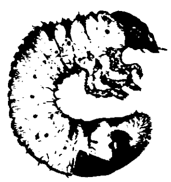
K-STATE
Kansas State University

Home and Horticultural PESTS

Entomology 403

White Grubs

Lawn and Turf Insect Management—Part I. White Grubs

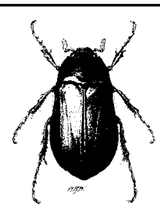


White Grub Larvae

White grubs are the larva of scarab beetles such as May beetles (sometimes called June bugs), "masked" chafers and black turfgrass ataenius. May beetles/June (MB/JB) bugs and chafer beetles are commonly observed at night when they swarm around lights on the street or around homes. While the beetles do not damage turf, their grubs can be very destructive.

Descriptions and Life Cycles

May Beetles/June Bugs—MB/JB are common names applied to various species of scarab beetles of the genus *Phyllophaga*. They are so named because they are most active during May and June. Although the beetles of some species may feed on the foliage of certain trees or shrubs, the damage is minimal, and, for the most part, goes unnoticed. It is the larvae, **only of some species,** which have the potential to damage turf.



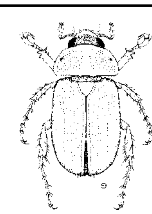
May Beetle/June Bug

Most MB/JB have a three-year life cycle. During the first year (Figure 1), beetles mate and deposit eggs in the soil during late spring and early summer. Larvae develop slowly during the remainder of the summer and into the fall. (Although they feed on grass roots, they are incapable of causing serious damage because of their small size.) As soil temperatures cool during the fall, larvae cease feeding and move deeper into the soil. The depth at which they overwinter is dependent upon the depth of the frost line.

When soil temperatures warm up in spring, larvae move up in the soil until they are again in contact with grass roots (Figure 2). Grubs mature during this second year. (By late summer, large grubs are capable of causing extensive damage to grass roots, as evidenced by patchy dead spots in lawns.) With the return of cool soil temperatures in the fall, the mature or nearly mature larvae again move deeper into the soil and overwinter below the frost line.

When soil warms up the next spring (Figure 3), grubs return to root zones. However, because grubs essentially completed their development the previous year, there is little additional feeding damage. Rather, grubs form an earthen cell inside of which they pupate. By early to mid-fall, the adult beetle emerges from its pupal case, but remains in the earthen cell where it overwinters. As the soil warms up during the next spring, the beetles emerge to mate and repeat the three-year cycle.

Masked Chafers—Chafers belong to the genus *Cyclocephala*. Unlike *Phyllophaga* of which there are many species, there are only a few species of *Cyclocephala*. Unlike



Masked Chafer

the many species of adult *Phyllophaga* which feed, no *Cyclocephala* feed as adults. Unlike most *Phyllophaga* which have three-year developmental cycles, all *Cyclocephala* have a one-year life cycle.

Adult chafers are active from mid-June (Figure 4) to mid-July depending on the location in Kansas. During an approximately three-week flurry of activity, chafers mate and deposit eggs in the soil. Larvae emerge from eggs two to three weeks later and immediately begin feeding on grass roots ***and*** other organic material in the soil. Larvae rapidly progress through their growth stages. (By late summer and early fall, grubs are capable of causing extensive damage to grass root systems resulting in dead patches in lawns.) Feeding activities cease when cool soil temperatures force larvae deeper into the soil where they overwinter beneath the frost line.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Figure 1. May beetle or “June bug,” first year.

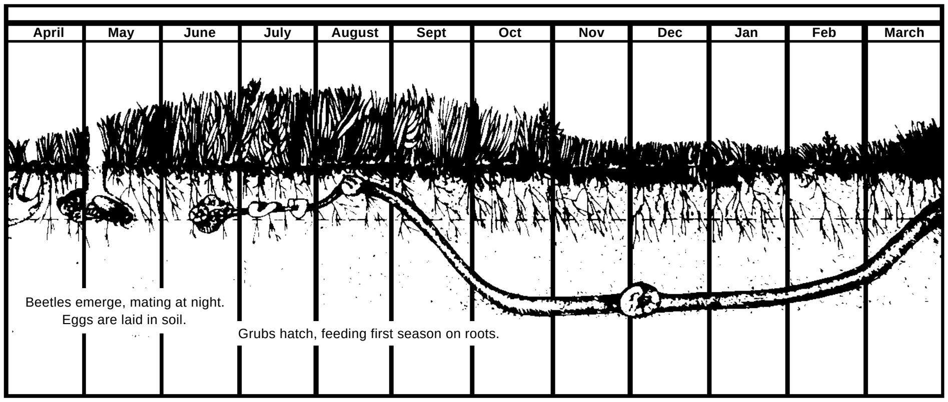


Figure 2. May beetle or “June bug,” second year.

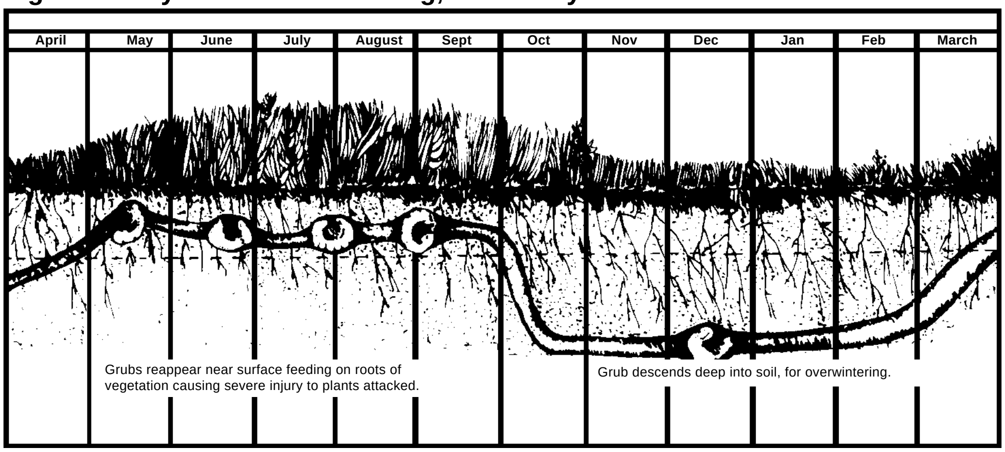
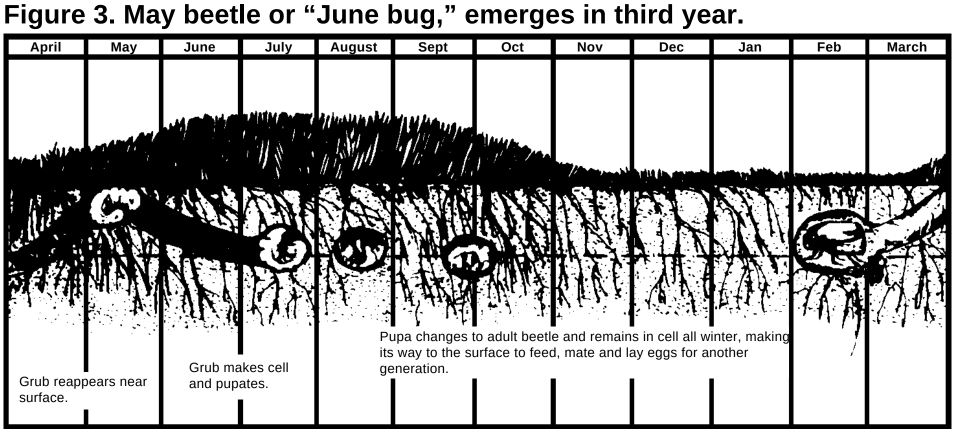
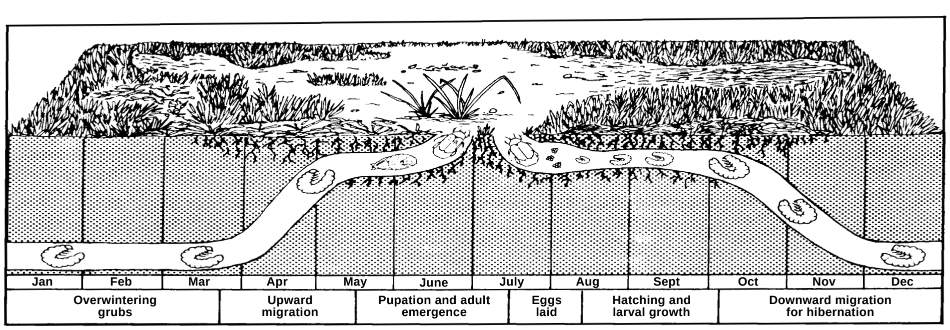


Figure 3. May beetle or “June bug,” emerges in third year.



Life cycle of the June beetle in its third year.

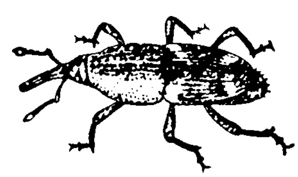
Figure 4. Seasonal life cycle of masked chafer beetles.



Adapted from, R. McMillen–Sticht, NYSAES

When the soil warms up during the following spring, larvae move up the grass roots where they do but minimal feeding (if necessary to complete their development). Mature larvae form an earthen cell inside of which they pupate. Approximately three weeks later, adult chafers emerge, mate, and repeat the yearly cycle.

Black turfgrass ataenius—Occasionally, bentgrass and annual bluegrass golf greens in metropolitan Kansas City and Topeka have been attacked by the larvae of black turfgrass ataenius (BTA) beetles. The small BTA beetles (⅛ to 3⁄16 inch long) overwinter under leaves and debris on and around golf courses. Beetles become active as early as March (but more normally in April), and can be seen flying close to the ground, especially during warm late afternoon and early evening hours. During April and May, egg clusters (averaging 10 eggs/cluster) are deposited in the thatch or in the soil immediately below the thatch. Grubs feed and rapidly grow during May and June, after which they pupate. In July and August, adults appear and deposit eggs for the second generation. It is the adults of the second generation which overwinter.



Billbug

Billbugs—Billbugs, although not scarab beetles, often are included in discussions of "grubs" because their larvae are white and grub-like. Billbugs are not "bugs"—they are beetles with snouts (weevils). And although billbug larvae are grub-like in appearance, they can be separated from other white grubs because they (billbug larvae) are legless.

Two billbug species are found in Kansas. Bluegrass billbugs attack cool season grasses (bluegrass, fescues, perennial rye grass), and hunting billbugs are associated with warm season grasses (zoysia grass and Bermuda grass). The lifecycles of both are similar. Although there are no definitive lifecycle studies from Kansas, it is likely that both billbug species only produce a single generation per year.

Adult billbugs (¼ to 7⁄16 inch long, generally dark in color) overwinter under leaves, debris and other sheltered sites around previously infested turf. Billbugs become active with warming temperatures in spring, and are commonly seen (from late April into June) crawling across driveways, sidewalks and concrete surfaces. Billbugs deposit their eggs into holes chewed into the stems/crowns of grass host plants. While small, larvae feed and tunnel within the stems and crowns. Partially grown larvae exit plants, moving into the soil where they complete their development by feeding on grass roots. Mature larvae (only ¼ inch long) pupate in late July and August. Newly emerged adults may be seen in September and October prior to their seeking overwintering sites.

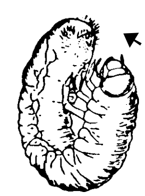
Determining Grub Damage

Various factors (other than grubs) can cause yellowed, brown or dead areas in lawns. Included are turf diseases, fertilizer burn, improper herbicide use, improper mowing techniques, environmental stresses (hot weather, moisture, soil type), feeding by above-ground insects and urine spots from dogs.

The presence of *Phyllophaga* and *Cyclocephala* grubs in lawns/turf generally goes unnoticed until late summer or early fall, at which time visual symptoms appear. There may be the appearance of an off-colored spot or area in a lawn. Upon closer inspection, the off-color might be due to wilted grass. Grass vigor might have been reduced and the stand thinned out. Or grass plants may actually be yellowed and brown, dead or dying. Individual plants might be easily pulled up. Moles and skunks might tear up sod while searching for grubs. Entire sections of sod might be rolled back with little effort, leaving the C-shaped grubs lying exposed on the soil surface.

Attacks by the grubs of black turfgrass ataenius generally are apparent by mid-July and September (generations 1 and 2, respectively). BTA damage is more frequently associated with bentgrass golf greens. Due to their small size (only 3⁄16 to ¼ inch in length) individual grubs do little damage. However, it is the cumulative feeding of many mature grubs that cause noticeable damage.

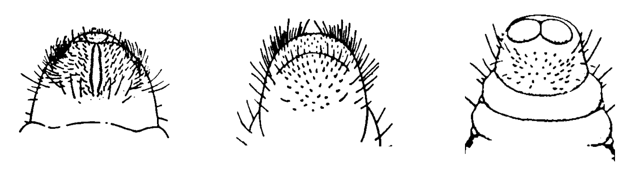
Damage by billbug weevils and their larvae/grubs becomes apparent by early to mid-July, but is more difficult to assess. Infested/damaged turf may take on a droughty appearance. Stems of individual grass plants must be inspected for the presence of the white and legless larvae, or for the existence of tunnels made by the larvae. Larvae may also "hide" in the thatch or soil around infested plants.



Bottom side of last segment bears the raster

Identification of grub species

Depending upon the situation and time of year, different individual grub species could be responsible for damage to turfgrass. Or, damage could be the cumulative effect of several species of grubs. The identification of scarab beetle grubs can be done (with relative ease) by using a 10X hand lens to examine the hairs and spines (raster pattern) on the ventral surface of the last abdominal segment.



May Beetle **Masked Chafer** **Black Turfgrass Ataenius**

In addition to setal hairs, MB/JB larvae possess two very distinct rows of short, thick spines (palidia) with a narrow bare area between the palidia. The anal slit (beyond the palidia) is somewhat V-shaped. Chafer larvae lack palidia (hence there is no "bare area"). Setal hairs cover the entire ventral surface of the last abdominal segment, and the anal slit of a chafer larva is distinctly crescent shaped. In addition to their small size, BTA larvae possess a pair of pad-like structures between their setae and anal slit.

Thresholds—Treatment thresholds are concepts designed to provide people a basis for withholding or initiating a corrective action against pests (in this instance, white grubs). However, the number of grubs per ft^2 is not a guaranteed, cut and dry factor upon which treatment applications can be made.

MB/JB grubs are larger than annual (chafer) grubs, and feed exclusively on grass root systems. The commonly cited treatment threshold for MB/JB grubs is two to five grubs/square foot.

Chafer (annual) grubs feed on organic material in the soil as well as on grass roots. Due to this varied diet and their smaller size, 10 to 12 grubs/square foot is a commonly cited threshold. The condition of the turf will modify thresholds. In certain studies, there was no visible damage in vigorously growing turf where populations of annual grubs exceeded 40/square foot, whereas only eight to 10 annual grubs/square foot caused visible damage in stressed turf.

As previously mentioned, BTA larvae are small (only 3⁄16 to ¼ inch long). An individual larvae may do but minimal damage to the root system of a grass plant. Rather, it would require higher numbers to cause noticeable damage. There is little information on BTA treatment thresholds, beyond observations that unstressed turf can tolerate 30 to 50 grubs/square foot, and that more than 200 grubs/square foot caused visible damage to turf. Treatments are usually timed to be applied soon after the cessation of observable BTA beetle flights. This should somewhat coincide with the presence of newly emerged BTA grubs.

Given the vagueness of billbug life histories, and if there is concern regarding billbug damage, insecticide treatments are timed with the appearance of adult billbugs. Treatments are directed at the adults before eggs can be deposited.

Factors to Consider When Implementing Grub Control Procedures

Bear in mind that grubs are in the soil, and that the insecticides used to control grubs are applied to the soil surface. Grubs are only killed after they have come into contact with insecticides that have moved into the soil.

Thatch

Thatch is a soil surface accumulation of organic matter (stems, rhizomes, stolons), dead grass and other organic debris. Thatch can be beneficial because it helps to somewhat maintain a soil's surface moisture. However, thatch can be detrimental, causing shallow rooting of grass (resulting in more rapid drying), and impeding the movement of water into the soil. Also, thatch tends to intercept/bind-up insecticides. Power raking, verti-slicing and core aeration are methods which help promote the movement of surface applied insecticides through the thatch layer down into the soil.

A final grass mowing (and removal of those grass clippings) just prior to treatment applications has a twofold objective. Especially if a spray treatment is applied, more insecticide will immediately fall to the soil surface as opposed to being intercepted by grass foliage. Granular applications similarly will have a more even distribution with less deflection as they are delivered to the soil surface. Thus, more insecticide will be immediately available for watering into the soil.

Moisture

Moisture considerations are essential for achieving grub control. Prewatering of turf has a tendency to force grubs to move up closer to the soil surface, thus bringing them into closer contact with insecticides which will be watered into the soil. Additionally, premoistened soil will more efficiently "accept" insecticides upon their being watered in after they have been applied to the soil surface. Product labels should be read to determine recommended amounts of water for post-treatment irrigation for those individual products. Post-treatment irrigations should be done a soon as possible in order to minimize insecticide degradation due to exposure to sunlight and high temperatures.

Application Equipment

In order to ensure the accurate application of insecticides, it is imperative that equipment be accurately calibrated. On the labels of granular insecticides, there are recommended settings for various brands of drop and rotary spreaders. Spreaders should be checked for their individual delivery rates on measured test strips (on a driveway, for instance). Despite the fact that several units of the same model came off of the same manufacturer's assembly line, there can be individual differences between them. Occasional recalibrations are recommended due to the fact that normal wear-and-tear can alter flow rates.

Similarly, sprayers used to apply liquid insecticide formulations require calibration. Sprayers should be checked for leaks. Worn nozzles should be replaced with new nozzles to ensure a uniform spray pattern and proper coverage.

Insecticide Considerations

Use of proper insecticide rates is critical for achieving grub control. Insecticide concentrations may vary between different products. It is the responsibility of the user to read the product label to ensure that proper rates are used. LABELED RATES ARE SUFFICIENT TO KILL GRUBS. Therefore, it is unnecessary (and also illegal) to apply insecticides ***over*** labeled rates. LESS THAN LABELED RATES MAY NOT BE SUFFICIENT TO KILL GRUBS. Although it is legal to apply insecticides ***under*** labeled rates, ***DO NOT*** cut back treatment dosage rates for the purpose of saving money by using less/purchasing less material.

Insecticide Applications

When applying insecticides, uniform coverage is as important as the previously mentioned factors. Spray treatments should be applied under calm conditions to reduce drift and ensure complete and even coverage. Granular insecticides can be applied under slightly breezy conditions because of the close proximity of the insecticide "drop point" in relation to the soil surface. Whether using spray products or granular formulations, a constant rate of speed is important to assure uniform coverage. Attempt to have a slight overlap when applying treatments to avoid areas/swaths/ passes receiving no insecticide.

When using spray formulations, do not make more solution than you intend to use. Apply solutions immediately after mixing because some insecticides degrade very rapidly after they are mixed with water. Read package labels to comply with compatibility statements. Some insecticides cannot be mixed with other pesticides. Some insecticides may be altered when in alkaline solutions. Some spray formulations require continual agitation to avoid their settling out in spray tanks.

Timing of Treatments

"Preventative/Insurance" Treatments

In situations where there is zero tolerance for grub damaged turf, a "wait-until-you-see-grub-damage" strategy may not be an option. Hence, preventative/insurance grubacide treatments may be applied. ***IDEALLY***, one should sample the turf in question to ascertain whether or not grubs are present, if their population levels are sufficient to cause damage, and what portion of the turf would require a preventative/insurance treatment. ***REALISTICALLY***, such sampling would be time consuming, as well as impractical for delineating areas to receive or not receive treatments. Thus, blanket treatments are automatically applied on a yearly basis.

Grounds maintenance personnel in charge of high visibility lawn/landscape grounds (eg. industrial complexes and parks, apartment complexes, churches, hospitals, etc.) rely on preventative treatments. Personnel responsible for maintaining athletic grounds (golf courses, football and baseball/softball fields) and municipal parks may similarly rely on preventative treatments. Given the volume and the expectations of their clientele, lawncare service personnel often rely on preventative treatments. Applicators may somewhat reduce the overall size of treatment areas by only automatically treating those areas with a running history of grub problems.

Assuming that Kansas is no different than other states (Nebraska, Oklahoma, Texas, Iowa, Missouri, Illinois, Indiana, Ohio, Pennsylvania, Kentucky), chafer (*Cyclocephala*) annual grubs are the major white grub pest of high maintenance turfgrass. Thus, the ideal time to apply "preventative/ insurance" treatments is 30 to 40 days after the peak flight of chafer beetles. At that time, an estimated 90 percent of the grubs (from eggs deposited by the chafers) will be in their 1st and 2nd instars—too small to have caused much damage, and easy to kill because of their small size.

Chafer flight activities (and peaks) vary depending on locations in Kansas. The earliest peaks have been recorded from southeast and south central Kansas (3rd to 4th week of June) while flight peaks in southwest and northwest Kansas have occurred a month later. After several more seasons of recording chafer activities (blacklight traps used to capture chafers), average flight patterns will be more accurately defined.

"Rescue" Treatments

It is difficult to predict where grub problems will appear from year to year, more/less whether they'll appear at all. Ideally, insecticides should only be applied when and where needed. Unfortunately, the "when and where needed" can only be determined after the appearance of a problem area, and the validation that grubs are indeed responsible for the problem area.

One option is to determine what type of grubs are responsible for the damage (see earlier discussion on grub identification). ***IF*** the grubs causing the damage are annual "chafer" grubs, people may choose to let the grubs run their course, and reseed early the next spring, knowing that the annual grubs essentially did their damage the previous season. ***IF*** the grubs causing the damage were those of MB/JB, people might choose (again) to let the grubs run their course, and reseed early the next spring, knowing that the three-year grubs had completed their second (and damaging) year of development. If, however, in the damaged area, there are (found) sufficient numbers of small first year *Phyllophaga* grubs which would do most of their development and damage the next year, a rescue treatment would be warranted.

A second option is to apply a rescue treatment to kill grubs, thus preventing further damage to the turf. Eliminating, or reducing grub populations to non-damaging levels might even allow damaged plants to recover and put on good growth for the remainder of the season.

Insecticides for Grub Control

Contact Insecticides

Insecticides are chemicals capable of killing insects. Insecticidal products contain an **active ingredient** (the actual toxicant). Active ingredients may be formulated in various ways. For instance, the active ingredient trichlorfon may be formulated as an SP (sprayable powder to be mixed with a water carrier) or a G (dry granular formulation). Furthermore, several companies may market *trichlorfon* under different trade names (eg. SP formulations include Dylox and Proxol; G formulations include Insecticide VI, White Grub and Sod Webworm Insecticide, Pronto, Dylox).

Further registration considerations pertain to end users. Some products may only be sold to personnel certified to purchase and use "restricted use products" (RUP's). Other products may be marketed for use by professional and commercial applicators. Lastly, there are products marketed for sale to and use by homeowners—these are the products available through normal retail outlets. A listing of insecticides for grub control can be found in the 1993 Extension Publication MF-1067, Annual White Grubs.

Stomach Poisons

Since the printing of the MF-1067, several new products containing the active ingredient *imidacloprid* have been made available for grub control. Products include several formulations of Merit for sale to and use by professional and commercial applicators. Imidacloprid products marketed towards homeowners include various granular products including Scotts Grubex, Knox Fertilizer's Gro-fine Grub Preventor with Merit, Lesco's Merit, Lebanon's Lebanon Fertilizer with Merit, Howard Johnson's Merit Granules and The Andersons Season Long Grub Control with Merit.

Unlike products recommended for "rescue" treatments which kill on contact, imidacloprid is a stomach poison used as a "preventative/insurance" treatment. Imidacloprid is taken into plants via their root systems and transported systemically throughout the plant via their vascular systems. Grubs ingest the poison contained in the root tissue upon which they feed. Given its season-long persistence, the timing of imidacloprid applications is less critical than that for contact poisons. Label instructions suggest that imidacloprid applications be applied from April through mid-August. For the control of annual grubs in Kansas, it is recommended that imidacloprid products be applied about the time of chafer flight peaks. That allows adequate time for the uptake of the product into the plant for when it is needed 30 to 40 days after chafer flight peaks.

Milky Spore Disease

The "milky spore disease" bacterial organism contained in various products is very specific for the white grubs of Japanese beetle, a species which is not considered a pest of turfgrass in Kansas. Although milky spore disease products may be marketed in Kansas, or may be promoted through seed catalogs or various trade magazines, *DO NOT PURCHASE MILKY SPORE DISEASE PRODUCTS WITH THE EXPECTATION THAT THEY WILL CONTROL WHITE GRUBS SPECIES FOUND IN KANSAS.*

Robert J. Bauernfeind
Extension Specialist, Horticultural Entomology
Department of Entomology
Kansas State University

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

Publications from Kansas State University are available on the World Wide Web at: http://www.oznet.ksu.edu

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

MF-755 May 1997

File code: Entomology–4 5-97—5M; 3-98—5M