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Turf Grass TRENDS

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Chinch bugs, a refresher course

by Christopher Sann

Cool-season turfgrasses stands can suffer from the infestations of up to three different species of chinch bugs at the same time.

The primary species of cool-season turf is the hairy chinch bug, *Blissus leucopterus hirtus*. The common chinch bug, *Blissus leucopterus leucopterus*, affects a larger geographic area but produces less damage.

In warm season turf areas, turf is subject to infestation by the southern chinch bug, *Blissus insularis*.

In areas where their distribution areas overlap, the different species can form a chinch bug complex that was described in scientific literature as long ago as 1926. Because of many similarities in morphology (size, shape, coloration and function) it is virtually impossible to tell the difference between individual species when two or more of the chinch bug species form this complex.

Chinch bug distribution

The common chinch bug is the most widely distributed of the three species and has been identified in 26 states, ranging from the eastern slopes of the Rockies, through the Midwest, south to the Piedmont states and across the southern tier of states, north of Florida.

Photo provided by Dr. Mike Villani, Cornell University

A short-winged version of a Hairy Chinch Bug adult.

The hairy chinch bug is found from the southern Canadian provinces, through the New England states to the mid-Atlantic area and west to Minnesota.

The southern chinch bug is found in all of the southern states, west across northern Mexico to California. The area of overlap for the two northern species, common and hairy, occurs in the states bordering the Mason-Dixon line and the upper Midwest, while the southern tier of states north of Florida and west to Texas comprises the area of overlap of the common and the southern species.

Host and site conditions

The hairy chinch bug infests stands of most of the cool-season grasses: bluegrasses, bentgrasses, ryegrasses, fine fescues, and zoysia. The southern chinch bug infests primarily St. Augustine grass but it has been found on almost any warm season turf species, occasionally including monocot weed species.

The common chinch bug is primarily a pest of small grains and

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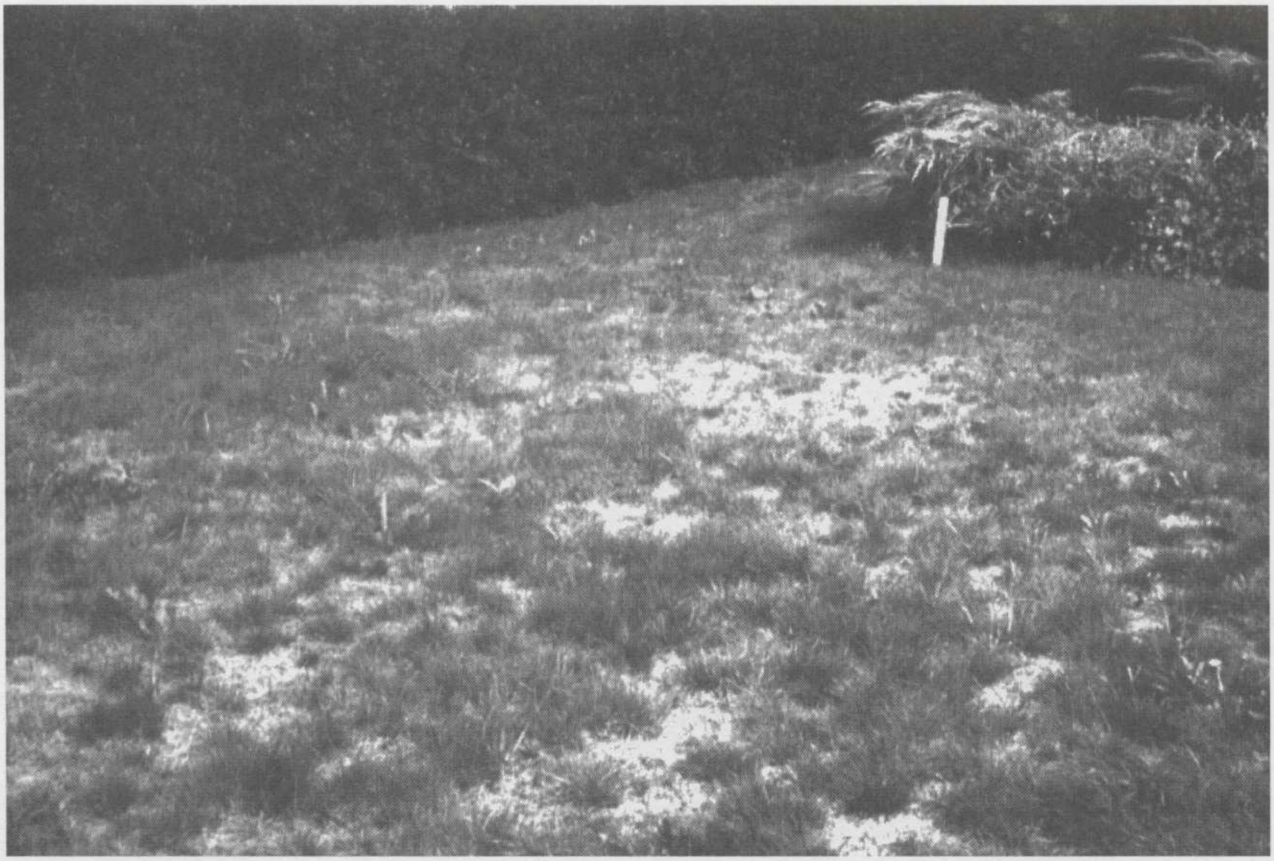

Photo provided by Dr. Mike Villani, Cornell University

Typical summer chinch bug damage to a sloped home lawn. Undamaged turf areas are resistant tall fescue or ryegrass varieties.

corn. It will however move out of agricultural fields and infest turf, primarily Bermuda grass and bluegrasses.

Populations of chinch bugs are generally highest at drier sites with older turf stands, maintained at moderate to higher levels of fertilization and with moderate to high thatch levels. Newly established, thin, low thatch or maintenance turfs will rarely hold significant populations of chinch bugs. A study of the connection between turf environment conditions and hairy chinch bug populations conducted at Michigan State University and reported in 1990 showed that there was a high correlation between thatch depth and chinch bug populations. In a survey of lawns, the average thatch depth for lawns that were classified as infected was 5/16 inch, while those lawns classified as uninfected lawns averaged 3/16 inch. The same study also showed a correlation between fine fescue content and chinch bug presence. A higher percentage of fine fescue and a lower percentage of bluegrass sites showed higher chinch bug populations. When the bluegrass content of a site averaged 60% or more and the fine fescue averaged 15% or less, the areas were classified as uninfected. However, when the bluegrass content fell to 40% and the fine fescue increased to 35%, the site was more likely to be classified as infected.

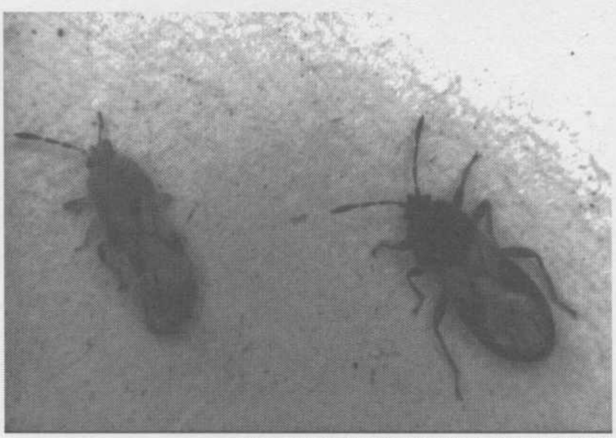

Photo provided by Dr. Mike Villani, Cornell University

The Hairy Chinch Bug, left, is an example of the fourth instar and, right, an example of a long-winged adult.

Using these data, the researchers were able to produce a predictive model that combined both thatch depth and fine fescue content. It was 60% to 80% accurate at predicting chinch bug infestations. However, the same study indicated that thatch depth and site turfgrass species content were only factors in creating an environment that attracted chinch bug feeding rather than caused chinch bug infestation. When chinch bugs were released into two test plots and counted 24 hours later, the thatched plots contained an average of 329% more insects than plots that had been dethatched. Also, the researchers concluded that the

Photo provided by Dr. Mike Villani, Cornell University

Chinch bug eggs and cheesecloth with a Canadian dime for size comparison.

mature stage is black but still with undeveloped wings.

Each instar and adult feeds on the host turfgrass species by piercing the leaves, stems, and crowns of the plant and sucking the sap from the plant. During feeding, chinch bugs inject a toxin into the plant causing it to turn yellow then tan before it dies. Turf grown in sandier, well-drained soils in full sunlight or turfgrass plants that have suffered previous root damage are most susceptible to chinch bug damage. Once attacked, early season turf stands may not show symptoms until stressed by heat or lack of moisture, while second generation infested sites will show substantial damage rapidly.

No matter when symptoms appear, the attacked turfgrass

presence of the feeding chinch bugs probably contributed to both increases in the thatch depth and the acceleration of site turfgrass species change over to fine fescue species.

Morphology & Biology

The adults of all three species of chinch bugs are white winged, black bodied bugs, approximately 1/8 inch wide and 1/6 inch long. Their legs and lower bodies are yellow to orange in color. The hairy chinch bug has both short and long winged versions. Newly laid whitish eggs are approximately 1/64 inch wide by 1/32 inch long. After a few days, the eggs turn from yellow to red several days before hatching.

Immature forms of all three chinch bugs go through five instars, or growing stages, starting at a size of less than 1/16 inch long and 1/64 inch wide. The first and second instars are bright red with a white abdominal stripe. The third instar is orange with vestigial wings, while the fourth is darker orange with longer wings. The final im-

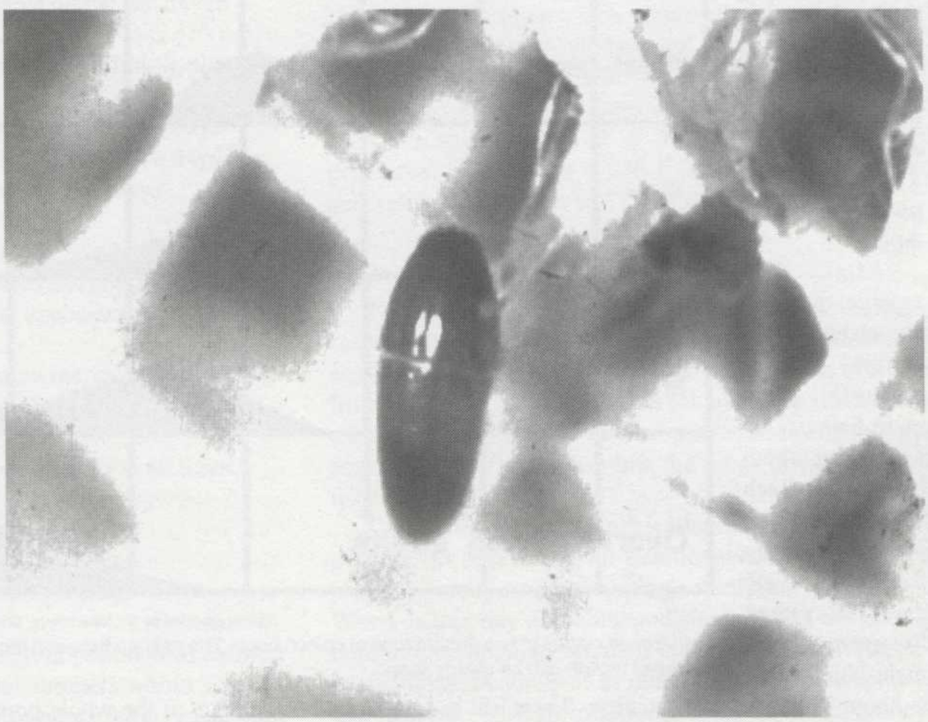

Photo provided by Dr. Mike Villani, Cornell University

A mature chinch bug egg that has the darkened as it nears hatching. The magnified threads in the background are from cheesecloth.

stand usually has large, uniformly brown areas that first appear beside walkways, along driveways, on south facing slopes or in areas of reflected heat or sunlight. When heat stressed, the damaged turf will often have a stiff feel and may remain erect for some time unless disturbed by traffic or watering. Two particular indicators of chinch bug damage are, though the damaged area may be uniformly brown, individual, dicot weed species growing within the affected area. This is because chinch bugs do not feed on dicots. And areas of shade that appear to have been unaffected are so because chinch bugs prefer hot dry locations and are the most shade-avoiding of all the turfgrass damaging insects.

Adult chinch bugs emerge from their over-wintering sites in leaf litter and thatch when air temperatures reach about 45 F (7 C). Thus, the first adults of the hairy chinch bug can appear as early as February in the mid-Atlantic states and March in northern Ohio and coastal New England. In Ontario and northern New York they can appear in early April.

After they emerge, the adult chinch bugs eat to regain their strength and mate. Females lay eggs after about two weeks. Each female will lay up to 20 eggs per day for up to thirty days. The average life span of a female chinch bug is about 70 days after hatching. Their life is four to six weeks as an immature and four to six weeks as an adult. About 90% of over-wintering chinch bugs do so as adults.

To illustrate the explosive population growth of chinch bugs consider this scenario: assume the optimum conditions of a warm dry site, a complete hatch and no control applications or natural death. One over-wintering female chinch bug in three generations could theoretically produce a feeding population of 54 million chinch bugs in eight months or enough chinch bugs to cover 85 acres at a control application threshold of one chinch bug per square inch.

Luckily these optimum conditions and potentially explosive population growth rates are rare. Most cool season sites will experience no more than two generations per year. The northern tier of states and the southern provinces of Canada will have only one. Studies in New Jersey have found that natural morbidity plays a significant role in the chinch bug life cycle. Research found a very high rate of egg mortality from various sources; spring generations suffer an average of 60% mortality and summer generations suffer 50%. Additional studies of over-wintering adult mortality rates showed rates of from 30% to 70% mortality. The main factor controlling over-wintering adult mortality seemed to be available moisture conditions at the over-wintering site. Sites with long periods of snow cover showed lower death rates than areas without snow cover.

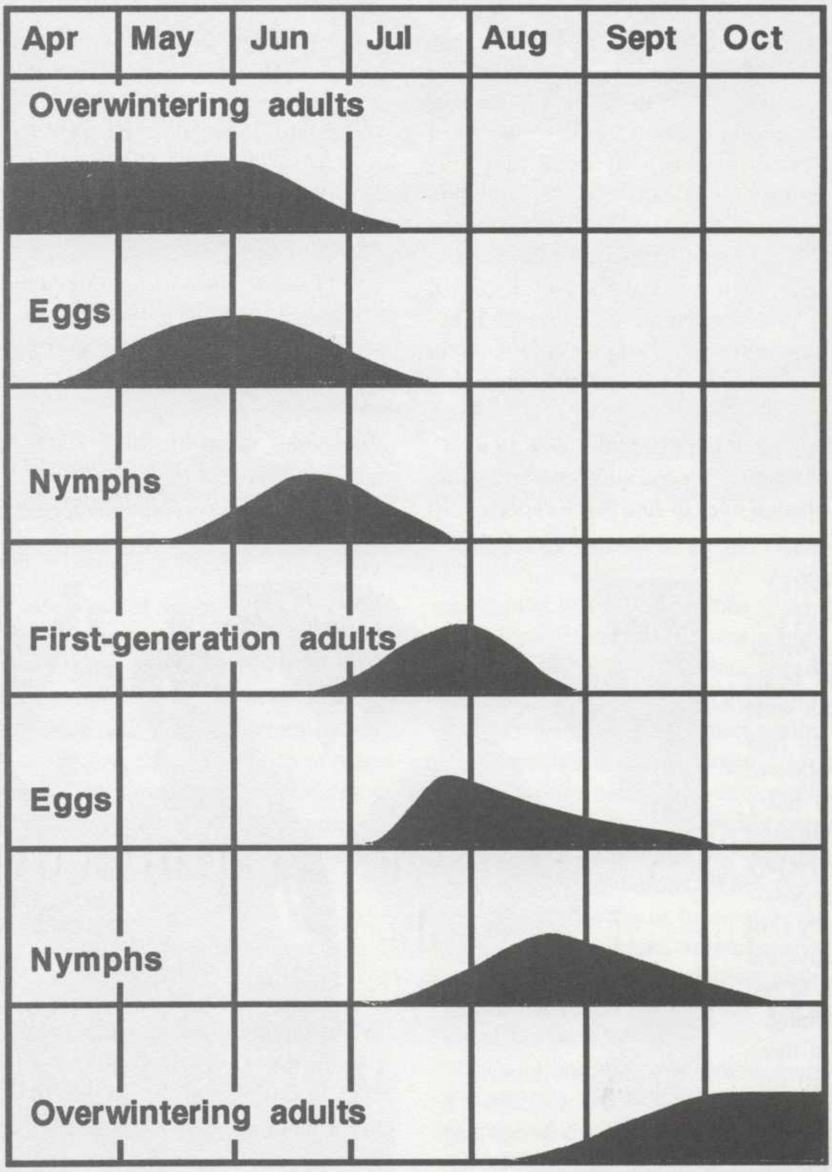

Figure provided by Dr. Mike Villani, Cornell University

The various stages of two generations of chinch bugs. The overlap between the various stages of growth can be clearly seen.

Distributions

The distribution of the five instars and adults at a given site over a growing season can show dramatic changes, depending on the month.

Studies in Ohio found that, as a percentage of the whole population, adults dominated in the first two months of activity, April and May, and the last two months of the growing season, October and November. Early-season adults comprise as much as 100% of the chinch bug population and 80% to 90% of the fall populations. During the four middle months the percentage of adults in the population was dramatically reduced and ranged from a low of 8% to a high of 33% despite the fact that two actual population peaks occurred in August and October. Even though over 100 adult chinch bugs were counted in the one-square-foot test areas over the eight months of the study period, the number of over-wintering adults that started and ended the season was quite low, averaging only about 3% of the total.

The distribution of the five instars was confined primarily to the four middle months of the growing season: July, August, September, and October. During July and August, the first and second instars dominate with the third through fifth dominating in September and October. Over the course of eight months, the test site saw individual populations of 108 first instars, 97 second, 52 third and fourth, 70 fifth, and 102 adults. The 50% drop in instar populations of from 108 in the first to 52 third and fourth is probably due to natural mortality, with the subsequent increase in fifth instars and adults due primarily to these instars increased mobility.

Population patterns

Test results from the Ohio studies show a remarkable consistency in the pattern of the timing and dynamics of first generation instar appearance and population growth over a three year period at different sites on different plant hosts.

- first instar appearance occurred on the last day of May, plus or minus 10 days
- second instar appearance occurred on June 6, plus or minus six days
- third instar on June 10, plus or minus five days
- fourth instar June 22, plus or minus seven days
- fifth instar July 1, plus or minus two days.

The average first appearance date of all the instars was June 14. Each instar showed exponential population growth immediately following its initial appearance.

- first instars showed population increases of from 25 to 60 times in the two weeks following initial appearance
- second instars showed increases of 15 to 60 times in four weeks
- third instars 25 to 60 times in 4 weeks
- fourth instars 25 to 50 times in 3 weeks
- fifth instars 45 to 55 times in 3 weeks.

Averaged together, the five instar populations showed increases of 43 times their initial numbers within 3 weeks of their initial appearances. Coupling the average first appearance date, June 14, with the average maximum population increases of 205% per day and the average time to reach those maximum population levels (three weeks) with the often observed late June occurrence of the first heat and moisture stress of the summer, produces a picture of maximum damage potential occurring on approximately July 7. That is very much in line with many turfgrass managers' field experiences.

Degree day modeling

Degree day measurements are a calculation of the number of degrees the average daily air temperature exceeds a predetermined threshold value. This is summed to provide a measurement of temperature and time or duration. For instance, if the high temperature for a day is 90 F and the low is 70 F, then the average temperature for the day would be 80 F. That 80 F would be compared to a threshold, say 50 F and would produce a degree day rating of 30. These figures would be added together on a cumulative basis to produce a degree day cumulative figure and this total would be compared to events that occur, such as chinch bug egg hatch or first instar appearance, to see if there is a correlation between the event occurrence and a certain range of values. This observed range can then be used to try to predict the timing of the event taking place. Degree day modeling, or the use of these temperature over time period figures to predict an event is most commonly used by the heating oil industry to estimate needs for heating oil deliveries during the winter months.

The degree day data in the Ohio studies produced a predictive model for areas with one generation of chinch bugs per season. Using a 45 F starting threshold and a one chinch bug per square inch control threshold the model successfully recommended control applications at 1400 - 1650 F degree days. Work in New Jersey, where two generations are common, produced degree day models that used a starting threshold of 58 F and predicted first generation egg hatches at 240 F degree days and second generation egg hatches at 1550 F degree days.

New control strategies

These degree day models combined with site scouting could be used easily to trigger a control application strategy, particularly if the degree day information is available from local extension agents or is calculated on site. Chemical control applications can be initiated as the cumulative degree day totals increase into the range of values established for control.

Combining field scouting and degree day modeling will produce the best timing for traditional control methods to produce maximum results using a minimum of materials. When degree day modeling and site scouting are used to control grub populations, their use has resulted in reduced pesticide applications of as much as 70%. These reduced applications show up in reduced material costs, reduced labor costs, longer equipment life and reduced scheduling conflicts.

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Alternative strategies for controlling chinch bugs

by Christopher Sann

Despite the fact that the three different chinch bug species cause significant economic damage to turf stands across the country, little recent research has been done in new, alternative strategies for controlling chinch bug populations.

Currently grubs appear to be garnering the majority of the research for alternative methods of controlling turfgrass insect pests. But a considerable amount of information about chinch bugs is available to help turfgrass managers: to reduce overall pesticide usage, to reduce the cost of implementing those control strategies, and to provide superior control to many of the traditional approaches.

Chinch bugs have natural enemies

The main reason that the explosive population growth of chinch bugs has not led to their becoming the most widespread and devastating of all of the turfgrass insect pests is the large number of natural enemies that chinch bugs must contend with.

The southern chinch bug has at least eight different insect predators and parasites that feed on the various stages of chinch bugs and at least one fungal microorganism that can attack it. The other two chinch bug species have similar numbers of predators.

One of the insect predators is the big eyed bug. Big eyed bugs prey on chinch bug in all stages of life. They eat on average two chinch bugs per day. What big eyed bugs lack in feeding habits they make up with large numbers. Populations can be as high as 15 to 18 per square foot in chinch bug infested turf, where they rely on their greater speed to capture their prey. Earwigs are also a predator and can be voracious feeders on adult chinch bugs, consuming as many as 50 in a 24-hour period. Additionally, chinch bugs are the prey for certain parasitic wasps and some spiders and mites. Populations of predator insects and a pathogenic fungus, *Beauveria bassiana*, were so prevalent at one infested site being studied in Florida that the normally high summer time populations collapsed in August because of their feeding.

In turf stands that are not treated with insecticides, natural predators and other factors contributing to natural mortality are the controlling factors that keep chinch bug populations below explosive levels. If natural predators can be so successful at controlling chinch bug populations, the question arises: why do spotty chinch bug infestations continue? The answer lies in the fact that, even in unmanaged environments, turf stands develop the sort of ideal micro-environments that can lead to self-sustaining wild populations and that managed turf areas that get regular insecticide applications will often have problems with chronic chinch bug infestations.

Insecticide clearly controls the chinch bugs species at the sites, but it also controls their non-targeted natural enemies. This unintended side effect can be avoided if insecticide applications are withheld until monitored chinch bug populations reach a level of 25 to 30 bugs per square foot. This level of chinch bug infestation indicates that the predators to prey relationship is out of balance and that the predators and other natural factors have failed to control the infestation.

At this point outside intervention, in the form of an insecticide application, is required. This is made, despite

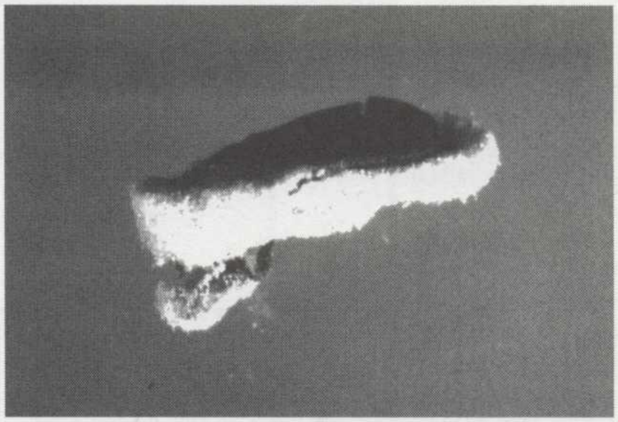


Photo provided by Dr. Mike Villani, Cornell University

An adult chinch bug infected with the parasitic fungus, *Beauvaria bassiana.*

the unintended consequences to the existing natural predator complex, to avoid the probable explosive population growth with its accompanying severe turfgrass damage and its long term potential for self-sustaining populations.

Less toxic insecticide tests show mixed results

Testing of low-toxic insecticides, like insecticidal soap and horticultural oils, as alternatives to the traditional high-toxic insecticides used to control many of the turf grass insect pest species, have been only partially successful. When tested by themselves, they showed little to no control. When combined with other turf insecticides that had previously shown excellent control results, the combinations showed commercially acceptable results, 80% control or greater, at active ingredient levels of the high-toxic insecticides that were only 25% to 50% of the normally recommended amounts. On sites where liquid controls are used these combinations of reduced-rate turf insecticides with non-traditional low toxic insecticides may reduce the damage to the non target species.

Applications of bio-rational products like Neem oil extracts and biological based controls such as some species of parasitic nematodes have shown control levels that averaged about 50%, but none of the applications control levels approached the commercially acceptable standard. However, one test of a strain of nematodes, sold as Exhibit, did prove just as successful at controlling chinch bug populations as any of the traditional chemical insecticides that were tested.

A new approach to chinch bug control

Since the results of testing on low toxic insecticides, bio-rationals, and biological controls have been hit or miss at best and no new alternative controls are appearing, the most successful method of controlling burgeoning chinch bug populations is still applications of traditional turf insecticides. When these applications are combined with accurate field inspection data and a good working knowledge of chinch bug biology, the amount of pesticides required to control high populations is often reduced by as much as 90%. This means that the judicious application of these materials can dramatically reduce the cost of control while reducing the amount of toxics in the environment.

Site surveys are critical

The first action a turfgrass manager must take in establishing this new knowledge-based chinch bug control strategy is to survey the sites under his management and classify each area as either high priority or low priority for chinch bug infestation.

High priority areas are:

- sunny, dry sites, such as south-facing sloped areas or areas next to sidewalks and roadways
- sites with a high fine fescue populations, such as turf stands where bluegrass and fine fescue plant populations are roughly equal
- sites maintained at high fertilization levels
- sites that have a history of chinch bug infestations
- sites immediately adjacent to areas with a history of chinch bug infestation
- sites that get regular insecticide applications for chinch bugs or any other turf insect pest

Low priority areas are:

- turf stands with high proportions of bluegrass, greater than 60%, and low proportions of fine fescue, less than 15%
- turf areas with high proportions of tall fescues or high-endophitic ryegrasses varieties
- sites that are shady or tend to be wet
- sites maintained at low fertilization levels
- sites with no history of chinch bug infestations
- sites that do not receive regular doses of insecticide

Once a site has been prioritized, the designation will indicate the strategy the turfgrass manager should pursue to manage chinch bugs infestations.

Cultural practices

Areas designated as high priority should have a comprehensive strategy of cultural practices in place before any decision is made to make any insecticide applications. Where thatch is a problem, regular efforts should be made to reduce thatch by dethatching, core aeration and thatch reducing compounds. Where areas are subject to much sunshine, well-placed trees can increase shade and cause the shade-intolerant chinch bug to look elsewhere for forage. Where turf stands are prone to be dry, increased watering, wetting agents and rooting compounds can increase root mass and reduce plant stress.

Increase cutting height in drought prone areas. Overseed areas with high fine fescue populations with high endophite tall fescue or ryegrass species. Reduce excess fertilization by using slow release or organic based fertilizers.

Low priority areas should be monitored to watch for changes that would favor chinch bug infestations. Changes, such as increases in thatch levels, increases in fine fescue populations, infestations in adjacent areas, loss of shade in an area, and permanent reductions in canopy moisture levels should be regularly rated and recorded. As these changes take place corrective measures should be undertaken to lessen the negative effects of these changes.

Scouting is the crucial element

Despite the best planned cultural management strategies for either priority, chinch bug populations may reach levels that require outside intervention. No matter what the priority designation of a site may be, timely samplings should be made to check on the presence of chinch bugs, the life stages present, and their population densities per square foot. Sites that have high priority designations should be scouted two to three times more often than low priority areas. Once a population of 25 to 30 individuals, instars and adults, is counted, an appropriate insecticide application should be made.

The exception to this rule is sites with chronic infestation histories. These sites are best managed with regular insecticide applications. But a site that has a history of stubborn, chronic infestations might benefit from some changes in application timing. An early, preemptive application, at the first appearance of over-wintering adults, combined with a late fall application to reduce the number of adults that may survive at over-wintering sites, may reduce population thresholds to the point that natural factors and predators can keep populations low enough that future insecticide applications can be dictated by actual numbers of individuals rather than the history of the site.

Managed chinch bug control will continue

A combination of cultural practices and chemical controls will be the dominant strategy for controlling chinch bug population for the foreseeable future. Alternative chinch bug management techniques should prove to be very successful in a majority of infestations, but they will require an increased level of research and funding for them to become a reality. ■

Scouting for chinch bugs

by Christopher Sann

Any decision to control chinch bugs with insecticides must be based on an accurate survey of chinch bug populations. The only way to obtain accurate information about those populations is to scout the sites and sample the areas for chinch bug populations.

When to scout a site

When a site should be scouted is a function of the site's priority designation, the life cycle of the pest to be monitored, and the temperature over the recent history of the site. The information gathered at this and all subsequent scoutings should be recorded and kept as a reference when making control decisions.

Photo provided by Dr. Mike Villani, Cornell University

Sampling for chinch bugs, using an eigh-inch metal cylinder filled with water.

No matter what the designation, each site should be scouted beginning about seven to 10 days after the daytime high temperatures are consistently at 45 F or greater. This initial scouting should be used to determine if there are any over-wintering chinch bug adults at the site. If no adults are found at the initial scouting, then low priority sites should be rescouted at four to six week intervals through July depending on degree day numbers or temperatures for that time period. Samples should be gathered every four weeks during warm temperatures and every six weeks during cool temperatures.

For sites with a high priority designation, a follow-up sampling should be considered every two to three weeks through August. A final sampling for over-wintering adults should be made in late September or early October. Information gathered at this sampling period should be used to guide control strategies for the following year.

The frequency of actual scouting, the time of day that the scouting occurs and the environmental conditions under which the scouting will be conducted are subject to adjustment for availability of qualified scouts, scheduling of other jobs, and the pest being scouted for. Use the same scout or group of scouts at the same site all season long. That way old, damaged areas will not be misidentified as new infested areas, possibly causing a errors in treatment. The type of pest being scouted will affect the time of day and the conditions under which the scouting is under taken. Chinch bugs should be scouted during the hottest time of a sunny day, and not in the morning when dew is present or after an irrigation or rainfall. Scouting for Dollar Spot, on the other hand, should be conducted in the early morning, when the canopy is still wet from dew or a rainfall.

How to scout for chinch bugs

The traditional method of scouting for chinch bugs was to get down on one's hands and knees, spread the turf leaves and look for anything that moved. This technique is an acceptable way to scout for chinch bug presence, but is not effective for establishing accurate population densities. To establish this, one must count all adults and instars within a given area.

The most effective way of establishing this is to section off a given area, either one-quarter or one-third of a square foot with a metal square or circle that is inserted into the ground to a depth of one to two inches. This square or circle is filled with water of sufficient quantity so that the chinch bugs will float to the top of the water in about 10 minutes. This may require adding additional water so that the water level is higher than the turf canopy for the duration. Once 10 minutes have passed, one counts the number of adult and instars that are floating. Then multiply that number by the denominator of the fraction of the square foot tested, i.e. for 1/3 of a square foot multiply by three, four for 1/4, etc. The total is the chinch bugs per square foot.

The threshold for applying insecticide should be between 25 and 30 chinch bugs per square foot. Large populations at sites that do not show telltale symptoms when taken late in a growing season, September or October, can be ignored if the temperature trend is decidedly downward, as the bugs will do little damage to the turf at the site and only 3% of that population will survive the winter to restart the infestation the following year. Conversely, large populations early in the growing season, April or May, will surely point to extensive populations by July and August.

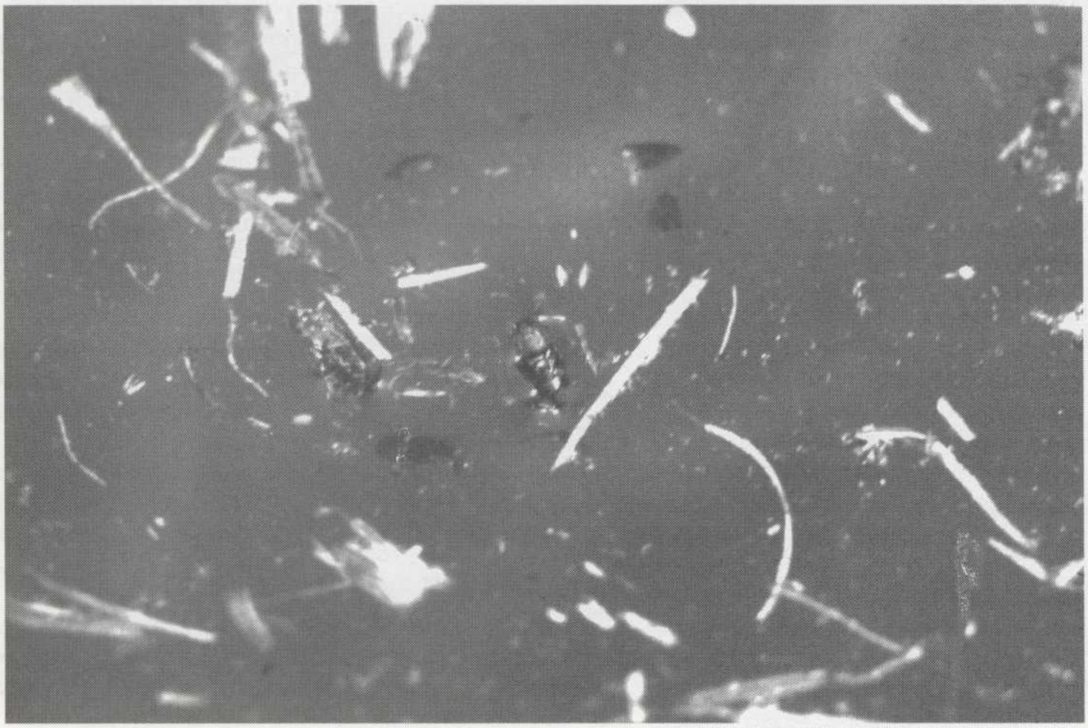


Photo provided by Dr. Mike Villani, Cornell University

Two adult hairy chinch bugs floating on the surface of the water in the sampling cylinder.

What areas should be sampled?

Since chinch bugs rarely infest the whole site at once, it is necessary to systematically walk the entire site to be sure that all potential trouble spots are observed. Each site should be walked in a predetermined pattern such as a zig-zag or "w" pattern so that the maximum area can be covered in a reasonable time.

An area at a site should be sampled if:

- there is a history of past chinch bug populations
- there are several factors favoring infestation
- it is an area adjacent to that site has had chinch bugs identified on it
- or there is some visual symptom that indicates that the turf is stressed either by environmental factors or by pest pressure.

If an area consistently does not yield any chinch bugs, then that area may not be conducive to chinch bug feeding activity and should designated as a location that should be sampled only when there are significant signs of an infestation. Areas that consistently yield various stages of chinch bugs should designated as an area that should always be sampled, because explosive population growth can occur in as little as two to three weeks.

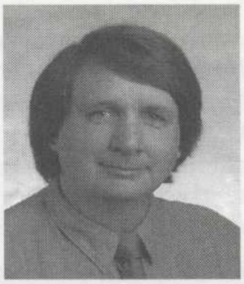
Once an area yields chinch bugs of increasing density, a series of samples should be taken at ever increasing distances to gauge how far the chinch bugs have spread from the initial infestation site. This new data can be used to establish how large an area should be treated, when the 25 to 30 per square foot threshold is reached. The area that is treated should be 15 to 25 feet past the last location that yielded a chinch bug. Do this to catch any chinch bugs that have escaped unnoticed. The entire treated area should sampled in a random fashion two to four weeks after the application to check on the efficacy of the treatment. If first or second instars are present then a follow-up application should be considered only if a very short residual insecticide was applied. Otherwise, the insecticide residues should control the instars from any newly hatched eggs.

Sampling is the key

Only consistent and accurate scouting and sampling procedures can establish accurate population densities. And only consistently and accurate data should be used to make any application decision. ■

Wind, application drift and the applicator

by Christopher Sann



As people have become increasingly aware of pesticides and their potential for misuse, the number of complaints to companies and regulatory agencies about drift of applied materials has risen.

Whether the actual number of drift problems has increased, because more applications are being improperly made or because the public's willingness to voice its complaints about application drift has increased, is not known. Either way all applicators of either dry or liquid applications must make every effort to avoid drift of applied materials and thereby avoid the complications of having to deal with a complaint.

Think of an application drift problem as analogous to a pesticide spill. The best way to deal with a material or pesticide spill is not to have one.

Know what you are applying.

The first and most important principle in avoiding drift is to have thorough knowledge of the material that you will be applying.

Read the label. It should provide a list of the proper environmental conditions under which that product can be used.

Follow the directions exactly. It's the law. If the label is not specific about the conditions under which the product can be used and there is the slightest possibility that drift will occur, contact the manufacturer and discuss your intended use of that product.

If, after discussing things with the manufacturer, you are still uncertain, **do not make the application**. Wait until conditions are more suitable.

Know the equipment that you are using.

The second most important principle to avoid drift, is to know the equipment that you will be using to make the application. If you do not have enough experience with that particular piece of equipment, **do not make the application**. Find someone more experienced to operate the equipment or wait until you have had enough experience under non drift conditions to feel comfortable with the application. Equally important in knowing how to use the application equipment, is the question: is the proposed application equipment the appropriate equipment to use for the application of the material at the proposed site? And if it is the correct equipment, can it be operated in a manner that will preclude the possibility of drifting? If the answer to either one of these questions is "no", then **do not make the application**.

Know the application conditions

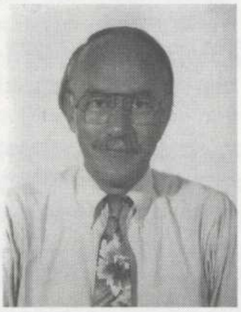
Finally, do the site conditions meet the minimum requirements needed to make the application? What are the wind speed, wind direction, and relative humidity at the site? Not only is this information that you are must record for regulatory requirements, but it is information that you, the applicator, need to make the decision of whether or not to make the application. If this information is not available, **do not make the application.** Low relative humidity is a concern on hot dry days. Liquid applications made under these conditions tend to evaporate much faster than in a cooler, wetter location, so knowing the volatility of the product is important under these circumstances. If the product has a low vapor pressure like a ester-based herbicide and the site is hot and dry, **do not make the application**.

If the wind direction could carry any of the applied material from the target area onto another person's property, near people, pets or other animals, into a building or into a body of water or a drainage system, **do not make the application**.

Finally, know what the wind speed at the site is. Most labels will state what the maximum wind speed may be for the proposed application site. There are at least five different commercial hand-held wind speed instruments available to measure wind speed. If the wind speed exceeds that recommendation, **do not make the application**. Knowing the wind speed at eye level is not going to stop drift, if you are going to be making an application 25 feet over your head. You need to know what the wind speed is at the height you will be making the application. This takes into account the fact that wind speed in miles per hour increases exponentially the higher you are above the ground. So if you measure the wind speed at six miles per hour at six feet off the ground, a speed that is within the application parameters, and you are going to be spraying an ornamental tree 25 feet off the ground then the wind speed at that height will

-continued on page 11

A welcome to our new subscribers



by Juergen Haber

Over the course of the last few months we at *Turf Grass Trends* have been working hard at broadening our subscriber base. And the results are gratifying.

In addition to the core group of readers that Chris Sann, field editor and former publisher, brought on board, we have brought into our circle of readers others who are interested our in-depth treatments of information for everyone in the industry — from lawn care operators to golf course superintendents to manufacturers.

Our veteran subscribers have seen several issues of the new *Turf Grass Trends*, but we'd like to tell those of you who are seeing the newsletter for the first or second time about the faces behind the news.

I've been editing and publishing newsletters and helping other publishers since 1977 when I took over *Housing and Urban Affairs Daily*. I took over the publishing functions here in November and the editing functions in February.

Field Editor Chris Sann is a successful lawn care operator with over 20 years experience where it counts — out in the field. He's been writing on turfgrass issues since 1990 and then founded *Turf Grass Trends*.

Science Advisor Eric Nelson is an associate professor of plant pathology at Cornell University. He is an internationally recognized academic researcher into the expansion of scientific understanding of progress in the turfgrass field.

Art Director Dan Robinson is also art director for the city newspaper for Takoma Park, MD, as well as designer and producer of publications for several other clients.

We and other contributors, like veteran business writer Jim Parks and Cornell University's Dr. Joseph Neal, will help you face a daunting combination of challenges through the pages of *Turf Grass Trends*:

- increasing environmental regulations changing the way every segment of the green industry does business,
- our economy is undergoing fundamental structural changes that are difficult to grasp — much less to manage,
- and the relief promised by the explosion of new knowledge and new tools is complicated by obstacles to gaining access to these new resources and putting them to use in the field.

But why do it in a newsletter instead of a trade magazine? First, I'd like to acknowledge the contributions of magazines like *Landscape Management* and *Pro*. The green industry needs their voices and the insights they provide to the general public. But we believe the industry needs an independent newsletter that takes an approach to the subject of turf that is lean and mean, no frills and no distractions, just solid information.

Beginning with the November issue, we increased the size of *Turf Grass Trends* from 12 to 16 pages. We've brought the production of the newsletter from Wilmington, Delaware, to Washington, DC, making the logistics and communications lines shorter and more efficient. In the coming months we'll be making other changes — the publication of new services for our readers. We'll be broadening our roster of regular contributors. And more changes are in the works for 1994 and beyond — all to make it easier for all of us in the green industry to cope with all of the challenges we face every day.

But we can't do our job here at *Turf Grass Trends* in a vacuum. We invite reaction and interaction from our readers. You've seen the Ask The Experts feature we publish when we have room. We invite questions from you. We will also publisher letters from readers. Don't forget that we have tried to make communicating with the *Turf Grass Trends* team easy: the box on the back cover lists our address, phone number, fax number and electronic mail address.

So, we hope our veteran readers and our new subscribers all will profit from what we bring you. ■

***Drift** continued from page 10*

probably exceed the maximum allowable limit. Conversely, an application that is to be made at twenty inches off the ground can probably still be made within the parameters even though the wind speed is 12 miles per hour at six feet off the ground.

Only you can stop drift

You, the applicator, are the person directly responsible for application drift and its consequences - not your supervisor, not the office manager, not the homeowner, not the manufacturer. You are the person who can stop application drift. And remember to best way to avoid application drift is **do not make the application** unless you are convinced that every effort has been made to avoid application drift . ■

Refresher course continued from page 5

The disadvantage of this method is that it requires great flexibility in scheduling and allocation of personnel and managing potential site usage conflicts.

Traditional control strategies

For those turfgrass managers for whom the use of periodic site scouting and degree day models is a organizational problem, the same research information that was used to produce the models can be used to increase the efficacy of the more traditional approach of the applications of control chemicals at specific times.

Traditional chemical control strategies have consisted of one of two approaches: either make chemical control applications early in the growing season to control the activities of over-wintering adults and second generation immature bugs or wait until a threshold symptom level has been reached at a site and then apply controls. The positive aspects of these strategies is that applications can be scheduled far in advance and that cool wet years may not require application of pesticides. The negative part of these approaches is that their use can cost extra money.

Preemptive applications that are scheduled simply by use of the calendar can often be very inefficient, particularly if an insecticide with the proper residual is not used and thus requires reapplications. Threshold applications may often not reveal the full extent of site damage necessitating site repair at a later date.

A slight modification of these more traditional control strategies may dramatically improve their performance and lower the costs of implementing them. In both cases the site should be scouted to establish thatch levels and fine fescue content. Drier sites with thatch levels exceeding 3/8 inch and with species mixtures of equal numbers of bluegrass and fine fescue plants should be considered to be prime chinch bug territory and given a high priority. Newly established, wet, shaded, high bluegrass content sites, or low or no thatch sites should be given lower priority. Only at identified high priority sites, should preemptive control applications with a long duration insecticides be made four weeks after the day-time air temperature consistently reach 45 to 50 F. This will ensure that over-wintering adults and first instars are reduced to the point that subsequent generation populations will not reach the critical mass necessary to produce significant turf damage, saving a follow-up application to control second generation instars. Additional, dense, low priority sites or sites that show a turf species change-over to fine fescues should be considered for preemptive applications but only if chinch bug populations are present. Low priority sites that have a history of chinch bug infestations should either be considered high priority sites or scouted for chinch bug populations eight to 10 weeks after the 45 to 50 degree air temperature threshold has been achieved.

Most low priority sites will not need periodic applications of control agents unless long periods of hot dry weather occur. Then, care should be taken to see that chinch bugs are present before any insecticide is applied.

Control materials for "curative" applications can be of a shorter duration and lower efficacy than those used as preemptive controls because the various instar populations often exist simultaneously. Since only a small percentage of adults survive to over winter less efficient controls can be used.

A complete understanding of the chinch bug distribution, biology and life cycle will enable the turfgrass manager to analyze and prioritize his sites, thereby increasing control efficiencies and reducing costs. In southern Florida and the Caribbean islands where as many as twelve generations per year are not uncommon, timely application of controls based on biology of chinch bugs can reduce pesticide applications from five to six times per year to two to three times. ■

Florida study

No link between fertilization and chinch bug activity

A recent Florida study was designed to test the oft-stated premise that turf that received high fertilization was prone to greater damage by feeding chinch bug populations. The results of that study found that, although chinch bugs may prefer luxuriant turf, there was no consistent trend. In tests of the amount of damage that occurred to high and low maintenance sites, the high maintenance sites sustained an average 18% more damage. But tests for chinch bug populations found that fertilization practices did not play a significant role.

TGT's view: The fact that the 18% greater damage that occurred on high fertilization sites was not caused by a significantly greater population of chinch bugs indicates that other factors such as reduced instar mortality or more hospitable site conditions may play a role in turf canopy damage. CS

Hawaiian study

Genetics plays role in insecticide resistance

A Hawaiian study of genetic variation within a population of insects indicates that isolated populations of insects that can have dramatically increased resistance to applied insecticides.

The study found that where the insect populations had a high level of genetic variation (2% of the population was resistant) and that population was subject to the pressure of an average of one insecticide application every 10 days, the amount of time required for more than 50% the population to have developed resistance was 5.5 times faster for the high variation than the low variation (.02% of the population resistant). When the same populations had increased migration from outside insect populations, the ratio between high and low variation populations stayed the same, but the resistance took from 20 - 50% longer to develop.

TGT's view - Resistance of an insect population to a specific insecticide may develop after exposures to as few as 10 applications of that insecticide for groups with 2% resistance. Or that resistance can develop more slowly requiring as many as 55 exposures in groups with .02% resistance. Also sites that have a high rate of migration from off-site groups will delay the development of population resistance by as much as 50%. This study identifies two of the prerequisites for the development of insecticide resistance in a given insect population:

- *consistent use of the same or similar control materials for 10-55 times without changing to an insecticide with a different mode of action. This means resistance can occur within five years at a typical northern site that receives two insecticide applications per year and within three years at warmer sites that receive three applications per year.*
- *isolated sites with indigenous populations are more likely to develop resistance than less isolated populations that intermix with individuals of outside populations.*

Turfgrass managers, particularly at isolated sites, should vary the control materials applied between products with different modes of action, i.e. substitute a carbamate-based insecticide for an organophosphate-based material. Turf managers with an existing resistant insect population should reduce any additional pressure on that population to adapt by employing all cultural control appropriate for that pest species before any additional insecticide applications are made. -CS

Milky spore disease may not be an effective biological control for grubs

At a recent conference on turfgrass research Daniel Potter of the University of Kentucky questioned the efficacy of milky spore disease for control of grub populations. In an address on integrated pest management techniques for insect control in turf he commented that many of the field tests conducted between 1940 and 1975 by the U.S. Department of Agriculture on the efficacy of *Bacillus popilliae* were not replicated, failed to include proper controls, failed to establish a dose response, and were not published in the scientific literature. Also, he cited recent studies that have failed to show any increase in disease infected grubs at treated sites or any reduction in grub populations over the four-year period of the studies. In short, he concluded that the efficacy of milky spore disease had not been established.

TGT's view: Turfgrass managers who are considering milky spore disease as a biological grub control should look at some of the newly-formulated parasitic nematode products as an alternative until new information is developed on the efficacy of bacillus popilliae. -CS

Iowa College of Medicine

Health effects of farming on farmers

The University of Iowa's College of Medicine has begun a study of the long-term health effects of farming on farmers, commercial applicators and their families. The study will monitor the participants over a 10-year period for the development of cancers and other diseases that might be related to farming activities. Historically, farmers and their families have lived longer than other populations, despite the fact that farming is considered to be the most dangerous occupations. The researchers plan to use the gathered information as a means of developing better health and safety programs for farmers.

University of Georgia Research

Bermuda grass can be controlled in tall fescue

Research at the University of Georgia indicates bermuda grass can be suppressed in tall fescue stands with multiple applications of fenoxaprop, whose trade name is Aclaim. Lighter-rate multiple applications over two years provided control equal to heavy rate over one year with only minimal (15%) phytotoxic injury to the tall fescue. Table 1 lists the average control achieved over a two year period at various light rates of application over a varied number of applications.

Table 1

Rates of fenoxaprop applications to control bermuda grass

Rate(ounces/sq.meter)	No.of applications	%Control vs. no applications
0	0	0
.0225	8	23
"	10	29
"	12	42
.045	8	57
"	10	65
"	12	66
.0675	8	91
"	10	93
"	12	97
.09	8	90
"	10	90
"	12	90

TGT's view: There appears to be a threshold amount of fenoxaprop needed to give excellent control (> 90%) of bermudagrass in tall fescue and the effects appear to be cumulative. That amount is .54 ounce per thousand square feet over two years with minimum application rates of .0675 ounces per square meter per application. Applications at higher rates over one year periods required application rates that were 2.5 to 4 times greater to achieve the same results with twice the phytotoxic damage occurring at the higher rates. -CS

High endophyte levels in tall fescue does not deter grub feeding

A recent Kentucky study of the feeding habits of grubs, under both laboratory and field conditions, showed inconsistent results when the grubs feed on the roots of an endophyte-infected version and non-endophyte version of a variety of tall fescue. In the laboratory, the grubs would reduce their feeding on the endophyte-infected roots by as much as 35%. However, in the field, their was little or no reduction in feeding found by several means of measurement. The study did indicate that grub mortality averaged twice as high in tall fescue and bluegrass stands versus ryegrass, bentgrass, and hard fescue stands.

TGT's view: Until shown otherwise, the level of endophyte infection in a turfgrass variety should not be a consideration in choosing a variety where grubs are the primary insect pest. Species choice should be a consideration in those determinations. -CS

Coming attractions

June Issue

Rhizoctonia
by Christopher Sann

July Issue

Pythium diseases
by Dr. Eric B. Nelson

Pythium fungicides
by Dr. Eric B. Nelson

Cool vs. warm season Pythium
by Dr. Eric B. Nelson

Pythium species & other fungi
by Dr. Eric B. Nelson

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