Chapter 7

Invertebrate Pest Management

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The major invertebrate pests of rice in Louisiana are the rice water weevil and the rice stink bug. In addition, rice stem borers, rice seed midge, the rice leaf miner, the South American rice miner, and armyworms can be important rice pests. The panicle rice mite has recently been reported in rice fields in the state. The panicle rice mite is an arachnid and not an insect. Under heavy infestation levels, all of these pests can cause economic losses. This section contains information about the identification, life cycle, injury to rice and current scouting and management practices for these pests. The scouting and management recommendations are based on the best available information and will be modified as additional research is conducted. If you suspect insect injury in your field(s), contact your county agent for verification and help with insect management and damage assessment.

The preferred approach to controlling insect pests is by developing and following an integrated pest management plan. IPM is the integration of a variety of pest control strategies to effectively maintain a pest insect population at densities below the economic threshold for treatment. An effective integrated pest management plan relies on knowledge of the important pest species attacking the crop and utilization of a variety of control tactics. These tactics can include cultural practices, application of insecticides, biological control and breeding for resistance. The use of a variety of control strategies can result in a more effective and less expensive control program. Cultural control strategies include such practices as water and weed management. Resistant rice varieties may have the ability to tolerate insect infestations or may be more difficult for insects to feed and develop on. The use of insecticides with varying modes of action remains a vital component of the management program for most rice pests, but use of insecticides and miticides ideally should be limited because insecticides disrupt natural controls, can affect nontargets and are expensive. In addition, if an insecticide is used repeatedly within a season, insects can develop resistance to this product, making it ineffective for controlling insects. To avoid the development of resistance, it is important to use a variety of means to control insects. The products, which are discussed in this section, have varying levels of toxicity to crawfish and extreme caution should be used when controlling insects in rice fields which are near crawfish ponds.

The first step in effective integrated pest management is to properly identify the insect attacking the crop. Once the pest has been identified, it is important to develop an understanding of the life cycle of the pest and how it damages the crop. Finally, a well-thought-out plan must be developed to effectively manage the pest while continuing to utilize best management practices. For this reason, it is very important to be familiar with your field and what complex of diseases, insects and weeds exists in the particular agro-ecosystem.

Rice Water Weevil

Lissorhoptrus oryzophilus Kuschel

Description and Life Cycle

The rice water weevil is the most important early season insect pest of rice in Louisiana. Adults of this insect emerge from overwintering sites beginning in early April in southern Louisiana (later in northern Louisiana) and fly to rice fields, where they feed on young rice leaves. This form of injury is not economically important except under unusually heavy infestations or prolonged cold springs when rice grows slowly. Egg-laying commences when standing water is present in a field that is infested with adults. This condition is usually met immediately after a permanent flood is applied to a field. Young rice is preferred for oviposition. After eclosing from eggs, larvae feed under water on rice roots and pass through four larval instars and a pupal stage in approximately 30 days.

Fig. 7-1. Adult rice water weevil.

The rice water weevil is the most injurious insect pest in Louisiana rice production. Yield losses in excess of 25 percent can occur from severe infestations.

Rice water weevil adults are grayish-brown weevils (beetles) about 1/8 inch long with a dark brown V-shaped area on their backs (Fig. 7-1). Rice water weevils overwinter as adults in grass clumps and ground debris near rice fields and in wooded areas. A degree day model based on historical records of weevil emergence from overwintering was recently developed to predict adult emergence. According to this model, emergence from overwintering sites usually begins in the first 2 weeks of April in southwestern Louisiana. Adults emerging from overwintering will invade either unflooded or flooded rice fields and begin feeding on the leaves of rice plants. One key aspect of the biology of female rice water weevils is that females do not lay many eggs until fields are flooded. In unflooded fields, females may lay eggs in areas of fields that contain standing water, such as low spots, potholes or tractor tire tracks. Application of the permanent flood is a trigger for females to lay numerous eggs in leaf sheaths of rice plants. Females deposit white, elongate eggs in the leaf sheath at or below the waterline. In addition to laying eggs in rice, adult rice water weevils will oviposit (lay eggs) in most aquatic grasses and sedges, including barnyard grass, fall panicum, red rice, yellow nutsedge and broadleaf signalgrass. Thus, the presence of these weeds on levees surrounding rice fields may make the fields more susceptible to attack by rice water weevil adults.

White, legless, c-shaped larvae with small brown head capsules emerge from eggs in about 7 days. First instar larvae are about 1/32 inch long and feed in the leaf sheath for a short time before exiting the stem and falling through the water to the soil, where they burrow into the mud and begin feeding on the roots of rice plants (Fig. 7-2). The larvae continue to feed in or on the roots of rice plants and weeds in and around the field developing through four instars in about 27 days. Larvae increase in size with each succeeding molt. Fourth instar larvae are about 3/16 inch long. Larvae pupate in oval, watertight cocoons attached to the roots of rice and weed plants. The cocoons are covered with a compacted layer of mud and resemble small mud balls (Fig. 7-3). Peak larval density occurs 3 to 5 weeks after flooding.

Fig. 7-2. Rice water weevil larva (root maggot).

Adults emerge from the cocoons and are able to fly a short time after emerging and may return to overwintering sites or attack a different rice field. Newly emerged adult weevils usually do not re-infest the same field that they emerge from because they prefer to attack young plants. The life cycle from egg to adult takes about 30 days. The length of the life cycle is temperature-dependent, however, and can vary from 25 to 45 days in warm and cool weather, respectively. The number of generations per year varies with latitude. As many as three to four generations can occur in the southern rice-growing areas of Louisiana.

Fig. 7-3. Rice water weevil pupae.

Fewer generations occur in the northern rice-growing areas.

Injury

Adult rice water weevils feed on the upper surface of rice leaves, leaving narrow longitudinal scars that parallel the midrib (Fig. 7-4). Adult feeding can kill plants when large numbers of weevils attack very young rice, but this is rare and is usually localized along the field borders. Most economic damage is caused by larvae feeding in or on rice roots. Under heavy infestation, the root systems of affected plants can be severely damaged (Fig. 7-5). This feeding or root pruning results in reduction in the number of tillers and in the amount of aboveground plant material produced by the damaged plant. Root pruning may interfere with nutrient uptake by plants. Damage to roots ultimately can result in yield losses by decreasing panicle densities, numbers of grains per panicle, and grain weights. Plants with severely pruned root systems (Fig. 7-5) may turn yellow and appear to be N deficient. Infested stands are often thin in appearance and are more susceptible to lodging. At harvest, plants from heavily infested fields will be shorter than normal and have lower yields. Each larva found in a 4-inch (diameter) by 3-inch (deep) core sample is associated with an approximately 0.5 to 1.5 percent loss in yield. Yield losses tend to be higher in water-seeded rice fields. Losses are higher because these fields are usually flooded at an earlier stage of plant growth and thus are susceptible to oviposition and infestation by larvae earlier. Young rice plants are more susceptible to yield losses than are older plants with more established root systems.

Fig. 7-4. Rice water weevil feeding scars.

Fig.7-5. Heavily pruned roots (left) versus healthy roots (right).

All currently grown rice varieties are susceptible to the rice water weevil. Recent research, however, indicates some differences in varietal susceptibility. Medium-grain varieties appear to be more susceptible to infestation than long-grain varieties.

Scouting and Management Using Insecticides

A variety of cultural and chemical controls can control rice water weevils in rice fields. Cultural strategies include planting rice early in the season rather than late, delaying the application of permanent flood and perhaps managing weeds in and around rice fields. Insecticide management practices for the rice water weevil are evolving as pesticides are added to and removed from the integrated pest management plan. These insecticides fall into three general categories: (1) prophylactic seed treatments, (2) early post-flood adulticides and (3) larvicides. For the most current list of registered pesticides, please consult LSU AgCenter publications 1838 ("Pest Management Guide") and 2270 ("Rice Varieties and Management Tips").

Adult Monitoring and Management

Adulticides include liquid and granular formulations of insecticides. The timing of application of foliar and granular applications of insecticides to control adults is crucial, and more than one application may be required. Oviposition is possible when standing water is present in a field, i.e. when the field has been saturated by rainfall or flushing or when permanent flood has been established. In most fields, the majority of oviposition is likely to occur after the establishment of permanent flood. To apply an adulticide at the optimum time for adult weevil control, scout for adults immediately after application of the permanent flood. To scout for weevil adults, check at least five to 10 locations per field for the presence of adults or their feeding scars. Treat when adult weevils or their scars are observed and conditions for egg laying are favorable as described above. Applications made 24 hours before initiation of permanent flood also can be effective when adults are present in unflooded fields and feeding scars are visible. More than one application of insecticide may be required because residual activities of most insecticides appear to be less than 1 week and weevils will continue to invade the field. Be sure to follow label instructions for limitations on the number of insecticide applications allowed in one season and the preharvest interval. Once fields have been treated, begin sampling again after 7 days.

The goal of the use of adulticidal insecticides is to reduce larval infestations by killing adults before they lay eggs. Once eggs are laid in rice leaf sheaths or larvae are in the roots, these insecticides will not be effective. Applications of adulticides for the control of eggs or larvae are ineffective. Work on managing rice water weevil using foliar insecticides is ongoing. As insecticides are added to and removed from the market, recommendations for the management of the rice water weevil with foliar insecticides may change.

Applications of granular formulations of adulticides are an alternative method that minimizes insecticide drift into nontarget areas (such as crawfish ponds). These formulations will only control adults and are to be used in a manner identical to that described above for liquid formulations of adulticides. Similarly, pyrethroids impregnated on fertilizer will kill adults but will not kill larvae feeding on roots.

Larval Monitoring and Management

Larvicidal compounds are insecticides that target larval rice water weevils after they have established on the roots of rice plants. Carbofuran (Furadan) was a widely used example of this type of insecticide. Carbofuran is no longer registered for use in rice fields, but larvicidal insecticides may become available in the future. Larvicidal insecticides should be applied when densities of larvae exceed three larvae per core. The numbers of larvae on rice roots peak 3 to 5 weeks after application of permanent flood. At this time, many of the larvae will be large, and a significant amount of root pruning will have occurred. Larvicidal compounds should be applied before larval populations reach their peak. Early scouting of fields (10 to 20 days after flooding) can indicate if and when larvicidal treatment is required to prevent damaging infestations.

Fig. 7-7. Rice water weevil sampling bucket.

To scout for rice water weevil larvae, take the first larval count 10 to 14 days after establishment of the permanent flood in a drill-seeded system. At least six sites should be randomly selected in each field. At each site, remove a single core of plants and soil 4 inches in diameter and 3 inches deep and place it in a 10-quart bucket with a 40-mesh screen bottom (Fig. 7-7). Wash the soil from the plant roots through the screen bottom in the bucket by thoroughly stirring the soil in the water. Push the bucket up and down vigorously in the water several times. This forces water up through the screen bottom and helps to separate larvae from any plant debris remaining in the bucket. After a few seconds, larvae will float to the surface where they can be counted and removed. Repeat the washing procedure several times to make sure all larvae in a sample have been counted. If larvae are not found in any sample, sample the field again in five to 7 days. If the average number of larvae per sample is fewer than five, sample the field again 3 to 5 days later. If the average number of larvae per sample is five or more, the field should be treated with available larvacides or drained. Sampling should cease when the field has been treated or when plants have reached the 2-mm panicle stage of development.

Prophylactic Seed Treatments

With this method of control, the insecticide is applied directly to the seed. Depending on the type of insecticide, either larval or adult control may occur. Scouting is not required with this method since it is used as a preventative treatment. Effectiveness of prophylactic seed treatment, however, should be assessed by monitoring larval populations using the bucket sampling method described above.

Management Using Cultural Control

Three primary cultural control strategies can be used to augment use of insecticides to control rice water weevils. The first cultural control strategy is early planting of rice. Early planting has multiple advantages. The first advantage is that populations of rice water weevil adults infesting early planted fields are generally smaller than populations that infest later-planted fields. This is true because emergence from overwintering sites occurs over a long window of time and the population is not fully emerged when rice is planted early. More weevils are present in late-planted rice fields because they are infested by weevils both from overwintering sites and surrounding rice fields. The second advantage of early planting is the plants are infested at a later stage of development, when they are more tolerant to injury and less susceptible to oviposition. Adults prefer to oviposit on young rice plants.

Fig. 7-8. Rice stink bug adults.

Another cultural control strategy is draining fields to reduce rice water weevil larvae numbers. Soil must dry to the point of cracking. Draining fields is the only rice water weevil control method available for rice grown in rotation with crawfish. Draining fields for rice water weevil control requires careful planning so conflicts with weed, disease and fertilizer management programs can be avoided or minimized. Moreover, draining may not effectively kill larvae if rainfall prevents soil from drying until “cracking.”

Finally, delaying the application of permanent flood can substantially reduce the amount of damage caused to your crop by rice water weevils. On average, 10 percent greater yield losses were observed in early flooded rice plots compared with yield losses in field in which flooding was delayed by 2 weeks.

Rice Stink Bug

Oebalus pugnax (F.)

Description and Life Cycle

Adult rice stink bugs are shield-shaped, metallic-brown insects about 1/2 inch long (Fig. 7-8). Rice stink bugs overwinter as adults in grass clumps and ground cover. They emerge from overwintering sites in early spring and feed on grasses near rice fields before invading fields of maturing rice. They are particularly attracted to rice during the flowering stage. Adults live 30 to 40 days. Females lay masses of light green cylindrical eggs on the leaves, stems and panicles of rice plants. Eggs are laid in parallel rows with about 20 to 30 eggs per mass (Fig. 7-9). As they mature, eggs become black with a red tint. Immature stink bugs (nymphs) emerge from eggs in

Fig. 7-9. Rice stink bug hatchling (first instar nymphs).

Fig. 7-10. Rice stink bug nymph.

4 to 5 days in warm weather or as long as 11 days in cool weather. Nymphs develop through five instars in 15 to 28 days. Newly emerged nymphs are about 1/16 inch long, with a black head and antennae and a red abdomen with two black bars (Fig. 7-9). Nymphs increase in size with successive molts, and the color of later instars becomes tan-green (Fig. 7-10).

Injury

Nymphs and adults feed on the rice florets and suck the sap from developing rice grains. Feeding on florets and on grains in the early milk stage can reduce rough rice yields; however, most economic loss results from reductions in grain quality that results from stink bugs feeding on developing kernels. Pathogens enter the grain at the feeding spot and the pathogen infection and bug feeding together cause discolored and pecky rice kernels. Discolored or "pecky" rice kernels have lower grade and poor milling quality (Fig. 7-11). Both adult and nymph rice stink bugs feed on developing rice grains, but adults alone account for most economic losses in rice. Relationships between stink bugs and stink bug injury show a strong increase in percentage of pecky rice and a strong decrease in percentage of head yield with increasing numbers of adult stink bugs during the heading period.

Fig. 7-11. Pecky rice, stink bug damage.

Scouting and Management

Several natural enemies are important in reducing rice stink bug numbers in rice. Adults and nymphs are parasitized by the flies, *Beskia aelops* (Walker) and *Euthera tentatrix* Lav. Rice stink bug eggs are parasitized by the tiny wasps, *Oencyrtus anasae* (Ashm.) and *Telonomus podisi* (Ashm.). Management relies significantly on the activity of these naturally occurring biological control agents. Insecticidal control based on the results of field scouting is recommended when rice stink bugs escape from the control provided by natural enemies.

Rice fields should be sampled for stink bugs using a 15-inch diameter insect sweep net once each week beginning immediately after pollination and continuing until kernels harden. Do not sample fields at midday when stink bugs may be seeking shelter from the heat in the shade at or near the ground. Avoid sampling field borders, where stink bug numbers are often higher than in the field interiors. A sample consists of 10 consecutive 180 degree sweeps made while walking through the field. Hold the net so that the lower half of the opening is drawn through the foliage. After 10 successive sweeps, count the number of rice stink bug nymphs and adults. Normally, 10 samples of 10 sweeps each are made per field. Alternatively, 100 random sweeps may be taken per field. During the first 2 weeks of heading, fields averaging one or more rice stink bugs per three sweeps (30 or more per 100 sweeps) should be treated with an insecticide. After the first 2 weeks of heading, treat fields when an average one or more stink bugs per sweep (100 or more per 100 sweeps) is found. Do not treat fields within 2 weeks of harvest. Contact your parish LSU AgCenter extension agent for specific treatment recommendations. Please consult LSU AgCenter publications 1838 ("Pest Management

Guide") and 2270 ("Rice Varieties and Management Tips") for the most current list of pesticides registered to control rice stink bugs.

Stem Borers

The rice crop in Louisiana can be attacked by the European corn borer, rice stalk borer, sugarcane borer and Mexican rice borer. The sugarcane borer and the rice stalk borer are increasingly important pests of rice in Louisiana. In addition, the European corn borer has been reported affecting localized rice fields in northern parts of the state. A fourth stem borer, the Mexican rice borer, is present in Texas. Two adult males were trapped in Louisiana in 2008. It is likely this borer will become a pest of rice in Louisiana. Increased adoption of minimum tillage and several years of mild and dry winters contributed to the growth of borer populations. In addition, corn, sorghum and rice fields frequently lie in close proximity to one another and are sequentially planted in the northern half of the state. This creates an array of suitable host crops available for the development and expansion of borer populations throughout the growing season. Rice is susceptible to economic injury from panicle differentiation through the dough stage. Yield loss in rice results from plant tunneling, lodging, "deadhearts," "whiteheads" and "partial whiteheads."

The sugarcane borer and the rice stem borer are distributed statewide. Both species overwinter as last instar larvae in the stalks of rice and other weedy host plants. For this reason, the stubble should be plowed to remove the overwintering habitat. These larvae pupate in the spring, and adult moths emerge during early May.

Sugarcane Borer

Diatrea saccharalis (F.)

Description and Life Cycle

The sugarcane borer is the most aggressive and economically important stem borer that attacks rice in some central and northeastern Louisiana rice areas. Sugarcane borers overwinter as last instar larvae in the stalks of rice and other weedy plants. These larvae pupate in the spring, and adult moths emerge as early as May, mate and live on various hosts until rice stem

Fig. 7-12. Sugarcane borer adult.

Fig. 7-13. Sugarcane borer egg mass.

diameter is large enough to support larval feeding. Adult sugarcane borers are straw-colored moths about 3/4 inch long with a series of black dots, arranged in an inverted V-shape pattern, on the front wings (Fig. 7-12). Egg-laying on rice can begin as early as May, but economically damaging infestations generally do not occur until July through September. The flat, oval, cream-colored eggs are laid at night in clusters of two to 100 on the upper and lower leaf surfaces over 1 to 6 days (Fig. 7-13). Larvae emerge in 3 to 5 days, crawl down the leaf and bore into the plant stem. They move up and down the stem, feeding for 15 to 20 days before chewing an exit hole in the stem and pupating. Larvae are pale yellow-white in the summer, with a series of brown spots visible on the back (Fig. 7-14). Overwintering larvae are a deeper yellow and lack the brown spots. The lack of stripes

Fig. 7-14. Sugarcane borer larva.

Fig. 7-15. Sugarcane borer pupa.

Fig. 7-16. Rice stalk borer adult.

Fig. 7-17. Rice stalk borer larva.

distinguishes sugarcane borer larvae from rice stalk borer larvae, which have stripes in the winter and summer. Mature larvae are about 1 inch long and do not enclose themselves in a silken web before pupation. The pupae are brown, about 1 inch long and roughly cylindrical in shape, not smoothly tapered as are rice stalk borer pupae (Fig. 7-15). Overwintering sugarcane borer larvae are usually found closer to the plant crown than rice stalk borer larvae. The pupal stage lasts 7 to 10 days. There are three generations per year.

Rice Stalk Borer

Chilo plejedellus (Zink)

Description and Life Cycle

The rice stalk borer is a sporadic pest of rice in Louisiana. Rice stalk borers overwinter as last instar larvae in the stalks of rice and other host plants. Larvae pupate in the spring, and adult moths emerge in early to late June, mate and live on various hosts until rice stem diameter is large enough to support tunneling larvae. Adults are about 1 inch long with pale white fore and hind wings tinged on the edges with metallic gold scales. Front wings are peppered with small black dots (Fig. 7-16). Although egg laying may begin in late May, injurious infestations usually occur from August through September. Flat, oval, cream-colored eggs are laid in clusters of 20 to 30 on the upper and lower leaf surfaces. Eggs are laid at night over 1 to 6 days. Larvae emerge in 4 to 9 days and crawl down the leaf toward the plant stem. Larvae may feed for a short time on the inside of the leaf sheath before boring into the stem. Larvae of the rice stalk borer are pale yellow-white with two pairs of stripes running the entire length of the body and have a black head capsule (Fig. 7-17). These stripes distinguish rice stalk borer larvae from sugarcane borer larvae, which have no stripes. Mature larvae are about 1 inch long. Larvae move up and down the stem feeding for 24 to 30 days before moving to the first joint above the waterline, chewing an exit hole in the stem and constructing a silken web in which to pupate. Pupae are about 1 inch long, brown and smoothly tapered. The pupal stage lasts 7 to 10 days. There are two to three generations per year in rice.

Fig. 7-18. European corn borer adult.

Fig. 7-19. European corn borer larva.

European Corn Borer

Ostrinia nubilalis (Hübner)

Description and Life Cycle

The European corn borer may increase their population densities in corn and grain sorghum before migrating to rice fields. They have the potential for severe infestations in rice in central and northern latitudes of Louisiana. Adult European corn borers have delta-shaped wings with wavy dark lines running across them (Fig. 7-18). Adults infest the crop, and the lifecycle is very similar to sugarcane borer or rice stalk borer. Larvae of the European corn borer have a flesh-colored body that may have a grayish, greenish or pinkish tinge (Fig. 7-19). Spots run the length of the body and may be the same color as the body. It has two distinct light brown spots on the top of each abdominal segment and a distinctive mid-dorsal dark band. The head capsule is reddish to black.

Fig. 7-20. Mexican rice borer adult.

Fig. 7-21. Mexican rice borer larva.

Mexican Rice Borer

Eoreuma loftini (Dyar)

Description and Life Cycle

The Mexican rice borer is a devastating pest of sugarcane and a serious rice pest. Basic life cycle biology of the Mexican rice borer has been studied mainly on sugarcane, which has suffered from severe infestations in Texas. Mexican rice borer moths are light tan with delta-shaped wings (Fig. 7-20). Adult moths lay spherical, cream-colored eggs in groups of five to 100. Young larvae feed on the tissue inside the leaf sheath and quickly migrate from the oviposition site to bore into the rice stem after about one week of feeding. Larvae are honey-colored with two pairs of stripes running the length of the body (Fig. 7-21). Pupation takes place inside the rice stem after mature larvae have constructed an emergence window covered by one or two layers of plant tissue.

Fig. 7-22. Dead heart caused by Mexican rice borer.

Fig. 7-23. White head.

Injury

Injury to rice results from stem borer larvae feeding on plant tissue as they tunnel inside the stem. Injury is often first noticed when the youngest partially unfurled leaf of the plant begins to wither and die, resulting in a condition called dead-heart (Fig. 7-22). Later in the growing season, these rice stems are weakened and may lodge before harvest. Stem feeding that occurs during panicle development causes partial or complete sterility and results in the white-head condition (Fig. 7-23). The white, empty panicles are light in weight and stand upright.

Scouting and Management

Scouting for stem borers should start at green ring and must be intensified as plants get closer or reach early boot stages. Scouts should look for feeding lesions located on the inside surface of the leaf sheath (Fig. 7-24). These lesions are caused by the larva that feeds underneath the leaf sheath during the 2 or 3 days before it bores into stems. These feeding lesions are easily observed from the outside. Care must be taken, however, to avoid confusing these lesions with those caused by sheath blight. Peel off the leaf sheath to expose the feeding larva or to detect the presence of frass to ensure it is the stem borer and not sheath blight damage (Fig. 7-25). In addition, scouts must look for adults, egg masses or fresh feeding scars on the leaves.

Fig. 7-24. Borer damage at collar of leaf.

Fig. 7-25. Borer feeding on stem behind leaf sheath.

Unfortunately, by the time signs of field infestations (deadhearts, white-heads) are noted, it is usually too late to apply effective insecticides. For insecticides to be effective, application must coincide with larval emergence so small larvae are killed before they enter rice stalks. Once larvae enter the stalks, insecticides are not effective. Extensive scouting of rice fields is required to time insecticide applications properly. Scouting can be conducted for stem borer adults or egg masses. Eggs are laid over an extended period, however, and although some injury may be prevented, satisfactory control using insecticides is difficult and generally has not been successful. Please consult LSU AgCenter publications 1838 ("Pest Management Guide") and 2270 ("Rice Varieties and Management Tips") for the most current list of insecticides labeled to control borers in rice.

Biological control can sometimes be effective to control stem borers. Stem borer eggs and larvae are parasitized by the wasps, *Trichogramma minutum* Riley and *Agathis stigmaterus* (Cresson), respectively. It is believed these parasites play an important role in maintaining stem borer numbers below economic levels.

The most effective means for reducing overwintering borer populations is areawide destruction of crop residues after harvest. For this to be effective, plant stubble must be destroyed close to or below the soil surface. Crop rotation is not an effective tool for managing borers because the field-to-field mobility of moths allows them to infest newer areas. Pheromone traps are useful for monitoring the emergence and movement of the European corn borer and Mexican rice borer, but no pheromone is currently available to monitor sugarcane borer moths. Therefore, plant inspections still are needed to detect sugarcane borer infestations. Early planting is also important for rice grown near corn in areas with a history of borer infestations. Early planting allows those crops to mature before the beginning of moth migration from maturing corn fields. No economic thresholds have been developed for these insects in rice. Please consult your parish LSU AgCenter extension agent for the latest recommendations to control stem borers in rice.

Rice Seed Midge

Chironomus spp.

Description and Life Cycle

Adult midges can be seen in swarms over rice fields, levees, roadside ditches and other bodies of water (Fig. 7-26). Adult midges resemble small mosquitoes but lack the needlelike mouthparts and hold their forelegs up when resting. Elongate eggs are laid in strings, usually on the surface of open water. The strings are held together by a sticky material that forms a gelatinous coat around the eggs. After emerging, the larvae move to the soil surface, where they live in spaghetti-like tubes constructed from secreted silk, plant debris and algae. The larvae mature through four instars before pupating under water in the tubes (Fig. 7-27). The life cycle from egg to adult requires 10 to 15 days.

Fig. 7-26. Seed midge swarms.

Fig. 7-27. Midge tubes on soil under water.

Fig. 7-28. Seed midge damage.

Injury

Larvae injure rice by feeding on the embryo of germinating seeds (Fig. 7-28) or on the developing roots and seeds of very young seedlings. Midge injury occurs in water-seeded rice and is usually not important once seedlings are several inches tall. The potential for midge injury increases when fields are flooded far in advance of water-seeding rice. Water-seeded fields should be scouted for midge injury, checking for hollowed out seed within 5 to 7 days after seeding. Injury from the midge can be insignificant (not economically important) to very severe. Injury can also be localized, making damage assessment difficult. In some instances, whole fields may need to be replanted. In other instances, only parts of fields may require reseeding.

Scouting and Management

Rice seed midge is a problem only for rice seeds and seedlings in water-seeded fields. Midges are not a problem in rice more than 2 to 4 inches tall. Scout fields for midges and midge injury within 5 to 7 days after seeding. Repeat scouting at five- to seven-day intervals until rice seedlings are about 3 inches tall. Midge presence is indicated by larval tubes on the soil surface. There are many midge species, most of which do not attack rice, and the presence of midge tubes alone does not indicate the need to treat a given field.

Midge injury is indicated by the presence of chewing marks on the seed, roots and shoots and by the presence of hollow seeds (Fig. 7-28). If midge injury is present and plant stand has been reduced to fewer than 15 plants per square foot, treatment may be necessary.

Rice seed midge management includes chemical and cultural control options. One cultural management option is to drain fields to reduce numbers of midge larvae. Reseeding of heavily infested fields may be necessary. The potential for damaging levels of seed midge can be reduced or prevented by using recommended water and crop management practices. Holding water in rice fields for more than 2 to 3 days before seeding encourages the buildup of large midge numbers before seeding and should be avoided. Practices that encourage rapid seed germination and seedling growth, such as using presprouted seed and avoiding planting in cool weather, will help to speed rice through the vulnerable stage and reduce the chance for serious damage.

Rice Leaf Miner

Hydrellia griseola

Description and Life Cycle

Adult flies have clear wings on a metallic blue-green-to-gray thorax (Fig. 7-29). Less than 1/4 inch long, they can be seen flying close to the water and landing on rice leaves. They lay eggs singly on rice leaves. Eggs are laid on seedlings before application of permanent floodwater. After application of permanent flood, white eggs are laid singly on leaves that float on the floodwater. Transparent or cream-colored legless larvae emerge in 3 to 6 days and begin feeding between the layers of the rice leaf. Larvae become yellow to light green as they feed. Mature larvae are about 1/4 inch long (Fig. 7-30). The larvae feed for 5 to 12 days before pupating. Adults emerge after 5 to 9 days and live 2 to 4 months. Under ideal conditions, the life cycle can be completed in as few as 15 days. In cool weather, the life cycle can extend for more than one month.

Fig. 7-29. Adult leaf miner.

Fig. 7-30. Rice leaf miner larva.

Injury

The rice leaf miner is a sporadic problem in Louisiana. Rice is attacked in the early spring, and infestations usually occur on the upper side of levees

Fig. 7-31. Rice leaf miner damage in fields where water is more than 6 inches deep.

Fig. 7-32. Bumps in leaves indicate leaf miners.

Fig.7-33. Rice leaf miner pupa.

where water is deepest. Rice leaf miner is not usually a problem in water 4 to 6 inches deep. Problems are more severe in continuously flooded rice than in periodically flooded rice and when water is more than 6 inches deep. Larvae tunnel between the layers of the leaf, attacking and killing leaves closest to the water. Larvae move up the plant, killing additional leaves, and under heavy infestations the entire plant may die, reducing stands severely (Fig. 7-31). In Louisiana, rice leaf miner seems to attack fields in the same vicinity year after year.

Scouting and Management

Scout fields for rice leaf miners by walking through flooded rice fields and gently drawing the leaves of rice plants between the thumb and forefinger. Bumps in the leaves indicate the presence of leaf miner larvae or pupae (Fig. 7-32). The larvae or pupae can be found by separating the layers of the leaf (Fig. 7-33). If leaf miners are present and plant numbers are reduced to less than 15 per square foot, treatment is necessary. Rice leaf miner management involves cultural control or insecticide application, perhaps both. Maintaining water depth at 4 to 6 inches will usually prevent problems with rice leaf miner. If leaf miners are present, lowering the water level in rice fields so that rice leaves can stand up out of the water also will help to prevent injury. Contact your parish LSU AgCenter extension agent for specific control recommendations.

South American Rice Miner

Hydrellia wirthi Korytkowski

Description and Life Cycle

The South American rice miner (SARM) is an invasive insect pest of rice in the United States. It is a close relative of the rice leaf miner, which is widely distributed across U.S. rice fields. Current SARM distribution places this insect across the most important rice areas of Louisiana and Texas. SARM adults are small, gray to dark gray flies of about 1/10 inch in length. SARM eggs are elongated, ribbed, white or creamy-white and approximately 0.5 mm long and 0.2 mm wide (Fig. 7-34). Eggs are laid singly on the upper surface of rice leaves, near the leaf margins. Larvae are small, white or yellowish legless maggots of approximately 1/4 inch in length (Fig. 7-35). The puparium is elongate, tapered at both ends and brown (Fig. 7-36).

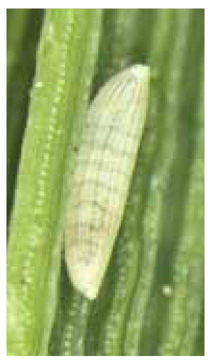

Fig. 7-34. SARM egg.

Fig. 7-35. SARM maggot.

Fig. 7-36. SARM pupa.

Injury

Economic injury to rice plants tends to occur in young rice from emergence until the tillering stages, particularly in late-planted fields (planted in May and June in central and southwest Louisiana). Injury is caused by the larva or maggot, which causes large, elongated lesions along the margins of emerging leaves. The maggot mines the leaf or rasps the leaf surface before the leaf unfurls. As the leaf expands, yellow damaged areas are more visible (Fig. 7-37). Affected young leaves usually break off or display a ragged appearance. The maggot continues to feed on the whorl tissue and enters the stem of developing plants. Because of the damage to the whorl of rice plants, the SARM also is termed “whorl maggot” by several rice producers. It is common to find more

Fig. 7-37. SARM or "whorl maggot" damage.

than one maggot in a single stem. Affected seedling plants are killed or their growth is severely retarded. Pupation occurs inside the affected stem, near the collar of the leaf. Field damage is distributed in large patches either in the center or along the margins of the field (Fig. 7-38).

Scouting and Management

Scout young rice for large, elongated lesions along the margins of emerging leaves. If you suspect a SARM infestation, contact your parish LSU AgCenter extension agent for damage assessment and to obtain the latest developments on this insect pest.

Fig. 7-38. SARM field damage.

Fig. 7-39. Chinch bugs on rice.

Chinch Bug

Blissus leucopterus leucopterus (Say)

Description and Life Cycle

Chinch bugs overwinter as adults in grass clumps, leaf litter and other protected areas, emerging in early to mid-spring to feed and mate on grass hosts, including small grains such as wheat, rye, oats and barley. Adults are small, black insects about 1/6 inch long, with white front wings (Fig. 7-39). Each wing has a triangular black spot near the outer wing margin. Adults lay white, elongated eggs 1/24 inch long behind the lower leaf sheaths or in the soil near the root. Eggs turn red as they mature and larvae emerge in 7 to 10 days. There are five nymphal instars. Early instar nymphs are red with a yellow band on the front part of the abdomen (Fig. 7-40). Last instar nymphs are black and gray with a conspicuous white spot on the back (Fig. 7-41). The

Fig. 7-40. Early instar nymph of Chinch bug on rice.

Fig. 7-41. Late instar nymphs and adult chinch bugs.

life cycle from egg to adult takes 30 to 40 days, and adults may live 2 to 3 weeks.

Injury

Chinch bugs are a sporadic pest of rice in Louisiana. They tend to be more of a problem in drill-seeded rice because of the delayed application of permanent flood. Economic injury to rice generally occurs when favorable weather conditions and production practices allow chinch bugs to build in corn, sorghum and wheat fields. As these crops mature and are harvested, large numbers of chinch bugs may move to young plants in nearby rice fields. Serious economic losses have resulted from chinch bug infestations in north and south Louisiana. The trend toward increasing acreage of small grains increases the potential for chinch bug problems. Chinch bug injury results when adults and nymphs feed on the leaves and stems of rice plants. Feeding on young seedlings causes leaves and stems to turn light brown (Fig. 7-42). High numbers of chinch bugs can kill young plants, severely reducing plant stands.

Scouting and Management

Check unflooded rice near small grain fields or recently cut grassy areas every 3 to 5 days from seedling emergence until application of permanent flood. Check foliage in rice fields for chinch bugs. During warm weather, chinch bugs will hide in cracks at the soil line. Young nymphs can be found feeding on roots. Thresholds for chinch bugs in rice are not available. If high numbers of chinch bugs are present and plant stands are being reduced, the field should be treated. Cultural and chemical control methods are available. Cultural control consists of flooding infested fields to kill chinch bugs or to force them to move onto rice foliage where they can be treated with an insecticide. This tactic requires that levees be in place and that rice plants be sufficiently large to withstand a flood. Cultural control may be more expensive than chemical control. Contact your parish LSU AgCenter extension agent for specific recommendations if chemical control is needed.

Fig. 7-42. Firing of lower leaves from chinch bugs.

Fall Armyworm

Spodoptera frugiperda (J. E. Smith)

Description and Life Cycle

The fall armyworm feeds on most grasses found in and around rice fields. It is also a serious pest of corn and pasture grasses. Since rice is not its preferred host, the fall armyworm is only an occasional pest on rice. Adult moths are about 1 inch long with gray-brown sculptured front wings and whitish hind wings (Fig. 7-43). The front wings of male moths have a white bar near the wing tip. This bar is absent in female moths. Females lay masses of 50 to several hundred whitish eggs on the leaves of rice and other grasses in and around rice fields. Egg masses are covered with moth scales and appear fuzzy. The larvae emerge in 2 to 10 days, depending on temperature, and begin feeding on rice plants. They vary from light green to brown to black but have distinctive white stripes along the side and back of the body

Fig. 7-43. Fall armyworm adult.

Fig. 7-44. Fall armyworm larvae.

Fig. 7-45. Mature larvae have a distinctive inverted "Y" on the head capsule.

(Fig. 7-44). Larvae feed for 2 to 3 weeks, developing through four instars. Mature larvae are about 1 inch long and have a distinctive inverted "Y" on the head (Fig. 7-45). Mature larvae prepare a cocoon and pupate in the soil or decomposing plant material. Moths emerge in 10 to 15 days, mate and disperse widely before laying eggs on new plants. At least four generations per year occur in Louisiana.

Injury

Fall armyworm larvae feed on the leaves of young rice plants, destroying large amounts of tissue. When large numbers of armyworms are present, seedlings can be pruned to the ground, resulting in severe stand loss. Fall armyworm infestations generally occur along field borders, levees and in high areas of fields where larvae escape drowning. The most injurious infestations occur in fields of seedling rice that are too young to flood. Larvae from the first overwintering generation, occurring in early spring, are the most injurious. Infestations later in the season may cause feeding injury to rice panicles, although this is rare.

Scouting and Management

After germination of seedlings, scout fields weekly for larvae on plants. Sample plants every 10 feet along a line across the field, and repeat this process in a second and third area of the field. Treat when there is an average of one armyworm per two plants. Fall armyworm management consists of cultural, chemical and biological control. Naturally occurring populations of parasitic wasps and pathogenic microorganisms frequently reduce armyworm numbers below damaging levels. Since adults lay eggs on grasses in and around rice fields, larval infestations can be reduced by effective management of grasses. When fall armyworm numbers reach threshold levels, cultural or chemical control is needed. Cultural control consists of flooding infested fields for a few hours to kill fall armyworm larvae. This requires that levees be in place and that rice plants be large enough to withstand a flood. Cultural control may be more expensive than chemical control. Contact your parish LSU AgCenter extension agent for specific recommendations if chemical control is needed.

Panicle Rice Mite

Steneotarsonemus spinki Smiley

Description and Life Cycle

The panicle rice mite (PRM), *Steneotarsonemus spinki* Smiley, has recently been reported in the continental United States. The panicle rice mite is a pest of commercial rice production in Asia, India, Central America and the Caribbean. Significant crop losses have been attributed to this mite, particularly in the presence of sheath rot and bacterial panicle blight. The adult PRM are clear to straw-colored, oval and

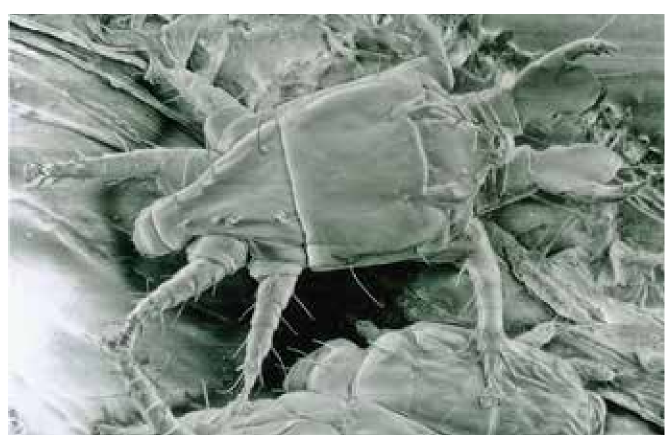

Fig. 7-46. Adult panicle rice mite. (USDA photo)

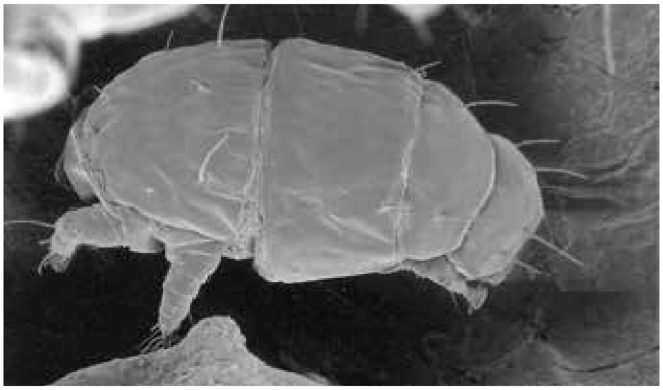

Fig. 7-47. Immature panicle rice mite. (USDA Photo)

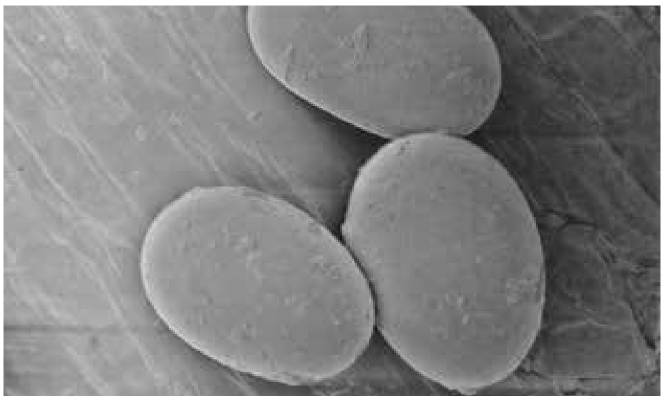

Fig. 7-48. Panicle rice mite eggs. (USDA Photo)

approximately 1/100 of an inch long (Fig. 7-46). Immature PRM are clear to straw-colored and about ½ the size of adults (Fig. 7-47). Eggs are clear in color, oval-shaped and about one-third the size of adults (Fig. 7-48). An entire lifecycle can be completed in 7 to 21 days, depending on temperature.

Injury

The PRM injures rice plants both directly by feeding on cells of rice leaves, stems and kernels and indirectly by vectoring and/or facilitating the establishment of fungal, bacterial and possibly viral pathogens. Feeding damage can result in a sterile grain syndrome, which is described as a loose and brownish flag leaf sheath, a twisted panicle neck, impaired grain development with empty or partially filled grains with brown spots and panicles standing erect. Extensive reports from important rice-producing areas of the world attribute yield losses to the interaction between the PRM and *Burkholderia glumae*, the causal agent of bacterial panicle blight, and the fungus *Sarocladium oryzae*, which is the causal agent of sheath rot and one of the many important contributors to kernel spotting ("pecky" rice). Injury to de-

Fig. 7-49. Panicle rice mite injury.

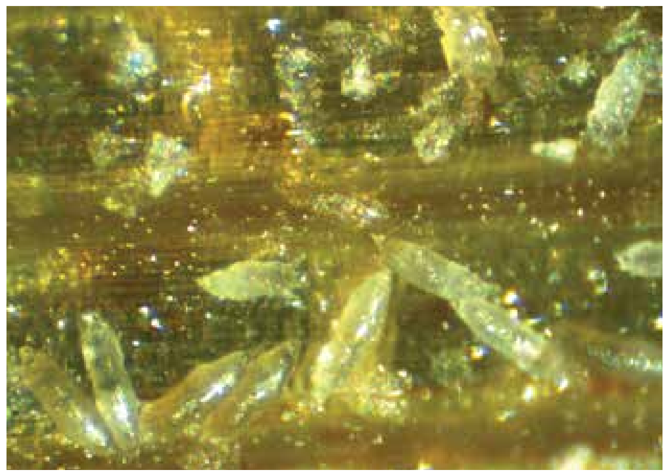

Fig. 7-50. Panicle rice mites on sheath.

veloping grains leads to panicle sterility. Malformed grains sometimes show a curved appearance, often referred to as "parrot-beak" symptom. Damage to the leaf sheath reduces the photosynthetic potential of the plant and can have a negative effect on fertility. The heaviest and most economically damaging populations of PRM are often reported during the second or ratoon crop.

Scouting and Management

Scout for PRM by looking for the symptoms associated with bacterial panicle blight and sheath rot. In affected plants, look for a cinnamon, yellow or chocolate-brown discolored lesion on the leaf sheath that does not have a distinct edge (Fig. 7-49). To find mites, pull the leaf sheath back and examine the underside of the leaf sheath with a minimum 20X hand-lens. The PRM feeds on the plant material on the inside of the flag leaf sheath (Fig. 7-50). Once a new leaf begins to develop, a female PRM will move to the new leaf sheath, produce male offspring and establish a new feeding lesion. Thus, damage will often be observed on interior sheaths when the outer sheath is removed. This continues until the PRM reaches the leaf nearest the stem. They also feed on developing panicles from the boot stage to the milk stage of heading.

Contact your parish LSU AgCenter extension agent if you suspect that this mite may be present in your field and to obtain the latest information on this pest.

Colaspis

Colaspis brunnea and *Colaspis louisianae*

There are two species of colaspis that can be found in Louisiana rice: *Colaspis brunnae* and *Colaspis louisianae*. This pest can be found damaging fields of dry-seeded rice in a soybean-rice rotation. In Arkansas, damage from this pest is typically more severe in light textured soils. The damage is often concentrated in high spots in the field.

Description and Life Cycle

Colaspis will complete a single generation in soybeans and lespedeza. This is why they are often called Lespedeza worms. The larvae of colaspis will overwinter in the soil (Fig. 7-51). When rice, or another crop, is planted into a field that is infested with colaspis larvae, the larvae will begin to feed on the roots of the plant. Feeding on fine root hair may result in plant death. The larvae will then pupate (Fig. 7-52) and emerge as adults. Adults are oval in shape and about ¼ inch in length. They are a light golden color with white/gold stripes down the back and long antennae (Fig. 7-53). Adults will not lay eggs on rice, but will most likely travel to a nearby soybean field. It is common to find a clumped distribution of larvae in the soil and patches of stand loss (Fig. 7-54).

Fig. 7-51. Colaspis larva.

Fig. 7-52. Colaspis pupa.

Fig. 7-53. Colaspis adult.

Fig. 7-54. Rice field damage caused by colaspis larvae feeding on roots.

Scouting

To scout for this pest, locate plants that are stunted, dying and surrounded by declining plants. The plants will often appear to be withering and drying. Dig around the base of the plants, carefully peeling back the soil and looking for white grubs with brown heads that are a little larger than RWW larvae. You may also find pupae or adults in the soil.

Management

We do not have any insecticides labeled to control colaspis in Louisiana rice. The only thing we can recommend is to apply permanent flood as soon as possible. These insects are not aquatic and so they cannot survive in a permanent flood. This is why they are not reported as a problem in water-seeded rice.

Amaurochrous dubius
(formerly called Black Rice Bugs)

Both nymphs (Fig. 7-55) and adults (Fig. 7-56) cause damage by feeding with their piercing mouthparts. Feeding on the leaf sheath can cause dead or dying leaves, usually lower leaves, in otherwise healthy rice. The damaged leaves will often have a yellow, orange or red coloration (Fig. 7-57). Adults are related to the more traditional stink bugs as evidence by their odor when disturbed. These bugs are sometimes called turtle bugs. Neither the term Black Rice Bug nor Turtle Bug is the correct common name for this insect.

Fig. 7-55. Amaurochrous dubius nymph

Fig. 7-56. Amaurochrous dubius adult

Fig. 7-57. Amaurochrous dubius rice damage.

Fig. 7-58. Southern green stinkbug.

Fig. 7-59. Billbug grub.

Fig. 7-60. Billbug adults.

Fig. 7-61. Skipper adult.

Fig. 7-62. Skipper larva.

Other Insect Pests of Rice

Several other insects may occasionally attack rice in Louisiana. They include the southern green stink bug, *Nezara viridula* (L.) (Fig. 7-58), rice levee bill bug (Figs. 7-59 and 7-60), several grasshopper species and the larvae of several species of skippers (Figs. 7-61 and 62) and tiger moths. The numbers of these insects in rice fields are usually below levels justifying treatment, but they may increase rapidly under favorable conditions and yield losses can occur. Contact your parish LSU AgCenter extension agent for specific treatment recommendations.

Stored Grain Pests of Rice

Rice that is stored as seed or grain for consumption may be susceptible to attack by grain pests. These include beetles and moths. The most important pests of stored rice in Louisiana are the lesser grain borer (Fig. 7-63), the rice weevil (Fig. 7-64), the Angoumois grain moth (Fig. 7-65) and the Indian meal moth (Fig. 7-66). The lesser grain borer and the Angoumois grain moth larva bore into the kernels and destroy them whereas the rice weevil attacks those kernels with broken hulls. Other insects of lesser importance that may be found in rice bins include the saw-toothed grain beetle, the red flour beetle, flat grain beetle, cigarette beetle and the Mediterranean flour moth. These insects infest secondarily, feeding mostly on broken kernels, flour and on the frass of the lesser grain borer and the other insects that bore directly into whole kernels.

The first step in control of stored grain pests is to thoroughly clean storage bins. Good sanitation may prevent infestation of stored grain and decrease cost by preventing the need for fumigants. Both old and new bins should be prepared in the same manner. The bins should be thoroughly cleaned at least 2 weeks prior to storing grain. To properly clean bins, all old grain, trash and debris should be removed from within the storage bin and fumigated or burned. Brush away all debris (including spider webs) attached to the sides of the bin and wash the inside and outside surfaces of the bin with a high-pressure hose. Be sure to remove all grain from cracks and crevices. Any grain left in the cracks can increase your chance of infestation by stored grain pests.

After the bin is clean, it should be treated with an insecticide. Spray the bin inside and out (including overhead) with a labeled insecticide. Consult LSU AgCenter publication 1838, "Insect Pest Management Guide," for currently labeled insecticides for treating bins. Treat the wall surfaces and any cracks and crevices. Be sure to follow all label instructions when applying any insecticides. The pH of the tank water should be adjusted using a buffering adjuvant as necessary. For best results, the tank water should be slightly acidic with a pH of 5.5 to 6.5. You may want to consider applying a grain protectant to rice that will be stored. This action may prevent early infestation of stored grain. Grain must be at the proper moisture content for storage prior to application. DO NOT apply the grain protectant before high-temperature drying. If rice is already infested with a grain pest (at the time of harvest), it must be fumigated before storage. If your rice becomes infested with a stored grain pest while it is being stored in a bin, fumigation is the only option of treatment. Check publication 1838, "Insect Pest Management Guide," for the latest fumigation registrations. Be sure to follow label instructions for application method, rate and insects to treat. The bin must be closed a minimum of 4 days during fumigation.

Fig. 7-63. Lesser grain borer. (Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Fig. 7-64. Rice weevil. (Joseph Berger, Bugwood.org)

Fig. 7-65. Angumois grain moth. (Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Fig. 7-66. Indian meal moth. (Joseph Berger, Bugwood.org)