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Rice-Feeding Insects of Tropical Asia

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1995
IRRI
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Contents

Abstract

This field guide documents the community of insects that feed on rice in the tropical zone of Asia and complements the IRRI publication *"Helpful insects, spiders, and pathogens: friends of the rice farmers."* It covers 78 phytophagous species in 64 genera, 27 families, and 8 orders. The phytophage guild represents five groups–general defoliators, (27 species), plant suckers (25 species), early vegetative pests (11 species), soil pests (9 species), and stem borers (6 species). Stem borers and plant suckers comprise the major rice pests. A brief description of each insect's life stage and damage it does to the rice plant is presented for a quick and reliable identification.

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Foreword

Before an intelligent decision about managing insect pests can be made, it is necessary to be able to identify which insect species are pests and which are beneficial.

This booklet illustrates representative examples of some of the more common species of insect pests that attack the rice crop.

It can be used with the IRRI booklet *Helpful insects, spiders, and pathogens: friends of the rice farmer,* which provides information only about beneficial species.

The occurrence of insect pests varies depending on the location, time of year, and crop cultural practices. Thus, we made no attempt to rank pest groups by their relative importance. Also, we have illustrated a few nonpest species that could be confused with pests.

Scientific language has been minimized so that the descriptions can be more easily understood. The pictures will provide an easy way of identifying pest species and thereby help prevent unnecessary chemical treatments.

Like *Helpful insects,* this booklet is designed to facilitate its easy and inexpensive translation and copublication in languages other than English. By doing so, it follows IRRI's dual objective in developing publications. First. we want to produce relevant information for our diverse target and client groups. At the same time, it is our aim to promote the production of rice-related literature in the respective partner countries, at low cost in high quality and, where appropriate, in the local language.

The very positive responses we have received so far is encouraging us to follow this policy in the future to the extent possible.

I strongly hope that this little booklet will reach as many IPM decisionmakers as possible on all relevant levels. It will help to increase knowledge about pests and reduce costs for their control.

Klaus Lampe
Director General

Introduction

A large community of insects and spiders is associated with the rice crop, Some are pests, but most are harmless or beneficial species. The leaves, stems, grains, and roots are subject to attack by insect pests during plant development. Fortunately, in tropical South and Southeast Asia, where most rice is grown, populations of insect pests are held in check in most instances by abundant communities of natural enemies (predators, parasites, and pathogens).

Rice plants, particularly high-tillering, modern varieties, have an amazing ability to compensate for damage by insect pests. In general, this compensatory ability declines as the plant matures. For example, research has shown that more than 75% of rice seedlings can be damaged by the whorl maggot without suffering yield loss. More than 20% deadhearts from stem borers can be tolerated by an otherwise healthy crop. The degree of tolerance, however, can vary with local conditions.

Effective insect management programs can be developed only after insect pests have been identified and their population density estimated to determine if significant yield losses could occur. The pest population level that causes economic loss is called the economic threshold. Threshold levels will vary by plant maturity. seeding density, fertility level, and the presence of pests and their natural enemies as well as environmental stresses. Pest species at densities below the economic threshold should not be targets for corrective action. Potential pest species at these noneconomic densities are important food sources for beneficial species. Indiscriminate use of insecticides not only reduces this food source but reduces the population of beneficial species themselves.

This book is divided into six sections: 1) pests that only attack the early crop, 2) general defoliators that attack all growth stages, 3) stem borers, 4) plant suckers, 5) grain suckers, and 6) soil pests.

This identification guide to rice insect pests is a companion to *Helpful insects, spiders, and pathogens: friends of the rice farmer.*

early vegetative pests

Early vegetative pests—rice caseworm

Nymphula depunctalis (Guenée)
Lepidoptera: Pyralidae

The rice caseworm is a moth that is highly specialized to semiaquatic environments. The larvae respire through gills and require standing water in a ricefield.

The first sign of caseworm is the characteristic cut leaves; the leaf blades are cut as though by scissors **(Fig. 1).** Cut leaf sections are used by the larvae to make their protective tubular cases. Cut leaf blades naturally roll up into a tube, which the larvae secure with silk. Larvae remain in their floating cases on the water surface during the day and feed at night **(Fig. 2).** They climb up the rice plants carrying their rolled leaf cases, each containing a reservoir of water for respiration. While moving or feeding, the larvae extend their heads out of the cases and cling to the leaf blade with their front legs **(Fig. 3).**

Larvae damage the plant by scraping the leaf blade leaving only the thin surface. Damaged leaves dry up and turn white **(Fig. 4).**


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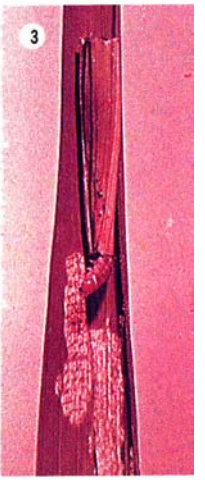
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Because wind tends to concentrate the floating leaf cases, damage often occurs in patches (**Fig. 5**). A young, vigorously growing crop can normally recover from high levels of defoliation.

The moths are bright white with light brown and black spots (**Fig. 6**). The rice caseworm is often confused with its look-alike relative *Parapoynx fluctuosalis* (Zeller). which does not feed on rice (**Fig. 7**). Instead its larvae feed on an aquatic weed *Hydrilla*.

Moths are active at night but remain sheltered in the crop foliage during the day keeping away from bird and dragonfly predators. When disturbed, the caseworm moths fly short distances and alight within the rice canopy. Eggs are laid on the under surfaces of leaves drooping into the water. The pale, yellowish green eggs are laid in one or two long rows (**Fig. 8**).

The overlapping eggs turn yellow as they mature. and the developing larvae can be seen within each egg (**Fig. 9**). Submergence protects the eggs from parasites and predators. As the crop matures, its leaves no longer touch the water thus denying favorable oviposition sites. That may be one reason caseworm becomes abundant only on a young crop inasmuch as exposed eggs dry out and are more vulnerable to natural enemies.

The larvae hatch underwater and begin scraping leaf tissue. When the larval case is opened, pairs of threadlike gills can be seen coming from each body segment (**Fig. 10**). The yellowish green larvae are translucent with their digestive tracts visible within their bodies. Cases are replaced with each molt. The pupae must breathe air, so in preparation for pupation, the larvae crawl above the water level and secure their cases to the rice plant.

The pupae form inside the larval cases (**Fig. 11**).


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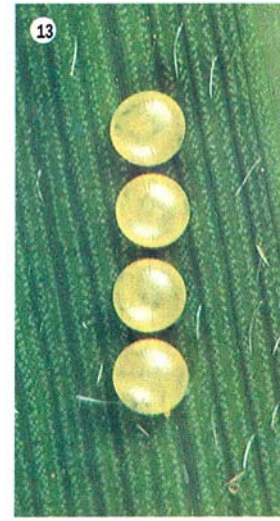
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Early vegetative pests—green hairy caterpillar

Rivula atimeta (Swinhoe)
Lepidoptera: Noctuidae

The first sign of the green hairy caterpillar is usually the moths. which dart off in short flights when they are disturbed. The moth is triangular, cream colored, and characteristically alights with its head facing downward **(Fig. 12).** Like other rice moths, the adults mate and lay eggs only at night seeking protection from aerial predators during the day.

The spherical and pale green eggs are laid in small clusters on leaf blades **(Fig. 13).** Being laid openly, the eggs are vulnerable to both egg parasites and predators.

Young green hairy caterpillars **(Fig. 14)** scrape tissue from leaf blades leaving only the lower white surface.

Older larvae have large mandibles that enable them to cut out sections of leaf blades (**Fig. 15**). When larval populations are high, the rice plants become severely defoliated creating uneven areas in the field (**Fig. 16**). A healthy crop, however, can tolerate much damage at this stage by sending out more tillers. Like the larvae of other defoliating moths, green hairy caterpillar larvae also feed on common ricefield weeds.


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Mature larvae do not form pupal chambers by folding over leaf blades (**Fig. 17**) as the green semilooper. The young pupae (**Fig. 18**) are green; the mature pupae (**Fig. 19**) are dark brown. Moths emerge in less than a week.

Early vegetative pests-green semilooper

Naranga aenescens **(Moore)**

Lepidoptera: Noctuidae

The green semilooper moth is yellow orange with two diagonal, dark red bands on each front wing as seen in this mating pair (**Fig. 20**). Its life cycle and damage are similar to those of the green hairy caterpillar.

Eggs are yellow and develop purple to violet markings as they mature (**Fig. 21**). They are laid in small clusters on leaf blades.

The damage is identical to that from the green hairy caterpillar. Young larvae scrape tissue from leaf blades leaving only the lower white surface (**Fig. 22**).


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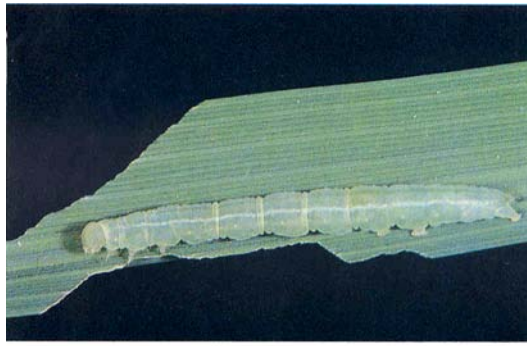

Older larvae form pupal chambers **(Fig. 17)** or cut out sections of leaf blades **(Fig. 23).** Normally, the rice crop can tolerate high levels of defoliation. Populations decline as the rice crop matures and natural enemy activity, particularly that of egg predators, increases sharply.

Green semilooper larvae make elaborate cocoons to protect the brown pupae from predators and parasites **(Fig. 24).** Parasites normally attack the larval stage and emerge after their host pupates.

Early vegetative pests—rice whorl maggot

***Hydrellia philippina* Ferino**

Diptera: Ephyridae

The whorl maggot is a fly that is particularly attracted to recently transplanted rice plants in standing water. Larvae of whorl maggots are translucent **(Fig. 25)** and tunnel within rice tillers and rasp the growing points of the developing leaves. The leaves later emerge showing characteristic yellow spots, streaks, and deformations **(Fig. 26).** Although plants become stunted and heavy infestations can delay crop maturity by 7-10 days, the crop normally can compensate unless under stress from other pests or environmental factors **(Fig. 27).**


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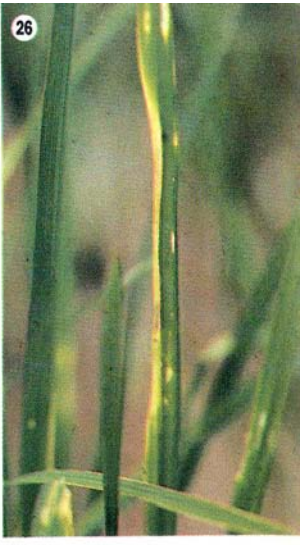
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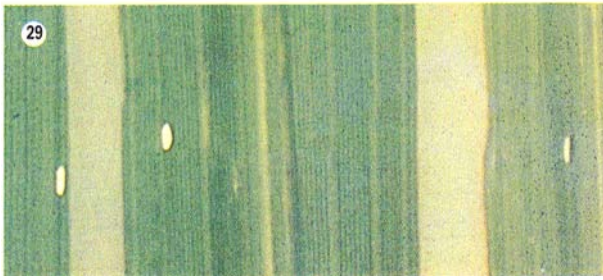
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Whorl maggot adults (**Fig. 28**) are gray, one-third the size of a house fly, and lay single, banana-shaped, white eggs on the leaves (**Fig. 29**).

The shell of the elongated egg is hard and protects it from egg parasites and most predators (**Fig. 30**). The adults are active only during daytime; at dawn, they are found resting on rice plants. Eggs are not laid if the water surface is covered by the crop canopy as in seedbeds, direct seeded fields, or an older transplanted crop. Whorl maggots pupate within larval tunnels or between two leaf sheaths (**Fig. 31**). Adult flies emerge in about one week.


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Early vegetative pests—rice seedling maggot

Atherigona oryzae Malloch
Diptera: Muscidae

Rice seedling maggot infests only upland ricefields or more rarely lowland fields without standing water. The larvae of this fly cut young tillers causing deadhearts (**Fig. 32**). A severely attacked field will have many missing plants as a result of tillers having been totally severed (**Fig. 33**). The fly has a wide host range and passes the dry season in dormancy. It re-emerges with the onset of the wet season. Thus, the seedling maggot is highly seasonal and can be avoided by early or late planting.

The adult is a common looking yellowish gray fly (**Fig. 34**) and is active during the day. It has two or three pairs of dorsal black spots on the lower half of the yellow abdomen.

Females lay elongated, white eggs on leaf blades, either singly or in small clusters (**Fig. 35**). The larvae are shiny, yellow maggots (**Fig. 36**), which descend to the base of the plants where they sever tillers to feed. Larvae feed on the decaying deadhearts. Damage only occurs during the tillering stage of crop growth as the larvae cannot cut hard, mature tillers with their rasping mouth hooks. Rice plants hardly compensate for seedling maggot damage. The larvae pupate within the base of tillers or less commonly in the soil (**Fig. 37**).


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Early vegetative pests—Asian rice gall midge

Orseolia oryzae (Wood-Mason)
Diptera: Cecidomyiidae

The Asian gall midge is a fly that attacks the crop only in the tillering stage. The mosquitolike adult female is reddish (**Fig. 38**); the male is yellow brown. Adults are active at night, are highly seasonal, and are attracted to light. An impending attack by the gall midge is signaled by the occurrence of adults on walls near lights. The gall midge attacks only cultivated rice and wild rice; related species attack grassy weeds. The gall midge is distributed only where suitable species of perennial wild rices occur to provide them shelter during dormancy in the dry season. But new nondormant strains are emerging in areas with dry season rice cropping. Early crop plantings normally escape attack by the gall midge. Late plantings are protected by the high incidence of larval parasites.

Eggs are laid openly on leaf blades in clusters and change color as they mature, appearing brownish, pink, or amber (**Fig. 39**).

The newly emerged maggot (**Fig. 40**) tunnels to the based of tillers and feeds on the growing points. Chemicals in the larval saliva cause the plant to grow abnormally, producing a hollow cavity at the base of a tiller (**Fig. 41**) within which the maggot feeds.


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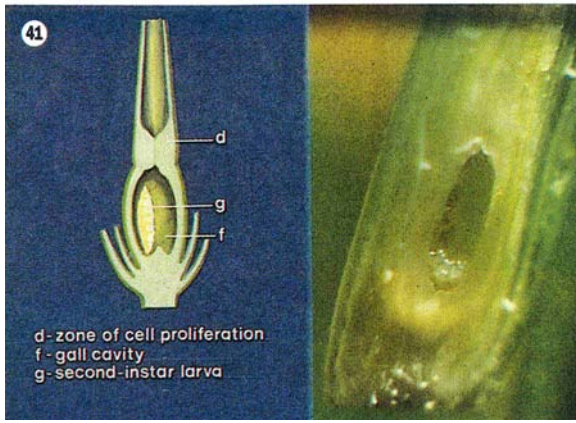
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d - zone of cell proliferation
f - gall cavity
g - second-instar larva


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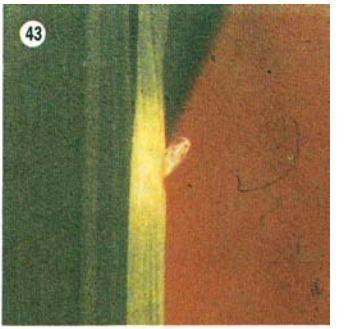
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Affected tillers become tubular and silvery colored similar to an onion shoot **(Fig. 42).**

The adult midge emerges through a hole in the infested tiller leaving its pupal case behind **(Fig. 43).** If the gall midge population lays eggs only during a short span of several weeks, an otherwise healthy crop may be able to produce enough tillers to compensate for damaged tillers. But if the gall midge attack occurs over an extended period, the new tillers also become infested causing severe stunting and high yield loss.

Rice leaf miner *Agromyza oryzae* (Munakata) *Pseudonapomyza asiatica* Spencer Diptera: Agromyzidae

Several species of flies are leaf miners of rice **(Fig. 44).** Their life cycles and damage are similar. Eggs are inserted into leaf tissue by ovipositing flies. Emerging larvae tunnel within the leaf blades consuming leaf tissue, leaving only the thin white outer leaf surface intact for protection from most natural enemies and for retaining plant moisture.

The pale yellow larva of the rice leaf miner is visible within its tunnel **(Fig. 45).**


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The irregular feeding tunnels of *Pseudonapomyza asiatica* are distinctly visible on the leaf blade **(Fig. 46).** Some highly specialized parasites can locate leaf miner larvae within their tunnels and deposit eggs in their host without entering the tunnel.

As with the larvae, the oval, black pupae are also conspicuous in the feeding tunnel **(Fig. 47).** The entire life cycle is passed within one tunnel.

Damage by leaf miners is usually not serious as the larvae are small and each tunnel affects only a small portion of a leaf blade. High populations would be required before economic losses would occur.

Early vegetative pests—flea beetles

Chaetocnema basalis (Baly)
Coleoptera: Chrysomelidae

Several flea beetle species feed on rice. All are small and damage is done only by the adult. The shiny adults have enlarged hind legs, which allow them to jump in a manner similar to a flea when they are disturbed (**Fig. 48**).

Large numbers of adults can aggregate on rice plants during the vegetative phase. They attack nonflooded fields and are prevalent in upland and early season deepwater rice. Adults make distinctive, long, narrow scrapings on the leaves (**Fig. 49**) after which strong winds cause damaged leaves to shred (**Fig. 50**). Normally, only low levels of defoliation occur from the feeding of these tiny beetles, and they are not considered a major pest in most rice-growing areas.

Larvae develop on the roots of grasses in fallow upland areas and are not pests of rice.


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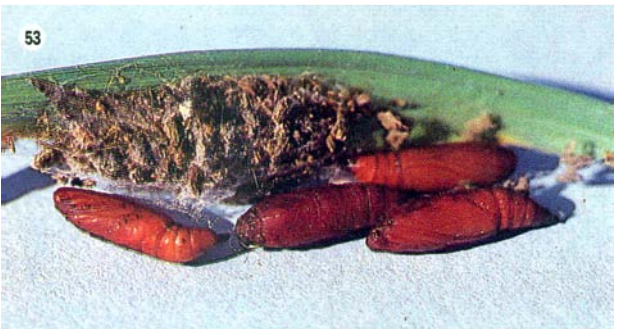
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Early vegetative pests—grass webworm

Herpetogramma licarsisalis (Walker)
Lepidoptera: Pyralidae

The grass webworm is a moth that occurs in upland and well-drained rainfed lowland fields, but is generally uncommon. Egg predators and other natural enemies normally keep webworm numbers in check. The larvae make tunnellike shelters on the outside of plants from webbing and excreta. Each tunnel has several trap doors from which the larvae emerge. Young larvae defoliate plants by scraping leaf tissue.

The larvae are translucent with short hairs extending from their bodies (**Fig. 51**). Pupation takes place within shelters made from cut leaf sections tied together by silk webbing (**Fig. 52**). Two or more brown pupae can be found inside each webbed shelter (**Fig. 53**).

The adult moths are gray brown (**Fig. 54**) and mate and oviposit at night. The disc-shaped eggs are laid on the leaf blade in an overlapping fashion (**Fig. 55**). The eggs turn orange brown as they mature (**Fig. 56**).


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general defoliators

General defoliators—hispa beetles

Rice hispa *Dicladispa armigera* (Olivier) *Leptispa pygmaea* Baly Coleoptera: Chrysomelidae

Rice hispa is a beetle that can become highly abundant, particularly in flooded rice in swampy areas. The adult is shiny black (**Fig. 57**) and covered with characteristic spines (**Fig. 58**). Adults and larvae feed on the leaves and frequently become sufficiently abundant to defoliate large tracts of rice, causing high yield losses (**Fig. 59**).


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Adults fly to ricefields from nearby areas and feed by scraping leaf tissue, making elongated, clear, feeding marks similar to the damage of flea beetles (**Fig. 60**). Oval eggs are inserted singly within leaf blade tissue (**Fig. 61**).

The larvae hatch and become leaf miners (**Fig. 62**). The miner appears translucent as only the white surface remains (**Fig. 63**).

Pupation occurs within the larval tunnels (**Fig. 64**). The feeding behavior of hispa larvae offers protection against natural enemies, which may be one reason why outbreaks recur.

A related but less abundant species *Leptispa pygmaea* is longer and lacks spines (**Fig. 65**). It produces the same damage symptoms as the rice hispa.


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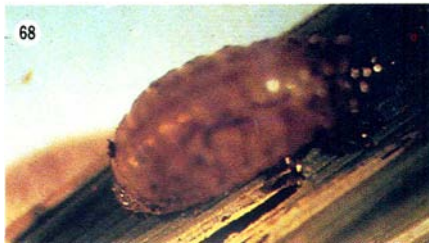
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General defoliators—rice leaf beetle

Oulema oryzae (Kuwayama)
Coleoptera: Chrysomelidae

The rice leaf beetle is similar to the hispa beetle, but the larvae do not tunnel within leaf blades. The leaf beetle is restricted, however, to temperate regions. Both adults and larvae are defoliators and cause damage similar to that of hispa.

The adult is shiny black with a brown thorax (**Fig. 66**). The black, oval eggs are laid in masses on leaf blades and are covered by excreta produced by the female (**Fig. 67**). The excreta may protect the eggs from natural enemies.

Larvae have large, globular abdomens and feed by scraping leaf tissue (**Fig. 68**).

Their bodies are also covered by their own excreta (**Fig. 69**).
Pupation occurs within a silken cocoon on the leaf blade (**Fig. 70**).


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General defoliators—armyworms

Swarming caterpillar *Spodoptera mauritia acronyctoides* (Guenée)
Ear-cutting caterpillar *Mythimna separata* (Walker)
African armyworm *Spodoptera* exempta (Walker)
Lepidoptera: Noctuidae

Armyworms are larvae of a group of robust moths. About a half dozen species prefer rice. The larvae tend to aggregate in the field after hatching from an egg mass, which may contain hundreds of eggs, but disperse as they mature. The larvae are voracious defoliators and occur in seedbeds, particularly dry seedbeds, but can damage the crop at any age. The name armyworm is applied to those species that migrate en masse to neighboring fields after severely defoliating a crop.

Armyworm larvae are more adapted to nonflooded fields because they pupate in the soil and the larvae readily drown when submerged. Their presence in the field is characterized by localized patches of defoliation or severed panicles. On cloudy days the larvae feed in the upper canopy (**Fig. 71**). The larvae are stout and hairless and curl into the shape of a C when held in the hand. Color varies considerably within the same species.

The larvae feed from leaf edges, removing whole sections of the leaf blades (**Fig. 72**). Armyworms are particularly abundant after droughts or floods, which kill their natural enemies—usually larval parasites. Armyworms also tend to be more abundant in the wet season with the greater availability of alternate grassy weed hosts. Armyworm larvae are also susceptible to epidemics of insect diseases, particularly viruses.

General defoliators—armyworms

Swarming caterpillar *Spodoptera mauritia acronyctoides* (Guenée)

Lepidoptera: Noctuidae

The rice swarming caterpillar is an armyworm. The dark brown moth **(Fig. 73)** has dull, gray brown front wings with black markings. It is a strong flier and can migrate tens and even hundreds of kilometers in fast-moving monsoon weather fronts to quickly colonize ricefields. Swarms of moths often concentrate in the same area causing patches of severe damage. The eggs are laid on leaves and covered with pale hairs from the female's abdomen **(Fig. 74).** A female will lay several hundred eggs in the mass, and the larvae hatch within minutes of each other, usually in the morning **(Fig. 75).**


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The body of the rice swarming caterpillar larvae can be shades of green, gray, or brown with dark, longitudinal stripes. There are two rows of C-shaped black spots along the back (**Fig. 76**). Different colored larvae still retain the C-shaped spots (**Fig. 77**).

The stout, brown larvae burrow into the soil to pupate (**Fig. 78**). If the field is flooded, they pupate on the plant (**Fig. 79**).


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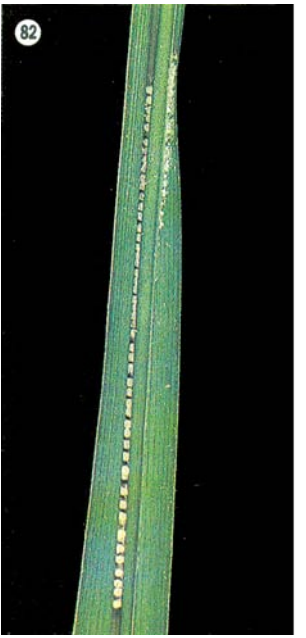
Ear-cutting caterpillar *Mythimna separata* (Walker)
Lepidoptera: Noctuidae

The ear-cutting caterpillar gets its name from its habit of cutting panicles. Its larvae are also defoliators during the vegetative and reproductive phases but during the ripening phase can cause high yield loss (**Fig. 80**).

The ear-cutting caterpillar moth is orange brown with light brown front wings (**Fig. 81**).

The eggs are laid in rows along leaves, which fold over and protect the eggs (**Fig. 82**). The pale yellow, spherical eggs can be seen when the leaf blade is unfolded (**Fig. 83**).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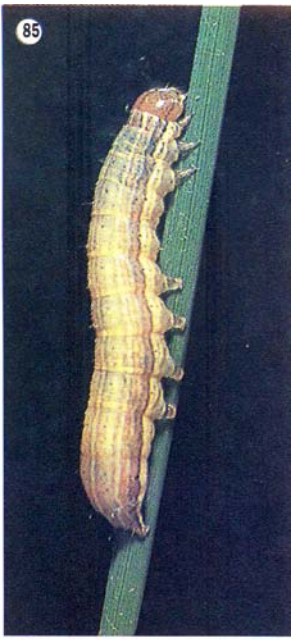
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As with other armyworms, the body of the larvae can be of many colors but is usually light brown or gray green. The distinguishing feature is the longitudinal dark band midway down the side of the body (**Fig. 84**). Another individual exhibits the same band (**Fig. 85**).

The larvae can pupate in the soil or on plants. The pupae are similar to those of other armyworms (**Fig. 86**).

African armyworm *Spodoptera exempta* (Walker) Lepidoptera: Noctuidae

Despite its name, the African armyworm also occurs in Asia, As is true with all armyworms, it can concentrate in numbers to severely defoliate rice, usually in patches (**Fig. 87**).

The larvae are similar to those of the swarming caterpillar and have C-shaped dark spots along the back. The color of the larvae is lighter than that of the swarming caterpillar (**Fig. 88**).


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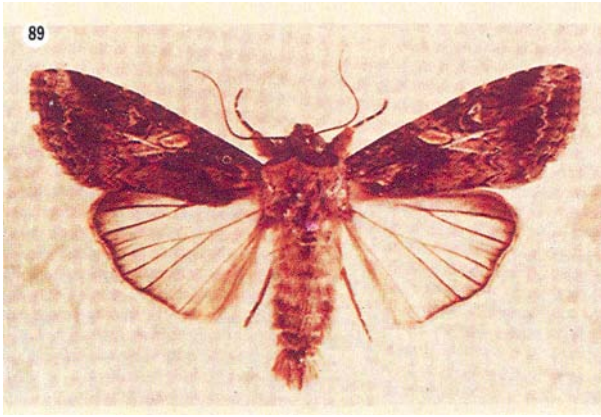
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The moth is similar to the common cutworm with fewer white markings on the front wings (**Fig. 89**).

General defoliators—cutworms

Common cutworm *Spodoptera litura* (Fabricius) Lepidoptera: Noctuidae

Cutworms are similar in appearance to armyworms, but the name refers to species that prefer to live in the soil as larvae, which cut the bases of seedlings. They often increase in upland areas and disperse to nearby ricefields.

The front wings of the common cutworm moth are dark brown with distinctive black spots and white and yellow wavy stripes (**Fig. 90**).

Larvae can be brown or green with longitudinal stripes, but are distinguished by the black spots ringing the body about one-fourth of the body length behind the head (**Fig. 91**).

This cutworm has a low preference for rice and usually occurs on other crops or weeds. The larvae can shift to rice after weeding or harvest of a nearby nonrice crop.


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General defoliators—leaffolders

Rice leaffolders
Cnaphalocrocis medinalis (Guenée)
Marasmia patnalis Bradley
Marasmia exigua (Butler)
lepidoptera: Pyralidae

Rice leaffolders are commonly found in most ricefields. Several species of rice leaffolders are defoliators and share similar life histories. The larval and pupal stages are spent within the shelter provided by a folded leaf. To fold the leaf. the larva alternately attaches silk strands to each edge of the blade by moving its head to and fro while moving backward **(Fig. 92).** The silk contracts upon drying, rolling the entire leaf blade into a tube. The folded leaf protects the larvae from rainfall and provides partial protection from some natural enemies.

Leaffolders become more prevalent with high levels of fertilizer and indiscriminate use of insecticides. Nitrogen fertilizer enriches the food value of the leaf blade, causing the larvae to feed more voraciously and grow faster. becoming larger adults that produce more eggs. Even though the larvae appear well protected within a folded leaf. they are normally highly parasitized by wasps. Predators are important in keeping populations of leaffolders under control by feeding on eggs. Examples of these include beetles, crickets, and the mirid bug *Cyrtorhinus lividipennis* Reuter. Insecticides inadvertently kill many natural enemies, which normally keep leaffolder numbers in check. Predators contact more insecticide as their searching behavior causes them to walk over treated foliage in contrast to the more stationary insect pests.

Leaffolder larvae scrape the green tissue from within the folded leaf blade, leaving a lower white surface (**Fig. 93**). Under heavy attack, a field will appear gray white from a distance (**Fig. 94**). The larvae normally seek a new leaf after each molt; each larva, therefore, can damage up to five leaves before pupation.

Leaffolders are common and can be found in almost every ricefield and during any crop growth stage. Greatest yield loss occurs from damage to the flag leaf and the next two youngest leaves in each tiller. Damage before panicle exsertion normally can be tolerated, particularly if the crop is not otherwise stressed. Rice farmers often treat for this pest even when populations are too low to cause yield loss.

The first sign of leaffolder infestation is the presence of moths in the field. As a person walks through the fields, flushed moths will dart and flutter in a characteristically erratic manner. The moths are yellow brown with dark markings. When at rest, a moth appears triangular.


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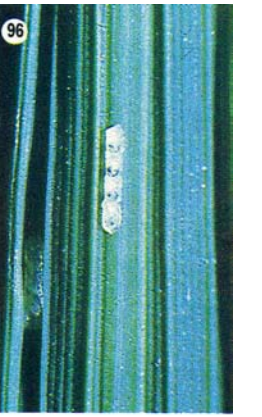
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General defoliators—leaffolders

Cnaphalocrocis medinalis (Guenée)

Lepidoptera: Pyralidae

Cnaphalocrocis medinalis can be distinguished from other related species by the complete, transverse bottom band nearest the tips of the front wings (farthest away from the head) (**Fig. 95**). Also, the middle of the three dark bands is incomplete. *Cnaphalocrocis* has numerous grassy-weed alternate hosts. The moths are inactive during the day but move about freely at night to mate and lay eggs. *Cnaphalocrocis* moths are highly migratory and are more attracted to ultraviolet light traps than to fluorescent light traps. As is common with moths, the male finds the female by a chemical perfume called a pheromone, which is emitted by the female.

The eggs are laid in small clusters on the leaf blades and are barely visible to the naked eye (**Fig. 96**). Close up, the eggs appear disc-shaped (**Fig. 97**). If not consumed by a predator or parasitized, the eggs will hatch in about 5 days.

Newly hatched larvae seek the protection of the bases of unopened leaves where they begin scraping tissue from leaf blades. Young larvae are translucent but turn yellowish green as they mature. The digestive tract with leaf tissue is visible within the body. The head capsules and thoraxes of the larvae are brown. The larvae of *Cnaphalocrocis* have one pair of dark spots on the abdomen near the head (**Fig. 98**). Larvae tend to be more abundant during the vegetative stage of rice.

After the larval feeding period, each larva spins a silken cocoon and pupates within the folded leaf chamber (**Fig. 99**).

The pupa is brown without distinctive features (**Fig. 100**).


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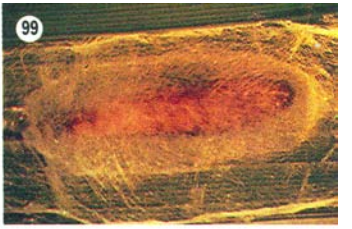
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General defoliators—leaffolders

Marasmia patnalis Bradley
Lepidoptera: Pyralidae

Marasmia patnalis is different from other leaffolders in that it feeds almost exclusively on rice. It is as prevalent as *Cnaphalocrocis medinalis* and tends to be more numerous during the reproductive stage of rice.

This leaffolder moth can be distinguished from the other species by having an incomplete third (bottom) band which connects the middle bands (**Fig. 101**). *Marasmia patnalis* moths are more attracted to fluorescent light traps than to ultraviolet light traps.

The egg and pupa are indistinguishable from other leaffolders.

Marasmia patnalis larvae characteristically have two pairs of faint spots behind the head region (**Fig. 102**). Defoliation during the reproductive stage leads to higher yield losses than the equivalent damage during the vegetative stage. All leaffolder species share the same wide array of predators, parasites, and pathogens that attack all leaffolder stages.

Marasmia exigua (Butler)
Lepidoptera: Pyralidae

Marasmia exigua is smaller and less fertile than the other two leaffolder species and is less commonly found. It is more abundant during the reproductive stage of rice. The moth can be distinguished by the three or four complete bands (**Fig. 103**).

The larvae of *Marasmia exigua* are smaller and yellowish green with no apparent spots (**Fig. 104**). As with *Cnaphalocrocis medinalis,* the larvae have a wide host range of ricefield weeds.


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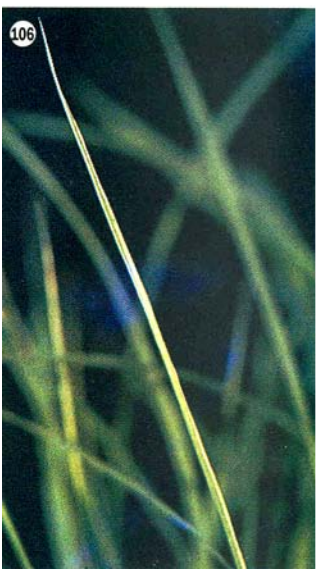
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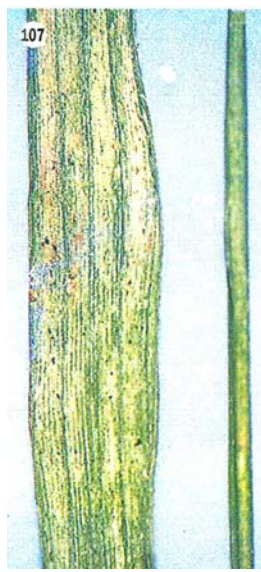
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General defoliators—thrips

Stenchaetothrips biformis (Bagnall) Thysanoptera: Thripidae

Thrips are small, soft-bodied insects, which rasp leaf tissue in both lowland and upland rice. They become abundant during dry periods. A heavy downpour can severely lower thrips numbers. Irrigated rice is often damaged in the vegetative phase in the dry season (**Fig. 105**). The rasped leaves dry up and turn brown. In upland rice, another symptom is leaf rolling caused by thrips feeding (**Fig. 106**). But rolled leaves are also a symptom of drought; unrolling the leaves verifies the presence or absence of thrips.

Rolled leaves offer high humidity and protection from some predators. Various stages of thrips and yellow feeding damage can be readily seen in **Figure 107.**

Thrips insert their eggs into leaf blades and the white, wingless larvae emerge (**Fig. 108**). The larvae become darker as they mature (**Fig. 109**). The black-winged adult also scrapes leaf tissue (**Fig. 110**).


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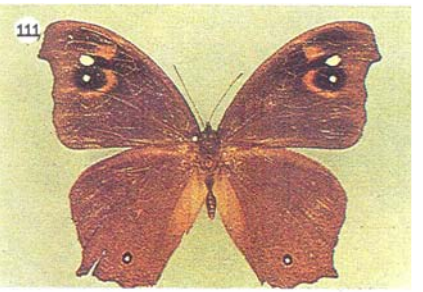
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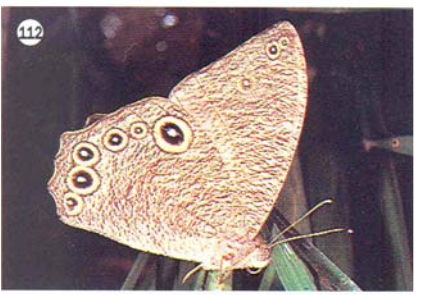
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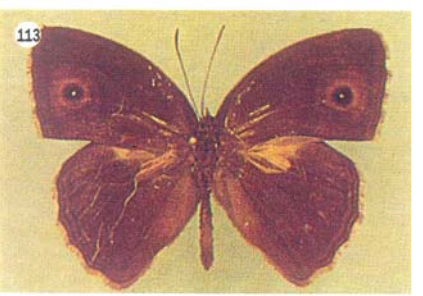
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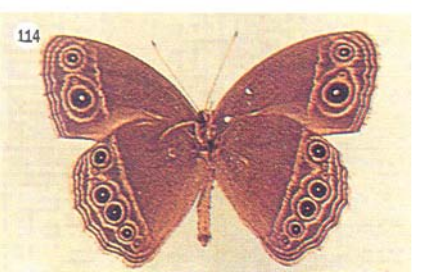
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General defoliators—greenhorned caterpillars

Melanitis leda ismene Cramer
Mycalesis sp.
Lepidoptera: Satyridae

The larvae of several species of greenhorned caterpillars defoliate rice and are more remarkable for their large, conspicuous larvae than for the damage they cause. They rarely become abundant because parasites normally keep them under control. In addition, they have low rates of reproduction and tend to colonize the rice crop after the vegetative phase.

The adult butterflies hide during the day in shady areas in or near the rice crop. The adults rest with their wings folded shut above their bodies. The brown coloration camouflages them and the wing markings resembling eye spots are defense mechanisms to frighten away predatory birds.

The two common genera of greenhorned caterpillars—*Melanitis* (**Fig. 111, 112**) and *Mycalesis* (**Fig. 113, 114**)—can be distinguished by the pattern of eye spots on the top and undersides of their wings. *Melanitis* adults have two white ring spots on the front wing and seven on the back wing of the top side (**Fig. 111**). On the underside, there are three spots on the front wing and six on the back wing, all ringed with violet and yellow circles (**Fig. 112**). *Mycalesis* adults, on the other hand, have only a single ring spot on the top side of their wings (**Fig. 113**). The underside has two in the front wing and five in the back wing (**Fig. 114**). The butterflies become active at dusk when mating and egg laying occur.

The shiny, spherical eggs are laid singly or in small clusters openly on the leaf blades (**Fig. 115**).

The larvae are called greenhorned caterpillars because of the two pairs of horns; one pair on their heads and another pair projecting from the rear of their bodies. The horns may frighten predators such as birds. The horns on the head of *Melanitis* are white or black (**Fig. 116**); those on *Mycalesis* are red (**Fig. 117**).


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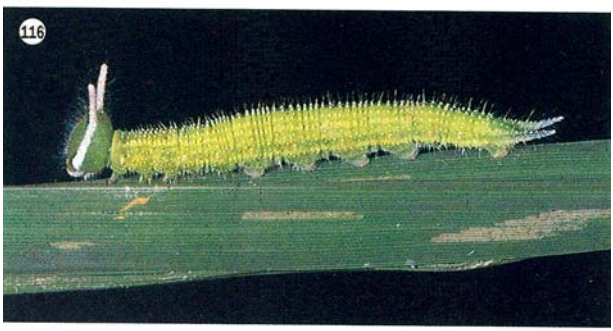
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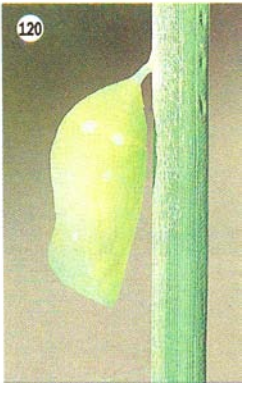
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The larvae feed openly on the foliage. The mature larvae are capable of removing large amounts of leaf tissue (**Fig. 118**).

Upon pupation, the larva attaches its rear end to a tiller and forms a smooth, light green pupa, which hangs head downward. The pupa of *Mycalesis* is more elongated (**Fig. 119**) and bears no constriction toward the head region compared with that of *Melanitis* (**Fig. 120**). The adult emerges from the pupa and can migrate long distances in search of plant hosts. Greenhorned caterpillars feed on a wide array of grasses as well as rice.

General defoliators—skipper butterflies

Pelopidas mathias (Fabricius)
Parnara guttata Bremer & Grey
Lepidoptera: Hesperiidae

Skipper butterflies are day fliers, and the adults are often found sucking nectar from flowers (**Fig. 121**). The name skipper refers to the darting flight pattern of the adult. They require sugar as energy source for flight and for egg development. There are several species of skippers, but the two most common are *Pelopidas mathias* (**Fig. 122, left**) and *Parnara guttata* (**Fig. 122, right**), which can be distinguished by the pattern of white spots on their brown wings. The adults rest with their wings upright as shown by *Pelopidas mathias* (**Fig. 123**).


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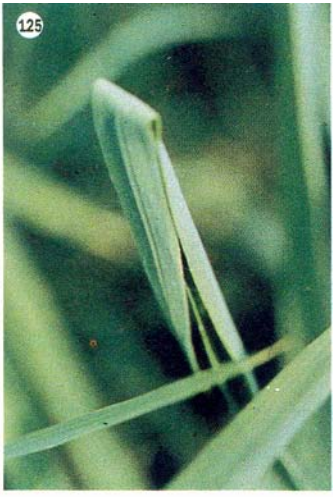
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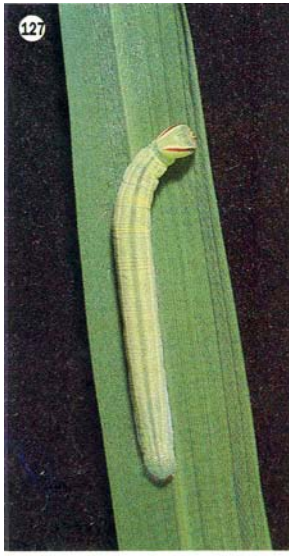
The pearl-like eggs are laid singly on leaf blades (**Fig. 124**). The skipper larvae are about the same size as those of greenhorned caterpillars but they lack horns. Their heads are flat and slanted backward. The defoliation they cause is similar to that caused by greenhorned caterpillars. Skipper larvae make shelters inside folded leaves, but the method of folding the leaf is different from that done by leaffolders. Skipper larvae bring the leaf tip down to form the protective chamber (**Fig. 125**).

The larvae of the different species can be distinguished by the coloration on the head (**Fig. 126**).

Pelopidas larvae have reddish vertical bands at each side of the head (**Fig. 126 [left], 127**) whereas the bands in *Parnara* are dark brown, closer together, and W-shaped (**Fig. 126 [right], 128**). The larvae hide during the day within folded leaves and form a pupa similar to that of the greenhorned caterpillar (**Fig. 129**). Numbers are usually low due to an array of egg and larval predators, low fertility, and wide host range.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General defoliators—brown semilooper

Mocis frugalis (Fabricius)
Lepidoptera: Noctuidae

Another group of defoliating larvae are the false loopers or semiloopers. The brown semilooper is an example. This moth prefers upland environments and the larvae remove leaf tissue from many kinds of plant hosts.

Adult moths are triangular at rest and are shades of gray and brown (**Fig. 130**). The spherical eggs are white and mottled brown (**Fig. 131**).

Larvae have no legs in the middle of their bodies causing them to form a loop when they crawl. The elongate larvae have brown, gray. and light green stripes (**Fig. 132**). Larvae defoliate rice leaves in the same manner as armyworms.

Larvae fold the leaf over when they are ready to pupate (**Fig. 133**). Pupae are brown with a tinge of gray (**Fig. 134**). Populations are normally low as rice is not a preferred host.


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General defoliators—hairy caterpillars

Creatonotus gangis Linnaeus
Lepidoptera: Arctiidae

A number of species of hairy caterpillars. of which *Creatonotus gangis* is an example, can also be found from time to time in a rice crop. The large caterpillars are covered by long hairs (**Fig. 135**). Often these hairs will produce an irritating sting if handled. The voracious caterpillars can defoliate a plant quickly but normally their numben are low inasmuch as rice is not a preferred host (**Fig. 136**).

Pupation occurs on the plant in flooded rice or in the soil in drier habitats (**Fig. 137**). Pupae are protected by hairs from the shed larval skin (**Fig. 138**).

Moths are stout and often brightly colored (**Fig. 139**). A female lays hundreds of golden eggs in neat rows on the foliage without covering them (**Fig. 140**). Many of the eggs, however, are attacked by predators and parasites.


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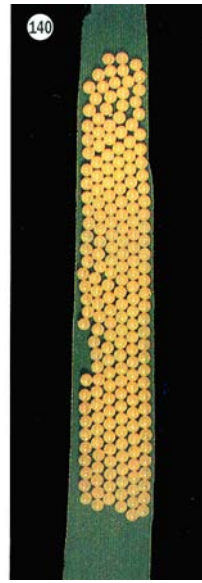
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General defoliators—grasshoppers

Rice grasshopper *Oxya hyla intricata* (Stål) Orthoptera: Acrididae

Grasshoppers and locusts can be distinguished as adults from related species by having antennae shorter than their body length.

The rice grasshoppers (several species of *Oxya*) are adapted to aquatic environments and lay their eggs on rice foliage. Adults are emerald green with a black band on the thorax extending to the wings as shown by *Oxya hyla intricata* (**Fig. 141**)**.**

The yellow, capsule-shaped eggs are laid behind leaf sheaths in compact masses covered with a white frothy secretion to protect them from drying out **(Fig. 142).** As with all grasshoppers, both nymphs and adults feed on leaf tissue, consuming large sections from the edges of leaf blades.

General defoliators—grasshoppers

***Ailopus thalassinus tamulus* (Fabricius)**
***Heteropternis banian* I. Bolivar**
Acrida sp.
***Acrida turricata* (Linnaeus)**
Orthoptera: Acrididae

***Atractomorpha psittacina psittacina* (de Haan)**
***Atractomorpha bedeli* Olivier**
Orthoptera: Pyrgomorphidae

Most grasshoppers are adapted to rainfed environments and usually have low preference for rice. They tend to be more prevalent in areas with extensive uncultivated grasslands nearby, and often several species occur together. They may be difficult to recognize as there are color variations between individuals or stages.

Adults of the same species such as *Ailopus thalassinus tamulus* may be colored differently (**Fig. 143, 144**). Color may vary between sexes and even within the same sex. The nymph (**Fig. 145**) may also be colored differently from the adult.


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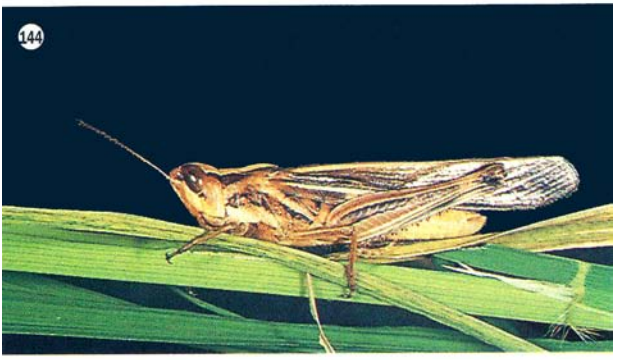
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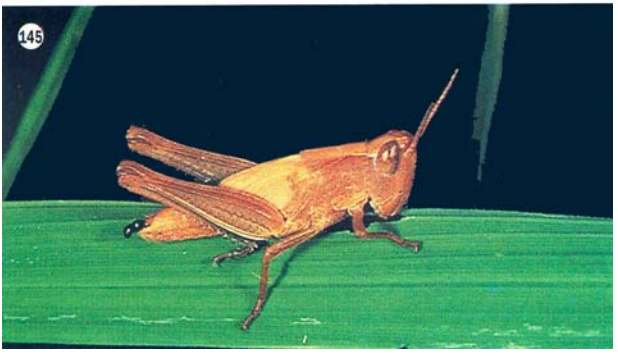
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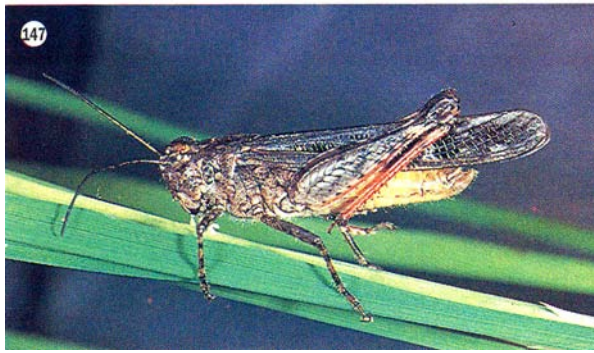
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But the color of nymphs (**Fig. 146**) and adults (**Fig. 147**) of other species, such as *Heteropternis banian*, can be similar.

Body shapes of grasshoppers may also vary widely. Some have slanted faces and highly elongated heads such as *Acrida* sp. (**Fig. 148**) and *Acrida turricata* (**Fig. 149**).


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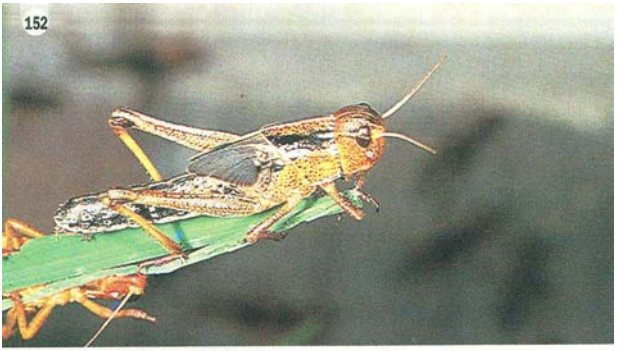
Others such as *Atractomorpha psittacina psittacina* (**Fig. 150**) and *Atractomorpha bedeli* (**Fig. 151**) have slanted and short pointed heads.

General defoliators—locusts

Locusta migratoria manilensis (Meyen)
Orthoptera: Acrididae

Locusts such as *Locusta migratoria manilensis* are grasshoppers which can become highly abundant and can migrate in swarms. These species prefer drier environments and avoid flooded rice. They may feed more on weeds in ricefields than on rice itself.

The color of the nymph (**Fig. 152**) and adult (**Fig. 153, 154**) may vary widely. The darker individuals are migratory forms with longer wings and stouter musculature (**Fig. 154**). The migratory form appears as a result of crowding during periods of high populations. Locust outbreaks often follow droughts.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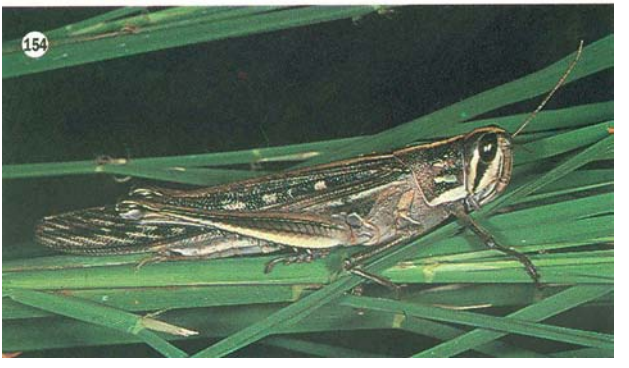
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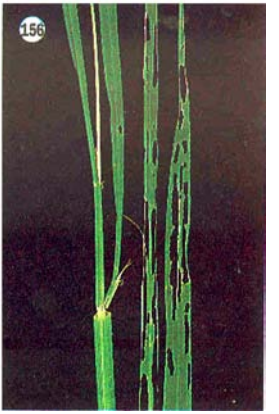
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General defoliators—crickets

Euscyrtus concinnus (de Haan)
Orthoptera: Gryllidae

Crickets have antennae longer than their body length and their bodies are stout. Some crickets are beneficial predators. but others such as *Euscyrtus concinnus* (**Fig. 155**) are defoliators.

Euscyrtus concinnus is adapted to rice grown in aquatic habitats and usually is active at night. This cricket makes a distinctive damage symptom in that it cuts out the center portions of leaf blades (**Fig. 156**). It can be numerous at times. In upland areas, crickets aggregate underneath heaps of organic matter such as piles of weeds.

General defoliators—katydids

Conocephalus longipennis (de Haan) Orthoptera: Tettigoniidae

Katydids are also known as meadow grasshoppers and have wide food preferences. Katydids are both herbivores and carnivores as they may be defoliators or beneficial predators. A katydid has the body shape of a slender grasshopper but has antennae longer than its body length.

The most common ricefield katydid *Conocephalus longipennis* is prevalent in all rice environments. It feeds on milk stage rice grains but is also a predator of many insect pests. The chewed grains can be confused with bird damage (**Fig. 157**). Katydid populations build up progressively during rice crop growth.

The adult female oviposits elongated eggs into rice tillers to protect them from natural enemies (**Fig. 158**).


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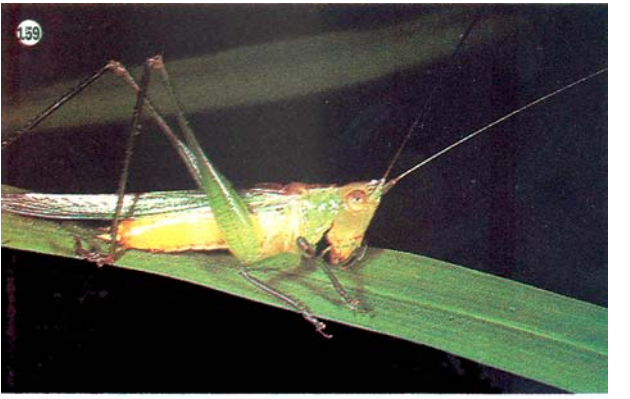
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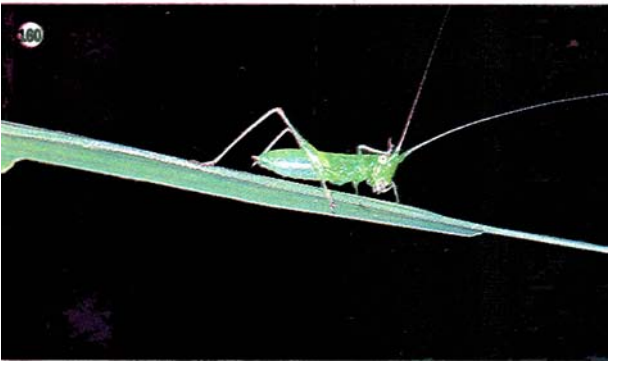
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The adult has wings that extend far beyond the body (**Fig. 159**). The nymph is green with elongated antennae and short wings (**Fig. 160**).

stem borers

Stem borers

Yellow stem borer *Scirpophaga incertulas* (Walker)
White stem borer *Scirpophaga innotata* (Walker)
Striped stem borer *Chilo suppressalis* (Walker)
Gold-fringed stem borer *Chilo auricilius* Dudgeon
Dark-headed stem borer *Chilo polychrysus* (Meyrick)
Lepidoptera: Pyralidae

Pink stem borer *Sesamia inferens* (Walker)
Lepidoptera: Noctuidae

Stem borers are the most common and pervasive insect pests of rice, Most species are moths whose larvae tunnel into rice tillers and panicles. Often several species will be present in the same field, commonly in the same plant, but less commonly in the same tiller. The earliest signs of their presence, before damage occurs, are moths that fly to ricefields to mate and lay eggs. Moths are inactive during the day. They cling tightly to foliage but will fly erratically for several meters if disturbed. A good detection method is to beat weedy areas bordering ricefields with a stick (**Fig. 161**).


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The moth most clearly distinguishes stem borer species. All stem borer species lay their eggs in masses. Stem borer larvae hatch from an egg mass within a few minutes of each other in the early morning and quickly disperse. Each larva soon enters a tiller or panicle where its feeding causes the tillers to become stunted or to die (**Fig. 162**). Dead tillers before panicle formation are referred to as deadhearts (**Fig. 163**). The plant can partially compensate by producing new tillers. Rats and some diseases can also cause deadhearts.

Larvae also tunnel into developing panicles that, when severed, produce empty spikelets or whiteheads (**Fig. 164**). In the field, these are often found in clusters emanating from a single egg mass (**Fig. 165**). The plant can compensate by filling more spikelets in younger tillers. Drought, blast, crickets, and mites can also cause whiteheads.

The larva must penetrate the plant to survive. Larval success in penetrating a tiller depends greatly on the growth stage of rice. The plant is particularly susceptible during the two periods of elongation—before maximum tillering and during panicle exsertion. Silica density in the stems is least at these two stages. A plug of excreta signals a fresh entrance hole (**Fig. 166**). Stem borers often lay egg masses in the seedbed, but the threat of damage is minimal as seedlings are too narrow for larvae to form tunnels and modern varieties can easily compensate for damage at this stage by increased tillering.


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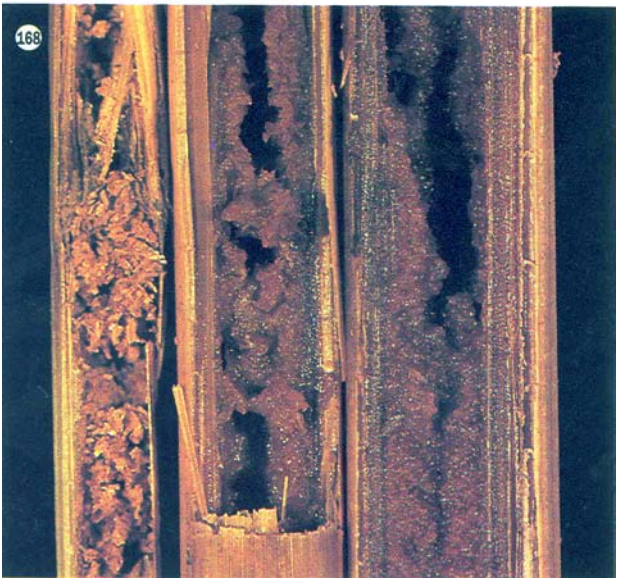
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Stem borer damage may be verified by pulling deadhearts and whiteheads and looking for evidence of tunneling as round holes in the sides (**Fig. 167**) or splitting the tiller open and looking for discolored tunnels containing excreta (**Fig. 168**).

All stem borer species pass through five or six larval stages. Older larvae have the most distinctive features. Color and markings vary between individuals of the same species. Larvae of most species descend to the base of the plant before pupation where they prepare a cell lined with silk, typically above the water line in flooded rice or below ground level in drained fields. The larvae cut a circular exit hole in the stem where the adult will emerge because the moth cannot chew its way out.

Stem borers—yellow stem borer, white stem borer

Yellow stem borer *Scirpophaga incertulas* (Walker)

White stem borer *Scirpophaga innotata* (Walker)

Lepidoptera: Pyralidae

The yellow stem borer is the most common species in tropical wetland areas as its larvae feed only on rice and moths seek out flooded fields. The female moth has pale yellow or light brown front wings, each with a characteristic single, black spot (**Fig. 169**). The smaller gray or light brown male has two rows of small spots at the tip of each front wing (**Fig. 170**).

The closely related but less common white stem borer typically occurs in tropical rainfed wetland rice where the stubble remains undisturbed in the field during the dry season. It also can occur year-round in multirice crop irrigated areas as it feeds only on rice. The moth is bright white with no markings and has a distinctive tuft of long hairs on the thorax (**Fig. 171**). Both sexes have similar coloration, but the male is smaller. The common names yellow and white stem borer refer to the moth coloration, not the larvae.


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Moths become active at night, and a female can lay up to three egg masses during her 7- to 10-day life as an adult. Egg masses of yellow and white stem borers are disc-shaped. Egg masses of both species are identical, being covered by a light brown mat of hair from the females' abdomen (**Fig. 172**). Eggs are laid in overlapping rows of 10-50 eggs to a mass as shown in a partially scraped brown mat covering (**Fig. 173**). The mat covering offers protection against some natural enemies.

The larvae of yellow (**Fig. 174**) and white (**Fig. 175**) stem borers are indistinguishable. Both are unmarked and range from light yellow to white. Only one larva occurs per tiller.

The yellow stem borer is unique in that the larvae seal off both the entrance and exit holes with silk, making the tiller waterproof. Both larvae and pupae (**Fig. 176**) can survive below the water line and thus are a major problem in deepwater rice.

Mature white stem borer larvae can lie dormant over a long dry season in pupal cells below ground level. Larvae terminate dormancy and pupate (**Fig. 177**) after the first rains of the wet season. Newly pupated white stem borers are more robust than older pupae (**Fig. 178**).


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Stem borers—striped stem borer

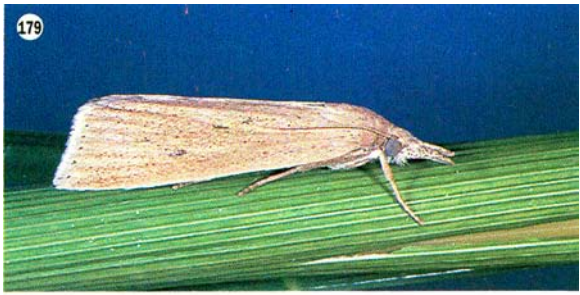
Chilo suppressalis (Walker)
lepidoptera: Pyralidae

The striped stem borer thrives in both temperate and tropical regions. It feeds on other plants in addition to rice. The male and female moths are light brown with silvery scales and a row of 7 or 8 small, black dots at the terminal margin of each front wing (**Fig. 179**).

The egg masses of the striped stem borer are disc-shaped and are laid in overlapping rows openly on leaves without a protective covering of hairs (**Fig. 180**).

As opposed to *Scirpophaga* stem borer, it is common for striped stem borer to have many larvae per tiller. Striped stem borer larvae have an orange or brown head. The body is light brown or pink with five rows of longitudinal brown or pale purple stripes (**Fig. 181**).

The striped stem borer larvae do not always go to the base of the plant to pupate. They can overwinter as mature larvae in straw piled for animal feed after harvest. With warmer weather in the spring, the larvae transform into brown pupae (**Fig. 182**). However if the straw is burned or incorporated into the soil after harvest, the larvae perish.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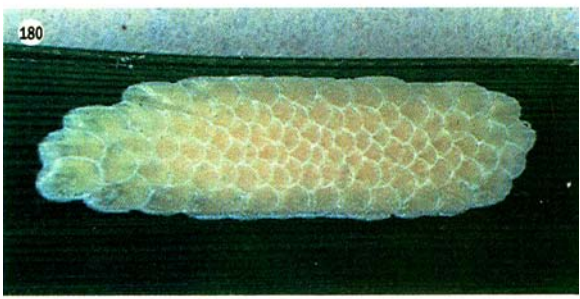
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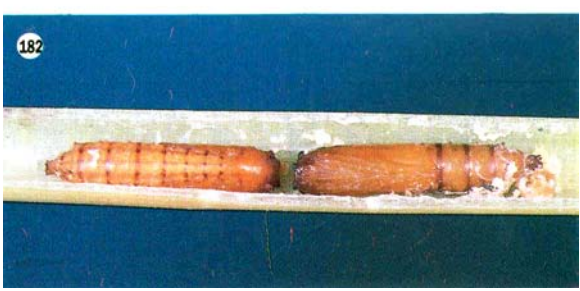
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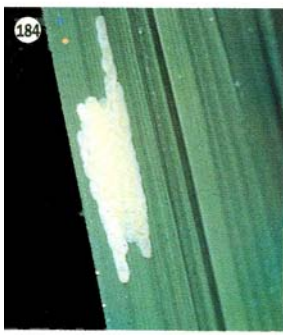
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Stem borers—gold-fringed stem borer,
dark-headed stem borer

Gold-fringed stem borer *Chilo auricilius* Dudgeon
Dark-headed stem borer *Chilo polychrysus* (Meyrick)
lepidoptera: Pyralidae

The gold-fringed stem borer and dark-headed stem borer are separate species but are indistinguishable except to experts. Less common in the wetlands, both species prefer maize and upland rice to flooded rice.

The moths of both species appear similar to the striped stem borer but can be distinguished by dark markings near the center of the front wings (**Fig. 183**). The markings may be rubbed off on older specimens.

Egg masses (**Fig. 184**) are also similar to those of the striped stem borer.

The gold-fringed and dark-headed larvae are indistinguishable from one another. They are both characterized by the black color of the head and the first body segment behind the head (**Fig. 185**).

The dark brown-to-black pupae of the gold-fringed stem borer (**Fig. 186**) and dark-headed stem borer are almost identical.

Stem borers—pink stem borer

Sesamia inferens (Walker)
Lepidoptera: Noctuidae

The pink stem borer is stouter than the other borers because it belongs to the same family as armyworms. It prefers domestic and wild sugarcane to rice and occurs in both temperate and tropical areas. The moths are light brown with dark brown markings (**Fig. 187**). The thorax is covered with a mat of short hairs. A typical radiation of gray black lines spreads from a central point in each front wing toward the wing tips, ending in a thin terminal line of dark spots.

Pink stem borer eggs are spherical, uncovered, but hidden behind leaf sheaths away from natural enemies (**Fig. 188**).

Pink stem borer larvae can be easily confused with striped stem borer larvae, but they are stouter and lack distinctive body stripes (**Fig. 189**).

The pupae are robust and brown or yellow brown (**Fig. 190**). They can survive the winter or dry season in rice stubble or alternate hosts.


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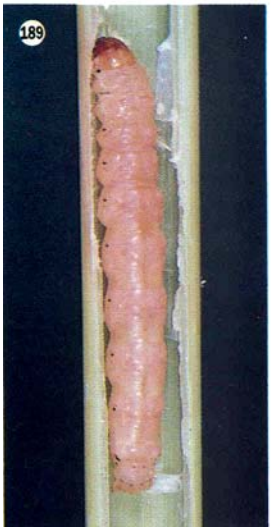
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plant-sucking pests

Nephotettix virescens (Distant)
Nephotettix nigropictus (Stål)
Nephotettix cincticeps (Uhler)
Nephotettix malayanus Ishihara & Kawase
Hemiptera: Cicadellidae

Green leafhoppers are the most common leafhoppers and are more prevalent in the upper portions of the rice plant. Four species, all of genus *Nephotettix,* vector viral and mycoplasma diseases, tungro virus being the most important. Leafhopper species can best be distinguished by the shape of the head (pointed or blunt) and the presence or absence of black lines or bands between the eyes. As with all leafhoppers and planthoppers, both nymphs and adults feed on rice by extracting plant sap with their needle-shaped mouthparts. The undigested sugary plant sap is expelled as honeydew, becoming a source of food for some natural enemies.

Nephotettix virescens is the most important species because rice is its best host. The adults can have black spots on the centers or tips of the wings (**Fig. 191**) or be without spots (**Fig. 192**). Coloration is determined genetically and does not indicate sex. *Nephotettix virescens* are distinguished by their green, pointed heads and the absence of black lines between the eyes; the nymph is shown in **Figure 193**.


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Nephotettix nigropictus adults most commonly have black spots on the centers and tips of the wings (**Fig. 194**). An entirely green form also exists, but black lines on the head distinguish it from other leafhoppers. Its head is blunt with two, thin, black lines between the eyes as seen in the nymph (**Fig. 195**). *Nephotettix nigropictus* feeds more on grassy weeds than on rice but still can transmit viral diseases to rice after landing on a plant. Leafhoppers probe with their mouthparts, an activity that transmits viruses. *Nephotettix nigropictus,* however, is a less efficient virus transmitter than *N. virescens.*

Nephotettix cincticeps is a temperate-region green leafhopper. Adults have blunt heads, have no central black spots on the wings, but do have two narrow black lines between the eyes (**Fig. 196**). The females are uniformly green without black bands near the tips of their front wings. They develop equally well on rice and some grassy weeds.

Nephotettix malayanus is a tropical species and can develop on some varieties of rice, but it prefers grassy weeds. Like *N. cincticeps*, it has no central black spot on the wings, but it does have comma-shaped, black lines between the eyes on the blunt head (**Fig. 197**). The nymphs also have the same characteristic head and black lines between the eyes (**Fig. 198**).

Females of all green leafhoppers insert white, cigar-shaped eggs into leaf sheaths (**Fig. 199**). The eye spots of the nymphs can be seen in eggs when they are ready to hatch (**Fig. 200**).


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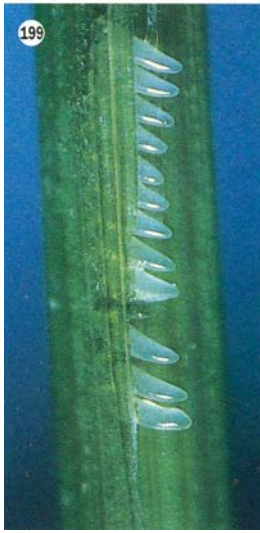
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Plant-sucking pests—zigzag leafhopper *Recilia dorsalis* (Motschulsky) Hemiptera: Cicadellidae

The zigzag leafhopper feeds equally well on rice and some grassy weeds, and is an important vector of viral diseases, including tungro. It is more prevalent on rice in the vegetative phase.

The zigzag leafhopper can be readily recognized by its characteristic wing markings (**Fig. 201**). Mature nymphs are white with brown markings (**Fig. 202**).

Zigzag and green leafhoppers rarely cause economic loss directly from their feeding, but are important in disease transmission.

Cofana spectra (Distant)
Hemiptera: Cicadellidae

The largest rice leafhopper is the white leafhopper (**Fig. 203**). It is remarkable only for its size as it does not transmit viral diseases and only rarely becomes sufficiently abundant to cause yield loss.

White leafhopper nymphs are unmarked, pale bluish green, and become silvery as they mature (**Fig. 204**). The white rice leafhopper inserts its eggs into stems and leaf sheaths as do other rice leafhoppers (**Fig. 205**).

Nisia carolinensis Fennah (= *atrovenosa*) is often abundant along the edges of ricefields and can be confused with the white leafhopper (**Fig. 206**). *Nisia* belongs to another family of hoppers and feeds on the grass *Cyperus rotundus.* Though often reported as a rice pest, it has not been found to feed on rice.


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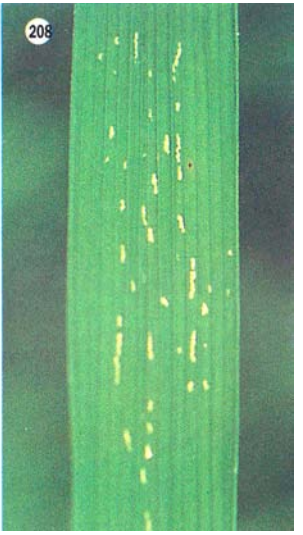
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Thaia oryzivora Ghauri
Hemiptera: Cicadellidae

The orange leafhopper (**Fig. 207**) causes a different damage symptom from other leafhoppers. Feeding does not occur in the vascular tissues but in the cells of the leaf blade. Removal of sap during feeding removes chlorophyll, producing small yellow spots on the leaf surface (**Fig. 208**).

The orange leafhopper does not transmit viral diseases and only infrequently would be sufficiently abundant to cause yield loss.

Plant-sucking pests—maize orange leafhopper

Cicadulina bipunctata (Melichar)
Hemiptera: Cicadellidae

Cicadulina leafhopper prefers maize to rice, but when it feeds on rice it causes characteristically twisted, deformed leaves, which are often confused as a disease symptom (**Fig. 209**). This plant injury is a reaction to a toxin injected during feeding. *Cicadulina,* however, is uncommon on rice.


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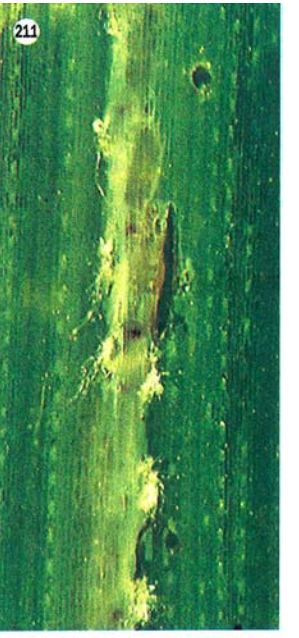
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Adults have pale white wings and orange heads (**Fig. 210**). The female inserts eggs into rice tillers and caps them with a protective secretion (**Fig. 211**). The nymphs may be pale green with or without black markings (**Fig. 212**, **213**).

Plant-sucking pests—brown planthopper

Nilaparvata lugens (Stål)
Hemiptera: Delphacidae

Planthoppers are more robust in appearance than leafhoppers, but are less active. They also occur at the base of the plant, and they may become very abundant. The most abundant and thus important planthopper is the brown planthopper (**Fig. 214**). In most tropical areas of Asia, outbreaks are normally caused by indiscriminate use of insecticides, which kill their natural enemies. Removal of plant sap and blockage of vascular vessels by feeding sheaths cause the plant to eventually wilt and die. This condition is referred to as hopperburn (**Fig. 215**). The excreted honeydew also becomes a medium for a sooty mold fungus. Planthoppers produce more honeydew than leafhoppers.


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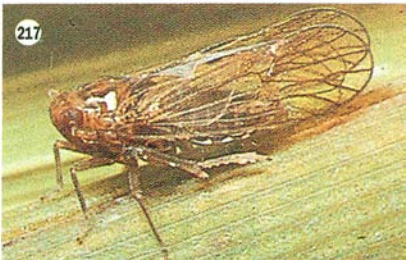
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Brown planthoppers are distributed in clumps in a field, causing hopperburn to appear as patches (**Fig. 216**). When hopperburn starts on a few plants, the planthoppers move to uninfested plants as the dead plants no longer provide sap. The population then becomes concentrated along the edge of the developing patch, which slowly widens as more plants die at the center.

Long-winged adults (**Fig. 217**) are suited for dispersal. Winged forms appear during the ripening phase of crop growth in preparation for the population to migrate to a younger field. The long-winged form, assisted by prevailing winds, can disperse hundreds of kilometers in search of rice.

Long-winged adults are the first to colonize a field. Adults in succeeding generations concentrate on reproducing and are short-winged **(Fig. 218).** The short-winged forms can be confused with nymphs (**Fig. 219**)**,** but nymphs have only wing pads, not wings.

Planthopper eggs appear similar to leafhopper eggs and are also inserted in rows into tillers and sheaths (**Fig. 220**)**.**

The brown planthopper not only directly damages the rice crop but also transmits several viral diseases of rice—grassy stunt and ragged stunt. It normally feeds only on rice, but one population has been found on *Leersia hexandra,* an aquatic weed. The population on *Leersia,* however, is reproductively isolated and does not successfully mate with the rice-feeding general population.


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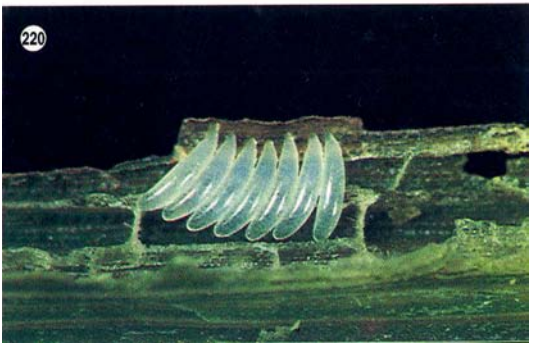
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Plant-sucking pests—whitebacked planthopper

Sogatella furcifera (Horvath)
Hemiptera: Delphacidae

The whitebacked planthopper is a close relative of the brown planthopper. Its population, which can also increase after insecticide application, does not transmit diseases. It can, however, cause extensive hopperburn (**Fig. 221**).

The whitebacked planthopper has a characteristic white band on its thorax. The male (**Fig. 222**) occurs only in the long-winged form. The females can be either long-winged (**Fig. 223**) or short-winged (**Fig. 224**). The abdomen of the short-winged form is swollen with eggs ready to be laid.


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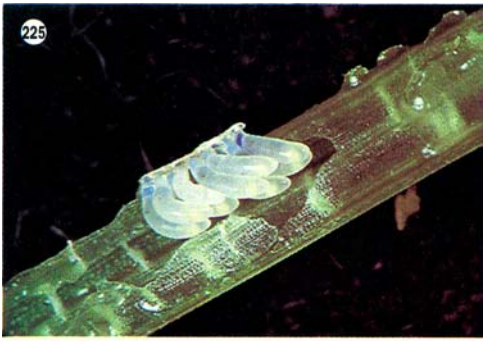
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The whitebacked planthopper lays its eggs in rice stems or leaf sheaths (**Fig. 225**). The newly emerged nymphs are white, but begin to show more coloration as they mature (**Fig. 226**).

The whitebacked planthopper feeds equally as well on some grasses as it does on rice. On grasses it may be confused with several nonrice species that also have a white band such as *Tagosodes pusanus* (Distant) (**Fig.** 227).

Plant-sucking pests—smaller brown planthopper
Laodelphax striatellus (Fallén)
Hemiptera: Delphacidae

The smaller brown planthopper is a temperate species. It transmits stripe and black streaked dwarf virus diseases. The adult is darker than either the brown or whitebacked planthoppers (**Fig. 228**). It feeds not only on rice but also on other cereal crops and some grassy weeds.

Young nymphs overwinter on plants in fallow fields. The smaller brown planthopper usually does not occur in numbers sufficient to cause hopperburn.


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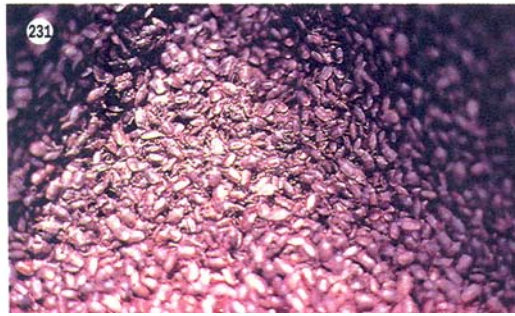
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Malaysian black bug *Scotinophara coarctata* (Fabricius)
Japanese black bug *Scotinophara lurida* (Burmeister)
Scotinophara latiuscula Breddin
Hemiptera: Pentatomidae

Black bugs are true bugs related to grain-sucking, stink bugs of rice. They are included with plant-sucking pests because the large adults and nymphs have sucking mouthparts and remove plant sap from tillers. Black bugs can become highly abundant and cause plants to wilt, producing a condition referred to as bug burn (**Fig. 229**). As with other true bugs, they do not produce honeydew.

There are several species of black bugs, but Malaysian black bug is the most common on rice. The charcoal black female lays grayish pink eggs in clusters and, having maternal instincts sits over the eggs protecting them from parasites and predators (**Fig. 230**). Therefore parasites are able to attack only the eggs at the outer edge of a mass.

Black bugs are not restricted to rice and feed on some grasses and maize. These hosts are important in maintaining populations of black bugs during nonrice seasons. The adults fly at night and are strongly attracted to artificial light. During outbreaks they accumulate in large numbers beneath street lamps (**Fig. 231**). Even though the black bug is highly dispersive, it tends to be restricted in distribution to specific sites where it recurs year after year. These sites tend to be near swampy places. Black bugs can span the dry season in dormancy at the base of plants or in cracks in the soil.

Related species also feed on rice but usually are not as abundant as the Malaysian black bug. The Japanese black bug occurs in more temperate regions and also can cause economic losses (**Fig. 232**). The shiny brown eggs are laid in clusters on leaves (**Fig. 233**). *Scotinophara latiuscula* prefers grasses to rice and has a purple hue as seen in this mating pair (**Fig. 234**). Eggs are purple pink (**Fig. 235**). Populations of this species are rarely abundant enough to be of economic importance.


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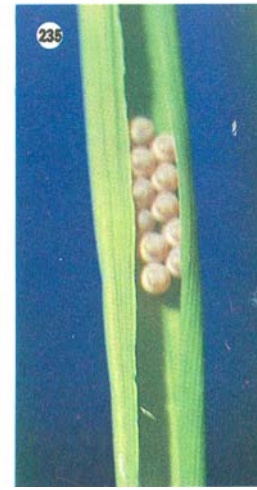
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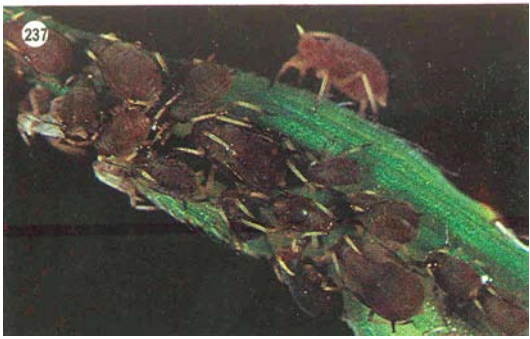
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Plant-sucking pests—aphids

Hysteroneura setariae (Thomas) Hemiptera: Aphididae

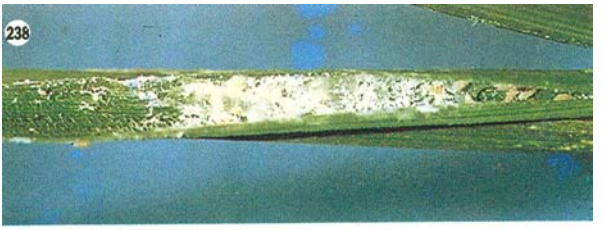
Foliar-dwelling aphids aggregate on plant tillers and panicles to remove plant sap and produce honeydew. Aphids are only locally important: in general, they are not considered major pests. However, populations can explode even more quickly than most other insect groups because all the offspring are females that, when born, are ready themselves to give birth in less than a week.

Aphids passively disperse long distances during the day, borne by the wind. The winged female colonizes the crop (**Fig. 236**) and rapidly gives birth to numerous offspring (**Fig. 237**). Males are rare and mating is not necessary to produce a new generation as unfertilized eggs produce female offspring. Aphid populations are common in wild rice. No rice virus diseases are known to be transmitted by aphids in Asia.

Rice mealybug *Brevennia rehi* (Lindinger) *Pseudococcus saccharicola* Takahashi Hemiptera: Pseudococcidae

Powdery white mealybugs can be found behind the leaf sheaths, particularly in upland rice or deepwater rice (**Fig. 238**). *Brevennia rehi* is the most prevalent rice mealybug. Similar to aphids, mealybug offspring remain near the colonizing mother to form a colony. Mealybug populations explode during droughts as the plants, in attempting to overcome the injury from the stress, transport sugars from storage in the roots to the leaves. The mealybugs intercept the carbohydrate nutrients with their sucking mouthparts. The resulting damage produces a wilt (**Fig. 239**). The restoration of water in the field stimulates plant growth and permits the crop to tolerate the mealybugs.

As is the case with aphids, males are rare, and reproduction occurs without mating. The powdery wax protects the mealybugs from drying out and from natural enemies. *Pseudococcus saccharicola* produces a wax in strands giving the mealybug a spiny appearance (**Fig. 240**).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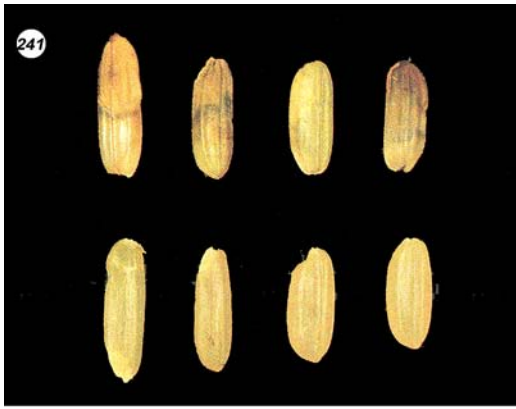
grain-sucking pests

Grain-sucking pests—slender rice bugs
***Leptocorisa oratorius* (Fabricius)**
***Leptocorisa acuta* (Thunberg)**
Hemiptera: Alydidae

A number of grain-sucking bugs feed on a ripening crop. These true bugs give off offensive odors when disturbed. Odors are not only a defense mechanism to ward off enemies, but may serve to attract more bugs of the same species.

The nymphs and adults insert their needlelike mouthparts into rice grains to feed. Feeding during the milk stage causes empty or small grains; feeding during soft or hard dough stages causes deformed or spotty grains (**Fig. 241**). Spotty or pecky grains come from infection due to bacteria transmitted during feeding. In addition, milky endosperm often spills onto the grain surface and becomes a medium for fungi, which can cause the grain to become dark (**Fig. 242**). However, not all discolored grains are caused by rice bugs. Free-living fungi also infect rice panicles causing discolored or dirty panicles.

Several species of slender rice bugs *Leptocorisa* are the most common grain-sucking bugs (**Fig. 243**). They can be distinguished by markings along the sides of their abdomens.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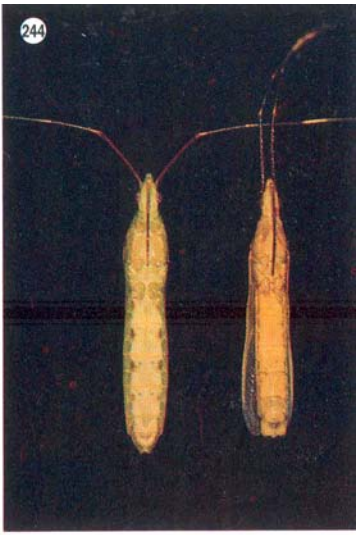
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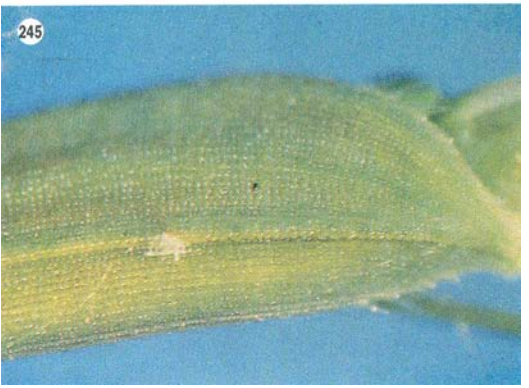
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Leptocorisa oratorius, adapted to tropical lowlands, has ventral spots (**Fig. 244 [left]**); *Leptocorisa acuta*, adapted to temperate regions, does not (**Fig. 244 [right]**). All species of rice bugs feed on the grains of many kinds of grasses as well as rice. Rice becomes particularly attractive during the milky stage.

The slender rice bug inserts its long mouthparts into the opening between the two halves of the rice hull. A white material that is secreted to aid the mouthparts during feeding is called a stylet sheath (**Fig. 245**). Rice bugs cause empty grains indirectly from feeding at the milky stage. A rice bug feeds on 5-10 developing grains per day.

Rice bugs are highly mobile at night, moving between fields to feed. Large numbers of bugs can move en masse to infest a field. During midday, adults and nymphs rest at the lower parts of plants where it is cooler. Adults live up to four months during the rainy season. In the dry season, they harbor in wooded areas or areas with perennial grass. The nonfeeding adults remain clustered together until their dormancy is broken by rains.

Slender rice bugs lay rows of dark, red brown, disc-shaped eggs on rice foliage (**Fig. 246**). The flat newly hatched nymphs are green (**Fig. 247**). Their bodies elongate as they mature, leading to the name slender rice bugs (**Fig. 248**). Mature nymphs feed at higher rates than adults.


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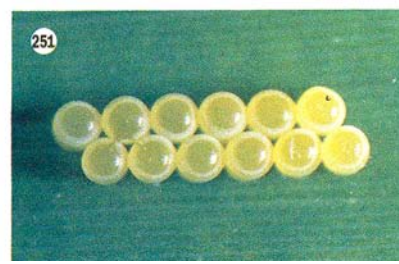
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Grain-sucking pests—stink bugs

***Nezara viridula* (Linnaeus)**
***Pygomenida varipennis* (Westwood)**
***Eysarcoris* spp.**
Hemiptera: Pentatomidae

***Cletus* spp.**
Hemiptera: Coreidae

Stink bugs differ from slender rice bugs in that they are shorter and more robust. In contrast to the slender seed bugs, they directly penetrate the grain hull with their strong mouthparts to feed on the endosperm. The nymphs of the common stink bug *Nezara viridula* are black with red and orange spots (**Fig. 249**); the adults are nearly always green (**Fig. 250**).

Stink bugs feed on the seeds of a wide variety of crops including legumes. The eggs of stink bugs are spherical and laid in compact rows on the plants as are the eggs of another common stink bug *Pygomenida varipennis* (**Fig. 251**).

Newly hatched nymphs are black with cream markings (**Fig. 252**). The adults can be orange (**Fig. 253**) or black (**Fig. 254**).


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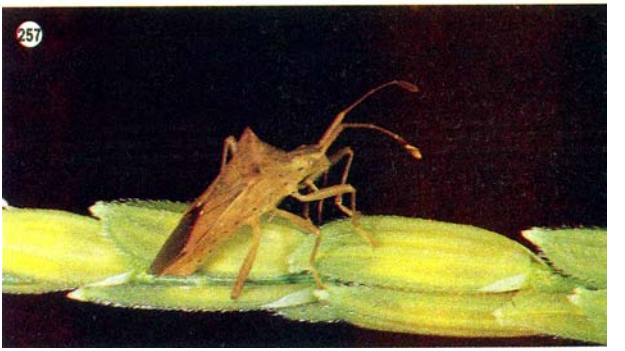
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Other less common stink bugs in ricefields are *Eysarcoris* spp. and *Cletus* spp., most of which breed in nearby grasslands. *Eysarcoris* nymphs are greenish (**Fig. 255**); adults are brown (**Fig. 256**). *Cletus* adults are more angular shaped (**Fig. 257**).

soil pests

Soil pests—root aphids

Rhopalosiphum rufiabdominalis (Sasaki)
Tetraneura nigriabdominalis (Sasaki)
Hemiptera: Aphididae

Soil pests are important in upland, nonflooded environments. Flooding kills those pests that spend at least one growth stage in the soil and feed on roots or sown seed.

Several species of root aphids remove plant sap from the roots of upland rice causing plants to turn yellow (**Fig. 258**). The pattern of infested plants is patchy. The winged adults of *Rhopalosiphum rufiabdominalis* (**Fig. 259**) colonize rice from alternate host plants, which sustain their numbers over the dry season or winter. Some species overwinter by feeding on trees, but others pass the dry season on perennial grasses.

The female *Tetraneura nigriabdominalis* gives birth to young nymphs at the base of rice plants. The nymphs are globular and remain attached to the roots when the plant is uprooted (**Fig. 260**). The tan or brown nymphs excrete sugary honeydew, which attracts tending ants. Ants protect the aphids from predators and parasites. They also distribute the aphids from plant to plant. The ants dig at the base of plants and carry the soft-bodied nymphs below the soil surface onto roots.

The life cycle of aphids is short and they multiply quickly. Damage to the rice plants increases during drought.


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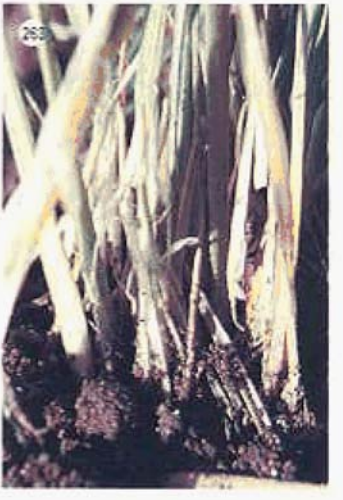
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Soil pests—oriental mole cricket

Gryllotalpa orientalis Burmeister
Orthoptera: Gryllotalpidae

Mole crickets are related to crickets and grasshoppers. The oriental mole cricket tunnels in the soil with its enlarged front legs (**Fig. 261**). Adults feed on sown seeds and roots. They also forage for food aboveground at night. Populations can become abnormally high, particularly if the dry season is short.

Young plants, especially, can die from root loss producing bare spots in the field (**Fig. 262**). Rice yields can be significantly reduced. In older plants, tillers near the soil surface may be chewed, but the damage can generally be tolerated (**Fig. 263**).

Soil pests—white grubs, black beetles

***Leucopholis irrorata* (Chevrolat)**
***Holotrichia mindanaoana* Brenske**
***Phyllophaga* spp.**
***Heteronychus* spp.**
Coleoptera: Scarabaeidae

The larvae of white grubs feed on the root mass, trimming roots as seen in **Figure 264**. White grubs are the larvae of scarab beetles. At first, the leaves of white grub-damaged rice turn orange yellow, similar in appearance to nutrient deficiency (**Fig. 265**).

Young plants wither and die as a result of root loss (**Fig. 266**). Root removal from older plants causes deadheart symptoms.


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Damaged rice plants can be easily pulled by hand. Digging in the soil reveals the robust white larvae **(Fig. 267).**

The young larvae typically roll into a C shape when held (**Fig. 268**). Older larvae have an enlarged translucent area at the tip of the abdomen (**Fig. 269**).

The larvae require a moist, light-textured, well-drained soil. They move up and down in the soil horizon in response to soil moisture. They are slow to develop so they feed for long periods. The larvae pass the dry season 0.5-1 m below the soil surface. They pupate with the onset of the rainy season (**Fig. 270**).

Adults emerge from the soil soon after repeated rains and congregate in nearby trees where they feed on the foliage and mate. Species of white grubs are diverse and vary depending upon the region of a country. The adults are stout, smooth-bodied, and are gray brown such as *Leucopholis irrurata* (Fig. 271), or tan such as *Holotrichia mindanaoana* (**Fig. 272**). They have 1 - or 2-year life cycles depending on the rainfall pattern. The life cycle may vary within the same species depending on site.


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Related species in the genera *Phyllophaga* and *Heteronychus* are called black beetles. The adults burrow in the soil to feed on rice plants, cutting tillers at soil level. Adults of these species are shiny black (**Fig. 273**). They fly from field to field and thus are hard to control. The grubs of black beetles feed on organic matter and not rice or other living plants.

Soil pests—termites

Macrotermes gilvus (Hagen)
Isoptera: Termitidae

Some species of grassland termites feed on rice roots. These termites are permanent residents in grasslands, making their nests deep in the soil below the plow zone. Termites prefer dead plant matter, but if the supply is limited they will attack living plants. Plant material, including rice roots, is taken into underground cells and inoculated by fungi maintained by the termites. These termites feed on the fungi, not directly on the plant material.

Damage symptoms are similar to those caused by white grubs (**Fig. 274**), but the termites can be recognized upon digging up soil around the rice plants (**Fig. 275**).


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Soil pests—ants

Solenopsis geminata (Fabricius) Hymenoptera: Formicidae

Ants inhabit the bunds of lowland ricefields or upland areas. Ants cannot colonize flooded soils. A number of species of ants such as *Solenopsis geminata* (**Fig. 276**) sometimes feed on sown seeds of rice and grass although they mainly prey on other insects. The ants are active at night, searching for seed sown to nonflooded fields. They carry these seeds to underground nests. The result is missing plants in the field (**Fig. 277**). The longer the seed remains in the soil before emergence, the greater the damage. Therefore rainfall is important at seeding time in ant-infested fields.

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