Chapter

12

Insect Management in Rice

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Compared to other crops grown in the Mid-South, there are only a few insects considered to be important pests of rice. Insects may damage rice by feeding on the leaves, stems, roots or grain. This section contains a brief description of the pests of rice, the injury they cause, scouting procedures and control methods for the major and minor insect pests of rice. We have learned in recent years the impact that broad spectrum insecticide applications can have in disrupting the natural balance of insects in rice and recommend that foliar insecticide applications be considered only when insect numbers reach levels that may reduce rice yield and/or quality. Be reminded that many crop production practices directly influence insect populations. Use of best management practices can reduce insect pests and the need for insecticide applications. Some factors that can impact rice insect pest populations include:

Planting date can influence many insect pests. Very early- and late-planted rice is most vulnerable to rice stink bug infestation. If you plant earlier than surrounding growers, rice stink bugs will be attracted to the first fields that are heading, and numbers can be extremely high until surrounding fields begin to head and rice stink bugs disperse. The same is true for late-planted rice. If all the rice around you is mature and being harvested and you still have green rice, stink bugs will be attracted in high numbers to these fields. Late-planted rice is also susceptible to armyworms and stalk borers.

Rice stand has a significant impact on rice water weevils. Thinner stands usually have larger numbers of rice water weevil and subsequent damage than adequate stands. Thin stands are often associated with weed problems, particularly grass, which can attract rice stink bug. Thin stands can often be associated with chinch bug problems as well.

Weed control can also impact insect pest numbers. Grass weeds, particularly barnyardgrass, in and around rice fields are very attractive to rice stink bugs. Often rice stink bugs will stage around fields with heading barnyardgrass, as well as other grasses, and build up in number before moving into rice when it begins to head. Rice fields near pastures, sorghum, CRP, etc., are more susceptible to rice stink bug problems. Examination of these areas by rice fields should be made as an indication of potential problems before rice begins to head.

Fertilization can also play a role in insect problems. Overfertilization can attract insects, and growers can reduce exposure to insects as well as disease and lodging problems by proper fertilization.

Water management can be very helpful in controlling insect pests. One way to control armyworms and chinch bugs is with timely flushing or flooding of the field. Flooded rice is much less prone to armyworm damage. Flushing a field will push chinch bugs out of the soil and up to the plant where they can be reached with a foliar insecticide application. Rice water weevils can be controlled by pulling the flood and allowing the ground to crack, as the larvae must have saturated soil to survive. This method of control for weevils can be very effective.

These cultural practices can help growers manage insect pests, reduce the need for supplemental insecticides and help increase profitability.

Major Pests of Rice

Insects that are considered pests in rice include aboveground plant feeders, stem borers, stem and root feeders and panicle feeders. Figure 12-1 provides an overview of the growth stages when specific insects are likely to damage drill-seeded rice. In contrast, water-seeded rice presents a slightly different scenario, particularly during the early part of the season (Figure 12-2). It is important to understand when the plant is most heavily affected to ensure proper timing for scouting and control measures.

Grape Colaspis or Lespedeza Worm [*Colaspis brunnea* (F.)]

Description

Adults are golden-brown beetles about 3⁄16 inch in length but oval in overall shape (Photo 12-1). Larvae are white grubs about ¼ inch in length with a brown head and cervical shield (Photo 12-2). Larvae have three pairs of thoracic legs plus fleshy appendages bearing a few apical hairs on the abdominal segments. Grape colaspis larvae can be distinguished from other white grubs with use of a 10X lens by identification

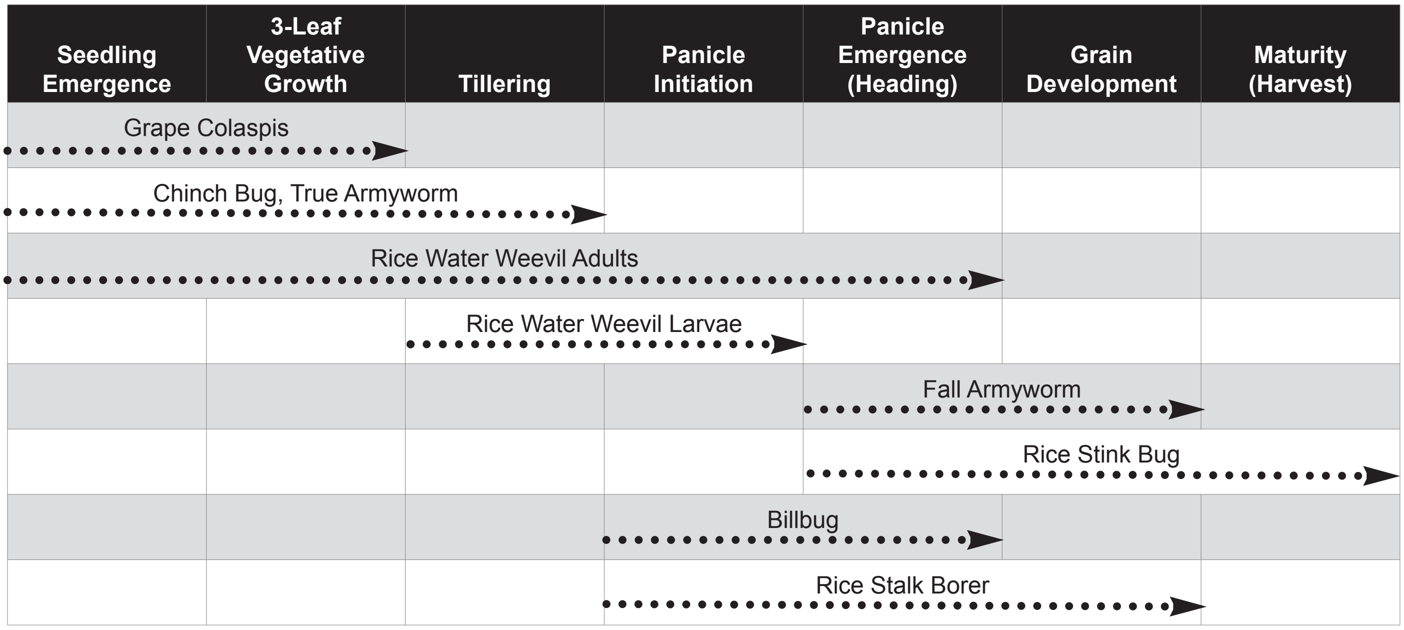

Figure 12-1. Insects impacting drill-seeded rice and general growth stages affected.

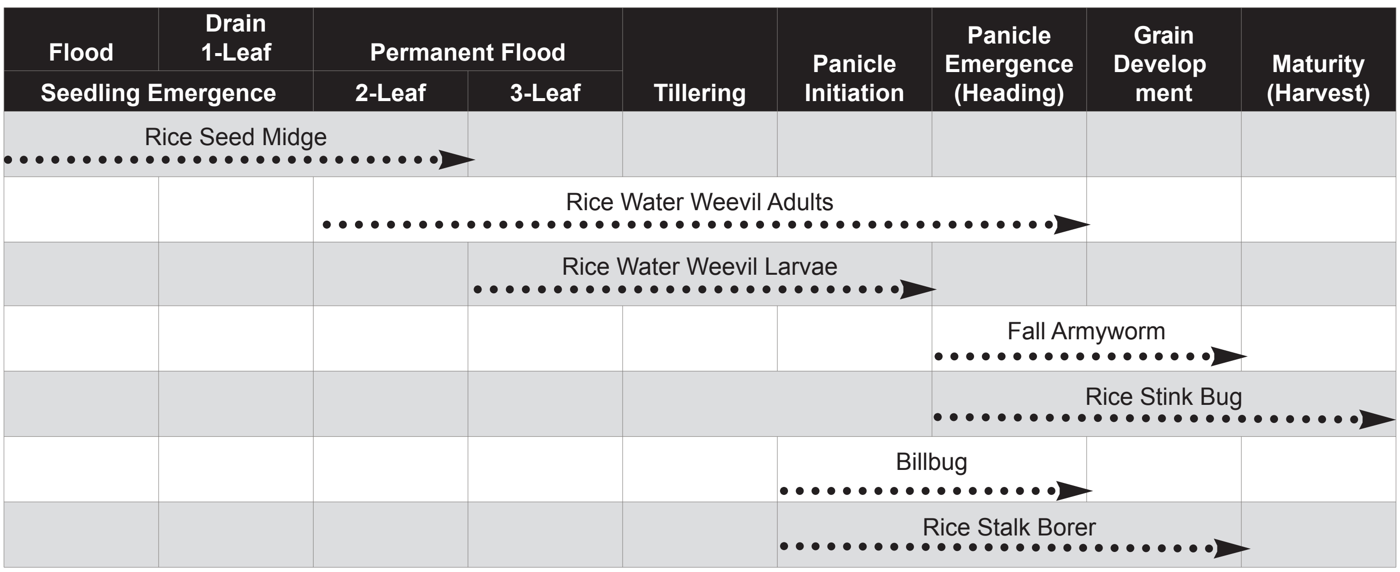

Figure 12-2. Insects impacting water-seeded rice and growth stages affected.

of the ventral fleshy projections on the abdominal segments. Pupae construct earthen cells in the soil.

Photo 12-1. Adult grape colaspis beetle.

Photo 12-2. Grape colaspis larvae (lespedeza worm).

Life Cycle as Related to Rice and Soybean

Legumes such as soybeans are the primary host for grape colaspis. They are often found in corn and other weedy legume species. Adults lay eggs in legumes and corn. The larvae (third through eighth stage) overwinter deep in the soil. In the spring, larvae move upwards in the soil profile seeking roots and underground stems on which to feed. Because legumes and corn are often rotated with rice in the Mid-South, grape colaspis larvae often have only rice on which to feed. Larvae usually complete development on rice. However, rice is not a primary host that adult grape colaspis uses for egg laying.

Damage and Symptoms

Larvae and adults are commonly found in legumes such as soybean, with multiple generations per year common. The last generation of larvae descends deep into the soil to overwinter. In the spring, grape colaspis larvae move up toward the soil surface and resume feeding. Because leguminous crops are rotated with rice, larvae often only have rice on which to feed.

When overwintered larvae reach the root zone, feeding occurs on the seedling rice roots and the portion of the plant stem (mesocotyl) between the germinated seed and the soil surface. Larvae girdle the below-ground stem until only an unsevered threadlike portion remains (Photo 12-3). Girdled seedlings become yellowed, stunted and wilted. Under stress, many damaged plants will die. These symptoms resemble and, therefore, are easily confused with seedling disease and salinity injury.

Photo 12-3. Damage by grape colaspis larvae on stem between seed and base of plant (right) compared to normal (left).

Plants with less than two leaves are very susceptible to damage by grape colaspis. Older plants may also be injured, but more damage is necessary for these plants to show above-ground symptoms. Some larvae complete development on rice, pupate and adults emerge later in the spring. In general, grasses, including rice, are not host plants for adults and are not used for egg laying. Grape colaspis injury occurs only to dry-seeded rice.

When rice follows soybean, low to moderate densities of grape colaspis are often found. Areas of damage are randomly distributed and characterized by 6- to 10-inch row sections with plants showing damage symptoms. Silt and sandy loam soils will have more problems with grape colaspis than heavy clay soils. Increased use of reduced tillage rice production systems on silt and sandy loams has shown a higher frequency of problems with grape colaspis.

Scouting and Management. No formal sampling plan is available to scout for grape colaspis. Often, below-ground damage is completed before above-ground symptoms are noticed. If grape colaspis damage is suspected, examine the seedlings, roots and soil from a 2- to 4-inch-deep soil sample. Carefully inspect plants for evidence of grape colaspis damage. Grape colaspis injury has historically been a problem in rice on silt loam soils. However, clay soils are rarely affected. Confirmation of grape colaspis presence or underground injury symptoms is needed because above-ground symptoms may resemble seedling diseases or soil problems (high salt or pH).

Insecticides. Insecticide seed treatments including Cruiser® 5FS (Syngenta Crop Protection) and NipsIt INSIDE (Valent Corporation) have been tested extensively in Arkansas for control of grape colaspis. Based on these studies, we have concluded that Cruiser and NipsIt INSIDE are recommended for grape colaspis.

Foliar applications of pyrethroids such as Mustang Max and Karate followed by a rain or flushed in may aid in suppressing grape colaspis. The application should be made with preemergence herbicide up to 1- to 2-leaf rice. Fields should be flushed within 2 to 3 days after application to incorporate the insecticide in the rice root zone for maximum activity. Recent studies have shown this approach to be largely ineffective.

Cultural Control. Methods to reduce grape colaspis damage in dry-seeded rice are (1) deep spring tillage and (2) flush fields and hold water for at least 48 hours. Deep tillage (disking) in early fall and late spring tends to disrupt larval cells and kill some larvae. Recent trends towards conservation tillage in rice and soybeans are coincident with a higher frequency of problems with grape colaspis.

Fields that are actively encountering a grape colaspis problem can be "temporarily flooded" (flushed). Flushing may kill some small larvae and dislodge others. The primary purpose of flushing is to keep the soil moist so that some moderately and slightly damaged plants can replace roots and avoid water stress. It is recommended that water be held for a minimum of 48 hours. An application of fertilizer, such as urea, ammonium sulfate or DAP, is often applied to fields ahead of the flush to aid in recovery. While the plants are stressed, the fertilizer may not be of much assistance. However, as the plants begin to recover, uptake of the fertilizer will enhance seedling growth so that the plant will increase tolerance to feeding from grape colaspis.

Management Key

In areas with a history of grape colaspis, we strongly recommend the use of an insecticide seed treatment.

Rice Water Weevil [*Lissorhoptrus oryzophilus* (Kushel)]

Description

Adult rice water weevils are snout beetles about ⅛ inch long. When dry, the adults are grayish-brown with black markings on the back but are uniformly dark brown when wet (Photos 12-4 and 12-5). Eggs are placed in the leaf sheath and are fragile, pearly-white, cylindrical with rounded ends and about 1⁄32 inch in length.

The larvae, sometimes called "root maggots," are white, legless, range in size from 1⁄32 to 3⁄16 inch in length and have a brown head (Photo 12-6). Abdominal segments two through seven have a pair of hooks or bumps on the dorsal surface of the body. The hooks are primarily used to obtain oxygen from plant roots and may also be used to aid in movement. The larva has respiratory tubes that distribute oxygen throughout the body of the insect. Pupation occurs in an oval, watertight silken cocoon covered with a thin layer of soil which is attached to the roots.

Life Cycle

Adults enter diapause and overwinter in accumulated leaf litter around trees, in the base of bunch grasses and in other sheltered places. The indirect flight muscles degenerate while adults overwinter. In the spring, flight muscle regeneration is regulated by temperature. Following flight muscle regeneration, adults leave overwintering sites, usually in late April through late May, and fly during early-morning and evening hours. Adult rice water weevils are attracted to open water. Adults feed on host plants, including rice, leaving white, linear feeding scars parallel to the leaf veins and midrib (Photos 12-5 and 12-7).

Photo 12-4. Rice water weevil adult.

Photo 12-5. Leaf scars from adult rice water weevil feeding.

Photo 12-6. Rice water weevil larva.

Adults move under debris or into cracks in the soil during the day and emerge in the evening to feed. If the soil becomes too dry, adults will leave a dry area and search for more moisture. Leaf scarring can be heavy, but even the heaviest scarring will not result in yield loss. Heavy scarring is usually seen in field areas with deep water and/or thin stands, such as near the levees.

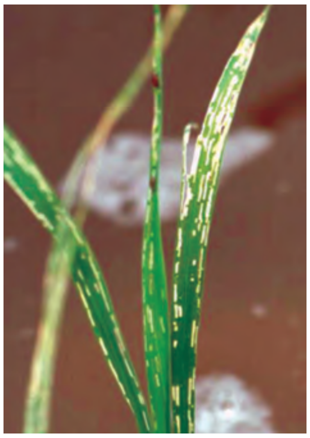

Photo 12-7. **Leaf scars from adult rice water weevil feeding.**

Feeding by adults on rice leaves will begin soon after rice emergence and continue until after internode elongation. Once the fields are flooded, rice water weevils already in the soil and others that fly into the field begin feeding and searching for mates. In flooded rice fields, the indirect flight muscles of 80 to 90 percent of adults begin to degenerate and render adults flightless in about 5 to 7 days.

Females begin to lay eggs about 1 to 2 weeks after emergence from overwintering but only when part of the host plant is submerged in water. The majority of eggs are deposited within 2 weeks. Eggs hatch in 4 to 9 days (depending on temperature). The larvae may feed in the leaf sheath for a short time before chewing a hole in the leaf, sinking to the soil surface and burrowing into the soil to feed on roots. Larvae are the damaging stage of the life cycle. Small larvae often enter the larger roots to feed and cause the death of the whole root. Larger larvae damage roots through external feeding. Larvae complete development in about 4 weeks.

Pupation occurs in an oval, watertight cocoon covered with a thin layer of soil which is attached to the roots. The pupal stage typically lasts 7 to 10 days. The time from egg to adult takes from 35 to 40 days in the southern U.S. but may take up to 75 days in California.

In Arkansas, first-generation adults (from hatched eggs) feed on rice leaves from June to early September before finding a site to overwinter. Overwintered adult rice water weevils begin to die in July. A small percentage of first-generation adults will deposit eggs in rice, giving a partial second generation. Adult weevils are commonly found on rice panicles. Adults will feed on the rice flowers when the hulls are open and the floral parts are exposed. However, the rice hull is an effective barrier and keeps adults from feeding on the kernel. Economic damage is not expected from rice water weevil adults found on rice panicles. In Louisiana, two complete generations and a partial third generation are present each year. Rice water weevils in the other rice-producing states have generations similar to those in Arkansas.

Damage and Symptoms

Adults feed on rice leaves and cause white, linear feeding scars parallel to the leaf veins (Photo 12-4). While the feeding scars may be heavy, yield loss does not occur. The rice water weevil causes yield loss when the larvae feed on the rice root system and can cause severe injury (Photo 12-8). When the rice root system is damaged by larval feeding, plant uptake of nutrients is reduced and plants may exhibit nutrient deficiency symptoms (usually N). Plants will not usually show deficiency symptoms unless root damage is severe or availability of nutrients is low. Severe root pruning may cause rice to turn yellow, reduce growth (stunting), delay maturity and, when severe, reduce yields. Plants with a severely pruned root system may lean in the water or float when physically disturbed.

Photo 12-8. **Roots injured by rice water weevil larvae feeding.**

The severity of rice water weevil infestation in any rice field is related to several factors:

1. The weevil population in the area during previous years.
2. Availability and proximity of “good” overwintering sites.
3. Overwintering survival.
4. The sequence of flooding of rice fields in the area.
5. Rice cultural seeding method (drill-seeded or water-seeded).
6. Stand density, water depth and rice cultivar.

Yield loss attributed to rice water weevil damage is usually greater in water-seeded than in drill-seeded fields. Water-seeded rice will begin to attract adults when seedlings (one to two leaves with a small root system) emerge from the water and will continue to attract adults for several weeks. In comparison, drill-seeded rice will begin to attract adults when rice has four to five leaves, developed tillers and has a more developed root system when flooded. Thus, drill-seeded rice is attractive to colonizing adult rice water weevils for only 1 or 2 weeks after flood establishment. Larval densities peak 21 to 35 days after flooding in drill-seeded rice and 28 to 42 days after permanent flooding in water-seeded rice. Adults and larvae are usually present in higher densities for a longer time in water-seeded rice.

Scouting and Management

Sampling for Rice Water Weevil Larvae. The oldest scouting method in rice, larval counts, is not often used today because insecticides that were used in the past are no longer available and foliar-applied insecticides currently used are targeting the adult stage, not the larval stage. However, this method may be used to decide on nonchemical management decisions, such as pulling the flood and draining the field, which may reduce larval injury or aid in plant recovery. Other scouting methods have become more useful in scouting for adults, which are the target for current foliar insecticides. Scouting for larvae is the same in drill-seeded and water-seeded rice and should be conducted 2 to 3 weeks after permanent flooding.

Rice plants and soil that surrounds the root system can be used to determine the larval infestation. The size of the soil/plant sample should be 4 inches in diameter and 3 to 4 inches deep in a silt loam soil and 2 to 3 inches deep in a heavy clay soil. Place the soil/plant sample in a bucket that has a 40-mesh screen bottom. Wash the soil from the plants by vigorously swirling the plants in the water to dislodge larvae from the roots. Move the sample vigorously up and down in the water several times to help wash away the soil. Most larvae will float to the water surface and can be removed from the bucket and counted. Continue to repeat the soil removal motions and larval counts until no additional larvae float to the surface or are visible in debris inside the bucket. Additional samples may be needed in large fields. The number and size of larvae can be used to predict how much damage has and/or will occur in dry-seeded rice, **if the samples are taken during peak densities**. Recent studies in Texas indicate a yield loss of 1 percent for every larva per core.

Leaf Scar Counts. In drill-seeded rice, begin scouting and using leaf scar counts 2 to 7 days after the field is flooded. Examine only the youngest mature leaf for adult feeding scars on plants at least 6 feet from levee furrows (barrow or bar ditch). Do not count scars on older leaves. Scouting procedures should ensure that representative field areas are scouted. Counts will generally be higher along tree lines and levees than in any other part of the field. At each stop, inspect 40 plants and record the number of plants with at least one scar on the youngest mature leaf. If a treatment decision cannot be made after a reasonable number of stops, scout the field again in 4 to 5 days. When the percentage of the youngest mature leaves with feeding scars equals or exceeds 60 percent in drill-seeded rice, control measures are justified.

For water-seeded rice, begin scouting and using leaf scar counts when seedlings emerge from the flood. Follow the same procedures as described for drill-seeded rice. When the percentage of plants with at least one adult feeding scar on the youngest mature leaf equals or exceeds 50 percent, an insecticide application is recommended. The treatment threshold is lower for water-seeded rice because rice plants are smaller and more susceptible to damage. Leaf scar thresholds for water-seeded rice are preliminary and subject to change with additional research, so check with your county Extension agent for the latest recommendations.

For control of rice water weevil adults, the leaf scar method should be used for only the first 2 weeks after the permanent flood is established, regardless of the cultural seeding method. In rice fields where an insecticide seed treatment is used, leaf scar counts may not be effective as a treatment threshold. Insecticide seed treatments can provide control of larvae feeding on roots but do not necessarily prevent leaf feeding by adults. However, under intense pressure, extremely high leaf scar counts can be evidence that insecticide seed treatments may be overwhelmed and a supplemental foliar insecticide application may be justified. In these situations, leaf scar counts may need to be supplemented with larval counts.

Counting Rice Water Weevil Adults. Scouting of rice water weevil adults can be an effective way to determine the need for control measures. Fields should be scouted during the first 4 to 7 days after flooding. If fields take more than 10 days to flood, growers should check the first levees that have been flooded for 4 to 7 days for weevils. All fields should be inspected for the abundance of adult water weevils. The key to observing adults is to scout fields in the morning hours between 8 and 10 a.m. when adults move out of the water onto plants for feeding. If the average field-wide density of rice water weevil adults exceeds one adult per row foot, the chemical treatment for rice water weevils is justified. If less than the whole field is infested at a rate less than one adult per row foot, then treating only the heavily infested areas could be sufficient. An application of an insecticide to control rice water weevil adults can be made using observations on weevil density.

Days After Flooding. For fields that have a history of heavy rice water weevil infestations, treatment decisions can be made solely on the number of days after flooding. In general, a single application of an insecticide timed between 5 and 9 days after permanent flood will control rice water weevil adults. In all previous research studies, insecticides applied 10 or more days after permanent flood did not effectively control rice water weevils.

Management Key

An insecticide application to control adults can be timed using observations on weevil density, counting leaf scars or on the days after the field has been flooded.

Insecticides. The only foliar insecticides currently labeled for control of rice water weevils need to be applied to kill adults or newly-layed eggs. Thus, the timing of application should be when adults are abundant but before the peak egg-laying period. An application after the majority of eggs have been laid will be ineffective. In drill-seeded rice, peak egg laying could occur at any time between 5 and 14 days after the permanent flood.

Four insecticides are currently available for rice water weevil control. The relative efficacy rating is presented in Table 12-1 and the recommended rates and timings are shown in Table 12-2. Three of the products are synthetic pyrethroid insecticides applied only for the control of rice water weevil adult. These products are Declare, Karate Z, Mustang Max, Proaxis and Prolex and have provided similar results. Application(s) should be timed when adults are abundant but before peak egg laying occurs. For drill-seeded rice, peak egg laying could occur between 5 and 14 days after

Table 12-1. Rice insecticide performance ratings.

	Restricted Use	Chinch Bug	Fall Armyworm	True Armyworm	Short Horned Grasshopper	Rice Stink Bug		Rice Water Weevil			Rice Stalk Borer	Aphids (Greenbug, Oat Bird, Cherry Aphid)	Grape Colaspis
						Adults	Eggs and Immatures	Adults	Larvae	Eggs			
Seed Treatments													
Dermacor X-100	X	1	8	8					8.5		8		2
Cruiser	X	6		2				6	7				8
Nipsit Inside	X	6		2				6	7				8
Foliar Insecticides													
Declare/Prolex	X	7	8	8	7	8	8	9				8	
Dimilin 2 L	X							0	8	7			5
Lambda-cyhalothrin†	X	7	8	8	7	8	8	9				8	
Malathion		1	2	5	6	6	5	0				4	
Mustang Max	X	7	8	8	7	8	8	9				8	
Sevin		6	6	5	6	8	5					1	
Tenchu	X					8	8						

†Includes other products containing lambda-cyhalothrin.

Table 12-2. **Insecticides labeled for rice water weevil control†.**

Insect	Type of Damage	Timing of Treatment	Treatment	Active Ingredient /Acre	Product Rate/Acre	Preharvest Interval
Rice Water Weevil adults	Prevent adults from laying eggs	**Drill-Seeded:** Apply Karate Z, Prolex, Proaxis, Declare and Mustang Maxx within 10 days after permanent flood when adults are present. **Water-Seeded:** Apply Karate Z, Prolex, Proaxis, Declare, and Mustang Maxx within 7 days after permanent flood when adults are present; a second application may be necessary 5 to 7 days later. DO NOT apply Belay after 3rd tiller initiation. DO NOT apply to rice that has clothianidin seed treatment. Hold water for 14 days after treatment.	**chlothianidin** Belay 2.13	0.075 lb	4.5 fl oz	
			gamma-cyhalothrin Prolex/Declare 1.25 CS Proaxis 0.5 CS	0.0125 – 0.02 lb	1.28 – 2.05 fl oz	21 days
			lambda-cyhalothrin	0.025 – 0.04 lb	3.2 – 5.12 fl oz	21 days
			zeta-cypermethrin Mustang Max 0.8 EC	0.02 – 0.025 lb	3.2 – 4.0 fl oz	14 days
larvae	Prevent larvae from damaging roots	See insecticide seed treatments in Table 4-6.				
eggs	Prevent eggs from hatching	**Drill-Seeded:** Within 10 days after permanent flood when adults are present. **Water-Seeded:** Within 7 days after permanent flood when adults are present;	**diflubenzuron** Dimilin 2L	0.125-0.25 lb	12 to 16 fl oz	

† Labels are frequently changed, so always check the most recent label of any insecticide for directions and restrictions prior to application. Insecticides applied to heading rice have a pre-harvest interval. Be sure to know the pre-harvest interval before application

‡There are many formulations of lambda-cyhalothrin; make sure to read the label for appropriate rates.

permanent flooding. An application of a pyrethroid can be timed with leaf-feeding scars or on days after flooding if a field has a history of rice water weevil damage. A single application timed between 5 to 10 days after permanent flooding may give adequate control in most rice fields, when needed. Application 10 days after flooding will not likely give adequate control since peak egg laying may have occurred. **The floodwater cannot be released within 7 days after application of a synthetic pyrethroid.**

In water-seeded rice, pyrethroids should be applied when adults are present and leaf scars are found on 50 percent of the youngest leaves. Carefully scout water-seeded rice after the first application for the presence of adult weevils since a second application may be necessary 5 to 7 days after the first application. Pyrethroid applications, whatever the seeding method, should be made during the morning hours (approximately 9 to 11 a.m.). Application during this time will be most effective due to the behavior of adult weevils. The synthetic pyrethroid insecticides may have a short residual time, depending on application rate and environmental conditions. The synthetic pyrethroid insecticides do not interact with herbicides. Always check and follow the most recent label of any insecticide for use directions and restrictions.

Dimilin 2L is an insect growth regulator that has activity against rice water weevil eggs. Dimilin needs to be in the water when adults are present and actively laying eggs. Timing of Dimilin application(s) is the key to controlling rice water weevil with this product.

The recommended Dimilin 2L rates that have been tested are 0.187 and 0.25 pound ai per acre (12 or 16 ounces of product per acre). In water-seeded rice, Dimilin should be applied when adults are present and leaf scars are found on 50 percent of the youngest leaves. A split application of 0.095 or 0.125 pound ai per acre (6 or 8 ounces per acre) after the leaf scar threshold is reached followed by another 0.095 or 0.125 pound ai per acre (6 or 8 ounces per acre) in 5 to 7 days will improve control of rice water weevil. The split application is recommended for water-seeded rice since egg laying is extended and the peak may not occur until 7 to 28 days after permanent flooding. A split application in dry-seeded rice may improve control of rice water weevil if infestation is continuous (extended). Dimilin does not interact with herbicides.

Cultural Methods. Control of rice water weevils can be accomplished by cultural or chemical means. One alternative to insecticide control is water management. Often called "drain and dry," this cultural practice involves the removal of water from the field 10 to 14 days after permanent flooding. The DD50 period for drying soil for straighthead prevention can also be used for rice water weevil control. Drying the soil is effective if the soil is allowed to dry thoroughly. Incomplete drying may not sufficiently reduce the number of larvae. Draining and drying the soil needs to be accomplished in 10 days or, preferably, less. Rain or slow drying conditions may reduce its effectiveness. If more than 10 days is required to drain and dry, then weeds can reinfest and become a problem.

"Drain and dry" is a remedial cultural practice that should be considered if currently registered insecticides were not used and scouting has shown a density of larvae that may cause enough damage to reduce the yield. Other factors such as water availability, weed control, straighthead history or cultivar susceptibility, fertilizer management and growth stage must be considered before drying a field for rice water weevil control. This practice can be cost prohibitive due to fuel prices. Also, drying the field at this stage in the season can increase weed problems, delay maturity, impact fertilization, and may enhance blast problems.

Planting date can have an influence on rice water weevil infestation. When flooded, fields planted during the usual early dates will attract overwintered adults and can have low to high infestations. Fields that are planted after the majority of rice is planted will generally have fewer weevils available and infestations will be low to moderate. Late-season planted rice will attract the first generation adults and will tend to have high infestations.

A cultural practice that influences rice water weevils but is normally not done specifically for this reason is delaying the permanent flood. The normal delay of flood until the 4- to 5-leaf growth stage (21 to 35 days after emergence) allows plants to develop a sizeable root system and conveys tolerance to root feeding from rice water weevil larvae. Another benefit of delayed flooding is the preferences of adult weevils for suitable plants. Previous research has shown that adults lay eggs in plants of all ages. However, when given an array of plants at different ages, the highest larval densities were found in plants 20 to 30 days of age (Table 12-3).

This may imply that rice water weevils infest a field shortly after permanent flood, but all may not remain if plants are not of suitable age. Other research by agronomists showed that yield was not reduced if permanent flood was delayed for an additional 7, 14 or 21 days. The use of an extended delayed flood as a cultural practice to lower the number of rice water weevil larvae can be successfully used by rice growers. When the flood is delayed an additional 10 days longer than normal, yields are not reduced, heading is not delayed and weevils are reduced. Neonicotinoid seed treatment efficacy against rice water weevil begins approximately 35 days after planting. Dermacor X-100 provides better control of rice water weevil after this window, but provides little to no control of grape colaspis.

Table 12-3. Effect of extended delayed permanent flood on densities of rice water weevils in plots of rice of different ages and grain yields.

Year	Plant Age at Flood	Rice Water Weevils Larval Density†			Grain Yield
		3 WAF	4 WAF	5 WAF	
	days	larvae/core			bu/A
2001	20	43.3	32.3	16.8	199
	30	22.6	22.5	8.7	219
	40	14.2	8.8	6.0	218
2002	20	36.4	32.1	26.2	178
	30	18.3	19.8	13.6	184
	40	15.8	11.3	9.8	188

† WAF = weeks after flood.

Drill-seeded rice followed by delay of the permanent flood allows plants to grow to the 4- to 5-leaf growth stage and develop a sizable root system. Water-seeded rice with continuous flood has water on small plants with a small root system. Rice water weevils are attracted to flooded rice where females lay eggs in the leaf sheath. Therefore, water-seeded rice plants are susceptible to water weevils for a longer time than drill-seeded rice. More weevils over a longer period of time results in too much damage (root pruning) for unprotected plants to overcome for normal grain yield in this system (Figure 12-3). Growers who utilize water seeding should be aware of the increased risk and the seriousness of problems that can occur as the result of rice water weevils. Chemical control of rice water weevils in water-seeded rice is needed in almost every situation. In furrow-irrigated rice systems, rice water weevil is less of a threat due to the lack of flooded conditions; however damage may still occur in locations where water pools for an extended period of time.

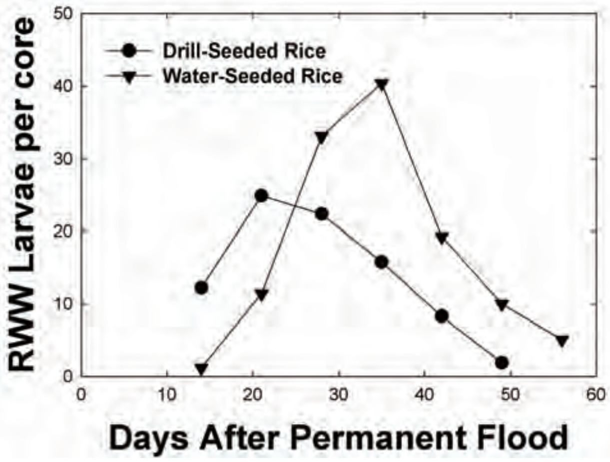

Figure 12-3. Number of rice water weevil larvae in untreated drill-seeded and water-seeded rice.

Another alternative to insecticides is supplemental nitrogen application. Growers commonly apply extra N fertilizer to treat the N deficiency symptoms that result from damage to the rice root system. Research data is presently unavailable to confirm the benefit of supplemental N application. The efficiency of fertilizer N uptake by plants with damaged root systems is reduced. However, application of low N rates (30 to 45 pounds N per acre) near, but before, mid-season may help damaged plants recover. Mid-season N application rates may also need to be increased to compensate for larval damage. Be aware that application of extra N fertilizer is treatment of a symptom caused by the larval feeding. Extra N may help if the larval population has peaked and is declining.

Management Key

Nitrogen deficiency induced by rice water weevil feeding may be corrected by an application of urea near, but before, midseason. Slow uptake may result if roots are damaged to the point of restricting the amount of nitrogen that is taken up by the plant.

The severity of a rice water weevil infestation in any particular field is related to several factors which include:

- The weevil population in the area during the previous year(s).
- Availability and proximity of suitable overwintering sites.
- Overwintering survival.
- The sequence of flooding of rice fields in the area (planting date).
- Other factors such as cultivar, production systems, stand density, and flood depth.

Biological Control. Rice water weevils have several natural enemies that provide some degree of biological control. A mermithid nematode was discovered in a small percentage of adults. The extent and control provided by this nematode remains unknown. Several aquatic predators found in rice fields may also attack adult weevils. Long-horned grasshoppers and small green katydids, common in and near all rice fields, readily feed on adult weevils when adults become numerous shortly after permanent flooding. The impact of all general aquatic predators remains unquantified.

Rice Stink Bug [*Oebalus pugnax* (F.)]

Description

The adult rice stink bug has reddish antennae and a body similar to the color of mature rice grains (Photos 12-9 and 12-10). The rice stink bug's body is about ⅜ to ½ inch in length. The rice stink bug can be distinguished from other stink bugs by the pointed spines, with points directed forward and slightly outward, that are located on the shoulders. Adult stink bugs overwinter in accumulated leaf litter around trees, in the base of bunch grasses, and in other sheltered places. Emergence from overwintering sites generally begins in April and continues to the end of May, depending on the temperature and location in Arkansas.


Photo 12-9. Adult rice stink bugs mating.


Photo 12-10. Rice stink bug adult.

The rice stink bug has several cultivated and wild plant hosts. Cultivated hosts include grain sorghum, oats, rice, rye, and wheat. There are about 40 wild host plants, but the availability of barnyardgrass, bearded sprangletop, dallisgrass, lovegrass (*Eragrostis* sp.), ryegrass (*Lolium* sp.), crabgrass, broadleaf signal-grass and several species of *Panicum* are very critical to seasonal stink bug populations. Weedy grasses (wild host plants) are essential to rice stink bug survival, but eggs are not placed in all host plants upon which adults feed. Stink bug longevity (life span) and fecundity (number of eggs) are influenced by which host plants rice stink bug nymphs and adults feed on.

Stink bug eggs are always placed in two parallel lines on leaves, stems or panicles of host plants (Photo 12-11). Each egg mass contains 20 to 40 eggs but have been reported to range from 10 to 70. Individual eggs are barrel-shaped and about 1/25 inch long and 1/50 inch in diameter. When first layed, stink bug eggs are green but eventually turn red before hatching. Eggs hatch in 4 to 7 days, depending on temperature, and first instars remain clustered around the egg shells.

Photo 12-11. Just-hatched rice stink bug nymphs clustered near egg shells.

Nymphs pass through five distinct instars and do not have wings or shoulder spines. The first instar is about 1/25 inch long with all black body parts except the abdomen which is red with two or three black spots (Photo 12-11). The second through fifth instars gradually increase in size and are light brown with red and black spots on the abdomen (Photo 12-12). First instars do not feed on rice. Older nymphs (second through fifth instar) primarily feed on seeds. Total time spent as a nymph is between 15 and 28 days.

Photo 12-12. Rice stink bug nymph.

Female stink bugs start egg laying 3 or 4 days after becoming an adult. Egg laying gradually decreases and eventually stops in old adults. Adult stink bugs that overwintered begin to die in mid-July. Adults, like nymphs, feed primarily on seeds and remain active in host plants until the host plant becomes senescent or cool weather arrives. At least four generations of rice stink bug occur each year in Arkansas.

Life Cycle

Adults overwinter in leaf litter, clumps of grass or in other sheltered places. In Arkansas, emergence from overwintering sites occurs in late April and early to mid May. A series of cultivated and wild hosts are used during the season and are critical to population survival and increase. Cultivated hosts include heading wheat and oats (rye and barley also) early in the season and then grain sorghum later in the season. Grasses (weeds/wild hosts) are essential to rice stink bug survival before rice, the favored host, is available. The list of host plants is extensive and includes barnyardgrass, bearded sprangletop, dallisgrass (*Paspalum* sp.), vaseygrass (*Paspalum* sp.), lovegrass (*Eragrostis* sp.), ryegrass (*Lolium* sp.), crabgrass (*Digitaria* sp.), broadleaf signalgrass (*Panicum* sp.), johnsongrass and many others. Rice stink bugs do not place eggs in all cultivated and wild hosts upon which the adults feed. The life span and the number of eggs that females produce are influenced by the host plants. Rice stink bugs are estimated to produce four generations each year.

Eggs hatch in 4 to 7 days and the nymphs remain clustered around the egg shells. The first instar does not feed on plants but may ingest water. The second through the fifth instar feeds primarily on seeds. Total time spent as a nymph is between 15 and 28 days. After becoming an adult, females start depositing eggs in about 3 to 4 days. Egg laying gradually decreases and eventually stops in old adults. Adult longevity has been observed to average about 50 days. Overwintered adults begin to die in mid July. Adults are active in plant hosts until a host becomes senescent and/or cool weather arrives.

Table 12-4. **Insecticides labeled for rice stink bug control†.**

Insect	Type of Damage	Timing of Treatment	Treatment	Active Ingredient /Acre	Product Rate/Acre	Preharvest Interval
Rice Stink Bug (nymphs and adults)	Both stages suck juices from kernel, causing blanks and/or discolored rice kernels	5 bugs per 10 sweeps at heading; 10 bugs per 10 sweeps 2 weeks after heading; scout in morning for best results. Terminate application at an average of 60% hard dough down the panicle.	**carbaryl** Sevin 80S, 80WSP Sevin 4L, 4F, XLR	1.0 – 1.5 lb	1.25 – 1.87 lb 2 – 3 pt	14 days
			dinotefuran Tenchu	0.094 – 0.13 lb	7.5 – 10.5 fl oz	7 days
			malathion Malathion 57% EC	0.625 – 0.94 lb	1 – 1.5 pt	7 days
			gamma-cyhalothrin Prolex / Declare 1.25 CS Proaxis 0.5 CS	0.0125 – 0.2 lb	1.28 – 2.05 fl oz 3.2 – 5.12 fl oz	21 days
			lambda-cyhalothrin‡	0.025 – 0.04 lb		21 days
			zeta-cypermethrin Mustang Max 0.8 EC	0.0165 – 0.025 lb	2.64 – 4.0 fl oz	14 days

† Labels are frequently changed, so always check the most recent label of any insecticide for directions and restrictions prior to application. Insecticides applied to heading rice have a pre-harvest interval. Be sure to know the pre-harvest interval before application.

‡There are many formulations of lambda-cyhalothrin; make sure to read the label for appropriate rates.

Damage and Symptoms

Adults and nymphs have piercing-sucking mouthparts. Entry of the stylets (mouthparts used for feeding) is facilitated by a salivary secretion that hardens on contact with air and remains attached to the rice grain. The secretion is called a feeding sheath (Photo 12-13). The feeding sheath is the only external evidence that feeding by rice stink bugs has occurred on grain. No hull discoloration is associated with feeding by rice stink bugs. The stylet penetrates the hull allowing the stink bug to feed on the developing rice kernel.

Photo 12-13. **Rice stink bug feeding scars on a rice kernel.**

The amount and type of rice stink bug damage depends upon the stage of rice kernel development. Feeding at any time before the milk stage stops any further development of the kernel, resulting in yield loss (Photo 12-14). Feeding during the milk (Photo 12-15) and soft dough stages (Photo 12-16) may result in the removal of all or part of the contents (also a yield loss). Pathogens are introduced into the kernel by rice stink bug feeding. Infection of the kernel by pathogens (fungi and bacteria) and enzymes produced by the rice stink bug can cause discoloration and weakening of the kernel (quality loss). Discolored kernels often break during milling procedures, resulting in reduced quality (Photo 12-17). During the first 2 weeks of heading, damage from each adult rice stink bug will total two to six lightweight kernels and two to six discolored kernels per day. During the third and fourth weeks after heading, adult feeding activities will cause one to five discolored kernels and one to two light weight kernels per day. Grains discolored by rice stink bug feeding activity remain attached to the panicle. Lightweight, damaged kernels are often lost with straw and chaff at harvest. Partially filled and discolored kernels are mixed with undamaged grain.

Management Key

Rice stink bug typically causes yield and quality losses during the first 2 weeks after heading and primarily quality losses (pecky rice) during the third and fourth weeks after heading. Add Terminate insecticide applications at 60% hard dough.

An excessive amount (1 percent or higher) of discolored kernels in grain can result in lower grade and price when the grain is sold. All discolored kernels, whatever the cause, are called “pecky rice.” Rice stink bugs are not the sole cause of pecky rice but contribute to the total. Control of potentially damaging populations of rice stink bugs can reduce the amount of discolored kernels and improve rice grade, quality and selling price. Stink bug infestations and resulting injury tend to be cyclical from year to year. The highest infestations were observed in 2001 and 2011.

Photo 12-14. Rice stink bug feeding during early development of rice kernels (normal kernel at left).

Photo 12-15. Rice stink bug feeding during milk stage of rice kernels.

Photo 12-16. Rice stink bug feeding during the soft dough stage of rice kernels.

Photo 12-17. Broken kernels during milling resulting from rice stink bug feeding.

Scouting and Management

Stink bug populations in rice fields should be scouted weekly or preferably twice weekly beginning at 75 percent panicle emergence and continuing until grain maturity (30 to 35 days after 50 percent heading). Scouting during the morning hours of 8 to 11 a.m. or evening hours of 7 to 9 p.m. will provide better estimates of rice stink bug densities. Rice stink bug adults are alert to disturbances and movement and are quick to fly.

Scouting is done using a 15-inch diameter insect sweep net to sample rice stink bugs. At each sample site, make 10 consecutive 6-foot wide sweeps to determine rice stink bug densities. Sweeps should be taken at a quick pace to provide distance between each sweep to assure the same area is not swept twice. Sweeps should be done from side-to-side in front of the sweeper's body. The top rim of the sweep net should pass 2 to 3 inches above the rice heads, with the majority of the rim encompassing rice panicles. After each 10-sweep sample, grasp the net under the ring to keep the insects from escaping. Slowly open the net and count adults and nymphs of the rice stink bug. Repeat the sampling procedure at several random sites (ten or more). Calculate the average number of rice stink bugs per 10 sweeps. Usually, weedy host plants are more abundant along field margins and will attract more rice stink bugs.

Management Key

For best results, scout for rice stink bugs early in the morning (before 9 a.m.) or late in the evening (after 7 p.m.).

Insecticide application is recommended if stink bug densities average five or more per 10 sweeps during the first 2 weeks of heading. During the third and fourth week of heading, applications are recommended when rice stink bug densities exceed 10 individuals per 10 sweeps. If the sample density is slightly above or below the threshold or if the field is very large, additional samples will improve confidence in population estimates. Insecticide applications are warranted through hard dough until 60 percent hard dough is observed across 50 percent of the field. In this case, hard dough is defined as a turn from green kernels to straw-colored kernels (Photo 12-18). Similar to recommended scouting times, insecticides should be applied in the morning (8 to 11 a.m.) or late evening (7 to 9 p.m.) for best control. Insecticides available for control of rice stink bugs are listed in Table 12-4. Always consult the label prior to use.

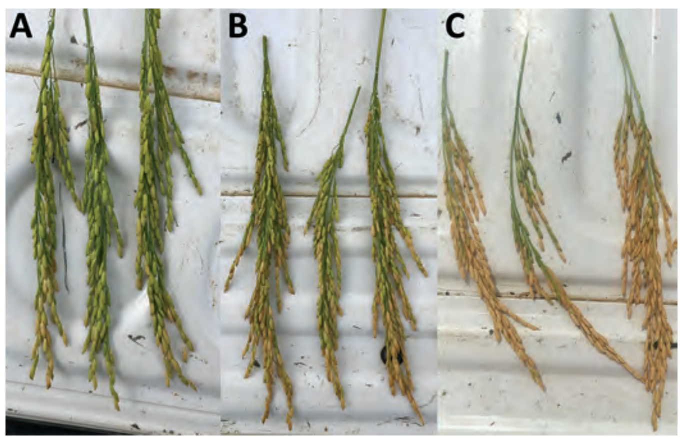

Photo 12-18. Rice panicles below 60% hard dough (A), at 60% hard dough (B), and above 60% hard dough (C).

Management Key

Apply insecticides for control of rice stink bugs when more than 5 bugs per 10 sweeps are present during the first 2 weeks after heading or 10 bugs per 10 sweeps during the third or fourth weeks after heading. Terminate insecticide applications at 60 percent hard dough.

When sampling near weedy areas and field borders, note the stink bug counts in these areas. Treatment of field borders or isolated field areas where stink bugs are concentrated, rather than the entire field, may be feasible.

Photo 12-19. Proper sweepnet method for sampling rice stink bug.

Insecticides. Insecticides available for control of rice stink bugs are carbaryl (Sevin XLR), lambda-cyhalothrin, zeta-cypermethrin (Mustang Max) and gamma-cyhalothrin (Prolex, Proaxis). Applications should be made in the morning (8 to 11 a.m.) or late evening (7 to 9 p.m.) in 5 to 10 gallons of water to get the best results. Sevin will have some initial kill with 3 to 5 days of residual activity. The synthetic pyrethroid insecticides (lambda-cyhalothrin, Mustang Max, Prolex, Proaxis) have good initial kill and 1 to 2 days of residual activity. When high stink bug densities are observed along field margins and low densities are within the field, treatment of field borders using a quick-kill insecticide should be considered. The floodwater cannot be released within 7 days after application of a synthetic pyrethroid.

Management Key

Insecticides are most effective if applied prior to 9 a.m. or after 7 p.m.

Biological Control. Several predators and parasites have been reported to attack rice stink bugs and are important biological control agents. Among them are two species of parasitic flies (*Tachinidae*) that attack nymphs and adults but at low levels of parasitism (1 to 15 percent parasitism). Tiny wasps may also parasitize and kill eggs. The wasp parasite (*Telenomus podisi*) is very active throughout the year in all host plants of the rice stink bug (Photo 12-20). High levels of control (greater than 90 percent) have been documented in wild host plants when rice stink bugs are concentrated (>20 bugs per 10 sweeps). Even at lower densities of adults, parasitism usually averages slightly above 70 percent in some weed hosts. Rates of parasitism in rice fields is usually low (2 to 20 percent). Egg masses that are black, not the usual red or green, show parasitism by the wasps. Blackbirds and green tree frogs feed on rice stink bug adults, and long-horned grasshoppers will feed on eggs and nymphs (refer to grasshopper section for more information on grasshoppers).

Photo 12-20. Egg parasite feeding on rice stink bug eggs.

Cultural Controls. Rice cultivars differ in susceptibility to the rice stink bug, as evidenced by the amount of discolored grains in cultivars. Susceptibility to damage tends to be greatest in short grains, somewhat less in medium grains and usually the lowest in long grains. However, within a grain type, the susceptibility also varies. Some rice cultivars appear to be more susceptible due to differences in rates of panicle maturity or other factors.

Wild host plants are important to the survival and abundance of rice stink bugs. Reduction of weed hosts in and around rice fields will aid in the reduction of rice stink bugs. Rice cultivar and grain type (long, medium or short) are also important factors that influence the amount of rice stink bug damage. Usually, stink bug damage is greatest in short-grain cultivars and least in long-grain cultivars. Seeding date may also influence the amount of stink bug damage. Rice stink bugs may concentrate in the earliest maturing fields as well as the latest maturing fields.

Minor Rice Insects

Rice is sometimes damaged by insects that originate in and prefer crops other than rice. Examples of these crossover pests include armyworms and aphids. Occasionally rice stalk borers, billbugs, rice seed midges, short-horned grasshoppers, fall armyworms, chinch bugs or rice root aphids will become numerous and may cause noticeable damage to rice. A brief description of these pests and possible cultural and chemical control measures are provided in the following section.

Armyworms: True Armyworm [*Pseudaletia unipuncta* (Haworth)] and Fall Armyworm [*Spodoptera frugiperda* (J.E. Smith)]

Description

True armyworms and fall armyworms both fall into the armyworm complex but have distinguishing characteristics between one another. The adult moth for true armyworm have a wingspan of about 1½ to 1¾ inches. The color of the forewings is tan with a single, small, white spot midway across the width and length of the wing. Hind wings are gray or gray-brown. Fall armyworm moths have a similar wingspan as true armyworms, spanning from 1½ to 1¾ inches. The forewings on fall armyworm adults is are mottled dark gray with a prominent white spot at the extreme tip of the wing. The hindwings are a white color with a purple sheen.

Moths are active at night and lay eggs in large masses behind the leaf sheath of host plants. Armyworm adults are often transported with weather fronts moving from the west and south into Arkansas. Adults are not known to lay eggs directly into rice.

True armyworm larvae (caterpillars) can be either green or brown but have a distinctive pattern of longitudinal stripes – a dark stripe along each side and broad stripe along the back (dorsal stripe) (Photo 12-21a). The dorsal stripe has a lighter colored broken line down the center. The head is pale brown with green and brown mottling. Fall armyworm larvae (caterpillars) vary in color from light tan or green to nearly black. Larvae have three yellow-white thin lines running down the back of the caterpillar (Photo 12-21b). On both sides of the body next to the yellow thin lines is a wider dark stripe. Fall armyworm larvae also have a distinct inverted y on their head capsule (Photo 12-21c).

Life Cycle

Some armyworm larvae or pupae may survive Arkansas winters to emerge in the spring. Larvae often become numerous in wheat or oat fields before or shortly after heading. Large larvae sometimes leave the wheat fields and move into adjacent areas as the wheat heads mature and the foliage begins to desiccate. If a rice field is adjacent, damage usually occurs near the border of the two crops and seldom is found over the entire field. Pupation can occur in rice fields, but adults are not known to deposit eggs directly onto rice.

Armyworms can also be found in fields that have a growth of winter/spring weeds. Growers must be aware of this situation and not plant rice too early after application of a burndown herbicide. Allow the foliage on weeds to die to prevent the armyworms from moving from the weeds to seedling rice.

Damage and Symptoms

Armyworms feed on leaves and stems and may consume the entire above-ground rice seedling. The growing point is usually not damaged and seedlings normally recover; however, crop maturity can be

Photo 12-21. True armyworm larva (A), fall armyworm larva (B) and inverted "Y" of fall armyworm (C).

delayed (Table 12-5). Older plants that are defoliated will be delayed more than younger plants.

Table 12-5. Comparison of undamaged plants with simulated armyworm damage.

Growth Stage When Damaged†	Heading Delay	Grain Yield Loss‡
	days	bu/A
2-leaf	2	5.2
3-leaf	4	9.3

† Plants were cut to ¼ inch above the soil surface at the 2- or 3-leaf growth stage.
‡ Francis rice seeded at 100 lb/acre.

Scouting and Management

No formal scouting plan or treatment threshold is used for armyworms in rice. Growers should observe rice fields next to wheat or oat fields that contain armyworms and watch for movement between the crops. Treatment should be applied before severe damage occurs to prevent stand reduction. If plants become water stressed as the result of feeding, yield losses can be observed.

Insecticides available for control of armyworms are listed in Table 12-6. The timing between applications of herbicides containing propanil and carbamate insecticides is critical. Certain insecticides inhibit the action of an enzyme present in rice that prevents rice from being killed by grass herbicides. Thus, rice sprayed with propanil can be killed or severely injured if a carbamate insecticide follows or precedes propanil. The severity of damage depends on the time between the applications and the class of insecticide. If a carbamate insecticide (i.e., Sevin) is used, a waiting period

Table 12-6. Insecticides labeled for control of other rice insects†.

Insect	Type of Damage	Timing of Treatment	Treatment‡	Product/Acre
Short-Horned Grasshoppers (nymphs and adults)	Leaf feeding and head damage	Treat where damage is evident; border treatment may be beneficial	Lambda-cyhalothrin Mustang Max 0.8 EC Proaxis 0.5 CS Prolex/Declare 1.25 CS	0.025-0.04 0.0165-0.025 0.0125-0.20 0.0125-0.20
Chinch Bug (nymphs and adults)	Reduce plant stand by sucking sap	When insects are causing stand reduction	Belay 2.13 Lambda-cyhalothrin Mustang Max 0.8 EC Proaxis 0.5 CS Prolex/Declare 1.25 CS Sevin 4L,F, XLR Sevin 80S, 80WSP	0.075 0.025-0.04 0.0165-0.025 0.0125-0.20 0.0125-0.20 1.0-1.5 1.0-1.5
Fall Armyworm (larvae) True Armyworm (larvae)	Flag leaf and panicle feeding reduces yield Plant feeding may reduce stand or delay growth	Treat when six or more armyworms per square foot. Later in the season, treat when fall armyworms are present and damaging the flag leaf.	Dermacor X-100 Lambda-cyhalothrin Mustang Max 0.8 EC Proaxis 0.5 CS Prolex/Declare 1.25 CS	0.06-0.08 0.025-0.04 0.0165-0.025 0.125-0.20 0.125-0.20
Rice Stalk Borer Sugarcane Borer (larvae)	Cause deadhearts before heading and white heads at heading	Apply at boot stage and/or panicle emergence for suppression of white heads	Lambda-cyhalothrin Proaxis 0.5 CS Prolex/Declare 1.25 CS	0.025-0.04 0.125-0.20 0.125-0.20
Aphids, Greenbug, Birdcherry-Oat Aphid (nymphs and adults)	Reduces stand and causes stunting	Treat when 2-3 greenbugs per 1-2 leaf rice or when plants become yelllowed and stunted	Belay 2.13 Lambda-cyhalothrin Mustang Max 0.8 EC Proaxis 0.5 CS Prolex/Declare 1.25 CS	0.075 0.025-0.04 0.0165-0.025 0.0125-0.20 0.0125-0.20

† Labels are frequently changed, so always check the most recent label of any insecticide for directions and restrictions before application. Insecticides applied to heading rice have a pre-harvest interval. Be sure to know the pre-harvest interval before application.
‡ **CAUTION:** Insecticides listed for rice insect control may interact with propanil causing severe injury to rice unless timed properly. Do not apply malathion or Sevin within 14 days before or after propanil applications. If insecticides are necessary and the time frame suggested cannot be followed, consider herbicide options other than propanil. Many generic lambda-cyhalothrin materials are available, be sure to read the label for appropriate rates.

of 14 days before or after propanil is recommended. Moderate injury may be observed even when the waiting period is observed. However, rice can be killed if the waiting period is not followed. Problems with lethal interactions can be avoided by using one of the synthetic pyrethroid insecticides (i.e., Declare, lambda-cyhalothrin, Mustang Max, Prolex, Proaxis) since they do not interact with herbicides. However, the floodwater cannot be released within 7 days after application of a synthetic pyrethroid. Reduced damage and lower densities of armyworms have been observed when Dermacor X-100 was used as a seed treatment.

Recent observations indicate Dermacor X-100 seed treatment will control true armyworm larvae on seedling rice. However, the larvae must feed on the plant to die and some damage may occur on field edges where the larvae enter the field.

Management Key

Use caution if using propanil herbicide and applying malathion or a carbamate insecticide. Be sure to adhere to the recommended waiting period.

Aphids: Greenbug [*Schizaphis graninum* (Rondani)] and Bird Cherry-Oat Aphid [*Rhopalosiphum padi* (L.)]

Description

Adults are small, oval, soft-bodied insects with or without wings. Near the tip of the abdomen are two tubelike structures called cornicles. Two species, the greenbug (Photo 12-22) and the bird cherry-oat aphid, have been reported in rice. The greenbug has a pale green or yellowish-green body, pale green legs with dark tips, a dark green stripe down the center of the abdomen and pale green cornicles with black tips. The bird cherry-oat aphid has a purplish-green to dark purple body, legs with black tips, cornicles with black tips, and at the base of the cornicles is a reddish-orange spot across the bottom half of the abdomen.

Photo 12-22. Adult an nymph greenbugs.

Life Cycle (as Related to Wheat, Weeds and Rice)

The greenbug and bird cherry-oat aphids are common pests of wheat. Aphid infestations are rare in rice fields and normally do not begin in rice. Aphids that have infested wheat or adjacent weedy areas move into rice. Before 1996, greenbugs were an uncommon pest in rice fields. That year, greenbugs were often found feeding on rice and reduced stands in many fields. The bird cherry-oat aphid was first reported in rice in 1997. Each year since, fewer fields have been reported to be infested with these pests. However, severe infestations do still occur.

Damage and Symptoms

Aphids have piercing-sucking mouthparts and feed on plant sap. The greenbug also injects a toxin into the plant while feeding. The symptoms of aphid feeding include stunted plants, curled leaves or leaves that fail to unroll or light green, yellow, red or brown discolorations on the leaves. The toxin causes yellowing of leaves, and small plants may die with heavy feeding. Seedling rice plants with one to two leaves have been killed with only two to three greenbugs per plant or four to five bird cherry-oat aphids per plant. Larger plants with two or three greenbugs per plant may be stunted and turn yellow but have not been reported to die. However, other unknown consequences of aphid infestation on larger plants may result but are not obvious.

Scouting and Management

Thresholds are not available for treatment of aphids in rice. However, should greenbugs become numerous (two to three greenbugs per 2-leaf or smaller rice; four to five bird cherry-oat aphids per plant), insecticide application may be beneficial. Synthetic pyrethroid insecticides are mostly effective against aphids and do not interact with commonly used rice herbicides (Table 12-6).

Conservation tillage practices where herbicides are used to kill weeds prior to planting often encourage infestation of aphids in rice. It is recommended to

Table 12-7. Quick threshold guide for rice insect pests.

Insect	Threshold	Scouting Procedure
Chinch bug	Treat when bugs are causing stand reduction.	Check seedling rice, particularly fields bordering wheat.
Fall armyworm, true armyworm	Treat when 6 or more armyworms per square foot early season. Late season treat when fall army-worms are damaging flag leaf.	Early season watch rice bordering wheat for migration of true armyworms into field (damage can occur quickly when armyworms move in).
Grasshopper	Treat when damage is evident.	Watch field borders, particularly near grassy areas.
Greenbug	2 to 3 greenbugs per plant on 1- to 2-leaf stage rice.	General visual observation.
Stink bug	5 stink bugs per 10 sweeps during first 2 weeks of panicle emergence. 10 stink bugs per 10 sweeps after first 2 weeks of panicle emergence.	Sample for stink bugs during the morning hours or late evening. Stink bug levels are difficult to estimate during high daytime temperatures.
Rice water weevil		Inspect the youngest leaf on 40 rice plants at each stop for adult feeding scars. Avoid areas with thin stand. DO NOT count older leaves with scars.

wait until the treated plants show definite signs of leaf death before planting rice. If rice is planted too early following the burndown herbicide, aphids present in the weeds can damage and destroy rice seedlings.

Rice Stalk Borer [*Chilo plejadellus* Zincken]

Description


Photo 12-23. Adult rice stalk borer.

The adult rice stalk borer is a moth with a wingspan of about 1 to 1½ inches (Photo 12-23). The fore-wings are white or light brown with randomly placed very small black scales or spots. Edges of each fore-wing have a row of very small metallic gold and black spots. Hind wings are white or light brown. Eggs are pearly white, flattened and laid in masses with eggs overlapping and resembling a pattern similar to fish scales. Larvae are light brown with one longitudinal dark brown stripe on the center of the back and one light brown stripe along each side of the body (Photo 12-24). Mature larvae have a length of 1 to 1½ inches. Pupae are dark brown. The first confirmed infestation in Arkansas was found in Chicot County in 1981. Since then, the rice stalk borer has been found in all counties with rice in Arkansas, including southwest Arkansas, the Arkansas River Valley and all of eastern Arkansas.


Photo 12-24. Rice stalk borer larva.

Life Cycle

Larvae overwinter in rice stubble and pupation occurs in the stem during the spring. Moths emerge in May (based on ultra-violet light traps) and lay eggs only in flooded rice. Eggs are placed in masses of 10 to 30 eggs on the top or bottom side of the leaf and some-times behind the leaf sheath. Eggs hatch in 5 to 6 days. Eggs can be placed on plants to which permanent flood has just been applied or later in the season when the panicle is just about to emerge. The small larvae from a single egg mass enter one or more rice plants by chewing a hole either behind the leaf sheath or near the base of the panicle (Photo 12-25). More than one larva may enter the stem through a single hole. The larvae eat the inner stem tissue beginning at the entry point and move downward (Photo 12-26). Mature larvae chew

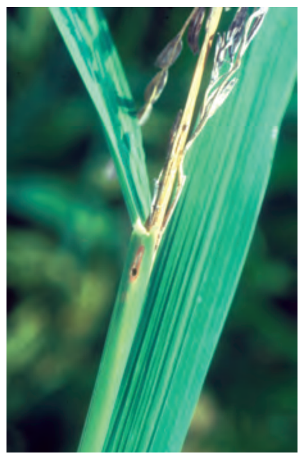
Photo 12-25. Entry hole into stem made by a borer larva.

through the tissues until only a single thin layer covers a circular hole in the stem wall above the water line. Very seldom does more than one larva reach maturity in a single stem. When several small larvae enter the same plant, most exit the plant when half grown and infest nearby rice plants. The adult escapes through the hole.

Photo 12-26. Nearly fully grown rice stalk borer larva near the bottom of the stem.

Damage and Symptoms

Larvae feed on the vascular stem tissue from the inside, effectively halting translocation of nutrients and water. If the plant is infested any time after permanent flooding but before heading, the main stem may die but not the tillers (called a deadheart). Likewise, if the larvae enter behind the leaf sheath of a tiller, the tiller may die but not the main stem. If the plant is infested just before emergence of the panicle, the green panicle emerges, but soon all the florets turn white (whitehead; See Photo 12-27). Larvae that enter a plant after panicle emergence may cause panicles to be partially filled. Whiteheads are more numerous on edges of fields, paddy edges beside levees and on plants in the bar ditches. Fields bordered by weedy ditches or wooded areas often have higher infestations.

Photo 12-27. Whitehead (blank panicle) due to rice stalk borer in flooded rice or billbug on levee.

Scouting and Management

No formal scouting plan has been devised for sampling rice stalk borer and, therefore, no thresholds have been established for chemical treatment.

Insecticides. Insecticide application for the rice stalk borer is usually not recommended. Infestation and losses are usually not enough for economic return. Recently, stem borers were added to the label of synthetic pyrethroid insecticides registered in rice (Table 12-6). This recommendation was in response to problems with stem borers in Texas. Recent studies also show Dermacor X-100 seed treatment can give control or suppression of stalk borers. For fields that have a history of severe rice stalk borer infestations, an application is recommended at panicle initiation to reduce deadhearts and again at boot stage rice to reduce whiteheads. However, treatment for rice stalk borer is seldom warranted in Arkansas.

Cultural Control. Because larvae overwinter in rice stubble, any method of stubble destruction, such as plowing, rolling, burning or flooding, should reduce the number of larvae that survive overwintering in the field. Fields that will be flooded for waterfowl habitat should have the rice stubble rolled, including stubble near and on the levees, to reduce overwinter sites. Any stubble left standing beyond the end of March will positively influence the survival of overwintering larvae. Seeding date also impacts infestation by rice stalk borer. As planting becomes later, rice stalk borer infestations increase exponentially (Figure 12-4).

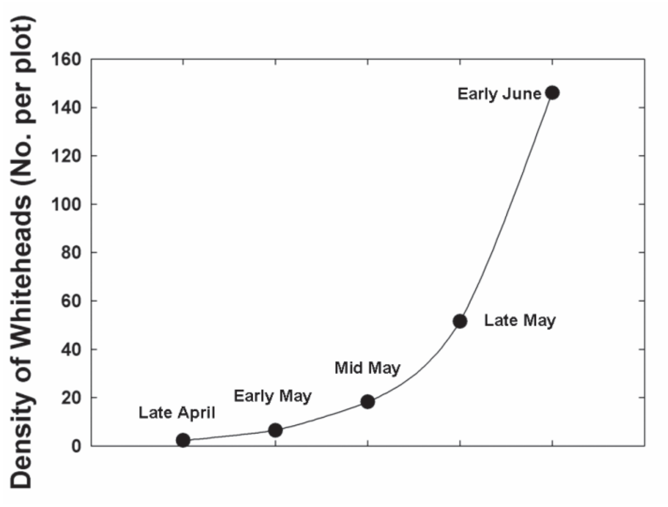

Figure 12-4. Influence of planting date on infestation by rice stalk borer.

Biological Control. Some degree of biological control is provided by an egg parasite (*Trichogramma minutum*) that has been recovered from rice stalk borer eggs. The amount of parasitism by these egg parasites is unknown but is certainly important. High rates of parasitism have been observed late in the season.

Sugarcane Borer
[*Diatrea saccharalis* (E.)]

Description

Adult moths have a 1 to 1½ inch wingspan with straw-colored forewings and darker markings (Photo 12-28). Hindwings are a straw color. The size of the moth varies with the amount of food (host plant) taken by the larvae. The eggs are oval and flattened, laid in clusters with the individual eggs overlapping so that a pattern like fish scales is formed. Egg masses usually consist of 50 eggs or less. Larvae are yellowish white with brown spots (Photo 12-29). Overwintered larvae are more deeply yellow with the color of the spots very light or absent. Mature larvae have a length of about 1 to 1½ inches. The first confirmed infestation in Arkansas was found in Desha and Chicot counties in 2003.

Photo 12-28. Adult sugarcane borer.

Photo 12-29. Sugarcane borer larva.

Life Cycle

Larvae overwinter in rice, corn and grass stubble. Pupation occurs in the spring, and adults emerge in May. The number of generations each year in Arkansas is unknown. Egg masses are placed on the leaf and sometimes behind the leaf sheath. Eggs hatch in about 5 days. The small larvae can enter the plant by chewing a single hole near the base of the panicle or, more commonly, the larvae can mine the leaf sheath for a short time, then enter the plant stem (Photo 12-25). The larvae eat the inner tissues of the stem, grow larger and push excrement (frass) through a hole and out of the stem (Photo 12-30). Mature larvae chew through the stem until only a very thin layer of tissue remains. The circular hole in the stem is above the water line and allows the adult to escape. Pupation occurs in the rice stem. Very seldom does more than one larva mature in a single stem. When several small larvae enter the same plant, most exit the plant when half grown and infest nearby rice plants.

Photo 12-30. Frass from sugarcane borer larva.

The following list of host plants has been recorded for the sugarcane borer: the cultivated crops of sugarcane, corn, sorghum and rice; the wild hosts johnsongrass (*Sorghum halepense*), Sudangrass (*S. bicolor* ssp. *drummondii*), giant broomsedge (*Andropogon* sp.), vaseygrass (*Paspalum urvillei*), fall panicum (*Panicum dichotomiflorum*), Amazon sprangletop (*Leptochloa panicoides*), and broadleaf signalgrass (*Urochloa platyphylla*). Stages of sugarcane borer are found only in Amazon sprangletop, johnsongrass and vaseygrass in Louisiana.

Damage and Symptoms

Larvae eat inner tissues of the rice plant stem and effectively stop any translocation of nutrients and water. If the rice growth stage is just after permanent flood when the larvae enter the plant, the main culm or tillers may die (deadheart). If the growth stage is just prior to emergence of the panicle when the larvae enter the plant, the green panicle emerges but soon turns white (whitehead). What is different from the rice stalk borer is that sugarcane borers enter more plants lower on the stem and later in panicle development. This causes more partial whiteheads.

Scouting and Management

No formal scouting plan has been devised for sampling for sugarcane borer and no thresholds have been formed.

Insecticides. Insecticide application for the sugarcane borer is usually not recommended. Infestation and losses are usually not enough for economic return. Recently, stem borers were added to the label of synthetic pyrethroid insecticides registered in rice. This recommendation was in response to the problems with three species of stem borers in Texas. In Texas, an application is recommended at panicle initiation to reduce deadhearts and again at boot stage rice to reduce whiteheads. Again, treatment(s) for stem borers is usually not recommended in Arkansas.

Cultural Control. Larvae overwinter in rice stubble. Any method of stubble destruction such as plowing, rolling, burning, or flooding should certainly lower the number that survives overwintering. Leaving stubble standing beyond the end of March would positively influence the survival of overwintering larvae. If fields are to be flooded for ducks, then rolling of stubble including that near the levees is highly recommended. Sugarcane borer infestations are generally concentrated on field edges and edges of paddies near levees.

Data obtained indicate that heavy pasturing of stubble reduces the number of overwintering larvae by 75 percent. Burning of stubble also decreases the number of larvae (note: burning must be complete to reduce larvae). Fields plowed in the fall had less than 1 percent of larvae surviving the winter. A high mortality of overwintering larvae was found if the field was flooded during the winter. A flood depth of 5 inches was required to get 40 percent mortality if stubble was left standing. However, if stubble were rolled and then flooded the mortality was increased to 85 percent.

Precaution: When rice and corn are grown in the same vicinity, the sugarcane borer infestation is usually heavier in both crops than where one is grown in the absence of the other. The increased infestations result from moths from rice stubble to give a heavy spring infestation to corn. Corn serves as a breeding place for borers which later infest rice.

Other Stem Borer Species

There are two other species of insects that cause similar damage to rice as the rice stalk borer and the sugarcane borer. Rice is a host for the European corn borer (Photo 12-31) and the Mexican rice borer (Photo 12-32). However, the Mexican rice borer has not yet been found in Arkansas. They have experienced problems with Mexican rice borer in Texas rice production and Louisiana has recently reported finding the pest in rice there.

Photo 12-31. Adult European corn borer.

Photo 12-32. Adult Mexican rice borer.

Billbug [*Spenophorus* sp.]

Description

The adult is a large black weevil ¾ to 1 inch in length with a prominent snout (Photo 12-33). The legless larvae (grubs) have a white body, a reddish-brown head and are ¾ inch long when fully grown (Photo 12-34).

Photo 12-33. Adult billbug.

Life Cycle

The billbug completes one generation per year. Adults overwinter in protected sites and along field margins. Emergence begins in mid April and lasts to mid May. Mating and egg laying occur in the spring. It is believed that the female chews a small cavity near the base of the rice plant and deposits a single egg, or the egg is laid in the soil. The grub begins to feed on inner tissues of the stem about 2 inches above and below the soil surface (into the root crown). Larvae pupate in the plant stem and adults emerge in late

Photo 12-34. Billbug larva in cavity at base of stem.

summer and early fall. Adults disperse by walking and only fly if harassed. Development is lengthy compared to many rice insects, taking 50 to 60 days.

Damage and Symptoms

Billbug-injured plants turn brown and die. Adults are known to feed on the rice plant stem and the leaf whorl. Rows of oblong holes in expanded leaves are evidence that feeding has occurred. Larval feeding inside the root crown and lower stem generally causes the plant to die. The main symptom that a stem is infested with a billbug larva is a whitehead (totally blank panicle) similar to the whiteheads caused by stem borers. Billbug larvae cannot survive flooded conditions, even when inside the plant stem. Therefore, the whiteheads caused by billbug larvae will be found mostly on levees. In contrast, rice stem borers cause whiteheads in the flooded parts of the field. It is not known how many generations occur each season, nor if rice is the only host plant.

Scouting and Management

No formal scouting system or thresholds have been developed and no insecticides are currently registered for billbug control. Billbugs have never been reported to be a major problem in conventionally-flooded rice fields. However, some reports of difficulty maintaining a stand of rice on levees has been reported.

Recently growers have increased interest in furrow-irrigated rice production. Experience derived through the Rice Research Verification Program (RRVP) has demonstrated that this production system results in billbug infestations much higher than normal. In two furrow-irrigated rice fields in the RRVP program, estimates of 10 percent yield loss were observed due to billbug injury. Current research is underway to develop a better understanding of the life cycle, insecticides for control and treatment thresholds for furrow-irrigated rice.

Rice Seed Midges [Family *Chironomidae*]

Description

Adult midges resemble small mosquitoes and range in size from ⅜ to ⅝ inch. The mouthparts of midges are underdeveloped and adults are nonbiting. Larvae are light brown or red (bloodworms), very slender, legless, distinctly segmented and have a nonretractable head with opposable jaws. Mature larvae range from ⅛ to ⅞ inch in length, depending on the midge species. Several species have been found to damage rice.

Life Cycle

Adult midges prefer to lay eggs on open water. Masses of eggs are laid in strings held together by a sticky mucus-like material that forms a protective envelope around the eggs. Eggs hatch in 1 to 2 days. The larvae use silk, bits of mud and debris to build tubes on the soil surface. Larval development is completed in 7 to 10 days. Pupation occurs underwater in the tubes. Adults emerge in 2 to 3 days.

Damage and Symptoms

Severe damage to rice is limited to germinating seeds, germinated seeds and very young seedlings in water-seeded rice with continuous or pinpoint flooding. Larvae feed by chewing on the developing seed embryo, root shoots and young seedlings. Larvae are often found inside the seed hulls and in tubes built on the seed. Injury to seed embryos from feeding causes plant development to cease.

Scouting and Management

Water-seeded fields with continuous or pinpoint flooding should be checked for midge infestation and damage 2 to 5 days after seeding. Examine fields for midge larvae, tubes, injured seed and injured plants. Scouting should continue until plants are about 1 to 1½ inches tall. All midge larvae that will damage rice seed will be found on the soil surface or in tubes on the soil surface. The criteria used to determine if a field needs to be reseeded include:

- the number of viable seed per square foot
- whether larvae are present
- the number of plants per square foot

Depending on the number of larvae present, the field may need to be drained and dried before reseeding. If larvae are abundant, drain the field and dry the soil to at least ½ inch deep prior to reseeding the field.

Some midge larvae are red and called bloodworms. These larvae are relatively large (¾ to 1 inch long) and can be commonly found in the soil of rice fields before and after flooding. The abundance is related to the amount of decaying organic matter present in the soil. It is not known if bloodworms damage rice seedlings or injure rice seed as much as non-red midge larvae. However, no evidence has been collected to demonstrate significant injury from bloodworms.

Since fipronil (Icon) is no longer available, no insecticides are registered for control of rice midge. However, other steps can be taken to minimize the injury from rice midges.

- Fields should be seeded as quickly as possible after establishment of the flood.
- Use pregerminated seed to hasten stand establishment.
- Avoid seeding during periods of cool weather because cool temperatures will delay rice growth but will not delay midge infestations.

Fields should be flooded and seeded as quickly as possible. Delaying seeding after the flood is established allows midge densities to increase before the rice is seeded. Using pregerminated seed is critical for no-till water-seeded fields that have been flooded during the winter. Water-seeding during periods of cool weather delays seedling development and enhances the opportunity for feeding by rice midges.

Management Key

Use pregerminated seed and water seed during warm weather to minimize damage from rice seed midge.

Grasshoppers

Description

Two general types of grasshoppers are commonly found in rice. The two types are short-horned and long-horned grasshoppers. The short-horned grasshoppers have antennae that are shorter than the body, a robust body, a large rounded head and powerful jaws (Photo 12-35). The short-horned grasshoppers can be green, brown, yellow or a mix of the three colors. Long-horned grasshoppers have a slender body with antennae that are as long as or longer than the body (Photo 12-36). They are typically small (1 to 2 inches long) and nearly all green in color. The reference to "long-horned" or "short-horned" is in regards to the length of the antennae.

Short-Horned Grasshoppers [Family *Acrididae*] – Short-horned grasshoppers are usually not as abundant in or around rice fields. However, on occasion, these grasshoppers do become numerous and damage rice. Short-horned grasshoppers are generally found near field margins and on levees. The differential grasshopper [*Melanoplus differentialis* (Thomas)] is the most common short-horned grasshopper known to damage rice. The large hind legs have a row of black chevrons. Adults (1¼ to 1½ inches long) and nymphs have strong jaw muscles and are vegetation feeders. Rice leaves, stems and panicles are occasionally damaged, especially when alternate food sources becomes scarce.

Photo 12-35. Short-horned grasshopper (line = 1 inch).

Along the field or levee margins, short-horned grasshopper feeding may damage newly emerged panicles. The panicle stem may be damaged and result in a whitehead. Careful scouting of field borders can locate potentially damaging infestations. Treatment with an insecticide is at grower discretion and recommended whenever sufficient damage to panicles is evident. No formal scouting system is in place, and treatment is based on evidence of damage. Border treatments may be beneficial. Insecticides are available for control of short-horned grasshoppers (Table 12-5).

Long-Horned Grasshoppers [Family *Tettigonidae*] – The most common and abundant grasshoppers in rice are long-horned grasshoppers. Long-horned grasshoppers may outnumber short-horned grasshoppers by as many as 300 to 1. The adults and nymphs have weak jaw muscles and cause only minor damage to rice foliage. Before panicle emergence, long-horned grasshoppers primarily feed on other insects, including rice water weevils, midge adults, damselfly adults and leafhoppers. After heading, these grasshoppers feed exclusively on pollen while flower anthers

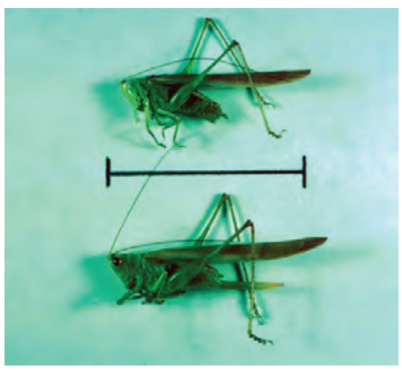

Photo 12-36. Long-horned grasshopper (line = 1 inch).

are available. A small amount of this feeding will damage flower parts and prevent pollination. However, the amount is small and not economically threatening. After flowering, long-horned grasshoppers scavenge anthers from florets at the bottom of the panicle, feed on whatever insects are available and may feed on kernels in the milk stage later in the season. Any kernels that these grasshoppers feed on are at the bottom of the panicle and are either immature or in the milk stage of development. This feeding does not result in an economically important loss. Insecticide application for long-horned grasshopper control is not recommended.

Chinch Bug [*Blissus leucopterus leucopterus* (Say)]

Description

Adults are about ⅕ to ⅙ inch long, black and have wings folded onto their backs that appear like a white "X." The first instar is orange and the other four instars have a black or dark gray head and thorax with a white or yellow band across the top of the abdomen. Both adults and nymphs have piercing-sucking mouthparts.

Photo 12-37. Adult chinch bugs on young rice.

Life Cycle

Adults overwinter in clump grasses. In late spring, adults leave overwintering sites and infest small grains such as wheat, corn, grain sorghum, oats and rice. Females lay eggs at the base of the host plant. By utilizing several hosts, chinch bugs may have as many as three generations per year, but overwintered adults do the most damage to seedling rice.

Damage and Symptoms

Damage is caused from chinch bugs by sucking sap from small plants. In rice, adults and nymphs can be found on nearly all plant parts, including the roots which can be accessed through cracks in the soil and around the plant base. Nymphs often cluster around the plant nodes. Symptoms of feeding injury include stunted plants, red or yellow areas on leaves and leaf sheaths and dead plants. Seedling rice plants are the most susceptible to damage. Severely damaged seedlings turn brown and die.

Scouting and Management

Very low densities of chinch bug adults can be found in almost any rice field. However, chinch bug numbers occasionally increase to damaging levels. Chinch bugs are relatively small, so examine inside whorled leaves, behind the leaf sheath, at the base of the stem and, if the soil is cracked, examine exposed roots. An average of two chinch bugs per 1- to 2-leaf seedling can cause significant seedling mortality, reduction in height and delay in maturity of surviving plants. Therefore, if chinch bug populations average two adults per plant, insecticide application is recommended. Observe fields for areas near the margins of the plants that have yellow or reddish spots and then check for the presence of adults and nymphs.

Should a field or area in a field become infested with chinch bugs, it is best if the field can be flushed prior to treatment. Flushing or flooding will move chinch bugs above the water line and onto the plants by closing the soil cracks. Any treatment will be more effective if the bugs are all on above-ground plant parts. Insecticides for chinch bug control include the synthetic pyrethroids (Declare, Mustang Max, Prolex, Proaxis) and carbaryl (Sevin) (Table 12-6). Remember to apply carbaryl 15 days before or after propanil. The synthetic pyrethroids can be applied safely before or after herbicide applications. However, floodwater cannot be released within 7 days after application of a synthetic pyrethroid. CruiserMaxx Rice and NipsIt INSIDE seed treatments provide suppression of chinch bugs.