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## 1978 CHEMICAL WEED CONTROL GUIDE for Field Crops & Perennial Weeds

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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 CHEMICALS ONLY AS RECOMMENDED ON THE LABEL.

APPLICATION RATES are broadcast and expressed as active ingredient or acid equivalent, and in the amount of commercial product. Commercial formulations of the same herbicide may vary in their amount of active ingredient. For example, a pint of 4-pound acid equivalent per gallon 2,4-D contains 1/2 pound acid equivalent, a pint of 3.3-pound acid equivalent per gallon contains 2/5 pound, and a pint of 6-pound acid equivalent per gallon contains 3/4 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  $3 \frac{3}{4}$  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

can be an effective supplement. Timely applications of selective herbicides at the recommended rate will control many annual weeds satisfactorily without damaging the crop in which the weeds are growing.

POSTEMERGENCE HERBICIDES: Consider crop tolerance, weed species and climatic conditions 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 post-emergence herbicides under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of drouth or prolonged cool weather, or for well established weeds, use the highest recommended rate, except for barban (Carbyne). (See Wild Oat Section for discussion of barban use.)

IDEAL TEMPERATURES for applying most post-emergence herbicides are between 65 degrees and 85 degrees F. Below 60 degrees, weeds are killed very slowly or not at all; above 85 degrees 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.

SPRAY DRIFT is a serious problem in North Dakota each year as herbicides move from target fields into non-target fields containing crops susceptible to the herbicide. Spray drift and crop injury are affected by several factors.

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1) Spray particle size: Large droplets will drift less than small particles. Use of low spray pressures (20 to 30 psi) and nozzles which deliver high gallons per acre will produce larger spray droplets.

2) Wind velocity and direction: To minimize spray drift, wind direction should be away from susceptible crops when herbicides are applied. The wind velocity should be less than 10 miles per hour. However, drift can occur even with lower wind velocities.

3) 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.

4) Herbicide formulation: 2,4-D and MCPA are formulated as amines and as esters. Particle drift can occur with both formulations, but ester formulations are volatile so drift from esters can occur in the particle form during application and also in the vapor form after application. Dicamba (Banvel) is also volatile and can drift as particles or vapor.

Injury to susceptible crops from drift is more unpredictable with volatile herbicides (2,4-D and MCPA esters or dicamba) than with an amine, so volatile herbicides should not be used near susceptible crops. Some of the so-called high volatile esters of 2,4-D vaporize at temperatures as low as 70 degrees F. and most vaporize readily at temperatures above 85 degrees F. The temperature at ground level always is several degrees warmer than at chest height. Consequently, vaporization from the high volatile esters could occur at temperature readings as low as 60 degrees F. Vapor drift may be avoided by using the 2,4-D amines.

5) Drift control: Certain spray nozzles such as the Delavan Raindrop nozzles and the Spraying Systems LP nozzles produce large droplets which reduce drift. Nalco-Trol, an additive to spray mixtures causes larger droplets which reduces drift.

6) Drift injury from herbicides: Damaging drift to non-target crops is primarily a problem with 2,4-D, MCPA, dicamba (Banvel) and picloram (Tordon) in North Dakota. Other herbicides may drift but generally do not cause significant damage. Drift control techniques should be used only with post-emergence herbicides that cause a drift problem because many other postemergence herbicides, such as barban (Carbyne), desmedipham (Betanex), and bentazon (Basagran), require small droplets for optimum performance.

**HERBICIDE COMBINATIONS:** 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 from the use of the individual herbicide alone. However, loss of weed control or increased crop damage may sometimes result from the use of certain other herbicides in combination.

Use herbicide combinations 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.

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 any possible crop injury, inadequate weed control and illegal residues.

**HERBICIDE-FERTILIZER COMBINATIONS:** Thorough mixing and a continuous vigorous agitation are required to obtain an even application of herbicide-fertilizer combinations. Even with mixing and agitation, herbicides may not always mix evenly throughout a sprayable liquid fertilizer, or the components may separate out, making their combined use impractical. 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. Put 1 pint of fertilizer in a quart jar and add 2 teaspoons of the liquid herbicide. For wettable powders, mix two 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 foams, 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. Different batches of the same formulation of fertilizer may differ in their mixing properties so should be tested separately.

**PREEMERGENCE HERBICIDES:** Good weed control with preemergence herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature and 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 in-



corporated into the soil surface usually depend less upon rainfall after application for effective weed control than unincorporated herbicides. If weeds are emerging through a preemergence herbicide treatment, the field may be rotary hoed without reducing the effect of the herbicide.

**INCORPORATION OF HERBICIDES:** Many herbicides which are applied before crop and weed emergence need to be incorporated to give optimum weed control. Included in this group are EPTC (Eptam, Eradicane), cycloate (Ro-Neet), butylate (Sutan), triallate (Far-go), diallate (Avadex), trifluralin (Treflan), profluralin (Tolban), fluchloralin (Basalin), and dinitramine (Cobex). Alachlor (Lasso) and pendimethalin (Prowl) should be incorporated in some cases.

EPTC, cycloate, butylate, diallate, triallate, and profluralin should be incorporated immediately (within minutes) after application. Incorporate fluchloralin within eight hours of application. Trifluralin incorporation also may be delayed up to eight hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Dinitramine incorporation can be delayed up to 24 hours. Pendimethalin must be used preemergence on corn but may be incorporated for soybeans. Incorporation often improves the performance of pendimethalin. Incorporation of pendimethalin may be delayed up to seven days after application. Alachlor may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor may be delayed several days.

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 matched to the herbicide.

EPTC, cycloate, butylate, trifluralin, profluralin, fluchloralin, and dinitramine require a thorough incorporation and should be incorporated by one of the following methods or a method which will do a similar job to the methods listed.

1) A tandem disk should be set at a depth of 3 to 4 inches for dinitramine and a depth of 4 to 6 inches for the others. Operating speed should be 4 to 6 mph.

2) 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 dinitramine and 4 to 6 inches for the others. 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 will usually be 6 to 8 mph.

3) 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.

A single incorporation with a power driven tiller is sufficient for EPTC, cycloate, butylate, trifluralin, fluchloralin, profluralin, or dinitramine. However, a second tillage at right angles to the initial incorporation should be done if the disc or field cultivator is used. The second incorporation has two purposes.

1) Most of the herbicide left on the surface after the first incorporation will be mixed into the soil with the second tillage, and

2) the second tillage will give more uniform distribution of the herbicide in the soil which will improve weed control and reduce crop injury.

Trifluralin 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 a deep incorporation but fair to good control of shallow germinating weeds such as green and yellow foxtail (pigeongrass) can be obtained.

Pendimethalin does not require deep incorporation but deep incorporation will not harm performance. A tillage tool operating at a minimum depth of 2 inches will give adequate incorporation.

Diallate and triallate will perform adequately 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 showed that deeper incorporation did not reduce wild oat control from diallate or triallate and even gave better control of deep germinating wild oats. However, triallate used on wheat, durum, or barley should be incorporated less deeply than the placement of the crop seed. If triallate is incorporated around the wheat seed, crop injury may result. 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.

**USE OF THE SOIL ORGANIC MATTER TEST:** Certain herbicides are partially adsorbed and inactivated by soil organic matter, so knowledge of the organic matter level will serve as a guide to select an effective herbicide and an effective herbi-



cide rate. Herbicides such as EPTC (Eptam), pyrazon (Pyramin), atrazine, linuron (Lorox) and cycloate (Ro-Neet) require higher rates to be effective in high organic matter soils. On the other hand, crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, so clay content affects herbicide performance. However, organic matter level generally affects herbicide performance more than clay content.

EPTC is used on flax, sugar beets, sunflowers, dry beans and potatoes. Flax and sugar beets 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 gives some guidelines but does not give firm rules. Since other factors such as method of incorporation also affect EPTC performance (immediate and thorough incorporation gives best performance), each grower must decide on the best rate for his conditions. The suggested EPTC rate is 2 to 3 pounds per acre. When a soil has a silty clay texture with more than 7 per cent organic matter, the 3-pound per acre rate would be expected to give good weed control without crop injury. When a soil is sandy loam or coarser textured and has less than 4 per cent organic matter, crop injury to sugar beets and flax may result even with the minimum rate of 2 pounds per acre. EPTC rate should be adjusted within the 2 to 3-pound per acre range when the soil is intermediate between the two extremes. EPTC at 2.5 pounds per acre should give good weed control and little crop injury on clay loam or finer textured soils with more than 5 per cent organic matter.

Safer herbicides such as TCA, diallate (Avadex), cycloate (Ro-Neet), or pyrazon (Pyramin) + TCA may be used in sugar beets on the low organic matter soils where EPTC injury is excessive. EPTC is the only preemergence or preplant incorporated herbicide cleared for use on flax. Stunted plants and stand reduction are symptoms of flax injury from EPTC. Usually, flax yield 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.

Some herbicides give good weed control only when organic matter levels are low. Pyrazon and linuron have not been effective in the Red River Valley, except on the coarser textured soils with less than 5 per cent organic matter. The lower the organic matter, the more effective they become. The atra-

zine rate must be adjusted according to organic matter levels. Apply the higher labeled rates on higher organic matter soils.

Many herbicides such as trifluralin (Treflan), propachlor (Ramrod), triallate (Far-go), diallate (Avadex) and most postemergence herbicides are affected only slightly by organic matter levels.

Determine organic matter levels 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 often enough.

## WEED CONTROL IN FIELD CROPS

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

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 is more resistant 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 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 there is little or no difference in such tolerance among the wheat and barley varieties.

Rates of 2,4-D or MCPA required to control most broadleaf weeds cannot be applied in small grain crops underseeded to sweetclover, alfalfa or other legumes without seriously injuring or killing the legumes.

Dicamba (Banvel) controls wild buckwheat, smartweed and certain other broadleaf weeds in wheat and oats. Dicamba can be applied alone but usually is applied with MCPA to increase control of wild mustard. Oats is more tolerant to dicamba than wheat. Both crops must be treated at the second through fourth leaf stage. Barley is more susceptible to injury from dicamba than wheat or oats.

Picloram at 1/4 ounce per acre with 4 to 6 ounces per acre of 2,4-D has a North Dakota label for broadleaf weed control in wheat and barley. Picloram may be applied from tillering to the boot stage. However, application to durum should be



before the six-leaf stage to reduce possible shortening and spike retention by the flag leaf sheath. Do not rotate treated wheat or barley fields to other crop uses.

Bromoxynil (Buctril, Brominal) controls wild buckwheat, fumitory and most annual broadleaf weeds in wheat and barley from the third leaf stage of the crop to early boot. Mixtures of bromoxynil plus MCPA ester (Bronate and Brominal Plus) are applied to improve wild mustard control.

Trifluralin at 1/2 to 3/4 pound per acre and harrow incorporated shallowly after seeding has a North Dakota label for foxtail (pigeongrass) control in wheat. 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. 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.

**HARROWING FOR WEED CONTROL** in small grains: 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 ahead of the seeded crop. 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 leaves, and when soil moisture is good but the soil surface is dry. However, harrow before the small grain begins to stool. Weeds should be small, especially foxtail and wild oats, as many of them are killed by being covered with soil rather than by being harrowed out.

After the seeded crop is up, wheat can be harrowed one to three times, but barley only once. Oats normally is not harrowed because it is injured more easily than wheat and barley.

Good control of wild oats and other weeds is possible by shallow disking or using a rod weeder shortly after the seeding crop has sprouted but well before it emerges.

NOTE: Wild oat control in small grains is discussed in the wild oat section of this circular.

### FLAX

Flax is a poorer competitor with weeds than are small grains, and should be grown on relatively

weed-free fields. Early after-harvest tillage of small grain stubble will prevent weed seed production, control perennial weeds and encourage annual weed seed germination prior to freeze-up.

Use flax in the rotation following corn, soybeans or other cultivated row crops. If good weed control practices were employed in the previous year's crop, flax would require only shallow tillage. One or more crops of wild oats frequently are destroyed by spring tillage before flax is sown. However, delayed planting generally reduces crop yields. Plant early maturing varieties with late seeding.

MCPA at 1/4 pound per acre controls most broadleaf weeds in flax when it is 2 to 6 inches tall. Rates of MCPA amine higher than 1/4 pound per acre or MCPA ester should be used in flax only for the more resistant weeds.

Postemergence weed control in flax is most effective when the herbicide is applied as soon as most of the weeds have emerged. While an application of MCPA may reduce the yield of both seed and straw, weed competition generally is reduced sufficiently to compensate for any herbicide injury.

Dalapon (Dowpon) will control green and yellow foxtail (pigeongrass) in young flax. Apply dalapon when the flax is over 2 inches tall and the weeds less than 2 inches for best results. Caution: Spraying must be completed prior to the early bud stage. Generally dalapon is applied in a mixture with MCPA amine to control both the susceptible grassy and broadleaf weeds with one application.

EPTC (Eptam) spring applied at 2 to 3 pounds per acre or fall applied at 4 pounds per acre controls annual grass weeds, including wild oats, and some broadleaf weeds in flax. Fall applied EPTC at 3 pounds per acre generally has given good control in coarse textured soils. Incorporate EPTC immediately (within minutes) and thoroughly after application. Tandem disk twice at right angles or use any other method which will thoroughly mix the chemical with the top 3 inches of soil.

Flax tolerance to EPTC is marginal. EPTC is more injurious to flax on coarse textured and low organic matter soils. In experiments at North Dakota State University, EPTC has not caused flax injury on fine textured, high organic matter soils. A limited reduction in the flax stand from EPTC will not reduce yields since weed competition is decreased and there is an increased branching of the remaining plants. See section on use of the organic matter test.



## CORN

A combination of cultural practices and herbicide application is necessary for weed control in corn.

Destroy early germinating weeds by cultivation before planting if conventional tillage is used. Leave the space between the rows loose to reduce weed germination. Use a rotary hoe as soon as weeds appear. Cultivate soon after the weeds have emerged.

Atrazine applied preemergence at 2 to 4 pounds per acre gives good control of annual weeds without crop injury. Fine textured soils and those high in organic matter require a 4-pound per acre application. Atrazine residues injurious to susceptible crops may remain in certain soils longer than one growing season. Residues are more likely to persist with low soil temperatures or low moisture conditions.

Crops vary in their tolerance to atrazine. Corn and millet are tolerant. General ranking of other crops in order of least to most tolerant is sugar beets, sunflowers, oats, wheat, barley, soybeans and flax. Minimize residues by applying the lowest rate of chemical consistent with good weed control, using band instead of broadcast applications, and plowing the field prior to planting the next crop.

Propachlor (Ramrod, Propachlor and Bexton) applied preemergence at 4 to 5 pounds per acre controls annual grasses and some broadleaf weeds but is ineffective against wild mustard or perennial weeds. Propachlor often is used in mixtures with atrazine, cyanazine (Bladex) or linuron (Lorox) to enhance broadleaf weed control.

Alachlor (Lasso) is used preemergence at 2 1/2 to 3 1/2 pounds per acre 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. Propachlor in North Dakota State University experiments has given superior weed control to alachlor except when alachlor was incorporated.

Penoxalin (Prowl) is used at 1 1/2 to 2 pounds per acre for control of annual grasses and certain broadleaf weeds such as redroot pigweed. Harrow if no rain occurs within 7 days after application. Do not use penoxalin on sands or loamy sands or on soils with less than 1.5 per cent organic matter. Penoxalin is labeled for mixing with atrazine, dicamba and cyanazine (see label for details).

Cyanazine (Bladex) at 2 to 3.2 pounds per acre preemergence controls annual grasses and broad-

leaf weeds in corn. Cyanazine requires more than 1/2 inch of rain for activation, especially on fine textured soils. Cyanazine has a short soil residual permitting normal crop rotations. Mixtures of cyanazine with propachlor and alachlor improves grassy weed control. Cyanazine alone gives poor to fair redroot pigweed control. Alachlor and cyanazine are difficult to mix. For best results, fill the sprayer tank one half full of water, add the alachlor while agitating, and wait 10 minutes. Mix the cyanazine in a small amount of water to form a slurry, and add it slowly into the tank while continuing the agitation.

Atrazine applied postemergence at 1 to 2 pounds per acre generally controls most annual grasses in corn and control of broadleaf weeds is excellent. Apply atrazine within three weeks of planting while the weeds are less than 1 1/2 inches tall. Adding 1 to 2 gallons per acre of crop (petroleum) oil with an emulsifier increases the effectiveness of the treatment. Substituting 1 to 1 1/2 quarts per acre of an emulsifiable crop origin oil (Bio-Veg or Midland EV) gives results similar to petroleum oil applied at 1 to 2 gallons per acre. The emulsifiable crop origin oils also are known as vegetable oils.

Cyanazine (Bladex 80W) is labeled at 1.2 to 2 pounds per acre with 1 quart per acre of an emulsifiable crop origin oil (Bio-Veg or Midland EV) as an early postemergence treatment for grassy and broadleaf weed control in corn. Only the 80W formulation is registered for postemergence weed control. Cyanazine at 1.2 pounds per acre with 1 quart per acre of crop origin oil has given good control of small weeds (less than 1 1/2 inches tall). Higher rates will give more consistent weed control but also increases the possibility of corn injury. Occasionally corn leaf burn occurs, but recovery is good. Corn should not be treated after the 4-leaf stage or during extended cold, wet conditions. Cyanazine residues are unlikely to prevent normal crop rotations. The 1.2 pound per acre rate in fine textured soils only controls emerged weeds. Thus, later emerging weeds are sometimes a problem and should be controlled by cultivation.

2,4-D amine at 1/4 to 1/2 pound per acre applied postemergence to corn 3 to 8 inches tall will control broadleaf weeds. Use the 1/4-pound rate for susceptible weeds like wild mustard. The 1/2-pound rate will control the more resistant weeds, 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, use drop nozzles to avoid getting the 2,4-D on the upper leaves and leaf whorl. This reduces the danger of 2,4-D injury. Corn sprayed with 2,4-D may show signs of injury. Brittleness, followed by bending or breaking of



the stalks, sometimes occurs. A severe stand loss may result when applications of 2,4-D are followed by a storm or careless cultivation.

Dicamba (Banvel) at 1/8 to 1/4 pound per acre, either alone or in a mixture with 2,4-D amine at 1/4 pound per acre, can be applied postemergence in corn. Dicamba gives better control of Canada thistle, smartweed and wild buckwheat than 2,4-D with less effect on corn. Make dicamba applications until corn is 3 feet tall or until 15 days before tassel emergence, whichever comes first. Use drop nozzles after corn is 8 inches tall if dicamba is applied with 2,4-D.

EPTC + R-25788 (Eradicane) is registered for use on field and silage corn. R-25788 increases the tolerance of corn to EPTC. Apply 4 pounds per acre in 10 to 50 gallons of water per acre with low pressure. Be sure the soil is well worked and dry enough to permit immediate and thorough soil incorporation. This chemical controls a large number of annual broadleaf and grass weeds and at 6 pounds per acre gives fair to good quackgrass control.

1,8-naphthalic anhydride (Protect) is a seed treatment product for field, silage and sweet corn that permits the use of EPTC at 4 pounds per acre. Use one 2-ounce package of Protect for each 1/2 bushel of corn to be treated. Protect must be thoroughly mixed with the seed so each kernel is completely coated. After treatment, the corn may be stored until planting time or transferred directly to the planter box. Just before the corn is planted, apply and incorporate EPTC according to its label.

Emergency control of broadleaf and grassy weeds in corn can be obtained with directed applications of ametryne (Evik) or linuron (Lorox). Apply ametryne at 2 to 2.5 pounds per acre or linuron at 0.6 to 1.5 pounds per acre as a directed spray to the weeds. Keep the chemicals off the leaves of corn. Application over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply ametryne before corn is 12 inches high and linuron before corn is 15 inches high. The weeds should not be more than 6 inches high.

### SUGAR BEETS

Herbicides may be used in sugar beets to supplement conventional practices. Hand labor, mostly hoeing, is still needed for optimum weed control but can be reduced by timely cultivations and herbicide applications. The uses of preplant, preemergence and early postemergence herbicides in sugar beets are discussed in the table.

EPTC spring applied at 2 to 3 pounds per acre or fall applied at 4 to 4 1/2 pounds per acre gives good control of annual grasses and certain broadleaf weeds. EPTC sometimes causes a sugar beet stand reduction and temporary stunting, however, if enough sugar beets remain to obtain an adequate plant population after thinning, no yield reduction will result. Use EPTC with extreme caution on sugar beets grown in sandy loam or lighter soils with low organic matter levels because it is difficult to predict a safe rate on such soils. See section on use of the soil organic matter test.

Desmedipham (Betanex) and phenmedipham (Beta-nal) are postemergence herbicides for the control of annual broadleaf weeds. To avoid possible sugar beet injury from desmedipham and phenmedipham, observe several precautions. The sugar beets should have at least four true leaves before treatment. Use no more than 1 pound per acre following EPTC or TCA. Start application late in the afternoon or early in the evening so cool temperatures follow application. Do not apply if the highest temperature on the day of application exceeds 85 degrees F. Set the desired band width near the top of the sugar beets so that the beets rather than the ground receive the proper rate. Calibrate the sprayer accurately.

Trifluralin (Treflan) is cleared at 3/4 pound per acre and EPTC (Eptam) is cleared at 3 pounds per acre for use on sugar beets after thinning for annual grass and broadleaf control. Broadcast, apply and incorporate immediately with cultivators or tillers adjusted to mix the herbicides thoroughly with soil in the row without damaging the sugar beets. The crop should be clean cultivated before application since established weeds are not controlled. Late germinating weeds can become a problem in sugar beets with early seeding or when good moisture conditions prevail well into the season.

### SOYBEANS

Soybeans are poor competitors with weeds when cool soil temperatures slow germination and growth. They are good competitors in warm soils, however, because 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. After planting but before the soybeans emerge, kill weeds by using a rotary hoe, harrow or weeder.



However, do not cultivate by these means when the soybeans are just emerging. Once the soybeans have emerged and are standing erect (beyond the crook stage), the crop can be harrowed.

The rotary hoe is an effective and economical weed killer in soybeans. For best results use it when the ground is not trashy, lumpy or wet and when weeds are just emerging, and not more than 1/4 inch tall. A rotary hoe, light harrow or weeder can be used in soybeans 3 to 8 inches tall to kill weed seedlings effectively with little damage to the crop. 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 wilt and die more quickly.

Preemergence herbicides in soybeans are easily banded to reduce costs whereas preplant herbicides must be incorporated, making band application difficult.

Trifluralin (Treflan), profluralin (Tolban), fluchloralin (Basalin), dinitramine (Cobex) and pendimethalin (Prowl) 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 is essential. See the discussion concerning incorporation of the specific herbicides as requirements differ. Apply trifluralin and profluralin at 1/2 to 1 pound per acre, dinitramine at 1/3 to 2/3 pound per acre, and penoxalin at 1 to 1 1/2 pound per acre. Apply the lower rate on coarse textured soil and the higher rate on fine textured soil.

Alachlor (Lasso) at 2 1/2 to 3 1/2 pounds per acre gives good preemergence control of annual grasses and some broadleaf weeds, including red-root pigweed and common lambsquarters. Apply the higher rate on clay soils high in organic matter. It is ineffective against wild mustard. Soybeans have good tolerance to alachlor. Incorporation of alachlor improves the consistency of weed control.

Chloramben (Amiben) at 2 to 3 pounds per acre is applied preemergence to control most grassy and broadleaf weeds, including wild mustard. At least one-half inch of rain is necessary within 10 days after application to activate the herbicide.

If rain falls later than this, the degree of weed control will be reduced. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury.

Linuron (Lorox) is a preemergence herbicide for controlling most annual broadleaf weeds and grasses. Rates of application are 1/2 to 2 1/2 pounds per acre. Weed control and crop injury with linuron are greatly influenced by soil texture and organic matter. Linuron works best on medium textured soils with less than 4 per cent organic matter. Crop injury occurs occasionally on sandy soils. Use rates recommended on the label for various soil types.

Metribuzin (Sencor, Lexone) controls many kinds of broadleaf weeds, including wild mustard and certain grass weeds. The **rate is critical**. Consult the label for the proper dosage based on soil type and per cent organic matter. Do not apply to sandy soils. Do not use on soil above pH 7.4. Do not use on Altona or Vansoy soybeans as these varieties are sensitive to metribuzin and injury to the crop may result. Seed soybeans 1 1/2 to 2 inches below the soil surface to reduce possible crop injury. Metribuzin is registered alone or in a tank-mix combination with alachlor (Lasso) as a preemergence broadcast or band application to soybeans. Also it may be applied as a preplant incorporated treatment with trifluralin (Treflan), profluralin (Tolban) and pendimethalin (Prowl), or as a preemergence broadcast or band overlay application following a preplant incorporated treatment of trifluralin, profluralin or dinitramine (Cobex). When used in a preplant, incorporated treatment with trifluralin, profluralin or pendimethalin, the 1/4-pound per acre rate of metribuzin is adequate to control wild mustard under North Dakota conditions. Alachlor, profluralin, pendimethalin and trifluralin do not give adequate wild mustard control but good control is possible when used in combination with metribuzin. Also these combinations permit a lower rate of metribuzin to be used thus reducing the risk of soybean injury.

Bentazon (Basagran) at 3/4 to 1 1/2 pounds per acre is a postemergence herbicide for use in soybeans. In North Dakota good wild mustard control has been obtained with 1/2 pound per acre when wild mustard is small (less than 4 inches tall) and when used with a surfactant (Citowett). Bentazon does not control grassy weeds, and red-root pigweed and common lambsquarters are quite resistant. However, 1 pound per acre applied with a surfactant to very small (less than 1 1/2 inches) redroot pigweed and common lambsquarters has given fair control on occasion. Soybean leaf burn occurs occasionally from bentazon application, but recovery is good.

Dinoseb at 1.5 pounds per acre applied early post-emergence 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 in soybeans.

Application at the cracking stage kills the emerged weeds and may provide some residual control of wild mustard which may emerge shortly thereafter. Dinoseb kills weeds rapidly and is more effective at temperatures above 75°F.

### DRY, EDIBLE BEANS

See discussion under soybeans for use of chloramben, trifluralin, profluralin, dinitramine and dinoseb. See flax section for use of EPTC.

### SUNFLOWERS

Weeds usually are a problem in sunflowers as the crop does not develop ground cover rapidly enough to prevent weeds from becoming established.

Since weeds generally emerge before the sunflowers, cultivating with a spiketooth or coil spring harrow about one week after sowing but prior to germination of the crop will kill many weeds. After sunflowers reach the four to six-leaf stage, kill weeds in the row by using a weeder, coil spring or spiketooth harrow or rotary hoe. Cultivate to control weeds between the rows.

Trifluralin (Treflan), profluralin (Tolban), dinitramine (Cobex), and EPTC (Eptam) are herbicides that are applied preplant and incorporated into the soil. See the preceding soybean discussion concerning the incorporation of trifluralin, profluralin, dinitramine and EPTC. Apply profluralin and trifluralin on sandy soil at 1/2 pound per acre and increase the rate to 1 pound per acre on clay soil. Rates of dinitramine vary from 1/3 to 2/3 pounds per acre depending on soil type. Apply EPTC at 3 pounds per acre and incorporate immediately (within minutes) and thoroughly.

Chloramben (Amiben) at 2 to 3 pounds per acre is applied preemergence to control most grassy and broadleaf weeds, including wild mustard. At least 1/2 inch of rain is necessary within 10 days after application to activate the herbicide. If rain falls later than this, the degree of weed control will be reduced. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury.

### LEGUME ESTABLISHMENT

Seedling legumes usually are poor competitors with weeds. Good management practices in preceding

crops are recommended such as clean cultivation of row crops and after harvest tillage to reduce the amount of weed seeds in the soil. Weed control for establishment of legumes when sown alone can be aided by mowing (except sweetclover) or by seeding a companion crop.

When alfalfa, sweetclover, alsike clover or birdsfoot trefoil are sown without a companion crop or a grass in a mixture, EPTC (Eptam) at 2 to 3 pounds per acre preplant and incorporated, effectively controls annual grass and broadleaf weeds except wild mustard.

### WILD OATS CONTROL

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

Preplant or preemergence incorporated applications of diallate (Avadex) at 1 1/2 pounds per acre controls wild oats in flax, corn, soybeans, potatoes and sugar beets. Triallate (Far-go) is applied preemergence to wheat at 1 pound per acre and barley at 1 1/4 pounds per acre for wild oat control. Both herbicides are volatile. Incorporate them in the top 2 inches of soil by harrowing immediately after application to prevent losses by evaporation.

Wild oats in alfalfa seeded with barley as a companion crop can be controlled with diallate. Apply diallate at 1 1/4 pounds per acre in the spring as a preemergence soil incorporated treatment. Or make a fall preplant soil incorporation treatment within 3 weeks of soil freeze-up and plant the alfalfa and barley the following spring.

Barban (Carbyne) for postemergence control of wild oats is applied when the majority of the weeds are in the 1 1/2 leaf stage, which generally occurs from 4 to 9 days after emergence. Rates of 4 to 6 ounces per acre are applied to wheat, barley, flax, soybeans, sunflowers and mustard. Thick, vigorous stands of crop plants help suppress wild oats and enhance the degree of control obtained with barban. Crop competition is important for wild oat control; therefore, control may not be satisfactory in thin crop stands. In sugar beets apply 12 to 16 ounces per acre of barban.

Barban must be applied before the 14th day after wheat, durum and barley emerge and before the fourth leaf stage of the crop to avoid injury and poor wild oat control. Treat flax before the 12th leaf stage and soybeans before the first trifoliolate



leaf stage or no later than 14 days after crop emergence. There are no restrictions on winter wheat. Check label for restrictions on other crops. Do not mix barban with any other chemical.

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

Tioga is slightly more susceptible to barban than the other hard red spring wheat varieties. Leeds and Wells durum are similar to most hard red spring wheat varieties in their tolerance to barban. However, all other durum varieties are more susceptible. Barban is still selective with the more susceptible varieties. When treating the less tolerant durum varieties, observe very closely the precautions stated in the above paragraph.

Difenzoquat (Avenge) is applied at 10 to 16 ounces per acre for control of wild oats at the 3- to 5-leaf stage. Difenzoquat is cleared for use in barley, Era wheat, durum wheat (except Lakota and Wascana) and winter wheat. Wild oats is more susceptible at the 5-leaf than the 3-leaf stage of growth and control also is improved by good crop competition. Use higher rate when applied to 3-leaf wild oats. Crop injury may occur at temperatures above 80 degrees F. Certain wheat varieties have been nearly as susceptible to difenzoquat as wild oats, so use only for wheat varieties listed on the label. Difenzoquat may be mixed with MCPA amine, bromoxynil, or MCPA plus bromoxynil for broadleaf weed control without loss of wild oat control.

Diallate and triallate can be applied in the fall after October 15 until freeze-up. Granular formulations of both are available for use as fall applications.

#### PERENNIAL WEED CONTROL

**PERENNIAL WEEDS IN SMALL GRAINS:** Canada thistle, perennial sowthistle and field bindweed can be controlled in tolerant crops with MCPA and 2,4-D. MCPA is as effective as 2,4-D but MCPA will cause less injury to small grain crops than 2,4-D.

When controlling thistles in small grains except oats, apply the maximum rate of 2,4-D or MCPA the crop will tolerate: 3/4 pound per acre of 2,4-D or MCPA amine and 2/3 pound per acre of 2,4-D low volatile ester or MCPA ester. If such herbicides are planned for controlling hard-to-kill annuals or perennial weeds in crops, grow the more tolerant cereals—rye, wheat and barley. Use MCPA to suppress thistles in oats and flax. However, these crops do not tolerate rates of MCPA necessary to give adequate thistle control.

Fall herbicide treatments are more effective than spring or summer treatments for eliminating 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. The chemical application may be pre-harvest, post-harvest, or on pasture, fallow land, and tree belts. Weeds such as field bindweed, leafy spurge, and Canada thistle should have 12 inches or more of stem tissue before treatment, so there is adequate leaf area to absorb a larger quantity of herbicide. The weeds in pastures and non-cropland can be mowed in early or mid-summer to prevent seed production. Tillage or fallow land can be discontinued in mid-July to allow adequate plant regrowth by treatment time. Post-harvest treatments can be used when harvest is completed early enough for weed regrowth to reach approximately one foot length before treatment. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later; there should be at least five days between herbicide treatment and swathing for adequate herbicide translocation.

**PERENNIAL WEEDS IN PASTURE:** Picloram (Tordon 22K) has a state registration for the control of 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 pounds per acre give excellent control of these weeds and are economical for spot treatment. During a single growing season do not use more than 10 gallons of picloram for any 100-acre area and do not treat more than 20 acres of any 100-acre area. To suppress the growth of perennial broadleaf weeds in large areas, use 1/4 to 1/2 pound per acre and apply as a broadcast spray only once during a growing season. Retreatment at the same rate may be necessary the following year.

Picloram is very toxic to many broadleaf plants. Do not allow spray drift of picloram, as tiny amounts may cause damage to sensitive plants. Especially susceptible to picloram are dry beans,



soybeans, potatoes, safflower, sunflowers and sugar beets. Picloram is highly water soluble and may leach in the soil; consequently, do not apply in areas with a high water table. Do not apply near shelterbelts, shrubs or trees. Do not treat or allow picloram spray drift to fall onto the inner banks or bottoms of irrigation and drainage ditches.

Do not graze picloram treated areas with dairy animals. Do not transfer beef cattle directly from areas treated in any one growing season onto broad-leaved crop areas without allowing 7 days on untreated grass pastures, as urine may contain enough picloram to cause crop injury.

### TILLAGE SUBSTITUTE

Paraquat, a non-selective contact herbicide, can be used as a substitute for a weed controlling tillage operation when wet fields or the desire to conserve seedbed moisture make tillage impractical. Paraquat may be applied before planting 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 surfactant to the spray solution at 8 ounces per 100 gallons. Paraquat can be used on land intended for barley, wheat, corn, potatoes, sugar beets and soybeans. Paraquat is corrosive to exposed aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is quite toxic. Avoid contact with the skin. Even small amounts could be fatal if swallowed.

Glyphosate (Roundup) is a translocated non-selective herbicide with no soil activity. For the control of annuals, apply 3/4 pound per acre of glyphosate to actively growing grasses and broad-leaf weeds less than 6 inches tall. However, 3/8 pound per acre often has given good control of very small annual weeds except wild buckwheat and Russian thistle. Weeds over 6 inches tall require 1 pound per acre. Delay tillage for at least three days after treatment. For quackgrass and Canada thistle control, apply 1 1/2 to 2 1/4 pounds of glyphosate per acre. Spray quackgrass when it is at least 8 inches tall (3 or 4 leaf stage) and actively growing. Apply to Canada thistles when they are at least 10 inches or more tall or are approaching early bud stage. Fall treatment of Canada thistle must be made before frost for best results. Do not till until three or more days after treatment. Glyphosate can be used in the spring before planting or after planting but before the emergence of barley, corn, oats, soybeans, wheat and sorghum (milo), or in the fall when these crops will be planted the next growing season.

Cyanazine (Bladex) is a preemergence, moderately short residual herbicide to control annual weeds on fallow for future planting to wheat, barley, oats, sorghum or corn. 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. Fall applications may be made at any time after harvest when rain is reasonably expected. A late fall application about two weeks ahead of expected soil freeze-up will result in adequate herbicide residual to control the early germinating weeds during the following spring when the fallow land may be too wet for tillage or spring farm operations are competing for labor. Spring applications of cyanazine should be made as soon as practical after the soil thaws to take advantage of spring rains for activation and to get the herbicide in the soil before spring weeds germinate. If winter annual weeds are present or spring weeds have emerged, then a tank mix of paraquat and cyanazine should be used because cyanazine generally does not kill emerged weeds.

### HERBICIDE RESIDUE

Herbicide residue or the persistence of phytotoxic levels of a herbicide for more than one year can be a problem with some of the herbicides used in North Dakota. Herbicide residues are most likely to occur following years with unusually low rainfall because chemical and microbial activity needed to degrade herbicides is 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.

Atrazine (several trade names) generally has a residue the year following application to corn at 2 to 4 pounds per acre in North Dakota. Even 1 pound per acre of atrazine often causes crop injury the following year if soil moisture is deficient. Corn and millet are tolerant to atrazine while other crops are susceptible to various degrees. The approximate ranking of other crops from most to least tolerant is flax, soybeans, barley, wheat, oats, sunflowers, and sugar beets.

Trifluralin (Treflan), profluralin (Tolban), and fluchloralin (Basalin) are similar herbicides called dinitroanilines. Under dry soil conditions these



herbicides can persist in the soil for more than one year. Sunflowers, 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, oats, corn, and sugar beets. Approximately 7 inches of rainfall between planting and freeze-up will be sufficient to dissipate 3/4 pound per acre of trifluralin, profluralin, or fluchloralin while approximately 11 inches would be required to dissipate 1 pound per acre to a level where most crops can be grown, except sugar beets. Sugar beets are very sensitive to these herbicides but moldboard plowing plus adequate rainfall generally will prevent injury to this crop.

Picloram (Tordon) is used in combination with

2,4-D on wheat and barley at 1/4 ounce per acre active ingredient or 1 ounce per acre of formulated product. Only wheat or barley should be planted on fields treated with picloram the previous year. Sunflowers, soybeans, dry edible beans, and potatoes are especially susceptible to picloram.

Metribuzin (Sencor, Lexone) 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 1/4 pound per acre active ingredient. Rates of 1/2 pound per acre or higher could cause damage to susceptible crops the next year. The approximate ranking of crops from most to least tolerant are potatoes, soybeans, dry edible beans, corn, barley, wheat, oats, sunflowers, flax, and sugar beets.



## CHEMICAL WEED CONTROL For Field Crops

Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
WHEAT, DURUM OR BARLEY (See later section for wild oat control)	2,4-D amine 2,4-D L.V. ester	1/4 to 1/2 (1/2 to 1 pt. of 4 lb/gal conc.)	Broadleaf	Crops—5th leaf to boot	Do not apply from early boot to dough stage. Barley more sus- ceptible than wheat. Use 1/2 lb/A for volunteer sunflowers.
	MCPA amine MCPA ester	1/4 to 2/3 (1/2 to 1 1/3 pt of 4 lb/gal conc.)		Crops—emergence to early boot	Apply 1/4 to 1/2 lb/A from emer- gence to tiller stage. Use 1/2 lb/A for volunteer sunflowers.
	Bromoxynil + MCPA ester	1/4 + 1/4 (1 pt + 1/2 pt of 4 lb/gal MCPA)	Wild buck- wheat, volun- teer sun- flowers, and most broad- leaf weeds	Crops—3rd leaf to boot stage	Apply when weeds are in early seedling stage for best results. Commercial mixtures (Brominal Plus & Bronate) are available.
	Paraquat	1/2 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emer- gence	A non-selective, postemergence herbicide. No soil residual activity. Apply with X-77 surfactant. Good coverage is essential.
	Glyphosate (Roundup)	3/4 (1 qt)			A non-selective, translocated, postemergence herbicide. No soil residual activity.
WHEAT OR DURUM	Dicamba (Banvel) + MCPA amine	1/8 + 1/4 (1/4 pt + 1/2 pt of 4 lb/gal conc.)	Wild buck- wheat and most broad- leaf weeds	Crops—2nd through 4th leaf stage	Commercial mixture (Mondak) is available. Volunteer sunflower control similar to 1/2 lb/A of 2,4-D.
WINTER WHEAT OR RYE	2,4-D amine 2,4-D L.V. ester	1/4 to 1/2 (1/2 to 1 pt of 4 lb/gal conc.)	Broadleaf	Crops—fully tillered to boot	Do not apply in the fall.
OATS	MCPA amine MCPA ester	1/4 to 1/2 (1/2 to 1 pt of 4 lb/gal conc.)	Broadleaf	Oats—emergence to boot	Early jointing stage most sus- ceptible. Possible injury to oats at any growth stage. Use 1/2 lb/A for volunteer sun- flowers.
	Bromoxynil + MCPA ester	1/4 + 1/4 (1 pt plus 1/2 pt of 4 lb/gal MCPA)	Wild buck- wheat, volun- teer sun- flowers and most broad- leaf weeds	Crops—3rd leaf to boot stage	Apply when weeds are in early seedling stage for best results. Commercial mixtures (Brominal Plus & Bronate) are available.

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next page)

\* 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 formula-  
tion needed for a specific rate of active ingredient, see discussion section.

\*\* See narrative for additional comments.



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
OATS (cont.)	Dicamba (Banvel) + MCPA amine	1/8 + 1/4 (1/4 pt + 1/2 pt of 4 lb/gal conc.)	Wild buck- wheat and most broad- leaf weeds	Crops—2nd through 4th leaf stage	Commercial mixture (Mondak) is available. Volunteer sunflower control similar to 1/2 lb/A of MCPA.
	Glyphosate (Roundup)	3/4 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A non-selective, translocated, postemergence herbicide. No soil residual activity.
SMALL GRAIN PRE-HARVEST	2,4-D L.V. ester	3/4 to 1 1/2 (1 1/2 to 3 pt of 4 lb/gal conc.)	Broadleaf	Crops—dough stage to harvest	Use only when weeds may inter- fere with harvest operations. Do not feed straw to livestock.
FLAX (See later section for wild oat control)	MCPA amine	1/4 (1/2 pt of 4 lb/ gal conc.)	Broadleaf	Flax—2 to 6 inches tall	Use higher rates or MCPA ester for hard-to-kill weeds.
	Dalapon (Dowpon, Basfapon)	3/4 (1 lb)	Annual grasses ex- cept wild oats	Best results obtained when flax is over 2 inches and weeds are under 2 inches tall	Mix MCPA with dalapon to control broadleaf and annual grassy weeds. Under drouth conditions, grass control is poor and flax injury may occur.
	Bromoxynil (Buctril, Brominal)	1/4 to 1/2 (1 to 2 pt)	Wild buck- wheat and certain broadleaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible.
	EPTC (Eptam)	2 to 3 (2.3 to 3.4 pt) 4 (4 1/2 pt 7-E, 40 lb 10-G)	Grasses and some broad- leaf weeds	Preplant incorporated  Fall incorporated after October 15 until freeze-up	See organic matter and incor- poration discussion in narrative for details. Flax safety is marginal. Weak on wild mustard.
	Glyphosate (Roundup)	3/4 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A non-selective, translocated, postemergence herbicide. No soil residual activity.
CORN	Paraquat	1/2 (1 qt)	broadleaf weeds		A non-selective, contact post- emergence herbicide. No soil residual activity. Apply with X-77 surfactant. Good coverage is essential.

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next page)



Crop	Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
CORN (cont.)	Alachlor (Lasso)	2 1/2 to 3 1/2 (2 1/2 to 3 1/2 qt)	Grasses and some broad- leaf weeds	Preplant incorporated or preemergence	Ineffective against wild mustard. Usually less effective preemer- gence than propachlor in North Dakota. Preplant incorporation gives more consistent weed con- trol. Use higher rate on clay soils high in organic matter.
	Atrazine	2 to 4 (2 to 4 qt 4-L, 2 1/2 to 5 lb 80-W)	Broadleaf and grasses		Atrazine may remain in soil longer than one year and damage following crops other than corn or millet. Use higher rate on heavy soils for quackgrass and Canada thistle control.
	Atrazine + Alachlor (Lasso)	1 + 2	Most grasses and broadleaf weeds	Preplant incorporated or preemergence	See soil residue comment under atrazine.
	Atrazine + Butylate (Sutan)	1 + 3		Preplant incorporated	See incorporation discussion in narrative for details. See soil residue comments under atrazine.
	EPTC + R-25788 (Eradicane)	4 to 6 (4 3/4 to 7 1/3 pt)	Grasses and some broad- leaf weeds.	Preplant incorporated	See corn and incorporation dis- cussions in narrative for de- tails. R-25788 and naphthalic anhydride protect corn from injury by EPTC. EPTC plus R-25788 is a commercial mixture.
	EPTC (Eptam) + naphthalic anhydride (Protect)	4 (4 1/2 pt 7-E)	Weak on wild mustard	EPTC prelant incor- porated with naph- thalic anhydride treated seed	
	Atrazine + Propachlor	1 plus 3 (tank mix)	Broadleaf and annual grasses	Preemergence	Commercial mixture is available (ratio 1 lb. atrazine to 2.3 lb. propachlor). See soil residue comment under atrazine.
	Cyanazine (Bladex)	2 to 3.2 (2 1/2 to 4 lb 80-W, 2 to 3.2 qt 4-WDS)			Soil residues unlikely the year after treatment. Weak on redroot pigweed. Use higher rate on clay soils.
	(cont. on next page)				

\* 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 formu-  
lation needed for a specific rate of active ingredient, see discussion section.

\*\* See narrative for additional comments.



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
CORN (cont.)	Cyanazine (Bladex) + Alachlor (Lasso)	1 to 2 + 2	Most grasses and broadleaf weeds	Preemergence	Use lower rate of cyanazine on sandy soils. See discussion section for mixing directions.
	Dicamba (Banvel) + Alachlor (Lasso)	1/4 to 1/2 + 2	Broadleaf and annual grasses		Use lower rate of dicamba on sandy soils.
	Linuron (Lorox) + Alachlor (Lasso)	3/4 to 1 + 1 1/2 to 2 1/2			Use the higher rate on clay soils high in organic matter. Soil residues unlikely the year after treatment.
	Linuron (Lorox) + Propachlor	3/4 to 1 1/2 + 3			Use the higher rate of linuron on clay soils high in organic matter. Soils residues unlikely the year after treatment.
	Metolachlor (Dual)	2 to 2.5 (2 2/3 to 3 1/3 pt)	Grasses and some broad- leaf weeds		Rate depends on soil type. Check label for details. Use on field corn grown for grain only. Do not graze or use fodder as forage. Atrazine carryover may be a prob- lem with rates used in the mix- ture.
	Metolachlor (Dual) + atrazine (AAtrex)	1.5 to 2 + 1.6 to 2 (2.4 to 4 pt 4L; 2 to 2.5 lb 80 W)	Most grasses and broadleaf		
	Pendimetha- lin (Prowl)	1 1/2 to 2 (3 to 4 pt)	Grasses and some broad- leaf weeds		Do not use on sands or loamy sands. Use higher rate on clay soils high in organic matter. Cleared for tank mixture with cyanazine (Bladex) or atrazine.
	Propachlor	4 to 5 (6 to 8 lb W-65)			Ineffective against wild mustard.
	Atrazine + phytobland oil	1 to 2 + a phyto- bland oil	Broadleaf and grasses	Early postemergence— weeds less than 1 1/2 inches tall	Use emulsifiable crop origin oil (linseed or soybean) or petroleum oils at volume recommended on label. See soil residue comment under atrazine.
	(cont. on next page)	Cyanazine (Bladex 80W) + crop origin oil	1.2 + 1 qt crop origin oil (1 1/2 lb 80-W)	Broadleaf and grasses	Early postemergence— weeds less than 1 1/2 inches tall



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
CORN (cont.)	Dicamba (Banvel)	1/8 to 1/4 (1/4 to 1/2 pt)	Wild buck- wheat, Canada thistle, P. sowthistle	Postemergence, before corn is 36 inches tall	See narrative under corn at be- ginning of this Guide. Use drop nozzles after corn is 8 inches tall.
	2,4-D amine	1/4 to 1/2 (1/2 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence, corn— 3 inches of tasseling	Use drop nozzle when corn is over 8 inches tall but before tasseling. Dicamba can be mixed with 1/4 lb of 2,4-D.
SOYBEANS (See later section for wild oat control)	Glyphosate (Roundup)	3/4 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A non-selective, translocated, postemergence herbicide. No soil residual activity.
	Paraquat	1/2 (1 qt)			A non-selective, postemergence herbicide. No soil residual activity. Apply with X-77 sur- factant. Good coverage is essential.
	Dinitramine (Cobex)	1/3 to 2/3 (1 1/3 to 2 2/3 pt)	Grasses and some broad- leaf weeds	Preplant, shallow incorporation (2 to 3 inches)	See incorporation discussion in narrative for details. Weak on wild mustard.
	Pendimetha- lin (Prowl)	1 to 1 1/2 (2 to 3 pt)		Preplant incorporated	Incorporation may be delayed up to 7 days after application. Weak on wild mustard.
	Profluralin (Tolban)	1/2 to 1 (1 to 2 pt)			See incorporation discussion in narrative for details. No wild mustard control.
	Fluchlora- lin (Basalin)	1/2 to 1 1/2 (1 to 3 pt)		Preplant incorporated (1 1/2 to 3 inches)	Incorporate within 8 hours of application. No wild mustard control.
Trifluralin (Treflan)	1/2 to 1 (1 to 2 pt)		Preplant incorporated, fall or spring	See incorporation discussion in narrative for details. No wild mustard control.	

Trifluralin (Treflan), profluralin (Tolban), pendimethalin (Prowl) and dinitramine (Cobex) are dinitroaniline (DNA) herbicides having similar herbicidal properties. All are applied as preplant incorporated herbicides, all are weak on wild mustard, and all are cleared for use with metribuzin (Sencor or Lexone). Adding metribuzin at 1/4 lb/A (active ingredient) will provide good wild mustard control. Combinations that are cleared for preplant incorporated applications with metribuzin are trifluralin, profluralin and pendimethalin. Combinations cleared for sequential applications (the dinitroanilines applied preplant incorporated and metribuzin applied preemergence) are trifluralin, profluralin and dinitramine, all with metribuzin at 1/4 to 3/8 lb/A (active ingredient). The rate of metribuzin is critical. See the narrative in the soybean section for more details. In these mixtures, the dinitroanilines are applied at the regular rate for the soil type.

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next page)

\* 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 discussion section.

\*\* See narrative for additional comments.



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
SOYBEANS (cont.)	Alachlor (Lasso)	2 1/2 to 3 1/2 (2 1/2 to 3 1/2 qt)	Grasses and some broad- leaf weeds	Preemergence	Wild mustard and wild oat control not adequate. Preplant incorpora- tion gives more consistent weed control. Use higher rate on clay soils high in organic matter.
	Alachlor (Lasso) + Metribuzin (Sencor, Lexone)	2 + 1/4 to 3/8	Broadleaf weeds in- cluding wild mustard and annual grasses		Do not incorporate. Use lower rate of metribuzin on light soils. Poor on wild oats.
	Chloramben (Amiben)	2 to 3 (2 to 2 1/2 qt)	Grasses and broadleaf weeds		Wild oat control not adequate.
	Linuron (Lorox) + Alachlor (Lasso)	1 + 2			Use only on sandy loam soil with 1/2 to 2% organic matter.
	Dinoseb amine salt (Premerge)	1 1/2 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbicides weak on wild mustard.
	Bentazon (Basagran)	3/4 to 1 1/2 (3/4 to 1 1/2 qt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sunflowers	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 under unfavorable conditions such as drought, cold or hail damage.
	Paraquat	1/4 (1 pt)	Desiccant	Prior to harvest	Make applications when beans are fully developed and half of leaves have dropped and remaining leaves are turning yellow.
DRY, EDIBLE BEANS	Alachlor (Lasso)	2 1/2 to 3 (2 1/2 to 3 qt)	Grasses and some broad- leaf weeds	Preplant incorporated	Wild mustard and wild oat control not adequate. Use higher rate on clay soils high in organic matter.
(cont. on next page)	Dinitramine (Cobex)	1/3 to 2/3 (1 1/3 to 2 2/3 pt)		Preplant, shallow incorporation (2 to 3 inches)	See incorporation discussion in narrative for details. Weak on wild mustard.



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
DRY, EDIBLE BEANS (cont.)  (Note: Bentazon is cleared for use. See page 29.)	EPTC (Eptam)	3 (1 3/4 qt) 4 to 4 1/2 (4 1/2 to 5 1/4 pt 7-E, 40-45 lb 10-G)	Grasses and some broad- leaf weeds	Preplant incorporated  Fall incorporated after October 15 until freeze-up Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.  See incorporation discussion in narrative for details.
	Profluralin (Tolban)	1/2 to 1 (1 to 2 pt)			
	Trifluralin (Treflan)				
	Trifluralin (Treflan) + EPTC (Eptam)	1/2 + 1.5 (1 pt + 1 3/4 pt)			Enhances wild oat control and re- duces potential carryover of tri- fluralin residue. See incorpora- tion discussion in narrative.
	Chloramben (Amiben)	2 (2 qt)	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate.
	Dinoseb, amine salt (Premerge)	1 1/2 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbi- cides weak on wild mustard.
SAFFLOWER	EPTC (Eptam)	3 (1 3/4 qt)	Grasses and some broad- leaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.
	Profluralin (Tolban)	1/2 to 1 (1 to 2 pt)			See incorporation discussion in narrative for details. No wild mustard control.
	Trifluralin (Treflan)			Preplant incorpora- ted, spring or fall	
SUNFLOWERS (See later section for wild oat control)	EPTC (Eptam)	3 (1 3/4 qt)	Grasses and some broad- leaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.
	Dinitramine (Cobex)	1/3 to 2/3 (1 1/3 to 2 2/3 pt)			
	Profluralin (Tolban)	1/2 to 1 (1 to 2 pt)			See incorporation discussion in narrative for details. No wild mustard control.
	Trifluralin (Treflan)				
(cont. on next page)	Chloramben (Amiben)	2 to 3 (2 to 2 1/2 qt)	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate.

\* 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 discussion section.

\*\* See narrative for additional comments.



Crop	Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
SUNFLOWERS (cont.)	Paraquat	1/4 to 1/2 (1 to 2 pt)	Desiccant	Back side of sunflower heads yellow and bracts turning brown	Registered for oilseed varieties only. Harvest 7 to 21 days after application. Add Ortho X-77. Spreader at 1 qt. per 100 gal. water.
	EPTC (Eptam)	2 to 3 (2.3 to 3.4 pt, 20 to 30 lb 10-G) 4 to 4 1/2 (4 1/2 to 5 1/4 pt 7-E, 40 to 45 lb 10-G)	Annual grasses and some broad- leaf weeds	Preplant incorporated  Fall incorporated after October 15 until freeze-up	See organic matter and incorpora- tion discussions in narrative for details. Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.
SUGAR BEETS (See later section for wild oat control)	Cycloate (Ro-Neet)	3 to 4 (4 to 5.3 pt 6-E, 30 to 40 lb 10-G)		Preplant incorporated	See organic matter and incorpora- tion discusses in narrative for details. Sugar beets have better tolerance to cycloate than to EPTC. Weak on wild mustard.
	TCA (various names)	4.7 to 7.1 (6 to 9 lb, 8 to 12 pt)	Most annual grasses	Preemergence	Weak on wild oats. Do not use sugar beet tops for livestock feed.
	Pyrazon (Pyramin + TCA)	3.8 (5 lb) + 5 to 7	Annual grasses and most broad- leaf weeds		Has not been effective on soils with more than 5% organic matter.
	Dalapon (Dowpon, Basfapon)	2 to 3 (2.7 to 4 lb)	Most annual grasses	Apply from emergence to 6-leaf stage of sugar beets. Use directed spray after beets have 6 leaves	Use high rate if grasses have over 2-4 leaves or if they are growing slowly due to dry conditions. May be applied more than once up to a maximum of 5.9 lb/A per year. Some yield reduction may occur from rates over 3 lb/A. Add any improved agricultural surfactant at 1/2 to 2 pints per 100 gal. spray solution.

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next page)



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
SUGAR BEETS (cont.)	Endothall (Herbicide 273)	3/4 to 1 1/2 (2 to 4 pt)	Wild buck- wheat, smart- weed, marsh- elder	Sugar beets 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 sugar beets. Endothall is ineffec- tive at temperatures below 60°F.
	Phenmedi- pham (Betanal)	1 to 1.5 (6.1 to 9.2 pt)	Most annual broadleaf weeds except redroot pigweed	Postemergence when broadleaf weeds are between cotyledon and four-leaf stage and the sugar beets are in the four-leaf stage or later	To avoid sugar beet injury, use no more than 1 lb/A following EPTC or TCA. Do not apply if highest temperature during day is over 85°F. and apply late in afternoon or early in the evening.
	Desmedipham (Betanex)	1 to 1 1/4 (6.1 to 7.7 pt)	Most annual broadleaf weeds in- cluding redroot pigweed		
	Paraquat	1/2 (1 qt)	Emerged an- nual grasses and broad- leaf weeds	Preplant or anytime prior to crop emer- gence	A non-selective, postemergence herbicide. No soil activity. Apply with X-77 surfactant. Good coverage is essential.
TAME MUSTARD (See later section for wild oat control)	Trifluralin (Treflan)	1/2 to 3/4 (1 to 1 1/2 pt)	Grasses and broadleaf weeds	Preplant incorporated	See incorporation discussion in narrative for details.
POTATOES (See later section for wild oat control)	Dalapon (Dowpon, BASFapon)	6 (8 lb)	Quackgrass	Preplant in spring when grass is 4 to 6 inches tall	Plow after 4 days and potatoes may be planted immediately.
	EPTC (Eptam)	3 to 6 (3 1/2 to 6 3/4 pt)	Grasses and some broad- leaf weeds	Preplant or directed spray at dragoff Fall incorporated after October 15 until freeze-up	See organic matter and incorpora- tion discussion in narrative for details. Weak on wild mustard.
	Linuron (Lorox)	3/4 to 2 (1 1/2 to 4 lb)	Most annual grasses and broadleaf weeds	Preemergence (just before crop emerges)	Apply to crop planted 2 inches deep, after dragoff or hilling. Do not plant to other crops with- in 4 months after treatment.

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tion needed for a specific rate of active ingredient, see discussion section.

\*\* See narrative for additional comments.

Crop	Herbicide	Act. Incred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
POTATOES (cont.)	Metribuzin (Sencor, Lexone)	1/2 to 1 (1 to 2 lb)	Broadleaf weeds includ- ing wild mustard and some grasses	Preemergence or post- emergence (on white skinned varieties, late maturing)	Use lower rate on sandy soils. Soil residue harmful to fol- lowing susceptible crops may occur. See label for details.
	Trifluralin (Treflan)	1/2 to 1 (1 to 2 pt)	Grasses and broadleaf weeds	After planting, in- corporated. Use up to or immediately following dragoff	Care should be taken that in- corporation machinery does not damage seed pieces or elonga- tion sprouts.
	Paraquat	1 (2 qt)	Most annual grasses and broadleaf weeds	Preemergence—when weeds are up but be- fore crop emerges	Do not apply later than ground cracking. Paraquat kills only emerged weeds.
POTATO VINE KILLING	Endothall (Des-i- Cate)	3/4 to 1 (1 1/2 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 1/4 to 2 1/2 (2 to 4 pt)			See label for details. Rate depends on temperature, spray volume, potato variety and vigor of the vines.
	Paraquat	1/4 to 1/2 (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.
GRASS Seedling	2,4-D	1/2 to 3/4 (1 to 1 1/2 pt of 4 lb/gal conc.)	Broadleaf	After 3-leaf stage of grasses	Use rate for established grasses after tillering.
Established (See later section for control of specific perennial weeds)	2,4-D	3/4 to 2 (1 1/2 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Weeds-emergence to bud stage, preferably when young and actively growing	Do not graze dairy cows for 7 days after application. Do not apply after boot stage on grasses for seed production. Use 1 lb/A on annuals and gum- weed and 2 lb/A on sages and other perennials.
LEGUMES Alfalfa and clover with nurse crop (cont. on next page)	MCPA	1/8 to 1/4 (1/4 to 1/2 pt of 4 lb/gal conc.)	Broadleaf	Legumes 2 to 3 inches tall and nurse crop 4 to 16 inches tall	Canopy of crop or weeds re- duces injury. NOTE: POSSIBLE INJURY TO SWEETCLOVER AND ALFALFA.



Crop	Herbicide	Act. Ingrid. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks**
LEGUMES (cont.) Alfalfa and clover with nurse crop	Dinoseb, amine salt (Premerge)	1.1 to 1.5 (1.5 to 2 qt)	Small broad- leaf weeds	Grain—3 to 6 inches tall and weeds small	Apply in 30 gallons of water per acre. Partial burning of grain leaves is not ordinarily harmful.
Alfalfa, trefoil seeding	EPTC (Eptam)	3 (3 1/2 pt)	Grasses and some broad- leaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.
Alfalfa or trefoil alone. Estab- lished or seedling stage	2,4-DB	1/2 to 1 (1 to 2 pt of 4 lb/gal conc.)	Broadleaf	Weeds and legumes less than 3 inches tall, nurse crop 1 to 6 inches tall	Sweetclover killed by 2,4-DB. Wild mustard control gen- erally not adequate. 2,4-DB must be applied 30 days before hay harvest or grazing. See narrative at beginning of this Guide for herbicides in legume establishment.
Alfalfa only	Simazine (Princep)	0.8 to 1.6 (1 to 2 lb 80-W)	Grasses and broadleaf weeds includ- ing wild oats and mustard	After last cutting but before freeze-up	Do not use on sands or loamy stands 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.

Weed	Herbicide	Rate per Acre (Formulation/A)*	Crop	When to Apply	Remarks**
WILD OATS Selective control in crops	Triallate (Far-go)	1 1/4 lb liquid (1 1/4 qt) 1 1/4 to 1 1/2 lb granules (12 1/2 to 15 lb 10-G)	Barley	Fall—after October 15 and until freeze- up	See incorporation discussion in narrative for details. Keep spring tillage to minimum. Use lower rate of granules on wheat.
(cont. on next page)	(cont. on next page)	1 lb liquid (1 qt) 1 1/4 to 1 1/2 lb granules (12 1/2 to 15 lb 10-G)	Wheat and durum		

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\*\* See narrative for additional comments.

Weed	Herbicide	Rate per Acre (Formulation/A)*	Crop	When to Apply	Remarks**	
WILD OATS (cont.)	Triallate (Far-go) (cont.)	1 1/4 lb (1 1/4 qt)	Barley, peas and lentils	Spring—immediately after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation. Wheat must be below the incor- porated zone.	
		1 lb (1 qt)	Wheat and durum			
			1 1/2 to 2 lb (1 1/2 to 2 qt)	Flax, sugar beets, soy- beans and potatoes	Preplanting	See incorporation discussion in narrative for details.
	Diallate (Avadex)		1 1/2 lb (1 1/2 qt)	Corn and lentils	Preplanting or preemergence	See incorporation discussion in narrative for details.
			1 1/4 lb (1 1/4 qt)	Peas		
			1 1/2 to 2 lb liquid (1 1/2 to 2 qt)	Flax and sugar beets	Fall—after October 15 and until freeze- up	See incorporation discussion in narrative for details. Keep spring tillage to minimum.
			1 1/2 to 2 lb granules (15 to 20 lb 10-G)	Sugar beets		
			4 to 6 oz (2 to 3 pt)	Wheat, bar- ley, winter wheat	Wild oats in 2-leaf stage and before 4- leaf stage of crop except winter wheat where crop stage is not applicable.	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbi- cide. See narrative for effects of temperature, low soil fertility and droughty conditions on barban activity.
	Barban (Carbyne)			Peas	Wild oats 2-leaf and before 6-leaf stage of crop	
				Flax	Wild oats 2-leaf and before 12-leaf stage of crop	
			6 oz (3 pt)	Sunflower, safflower, lentils, soy- beans, mus- tard (grown for oil)	Wild oats 2-leaf and within 30 days after emergence of crop	
			12 to 16 oz (3 to 4 qt)	Sugar beets		

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next page)



Weed	Herbicide	Rate per Acre (Formulation/A)*	Crop	When to Apply	Remarks**
WILD OATS (cont.)	Difenzoquat (Avenge)	10 to 16 oz (2 1/2 to 4 pt)	Barley, Era wheat, durum wheat (except Lakota and Wascana) and winter wheat	3 to 5 leaf stage of wild oats	Use higher rate when applied to 3-leaf wild oats. Can be applied with MCPA amine, bromoxynil, or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.
	Triallate (Far-go)	1 1/4 lb (1 1/4 qt)	Barley	Immediately after planting	Use only if wild oats also is a problem, because of cost. Incorporation in top 2 inches of soil by cultivation. Wheat must be below incorporated zone.
FUMITORY	Diallate (Avadex)	1 1/2 lb (1 1/2 qt)	Wheat and durum	Preplanting	Other broadleaf weeds also will be controlled. Commercial mix- tures (Brominal Plus and Bronate) are available.
	Bromoxynil + MCPA ester	1/4 to 1/3 lb + 1/4 to 1/3 lb	Wheat and barley	After fumitory is established to boot stage of crop	
DOWNY BROME (CHEATGRASS)	Atrazine (AATrex)	0.8 to 1.0 lb (1 to 1 1/4 lb 80-W, 1.6 to 2 pt 4-L)	Rangeland	Fall—late September until freeze-up	Apply in minimum of 10 gallons of water per acre. Grazing per- mitted 7 months after applica- tion.

### CHEMICAL WEED CONTROL For Fallow

Crop	Herbicide	Act. Ingrid. Lb/A or Sq. Rd. (Formulation/A)*	Weeds	When to Apply	Remarks**
For future planting to wheat, barley, oats, corn or sorghum (cont. on next page)	Cyanazine (Bladex 80WP)	2.4 to 3.2 (3 to 4 lb/A)	Annual broadleaf and grassy	Fall—anytime after harvest but before <u>weeds germinate</u>	Use higher rates on clay soils. If 1/2 inch of rainfall is not received within 10 days of application, under cutting with sweeps may be desirable to de- stroy weeds until cyanazine is activated.
		1.6 to 2.8 (2 to 3.5 lb/A)	weeds	Early spring before weeds germinate	

Crop	Herbicide	Act. Ingrid. Lb/A or Sq. Rd. (Formulation/A)*	Weeds	When to Apply	Remarks**
For future planting to wheat, barley, oats, corn or sorghum (cont.)	Cyanazine (Bladex) +	2.4 to 3.2 (3 to 4 lb/A + 0.5 (1 qt/A)	Annual broadleaf and grassy weeds	Fall—anytime after harvest if weeds have emerged	Use only if weeds have emerged at time of application. Use higher rates of cyanazine on clay soils.
	Paraquat	1.6 to 2.8 (2 to 3.5 lb/A) + 0.5 (1 qt/A)		Spring—after weeds have emerged	

### CHEMICAL WEED CONTROL For Perennial Weeds

Weed	Herbicide <sup>1/</sup>	Act. Ingrid. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks**
FIELD BINDWEED Fallow or post harvest	2,4-D L.V. ester or oil soluble amine	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	Regrowth 6 inches to bud stage	Cultivate fallow until mid-July. Spray in late August or September. Respray in following year's crop.
	Glyphosate (Roundup)	3 to 3 3/4 lb/A (4 to 5 qt/A)		
Wheat and barley	2,4-D amine	3/4 lb/A	Tiller stage of crop	Rates higher than listed may injure crop but may be worthwhile, especially in small areas, to control bindweed.
	2,4-D L.V. ester	2/3 lb/A		
Patches or individual plants in pastures or non-cropland <sup>2/</sup>	Picloram (Tordon 22K)	1 lb/A (2 qt/A)	Bindweed actively growing	Tordon granules available. Do not use in areas with high water table. Apply to foliage and/or soil. Do not graze for 60 days or make hay for 90 days for dairy cows or graze or feed hay to beef cattle 30 days before slaughter.
	Dicamba (Banvel)	4 to 8 lb/A (1 to 2 gal/A)		
LEAFY SPURGE On fallow (cont. on next page)	2,4-D L.V. ester	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	4 to 6 inches	Cultivate or respray whenever regrowth is 4 to 6 inches high. Respray in following year's crop.

<sup>1/</sup> Several soil sterilants will control perennial weeds. Follow directions on the label.

<sup>2/</sup> Non-cropland means roadsides and waste areas not used to produce animal feed.

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\*\* See narrative for additional comments.



Weed	Herbicide <sup>1/</sup>	Act. Incred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks**
LEAFY SPURGE (cont.) Pasture and rangeland	2,4-D L.V. ester or oil soluble amine	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	Early bud stage and fall	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days after treatment.
	Picloram (Tordon 22K)	1/2 lb/A (2 pt/A)	Spurge actively growing	Retreatment at the same time usu- ally will be necessary the following year.
Patches or indi- vidual plants in pastures	Dicamba (Banvel)	4 to 8 lb/A (1 to 2 gal/A)	Spurge actively growing	Apply to foliage and/or soil. Do not graze for 60 days or make hay for 90 days for dairy cows or graze or feed hay to beef cattle 30 days before slaughter.
	Picloram (Tordon 22K)	1 to 2 lb/A (2 to 4 qt/A)		During a single season do not use more than 10 gals. of Tordon 22K for any 100 acre area. Do not treat more than 20 acres of any 100 acre area. Tordon granules available.
Trees	Glyphosate (Roundup)	1 to 1 1/2 lb/A (1 1/2 to 2 qt/A)	Fall only, after August 15 and spurge actively growing	Avoid spraying tree foliage.
CANADA THISTLE AND SOWTHISTLE Wheat and Barley	MCPA amine MCPA ester	3/4 lb/A 2/3 lb/A	Tiller stage of crop	Higher rates than listed may in- jure crop but may be worthwhile, especially in small areas, to achieve thistle control.
Corn	Atrazine	4 lb/A (1 gal/A 4-L, 5 lb/A 80-W)	Use split treatment similar to quackgrass, or make 2 postemer- gence treatments with oil	Plant only corn year following treatment.
Fallow or post harvest	2,4-D	1 lb/A (1 qt/A of 4 lb/gal conc.)	6 inches tall and ac- tively growing. Post harvest mowing pro- motes active regrowth	Cultivate fallow until mid-July. Spray in late August or September.
	Dicamba (Banvel)	1 to 2 lb/A (1 to 2 qt/A)		
	Glyphosate (Roundup)	1 1/2 to 2 1/4 lb/A (2 to 3 qt/A)	Thistles at or beyond the bud stage of growth	Allow 3 or more days after appli- cation before tillage. Only bar- ley, oats, wheat, corn and soy- beans may be planted within 1 year of application. Has not been tested on perennial sowthistle.

(cont. on  
next page)

<sup>1/</sup> Several soil sterilants will control perennial weeds. Follow directions on the label.

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lation needed for a specific rate of active ingredient, see discussion section.

\*\* See narrative for additional comments.

Weed	Herbicide <sup>1/</sup>	Act. Ingrid. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks**
CANADA THISTLE AND SOWTHISTLE (cont.)	Glyphosate (Roundup)	1 1/2 to 2 1/4 lb/A (2 to 3 qt/A)	Thistles at or beyond the bud stage of growth	Avoid spraying tree foliage.
Trees				
Pasture and Rangeland	Picloram (Tordon 22K)	1/4 to 1/2 lb/A (1 to 2 pt/A)	6 inches tall and ac- tively growing. For fall treatment, mowing promotes active growth	Retreatment at the same rate usu- ally will be necessary the follow- ing year. Do not graze dairy cattle on treated area.
	Dicamba (Banvel)	1/2 lb/A (1 pt/A)		Do not graze dairy cows for 7 days or make hay for 37 days after treatment. Do not graze meat ani- mals in treated areas within 30 days of slaughter.
	2,4-D	1 to 2 lb/A (1 to 2 qt/A of 4 lb/ gal conc.)		Do not graze dairy cows for 7 days after treatment.
Patches or indi- vidual plants in pastures	Picloram (Tordon 22K)	1 lb/A (2 qt/A)	When thistles are actively growing	During a single season do not use more than 10 gals. of Tordon 22K for any 100 acres. Do not treat more than 20 acres of any 100 acre area.
	Dicamba (Banvel)	4 lb/A (1 gal/A)		Do not graze for 60 days or make hay for 90 days for dairy cows or graze or feed hay to beef cattle 30 days before slaughter.
COMMON MILKWEED Fallow or post harvest	Glyphosate (Roundup)	2 1/4 lb/A (3 qt/A)	Late bud to flower stage and actively growing	Allow 3 or more days after appli- cation before tillage. Only bar- ley, oats, wheat, corn and soy- beans may be planted within 1 year following application.
Pasture and rangeland (cont. on next page)	Picloram (Tordon 22K)	1/2 lb/A (2 pt/A)	Actively growing	Retreatment at the same rate usu- ally will be necessary the follow- ing year.

<sup>1/</sup> Several soil sterilants will control perennial weeds. Follow directions on the label.



Weed	Herbicide <sup>1/</sup>	Act. Incred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks**
COMMON MILKWEED (cont.) Patches or individual plants in pastures	Picloram (Tordon 22K)	1 to 2 lb/A (2 to 4 qt/A)	Actively growing	During a single season do not use more than 10 gals. of Tordon 22K for any 100 acres. Do not treat more than 20 acres of any 100 acres area.
QUACKGRASS Fallow	Dalapon (Dowpon)	6 to 11 lb/A (8 to 14 3/4 lb/A)	On fallow after 4 to 6 inches growth	Cultivate after 10 to 20 days.
Corn	Atrazine	4 lb/A (5 lb/A 80-W)	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 year of application and year following treatment. A total of 3 lb/A is adequate on sandy soils.
Preplant, fallow or post harvest	Glyphosate (Roundup)	1 1/2 to 2 1/4 lb/A (2 to 3 qt/A)	At least 8 inches tall at 3 to 4 leaf stage and actively growing	Allow 3 or more days after application before tillage. Only barley, oats, wheat, corn and soybeans may be planted within 1 year following application.
AROUND BLDGS., TELEPHONE POLES, ETC.	Atrazine, bromacil, monuron, prometone or similar products	See label	Any time during and prior to growing season. See label	Use heavy rates for complete long-time soil sterility.

<sup>1/</sup> Several soil sterilants will control perennial weeds. Follow directions on the label.

\* 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 discussion section.

\*\* See narrative for additional comments.

*Bentazon (Basagran) has been cleared for use on dry, edible beans. Apply 3/4 to 1 lb (3/4 to 1 qt) per acre of bentazon early postemergence when weeds are small (mustard 4 to 6 leaf stage, volunteer sunflowers less than 8 inches) and actively growing which generally corresponds to the 1 to 2 expanded trifoliolate leaf stage in beans. Beans are tolerant at all stages of growth after the first trifoliolate leaf has fully expanded. Major weeds controlled: wild mustard, common cocklebur, wild and volunteer sunflowers. Thoroughly cover weeds with spray. Do not apply under unfavorable conditions such as drought, cold or hail damage. See label for other weed species and application details.*

## GLOSSARY OF CHEMICAL NAMES

COMMON NAME	TRADE NAME <sup>1/</sup> AND MANUFACTURER	CONCENTRATION AND COMMERCIAL FORMULATIONS <sup>2/</sup>
Alachlor	Lasso (Monsanto)	4 lb/gal L 15% G
Ametryne	Evik (Ciba-Geigy)	80% WP
Atrazine	Several (various)	80% WP 4 lb/gal L
Barban	Carbyne (Gulf)	1 lb/gal L
Bentazon	Basagran (BASF)	4 lb/gal L
Bromacil	Hyvar-X, Hyvar-XL (DuPont)	80% WP 2 lb/gal L
Bromoxynil	Buctril (Chipman) Brominal (Amchem)	2 lb/gal L
Bromoxynil and MCPA	Bronate (Chipman) Brominal Plus (Amchem)	2 lb/gal MCPA plus 2 lb/gal bromoxynil L
Butylate	Sutan (Stauffer)	6 lb/gal L, 10% G
Chloramben	Amiben (Amchem)	10% G 2 lb/gal L
Cyanazine	Bladex (Shell)	80% WP, 4 WDS 15% G
Cycloate	Ro-Neet (Stauffer)	6 lb/gal L 10% G
Dalapon	Basfapon (BASF) Dowpon M (Dow)	74% WSP
Dalapon and TCA	Dowpon C (Dow)	46.5% dalapon 26.2% TCA WSP
Desmedipham	Betanex (Nor-Am)	1.3 lb/gal L
Diallate	Avadex (Monsanto)	4 lb/gal L 10% G
Dicamba	Banvel (Velsicol)	4 lb/gal L
Dicamba and MCPA	MonDak (Velsicol)	1.25 lb/gal dicamba plus 2.50 lb/gal MCPA L
Difenzoquat	Avenge (American Cyanamid)	2 lb/gal L
Dinitramine	Cobex (U. S. Borax)	2.0 lb/gal L
Dinoseb amine salt (DNBP) oil soluble	Premerge (Dow) Dow General (Dow)	3 lb/gal L 5 lb/gal L
Endothal	Endothal, Herbicide 273 (Pennwalt)	1.46 lb/gal L 3 lb/gal L, 5% G
Endothal (as a desiccant)	Des-i-Cate (Pennwalt)	0.52 lb/gal L
EPTC	Eptam (Stauffer)	7 lb/gal L 10% G
EPTC plus R-25788	Eradicane (Stauffer)	6.7 lb/gal L

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

<sup>2/</sup> G-granular, L-liquid, WP-wettable powder, WSP-water soluble powder, WDS-water dispersible solution.



## GLOSSARY OF CHEMICAL NAMES (Cont.)

COMMON NAME	TRADE NAME <sup>1/</sup> AND MANUFACTURER	CONCENTRATION AND COMMERCIAL FORMULATIONS <sup>2/</sup>
Fluchloralin	Basalin (BASF)	4 lb/gal L
Glyphosate	Roundup (Monsanto)	3 lb/gal L
Linuron	Lorox (DuPont)	50% WP
MCPA	Several (various)	Various L
Metolachlor	Dual (Ciba-Geigy)	6 lb/gal L
Metribuzin	Lexone (DuPont) Sencor (Chemagro)	4 lb/gal L 50% WP
Monuron	Telvar (DuPont)	G, L, WP Various
1, 8-naphthalic anhydride	Protect (Gulf)	Seed treatment
Paraquat	Ortho Paraquat (Chevron)	2 lb/gal L
Pendimethalin	Prowl (American Cyanamid)	4 lb/gal L
Phenmedipham	Betanal (Nor-Am)	1.3 lb/gal L
Picloram	Tordon 22K, Tordon 10K, Tordon Beads (Dow)	10%, 2% G 2 lb/gal L
Profluralin	Tolban (Ciba-Geigy)	4 lb/gal L
Propachlor	Several (various)	65% WP 20% G
Simazine	Princep (Ciba-Geigy)	80% WP 4% G
TCA	TCA (various)	4.76 lb/gal L 79.3% WSP
Triallate	Far-go (Monsanto)	4 lb/gal L 10% G
Trifluralin	Treflan (Elanco)	4 lb/gal L 5% G
2,4-D	Several (various)	L, G Various
2,4-DB	Butyrac (Amchem) Butoxone (Chipman)	L Various

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

<sup>2/</sup> G-granular, L-liquid, WP-wettable powder, WSP-water soluble powder, WDS-water dispersible solution.

## RELATIVE RESPONSE OF WEEDS TO HERBICIDES

	Barnyardgrass	Cocklebur	Field bindweed & per. thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oat
<b>PREPLANT INCORPORATED</b>												
Dinitramine (Cobex)	G	P	N	G	G	G	G	G	N	F	P	P-F
EPTC (Eptam)	G	P	N	G	F	G	G	P	N	F	P	G
Fluchloralin (Basalin)	G	P	N	G	G	G	G	G	N	F	N	F
Pendimethalin (Prowl)	G	N	N	G	F-G	G	G	F	N	N	N	F
Profluralin (Tolban)	G	P	N	G	G	G	G	G	N	F	N	F
Trifluralin (Treflan)	G	P	N	G	G	G	G	G	N	F	N	F
<b>PREEMERGENCE INCORPORATED</b>												
Di- & Triallate (Avadex, Far-go)	N	N	N	N	N	N	N	N	N	N	N	G
Trifluralin (Treflan)	G	N	N	G	F	F	F	F	N	N	N	P-N
<b>PREEMERGENCE</b>												
Alachlor (Lasso)	G	N	N	G	F	F	G	F	N	F	P	P
Atrazine (AAtrex)	G	F	P	G	G	G	G	G	F	G	G	G
Chloramben (Amiben)	G	P	N	G	F	G	G	G	N	G	F	F
Cyanazine (Bladex)	F	F	N	G	F	G	F	G	F	G	G	P
Di- & Triallate (Avadex, Far-go)	N	N	N	N-F	N	N	N	N	N	N	N	G
Metribuzin (Sencor, Lexone)	G	F	N	G	G	F	G	G	N	F	G	P
Pendimethalin (Prowl)	G	N	N	G	F-G	G	G	F	N	N	N	F
Propachlor (Ramrod, Bexton)	G	P	N	G	G	F	G	P	N	F	P	P
TCA	G	N	N	G	N	N	N	N	P	N	N	P
<b>POSTEMERGENCE</b>												
Atrazine + oil	G	G	P	G	G	G	G	G	G	G	G	G
Barban (Carbyne)	N	N	N	N	N	N	N	N	N	P	N	G
Bentazon (Basagran)	N	G	F	N	--	P-F	P-F	P	G	P	G	N
Bromoxynil + MCPA (Brominal Plus, Bronate)	N	G	F	N	G	G	G	G	G	G	G	N
Dalapon (Dowpon, Basfapon)	G	N	N	G	N	N	N	N	N	N	N	F
Desmedipham (Betanex)	P	P	N	P	F	G	G	F	P	F	G	N
Dicamba (Banvel)	N	G	G	N	G	G	G	F-G	G	G	F	N
Dicamba + MCPA (Mondak)	N	G	G	N	G	G	G	F-G	G	G	G	N
Difenzoquat (Avenge)	N	N	N	N	N	N	N	N	N	N	N	G
Endothall (Herbicide 273)	N	P	N	N	P	P	F	P	P	G	F	N
MCPA	N	G	G	N	F	G	F	N	F-G	N	G	N
Phenmedipham (Betanal)	P	P	N	F	F	G	P	F	P	G	G	N
2,4-D	N	G	G	N	F	G	G	F-G	G	P	G	N

G = Good    F = Fair    P = Poor    N = None

This table is a general comparative rating of the relative effectiveness of herbicides to certain weeds. 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.

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