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UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

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1976 CHEMICAL WEED CONTROL GUIDE for Field Crops and Perennial Weeds

NORTH DAKOTA
STATE UNIVERSITY

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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 Committee 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 rates and are based on active ingredient or acid equivalent rather than 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, or 3 pounds active ingredient is 3 3/4 pounds of product (3 ÷ 0.80 = 3.75).

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

CONSIDER BOTH the crop tolerance and kind of weeds present in determining the rate of herbicide to apply. A range of rates is given for most of the herbicides in this circular. Use the lowest recommended rate of postemergence herbicides under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of 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, shelter-belts or farmsteads.

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

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WEED COMPETITION reduces crop yields severely, unless weeds are removed when small. Good cultural practices are one of the many methods of con-

FLAX

always is several degrees warmer than that 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. However, spray drift (droplets) can occur even with non-volatile herbicides and cause injury to susceptible plants.

DO NOT SPRAY when there is danger of spray or vapor drift, or when the wind is blowing toward a neighboring crop or planting more susceptible than the crop being sprayed. The amines of 2,4-D and MCPA are not volatile and eliminate the danger of vapor injury.

PREEMERGENCE HERBICIDES: Soil type, weather conditions and the weeds to be controlled determine the rate of preemergence herbicides to apply. Generally heavy clay soils high in organic matter require higher rates of such herbicides than lighter soils or those lower in organic matter.

Good weed control with preemergence herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature and soil type. For these reasons, preemergence chemicals applied on the soil surface sometimes fail to give satisfactory weed control. Herbicides which are incorporated 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.

HERBICIDE COMBINATIONS: The effect of post-emergence herbicides often is increased when applied to areas already treated with a preemergence or pre-plant herbicide. Combinations of certain post-emergence 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. However, agricultural pesticides may be tank mixed if all pesticides in the mixture are registered by the Environmental Protection Agency on the crop being treated. Users must assume liability for any possible crop injury, inadequate weed control and illegal residues.

MCPA at 1/4 pound per acre controls most broadleaf weeds in flax when it is 2 to 6 inches tall. Avoid spraying flax during the period between bud stage and when 90 per cent of the bolls have formed, as serious crop injury likely would occur. In addition, applying MCPA between full bloom and the stage when flax seeds are colored may reduce germination of the seed. 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.

EPTC (Eptam) at 2 to 3 pounds per acre controls annual grass weeds, including wild oats, and some broadleaf weeds in flax. Incorporate EPTC immediately (within minutes) and thoroughly after application. Double disk twice in opposite directions 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 it 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.

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.

Flax is a poorer competitor with weeds than are small grains. Consequently, grow flax 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 con-

tol 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 sometimes reduces crop yields. Plant early maturing varieties with late seeding.

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 the time of emergence until the early 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. Oats in the five-leaf stage of growth is especially susceptible to injury from 2,4-D. Use 2,4-D on oats only for such hard-to-kill weeds as Russian thistle, kochia, common ragweed and redroot pigweed. 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. Do not treat small grains in the boot stage. 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. It can be applied alone or in a mixture with MCPA to increase control of wild mustard. Dicamba alone usually gives unsatisfactory 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.

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 for better wild mustard control.

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 seeded 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.

CORN

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

Destroy early germinating weeds by cultivation before planting if conventional tillage is used for controlling weeds. Leave the space between the rows rough to reduce weed germination. Cultivate after the weed seeds have germinated or as soon as the weeds appear above the soil surface. Use a rotary hoe as soon as weeds appear.

Atrazine (AAtrex) 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) 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 experiments has given superior weed control to alachlor except when alachlor was incorporated.

Penoxalin (Prowl), a dinitroaniline herbicide, was registered for preemergence weed control in corn for the first time in 1975. It has given erratic weed control on clay soils high in organic matter. Shallowly incorporate the herbicide with a 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 and cyanazine (see label for details).

Early postemergence weed control must be done at the proper time for satisfactory results. Atrazine effectively controls most annual weeds in corn and control of broadleaf weeds is excellent. Apply 1 to 2 pounds per acre of 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 emulsifiable vegetable oil (Bio-Veg, a linseed oil) gives results similar to petroleum oil applied at 1 to 2 gallons per acre.

Cyanazine (Bladex 80W) is labeled with 1 qt/A of an emulsifiable crop origin oil (Bio-Veg or Midland EV), as an early postemergence treatment for grassy and broadleaf weed control in corn. The emulsifiable crop origin oils also are known as vegetable oils. Cyanazine is labeled at 1.2 to 2 lb/A (1 1/2 to 2 1/2 lb Bladex 80W). Cyanazine at 1 lb/A with 1 qt/A 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 will not leave a residue to prevent normal rotations. The 1 lb/A rate in most soils only controls emerged weeds. Thus, later emerging weeds are sometimes a problem and should be controlled by cultivation.

When corn is 3 to 8 inches tall, an overall broadcast application of 2,4-D amine at 1/4 to 1/2 pound per acre can be made to control broadleaf weeds. Use the 1/4 pound rate for susceptible weeds like wild mustard. The 1/2 pound rate is satisfactory for controlling 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 of the crop. 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 to 1/2 pound per acre, can be applied postemergence in corn. It gives better control of Canada thistle, smartweed and wild buckwheat than 2,4-D with less effect on the 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 using a properly calibrated, low-pressure sprayer having good agitation. 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 as well as giving some 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 only 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 to 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 cultivation practices. Hand labor, mostly hoeing, is still needed 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.

Late germinating weeds can become a problem in sugar beets with early seeding or when good moisture conditions prevail well into the season. Trifluralin (Treflan) is cleared at 3/4 lb/A and EPTC (Eptam) is cleared at 3 lb/A for use on sugar beets after thinning for annual grass and broadleaf control. Broadcast apply and incorporate the chemicals immediately with cultivators or tillers adjusted to mix them 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. Cover exposed sugar beet roots with soil prior to trifluralin application to reduce possibility of girdling.

EPTC sometimes will cause 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. EPTC is less phytotoxic on fine textured, high organic matter soils so rates must be increased on these soils and decreased on coarse-textured, low organic matter soils. 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.

To avoid possible sugar beet injury from desmedipham (Betanex) and phenmedipham (Betanal), observe several precautions. The sugar beets should

have at least four true leaves before treatment. Do not apply if the highest temperature on the day of application exceeds 85 degrees F. 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. Set the proper band width near the top of the sugar beets so that the beets rather than the ground receive the proper rate. Calibrate the sprayer very carefully.

SOYBEANS

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

Profluralin (Tolban) is a preplant herbicide that must be incorporated into the top 2 to 3 inches of soil. Apply 1/2 to 1 pound per acre to the soil surface and incorporate in the same operation, if possible, to assure maximum herbicidal activity. Incorporate thoroughly in two directions 3 to 4 inches deep by double disking twice in opposite directions or by other methods which mix the herbicide with the top 3 inches of soil. Poor weed control may result from a delayed incorporation, especially if the chemical is applied to a warm, wet soil.

Trifluralin (Treflan) applied 1/2 to 1 pound per acre preplanting and thoroughly incorporated gives good control of annual grasses and broadleaf weeds except wild mustard. Proper incorporation is essential. Incorporate thoroughly in two directions 3 to 4 inches deep. Properly incorporate trifluralin by double disking twice in opposite directions or by other methods which thoroughly mix the chemical with the top 3 inches of soil. Incorporate as soon as possible after application for best results. Incorporation may be delayed up to eight hours on cool, dry soils.

Dinitramine (Cobex) is a preplant herbicide that must be thoroughly and shallowly incorporated into the top 1 1/2 to 2 inches of soil. Apply at 1/3 to 2/3 pounds per acre depending on soil type. Completely incorporate within 24 hours of application. The herbicide effectively controls many annual grasses and broadleaf weeds as they germinate, but does not control cocklebur or sunflower. Wild mustard control is not adequate.

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 redroot 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.

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.

Bentazon (Basagran) at 3/4 to 1 1/2 lb/A is a new postemergence herbicide for use in soybeans. In North Dakota good wild mustard control has been

obtained with 1/2 lb/A when wild mustard is small (less than 4 inches tall) and when used with a surfactant (Citowett). Bentazon does not control grassy weeds, and redroot pigweed and common lambsquarters are quite resistant. However, 1 lb/A 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.

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) or as a preemergence broadcast or band overlay application following a preplant incorporated treatment of trifluralin. When used in a preplant, incorporated treatment with trifluralin, the 1/4 lb/A rate of metribuzin is adequate to control wild mustard under North Dakota conditions. Alachlor 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.

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) and EPTC (Eptam) are herbicides that are applied preplant and incorporated into the soil. See the preceding soybean discussion

concerning the incorporation of trifluralin. Apply trifluralin on sandy soil at 1/2 pound per acre and increase the rate to 1 pound per acre on clay soil. Apply EPTC at 3 pounds per acre and incorporate immediately (within minutes) and thoroughly. Properly incorporate EPTC by double disking twice in opposite directions or by other methods which thoroughly mix the chemical with the top 3 inches of soil. Trifluralin and EPTC control grasses and some broadleaf weeds.

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. Mowing seedling legumes (except sweetclover) when sown alone, or the stubble of companion crops, and mowing patches of perennial weeds also aid in weed control.

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.

Apply barban (Carbyne) for postemergence control of wild oats 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 4th 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 trifoliate 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 3 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 the precautions stated in the above paragraph very closely.

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.

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.

See Circular A-351, "Chemical Control of Wild Oats in Field Crops" for additional information.

PERENNIAL WEED CONTROL

Perennial weeds in crops such as field bindweed, leafy spurge, Canada thistle and perennial sowthistle also can be controlled. MCPA is as effective as 2,4-D on Canada thistle, but 2,4-D gives slightly better control of sowthistle. Use MCPA to suppress thistles in oats and flax. However, these crops do not tolerate rates of MCPA necessary to give adequate thistle control.

When controlling field bindweed and thistle 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.

Fall herbicide treatments are more effective than spring or summer treatments for eliminating perennial weeds. The optimum time of treatment probably 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. The weeds like 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 pre-harvest 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 PASTURES: 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 single broadcast spray during any one growing season. Retreatment at the same rate may be necessary the following year.

Picloram is a highly potent herbicide. Do not allow spray drift of picloram, as tiny amounts may cause damage to sensitive plants. Especially susceptible to picloram are soybeans, potatoes, safflower, sunflowers and sugar beets. Picloram is highly water soluble and moves in the soil; consequently, do not apply in areas with a high water table. Do not apply near shelterbelts or 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 aluminum so aluminum spray equipment and aluminum aircraft structures exposed to paraquat should be rinsed thoroughly immediately after use. Paraquat is quite toxic. Avoid contact with the skin. Even small amounts could be fatal, if swallowed.

Cyanazine (Bladex) is a preemergence, moderately short residual herbicide to control annual weeds on ground being fallowed for future planting to wheat,

barley, oats, sorghum or corn. Cyanazine can be tank mixed with paraquat where kill of existing weeds is desired, because cyanazine generally will not kill emerged weeds. Rainfall is required for activation of this herbicide in soil. Generally, 0.5 inch will be adequate if it wets the soil to a depth of 1.5 to 2 inches. Whenever possible, it is desirable to apply cyanazine 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 2 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.

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 herbicide rate. Herbicides such as Eptam (EPTC), Pyramin (pyrazon), AAtrex (atrazine), Lorox (linuron) and Ro-Neet (cycloate) 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.

Eptam is used on flax, sugar beets, sunflowers and potatoes. Flax and sugar beets have marginal tolerance to Eptam, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussions on selecting an Eptam rate gives some guidelines but does not give firm rules. Since other factors such as method of incorporation also affect Eptam performance (immediate and thorough incorporation gives best

performance), each grower must decide on the best rate for his conditions. The suggested Eptam rate is 2 to 3 lb/A. When a soil has a silty clay texture with more than 7 per cent organic matter, the 3 lb/A rate would be expected to give good weed control without crop injury. When a soil is sandy loam or more coarse in texture 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 lb/A. Eptam rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes. Eptam at 2.5 lb/A 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, Avadex, Ro-Neet, Pyramin + TCA, or Nortron + TCA may be used in sugar beets on the low organic matter soils where Eptam injury is excessive. Eptam is the only pre-emergence or preplant incorporated herbicide cleared for use on flax. Stunted plants and stand reduction are symptoms of flax injury from Eptam. 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 Eptam on a small acreage of flax on the lighter soils to determine if the benefits from the Eptam offset possible injury.

Some herbicides give good weed control only when organic matter levels are low. Pyramin and Lorox have not been effective in the Red River Valley, except on the more coarse textured soils with less than 5 per cent organic matter. The lower the organic matter, the more effective they become. The AAtrex rate must be adjusted according to organic matter levels. Apply the higher labelled rates on higher organic matter soils.

Many herbicides such as Treflan (trifluralin), Ramrod (propachlor), Far-go (triallate), Avadex (diallate) 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.

RELATIVE RESPONSE OF WEEDS TO HERBICIDES

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

CHEMICAL WEED CONTROL
For Field Crops

Crop	Herbicide	Act. Ingrid. lb. per Acre	Weeds	When to Apply	Remarks
WHEAT, DURUM OR BARLEY	2,4-D amine 2,4-D L.V. ester	1/4 to 1/2	Broadleaf	Crops—5th leaf to boot	Do not apply from early boot to dough stage. Barley more sensi- tive than wheat.
	MCPA amine MCPA ester	1/4 to 2/3	Broadleaf	Crops—emergence to early boot	Apply 1/2 lb/A or less from emer- gence to tiller stage.
	Bromoxynil plus MCPA ester	1/4 plus 1/4	Wild buckwheat and most broad- leaf weeds	Crops—3rd leaf to boot stage	Apply when weeds are in early seed- ling stage for best results. Com- mercial mixtures (Brominal Plus & Bronate) are available.
	Paraquat	1/2	Emerged annual grasses and broadleaf 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.
WHEAT OR DURUM	Dicamba (Banvel) plus MCPA amine	1/8 plus 1/4	Wild buckwheat and most broad- leaf weeds	Crops—2nd through 4th leaf stage	Commercial mixture (Mondak) is available.
WINTER WHEAT OR RYE	2,4-D amine 2,4-D L.V. ester	1/4 to 1/2	Broadleaf	Crops—fully tillered to boot	Do not apply in the fall.
OATS	MCPA amine MCPA ester	1/4 to 1/2	Broadleaf	Oats—emergence to boot	Early jointing stage most sensitive. Possible injury to oats at any growth stage.
	Bromoxynil plus MCPA ester	1/4 plus 1/4	Wild buckwheat and most broad- leaf weeds	Crops—3rd leaf to boot stage	Apply when weeds are in early seed- ling stage for best results. Com- mercial mixtures (Brominal Plus & Bronate) are available.
	Dicamba (Banvel) plus MCPA amine	1/8 plus 1/4	Wild buckwheat and most broad- leaf weeds	Crops—2nd through 4th leaf stage	Commercial mixture (Mondak) is available.
SMALL GRAIN PRE-HARVEST	2,4-D L.V. ester or 2,4-D oil soluble amine	3/4 to 1 1/2	Broadleaf	Crops—dough stage to harvest	Use only when weeds may interfere with harvest operations. Do not feed straw to livestock.

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks
FLAX	MCPA amine	1/4	Broadleaf	Flax—2 to 6 inches tall	Use higher rates or MCPA ester for hard-to-kill weeds.
	Dalapon (Dowpon)	3/4	Annual grasses except 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 plus MCPA ester	1/4 plus 1/4	Wild buckwheat and most broadleaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Flax injury is possible.
	EPTC (Eptam)	2 to 3	Grasses and some broadleaf weeds	Preplant incorporated	Incorporation directions and rate discussed under flax narrative at beginning of Weed Control Guide. Flax safety is marginal. Weak on wild mustard.
CORN	Alachlor (Lasso)	2 1/2 to 3 1/2	Grasses and some broadleaf weeds	Preplant incorporated or preemergence	Ineffective against wild mustard. Usually less effective preemergence than propachlor (Ramrod) in North Dakota. Preplant incorporation gives more consistent weed control. Use higher rate on clay soils high in organic matter.
	Atrazine (AAtrex)	2 to 4	Broadleaf and grasses	Preplant incorporated or preemergence	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.
	Cyanazine (Bladex)	2 to 3.2	Broadleaf and annual grasses	Preemergence	Soil residues unlikely the year after treatment. Weak on redroot pigweed. Use higher rate on heavy soils.
	Propachlor (Ramrod)	4 to 5	Grasses and some broadleaf weeds	Preemergence	Ineffective against wild mustard.
	Penoxalin (Prowl)	1 1/2 to 2	Annual grasses and some broadleaf weeds	Preemergence	Do not use on sands or loamy sands. Use higher rate on clay soils high in organic matter.
	Dicamba (Banvel) plus Alachlor	1/4 to 1/2 plus 2	Broadleaf and grasses	Preemergence	Use lower rate of dicamba on sandy soils.
	Atrazine plus Alachlor	1 plus 2	Most grasses and broadleaf weeds	Preplant incorporated or preemergence	See soil residue comment under atrazine.

(cont. on next page)

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks
CORN (cont.)	Atrazine plus 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.
	Atrazine plus Butylate (Sutan)	1 plus 3	Most grasses and broadleaf weeds	Preplant incorporated	Incorporate immediately (within minutes) and thoroughly in two directions 4 to 6 inches deep with tandem disk. See soil residue comments under atrazine.
	Cyanazine plus Alachlor	1 to 2 plus 2	Most grasses and broadleaf weeds	Preemergence	Use lower rate of cyanazine on sandy soils.
	EPTC plus R-25788 (Eradicané)	4	Grasses and some broadleaf weeds. Weak on wild mustard	Preplant incorporated	See discussions under corn at beginning of Weed Control Guide for rates and incorporation directions. 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		EPTC preplant incorporated with naphthalic anhydride treated seed	
	Linuron + propachlor	3/4 to 1 1/2 plus 1 1/2 to 3	Broadleaf and annual grasses	Preemergence	Use the higher rate on heavy soils. Soil residues unlikely the year after treatment.
	Atrazine (AAtrex) plus phytobland oil	1 to 2 plus a phytobland oil	Broadleaf and grasses	Early postemergence— weeds less than 1 1/2 inches tall	Use emulsifiable linseed or petroleum oils at volume recommended on label. See soil residue comment under atrazine.
	Cyanazine (Bladex) + crop origin oil	1 plus 1 qt crop origin oil	Broadleaf and grasses	Early postemergence— weeds less than 1 1/2 inches tall	Use emulsifiable crop origin oil such as linseed or soybean oil. See comments under cyanazine in corn narrative at beginning of Weed Control Guide.
	Cyprazine (Outfox)	3/4	Broadleaf and annual grasses	Early postemergence	Cyprazine residue remains in soil longer than one year and may damage following crops other than corn. Best results when weeds less than 2 inches high.
	2,4-D amine	1/4 to 1/2	Broadleaf weeds	Postemergence, corn— 3 inches to tasseling	Use drop nozzle when corn is over 8 inches tall but before tasseling.
	Dicamba (Banvel)	1/8 to 1/4	Wild buckwheat, Canada thistle, P. sowthistle	Postemergence, before corn is 36 inches tall	See narrative under corn at beginning of the Weed Control Guide.

Crop	Herbicide	Act. Ingrid. lb. per Acre.	Weeds	When to Apply	Remarks
SOYBEANS (See later section for wild oat control)	Chloramben (Amiben)	2 to 3	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate.
	Trifluralin (Treflan)	1/2 to 1	Grasses and some broadleaf weeds	Preplant incorporated, fall or spring	Incorporation directions discussed under soybean narrative at beginning of Weed Control Guide. No wild mustard control.
	Profluralin (Tolban)	1/2 to 1	Grasses and some broadleaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at beginning of Weed Control Guide. No wild mustard control.
	Dinitramine (Cobex)	1/3 to 2/3	Grasses and some broadleaf weeds	Preplant, shallow incorporation	Incorporation directions discussed under soybean narrative at beginning of Weed Control Guide. Weak on wild mustard.
	Chloroxuron (Tenoran, Norex)	1	Wild mustard and some other broadleaf weeds NOT GRASSES	When weeds are less than 2 inches tall and crop has first trifoliolate leaf	Use as emergency wild mustard control measure. Must be applied with surfactant (Adjuvan T).
	Alachlor (Lasso)	2 1/2 to 3 1/2	Grasses and some broadleaf weeds	Preemergence	Wild mustard and wild oat control not adequate. Preplant incorporation gives more consistent weed control. Use higher rate on clay soils high in organic matter.
	Linuron (Lorox) + Alachlor	1 plus 2	Grasses and broadleaf weeds	Preemergence	Use on sandy soils only.
	Trifluralin plus Metribuzin (Sencor, Lexone)	1/2 to 1 plus 1/4 3/4 to 1 plus 1/4 to 1/2	Broadleaf weeds including wild mustard and annual grasses	Preplant incorporated	Rate of metribuzin is critical. See label for details.
				Trifluralin preplant incorporated, metribuzin preemergence	
		Alachlor plus Metribuzin	2 plus 1/4 to 1/2	Broadleaf weeds including wild mustard and annual grasses	Preemergence
	Dinoseb, amine salts	1 1/2 to 2 1/4	Wild mustard	Cracking stage	Use the higher rate below 75°F and the lower rate above 75°F.
(cont. on next page)	Paraquat	1/2	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A non-selective, postemergence herbicide. No soil activity. Apply with X-77 surfactant. Good coverage is essential.

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks
SOYBEANS (cont.)	Bentazon (Basagran)	3/4 to 1 1/2	Wild mustard, cocklebur, Canada thistle	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	Desiccant	Prior to harvest	Make application when beans are fully developed and half of leaves have dropped and remaining leaves are turning yellow.
DRY, EDIBLE BEANS	Chloramben (Amiben)	2	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate.
	EPTC (Eptam)	3	Grasses and some broad- leaf weeds	Preplant incor- porated	Incorporation directions discussed under sunflower narrative at beginning of Weed Control Guide. Weak on wild mustard.
	Profluralin (Tolban)	1/2 to 1	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.
	Trifluralin (Treflan)	1/2 to 1	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.
	Dinitramine (Cobex)	1/3 to 2/3	Grasses and some broad- leaf weeds	Preplant, shallow incorporation	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. Weak on wild mustard.
	Dinoseb	3 to 4 1/2	Small broad- leaf weeds	Emergence, not beyond "crook" stage	Apply in 30 gallons of water per acre.
SAFFLOWER	Trifluralin (Treflan)	1/2 to 1	Grasses and some broad- leaf weeds	Preplant incorporated, spring or fall	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.
SUNFLOWERS (See later section for wild oat control) (cont. on next page)	EPTC (Eptam)	3	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under sunflower narrative at begin- ning of Weed Control Guide. Weak on wild mustard.
	Profluralin (Tolban)	1/2 to 1	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks	
SUNFLOWERS (cont.)	Trifluralin (Treflan)	1/2 to 1	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.	
	Chloramben (Amiben)	2 to 3	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate.	
	Paraquat	1/4 to 1/2	Desiccant	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.	
SUGAR BEETS (See later section for wild oat control)	EPTC (Eptam)	2 to 3	Annual grasses and some broad- leaf weeds	Preplant incor- porated	Incorporation directions discussed under sunflower narrative at begin- ning of Weed Control Guide. Use higher rates on heavy, high organ- ic matter soils. Some stand reduction and temporary stunting may occur from the use of EPTC. Weak on wild mustard.	
		4 to 4 1/2 (See narra- tive sec- tion for details.)		Fall incorporated after October 15 until freeze-up		
	Cycloate (Ro-Neet)	3 to 4	Annual grasses and some broadleaf weeds	Preplant incor- porated		Use lower rate only on light, sandy soils. Incorporate same as EPTC. Sugar beets have better tolerance to cycloate than to EPTC. Following cycloate with a postemergence herbicide is sug- gested. Weak on wild mustard.
	TCA (various names)	6 to 8	Most annual grasses	Preemergence		Weak on wild oats. Do not use sugar beet tops for livestock feed.
	Pyrazon (Pyramin plus TCA)	3.8 plus 6 to 8	Annual grasses and most broad- leaf weeds	Preemergence		Has not been effective on soils with more than 5% organic matter.
	Pyrazon plus Dalapon (Pyramin Plus)	3.8 plus 2.2	Most annual grasses and broadleaf weeds	Postemergence when broadleaf weeds are in the two-leaf stage or earlier, and the sugar beets are in the two-leaf stage or later		Results on soils with more than 5% organic matter have been erratic
(cont. on next page)						

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks
SUGAR BEETS (cont.)	Dalapon (Dowpon, Basfapon)	2 to 3	Most annual grasses	Apply from emer- gence to 6-leaf stage of sugar beets. Use directed spray after beets have 6 leaves	Use high rate if grasses have over 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.
	Endothall (Herbicide 273)	3/4 to 1 1/2	Wild buckwheat smartweed marshelder	Sugar beets should have 4-6 leaves. Do not apply later than 40 days after emer- gence	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	Most annual grasses and 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 tem- perature during day is over 85°F. and apply late in afternoon or early in the evening.
	Desmedi- pham (Betanex)	1 to 1 1/4	Most annual grasses and broadleaf weeds including red- root pigweed		
		Paraquat	1/2	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emer- gence
TAME MUSTARD (See later section for wild oat control)	Trifluralin (Treflan)	1/2 to 3/4	Grasses and broadleaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide.
POTATOES (See later section for wild oat control) (cont. on next page)	Dalapon (Dowpon, Basfapon)	6	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	Grasses and some broadleaf weeds	Preplant or directed spray at dragoff	Incorporation directions discussed under sunflower narrative at beginning of Weed Control Guide. Weak on wild mustard.
	Linuron (Lorox)	3/4 to 2	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 within 4 months after treatment.

Crop	Herbicide	Act. Incred. lb. per Acre	Weeds	When to Apply	Remarks
POTATOES (cont.)	Metribuzin (Sencor, Lexone)	1/2 to 1	Broadleaf weeds including wild mustard and some grasses	Preemergence	Use lower rate on sandy soils. Soil residue harmful to following susceptible crops may occur.
	Trifluralin (Treflan)	1/2 to 1	Grasses and broadleaf weeds	After planting, incorporated. Use up to or immediately following dragoff	Care should be taken that incor- poration machinery does not damage seed pieces or elongating sprouts.
	Chlorbro- muron (Maloran, Bromex)	2 to 4	Most annual grasses and broadleaf weeds	Preemergence, after planting or dragoff	Do not plant crops other than potatoes, corn or soybeans within 6 months after application. Generally does not perform satisfactorily on heavy, organic soils.
	Paraquat	1	Most annual grasses and broadleaf weeds	Preemergence—when weeds are up but before crop emerges	Do not apply later than ground cracking. Paraquat kills only emerged weeds.
POTATO VINE KILLING	Endothall (Des-i-Cate)	3/4 to 1	Desiccant	10 to 14 days prior to harvest	Use higher rate during cool, cloudy weather and on heavy vine growth.
	Dinoseb	1 1/4 to 2 1/2	Desiccant	10 to 20 days prior to harvest	See label for details. Rate depends on temperature, spray volume, potato variety and vigor of the vines.
	Paraquat	1/4 to 1/2	Desiccant	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	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	Annual and perennial broadleaf weeds	Weeds—emergence to bud stage, pref- erably when young and actively growing	Do not graze dairy cows for 7 days after application. Do not apply after boot stage on grasses for seed production. Use 1 lb/A on annuals and gumweed and 2 lb/A on sages and other perennials.
LEGUMES Alfalfa and clover with nurse crop (cont. on next page)	MCPA	1/8 to 1/4	Broadleaf	Legumes 2-3 inches tall and nurse crop 4-16 inches tall	Canopy of crop or weeds reduces injury. NOTE: POSSIBLE INJURY TO SWEETCLOVER AND ALFALFA.
	Dinoseb	1.1 to 1.5	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.

Crop	Herbicide	Act. Ingrid. lb. per Acre.	Weeds	When to Apply	Remarks
LEGUMES (cont.) Alfalfa, trefoil seeding	EPTC (Eptam)	3	Grasses and some broad- leaf weeds	Preplant incorporated	Incorporation directions discussed under soybean narrative at begin- ning of Weed Control Guide. No wild mustard control.
Alfalfa trefoil alone. Established or seedling stage	2,4-DB	1/2 to 1	Broadleaf	Weeds and legumes less than 3 inches tall, nurse crop 1- 6 inches tall	Sweetclover killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied 30 days before hay har- vest or grazing. See narrative at beginning of Weed Control Guide for herbicides in legume establish- ment.
Alfalfa only	Simazine (Princep)	0.8 to 1.6	Grasses and broadleaf weeds including wild oats and mustard	After last cutting but before freeze- up	Do not use on sands or loamy sands or where soil pH is above 7.5. Use low rate on sandy loam. Apply to pure stands of alfalfa established at least 12 months.

Weed	Herbicide	Rate per Acre	Crop	When to Apply	Remarks		
WILD OATS Selective control in crops	Triallate (Far-go)	1 1/4 lb liquid	Barley	Fall—after October 15 and until freeze-up	Incorporate immediately by culti- vation. Keep spring tillage to minimum. Use lower rate of granules on wheat		
		1 1/4-1 1/2 lb granules					
		1 lb liquid	Wheat and durum				
		1 1/4-1 1/2 lb granules					
			1 1/4 lb	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 incorporated zone.	
			1 lb	Wheat and durum			
		Diallate (Avadex)	1 1/2 to 2 lb	Flax, sugar beets, soybeans and potatoes	Preplanting	Incorporate immediately by cultivation.	
				1 1/2 lb	Corn and lentils	Preplanting or preemergence	Incorporate immediately by cultivation.
				1 1/4 lb	Peas		
				1 1/2 to 2 lb liquid	Flax and sugar beets	Fall—after October 15 and until freeze- up	Incorporate immediately by culti- vation. Keep spring tillage to minimum.
				1 1/2 to 2 lb granules	Sugar beets		
		Barban (Carbyne)	4 to 6 oz	Wheat, winter wheat, durum, barley, flax, peas, mustard, sunflowers and lentils	Wild oats—1 1/2 leaf stage. Crops: Small grain before 4th leaf stage; flax before 12th leaf stage; peas before 6th leaf stage; mustard before true 3rd leaf stage; winter wheat, no restrictions; sugar beets before the 30th day; sunflowers before the 14th day	Usually applied 4 to 9 days after wild oats emerge. Must be applied before the 14th day after wheat, durum, barley and lentils emer- gence and before the 4th leaf stage to avoid serious crop injury and poor wild oat control. Do not mix barban with any other chemicals. See Narrative for effects of temperature, low soil fertility and droughty conditions on barban activity.	
				12 to 16 oz			Sugar beets
			4 to 6 oz	Soybeans			Before the first trifoliolate leaf stage or no later than 14 days later crop emerges
FUMITORY	Triallate (Far-go)	1 1/4 lb	Barley	Immediately after planting	Use only if wild oats also is a problem, because of cost. Incor- porate in top 2 inches of soil by cultivation.		
			1 lb			Wheat and durum	
(cont. on next page)	Diallate (Avadex)	1 1/2 lb	Flax	Preplanting			

Weed	Herbicide	Rate per Acre	Crop	When to Apply	Remarks
FUMITORY (cont.)	Bromoxynil plus MCPA ester	1/4 to 1/3 lb plus 1/4 to 1/3 lb	Wheat and barley	After fumitory is established to boot stage of crop	Apply in 10 to 15 gal. water per acre. Other broadleaf weeds also will be controlled. Commer- cial mixtures (Brominal Plus and Bronate) are available.
DOWNY BROME (CHEAT- GRASS)	Atrazine (AAtrex)	0.8 to 1.0 lb.	Rangeland	Fall—late September until freeze-up	Apply in a minimum of 10 gallons of water per acre. Grazing per- mitted 7 months after applica- tion.

CHEMICAL WEED CONTROL For Perennial Weeds

Weed	Herbicide ^{1/}	Act. Ingrid. Lb/A or Sq/Rd	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	Regrowth 6 inches to bud stage	Cultivate fallow until mid-July. Spray in late August or September. Respray in following year's crop.
Wheat and barley	2,4-D amine 2,4-D L.V. ester	3/4 lb/A 2/3 lb/A	Tiller stage of crop	Higher rates may injure crop but may be worthwhile, especially in small areas, to control bindweed.
Patches or individual plants in pastures or non-cropland ^{2/}	Picloram (Tordon 22K)	1 lb/A	When bindweed is actively growing	Tordon granules available. Do not use in areas with high water table. Do not graze dairy cattle on treated area.
	Dicamba (Banvel)	4 to 8 lb/A	When bindweed is 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.
LEAFY SPURGE On fallow	2,4-D L.V. ester	1 to 2 lb/A	4 to 6 inches	Cultivate or respray whenever re- growth is 4 to 6 inches high. Re- spray in following year's crop.
Pasture and Rangeland	2,4-D L.V. ester or oil soluble amine	1 to 2 lb/A	Early bud stage and fall	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days after treat- ment.
(cont. on next page)	Picloram (Tordon 22K)	1/4 to 1/2 lb/A	Any time spurge is actively growing	Retreatment at the same time usually will be necessary the following year. Do not graze dairy cattle on treated area.

^{1/} Several soil sterilants will control perennial weeds. Follow directions on the label.

^{2/} Non-cropland means roadsides and waste areas not used to produce animal feed.

Weed	Herbicide ^{1/}	Act. Incred. Lb/A or Sq/Rd	When to Apply	Remarks
LEAFY SPURGE (cont.) Patches or individual plants in pastures	Dicamba (Banvel)	4 to 8 lb/A	When spurge is 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	Any time spurge is actively growing	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.
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 injure crop but may be worthwhile, espe- cially in small areas, to achieve thistle control.
Corn	Atrazine (AAtrex)	4 lb/A	Use split treatment similar to quackgrass, or make 2 postemergence treatments with oil	Plant only corn year following treatment.
Fallow or post harvest	2,4-D	1 lb/A	6 inches tall and actively growing. Post harvest mowing promotes active regrowth	Cultivate fallow until mid-July. Spray in late August or September.
	Dicamba (Banvel)	1 to 2 lb/A		
Pasture and Rangeland	Picloram (Tordon 22K)	1/4 to 1/2 lb/A	6 inches tall and ac- tively growing. For fall treatment, mowing promotes active growth	Retreatment at the same rate usually will be necessary the following year. Do not graze dairy cattle on treated area.
	Dicamba (Banvel)	1/2 lb/A		Do not graze dairy cows for 7 days or make hay for 37 days after treat- ment. Do not graze meat animals in treated areas within 30 days of slaughter.
	2,4-D	1 to 2 lb/A		Do not graze dairy cows for 7 days after treatment.

^{1/} Several soil sterilants will control perennial weeds. Follow directions on the label.

Weed	Herbicide ^{1/}	Act. Ingrid. Lb/A or Sq/Rd	When to Apply	Remarks
CANADA THISTLE AND SOWTHISTLE (cont.) Patches or individual plants in pastures	Picloram (Tordon 22K)	1 lb/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		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.
QUACKGRASS	Dalapon (Dowpon)	6 to 11 lb/A	On fallow after 4 to 6 inches growth	Cultivate after 10 to 20 days.
	Atrazine (AAtrex)	4 lb/A	Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting time	Make 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.
AROUND BLDGS., TELEPHONE POLES, ETC.	Atrazine, bro- macil, monuron, prometone or similar products	See label	Any time during and prior to growing sea- son. See label	Use heavy rates for complete long- time soil sterility.

^{1/} Several soil sterilants will control perennial weeds. Follow directions on the label.

GLOSSARY OF CHEMICAL NAMES

COMMON NAME	TRADE NAME ^{1/} AND MANUFACTURER	CONCENTRATION AND COMMERCIAL FORMULATIONS ^{2/}
Alachlor	Lasso	4 lb/gal L
	(Monsanto)	15% G
Ametryne	Evik	80% WP
	(Ciba-Geigy)	
Atrazine	AAtrex	80% WP
	(Ciba-Geigy)	4 lb/gal L
Barban	Carbyne	
	(Gulf)	1 lb/gal L
Bentazon	Basagran	
	(BASF)	4 lb/gal L
Bromacil	Hyvar-X, Hyvar-XL	80% WP
	(DuPont)	2 lb/gal L
Bromoxynil	Buctril (Chipman)	
	Brominal (Amchem)	2 lb/gal L
Bromoxynil and MCPA	Bronate (Chipman)	2 lb/gal MCPA plus
	Brominal Plus (Amchem)	2 lb/gal bromoxynil L
Butylate	Sutan	
	(Stauffer)	6 lb/gal L, 10% G
Chloramben	Amiben	10% G
	(Amchem)	2 lb/gal L
Chlorbromuron	Bromex (Nor-Am)	
	Maloran (Ciba-Geigy)	50% WP
Chloroxuron	Norex (Nor-Am)	
	Tenoran (Ciba-Geigy)	50% WP
Cyanazine	Bladex	80% WP
	(Shell)	15% G
Cycloate	Ro-Neet	
	(Stauffer)	6 lb/gal L
Cyprazine	Outfox	
	(Gulf)	1 lb/gal L
Dalapon	Bastapon (BASF)	
	Dowpon M (Dow)	74% WSP
Dalapon and TCA	Dowpon C	46.5% dalapon
	(Dow)	26.2% TCA WSP
Desmedipham	Betanex	
	(Nor-Am)	1.3 lb/gal L
Diallate	Avadex	4 lb/gal L
	(Monsanto)	10% G
Dicamba	Banvel	
	(Velsicol)	4 lb/gal L
Dicamba and MCPA	MonDak	1.25 lb/gal dicamba plus
	(Velsicol)	2.50 lb/gal MCPA L
Dinitramine	Cobex	
	(U. S. Borax)	2.0 lb/gal L
Dinoseb (DNBP)	Severol	1, 3, 5 lb/gal L
	(various)	10% G
Endothall	Endothal, Herbicide	1.46 lb/gal L
	273 (Pennwalt)	3 lb/gal L, 5% G
Endothall (as a desiccant)	Des-i-Cate	
	(Pennwalt)	0.52 lb/gal L
EPTC	Eptam	7 lb/gal L
	(Stauffer)	10% G
EPTC plus R-25788	Eradicane	
	(Stauffer)	6 lb/gal L
Linuron	Lorox	
	(DuPont)	50% WP
MCPA	Severol	
	(various)	Various L
Metribuzin	Lexone (DuPont)	
	Sencor (Chemagro)	50% WP
Monuron	Telvar	G, L, WP
	(DuPont)	Various
1,8-naphthalic anhydride	Protect	
	(Gulf)	Seed treatment
Paraquat	Ortho Paraquat	
	(Chevron)	2 lb/gal L
Penoxalin	Prowl	
	(American Cyanamid)	4 lb/gal L
Phenmedipham	Betanal	
	(Nor-Am)	1.3 lb/gal L
Picloram	Tordon 22K, Tordon	10%, 2% G
	10K, Tordon Beads (Dow)	2 lb/gal L
Profluralin	Tolban	
	(Ciba-Geigy)	4 lb/gal L
Propachlor	Ramrod	65% WP
	(Monsanto)	20% G
Propazine	Milogard	
	(Ciba-Geigy)	80% WP
Pyrazon	Pyramin	
	(BASF)	80% WP
Pyrazon and dalapon	Pyramin Plus	27% pyrazon
	(BASF)	18.5% dalapon WP
Simazine	Princep	80% WP
	(Ciba-Geigy)	4% G
TCA	TCA	4.76 lb/gal L
	(various)	79.3% WSP
Triallate	Far-go	4 lb/gal L
	(Monsanto)	10% G
Trifluralin	Treflan	4 lb/gal L
	(Elanco)	5% G
2,4-D	Severol	L, G
	(various)	Various
2,4-DB	Butyrac (Amchem)	L
	Butoxone (Chipman)	Various

^{1/} "Severol" 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.

^{2/} G—granular, L—liquid, WP—wetable powder, WSP—water soluble powder.