# 1984 Insect Pest Management Guide

# FIELD and FORAGE CROPS

You must be certified as a pesticide applicator to use restricted-use pesticides.
See your county Extension adviser in agriculture for information.

## FEDERAL AND STATE LAWS

The U.S. Environmental Protection Agency is classifying pesticides for "general" or "restricted" use. Only a few pesticides have been classified.

*Commercial* applicators who apply restricted-use pesticides must be certified. Commercial applicators include persons applying a pesticide for hire and governmental personnel, chemical company representatives, and others involved in demonstrational, regulatory, and public health pest control. Certification as a commercial applicator requires passing a written examination administered either by the Illinois Department of Agriculture or the Department of Public Health.

*Private* applicators who use restricted-use pesticides "for the purpose of producing any agricultural commodity on property owned or rented by him or as exchange labor (no compensation) on the property of another" must also be certified, either by attending an educational training program or by passing an examination.

Educational training programs for farmers (private applicators) and commercial pesticide applicators are conducted by the Cooperative Extension Service to prepare persons for certification. For additional information, consult your county Extension adviser in agriculture. The actual certification and the issuing of permits or licenses are handled by the Illinois Department of Agriculture or the Illinois Department of Public Health.

### Special Local Need Registrations

Section 24(c) of the amendments to the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 allows states the right to register pesticides for use within the state to meet special local needs (SLN). The authority for state registration of pesticides is the Illinois Department of Agriculture. A special label, which lists the new 24(c) uses, is printed by the formulator. A copy of this label must be in the possession of the operator during application of the pesticides.

In the following pages, all SLN, or 24(c), registrations are indicated by this sign: †.

### Insecticides and Classifications

At the time this publication was in preparation, only a few of the insecticides listed below had been classified for either "restricted" or "general" use by the EPA. Additional insecticides are expected to be classified

**Table 1. Insecticide Classifications**

| Common name | Trade name | Classification |
|---|---|---|
| acephate | Orthene | unclassified |
| *Bacillus thuringiensis* | Dipel, Thuricide, Bactur, SOK | unclassified |
| carbaryl | Sevin, Savit | unclassified |
| carbofuran | *Furadan | restricted[a] |
| carbophenothion | Trithion | unclassified |
| chlorpyrifos | Lorsban | unclassified |
| diazinon | Diazinon | unclassified |
| dimethoate | Cygon, De-Fend | unclassified |
| disulfoton | *Di-Syston | restricted[a] |
| ethion | Ethion | unclassified |
| ethoprop | *Mocap | restricted[a] |
| fenvalerate | *Pydrin | restricted[b] |
| fonofos | *Dyfonate | restricted[a] |
| isofenphos | *Amaze | restricted[a] |
| malathion | Cythion, malathion | unclassified |
| methidathion | *Supracide | restricted[b] |
| methomyl | *Lannate, *Nudrin | restricted[c] |
| methoxychlor | methoxychlor | unclassified |
| methyl parathion | *Methyl parathion | restricted[b] |
| methyl parathion (microencapsulated) | *Penncap-M | restricted[b] |
| permethrin | *Ambush, *Pounce | restricted[b] |
| phorate | Thimet | unclassified |
| phosmet | Imidan | unclassified |
| terbufos | Counter | unclassified |
| trichlorfon | Dylox, Proxol | unclassified |
| trimethacarb | Broot | unclassified |

[a] Liquid formulations are restricted.
[b] All formulations are restricted.
[c] All formulations except water-soluble packages, 25% wettable powder, and granulars are restricted.

**Asterisks (*) are used throughout this circular to indicate insecticides classified for "restricted" use.**

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN COLLEGE OF AGRICULTURE COOPERATIVE EXTENSION SERVICE
In cooperation with ILLINOIS NATURAL HISTORY SURVEY CIRCULAR 899 (revised annually) November, 1983

before the 1984 planting season. Your county Extension adviser will have additional information on insecticide restrictions.

The chemical names used in this circular may be unfamiliar to you. These names are the common, coined chemical names and as such are not capitalized (for example, terbufos). Trade names are capitalized (for example, Counter). In the table of limitations (Table 15), the trade names are listed first, with the common name in parentheses following the trade name. In the tables of suggestions, only the trade name is listed.

## POLICY STATEMENT

The *Illinois Insect Pest Management Guide: Field and Forage Crops* (Circular 899) is revised annually and is intended for use during the current calendar year only. Not all registered insecticides for crop pests are included in this circular. Insecticides that are effective and do not present an undue hazard to the user are suggested whenever possible.

Trade names have been used for simplicity, but their usage does not imply endorsement of one product over another, nor is discrimination intended against any product.

This guide for insect control is based on research results from the Illinois Natural History Survey, the University of Illinois Agricultural Experiment Station, other experiment stations, and the U.S. Department of Agriculture.

Requested label clearances for a few uses of some insecticides, carriers, and solvents are uncertain for 1984 because many requests have not yet been officially cleared. Be sure to check with your county Extension adviser in agriculture if you are in doubt about an insecticide you plan to use. We will make announcements of label changes through the news media to keep you up to date.

## REFERENCES

Fact sheets (designated by NHE numbers) discussing nonchemical control methods, descriptions of specific insects, and their life history and biology can be obtained from the office of the county Extension adviser in agriculture or by writing to Entomology Extension, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

## PEST-MANAGEMENT SCOUTING PROGRAMS

Integrated Pest Management (IPM) and pest scouting have become increasingly important in the past 10 years. IPM is a systematic method of looking for pests in the field, of determining whether any control measures are needed, and if there is a problem, of deciding on the proper measures to use. Pest scouting enables farmers to detect and control pest outbreaks before significant yield losses occur. Because decisions on chemical control are based on economic thresholds and not on guesswork, these programs also keep unnecessary pesticide use to a minimum.

Pest scouting has been accepted as an important management tool by many Illinois farmers in the past several years. As farming costs increase, growers are realizing the advantages of treating a field only when an economically harmful pest population occurs, rather than treating it automatically regardless of the situation. By using pesticides on this basis, farmers have a better chance of reducing management costs.

Pest scouting programs have been initiated by several pest-management consulting firms throughout the state. In addition to pest scouting, most offer other services such as soil testing and nematode monitoring.

## PESTICIDE SAFETY

Certain precautionary steps should be taken when handling insecticides. The insecticides suggested in this publication can be poisonous to the applicator. The farmer is expected to protect himself, his workers, and his family from needless exposure.

When using insecticides, apply all the scientific knowledge available to make sure that there will be no illegal residue on the marketed crop. Such knowledge is condensed on the label. READ THE LABEL CAREFULLY AND FOLLOW THE INSTRUCTIONS. The label should be recent and not from a container several years old. Do not exceed the maximum rates suggested. Observe the interval between application and harvest. Apply only to crops for which use has been approved. Keep records of pesticide use for each field. Record the product used, the trade name, the percentage content of the insecticide, the dilution, the rate of application per acre, and the date or dates of application.

Always handle insecticides with respect. The person most likely to suffer ill effects from insecticides is the applicator. Accidents and careless, needless overexposure can be avoided. Following these rules will prevent most insecticide accidents:

1. Wear rubber gloves when handling insecticide concentrates.
2. Do not smoke while handling or using insecticides.
3. Keep your face turned to one side when opening, pouring from, or emptying insecticide containers.
4. Leave unused insecticides in their original containers with the labels on them.
5. Store insecticides out of the reach of children, irresponsible persons, or animals; store preferably in a locked building. Do not store near livestock feeds. Better yet, buy no more pesticide than you will use, thus eliminating a pesticide storage and disposal problem.
6. Triple rinse, bury, or burn all empty insecticide containers or take them to an appropriate sanitary landfill.

7. Do not put the water-supply hose directly into the spray tank or blow out clogged nozzles or spray lines with your mouth.

8. Wash with soap and water exposed parts of the body and clothes contaminated with insecticides.

9. Do not apply to fish-bearing or other waters.

10. Do not leave puddles of spray on impervious surfaces or apply insecticides near dug wells or cisterns.

11. Do not apply insecticides, except in an emergency, to areas with abundant wildlife.

12. Do not spray or dust when weather favors drift.

13. To avoid bee kill, apply insecticides after bee activity has been completed for the day; use the least toxic materials. *Warn beekeepers that you are applying insecticides.*

## PREDICTING THE NEED FOR SOIL INSECTICIDES ON CORN

Several different cover crops were used by farmers for the PIK program in 1983. As a result, several soil insect pests could be more abundant in 1984, depending on the cover crop, tillage, and weather. In general, the potential for insect problems in corn after PIK is greater than those experienced in a corn-soybean rotation. Although it is unlikely that some insects, such as wireworms and white grubs, would increase dramatically in a single season, many fields could have a complex of soil insect pests. One species alone may not cause economic damage, but a complex of cutworms, wireworms, grape colaspis, seedcorn maggots, rootworms, billbugs, and white grubs may be present in sufficient numbers to cause stand reduction in some fields.

Some guidelines follow for predicting soil insect problems in corn and for determining the need to use a soil insecticide at planting time. The type of crop rotation greatly influences whether a soil insect problem will occur and what kind it will be. Weather, weeds, soil type, planting date, hybrid, tillage, and natural enemies also influence insect populations. Knowledge about soil insect damage in a particular field during previous years is also helpful because infestations tend to occur in the same fields and in the same area.

***Corn After Soybeans.*** The potential for soil insect problems in corn after soybeans is generally low, and the use of soil insecticides rarely pays. In most fields, a diazinon planter-box seed treatment will be adequate to protect against attack by seedcorn beetles and seedcorn maggots. Corn rootworms rarely cause damage to corn after soybeans.

White grubs are an occasional problem in east-central Illinois in corn after soybeans.

***Corn After Corn.*** The potential for rootworm damage is moderate to severe in the northern two-thirds of Illinois. A rootworm insecticide may be needed in most fields of corn after corn. Wireworms are occasionally a problem in the southern part of Illinois.

***Corn After Grass Sod.*** Wireworms and white grubs are potential problems. Apply a labeled soil insecticide at planting time.

***Corn After Sorghum/Sudangrass.*** Seedcorn maggot flies are attracted to decaying vegetation to lay their eggs in the spring. Sorghum/sudangrass residues will be plentiful, so there is some potential for seedcorn maggot damage. A planter-box treatment of diazinon or diazinon + lindane will protect the corn seeds against seedcorn maggots. Scout the fields for cutworms as the corn emerges. Corn rootworms are rarely a problem where corn follows sorghum/sudangrass.

***Corn After Legumes.*** Cutworms, grape colaspis, grubs, and wireworms occasionally damage corn planted after clover and alfalfa. In addition, adult northern corn rootworms are sometimes attracted to legumes or to blooming weeds in legumes for egg laying, particularly in years when beetles are forced to leave adjacent fields of drouth-stressed corn to seek food. A soil insecticide that controls the cutworm-rootworm complex should be considered for this cropping sequence.

***Corn After Small Grain.*** There is a slight potential for damage by wireworms, seedcorn beetles, and seedcorn maggots in corn after small grain, particularly wheat. In most instances, a diazinon + lindane planter-box seed treatment will be adequate. If wireworms are present, use a soil insecticide at planting time. Excessive weed cover in small grain stubble fields may have been attractive to northern corn rootworm beetles for egg laying as the beetles moved from adjacent fields of drouth-stressed corn.

## CORN ROOTWORM SITUATION

### Problem Area

The potential for rootworm damage to corn following corn is greatest in the northern two-thirds of the state. Populations of northern and western corn rootworm beetles were much higher during 1983 than in 1982. Moderate to severe damage to corn roots by larvae may occur in continuous corn anywhere in Illinois.

### Determining Potential

Corn growers should base the need for using a rootworm soil insecticide in 1984 on the abundance of rootworm beetles in cornfields during late summer of 1983. If beetle numbers reached or exceeded one per plant at any time during late July, August, or September, 1983, plan to apply a rootworm soil insecticide if the field is to be replanted to corn in 1984.

Fields of corn planted in late May or June, 1983, may have extensive rootworm damage if replanted to corn in 1984. During August and September, rootworm beetles are especially attracted to late planted or late maturing fields. Seeking fresh pollen and silks to feed on, the beetles lay millions of eggs in these fields. The

heavy infestations may overwhelm even the most effective soil insecticide. Planting the fields to a crop other than corn in 1984 is suggested to reduce the rootworm population.

## SUGGESTIONS FOR ROOTWORM CONTROL, 1984

### Crop Rotation

Crop rotation is an extremely effective way to prevent damage by northern and western corn rootworm larvae. If feasible, do not grow corn two years in succession in the same field. First-year corn following soybeans will generally not require a soil insecticide for rootworm control.

Although rootworm beetles can be found in "clean" or weed-free soybean fields, and may even lay a few eggs there, the number of eggs is not great enough to warrant the use of a soil insecticide on corn the following season. In a few instances, rootworm larval damage has occurred to corn planted after soybeans when the bean field had been heavily infested with volunteer corn or weeds during August. Adult northern and western corn rootworms were attracted to these weedy soybean fields to deposit eggs. As a result, root damage by larvae occurred the following season. Good weed control in soybeans will prevent rootworm damage in corn following soybeans. Soybean fields with 5,000 or more volunteer corn plants per acre will usually warrant treatment for rootworm control the following year if planted to corn.

Corn rootworm beetles deposit the vast majority of their eggs in cornfields. The larvae cannot survive on the roots of broadleaf crops (soybeans or alfalfa) or broadleaf weeds. Consequently, when a crop other than corn, soybeans for example, is planted in a field with soil containing millions of rootworm eggs, the rootworm larvae die before becoming egg-laying beetles.

### Soil Insecticides

The suggestions for rootworm control that follow are based on research conducted by entomologists in Illinois and other states.

***At Planting.*** Apply Broot 15G, Counter 15G, Dyfonate 20G or 4EC, Furadan 15G or 4F, Lorsban 15G, Mocap 10G or 15G, or Thimet 20G in a 7-inch band ahead of the planter press wheel at the suggested rate (see Table 2). Counter 15G has provided the most consistent control of rootworm larvae in recent years. IMPORTANT: Read the suggestions in the section on alternating rootworm soil insecticides.

Soil insecticides will give 50 to 70 percent control of corn rootworm larvae. This degree of control is adequate to prevent economic levels of larval damage in most fields. But in some heavily infested fields enough larvae may survive to cause economic levels of root damage, and beetle populations may be large enough to interfere with pollination.

Planting-time treatments applied in early April may provide only marginal control. Consider a cultivator application in late May or early June in such fields, rather than a treatment at planting time.

*Liquid formulations.* Dyfonate 4E or Furadan 4F may be mixed with water and applied as a spray in a 7-inch band ahead of the press wheel. They may also be mixed with liquid fertilizer and used with a split-boot applicator at planting.

*Incompatibility or crop injury* may be a problem in treatments using a liquid insecticide with a liquid fertilizer at planting. The insecticide *must* be compatible with the fertilizer. Conduct a test before planting to make certain that the two are physically compatible. Maintain agitation in the tank after mixing and during application to prevent separation. **Use caution when handling liquid insecticide formulations.**

**Table 2. Soil Insecticides Suggested For Rootworm Control, Illinois, 1984**

| Insecticide[a] | Time of application | Ounces of product per 1,000 ft. of row | Amount of product needed per acre | | | |
|---|---|---|---|---|---|---|
| | | | 40″ rows | 38″ rows | 36″ rows | 30″ rows |
| Broot 15G | At planting | 8 | 6.7 lb. | 7.0 lb. | 7.4 lb. | 8.7 lb. |
| Counter 15G | At planting or cultivation | 8 | 6.7 lb. | 7.0 lb. | 7.4 lb. | 8.7 lb. |
| Dyfonate 20G | At planting or cultivation | 6 | 5.0 lb. | 5.3 lb. | 5.6 lb. | 6.7 lb. |
| Dyfonate 4E | At planting | 2.4 fl. oz. | 2 pints | 2⅛ pints | 2¼ pints | 2¾ pints |
| Dyfonate 4E | Preplant | Broadcast | 3 quarts | 3 quarts | 3 quarts | 3 quarts |
| Furadan 15G | At planting or cultivation | 8 | 6.7 lb. | 7.0 lb. | 7.4 lb. | 8.7 lb. |
| Furadan 4F | At planting or cultivation (†) | 2.4 fl. oz. | 2 pints | 2⅛ pints | 2¼ pints | 2¾ pints |
| Lorsban 15G | At planting or cultivation | 8 | 6.7 lb. | 7.0 lb. | 7.4 lb. | 8.7 lb. |
| Lorsban 4E | At cultivation | 2.4 fl. oz. | 2 pints | 2⅛ pints | 2¼ pints | 2¾ pints |
| Mocap 10G | At planting or cultivation | 12 | 10.0 lb. | 10.5 lb. | 11.1 lb. | 13.3 lb. |
| Mocap 15G | At planting or cultivation | 8 | 6.7 lb. | 7.0 lb. | 7.4 lb. | 8.7 lb. |
| Thimet 20G | At planting or cultivation | 6 | 5.0 lb. | 5.3 lb. | 5.6 lb. | 6.7 lb. |

[a] Consult text for more information. LIQUID FORMULATIONS ARE HIGHLY TOXIC.

**Table 3. Labeled Uses of Soil Insecticides on Corn**

| Insecticide | Field corn | Popcorn | Sweet corn | Silage | Grain harvest interval |
|---|---|---|---|---|---|
| Broot | yes | yes | no | yes | 90 |
| Counter | yes | yes | yes | yes | * |
| Dyfonate | yes | yes | yes | yes | 30 |
| Furadan | yes | yes | yes | yes | * |
| Lorsban | yes | yes | yes | yes | * |
| Mocap | yes | no | yes | yes | * |
| Thimet | yes | no | yes | yes | 30 |

* No restriction when used according to label.

***At Cultivation.*** Apply Counter 15G, Lorsban 15G or 4E, Dyfonate 20G, Mocap 10G or 15G, Furadan 15G or 4F (†), or Thimet 20G on both sides of the row at the base of the plants just ahead of the cultivator shovels. Cover the insecticides with soil. The best time to apply a basal treatment of a soil insecticide by cultivator is in late May or early June, near the beginning of egg hatch. Such treatments may be more effective than treatments at planting time in early April.

***Suggestions For Alternating Rootworm Soil Insecticides.*** Consider the following suggestions for alternating rootworm soil insecticides:

1. Consider alternating an organophosphate with a carbamate. Keep in mind, however, that growers generally have had no advance warning of poor control where problems have occurred. Rootworm control with Furadan has been erratic in recent years. Furadan has performed effectively at some research locations and has been marginal or ineffective at others.
2. If a carbamate (Furadan) was used in 1983, switch to an organophosphate (Counter, Dyfonate, Mocap, Lorsban, or Thimet) in 1984.
3. Rootworm control with Furadan should be satisfactory in fields where it has never been used before.
4. Do not use Furadan if rootworm control with Furadan was poor or marginal in recent years.

The advantages of switching from an organophosphate to a carbamate are not always apparent from the research, even where an organophosphate has been used for several consecutive years. But switching from one organophosphate to another may have some merit. The continuous use of any one insecticide may possibly lead to problems caused by microbial degradation of the insecticide or insect resistance. To avoid this possibility, consider switching rootworm insecticides occasionally rather than using one product year after year. A word of caution, however, about rotating soil insecticides: in some instances, rotation of soil insecticides has not given good results. The performance of an insecticide that gives only fair control of rootworms will not be improved by rotation with other insecticides.

***Soil Insecticide Failures.*** Many factors interacting with one another can affect the performance of a soil insecticide. Heavy rains immediately following planting hasten the decomposition of soil insecticides and reduce control. Lack of rainfall may prevent the activation and movement of the insecticide from the soil surface to the area where rootworm larvae are feeding. Early planting is another problem, because soil insecticides applied in early to mid-April may have lost much of their potency by the time rootworm eggs hatch in late May and June. Hence, late hatching larvae have a high survival rate, and ultimately the number of beetles is large. These factors, coupled with insecticide rates that are too low, often cause poor or marginal rootworm control. In addition, some research indicates that the erratic performance is due to microbial degradation of the soil insecticide and to increasing tolerance of rootworm larvae.

***Amaze Situation.*** Amaze 20G, a relatively new rootworm soil insecticide, gave poor control of rootworm larvae in a number of farmers' fields in northwestern Illinois and in some fields and research plots in Wisconsin and Indiana in 1983. The problems with Amaze in 1983 were completely unexpected. The cause(s) for poor rootworm control with Amaze were not identified at the time this circular was prepared (October). Consequently we will not recommend Amaze 20G for corn soil insect control in Illinois for 1984 unless the manufacturers provide information that will ensure us that the problem has been solved.

### Scouting to Determine Rootworm Potential

The abundance of rootworm beetles in a cornfield in July and August is an excellent indicator of future rootworm problems. Corn growers can determine the potential for rootworm damage in 1985 by counting western and northern corn rootworm beetles from mid-July through August, 1984, in this way:

1. Make 3 or more counts for western and northern corn rootworm beetles at 7- to 10-day intervals between mid-July and late August in fields to be replanted to corn.
2. Examine 10 plants selected at random in each of 5 areas of the field. Count all of the western and northern corn rootworm beetles on 50 plants each time. The counts take about 45 minutes in a 40-acre field.
3. As you approach a plant, move quietly to avoid disturbing the beetles. Count the beetles on the entire plant, including the ear tip, tassel, leaf surface, and behind the leaf axils.
4. Record the number of beetles you find per plant. If the average is more than one beetle per plant for any sampling date, plan to apply a rootworm soil insecticide in 1985. If average populations range from ½ to 1 beetle per plant, the probability of economic damage the following year is low, and a soil insecticide is likely

to be unnecessary. If populations do not exceed an average of ½ beetle per plant for any sampling date, a soil insecticide will not be needed the following season.

### Rootworm Life Cycle

Western and northern corn rootworm beetles deposit their eggs in the soil at the base of the corn plants or between rows during August and September. The eggs overwinter in the soil and begin hatching in late May. Egg hatch usually takes place over a period of 3 to 5 weeks. Consequently, in July and August all stages of the corn rootworm — egg, larva, pupa, and adult — may be found. The rootworm larvae feed on the roots of corn plants during June, July, and August. When a larva is fully grown (½ inch), it builds a cavity in the soil and goes into the pupal or resting stage. After 5 to 10 days, the beetle emerges from the soil. The development from egg hatch to adult emergence takes 27 to 40 days. After the females emerge from the soil and mate, 14 days or more elapse before they begin laying eggs. Rootworm beetles may deposit as many as 1,000 eggs; an average of 500 per female is probably common. Most egg laying in Illinois occurs after August 1.

## CORN CUTWORMS

The occurrence and extent of cutworm infestations are difficult to predit each year. *Sandhill, dingy,* and *claybacked cutworms* all overwinter in Illinois as partially grown larvae, but their populations are seldom widespread. As a result, they cause damage early in the growing season in scattered areas. Sandhill cutworms are a problem in sandy areas almost every year. Dingy and claybacked cutworms occur more frequently in corn planted after sod or forage legumes than in other crop rotations.

*Black cutworms* do not overwinter in Illinois, so outbreaks are difficult to forecast. Infestations of black cutworm larvae arise from eggs laid by moths that fly into Illinois in the early spring. A statewide program of monitoring black cutworm pheromone traps provides information about the time and intensity of spring moth flights.

Certain factors favor black cutworm outbreaks. The most important factors may be late planting and preplant weed infestations. Fields that are tilled and planted late are more likely to develop a preplant weed infestation than fields that are planted early. These late-planted fields with weeds are more attractive to cutworm moths as a site on which to deposit their eggs.

Currently, three options are available for cutworm control: preplant or planting-time applications of soil insecticides to prevent damage and rescue treatments after the infestation appears. All have limitations.

Because of the uncertainty in predicting which fields will have light, moderate, or heavy infestations of cutworms, it may be more feasible to use rescue treatments for cutworm outbreaks rather than to use a preplant or planting-time treatment unnecessarily.

Based on the relatively low incidence of cutworm problems over the past 25 years, a grower may find an economic advantage to the wait-and-see system, which involves field scouting, rather than a costly always-apply program in which the soil insecticide is routinely applied at or before planting for a problem that may not exist.

*Rescue (or emergency) treatments* to control outbreaks of cutworms include sprays of Lorsban, Pydrin, Sevin, or Proxol or Dylox, or Sevin pelletized bait. Broadcast the pelletized bait on the surface, but do not incorporate. Lorsban and Pydrin sprays should also be broadcast. Sprays of Sevin may be banded over the row or broadcast, but the rates need to be increased if the sprays are broadcast. Dylox or Proxol sprays should be banded.

The keys to effective cutworm control with the rescue treatments are the amount of surface moisture and the movement of the worms. Control may be poor, regardless of the insecticide used, if the topsoil is dry and crusted and the worms are working below the soil surface. When the soil is dry, the high rate of Lorsban or Pydrin is recommended.

To determine the need for rescue treatments, scout the fields during plant emergence, particularly those fields considered to be high-risk. Early detection of leaf-feeding or of cutting by cutworms is vital. When the corn plants are beginning to emerge, check the fields for leaf-feeding, cutting, wilting, or missing plants. Small cutworm larvae (less than ½ inch) feed on the leaves and do not begin cutting plants until they are about half grown.

A control measure is needed on corn in the 2-leaf stage if 3 percent or more of the plants are cut and if there are 2 or more cutworms per 100 plants. At the 4-leaf stage, control is justified if 3 percent or more of the plants are cut and if there are 4 or more worms per 100 plants. A single cutworm will cut fewer of the 4-leaf plants than those in the 2-leaf stage.

*Planting-time treatments* of Lorsban 15G, Mocap 10G or 15G, Dyfonate 20G, and Counter 15G are registered for the control of cutworms in corn. The Mocap label states that Mocap will "control light to moderate infestations of black and sandhill cutworms"; Dyfonate is labeled for "suppression of black cutworms"; Counter is labeled for "suppression of cutworms." Some growers may want to use one of these products in fields with a history of cutworm problems or in high-risk fields. Lorsban has provided the best cutworm control in research trials during the past few years. Research also indicates that planting-time treatments are relatively effective in controlling light to moderate infestations, but control may be unsatisfactory for heavy infestations.

*Preplant broadcast treatments* of Lorsban 4E and Dyfonate 4E are also registered for corn cutworm control. Lorsban is labeled at rates of 1 to 2 quarts per acre;

the higher rate is suggested. Dyfonate is labeled for "suppression of black cutworms" at 4 quarts per acre. Both insecticides should be incorporated into the top 2 to 4 inches of soil immediately after application.

*Replanting* may be required if cutworm damage is extremely severe. Before replanting apply Lorsban 4E as a broadcast spray at 3 to 4 pints per acre, and incorporate the insecticide into the top 2 to 4 inches of soil. Or you can apply a labeled granular insecticide. If the cutworm infestation is heavy, the Lorsban spray will be more effective.

## WIREWORMS

Wireworms may attack the seed or drill into the base of the stem below ground level, damaging or killing the growing point. Damage will show up as wilted, dead, or weakened plants and spotty stands. Wireworm larvae are yellowish-brown and wirelike; several species are known to attack corn. They live for two to five years in a field in the larval stage, feeding on the roots of grasses and crops. There is often a relationship between crops that were in the field two to four years before damage to the corn. Most reports of damage to corn have been in fields where corn follows soybeans or where there has been a corn-soybean-small grain rotation.

The adult (a click beetle) prefers to deposit its eggs in small-grain stubble or in grassy fields. Attempts to control wireworms with an insecticide rescue treatment after the damage appears are not very successful. Therefore, if an infestation is known to be present, insecticides must be applied at planting.

Wireworms are usually most damaging in bottomlands or in poorly drained areas on upland soils. Low spots in the field often have the heaviest populations.

The proportion of fields of corn affected by wireworms in Illinois is small (less than 1 percent) and does not justify the widespread use of a soil insecticide on first-year corn after soybeans. A diazinon + lindane planter-box seed treatment at planting may help deter the wireworms from attacking the seed but will not protect the seedling.

### Checking for Wireworms

A technique using baits has been developed for evaluating wireworm potential before planting. The bait stations should be established 2 to 3 weeks before the anticipated planting date. Fields where small grain or grasses have been grown the preceding 2 or 3 years are the best candidates for bait stations.

Since wireworm infestations are often localized within a field, it will be necessary to place the bait stations randomly throughout the field. One bait station per acre is desirable. As a minimum, place 2 stations at the highest elevation in a field, 2 on a slope, and 2 in the lowest area.

Follow this procedure for baiting:

1. Use a mixture of 1 cup of untreated wheat and 1 cup of untreated shelled corn at each station.
2. Bury the bait about 4 inches deep. It is also desirable to cover the ground over each bait station with an 18-inch square of black plastic. The plastic collects solar heat and speeds germination of the corn and wheat, which entices overwintering wireworms.
3. Mark each station with a flag or stake.
4. Dig up the bait stations in 10 to 14 days and count the number of wireworms.

### Need for Treatment

If you find an average of one wireworm per bait station, use a labeled soil insecticide. In some instances, several wireworms may be found in one bait station and none in others. Wireworm infestations tend to concentrate in some locations. It may be possible to limit treatment to areas where the concentration is heaviest.

## WHITE GRUBS

Several species of economically important white grubs have 3-year life cycles. Peak years of damage usually occur during the year following large flights of May beetles, the adult stage of white grubs. The beetles prefer to lay their eggs in ground covered with vegetation, such as weedy soybean fields and sod.

The C-shaped white grub larvae chew on the roots and root hairs of corn seedlings. During peak years of damage, the grubs feed all season long. Damage to a cornfield is most apparent in the spring. Symptoms of white grub injury visible aboveground are irregular emergence, reduced stands, and stunted or wilted plants. The damage is usually spotty throughout the field.

There are no effective rescue treatments for white grubs after the damage appears. However, if plants show symptoms of injury, dig around the root system of several corn plants. If white grubs are causing the problem and replanting is warranted, use a labeled soil insecticide.

## PLANTER-BOX SEED TREATMENTS

***Corn.*** Use a seed treatment in fields that do not receive a soil insecticide at planting time. A planter-box seed treatment with diazinon will protect germinating corn against attack by seedcorn beetles and maggots. A diazinon + lindane planter-box seed treatment protects seed from attack by seedcorn maggots, seedcorn beetles, and wireworms. Lorsban 50-SL is labeled as a slurry treatment on seed before planting to protect germinating seed against injury by seedcorn maggots and beetles. NOTE: Excess dust from the seed treater may interfere with the electronic monitor in air planters.

***Soybeans.*** Use a diazinon or diazinon + lindane seed protectant to prevent damage to germinating soybeans from seedcorn maggots. Follow the label directions for application. The potential for damage is greatest during cool, wet springs when germination is slow.

### EUROPEAN CORN BORERS

Corn borer moths begin to emerge in late May in southern Illinois and mid- to late June in the central and northern regions. The females lay most of their eggs in the evening. They spend the daylight hours in fencerows and other protected areas.

*First-generation borers* reduce yields by stalk-tunneling, which weakens the plant and destroys the tissue used to transport food within the plant.

Corn that is planted early (the fields with the tallest corn) should be monitored closely from mid-June to early July for signs of whorl-feeding by corn borer larvae. The fields with the tallest corn are the most attractive to moths laying eggs for the first generation. Control is warranted if 50 percent or more of the plants have fresh whorl-feeding, if live borers are present, and if plants are 24 or more inches tall (with the leaves extended). Seed production fields should be treated when 15 to 25 percent of the plants have whorl-feeding and larvae are present.

Corn hybrids have varying degrees of tolerance or resistance to leaf-feeding by first-generation borers. Consider this trait when selecting varieties for 1984.

Corn planted late is most attractive to moths laying eggs for the *second generation.* Yield losses caused by second-generation borers are a result of stalk breakage and ear drop, as well as physiological damage. Corn-borer entrance holes also provide avenues for stalk rot organisms. Monitor fields from mid-July to mid-August for egg masses or newly hatched larvae of the second brood.

To assess the potential for second-generation corn borer, start checking for egg masses when moth flight is underway. Examine a minimum of 25 plants, selected at random throughout the entire field, and count the number of egg masses that are found on each plant. Although the moths usually lay their eggs on the two or three leaves above or below the developing ear, you should check all the leaves. One technique is to remove the leaves one by one, starting at the bottom of the plant, and carefully scan them for egg masses.

The eggs, which are deposited in masses of 15 to 30, overlap like the scales of a fish. Calm nights favor egg deposition by the moths. The absence of hard, beating rains during moth emergence also increases the potential for infestations.

Egg masses are flat and about half the size of your little fingernail. Newly deposited eggs are white, then turn pale yellow, and become darker just before hatching. Eggs that are about to hatch have distinct black centers. These are the black heads of the larvae that are visible through the translucent eggshell. The eggs hatch in 3 to 7 days, depending on the temperature. The female moth hides in grass and weeds during the day. Noncrop areas that border cornfields may harbor large numbers of corn borer moths during the day. Check these areas for moths as you enter the field to determine the amount of corn borer infestation.

Treatment is warranted when you find 1 egg mass for every two plants. Because peak egg laying generally occurs over a period of 2 to 4 weeks, it will be necessary to resample fields if egg masses are not present on half of the plants during the initial survey. If cumulative counts (taken 1 week apart) exceed 1 egg mass for every two plants, apply a treatment.

For best results, treatment should be applied soon after egg hatch to kill the young larvae before they bore into the plant. The larvae begin tunneling into the stalks about 10 days after hatching. Because egg laying for the second generation extends over a 3- to 4-week period, timing of insecticide application should be precise. Occasionally, two treatments may be necessary for satisfactory control.

### CORN LEAF APHIDS

Corn leaf aphids are small, soft-bodied, greenish-blue plant lice about the size of a pinhead. They do not overwinter in Illinois. Winged corn leaf aphids, blown into Illinois on southwesterly winds during mid- to late June, become established within the whorl leaves of the corn plant. These aphids give birth to living young. In the absence of predators, parasites, diseases, and hard beating rains, aphid populations may increase very rapidly.

Corn leaf aphids cause damage by sucking moisture and nutrients from the corn plant. Soil moisture stress and heavy infestations on the upper leaves and tassel may result in barren plants or reduced ear size. The critical period for damage is during tassel emergence through pollination. If aphids are allowed to cover the tassel and upper two or three leaves, yield losses are likely to occur.

Fields should be scouted for aphids beginning about one week before tassel emergence. Pull and unroll the whorl leaves of plants selected at random to check for aphids. Treatment is suggested if 50 percent of the plants have 100 or more corn leaf aphids per plant during tassel emergence and if *plants are under drouth stress.* Aphid populations usually decline after pollination is complete. However, treatment may be warranted following pollination if aphid populations continue to cover the tassel and one or two of the upper leaves.

### REDUCED TILLAGE AND NO-TILL INSECT PESTS

Concern about insect problems should not keep growers from adopting conservation tillage practices. The soil-insect complex in corn, which is similar in many ways for conventional and reduced-tillage systems, can be readily controlled by applying soil insecticides at planting time. Outbreaks of insects feeding on foliage can usually be controlled with properly timed treatments

of insecticides. Close monitoring of fields to detect insect outbreaks is very important, regardless of the tillage system.

Weather conditions and the type of crop rotations determine to a great extent whether a soil insect problem will occur and what kind it will be. In some instances, tillage may also influence the kind and abundance of an insect pest. Some tillage operations favor specific pests. Others tend to reduce pest problems. The general expectation is that insect infestations will be more pronounced where no-tillage is used in corn than where conventional or reduced-tillage systems are used.

#### No-Till Pests

Insect problems occur more frequently in no-till corn than in any other conservation tillage system and are often more serious. Crop residue left by the use of no-till practices provides a stable environment for pest survival and development. Pest problems occurring under these conditions include *European corn borer, cutworms, armyworm, common stalk borer, wireworms, seedcorn maggots, billbugs, slugs,* and *mice.* Soil insecticides may be needed on no-till corn following corn (in rootworm area), grass sod, legumes, or following any crop in which grasses and broadleaf weeds are prevalent.

#### Soil Insect Control

Select a soil insecticide that will control the anticipated soil insect pest. Consult Table 5 for suggestions. If a soil insecticide is not applied at planting, a diazinon planter-box seed protectant will give protection against seedcorn maggots and seedcorn beetles.

Surface residues from no-till and reduced-tillage systems may present some problems with the placement and incorporation of granular soil insecticides applied at planting. To be most effective, the soil insecticide should be incorporated into the upper ½ inch of soil, and not just broadcast on the surface. Granules remaining on the soil surface are degraded by sunlight, resulting in erratic or poor control.

NOTE: Before using Broot, Mocap, Dyfonate, or Thimet on no-till corn, be sure that soil moisture is low enough to ensure closing of the seed furrow to prevent the insecticide granules from contacting the seed. Crop injury may occur with these products.

#### Aboveground Insect Pests

Aboveground insects will be more of a problem in no-till corn than under reduced or conventional tillage. Corn planted in grass sod or fall-seeded rye is vulnerable to attack by *armyworms.* The moths lay eggs on the grasses during April or early May. After vegetation is killed by a herbicide, the larvae move to the young corn seedlings and feed on them. Control is justified when 25 percent of the plants are being damaged. Rescue treatments are effective, but a spray volume of 15 to 20 gallons per acre will improve coverage and control.

Instances of damage to corn by the *common stalk borer* have been greater in no-till corn than with other tillage systems. Moths of this insect deposit their eggs on weeds in late August and September. When a herbicide is applied in the spring to no-till corn in fields previously infested with host weeds, the newly hatched stalk borer larvae move from the dead vegetation and attack newly emerging corn plants. Rescue treatments may give erratic control of common stalk borer because the chemicals cannot reach the worms inside the stem. To reduce the potential of stalk borer damage in a subsequent season, it is essential to practice good weed control within a field during August and September, when moths are laying eggs.

Noninsect pests in no-till corn include *slugs* and *mice.* There are no effective control measures for slugs. Mouse damage may be a severe problem, particularly in corn following sod. To reduce or prevent mouse damage to corn, use a hopper-box seed treatment of Mesurol 50 percent bird repellent at the rate of 1 pound per 100 pounds of seed corn. This product has a state label.

### FORAGE INSECTS

*Alfalfa weevils* may cause moderate to severe damage to the first cutting of alfalfa in most areas of Illinois. In the southern counties, where a lot of egg laying takes place in the fall, alfalfa-weevil larval damage occurs early in the spring. Damage to the first cutting in northern Illinois is more likely to occur if hay harvest is delayed. Otherwise, the injury to alfalfa in the northern counties will occur on the stubble and new growth of the second cutting.

Numbers of alfalfa weevils are regulated to a large extent by winter weather. During a cold, open winter the mortality rate is high in overwintering weevil populations; during mild winters the mortality rate is low.

A parasitic wasp and a fungal disease organism that attack alfalfa weevil larvae sometimes regulate weevil numbers in the spring. Although the wasp and the fungus will be present in alfalfa fields in 1984, we cannot yet predict their effect on weevil numbers.

Alfalfa growers in southern and central Illinois should inspect their fields closely in April, May, and June. Early larval damage appears as pinholes in the growing terminals. As the larvae grow, they skeletonize the leaves, and damaged fields appear tattered. Growers in northern Illinois should look carefully for larval damage in May and June. All growers should examine the stubble after the first cutting, because larval and adult feeding can slow or halt new growth. Follow the suggestions in Circular 1136, "Alfalfa Weevil Pest Management Program," to determine the need and proper timing of a treatment. If this circular is unavailable, a rule of thumb is to treat when 25 percent of the tips are being skeletonized. This threshold is 40 percent in northern Illinois where damage occurs later in the season.

*Potato leafhoppers* may cause moderate to severe damage to the second and third cuttings of alfalfa in all areas of Illinois. Populations of leafhoppers were very large in 1983, and many acres of alfalfa were injured severely. Damaged alfalfa was stunted and turned yellow or brown. Many people confuse the damage with diseases or nutrient deficiency.

Damage first appears as a yellow, wedge-shaped area at the tip of the leaf and is more evident during dry weather. However, population levels are difficult to predict because the leafhoppers do not survive the winter in Illinois. They migrate from southern states into Illinois during May and June.

Potato-leafhopper damage may begin on the new growth as soon as the first hay crop is removed. Stunting and yellowing are signs of leafhopper injury. A swarm of leafhoppers at the time of the first cutting indicates that there may be a problem in the new growth. The economic threshold for potato leafhoppers varies with the height of the alfalfa (see Table 4). A treatment is justified when the number of leafhoppers exceeds the economic threshold.

**Table 4. Economic Thresholds for Potato Leafhoppers on Alfalfa**

| Alfalfa height (inches) | Average number of leafhoppers per sweep of sweep net |
|---|---|
| 0-3 | 0.2 |
| 3-6 | 0.5 |
| 6-12 | 1.0 |
| 12 or taller | 1.5 |

### BEAN LEAF BEETLES

Bean leaf beetles overwinter as adults under debris in fencerows, wooded areas, and other protected sites. The survival of the overwintering beetles depends on the winter weather. A mild winter increases the chances for a large population in the spring. In addition, if soybeans are planted early in 1984, the beetles will establish themselves early. The availability of soybeans during the early part of the season is essential for the survival of bean leaf beetles. The survival of large numbers early in the season generally means an even larger population in August. On the other hand, a severe winter and later planted soybeans will reduce the number of bean leaf beetles in the spring.

The beetles may cause considerable leaf-feeding injury to double-cropped soybeans and late maturing soybean varieties. Insecticide treatments are recommended during the critical pod-set and pod-fill stages when defoliation exceeds 20 percent. The greatest concern, however, is caused by the beetles' pod-feeding damage, which leaves scars on many pods. These scars predispose the pods to fungal infections. A treatment is recommended when 5 to 10 percent of the pods are damaged.

### CHEMICAL INJURY TO SOYBEANS

There have been instances of phytotoxicity to soybeans when organic phosphate soil insecticides were used. The problems have occurred where growers started planting soybeans without first emptying the insecticide boxes. Organic phosphate soil insecticides applied in soybean fields treated with Sencor or Lexone may result in injury to a soybean crop, according to information on the labels.

### CALIBRATION FOR GRANULAR SOIL INSECTICIDES

Calibrate the applicators for granular soil insecticides before the planting season begins. In some instances, poor control is caused by applying rates that are too low. Proper calibration will help avoid this problem. Most soil insecticide bags have a list of suggested settings for the particular model of applicator. The settings are based on planting speed. The *beginning settings* are helpful, but be sure to check your actual application rate under your own operating conditions.

Follow these steps for calibrating the applicator:

1. Calibration of granular applicators for soil insecticides is usually based on determining how many ounces of product are needed per 1,000 feet of row. Consult the insecticide label or Table 2 for labeled rates for rootworm control. These rates are expressed in ounces per 1,000 feet of row and in pounds of product per acre.
2. Consult the label or manufacturer's recommendation for an approximate application setting. Adjust the setting on each hopper.
3. Select an area for a test run, preferably in the field, so that speed and traction conditions are constant. Measure off 1,000 feet.
4. Fill the hoppers and attach a plastic bag or container to each delivery tube to catch the granules from each hopper.
5. Drive the premeasured distance (1,000 feet) at the same speed to be used during the planting operation.
6. Weigh the material collected from each hopper. Use a scale that weighs in ounces (e.g., a postal scale or a diet scale).
7. Compare the quantity (ounces) per bag against those given in Table 2. To obtain one pound of active ingredient per acre the following amounts of material should be collected:

| Formulation, percent | Oz. collected per 1,000 ft. |
|---|---|
| 10 | 12 |
| 15 | 8 |
| 20 | 6 |

8. Recalibrate if the difference in quantity applied during the calibration process is more than 10 percent over or under the rate suggested on the label.

## MANAGING INSECT PESTS IN STORED GRAIN

This section describes a program for preventing insect problems in stored grain. For more details on insecticides, rates, and methods of application, see Table 11.

Store only clean, dry grain. Its moisture content should be 13 percent or less; it should be cooled below 50°F as soon as possible; and foreign material should be kept to a minimum. Do not mix new grain with old grain. If grain is to be stored one month or more between May and October, follow the procedures listed below.

### New Grain (Wheat, oats, shelled corn, sorghum, barley, rye, and sunflowers)

1. Thoroughly clean in, around, and under the bin and clean grain-handling equipment before harvest. Collect the first few bushels coming through the combine and feed to livestock. Clean up seed storage areas, feed rooms, hay mows, and other areas where insects may be present.

2. Spray the walls, ceiling, and floor of the bin to runoff with 2.0 percent malathion; use 4 ounces of the 50 to 57 percent EC per gallon of water. For best results make the application 2 weeks before storage of the grain.

3. Treat the grain with malathion. Mix 1 pint of malathion 50 to 57 percent EC in 2 to 5 gallons of water and spray the mixture as uniformly as possible over each 1,000 bushels. Treat the grain as it is being augered or elevated into the bin. An alternative is to apply 10 pounds of 6 percent, 15 pounds of 4 percent, or 30 pounds of 2 percent malathion dust (wheat flour) per 1,000 bushels. Do not treat the grain with malathion until after it is heat dried. This treatment is effective for about 12 months.

4. In order to protect the grain from Indian meal moths, which are resistant to malathion, follow either Step A or Step B.

***Step A.*** Hang one dichlorvos resin strip per 1,000 cubic feet of overspace in enclosed bins and replace the strips every 6 weeks. In open bins use the dichlorvos resin strips under a raised tarp.

***Step B.*** An alternative to the dichlorvos strip is *Bacillus thuringiensis* (Dipel, Topside, SOK-BT). Apply it as a wettable powder (1 pound per 10 gallons of water) or liquid concentrate (4 pints per 10 gallons of water) at 0.6 pint per bushel to the top 4 inches of grain as it is augered into the bin. A dust formulation of *Bacillus thuringiensis* is available and should be applied at ½ ounce per bushel on the top 4 inches of grain as it is binned. Level the surface of the grain after treatment.

Although best results are obtained when the *B.t.* is applied to the grain as it is going into storage, the *B.t.* can also be applied after the grain is binned. Apply one third of the dosage over the entire surface and rake it in with a garden rake to a depth of 4 inches. Follow the same procedure for the second one third of the dosage, and rake at a 90° angle to the first raking. Apply the last one third over the surface and leave it undisturbed.

5. Spray the surface of the grain with malathion. Add 4 ounces of malathion 50 to 57 percent EC to 1 gallon of water. Apply at a rate of 2 gallons of finished spray per 1,000 square feet. An alternative is to apply malathion 6 percent dust at 5 pounds, the 4 percent dust at 7.5 pounds, or the 2 percent dust at 15 pounds per 1,000 square feet. The surface treatment will help prevent infestation by insects entering bins through the top vent. Do not rake this treatment into the surface grain.

6. Cool the grain below 50°F as soon as possible. Insect reproduction ceases below 60°F, and feeding stops below 50°F.

7. Reinspect the grain at regular monthly intervals. Insert metal rods or a temperature probe down through the center of the grain to check for "hot spots."

### Soybeans

Clean the bin and grain-handling equipment before harvest, and spray the walls, ceiling, and floor of the bin as suggested for new grain in step 2. If soybeans are harvested before October 1 or carried over beyond May 15 of the following year, follow step 4 under "New Grain." Aluminum phosphide can be used to fumigate soybeans.

### Infested Grain

Explore the option of cooling the grain below 50°F until you are ready to sell it or feed it to livestock. Also consider screening the grain and marketing it to avoid treatment costs. Weigh the loss due to a discount against the cost of control. It may be that immediate marketing is best from an economic standpoint.

If the problem is only with Indian meal moth, an alternative to fumigation is to use both the *Bacillus thuringiensis* and dichlorvos resin strip treatments as suggested in step 4 under "New Grain."

As an alternative to fumigation, it may be possible to use a malathion protectant treatment. If the grain can be moved to a clean and sprayed bin, apply a spray of malathion to the grain as it is augered or elevated to the new bin. The spray is commonly applied from a 3-gallon tank sprayer. Mix 1 pint of 50 to 57 percent malathion in 2 to 5 gallons of water and spray the mixture on each 1,000 bushels. Although the malathion will not immediately kill insects that are inside the kernels, it will eventually provide effective control. Then follow steps 4 through 7 as suggested under "New Grain."

Infested grain that cannot be handled as suggested should be fumigated. Bins with a capacity of more than 5,000 bushels should probably be treated by a licensed, professional fumigator. See your county Extension adviser in agriculture for a list of licensed fumigators.

To do your own fumigation, follow these steps:

1. On a calm, warm day when the grain temperature is above 70°F, seal cracks and holes in the bin, paying particular attention to the base area around the doors and ventilating fan.
2. Level the surface of the grain, break up any caked or crusted areas, and remove webbing. The surface level of the grain should be at least 8 inches below the lip of the bin.
3. Spray the outside surface of the bin to runoff with a diluted spray of malathion. Mix 4 ounces of 50 to 57 percent malathion EC per gallon of water.
4. Apply a liquid fumigant at 3 to 5 gallons per 1,000 bushels. Use the higher rate on wooden bins and in flat storages. Place the containers on the surface, spacing them evenly. Loosen the caps slightly, then remove them, and invert the containers on the surface. *Get out of the bin within 30 seconds to one minute. Follow all directions and precautions on the label when using a fumigant. Wear protective clothing including the proper respirator. Have someone watching you from outside the bin as a safeguard.* It is better to apply the liquid fumigant uniformly over the surface as a coarse spray if you can do so from outside the bin.

Some common liquid fumigants are carbon bisulfide + carbon tetrachloride (80:20 mixture), and ethylene dichloride + carbon tetrachloride (75:25 mixture). Other liquid fumigants are available as alternatives to those mentioned. A dry fumigant called aluminum phosphide (Phostoxin, Detia, Fumitoxin, Gastoxin) may be used in place of the liquid fumigants. A special applicator is required to place the tablets or pellets in the grain mass. When handling the tablets, do not allow water to come in contact with them. Wear neoprene rubber gloves to prevent perspiration from contacting the tablets or pellets. Follow all label directions and precautions.

NOTE: Anhydrous ammonia is not suggested for fumigation of stored grains. It is generally ineffective against insects in stored grain at dosages below the point at which grain is blackened from exposure.

5. Put a tarp over wooden bins and bins treated with aluminum phosphide if you can do so safely.
6. Place signs at all entrances warning that the bin is being fumigated. List the fumigant used and the name, address, and telephone number of a responsible person to contact in case of emergency.
7. Close the bin for 72 hours and then air out. The empty containers should be removed from the bin after airing and disposed of properly.
8. Follow steps 4 through 7 as suggested under "New Grain."

### Carry-Over Grain

Beginning about May 15 in the southern half of Illinois and June 1 in the northern half of the state, follow these suggestions. Treat the grain (you need to move the grain) with malathion as directed in step 3 under "New Grain" as long as there has been no treatment of this kind within the last 12 months. If a malathion treatment is not possible, then monitor the grain for insects every 2 to 3 weeks from June to October. If insects are found, follow the suggestions given under "Infested Grain." In addition, follow steps 4 through 7 under "New Grain." Follow the same procedure for each succeeding year of storage.

**Table 5. Field Corn**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Armyworms | Furadan granules | 1[b] | Band, furrow | Apply Furadan 15G as a planting-time treatment for armyworms in corn planted no-till in grass sod or small grains. |
| | Dylox, Proxol | 1 | Broadcast | At first migration, or when worms are eating leaves above ear level. |
| | *Lannate, *Nudrin | ½ | | |
| | Lorsban | ½-1 | | |
| | malathion | 1 | | |
| | *Penncap-M | ½-¾ | | |
| | Sevin | 1 | | |
| Billbug | Counter | 1[b] | Band, furrow | At planting. |
| | Lorsban granules | 1[b] | Band | |
| | Lorsban spray | 2 | Broadcast-PPI[c] | |
| | Counter[d] | 1½[b] | Over row | Apply Counter granules over the row of seedling corn plants and incorporate; or apply Lorsban spray as a postemergence rescue treatment when damage appears. Apply rescue treatments with ground equipment. |
| | Lorsban spray | 1 | Broadcast | |

**Table 5. Field Corn (continued)**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Chinch bug | Lorsban | 1[b] | Spray at base of plant. | At start of migration from small grains. Use only ground equipment and apply 20 to 40 gallons per acre. |
| | *Pydrin | 0.1-0.2[b] | | |
| | Sevin | 2[b] | | |
| Common stalk borer | Furadan granules | 2-3[b] | Band, furrow Over row | Application of Furadan at planting time may provide early season suppression of common stalk borers. A postemergence spray of Pydrin may give some control if applied when damage first appears. |
| | *Pydrin | 0.15-0.2[b] | | |
| Corn earworm | *Lannate, *Nudrin | ½ | Over row | Justified only in seed corn fields. Insecticide applications are rarely effective for the control of earworms in commerical field corn after worms enter ear tips. |
| | *Penncap-M | ½-1 | | |
| | *Pydrin | 0.1-0.2 | | |
| Corn leaf aphid | Lorsban | ½ | On foliage | Apply during late whorl to early tassel when 50% of plants have light to moderate infestations and plants are under drouth stress. |
| | malathion | 1 | | |
| | *Penncap-M | ½ | | |
| Corn rootworm beetles | diazinon | ½ | Overall spray or directed toward ear zone | Before 75% of plants have silked, if there are 5 or more beetles per plant, and if silk clipping is observed. Only to protect pollination. Imidan is labeled for suppression of corn rootworm beetles. |
| | malathion | 1 | | |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.1-0.2 | | |
| | Sevin, Savit | 1 | | |
| Corn rootworm larvae | Broot | 1[b] | Band | For John Deere 7000 series planters, place Broot, Dyfonate, Mocap, and Thimet behind the firming wheels. Do not place Broot, Dyfonate, Mocap, or Thimet in direct contact with the seed. Basal treatments during cultivation with Counter 15G, Dyfonate 20G, Furadan 15G or 4F(†), Lorsban 15G or 4E, Mocap 10G or 15G, or Thimet 20G are effective in late May or early June. |
| | Counter | 1[b] | Band | |
| | Dyfonate | 1[b] | Band | |
| | **Dyfonate spray | 3 | Broadcast-PPI[c] | |
| | **Furadan | 1[b] | Band | |
| | Lorsban | 1[b] | Band | |
| | **Mocap | 1[b] | Band | |
| | Thimet | 1[b] | Band | |
| Cutworms | Lorsban granules | 1[b] | Band | At planting. Planting-time applications of Mocap 10G or 15G will control light to moderate infestations of black and sandhill cutworms. Dyfonate 20G applied at planting time will suppress black cutworms. Counter 15G applied at planting time will suppress cutworms. |
| | Lorsban spray | 1-2 | Broadcast-PPI[c] | |
| | Dylox, Proxol | 1[b] | Plant base | Apply as a postemergence rescue treatment when 3 percent or more of the plants are cut in the 2-leaf stage and there are 2 or more cutworms per 100 plants. At the 4-leaf stage, control is justified if 3 percent or more of the plants are cut and there are 4 or more worms per 100 plants. |
| | Lorsban spray | 1-1½ | Broadcast | |
| | *Pydrin | 0.1-0.2 | Broadcast | |
| | Sevin spray | 2[b] | Plant base | |
| | Sevin bait | 1-2 | Broadcast | |
| European corn borer, first generation | diazinon granules | 1 | On upper ⅓ of plant and into whorl | When 50% or more of the plants have fresh whorl-feeding, live borers are present, and extended leaf height is 24 inches or greater. |
| | Dyfonate granules | 1 | | |
| | Furadan granules | 1 | | |
| | Lorsban granules | 1 | | |
| | *Penncap-M | 1 | | |
| European corn borer, second generation | diazinon granules | 1 | On foliage | Apply at first hatch when half of the plants have egg masses, or when cumulative counts, made one week apart, exceed 1 egg mass for every 2 plants. |
| | Dyfonate granules | 1 | | |
| | Furadan granules | 1 | | |
| | Lorsban | 1 | | |
| | *Penncap-M | 1 | | |
| | *Pydrin | 0.2 | | |
| Fall armyworm | diazinon granules | 1 | On foliage | Treat when 35% of plants have whorl damage and if worms are present. Ground sprays directed over the row are more effective than broadcast sprays. Treatments to control worms in ear tips are not effective. |
| | Dylox, Proxol | 1 | | |
| | *Lannate, *Nudrin | ½ | | |
| | Lorsban | 1 | | |
| | Sevin, Savit | 2 | | |
| Flea beetles | diazinon | ½[b] | Over row as spray | When leaves on seedling plants are severely damaged and some plants are being killed. |
| | Lorsban | 1[b] | | |
| | *Penncap-M | ½[b] | | |
| | Sevin, Savit | 1[b] | | |
| | Counter | 1[b] | Band, furrow | At planting. |
| | Furadan | 1[b] | Band, furrow | |

**Table 5. Field Corn (continued)**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Garden symphylan | Counter | 1[b] | Band, furrow | At planting. |
| | **Dyfonate | 2 | Broadcast-PPI[c] | |
| | Lorsban granules | 1-1½[b] | Band | |
| | Lorsban spray | 1-2 | Broadcast-PPI[c] | |
| Grasshoppers | Cygon | ½ | On foliage | As needed. |
| | diazinon | ½ | | |
| | Lorsban | ¼-½ | | |
| | malathion | 1 | | |
| | *Penncap-M | ½ | | |
| | Pydrin | 0.1-0.2 | | |
| | Sevin | 1 | | |
| Hop vine borer | None labeled | . . | . . . | Postemergence sprays of Pydrin, Sevin, Nudrin, Lannate, or Lorsban may give some control if applied when damage first appears. |
| Japanese beetle | Sevin, Savit | 1 | On foliage | During the silking period to protect pollination if less than 75% of plants are silked and there are 3 or more beetles per ear. |
| Picnic, sap beetles | diazinon | 1 | On foliage | Justified only in seed corn fields. |
| | malathion | 1 | | |
| | Sevin | 1 | | |
| Seedcorn beetles | Counter | 1[b] | Band, furrow | At planting. |
| | **Dyfonate | 1[b] | Band | |
| | Lorsban | 1[b] | Furrow | |
| | Thimet | 1[b] | Band | |
| | diazinon | See label | On seed | Use formulations that are prepared as seed treaters. |
| | Lorsban | | | |
| Seedcorn maggots | Counter | 1[b] | Band, furrow | At planting. |
| | **Dyfonate | 1[b] | Band | |
| | Lorsban | 1[b] | Furrow | |
| | diazinon | See label | On seed | Use formulations that are prepared as seed treaters. Seed treatments should be considered for fields that do not receive a soil insecticide at planting. |
| | diazinon + lindane | See label | On seed | |
| | Lorsban | See label | On seed | |
| Sod webworm | None labeled | . . | At base of plant | At time of initial attack, sprays of Sevin or Lorsban may be effective. |
| Southwestern corn borer | diazinon granules | 1-2 | On foliage | Direct granules over row. Apply when 25% of the plants have egg masses or larvae on leaves. Early-planted corn usually escapes damage. |
| | Dyfonate granules | 1 | | |
| | Furadan granules | 1 | | |
| | Lorsban | 1 | | |
| | *Penncap-M | 1 | | |
| | *Pydrin | 0.1-0.2 | | |
| Spider mites | diazinon spray | ½ | On foliage | Begin control if the majority of plants are infested with mites severe enough to cause some yellowing or browning of the lower leaves before dent stage. |
| | Di-Syston granules[d] | 1 | | |
| | ethion spray[d] | 1 | | |
| | Thimet granules[d] | 1 | | |
| Thrips | malathion | 1[b] | On foliage | When severe wilting and yellowing of leaves are noticed. |
| White grubs | Counter | 1[b] | Band, furrow | At planting. |
| | Lorsban granules | 1[b] | Furrow | |
| | Lorsban spray | 1-2 | Broadcast-PPI[c] | |
| Wireworms | Counter | 1[b] | Band, furrow | Thimet and Dyfonate applied in a 7-inch band are labeled for suppression of wireworms. |
| | **Dyfonate | 4 | Broadcast-PPI[c] | |
| | Furadan granules | 2[b] | Band, furrow | |
| | Lorsban granules | 2[b] | Band, furrow | |
| | Lorsban spray | 2 | Broadcast-PPI[c] | |
| | **Mocap | 1[b] | Band | |
| Woollybear caterpillars | None labeled | . . | . . . | Silk clipping caused by caterpillars does not generally warrant control. |

**Table 5. Field Corn (continued)**

* Use restricted to certified applicators only.
** Liquid formulations of Dyfonate, Furadan, and Mocap are restricted.
† State labeled insecticide. Applicator must have Illinois label in possession when applying.
[a] See Table 15 for insecticide restrictions.
[b] Based on 40-inch row spacing. Increase rates for narrow rows.
[c] PPI Pre-plant incorporated.
[d] To be applied only by experienced operators or those wearing protective clothing.

**Table 6. Soybeans**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Bean leaf beetle | *Ambush | 0.05-0.1 | On foliage | Before bloom: when defoliation reaches 30%, at least 1 cotyledon per foot of row is destroyed, and there are 5 or more beetles per foot of row. Bloom to pod fill: when defoliation reaches 20% and there are 16 or more beetles per foot of row. Seed maturation: when 5 to 10% of the pods are damaged, the leaves are green, and there are 10 or more beetles per foot of row. |
| | Cygon | ½ | | |
| | Lorsban | ½ | | |
| | Orthene | ½ | | |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.1 | | |
| | Sevin, Savit | 1 | | |
| Blister beetles | Sevin | 1 | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| Corn earworm | *Ambush, *Pounce | 0.1 | On foliage | Damage occurs when larvae feed on pods. Apply control if populations exceed 1 per foot of row. |
| | *Lannate, *Nudrin | ½ | | |
| | Lorsban | 1 | | |
| | Orthene | 1 | | |
| | *Penncap-M | 1 | | |
| | *Pydrin | 0.1-0.2 | | |
| | Sevin | 1 | | |
| Cutworms | Sevin bait | 1-2 | Broadcast | During plant emergence if stand has gaps of one foot or more and cutworms are present. |
| | Sevin spray | 1-1½ | Broadcast | |
| | Lorsban | 1 | Broadcast | |
| | *Pydrin | 0.1-0.2 | Broadcast | |
| Grasshoppers | Cygon | ½ | On foliage | When migration into fields begins and defoliation or pod feeding reaches economic levels. When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| | Lorsban | ¼-½ | | |
| | Orthene | ½ | | |
| | *Penncap-M | ½ | | |
| | Sevin, Savit | 1 | | |
| Green cloverworm | *Ambush, *Pounce | 0.05-0.1 | On foliage | When defoliation occurs during blooming, pod set, and pod fill. Usually requires 12 or more half-grown worms per foot of row and 20% defoliation to justify treatment. |
| | Dipel, Thuricide, Bactur, SOK (*Bacillus thuringiensis*) | See label | | |
| | Lorsban | ½ | | |
| | malathion | 1 | | |
| | Orthene | ½ | | |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.05-0.1 | | |
| | Sevin | ½ | | |
| Japanese beetle | Sevin | 1 | On foliage | When defoliation reaches 20% during bloom and pod fill. |
| | *Penncap-M | ¾-1 | | |
| Loopers | *Ambush, *Pounce | 0.05-0.1 | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| | Orthene | ½-1 | | |
| | *Pydrin | 0.1-0.2 | | |
| | Thuricide, Dipel, Bactur, SOK (*Bacillus thuringiensis*) | See label | | |

**Table 6. Soybeans (continued)**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Mexican bean beetle | *Ambush, *Pounce | 0.05-0.1 | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| | Cygon | ½ | | |
| | Lorsban | ½ | | |
| | Orthene | ½ | | |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.05-0.1 | | |
| | Sevin, Savit | 1 | | |
| Potato leafhopper | *Ambush | 0.05-0.1 | On foliage | When leafhoppers are numerous and the edges of the leaves appear burned. |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.05-0.1 | | |
| | Sevin | 1 | | |
| Saltmarsh caterpillar | *Lannate, *Nudrin | ½ | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| | Sevin, Savit | 2 | | |
| Seedcorn maggot | diazinon | See label | On seed | At planting time. Use formulations that are prepared as seed treaters. |
| | diazinon + lindane | See label | On seed | |
| Spider mites | Cygon | ½ | On foliage | As needed on field margins or entire field. |
| | Trithion | ½-¾ | | |
| Stink bugs | Lorsban | 1 | On foliage | When adult bugs or large nymphs reach 1 per foot of row during pod fill. |
| | Orthene | ¾ | | |
| | *Penncap-M | ½ | | |
| | *Pydrin | 0.15 | | |
| | Sevin | 1 | | |
| Thistle caterpillar | Sevin | 2 | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| Thrips | *Penncap-M | ½-¾ | On foliage | If seedlings are being seriously damaged and some plants are being killed. |
| | Sevin, Savit | 1 | | |
| Webworms | Sevin, Savit | 1 | On foliage | When defoliation reaches 30% before bloom and 20% between bloom and pod fill. |
| Whitefly | None labeled | . . | . . . | High infestations are occasionally present on double-crop soybeans, but are rarely economic. |
| Woollybear caterpillars | None labeled | . . | . . . | When defoliation reaches 30 % before bloom and 20 % between bloom and pod fill. Sprays of Ambush, Lorsban, Penncap-M, Pounce, or Pydrin may be effective. |

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.

**Spraying blossoming soybeans can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.**

**Table 7. Alfalfa and Clover**

| Insect | Insecticide[a,b] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Alfalfa weevil (spring treatment for larvae) | *Furadan | ¼-½ | On foliage | Refer to Circular 1136. Or when 25% of tips are being skeletonized and if there are 3 or more larvae per stem, treat immediately. Do not apply sprays during bloom. Instead, cut and remove the hay. Two treatments may be necessary on first cutting. Watch regrowth for signs of damage, and treat if feeding damage is apparent. |
| | Imidan | 1 | | |
| | Lorsban[c] | 1 | | |
| | malathion + methoxychlor | 2 qt. per acre | | |
| | *Supracide | ½ | | |
| To avoid injury to bees, do not spray alfalfa during bloom or if weeds are blooming. | | | | |

**Table 7. Alfalfa and Clover (continued)**

| Insect | Insecticide[a,b] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Alfalfa weevil adults | *Furadan | ½-1 | | As a stubble spray. Technically, Supracide could be used, since the label does not distinguish between larvae and adults. |
| | Lorsban[c] | 1 | | |
| Aphids | Cygon, De-Fend | ¼ | On foliage | When aphids average 100 or more per sweep and lady beetle larvae and adults, parasites, and diseases are not abundant. |
| | *Furadan | ¼ | | |
| | *Lannate | ½ | | |
| | Lorsban[c] | ½ | | |
| | malathion | 1 | | |
| | *Supracide | ½ | | Avoid treatments when plants are blooming. |
| Clover leaf weevil | malathion | 1 | On foliage | When larvae are numerous (5 or more per crown) and leaf feeding is noticeable, usually in early to mid-April. |
| Cutworms | Dylox, Proxol | 1½ | On foliage | As needed on regrowth of second cutting. |
| | *Lannate, *Nudrin | ½ | | |
| | Lorsban[c] | 1 | | |
| | Sevin | 1½ | | |
| Fall armyworm | Dylox, Proxol | 1 | On foliage | Usually in late summer or early fall on new seedlings or established stands. |
| | *Lannate, *Nudrin | ½ | | |
| | Lorsban[c] | ½ | | |
| | Sevin | 1 | | |
| Grasshoppers | Cygon, De-Fend | ½ | On foliage | When grasshoppers are small and before damage is severe. Avoid treatments when plants are blooming. Cut the hay and remove the crop. |
| | diazinon | ½ | | |
| | *Furadan | ¼ | | |
| | Lorsban[c] | ¼-½ | | |
| | Sevin, Savit | 1 | | |
| Leafhoppers | Cygon, De-Fend | ½ | On foliage | Treatment is justified at these combinations of alfalfa height and leafhopper numbers: |
| | *Furadan | ½ | | |
| | Lorsban[c] | ½-1 | | |
| | Sevin, Savit | 1 | | |
| | *Supracide | ½ | | |

| Alfalfa height (inches) | Leafhoppers per sweep |
|---|---|
| 0-3 | 0.2 |
| 3-6 | 0.5 |
| 6-12 | 1.0 |
| 12 or taller | 1.5 |

Avoid treatments when plants are blooming.

| | | | | |
|---|---|---|---|---|
| Plant bugs | Cygon, De-Fend | ½ | On foliage | When tip damage is obvious and nymphs and adults are numerous. |
| | Dylox, Proxol | 1 | | |
| | *Furadan | 1 | | |
| | Lorsban[c] | ½-1 | | |
| | Sevin | 1 | | Avoid treatments when plants are blooming. |
| Spittlebug | Lorsban[c] | ½-1 | On foliage | When spittle masses are found and nymphs average more than 1 per stem. |
| | malathion + methoxychlor | 2 qt. per acre | | |
| | malathion | 1 | | Avoid treatments when plants are blooming. |
| Webworms | Dylox, Proxol | 1 | On foliage | If damage appears. |
| | malathion + methoxychlor | 2 qt. per acre | | |
| | Sevin, Savit | 1 | | |

* Use restricted to certified applicators only.

[a] See Table 15 for insecticide restrictions.

[b] Before applying insecticides, be certain to clean all herbicides out of equipment. During pollination, apply very late in day or, if possible, avoid application during bloom.

[c] Young, tender, rapidly growing alfalfa may show some phytotoxic symptoms when treated with Lorsban 4E.

**Spraying blossoming alfalfa can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.**

**Table 8. Grain Sorghum**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Chinch bug | Sevin | 2 | At plant base | |
| Corn earworm | *Lannate, *Nudrin<br>Sevin, Savit | ½<br>1-2 | Over row | When there is an average of 2 worms per head. |
| Corn leaf aphid | Cygon<br>malathion | ¼<br>1 | Over row | Corn leaf aphids rarely cause economic damage unless populations are heavy and drouth conditions exist. |
| Cutworms | Sevin | 2 | Over row | When seedling plants are being cut. |
| Fall armyworm | *Lannate, *Nudrin<br>Sevin, Savit | ½<br>1½ | Over row | When there is an average of 2 worms per head. Leaf feeding or whorl damage is seldom economic. |
| Grasshoppers | Cygon | ½ | Over row | As needed. |
| Greenbug | Cygon, De-Fend<br>diazinon<br>malathion | ¼<br>½<br>1 | Over row | When greenbug damage is sufficient to cause death of more than 2 normal-sized leaves before the hard-dough stage. CAUTION: Some sorghum varieties are sensitive to organophosphate insecticides. |
| Sorghum midge | Cygon, De-Fend<br>diazinon<br>*Lannate, *Nudrin<br>Lorsban[b]<br>Sevin | ¼<br>¼<br>¼<br>¼<br>1½ | Over row | Apply during bloom when 50% of heads have begun to bloom and there are 1 or more midge adults (flies) per head. |
| Webworms | *Lannate, *Nudrin<br>Sevin, Savit | ½<br>1-2 | Over row | When 5 or more larvae per head are found. |
| Yellow sugarcane aphid | Cygon | ½ | Over row | Treatment should be applied at first sign of damage to seedling sorghum; 5 to 10 aphids per leaf. |

* Liquid formulations are restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.
[b] To avoid phytotoxicity, do not treat plants that are under extreme heat and drouth stress.

**Table 9. Small Grains (Barley, Oats, Rye, Wheat)**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Armyworm | Dylox, Proxol<br>*Lannate, *Nudrin<br>*Penncap-M<br>Sevin | 1<br>½<br>½<br>1 | On foliage | When there are 6 or more armyworms per linear foot of row and before extensive head cutting occurs. Do not use Dylox, Proxol, or Penncap-M on rye. |
| Fall armyworm | Dylox, Proxol<br>Sevin | 1<br>1 | On foliage | During fall when damage to new growth is apparent. Do not use Dylox or Proxol on rye. |
| Grasshoppers | Cygon<br>*Furadan<br>malathion<br>*Penncap-M<br>Sevin | ½<br>¼<br>1<br>½<br>1 | On foliage | During fall when damage is apparent, treat field borders and noncrop areas to stop migration. Do not apply Penncap-M to rye. |
| Greenbug, English grain aphid, oat bird-cherry aphid | Cygon<br>malathion<br>*Penncap-M | ¼<br>1<br>¼ | On foliage | Aphids damage plants indirectly by transmitting disease. Once yellowing is noticeable, it is usually too late to treat. Use Cygon on wheat only. Do not apply Penncap-M to rye. |
| Variegated cutworm | Dylox, Proxol | 1 | | As needed. Do not use Dylox or Proxol on rye. |
| Wheat stem maggot | None | . . | . . . | No chemical control. Damage shows as white heads when field is still green. |

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.

**Table 10. Grass Pasture**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Armyworms | Dylox, Proxol | 1 | On foliage | As needed. Sevin, Dylox, and Proxol may be applied without removal of grazing livestock. |
| | malathion | 1 | | |
| | *Penncap-M | ½ | | |
| | Sevin | 1 | | Do not apply when weeds are blooming. |
| Grasshoppers | diazinon | ½ | On foliage | As needed. |
| | malathion | 1 | | |
| | *Penncap-M | ½ | | |
| | Sevin | 1 | | Do not apply when weeds are blooming. |

* Use restricted to certified applicators only. [a] See Table 15 for insecticide restrictions.

**Table 11. Stored Grain (Corn, Wheat, Oats)[a,b]**

| Insect | Insecticide and dilution | Dosage | Placement | Suggestions |
|---|---|---|---|---|
| Angoumois grain moth (earcorn) | malathion 57% E.C. 4 oz. per gal. water | Apply to runoff | Spray surface and sides about May 1 and August 1 | Plant tight husk varieties. Store as shelled corn to avoid all but surface damage by Angoumois moth. |
| Indian meal moth[c] | dichlorvos 20% (DDVP, Vapona) plastic resin strip[d] | 1 strip per 1,000 cubic feet of space above grain mass | Attach to ceiling or side wall | Clean and spray bin with 2.0% malathion to runoff before storage. Store only clean, dry grain. Install strips on May 15 or at storage. Replace strips every 6 weeks between May and October. As an alternative to the strips, apply *Bacillus thuringiensis (B.t.)* at the auger as the grain is binned. NOTE: Level the grain after treatment. For infested grain use both *B.t.* raked in and the dichlorvos resin strip. |
| | *Bacillus thuringiensis*[e,f] dust 4,000 units per mg. | ½ oz. per bu. (See Table 12.) | Apply to top 4 inches of grain | |
| | *Bacillus thuringiensis*[e,f] WP 16,000 units per mg. 1 lb. in 10 gal. water | 0.6 pt. per bu. (See Table 12.) | Apply to top 4 inches of grain | |
| | *Bacillus thuringiensis*[e,f] LC 4,000 units per mg. 4 pt. in 10 gal. water | 0.6 pt. per bu. (See Table 12.) | Apply to top 4 inches of grain | |
| GENERAL Internal and external feeders Rice and granary weevils Flat grain beetle Saw-toothed grain beetle | malathion 57% E.C. 1 pt. per 2-5 gal. water[g] | 2-5 gal. per 1,000 bu. | Spray uniformly as grain is binned. After binning apply 2 gallons per 1,000 square feet over the surface. | Clean and spray bin with 2.0% malathion to runoff before storage. Store only clean, dry grain. Protect surface with dichlorvos resin strips or *B.t.* as recommended for meal moths. |
| Rusty grain beetle Foreign grain beetle Cadelle beetle Flour beetles | malathion 6% wheat flour dust[g] | 10 lb. per 1,000 bu. | Apply over grain in combine hopper or uniformly as grain is binned. After binning, apply 5 pounds of 6%, 7.5 pounds of 4%, or 15 pounds of 2% per 1,000 square feet over the surface. | |
| | malathion 4% wheat flour dust[g] | 15 lb. per 1,000 bu. | | |
| | malathion 2% wheat flour dust[g] | 30 lb. per 1,000 bu. | | |
| | liquid fumigant[h,i] | 3-5 gal. per 1,000 bu. | On surface; repeat if necessary. | Clean and spray bin with 2.0% malathion to runoff before storage. Store only clean, dry grain. Use on infested grain. Protect surface with dichlorvos resin strips or *B.t.* as recommended for meal moths and malathion for other insects. |

**Table 11. Stored Grain (Corn, Wheat, Oats)[a,b] (continued)**

| Insect | Insecticide and dilution | Dosage | Placement | Suggestions |
|---|---|---|---|---|
| GENERAL (Continued) | *aluminum phosphide[j] | 180 tablets or 300 pellets per 1,000 bu. | Uniformly throughout | Fumigants are best used for emergency control of existing infestations. |

* Use restricted to certified applicators only.

[a] Corn, sorghum, and sunflowers need not be treated if harvested after October 1 unless it is to be carried over after May 15 the following year. Wheat, oats, barley, and rye should be treated if they are to be held for one month or more in storage after harvest. Soybeans stored at safe moisture levels are attacked only by Indian meal moth.

[b] Grain carried over after May 15 of the following year should receive a surface spray of malathion or a dust treatment of malathion for general feeders and either a *B.t.* or dichlorvos resin strip application for Indian meal moth.

[c] Remove webbing before treatment.

[d] Effective only in enclosed bins. Kills adult moths but not the eggs or larvae. Several weeks (3-6) are required to control an existing infestation. Fumigate the grain if immediate control is desired. Also cleared for use in bins of stored soybeans.

[e] Kills larvae only. Several weeks (3-6) are required to control an existing infestation. Fumigate the grain if immediate control is desired. Cleared for use on soybeans. Called Dipel, Topside, and SOK-BT. Blend *B.t.* treated surface grain with other grain before feeding to livestock.

[f] Best results are obtained when *B.t.* is applied on grain going into storage (top 4 inches) rather than raked in after the grain is binned. If you do make a post storage rake-in treatment with *B.t.* apply ⅓ of the amount and rake in to a depth of 4 inches; apply the next ⅓ of the dosage and rake in at right angles to the first raking; then apply the remaining ⅓ of the dosage and leave without raking.

[g] Use only the grade of malathion labeled for use on stored grain. Apply after drying, because malathion vaporizes and is lost rapidly when grain is heat dried.

[h] Two common liquid fumigants are carbon bisulfide + carbon tetrachloride and ethylene dichloride + carbon tetrachloride.

[i] Use with extreme caution. Apply only under calm conditions and when grain temperature is 70°F or above. Grain should be 8 inches below the lip of the bin and should be leveled before fumigating. Cover the surface with a plastic tarp for 24 hours, then air out.

[j] Called Phostoxin, Detia, Fumitoxin, or Gastoxin. Slow vaporization with a 3-day exposure period. Can be used at grain temperature of 60°F or above. Grain should be 8 inches below the lip of the bin and should be leveled before fumigating. Cover the surface with a plastic tarp for 3 days, then air out.

**Table 12. Amount of *Bacillus thuringiensis (B.t.)* to Apply**

| Bin diameter (feet) | Bushels in top 4 inches of grain | Amount of *B.t.* wettable powder (lb.) and water (gal.) needed | Amount of *B.t.* liquid concentrate (oz.) and water (gal.) needed | Amount of *B.t.* dust (oz.) needed |
|---|---|---|---|---|
| 8 | 13 | 0.1/1 | 6.5/1 | 6.5 |
| 12 | 30 | 0.25/2.5 | 14.5/2.5 | 15 |
| 16 | 53 | 0.4/4 | 26/4 | 27 |
| 20 | 84 | 0.6/6 | 39/6 | 42 |
| 24 | 120 | 0.9/9 | 58/9 | 60 |
| 28 | 163 | 1.25/12.5 | 80/12.5 | 82 |
| 32 | 214 | 1.6/16 | 103/16 | 107 |
| 36 | 336 | 2.5/25 | 160/25 | 168 |
| 40 | 415 | 3.1/31 | 198/31 | 208 |
| 48 | 478 | 3.6/36 | 230/36 | 239 |

**Table 13. Noncrop Areas**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Grasshoppers | diazinon | ½ | On foliage | When grasshopper nymphs average 15 to 20 per square yard along roadsides and fence rows. Do not spray areas adjacent to water or where runoff is likely to occur. Apply treatments while hoppers are small and before they migrate into row crops. |
| | malathion | 1 | | |
| | *Pydrin | 0.05-0.1 | | |
| | Sevin | 1 | | |

* Use restricted to certified applicators only.

[a] See Table 15 for insecticide restrictions.

**Table 14. Sunflowers**

| Insect | Insecticide[a] | Pounds of active ingredient per acre | Placement | Timing of application, comments |
|---|---|---|---|---|
| Armyworm | Sevin | 1½ | Over row | When defoliation reaches 25%. |
| Cutworms | Sevin<br>Lorsban | 1½<br>1 | Over row | When 10% of the seedlings are damaged. |
| Fall armyworm | Sevin | 1½ | Over row | When defoliation reaches 25%. |
| Grasshoppers | Sevin | 1 | Over row | When defoliation reaches 25%. |
| Stem weevil | Lorsban<br>Sevin<br>*Supracide | ½<br>1<br>½ | Over row | When there are 2 or more beetles per plant. |
| Sunflower beetle | Lorsban<br>Sevin | ½<br>1 | Over row | When defoliation reaches 25%. |
| Sunflower moth larvae | Lorsban<br>*Supracide | ½<br>½ | Over row | Apply first treatment when a field has reached 20 to 25% bloom and moths are present. |

* Use restricted to certified applicators only.
[a] See Table 15 for insecticide restrictions.

**Spraying blossoming sunflowers can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays.**

**Table 15. Limitations in Days Between Application of the Insecticide and Harvest of Crop and Restrictions on Use of Insecticides for Field Crop Insect Control (These are only guidelines — read the label for more detailed information)**

**(Blanks denote that the product may not be labeled or suggested for that specific use in Illinois)**

| | Worker re-entry time (hours)[a] | Field corn | | | Forage crops | | |
|---|---|---|---|---|---|---|---|
| | | Grain | Ensilage | Sorghum | Alfalfa | Clover | Pasture |
| *Amaze (isofenphos)[b] | ... | 75,A | 75,A | ... | ... | ... | ... |
| Broot (trimethacarb) | ... | 90 | 90 | ... | ... | ... | ... |
| Counter (terbufos) | ... | B | 30,C | ... | ... | ... | ... |
| Cygon, De-Fend (dimethoate)[b] | ... | 14 | 14 | 28 | 10,D | ... | ... |
| Diazinon | ... | B | 10 | 7 | 7 | 7 | 0 |
| **Di-Syston (disulfoton)[a,b] | ... | 40 | 40 | ... | ... | ... | ... |
| **Dyfonate (fonofos)[b] | ... | 30 | 30 | ... | ... | ... | ... |
| Dylox, Proxol (trichlorfon) | ... | E | E | ... | 0 | 0 | 0 |
| Ethion | 24 | 50,F | 50,F | ... | ... | ... | ... |
| **Furadan (carbofuran)[b] | ... | G,H | G,H | ... | G,I | ... | ... |
| Imidan (phosmet) | ... | 14 | 14 | ... | 7,D | ... | ... |
| **Lannate (methomyl)[a,b] | ... | B | 3 | 14 | 7 | ... | ... |
| Lorsban (chlorpyrifos) | ... | 35,J | 14,J | 14,K | 14-21,L | ... | ... |
| Malathion | ... | 5 | 5 | 7 | 0 | 0 | 0 |
| Methoxychlor | ... | ... | ... | ... | 7 | 7 | ... |
| **Mocap (ethoprop)[b] | ... | B | B | ... | ... | ... | ... |
| **Nudrin (methomyl)[a,b] | ... | B | 3 | 14 | 7 | ... | ... |
| *Penncap-M (microencapsulated methyl parathion)[a,b] | ... | 12 | 12 | ... | 15 | ... | 15 |
| *Pydrin (fenvalerate)[a,b] | ... | 21,M | 21,M | ... | ... | ... | ... |
| Sevin, Savit (carbaryl) | ... | 0 | 0 | 21 | 0 | 0 | 0 |
| *Supracide (methidathion)[b] | ... | ... | ... | ... | 10,N | ... | ... |
| Thimet (phorate) | ... | 30,P | 30,P | ... | ... | ... | ... |

**Table 15. Limitations (continued)**

| | Barley | Oats | Rye | Wheat | Soybeans | Sunflowers |
|---|---|---|---|---|---|---|
| *Ambush, *Pounce (permethrin)[a,b] | ... | ... | ... | ... | 60,Q | ... |
| Cygon (dimethoate)[b] | ... | ... | ... | 60 | 21 | ... |
| Dipel, Thuricide, Bactur, SOK (*Bacillus thuringiensis*) | ... | ... | ... | ... | 0 | ... |
| Dylox, Proxol (trichlorfon) | 21 | 21 | ... | 21 | ... | ... |
| **Furadan (carbofuran) | G,R | G,R | ... | G,R | ... | ... |
| **Lannate (methomyl)[a,b] | 7 | 7 | 7 | 7 | 14 | ... |
| Lorsban (chlorpyrifos) | ... | ... | ... | ... | 28,S | 42,T |
| Malathion | 7 | 7 | 7 | 7 | 0 | ... |
| **Nudrin (methomyl)[a,b] | 7 | 7 | 7 | 7 | 14 | ... |
| Orthene (acephate) | ... | ... | ... | ... | 14,U | ... |
| *Penncap-M (microencapsulated methyl parathion)[a,b] | 15 | 15 | ... | 15 | 20,V | ... |
| *Pydrin (fenvalerate) | ... | ... | ... | ... | 21,W | ... |
| Sevin (carbaryl) | ... | ... | ... | 21,X | 0 | 60 |
| *Supracide (methidathion)[b] | ... | ... | ... | ... | ... | 50,U |

A. Do not use for forage, fodder, or ensilage or harvest fresh corn (including sweet corn) or corn grain within 75 days of last application. Make only one application per season either at planting or cultivation. Soybeans may be planted one year after application. Other crops not listed on the label may be planted 10 months after application.

B. No specific restriction when used as recommended.

C. Do not graze or cut for forage within 30 days of treatment. Only 1 postemergence incorporated treatment or 1 cultivation-time treatment may be used in addition to treatment at planting time.

D. Apply only once per cutting; do not apply during bloom.

E. Three applications may be made per season. Can be applied up to harvest.

F. Do not make more than 1 application after ear formation. Do not feed treated forage to livestock.

G. Do not rotate to a succeeding crop other than alfalfa, corn (field, pop, or sweet), cotton, cucurbits (cucumbers, melons, pumpkins, or squash), grapes, peanuts, peppers, potatoes, rice, small grains (barley, oats, or wheat), sorghum, soybeans, strawberries, sugar beets, sugarcane, and tobacco. Tomatoes, cabbage, peas, succulent beans, and dry beans may be planted the following season provided the prior season's application did not exceed 8.7 pounds per acre of Furadan 15G, 13 pounds per acre of Furadan 10G, or 2 pints 10 fluid ounces of Furadan 4F. Any other crop may be planted if it is not harvested or grazed.

H. Do not make a foliar application if Furadan 15G was applied at more than 8 ounces per 1,000 linear feet of row (6.7 pounds per acre with 40-inch row spacing) at planting. Do not make more than 2 foliar applications per season.

I. Make no more than 2 applications per season. Do not apply more than once per cutting. Do not use more than 1 pint per acre in the second application. Apply only to fields planted to pure stands of alfalfa. When using no more than ¼ pound per acre, allow 7 days between application and harvest. When using ¼ to ½ pound per acre, allow 14 days between application and harvest. When using ½ to 1 pound per acre, allow 28 days between application and harvest. Do not move bees to alfalfa fields within 7 days of application.

J. For soil insect control, do not exceed 13.5 pounds of Lorsban 15G per acre per year. For foliar insect control, do not exceed 13 pounds of Lorsban 15G per acre per year. Do not apply more than 15 pints of Lorsban 4E per acre per season. Do not allow livestock to graze in treated areas nor feed treated corn silage to meat or dairy animals within 14 days after treatment. Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

K. Do not exceed 3 applications. The treated crop is not to be used for forage, fodder, hay, or silage within 14 days after last treatment. Do not treat sweet varieties of sorghum.

L. Do not apply more than once per cutting. Do not cut or graze treated alfalfa within 14 days after application of 1 pint of Lorsban 4E per acre, nor within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per year.

M. Do not exceed 1.0 pound of active ingredient per acre per season.

N. Make no more than 1 foliage and 1 stubble application per cutting.

P. Do not make more than 1 application over the plant. Do not graze or cut for forage within 30 days of treatment. Do not apply under prolonged drouth conditions.

Q. Do not graze or feed soybean forage. Do not plant rotational crops within 60 days of last application. Do not make more than 2 applications per season.

R. Apply before heads emerge from boot. Do not make more than 2 applications per season. Do not feed treated forage to livestock.

S. Do not apply more than 6 pints of Lorsban 4E per acre or 3 pounds of chlorpyrifos (active ingredient) per acre per season. Do not apply last treatment within 28 days before harvest nor apply last 2 treatments closer than 14 days apart. Do not allow livestock to graze in treated areas nor otherwise feed treated soybean forage to meat or dairy animals within 14 days after application. Do not feed straw from treated soybeans to meat or dairy animals within 28 days after application.

T. Do not apply more than 9 pints of Lorsban 4E per acre per season. Do not apply within 42 days before harvest. Do not allow livestock to graze in treated areas.

U. Do not graze or feed treated crop to livestock.

V. Do not make more than 2 applications per season.

W. Do not feed or graze livestock on treated plants. Do not exceed 0.8 pound active ingredient per acre per season.

X. Do not make more than 2 applications after grain heads emerge from boot.

* Use restricted to certified applicators only.

** Liquid formulations are restricted.

[a] Workers should be warned in advance of treatments. Workers may not enter fields treated with the insecticides without wearing protective clothing for the intervals indicated. They may not enter a field treated with other insecticides without protective clothing until the spray has dried or the dust has settled. Protective clothing includes a hat, long-sleeved shirt, long-legged pants, and shoes and socks.

[b] Sprays to be applied only by experienced operators wearing proper protective clothing.

**Table 16. Relative Toxicities of Commonly Used Agricultural Insecticides**

| Trade name | Chemical name | Toxicity to mammals[a] | | Toxicity to | | |
|---|---|---|---|---|---|---|
| | | Acute oral | Acute dermal | Birds | Fish | Bees |
| **Amaze | isofenphos | high | high | high | high | . . . |
| Counter | terbufos | high | high | high | very high | . . . |
| Cygon, De-Fend | dimethoate | moderate | moderate | moderate | very low | high |
| Diazinon | diazinon | moderate | moderate | high | high | high |
| Dipel, Bactur, Topside, Thuricide, SOK | *Bacillus thuringiensis* | very low | very low | very low | very low | very low |
| **Di-Syston | disulfoton | high | high | moderate | . . . | moderate |
| **Dyfonate | fonofos | high | moderate | moderate | . . . | . . . |
| Dylox, Proxol | trichlorfon | low | low | low | very low | low |
| Ethion | ethion | high | high | low | . . . | very low |
| **Furadan | carbofuran | high | moderate | moderate | moderate | high |
| Imidan | phosmet | moderate | low | low | . . . | high |
| **Lannate, **Nudrin | methomyl | high | moderate | low | . . . | high |
| Lorsban | chlorpyrifos | moderate | moderate | moderate | very high | high |
| Malathion | malathion | low | low | low | moderate | high |
| Methoxychlor | methoxychlor | low | low | very low | very high | low |
| *Methyl parathion | methyl parathion | high | high | moderate | very low | high |
| **Mocap | ethoprop | moderate | high | moderate | . . . | moderate |
| Orthene | acephate | moderate | moderate | moderate | low | high |
| *Penncap-M | microencapsulated methyl parathion | moderate | low | moderate | very low | high |
| *Pydrin | fenvalerate | moderate | low | low | very high | very high |
| Sevin | carbaryl | low | low | very low | very low | high |
| *Supracide | methidathion | high | moderate | moderate | high | high |
| Thimet | phorate | high | high | moderate | very high | moderate |

* Use restricted to certified applicators only.

** Liquid formulations are restricted.

[a] Relative toxicities based on acute oral and acute dermal $LD_{50}$ values of technical insecticide. Toxicities of formulated materials vary.

**Always read the label before applying insecticides.**

The suggestions given in this circular are revised annually by entomologists of the College of Agriculture and the Illinois Natural History Survey.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. WILLIAM R. OSCHWALD, Director, Cooperative Extension Service, University of Illinois at Urbana-Champaign. The Illinois Cooperative Extension Service provides equal opportunities in programs and employment.

18M—11-83—57843—lm