AN INDEPENDENT NEWSLETTER FOR TURF MANAGERS

Turf Grass TRENDS

Volume 3, Issue 5

May 1994

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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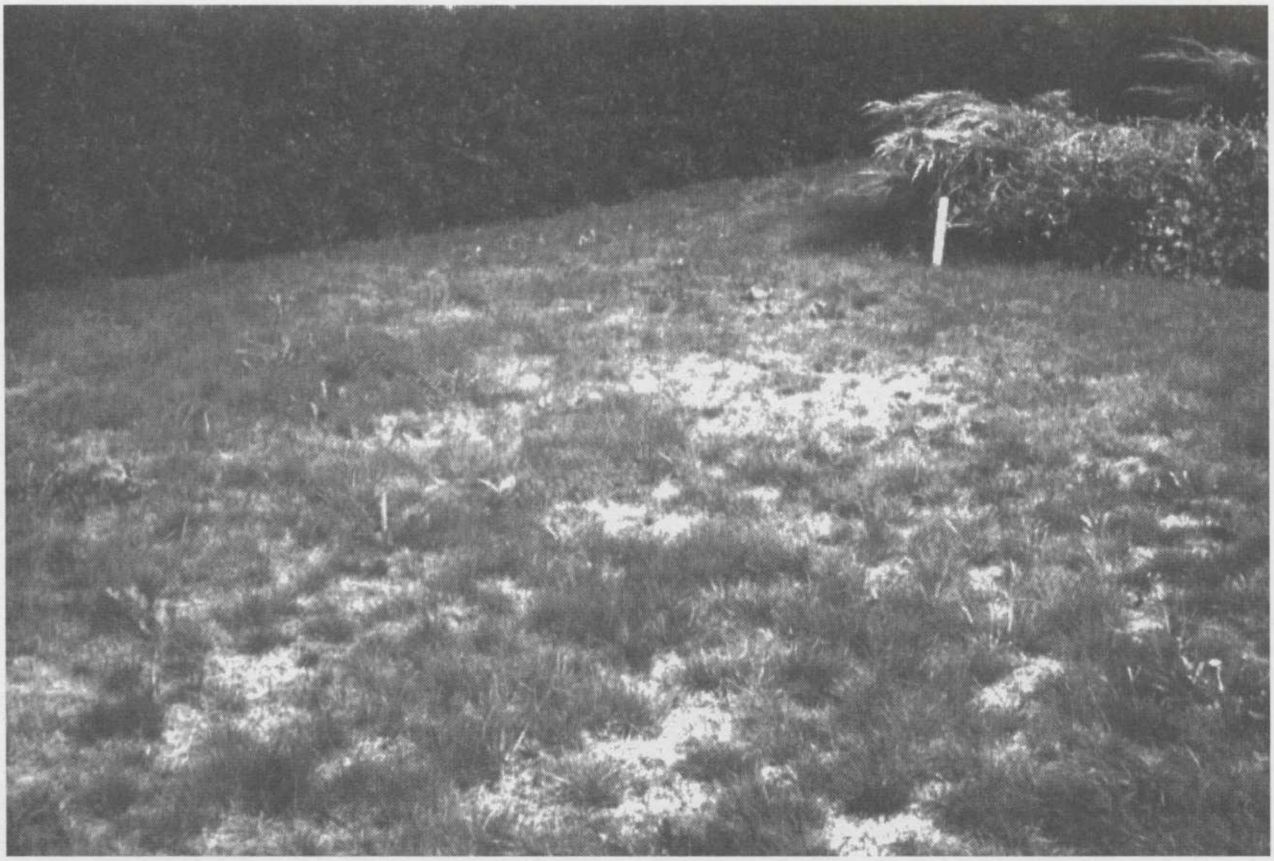

Photo provided by Dr. Mike Villani, Cornell University

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

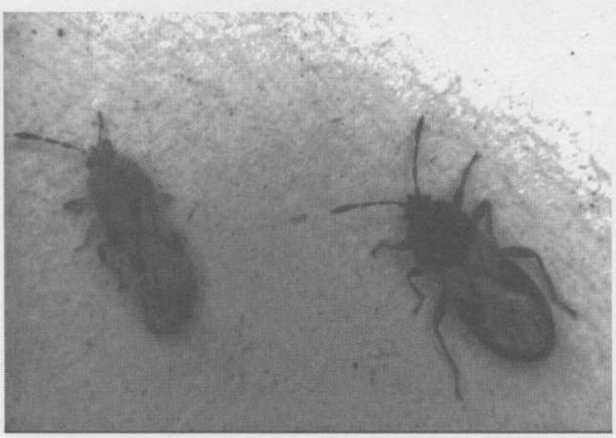

Photo provided by Dr. Mike Villani, Cornell University

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

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.

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-

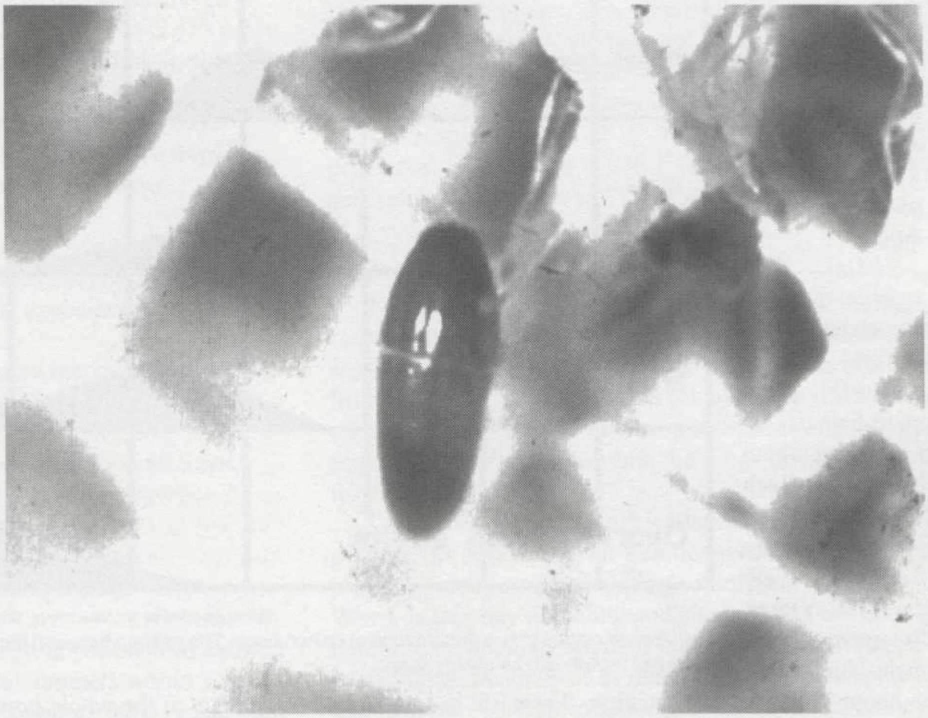

Photo provided by Dr. Mike Villani, Cornell University

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.

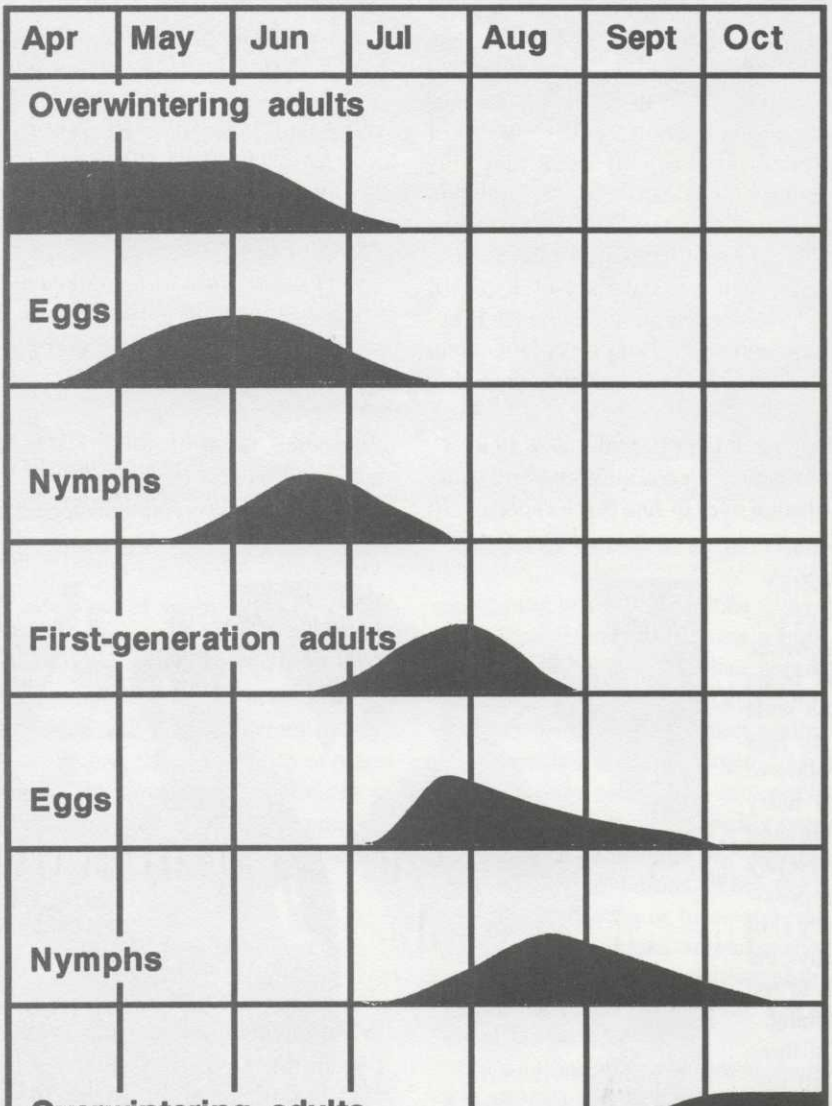

Figure provided by Dr. Mike Villani, Cornell University

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

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.

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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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