

Sprayable Sex Pheromones Disrupt Oriental Beetle Mating

By Albrecht M. Koppenhöfer

The oriental beetle (OB), *Anomala orientalis*, has become the most important white grub species in turfgrass in New Jersey, southeastern New York, Connecticut and Rhode Island. It is also the major white grub species in ornamental nurseries and blueberries, and it causes losses in other crops. An increase in OB significance may occur in other areas where it is already established, such as all of coastal New England and Middle Atlantic states as well as Ohio, Virginia, North Carolina, South Carolina, West Virginia and Tennessee.

The OB has a one-year life cycle similar to that of other important white grub species. At the latitude of New Jersey, OB flight occurs from early June through early August with peak flight activity in late June/early July. The adult beetles only live for about two weeks and do not cause significant damage. After mating, the females lay eggs among the roots of host plants, and the eggs hatch in two to three weeks. The first and second instar each last around three weeks so that by mid-September the majority of the larvae are in the third instar.

After overwintering below the frost line, the third instars resume feeding until pupation in late spring. The extensive feeding activity of the larger larvae can kill large areas of grass from mid-August into mid-October, especially under warm, dry conditions. In addition, vertebrate predators can tear up the turf to feed on the grubs.

Sex pheromone-mediated mate finding and copulation of OB occur at or near the soil surface, immediately after female emergence from the soil, close to the emergence site (Facundo et al. 1999a, b). Males respond to female-released pheromone by a combination of flying upwind and walking short distances. Both sexes are most active between 6 p.m. and

PHOTO 1



A male oriental beetle (bottom) pursues a female. The adult beetles only live for about two weeks and do not cause significant damage.

10 p.m. The OB sex pheromone consists of 9:1 blend of (Z)-7-tetradecen-2-one and (E)-7-tetradecen-2-one (Zhang et al. 1994, Facundo et al. 1994).

Mating disruption with sex pheromones is widely used as an environmentally safe, non-toxic alternative to broad-spectrum insecticides for several moth species (Cardé and Minks 1995). But only recently has mating disruption technology been considered a possibility for management of white grubs (Polavarapu et al. 2002).

Mating disruption field trials

To determine the feasibility of mating disruption technology in turfgrass, this study conducted field trials with sprayable microencapsulated formulation of the OB sex pheromone. Two methods were used to determine the effect of treatments on the mating success of OB. The first method measured the ability of OB males to locate a pheromone source similar

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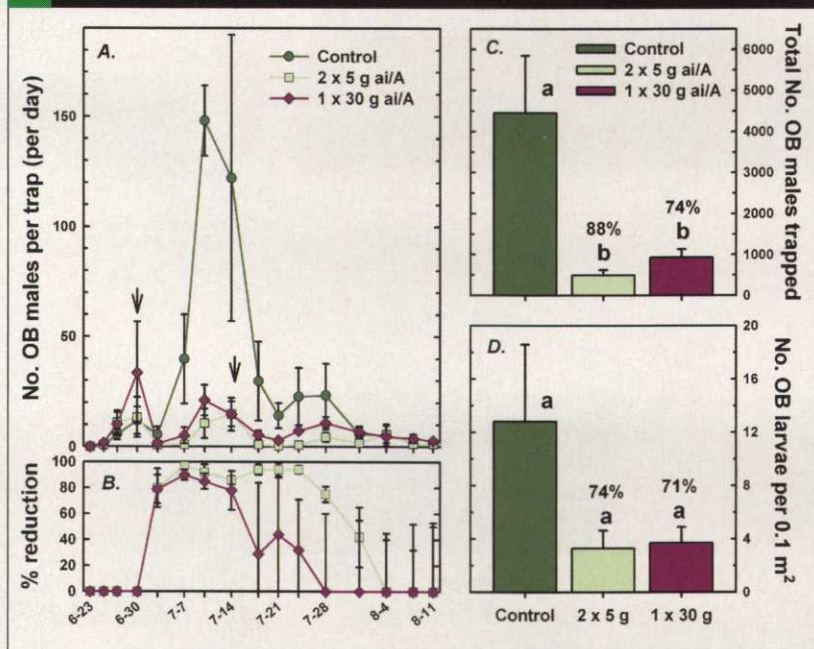


Bayer Environmental Science

QUICK TIP

Put *Poa* in its place this fall! Prograss® herbicide eliminates *Poa annua* in perennial ryegrass, Kentucky bluegrass, creeping bentgrass and turf-type tall fescue. Because rates and number of applications vary with the tolerance of the desirable turfgrass, superintendents should gain experience with Prograss by testing selected areas before application. Remember: Turf at its optimum level of fertility better tolerates Prograss, allowing desirable grass to fill in when *Poa* is controlled.

FIGURE 1



Field season 2003 *A. orientalis* mating disruption trial. A) Twice-weekly male trap captures (arrows indicate application dates). B) Percentage reduction in twice-weekly trap captures. C) Total seasonal trap captures. D) *A. orientalis* larval densities in September following application. Data with the same letter are not significantly different, and figures above bars indicate percent reduction compared to control.

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to a female by determining the number of OB males captured in traps. Trapping was also used to monitor OB male flight and optimize application timing. Four (2002) or three (2003) traps lured with septa containing the pheromone were placed in each plot. Captured males were killed and counted.

The second method estimated OB larval densities during September following the applications by taking 30 soil/sod cores (4.25 inches in diameter by 4 inches deep) in a grid pattern at least 50 feet inside the plot. Plots measuring 0.8 acres to 1.4 acres were situated in large lawn areas and golf course rough areas in Monmouth County, N.J.

The treatment plots were broadcast sprayed with microencapsulated OB sex pheromone using locally available spray equipment. The first

spray was applied about 10 days after the first OB males were captured in traps. Where applicable, a second spray was applied about 14 days after the first spray. In 2002, one treatment was applied consisting of two sprays of 20 grams actual ingredient per acre (g ai/acre) of a formulation developed by 3M Canada Co. (London, Ontario) containing 20 percent (Z)- and (E)-7-tetradecen-2-one at a 93:7 ratio.

In 2003, treatments consisted of one spray of 30 g ai/acre or two sprays of 5 g/acre.

Results

In 2002, OB male flight started in the first week of June and trap captures had two distinct peaks on 25 June and around 5 July (Fig. 1A). Percent reduction in trap captures (Fig. 1B) in the treated plots was 96 percent to 100 percent for the first week after each appli-

cation but started to drop during the second week. Total trap captures were 87 percent fewer in the treated plots than in the control plots (Fig. 1C).

OB larval densities in September were 68 percent lower in the treated plots than in the controls. But due to high variation in the control plots, the reduction was not statistically significant in 2002 or 2003.

In 2003, OB male flight started in the last week of June, and trap captures peaked around July 10 to July 14 (Fig. 2A). Percent reduction in trap captures (Fig. 2B) in the treated plots was 96 to 100 percent for the first week after each application but started to drop during the second week. Total trap captures were lower in the single application at 30 g ai/acre treatment (74 percent reduction) than in the control, and were the lowest in the double application at 5 g ai/acre treatment (88 percent reduction) (Fig. 2C). OB larval densities in September were 71 percent to 74 percent lower in the treated plots than in the controls (Fig. 2D).

Adsorption of sex pheromone on shoes

OB pheromone can adsorb on surfaces it comes into contact, such as shoes. These can then attract male OB over an extended period of time.

To test whether shoes can be contaminated with enough OB pheromone to cause potential nuisance to their owners, one pair of athletic shoes was walked for 30 minutes through each of the areas treated with OB pheromone in the large field trials at one or eight days after treatment (DAT).

The shoes were lined up in a non-pheromone-treated turfgrass area, and OB males were collected from them for 45 minutes. No males were attracted to the control shoes. Significantly fewer males were attracted to shoes walked at eight DAT (average 1.8) than to shoes walked at one DAT (average 42.3).

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QUICK TIP

From the outside looking in, golf courses are marvels of aesthetic beauty with a harmonious blend of grasses, trees and other native features. Everything appears to be as nature had intended. But a tremendous amount of work goes into maintaining a course. And at some point, turf maintenance might be associated with negative impacts on the environment. These accusations — whether true or not — must be addressed. A superintendent has the responsibility of doing what is right for the environment in addition to providing expected playing conditions. The knowledge gained from these experiences can be a powerful influence on how communities address problems regarding their local environment. Superintendents are consultants. And superintendents have a responsibility within the green industry to be stewards of the environment. After all, resolving the Earth's ecological issues begins at home.

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Conclusions

This study demonstrates the feasibility of mating disruption in turfgrass.

However, the effect of the pheromone spray started to wane after about 10 days, making a second application after 14 days necessary. White grub larval counts in the nontreated areas were too variable to allow for the detection of statistically significant difference. Nevertheless, the trend in the 2002 and 2003 field seasons was very consistent with 68 percent to 74 percent lower OB larval populations in the treated areas.

The efficacy of mating disruption using sprayable formulations could be improved with more frequent applications, probably even with lower pheromone application rates than used in this study. However, the availability of highly effective insecticides will limit the acceptance of mating disruption unless a formulation can be developed that is more effective and/or requires only one seasonal application. We don't believe that this goal can be achieved using microencapsulated sprayable formulations. The potential contamination of shoes and other clothing articles by the sprayable formulation also presents a liability to these formulations.

Dispersible pheromone formulations consisting of numerous broadcast small pheromone sources may solve the problems of limited persistence as well as contamination of clothing articles. Our ongoing studies with dispersible formulations look very promising and suggest that mating disruption can be an effective, safe, environmentally and economically sound, easily implementable, durable, and highly integrated pest management compatible option for OB management in turfgrass.

Albrecht Koppenhöfer is associate professor and extension specialist in turfgrass entomology at Rutgers University in New Jersey. His research and teaching emphasize the development of integrated pest management strategies for important turfgrass insect pests in the Northeast, in particular for the white grub complex and the annual bluegrass weevil. Collaborating with Koppenhöfer on the research and article were: Sridhar Polavarapu, professor and extension specialist in at Rutgers (deceased in 2004); Eugene M. Fuzy,

senior laboratory technician in turfgrass entomology at Rutgers; Aijun Zhang, research chemist with the USDA-ARS Chemicals Affecting Insect Behavior Laboratory at Beltsville, Md.; Kristin Ketner, researcher with Suterra LLC in Bend, Ore.; and Thomas Larsen. Ph.D., director of product development at Suterra.

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