

# AGRICULTURAL GUIDE

Published by the University of Missouri-Columbia Extension Division

Soil Insects

JUL 13 1983

## Soil insect control in reduced tillage cropping systems

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**Note:** For more information, refer to Guide 4150 for 1983 corn cutworm control, to Guide 4151 for 1983 corn rootworm control, to Guide 4154 for 1983 wireworm and other corn soil insect control, and to picture sheets Numbers 4, 5, 6 and 7 for insect identification.

Missouri row crop producers have rapidly accepted and adopted reduced, conservation, or no-tillage practices. They planted about 55 percent or 6,000,000 acres of the 1981 crop of soybeans, corn, small grains, and grain sorghum in soils receiving some degree of reduced tillage.

Although reduced tillage practices offer several advantages, one disadvantage is difficult insect control. Major insect problems occur more frequently and are often more damaging with reduced than with conventionally tilled crops.

Soil insects present a serious threat to reduced tillage crops because they damage germinating seeds, seedlings, and young stands. Although these problems do not occur uniformly in all fields or on all reduced tillage crops, their occurrences are frequent enough for producers to plan for control before seeding time. Apparently, some insects cause more damage as tillage is reduced. The most severe problems occur in no-till plantings.

Control above-ground insect pests in reduced tillage crops with the same procedures and methods used on conventionally tilled crops. Presently, there is little or no indication that above-ground insect problems are increasing along with the increase in reduced tillage practices. The exceptions are stalk borer, billbugs and Hessian fly.

This guide sheet lists the major soil insect pests and control alternatives in reduced and no-till production of soybeans, corn, small grains, and grain sorghum.

With some pests, though, there are few acceptable controls.

### Soil insect control alternatives

Some soil insect pests are known to be *crop specific*, and others are known to be more or less *general feeders*, so don't expect control alternatives to control all soil insects on all crops effectively. Some control alternatives give you some freedom in selecting and establishing crop rotations, selecting resistant varieties and planting dates, and selecting the tillage and planting equipment to fit the task.

#### Crop rotations

An effective control for northern and western corn rootworms is to rotate corn annually with any other row crop. When rotating sod, meadows, or legumes with any row crop, the time for establishing sod or legumes is important. The first year after establishment presents a threat from only armyworms, but two or more years after establishment the possibility for problems from such pests as cutworms, wireworms, sod webworms, white grubs, stalk borer, billbugs, and seed corn maggots increases several times.

#### Resistant varieties

Very few, if any, of these crops are resistant to any of the soil insects. Those crops with some resistance are resistant to pests feeding above ground, such as European corn borer, greenbug, and Hessian fly.

#### Planting dates

Delaying spring planting dates for optimum soil temperatures is one way to prevent losses from seed-damaging insects, such as seed corn maggots and light infestations of wireworms. Observing the *fly free* date for seeding winter wheat is an established method for controlling Hessian fly. Another established practice is seeding sorghums after the soil temperature reaches 65 degrees F to prevent seedling injury by greenbugs. Delaying planting to prevent damage from other soil insects, such as cutworms, usually means that you would plant so late that yields would be considerably reduced.

#### Selecting tillage and planting equipment

This guide sheet won't go into the various makes and types of tillage and planting equipment. However,

tillage implements should be adequate to perform the desired degree of tillage reduction.

Both no-till and conventional planters should have optional accessories capable of delivering insecticides as a band, in-furrow, or both in either dry or liquid formulations. Also, consider devices capable of incorporating insecticides at different depths. Wireworms are better controlled by in-furrow placement, while several other soil insect pests are better controlled by a band over the row and lightly incorporated.

## Soil insecticide and application methods

As you give up conventional tillage to slow down soil erosion losses, you lose the soil insect control that the plow provides. So, growers are forced to use pesticides for controlling their disease, weed, and insect problems. Depending on any one method of pest control is risky and should be viewed as a short-term approach. But until other means of insect control are developed, the judicious use of insecticides is the only alternative.

Missouri corn growers have used soil insecticides since the early 1950s. Most early use of aldrin and heptachlor was to prevent cutworm and wireworm damage. Its use continued until the western corn rootworm moved eastward through the state. This species had already developed resistance to the organochlorine insecticides before appearing in Missouri.

Eventually, several organophosphate and carbamate insecticides were developed for use on the western corn rootworm. Because of their shorter residual properties in the soil and their effective and primary use for controlling rootworms and a few other soil insects, these compounds are now referred to as *corn rootworm insecticides*. These are the insecticides producers must depend on for soil insect pest control for reduced and no-till production of row crops.

Although the insecticides in Table 1 are used for corn rootworm control, several of them also *suppress* some other soil insect pests at varying levels. In low to moderate pest populations, suppression may be all that is required for good germination and seedling stand retention. Sometimes, a seed treatment insecticide along with an insecticide that suppresses pests works well. However, when several pests occur in heavy numbers, suppression is not adequate.

Apply insecticides for soil insect pest control with any or a combination of the following methods: seed treatment, in-furrow, row band, broadcast, or post-emergence rescue.

### Seed treatment insecticides

Only three seed treatment insecticides are currently registered and available for control of certain soil insect pests. They are chlorpyrifos (Lorsban), diazinon and lindane.

Soil insects controlled by seed treatment include seed corn beetles, seed corn maggots, thief or kafir

ants, and low numbers of wireworms. Seed treatment aids in protecting seed from insect injury during periods of slow germination but does not protect seedlings.

**Lorsban 25-SL** is labeled for control of seed corn beetles and seed corn maggots as a slurry treatment on field and sweet corn seed. Corn seed must be commercially treated before planting.

**Diazinon** (50W and other trade name products formulated with graphite) is labeled for control of seed corn beetles and seed corn maggots. Use it as a planter-box treatment on field corn, sweet corn, and soybean seed.

**Lindane (25W)** is labeled for control of seed corn maggots and wireworms. Use as a premix just before planting or as a planter-box treatment on field, pop, and sweet corn, on all small grains, sorghums, and soybean seed. Seed corn maggots have developed resistance to lindane in the northeast and east-central areas of the state.

**Do not** use insecticide-treated seed for any purpose except planting.

### In-furrow application insecticides

For environmental safety and maximum performance in reduced and no-till crop production, some incorporation into the soil is important. Some planting equipment, especially some no-till planters, limits you to in-furrow placement of insecticides. In-furrow placement further limits your choice of soil insecticides and the number of soil insect species that will be controlled.

When placed in-furrow in direct contact with seed, these insecticides must not be phytotoxic (toxic to plants). If they are, they will reduce germination. Weather conditions affect the severity of seed injury. Any factor, such as cold and wet soils, which may slow germination, increase the probability of phytotoxicity.

Currently, three of the granular rootworm insecticides are labeled for in-furrow application at planting time. They are carbofuran (Furadan), chlorpyrifos (Lorsban) and terbufos (Counter). The labels claim a variance in soil insects controlled or suppressed.

**Furadan (10G and 15G)** is labeled for in-furrow application on field, pop, and sweet corn for control of corn rootworms, wireworms, flea beetles, and early season armyworm. It's labeled for the suppression of stalk borer, leafhoppers, billbugs, and first generation European corn borer. It is also labeled for sorghums (grain and forage) for early season control of greenbugs and chinch bugs. Although it's not included on the label, this application should also control wireworms in sorghum.

**Lorsban (15G)** is labeled for in-furrow application on field, pop, and sweet corn for control of seed corn beetles, seed corn maggots, and wireworms. It's also labeled for the suppression of cutworms and billbugs.

**Counter (15G)** is labeled for in-furrow application on field, pop, and sweet corn for control of corn rootworms, seed corn maggots, and wireworms. It's labeled as well for the suppression of white grubs and billbugs.



Two granular insecticides are labeled for in-furrow application (but not direct contact) for fall-seeded wheat. Both **Di-Syston (15G)** and **Thimet (15G)** claim control of Hessian fly and fall-infesting aphids, particularly greenbug.

#### Row band application insecticides

With this common method of applying granular rootworm insecticides, place granules in a 5-to 7-inch band directly behind the planter shoe and in front of the press wheel. Most of these insecticides require some means of light incorporation, from ½ to 1 inch. Incorporate with furrow-covering devices, a press wheel, a short loop of heavy chain dragging behind the press wheel, a rotary wheel, or spring tine incorporators installed directly behind the press wheel. Proper incorporation is more difficult or impossible as the amount of soil surface residue increases.

With row band application at planting time, there's a wider choice of insecticides. Remember, though, that granules of only three of the seven insecticides should come in direct contact with the seed. Besides corn rootworms, all seven of these insecticides claim to control one or more additional soil insects.

**Carbofuran (Furadan 10G and 15G)** is labeled for row band application on field, pop, and sweet corn for control of rootworms, wireworms, flea beetles, armyworm, and for the suppression of stalk borer, billbugs, leafhoppers, and first generation European corn borer. It's also labeled for early season control of chinch bugs and greenbugs on sorghum.

**Chlorpyrifos (Lorsban 15G)** is labeled for row band application on field, pop, and sweet corn for control of rootworms, cutworms, seed corn maggots, and billbugs. It should also control or suppress wireworms, depending upon the depth of incorporation.

**Ethoprop (Mocap 10G)** is labeled for row band application over closed or covered seed furrows on field and sweet corn for control of rootworms, wireworms, and for the suppression of cutworms.

**Fonofos (Dyfonate 20G)** is labeled for row band application on field, pop, and sweet corn for control of rootworms, seed corn beetles, seed corn maggots, and for the suppression of cutworms and wireworms.

**Isofenphos (Amaze 20G)** is labeled for row band application on field, pop, and sweet corn for control of rootworms, seed corn beetles, seed corn maggots, and for the suppression of wireworms, white grubs and billbugs.

**Phorate (Thimet 15G and 20G)** is labeled for row band application on field and sweet corn for control of rootworms, seed corn beetles, and for the suppression of wireworms. It's also labeled on sorghum for early season control of greenbug.

**Terbufos (Counter 15G)** is labeled for row band application on field, pop, and sweet corn for control of rootworms, seed corn maggots, wireworms, billbugs, and for the suppression of white grubs.

## Preplant, broadcast application insecticides

A few rootworm and other insecticides are registered for the control of one or more soil insects with this application method. Obviously, it doesn't apply to no-till sod plantings, and it becomes less effective as tillage decreases.

#### Incorporation

Except for toxaphene on no-till sod plantings, preplant, broadcast insecticides must be incorporated or thoroughly mixed into the top 2 to 6 inches of soil with a disk or other suitable equipment. Incorporation depth varies with the insecticides and the major insect pests to be controlled. Dosage rates for preplant, broadcast applications are quite high, which makes this application method the most expensive. The following insecticides are registered for broadcast, preplant, incorporated application. Dosages are given in active ingredient per acre.

**Chlorpyrifos (Lorsban 15G or 4E)** should be applied at 2 pounds per acre and immediately incorporated into top 2 to 6 inches of the soil on field, pop, and sweet corn. Use it for the control of cutworms, wireworms, grubs, billbugs, and for the suppression of rootworms.

**Diazinon (14G, 50W or 4EC)** at 4 pounds per acre should be applied just before planting and immediately incorporated into top 2 to 6 inches of soil. It's labeled for use on field, pop, and sweet corn to control seed corn maggots, cutworms, and wireworms. This dosage is also labeled for use on sorghum and soybeans for cutworm control.

**Ethoprop (Mocap 10G or 6EC\*)** at 6 pounds per acre should be immediately incorporated into top 2 inches of soil. Use it on field and sweet corn to control rootworms and wireworms.

**Fonofos (Dyfonate 20G or 4E\*)** at 4 pounds per acre should be incorporated by disking on field, pop, and sweet corn. Dyfonate 20G is labeled for control of wireworms and billbugs, and Dyfonate 4E is labeled for control of rootworms, wireworms, and for cutworm suppression.

#### Surface application

The exception noted under "Incorporation" involves toxaphene\* application, either alone, mixed with paraquat\*, or with liquid fertilizer, to no-till sod plantings. When you use it with another pesticide or carrier besides water, check for compatibility before tank mixing. Use toxaphene\* (Attac 6 or Attac 8) at the rate of 3 pounds per acre on field corn for control of cutworms and armyworm. Thorough coverage of vegetation and ground cover (residues) is required for maximum results.

The effectiveness of toxaphene when it's applied either to the soil surface or incorporated into tilled fields remains unanswered. Besides growers' testimonies, there remains a striking lack of data to support or refute such use.

Table 1. Soil insect control with recommended granular rootworm insecticides.

Insecticides	Root-worms	Wire-worms	Cut-worms	Seed corn maggots	Seed corn beetles	Army-worm	Billbugs	Stalk borer	White grubs
<b>Corn</b>									
Carbofuran									
Furadan 10 & 15 G	X	X				X	S	S	
Chlorpyrifos									
Lorsban 15G	X	X	X and S	X	X		X or S		X
Ethoprop									
Mocap 10 G	X	X	S						
Fonofos									
Dyfonate 20 G	X	S	S	X	X				
Isofenphos									
Amaze 20 G	X	S		X	X				X or S
Phorate									
Thimet 15 & 20 G	X	S							
Terfubos									
Counter 15 G	X	X		X			S		X
<b>Soybeans</b> none									
<b>Sorghums</b>									
Furadan 10 & 15 G	Greenbug and chinch bugs								
Thimet	Greenbug								
<b>Small Grains</b>									
Dy-Syston 15 G	Hessian fly and greenbug								
Thimet 15 & 20 G	Hessian fly and greenbug								
X = Control									
S = Suppression									

**Postemergence or rescue application insecticides**

Frequently, soil insect pests continue their damage after seed germination. Such injury continues from the seedling stage through the six-leaf stage of development. Cutworms, wireworms, white grubs, billbugs, stalk borer, slender seed corn beetle, red-headed flea beetle, and seed corn maggots may continue damaging plants even longer.

A rescue application controls only those species whose larvae or adults come to the soil surface or feed above ground. Therefore, only cutworms, billbugs, and stalk borer may be controlled or reduced by a rescue application. Control of other soil insects that feed entirely below ground can be obtained only through an insecticide application as preplant or at the planting time. Table 2 presents those insecticides labeled as rescue application for control of certain soil insect pests.

The Lorsban and Pydrin broadcast spray application has been shown to be the most effective for cutworms under most Missouri conditions. Use the maximum rates when soil surface residues are heavy. Expect the best results when you detect cutworms before they reach an inch in length and when soil moisture is adequate to bring cutworms to or near the soil surface. Under dry soil conditions, rotary hoeing

before or after application often aids control as does making the application during late afternoon or evening. Although adult billbug numbers have been high during the springs of 1981 and 1982, their injury has largely been confined to foliage feeding. This damage has not contributed to economic losses of stand. This sudden increase in billbug numbers cannot be easily explained, although sedges and especially nut grasses, which are their native hosts, have been more numerous during the past two wet seasons.

Note the absence of labeling for the increasing problem of stalk borer.

**Detecting insect pest problems**

The key to any pest management program is field monitoring. These soil insect pests do not occur each year in all fields. Frequently, they do not reach a level of infestation capable of causing damage that would exceed the cost of control efforts. Field monitoring (scouting) means that you or a member of your family learns to identify these insects and their early season damage. Or you could hire the services of either a private consultant or an extension pest management scout. These scouts make weekly or more frequent counts of all potential pest problems in contracted



Table 2. Rescue treatment for soil insect pests.

Insecticide	Pounds active ingredient per acre	Placement	Pests		
			Cutworms	Billbugs	Stalk borer
<b>Corn</b>					
Carbaryl (Sevin)					
5 or 20% bait	1	broadcast	X		
sprays	2	plant base	X		
Chlorpyrifos					
Lorsban 4E	1.0 - 1.5	broadcast	X	X	
<b>(RU)</b> Fenvalerate					
Pydrin 2.4EC	0.15	broadcast	X		
<b>(RU)</b> Methyl Parathion					
Penncap M	1	broadcast	X		
<b>(RU)</b> Toxaphene	3	plant base	X		
Trichlorfon					
Dylox LS	1	plant base	X		
<b>Grain Sorghums</b>					
Carbaryl (Sevin)					
sprays	2	plant base	X		
<b>(RU)</b> Toxaphene	2	plant base		X	
	3	plant base	X		
<b>Soybeans</b>					
Carbaryl (Sevin)					
sprays	1.5	plant base	X		
Lorsban 4E	1.0	broadcast	X		

**(RU)** Preceding insecticide indicates restricted use pesticide.

it could save you one or more pesticide applications. And that might reduce your total production costs.

#### Bait trapping

Using solar bait traps before planting is a means of determining the need for a preplant or planting time application of an insecticide for controlling wireworms. (See *UMC Agricultural Guide* 4154 for details on establishing and evaluating wireworm solar bait traps.)

Likewise, using bait traps immediately following planting is a means of determining the need for a rescue insecticide application for cutworm control. (See *UMC Agricultural Guide* 4150 for details on preparing, establishing, and evaluating cutworm bait traps.)

Pheromone traps with sex attractants for one or the other sex are commercially available for black cutworms and for European corn borer. However, pheromone trapping indicates the abundance of adult moths. As yet, such numbers have not been shown to correlate with the ensuing larval infestations.

#### Visual observations and counts

Making a count of adult corn rootworm beetles sometime within a three-week period after pollination is a means of determining the need for a rootworm insecticide during the next season in continuous corn. With the other soil insects, you'll have to scout and count them during their damaging stage, or watch for

signs of feeding injury. For additional information, review pest field history and determine the percentage of soil surface covered with plant residues. The higher this percentage of plant residue cover, the higher the probability of one or more soil insect pest problems.

#### Soil insect problems in reduced and no-till cropping systems

There is almost no end to the many possible cropping rotations, varying degrees of reduced tillage, and combinations of them. Therefore, this guide sheet considers only the more common crop rotations. If you are using these cropping rotations, refer to the section on the insecticide application methods that correspond to your application equipment. After reviewing the insecticide choices for your particular application method, select one or more products that should provide the widest spectrum of soil insect pest control.

#### Corn after corn

**No cover crop and no wireworm history.** Corn rootworms will likely be the most common problem, especially north of a line stretching between Joplin to St. Charles. Determine rootworm beetle population. Then, either rotate to another crop, or use a rootworm insecticide application when planting next season's

especially north of a line stretching between Joplin to St. Charles. Determine rootworm beetle population. Then, either rotate to another crop, or use a rootworm insecticide application when planting next season's corn. Other expected pests include seed corn maggots, cutworms, and seed corn beetles. Possible minor pests include stalk borer, root aphids, and billbugs.

**A cover crop and no wireworm history.** Add armyworm to the insects included above, and expect some increased incidence of seed corn maggots, cutworms, and stalk borer.

**No cover crop and wireworm history.** Depending upon the intensity of wireworm and rootworm populations, it may be a toss-up as to the most damaging. Wireworms reduce stand by feeding on seed and by boring into the underground stem just above primary roots. This damage results in seedling death. On the other hand, rootworm larvae may destroy one or more rings of primary or brace roots. This damage results in lodging and yield reduction. Bait fields with solar bait traps two to three weeks before planting to establish wireworm populations. Use a seed treatment insecticide (planter box). Also, a row band of a wireworm insecticide at planting is probably the best approach for this combination of soil insects if your planter can incorporate insecticide properly. As soil surface residues increase, other expected insect problems include seed corn maggots, seed corn beetles, and cutworms.

#### Corn after soybeans

**No cover crop and no wireworm history.** Seed damaging insects and cutworms are the most likely problems. Use a seed treatment insecticide (planter box). Also, under conditions conducive to cutworms, monitor for their development and use a rescue application, if needed. Or use a row band of a cutworm insecticide at planting.

**With or without a cover crop and wireworm history.** Use seed treatment insecticide (planter box) plus an in-furrow or row band wireworm insecticide at planting. Monitor for cutworms and armyworm in the cover crop, and use a rescue application, if needed.

#### Corn after pasture, meadow, sod, or legume

**Established only one year.** This rotation seems to provide fewer insect problems than others. Likely insect problems are seed corn maggots and possibly cutworms and armyworm. Use a seed treatment insecticide (planter box). Monitor for cutworms and armyworm, and use rescue application, if needed.

**Established grass or legume for two or more years.** As the length of established grasses or legumes increases, problems with wireworms, white grubs,

cutworms, sod webworms, armyworm, seed corn maggots, billbugs, and stalk borer also become more likely. For such no-till plantings, use a seed treatment insecticide (planter box). Or if mice are common, use Mesuro seed treatment plus an in-furrow application of an insecticide for wireworms, white grubs, and other pests. An alternative is toxaphene\* with paraquat\* preplant, broadcast for cutworms and armyworm plus a seed treatment (planter box) for seed damaging insects or mice.

#### Soybeans after corn

The seed corn maggot appears to be the most likely problem with probabilities of occurrence increasing as surface residues increase. Use a seed treatment insecticide (planter or drill box) at planting.

#### Soybeans after wheat

**Double crop.** The seed corn maggot is the most likely problem. Use a seed treatment insecticide (planter or drill box) at planting. During wet seasons when fields have heavy stubble, slugs may be a seedling problem. There is no registered pesticide for slug control.

#### Soybeans after pasture, meadow or sod

Seed corn maggots, wireworms, white grubs, cutworms, and slugs are likely problems. Use a seed treatment insecticide (planter box) at planting. Use a rescue application for cutworms. No preplant or planting time application is currently available for other pests.

#### Sorghum after any other row crop

Thief ants and one species of annual wireworm are the most likely problems. Use a seed treatment insecticide (planter box) at planting or an in-furrow application of Furadan for wireworms and seedling control of greenbugs.

#### Sorghums after small grains

**Double crop.** The same problems as above are likely, and, there's a possibility of slugs with wet weather and heavy stubble. Use the same controls as above.

#### Small grains after any row crop

There are no particular soil insect problems. Plant wheat after *Hessian fly free date* with a resistant variety.

#### Small grains after small grains

Avoid such rotation to restrict buildup of diseases and above ground feeding insects.

**Missouri insect control recommendations are revised annually and are subject to possible change during the growing season. This guide is intended for use during the 1983 growing season only.**

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. Leonard C. Douglas, Director, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.