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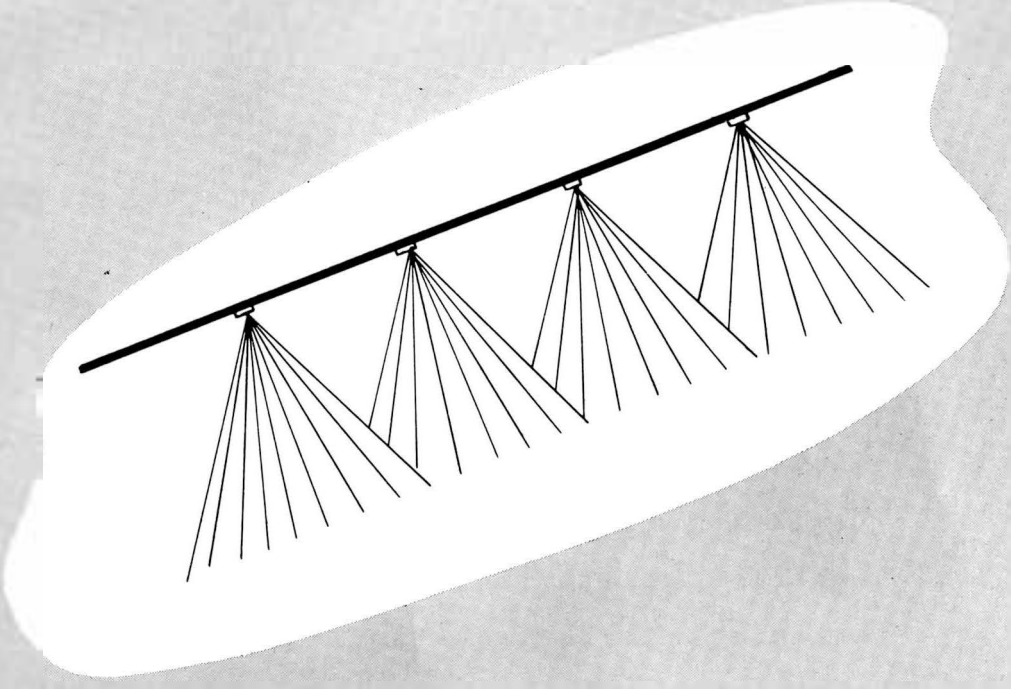

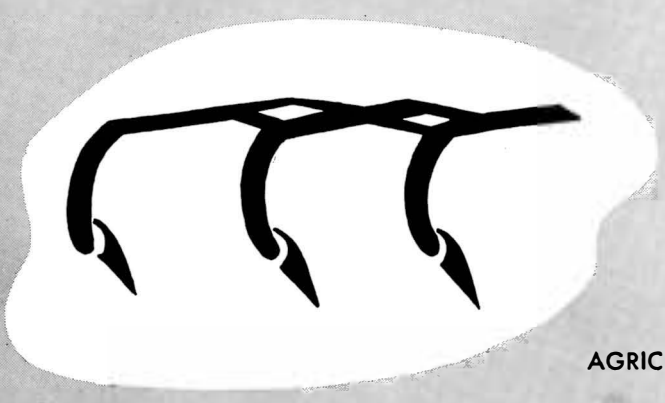

AGRONOMY DEPARTMENT

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE, BROOKINGS

CONTENTS

Weed Control in Field Crops

LYLE A. DERSCHEID and KEITH E. WALLACE[1]

Clean seed, proper seedbed preparation, good rotations, and sound soil management practices are prime requisites for controlling weeds in crops. They will eliminate many annual weeds and prevent infestation by most perennial weeds. Chemicals are valuable supplements to these practices. However, if we rely on 2,4-D or other chemicals, we at least partially neglect the standard practices. Consequently, weeds resistant to chemicals are allowed to spread.

Once weeds become established, special practices are needed to eliminate them. These practices include the use of special cultivation, competitive crops, and chemicals in addition to the old reliable practices already mentioned. One application of any one method seldom eliminates all perennial weeds. Even though they are eliminated, new weeds come from seeds in the soil. Some of these seeds remain viable for as long as 20 years and many years of diligent work are required to eradicate them.

Numerous tillage and chemical methods that will control weeds in crops are available. In fact, it is possible to eliminate some of the most persistent perennial noxious weeds while growing crops if the proper combination of crops, cultivation, and chemicals is used. For detailed information on the control or elimination of any of South Dakota's noxious weeds, refer to the circular that discusses the specific weed.

If chemicals are to be used in the weed program, it is important to remember that chemicals cause more damage to crops when applied at certain stages than at others. This is particularly true when rates of application required to control perennial weeds are used. If the most tolerant stage of the crop does not occur when the weeds are in the most susceptible stage of growth, there are two choices—risk injuring the crop to get good weed control or get poor weed control with less chance of injuring the crop. Good weed control usually pays off in the long run.

The maximum rate of chemical application that can be used on crops without much risk of reduc-

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ing the yield is discussed on the following pages. Many annual weeds are killed with lower rates; consequently, the rate of application will frequently be lower than the maximums mentioned. On the other hand, many perennials will require higher rates than the safe rates mentioned. As a result one may have to use a more tolerant crop or risk injuring the crop if he wishes to eliminate the weed.

SMALL GRAINS

In many areas of South Dakota, a small grain crop is grown 3 years out of 4. As a result, weeds that have growth characteristics similar to those of the crop become established. As an example, much of the spring wheat growing area is badly infested with wild oats. Wild oats and wheat have the same life cycle. They germinate, grow, and mature at the same time. Many wild oat seeds shatter before harvest, leaving seed for next year's crop of wild oats.

Another example is found in much of the winter wheat area where Japanese chess and downy bromegrass (both called cheat) are a problem. The crop and weeds have the same life cycle. They both germinate in the fall, grow the next spring, and mature during late June or early July. Pennycress has the same life cycle, but it can be killed with 2,4-D.

At present, there is no chemical available that will selectively control wild oats, Japanese chess, or downy bromegrass in these crops. Until one is developed, the only method of controlling these weeds is to grow crops in the rotation that do not have the same growth habits and the same life cycle as the weed.

Seeding to perennial grasses or legumes is helpful for controlling weeds. The frequent cutting or grazing prevents weed seed production. Likewise, frequent cultivation of row crops prevents the production of weed seeds. In a few years the weed seeds in the upper levels of the soil germinate. If other weed seeds are not returned, these upper levels eventually become free of weed seeds. Deep plowing of grass or legume sod, however, will bring a new crop of seeds to the surface. Therefore, at least 2 years of a grass or legume and at least 1 year of a row crop or summer fallow should be included in a 4- to 6-year rotation.

Annual weeds, such as wild oats, that do not germinate readily during the fall can be destroyed with spring tillage. Harrow and pack the area early in the spring to form a good seedbed to induce early germination of weed seeds. After the weeds emerge, kill them with cultivation before the crop is seeded. However, the weeds do not emerge early enough to permit seeding small grains at the normal seeding date, and late seeding generally results in lower than normal yield. This can be partially overcome by using early varieties or by using late seeded crops such as corn, soybeans, sorghum, sudangrass, or millet.

Many broad-leaved weeds can be controlled with 2,4-D or MCPA. When the same amount of 2,4-D is

used, an ester form is generally more injurious to crops than an amine form, and MCPA is generally less damaging than either form of 2,4-D. However, MCPA is more expensive and is not effective for as many species of weeds. Amitrol, TBA, TCA, and dalapon will injure oats, barley, wheat, or rye.

Spring Wheat and Barley

Proper use of 2,4-D seldom causes injury to these crops. However, some stages of growth are more susceptible than others. Do not spray these crops during the seedling period, extending from the time that plants emerge until they are in the 5-leaf stage of growth (see figure 1). Application of 2,4-D during this period inhibits tiller formation. A reduced number of tillers results in fewer heads and serious yield reduction.

When to spray. The best time to spray is between the 5-leaf stage and the early boot stage of growth (see figure 2). Any yield reduction

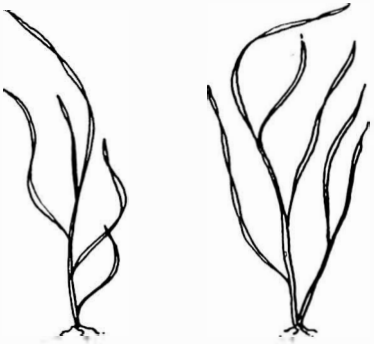

Figure 1. Both of these plants are in the 5-leaf stage of growth. The one on the left has five leaves and the one on the right has four leaves and one tiller.

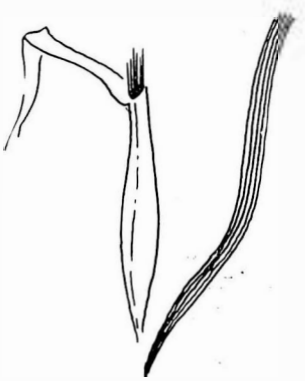

Figure 2. Here is a close-up of the early boot stage of development.

is caused by reducing the number of seeds per head. If there is adequate soil moisture and cool temperature, the number of seeds per head may be reduced slightly by application of 2,4-D. This injury may occur any time during the period, but seldom results in an appreciable yield reduction.

If the soil is dry and temperature high, the number of seeds per head may be drastically reduced by spraying about 1 day out of 5. It may result in a yield reduction, but there is no way of determining which day is the wrong day to spray until it is too late. However, yield is seldom greatly reduced by an application of one-third pound 2,4-D acid in an ester form or one-half pound in an amine form or by one-half pound MCPA acid per acre. The 5-leaf to early boot stage is the best time to spray because later applications of 2,4-D will not prevent the weeds from reducing the yield.

Do not spray between the boot stage and the fully headed stage of

growth. Serious yield reductions frequently result. It is safe to spray after the grain is in the milk stage. An application of 1 pound 2,4-D acid per acre seldom causes a yield reduction. However, spraying at this time will not prevent the weeds from reducing the yield. Annual weeds have usually taken their toll by the time they are 6 inches tall. The maximum benefit that can be obtained by 2,4-D application at this late date is to prevent weed seed production and make harvesting operations easier.

Variety sensitivity. Some varieties are slightly more susceptible to 2,4-D than others. In South Dakota tests during 1947-49, Wisconsin 38 barley was more susceptible than Plains, Feebar, Spartan, Odessa, and Kindred. Similar tests during 1955-58 showed that Liberty, Traill, Fox and Parkland were similar to Plains. Yield was not affected by one-half pound of 2,4-D amine applied between the 5-leaf and boot stages of growth.

Only a few wheat varieties have been tested, but earlier work indicated that Rescue, Thatcher, and Regent are more susceptible than other varieties. South Dakota tests conducted during 1955-58 showed that Lee, Rushmore, Selkirk, and Conley are tolerant to one-half pound of 2,4-D amine applied between the 5-leaf and boot stages of growth.

Oats

Yield reductions seldom occur when one-third pound of 2,4-D acid in an ester form or one-half pound in an amine form or one-half pound of MCPA acid is applied during tolerant periods of growth. As much as 1 pound of 2,4-D acid per acre seldom reduces oat yields when applied after the grain is in the dough stage.

Varieties of oats differ more in their reaction to 2,4-D than do varieties of barley or wheat. Results of the South Dakota 1947-49 trials showed that Mindo and Marion are easily damaged until they have headed. Nemaha and Cherokee are also injured if treated before the boot begins to swell. Clinton, Bonda, and Ajax can be safely sprayed between the 6-leaf and boot stages, while Andrew and Brunker are tolerant between the 5-leaf and boot stages of growth.

Results from 1955-58 tests indicate that Mo-O-205 and Garry are two of the most tolerant varieties. They are not adversely affected by the application of one-third pound of 2,4-D ester per acre at any time of growth after the 3-leaf stage. Dupree, Minhafer, and Burnett are tolerant to a similar dosage after the 5-leaf stage. Ransom, Waubay, Newton, and Andrew are consistently injured by treatment with a similar dosage at or before the 6-leaf stage and are sometimes injured at later stages of development.

Canadian workers have reported that Anthony and Vanguard are more susceptible to 2,4-D than several other Canadian varieties.

Most oat varieties are more tolerant to MCPA than to 2,4-D. It is, therefore, frequently advisable to spray oats with MCPA instead of 2,4-D. This is especially true if the

weeds can be controlled with MCPA and if the oats to be sprayed is one of the more sensitive varieties.

Winter Wheat and Rye

Early spring applications of 2,4-D seldom cause damage to these crops. Do not spray these crops during the fall. Both crops produce tillers at that time and small dosages of 2,4-D will inhibit tiller formation. A reduction in the number of tillers is reflected in a decreased number of heads the following spring, resulting in a material yield depression.

However, both crops can be safely sprayed with 2,4-D during the spring. One-half pound of 2,4-D acid in an ester form or three-fourths pound in amine form seldom cause any material decrease in yield if applied before the boot begins to swell (see figure 2). One pound of 2,4-D acid seldom injures the crop if applied after the grain is in the dough. However, there have been reports of injury on wheat with small dosages applied immediately after heading. These late treatments, however, are of little value except to prevent weed seed production or to facilitate harvesting operations.

A rotary hoe, spike-toothed harrow, or similar implement controls many annual weeds during early spring when operated in the grain at the time the weeds are emerging. Such an operation is much less effective for winter annuals, such as pennycress, Japanese chess, or downy bromegrass (cheat), because they come up during the fall and are established by spring. An implement that will kill them will generally injure the crop.

FLAX

This crop does not compete well with weeds and is much inferior to small grains in this respect. Likewise it is more easily injured with 2,4-D and MCPA than small grain. Only the most susceptible weeds can be killed with the amount of 2,4-D or MCPA that flax will tolerate. It is therefore advisable to plant flax on weed-free land. Flax does have one advantage over small grains, however. It is sufficiently tolerant to TCA and dalapon so that several species of annual grassy weeds can be killed with these chemicals in flax without injuring the crop.

Cropping. Good crop sequence for controlling the predominant weed species and timely tillage are the basic cultural practices for weed control in flax. The best crop sequences include a row crop, such as corn, soybeans, or sorghum the year before flax is grown. Proper cultivation of the row crops prevents weeds from producing seed. When small grain precedes flax, use early after-harvest tillage to aid in the control of perennial weeds, prevent seed production by some weeds, and stimulate weed seed germination. Shallow tillage before seeding the flax eliminates the possibility of bringing other weed seeds to the surface to germinate and cause a weed problem.

Full stands of flax are essential in obtaining satisfactory weed control. Flax drilled in rows 6 inches

apart is less weedy than flax drilled in rows 7 inches apart or broadcast. Delayed seeding of flax to permit late spring tillage is helpful for the control of wild oats. However, the seeding must be delayed until late May to give the wild oats a chance to emerge and be killed by cultivation. Consequently the yield of flax is often lower than it would be if seeded at the normal date of seeding. This decreased yield can be partly or wholly overcome by seeding an early variety, such as Marine, Sheyenne, or Bolley.

Chemical control. Early research results indicated that several flax varieties were more susceptible than others to 2,4-D. However, it is now believed that all the commercially important varieties are equally tolerant except Minerva, which appears to be the most sensitive.

Use one-fourth pound acid equivalent of 2,4-D amine to control or eliminate lamb's quarters, mustards, pigweed, ragweed, or pennycress before the weeds are more than 4 inches tall. One-fourth pound of MCPA acid equivalent controls mustards and lamb's quarters. Five pounds acid equivalent of TCA (6¼ pounds of 90% sodium salt) or 1 pound acid equivalent of dalapon (1⅓ pounds of 85% sodium salt) controls foxtails and barnyard grass if applied before the weeds are 2 inches tall. TCA does not affect wild oats but dalapon does occasionally kill it.

Spray flax as soon as the weeds come up. Either 2,4-D or MCPA may be mixed with either TCA or dalapon to control both types of weeds with one spraying. When two chemicals are mixed together, slightly lower rates of chemical are satisfactory.

MCPA is less toxic to flax than 2,4-D or TCA. It seldom delays maturity, while the others sometimes cause a delay of 3 to 7 days. The later date of maturity does not directly affect yield, but some varieties that normally escape disease infection may be delayed long enough to become infected. The yield is sometimes reduced by the diseases. Likewise, a delay in maturity may allow heat and drought to reduce the yield. Therefore, MCPA is generally more satisfactory than 2,4-D if it will control the weeds. Dalapon is somewhat less toxic than TCA and is cheaper; therefore, it is preferred for control of annual grassy weeds.

Flax often appears wilted for several days after spraying and the stems are almost always curved, but this does not necessarily mean that the yield will be reduced.

Spraying flax with 2,4-D or MCPA right after the bolls are set causes poor germination of seed. Therefore, do not spray flax grown for seed at this stage of growth.

When flax is used as a companion crop to establish legume or grass stands, use 2,4-D, MCPA, or 2,4-DB to kill annual broad-leaved weeds. Use TCA or dalapon to kill annual grassy weeds as directed for legumes and grasses in the forage crop section of this publication.

ROW CROPS

Proper cultivation of row crops usually controls most annual weeds.

However, there are several chemicals that can be used.

The rotary hoe controls annual weeds early in the season, but its efficiency depends on several factors. Use it when the weeds are just emerging. Travel at a speed of 8 to 10 miles per hour and use a shield over the hoe or behind the tractor driver's head as a protection from flying clods and stones. It is most effective if the soil is crusted as a result of drying after a rain, but is also effective on moist soil. It may cover small plants growing in furrows, tractor tracks, or loose soil. If crop plants are large, use during the heat of the day to prevent breaking the plants.

A good cultivation system for a crop planted in furrows is to use disks for the inside shovels and "throw out" as soon as the operation can be performed without covering the crop, and "throw in" during the second cultivation as soon as new weeds emerge. Many small weeds in the row are covered by the second operation.

The annual weed control problem is greatly reduced in "tractor-track" planted crops, by planting within 24 hours after plowing. Delayed planting frequently allows weeds in the tractor tracks to emerge earlier than the crop. Cultivation may cover the crop while attempting to kill the weeds.

Although proper cultivation will control most annual weeds, there are times when cultivation cannot be done properly. Several chemicals are useful for the control of annual weeds under these conditions and also for the control of perennial weeds.

Corn

Many broad-leaved annual weeds and some perennial weeds can be killed with 2,4-D in corn. Some hybrids are more susceptible than others. However, corn is usually tolerant to one-fourth pound of 2,4-D acid in an ester form or one-half pound in an amine form at any stage of growth except the week before silking. Stalks often become brittle after treatment with 2,4-D and a strong wind or careless cultivation may break many of them (the larger the corn at time of treatment, the greater the chance of breakage). Sometimes brace roots are damaged and severe injury will allow the corn to lodge.

Environmental conditions influence the degree of injury more than stage of growth at the time of treatment (except for the week before silking). Corn is more susceptible when growing rapidly. The temperature during the period before treatment is more important than the temperature at time of treatment. Corn is much more susceptible after several days at 85° F. than it is after several days at 65° F.

For cockleburs and sunflowers, use at least one-third pound of 2,4-D before the weeds are 6 inches tall. The use of less 2,4-D or treatment after the weeds become larger generally gives disappointing results. For the control of noxious weeds, three-fourths pound of 2,4-D per acre is usually required. Although there is some chance of injuring the

corn, numerous applications at this rate have been made near the time of the second cultivation without causing damage. Apply a second treatment after tasseling when attempting to kill noxious weeds.

Use drop nozzles for 2,4-D applications after the corn is knee high. The spray does not touch the tops of the corn and the risk of injury to the crop is reduced. Better coverage of weeds is often obtained; however, it is essential that the spray hit the tops of the weeds. Use a high clearance sprayer with drop nozzles for applications made after tasseling.

Preemergence treatments with simazin, CDAA ("Randox"), and EPTC ("Eptam") sprays are sometimes effective for the control of annual grassy weeds and some annual broad-leaved weeds. Rates of 3 to 4 pounds active ingredient of simazin, 4 pounds of CDAA, and 4 pounds of EPTC are required under favorable environmental conditions. These rates of simazin and CDAA very seldom injure the corn, but EPTC does cause some damage under certain conditions.

Environmental factors. All the environmental factors that influence the results are not understood at present. However, it appears that soil temperature must be above 65° F. at time of application, and that at least one-half inch of rainfall must be received during the first week after application for CDAA spray to be effective. The granular form appears to be more effective when applied to wet soil.

It appears that the action of simazin is not affected by soil moisture or temperature at time of treatment, but that at least one-half inch of rainfall must be received during the first 2½ to 3 weeks after application for it to be effective. EPTC is not effective unless it is incorporated into the soil. A spike tooth harrow or a loop of log chain drawn behind the chemical applicator gives sufficient incorporation. It is also possible that incorporation will increase the effectiveness of CDAA and simazin. Under the best of conditions an over-all application of CDAA or EPTC replaces one cultivation and simazin replaces two cultivations.

Chemical characteristics, costs. Corn is exceptionally tolerant to simazin, but other crops are not. The residual effect of a 4-pound application at corn planting time one year generally damages small grain planted the following spring. It is possible that soybeans, flax, or legumes may be seeded the following spring, but too little data are available to be certain about their tolerance.

CDAA has a pungent odor and is very irritating to the skin. Commercial applicators generally wear goggles, rubber gloves, other protective clothing, and sometimes respirators when using this spray. The granular form is less toxic.

The cost of all three chemicals is high and they, therefore, are impractical for many areas. The cost can be reduced by treating a band over the row—it should be at least 12 inches wide. When band applications are made, the weeds be-

tween the rows must be cultivated. It is suggested that these chemicals be used on a trial basis only.

A DNBP amine ("Premerge") is sometimes a satisfactory substitute for a rotary hoe for the control of annual grassy weeds. Apply 3 to 4 pounds active ingredient per acre in a minimum of 20 gallons of water. Treat when the corn is in the 2-leaf stage and foxtails are less than 1 inch tall. It too should be used on a trial basis.

Sorghum

Chemicals are used for controlling weeds in sorghum in much the same way as they are used in corn; however, there are some differences. Forage sorghums are generally more tolerant than grain sorghums to 2,4-D unless the forage sorghums are grown for seed. Forage yields are seldom reduced by 2,4-D application, but treatment at the wrong time may decrease grain yields greatly.

Do not spray sorghums before they are 4 inches tall because both types can be severely injured and sometimes killed if treated at this stage. The best time to spray is when plants are 4 to 12 inches tall. These heights are determined by measuring from the ground up to where a new leaf is emerging. An application of one-third pound of 2,4-D acid in ester form or one-half pound in an amine form during this period seldom causes a serious yield reduction. However, brace roots are sometimes injured. Severe injury may result in lodging.

Grain sorghum is in the most susceptible stage of development when approximately 12 inches tall. The head is beginning to develop within the plant only a few inches above the ground. Use a sharp knife or razor blade to slit the stalk. If the head can be seen, do not spray with 2,4-D.

Severe damage to grain yield results from 2,4-D application at the time that the sorghum is heading. Little damage occurs from spraying after the grain has started to form. When the sorghum has reached this stage, annual weeds have already done their damage, but high clearance sprayers with drop nozzles should be used to spray perennial noxious weeds after the grain has started to form.

Very little is known about the use of amitrol or dalapon as lay-by sprays as discussed for corn. Likewise, little is known about the use of preemergence treatments in sorghum. Limited trials indicate that sorghum is susceptible to EPTC but that simazin or CDAA could be used as for corn.

Soybeans

Proper crop sequence and timely tillage are the most reliable methods of controlling weeds in soybeans. The best crop sequences include a crop that can be kept weed-free the year before soybeans are grown. Proper cultivation of row crops such as corn or sorghum may prevent annual weeds from producing seeds. However, they are of little help if a crop of weed seeds is brought to the surface by plowing before the beans are planted. Early fall plowing of small grain stubble aids in controlling perennials, pre-

vents seed production by some weeds, and stimulates weed seed germination. Use shallow tillage the next spring before seeding beans so that a new crop of weed seeds is not brought to the surface.

Full stands and cultivation practices discussed at the beginning of the section on row crops also are helpful in reducing the annual weed problem. There is little chance of controlling perennial noxious weeds in soybeans.

The use of chemicals for weed control is not reliable enough to warrant any recommendation. MCPA, 2,4-D, TCA, dalapon, and simazin cause injury to the beans when applied at rates required to kill the weeds. However, there are two chemicals that might be used on a trial basis.

DNBP amine ("Premerge") applied at 3 to 4 pounds of active ingredient in 20 gallons of water per acre just before the beans come up has been effective for control of foxtail in some tests. The time for application is short—treatment too early may give poor weed kill and treatment after the beans emerge may injure the beans. Likewise a preemergence application of 4 pounds of CDAA may be used as discussed for corn.

Sugar Beets

As with soybeans, proper crop sequence and methods of cultivation suited to the area are the most reliable methods of weed control. Some of the suggestions offered for soybeans may be helpful.

Although neither 2,4-D nor MCPA can be used without injuring beets, there are two chemicals that will control annual grassy weeds in beets.

An application of 5 pounds TCA acid (6¼ pounds of 90% sodium salt) per acre just before the beets come up kills annual grassy weeds such as foxtails and barnyard grass (not wild oats). To reduce cost, spray a band over the row and cultivate weeds between the rows.

Dalapon can be used as a postemergence treatment for the control of annual grassy weeds. Two pounds of active ingredient (2⅔ pounds of 85% sodium salt) per acre kills foxtails and barnyard grass, but twice as much is needed for wild oats. Apply the dalapon before the grasses are more than 4 inches tall. The grasses die slowly, but seldom grow after treatment. The beets may be temporarily retarded, particularly by the 4-pound rate, but soon outgrow the ill effects.

FORAGE CROPS

The use of a row crop or afterharvest tillage the preceding year to prevent weed seed production is the best method of controlling annual weeds for the establishment of forage crop stands. Use some of the systems discussed for use in flax. Mowing the weeds in a new seeding (except for sweet clover) that is not in a companion crop is also a good practice for controlling annual weeds.

Legumes

Broad-leaved annuals. One-fourth pound acid equivalent of 2,4-D amine or MCPA amine controls susceptible annual broad-

leaved weeds. The 2,4-D kills Kochia, pigweed, ragweed, cocklebur seedlings, pennycress, mustard, and lamb's quarters. The latter two are killed with MCPA or with less than one-fourth pound of 2,4-D. Red clover, ladino clover, alsike clover, lespedeza, and birdsfoot trefoil are seldom injured by treatment with either chemical. Alfalfa is damaged more frequently and sweet clover is generally injured.

Treat when the legume is 4 to 6 inches tall and the companion crop is 10 to 15 inches tall and forms a canopy over the legume. A small canopy protects the seedlings from the spray, but too much canopy produces enough shade to cause the seedlings to be more sensitive to 2,4-D or MCPA.

A new chemical, 4(2,4-DB), commonly called 2,4-DB, is less injurious to legumes than either 2,4-D or MCPA. One-half pound of 2,4-DB acid in an ester form or 1 pound in an amine form controls Kochia, Russian thistle, pennycress, lamb's quarters, pigweed, mustards, and smartweed. It kills the tops of field bindweed, Canada thistle, and curled dock. These rates seldom cause injury to seedling alfalfa, birdsfoot trefoil, red clover, or alsike clover, but frequently damage sweet clover, severely. Apply these treatments when the legume is 2 to 4 inches tall. This chemical has not been cleared for this use by the Pure Food and Drug Administration; therefore, this chemical should not be used if a companion crop is used and *forage from the first year's crop should not be fed to livestock.* The cost of chemical is very high. Consequently 2,4-DB may not be practical for use by anyone who is not producing legume seed.

Grassy annuals. When annual broad-leaved weeds are controlled, the lack of their competition allows annual grassy weeds to flourish in new seedings of legumes. Use 1 pound of dalapon (1⅛ pounds of 85% sodium salt) or 5 pounds of TCA (6¼ pounds of 90% sodium salt) to kill foxtails, barnyard grass, and other annual grassy weeds (not wild oats) in alfalfa, birdsfoot trefoil, or sweet clover that is 2 inches tall. These treatments do not injure the legume or flax used as a companion crop, but will injure oats, wheat, barley, or rye. *Forage from the first year's crop should not be fed to livestock.*

Legume crops used for seed production can be kept weed-free more easily if the crop is planted in rows and cultivated. A higher yield of seed is usually obtained from row seedings, especially under dry conditions. Reduce the cost of chemical weed control by applying it in bands over the row.

Established stands of legumes are susceptible to most chemicals, but full stands seldom have weed problems. Therefore, the best method of controlling weeds in legumes is to use every precaution at seeding time to insure getting a full stand.

Five pounds of TCA per acre applied to established alfalfa, sweet clover, or birdsfoot trefoil or 2 pounds of dalapon applied to alfalfa or birdsfoot trefoil kills many annual grassy weeds if they are

less than 2 inches tall at time of treatment. Although TCA causes little damage to these crops, it is apt to injure red clover, ladino clover, alsike clover, and lespedeza.

DNBP ("Dow General") is sometimes effective for the elimination of annual weeds or sweet clover from the stand of a perennial legume when applied at the rate of 1½ pounds per acre. It kills the tops of all plants including the perennial legume; however, the perennials will produce regrowth from the roots.

Grasses

Grasses are susceptible to dalapon, TCA, amitrol, and TBA, but are tolerant to 2,4-D, MCPA, 2,4-DB, and other broad-leaved weed killers. Consequently, broad-leaved weeds can be controlled, but the lack of their competition allows grassy weeds to thrive in new grass seedings. Therefore, good cultural practices, as discussed at the beginning of this section on forage crops, are important for weed control in new seedings.

Perennial grasses (bromegrass, bluegrass, and the wheatgrasses) are not damaged by three-fourths pound acid equivalent of 2,4-D or MCPA after they reach the 4-leaf stage of growth. They are not injured by 2,4-DB, but the cost of this chemical makes it impractical for use on grasses unless they are seeded in a mixture with legumes.

Established stands of grasses are not easily injured by 2,4-D, MCPA, or 2,4,5-T. The amount of chemical needed to kill the weed can be applied with little risk of injuring the grass. However, it is advisable to refrain from spraying grass stands being used for seed production while the grass is in the boot stage of growth. Also rates of 12 to 15 pounds per acre may cause damage to these grasses.

It is sometimes desirable to spray annual grasses, such as the millets or sudangrass. There are no experimental data to indicate the best time for spraying. However, numerous farmers have sprayed these crops at various stages without causing injury. It would be advisable to refrain from spraying seed crops when they are in the boot stage of growth.

Pastures and Rangeland

Good pasture management and controlled grazing are the best means of preventing an infestation by weeds. Once the pasture is overrun with weeds, however, chemicals or mowing or a complete pasture renovation is needed. Pasture renovation, on land where it can be done, is frequently the best method. It involves seedbed preparation, seeding, and protecting the seedlings until they become established.

Many weeds, including some perennials, can be controlled by mowing at the right time. Mowing will have to be repeated several years to eliminate perennials. Some perennials, including ironweed, can be eliminated by mowing for several years when the weed is budding or starting to bloom.

Use 2,4-D, MCPA, or 2,4,5-T to control weeds in grassland. A single spraying in June is better than a single mowing, but two applica-

tions a year for 2 or more years are needed to control some perennial weeds. There is no danger of 2,4-D causing any direct ill effect on livestock, although it could cause some plants to produce more potassium nitrate which will cause nitrate poisoning. Or it may cause some poisonous plants, that are ordinarily not palatable, to be palatable enough for livestock to eat and become poisoned. It is therefore advisable to keep livestock off the sprayed area for a week or so. If this is not possible, it is advisable to watch them closely to see if they are eating more weeds than usual. If they are, they should be removed or watched closely for any ill effects.

Weed control in pastures generally results in an increased production of a more desirable forage and improvement of grass stands. Chemicals may reduce the stand of some legume species present in the pasture, but many native legumes are quite resistant to 2,4-D.

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