Chemical Control of WEEDS and BRUSH

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CHEMICAL CONTROL OF WEEDS AND BRUSH

By W. O. Scott and F. W. Slife

That weeds cause tremendous losses in agriculture is, of course, well known. The damage is only too obvious when a weed infestation becomes severe or when weed parts show up in harvested grain or forage.

But long before the damage reaches this state, weeds have been taking their toll. Every weed in a crop field competes with the crops for light, water, and mineral nutrients. According to the U. S. Department of Agriculture, one plant of common yellow mustard requires twice as much nitrogen, twice as much phosphoric acid, four times as much potash, and four times as much water as a well-developed oat plant. Common ragweed has a water requirement three times that of corn. Weeds not only damage crops directly, but they also harbor insects and diseases that attack crop plants.

To control weeds effectively a combination of practices is necessary. One important weapon is found in the new chemical weedkillers, or herbicides, which are discussed in this circular. It must be remembered, however, that they are only a supplement to good farming methods. In the control of weeds there is no substitute for these conditions and practices:

1. Crop seed that is free from weed seed.
2. A good crop rotation.
3. High soil fertility.
5. Practices that will prevent weeds from maturing viable seed.

Types of Herbicides

Herbicides are divided into two major groups: nonselective, which kill all vegetation in the treated area; and selective, which kill certain plants but do not injure others.

Nonselective herbicides

Sodium chlorate, borax, and boron-chlorate combinations have been used for many years to control certain perennial noxious weeds. They have proved to be valuable herbicides, with relatively long-
lasting effects. When applied at rates heavy enough to kill weeds, however, they also kill or depress all other vegetation for one or more years. Therefore they are not recommended for controlling weeds in crops except on a spot-treatment basis.

Other newer nonselective herbicides may also have a place in a weed-control program.

**Sodium chlorate** or Atlacide (a preparation of sodium chlorate) is recommended for controlling Johnson grass, quack grass, leafy spurge, hoary cress, Canada thistle, and perennial sow thistle where soil sterilization for one or more years is not objectionable. This chemical can also be used in crops to control single weeds or small patches of weeds.

The usual rate for sodium chlorate is 5 pounds per square rod during the growing season or 3 pounds in late October or early November. Atlacide should be used at a slightly higher rate—probably 6 to 7 pounds per square rod during the growing season and 4 to 5 pounds in the late fall. These materials can be applied either dry or as a spray.

**Clothing and foliage that have been wet with a spray of sodium chlorate and then dried are highly inflammable. Atlacide has a similar effect but to a lesser degree.**

**Borax** compounds are not inflammable and can be used safely around warehouses and grain elevators to control noxious weeds. When applied at rates high enough to kill weeds, however, these compounds sterilize the soil for relatively long periods. The usual rate of application is 15 to 25 pounds per square rod.

**Boron-chlorate** combinations also sterilize the soil. They should be applied at rates of 5 to 9 pounds per square rod.

**Ammate** (ammonium sulfamate) may be used as a woody plant killer. Apply as a spray at the rate of 1 pound per gallon of water. Immediately after spraying, wash the spray equipment to reduce corrosion. Ammate kills all vegetation but does not sterilize the soil for as long as does sodium chlorate or borax.

**CMU** is a new chemical that is nonselective at relatively heavy rates. It has been released by the manufacturer only for use on non-crop land. CMU may be a valuable herbicide for railroad rights of way and other areas where soil sterilization is desirable. Since it is very insoluble in water, however, erosion can carry it to cropland, where it may damage crops. So even when it is applied to noncrop land, certain precautions are necessary.

CMU moves very slowly through the soil; therefore it is less effective on some deep-rooted perennial weeds than are the other soil-sterilizing materials.
Dinitro and TCA. Dinitro compounds, TCA, and other non-selective herbicides are discussed later under specific weed problems.

Selective herbicides

The most popular selective herbicides now in use in Illinois are 2,4-D, MCP, and 2,4,5-T. All three are nonpoisonous, noncorrosive, relatively cheap, and easy to apply. Under most conditions, they will kill certain species of plants and leave others undamaged.

Nevertheless, there are hazards to using these chemicals, all of which are exceedingly powerful. Under certain weather and soil conditions they may injure crops like corn and small grains, which are ordinarily more or less tolerant to them. And drift is always a hazard. Drifting spray may be just as injurious to susceptible plants, such as legumes, soybeans, shrubs, or garden plants, as a direct spray.

For these reasons, we suggest these precautions in the use of selective herbicides:

1. Do not use them in growing crops unless weeds are serious enough to reduce crop yield or quality and cannot be eliminated economically by other means.

2. Never spray fields next to susceptible crops or gardens on a windy day.

3. Calibrate your spraying equipment often and under conditions similar to those where spraying is to be done.

4. Follow recommendations for rates, times, and methods of application. Mistakes can cause serious reductions in crop yields.

Recommendations for applying herbicides are given on the following pages under specific crops or weeds. The recommended rates and methods do not eliminate all hazards, but they are the safest known at present.

Rate recommendations in this circular give actual amounts of acid to be applied. Most containers state the amount of acid in a particular formulation. It is then relatively simple to determine how much of the material to use. For instance, to apply 1/4 pound of 2,4-D per acre, use ½ pint of a material that contains 4 pounds of acid to the gallon or about ¾ pint of a material that contains 3.3 pounds of acid to the gallon.

MCP or 2,4-D may be applied in 10 or more gallons of water per acre. The amount of water does not affect the results, provided the right amount of acid is applied and the application is properly made. But it is important that the weeds be covered with the spray.
Weed Control in Farm Crops

Small grains

Two chemicals — 2,4-D and MCP (a new herbicide closely related to 2,4-D) — are recommended for use in small grains. MCP is not so effective as 2,4-D in controlling some weeds, but it is less injurious to legume underseedings. Both, however, may seriously damage legumes; so they should not be used where there are legume underseedings unless the weed hazard is serious.

Spring oats, barley, and wheat. Apply the amine type of 2,4-D or MCP. If there is no legume underseeding, as much as 1/2 pound of acid per acre may be applied, although this may reduce grain yields somewhat. Where there are legumes, no more than 1/4 pound should be used. Apply after the grain has passed the five-leaf stage and before it is in the boot stage.

If the grain contains only small areas of Canada thistle, field bindweed, or other noxious weeds, spot treatments at the rate of 1/2 to 1 pound of acid per acre are suggested. Although this rate will destroy the legume underseeding and probably reduce grain yield in the treated area, this disadvantage may not be objectionable if the area is small.

Winter wheat. In general, winter wheat tolerates 2,4-D better than most spring grains. It should not, however, be sprayed with 2,4-D in the fall.

Where legumes have been seeded with the wheat, 1/4 pound of 2,4-D acid per acre is the maximum amount to use. This rate will usually control most troublesome weeds except wild onion and garlic. Spray after the wheat has finished stooling in the spring and before it is in the boot stage. April is usually the proper time.

To control wild onion and garlic, use 1/2 to 3/4 pound of ester or amine. This amount may slightly reduce the wheat yield, and it will probably destroy legume underseedings. Even this heavy rate will kill only 30 to 50 percent of the wild garlic, but the remaining plants will usually be so distorted that the combine will miss them if the wheat is not lodged.

Corn

The chemical weed killer most commonly used in corn is 2,4-D. Other materials, such as dinitro and Crag Herbicide I, can also be used (see discussions of pre-emergence and post-emergence spraying).

2,4-D can be used in corn most of the time from planting until maturity. It should not, however, be applied from the time the corn begins to tassel until the kernels are in the soft-dough stage.
Pre-emergence sprays. These sprays are applied before the corn and weeds emerge. Their purpose is to control the broad-leaved weeds and some annual grasses until the corn has a chance to get started. They are not effective unless the soil is moist enough that the weed and grass seeds will germinate within 2 weeks after treatment.

Under the right moisture conditions, the ester type of 2,4-D will effectively control some annual grasses and broad-leaved weeds on most soils. This treatment should not be used on light or sandy soils. Use no more than 2 pounds of 2,4-D acid per acre. Application can be made any time from planting until the corn comes through the ground, but not after the leaves unfold. Spraying 3 to 5 days after the corn is planted gives best control. Only the ester type is recommended for pre-emergence sprays.

Dinitro applied at the rate of 10 to 12 pounds of active ingredient per acre can be used as a pre-emergence application before the corn comes through the soil. Like 2,4-D, it is effective only if there is enough soil moisture to cause immediate germination of the weed and grass seeds.

Crag Herbicide I, a material similar to 2,4-D, is also recommended if the soil is not light or sandy. It should be used at 4 pounds per acre.

Post-emergence sprays, which are made after the corn and weeds start to come up, are effective only on susceptible broad-leaved weeds. They do not affect annual grasses.

Post-emergence sprays are recommended only if the weed problem cannot be controlled by normal cultivation. Growing corn may be damaged by 2,4-D, the most severe type of injury being stalk brittleness. A storm or cultivation before the brittleness disappears may result in serious stalk breakage.

If you do spray the growing corn, keep danger at a minimum by using proper rates and methods of application. In general, it isn’t safe to apply more than $\frac{1}{4}$ pound of acid of the ester type or $\frac{1}{2}$ pound of acid of the amine type per acre. (Circumstances under which these rates may be increased are described below.)

Stalk brittleness is usually most serious when corn is growing rapidly. It seems most likely to occur when corn is sprayed after periods of high daytime temperatures ($85^\circ$ to $90^\circ$ F. or above). Brittleness, as well as other types of injury, can be held to a minimum by using nozzle extensions to keep the spray off as much of the plant as possible. Until the corn is 3 or 4 feet tall, apply no more than $\frac{1}{4}$ pound of acid of the ester type per acre or $\frac{1}{2}$ pound of acid of the amine type. After the corn has reached this height, the rates may be increased if a nozzle extension is used and the spray is confined to the soil and base of the corn plant.
If you expect a dense growth of weeds after the last cultivation, you can apply 1 pound of 2,4-D acid after this cultivation — provided you apply it directly to the soil and use a boom extension. Do not spray corn from the time it starts to tassel until after the kernels are in the soft-dough stage.

A light application of dinitro can be used to control annual grasses such as giant foxtail. Timing of the application is quite important — the material should be applied just as the grasses are emerging from the soil. Dinitro is least injurious to corn when the corn is in the spike stage — at this time 3 to 5 pounds of active ingredient will cause no injury. After the corn leaves unfold, no more than 3 pounds should be used, and even this may result in slight burning of the leaves. However, the burning will disappear after several days.

**Special weed problems in corn.** Wild sweet potato in cornfields can be killed by applying ½ pound of ester or ½ pound of amine 2,4-D acid per acre at the bud stage — usually in late July or early August. Use high-clearance equipment or a knapsack sprayer. Applications made either before or after the bud stage will kill the top growth but will usually not affect the root system.

*Wild cucumber* is resistant to 2,4-D but is susceptible to 2,4,5-T. To control this weed, apply ½ pound of 2,4,5-T acid per acre any time before the cucumbers start to bloom. This material has about the same effect on corn as 2,4-D.

**Soybeans**

Soybeans are much more susceptible to severe injury from herbicides than are most other crops. Therefore, weeds in soybeans should be controlled with good cultural practices if at all possible. The most effective method is to prepare the seedbed early and destroy one or more crops of weeds before the beans are planted.

If previous experience indicates that cultivation will not control weeds and that yields may be severely reduced as a result, then you might try the following suggestions for pre-emergence and post-emergence spraying. It is essential, however, to follow recommended rates, methods, and timing exactly. Otherwise, severe injury may result to your crop.

**Pre-emergence sprays.** Chloro IPC and dinitro have been the most effective chemicals for pre-emergence treatment of soybeans. *Under no circumstances, however, should these materials be used on sandy soils.* On other soils, use 6 to 8 pounds of acid equivalent per acre either as an over-all treatment or, to reduce cost, as a band about 12 inches wide over the row. The 6-pound rate should be used on
lighter soils and the 8-pound rate on heavier soils or those that have a high clay content. These rates may reduce soybean stands to some extent, but usually not enough to reduce yields.

The material must be applied before the beans come up. Spraying 2 or 3 days after planting will give the best results, but rains often prevent spraying at this time. Therefore, the recommended method is to apply the chemical at planting time, using a sprayer mounted on the planter so that the spray will fall behind the planter wheels.

Effectiveness of pre-emergence treatment with either dinitro or Chloro IPC depends largely on the weather. If the soil is moist enough to insure prompt germination of weed seeds, the results should be good. But if the soil stays dry for 2 or 3 weeks after treatment, the chemical will decompose or lose its strength before the weeds germinate.

Both materials are contact killers and must therefore come into contact with the weed. Consequently, if the seedbed is rough and cloddy, the effectiveness of the treatment is decreased. If the area can be rolled before treatment, better results will be obtained.

Pre-emergence sprays usually do not affect perennial weeds. Nor do dinitro and Chloro IPC control all types of annual weeds. These chemicals are effective on most broad-leaved annual weeds, but the 6- to 8-pound rate will not completely control giant foxtail or wild millet and some of the other annual grasses. Ten pounds of either chemical will normally control giant foxtail, but soybeans will not tolerate this rate.

If you get good weed control with a pre-emergence spray used as a band treatment, avoid introducing new weed seeds into the treated area by cultivation.

It is suggested that pre-emergence spraying of soybeans be tried out in small areas for a year or two before it is attempted on a large scale.

**Post-emergence sprays.** Experiments and experience of farmers indicate that 2,4-D can be used at extremely light rates to control certain weeds in soybeans. Two ounces of the amine type of acid, *applied when the soybeans are 2 to 6 inches tall*, will control cocklebur, ragweed, pigweed, and annual morning glories without damaging the crop. Velvetweed, Jimson weed, and smartweed are not always killed at this rate, but are usually stunted so that cultivation destroys many of them.

If you use this treatment, try it on just a few acres for at least one year so that you can observe results and attain proficiency in using such light rates.
Control of Specific Weeds

Canada thistle

Several strains of Canada thistle grow in Illinois. Some strains are very susceptible to 2,4-D, while others are almost entirely resistant. Occasionally susceptible and resistant strains will be found in the same patch or field.

Because 2,4-D is very effective against some strains, and also because it is cheap, easy to apply, and can be used in some crops, it is the main chemical weapon against Canada thistle.

For spot treatments, or where crops will not be injured by 2,4-D, the recommended rate is 1/2 to 1 pound of acid per acre. The material should be applied two or three times a season — first at the bud stage, and again whenever regrowth occurs. More than 1 pound per acre is normally less effective than 1/2 to 1 pound. Heavy rates cause a top-kill so rapid that little of the 2,4-D penetrates to the roots. Relatively slow top-kills usually result in better root-kills. For adequate control, continue the bud-stage and late-summer treatments for 2 or more years.

If the thistles are located in a growing crop and it is not practical to make spot treatments, a lower rate of application should be used, depending on the crop. Also, the material should be applied at a time when it will do the least harm to the crop, even though this may mean poorer control of the weeds.

If you are dealing with a resistant strain, you will need to make a spot treatment of sodium chlorate or Atlacide or follow a system of clean cultivation in order to complete the job.

One cultural method that has proved effective in controlling Canada thistle is to plow under the weed when budding starts and follow with a field cultivator every 2 or 3 weeks until fall or until winter wheat or rye is planted. After the crop is harvested the following year, the process should be repeated. Following this practice for 2 or 3 years should eliminate most of the thistles.

Wild garlic

Wild garlic is not easy to control. The two best methods are winter plowing and spraying with 2,4-D. Because this weed forms new underground bulbs during March or April, it is important to spray at that time or earlier. Best results have been obtained by using 2 to 3 pounds of 2,4-D acid of the ester type per acre during October, November, February, March, or April. An application this heavy cannot be used on crops, but it can be used on soybean stubble, corn-
stalk land, or grass pasture. If you don't spray until February or later, leave the land undisturbed as long as possible, and don't plow for corn or soybeans until at least 3 or 4 weeks after spraying. For adequate control, this procedure should be repeated for 2 or 3 successive years.

Spraying garlic in growing wheat has been discussed under "Winter wheat" (page 5).

**Quack grass and Johnson grass**

Two new chemicals, TCA and Dalapon, are recommended for controlling quack grass and Johnson grass on cropland. When applied at heavy rates, they sterilize the soil, but the soil recovers from their effects in less than a year. Sodium chlorate and borax also control these two grasses, but they sterilize the soil for 2 or more years, and so are not recommended for cropland.

At present TCA and Dalapon are too expensive for large-scale applications. They are, however, practical and efficient on a small scale except during a long dry period. There must be enough rainfall to wash the chemicals into the soil around the roots of the weeds. Dalapon seems to be absorbed through the foliage more readily than TCA. Both are somewhat caustic and should not come into contact with the skin.

**Quack grass.** Plow or disk quack grass in the late summer, and apply 40 to 60 pounds of TCA per acre or 20 to 30 pounds of Dalapon. This application can be followed by a crop of corn or soybeans in the spring. Hoeing or intensive cultivation of the crop will be necessary to prevent the quack grass from re-establishing itself the following year.

*Maleic hydrazide (MH 40)* may have an important place in controlling quack grass and other troublesome grasses. Ten pounds of MH 40 should be applied in the spring to quack grass 6 to 8 inches tall. Plow down the treated area 6 to 8 days after treatment, then prepare the ground for crop planting. This method has resulted in more than 90 percent control of quack grass. The treatment is expensive, but it may be worth while on small areas. It is at present recommended on a trial basis.

**Johnson grass.** Plow or disk Johnson grass early in August or September, and apply 60 to 80 pounds of TCA acid per acre or 30 to 40 pounds of Dalapon in September or October. This application can be followed by a crop of corn the following spring. Here too the land will have to be hoed or intensively cultivated to keep the weeds from getting a new start.
In areas that are not subject to floods in winter or early spring, Johnson grass can be kept under practical control by starting clean cultivation in June or July after winter wheat or barley has been harvested. The area should be kept free of the weed until September or October, when winter wheat or barley is planted again. Heavy pasturing or frequent clipping, or a combination of the two, will also reduce stands of Johnson grass.

**Fence Row Spraying**

If the vegetation in fence rows consists primarily of weeds, use 2,4-D at the rate of \( \frac{1}{2} \) to 1 pound of acid per acre. The first application should be made early, probably in May, to control early weeds, and another application should be made in July or early August to control late weeds.

If the fence row vegetation consists chiefly of woody plants, use a mixture of 2,4-D and 2,4,5-T as described below.

**Control of Woody Plants**

Both 2,4-D and 2,4,5-T have a definite place in controlling woody plants. Foliage sprays of 2,4-D will kill some plants that 2,4,5-T won't kill, and vice versa. Therefore mixtures of 2,4-D and 2,4,5-T are recommended for general foliage spraying of mixed brush. For basal bark applications, 2,4,5-T in oil is preferable.

**Foliage sprays** of 2,4-D and 2,4,5-T are most effective on woody plants less than 15 feet tall. For larger plants, it is better to use the basal or stump treatment described below.

If woody plants are sensitive to either 2,4-D or 2,4,5-T, spray the foliage with 3 to 4 pounds of acid per 100 gallons of water during the period from full leaf in the spring until about the last of August. Except for buckbrush, use a mixture of 2,4-D and 2,4,5-T; to kill buckbrush, 2,4-D alone will be more effective. Ester formulations will usually be most satisfactory; and water is usually preferable to oil as the carrier.

Drift is always a hazard to adjacent susceptible crops. If soybeans, legumes, or other sensitive crops are located near by, a low-volatile ester should be used and spraying should be done on days when there is no wind.

**Basal bark sprays** will control larger woody plants and also several species, including some oaks and maples, that are tolerant to foliage sprays. A 2-percent solution of 2,4,5-T in oil, such as kero-
sene, is recommended. This will be \( \frac{1}{2} \) pound of acid in 3 gallons of oil or 16 pounds in 100 gallons.

Spray the base of the trunk from the ground to a height of 15 inches. Circle the trunk completely, and spray until the soil immediately at the base of the tree is wet from the runoff. The spray can be applied at any time of year, but best results are obtained from spraying between December 15 and March 15.

Kill of trees larger than 8 inches in diameter may be improved by cutting frills in the bark at a height of 2 to 3 feet and applying the material in the frills. The mixture can be applied in the frills with an ordinary oil can.

**Stump treatments.** If woody plants are removed by cutting, 2,4-D, 2,4,5-T, or Ammate applied to the freshly cut stump will keep most species from sprouting. The preferred treatment is \( \frac{1}{2} \) pound of 2,4,5-T acid, ester type, in 3 gallons of oil, such as kerosene or fuel oil. Circle the stump with the spray, and apply until there is runoff. A mixture of 2,4-D and 2,4,5-T can also be used, but at a heavier concentration. Stump treatments can be made at any time of year. Some shrubs and trees that tolerate foliage sprays can be killed by this method.

Ammate applied as a dry salt (1 tablespoon per 2 inches of diameter) or a concentrated water solution (6 to 9 pounds per gallon of water) also prevents sprouting of most species of woody plants.

**Effect of Chemicals on Livestock**

2,4-D, MCP, 2,4,5-T, Dalapon, and TCA, if used at recommended rates, are not poisonous to livestock. But there is some indication that the first three of these chemicals do make poisonous plants more palatable to animals. Therefore, if pastures that are being sprayed contain Jimson weed, white snakeroot, or other poisonous weeds, livestock should be kept out until the weeds have died or been removed.

Some other herbicides may be toxic. Before using a herbicide on pasture land, find out from the manufacturer whether it is harmful to livestock.