Greater Pittsburgh Chapter GCSAA GOLF COURSE SUPERINTENDENTS ASSOCIATION OF AMERICA

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# THREE RIVERS GREEN

A PUBLICATION OF THE GREATER PITTSBURGH GOLF COURSE SUPERINTENDENTS ASSOCIATION

# Controlling Annual Bluegrass Weevil: Optimal Insecticide Timing and Rates

***Many insecticides are effective against annual bluegrass weevils susceptible to pyrethroids, but nearly all insecticides are less effective against pyrethroid-resistant weevils.***

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The annual bluegrass weevil *(Listronotus maculicollis, formerly Hyperodes maculicollis)* is a highly destructive pest of short-mowed golf course turf in the northeastern United States and eastern Canada. Damage caused by larval feeding is particularly apparent on tees, fairways, collars and greens with high percentages of annual bluegrass *(Poa annua)*, which is preferred over bentgrasses for egg-laying and is also less tolerant of larval feeding. Females place eggs between the leaf sheaths or inside the stem of the turfgrass plant. The first through third larval instars feed within the grass stem. Third instars eventually exit the stem, and the fourth and fifth instars feed externally at the soil/thatch surface, each killing up to a dozen plants when they feed on the crowns.

## *Life Cycle*

Around the New York metropolitan area, the annual bluegrass weevil has two to three generations per year. A partial fourth generation may occur some years in the Mid-Atlantic states. A majority of adults overwinter in protected areas along the edge of woods or in the rough. In spring, between full bloom of forsythia (Forsythia species) and full bloom of flowering dogwood (Cornus florida) and eastern redbud (Cercis canadensis), these adults migrate onto the golf course to feed on grass blades and mate. Toward the end of this period, females start depositing eggs and will continue to do so for several weeks. By the time hybrid rhododendron (Rhododendron catawbiense) is in full bloom, larvae will start to emerge from the plants and feed externally. The resulting turf damage typically appears between late May-early June and mid-June. After reaching full size, the larvae stop feeding, pupate near the soil surface, transform into adults, and appear on the turf surface around late June.

These spring-generation adults mate and lay eggs. The resulting second annual bluegrass weevil generation is present predominantly as large larvae around late July-early August, when additional damage — usually less severe than spring damage — may occur. The second generation pupates in August and starts emerging as adults around mid-August. A third generation may develop between mid-August and mid to late September, but is usually lower in density, rarely causing damage.

## *Pest Management*

The annual bluegrass weevil has become one of the most difficult-to-manage insect pests on golf courses. Until the early 2000s, superintendents could be assured that a well-timed pyrethroid spray in the spring would prevent damage for the remainder of the season. The strategy was to apply an adulticide to the fairways, or even just the perimeters, at the time that forsythia (Forsythia species) reached the half-gold, half-green late stage of bloom, or when downy serviceberry (Amelanchier arborea) was in bloom. At this time, the vast majority of adult weevils are already on the short-mowed areas but have not yet started laying eggs. In recent years, many courses have observed a decrease in the efficacy of this strategy when using traditional products such as pyrethroids.

Because of the low tolerance for annual bluegrass weevil damage, superintendents may make several applications against emerging adults and their offspring and additional applications against the summer generations. Overreliance on and overuse of insecticides, particularly of the pyrethroid class, has led to the development of pesticide-resistant populations on an increasing number of golf courses (1,2). Current management practices are not sustainable and new approaches are needed.

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## *IN THIS ISSUE*

# President's Message

Yet another mild winter is in the past, and spring is slowly creeping in. Flowers are blooming, seed heads too, the smell of fresh cut grass fills the air, and aerification plugs are flying. Oh yeah, and hopefully we are starting to see some golf being played. Most golfers have been itching to get out and the gradual spring seems to temper the mad rush to the tee. As we continue preparations for the season, and rounds increase, it's good to see the course back in use again. Not sure I like the cart traffic damage but I guess you have to take the good with the bad.

I want to thank all of our vendor sponsors for their continued support of our local association. The package programs in place for sponsorship seem to still be beneficial. We challenge ourselves to add value to each category, and continue to request your input in developing value added benefits. The organization serves all the members, be it individual or commercial and we take pride in our offerings that are well received by the vast majority.

Our first event was a change from the norm. We held a miniature golf tournament inside Shannopin Country Club, on Wednesday, March 6th, and it was truly a first class set up. The course was complete with many challenging hills, a bridge, a windmill, and a plinko board, yeah that's right, PLINKO. Eric Wygant and the entire staff at Shannopin is to be commended for their efforts, and a special thanks goes out to the two assistant superintendents, Terry and Jeff, for their help in running the event, as Eric was in Florida at the time.

The schedule of events is published in this newsletter, the directory, and on the website for your reference. Please add these events to your calendars and plan on attending. As I have said before, your support of these functions is what makes them successful, so you can contribute to your own success. Don't forget to like us on facebook and follow us on twitter, as we issue timely reminders, and current information on those media sites. It is about the time when we all will become engrossed in the goings on of our own facilities. I would encourage you to reach out to other peers and vendors alike to keep a broad perspective on the environment around the Pittsburgh area. The events we have scheduled throughout the season provide an excellent opportunity to do just that.

As always, I welcome your comments and suggestions for improvement, and if you have any questions, please do not hesitate to contact me. I look forward to another great year, and wish you all the best for the upcoming season.

*Toby Kiggins*

***Golf Course Superintendent***
***Green Oaks Country Club***

***ATTENTION ADVERTISERS - Please let us know if you have any changes or corrections to your ad or information in the back of the newsletter - gpgcsa@comcast.net or jesmarsha@aol.com***

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*Welcome to the GPGCSA*

# 2013 GPGCSA Meeting Schedule

**March 6th** — **Shannopin Country Club**
ERIC WYGANT, CGCS

**April 23rd** — **The Madison Club**
JOHN MCCLAREN

**May 21st** — **Valley Brook Country Club**
JOHN SHAW, CGCS

**June 17th** — **Westmoreland Country Club**
Joint Meeting with MVGCSA
BILL STOWERS

**July 8th** — **Allegheny Country Club**
Scholarship & Research Tournament
DAVID DICKSON

**August** — **TBD**
Sponsor Appreciation Outing

**August 31st** — **Family Outing**
PNC Park Skyblast Night

**September 19th** — **Hillcrest Country Club**
WILLIAM COOK

**October 7th** — **Rolling Rock Club**
GPGCSA Annual Meeting
IAN HOFFMANN



# Dollar Spot Control on a Creeping Bentgrass / Poa Annua Fairway, 2012

**Dr. Wakar Uddin and Brian Aynardi, Professor and Research Technician**
**Department of Plant Pathology, The Pennsylvania State University**

## INTRODUCTION

Dollar spot caused by Sclerotinia homoeocarpa causes serious damages to turf in golf courses in almost all regions of the United States, except for certain areas in the arid regions of southwestern United States. Most species of turfgrass are susceptibe to dollar spot, and the disease is particularly devastating to low-cut turf, such as tees, fairways, and greens. Fungicides are the main method of control of dollar spot. This study was conducted at the Joseph Valentine Turfgrass Research Center, University Park, PA, on a stand of creeping bentgrass (Agrostis Palustris, 'Penneagle') and annual bluegrass (Poa annua). The experiment included various fungicides, rates, mixtures, application timing, and intervals to determine the efficacy of fungicides.

## MATERIALS AND METHODS

The experiment was conducted on a creeping bentgrass and annual bluegrass fairway maintained under golf course fairway management conditions, and mowed three times per week at a height of 0.5-inch. The soil was Hagerstown silt loam with a pH of 6.9. Treatment plots, 3 ft x 6 ft, were arranged in a randomized complete block design with four replications. Applications were made with a CO2-powered sprayer, using a TeeJet 11008E nozzle, at 40 psi, in water equivalent to 2 gal per 1000 sq ft unless otherwise listed in the treatment column. The treatments were applied on 12 and 31 May, 21 Jun, 11 Jul, and 2 Aug on a 21-day interval. Dollar spot incidence (infection centers per plot) was assessed on 25 May, 1, 8, 19, and 28 Jun, and 3, 14, and 20 Jul. Data were subjected to analysis of variance and multiple comparisons of the mean values were made using the Waller-Duncan k-ratio test(k=100).

## RESULTS AND DISCUSSION

Dollar spot symptoms initiated earlier than usual in 2012 in Central Pennsylvania, but disease incidence did not distribute evenly over the trial area until the beginning of June. Though

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several of the tank-mix combinations worked well and offered very good control, other treatments offered curative contol roughly 10 days post-treatment, and therefore, the 21-day interval proved to be inconsistent throughout the duration of the trial. However, several tank-mixes did provide very good control throughout, including the tank-mix of Iprodione Pro and Daconil Ultrex, the Banner MAXX and Iprodione Pro tank-mix, and the Iprodione Pro and Urea tank-mix. Good control was observed in plots treated with a tank-mix of Iprodione Pro, Daconil Ultrex, and Urea, the tank-mix of Banner MAXX, Daconil Ultrex, and Urea, Daconil Ultrex at the full rate, and Iprodione Pro at the full rate, although the tank-mixes and treatments noted were very consistent with the exception of the data collected on 14 Jul during intense disease pressure.

| | | | | DISEASE INCIDENCE[z] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trt No.[y] | Treatment[x] | Rate | | 6/8/2012 | | 6/19/2012 | | 6/28/2012 | | 7/3/2012 | | 7/14/2012 | | 7/20/2012 | |
| 2 | Emerald | 0.18 | oz/1000 ft2 | 3.7[w] | b | 0.7 | b | 1.7 | a | 0.3 | d | 0.3 | f | 0.0 | c |
| 11 | Iprodione Pro | 3.0 | fl oz/1000 ft2 | 1.0 | b | 1.7 | b | 2.3 | a | 3.0 | d | 13.3 | def | 0.0 | c |
| | Daconil Ultrex | 1.8 | oz/1000 ft2 | | | | | | | | | | | | |
| 14 | Banner MAXX | 1.0 | fl oz/1000 ft2 | 0.7 | b | 1.0 | b | 0.0 | a | 0.3 | d | 3.3 | ef | 0.0 | c |
| | Iprodione Pro | 3.0 | fl oz/1000 ft2 | 0.7 | b | 1.0 | b | 0.0 | a | 0.3 | d | 3.3 | ef | 0.0 | c |
| 13 | Iprodione Pro | 3.0 | fl oz/1000 ft2 | 6.7 | b | 0.0 | b | 2.0 | a | 1.3 | d | 7.0 | def | 0.7 | c |
| | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | | | | | | | | | | | | |
| 12 | Iprodione Pro | 3.0 | fl oz/1000 ft2 | 3.3 | b | 2.0 | b | 7.3 | a | 7.0 | cd | 25.3 | c-f | 1.0 | c |
| | Daconil Ultrex | 1.8 | oz/1000 ft2 | | | | | | | | | | | | |
| | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | | | | | | | | | | | | |
| 6 | Banner MAXX | 1.0 | fl oz/1000 ft2 | 0.7 | b | 0.3 | b | 2.0 | a | 1.0 | d | 18.0 | def | 1.3 | c |
| | Daconil Ultrex | 1.8 | oz/1000 ft2 | | | | | | | | | | | | |
| | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | | | | | | | | | | | | |
| 7 | Daconil Ultrex | 3.6 | oz/1000 ft2 | 0.3 | b | 0.3 | b | 1.3 | a | 0.7 | d | 14.7 | def | 3.7 | c |
| 10 | Iprodione Pro | 3.0 | fl oz/1000 ft2 | 2.3 | b | 0.0 | b | 1.3 | a | 3.0 | d | 14.3 | def | 4.3 | c |
| 5 | Banner MAXX | 1.0 | fl oz/1000 ft2 | 6.0 | b | 1.0 | b | 7.7 | a | 5.7 | cd | 29.0 | bcd | 8.3 | c |
| | Daconil Ultrex | 1.8 | oz/1000 ft2 | | | | | | | | | | | | |
| 3 | Banner MAXX | 1.0 | fl oz/1000 ft2 | 10.3 | b | 1.7 | b | 9.3 | a | 7.3 | cd | 27.3 | b-e | 11.3 | c |
| 4 | Banner MAXX | 1.0 | fl oz/1000 ft2 | 14.7 | b | 2.3 | b | 3.0 | a | 2.3 | d | 28.0 | b-e | 12.7 | c |
| | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | | | | | | | | | | | | |
| 8 | Daconil Ultrex | 1.8 | oz/1000 ft2 | 14.7 | b | 9.0 | ab | 18.0 | a | 21.7 | bc | 51.7 | ab | 50.0 | b |
| | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | | | | | | | | | | | | |
| 9 | Urea 46-0-0 | 0.20 | lb ai/1000 ft2 | 54.0 | a | 13.3 | a | 25.0 | a | 33.0 | ab | 48.3 | abc | 88.3 | a |
| 1 | Untreated control | | | 58.7 | a | 8.7 | ab | 39.0 | a | 44.7 | a | 64.3 | a | 90.7 | a |

**[z] Dollar Incidence Assessment: Number of necrotic spot per 18 sq ft plot. Means of three replications.**

**[y] Tank-mix shown as single treatment number.**

**[x] Application made on 21-day interval for all treatments. Dates of applications: 12 and 31 May, 21 Jun, 11 Jul, 2 Aug**

**[w] Means followed by same letter do not significantly differ (P=0.05, Waller-Duncan k=100).**
**Ranking of treatments in the table is based on the disease severity assessment on 20 Jul.**

# Jacobsen Names Darrin Batisky Sales Manager of the Year

## *Batisky takes top sales award during Golf Industry Show in San Diego*

Jacobsen, a Textron Inc. (NYSE: TXT) company, recognized its top-performing dealers and salespeople during last week's Golf Industry Show in San Diego.

Darrin Batisky, Territory Sales Manager for Jacobsen in the Northeast, was awarded Sales Manager of the Year. The honor is based on a sales manager's forecast accuracy, number of customers touched and the percentage of sales from activities.

Darrin supports Jacobsen dealers: MTE Turf Equipment in New York, Vermont, New Hampshire, Maine and Massachusetts; Krigger and Company in Ohio, West Virginia and Pennsylvania; and O.J. Compagnie in Quebec, Canada.

Prior to his tenure at Jacobsen, Darrin served as a golf course superintendent for 15 years, managing courses in Pennsylvania and New York. Batisky is still an active member of the GCSAA, recently teaching a class during the Golf Industry Show in San Diego.

One of Batisky's dealers was named Jacobsen's Dealer of the Year; O.J. Compagnie, a Canadian-based dealer with more than 60 years in the industry. The top honor is based on a dealer's sales growth, market penetration and market share. "The Northeast continues to be a strong and growing region for us and these awards bear that out," said Ric Stone, VP of Sales for Jacobsen. "We will continue to add resources and build relationships in the Northeast both in 2013 and beyond."

Darrin has been an active member of the Greater Pittsburgh Golf Course Superintendents Association for over 10 years. Currently he serves as one of the Industrial representatives on the board and is an active member of multiple committees on the board. Please take time to congratulate Darrin for receiving this prestigious award.

*During the 2013 Golf Industry Show in San Diego, Jacobsen held its annual dealer awards ceremony. Darrin Batisky was awarded Sales Manager of the Year during the ceremony. Pictured here (from left) are David Withers, President of Jacobsen, Darrin Batisky, Territory Sales Manager for Jacobsen, Ric Stone, VP of Sales for Jacobsen and Chuck Greif, Director of Sales, Eastern Division for Jacobsen.)*

The GPGCSA will continue efforts to locally promote the golf course superintendent profession and for the game of golf. We will be continuing our partnership with ESPN 970 am. The GPGCSA has been fortunate to receive additional funding from the GCSAA to assist in this type of effort in the past and will again be applying for co-funding for this year's program.

"Although GCSAA dedicates considerable resources to national outreach, those efforts alone are not enough to achieve desired results. For this reason, GCSAA has established a fund to help chapters engage in activities that complement its efforts to communicate the value of membership to key constituents, primarily golfers and employers.

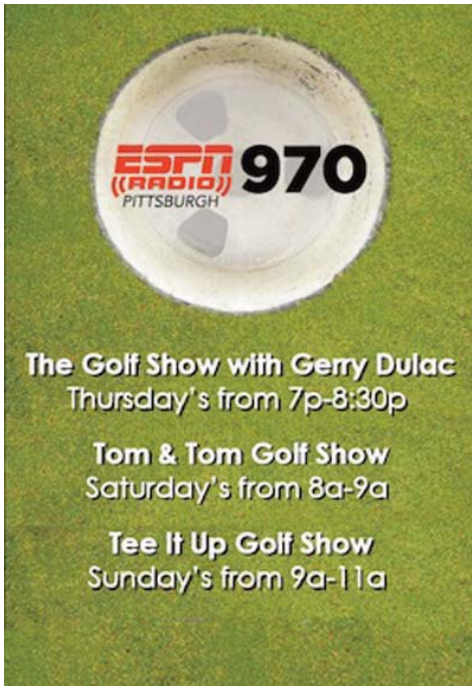
By creating awareness, the goal is to build greater understanding that leads to action. That action is manifested in increasing salaries, growing opportunities for career success/advancement and support of membership in GCSAA and its chapters. The support, in addition to providing dues, includes access to continuing education and networking resources."

This year's program will include several show sponsorships and appearances. Basically, during any ESPN 970 golf broadcast or programming the GPGCSA will have commercials aired promoting golf course superintendent's efforts and respect for the courses we care for.

Individuals representing the interests of both the GPGCSA and the GCSAA are tentatively scheduled to appear as guests for 10 minute segments on the Golf Show with Gerry Dulac Thursdays, 7:00 pm – 8:30 pm (exact times during the shows may vary):

**May 2nd  June 6th  July 18th**

Anyone who has ideas for show topics or would like to volunteer as an association representative during a live broadcast should contact Michelle Shaw at (412) 714-8707 or, by email, at GPGCSA@comcast.net for details.



## Insecticide efficacy summary

This article summarizes and discusses the results of field tests of synthetic insecticides for annual bluegrass weevil management conducted between 1992 and 2011 in more detail and with four years of additional data that were not previously reported (1). The goal is to provide a better understanding of the optimal use of presently available insecticides and to delineate effective alternatives to the overused pyrethroids. The data in the summary are only from applications in spring against the overwintered adults and the spring-generation larvae; data from applications against the summer generations are very limited. In addition, the spring generation is generally the most damaging, and optimizing control of this generation will generally reduce the need for control measures against subsequent generations.

A list of representative formulations of active ingredients available for annual bluegrass weevil control, the names of their manufacturers, and information on their mode of action, labeled rates and restrictions are given in Table 1.

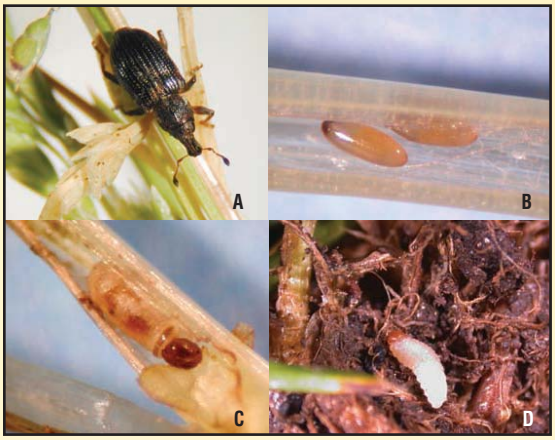
### *Application intervals*

We have sorted the data into three application periods or intervals (Figure 1). Application interval A is the traditional adulticide application interval extending from full-bloom forsythia until late-bloom forsythia/start of full-bloom dogwood or redbud (typically until early May in the New York metropolitan area). However, systemic insecticides applied during this period will target the young larvae inside the plants. Application interval B extends from late-bloom forsythia/full-bloom dogwood until full-bloom hybrid rhododendron (typically early through mid-May in the New York metropolitan area) and typically targets early stages of the larvae, still within the plant. Application interval C extends from full bloom through late-bloom hybrid rhododendron or until damage appears (typically mid-May through early June in the New York metropolitan area) and targets the mid-sized to large larvae.

In the data presented below, average control rates (percent population reduction relative to untreated check plots) are followed by a letter in parentheses (A, B or C) indicating the application interval.

### *Susceptible and resistant populations*

We separately discuss the findings for trials conducted against pyrethroid-susceptible populations, which probably still constitute the vast majority of populations, and pyrethroid-resistant populations, which appear to be common in the New York metropolitan/southwestern Connecticut area. If data for different formulations of a compound were similar, they were combined; if they seemed to differ, formulations with data sets too small for meaningful interpretation were not included in the summary.




*Some stages of annual bluegrass weevil:*
*A - adult; B - eggs inserted in the grass stem;*
*C - second-stage larva within stem;*
*D - fourth-stage larva in thatch.*

## Pyrethroid-susceptible populations: single-ingredient products

### *Pyrethroids*

For Talstar (bifenthrin, FMC Corp.) (only liquid formulations included), the 0.05 and 0.1 pound a.i./acre (56 and 112 grams/hectare) rates did not differ in efficacy and were combined, averaging 90% (A), 86% (B), and 72% (C) control. Our data suggest that bifenthrin is only slightly less effective as a larvicide than the typical larvicides (for example, Dylox, Conserve, Provaunt). Data for other pyrethroids are more limited. Tempo (cyfluthrin, Bayer) (data mostly from the dry formulation) averaged 85% (A) and

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75% (B) control. DeltaGard (deltamethrin, Bayer) (liquid and granular formulations) averaged 90% (A) and 82% (B) control. Scimitar (lambda-cyhalothrin, Syngenta) averaged 98.7% (A) control.

Pyrethroids are known to "stick where they hit" and therefore are not recommended against soil-dwelling pest stages. However, annual bluegrass weevil larvae start to move between plants around the third stage and feed near the surface in the fourth and fifth stage, where they can come into contact with pyrethroids. The only slight decline in efficacy (4%-10%) from the A to the B interval for the three pyrethroids tested in both intervals could therefore be due to a combination of two factors. First, a significant amount of egg-laying still occurs during the B period so that killing adults during this time has some effect, although that effect declines with application date. Second, the later that Talstar is applied, the more residue will be present on the soil/thatch surface when the larvae start to emerge from the plants.

*Table 1. Synthetic insecticides and representative formulations available for annual bluegrass weevil management.*

| Active ingredient | IRAC No.† | Formulation | Company | ABW rate | Max. rate/ application | Max. rate/ year |
|---|---|---|---|---|---|---|
| | | | | Pounds a.i./acre | | |
| Chlorpyrifos | 1B | various | various | 1.0 | 1.0 | --- |
| Trichlorfon | 1B | Dylox 80 | Bayer | 8.2 | ---‡ | 24.5 |
| | | Dylox 420 SL | | 7.3 | ---‡ | 24.5 |
| | | Dylox 6.2 G | | 8.1 | ---‡ | 24.5 |
| Bifenthrin | 3A | Talstar S | FMC Corp. | 0.05-0.1 | 0.2 | 0.2 |
| | | Talstar (G) | | 0.1-0.2 | 0.4 | 0.4 |
| Cyfluthrin | 3A | Tempo Ultra 5SC | Bayer | 0.09 | --- | --- |
| | | Tempo 20 WP | | 0.14 | --- | --- |
| Deltamethrin | 3A | DeltaGard 5 SC | Bayer | 0.08-0.13 | --- | --- |
| | | DeltaGard (G) | | 0.08-0.13 | --- | --- |
| Lambda-cyhalothrin | 3A | Scimitar (SC) | Syngenta | 0.07 | --- | --- |
| Clothianidin | 4A | Arena 50 WDG | Valent | 0.2-0.4 | --- | 0.4 |
| | | Arena 0.25 G | | 0.2-0.4 | --- | 0.4 |
| Imidacloprid | 4A | Merit 75 WP | Bayer | 0.3-0.4 | --- | 0.4 |
| | | Merit 2F | | 0.3-0.4 | --- | 0.4 |
| | | Merit 0.5 G | | 0.3-0.4 | --- | 0.4 |
| Spinosad | 5 | Conserve SC | Dow AgroSciences | 0.4 | ---‡ | --- |
| Halofenozide | 18 | Mach 2SC | Dow AgroSciences | 2.0 | 2.0 | 2.0 |
| | | Mach 2 1.5G | | 2.0 | 2.0 | 2.0 |
| Indoxacarb | 22A | Provaunt (WDG) | DuPont | 0.23 | 0.23 | 0.45 |
| Chlorantraniliprole | 28 | Acelepryn (SC) | DuPont | 0.16-0.26 | 0.31 | 0.5 |
| | | Acelepryn (G) | | 0.15-0.2 | 0.25 | 0.5 |
| Bifenthrin+clothianidin | 3A+4A | Aloft SC | Arysta LifeScience | 0.3-0.49 | --- | 0.6 |
| | | Aloft G | | 0.3-0.6 | --- | 0.6 |
| Bifenthrin+imidacloprid | 3A+4A | Allectus SC | Bayer | 0.18-0.35 | 0.35 | 0.7 |
| | | Allectus G | | 0.27-0.45 | --- | 0.9 |

†Mode of action (insecticide class): 1B = acetylcholine esterase inhibitor (organophosphate); 3A = sodium channel modulator (pyrethroid); 4A = nicotinic acetylcholine receptor agonist (neonicotinoid); 5 = nicotinic acetylcholine receptor allosteric activator (spinosyn); 18 = ecdysone receptor agonists (diacylhydrazine); 22A = voltage-dependent sodium-channel blockers (oxadiazine); 28 = ryanodine receptor modulator (anthranilic diamide).
‡Minimum of seven days between applications.

## Organophosphates

Chlorpyrifos is available in various generic formulations that include golf turf on the label. (Note that Dursban formulations can no longer be applied to turf.) In turf, chlorpyrifos can only be applied at a maximum rate of 1.0 pound a.i./acre (1.1 kilograms/hectare) per application. Few data are available for this low rate, as the previous rate was 4.0 pounds a.i./acre (4.5 kilograms/hectare). We therefore used data from the 2.0 pounds a.i./acre (2.2 kilograms/hectare) rate for our summary. At this rate, chlorpyrifos provided 66% (A), 82% (B) and 83% (C) control, suggesting that it is more effective as a larvicide than an adulticide. At 1.0 pound a.i./acre, lower control rates can be expected.

For Dylox (trichlorfon), our summary clearlyshows that, despite the label's claims for adult and larval control, trichlorfon is only effective as a short residual larvicide with 15% (A), 38% (B) and 83% (C) control.

## Neonicotinoids

For neonicotinoids and Acelepryn and Provaunt (see next section), average control rates (percent population reduction relative to untreated check plots) listed below (if not shown in the figures) are followed by a number in parentheses that indicates the number of treatments included in the summary; the higher that number, the more reliable the mean control rate given.

For Arena (clothianidin, Valent) (only WDG formulation included), rates of 0.2-0.25 pound a.i./acre (224-280 grams/hectare) [46% (17)] are less effective than rates of 0.3-0.4 pound a.i./acre (336-448 grams/hectare) [60% (25)], and later applications are more effective than earlier applications with 46% (11, interval A), 50% (21, interval B), and 63% (10, interval C). However, for the 0.3-0.4 pound a.i. rate range alone, the effect of timing was not so evident with 54% (A), 63% (B) and 64% (C).

For Merit (imidacloprid, Bayer and many generic formulations) (only dry and liquid formulations included), 0.3 pound a.i./acre [52% (27)] is somewhat less effective than 0.4 pound a.i./acre [64% (13)], and application in the C interval may be more effective (78%) than in the A (48%) and B (48%) intervals. Inclusion of the few available data points for the granular formulation further strengthens this trend (but we still have only five data points for C).

## Acelepryn

For Acelepryn (chlorantraniliprole, DuPont) (liquid formulation only), the mean control rates averaged across the three application intervals for the rates of 0.1, 0.16, 0.21, 0.26 and 0.31 pound a.i./acre (117, 176, 234, 291 and 351 grams/hectare) were 68% (13), 83% (29), 85% (23), 86% (21), and 92% (13), respectively. Using the recommended range (0.16-0.26 pound a.i./acre), mean control was 83% (A), 86% (B), and 81% (C) (Figure 1). Although Acelepryn is rec-

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ommended for application around the end of application period A, our summary suggests that the timing is not so critical because even application in the C interval seems to be quite effective. Given the limited benefit from increasing the application rate beyond 0.16 pound a.i./acre, it may be more beneficial to treat twice at lower rates (for example, 0.1-0.16 followed by 0.1-0.16) about two weeks apart to maintain a lethal concentration in the plants longer, rather than treating once at a higher rate (for example, 1 × 0.21-0.31). However, thus far, only very limited data support this approach. Chlorantraniliprole has particularly low toxicity and limited direct negative effects on beneficials.

### Provaunt

Provaunt (indoxacarb, DuPont) has short residual activity and can be applied as an adulticide and/or larvicide with mean control rates of 70% (A), 73% (B), and 74% (C). It has low toxicity and limited direct effects on beneficials.

### Biorational insecticides

Because of their low toxicity and limited direct effect on beneficials, Mach 2 (halofenozide, Dow AgroSciences) and Conserve (spinosad, Dow AgroSciences) are classified as biorational insecticides. Mach 2 efficacy averaged 47% (A), 31% (B) and 46% (C). Conserve has short residual activity and is somewhat more effective as a larvicide (81%, C) than as an adulticide (74%, A).

### Efficacy

In summary, among the presently available compounds for annual bluegrass weevil control, pyrethroids still tend to be the most effective (when targeting nonresistant populations) if they are applied as adulticides, ideally when forsythias are in the half-gold, half-green stage. Our summary suggests that Scimitar (lambda-cyhalothrin) may be the most effective pyrethroid. However, several effective alternatives exist that should be employed in view of the specter of pyrethroid resistance. Among these, Acelepryn (chlorantraniliprole) is the most effective when applied around the onset of full-bloom dogwood. Acelepryn is also the least toxic (to mammals) of the compounds tested and can provide season-long con-

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## Insecticide efficacy against ABW life stages

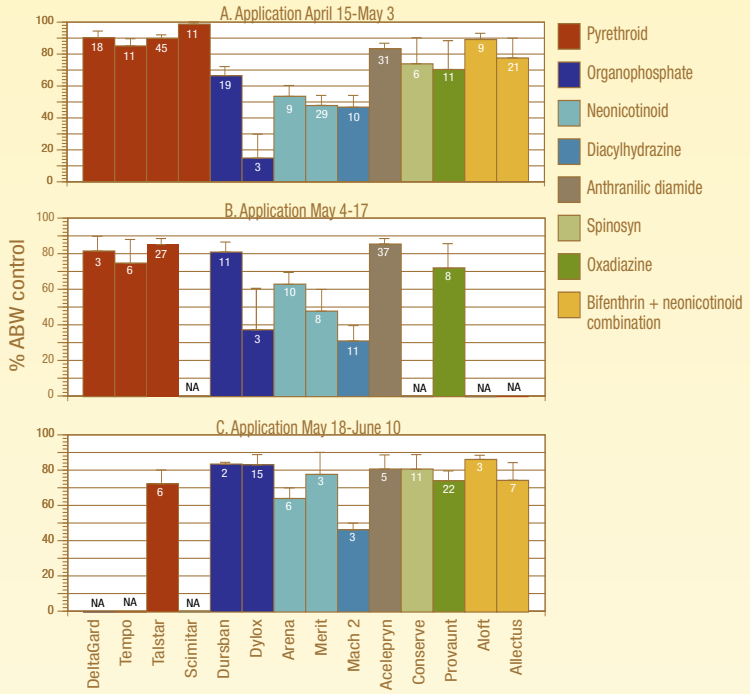


*Figure 1. Efficacy of insecticides targeting annual bluegrass weevil as immigrating adults (application interval A: April 15–May 3, full-bloom forsythia to late-bloom forsythia/full-bloom dogwood); early-stage larvae feeding within the grass stem (application interval B: May 4-May 17, late-bloom forsythia/full-bloom dogwood to late-bloom dogwood/first anthesis of Poa annua); or late-instar larvae feeding on the crown within the soil (application interval C: May 18-June 10, full-bloom to late-bloom Rhododendron catawbiense).*
*Dates are adjusted to the New York metropolitan area. Data are from trials conducted over the geographical range of all the collaborating authors over the past several years. The number of trials from which the mean and standard errors were calculated is given within the bar. Percent control is the percent reduction of larvae and pupae recovered relative to untreated check plots.*

trol of white grubs and caterpillars with the same application. Other compounds that can provide high control levels, when applied as larvicides in application interval C, include Conserve (spinosad), chlorpyrifos (but limited data are available), and Dylox (trichlorfon). Provaunt (indoxacarb) is somewhat less effective, but along with spinosad is considerably less toxic to vertebrates and non-target beneficial predatory insects than the organophosphates.

## Pyrethroid-susceptible populations: combination products and multiple applications

In this section we discuss the use of combination products and multiple applications against pyrethroid-susceptible populations. Because annual bluegrass weevil can sometimes occur at such high densities (>150 larvae/square foot), even moderately effective treatments (>70% control) may not prevent turf damage. To develop approaches for such high densities and for partially resistant annual bluegrass weevil populations, numerous trials over the last several years have examined combined or sequential applications of one or several compounds. Unfortunately, many combinations were tested fewer than three times and are therefore not discussed here.

### *Combination products*

Two products are available that combine bifenthrin with a neonicotinoid (Aloft and Allectus). Because of the small number of data available for other rates, our summary only includes the 0.37-pound a.i./acre (415-gram/hectare) rate for Aloft (clothianidin + bifenthrin), which averaged 89% (A) and 86% (C) control. For Allectus (imidacloprid + bifenthrin), there were no significant differences among rates and formulations. It provided 78% (A) and 74% (C) control. Even though both Allectus and Aloft use the same application rate as that for bifenthrin alone, in application interval A, Aloft provides only the same control rates as bifenthrin alone, and Allectus is even less effective. In contrast, Aloft seems to be very effective when applied as a larvicide (but data are limited).

Multiple applications Two applications of Provaunt (indoxacarb), each at 0.23 pound a.i./acre (252 grams/hectare), generally provided some additional control with 88% (A + B), 89% (A + C), 86% (B + C) and 90% (C + C) control. Sequential application of Acelepryn (chlorantraniliprole) (0.16 pound a.i./acre) and

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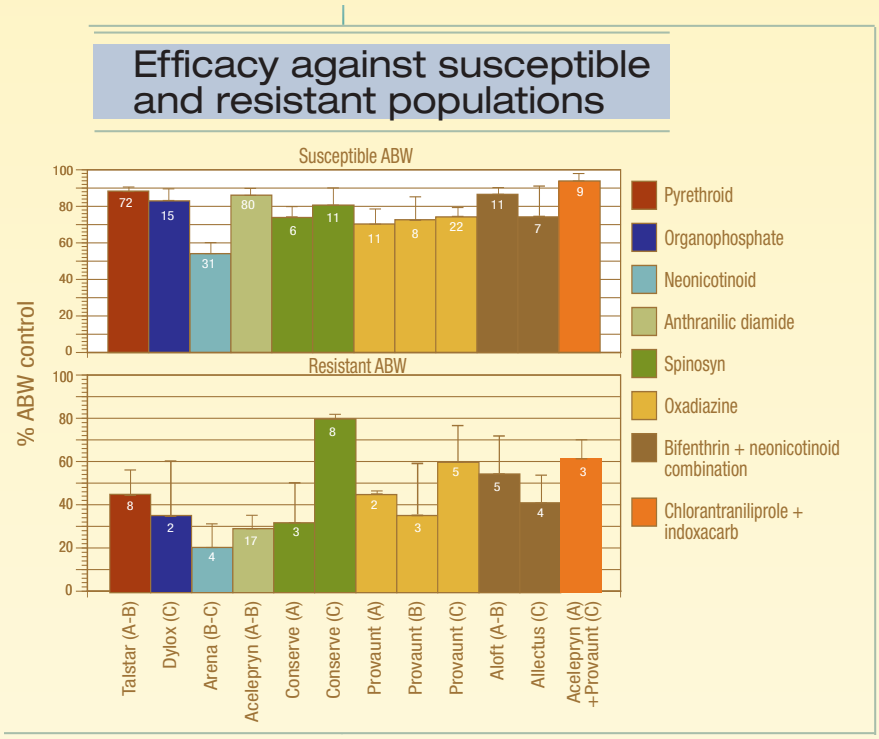


*Figure 2. Comparison of insecticide efficacy against susceptible and resistant annual bluegrass weevil populations. Letters in parentheses following an insecticide name indicate application interval(s) from which data were summarized (A: full-bloom forsythia to late-bloom forsythia/full-bloom dogwood; B: late-bloom forsythia/full-bloom dogwood to late-bloom dogwood/first anthesis of Poa annua; C: full-bloom to late-bloom Rhododendron catawbiense). Data are from trials conducted over the geographical range of all the collaborating authors over the past several years.*
*The number of trials from which the mean and standard errors were calculated is given within the bar. Percent control is the percent reduction of larvae and pupae recovered relative to untreated check plots*

*Controlling Bluegrass Weevil cont'd from page 12*

Provaunt (0.23 pound a.i./acre) gave 94% (A + C) control. And sequential applications of Talstar (bifenthrin, 0.1 pound a.i./acre), Acelepryn (0.16 pound a.i./acre) and Provaunt (0.23 pound a.i./acre) gave 95% (A + B + C) control, slightly higher than the best individual compound alone.

### *Efficacy*

Note that for pyrethroid-susceptible annual bluegrass weevil populations, the limited increase in annual bluegrass weevil control obtained from these combinations and sequential applications compared to the best individual compounds is only useful for very high annual bluegrass weevil population densities that require very high control rates. For most situations, one application should suffice, and a second application should only be applied to perennial trouble spots.

## Efficacy against pyrethroid-resistantpopulations

Because pyrethroid-resistant annual bluegrass weevil populations have only been recognized since the mid-2000s and, at least outside of the New York metropolitan/southwestern Connecticut area, still seem to constitute a small minority of populations, the data available are so limited that we combined data from application intervals if there seemed to be no significant difference. The direct comparison of the same treatments from the same intervals shows that in all but one case the efficacy against resistant populations was reduced, in some cases dramatically, with reductions ranging from 15% to 57% (Figure 2). Even application of a combination of Acelepryn (chlorantraniliprole) and Talstar (bifenthrin) [A; 63% (4)] and sequential application of Talstar + Acelepryn + Provaunt (bifenthrin + chlorantraniliprole + indoxacarb) [A + B + C; 47% (1)] did not provide good control. Thus, only Conserve (spinosad) — and only when applied as a larvicide — seems to be as effective against pyrethroid-resistant annual bluegrass weevils as it is against susceptible annual bluegrass weevils.

Future research will have to strengthen the data set for pyrethroid-resistant populations to allow for clearer interpretations and guidelines for management. But the data to date are in agreement with findings that pyrethroid resistance in annual bluegrass weevil is at least partly caused by enhanced

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enzymatic detoxification. These mechanisms are rather non-specific and may allow the insect to break down pyrethroids and insecticides with other modes of action more effectively before they can reach their targets in the organism (2). Therefore, overuse and over-reliance on any remaining effective synthetic insecticides is very likely to desensitize annual bluegrass weevils to these compounds, as well.

## Outlook

Optimizing application timing and techniques is essential to improving insecticide performance. For example, many of the insecticides now used to target annual bluegrass weevils have high organic-matter-binding characteristics and are rapidly degraded by sunlight (neonicotinoids, Acelepryn, Conserve) and should be watered in (0.2 inch [5 millimeters]) immediately following application. On sunny, windy days, applications may need to be done on only limited areas so that they can be watered in before moving to the next portion of the course. Timing insecticide applications is usually based on plant phenological indicators. This is certainly better than calendar-based application but may be improved by combination with degree-day models. However, much remains unknown about basic annual bluegrass weevil biology, such as the period when females become reproductively active, how long the oviposition period is, how many eggs are deposited, and when eggs are deposited relative to emergence. Understanding these key biological events and refining monitoring techniques could help turf managers better time controls, extend the useful life of current controls, and possibly assist in the development of novel controls. Using pesticides only when and where necessary is the key to reducing the selection pressure toward the development of insecticide-resistant pest populations. In next month's GCM, we will propose a number of management guidelines that will help turf managers develop management strategies that are effective but less likely to select for resistant populations.

## Disclaimer

Use pesticides only according to the directions on the label. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. Trade names are used only to give specific information; this publication does not recommend one product instead of another that might be similar.


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