Chinch Bug

Biology, Behavior and Control in Kansas

The common chinch bug, *Blissus leucopterus*, has been a serious pest of the eastern High Plains for more than 200 years. In 1873, populations in the upper Mississippi valley were estimated at 44 billion bugs per square mile (17,000 per square meter) over approximately half of the 90,000 square miles under agricultural production. Problems are worse where early stage nymphs feed on wheat before migrating to neighboring fields of spring-planted corn and sorghum. This ideal host plant succession – wheat or barley followed by corn or sorghum – is thought to be the cause of large-scale chinch bug populations. Outbreaks occur periodically in central and eastern Kansas and can cause substantial losses to corn and sorghum without effective management. Because the chinch bug only achieves high populations by exploiting these crops, farmers in affected areas can obtain perennial benefits from the regional application of appropriate management strategies. This publication provides agronomists and extension specialists with information on the biology and ecology of this pest, its potential effect on crop production, and effective management tactics.

Life history and ecology

Reproduction and development

Like all true bugs, chinch bugs have three life stages: egg, nymph and adult. Eggs are laid singly or in clusters around the base of host plants, either in the ground or behind leaf sheaths on lower plant parts. Eggs are whitish and elongate when freshly laid and darken to a reddish color before hatching. Eggs may be laid anytime from the end of April to early October, although in each generation most are laid over a two- to three-week period. Each female lays up to several hundred eggs. Female reproductive potential varies from year to year and may be affected by host plant quality during development. The time required for egg hatch ranges from one to two weeks and depends on temperature and location. Eggs in warm locations with good solar exposure hatch first.

Nymphs molt five times before becoming adults, growing and changing in appearance with each molt (Figure 1). The head and thorax are pale, yellowish-brown in early instars, but dark brown to black in later ones. Similarly, the abdomen is yellowish or reddish-orange in young nymphs, but darkens to almost black in the final instar. All nymphs have a characteristic white band across the middle of the body, although this feature becomes partially hidden by the developing wing pads in the fifth and final instar. Newly molted adults are pale at first, but darken quickly and develop a distinctive black-on-white X pattern on the wings (Figure 1). There are typically two generations per year in Kansas.

Figure 1. Adult chinch bugs

Plant damage

Chinch bugs puncture vascular tissues to extract plant juices. They secrete digestive enzymes that cause the breakdown of surrounding plant tissues as they feed. Feeding punctures can also allow pathogens to enter the plant. Consequently, damaged plants present a variety of symptoms including stunting, yellowing, wilting and necrotic lesions (Figure 2). Older nymphs are larger and cause more damage than younger ones. The effect of nymphal feeding depends to a large degree on the health and nutrition of the plants. In particular, growth stage and water balance are critical, because small or drought-stressed plants have less ability to tolerate or recover from chinch bug feeding damage.

Figure 2. Plants damaged by chinch bugs

Host plants and seasonal phenology

The chinch bug feeds on a variety of grasses, including many cereal and forage crops, which serve as spring, summer or overwintering host plants. The chinch bug became a pest as the prairie was developed and suitable crop plant hosts were introduced. In Kansas, overwintered chinch bug adults typically produce the first generation in wheat because it is readily available, although barley and other grasses are preferred. The rate of nymphal development and reproductive potential are influenced by the host plant. Healthy stands of winter wheat rarely experience much damage from first-generation nymphs in spring, but thin stands are more susceptible to fall or spring damage. Spring-sown cereals can be adversely affected when large chinch bug populations survive the winter.

In Kansas, the wheat crop usually matures and dries down before most first-generation chinch bugs complete development. Many post-reproductive adults may leave maturing wheat and fly to cornfields in alarming numbers, but they do little damage and have already laid most of their eggs. It is the *en masse* migration of flightless, immature bugs from maturing wheat fields into neighboring sorghum and corn fields that poses the greatest threat. Sorghum is a highly preferred food plant that is susceptible to damage, especially because it is planted late. In contrast, earlier planted corn is larger and more resilient at the time of nymphal migration, so damage is usually confined to border rows. Late-season damage is typically spotty, but even heading sorghum can be damaged by second-generation bugs when heavy populations are coupled with drought.

In addition to sorghum and corn, many wild, warm-season grasses also serve as summer host plants and may be colonized by winged adults that complete development on spring hosts. There are usually two generations in Kansas, although a third may occur when a warm summer follows an early spring. In response to shorter days and cooler autumn temperatures, many second-generation adults seek out native, bunch grasses, which they prefer for overwintering. Densely thatched crowns of these grasses provide chinch bugs with the protection they need to survive severe winter weather. A single cluster of bunch grass may shelter as many as 20,000 chinch bugs. Although bugs may survive in a variety of other locations during mild winters, crop residues usually do not harbor significant numbers of overwintering bugs. Some experts believe that conservation tillage systems have exacerbated chinch bug problems in grain production.

Mortality factors

Weather

Weather plays a significant role in chinch bug population dynamics. Extended periods of hot, dry weather can cause death by desiccation, especially of young nymphs. Chinch bugs are rarely a problem in western Kansas where the bunch grasses needed for overwintering are scarce because of inadequate rainfall. However, heavy rainfall is also an important source of mortality. Rain can pummel the insects to death and bury them in mud, as well as foster fungal infections than can lead to rapid, widespread mortality. Below-normal rainfall in late summer and early fall favors a large overwintering population, as does a mild winter that enhances survival in the less-protected overwintering sites. Heavy rainfall in May and June can significantly reduce the survival of first-generation nymphs. In general, damaging populations occur most often during growing seasons with above normal temperatures and below normal rainfall, especially when such conditions persist for successive years.

Natural enemies

No natural enemies of chinch bugs can reliably reduce or control large populations when conditions are favorable for their development. Predation by quail and certain passerine birds can be conspicuous, but likely has little effect on population growth. Many general predators such as damsel bugs, ground beetles and lacewings may occasionally feed on chinch bugs when they are abundant, but usually prefer other prey and appear to have little impact on chinch bug populations. Various ladybeetle species are mentioned as chinch bug predators in older literature, but recent tests suggest that more prevalent species such as *Hippodamia convergens* and *Coleomegilla maculata* do not feed on chinch bugs. Bigeyed bugs (*Geocoris* spp.) have been documented as potentially important chinch bug predators, but cannot be relied on for control. The insidious flower bug, *Orius insidiosus*, and several species of *Collops* beetles commonly occur in Kansas and have been recorded as predators of chinch bug eggs. At times, a significant proportion of the chinch bug population may be parastized by the Scelionid wasp *Eumicrosoma benefica*. Although a particular natural enemy can exert significant mortality under certain conditions, efforts to culturally enhance biological control have not been successful.

The chinch bug fungus, originally identified as *Sporotrichum globuliferum*, has been recognized for more than 100 years as possibly the most important biotic mortality factor. This pathogen is now known to be the cosmopolitan soilborne fungus *Beauveria bassiana*. It is not specific to chinch bugs and infects a wide range of arthropod species. Under suitable conditions, *B. bassiana* can attack and kill insects from many different orders in both immature and adult life stages. Periodically, *B. bassiana* can be a dramatic, area-wide source of chinch bug mortality, and historically there have been many attempts to induce epizootics by distributing inoculum in fields. However, the spores of this fungus are widespread in most soils and the development of an epizootic in the chinch bug population depends on suitable environmental conditions for infection and sporulation.

Infection of the insect occurs when an asexual spore, or conidium, germinates on the cuticle of a host insect. The spore produces hyphae that secrete enzymes to dissolve the insect cuticle and penetrate the body. Masses of mycelia grow within the insect and secrete toxins that suppress the immune system. Once the insect is killed, antibiotic substances are released to suppress the growth of bacteria present in the gut. Masses of mycelia may burst from the insect's body (Figure 3). Fruiting bodies form on these external hyphae and release conidia into the environment where they may remain dormant for extended periods. While spore germination and infection can occur at humidities as low as 35 percent, humidity must be higher than 90 percent for the fungus to grow outside the insect's body and produce the characteristic 'white bloom' appearance that is critical for rapid spread of the disease to other insects. Although there is variation among types of fungi, the growth rate is usually optimal around 25ºC, declining sharply at higher temperatures and more gradually at lower ones. Moderate temperatures and prolonged dampness favor outbreaks of this disease.

Figure 3. Chinch bugs killed by Beauveria bassiana

Horizontal transmission is also facilitated by close contact among the host insects, so epizootics spread faster in high-density chinch bug populations.

Management

Cultural controls

The chinch bug provides an early example of an area-wide approach to insect pest management. Historical literature is filled with descriptions of community-wide efforts to erect physical and chemical barriers to stop chinch bug migrations. Dust barriers – deep furrows filled with fine dust – were constructed along crop margins to trap migrating bugs. Periodically, a log or barrel was dragged up and down the furrow to squash the bugs, or they were burned in the furrow with a large gasoline torch. Other farmers filled the furrow with creosote or used soil ridges or paper fence barriers treated with creosote to guide the bugs into a series of regularly spaced postholes where they were dispatched with daily doses of calcium cyanide. Considering the cost of labor and large-scale corn and sorghum production, physical barriers are no longer a cost-effective alternative for today's farmer.

The destruction of bugs by burning overwintering sites has been promoted in the past, and at one time area-wide burn programs were conducted by entire communities. Fall burning was considered preferable to spring burning because surviving bugs were expected to die from exposure, having lost their protection from winter weather. Effective burns had to be conducted late enough in the fall that all bugs had entered the grass bunches and under sufficiently dry conditions that grass clumps could be burned to their very bases. However, burning to eliminate overwintering bugs is unlikely to be effective unless it can be done throughout the region. Burns conducted on individual farms are not worthwhile.

Plant resistance

Sources of resistance to chinch bug feeding damage have been identified in some sorghum varieties, particularly those with Kafir parentage. However, the sources of resistance currently available in commercial hybrids are only fully expressed in older plants, making them useful for mitigating mid-season attacks by second-generation bugs, but leaving seedlings dependent on other forms of protection.

Trap crops

At one time, the planting of non-host crops such as soybeans was promoted for reducing local chinch bug populations once their dependence on an appropriate sequence of grass hosts was understood. However, using non-host crops as barriers is not a reliable technique because migrating nymphs can cross such barriers and travel considerable distances to find suitable host plants. There are reports of chinch bugs crossing as many as 120 soybean rows to reach a suitable crop. However, an early-planted strip of corn or sorghum can serve as an effective trap crop if the plants are large enough to host numerous bugs, and the strip wide enough to detain the advancing tide. Deciding on a suitable width for the trap crop strip is not easy without knowing population size, which is usually difficult to predict. Once bugs have settled in to feed, the trap rows can be treated with an insecticide, which can cost significantly less than treating the entire field. Bugs that survive the treatment and complete development in the trap rows are likely to disperse by flight without damaging the adjacent crop.

Assessing the risk

In the past, overwintering populations have been estimated by excavating clumps of bunch grass in winter and counting the numbers of chinch bugs within them. However, large numbers of overwintering bugs do not necessarily mean that damaging migrations will occur, and low numbers do not reliably indicate an absence of risk. The size of an impending chinch bug migration from wheat fields can best be estimated immediately before planting by sampling 20 different points along the wheat row adjacent to the field where sorghum will be planted. Infestations of less than one bug per row foot of wheat, averaged across the 20 samples, are unlikely to result in economic damage to neighboring sorghum. Higher densities usually justify the use of treated seed or an in-furrow planting-time treatment. Some farmers seek to reduce costs by treating only those rows adjacent to the wheat field, but this approach is risky without accurate information on population levels that might indicate how many treated rows will constitute an adequate buffer zone.

Planting-time treatments

In-furrow applications of systemic insecticides at planting can provide good protection of emergent seedlings for a period of about three weeks under optimal conditions. Insecticides with systemic activity in the plant can provide excellent control of chinch bugs, aphids, flea beetles, wireworms and other seedling pests, but require adequate soil moisture in order to be taken up by the plants. Seed treatments are the latest weapon against chinch bugs. These are typically commercially applied by the seed company and use modern systemic insecticides (nitromethylene or chloronicotinyl compounds) with novel modes of action. However, sorghum sown early is at risk of outgrowing the protection from seed treatment before bug migration. If chinch bug populations are high, even plants properly treated with a systemic insecticide may be overwhelmed and killed, but the bugs feeding on them will also die, resulting in much lower final stand reduction than would occur without treatment.

Foliar sprays

Timely applications of foliar insecticides can rescue corn or sorghum fields invaded by migrating chinch bugs. Most approved materials have good efficacy against chinch bugs if three factors are considered.

First, it is important to use the full, recommended rate of the selected insecticide, preferably delivered in 20 to 40 gallons of water per acre. High gallonage ensures good plant coverage and enhances the movement of material into protected plant parts such as leaf sheaths, which increases the probability of contact with bugs.

Second, the material should be delivered with properly adjusted and calibrated equipment. Cone nozzles designed for high-pressure use will create smaller droplets and improve coverage. For plants up to 6 inches high, the nozzles should be mounted on drop pipes with the boom height set to deliver a 10- to 12-inch-wide band directly over each row. For taller plants, position drop pipes between rows and use double swivel nozzles adjusted to deliver a spray laterally onto the lower half of plants and surrounding soil.

Third, the timing of the insecticide application is critical. Early morning applications are preferred because winds are calm (reducing drift), temperatures are cool (reducing volatilization of chemicals) and many chinch bugs will be on the plants and exposed to the application. Applications should be made promptly as migrations begin and before significant numbers of bugs become established in the field. The earlier action is taken, the more likely it is that damage can be avoided by treating only a portion of the field. None of the materials currently registered for use against chinch bugs has long residual efficacy. Because peak migrations may continue for 10 days or more, monitoring is required to determine if additional applications to border rows are necessary. Refer to current recommendation guides available from your local K-State Research and Extension office or the K-State Research and Extension Web site: Corn Insect Management at *www.oznet.ksu.edu/library/ENTML2/Mf810.pdf* and Sorghum Insect Management at *www.oznet.ksu.edu/library/ENTML2/Mf742.pdf.*

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