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Cooperative Extension South Dakota State University

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Weed Control in Corn

COOPERATIVE EXTENSION SERVICE

SOUTH DAKOTA STATE UNIVERSITY

UNITED STATES DEPARTMENT OF AGRICULTURE
Weed Control in Corn

By Lyle A. Derscheid, extension agronomist

South Dakota farmers annually plant approximately 4 million acres of corn that produce a gross annual income of around $100 million. Weeds often reduce the crop yield by 25% and even more under adverse conditions.

In one test, a wet spring prevented early cultivation and a dry summer allowed the weeds to exert abnormal competition. Weed-free corn yielded 51 bushels per acre and weedy corn produced only 12 bushels. The weedy corn was cultivated three times, but weeds were not killed by the first cultivation because the soil was too wet. The weeds got too big to be controlled by later cultivations. Annual weeds reduced the yield 77%.

CULTIVATION

For many years the conventional method of planting corn was to check it. Excellent weed control could be obtained by cultivating lengthwise the first and third cultivations and crosswise the second time through. In recent years most corn is drilled, power checked, or hill-dropped, making it impossible to cultivate crosswise. Good weed control is more difficult to obtain by cultivation. However, several systems have proved to be effective.

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 wheel-track planted crops by planting within 24 hours after plowing. Delayed planting frequently allows weeds in the tracks to emerge earlier than the crop. Cultivation may cover the crop while attempting to kill the weeds.

Rotary Hoe

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, wheel tracks, or loose soil. If crop plants are large, use the rotary hoe during the heat of the day to prevent breaking the plants.

A much larger acreage can be rotary hoed than can be row-crop cultivated in the same length of time. However, several hoeings are generally required to replace one row-crop cultivation. The rotary hoe is generally not effective if weed seedlings are big enough to develop a green color.

Flexite Harrow

The flexite harrow is used in much the same way as the rotary hoe except that it is operated at slower speeds. The rotating action of the flexible tines makes it an effective implement for killing weed seedlings. As with the rotary hoe, a much larger acreage can be covered than with the row-crop cultivator; several harrowings are generally required to replace one row-crop cultivation and is not effective if weed seedlings are taller than one-fourth inch.

Costs of Cultivation

If labor is not considered, the cost of rotary hoeing is about 45 cents per acre, while the flexite harrow costs 21 to 24 cents per acre, and row-crop cultivation costs about 66 cents. If labor is worth $1.25 per hour, the costs increase to 67 cents, 35 cents and 91 cents per acre, respectively. The first row-crop cultivation takes longer than others and the cost would be some higher than the 66 or 91 cents quoted here. Consequently, two rotary hoeings or three harrowings can be done for approximately the same cost as the first row-crop cultivation.

SPRAYING WITH 2,4-D

Use 2,4-D to kill many broad-leaved annual weeds and some perennials in corn. Spray as soon as possible. Spray over the top until corn is knee high. Use drop nozzles for 2,4-D application after the corn is knee high. Use a high clearance sprayer with drop nozzles after tasseling for retreating perennial weeds.

Some hybrids are more susceptible to 2,4-D than others. However, corn is usually tolerant to ½ pound of 2,4-D acid per acre in an ester form or ¼ pound in an amine form at any growth stage except the week before silking. One pound seldom causes damage if applied after tasseling.

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.
Annual Weeds

Apply the amount of 2,4-D required to kill the weed. The quantity of herbicide required for control varies with the weed species. The same rate of herbicide is usually less effective as the weed matures. The amount of 2,4-D required to control numerous weeds at different stages of growth is listed below:

<table>
<thead>
<tr>
<th>1/4 lb/A.</th>
<th>1/2 lb/A.</th>
<th>3/4 lb/A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kochia, 2-4 in.</td>
<td>Kochia, 4-8 in.</td>
<td>Kochia, over 8 in.</td>
</tr>
<tr>
<td>Marsh elder, 2-4 in.</td>
<td>Marsh elder, over 4 in.</td>
<td>Clinquefoil</td>
</tr>
<tr>
<td>Ragweed, 2-4 in.</td>
<td>Ragweed, over 4 in.</td>
<td>Gumweed, 6-12 in.</td>
</tr>
<tr>
<td>Pigweed, 2-4 in.</td>
<td>Pigweed, over 4 in.</td>
<td>Marestail</td>
</tr>
<tr>
<td>Mustard, 3-6 in.</td>
<td>Mustard, over 6 in.</td>
<td>Puncture vine</td>
</tr>
<tr>
<td>Lamb's quarters, 4-6 in.</td>
<td>Lamb's quarters, over 6 in.</td>
<td>Plantain</td>
</tr>
<tr>
<td>Cocklebur, 2-6 in.</td>
<td>Cocklebur, over 6 in.</td>
<td></td>
</tr>
<tr>
<td>Sowthistle, annual</td>
<td>Sowthistle, annual</td>
<td></td>
</tr>
<tr>
<td>Sunflower, 2-6 in.</td>
<td>Sunflower, over 6 in.</td>
<td></td>
</tr>
<tr>
<td>Lady's thumb, 2-6 in.</td>
<td>Lady's thumb, over 6 in.</td>
<td></td>
</tr>
<tr>
<td>Velvet leaf, 4-6 in.</td>
<td>Velvet leaf, over 6 in.</td>
<td></td>
</tr>
<tr>
<td>Wild lettuce, 4-6 in.</td>
<td>Wild lettuce, over 6 in.</td>
<td></td>
</tr>
<tr>
<td>Russian thistle, 2-4 in.</td>
<td>Russian thistle, 4-6 in.</td>
<td></td>
</tr>
<tr>
<td>Wild buckwheat, 2 leaves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning glory, annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peppergrass, annual</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Noxious Weeds

Use 3 to 1 pound of 2,4-D per acre to control broad-leaved noxious weeds. Although there is some chance of injuring the corn, numerous applications at these rates have been made near the time of the second cultivation without causing damage. Apply a second treatment after tasseling with high clearance sprayer equipped with drop nozzles.

For more details on noxious weed control see the Fact Sheet that discusses the weed you have in question.

The cost of 2,4-D is about 90 cents a pound and the cost of application is about 75 cents per acre.

PRE-EMERGENCE SPRAYING

Atrazine, Ramrod, CDAA-T and atrazine mixed with limuron or Ramrod are useful for controlling annual weeds if applied before the weeds come up. They are absorbed by the roots of the weeds; consequently, they must be moved into the root zone in the soil. Rain will leach them into the soil and mechanical incorporation with rotary hoe or harrow will help if too little rain is received to do the leaching.

Atrazine

Use 2 to 3 pounds of active ingredient per acre to control foxtails, barnyard grass, pigweed, mustard, lamb's quarters, Russian thistle, kochia, and other annuals. Use the lower rate on light soils and the higher rate on heavy soils, treat 8- to 14-inch bands over the rows. Rotary hoe or harrow 2 weeks later if less than ½ inch of rain falls during the 2-week period. Cultivate twice with a row-crop cultivator.

This herbicide controls most annual grasses, numerous broad-leaved annuals, and quackgrass. Good control is obtained if applied to wet soil or if ½ to ¾ inch of rain falls within 2 weeks after application. Poor control can be expected if the rain is not received until the third week. If less than ½ inch of rain falls within 2 weeks after application, rotary hoeing or harrowing helps activate the herbicide and kills weed seedlings that may have started to emerge. To get effective weed control, higher rates of atrazine are needed on heavy soils or high organic matter soils than on light or low organic matter soils.

Rainfall at corn planting time has been adequate to activate atrazine and give good weed control in eastern South Dakota 8 of 10 years. Mechanical incorporation with a harrow or rotary hoe has improved results to give good weed control 9 of 10 years.

Residues from over 1 pound per acre of this herbicide, applied in corn one year, generally damage the crop planted the next year (figure 1). Damage from residues is reduced if the herbicide is applied in bands over the rows. Less area is covered and tillage the following spring dilutes the residue by mixing treated soil with untreated soil. Plowing reduces residual effect more than disk does.

Although an over-all application will replace one and sometimes two cultivations, the cost of the herbicide and the carry-over effect from chemical residues generally make it impractical to use such a treatment. Since two cultivations will generally be needed anyway, they will kill weeds between the rows.

Figure 1. Carry-over effect from band application of atrazine killed bands of small grain seeded 1 year after treatment.
Sprays may be applied with an applicator similar to the one shown in figure 2 or with a regular field sprayer that has nozzles spaced the same width as the rows. Be sure that you have good agitation in the sprayer tank to keep atrazine in suspension. Agitation is best accomplished by mechanical means. However, liquid pressure agitation is the type of agitation found on most corn belt sprayers and will do a good job if modified to some extent. The bypass line from the pressure regulator can be outfitted with a jet agitator which will create more turbulence than the normal outlet. However, for best results a separate agitator line should be installed between the pump and the pressure regulator. This new line can then be outfitted with a jet agitator. The pump should have at least the capacity of 10 gallons per minute to give good operating pressure and agitation.

Use 15 to 20 gallons of water per acre on the area treated. Use special nozzles that give uniform coverage over the entire width of the band and use nozzle screens 50 mesh or larger in size. Nozzles on regular field sprayers are designed to overlap and deliver low volumes of water. Consequently, they do not give uniform coverage over the swath of any one nozzle and are equipped with fine screens.

**CDAA and CDAA-T**

Use 4 pounds of active ingredient per acre of CDAA to control annual grassy weeds or 3 pounds of CDAA-T to control most grassy annuals and some broad-leaved annual weeds. Apply in 14-inch bands over the rows. Use a row-crop cultivator twice.

An over-all application seldom replaces more than the first row-crop cultivation. Since two cultivations are generally required to give good weed control, they will control weeds between rows and there is no point in making over-all treatments. Band applicators are shown in figures 2 and 3.

Both chemicals control most annual grasses and CDAA-T controls several broad-leaved annuals. Sprays of either herbicide give good control if applied to warm soil (60° to 65° F.) and if a minimum of ½ to ¾ inch of rain falls during the first week after application. CDAA and CDAA-T generally give better weed control on heavy soils high in organic matter than on light soils low in organic matter. Both herbicides are relatively volatile and relatively emulsifiable in water. Therefore, they must be leached into the soil before they volatilize, but heavy rain (2½ inches) may leach sprays beyond the root zone of weed seedlings.

Granules are effective over a wider range of conditions. They are effective if applied to cool soil, they are not rendered ineffective by heavy rains, and they are effective if rain is not received for 10 days or 2 weeks.

Rainfall at corn planting time has been adequate to activate CDAA and CDAA-T sprays and give good weed control in eastern South Dakota 5 out of 10 years. Granules have been effective 7 or 8 years.

CDAA and CDAA-T give weed control for a shorter time than atrazine and do not give good weed control as often as atrazine, but they do not leave a chemical residue that will damage next year’s crop.

**Ramrod**

Ramrod is the tradename for a new pre-emergence herbicide that is closely related to CDAA.

Use 4 pounds of active ingredient per acre at planting time to control grassy weeds. Apply in 14-inch bands over the rows. Use a row-crop cultivator twice.

An over-all application usually replaces the first row-crop cultivation and occasionally the second cultivation with optimum conditions. However, like CDAA, Ramrod doesn’t control broad-leaved weeds as effectively as other pre-emergence herbicides used in corn.
Chemical Mixtures

Although atrazine generally gives satisfactory weed control it sometimes fails. Also it has a carryover effect on next year's small grain, soybean or alfalfa crop. Therefore numerous studies have been conducted to determine ways of reducing cost, improving weed control and reducing carryover effect. Satisfactory weed control with less carryover can be obtained by mixing atrazine with linuron or Ramrod. Satisfactory weed control with less carryover and less cost can be obtained by applying atrazine in oil.

Atrazine plus linuron (tradename “Lorox”).

Use 1 pound active ingredient of atrazine (14 pounds of “Atrazine 80W”) and 1 pound active ingredient of linuron (2 pounds of “Lorox” 50% wettable powder) in 10 to 20 gallons of water per acre. Apply before weeds or corn come up.

Linuron, applied pre-emergence at the rate of 2 to 3 pounds per acre, gives good annual weed control, but sometimes damages corn.

If used at lower rates in combination with atrazine, good weed control results without crop injury. At the same time the rate of atrazine can be reduced, minimizing the chance of carry-over. Do not apply atrazine plus linuron mixtures to corn after the crop has emerged.

The same precautions in spraying this mixture should be observed as with atrazine alone. Use large 50-mesh screens in the suction strainer, line strainer and nozzle strainers of the sprayer. Be sure to have sufficient agitation of the spray mixture.

Atrazine plus Ramrod. Use 1 pound active ingredient of atrazine (14 pounds “Atrazine 80W”) and 2 to 3 pounds active ingredient (34 to 41/16 pounds of “Ramrod” 65W) of Ramrod in 10 to 20 gallons of water per acre. Use the lower rate of Ramrod on sandy soils. Apply before weeds or corn emerge.

Ramrod is effective against grassy annual weeds, but does not control broad-leaved weeds. It costs more than atrazine but does not have any carryover effect on next year's crops. The combination of the two herbicides gives better annual broad-leaved weed control, costs less than Ramrod alone and has less carryover than atrazine alone.

The same precautions in spraying this mixture should be observed as with atrazine alone. Use large 50-mesh screens in the suction strainer, line strainer and nozzle strainers of the sprayer. Be sure to have sufficient agitation of the spray mixture.

Atrazine Post-emergence

Atrazine may be applied post-emergence in two different ways.

Use 2 to 3 pounds active ingredient in 10 to 20 gallons of water per acre. Use before weeds are more than 1 inch tall. Use the lower rate on sandy soils. Plan to hoe or harrow about 10 days later if less than 1 inch of rain falls. Cultivate twice with a row-crop cultivator.

Use 1 pound active ingredient in 1 gallon of dormant spray oil and 10 to 20 gallons of water per acre. Apply before weeds are over 1 inch tall. Use a dormant spray oil with a viscosity of 80-100 seconds at 100°F, specific gravity of 32-34 API, flash point of 320°F. and unsulfonated residue content of 95% or above. It should contain about 1% emulsifier—enough to emulsify 1 gallon of the oil in 10 to 20 gallons of water. Cultivate twice with a row-crop cultivator.

When compared to a pre-emergence treatment with atrazine, the post-emergence application in water increases the number of days in which a treatment can be made. A regular field sprayer can be used instead of a planter-mounted sprayer generally used for pre-emergence application. However, the cost of herbicide is the same and carry-over effects on next year's crops are the same.

The use of oil not only makes it possible to use a field sprayer, but it also reduces the cost and reduces the hazard of carry-over.
Several oils have been tested extensively. They all meet the above specifications. Further testing will no doubt reveal that other oils are equally satisfactory. Limited tests indicate that diesel oil may be satisfactory if an emulsifying agent is added. Agents that have been tested include X-77 and Palmolive and Wisk liquid detergents.

One of the biggest problems with post-emergence application of atrazine will be timing. It takes about a week for weeds to emerge and get to be 1 inch tall.

**DIRECTED-SPRAYS**

Herbicides that would ordinarily damage corn if applied to the foliage may be applied as directed sprays. There are two sprays that can be used in this manner.

**Dalapon-2,4-D Mixture**

Use 1 ½ to 2 pounds acid equivalent per acre of dalapon (tradename Dowpon—2½ pounds) and ¾ pound acid equivalent of 2,4-D per acre of area treated. Apply with a directed-spray applicator (figures 4 and 5) in 12- to 14-inch bands on the rows when corn is 8 to 16 inches tall. Use 10 to 15 gallons of spray per acre treated.

This mixture stunts or kills most annual weeds in the row if the weeds are not over 6 inches tall. Excessive amounts of dalapon on the corn leaves stunt the plants. Twisted leaves and undeveloped ear husks are typical injury symptoms. This treatment is most effective if applied ahead of the second cultivation, but seldom gives satisfactory weed control if the first cultivation was not performed.

The directed-spray applicator may be attached directly to the tractor or on the cultivator. Special wires lift the corn leaves so that special nozzles can direct the spray under the leaves to the base of the corn plant.

**Linuron**

Use 2 pounds active ingredient of linuron (tradename Lorox 50W-4 lb. of product) per acre of area treated. Apply with a directed-spray applicator (figures 4 and 5) when corn is 15 inches tall. Add 0.5% of a surfactant.

Linuron will kill leaf tissue that it contacts. Although it gives better weed control than the dalapon-2,4-D mixture, serious yield reductions will be obtained if linuron is allowed to contact an appreciable number of leaves. Leaves must be lifted and spray directed to base of corn plants.

Since directed-sprays cannot be applied to small corn, use rotary hoe, harrow, pre-emergence herbicide, or row-crop cultivator to control early weed growth and to prevent yield reduction from weed competition. You may replace the second cultivation with directed sprays, but you will probably use it as an emergency measure for controlling heavy stands of annual weeds in the corn row.

**Herbicide-Insecticide-Fertilizer Mixtures**

You generally need separate applicators for each chemical. When applied with corn planter attachments, fertilizer is applied 2 inches to one side and 2 inches below the seed so that it will not damage the corn. The fertilizer applicator is mounted near the planter shoe. Herbicides applied pre-emergence are applied in 8- to 14-inch bands behind the packer wheel. Insecticides composed of chlorinated hydrocarbons, such as aldrin and heptachlor, may be applied as a liquid in a stream directly on the seed to control corn rootworm with an attachment that is mounted behind the planter shoe. Insecticides composed of phosphates, such as diazinon, thiamet, and parathion (stabilized), used to control western rootworm are applied as granules in 7-inch bands ahead of the packer wheel on the planter. The hydrocarbon insecticides may be applied as sprays or granules in the same manner. Figure 3 illustrates that three attachments are required to apply the three types of chemicals.

### Table 1. Cost of Herbicide

<table>
<thead>
<tr>
<th>Herbicide*</th>
<th>Average Cost of Herbicide per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40&quot; row</td>
</tr>
<tr>
<td></td>
<td>14&quot; band</td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td><strong>Active</strong></td>
</tr>
<tr>
<td>Atrazine</td>
<td>$2.45</td>
</tr>
<tr>
<td>CDAA (Granules)</td>
<td>0.44</td>
</tr>
<tr>
<td>CDAA (Liquid)</td>
<td>7.80†</td>
</tr>
<tr>
<td>CDAA-T (Granules)</td>
<td>0.39</td>
</tr>
<tr>
<td>CDAA-T (Liquid)</td>
<td>8.90†</td>
</tr>
<tr>
<td>Ramrod (Powder)</td>
<td>1.56</td>
</tr>
<tr>
<td>Ramrod (Granules)</td>
<td>0.51</td>
</tr>
<tr>
<td>Atrazine + Linuron</td>
<td>2.45 + 2.95</td>
</tr>
<tr>
<td>Atrazine + Ramrod</td>
<td>2.45 + 1.56</td>
</tr>
<tr>
<td>Linuron</td>
<td>2.95</td>
</tr>
<tr>
<td>Dalapon + 2,4-D</td>
<td>1.50 + 0.75</td>
</tr>
</tbody>
</table>

*Cost per gallon of product.
†Cost per gallon of product.
Some commercial firms have formulated and packaged herbicide-insecticide granular mixtures for application through one applicator. Such mixtures are advertised for both weed control and soil insect control. If the placement of the granular material satisfies both weed and insect control needs without endangering the crop plant, then such mixtures may be desirable. For good weed control purposes a wider band is needed (14 inches) than would normally be used for insect control purposes (7 inches). However, narrow bands may be more suited for lister-planted corn.

**COST OF SPRAYING**

The cost of application is very small if applied with a corn planter attachment. It is about 75 cents an acre if a field sprayer is used or about the same as a first cultivation (90 cents per acre) if a leaf-lifter applicator is used for directed sprays.

The cost of the herbicides is given in table 1.