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Weed Control in Corn

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Weed Control in Corn



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UNITED STATES
DEPARTMENT OF
AGRICULTURE

Weed Control in Corn

By Lyle A. Derscheid, Extension Agronomist, and
Robert Parker, Extension Agronomist—Weeds

South Dakota farmers annually plant approximately 3.7 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 the 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 hilldropped, 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.

Flextine Harrow

The flextine 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 over a quarter inch high.

NOTE

- Any person who uses any of the chemicals in this publication does so at his own risk.
- Observe label directions carefully as registrations for some uses suggested in this bulletin might change.
- Use of a trade name does not indicate endorsement of one product over another.

Costs of Cultivation

If labor is not considered, the cost of rotary hoeing is about 45 cents per acre, while the flextime 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.

POST EMERGENCE SPRAYING

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 $\frac{1}{4}$ pound of 2,4-D acid per acre in an ester form or $\frac{1}{2}$ 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:

1/4 lb/A	1/3 lb/A	1/2 lb/A
Kochia, 2-4 in.	Kochia, 4-8 in.	Kochia, over 8 in.
Marsh elder, 2-4 in.	Marsh elder, over 4 in.	Cinquefoil
Ragweed, 2-4 in.	Ragweed, over 4 in.	Gumweed, 6-12 in.
Pennycress, 4-6 in.	Pennycress, over 6 in.	Marestail
Pigweed, 2-4 in.	Pigweed, over 4 in.	Puncture vine
Mustard, 3-6 in.	Mustard, over 6 in.	Plantain
Lamb's quarters, 4-6 in.	Lamb's quarters, over 6 in.	Cocklebur, over 6 in.
	Cocklebur, 2-6 in.	Sowthistle, annual over 6 in.
	Sowthistle, annual, 2-6 in.	Sunflower, over 6 in.
	Sunflower, 2-6 in.	Ladysthumb, over 6 in.
	Ladysthumb, 2-6 in.	Velvet leaf, over 6 in.
	Velvet leaf, 4-6 in.	Wild Lettuce, over 6 in.
	Wild lettuce, 4-6 in.	Russian thistle, 4-6 in.
	Russian thistle, 2-4 in.	
	Wild buckwheat, 2 leaves	
	Morning glory, annual	
	Peppergrass, annual	

Noxious Weeds: Use $\frac{3}{4}$ 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.

Atrazine (trade name AAtrex 80W) Post-emergence

Atrazine may be applied post-emergence in two 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 $\frac{1}{2}$ inch rain falls. Cultivate twice with a row-crop cultivator.

Or use 1 to 2 pounds 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, and before grasses reach the 3-leaf stage. Use a dormant spray oil that contains an emulsifier. It should contain about 1% emulsi-



Figure 1. Carry-over effect from band application of atrazine killed bands of small grain seeded 1 year after treatment.

fier — 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 carryover 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 as well as the hazard of carryover.

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 Wink liquid detergents.

One of the biggest problems with post-emergence application of atrazine is timing. It takes only about a week for weeds to emerge and grow to be 1 inch tall. They are soon too big to be effectively controlled by this treatment.

PRE-PLANT SPRAYING

Atrazine (trade name AAtrex 80W)

Use $2\frac{1}{2}$ to 3 pounds of active ingredient per acre to control foxtails, barnyard grass, pigweed, mustard, lamb's quarters, Russian thistle, kochia and other annual weeds applied before planting corn. Use the lower rate on light soils and the higher rate on heavy soils. Preplant applications require disking for incorporation therefore banding of the herbicide can seldom be done.

Preplanting and disked-in applications of atrazine have resulted in weed control equal to or, under dry conditions, slightly better than pre-emergence applications with incorporation. Application may be made before, during, or after final seedbed preparation. Avoid deep incorporation of the atrazine. Broadcast applications necessary when preplanting treatments are used may increase the potential of atrazine carryover compared to banded pre-emergence applications.

Pre-plant incorporated application of atrazine is not recommended on soils high in organic matter. The organic matter will absorb some of the herbicide, which reduces its effectiveness for weed control.

Best results have been obtained when corn is planted 2 weeks after atrazine is applied.

PRE-EMERGENCE SPRAYING

Atrazine, propachlor, atrazine mixed with propachlor and linuron mixed with propachlor are useful

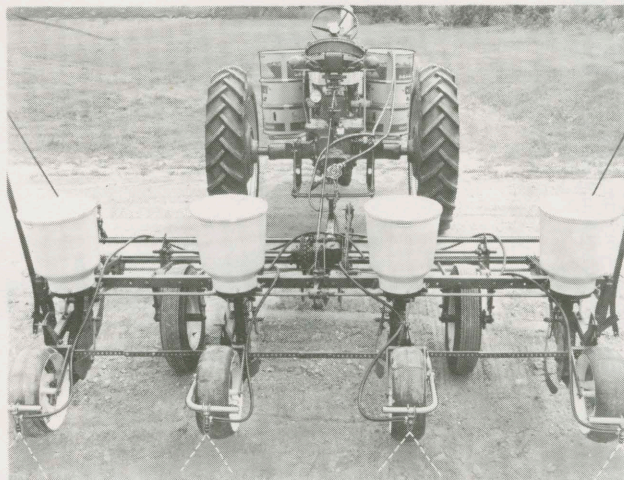


Figure 2. Corn planter equipped with sprayer attachment for band application of pre-emergence herbicides. (Photo Century Engineering Company.)

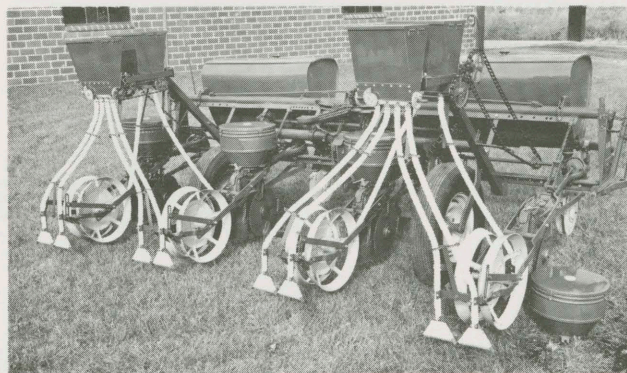


Figure 3. Corn planter equipped with attachments for application of granules of fertilizer, insecticide, and pre-emergence herbicides. Note different placement in soil for each chemical. (Photo Gandy Company Inc.)

for controlling annual weeds before the weeds come up and after the corn is planted. These chemicals 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 (trade name AAtrex 80W)

Use $2\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ to $\frac{3}{4}$ 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 $\frac{1}{2}$ 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 in 8 out of 10 years. Mechanical incorporation with a harrow or rotary hoe has improved results to give good weed control in 9 out of 10 years.

Residues from over 1 pound per acre of this herbicide, applied in corn one year, generally damage small grain, flax, soybean or legume crops planted the following 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 disking 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.

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 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 the 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 uni-

form coverage over the swath of any one nozzle and are equipped with fine screens.

Propachlor (trade name Ramrod)

Use 4 pounds of active ingredient per acre at planting time or shortly after to control annual 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. Propachlor doesn't control broad-leaved weeds as effectively as other herbicides used pre-emergence in corn, but it may be used in mixtures with atrazine or linuron for annual grass and broadleaf control.

On light sandy loam $\frac{1}{3}$ inch of rainfall and on heavy clay and/or high organic soils $\frac{1}{3}$ to $\frac{3}{4}$ inch of rainfall is required for activation of propachlor, depending upon original soil moisture. Best results are obtained when moisture occurs within 10 days after application.

A good program is to use propachlor either as a spray or granules at planting time to control annual grass weeds and follow with an early post-emergence application of 2,4-D to control broad-leaved weeds.

Although atrazine generally gives satisfactory weed control it sometimes fails. Also it has a carry-over effect on the following 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 propachlor or mixing linuron with propachlor. Satisfactory weed control with less carryover and less cost can be obtained by applying atrazine in oil.

Atrazine plus propachlor (AAtrex plus Ramrod)

Use 1 pound active ingredient of atrazine ($1\frac{1}{4}$ pounds "AAtrex 80W") and 2 to 3 pounds active ingredient of propachlor ($3\frac{1}{8}$ to $4\frac{11}{16}$ pounds of "Ramrod 65W") in 10 to 20 gallons of water per acre. Use the lower rate of propachlor on sandy soils. Apply before weeds or corn emerge.

Propachlor 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 the following year's crops. The combination of the two herbicides gives better control of annual broad-leaved weeds, costs less than propachlor 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 screens in the nozzles of the sprayer. Be sure to have sufficient agitation of the spray mixture.

Linuron plus propachlor (Lorox plus Ramrod)

Use 1 pound active ingredient of linuron (2 pounds of "Lorox" 50% wettable powder) and 2 pounds active ingredient of propachlor (3 $\frac{1}{8}$ pounds of "Ramrod 65W") in 10 to 20 gallons of water per acre. Apply before weeds or corn come up. The commercial mixture "Londax" is available as a wettable powder or granules. Use 6 $\frac{2}{3}$ pounds of "Londax" wettable powder or 20 pounds of "Londax G" to equal the above rate for linuron and propachlor.

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 propachlor, good weed control results with negligible crop injury. With this mixture the chances of carryover the following year are negligible.

Better broad-leaved weed control is obtained with the mixture than with propachlor alone. The same precautions in spraying this mixture should be observed as with atrazine. Use large 50-mesh screens in the suction strainer, line strainer and nozzle screens of the sprayer. Be sure to have sufficient agitation of the spray mixture.

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. Pre-emergence herbicides are applied in 8- to 14-inch bands behind the packer wheel. Corn rootworm control insecticides, composed of chlorinated hydrocarbons, such as aldrin and heptachlor, may be applied as a liquid in a stream directly on the seed 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.

Some commercial firms have formulated and packaged herbicide-insecticide granular mixtures for use 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 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. The approximate cost of herbicides is given in table 1.

Table 1. Cost of herbicide

Herbicide*	Cost per lb. Product	Cost per lb. Active	Average Cost of Herbicide per Acre				
			40" row		20" row		Overall
			14" band	8" band	14" band	8" band	
Atrazine	\$2.45	\$3.06	\$ 7.65	\$2.55	\$1.53	\$5.10	\$3.06
Propachlor (Granules) ..	.49	2.45	9.80	3.27	1.96	6.54	3.92
Propachlor (Powder)	1.36	2.09	8.36	2.79	1.67	5.58	3.34
Atrazine+propachlor ..	2.85+1.36	3.56+2.09	7.74	2.58	1.55	5.16	3.10
Linuron+propachlor ..	2.95+1.36	5.90+2.09	10.08	3.36	2.02	6.72	4.04

*Atrazine is formulated as an 80% wettable powder. Linuron is formulated as a 50% wettable powder. Propachlor is formulated as a 65% wettable powder or a 20% granule.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. John T. Stone, Dean of Extension, South Dakota State University, Brookings.
5M—Replaces FS 339—4-69—File: 2.4-2—8919

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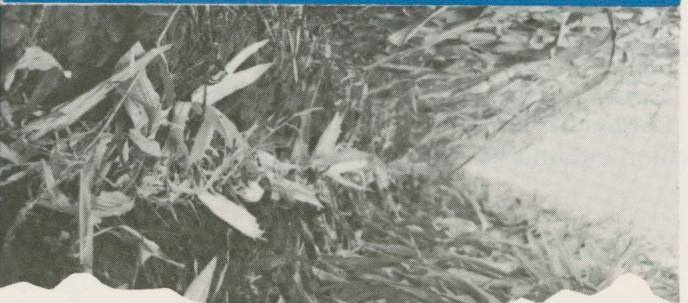
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