# THE ANNUAL BLUEGRASS WEEVIL, *Listronotus maculicolis* - 2011

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The following description of the biology and habits of the Annual Bluegrass Weevil (ABGW) offered herein is based on my review and interpretation of published literature, and personal involvement in conducting "demonstrations" of various approaches for control in cooperation with Superintendents of golf courses located in PA, CT, MA, and NJ. The control programs suggested are not intended to be promotions for the products mentioned.

My intention is to suggest programs based on the perspectives I developed after coordinating "demonstrations" from 2006 to 2010 on 122 golf holes, covering 424 acres of turf in cooperation with Golf Course Superintendents of 10 golf courses who applied these insecticides. Included was one course where the population of ABGW adults was shown to be highly resistant to bifenthrin and lambda-cyhalothrin..

This was a truly joint effort between me, cooperating Golf Course Superintendents and the industry that provides the products we currently have available for control of this serious pest.

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The annual bluegrass weevil (ABGW), formerly known as "The Hyperodes Weevil," has been a serious pest on golf course turf since 1931 when damage to annual bluegrass, *Poa annua,* was first observed in Connecticut. While the weevil's preferred host is *P.annua*, reports of damage to creeping bentgrass, *Agrostis palustris,* are increasing. To date, the insect has been officially recorded in 20 states from Minnesota to California, but has reportedly been seen on golf courses in 40 states.

## BIOLOGY AND HABITS

### ADULTS

Adult ABGW are small, 3/8-inch long, generally black weevils with a short, blunt snout, visible antennae, and yellow-brown and grayish-white scales over their bodies. Beginning as early as July and continuing through fall, adults fly to golf course roughs apparently orienting toward trees and the tree line where they fall to the ground and overwinter under pine-leaf litter, moss and grass. Few, if any, overwinter in the fairway or the immediate near rough. Most adults are found under trees and near the tree line, some as far as 65 yds from the nearest fairway. **However**, since larval infestations often occur in fairways where adjacent roughs are mowed and have few or no trees, adults must also overwinter in open roughs.

As spring soil and air temperatures increase, the overwintered adults begin migrating toward the mowed turf of fairways, greens and tees. Walking is the primary means of travel, **however**, some spring flight has been observed. The optimal temperature for adult activity is reported to be 68ºF. **However**, my record from pitfall trap collections on five eastern golf courses in 2010 showed activity began as early as March 19 and continued though soil temperatures at 1 inch were in the mid-40s. The day to day intensity of migration depends upon air and soil temperature which can vary between holes as well as the north to south location of the course. My trapping records show that once adult activity begins, migration continues despite the occasional occurrence of low temperatures, even snow. The peak of migration can occur from the second week of April to the first week of May. A second peak, usually of lesser magnitude, can also occur during the last two weeks of May.

### *ADULT MIGRATION AND FEEDING*

Upon recovery from what has been called their winter reproductive diapause, adults mate and since they have not fed since the previous fall, feed on grasses as they walk toward the mowed turf. I believe they continue feeding throughout their adult life. The literature mentions notches in grass blades and holes in the stems as evidence of feeding and describes it as "insignificant."

**My perspective** is that while this feeding may be insignificant in terms of visible damage to the grass plant, the fact that it occurs has significant implications with regard to possible approaches for control. ***Research by Dr. Dan Peck, New York State Agricultural Experiment Station, Geneva, New York, has shown that adults are capable of significant feeding on annual bluegrass, velvet and creeping bent grasses***.

Some studies have shown adults migrate well into and across fairways, and others show evidence of aggregation along fairway edges. My perspective is that both occur to varying degrees within and between fairways. The fact that larval infestations in May and June are also known to occur in the center areas of fairways indicates overwintered adults must have laid the eggs to produce the larvae. **The occurrence of overwintered adults across fairways has important implications regarding areas to treat to prevent infestations from developing in the center areas of fairways.**

### *EGG LAYING*

While some females mate in the fall, studies have shown that the incidence of mated females increases rapidly through April and May. While larvae have been found in the rough, primary oviposition does not begin until the females reach the short turf of greens, tees or fairways. Females insert clusters of 2-3 or more eggs behind the leaf sheath or in holes that they chew into the stem. Oviposition can begin as early as mid-April with first larvae occurring in late April. The literature reports a potential of 11-50 eggs from a single female. The larvae emerge, initially feeding within the stem and later at the base of the plant. A single larva can damage as many as 20 plants. Upon completion of their development, the larvae burrow into the soil, form a pupa, and after approximately five days, emerge as adults. The time from egg to adult is said to be about 6 weeks.

### *OVERLAPPING GENERATIONS*

Pitfall trapping data I have obtained from six eastern golf courses (2 PA, 2 MA, 2 CT) in 2009 showed that the first peak of migration can occur between the second week of April and the first week of May, with a second peak sometimes occurring the third and fourth week of May. This staggered-extended migration results in a period of time during which oviposition by overwintered adults, egg hatch, larval development, pupation, adult emergence, as well as, the beginning of a second generation are occurring at the same time. All stages of the insect can be found during this time. The overlap of life stages continues throughout June and July, therefore, there is potential for damage to occur well into August. As the result of what was likely a third and (though not known) thought to be a fourth generation on two courses in 2010 in Connecticut, insecticides were applied when adults and larvae were found in September.

## DIAGNOSING DAMAGE

Early evidence of damage shows yellowing of the plant caused by larvae tunneling within the stems. As more eggs hatch within the stems, damage increases causing chlorotic patches or general yellowing of turf at the edges of fairways, greens or tees. Such symptoms are sometimes incorrectly attributed to various diseases. If caused by ABGW, probing such areas with a ball mark repair tool or knife exposes white legless larvae $1/16^{th}$ to $3/16^{th}$ inches long, about the size of a small grain of white rice. Examination of the damaged areas in May and June often reveals the presence of adults and pupae. As mentioned above, due to the overlapping of the first and second generations, all stages of the insect may be found from May to August.

### *DISCLOSING SOLUTIONS*

***Larvae*** – The density of larval infestations can be measured by using a greens cup changer to obtain a core of turf, remove most of the soil, and place it into container of warm salt water (4 cups of table salt/ gallon water) for 1 hour. The larvae are irritated by the salt, crawl out of the turf and float to the surface. Breaking the core into quarters, placing it into a one quart Zip Loc plastic bag, and then adding a cup of salt solution, closing the bag and placing it in the sun for an hour or so, has also worked well. A series of half to one-quart plastic dishes can also be used.

***Adults*** – Adults can be irritated to the surface by applying a solution of lemon scented liquid detergent (1 tablespoon/ gallon of water) *[do not use powder detergents]* to the turf surface. **If applied to sites such as greens during high temperatures, the treated areas should be thoroughly rinsed with water to prevent burning the turf.**

In addition to monitoring the occurrence of ABGW larvae and adults, the above methods are also useful for determining the success (or not) of control measures as well as the need for treatments.

# ABGW CONTROL

Early efforts to control ABGW damage with chlorinated hydrocarbons were generally unsuccessful. Organophosphate insecticides were introduced during the 1970s and provided control through the 1980s. Synthetic pyrethroids were introduced in the early 1990s and provided control until 2005 when some north eastern golf courses reported reduced effectiveness. Bioassays conducted by Drs. Steve R. Alm and D. Ramoutar at the University of Rhode Island in 2008 using adults collected from courses reporting poor control showed resistance levels as high as 134X (Hartford Golf Club) to bifenthrin and lambda-cyhalothrin.

***MY PERSPECTIVE ON ABGW CONTROL***

Current efforts to control damage from ABGW are primarily focused on the larvae. ***My perspective is; WHY WAIT UNTIL OVERWINTERED ADULTS REPLICATE THEMSELVES BY LAYING 20-50 EGGS BEFORE APPLYING A CONTROL WHEN OVERWINTERED ADULTS (the source of all later problems), ARE AN* AVAIABLE TARGET!** As previously pointed out, this is not a new concept since adults were the target of early and apparently successful efforts to control damage using bifenthrin.

***INSECTICIDES AS "TOOLS"***

Like any "tool" the potential user must become thoroughly familiar with its properties and characteristics before putting it to work. The following are my perspectives on how the properties of some currently available "tools" can be used to control ABGW.

***BIFENTHRIN***

The contact toxicity property of bifenthrin, which I speculate lasts about ten days, is the primary reason for its effectiveness. The extended and successful use of bifenthrin for some 20 years can be attributed to timing applications so as to use this property to kill overwintered and first generation adults and prevent egg lying. In some cases, as many as three to six applications of insecticides directed at fairways, greens and tees, were necessary to achieve control. Despite the development of resistance at some locations and a limit of 0.1 lbai/A per application and a total of no more than 0.2 lbai/A per year, applications of this insecticide are still used extensively on some courses.

***USING COMBINATION PRODUCTS***

The combination insecticides ALOFT™ and ALLECTUS® contain a neonicotinoid plus bifenthrin and are labeled for control of ABGW. The soil residual properties of the neonicotinoid components have been put to good use for control of insects such as grubs. ***However, it is my view that the potential of their systemic properties for control of ABGW has not been fully explored.***

**Using Systemicity –** Translocation (= systemicity) of the clothianidin in ALOFT occurs first via absorption through the leaves immediately after a spray application. Absorption of ALLECTUS occurs a few days after application. As soon as either of these insecticides reaches the root zone, diffusion into the roots and translocation to the aerial parts of the plant occurs. The actual duration of the total time over which translocation of a lethal dose of clothianidin or imidacloprid is translocated to the portiton of the plant fed upon by ABGW larvae and adults is not known. ***HOWEVER, assays***

***grass clippings* (using the Enzyme –Linked ImmunoSorbant Assay (ELISA) method at Valent USA Corporation Laboratories) collected in 2010 from golf course fairways treated with ALOFT GCSC or ALLECTUS GCSC showed that toxicant levels began to diminish somewhat 20-30 days after the initial application. A second application 20 days later showed levels increased substantially and remained at what appear to be effective concentrations through May and into June.**

Though the LD50 toxicity, specifically to ABGW adults or larvae, of the toxicant levels found has not been studied, previous research on the impact of similar levels to other insects indicate that they should have a negative effect the behavior and oviposition potential of ABGW.

***TARGETING ADULTS***

***"Arming" the Plant – The basis of my approach is to take advantage of the fact that adults obtain their energy by feeding on grass plants during migration and throughout their life time. THE CONCEPT IS to "arm" the plant with the translocated toxicant in ALOFT (clothianidin) and ALLECTUS (imidacloprid) so that as the weevil adults feed on the grass plants, they will ingest a dose of the toxicant sufficient to, if not kill them directly or indirectly, render them unable to behave normally, mate and lay eggs.***

***TIMING OF APPLICATIONS***

***First Application*--**In order to begin affecting adults during their migration toward the mowed turf, **"ARMING" OF THE PLANT SHOULD TAKE PLACE 7-10 DAYS AFTER MIGRATION FIRST BEGINS.** The best way to determine when this occurs is to install pitfall traps that capture adults as they become active in spring. **TREATMENT SHOULD BE APPLIED 7-10 DAYS AFTER THE FIRST ADULT(S) APPEAR IN THE TRAPS.** By this time migration toward the short mowed turf should be in progress and have progressed far enough toward peak migration to warrant applying the insecticides. ***Phenology records taken during demonstrations conducted in 2009 and 2010 showed this time coincided with the FIRST APPEARANCE OF FULL BLOOM in COMMON DAFFODILS.***

***The primary focus of this approach to control of ABGW is to prevent damage by killing and/or eliminating the oviposition potential of overwintered ABGW adults. The objective is to rely on the combined 10 day contact activity of bifenthrin, plus the extended systemic toxicity provide by ALOFT GCSC and ALLECTUS GCSC to affect as many overwintered adults as possible throughout their lifetime. The systemic activity provided by these insecticides will also kill larvae that may develop.***

***Second Application--*** Demonstrations I have conducted on golf courses showed that in situations where ABGW populations are not high, a single treatment may provide season long control. **However,** the demonstrations also showed that **where ABGW populations were high**, the duration of systemicity and/or level of toxicant in the plant were apparently insufficient to provide season-long control. As the assays mentioned above showed, ***toxicant levels begin to diminish somewhat 20-30 days after the initial application and a second application, approximately 20 days after the first, increased and held levels high through May. THE OBJECTIVE OF THE SECOND APPLICATION IS TO KEEP TOXICANT LEVELS IN THE PLANT HIGH ENOUGH FOR AT LEAST 40-50 DAYS TO PREVENT OVERWINTERED ADULTS (the primary target and potential source of future problems) FROM LAYING EGGS...***

**There is debate** as to whether the second application should be applied approximately 20 days after the first or delayed to mid-May or when "half-gold-half green of Forsythia" occurs. **My perspective** is that delaying the second application allows time for the toxicant levels in the plant to lower, perhaps enough to allow some overwintered adults to survive and lay the eggs that lead to damage in June. Boosting the toxicant level by making the second application 20 days after the first, keeps it high through May and into June.

## A TRAPPING PROGRAM

**The first objective of trapping is to determine when migration begins in order to know when to make the first application.** Adopting a trapping program is also a good way of monitoring and keeping a record of the migration and seasonal occurrence of ABGW adults **on your golf course.** Trapping program records in 2009 showed that migration began during the last week of March and, despite some cold temperatures (including snow), continued into April. In 2010 migration at Bolton, MA began March 19 with as many as 32 adults appearing in one trap.

**I recommend that 4-5 pitfall traps be installed and functional by March 15**. Traps should be emptied and adults counted and recorded every 3-4 days. Traps may be located in the rough out from areas of fairways, greens or tees, where damage has previously occurred, some 20 ft from the edge of the fairway and others farther back into the rough. In addition to determining the time for the first insecticide application, catches in traps located within treated areas such as the rough, near greens, tees or fairways will also reflect adult activity after treatment(s). To measure migration without the influence of insecticide some traps can be located where treatments will not be applied.

***Instruction for construction, installation and maintenance of a pitfall trap and record forms for recording trap catches, air, soil temperatures, and the bloom stage of various plants on or near your golf course are provided with this report.*** **I suggest you keep these records each year to develop the pattern of adult activity ON YOUR COURSE.**

## PLANT PHENOLOLOGY RECORDS

The timing of applications for control of ABGW has historically been associated with various stages of bloom in a range of plants such as forsythia, white flowering dogwood, and service berry. As pointed out above, based on my experience and records, the timing of the first application that focuses on the migration of ABGW adults, coincides with the first occurrence of full bloom in common daffodils. Other approaches that primarily direct treatment against larvae, time applications based on the various stages of forsythia bloom. My recommendation is to use the form provided with this report to record development of bloom on plants suggested and relate that information to your trap collection records to time applications **ON YOUR COURSE.**

## SUGGESTED PREVENTIVE ABGW CONTROL PROGRAMS

***The programs suggested below are not intended to be a promotion for ALLECTUS GCSC or ALOFT GCSC. My intention is to suggest programs for control of ABGW based on the perspectives I developed after coordinating "demonstrations" from 2006 to 2010 on 122 golf holes, covering 424 acres of turf in cooperation with Golf Course Superintendents of 10 golf courses who applied these insecticides. Included was the Hartford Golf Club, where adult AGBW were highly resistant to the pyrethroids bifenthrin and lambda-cyhalothrin.***

***This was a truly joint effort between me, Golf Course Superintendents and the industry that provides the products we now have available for control of this serious pest.***

**ALOFT GCSC**

1. **14.4oz/A 7-10 days after adults first appear pitfall traps; TREAT ERs + E Frwy*($113.31/A)**

2. **11.65oz/A 7-10 days after adults first appear in pitfall traps; TREAT ERs+20F -2nd application 11.65oz/A 20 days later; TREAT 20Rs +E Frwy *($180.01/A)**

**ALLECTUS GCSC**

1. **72oz/A 7-10 days after 1st adults appear in pitfall traps; TREAT ERs + E Frwy *($116.64/A)**

2. **64oz/A 7-10 days after 1st adults appear in pitfall traps; TREAT ERs+20F - 2nd application 64oz/A 20 days later; TREAT 20Rs +E Frwy *($207.36/A)**

***DO NOT IRRIGATE* treated areas for 48hr to allow leaf absorption of the insecticide, and if possible, *DO NOT MOW* treated areas for 24 hr.**

***ERs+EFrwy = Both Entire Roughs + Entire Fairway***
***ERs+20F = Both Entire Roughs + 20 ft on both sides of Fairway***
***20Rs+EFrwy = 20 ft of both roughs + Entire Fairway***

***GREENS- Treat 10ft of perimeter and Entire rough around and back from green***
***TEES- Treat Entire tee and Entire rough around and back from tee***

## SUGGESTED RESCUE TREATMENTS

***The following are suggested as rescue treatments for existing infestations or when intolerable damage from larval infestations is expected. The target could also be adults that pose the potential for future larval damage. AS ALWAYS, READ AND FOLLOW THE LABEL.***

**CHLORPYRIFOS 4E, 32oz/A *($26/A)**
**PROVAUNT™, 12oz/A *($80/A)**
**ALOFT, 11.65oz/A *($90/A)**
**ARENA 50WDG, 8oz/A *($120/A)**
**ACELEPRYN®, 12oz/A *($165/A)**
**ZYLAM™, 20SG 2.7lb/A *($220/A)**
**CONSERVE®, 53oz/A *(260/A)**
**DYLOX®, 4-6oz/A *($260-290/A**

***Approximate cost to user**

## *AREA(S) TO TREAT*

Demonstrations for preventive control of ABGW using perimeter and wall-to-wall applications of various neonicotinoid insecticides were conducted from 2006 to 2010. The results from these demos are too extensive to include in this report but the following generalizations are offered.

**The effectiveness of both wall-to-wall and perimeter applications varied among courses and between holes on individual courses. Overall, "both worked"**. After considering these results and the fact that the literature indicated larval infestations occur primarily at the edges of fairways, treating the entire rough and 20 feet of the fairway should be adequate (so I thought!). **However** a further review of the literature and demonstrations in which treatments applied to these areas in 2010 showed otherwise**. Infestations requiring treatment did develop in the center areas of some fairways on some courses.**

***My* conclusion *following that experience is that the first application should be applied to the entire area of both roughs (to impact overwintering adults as they begin to migrate) and 20 feet of both sides of the fairway in order to affect the adults that migrate in from both sides. The second application should be applied to 20 ft of both roughs and the entire fairway to affect adults that have migrated into the center of the fairway as well as any larvae that my have developed.***

## *EXPECTATIONS*

The programs suggested here are based on my review and interpretation of published literature, experience with the biology and habits of ABGW, analytical data on systemic life of clothianidin and imidacloprid in the turfgrass plant, as well as development and testing various approaches by conducting demonstrations on golf courses in cooperation with Superintendents of 11 golf courses located in PA, CT, MA, and NJ from 2006 to 2010. **Through this involvement I learned that the season-long-effectiveness expected did not always happen.** Success sometimes varied between courses and between holes on a given course. Sensitivity to ABGW damage and/or potential for damage varied among courses was also a factor.

In years such as 2010, when turf is under stress from excessive heat and/or rains, annual bluegrass can be especially susceptible to damage and even though numbers of 2$^{nd}$ and 3$^{rd}$ generation larvae may be low, some courses made additional application(s) to prevent anticipated future damage**. However**, examination of areas where additional treatment(s) were applied, often showed a significant (1/2 inch or more) accumulation of **thatch.**

### *INFLUENCE OF THATCH ON EFFICACY*

**The systemic properties of the neonicotinoid insecticides are the key to their effectiveness for control of ABGW.** My view is that the soil type, turf composition and thatch depth are among the variations that exist between the fairways, roughs, green collars and surrounds (including the roughs), and surrounds of tees and bunkers of any golf course that alone can result in variations in the performance of treatments for control of ABGW and other insects as well. While some of the active ingredients are absorbed by the turf leaves upon application, the primary means by which they are delivered to the above ground plant parts is through of the roots. Where thatch accumulations of ½ inch or more occur, (fairways, roughs, collars and surrounds of greens, and surrounds of tees and bunkers) the active ingredients applied are adsorbed (=bound) to the thatch and do not reach the root zone. When this occurs, systemicity essentially stops, or is least minimized to the extent that the concentration of toxicant in the plant is insufficient to impact adults and/or kill larvae. The result are adults that survive lay more eggs that produce more larvae, and larvae that survive continue damaging turf and develop into adults that lay more eggs etc, etc etc. Insecticide adsorption to thatch and consequent interference with the insecticide reaching the zone where grubs feed is also a major reason for inadequate grub control.

***Suggestion***- Insecticide movement is improved if the medium through which it must pass to reach a target or target zone is moist. Adsorption is maximized when this medium is dry. Therefore, if the thatch and first inch of soil under it is dry, irrigation or significant rainfall should help. Generally, natural moisture should be adequate for spring applications but sometimes can be inadequate, especially in the rough and other non-irrigated areas. Check the area(s) to be treated for thatch and moisture before application. If dry or thatchy, irrigate where possible, the day before applying treatments or hope for a rain event. **Remember** however, that, unless specifically required by the product label, irrigation should be delayed for 48 hours after application in order to allow time for the insecticide to be absorbed by the turf leaves.

## *OTHER INSECTS CONTROLLED*

Experience gained through conducting demonstrations has shown that the 1st application of the programs suggested will provide season long control of white grubs, billbugs (*a pest that significantly reduces the quality of turf in roughs and areas around tees, greens and bunkers*) as well as suppression of ants. If application of a 2nd treatment includes tees and greens, control of black turfgrass ataenius, cutworms to July, and further suppression of ants should also be expected.

## *CONTROL OF BIFENTHRIN RESISTANT POPULATIONS*

Though no studies (that I know of) have been conducted to demonstrate how long the residual of bifenthrin causes the death of ABGW adults, from general knowledge of this insecticide I estimated it to be about 10 days. If, for the sake of discussion this were true, the first application of either ALOFT or ALLECTUS should result in adults acquiring a dose of both bifenthrin and clothianidin or imidacloprid **simultaneously** during this time. My perspective is that sub lethal levels of bifenthrin likely remain in the turf for some time beyond the 10 days and that continued exposure to these residues together with adults and larvae feeding on plants "armed" with clothianidin or imidacloprid will provide control.

***My opinion is that since the bifenthrin, imidacloprid and clothianidin impact the nervous system of adult ABGW by two very different modes of action, their simultaneous impact will control bifenthrin resistant populations for some time.***

**IN FACT**, ***demonstrations conducted in 2010 on the HARTFORD GOLF CLUB, West Hartford, CT, where the adult population has been determined to be 134X resistant to bifenthrin, two applications of either ALOFT GCSC or ALLECTUS GCSC to 6 holes each prevented ABGW damage through mid June.*** ***None of the treatments were mixed with DMI products.***

*Is there scientific evidence to support my theory regarding the impact of the toxicants when adults ingest them, or that the combination products will control bifenthrin resistant ABGW? ---none that I am aware of.* ***<u>However</u>****, if we waited until "scientific evidence" produces data to provide a basis for such an approach, we would wait a long time. My response was,* ***<u>let's just do it</u> on golf course holes <u>(not plots)</u> and see if it works---<u>so WE did, and that's the basis for the opinions, perspectives and suggested control programs, offered herein.</u>***


## ACKNOWLEDGEMENTS

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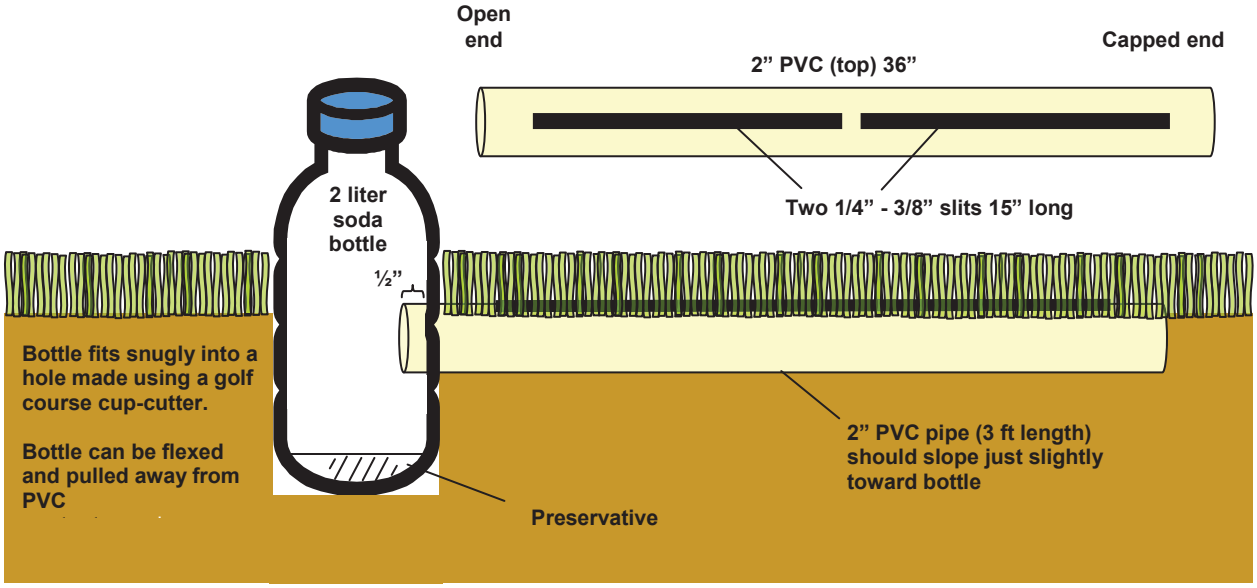
CHESTER VALLEY CC, Malvern, PA - David Visocan, Supt.—07, 08
LANCASTER CC, Lancaster, PA- Todd Bidlespacher, Supt.—06, 07, 08
SAUCON VALLEY CC, Bethlehem, PA - Jim Roney, Dir. Grounds and Golf—07, 08, 09, 10
PINE CREST CC, Brookville, PA – Kurt Becker, Supt.—07, 09
THE INTERNATIONAL, Bolton, MA - Brett Johnson, CGCS, Dir. Grounds Maint.—09, 10
SPRINGFIELD CC, West Springfield, MA - Doug Stahora, Supt.--09
HARTFORD GOLF CLUB, West Hartford, CT – Jonathan Burke, Supt.--10
BURNING TREE CC, Greenwich, CT - Mike Barton, CGCS, Supt.—07, 08, 09, 10
TUMBLE BROOK, CC, Bloomfield, CT - Cindy Johnson, Supt.--08, 09
PINE VALLEY GOLF CLUB, Pine Valley, NJ - Rick Christian, Supt.--10

## INSECTICIDE PRODUCTS PROVIDED BY:

ALOFT™ GCSC--- Dr. Doug Houseworth, *ARYSTA LIFESCIENCE*
ALLECTUS® GCSC---Dr. Bruce Monke, *BAYER ENVIRONMENTAL SCIENCE*

***THANK YOU ALL (and them some!)***

## RICHMOND LINEAR PITFALL TRAP FOR ABGW ADULTS




INSTALLATION IN UNTREATED OR AREA TO BE TREATED

1. **Install trap(s) no later than week of March 15** parallel to fairway, green or tees site(s) where overwintering ABGW adults will migrate in from the rough to nearby short mowed turf.
2. Use golf course cup changer to make hole and 1/2, 2/3 the length of the soda bottle deep in soil.
3. **Bury the PVC so the slits are above and level with the soil,** and the trap is slightly tilted toward the open end.
4. Make a 2 inch opening slightly above the center of the bottle, pour in 3oz of the preservative and replace the cap on the bottle.
   **PRESERVATIVE = Lemon scented liquid detergent – water solution (1 tbs/gallon)**
   Place the bottle into the hole and insert the open end of the trap 1/2 inch into the bottle opening.
5. **FLAG the trap to avoid damage from mowers, golf carts etc.**

**SAMPLE COLLECTION**

**Collect samples 3-5 days.** Slide the collection bottle off the trap opening and empty the contents onto a white cloth (towel). The volume of liquid in the bottle may be more than the original amount due to contribution from rain and/or irrigation. Tap the sides of the collection bottle to make sure ALL SPECIMENS are removed. **Count and record the number of ABGW adults collected**. **Add 3oz of fresh preservative to the collection bottle and reattach to the trap**.

*hdn 11/23/10*

## ABGW ADULT TRAP CATCH RECORD - YEAR_____

COURSE NAME_____SUPERINTENDENT_____

| Trap No. | Date | No. Adults | Air Temp | 1"Soil Temp | | Trap No. | Date | No. Adults | Air Temp | 1"Soil Temp | | Trap No. | Date | No. Adults | Air Temp | 1"Soil Temp |
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**KEEP THIS INFORMATION FOR YOUR RECORDS**

hdn 11/23/10

**DATES OF PHENOLOGICAL EVENTS – Year_____**

**COURSE NAME_____SUPERINTENDENT_____**

**COMMON DAFFODILS**

| green stems (-) fl heads | bloom stems (-) flowers | ½ full bloom | full bloom | ½ past full bloom | (-) blooms pods only |
|---|---|---|---|---|---|
| _____ | _____ | _____ | _____ | _____ | _____ |

**FORSYTHIA**

| bloom buds yellow | 1st blooms | ½ full bloom | full bloom | ½ gold ½ green | (-) gold all green |
|---|---|---|---|---|---|
| _____ | _____ | _____ | _____ | _____ | _____ |

**WHITE DOOGWOOD**

| flower buds | 1st blooms | ½ full bloom | full bloom | ½ bloom drop leaves showing | blooms dropped |
|---|---|---|---|---|---|
| _____ | _____ | _____ | _____ | _____ | _____ |

**RED MAPLE**

| large buds | 1st bloom | full bloom | blooms ½ gone | blooms dropping | winged seeds formed |
|---|---|---|---|---|---|
| _____ | _____ | _____ | _____ | _____ | _____ |

**STAR MAGNOLIA (only)**

| large buds | 1st blooms | ½ full bloom | full bloom | ½ bloom drop | blooms dropped |
|---|---|---|---|---|---|
| _____ | _____ | _____ | _____ | _____ | _____ |

**KEEP THIS INFORMATION FOR YOUR RECORDS**
hdn 11/23/10