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CATERPILLARS

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And then there's DuPont Professional Products' Acelepryn (chlorantraniliprole), which is in a category all by itself because its LD50 number is higher than 5,000, Shetlar says.

"And if the LD50 number is that high, the EPA says you don't need a signal word on the label," he says. "It's the first product I know of that has no caution label."

Shetlar says Valent's Arena has an active ingredient (clothianidin) with an LD50 of 5,000. "But the inerts made it more toxic," he adds. "The LD50 of that product is 3,500. With an LD50 of less than 5,000, you need a caution label."

One measure of safety for an insecticide is its effect on nontargeted pests. The newer chemistries are picking up on neural differences in insects and animals, making them more targeted, hence less toxic to noninsects, Shetlar says. But to go to the next level of safety is not an easy task.

"How do I make more money on more complicated products?" Shetlar asks. "The more complex they are to make, the higher the cost, and the use declines because the product is more targeted. From the end-users' views, they want products to be more broad spectrum so they don't have to buy and apply more. From an environmental aspect, the products [aim] to be more targeted."

Shetlar remembers a targeted product in the 1980s that killed only aphids, but it only lasted about three years on the U.S. market because it was too targeted.

All the insecticides have their own niches. Syngenta Professional Products' Meridian, for example, targets insects such as billbugs, white grubs, chinch bugs and mole crickets, Shetlar says. Arena has a broad spectrum and provides good control on weevils, Shetlar says. It has 14 to 20 days of action on caterpillars.

Arysta LifeSciences' Aloft, a combo product (bifenthrin and clothianidin) similar to Bayer Environmental Science's Allectus, effectively knocks down surface feeders, the caterpillar complex and chinch bugs, Shetlar says. Arena and Aloft take out billbugs quickly.

Acelepryn is preventive because it affects insects' muscles. Older insects could survive ingesting it (would get muscle cramps), but an early instar insect would be killed within hours.

Superintendents are impressed with the new insecticides. Jeff White, golf course and grounds manager at Lake Quivera Country Club in Quivera,

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Kan., manages bentgrass greens and zoysiagrass tees and fairways at the Audubon-certified course. White uses Aloft for grub control in the cool-season grass roughs (applied the last week in June or the first week in July once a year). This is the second season he has used it. Aloft controls surface-feeding insects and its use rates are ultra-low compared with what White used five years ago.

"I don't treat for any insect other than grubs," he says. "I do a lot of scouting. I don't want to impact the environment any more than I have to. I take those issues very seriously for all involved — golfers, members, workers, etc."

White likes the broader application windows of products such as Aloft.

With some of the older chemistries, timing was an issue, and turf damage was the result.

"With a lot of older products, if the timing was off, you'd have to go back and treat," he says. "With the newer products, I've never had to go back."

Tom Tuttle, superintendent at the Trenton (N.J.) Country Club, mainly controls annual bluegrass weevils and white grubs, and to a lesser degree cutworms and armyworms on *Poa annual* bentgrass greens and *Poa annual*/bentgrass/ryegrass fairways.

Tuttle has had issues with annual bluegrass weevils for nine years. With some of the older chemistries, timing was always an issue, and turfgrass damage was the result. Then he discovered products such as Provaunt (indoxacarb), a curative product, and Acelepryn during a winter seminar from Pat Vittum, Ph.D., of the University of Massachusetts and Paul Heller, Ph.D., of Penn State University, who were testing the products.

Last year, Tuttle used Acelepryn for white grubs. This year, he applied it in April for annual bluegrass weevil and white grubs. Last year, Acelepryn wasn't available until mid- to late June in his area, so it was too late to use it for annual bluegrass weevils.

"You put out Acelepryn early and get season-long control, which is attractive," he says. "Acelepryn is a little more expensive up front, but it's minimal. I'm more concerned about protecting my

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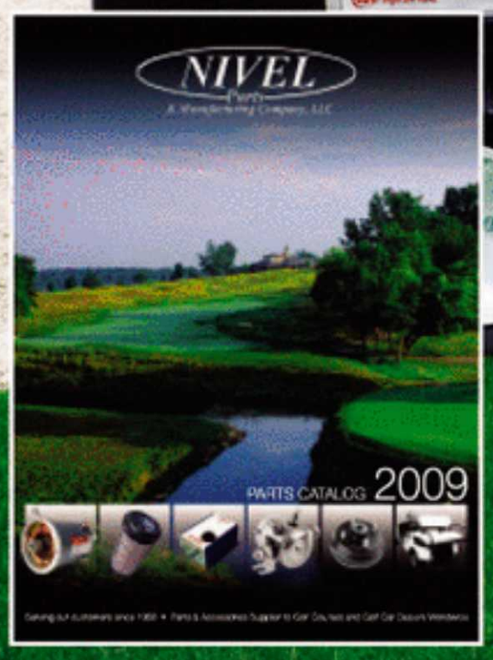

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turf. Acelepryn has good efficacy for surface feeders, but I don't target those insects."

Joe Noppenberger, superintendent at Wedgewood Golf & Country Club in Powell, Ohio, uses mostly Arena and Acelepryn to control cutworms, billbugs, white grubs, June beetles and masked chafers. He applies Arena and Acelepryn for white grubs and billbugs in late May. Then he treats roughs mid-summer for white grubs.

Arena and Acelepryn work much better than older products, Noppenberger says. Currently, he using the 6.4-ounces-per-acre rate with Arena and 8-ounces-per-acre rate with Acelepryn.

At Lincolnshire, Werner targets primarily black cutworms in bentgrass and white grubs under the irrigated areas (primary rough and fairways) except for greens. He treats cutworms curatively and white grubs preventively. He spot treats some areas in the rough because of cost, acreage and risk factor. Werner's treatment of white grubs is preventive (50 acres) with Meridian, which he has used since 2007.

"A lot of people are going out early in the season, but I typically treat in July, closer to when they hatch, which is in mid-August," he says. "It seems the failures occur with those who treated earlier in the year."

The entire neonicotinoids class — a class of insecticides that act on the nervous system of insects with lower toxicity to mammals — has a lower use rate and lower environmental load than the insecticides from the 1990s, Werner says. The insecticides are more pest specific, so there are not as many off-target issues.

"They're a tremendous improvement, which brings a peace of mind," says Werner, who says he's careful about his spray program because his course is surrounded by homes.

Despite the evolution of more targeted insecticides, the ideal pesticide is one that only kills the target, Shetlar says. "Well, we don't have that," he adds.

However, the newer insecticides, compared to older chemistries, are less toxic.

"If you told me 10 years ago that we would have some-

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thing like Acelepryn (which is applied in the first week in May and has caterpillar control through September), I would have told you you were crazy," Shetlar says.

Nonetheless, superintendents are wary of future regulations.

"It seems to be the consensus that we'll be using less pesticide in the future," Noppenberger says. "Look at Canada, for example. There are pesticide bans there. Using less pesticide will make the job more difficult because the expectations for turf conditions won't be lowered."

"I hope the people who make decisions about regulating them are making those decisions based on fact, not emotion," adds Tuttle, who believes manufacturers are making a concerted effort to make pesticides as effective and as environmentally friendly as possible.

"I don't see that trend changing," he adds. "But it's beneficial to us because there's less risk of exposure when mixing less product with the same efficacy." ■

Walsh is a freelance writer from Cleveland.

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GRUB CONTROL

Drubbing Grubs, Naturally

Tiphia parasitic wasps take on Japanese and Oriental Beetle grubs *By Ana Legrand*

The Japanese beetle, *Popillia japonica*, was first detected in Riverton, N.J., in 1916. It's believed this insect was accidentally introduced in infested nursery stock from Japan. Since then it has expanded its range, continuing to be a pest of ornamentals and turfgrass.

In 2008, surveys were completed to determine the extent of spring Tiphia parasitism on Japanese and Oriental beetle grubs. Collections were made at 12 sites that included public parks and golf courses in Connecticut.

Tiphia has been known as a parasitic wasp for decades. During the 1920s and early 1930s, U.S. Department of Agriculture entomologists imported *Tiphia vernalis* Rohwer (Hymenoptera: Tiphiidae) from Korea as a biological control agent against the Japanese beetle. C.P. Clausen and J.L. King, who spent several years in Japan and other parts of Asia searching for natural enemies of the Japanese beetle, led the effort.

T. vernalis, also known as the spring Tiphia, is a parasitic wasp that attacks Japanese and Oriental beetle grubs. The small insect is not harmful to people, and it's not known to attack any native beetle species (Ladd and McCabe 1966). With its help, populations of Japanese beetles are reduced in number from what potentially could be more severe infestations.

The USDA has made numerous wasp releases throughout the Northeast. *T. vernalis* was released in most of Connecticut's counties between 1936 and 1949. But since 1950, little information was available on the status of this wasp in the Northeast, and it was considered to be rare. However, a survey in Connecticut indicated that spring Tiphia wasps were widely distributed in the state (Ramoutar and Legrand 2007). Populations of the spring Tiphia have also been documented in Kentucky, Missouri, Ohio and Tennessee.

Tiphia wasps feed on extra-floral nectar from Peony Big Ben.

Spring Tiphia females are about a half-inch long and the males are about three-eighths of an inch long. These shiny black wasps are solitary. They don't live in nests or swarms, and they

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have only one generation per year. Male wasps emerge first and females emerge three to four days later. In Connecticut, spring Tiphia wasps are active from the first week of May to mid-June with a peak in numbers observed around the last week of May. Adult wasps feed on honeydew produced by insects like aphids, and they are seen on the foliage of maple and cherry. Tulip trees are reported as being one of their preferred plants for seeking honeydew.

After mating, female wasps burrow into the soil discreetly and search for grubs. When a grub is found, the wasp stings it and paralyzes it momentarily while the wasp attaches one egg on the ventral groove between the third thoracic and first abdominal segments. When the wasp egg hatches, the resulting parasitic larva begins feeding on the grub. The parasitic larva securely attaches itself outside the host and feeds on the grub until the host grub dies.

The parasitic larva grows rapidly and the full-grown larva spins a papery, water-resistant, silken cocoon. Within the cocoon, it completes its development and transforms into an adult wasp. It passes the winter in this stage within the cocoon until the next spring when wasps emerge to start the cycle again.

Tiphia females live for about a month and may lay 40 to 50 eggs on as many different grubs. The female wasps seek out the Japanese beetle grubs in May to early June when the grubs are feeding before pupation.

Samples at the 12 sites were taken throughout June. Larvae collected during the survey were from European chafers, Asiatic garden beetles, Japanese and Oriental beetles. As expected, only the Japanese and Oriental beetle larvae were parasitized by the spring Tiphia. Previous research had shown the range of parasitism rates of this parasitoid to be 19 percent to 61 percent on Japanese beetle grubs (King and Parker 1950). In our survey, we found a range of 61 percent to 100 percent parasitism on the Japanese beetle grubs (see table on page 52). In addition, the spring Tiphia is also inflicting mortality on Oriental beetle populations with a parasitism rate ranging from 7 percent to 33 percent in low-density Oriental beetle populations. Reding and Klein (2001) found in an Ohio nursery the rate of *T. vernalis* parasitism on Oriental beetles ranged from 6 percent to 23 percent.

(Above) The parasitic larva securely attaches itself outside the host and feeds on the grub. (Bottom) The full-grown larva spins a silken cocoon.

On average, parasitism of Oriental beetle was less than that found on Japanese beetle larvae, and we will continue work to determine possible reasons for this. Nevertheless, the spring Tiphia can be a significant source of mortality for the Japanese beetle, and it should be integrated with other management tactics.

Summer Tiphia

While the focus of this article has been the spring Tiphia, there is another beneficial wasp by the name of *Tiphia popilliavora* Rohwer that was released as part of the biological control effort against the Japanese beetle. This wasp is commonly referred to as the summer Tiphia. It behaves in a similar manner as the spring Tiphia with the exception of the time when it is active and where it places its egg on the host grub.

We did not have much information on this wasp, but surveys done in 2008 showed it was

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PHOTOS COURTESY: ANA LEGRAND