# WHAT'S NEW IN ENTOMOLOGY

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In 1994, Japanese beetle continued to expand it's range northward to Grand Rapids, Landing, and northern Detroit area. More golf courses in Grand Rapids and Detroit are reporting Japanese beetle activity. The grub activity and damage is concentrated in the fairways and irrigated rough, with fewer grubs being found in the rough. In Kalamazoo a new animal was added to the list of skunks, raccoons and others that dig turf looking for grubs: crows. Apparently some crows have learned how to pull up turf to find grubs. They are capable of causing substantial turf injury, causing some superintendents to spend time finding ways to scare off the crows or reduce the grub infestation.

European chafer grubs caused considerable damage to turf in Jackson and parts of southern Detroit and Grand Rapids in fall of 1994. The widespread turf injury this fall after two quiet years where little damage was found, was due to a spell of dry weather from late September through October. European chafer injury to turf is much more severe during periods of drought when turf becomes water stressed.

We lost a good insecticide and gained one in 1994. Biosis announced that they would no longer continue to develop the *Steinernema glaseri* nematodes as a turf insecticide because of production problems. *S. glaseri* are the nematodes most suited for grub control. S. carpocapsae will still be available as a microbial insecticide but it has not provided very consistent control of grubs. A new insecticide, **Merit**, was registered by Miles, Inc. for grub control this year. Merit, or imidacloprid, is a nitroquadine insecticide. It is systemic and long lasting. It is most effective against aphids, leafhoppers and other sucking insects in the Homoptera. It is also very effective against young grubs. For grub control apply Merit before August 10th. The primary use for Merit should be for areas with chronic grub problems, where it is almost certain that grubs will cause injury the following year. Merit is not recommended for areas where grub injury is sporadic and lawns or golf courses need to be sampled before a decision is made to use an insecticide, because by the time grubs can be sampled it is too late to apply Merit.

Villani and Cowles published a paper on how soil type may affect insecticides used for grub control (Cowles and Villani 1994. J. Econ. Entomol. 87: 1014-1021). They tested Turcam, Dursban, Triumph, and Sevin for grub control in different soil types and under different pH conditions (Table 1). They found that the activity of Dursban was decreased by the presence of organic matter, and that irrigation increased the effectiveness of most insecticides applied to soil with high organic matter by 5-10%. Sevin was not very effective for grub control when the pH was above 7.2 and Triumph was most effective when the pH was above 6.0

The most effective insecticide for control of European chafer grubs in our test at Jackson Country Club this year was Oftanol, with 57% control (Table 2). Rohm and Haas has a new insecticide effective against grubs, called RH-0345. RH-0345 should be registered in the next two years. FMC has developed a new formulation of bifenthrin (Talstar) for grub control. We observed 50% control of European chafer grubs using a 2.5 G formulation of Talstar. Marathon 1G gave about 45% control when applied on August 22. If we had applied Marathon earlier it probably would have worked better.

Dursban and Sevin reduced Chinch bugs by about 50% in our test in an Okemos home lawn (Table 3). M-Pede insecticidal soap did not provide chinch bug control.

In the last two years we found that golf courses in Michigan are plagued by two species of small black beetles: *Ataenius spretulus* and *Aphodius granarius.* Aphodius grubs are active in June while Ataenius grubs are active in late July. Some courses may have both Ataenius and Aphodius. I have attempted to identify the reasons for outbreaks of Ataenius and Aphodius beetles on golf course, where more than 500 grubs are found per square foot, compared with usual occurrence of 5 or less per square foot in a home lawn. In 1992 and 1993 we found a large proportion (10-75%)

of Ataenius and Aphodius grubs were infected with milky spore disease (*Bacillus popilliae*). Also in 1993, my students observed more ant activity in the irrigated rough than in the fairway. They suggested that I put more energy into investigating predator activity. With those thoughts in mind we created a new set of research plots at Oakland Hills and Franklin Hills to investigate how pesticides affect the natural incidence of milky spore disease in grubs, and how pesticides affect predators. At the same time we continued to explore how the irrigated rough differed from fairways as a habitat for grubs and predators.

As we were collecting data this summer a research paper was published on the effects of pesticides on milky spore disease. Dingman (1994) found that chlorothalonil (Dithane), iprodione (Chipco 26019) and chlorpyrifos (Dursban) inhibit cell growth of milky spore bacteria, even at concentrations as low as 10 ppm (Table 4). He also found that spores of *Bacillus popilliae* would not germinate in the presence of chlorothalonil at the concentration recommended for application to turf (Table 5). At our research plots at Franklin Hills and Oakland Hills we did not see a dramatic effect of the same pesticides on the prevalence of milky spore disease (Table 6). In fact, the control plots at Franklin hills had the lowest level of milky spore disease. At Oakland Hills the number of Aphodius grubs was so low that it was not possible to evaluate the effects of pesticides on milky spore disease.

In 1994 we used small glass vials, filled with ethylene glycol and sunk into the soil so that the tops of the vials were flush with the soil surface, to trap predators crawling on the soil surface. Two groups of predators dominated the trap catches: staphylinid beetles and ants. Staphylinids are a family of small (1/4 to 1/2 inch long) beetles that are mostly predators as adults and larvae. Staphylinids are also referred to as rove beetles. There are about 3,200 species of rove beetles in North America. Pesticides seemed to have little effect on the number of rove beetles caught in our traps. The most interesting result was that we caught 10-fold more rove beetles in the irrigated rough than in the fairway(Table 7). We found a similar situation for ants. Traps located in the irrigated rough had 3 to 10-fold more ants than traps located in the fairway (Table 8). Although ants and rove beetles probably feed on beetle eggs and small beetle grubs, we did not find a strong correlation between predators and grubs. When the number of ants and rove beetles were added together they explained 30% of the variation in the number of Ataenius grubs at Franklin Hills (Figure 1). The negative correlation is highly significant but other factors such as interplot movement of predators or the dependence of predators on the density of prey must also be important because the number of grubs per plot varied from 5 to 15 where no predators were found and from 0 to 5 where the most predators were found.

Dursban sprays reduced the number of Ataenius grubs found at Franklin Hills but caused an increase in the number of Aphodius grubs found at Oakland Hills. Apparently the Aphodius grubs at Oakland Hills are somewhat resistant to Dursban. Predator activity may account for lower number of grubs in the control plots compared with the Dursban plots. The different response of predators and grubs at one golf course compared with another is most likely due to differences in the level of grub resistance to pesticides. At both golf courses the highest number of grubs were in the plots treated with Daconil. In an insecticide trial on the same fairway at Oakland Hills we also found low numbers of grubs in the control plots and much higher number of grubs in one insecticide treatment. We found a total of 21 grubs in six plots treated with Oftanol, compared with 5 grubs in six control plots (Table 10). Apparently, predators were active in control plots but not in the Oftanol plots.

After our 1994 field research we believe that predators are playing an important role in keeping populations of Ataenius and Aphodius grubs under control at golf courses. At this point it appears that the most likely cause of outbreaks of grubs in fairways is reduced predator activity. The role that various pesticides play in suppressing predators and pathogens of is not clear. We will continue to investigate the importance of predators on golf courses and how pesticides effect the balance between predators and grubs in 1995.

**Figure 1.** Relationship between ants and staphylinid beetles to the number of Ataenius grubs per plot at Franklin Hills.

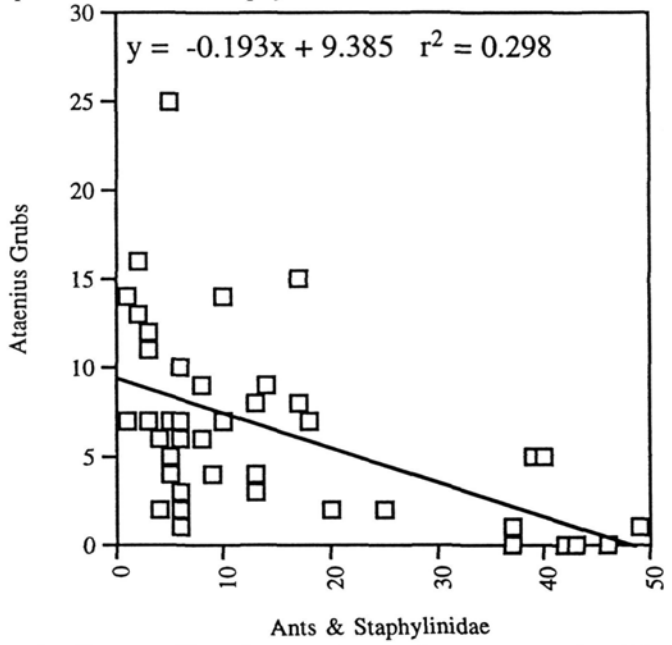


**Table 1. The effects of soil type, pH and percent organic matter on the efficacy of insecticides used for grub control (Cowles and Villani 1994).**

## RESULTS

1. chlorpyrifos: activity was reduced by presence of high % organic matter

2. carbaryl: soil pH of 6 = 80% control
   soil pH of 7.2 = 50% control

3. isazofos: Soil pH of 6 = 80% control
   Soil pH of 7.2 = 95% control

4. Irrigation was most helpful in soil with high organic matter. Control increased 5-10%.

**Table 2. Evaluation of insecticides for control of European chafer at Jackson Country Club, 1994.**

| Company | Compound/Formulation | Rate | mean no. of grubs |
|---|---|---|---|
| Miles | Oftanol 2I | 3 oz/1000 $ft^2$ | 4.0 a |
| Rohm & Haas | RH-0345 2.5%G XF-94015 | 2 lb ai/1000 $ft^2$ | 4.8 a |
| FMC | Bifenthrin 1EC (PL 94-59) | .0025 lb ai/1000 $ft^2$ | 4.8 a |
| Biosys | Steinernema glaseri | 1 billion/A | 5.0 a |
| Miles | Marathon 1G | .3 lb ai/A | 5.2 a |
| Rohm & Haas | RH-0345 2.5%G XF-94055 | 1 lb ai/A | 6.0 a |
| FMC | Bifenthrin 1EC (PC 94-59) | .00031 lb ai/1000 $ft^2$ | 6.3 a |
| - | Control | - | 9.2 a |

Numbers followed by the same letter are not significantly different. Data were converted by log (X + 1) prior to ANOVA/Fisher's LSD ($p<0.05$). Untransformed data are presented.

**Table 3. Evaluation of insecticides for control of chinch bug in an Okemos home lawn, 1994.**

| | | | Chinch bugs per 6 min | |
|---|---|---|---|---|
| Company | Compound | Given Rates | 26 July | 3 August |
| Rhone Poulenc | Sevin 80WSP | 6.0 lb ai/acre | 51.0 a | 19.0 a |
| Rhone Poulenc | Sevin 3.5G | 8.0 lb ai/acre | 44.4 a | 19.5 a |
| Mycogen | M-pede | 3% | 50.1 a | 36.5 a |
| DowElanco | Dursban 4E | 1.0 lb ai/100 gal | 52.5 a | 18.8 a |
| - | Control | - | 51.0 a | 35.7 a |

Means followed by the same letter are not significantly different ($P<0.05$ ANOVA/ Fisher's Protected LSD). Data were transformed using $\log_{10}$ (X+1) prior to ANOVA. Untransformed data are presented.

**Table 4. Inhibition of B. popilliae Cell Growth by Pesticides (Dingman 1994, Appl. Environ. Microbiol.).**

| | Percent inhibition of cell growth | | |
|---|---|---|---|
| Pesticide | 1 ppm | 10 ppm | 50 ppm |
| Fungicides | | | |
| Triadimefon | 28 | 44 | 86 |
| Chlorothalonil | >99 | >99 | >99 |
| Iprodione | 39 | >99 | >99 |
| Herbicide | | | |
| Pendimethalin | 25 | 40 | 94 |
| Insecticides | | | |
| Chlorpyrifos | 13 | 96 | 97 |
| Chlordane | 0 | 0 | 98 |

**Table 5. Effects of Pesticides on B. popilliae Spore Viability (Dingman 1994, Appl. Environ. Microbiol.).**

| | Percent reduction in spore viability | |
|---|---|---|
| Pesticide | 1 x | 5 x |
| Fungicides | | |
| Triadimefon | 0 | 43% |
| Chlorothalonil | 93% | 91% |
| Herbicides | | |
| Pendimethalin | 19% | 76% |
| 2, 4 - D + 2, 4 - DP | 20% | 83% |

**Table 6. Prevalance of milky spore disease in fungicides and insecticide test plots at Franklin Hills and Oakland Hills, 1994.**

| Treatment | Franklin Hills Ataenius % Bp | Oakland Hills Aphodius % Bp |
|---|---|---|
| Daconil | 27 | 0 |
| Dursban once | - | 60 |
| Dursban twice | - | 13 |
| Fairway Control | 16 | - |
| Banner | 30 | - |
| Bayleton | 39 | 29 |
| Curalin | 44 | - |
| Rubigan | - | - |
| Rough Control | - | - |

**Table 7. Impact of Pesticides on Staphylinid Beetles.**

| Treatment | Franklin Hills Staphylinids | Oakland Hills Staphylinids |
|---|---|---|
| Dursban once | 1.3 | 3.0 |
| Fairway control | 1.7 | 2.0 |
| Banner | 1.7 | 1.8 |
| Rubigan | 1.7 | 1.8 |
| Dursban twice | 1.8 | 2.3 |
| Curalin | 2.2 | 1.2 |
| Bayleton | 2.7 | 2.0 |
| Daconil | 3.3 | 2.2 |
| Rough Control | 19.8 | 7.7 |

**Table 8. Impact of Pesticides on Ants.**

| Treatment | Franklin Hills Ants | Oakland Hills Ants |
|---|---|---|
| Daconil | 3.2 | 6.5 |
| Bayleton | 3.2 | 16.3 |
| Curalin | 6.5 | 5.3 |
| Fairway Control | 8.0 | 4.3 |
| Banner | 12.0 | 12.2 |
| Dursban once | 8.3 | 4.3 |
| Dursban twice | 9.2 | 5.2 |
| Rubigan | 19.0 | 2.7 |
| Rough Control | 24.0 | 41.5 |

**Table 9. Dursban and Daconil Effects on Ataenius and Aphodius Grubs.**

| Treatment | Franklin Hills Ataenius grubs | Oakland Hills Aphodius grubs |
|---|---|---|
| Dursban once | 1.3 | 4.0 |
| Dursban twice | 0.3 | 2.3 |
| Daconil | 9.7 | 5.0 |
| Fairway control | 8.0 | 1.8 |
| Rough control | 0.2 | 2.5 |

**Table 10. Evaluation of insecticides for control of Aphodius grubs at Oakland Hills, 1994.**

| | | | | # of Aphodius grubs on 20 June | |
|---|---|---|---|---|---|
| Company | Treatment | Rate | /5 liters | Mean | Total |
| Rhone Poulenc | Mocap 10G | 5.0 lb ai/acre | 23.15 gr/plot | 0.67a | 4 |
| Rhone Poulenc | Sevin 80WSP | 8.0 lb ai/acre | 34.3 gr | 0.50 a | 3 |
| Rohm & Haas | RH-0345 2F | 1.0 lb ai/A | 14.3 ml | 0.17 a | 1 |
| Rohm & Haas | RH-0345 2F | 2.0 lbs ai/A | 28.6 ml | 0.00 a | 0 |
| Rohm & Haas | RH-0345 2F | 3.0 lbs ai/A | 42.9 ml | 0.00 a | 0 |
| Miles | Merit 1G | 0.3 lbs ai/A | 15.42 gr/plot | 0.00 a | 0 |
| Standard | Oftanol 2I | 3 fl oz/1000 $ft^2$ | 29.2 ml | 3.50 b | 21 |
| Control | | | | 0.83 a | 5 |

Means followed by the same letter are not significantly different ($P < 0.05$ ANOVA/Fisher's Protected LSD). Data were transformed using $\log_{10}(X+1)$ prior to ANOVA. Untransformed data are presented.