MINOR SOIL PESTS

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Introduction

Populations of any insect pest whose damaging stage occurs below the soil surface are difficult to detect and equally difficult in evaluating the need for an insecticide. Wireworms, white grubs, seedcorn maggots, and sandhill cutworms are minor soil pests but occasionally cause stand loss which requires replanting.

Management decisions regarding the economic feasibility of applying a soil insecticide specifically for a minor soil pest is made even more difficult because no postemergence insecticide rescue treatments are available for any of these four insects. Therefore, control measures must be applied at planting time if economic damage is anticipated based upon past field history or farming practices. Understanding basic biology and the field conditions that are conducive to stand loss from these insects can help reduce potential problems.

Wireworms

Wireworms infest corn, and occasionally soybean, fields and are found throughout Iowa. They are not considered to be serious pests in terms of annual acreage infested, but they occur often enough to cause severe stand losses in localized areas. Overall, the probability of any field suffering crop damage from wireworms is very, very low, except where the crop follows grass or several years of set aside, or where problems have appeared during the past one to three years.

Wireworms are the larvae of small-to medium-sized beetles, commonly known as click beetles. These beetles, when turned over on their backs, can flip their bodies several inches into the air when attempting to right themselves and at the same time produce an audible clicking sound. Adult beetles lay their eggs in grassy areas or cultivated fields, and the larvae require from one to several years to develop into adult beetles.

Wireworm injury to corn usually occurs either after pasture is converted to cultivated land or in fields with chronic infestations that have gone uncontrolled for several years. Most damage occurs when large populations contain a high percentage of mature or almost mature larvae (Riley and Keaster, undated).

Wireworms damage corn in several ways (Riley and Keaster, undated). Early season injury is caused by larvae boring into the seed before or during germination and hollowing out the seed. This prevents germination or kills the seedling before emergence above the soil surface. Death and injury of seedling plants also can occur when larvae tunnel into the base of the plant below the soil line. In heavily populated fields, wireworms sometimes bore into the stalks of large plants and move up into the plant several inches above the soil surface.

Commercial insecticides have been evaluated in Iowa for a number of years. Results of these studies are presented in Table 1. Based upon the available data, selecting the "best" wireworm insecticide is not possible. During two tests, 1986 (#1) and 1989 (#2), all insecticides (including the seed treatment) performed equally well even when damaged plants in the untreated checks averaged 62.4 and 35.6 percent. However, two performance trends are discernible from the tests: 1) the best seed protection occurs when insecticides are applied in furrow or if they are T-banded with an insecticide plus seed treatment mixture, and 2) the addition of a seed treatment to a soil insecticide improves seed protection compared to the same soil insecticide alone.

Recommendations for 1991: In corn, if wireworm problems have occurred during the last three years, or if the cultivated field follows grass, apply an insecticide in furrow or T-banded with an insecticide/seed treatment combination. In soybeans, apply a seed treatment if the same conditions exist.

Seedcorn Maggot

Seedcorn maggots, *Delia platura*, are occasional pests of germinating corn and soybean seeds, and cause reductions in yield because of stand loss. They are typically more of a problem in soybeans than corn and damage is more likely to occur during a cool or wet spring. Seedcorn maggots overwinter as pupae in the soil and adults emerge as flies in early spring. There are two periods of peak emergence and activity in Iowa (Higley and Pedigo 1984). During late April to early May the overwintered adults emerge, mate, and lay eggs. Then in late May to mid June another generation of flies emerges to repeat the cycle. In some years, there may be a partial generation that emerges in July but it is very small. After this time, no more activity occurs until the spring of the following year. During the spring, egg-laying

females are attracted to soil containing green organic matter (Hammond 1984).

With the adoption of conservation tillage practices, it was believed that seedcorn maggot injury would increase (Gregory and Musick 1976), but this has been shown not to be the trend. Studies by Funderburk et al. (1983), and Hammond and Stinner (1987) have shown that seedcorn maggot populations are influenced not only by type and timing of tillage, but also by the organic residues present at planting time. Seedcorn maggot densities were high in fields that were plowed or had some type of reduced tillage, where corn or soybean residues were incorporated into the soil, but were low in fields where the organic matter remained unincorporated on the soil surface.

The greatest potential for injury to field crops is when live, green organic matter is incorporated in the spring. The damage potential is minimal in no-tillage fields and germinating soybean seeds alone are not sufficiently attractive for egg laying under field conditions (Funderburk et al. 1983).

Hammond (1990) studied seedcorn maggot damage to soybeans following plots that were either no-tilled or plowed just prior to planting and had cover crops of soybean residue, corn residue, alfalfa, rye, weeds, or bare soil. He found that two variables, percentage damaged plants and adult fly populations, were not significantly different within any of the cover crops or bare soil in the no-tillage plots. However, significantly greater fly numbers and damaged plants were obtained from plots where alfalfa was plowed into the soil. Fewer problems were noted when rye, soybean residue, or weeds were plowed under. The least amount of damage occurred when corn residue was plowed under. He concluded that the damage potential from seedcorn maggot is great enough that precautionary measures should be taken whenever a green cover crop is incorporated into the soil prior to planting.

In set-aside acres that are tilled in the spring, a seed treatment which contains both diazinon and lindane, such as Agrox DL Plus, should provide effective protection from seedcorn maggots at a relatively low cost (about $1.00 per acre). Although several of the rootworm insecticides are also labeled for seedcorn maggot control, the added expense of these products would not be necessary if the maggot was the only insect of concern.

Insecticides have been evaluated for seedcorn maggot control for a number of years and most perform equally well. There were no significant stand differences among soil insecticides or seed treatment in 1986, 1987, and 1989. The 1985 test (Table 2) was the only year in which there were significant differences in the degree of plant protection and the much less expensive seed

treatment provided seed protection equal to or better than the more expensive soil insecticides.

Recommendations for 1991: If cover crops are plowed under during the spring, apply a seed treatment to corn or soybeans if the seedcorn maggot is the only insect of concern. Fields that have crop residue remaining on the surface or are no-tilled should not have problems from seedcorn maggots.

White Grubs

Two groups of white grubs are found in Iowa croplands; the true white grubs, *Phyllophaga* spp. which have a three-year life cycle, and annual white grubs, *Cyclocephala* spp. which have a one-year life cycle.

True white grubs are potential pests that can cause stand loss to seedling corn and soybeans. Their occurrence in any particular field is difficult to predict, so looking for them during preplant tillage operations is the best method of anticipating a problem. Observing the soil surface during spring tillage and bird activity in the field may provide clues as to the occurrence of white grubs. If grubs are found, they should be collected and properly identified to determine their potential for economic damage to corn. Large populations of true white grubs can significantly reduce plant stands, but annual white grubs are not considered to be economic pests because they have not been implicated as causing stand loss in Iowa. However, some damage from annual white grubs has been reported to corn in Indiana (Edwards et al. 1990).

An experiment was conducted this spring that focused on annual white grubs and their relationship to plant stand loss, or absence thereof. Annual white grubs and soil were collected from a field in Woodbury County on May 11 and returned to the lab were the soiled was sifted, placed in pots, and either two corn or soybean seeds were planted in the center. Three, six, or nine grubs were placed around each pair of seeds, covered with soil, and replicated five times. The check treatment contained no grubs. When the second seedling emerged from the soil, it was removed from the pot so that only a single plant remained. Plants were removed 27 days later. Measurements were taken on leaf area, root dry weight, and total dry plant weight. At the end of the experiment, 36% of the grubs had pupated.

In soybeans, up to nine grubs per plant did not have any noticeable effect on dry root weight, total dry plant weight, or leaf area. Feeding scars were present on some cotyledons when they emerged but this did not affect plant survivorship or plant size.

A similar situation was seen in the corn test. All pots had plants emerge and there was no difference in leaf area, dry root weight, or total dry plant weight when compared to the uninfested plants. All pots had seedlings emerge but a few seeds had feeding injury deep into the endosperm.

Based on this preliminary study, the hypothesis still stands that annual white grubs do not cause stand loss to corn or soybeans. The reason may be just a matter of synchrony; the grubs are done feeding and ready to pupate about the time that corn planting occurs. However, we will continue the experiment next year and will look at earlier planting dates, beginning in April.

During the past several years, true white grubs have caused significant stand reduction in Iowa corn, that in some cases has required replanting. The grubs, which are larvae of May or June beetles (the big brown ones that fly around yard lights during summer evenings), feed on the roots of seedling plants, causing them to wilt and die.

Because of differences in the ability to cause stand loss, correct identification of true white grubs is necessary. The larvae are C-shaped, creamy-white in color, and covered with tiny bristles. The last body segment is often darker colored. True white grubs can be separated from annual white grubs by examining the pattern of bristles on the underside of the last abdominal segment. Annual white grubs have the bristles scattered randomly while the true white grubs have two rows of parallel bristles (patterned like a zipper) in addition to the scattered bristles.

True white grubs have a three year life cycle. McLeod et al. (1986) summarized the biology (given below) of *Phyllophaga implicita* in North Dakota. Adults emerge from the soil in the spring and migrate to trees to feed and mate. In North Dakota, preferred hosts are willow and poplar. Females then fly down to the soil to lay their eggs. First-instar larvae emerge in two to three weeks and begin feeding on plant roots. Usually crops have a well developed root system by this time and significant injury does not occur. Before fall arrives, they molt one time. As cooler temperatures occur in the fall, the larvae migrate downward from one to several feet below the soil surface. Here they form an earthen cell and hibernate for the winter.

In the spring, the second-instar grubs migrate back to the soil surface. Larvae feed heavily on roots the entire second summer. Consequently, damage is usually greatest in the second year. By the end of the summer, the larvae have molted again, and begin the downward movement to form the overwintering cell.

The spring of the third year finds the larvae back near the soil surface again feeding on roots. Crop stand reduction can

also occur early in the third summer but damage may not be as extensive as the previous year. The grubs migrate back down in July, form another earthen cell, and then transform into an adult in August or September. They remain dormant in the soil until the following spring when they emerge to repeat the cycle.

Counter 15G, Counter 20CR, Lorsban 15G, and Thimet 20G are the only granular insecticides labeled for white grub control in corn at the corn rootworm rate. Insecticide tests conducted by North Dakota entomologists suggest that Counter applied in-furrow will provide the best results. Lorsban is labeled for white grubs both as a T-band (16 oz. rate) or in furrow (8 to 16 oz.). Thimet should be T-banded. Dyfonate, Force, Furadan, and Mocap are labeled for "suppression" or "aid in control" of white grubs. There are no soil insecticides labeled for white grub control in soybeans.

Entomologists at North Dakota State University have estimated that one or more true white grubs per cubic foot of soil will cause significant stand reductions in a seedling crop. If true white grubs are not found, then the use of an insecticide on first-year corn following soybeans is not warranted. In corn following sod, true white grub problems are more likely to occur and an insecticide should be applied at planting. There are no effective rescue treatments after white grub damage appears. If replanting of damaged stands is needed, an insecticide should be applied during the replanting operation.

Our white grub recommendation for 1991: In corn, a soil insecticide should be used only if true white grubs are detected prior to planting or if stand loss occurred last year. Soil insecticides used on corn for wireworm and white grub control are not registered for use on soybeans.

Sandhill Cutworm

Larvae of the sandhill cutworm, *Euxoa detersa*, are semi-translucent white in color with several pale longitudinal stripes. It is a minor soil pest from a statewide perspective but can be a major pest of corn planted in very sandy soils. Like most cutworms, it is primarily a problem in seedling stands. But unlike the black cutworm, sandhill cutworms mostly move below the soil surface and all feeding is on underground parts of the plant (Sechriest 1974).

This insect has one generation per year and because it overwinters as a partly grown larva (Hinks and Byers 1976) the damaging stage will be present in the field at planting. The larvae stop feeding in July, pupate, and after becoming adults in August, lay their eggs. In addition to corn, they have been observed feeding on soybeans, oats, wheat, rye, strawberries, sweet clover, and cocklebur (Rings and Johnson 1976, Sechriest

1974). Three important factors of the physical environment, temperature, soil moisture, and soil texture (Lafontaine 1981) are important in determining distribution patterns of cutworms. This species only inhabits areas of loose sand, often dune or relict sandbar areas, so soil texture is one of the important physical factors that determine the distribution of this cutworm in Iowa.

Recommendation for 1991: If corn stand loss has occurred in previous years on sandy soils, apply a soil insecticide in furrow at planting.

Literature Cited

Edwards, R., L. Bledsoe, and T. Turpin. 1990. Watch for white grubs during preplant tillage and planting operations. Pest management and crop production newsletter, no. 3, pg 3. Purdue Univ.

Funderburk, J. E., L. P. Pedigo, and E. C. Berry. 1983. Seedcorn maggot (Diptera: Anthomyiidae) emergence in conventional and reduced-tillage soybean systems in Iowa. J. Econ. Entomol. 76: 131-134.

Gregory, W. W., and G. J. Musick. 1976. Insect management in reduced till systems. Bull. Entomol. Soc. Am. 22: 302-304.

Hammond, R. B. 1990. Influence of cover crops and tillage on seedcorn maggot (Diptera: Anthomyiidae) populations in soybeans. Environ. Entomol. 19: 510-514.

Hammond, R. B., and B. R. Stinner. 1987. Seedcorn maggots and slugs in conservation tillage systems in Ohio. J. Econ. Entomol. 80: 680-684.

Higley, L. G., and L. P. Pedigo. 1984. Seedcorn maggot (Diptera: Anthomyiidae) population biology and aestivation in central Iowa. Environ. Entomol. 13: 1436-1442.

Hinks, C. F., and J. R. Byers. 1976. Biosystematics of the genus *Euxoa* (Lepidoptera: Noctuidae). V. Rearing procedures and life cycles of 36 species. Can. Entomol. 108: 1345-1357.

Lafontaine, J. D. 1981. Classification and phylogeny of the *Euxoa detersa* group (Lepidoptera: Noctuidae). Quaest. Entomol. 17: 1-120.

McLeod, M., D. D. Kopp, and D. K. McBride. 1986. White grub management. E-901, Coop. Ext. Serv., North Dakota St. Univ.

Riley, T. J., and A. J. Keaster. undated. A pictorial field key to wireworms attacking corn in the Midwest. Missouri Agri. Exp. Sta. MP517.

Rings, R. W., and B. A. Johnson. 1976. An annotated bibliography of the sandhill cutworm. Ohio Agric. Res. Develop. Cent., Res. Circ. 215.

Sechriest, R. E. 1974. Chemical control of *Euxoa detersa* in corn. J. Econ. Entomol. 67: 138-139.

Table 1. Average percentage damaged corn seeds for planting time wireworm insecticide treatments. Iowa, 1985-1989.

Year	Insecticide	Rate[1]	Placement[2]	% Damage[3] Test 1	Test 2
1985	Lorsban 15G	1.2	A+Ag	6.3a	27.8ab
	Agrox DL+	3.6 oz	--	21.8ab	23.1a
	Mocap 15G	1.2	R	25.0ab	63.7abc
	Counter 15G	1.2	F	25.9ab	46.6abc
	Lorsban 15G	1.2	A	42.9 b	54.4abc
	Lorsban 15G	1.2	F	44.9 b	37.5abc
	check	----	--	48.4 b	85.6 c
	Thimet 20G	1.2	A	50.5 b	50.0abc
	Dyfonate 20G	1.2	R	54.2 b	50.9abc
	Furadan 15G	1.2	F	57.6 b	80.0 bc
1986	Furadan 15G	2.4	F	0.0a	8.5a
	Lorsban 15G	1.2	A+Ag	2.5a	14.6ab
	Lorsban 15G	1.2	A	2.8a	56.9 c
	Dyfonate 20G	1.2	A	4.5a	42.5 bc
	Counter 15G	1.2	F	5.2a	7.3a
	Agrox DL+	3.6 oz	--	6.3a	35.0abc
	Lorsban 15G	1.2	F	7.0a	32.8abc
	Mocap 15G	1.2	R	7.5a	56.3 c
	Thimet 20G	1.2	A	7.5a	13.1ab
	check	----	--	62.4 b	90.5 d
1989	Force 1.5G	0.12	A+Ag	3.1a	0.0a
	Counter 15G	0.61	F	3.6a	0.0a
	Counter 15G	1.22	F	5.6a	0.0a
	Lorsban 15G	1.22	A+Ag	11.3a	0.0a
	Agrox DL+	3.6 oz	--	12.5a	2.5a
	Force 1.5G	0.15	F	14.9ab	3.1a
	Dyfonate 20G	1.22	A+Ag	18.8abc	0.0a
	Lorsban 15G	1.2	F	23.1abcd	2.5a
	Dyfonate II 20G	1.22	A	24.7abcd	2.8a
	check	----	--	41.3 bcd	35.6 b
	Lorsban 15G	1.22	A	43.8 cd	6.8a
	Counter 15G	1.22	A	48.2 d	5.6a

[1] Ounces active ingredient per 1,000 row feet. Agrox DL+ as ounces of material per hundred weight of seed.

[2] F = in furrow; A = 7-inch band ahead of closing wheels (=T-band); A+Ag = T-band with Agrox DL+ treated seed; R = 7-inch band to the rear of the closing wheels.

[3] Numbers in the same column and the same year that are followed by the same letter are not statistically different P>0.05, Duncan's new multiple range test. Percentage damage indicates an injured seed or seedling. The plant may or may not be dead.

Table 2. Average percentage damaged corn seeds for planting time seedcorn maggot insecticide treatments. Ames, Iowa, 1985.

Insecticide	Rate[1]	Placement[2]	% Damage[3]
Counter 15G	1.2	F	5.6a
Agrox DL+	3.6 oz	--	6.0a
Lorsban 15G	1.2	A+Ag	8.2ab
Lorsban 15G	1.2	A	12.8ab
Thimet 20G	1.2	A	16.0ab
Furadan 15G	1.2	F	28.4 b
Dyfonate 20G	1.2	R	29.6 b
baited check	----	----	88.1 c

[1] Ounces active ingredient per 1,000 row feet. Agrox DL+ as ounces of material per hundred weight of seed.

[2] F = in furrow; A = 7-inch band ahead of closing wheels (=T-band); A+Ag = T-band with Agrox DL+ treated seed; R = 7-inch band to the rear of the closing wheels.

[3] Numbers followed by the same letter are not statistically different, P>0.05, Duncan' new multiple range test.