qt) 1.25 granule (12.5 lb10G)		Fall-after October 15 and until freeze-up.	Keep spring tillage depth to minimum. Triallate granules may be surface ap- plied in the fall.	13,20
Triallate (Far-go) + Trifluralin (Treflan)	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	Immediately after seeding	Plant wheat 2 to 2.5 inches deep. Incorporate herbicide shallowly twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches.	13, 124
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Foxtails (pigeongrass)			12,44
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E) (5 to 7.5 lb 10G)	Foxtails (pigeongrass)	Fall - after September 1 and until freeze-up	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Wheat stand reduction may occur.	8,10, 21,29, 45
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broadleaf weeds and suppression of foxtails	Preemergence	See narrative for ro- tational restrictions. Do not apply on soils above pH 7.5. Shallow tillage may be used after application.	34,39
	1/64 (1/3 oz)		Fall		
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 1.5 pt)	Wild buck- wheat, volun- teer sun- flower, and most broadleaf weeds	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best re- sults. Weak on wild mustard.	38,47, 48,49

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

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

Hard Red Spring Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril or 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	Wild buck-wheat, volunteer sunflower, and most broadleaf weeds	Crop-3rd leaf until just prior to boot	Apply when weeds are in early seedling stage for best results. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	38,47 48,49
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.38 (1 to 1.5 fl oz. + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buck-wheat and most broad-leaf weeds	Crop-3rd through 5th leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	31,37, 47,48, 49
Dicamba (Banvel, Banvel II) + 2,4-D amine	0.06 + 0.25 (0.12 pt 4S or 0.24 pt 2S + 0.5 pt of 4 lb/gal conc.)	Wild buck-wheat and most broadleaf weeds	Crop-4 leaf stage only	Proper timing of application is important to avoid crop injury.	36
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-5th leaf until just prior to boot	Do not apply from early boot to dough stage. Use 0.5 lb/A for volunteer sunflower and kochia.	35,40, 47,48, 49
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)	Broadleaf weeds	Crops-emergence until just prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sunflower and kochia.	35,40, 47,48, 49
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 oz)	Most broadleaf weeds and suppression of foxtails	Crop in 2 to 3 leaf stage and prior to boot, weeds-small, less than 2 inches tall or 2 inches in diameter	Apply with surfactant WK or X-77 at 0.25% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	34,39
Dicamba (Banvel, Banvel II) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S or 0.24 to 0.5 pt 2S) + (0.5 to 0.75 pt of 4 lb/gal MCPA)	Wild buck-wheat and most broad-leaf weeds	Crop-2nd through 4th leaf stage	Commercial mixture available (Mondak, 1.25 lb dicamba + 2.5 lb MCPA per gallon). Use less dicamba and more MCPA on larger wheat.	36,47, 48,49
Propanil (Stampede)	1.5 (4 pts)	Green and yellow foxtail and certain annual broadleaf weeds	Weeds-2 to 4 leaf, crop-2nd through 4th leaf	Application to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased wheat injury.	43
Propanil (Stampede) + MCPA isooctyl ester	0.9 to 1.12 + 0.25 (2.5 to 3 pt + 0.5 pt of 4 lb/gal MCPA)	Green and yellow foxtail and annual broad-leaf weeds			
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and and fox-tail	Grass weeds-1 to 4 leaves	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves. Oil improves consistency of weed control under dry conditions. Do not mix with any herbicide except bromoxynil. Restricted use herbicide.	42, 129

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

Hard Red Spring Wheat

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal , Buctril)	0.75 to 1.25 + 0.25 (2 to 3.3 pt + 0.5 pt ME4 or 1 pt Buctril)	Wild oats, foxtail, broadleaf weeds	Grass weeds-1 to 4 leaves and small broadleaf weeds	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves. Do not use oil additive with this mixture.	38,40, 41,42, 129
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2-leaf stage	Wild oats usually develops to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer.	125, 126, 127
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5 leaf stage	Control decreases as wild oats stage increases.	
Barban (Carbyne 2EC) + diclofop (Hoelon 3EC)	0.25 to 0.38 + 0.25 to 0.50 (1 to 1.5 pt + 0.67 to 1.3 pt)	Wild oats and foxtail	Wild oats in 1½ to 4 leaf stage	Low rates of diclofop in combination with barban may result in reduced foxtail control.	42,125, 126, 127
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	Wild oats in 3 to 5 leaf stage	Cleared on Butte, Era, Kitt, Olaf, Solar, Coteau, Walera, Pro-Brand 711, Pro-Brand 715, Marshall, Wheaton, Oslo, Pioneer 2369, Pondera, Marberg, Stoa and Fortuna Wheat. Use high rate on high populations of 3-leaf wild oats. Can be applied with 2,4-D, MCPA amine, bromoxynil or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	128
Barban (Carbyne 2EC) + Difenzoquat (Avenge)	0.25 + 0.25 to 0.5 (1 pt + 1 to 2 pints)	Wild oats	Wild oats in 1½ to 5 leaf stage	Cleared on Butte, Era, Kitt, Olaf, Solar, Coteau, Walera, Pro-Brand 711, Pro-Brand 715, Marshall, Wheaton, Oslo, Pioneer 2369, Pondera, Marberg, Fortuna and Stoa.	125, 126, 127, 128
Difenzoquat (Avenge) + Chlorsulfuron (Glean)	0.62 to 1 + 1/128 to 1/43 (2.5 to 4 pt + 1/6 to 1/2 oz 75 DF)	Wild oats, most broad- leaf weeds and suppres- sion of foxtails	Crop in 2 to 3 leaf stage until just prior to boot, broadleaf weeds - small, less than 2 inches tall. Wild oats in 3 to 5 leaf stage	Cleared on Butte, Era, Kitt, Olaf, Solar, Coteau, Walera, Pro-Brand 711, Pro-Brand 715, Marshall, Wheaton, Oslo, Pioneer 2369, Pondera, Marberg, Fortuna and Stoa. Use only on land to be planted to wheat or barley for two years or more following ap- plication. Do not apply on soils above pH 7.5.	34, 39, 128

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

Durum Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with nonionic surfactant.	139
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)			A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77. Good coverage is essen- tial. Restricted use herbicide.	138
Triallate (Far-go)	1 (1 qt)	Wild oats	Spring-3 or more days prior to seeding or im- mediately after seeding	Preplant incorporate with field cultivator set to cut 4 inches deep. Postplant in- corporate with harrow set shallower than seed depth.	13, 124
	1 liquid (1 qt) 1.25 granule (12.5 lb 10G)		Fall-after October 15	Keep spring tillage depth to minimum. Triallate granules may be surface applied in the fall.	13, 20
Triallate (Far-go) + Trifluralin (Treflan)	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	In spring-immedi- ately after plant- ing	Plant wheat 2 to 2.5 inches deep. Incorporate herbicide shallowly twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches.	13, 124
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Foxtails (pigeongrass)			12,44
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E) (5 to 7.5 lb 10G)	Foxtails (pigeongrass)	Fall-after September 1 and until freeze-up	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Wheat stand reduction may occur.	8,10, 21,29, 45
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broad- leaf weeds and supres- sion of foxtails	Preemergence	See narrative for rotational restrictions. Do not apply on soils above pH 7.5. Shallow tillage may be used after application.	34,39
	1/64 (1/3 oz)		Fall		
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 1.5 pt)	Wild buck- wheat, volun- teer sun- flower, and most broadleaf weeds	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	38,47, 48,49
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-emergence until just prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sunflower and kochia.	35,40, 47,48, 49
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 oz)	Most broad- leaf weeds and suppres- sion of fox- tails	Crop in 2 to 3 leaf stage until just prior to boot, weeds-small, less than 2 inches tall or 2 inches in diameter	Apply with surfactant WK or X-77 at 0.25% v/v. See narra- tive for rotational re- strictions. Do not apply on soils above pH 7.5.	34,39

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Durum Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Dicamba (Banvel , (Banvel II)+ MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S or 0.24 to 0.5 pt 2S + 0.5 to 0.75 pt of 4 lb/gal MCPA)	Wild buck- wheat and most broad- leaf weeds	Crop-2nd through 4th leaf stage	Commercial mixture available (Mondak, 1.25 lb dicamba + 2.5 lb MCPA per gallon). Use less dicamba and more MCPA on larger wheat.	36,47, 48,49
Propanil (Stampede) + MCPA isooc- tyl ester	1.125 + 0.25 (3 pt + 0.5 pt)	Green and yel- low foxtail and annual broadleaf weeds	Weeds-2 to 4 leaf stage, crop 2nd through 3rd leaf	Application to foxtail larger than 3 leaves or durum larger than 3 leaves may result in reduced weed control or in- creased crop injury.	43
Bromoxynil (ME4 Brominal , Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril or 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	Wild buck- wheat, volun- teer sun- flower, and most broad- leaf weeds	Crop-3rd leaf and until just prior to boot	Apply when weeds are in early seedling stage for best re- sults. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sun- flower control better than 0.5 lb/A of 2,4-D.	38,47, 48,49
Dicamba (Banvel , Banvel II)+ 2,4-D amine	0.06 + 0.25	Wild buck- wheat and most broad- leaf weeds	Crop-4 leaf stage	Proper timing of application is important to avoid crop injury.	36
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-5th leaf until just prior to boot	Do not apply from early boot to dough stage. Use 0.5 lb/A for volunteer sunflower and kochia.	35,40, 47,48, 49
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and foxtail	Grass weeds-1 to 4 leaves	Use higher rates for dry conditions or grass weeds with 3 to 4 leaves. Oil im- proves consistency of weed control under dry conditions. Do not mix with any herbicide except bromoxynil. Restricted use herbicide.	129
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal , Buctril)	0.75 to 1.25 + 0.25 (2 to 3.33 pt + 0.5 pt ME4 or 1 pt Buctril)	Wild oats, fox- tail, broadleaf weeds	Grass weeds-1 to 4 leaves and small broadleaf weeds	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves.	38,40, 41,42, 129
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2- leaf stage	Wild oats usually develops to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer.	125, 126, 127
Barban (Carbyne 2EC) + diclofop (Hoelon 3EC)	0.25 to 0.38 + 0.25 to 0.50 (1 to 1.5 pt + 0.67 to 1.3 pt)	Wild oats and foxtail	Wild oats in 1½ to 4-leaf stage	Low rates of diclofop in com- bination with barban may result in reduced foxtail control.	42,125, 126, 127
Barban (Carbyne 2EC) + Difenzoquat (Avenge)	0.25 + 0.25 to 0.5 (1 pt + 1 to 2 pints)	Wild oats	Wild oats in 1½ to 5-leaf stage	Should not be used on Lakota, Wascana, Vic and Edmore durum Varieties	125, 126, 127, 128

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

Durum Wheat

Herbicide	Act. Incred. lb/A (Formulation:A)*	Weeds	When to Apply	Remarks	Refer- ence**
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	3 to 5-leaf stage of wild oats	Should not be used on Lakota, Wascana, Vic and Edmore durum varieties. Use high rate on high populations of 3-leaf wild oats. Can be applied with 2,4-D, MCPA amine, bromox- ynil or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	128
Difenzoquat (Avenge) + Chlorsulfuron (Glean)	0.62 to 1 + 1/128 to 1/43 (2.5 to 4 pt + 1/6 to 0.5 oz 75 DF)	Wild oats, most broadleaf weeds and suppression of foxtails	Crop in 2 to 3-leaf stage and prior to boot, broadleaf weeds, small, less than 2 inches tall. Wild oats in 3 to 5- leaf stage	Should not be used on Lakota, Wascana, Vic and Edmore durum varieties. Use only on land to be planted to wheat or barley for two years or more following appli- cation. Do not apply on soils above pH 7.5.	34, 39, 128

Winter Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with nonionic surfactant.	139
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)			A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77. Good coverage is essential. Restricted use herbicide.	138
Triallate (Far-go)	1.25 (1.25 qt) (12.5 lb 10G)	Wild oats	Before or after seeding	Preplant incorporated with field cultivator set to cut 4 inches deep. Postplant incorporate with harrow set shallower than seed depth.	20
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt, 1 to 1.5 pt)	Wild buck- wheat, vol- unteer sun- flower and most broadleaf weeds.	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	38,47, 48,49
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril, 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	Wild buck- wheat, volunteer sun- flower, and most broadleaf weeds	In spring prior to boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall. Commercial mixtures (3 + 3 Brominal & Bronate) are available.	38,46 48,49
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buck- wheat and most broad- leaf weeds	In spring after resumption of active crop growth and be- fore early boot stage	Do not apply in the fall. Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	31,37, 47,48, 49

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

Winter Wheat

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and foxtail	Grass weeds- 1 to 4 leaves; before jointing of wheat	Use higher rates for dry conditions or grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil. Restricted use herbicide.	129
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril)	0.75 to 1.25 + 0.25 (2 to 3.3 pt + 0.5 pt ME4 or 1 pt Buctril)	Wild oats, foxtail, broadleaf weeds	Grass weeds- 1 to 4 leaves; small broadleaf weeds; before jointing of wheat.	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves.	38,40, 41,42, 129
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2-leaf stage. Crop stage is not applicable.	Wild oats usually develops to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer.	125, 126, 127
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5-leaf stage	Control decreases as wild oats stage increases.	
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	3 to 5-leaf stage of wild oats	Use high rate on high populations of 3-leaf stage wild oats. Can be applied with chlorsulfuron, 2,4-D, MCPA amine, bromoxynil, or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	128
Chlorsulfuron (Glean)	1/128 to 1/64 (1/6 to 1/3 oz)	Most broad-leaf weeds and suppression of fox-tails	Preemergence	See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	34,39
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 oz)		In spring, crop in 2 to 3 leaf stage and until just prior to boot; weeds-small, less than 2 inches tall or 2 inches in diameter	Apply with surfactant WK or X-77 at 0.25% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	In spring when wheat is well tillered but prior to boot stage	Do not apply from early boot to dough stage. Do not apply in the fall.	35,40, 47,48, 49
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)		In spring from 4-leaf stage and prior to early boot		
Dicamba (Banvel, Banvel II) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S or 0.24 to 0.5 pt 2S + 0.5 to 0.75 pt of 4 lb/gal MCPA)	Wild buck-wheat and most broad-leaf weeds	In spring after winter dormancy but before wheat begins to joint	Commercial mixture (Mondak) is available. Do not apply in the fall.	36,47, 48,49
Dicamba (Banvel, Banvel II) + 2,4-D amine	0.06 + 0.25 (0.12 pt 4S or 0.24 pt 2S + 0.5 pt of 4 lb/gal 2,4-D amine)			Do not apply in the fall.	36

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Barley

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged an- nual grasses and broad- leaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity. Apply with nonionic surfac- tant.	139
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)			A nonselective, postemer- gence herbicide. No soil resi- dual activity. Apply with X-77. Good coverage is essential. Restricted use herbicide.	138
Triallate (Far-go)	1.25 (1.25 qt)	Wild oats	Before or after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation.	8,13, 121
	1.25 liquid (1.25 qt) 1.25 to 1.5 granule (12.5 to 15 lb 10G)		Fall-after October 15	Keep spring tillage to a minimum. The lower rate has generally given adequate con- trol. Triallate granules may be surface applied in the fall.	8,13, 20
Diallate (Avadex)	1.25 (1.25 qt)		After planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation. Restricted use her- bicide.	8,13, 121
			Fall-after October 15 and until freeze-up	Keep spring tillage depth to minimum. Restricted use herbicide.	13,18
Triallate (Far-go) + Trifluralin (Treflan)	1 (1 qt) + 0.5 (1 pt 4E)	Wild oats and foxtails (pigeongrass)	In spring-immedi- ately after plant- ing	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or diamond harrow to depth of 1 to 1.5 inches.	13,122
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Foxtails (pigeongrass)	After planting	Plant barley 2 to 3 inches deep. Incorporate shallowly twice with flex-tyne or dia- mond harrow to depth of 1 to 1.5 inches.	44
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E, 5 to 7.5 lb 10G)		Fall-after September 1	Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall. Stand reduction may occur.	7,10, 21,29, 44
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 1.5 pt)	Wild buck- wheat, volun- teer sun- flower, and most broadleaf weeds	Crop-emergence and prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	38,47, 48,49
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 oz)	Most broad- leaf weeds and suppres- sion of fox- tails	Crop in 2 to 3 leaf stage and prior to boot, weeds-small, less than 2 inches tall or 2 inches in diameter	Apply with surfactant WK or X-77 at 0.25% v/v. See narrative for rotational restrictions. Do not apply on soils above pH 7.5.	34,39

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Barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Propanil (Stampede) + MCPA iso- octyl ester	1.125 + 0.25 (3 pt + 0.5 pt)	Green and yellow fox- tail (pigeon- grass), and some annual broadleaf weeds	Weeds 2 to 4- leaf stage, crop 2 to 4-leaf stage	Application to foxtail larger than 3 leaves or barley larger than 4 leaves may result in re- duced weed control or increased crop injury.	43
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (1 pt Buctril + 0.5 pt ME4 Brominal + 0.5 pt of 4 lb/gal MCPA)	Wild buck- wheat, volun- teer sun- flower and most broad- leaf weeds	Crop-3rd leaf and prior to boot	Apply when weeds are in early seedling stage for best results. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	38,47, 48,49
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4 lb/ gal conc.)	Wild buck- wheat and most broad- leaf weeds	Crop-3rd through 5th-leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorg- hum or flax. Picloram is a restricted use herbicide.	31,37, 47,48, 49
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-5th leaf and prior to boot	Do not apply from early boot to dough stage. Barley more susceptible than wheat. Use 0.5 lb/A for volunteer sunflower and kochia.	35,40, 47,48, 49
MCPA amine or MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt of 4 lb/gal conc.)		Crop-emergence and prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sun- flower and kochia.	35,40, 47,48, 49
Diclofop (Hoelon)	0.75 to 1 (2 to 2.7 pt)	Wild oats and foxtail	Grass weeds-1 to 4 leaves	Use the higher rate for dry conditions on grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil. Restricted use herbicide.	128
Diclofop (Hoelon) + Bromoxynil (ME4 Brominal, Buctril)	0.75 to 1 + 0.25 (2 to 2.7 pt + 0.5 pt ME4 Brominal or 1 pt Buctril)	Wild oats, fox- tail and annual broadleaf weeds	Grass weeds in 1 to 4 leaf stage and small broadleaf weeds	Use the higher rate for dry conditions or grass weeds with 3 to 4 leaves.	38,40, 41,42, 129
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats in 2- leaf stage	Wild oats usually develops to the 2-leaf stage 9 days after emergence. Wild oats control improves with the addi- tion of 1 gal/A of aqueous nitrogen fertilizer.	125, 126, 127
	0.5 (2 pt of 2 lb/gal conc.)		Wild oats in 2.5 to 3.5-leaf stage	Control decreases as wild oats stage increases.	
Barban (Carbyne 2EC) + diclofop (Hoelon 3EC)	0.25 to 0.38 + 0.25 to 0.50 (1 to 1.5 pt + 0.67 to 1.3 pt)	Wild oats and foxtail	Wild oats in 1½ to 4-leaf stage	Low rates of diclofop in combination with barban may result in reduced foxtail control.	42,125, 126, 127
Barban (Carbyne 2EC) + Difenzoquat (Avenge)	0.25 + 0.25 to 0.5 (1 pt + 1 to 2 pints)	Wild oats	Wild oats in 1½ to 5-leaf stage	Cleared on all barley varieties.	125, 126, 127, 128

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Barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Difenzoquat (Avenge)	0.62 to 1 (2.5 to 4 pt)	Wild oats	3 to 5-leaf stage of wild oats	Cleared on all barley varieties. Use high rate on high popula- tions of 3-leaf wild oats. Can be applied with chlorsulfuron, 2,4-D, MCPA amine, bromox- nyl, or MCPA plus bromoxynil.	128
Difenzoquat (Avenge) + Chlorsulfuron (Glean)	0.62 to 1 + 1/28 to 1/43 (2.5 to 4 pt + 1/6 to 1/2 oz 75 DF)	Wild oats, most broad- leaf weeds and suppres- sion of foxtails	Crop in 2 to 3-leaf stage and prior to boot, broadleaf weeds, small, less than 2 inches tall. Wild oats in 3 to 5-leaf stage.	Use only on land to be planted to wheat or barley for two years or more following appli- cation. Do not apply on soils above pH 7.5.	34,39, 128

Oats

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged an- nual grasses and broad- leaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant.	139
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Oats-emergence to boot	Early jointing stage most sus- ceptible. Possible injury to oats at any growth stage. Use 0.5 lb/A for volunteer sunflower.	35,40, 47,48, 49
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt) (1 to 1.5 pt)	Wild buck- wheat, vol- unteer sun- flower, and most broadleaf weeds.	Crop-emergence until just prior to boot	Apply when weeds are in early seedling stage for best results. Weak on wild mustard.	38,47, 48,49
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (0.5 pt ME4 or 1 pt Buctril plus 0.5 pt of 4 lb/gal MCPA)	Wild buck- wheat, vol- unteer sun- flower and most broad- leaf weeds	Oats-3rd leaf to boot stage	Apply when weeds are in early seedling stage for best results. Commercial mixtures (3 + 3 Brominal & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	38,47, 48,49
Chlorsulfuron (Glean)	1/128 to 1/43 (1/6 to 1/2 oz)	Most broadleaf weeds and suppression of foxtails	Crop in 2 to 3- leaf stage and prior to boot. Weeds- small, less than 2 inches tall or 2 inches in diameter	Apply with surfactant WK or X-77 at 0.25% v/v. See nar- rative for rotational restric- tions. Do not apply on soils above pH 7.5.	34,39
Picloram (Tordon 22K) + MCPA amine	1/64 to 1/43 + 0.25 to 0.37 (1 to 1.5 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buck- wheat and most broad- leaf weeds	Oats-3rd through 5th-leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	31,37, 47,48, 49
Dicamba (Banvel, Banvel II) + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt 4S or 0.24 to 0.5 pt 2S + 0.5 to 0.75 pt of 4 lb/gal MCPA)		Oats-2nd through 4th- leaf stage	Commercial mixture is avail- able. (Mondak, 1.25 lb dicamba + 2.5 lb MCPA). Use less di- camba and more MCPA on larger oats.	37,47, 48,49

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Rye

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D amine or 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	In spring when rye is well tillered but prior to early boot stage.	Do not apply from early boot to dough stage. Do not apply in the fall.	35,40, 47,48, 49
MCPA amine or MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)		In spring from 4-leaf stage and prior to early boot		
Bromoxynil (ME4 Brominal, Buctril)	0.25 to 0.38 (0.5 to 0.75 pt (1 to 2 pt)	Wild buckwheat and other broad-leaf weeds	In spring prior to early boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall.	38,46, 48,49
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 + 0.25 (0.5 pt ME4 or 1 pt Buctril + 0.5 pt of 4 lb/gal MCPA)	Wild buckwheat and other broad-leaf weeds	In spring prior to early boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall. Commercial mixtures (3 + 3 Brominal & Bronate) are available.	38,46, 48,49

Small Grain Pre-Harvest

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D L.V. ester	0.75 to 1.5 (1.5 to 3 pt of 4 lb/gal conc.)	Broadleaf weeds	Crop-dough stage to harvest	Use only when weeds may interfere with harvest operations. Do not feed straw to livestock. CAUTION: Drift to broadleaf crops is hazardous at this time.	131

Flax

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant incorporated, fall or spring	Operating incorporation implement 4 to 6 inches deep does not reduce wild oats control. Restricted use herbicide.	13,18, 122
EPTC (Eptam, Genep)	4 (4.5 pt 7E, 40 lb 10G)	Grass and some broad-leaf weeds	Fall incorporated after October 15 until freeze-up	Flax safety is marginal. Weak on wild mustard.	10,19, 53

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Flax

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Trifluralin (Treflan)	0.5 to 1.0 (1 to 2 pt 4E or 5 to 10 lb 10G)	Grass and some broad- leaf weeds	Fall, incorporated	Use higher rates on fine- textured soils. Incorporate once in fall within 24 hours after application. Keep spring tillage depth shallower than fall.	8,10, 21,29, 52,54
Propachlor	4 (4 qt)	Grass and certain broad- leaf weeds	Preemergence	Ineffective against wild mustard and wild oats.	55
Barban (Carbyne 2EC)	0.25 to 0.37 (1 to 1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and before 12-leaf stage of crop	Wild oats usually develops to the 2-leaf stage 9 days after emergence.	125, 126
Bromoxynil (Buctril, ME4 Brominal)	0.25 to 0.5 (1 to 2 pt Buctril, 0.5 to 1 pt ME4)	Wild buck- wheat and certain broad- leaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Weak on wild mus- tard. Flax injury is possible.	57
Dalapon (Dowpon)	0.75 (1 lb)	Annual grasses except wild oats	Best results ob- tained when flax is over 2 inches and weeds are under 2 inches tall	Mix MCPA or MCPA + picloram with dalapon to control broad- leaf and annual grassy weeds. Under drought conditions, grass control is poor and flax injury may occur.	58
MCPA	0.25 (0.5 pt of 4 lb/ gal conc.)	Broadleaf weeds	Flax—2 to 6 inches tall	Use MCPA ester or higher rates of MCPA amine for hard- to-kill weeds. Early application less injurious to flax.	56
Picloram (Tordon 22K) + MCPA amine	1/64 + 0.25 (1 fl oz. + 0.5 pt of a 4 lb/gal conc.)			Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax. Picloram is a restricted use herbicide.	31,56

Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged an- nual grasses and broad- leaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfactant.	139
Paraquat (Ortho para- quat, Gramox- one)	0.5 (1 qt)			A nonselective, contact, post- emergence herbicide. No soil residual activity. Apply with X-77. Good coverage is essen- tial. Restricted use herbicide.	138

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Atrazine + Butylate + Safener (Sutan +, Genate +)	1 + 3	Most grass and broad- leaf weeds	Preplant incorpo- rated	Immediate incorporation is needed for best results. Safener protects corn from injury. Commercial mixture available (Sutazine + , ratio 4.8 lbs butylate to 1.2 lbs atrazine per gallon).	8,10, 28,65
EPTC + Safener (Eradicane)	4 to 6 (4.75 to 7 pt)	Grass and some broad- leaf weeds.	Preplant incorpo- rated	Safener protects corn from injury and Extender extends EPTC soil life under certain conditions. Immediate incorpo- ration is necessary. Use high rate of EPTC for wild proso millet control. Weak on wild mustard.	8,10,68
EPTC + Safener + Extender (Eradicane Extra)	4 to 6 (5.3 to 8 pt)				
EPTC + Safener or EPTC + Safener + Extender + Cyanazine (Eradicane + Bladex) (Eradicane Extra + Bladex)	4 to 6 + 1 to 3	Most grass and broad- leaf weeds	Preplant incorpo- rated	Use higher rates on fine- textured soils. Immediate in- corporation is needed for best results. Cyanazine at the high rate may injure corn in a cool, wet environment.	8,10, 63,66
Alachlor (Lasso, Lasso II)	2 to 3 (2 to 3 qt 4EC) (15 to 20 lb 15G)	Grass and some broad- leaf weeds	Preplant incorpo- rated or preemer- gence	Wild mustard control not adequate. Usually less effec- tive preemergence than pro- pachlor in North Dakota. Preplant incorporation gives more consistent weed control.	8,63
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb of 25G)				
Atrazine	2 to 4 (2 to 4 qt 4L, 2.5 to 5 lb 80W, 2.2 to 4.4 lb 90DF)	Broadleaf weeds and grasses	Preplant incorpo- rated or preemer- gence	Use higher rate on fine-tex- tured soils for quackgrass and Canada thistle control.	28,62
Cyanazine (Bladex)	2.2 to 5.5 (2.8 to 6.8 lb 80W, 2.4 to 6.1 lb 90DF, 2 to 4.8 qt 4F)		Preplant or pre- emergence incorpo- rated	Soil residues unlikely the year after treatment. Weak on red- root pigweed. Use higher rate on fine textured, high organic matter soil. Cyanazine at higher rates may injure corn in cool, wet environment. DO NOT USE ON SANDS, LOAMY SANDS OR SOILS WITH LESS THAN 1% ORGANIC MATTER. DO NOT USE BLADES 4L FOR NO-TILL CORN.	66

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Cyanazine (Bladex) + Atrazine	1 to 3 + 1 to 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90DF + 1.25 to 2.5 lb 80W, 1.1 to 2.2 90 DF or 1 to 3 qt 4L + 1 to 2 qt 4L	Broadleaf weeds and grasses	Preplant or preemergence incorporated	The tank mix allows lower rates of atrazine to be used, reducing the potential for atrazine carryover.	28,66
Cyanazine (Bladex) + Alachlor (Lasso)	1 to 3 + 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90DF, 1 to 3 qt 4F + 2 qt 4EC)	Most grass and broad- leaf weeds	Preplant or pre- emergence incorpo- rated	Use lower rate of cyanazine on coarse-textured soils. Cyana- zine at the high rate may in- jure corn in a cool, wet en- vironment. DO NOT USE ON SANDS, LOAMY SANDS OR SOILS WITH LESS THAN 1% ORGANIC MATTER.	63,66
Cyanazine (Bladex) + Metolachlor (Dual)	1 to 3 + 2 (1.25 to 3.75 lb 80W, 1.1 to 3.3 lb 90 DF, 1 to 2 qt 4F + 2 pt 8E)				59,63
Diallate (Avadex)	1.5 (1.5 qt)	Wild oats	Preplant or pre- emergence incorpo- rated	Operating incorporation imple- ment 4 inches deep does not reduce wild oats control.	8,13, 122
Atrazine + Alachlor (Lasso)	1 + 2 (1.25 lb 80W, 1.1 lb 90DF, 1 qt 4F + 2 qt 4E)	Most grass and broad- leaf weeds	Preplant incorpo- rated or preemer- gence	Do not harvest for silage within 12 weeks of applica- tion.	8,28, 62,63
Atrazine + Metolachlor (Dual)	1 to 2.4 + 1.5 to 2 (1.25 to 3 lb 80W, 1.1 to 2.6 lb 90DF + 1.5 to 2 pt)			Atrazine carryover may be a problem with rates used in the mixture. Commercial mixtures available (Bicep, ratio 2.5 lb metolachlor to 2.0 lb atrazine).	28,62, 63
Atrazine + Pendimethalin (Prowl)	1 to 2 + 1 to 1.5 (1.25 to 2.5 lb 80W or 1.1 to 2.2 lb 90 DF + 2 to 3 pt)	Most grass and broad- leaf weeds	Preemergence	Atrazine carryover may be a problem. Do not incorporate.	28,62, 70
Atrazine + Pro- pachlor (Ramrod)	1 + 3 (tank mix)	Broadleaf and and annual grasses		Commercial mixture is avail- able (ratio 1 lb atrazine to 2.3 lb propachlor).	28,62, 64
Dicamba (Banvel, Banvel II) + Alachlor (Lasso)	0.25 to 0.5 + 2 (0.5 to 1 pt 4S, 1 to 2 pt 2S + 2 qt 4E)			Use lower rate of dicamba on coarse-textured soils. Do not incorporate.	63,67
Linuron (Lorox) + Alachlor (Lasso)	0.75 to 1 + 1.5 to 2.5			Use only on medium to coarse- textured soils. Use lower rate on coarse-textured soils. Soil residues unlikely the year after treatment.	63,69
Linuron (Lorox) + Propachlor (Ramrod)	0.75 to 1.5 + 3				64,69

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Pendimethalin (Prowl)	1.5 to 2 (3 to 4 pt)	Grass and some broad- leaf weeds	Preemergence	Do not use on sands or loamy sands. Use higher rate on fine- textured soils high in organic matter. Do not incorporate.	70
Propachlor (Ramrod)	4 to 5 (6 to 7.7 lb 65W, 4 to 5 qt 4F, 20 to 25 lb 20G)			Ineffective against wild mustard.	64
Pendimethalin (Prowl) + Cyanazine (Bladex)	1 to 1.5 + 1.6 to 2 (2 to 3 pt + 2 to 2.5 lb 80W or 1.8 to 2.2 lb 90 DF)	Most grass and broad- leaf weeds	Preemergence or 1 to 2-leaf stage of corn	User can rotate from corn to other crops. Use lower rate of cyanazine on coarse-textured soils. Do not incorporate.	66,70
Atrazine + phytobland oil	1 to 2 + a phyto- bland oil	Broadleaf weeds and grasses	Early postemer- gence—weeds less than 1.5 inches tall	Use emulsifiable crop origin oil (linseed or soybean) or petroleum oils at volume recommended on label.	28,71
Cyanazine (Bladex) + crop origin oil	1.2 + 1 qt crop origin oil (1.5 lb 80W 1.3 lb 90 DF)	Grass and some broad- leaf weeds	Weeds less than 1.5 inches and corn 4-leaf stage or smaller	Use emulsifiable crop origin oil (linseed or soybean). Use only Bladex 80W or 90 DF for postemergence applications. Avoid application under cool, wet conditions.	72
Cyanazine (Bladex) + Atrazine	0.8 + 0.5 + 1 qt crop origin oil (1 lb 80W or 0.9 lb 90DF + 0.63 lb 80W or 0.6 lb 90DF)	Grass and some broad- leaf weeds	Grasses less than 1.5 inches, broadleaf weeds less than 4 inches and corn 4-leaf stage or smaller	Use emulsifiable crop origin oil (linseed or soybean) or petroleum oils at volume recommended on label.	28,71
Dicamba (Banvel (Banvel II)	0.25 (0.5 pt 4S, 1.0 pt 2S)	Broadleaf weeds inclu- ding wild buckwheat, Canada thistle, p. sow- thistle	Postemergence, before corn is 36 inches tall.	Use drop nozzles after corn is 8 inches tall to reduce drift. Apply at least 15 days before tasseling to avoid sterility.	74
2,4-D amine	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence, corn—3 inches to tasseling	Use drop nozzles when corn is over 8 inches tall but before tasseling. Dicamba can be mixed with 0.25 lb of 2,4-D.	73
Bromoxynil (Buctril, ME4 Brominal)	0.25 (1 pt) (0.5 pt)	Wild buck- wheat, volun- teer sun- flower and most annual broadleaf weeds	Postemergence— corn 3 to 20 inches	Apply when weeds are in seedling stage. Weak on wild mustard. Could be used when drift of dicamba or 2,4-D may injure sensitive broadleaf crops.	75
Bentazon (Basagran)	0.75 to 1.0 (1.5 to 2.0 pt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sun- flower	Postemergence when mustard is in the 4 to 6-leaf stage and thistles are 6 to 8 inches tall. See label for more de- tails. Corn is tol- erant at all stages of growth.	Could be used when drift of dicamba or 2,4-D may injure soybeans or dry beans. Thor- oughly cover weeds with spray. Do not apply during unfavorable conditions such as drought, cold, or hail damage. Split application needed for Canada thistle con- trol.	91

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Corn

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Ametryn (Evik)	2 to 2.5 (2.5 to 3 lb 80W)	Broadleaf weeds and grasses	Postemergence, Weeds less than 4 inches and corn at least 12 inches tall	Apply as postemergence direc- ted spray. Do not spray over top of corn or injury will occur. Do not apply within three weeks of tasseling. Use sur- factant WK or X-77 at 0.5% v/v. Use higher rate for taller weeds. See label for rotational restrictions.	1, 2, 3
Sodium chlorate (Oxy-Leafex)	6 lb/A (2 gal)	Dessicant	14 days prior to harvest	Through coverage of plant is essential. Do not graze or feed treated plants within 14 days of application. Refer to label for recommended water gallorage to use.	

Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged an- nual grasses and broad- leaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Apply with a nonionic surfac- tant.	139
Paraquat (Ortho para- quat, Gramoxone)	0.5 (1 qt)			A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77. Good weed coverage is essential. Restricted use her- bicide.	138
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant or preemergence incorporated	Operating incorporation imple- ment 4 inches deep does not reduce wild oats control. Restricted use herbicide.	8,13, 122
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broad- leaf weeds	Preplant incorporated or preemer- gence	Preplant incorporation gives more consistent weed control. Weak on wild mus- tard.	8,10 84
Ethalfuralin (Sonalan)	0.5 to 1.3 lb/A (1.3 to 3.5 pt)		Preplant incorporated 2 to 3 inches deep	The low rate should be used on coarse-textured, sandy soils. No wild mustard control.	83
Fluchloralin (Basalin)	0.5 to 1.5 (1 to 3 pt)	Grass and some broad- leaf weeds	Preplant incor- porated (1½ to 3 inches deep)	No wild mustard control.	8,10, 29,82
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incor- porated, fall or spring		8,10, 21,29 85

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

Soybeans

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Chloramben (Amiben) + dinitroanilines	1.8 to 2.7 (4 to 6 qts) + appropriate rate for soil type	Grass and broadleaf weeds	Dinitroanilines preplant incorporated, chloramben preemergence	Dinitroanilines include ethalfluralin, fluchloralin, pendimethalin, and trifluralin.	7, 9
			Preplant incorporated	Dinitroanilines include ethalfluralin, fluchloralin, pendimethalin, and trifluralin. Incorporation of chloramben improves wild mustard control.	8, 10 29,87
Metribuzin (Sencor, Lexone) + dinitroanilines	0.25 to 0.37 + appropriate rate for soil type	Grass and broadleaf weeds including wild mustard	Preplant incorporated	Dinitroanilines include ethalfluralin, fluchloralin, pendimethalin and trifluralin. May be used on soils with pH 7.5 or lower.	32,89
	0.19 + appropriate rate for soil type			Use 0.19 lb/A rate of metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only.	
Alachlor (Lasso, Lasso II)	2 to 3 (2 to 3 qt or 15 to 20 lb 15G)	Grass and some broadleaf weeds	Preplant incorporated or preemergence	Wild mustard control not adequate. Preplant incorporation gives more consistent weed control. Use higher rate on fine-textured soils high in organic matter.	8,86
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb of 25G)				
Alachlor (Lasso) or Metolachlor (Dual) + Metribuzin (Sencor, Lexone)	2 + 0.25 to 0.37	Broadleaf weeds including wild mustard and annual grasses		Use 0.25 lb/A of metribuzin on coarse-textured soils and for incorporation. Not recommended for use on soil with pH 7.5 or higher.	8,32, 86,89
Alachlor (Lasso) or Metolachlor (Dual) + Metribuzin (Sencor, Lexone)	2 + 0.19			Use 0.19 lb/A rate of metribuzin on soils with pH greater than 7.5. This rate applies to Sencor only.	

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Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	*Refer- ence**
Alachlor (Lasso) or Metolachlor (Dual) + Chloramben (Amiben)	2 + 2 (2 qt 4L + 4 qt 2L or 2.4 lb DS)	Broadleaf weeds including wild mustard and annual grasses	Preplant incorporated or pre-emergence	Incorporation of chloramben improves wild mustard control. Soybean tolerance is good.	8,86, 87
Chloramben (Amiben)	2 to 3 (4 to 6 qt, 2.4 to 3.6 lb DS, 20 to 30 lb 10G)	Grass and broadleaf weeds		Wild oats control not adequate.	87
Linuron (Lorox) + Alachlor (Lasso) or Metolachlor (Dual)	1 + 2		Preemergence	Use only on sandy loam soil with 0.5 to 2% organic matter.	86,88
Dinoseb amine salt (Premerge)	1.5 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbicides weak on wild mustard.	92
Dinoseb + Naptalam (Dyanap)	0.38 to 1 + 0.75 to 2 (1.5 to 4 qt)	Annual broad-leaf weeds including volunteer sunflower	After 1st trifoliolate fully expanded but before 20 inch height	At 1st trifoliolate stage of soybeans use only 1.5 to 2 qt/A rate of Dyanap. Treat when weeds are small. See narrative for more details.	93
Acifluorfen (Blazer)	0.37 to 0.5 (1.5 to 2 pt)	Wild mustard, redroot pigweed, eastern black nightshade, wild buckwheat	Postemergence. Soybeans-1 to 2 trifoliolate leaf stage. Weeds-1 to 4 inches tall.	Weak on volunteer sunflower. Low rate will control wild mustard and redroot pigweed, high rate needed for other weeds. Apply when daytime temperatures exceed 70 F.	90
Bentazon (Basagran)	0.75 to 1.5 (0.75 to 1.5 qt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sunflower	Postemergence when mustard is in 4 to 6 leaf stage and thistle is 6 to 8 inches tall. See label for more details	Thoroughly cover weeds with spray. Do not apply during unfavorable conditions such as drought, cold or hail damage. Split application needed for Canada thistle control. Soybeans are tolerant at any stage of growth.	91
Bentazon (Basagran) + Acifluorfen (Blazer)	0.75 + 0.25 (1.5 pt + 1 pt)	Broadleaf weeds	Postemergence, Soybeans-1 to 2 trifoliolate leaf stage. Weeds-less than 4 inches tall	Controls most seedling annual broadleaf weeds. Increase acifluorfen rate for eastern black nightshade control.	90,91
Diclofop (Hoelon)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats, foxtails (pigeon-grass) and volunteer corn	Grass weeds in 1 to 4-leaf stage, volunteer corn short enough for good coverage of the whorl. Crop-emergence through 5th trifoliolate.	Do not tank mix with bentazon (Basagran), acifluorfen (Blazer), or dinoseb + naptalam (Dyanap). Restricted use herbicide.	42,129
Fluazifop (Fusilade)	0.125 to 0.25 (0.25 to 0.5 pt)	Wild oats, foxtail, volunteer grain, wild proso millet, quackgrass	Grass weeds 2 to 4 inches; volunteer corn 6 to 18 inches but before soybeans bloom	Apply to actively growing grasses. See narrative for rates for different weed species. Apply with oil concentrate at 1% v/v.	94

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Soybeans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Wild oats, fox- tail, volunteer grain, wild proso millet, quackgrass	Grass weeds 2 to 4 inches; vol. corn 6 to 18 inches but before soybeans bloom	Apply to actively growing grasses. See narrative for rates for different weed species. Apply with oil concentrate at 1 qt/A	95
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/ gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days of crop emergence	Wild oats usually develops to the 2-leaf stage 9 days after emergence.	125
Naptalam + 2,4-DB (Rescue)	1 to 1.5 + 0.03 to 0.045 (2 to 3 qt)	Cocklebur, giant ragweed, volunteer sunflower	Weeds 10 inches or taller. Soybeans after first bloom	Salvage treatment for control of weed escapes. Apply with nonionic surfactant or oil con- centrate. Avoid drift to suscep- tible crops.	96
Paraquat (Ortho para- quat, Gramox- one)	0.25 (1 pt)	Desiccant	Prior to harvest	Apply when at least 65% of the seed pods have reached a mature brown color or when seed moisture is 30% or less. Restricted use herbicide.	
Sodium Chlorate (Oxy-Leafex)	6 lb (2 gal)		7-10 days prior to harvest, after pods are brown	Thorough coverage of plant is essential. Refer to label for recommended water gallonage to use.	

Dry Edible Beans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grass and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity.	139
EPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broad- leaf weeds	Preplant incor- porated	Weak on wild mustard	7 to 11, 17,19, 98
	4 to 4.5 (4.5 to 5.25 pt 7E, 40-45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E) (5 to 10 lb 10G)		Preplant incor- porated, fall after September 1, or spring	No wild mustard control.	7 to 11, 21,26, 29,97

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Dry Edible Beans

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Ethalfuralin (Sonalan)	0.5 to 1.3 (1.3 to 3.5 pt)	Grass and some broad- leaf weeds	Preplant incor- porated 2 to 3 inches deep	The low rate should be used on coarse textured, sandy soils. No wild mustard control.	97
Fluchloralin (Basalin)	0.5 to 1.5 (1 to 3 pt)		Preplant incor- porated 1½ to 3 inches	No wild mustard control.	7 to 11, 26,27, 29
Trifluralin (Treflan) + EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 pt to 2.25 pt)		Preplant incorpor- ated	EPTC enhances wild oats control and reduces potential of trifluralin carryover.	7 to 11, 15,26, 27,29 97
Chloramben (Amiben) + other herbicides	2 (8 pt or 2.4 lb DS) + appropriate rate for soil type	Annual grasses and broadleaf weeds		Other herbicides includes alachlor, metolachlor, and trifluralin.	97
Alachlor (Lasso)	2 to 3 (2 to 3 qt)	Grasses and some broad- leaf weeds		Wild mustard control not adequate. Use the higher rate on fine textured soils high in organic matter.	7, 97
Metolachlor (Dual)	2 to 3 (2 to 3 pt)		Preplant incor- porated or pre- emergence	Weak on wild mustard. Incorporation improves consis- tency of weed control. Use high rate on fine-textured soils.	7,97
Pendimethalin (Prowl)	0.5 to 1.5 (1 to 3 pt)		Preplant incor- porated	Use higher rates on fine- textured soils. Weak on wild mustard. Refer to label for rotational restrictions.	8, 97
Pendimethalin (Prowl) + EPTC (Eptam, Genep)	0.5 to 1.5 + 2.2 to 3.0 (1 to 3 pts + 2.5 to 3.5 pt)			Use higher rates on fine- textured soils. Do not use on flat-podded beans. Weak on wild mustard. Refer to label for rotational restrictions.	8, 10, 97
Chloramben (Amiben)	2 (4 qt, 20 lb 10G 2.4 lb DS)	Annual grasses and broadleaf weeds	Preemergence	Wild oats control not ade- quate.	87
Dinoseb amine salt (Premerge)	1.5 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbicides weak on wild mustard.	92
Bentazon (Basagran)	0.75 to 1 (0.75 to 1 qt)	Wild mustard, cocklebur, Canada thistle, wild and volun- teer sun- flower	Postemergence when mustard is in 4 to 6-leaf stage and sunflower less than 8 inches tall. Beans should be in first trifoliolate leaf stage or larger. See label for more details.	Thoroughly cover weeds with spray. Do not apply under un- favorable conditions such as drought, cold or hail damage.	97

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Lentils

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Diallate (Avadex)	1.5 (1.5 qt)	Wild oats	Preplant or preemergence incorporated	Operating incorporation im- plement 4 inches deep does not reduce wild oats control. Restricted use her- bicide.	8,13, 101, 122
Triallate (Far-go)	1.25 (1.25 qt)				8,13, 18,102, 124
Propham (Chem Hoe FL4)	4 (1 gal)	Wild oats, volunteer grain	Preplant incorporated	Operate incorporation imple- ment 4 inches deep.	101, 103
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/ gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after crop emergence	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	101, 104

Safflower

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
EPTC (Eptam, Genep)	3 (1.75 qt)	Grass and some broad- leaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.	7 to 11, 15
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E, 5 to 10 lb 10G)		Preplant incor- porated, fall or spring	No wild mustard control.	7 to 11, 26,27, 29
Metolachlor (Dual, Dual 25G)	2 to 3 (2 to 3 pt or 8 to 12 lb of 25G)		Preplant incor- porated or pre- emergence	Wild mustard control not adequate. Preplant incor- poration gives more consistent weed control.	7
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emer- gence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	125

Sunflower

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Paraquat (Ortho para- quat, Gramoxone)	0.5 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emer- gence	A nonselective, postemer- gence herbicide. No soil residual activity. Apply with X-77. Good coverage is essen- tial. A residual herbicide can be tank mixed with paraquat to control weeds emerging after treatment. Restricted use her- bicide.	138

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Sunflower

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Grass and some broad-leaf weeds	Preplant incorporated	Weak on wild mustard	7 to 11, 15,19, 107
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Fluchloralin (Basalin)	0.5 to 1.5 (1 to 3 pt)		Preplant incorporated (1½ to 3 inches)	No wild mustard control. Do not feed or graze sunflower forage.	7 to 11, 26,27, 29,107
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)		Preplant incorporated	Use the higher rate for fine textured soils.	15,107
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E)			No wild mustard control	7 to 11, 29
	0.5 to 1 (5 to 10 lb 10G)		Preplant incorporated, fall after September 1		27,29, 107
Trifluralin (Treflan)+ EPTC (Eptam, Genep)	0.5 + 1.5 to 2 (1 pt 4E + 1.75 to 2.25 pt)		Preplant incorporated	Enhances wild oats control and reduces potential carry-over of trifluralin	7 to 11, 15,26, 27,29, 106
Alachlor (Lasso, Lasso II)	3 (3 qt, 20 lb 15G)		Preplant incorporated or preemergence	Wild mustard control not adequate. Preplant incorporation gives more consistent weed control.	8
Chloramben (Amiben) + other herbicides	2 + appropriate rate for soil type	Annual grass and broadleaf weeds	Preplant incorporated	Other herbicides include EPTC, pendimethalin, trifluralin, and alachlor.	7 to 11, 15,19, 29, 84, 85,106, 107
Barban (Carbyne 2EC)	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	125
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)	Desiccant	Back side of sunflower heads yellow and bracts turning brown. Seed moisture under 35%.	Registered for oilseed varieties only. Apply with X-77 at 0.25% v/v. Randomly sample 10 average sized heads for moisture. Restricted use herbicide.	
Sodium chlorate (Oxy Leafex)	4.5 to 6 (1.5 to 2 gal)			For use on confectionary and oilseed varieties. Thorough coverage of the plant is essential. Low temperatures slow desiccation and higher rates are required.	

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Sugarbeets

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broad-leaf weeds	Preplant or any-time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity.	139
Paraquat (Ortho paraquat, Gramoxone)	0.5 (1 qt)			A nonselective, postemergence herbicide. No soil residual activity. Apply with X-77. Good coverage is essential. A residual herbicide can be tank mixed with paraquat to control weeds emerging after treatment. Restricted use herbicide.	138
EPTC (Eptam, Genep)	2 to 3 (2.3 to 3.4 pt)	Annual grasses and some broad-leaf weeds	Preplant incorporated	Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.	7 to 11, 14,15, 17,19, 24,25, 113
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up		
Cycloate (Ro-Neet)	3 to 4 (4 to 5.3 pt 6E, 30 to 40 lb 10G)		Preplant incorporated	Sugarbeets have better tolerance to cycloate than to EPTC. Weak on wild mustard. Weed control poor on fine-textured, high organic matter soils.	7 to 11
	4 (5.3 pt 6E, 40 lb 10G)		Fall incorporated after October 15 until freeze-up		
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt, 15 to 20 lb 10G)	Wild oats	Spring-preplant incorporated Fall-after October 15 and until freeze-up	Operating tillage implement 4 inches deep does not reduce wild oats control. Restricted use herbicide.	13,17, 18,111, 122
Ethofumesate (Nortron)	2 to 3.75 (1.25 to 2.5 gal E or 2 to 3.75 qts F)	Some annual grasses and broadleaf weeds. Especially good on redroot pigweed	Preemergence or preplant incorporated in band	Should be used with grass control herbicide. Incorporation generally improves weed control.	7 to 11, 33,116
Diethatyl (Antor)	4 to 6 (1 to 1.5 gal)	Redroot and prostrate pigweed and some annual grasses	Preemergence or preplant incorporated	Shallow (1 to 2 inch) incorporation gives best results.	117
TCA	4.7 to 7.1 (8 to 12 pt)	Most annual grasses	Preemergence	Weak on wild oats. Do not use sugarbeet tops for livestock feed.	114
Pyrazon (Pyramin) + TCA	3.8 to 7.6 + 5 to 7 (3.6 to 7.25 qt F + 8 to 12 pt)	Annual grasses and most broad-leaf weeds		Has been less effective on soils with more than 5% organic matter. Incorporation improves performance of pyrazon.	16

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Sugarbeets

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Dalapon (Dowpon)	2 to 3 (2.7 to 4 lb)	Most an- nual grasses	Apply from emer- gence to 6-leaf stage of sugar- beets. Use directed spray after beets have 6 leaves	Use high rate if grasses have over 4 leaves or if they are growing slowly due to dry conditions. May be applied more than once up to maximum of 5.9 lb/A per year. Some yield reduction may occur from rates over 3 lb/A. Add any nonionic surfac- tant at 0.5 to 2 pints per 100 gal. spray solution.	
Endothall (Herbicide 273)	0.75 to 1.5 (2 to 4 pt)	Wild buck- wheat, smart- weed, volun- teer sun- flower	Sugarbeets should have 4 to 6 leaves. Do not apply later than 40 days after emergence	When temperatures are over 80 F, endothall may cause excessive injury, especially to very small sugarbeets. Endo- thall is ineffective at tem- peratures below 60 F or when weeds are drought stressed after 60 F.	115
Desmedipham + Phenmedi- pham (Betamix)	0.16 to 0.6 + 0.16 to 0.6 (2 to 7.5 pt)	Most annual broadleaf weeds	Postemergence when broadleaf weeds are from cotyledon to 4-leaf stage Sugarbeets with less than 4 leaves will tolerate 0.32 to 0.5 lb/A of these herbicides and sugarbeets with 4 leaves or more will tolerate higher rates.	Risk of sugarbeet injury is reduced by starting application in late afternoon and risk is increased by certain environments. (See paragraph 118). Split application with reduced rates has reduced sugarbeet injury and increased weed control compared to single full dose application.	118
Desmedipham (Betanex)	0.32 to 1.2 (2 to 7.5 pt)				
Ethofumesate (Nortron EC) + Desmedipham (Betanex)	1.12 to 1.5 + 0.73 to 1 (0.75 to 1 gal E + 4.5 to 6.1 pt)	Most annual broadleaf weeds	Postemergence when sugarbeets have at least 6 leaves. Half rate may be applied to 4-leaf sugarbeets	Improved weed control and increased risk of sugarbeet injury compared to desmedi- pham or desmedipham + phenmedipham. Split appli- cation at half rates has reduced sugarbeet injury and increased weed control com- pared to single full dose ap- plication.	118
Ethofumesate (Nortron EC) + Desmedipham + Phenmedi- pham (Betamix)	1.12 to 1.5 + 0.365 to 0.5 + 0.365 to 0.5 (0.75 to 1 gal E + 4.5 to 6.1 pt)				
Barban (Carbyne 2EC)	0.75 to 1 (1.5 to 2 qt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emer- gence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	125

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Sugarbeets

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Trifluralin (Treflan)	0.75 (1.5 pt 4E)	Grass and some broad- leaf weeds	Sugarbeets 2 to 6 inches tall and well-rooted to withstand incorporation	Must be incorporated. Exposed beet roots must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugarbeets.	119
Sethoxydim (Poast)	0.1 to 0.5 (0.5 to 2.5 pt)	Wild oats, foxtail, volun- teer grain, wild proso millet	Wild oats 1 to 4 inches, foxtail 3 to 8 inches, volunteer wheat or barley 1 to 6 inches, wild proso millet 4 to 10 in- ches.	Apply to actively growing grasses. See narrative for rates for different grass species. Always apply with oil concentrate at 1 qt/A.	95

Tame Mustard

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Trifluralin (Treflan)	0.5 to 0.75 (1 to 1.5 pt 4E)	Grass and broadleaf weeds	Preplant incorporated	Use lower rate on coarse- textured, low organic matter soils.	7 to 11 26,27, 29
Barban (Carbyne 2EC)	0.37 (1.5 pt of 2 lb/gal conc.)	Wild oats	Wild oats 2-leaf and within 30 days after emer- gence of crop	Wild oats usually develop to the 2-leaf stage 9 days after emergence.	125

Millet

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D amine	0.25 to 0.5 (0.5 to 1 pt of a 4 lb/gal conc.)	Broadleaf weeds	Millet 4 to 6 inches tall	Apply with minimum of 5 gallons water per acre with ground sprayer. Do not permit dairy animals or meat animals being finished for slaughter to forage or graze treated fields within 2 weeks after treatment.	
Atrazine	0.5 to 1 lb/A (0.5 to 1 qt 4L, 0.6 to 1.25 lb 80W, 0.6 to 1.1 lb 90 DF)	Broadleaf weeds and grasses	Preplant incor- porated or preemer- gence	Only registered on Proso millet.	27, 28

Annual Canarygrass

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Triallate (Far-go)	1 (1 qt)	Wild oats	Preplant incorporated fall or spring	Operating incorporation implement 4 inches deep does not reduce wild oats control.	8,13, 124
Bromoxynil (Brominal 3 + 3) + MCPA	0.25 + 0.25 to 0.38 + 0.38 (0.66 pt to 1 pt)	Broadleaf weeds	Postemergence, weeds 2 to 4 inches tall	Apply when weeds are in early seedling stage for best results.	

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

Potatoes

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Dalapon (Dowpon)	6 (8 lb)	Quackgrass	Preplant in spring when grass is 4 to 6 inches tall	Plow after 4 days and pota- toes may be planted immediately.	
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated postemergence herbicide. No soil residual activity.	139
Diallate (Avadex)	1.5 to 2 (1.5 to 2 qt)	Wild oats	Preplant incorporated	Incorporate immediately. Operating incorporation implement 4 inches deep does not reduce wild oats control. Restricted use herbicide.	7 to 11, 18,122
EPTC (Eptam, Genep)	3 to 6 (3.5 to 6.75 pt)	Grass and some broad- leaf weeds	Preplant, dragoff, or directed spray at layby	Weak on wild mustard.	7 to 11 14,15, 19
	4.5 to 6 (5.25 to 7 pt 7E, 45 to 60 lb 10G)		Fall incorporated after October 15 until freeze-up		
Metolachlor (Dual)	2 to 3 (2 to 3 pt) (8 to 12 lb 25G)		Preplant incorpor- ated or pre- emergence	Weak on wild mustard. Incorporation improves consistency of weed control. Use the higher rate on fine- textured soils.	
Paraquat (Ortho para- quat, Gramoxone)	0.25 to 0.5 (1 to 2 pt)	Most annual grasses and broadleaf weeds	Preemergence— when weeds are up but before crop emerges	Do not apply later than ground cracking. Paraquat kills only emerged weeds. Apply with X-77. Restricted use herbicide.	138
Linuron (Lorox)	0.75 to 2 (1.5 to 4 lb WP)		Preemergence (just before crop emerges)	Apply to crop planted 2 inches deep, after dragoff or hilling. Do not plant to other crops within 4 months after treatment. Use higher rates on fine-textured soils.	16
Metribuzin (Lexone, Sencor)	0.5 to 1 (1 to 2 lb WP, 1 to 2 pt F, 0.67 to 1.33 lb DF)	Broadleaf weeds includ- ing wild mustard and some grasses	Preemergence or postemergence (on white skinned, late maturing varieties)	Use lower rate on coarse- textured soils. Soil residue harmful to following sus- ceptible crops may occur. See label for details.	26,27, 32
Pendimethalin (Prowl)	1 to 1.5 (2 to 3 pt)	Grass and some broad- leaf weeds	Preemergence or preemergence incorporated	Light incorporation in- creases weed control. Can be tank mixed with EPTC (Eptam, Genep) or metribuzin (Sencor, Lexone) or linuron (Lorox).	
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt 4E)		Preemergence incorporated	Must be incorporated. Care should be taken that incorpo- ration machinery does not damage seed pieces or elongating sprouts. Can be tank mixed with EPTC (Eptam, Genep).	

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Potato Vine Killing

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Endothall (Des-i-Cate)	0.75 to 1 (1.5 to 2 gal)	Desiccant	10 to 14 days prior to harvest	Use higher rate during cool, cloudy weather and on heavy vine growth	
Dinoseb oil soluble (Dow General)	1.25 to 2.5 (2 to 4 pt)			Rate depends on temperature, spray volume, potato vari- ety and vigor of the vines.	
Paraquat	0.25 to 0.5 (1 to 2 pt)		More than 3 days prior to harvest	Do not use when the potatoes are to be stored or used for seed. Apply with X-77. Re- stricted use herbicide	
Diquat	0.25 (1 pt)		More than 7 days prior to harvest	Apply with a nonionic sur- factant at 0.5 to 1 pt per 100 gal water.	
Sulfuric acid	20 gal		5 days prior to harvest	Extremely corrosive. Re- stricted use herbicide. Do not harvest within 5 days of ap- plication.	

Grass — Seedling

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D	0.5 to 0.75 (1 to 1.5 pt of 4 lb/gal conc.)	Broadleaf weeds	After 3-leaf stage of grasses	Use rate listed for estab- lished grasses after tillering of seedling grass.	
Bromoxynil (Brominal ME4)	0.38 to 0.5 (0.75 to 1 pt)		Anytime after grass emerges	Grass tolerance is excellent.	

Grass — Established

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Weeds—emergence to bud stage; pre- ferably when young and actively growing	Do not graze dairy cows for 7 days after application. Do not apply after boot stage on grasses for seed production. Use 1 lb/A on an- nuals and gumweed and 2 lb/A on sages and other perennials.	
Dicamba + MCPP + 2,4-D				Various commercial formula- tions available. See individual label for usage rates. Provides a broader spectrum of broad- leaf weed control than 2,4-D alone.	

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Legumes

Alfalfa and clover establishment with companion crop

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity.	139
MCPA amine	0.12 to 0.25 (0.25 to 0.5 pt of 4 lb/gal conc.)	Broadleaf weeds	Legumes 2 to 3 inches tall and companion crop 8- leaf to early boot	NOTE: POSSIBLE INJURY TO SWEETCLOVER AND ALFALFA. Use only when weed problem is severe.	120
Dinoseb amine salt (Premerge)	1.1 to 1.5 (1.5 to 2 qt)	Small broad- leaf weeds	Grain—2 or more leaves and weeds small	Apply in 30 gal/A of water. Burning of grain leaves is not ordinarily harmful. Do not graze or feed forage within 6 weeks after spraying.	120

Legumes

Alfalfa or trefoil establishment, no companion crop

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or any- time prior to crop emer- gence	A nonselective, translocated, postemergence herbicide. No soil residual activity.	139
Diallate (Avadex)	1.5 to 2.0 (1.5 to 2.0 qt)	Wild oats	Preplant incor- porated	Restricted use herbicide.	8,13, 123
EPTC (Eptam, Genep)	2 to 4 (2.25 to 4.5 pt)	Grass and some broad- leaf weeds		Weak on wild mustard. Incorporate immediately after application. Use lower rate for grass control only.	7 to 11
Benfen (Balan)	1.12 + 1.5 (3 to 4 qt)	Annual grasses and some broad- leaf weeds		No wild mustard control.	26,27, 29
2,4-DB ester	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Broadleaf weeds	Weeds less than 3 inches tall, alfalfa more than 2 tri- foliolate leaves	Sweetclover may be killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied at least 60 days before hay harvest or grazing.	120
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				
Dinoseb amine salt (Premerge)	1.5 (2 qt)	Small broad- leaf weeds	Alfalfa has one or more trifoliolate leaves	Some leaf burn on alfalfa can be expected. Do not use at temperatures higher than 85 F as crop injury may be severe. Do not graze within 6 weeks after spraying.	

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Legumes

Alfalfa established

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Hexazinone (Velpar)	0.45 to 0.9 (0.5 to 1.0 lb SP)	Annual broadleaf and grassy weeds	Fall, after alfalfa becomes dormant or early spring before new growth begins	Use lower rate on sandy soil. Apply to pure stands of alfalfa established at least 12 months. See label for crop rotation restrictions.	
Simazine (Princep)	0.8 to 1.6 (1 to 2 lb 80W)	Grass and broadleaf weeds including downy brome, wild oats and Kochia	After last cutting but before freeze-up	Do not use on sands or loamy sands or where soil pH is above 7.5. Use low rate on sandy loam. Apply to pure stands of alfalfa established at least 12 months.	120
Metribuzin (Lexone, Sencor)	0.37 to 1 (0.75 to 2 lb WP, 0.75 to 2 pt F, 0.5 to 1.25 lb DF)		Early spring to dormant alfalfa	May be applied on frozen soil. Do not apply to alfalfa during the first growing season after seeding. Rate depends on weeds present.	
2,4-DB ester	0.5 to 1 (2 to 4 pt of 2 lb/gal conc.)	Broadleaf weeds	Weeds less than 3 inches tall	Sweetclover may be killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied at least 30 days before hay harvest or grazing.	120
2,4-DB amine	0.5 to 1.5 (2 to 6 pt of 2 lb/gal conc.)				

CHEMICAL WEED CONTROL FOR FALLOW

For future planting to wheat, durum, barley, oats, corn or sorghum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Cyanazine (Bladex 80W)	2.4 to 3.2 (3 to 4 lb)	Annual broadleaf and grass weeds	Fall—anytime after harvest but before weeds emerge	Use the higher rate on fine-textured soils. If 0.5 inch of rainfall is not received within 10 days after application, under-cutting with sweeps may be desirable to destroy weeds until cyanazine is activated. Do not use Bladex 4L.	141
	1.6 to 2.8 (2 to 3.5 lb/A)		Early spring before weeds emerge		
Cyanazine (Bladex 80W) + Atrazine	2 to 2.8 + 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.	142
	2 to 2.8 + 0.4		Early spring before weeds emerge		

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For future planting to wheat, durum, barley, oats, corn or sorghum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Cyanazine (Bladex 80W) + Paraquat	2.4 to 3.2 (3 to 4 lb) + 0.25 to 0.5 (1 to 2 pt)	Annual broad-leaf and grass weeds	Fall—anytime after harvest if weeds have emerged	Use only if weeds have emerged at time of application. Use the higher rate of cyanazine on fine-textured soils. Paraquat is a restricted use herbicide.	141
	1.6 to 2.8 (2 to 3.5 lb) + 0.5 (1 qt)		Spring—after weeds have emerged		
Propham (Chem Hoe 135)	3 to 4 (4 to 5.3 qt)	Wild oats, downy brome and volunteer grain	Late fall	Apply in late fall after soil temperatures have cooled to 50 F or cooler in upper inch of soil. Use the higher rate on medium to fine-textured soils.	143
Dicamba (Banvel, Banvel II)	0.25 to 0.5 (0.5 to 1.0 pt, 1.0 to 2.0 pt)	Wild buck-wheat, kochia and other broadleaf weeds	Postemergence	Residue from fall application may damage broadleaf crops the next year.	140
					140
Glyphosate (Roundup)	0.19 to 0.75 (0.5 pt to 1 qt)	Emerged annual grasses and broad-leaf weeds	Weeds less than 6 inches tall	A nonselective, translocated, postemergence herbicide. No soil residual activity. See paragraph 139 for rates. Use lower rate for annual grasses.	139,
					140
Paraquat (Ortho paraquat, Gramoxone)	0.5 (1 qt)			A nonselective, contact, postemergence herbicide. No soil residual activity. Apply with X-77. Restricted use herbicide.	138
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Postemergence	Use the higher rate for perennial weeds.	
Glyphosate (Roundup) + dicamba (Banvel, Banvel II)	0.19 to 0.375 + 0.125 to 0.25	Emerged annual grasses and broad-leaf weeds	Weeds less than 4 inches tall	Low rates of dicamba should only be used when weeds are small and actively growing. Refer to paragraph 139 for glyphosate use rates.	136,
					139
Glyphosate (Roundup) + 2,4-D	0.19 to 0.38 + 0.5			Low rates of 2,4-D should only be used when weeds are small and actively growing. Refer to paragraph 139 for glyphosate use rates.	135,
					139

For future planting to wheat, durum and barley

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to apply	Remarks	Reference**
Trifluralin (Treflan)	0.6 to 1.0 (6 to 10 lb 10G)	Grass and some broad-leaf weeds	Incorporated in fallow	First incorporation required within 24 hours. Second incorporation may be delayed several weeks, until necessary to control weeds. Rates vary depending on time of application. Refer to paragraph 145 for rate information.	26,27, 29, 145

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For future planting to wheat and durum

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Chlorsulfuron (Glean)	1/64 to 1/43 (1/3 to 1/2 oz)	Most broad-leaf weeds and suppression of foxtail	Fall-postharvest Spring-early post-emergence	Apply with surfactant WK or X-77 at 0.25% v/v. Use only on land to be planted to wheat. Do not use on soils with pH 7.5 or higher.	34,144
Atrazine	0.5 to 1 (0.6 to 1.25 lb 80W)	Annual broad-leaf weeds and grasses including downy brome	Apply before weeds emerge	Plant at least 2 inches deep and allow 12 or more months between application and planting. Do not use on sandy soils, eroded hillsides, caliche and rock outcroppings or exposed calcareous subsoil. Apply combinations with nonionic surfactant at 1 to 2 pts/100 gal. Paraquat is a restricted use herbicide.	28, 142
Atrazine + Paraquat (Ortho paraquat, gramoxone)	0.5 to 1 + 0.25 to 0.5 (0.6 to 1.25 lb 80W + 1 to 2 pt)		Weeds emerged but less than 6 inches tall		
Atrazine + terbutryn (Igran)	0.5 to 1 + 1.6 to 2				
Chlorsulfuron + glyphosate (Glean + Roundup)	1/64 to 1/43 + 0.28 to 0.38 (1/3 to 1/2 oz + 12 to 16 oz)	Most emerged grass and broadleaf weeds	Before crop emergence, broad-leaf weeds less than 2 inches tall or across, grassy weeds 6 inches tall or less	Use 0.5% v/v of surfactants containing at least 50% active ingredient, use 1.0% v/v of surfactants containing less than 50% active ingredient. Do not use on soils with pH 7.5 or higher.	34,39, 144
Metribuzin (Lexone 4L)	1.0 to 1.5 (1 to 1.5 qt)	Annual broad-leaf and grass weeds	Fall—after harvest before weeds emerge	Use the higher rate on fine-textured soils. Do not plant spring wheat following fall applications or winter wheat within 6 months of treatment.	
	0.67 to 1.0 (0.67 to 1 qt)		Early spring before weed emergence		
Metribuzin + terbutryn (Lexone + Igran)	0.5 to 1 (1 to 2 pt) + 1.6 to 2 (2.0 to 2.5 lb 80W)	Annual broad-leaf and grass weeds	Spring—weeds emerged but less than 6 inches	Do not plant winter wheat within 4 months of application. Apply with a nonionic surfactant at 1 to 2 pts per 100 gallons.	
Metribuzin + paraquat (Lexone + Ortho Paraquat, Gramoxone)	1.0 to 1.5 (1 to 1.5 qt) + 0.25 to 0.5 (1 to 2 pt)	Annual broad-leaf and grass weeds	Fall—after harvest if weeds emerged	Use only if weeds have emerged at time of application. Use the higher rate of metribuzin on fine-textured soils. Do not plant spring wheat following fall applications or winter wheat within 4 months of treatment. Apply with X-77 at 1 qt per 100 gal water. Paraquat is a restricted use herbicide.	32,138
	0.67 to 1.0 (0.67 to 1 qt)		Spring after weeds have emerged		

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Special Annual Weed Problems

False Chamomile

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.37 + 0.37	Wheat, barley and oats	Chamomile less than 4 inches tall	Control of fall germinated plants will be less than those germinating in the spring.	50
Chlorsulfuron (Glean)	1/128 (1/6 oz)		Postemergence- crop in 2 to 3- leaf stage and prior to boot	Apply with surfactant WK or X-77 at 0.25% v/v. Use only on land to be planted to wheat, barley or oats for two years or longer following application. Do not apply on soils above pH 7.5.	34,39, 50
Picloram (Tordon 22K)	0.25 to 0.37 (1 to 1.5 pt)	Roadsides	Chamomile less than 4 inches tall	Use the higher rate on plants over 4 inches tall. Avoid drift of picloram to sensitive plants. Restricted use herbicide.	134
Paraquat (Ortho para- quat, Gramoxone)	0.5 (1 qt)	Tree rows or potholes	Chamomile less than 6 inches tall	Apply with X-77 at 1 qt per 100 gal water. Avoid contact with desirable plants. Restricted use herbicide.	138
Glyphosate (Roundup)	0.75 (1 qt)			Avoid contact with desirable plants.	50
Amitrole (Amitrole T, Cytrol)	1.5 (3 qt)				

Fumitory

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Triallate (Far-go)	1.25 (1.25 qt)	Barley	Immediately after planting	Incorporate in top 2 inches of soil by cultivation. Wheat must be below incorporated zone.	8
	1 (1 qt)	Wheat and durum			
Diallate (Avadex)	1.5 (1.5 qt)	Flax	Preplanting	Restricted use herbicide	8
Bromoxynil (ME4 Brominal, Buctril) + MCPA ester	0.25 to 0.37 + 0.25 to 0.37	Wheat, barley and oats	After fumitory is established to boot stage of crop	Other broadleaf weeds also will be controlled. Commercial mixtures (3 + 3 Brominal and Bronate) are available.	38

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CHEMICAL WEED CONTROL FOR PERENNIAL WEEDS

Absinth Wormwood

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D L.V. ester or amine	2 (2 qt of 4 lb/gal conc.)	Pastures and rangeland, noncropland, trees	12 inches tall and actively growing.	Plants are controlled slowly. Avoid spraying tree foliage. Do not graze dairy cows for 7 days after treatment.	135
Dicamba (Banvel , Banvel II)	0.5 to 1 (1 to 2 pt) (2 to 4 pt)	Pasture and rangeland, noncropland, fallow or postharvest		Plants are controlled slowly. Consult label for grazing re- strictions. Surfactant (0.5% v/v) may improve control of large plants.	136
Picloram (Tordon 22K)	0.125 to 0.25 (0.5 to 1 pt)	Pasture and rangeland, noncropland		Consult reference for grazing restriction. Surfactant (0.5% v/v) may improve control of plants.	133, 134
Picloram (Tordon 2K)	0.5 (25 lb 2K granules)	Patches or individual plants in pasture, range- land, or noncrop- land		The higher the rate is required with granular formulations to obtain adequate distribution. Restricted use herbicide.	
Glyphosate (Roundup)	0.25 to 1.0 (0.33 to 1.33 qt)	Trees, noncrop- land, fallow or postharvest		Avoid spraying tree foliage. Use a nonionic surfactant at 0.5% v/v for rates less than 0.5 lb/A. Use higher rates for older stands or larger plants.	130, 132

Canada Thistle and Sowthistle

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
MCPA amine MCPA ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Higher rates than listed may injure crop but may be beneficial especially in small areas, to achieve thistle con- trol.	131
Chlorsulfuron (Glean)	1/64 to 1/43 (1/3 to 1/2 oz)	Wheat, oats, and barley	Crop at 3-leaf stage or larger, thistle less than 6 inches tall	Provides suppression of Canada thistle during the year of application.	27,34, 39
Atrazine	4 (1 gal 4L, 5 lb 80W)	Corn	Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting, or two postemergence treatments at 2 lb/A each with oil 10 to 20 days apart.	Plant only corn year following treatment.	28,62

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Canada Thistle and Sowthistle

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Bentazon (Basagran)	1.0 (2 pt) applied twice	Soybeans	Canada thistle 8 inches tall to bud stage.	Make second application at 1.0 lb/A 7 to 10 days later.	
Bentazon (Basagran)	1.0 (2 pt) applied once	Dry edible beans		Apply once due to injury potential.	
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)	Patches in barley, corn, oats, soybeans or wheat	Prior to heading or flowering of crop, thistles at or beyond the bud stage of growth	Read label for crops that may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	130, 132
2,4-D ester or amine	1 (1 qt of 4 lb/gal conc.)	Fallow or postharvest	12 inches tall and actively growing.	Cultivate fallow until early July. Spray in late August or September. Retreatment will be necessary.	130, 135
Dicamba (Banvel, Banvel II)	0.25 (0.5 pt 4S) (1.0 pt 2S)	Corn	Before corn is 36 inches tall or 15 days prior to tassel emergence, whichever comes first.	Use drop nozzles in corn to reduce drift.	74
Dicamba (Banvel, Banvel II)	1 to 2 (1 to 2 qt) (2 to 4 qt)	Fallow or postharvest	Postharvest mowing promotes active regrowth	Rotate to wheat, corn, or sorghum only. Crop injury may occur if the interval between application and planting is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen.	136
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)		Thistles at or beyond the bud stage of growth	Wait 3 or more days after application before tillage. Read label for crops that may be planted within 1 year of application. Has not been tested on perennial sowthistle.	130, 132
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)	Trees	Thistles at or beyond the bud stage of growth	Avoid spraying tree foliage. A nonselective herbicide.	130
Picloram (Tordon 22K)	0.25 to 0.5 (1 to 2 pt)	Pasture and rangeland	12 inches tall and actively growing. For fall treatment, mowing promotes active growth	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide	133, 134
Dicamba (Banvel, Banvel II)	0.5 (1 pt) (2 pt)			Consult label for grazing restrictions.	136
2,4-D ester or amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)			Do not graze dairy cows for 7 days after treatment.	131, 135

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Canada Thistle and Sowthistle

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Picloram (Tordon)	1 (2 qt S, 50 lb G)	Patches or individual plants in pastures	When thistles are actively growing	Consult reference for grazing restrictions. Restricted use herbicide.	134
Dicamba (Banvel, Banvel II)	4 (1 gal) (2 gal)			Consult label for grazing restrictions.	136

Common Milkweed

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Glyphosate (Roundup)	2.25 (3 qt)	Stubble or patches in barley, corn, oats, soy- beans or wheat	Milkweed late bud to flower stage and actively growing. Prior to heading or flowering of crop	Allow 3 or more days after application before tillage. Read label for crops that may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	130, 132
Picloram (Tordon)	0.5 (2 pt S, 25 lb G)	Pasture and rangeland	Actively growing	Retreatment at the same rate usually will be necessary the following year. Restricted use herbicide.	133, 134
Picloram (Tordon)	1 to 2 (2 to 4 qt S, 50 to 100 lb G)	Patches or individual plants in pastures	Actively growing	Consult reference for grazing restrictions. Restricted use herbicide.	134

Field Bindweed

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow or postharvest	Regrowth 12 inches to bud	Cultivate fallow until early July. Spray in late August or September. Respray in follow- ing year's crop.	131, 135
Dicamba (Banvel, Banvel II)	1 to 2 (1 to 2 qt) (2 to 4 qt)	Fallow or postharvest	Regrowth 12 inches to bud	Mid to late fall treatments have been more effective than summer treatments. Rotate to wheat, corn, or sorghum. Crop injury may occur if the interval between application and plant- ing is less than 45 days per 0.5 lb dicamba used, excluding days when ground is frozen.	136
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Rates higher than listed may injure crop but may be benefi- cial, especially in small areas, to control bindweed.	131, 135

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

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

Field Bindweed

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
Glyphosate (Roundup)	3 to 3.75 (4 to 5 qt)	Patches in barley, corn, oats, soybeans or wheat	Prior to heading or flowering of crops, bindweed in bud and/or flowering stage and actively growing	Crop in the treated area will be killed. Avoid drift. Read the label for crops that may be planted within 1 year following application. Repeat applications are required for complete control.	130, 132
Picloram (Tordon)	1 (2 qt S, 50 lb G)	Patches or individual plants in pastures or non-cropland	Bindweed actively growing	Consult references for grazing restrictions. Restricted use herbicide.	133, 134
Dicamba (Banvel, Banvel II)	4 to 8 (1 to 2 gal) (2 to 4 gal)			Apply to foliage and/or soil. Consult label for grazing restrictions.	136
Glyphosate (Roundup)	3 to 3.75 (4 to 5 qt)	Trees		Avoid spraying tree foliage. A nonselective herbicide. Repeat applications are required for complete control.	130, 132

Leafy Spurge

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Reference**
2,4-D L.V. ester	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Fallow	Spurge 12 inches tall	Cultivate or respray whenever regrowth is 4 to 6 inches high. Retreat in following year's crop.	131, 135
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qt of 4 lb/gal conc.)	Pasture and rangeland	Early bud stage and fall	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days after treatment.	130, 135
Picloram (Tordon 22K) + 2,4-D ester or amine	0.25 to 0.5 + 1 (1 to 2 pt + 1 qt of a 4 lb/gal conc.)		Spurge actively growing, spring or fall	0.25 + 1 lb/A treatment was the most cost effective in NDSU trials. Retreatment at the same rate usually will be necessary for several years. Annual control was greater and years of retreatment needed were less with 0.5 rate. Picloram is a restricted use herbicide.	133, 134
Picloram (Tordon 22K)	Wiper applicator solution 1 part picloram: 3 to 7 parts water		Spurge 15 to 20 inches tall until freeze-up	Use a more concentrated solution for higher weed densities. Fall treatments are more effective than spring treatments. Retreatment with 2,4-D at 1 to 2 lb/A may be needed the following year to control seedlings. Restricted use herbicide.	134, 137

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

Leafy Spurge

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Dicamba (Banvel, Banvel II, Banvel 5G)	4 to 8 (1 to 2 gal, 2 to 4 gal, 80 to 160 lb.)	Patches or individual plants in pastures or non- cropland	Spurge actively growing spring or fall	0.5 cup picloram (2 lb/A rate) or 1 cup dicamba (8 lb/A rate) treats 100 square feet. Consult label for grazing restrictions.	136
Picloram (Tordon)	1 to 2 (2 to 4 qt S, 50 to 100 lb G)				133, 134
Glyphosate (Roundup)	0.75 (1 qt)	Trees	After July 1 and spurge actively growing	Avoid spraying tree foliage. A nonselective herbicide. Retreat the following spring with 2,4-D at 1 to 2 lb/A to control seed- lings and escapes.	130, 132

Quackgrass

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Atrazine	4 (5 lb 80W)	Corn	Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting time	First application 10 days to 2 weeks prior to plowing. Plant only corn the year of applica- tion and the year following treatment. A total of 3 lb/A is adequate on sandy soils.	28, 62
Fluazifop (Fusilade)	0.25 (0.5 pt)	Soybeans	Quackgrass — 4 leaves but less than 10 inches tall	If regrowth occurs, make a second application at 0.25 lb/A when quackgrass has 3 to 5 leaves.	94
Sethoxydim (Poast)	0.5 (2.5 pt)		Quackgrass 6 to 8 inches tall	If quackgrass regrowth occurs, make a second application at 0.3 lb/A when quackgrass regrowth is 6 to 8 inches tall.	95
Glyphosate (Roundup)	1.5 to 2.25 (2 to 3 qt)	Patches in barley, corn, oats, soybeans or wheat	Prior to heading or flowering of the crop, quack- grass at least 8 inches tall and actively growing	Crop in treated area will be killed. Read the label for crops that may be planted within one year following application. Avoid drift.	130, 132
Glyphosate (Roundup)	0.75 (1 qt)	Preplant, fallow or post- harvest	Fall or spring, quackgrass 8 inches tall and actively growing	Add a nonionic surfactant at 0.5% v/v. Allow 3 or more days after application before tillage. Read the label for crops that may be planted within 1 year following application. For established quackgrass sod, use glyphosate at 1.5 lb/A.	130, 139

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

Russian Knapweed

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Prevents seed formation only.	131, 135
Dicamba (Banvel, Banvel II)	0.25 (0.5 pt 4S, 1.0 pt 2S)	Corn	Before corn is 36 inches tall or 15 days prior to tassel emergence, whichever comes first	Use drop nozzles to reduce drift.	74,136
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qts of 4 lb/gal conc.)	Fallow or post- harvest, pasture and rangeland	Rosette stage pre- ferred. Also bud to bloom stage	Several years of annual treat- ment is necessary until seed is no longer viable.	131, 135
Dicamba (Banvel, Banvel II)	1 to 2 (1 to 2 qt) (2 to 4 qt)			In cropland rotate to wheat, corn or sorghum. Crop injury may occur if the interval bet- ween application and planting is less than 45 days per 0.5 lb of dicamba used, excluding days when ground is frozen.	136
Dicamba (Banvel)	2 to 6 (2.0 to 6.0 qt S 40 to 120 lb/G)	Pasture and rangeland, non- cropland	Spring or fall	Consult label for grazing restrictions.	136
Picloram (Tordon)	1.0 to 2.0 (2 to 4 qt S 50 to 100 lb G)		Anytime during growing season		133, 134
Clean cultivation		Cropland	Repeat whenever plants get 3 to 6 inches of top growth throughout growing season.		

Spotted Knapweed

Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
2,4-D L.V. ester or oil soluble amine	1 to 2 (1 to 2 qts of 4 lb/gal conc.)	Fallow or post- harvest, pasture and rangeland	Rosette stage pre- ferred. Also bud to bloom stage	Annual treatment for several years is necessary until seed is no longer viable.	131, 135
Dicamba (Banvel, Banvel II)	1 to 2 (1 to 2 qt) (2 to 4 qt)			In cropland rotate to wheat, corn or sorghum. Crop injury may occur if the interval be- tween application and planting is less than 45 days per 0.5 lb of dicamba used, excluding days when ground is frozen. Good spotted knapweed con- trol.	136
2,4-D amine 2,4-D L.V. ester	0.75 (1.5 pt) 0.66 (1.33 pt)	Wheat and barley	Tiller stage of crop	Prevents seed formation only. Rates higher than listed may injure crops, but may be beneficial.	131, 135

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

Spotted Knapweed

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Dicamba (Banvel, Banvel II)	0.25 (0.5 pt 4S) (1.0 pt 2S)	Corn	Before corn is 36 inches tall or 15 days prior to tassel emergence, which- ever comes first	Use drop nozzles to reduce drift. Prevents seed formation only.	74,136
Picloram (Tordon, Tordon 2K)	0.125 to 0.5 (0.5 to 2 qt S, 25 to 50 lb 2% G)	Pasture and rangeland, non- cropland	Rosette or head to bloom stage pre- ferred	Consult reference for grazing restriction. The higher rate is required in dense stands. The higher rate is required with granular formulations to obtain adequate distribution. Excel- lent spotted knapweed control.	133, 134
Clean cultivation		Cropland	Repeat whenever plants get 3 to 6 inches of top growth throughout growing season.	Spotted knapweed is not generally a problem in culti- vated land.	

Total Vegetation Control

Herbicide	Act. Incred. lb/A (Formulation/A)*	Weed Location	When to Apply	Remarks	Refer- ence**
Atrazine, bromacil, diuron, prometone, simazine, or similar pro- ducts.	See label	Around buildings, telephone poles, etc.	Anytime during and prior to growing season. See label.	Use high rate for complete long-term soil sterility.	

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

GLOSSARY OF CHEMICAL NAMES

TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Amiben (Union Carbide)	Chloramben	10% G, 75% SP 2 lb/gal S
Amitrole T (Union Carbide)	Amitrole	2 lb/gal S
Antor (Nor-Am)	Diethatyl	4 lb/gal E
Atrazine (Various)	Atrazine	80% WP, 90% DF 4 lb/gal F
Avadex (Monsanto)	Diallate	4 lb/gal E 10% G
Avenge (American Cyanamid)	Difenzoquat	2 lb/gal S
Balan (Elanco)	Benefin	1.5 lb/gal E
Banvel (Velsicol)	Dicamba	2 lb/gal S (Banvel II), 4 lb/gal S (Banvel), 5% G (Banvel 5G)

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

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

TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Basagran (BASF)	Bentazon	4 lb/gal S
Basalin (BASF)	Fluchloralin	4 lb/gal E
Betamix (Nor-Am)	Desmedipham + Phenmedipham	0.65 + 0.65 lb/gal E
Betanex (Nor-Am)	Desmedipham	1.3 lb/gal E
Bicep (Ciba-Geigy)	Atrazine + Metolachlor	2 + 2½ lb/gal F
Bladex (Shell)	Cyanazine	80% WP, 15% G 4 lb/gal F
Blazer (Rohm & Haas)	Acifluorfen	2 lb/gal E, S
Brominal ME4 (Union Carbide)	Bromoxynil	4 lb/gal E
Brominal 3 + 3 (Union Carbide)	Bromoxynil and MCPA	3 lb/gal MCPA plus 3 lb/gal bromoxynil E
Bronate (Rhone-Poulanc)	Bromoxynil and MCPA	2 lb/gal MCPA plus 2 lb/gal bromoxynil E
Buctril (Rhone-Poulanc)	Bromoxynil	2 lb/gal E
Butyrac Ester & 200 (Union Carbide)	2,4-DB	2 lb/gal E, S
Butoxone (Vertac)	2,4-DB	1.75 lb/gal amine S 2 lb/gal E
Carbyne 2EC (Velsicol)	Barban	2 lb/gal E
Chem-Hoe 135 (PPG)	Propham	3 lb/gal F
Chem-Hoe FL4 (PPG)	Propham	4 lb/gal F
Cytrol (American Cyanamid)	Amitrole	2 lb/gal S
Des-i-cate (Pennwalt)	Endothall (As a desiccant)	0.52 lb/gal S
Dowpon M (Dow)	Dalapon	74% SP
Dual (Ciba-Geigy)	Metolachlor	25% G 8 lb/gal E
Dyanap (Uniroyal)	Naptalam + dinoseb	3 lb/gal E
Eptam (Stauffer)	EPTC	7 lb/gal E 10% G
Eradicane (Stauffer)	EPTC plus Safener	6.7 lb/gal E
Eradicane Extra (Stauffer)	EPTC plus Safener + Extender	6.0 lb/gal E
Evik (Ciba-Geigy)	Ametryn	80% WP
Far-go (Monsanto)	Triallate	4 lb/gal E 10% G
Fusilade (ICI Americas)	Fluazifop	4 lb/gal E
Genate (PPG)	Safener + Butylate	6.7 lb/gal E
Genep (PPG)	EPTC	7 lb/gal E
Glean (DuPont)	Chlorsulfuron	75% DF

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TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Gramoxone (ICI Americas)	Paraquat	2 lb/gal S
Herbicide 273 (Pennwalt)	Endothall	3 lb/gal S
Hoelon (American Hoechst)	Diclofop	3 lb/gal E
Hyvar (DuPont)	Bromacil	2 lb/gal S (XL) 80% WP (X)
Igran (Ciba-Geigy)	Terbutryn	80% WP
Karmex (DuPont)	Diuron	80% WP
Lasso (Monsanto)	Alachlor	4 lb/gal E (Lasso) 15% G (Lasso II)
Lexone (DuPont)	Metribuzin	75% DF 4 lb/gal F
Lorox (DuPont)	Linuron	50% WP 4 lb/gal F
MCPA (Various)	MCPA	Various E, S
MonDak (Velsicol)	Dicamba plus MCPA	1.25 lb/gal dicamba plus 2.5 lb/gal MCPA S
Nortron (Nor-Am)	Ethofumesate	4 lb/gal F 1.5 lb/gal E
Ortho Diquat (Chevron)	Diquat	2 lb/gal S
Ortho Paraquat Plus (Chevron)	Paraquat	2 lb/gal S
Oxy Leafex-3 (Occidental)	Sodium chlorate	3 lb/gal S
Poast (BASF)	Sethoxydim	1.5 lb/gal E
Pramitol (Ciba-Geigy)	Prometone	2 lb/gal E 5% G
Premerge (Vertac)	Dinoseb amine salt	3 lb/gal S
Princep (Ciba-Geigy)	Simazine	80% WP, 4 lb/gal F 4% G, 90% DF
Prowl (American Cyanamid)	Pendimethalin	4 lb/gal E
Pyramin (BASF)	Pyrazon	4.2 lb/gal F
Ramrod (Monsanto)	Propachlor	65% WP, 4 lb/gal F 20% G
Rescue (Uniroyal)	Naptalam + 2,4-DB	2.06 lb/gal E
Ro-Neet (Stauffer)	Cycloate	6 lb/gal E 10% G
Roundup (Monsanto)	Glyphosate	3 lb/gal S
Sencor (Mobay)	Metribuzin	4 lb/gal F, 75% DF 50% WP
Sodium Chlorate (Riverside Chemical Co.)	Sodium chlorate	3 lb/gal S
Sonalan (Elanco)	ethalfuralin	3 lb/gal E
Stampede (Rohm & Haas)	Propanil	3 lb/gal E
Sutan + (Stauffer)	Safener + Butylate	6.7 lb/gal L 10% G

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

TRADE NAME ^{1/} AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Sutazine + (Stauffer)	Safener + Butylate + Atrazine	6 lb/gal F (4.8 lb Sutan +, 1.2 lb Atrazine)
TCA (Hopkins)	TCA	4.76 lb/gal S
Tordon (Dow)	Picloram	2% G (Tordon 2K) 2 lb/gal S (Tordon 22K)
Treflan (Elanco)	Trifluralin	4 lb/gal E, 5 lb/gal E 10% G
2,4-D (Various)	2,4-D	Various E, S
Velpar (DuPont)	Hexazinone	90% DF
Vertac General (Vertac)	Dinoseb (DNBP) oil soluble	5 lb/gal E

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

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

	Barnyardgrass	E. Black nightshade	Cocklebur	Field bindweed & per. thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oats	Herbicide Persistence After 12 months
PREPLANT INCORPORATED														
Butylate (Sutan, Genate)	G	—	—	N	G	—	P	F	P	N	P	P	G	N
Cycloate (Ro-Neet)	G	G	P	N	G	F	F	F-G	P	N	F	P	G	N
EPTC (Eptam, Genep)	G	G	P	N	G	F	F	F-G	P	N	F	P	G	N
Ethalfuralin (Sonalan)	G	G	P	N	G	G	G	G	G	N	F	N	F	S
Ethofumesate (Nortron)	P	—	P	N	F-G	F-G	P	G	—	P	G	F	F-G	O
Fluchloralin (Basalin)	G	N	P	N	G	G	G	G	G	N	F	N	F	S
Pendimethalin (Prowl)	G	N	N	N	G	F-G	G	G	F	N	N	N	F	S
Trifluralin (Treflan)	G	N	P	N	G	G	G	G	G	N	F	N	F	S
PREEMERGENCE INCORPORATED														
Di- & Triallate (Avadex, Far-go)	N	N	N	N	N-F	N	N	N	N	N	N	N	G	N
Trifluralin (Treflan)	G	N	N	N	G	F	F	F	F	N	N	N	P-N	S
PREEMERGENCE														
Alachlor (Lasso)	G	G	N	N	G	F	F	G	F	N	F	P	P	N
Atrazine (AAtrex)	G	G	F	P	G	G	G	G	G	F	G	G	G	O
Chloramben (Amiben)	G	F	P	N	G	F	G	G	G	N	G	F-G	F	N
Cyanazine (Bladex)	F	F	F	N	G	F	G	F	G	F	G	G	P	N
Diethatyl (Antor)	P-F	—	P	P	F-G	P	P	G	—	P	P	P	F-G	N
Hexazinone (Velpar)	G	—	—	—	G	P	F	F	P	—	P	F	F-G	O
Metolachlor (Dual)	G	G	N	N	G	F	F	G	F	N	F	P	N	N
Metribuzin (Lexone, Sencor)	G	P	F	N	G	G	F	G	G	N	F	G	P	S
Pendimethalin (Prowl)	G	N	N	N	G	F-G	G	G	F	N	N	N	F	S
Propachlor (Bexton, Ramrod)	G	—	P	N	G	G	F	G	P	N	F	P	P	N
Simazine (Princep)	G	G	F	P	G	G	G	G	G	F	G	G	G	O
TCA	G	N	N	N	G	N	N	N	N	P	N	N	P	N

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

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

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

	Barnyardgrass	E. Black nightshade	Cocklebur	Field bindweed & per. thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oats	Herbicide Persistence After 12 months
POSTEMERGENCE														
Acifluorfen (Blazer)	N	F-G	F	F	P	F-G	P-F	G	P	P	G	G	N	N
Atrazine + oil	G	G	G	P	G	G	G	G	G	G	G	G	G	S
Barban (Carbyne 2EC)	N	N	N	N	N	N	N	N	N	N	P	N	F-G	N
Bentazon (Basagran)	N	F	G	P-F	N	F	P	P	P	G	P	G	N	N
Bentazon (Basagran + oil)	N	F	G	P-F	N	F	F-G	P-F	-	G	P	G	N	N
Bromoxynil (ME4 Brominal, Buctril)	N	-	G	P-F	N	F-G	G	F-G	G	G	G	F	N	N
Bromoxynil + MCPA (3 + 3 Brominal, & Bronate)	N	G	G	F	N	G	G	G	G	G	G	G	N	N
Chlorsulfuron (Glean)	-	N	G	P-G	G	G	G	G	G	G	G	G	N	O
Cyanazine + oil (Bladex)	G	F-G	G	P	G	G	G	F-G	G	G	G	G	F	N
POSTEMERGENCE														
Dalapon (Dowpon)	G	N	N	N	G	N	N	N	N	N	N	N	F	N
Desmedipham + Phenmedipham (Betamix)	P	G	F-G	N	F	F	G	F-G	P	P	F-G	G	N	N
Desmedipham (Betanex)	P	G	P-F	N	P	P-F	G	G	P	P	F	G	N	N
Dicamba (Banvel)	N	G	G	G	N	G	G	G	F-G	G	G	F	N	S
Dicamba + MCPA (Mondak)	N	G	G	G	N	G	G	G	F-G	G	G	G	N	N
Diclofop (Hoelon)	F	N	N	N	G	N	N	N	N	N	N	N	G	N
Difenzoquat (Avenge)	N	N	N	N	N	N	N	N	N	N	N	N	G	N
Dinoseb (at cracking) (Premerge)	N	-	-	N	N	G	G	G	-	F	P	G	N	N
Dinoseb + Naptalam (Dyanap)	F-G	-	F-G	N	N	P	F	F-G	-	F-G	P	G	N	N
Endothall (Herbicide 273)	N	-	P-F	N	N	P	P	F	P	F-G	G	F	N	N
Fluazifop (Fusilade)	G	N	N	N	G	N	N	N	N	N	N	N	G	N
Glyphosate (Roundup)	F	-	-	P-G	G	F	G	G	F	G	P-F	G	G	N
MCPA	N	G	G	G	N	F	G	P-F	N	F-G	N	G	N	N
Paraquat	G	-	-	N	G	F	G	G	F	G	P	G	F	N
Picloram (Tordon 22K) + 2,4-D	N	G	G	G	N	F	G	G	G	G	G	G	N	O
Propanil (Stampede)	F	-	F	N	G	F	G	G	P	F	G	F	N	N
Sethoxydim (Poast)	G	N	N	N	G	N	N	N	N	N	N	N	G	N
2,4-D	N	G	G	G	N	F	G	G	F-G	G	P	G	N	N

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

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