

1977 Corn Soil Insect Control

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Pest Insect Situation

Expected corn soil insect problems, based on 1976 experiences, indicate a sizable increase in corn rootworm infestations over the northwestern half of the state and, to a lesser extent, in individual fields over the remainder of the state (see map). Cutworm injury can again be expected in some of the blackland soils of river and creek bottoms and, to a lesser extent, in 1976 cropped fields where harvest residue was allowed to accumulate on soil surface. Wireworm problems are again expected in some of the rolling fields following small grains or grass. Other pest problems are too dependent on favored environmental conditions to predict.

Cutworms

This pest will again prove to be the most difficult to control with those substitute insecticides registered for this purpose. Carefully consider the advantages and disadvantages of preplant application vs. post-emergence application, and choose on the basis of your corn management practices, frequency of problem occurrence, and insecticide availability.

Preplant, Broadcast, Incorporated Application. This application system for heptachlor and chlordane remains a reliable control for cutworms. However, the maximum registered chlordane rate has not been consistently effective under high population pressure.

Restrict this type of application to the following conditions: (1) corn soils subject to annual or frequent cutworm infestations, and (2) first-year corn following sod or established legumes, provided the soil has been plowed.

Use any of the carryover formulations of heptachlor or chlordane—emulsifiable concentrates, granules, or fertilizer-insecticide mixtures—at the following rates of actual chemical per acre: heptachlor at 1.5 to 2.0 pounds or chlordane at 4.0 pounds. Heavier soils subject to frequent cutworm outbreaks and soils with an organic matter content exceeding 4 per cent require the heavier heptachlor dosage.

Uniformly apply by spraying or spreading the proper dosage to the surface of plowed or tilled soil any time up to four weeks before planting. Don't plow under, don't inject with fertilizer applicators, and don't use with reduced or no-tillage practices where available equipment is insufficient for adequate incorporation. Immediately following application, incorporate into the top 3 to 5 inches of soil by disking or, as a second choice, with field cultivators. Other types of seed bed preparation equipment usually don't uniformly incorporate to the desired depth.

Precautions. Observe all precautions printed on the label when handling or applying either of these insecticides. Don't

contaminate water supplies while filling, mixing or applying. Where possible, avoid application to rolling land which drains directly into ponds, lakes or streams. Don't allow livestock to graze in any field during spring months after applying these insecticides. Promptly and properly dispose of empty containers as directed on the label.

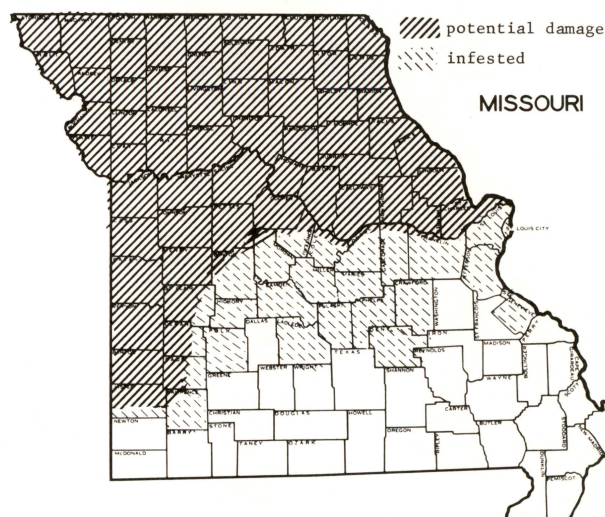
Postemergence Application. If cutworms are to be controlled successfully after the crop has germinated, all fields must be observed closely for possible development of infestations. Frequent observations should begin when corn is up to a stand and continue until about lay-by or mid-June. Make a postemergence application when 6 to 8 per cent of seedling plants are being fed on or cut above ground, or when 2 to 4 per cent of plants are being cut below ground. Use the lower percentage figure with lower plant populations (14-15,000 range), gradually increasing to the higher percentage figure with higher plant populations (20-22,000 range).

In addition to early detection, acceptable performance with either bait or spray application should be expected only when soil surface is moist and while worms are small and feeding at or very near the soil surface.

As *bait*, use a 5 per cent carbaryl apple pomace bait applied broadcast at the rate of 40 pounds per acre.

As *spray*, use either two pounds actual carbaryl, or three pounds actual toxaphene, or one pound actual trichlorfon (Dylox) per acre. Don't use toxaphene on dairy farms. Concentrate the spray at the base of plants and soil on both sides of plants, using at least 20 gallons of diluted spray per

Western Corn Rootworm Distribution



acre. Follow immediately with a light cultivation covering the treated area with 1 to 3 inches of soil.

Wireworms

These pests are more apt to be problems on corn following sod, small grains or forage sorghums. Wireworms feed on the seed and root system and frequently bore into the underground stem just above the roots.

There are no wireworm controls available after the crop has germinated. Therefore, control efforts must be employed preplant or at the time of planting. For preplant incorporation, use a broadcast application of carryover heptachlor as discussed under the section on cutworms. For light infestations, use a seed treatment plus a row band application at time of planting using any of the following granular rootworm insecticides at the following rates per acre: carbofuran (Furadan) at 2-3 pounds, ethoprop (Mocap) at 1 pound, or terbufos (Counter) at 1 pound. For heavy infestations, use an in-furrow application at time of planting of 2-3 pounds carbofuran (Furadan) or 1 pound terbufos (Counter) per acre.

Seed Treatment Insecticides

Depending on the intensity of corn soil insect pests in fields, a seed treatment insecticide may be the only soil insect control needed.

A seed treatment insecticide is considered beneficial when added to all corn seed planted before mid-May by helping protect the more slowly germinating seed. Seed corn maggot and slender seed corn beetle are resistant to chlorinated hydrocarbon type insecticides over the northern and east-central areas. These seed damaging insects also may be controlled, under favorable performance conditions, by row band application of any rootworm insecticides at planting.

In the resistant areas, use one and one-half ounces actual diazinon seed treater per bushel of seed. Elsewhere in the state, use either the above dosage of diazinon or one ounce actual (6 level tablespoons) of 50 per cent wettable powder seed treater of either aldrin (carryover supply), dieldrin (carryover supply), heptachlor (carryover supply), or lindane per bushel of seed. Follow label directions for mixing with seed. *Don't use insecticide treated seed for any purpose other than planting.*

Insect Control in No-Tillage Sod Planting

This method of corn planting often results in severe stand losses from mice, cutworms, armyworms and other pests, while severely limiting the choice of soil insecticides and application methods. Most soil insecticides should not be used with this method of planting because they either are not registered for this type of application or cannot be incorporated adequately for effective results. Furthermore, soil moisture or tilth should allow the seed furrow to be covered or closed. Otherwise, the insecticide remains exposed and creates an environmental hazard.

Only one soil insecticide, carbofuran (Furadan), currently is registered for use with this specific method of planting. However, this insecticide is recommended only where soil tilth is such that the seed and granular insecticide can be covered with soil adequately and immediately. Use two pounds actual carbofuran (20 pounds 10% Furadan granules) per acre applied directly into the seed furrow when planting. Such an application should protect the seed from most seed damaging insect pests, should help reduce cutworm and wireworm damage, will aid in or control both armyworm and flea beetle feeding damage, and will not cause germination problems.

Use a seed treatment insecticide where no other planting time insecticide application is to be used.

Corn Rootworms

Rootworm Situation. As indicated earlier, rootworm populations and damage increased sizably in 1976. This is expected to produce the highest potential for damage that Missouri has ever had.

Reports of poor results were received for all the recommended rootworm larval insecticides. Most of these reports involved applications made to very early plantings or the use of the same rootworm insecticide over a number of continuous growing seasons. Resistance to the recommended rootworm insecticides has not shown any significant changes during the past several years.

To offset some of this inadequate control, it is suggested that growers rotate a higher percentage of their corn acreage. If the 1977 season allows very early planting, another alternative would be to use either granular or liquid formulations of certain rootworm insecticides as "basal" application with cultivation sometime during May.

Crop Rotation and Other Cultural Practices. Western and northern corn rootworms prefer the roots of corn for larval feeding, although a very few larvae of both species may feed on the roots of other crops, grasses or weeds. Rarely has economic rootworm injury occurred on corn following grain sorghum, alfalfa or idle land. Therefore, where practical and economically feasible, rotating corn annually with any other crop should largely prevent serious damage or losses from these two species.

All cultural practices which aid in early plant growth are helpful in reducing rootworm damage. Select a variety or varieties adapted to your area and noted for their strong root development and ability to regenerate roots. Good seed bed preparation, especially in the area of planted seed, fertilizing to soil test, early planting and good weed control are helpful in getting early, vigorous growth. Cultivating some soil to surface planted corn, especially at lay-by time, helps brace roots become more firmly established, thereby reducing the severity of lodging and increasing the chances for faster root regeneration.

Chemical Control. On continuous corn planted prior to mid-April, use basal application of granular or liquid formulations of any of those insecticides listed in the chart under the column "Basal with cultivation" sometime during the first 20 days of May.

On continuous corn having or anticipating any rootworm problem and planted from mid-April to mid-May, use a granular formulation of any of the following insecticides applied as a row band at time of planting: carbofuran (Furadan), fensulfthion (Dasanit carryover supply), fonofos (Dyfonate), phorate (Thimet) or terbufos (Counter).

On continuous corn planted after mid-May, use either granular or liquid formulation of any insecticide from the above list or use chlorpyrifos (Lorsban), diazinon or ethoprop (Mocap).

Recommended dosage rates in the chart are given in terms of pounds of actual insecticide per acre for 40-inch row spacing and in ounces of formulated insecticide per 1,000 feet of row for narrower row spacing under the top section on early planting. The lower section of the chart gives dosage rates in terms of pound actual insecticide per acre.

Rotation of Rootworm Insecticides. Several corn producing states are recommending that growers alternate or rotate their use of rootworm insecticides by class or type of chemical compound. This means changing from a carbamate type to an organophosphate type or *vice versa*. There is growing evidence that consecutive season use of the same type of insecticide leads to a decline in rootworm larval control. Evidence to date indicates this is more apt to occur with the carbamates than with the organophosphates. The only car-

1977 Corn Rootworm Insecticide Recommendation Chart

Insecticide & Formulation	Lb. Actual/Acre 40" rows	Ozs. Formulation/ 1,000 ft. of row	Method of Application	Remarks
Very Early Planting (prior to mid-April)--Use basal application as given in lower section				
Early Planting (mid-April to mid-May)				
carbofuran Furadan 10%G	1.0	12.0	Row band at planting or directly into seed furrow	Do not make any foliar application if more than 1 lb. actual was used at planting and make no more than 2 foliar applications per season. Observe allowable crop rotations as directed on label.
fensulfothion Dasanit 10%G	1.0	12.0	Row band at planting	Performs better when used no earlier than 4 weeks of egg hatch
	1.0	8.0		
fonofos Dyfonate 10%G	1.0	12.0	Row band at planting	
	1.0	6.0		
phorate Thimet 15%G	1.0	8.0	Row band at planting	
terbufos Counter 15%G	1.0	8.0	Row band at planting or directly into seed furrow	Highly toxic. Follow all label precautions
Late Plantings, Basal, or Over-The-Row Applications				
	Row band at planting	Basal with cultivation	Over-the-row with cultivation	
carbofuran Furadan 10%G	1.0	1.0	1.0	See remarks under early planting above
	4-F 1.0			
chlorpyrifos Lorsban 10%G	1.0			Cover treated band with an extra 1-2 inches of soil by early cultivation
	15%G 1.0			
diazinon 14%G		1.0		
		48% AG500 1.0		
ethoprop Mocap 10%G	1.0	1.0		Do not place in direct contact with seed - may reduce germination
fensulfothion Dasanit 10%G	1.0	1.0		
	15%G 1.0	1.0		
	63% EC 1.0	1.0		
fonofos Dyfonate 10%G	1.0	1.0	1.0	Do not apply within 30 days of any harvest
	20%G 1.0	1.0	1.0	
	4-EC 1.0	1.0		
phorate Thimet 15%G	1.0	1.0		Do not make more than 2 applications per season
terbufos Counter 15%G	1.0			See remarks under early planting above

bamate type rootworm insecticide currently recommended is carbofuran (Furadan). Therefore, all remaining recommended insecticides are an organophosphate type. Growers who have used the same rootworm insecticide for two or more years and were dissatisfied with past season's performance should follow this rotation, if they can obtain a compound having nearly equal residual properties.

How to Use Rootworm Insecticides. The granular formulations may be applied by row banding when planting or as a postemergence application anytime after early May, but preferably no later than the last of May (shortly before time of egg hatch). Liquid application should be restricted to late plantings or basal application with cultivation during the same time period as given above.

Residual activity or persistence of these rootworm insecticides in the soil may range from 3 to 8 weeks, depending on such variable factors as insecticide, soil type, moisture, method of application and proper incorporation. Above normal moisture following application to very early planted corn with any of the recommended rootworm insecticides could result in faster chemical breakdown, causing poor or ineffective larval control.

Row Band at Planting Time. Apply the recommended dosage as a 5- to 7-inch band on the surface of the soil over the planted row and just ahead of the covering disks, knives or planter press wheel. Use a shield on the spreader attachment to prevent wind from blowing granules off to one side of row.

Make a concerted effort to cover or incorporate granules to a depth not exceeding one inch. Dragging a loop of chain behind each press wheel of planters not having covering devices gives better incorporation than that obtained with press wheels only. Failure to incorporate granules properly is one reason for some of the inadequate control witnessed during the past two seasons. Leaving granules exposed on soil surface may endanger wildlife or cause water contamination. Cover by disking any granules that may be exposed at end of treated rows, turns, and loading areas—then plant or replant these areas. Excepting carbofuran (Furadan) and terbufos (Counter), don't place other rootworm insecticides in the seed furrow with the seed since they may reduce germination when in contact with or very close to the seed.

Postemergence Application. During the past few years, research has shown properly timed postemergence application of either granules or sprays has resulted in about as good root protection as provided by row band application at planting time. Growers having the necessary application and cultivation equipment should find a postemergence application advantageous, particularly on very early or April planted corn.

Any postemergence application must be made before rootworm egg hatch (about May 20 in the southwest and central third and about June 1 in the northern third of the state). Therefore, postemergence application should be made sometime during the first half of May in the southwest and central third and during the last half of May over the northern third.

The *basal* type of postemergence application, whether granular or spray, should be made from both sides of the plants to the soil surface of the planted row and as near the center of the row as possible. Using one or more braces along the hose or tube should decrease the flexibility and vibrations caused by the larger corn leaves. Keep the opening of tube or spray nozzle high enough from the soil to allow the insecticide to cover uniformly 3 to 5 inches on both sides of the center of the row, making a band 6 to 10 inches wide. Cover treated area immediately with a light cultivation.

Over-the-Row Application. This type of postemergence granular application is made directly over the plants and usually performs better over small plants rather than larger plants. Use a spreader attachment on the tube and adjust height so that the spreader just clears the tops of plants. Make an effort not to have the band exceed 10 inches in width. Avoid application when wind velocities exceed 10-12 mph. Cover treated area immediately with a light cultivation.

General Comments. At the rates recommended for rootworm control, these insecticides should not be expected to control cutworms or heavy populations of wireworms effectively, although several of the labels claim "aids in control of" or "reduces" wireworm damage. Do not expect these insecticides to give complete control of corn rootworm larvae, although under favorable conditions control should range from about 60 to 80 per cent.

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Precautions - Safety Measures

READ, UNDERSTAND and FOLLOW directions and precautions printed on the label. *Without using these precautions, none of these insecticides can be considered safe.* Remember that you are legally responsible to use any pesticide only in a manner consistent with its labeling.

Be aware of the dermal and inhalation toxicity of these rootworm formulations. Avoid breathing dust and vapors while handling containers, when filling applicator boxes, and during calibration. Also avoid contact with skin by wearing protective clothing on arms and body, rubber gloves, and a respirator designed specifically to remove dust, vapors and spray mist of these insecticides. It is suggested that tight fitting goggles be worn when handling fonofos (Dyfonate).

Dermal toxicity (absorption through skin) of the granular rootworm insecticides would rate terbufos (Counter) as very high; chlorpyrifos (Lorsban), ethoprop (Mocap) and phorate (Thimet) as low; and carbofuran (Furadan), fensulfthion (Dasanit), diazinon and fonofos (Dyfonate) as very low.

Should skin contamination occur, wash exposed area thoroughly and repeatedly with soapy water. For eye contamination, flush with clear water for 10 to 15 minutes and get medical attention. Bathe with hot, soapy water at least daily. Change contaminated clothing at least daily and launder before rewearing.

Store these insecticides in their original, sound containers and under lock in a dry area removed from access by children and from the possibility of contaminating foods or animal feeds. Don't allow pets or livestock access to empty containers of any of these insecticides. Triple rinse liquid formulation containers prior to crushing and burial.

Properly and promptly dispose of empty containers as directed on the label. Empty containers completely and bury any unused insecticide and non-combustible containers at least 18 inches deep in some isolated place where drainage will not contaminate surface or underground water supplies; or, better yet, dispose at an approved sanitary landfill site.

Sometime before actual handling or applying these rootworm insecticides, it is suggested you notify your family physician of your intentions so that prompt treatment will be available in case of accident. Atropine sulfate is an antidote for organophosphate and carbamate insecticide poisoning.

Missouri insect control recommendations are revised annually and are subject to possible change during the growing season. Therefore, this guide is intended for use during the 1977 season only.