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Symposium on

# The Major Insect Pests of the Rice Plant

Proceedings of a Symposium at
The International Rice Research Institute
September, 1964

Published for THE INTERNATIONAL RICE RESEARCH INSTITUTE
By THE JOHNS HOPKINS PRESS, Baltimore, Maryland

Printed in the United States of America
Library of Congress Catalogue Card No. 65-27673

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# Insect Pests of Rice in East Pakistan

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Insect pests cause severe losses each year in rice, the staple food crop of Pakistan. Of the 23 species of insect pests identified as causing crop damage, 14 are considered to be major pests. They are, in order of importance:

| *Common Name* | *Scientific Name* | *Family and Order* |
|---|---|---|
| *Major Insect Pests* | | |
| Rice ear-cutting caterpillar | *Pseudaletia unipuncta* (Haworth) | *Noctuidae: Lepidoptera* |
| Rice swarming caterpillar | *Spodoptera mauritia* Boisduval | *Noctuidae: Lepidoptera* |
| Rice borers | *Tryporyzae incertulas* (Walker) | *Pyralidae: Lepidoptera* |
| | *Chilotraea auricilia* Dudgeon | *Pyralidae: Lepidoptera* |
| | *Chilotraea polychrysa* Meyrick | *Pyralidae: Lepidoptera* |
| | *Sesamia inferens* Walker | *Noctuidae: Lepidoptera* |
| Rice hispa | *Hispa armigera* Olivier | *Hispidae: Coleoptera* |
| Rice leafhoppers | *Nephotettix bipunctatus* Fabricius | *Jassidae: Hemiptera* |
| | *Nephotettix apicalis* Motschulsky | *Jassidae: Hemiptera* |
| | *Sclenocephalus virescens* Distant | *Jassidae: Hemiptera* |
| | *Sogata distincta* Distant | *Delphacidae: Hemiptera* |
| Rice bug | *Leptocorisa acuta* Thunberg | *Coreidae: Hemiptera* |
| Rice mealy bug | *Ripersia oryzae* Green | *Coccidae: Hemiptera* |
| Rice caseworm | *Nymphula depunctalis* Guenée | *Pyralidae: Lepidoptera* |
| *Minor Insect Pests* | | |
| Rice grasshopper | *Hieroglyphus Banian* Fabricius | *Acrididae: Orthoptera* |
| | *Oxya* sp. | *Acrididae: Orthoptera* |
| Rice leaf gallfly | *Oscinella frit* Linnaeus | *Chloropidae: Diptera* |
| Rice leaf roller | *Cnaphalocrocis medinalis* Guenée | *Pyralidae: Lepidoptera* |

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| | | |
|---|---|---|
| Rice hairy caterpillar | *Dasychira securis* Hubner | *Lymantriidae: Lepidoptera* |
| Rice leaf beetle | *Leptispa pygmoea* Baly | *Chrysomelidae: Coleoptera* |
| Rice thrips | *Thrips oryzae* Williams | *Thripidae: Thysanoptera* |
| Rice skipper | *Pelopidas agna* Moore | *Hesperiidae: Lepidoptera* |
| Rice butterfly | *Melanitis ismene* Cramer | *Nymphalidae: Lepidoptera* |

Research on the different insect pests shows the incidence during the calendar year (Fig. 34–1) and at different stages of plant growth (Fig. 34–2).

The climatic and agricultural conditions of a particular area greatly influence the appearance or absence of any pest.

## BIOLOGICAL STUDIES OF THE MAJOR RICE PESTS

The biological studies of the major rice pests conducted during the last few years, particularly in East Pakistan, are summarized below. The recommended different control methods, as based on trials, are also noted.

## RICE EAR-CUTTING CATERPILLAR, *PSEUDALETIA UNIPUNCTA* (HAWORTH)

*General.* The rice ear-cutting caterpillar is the most serious pest of rice in Pakistan. The mature caterpillars seriously damage the crop by cutting off the ripened ears of Amon rice. These caterpillars break out suddenly, and severe losses result before the pests are detected. They disappear as suddenly as they appear.

In East Pakistan, this insect is most likely to be confused with the rice swarming caterpillar. Both are noctuids, and their larvae are similar in appearance, especially during the last larval instars.

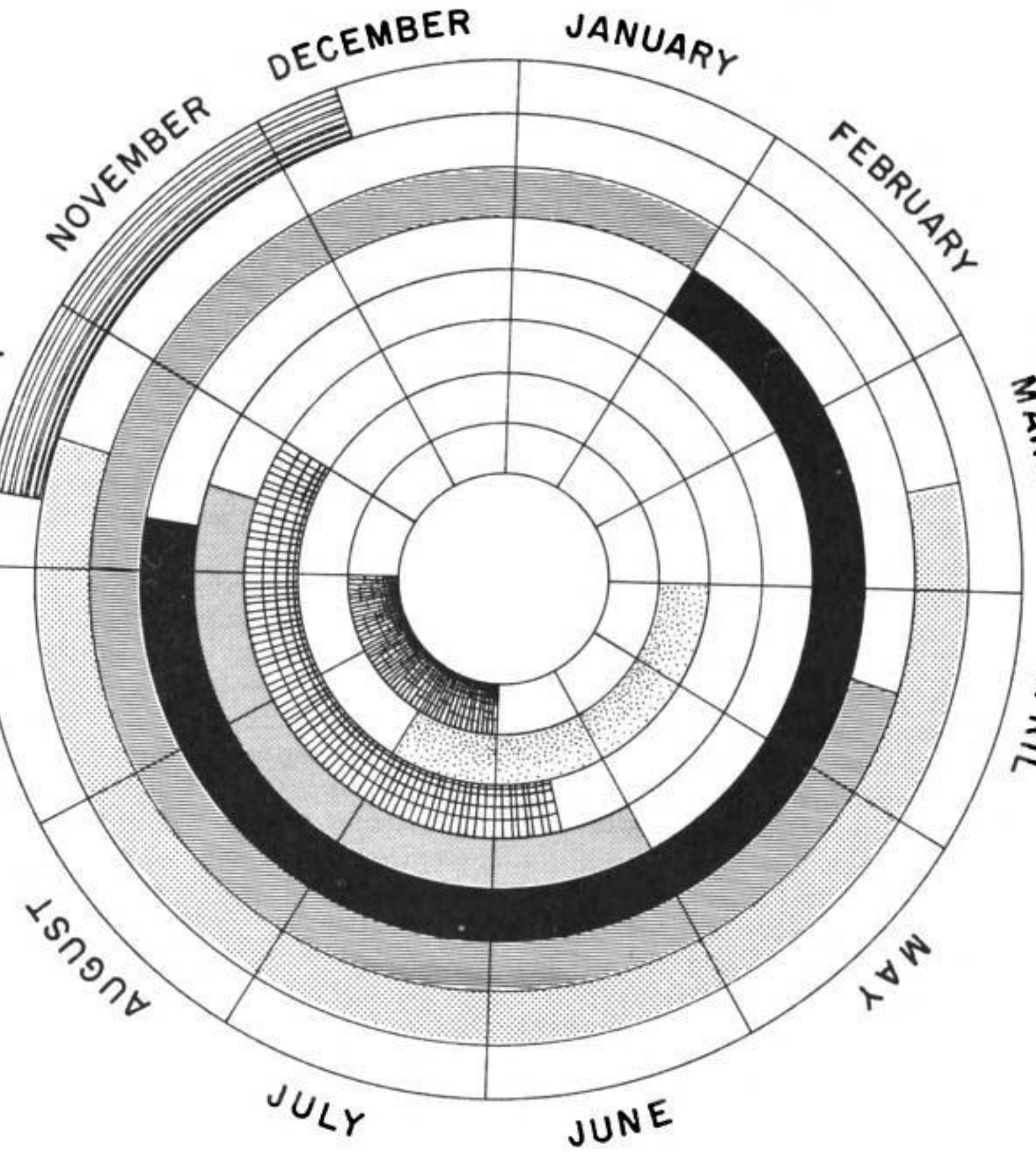
*Host Plants.* The caterpillar feeds on a wide range of grasses. In East Pakistan, it feeds on rice leaves and other succulent grasses, but serious damage has been recorded on the eared Amon rice crop only.

*Distribution.* The pest has been recorded in all southeast Asian countries and in Argentina, Hawaii, continental United States, and Canada. It is fairly common throughout East Pakistan.

*Life History.* Male longevity is three days and female, up to seven days. The incubation period is about seven to nine days. The female moths lay eggs—sometimes as many as 232—throughout their lives. Observations reveal that the female moth generally prefers to oviposit her eggs in tight places which conceal her eggs. An example of such a place is the narrow space between the sheath and blade of growing grasses, rice, or cut, dried straw of grass stalks which tend to fold lengthwise.

Oviposition may last up to five days, after which the female dies. The newly hatched larvae, which are dull white with a brownish head, are about 1.8 mm long. The first two pairs of prolegs are underdeveloped; therefore, they move with a looping motion. The hatching caterpillars, after a brief quiescent period, feed actively, causing a skeletonization of the leaves.

The looping motion and skeletonizing feeding habit are lost in the third instar, and the caterpillars are able to crawl and eat holes. The third to the sixth instars all have common habits. Caterpillars in these stages are active from dusk to dawn and feed mostly at night. During the day, they remain concealed under foliage and debris in the field. This habit of the caterpillar of concealing itself prevents its early detection. The fifth- and sixth-instar larvae begin their gregarious habit and migrate for additional large amounts of food. The sixth instar alone requires 80 per cent of the total food consumed during the entire larval period. This voracious feeding habit of the caterpillars in their



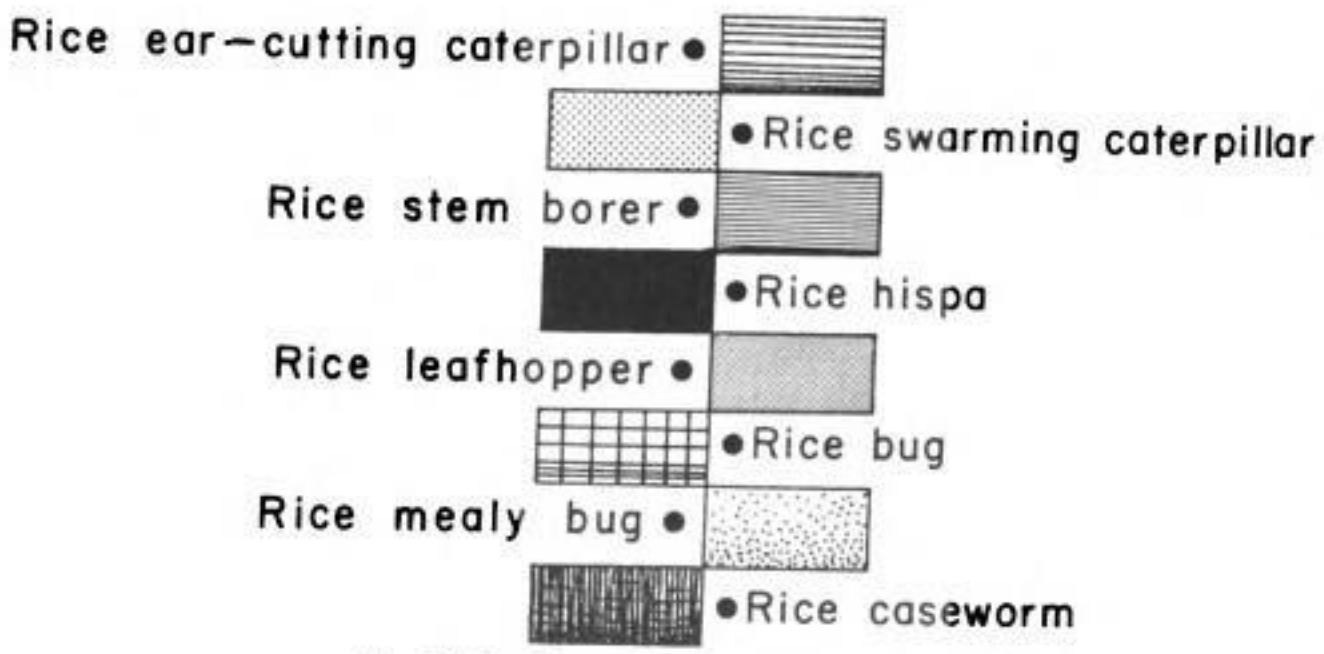




Fig. 34-1: East Pakistan rice pests calendar.

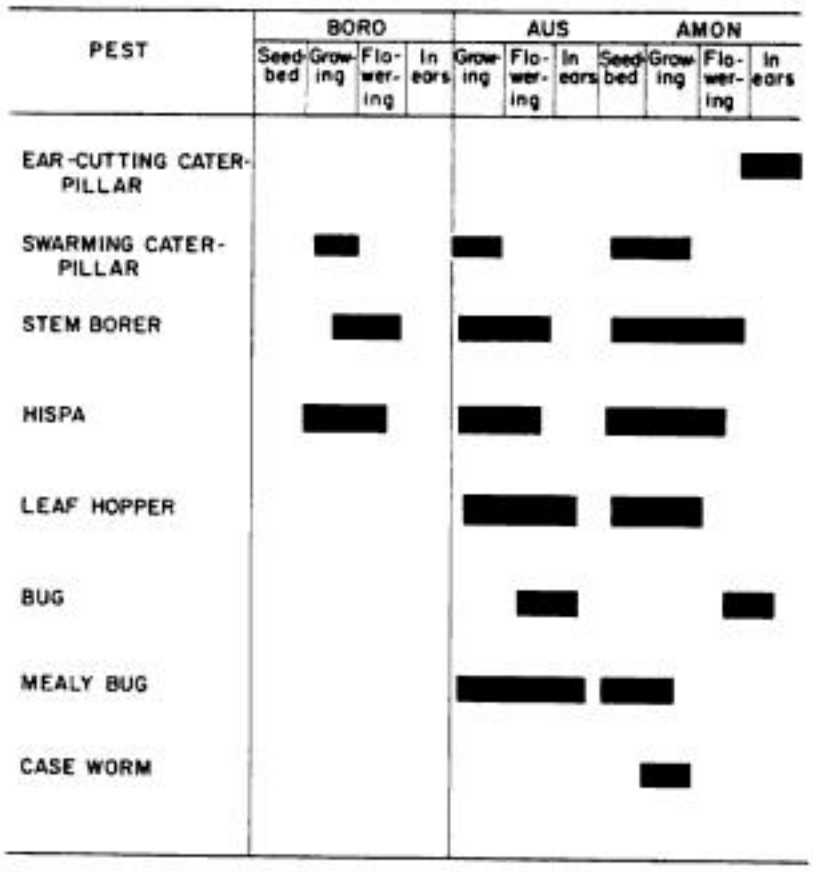



**Fig. 34-2: Incidence of major pests of rice at different stages of growth.**

last larval instar and their concealment by day results in their sudden appearance in large numbers and their severing off of half-ripened ears of rice from the rest of the plants.

The full-grown caterpillar is about 35 mm long and 6.5 mm wide. After crawling into the soil, it forms the earthen pupal cell or chamber where it moults to form the pupa.

The total larval period is 20 to 48 days, depending upon prevailing temperature and availability of food. The period is greatly extended during the winter months, when the fifth-instar larvae overwinter for about 132 days.

The pupa is about 17 mm long and 6 mm wide. The pupal period varies from 7 to 29 days. Temperature greatly affects the duration of the pupal stage, but humidity has little effect. Sexual dimorphism is evident.

The moth varies in size, measuring on the average about 40 mm in wing expanse. The front wings are pointed at the tips, reddish-grey or fawn in color, and highly specked with black atoms. Anterior to the center of each wing are two rather large, indistinct spots, distinguished from the rest of the wing by an absence of black specks and by a clearer reddish color. Immediately posterior to the outermost spots is a white point with an indistinctly blackish surrounding. A series of black points parallel the outer margin, with one usually perceptible on each vein. An oblique black streak which starts from this line of dots and ascends to the apex of the wing principally characterizes the species. Just inside the fringe is a series of black dots, one between every two veins. The hind wings are translucent grey, with blackish terminal border nervures, but with whitish nervures in the front wings. There is little difference between the sexes.

The underside of the wings is opalescent yellowish-white. Along the outer margin, particularly of the hind wings, are many black specks, so nearly confluent as to form a limited dusky terminal band. On the coastal margin of each forewing, near the tip, is a small, distinct, black dot, and at the center of each hind wing is a similar dot. The body is concolorous with the wings, and the legs are light grey, slightly reddish, tinged, and specked with black dots.

*Seasonal Cycle and Outbreaks.* There are five broods of the rice ear-cutting caterpillar in East Pakistan. The first-brood larvae appear in May, the second, in July, and the third, in September. The larval population up to the third brood is low, and no appreciable damage by it has been assessed up to this period in East Pakistan. The biotic factors (natural enemies—parasites, predators, and pathogens) and physical (abiotic) factors effectively keep the pest population below the economic-injury level. During the third brood, the physical factors (especially drought) influence the natural enemies (especially pathogens) to become ineffective in checking pest population; thus, the pest population becomes high in the fourth generation, sometimes a hundred times higher than the previous population. This happens from late October to November and sometimes up to mid-December. As the mature larvae require a large quantity of food and become

gregarious in habit, they feed extensively by migrating from field to field.

During this period, the half-mature ears of Amon rice generally are available. The larvae cut off the ears and seriously damage the rice crop.

The larvae of the next generation, the fifth brood, appear from early January, but they overwinter at the fifth instar before they become full fed. After hibernation, the pupae and moths are subject to natural death to a great extent, so that the first-brood larval population of the next year is small.

*Natural Enemies.* A large number of parasites, predators, and pathogens of the rice ear-cutting caterpillar have been recorded in different countries. Seventeen species of braconids, 21 of ichneumonids, and 30 of tachinids have so far been recorded as parasites of this pest. An ichneumonid species, *Barichneumon albetorius* Fabricius, has been recorded as a larval parasite of the pest in East Pakistan. Eighteen species of coleopterous insects and eight species of hemipterous insects have been recorded as insect predators. Besides these, three species of viruses, one of bacteria, and two of fungi also have been recorded as disease pathogens of the pest. Among these, one species of virus, *Morator nudus* Wasser, has been recorded as a virus pathogen effective in inflicting heavy mortality in the rice ear-cutting caterpillar population in East Pakistan.

*Control Considerations.* Outbreaks of the rice ear-cutting caterpillar cause heavy losses in rice in East Pakistan, in spite of the availability of good chemical control.

An impending outbreak usually goes unnoticed, as the individuals remain concealed by day and do little feeding until the final instar, when they begin to feed voraciously and gregariously. If a field containing a large population of ear-cutting caterpillars remains unnoticed for several days after the major portion of the larvae have matured, applying insecticides is ineffective.

Knowledge of the life history of the rice ear-cutting caterpillar can help reduce losses caused by it. A timely warning for applying insecticide would do much to prevent damage in a locality. A workable warning system can be developed with minimum effort once the life history and seasonal cycle of the species are known.

### Recommended Control Methods

*Cultural Control*

1. Burn the straw and stubble of the infested fields to kill the overwintering larvae. Large-scale practice of this method may lower the pest population in the subsequent cropping season.
2. After harvest, plow open the infested fields to expose the larvae to the sun, as well as to birds and other natural enemies.
3. Keep grasses from growing in or around rice fields.
4. In badly affected areas, grow early-maturing varieties of Amon crop, which may be harvested before the pest becomes gregarious.
5. Grow awned varieties of Amon rice in localities infested with the pest during the previous year, because such varieties have been observed not to be infested with the pest.
6. Flood the rice fields to kill the larvae and pupae in the soil.

*Chemical Control*

Any of the following methods may be used to control the pest.

1. Spraying the infested field with 0.2 per cent BHC or DDT can check the pest. In this case, 50 gal of spray is needed to cover an acre.
2. Using poisoned bait may sometimes control the pest effectively. The formula for the bait is as follows: (*a*) BHC 13 per cent (12 oz) or aldrin 40 per cent (4 oz); (*b*) wheat bran or rice kura (100 lb.); (*c*) molasses (10 lb.); (*d*) water (as much quantity as required for the above ingredients to make a paste only). This quantity will cover an acre of land.

The bait is prepared as follows: (1) Mix (*a*) and (*b*) thoroughly in a dry state; (2) dissolve (*c*) in a container with a small quantity of water; (3) mix (1) and (2) adding further water to make the mixture into a paste. The bait is then ready for use.

The bait is used as follows: Broadcast the prepared bait over the infested field, taking care to sow it thinly on the ground in flakes and not in lumps. Spread the bait late in the afternoon, since the larvae hide under the rice plants and come out and feed at dusk and at night. Aldrin should be used carefully, because it is poisonous to both men and animals. The bait should not come into contact with cut or wounded human or animal skin.

*Biological Control*

*Natural Control.* Some birds feed on caterpillars. It is advisable, therefore, to turn over lodged rice stems to expose the caterpillars to the birds. To encourage such birds, bamboos or twigs could be placed in the field to provide them with a perch to rest on while feeding on caterpillars. Such insectivorous birds, except poultry birds, are not interested in taking rice ears, so they will not cause damage to the crop.

*Microbial Control.* In tests, the microbial insecticide *Bacillus thuringiensis* Berliner spores effectively controlled the larval population within three to five days after spraying at the rate of 8 to 12 oz per 25 gal of water per acre. The material is not yet recommended, however, pending the conduct of large-scale trials.

## RICE SWARMING CATERPILLAR *SPODOPTERA MAURITIA* BOISDUVAL

*General.* The rice swarming caterpillar is a serious pest of rice, particularly of Aus rice. The insect generally causes serious damage on the Aus crop from June to August. Its presence on Boro in April–May and on Amon in August–October also has been recorded in some parts of East Pakistan.

*Host Plants.* The larvae of the pest defoliate the rice plants, grasses of pasture land, and other members of the grass family.

*Distribution.* The insect is distributed widely throughout the Orient and Australia. In East Pakistan, it is found on rice in almost all districts on the Aus crop and also on the Boro and Amon crops.

*Life History.* The adult insect is a grayish-black moth with a white blotch on its forewings. The male moth has immense tufts of hair on its forelegs. Generally, the eggs and young caterpillars escape notice and are detected only when they grow large and begin to eat voraciously. They feed on leaves and shoots of rice and grasses. They appear in big swarms and destroy the rice plants, especially the Aus crop, by eating the leaves, sometimes even up to the base of the plant. As they finish the crop in one field, they migrate to the next.

The female moth lays small, spherical eggs in blotches on rice leaves and grasses and covers them with greyish hairs. The clusters look like small masses of brownish hairs stuck on the surface. Each female moth lays 200 to 350 eggs. The eggs hatch in five to nine days, depending upon the temperature. The newly hatched caterpillars are green and often remain unnoticed in the green background of the rice leaves. Under favorable conditions, their number increases considerably. The caterpillars first nibble at the surface, eating only small bits of leaves, but as they grow, they eat voraciously, devouring whole fields in a short time, and then moving to other fields. The caterpillars are nocturnal in habit. When grown, they are about 38 mm long and become smooth and cylindrical and dark to pale green, with dull dorsal and subdorsal stripes. Their color varies greatly. The larval period is three to four weeks. The full-grown caterpillar enters the soil and changes into a pupa in an earthen cell. The pupa is dark brown and about 13 mm long, with two slender spines at its narrow apex. The pupal period lasts 10–14 days. Mating takes place within a day

or two, after which the female is ready for egg laying. The life cycle is completed in about 37 days. The insect breeds on different grasses.

*Natural Enemies.* Twelve different species of parasites on this insect have so far been recorded in the Indo-Pak subcontinent. Among these, *Cuphocera varia* F., *Gonia cinerascens* Rond., and *Sturmiopsis semiberbis* Bezzi (*Tachinidae: Diptera*); an Ichneumonid, *Cherops* species (*Ichneumonidae: Hymenoptera*); *Chelonus* species and *Apanteles* species (*Braconidae: Hymenoptera*); *Euplactrus* species (*Chalcididae: Hymenoptera*) have so far been recorded from East Pakistan.

### Recommended Control Methods

*Cultural Control*

1. Plow or collect the stubble and then burn it to reduce the aestivating or hibernating insect population.
2. Flood the infested fields to kill the larvae and pupae in the soil.
3. Do not allow grasses to grow in or around the rice fields.

*Chemical Control*

1. Spray the infested field with 0.02 per cent endrin, 0.03 per cent folidol M 50 or 0.2 per cent BHC or DDT. About 50 gal of spray will cover an acre.
2. Dust the infested crop early in the morning with 5 per cent BHC dust at the rate of 15–20 gal. per acre.
3. Use bait poisoned with BHC or aldrin.

*Biological Control*

1. Encourage insectivorous birds to feed on the insects by placing bamboo perches or twigs in the infested fields.
2. If possible, allow poultry birds in the fields to feed on caterpillars. This, however, should be done only before the heading of the crop.
3. Use of the microbe *Bacillus thuringiensis* Berliner may give good control, as proved by experimental evidence. Large-scale trials, however, are necessary before any recommendation is made.

## RICE STEM BORERS *TRYPORYZA (SCHOENOBIUS) INCERTULAS* (WALKER), *CHILOTRAEA AURICILIA* (DUDGEON), *CHILOTRAEA POLYCHRYSA* (MEYRICK), *SESAMIA INFERENS* WALKER

*General.* Rice stem borers are a major problem throughout the rice-growing countries of the world except the United States. They seriously damage rice crops in Pakistan.

*Distribution.* In East Pakistan, these pests occur in every rice-crop district and cause losses each year. The intensity of infestation is greater in the southern and eastern districts of East Pakistan.

Four species of rice borers, as enumerated above, have been recorded in East Pakistan. The first two species are more abundant than the other two. Their proportion appears to vary considerably at different times of the year. The average larval proportion of different species collected at random in different seasons at Dacca Farm on all rice crops (Aus, Amon, and Boro) was 13.8/7.6/3.0/0.3 for *Chilotraea auricilia, Tryporyza incertulas, Sesamia inferens,* and *Chilotraea polychrysa,* respectively.

*General Habits and Nature of Damage.* The rice stem borers are internal feeders, and the nature of the damage caused by all the species discussed here is more or less the same, with some minor differences.

The newly hatched caterpillars bore into the growing stem, cutting through the leaf sheath and stem wall. The larvae feed on the internal tissues of the stem. Young larvae also feed on the leaf sheath. As a result, the continuity of the vascular tissue is broken. This affects the formation and growth of all parts, including the ear above the point of damage. The extent of larval feeding in the stem varies considerably; in extreme cases, only the thin epidermal membrane is left.

The internode is littered with excreta and pieces of the broken tissues of the tiller. The extent of injury to the stem is influenced by the age of the stem, which determines the degree of formation of the band of sclerenchyma underlying the epidermis. The tissues consisting of thick-walled cells will naturally be much less favorable to the larvae.

In the case of *T. incertulas*, the larvae bore into the upper part of the stem, but the larvae of *Chilotraea* species bore at the basal parts of the young plants. In the mature crop, they bore into the upper parts of the plant, causing dead ears, known as "white heads."

As a result of the injury caused by the stem borers, young tillers are killed. Older tillers may not be killed, but the quality of the ear heads formed on them is drastically affected. The damage done, therefore, can be considered in two stages—damage to young plants and damage to older plants. The young affected tillers externally present in appearance are usually described as "dead hearts." The shoot, except the lowermost two or three leaves, becomes dry, pale-yellow or straw colored, and comes off easily when pulled. Ultimately, the tiller is killed.

The presence of borers may be determined by the following symptoms:

1. Presence of egg clusters on the leaves (but in the case of *S. inferens*, of rows of eggs underneath the outermost leaf sheath).
2. Appearance of "dead hearts."
3. Presence of empty or white ear heads.

It appears that the attack by borers at an early stage induces greater tillering. It also appears that the extent of infestation in a plant is not directly proportional to the number of eggs laid on it. The extent of damage under normal circumstances is from 3 to 20 per cent. In the district of Khulna, where the rice crop has suffered from severe outbreaks of the pest, the damage has reached 20 per cent.

*Life History.* The life cycles of the above-mentioned four species are more or less similar. The eggs of *C. auricilia* are laid on the under surface of the green leaves. The female moth of *S. inferens* thrusts the eggs underneath the outermost sheath in rows, and thus they are not detectable from the outside. But the eggs of *T. incertulas* are laid in clusters on the ventral surface of the green leaves and are densely covered with buff-colored, easily detected hairs. The female moth can lay 150 to 300 eggs, with these eggs hatching in 6 to 18 days, depending upon the temperature and other physical factors of the season.

The larvae of *Chilotraea* species can be identified by five parallel light-brown stripes on the dorsal body surface. The larvae of *T. incertulas* vary from creamy or yellowish-white to dirty-white. Those of *S. inferens* are much more robust than any of the previously mentioned borers and are pink. A full-grown caterpillar is 15 to 27 mm long. The larval period varies from 28 to 56 days, depending on the physical factors of the season; the majority pupate within the stem. More than 90 per cent of the caterpillars hibernate during winter in the rice stubble, and the rest hibernate as pupae. The pupal period generally lasts for 6 to 12 days. The life cycle is completed in 42 to 120 days, varying with the season.

*Seasonal History.* There are five generations of these pests passed on in rice crops and stubble during the year: the first generation on the Boro crop; the second, third, and fourth, on the Aus and Amon crops; and the fifth, on the Amon crop and stubble. The Amon crop suffers most heavily. The generations overlap. The moth population is low up to July, then gradually it increases until it reaches a peak by mid-October. Thereafter, the population declines sharply.

*Natural Enemies.* A large number of enemies, including parasites, predators, and some unidentified pathogens, were found associated with the immature stages of different species of borers. These are:

1. Egg parasite of *T. incertulas*
   a. *Tetrastichus schoenobii* Ferriere (*Eulophidae: Hymenoptera*)

2. Larval parasites
   b. On *T. incertulas* larvae
      (1) *Shirka schoenobii* Vierreck (*Braconidae: Hymenoptera*)
      (2) *Tropobracon indica* R. (*Braconidae: Hymenoptera*)
      (3) *Ischnojoppa lubeator* E. (*Ichneumonidae: Hymenoptera*)
      (4) *Temelucha* sp. (*Ichneumonidae: Hymenoptera*)
   c. On *C. auricilia* D. larvae
      (1) *Poecilotraphera taeniata* M. (*Platystomatidae: Diptera*)
      (2) *Sturmiopsis inferens* T. (*Tachinidae: Diptera*) (Also parasitizes *Chilotraea polychrysa* M. and *Sesamia inferens* W. larvae)
3. Pupal parasite of *C. auricilia* D.
   (a) *Tetrastichus* sp. (*Eulophidae: Hymenoptera*)

Crows, mynas, fingas, and two types of ants, *Monomorium latinoda* Meyer and *Terramorium simillimum* Sm. (*Formicidae: Hymenoptera*), predate on the different stages of the rice stem borers. Some fungal and nematode diseases of the larvae also were recorded, but the pathogens have not yet been identified.

**Recommended Control Methods**

1. As the larvae overwinter in the field, burn the straw and stubble of infested fields to control the pest in the next cropping season.
2. Collect and destroy egg clusters.
3. Pull and destroy affected plants showing "dead hearts."
4. While transplanting, discard the seedlings showing "dead hearts." Clip the top of the seedlings before transplanting to eliminate any egg masses present.

*Chemical Control*

Spraying the crop with 0.03 per cent methyl or ethyl parathion, 0.05 per cent dimecron, 0.2 per cent diazinon, 0.3 per cent dipterex, and 0.02 per cent endrin has satisfactorily controlled the rice stem borer.

Repeating any of the above treatments at three-week intervals can give total control. Insecticide spraying should be started in the Amon seed bed in June–July. There should not be any treatment after the crop has flowered.

## RICE HISPA *HISPA ARMIGERA* OLIVIERI

*General.* The rice hispa is an important pest of rice in East Pakistan. It is a regular and common pest of the Aus crop, but it also occurs on the Boro and Amon crops.

*Distribution.* The pest is distributed widely in Pakistan, India, Nepal, Burma, Sumatra, Cochin China, and Chickiang China. In East Pakistan, the pest is found in all parts of the province and is a serious problem, particularly in the eastern and southern districts.

*Damage.* The pest usually attacks young rice plants. Damage is done by both adults and grubs. The beetle feeds on the green portion of the leaf, leaving only the epidermal membranes. The damage is shown by characteristic white parallel streaks along the long axis of the leaf. The grubs mine into the leaf between the epidermal membranes, producing irregular, longitudinal white patches. Damage usually starts at the tip of the leaf and proceeds downward. As a result, the affected upper parts of the leaves ultimately wither.

Damage by this pest stunts and weakens the plant, causing a lower yield. Losses have been found to vary from 10 to 65 per cent, sometimes more. A conservative average loss estimate would be 20 per cent of the affected area. At least, 150,000 to 200,000 acres of rice crop are severely affected each year.

*Life History.* The minute eggs are laid singly by the female beetle and are partly inserted beneath the epidermis on the ventral surface of the leaf. In some cases, the eggs also are found on the dorsal surface of the leaf. They are usually scattered irregularly on the upper half of the leaf. Each egg is

covered by a minute quantity of a dark substance, which is probably secreted by the female. A single female lays from 18 to 101 eggs, with an average of 55. As many as 101 eggs may be found on the leaves of a single plant.

It has been observed that eggs laid on plants of poor growth and on plants heavily damaged by adults do not hatch satisfactorily. The incubation period is about four days.

The grub, on hatching, is 2.4 mm long, dorso-ventrally flattened, and pale yellow. It mines into the leaf, feeding on the green tissues and leaving only two epidermal membranes. The activity of the grub is evidenced by a gradually enlarging, discolored irregular patch in the leaf. The grub can be clearly seen feeding and pupating inside the leaf tunnel without migrating to a fresh leaf. The fully fed grub is about 5.5 mm long, dorso-ventrally flattened, and dull, pale yellow. The larval period ranges from 7 to 12 days, depending upon the season. A brief prepupal stage has been observed.

The pupa is of the exarate type, dorso-ventrally flattened, brown, and 4.9 mm long. The pupal period lasts about four days.

The emerging beetle cuts its way out of the larval tunnel. It is about 5 mm long, and shiny bluish-black with a spiny body. Pairing takes place 3 to 4 days after emergence, and egg laying continues for a few days at regular intervals. The average longevity of the adult is 20 days for the female and 14 days for the male.

The insect is active on the rice crop from February to August, in some areas up to September and October. The insect first appears on the Boro rice crop. It then migrates to the Aus crop, where its population increases rapidly. The maximum population of the pest is often observed in June and July. After this period, its population decreases rapidly, so that it causes little damage to Amon rice, where it goes next.

There are six generations of rice hispa in a year. The first generation is passed on the Boro crop; the second to fifth, on the Aus crop, and the sixth, on the Amon crop.

*Parasite.* A new species of larval parasite, *Brancon hispae* Alam, has been recorded in East Pakistan.

The female parasite lays eggs on the hispa grubs feeding inside the leaf tunnel. The hatching parasite larvae feed on the grubs. The parasitized grubs die before prepupation. In most cases, two parasitic larvae are found on a single grub. The fully fed larvae are elongated oval in shape, 4.5 mm long, and pale yellow. Pupation takes place inside the leaf tunnel near the dead host. The pupa is found enclosed in a thin parchment-like covering. The pupal period varies from two to three days. The parasite was observed in the field in May and June during the fourth and fifth generations of the hispa.

### Recommended Control Methods

*Control*

1. Spraying the crop with 0.02 per cent endrin, 0.03 per cent folidol M 50, 0.03 per cent dimecron, 0.1 per cent metasystox, 0.1 per cent BHC or DDT, 0.2 per cent diazinon, or dusting with agrocide 3 (5 per cent BHC) at the rate of 15 to 20 lbs. per acre satisfactorily controlled the pest.

2. Adult beetles may be collected in a field bag and killed by immersing them in a mixture of 1/10 parts of kerosene and water.

3. The tops of the leaves may be clipped up to six inches and then fed to cattle or destroyed.

The pest should be checked at the early stage of Aus infestation, and this will check the populations of the next generations.

## RICE LEAFHOPPERS *NEPHOTETTIX BIPUNCTATUS* FABRICIUS, *NEPHOTETTIX APICALIS* MOTSCHULSKY, *SELENOCEPHALUS VIRESCENS* DISTANT, *SOGATA DISTINCTA* DISTANT

*General.* Among the various species of rice leafhoppers, *Nephotetttix bipunctatus*

and *Nephotettix apicalis* are the most abundant.

The rice leafhopper *Nephotettix bipunctatus* is an important pest of rice in East Pakistan. The insect has been a major pest of rice only since 1956.

*Distribution.* The pest is distributed throughout the rice-growing areas of East Pakistan.

*Damage.* Both adults and nymphs suck the plant sap, making the plants lose their vigor; consequently, growth is retarded and the plants turn yellow.

During an outbreak of rice leafhoppers in 1956, it was assessed that crop losses ranged from 20 to 50 per cent on crops at the panicle stage and from 50 to 80 per cent on crops with unformed ears.

*Life History.* The adult leafhoppers are small, green insects about 4 mm long. They jump from plant to plant and suck the juice from the leaves and leaf sheaths. They are active and attracted to light. The male has a prominent black spot on each of the forewings, and its apical portion is pale black. The female has no such markings, but the apical portion of its forewings is pale brown.

The insect starts laying eggs, usually inside the leaf sheath, 6 to 9 days after reaching the adult stage. The female lacerates the inner tissues of the leaf sheath near the base of the leaf blade with her ovipositor and deposits the eggs below the epidermis, arranging them obliquely in a single row. The eggs are not visible from outside the plants. The number of eggs laid in a mass varies from 8 to 16. The eggs hatch in 3 to 5 days, and the nymphs start sucking sap from the leaf sheath. The nymphal stage lasts 15 to 21 days, during which the insect undergoes five moultings.

There are six generations of the insect in a year, and the maximum population is observed after the third generation, which generally occurs from July to August.

*Parasites.* Two homopterous parasites, *Telonomus* species (*Scelionidae*) and an unidentified chalcid, and one fungal parasite, *Nomura* species (*Moniliceae: Moniliales*), have been found to parasitize the eggs of the rice leafhopper. One species of ladybird beetle, *Coccinella arcuata* F., has been found to predate on the nymph and adult hoppers.

Heavy, continuous rainfall during summer has been observed to markedly decrease the insect population.

### Recommended Control Methods

*Control*

Spraying with 0.01 per cent endrin, 0.02 per cent ethyl parathion, 0.03 per cent dimecron, 0.03 per cent malathion, and 0.1 per cent BHC or DDT at the rate of 50 gal per acre has been found to control rice leafhoppers satisfactorily.

## RICE MEALY BUG *RIPERSIA ORYZAE* GREEN

*General.* The rice mealy bug is an important pest of rice in East Pakistan, having caused heavy rice crop losses.

*Damage.* An infested field shows isolated patches of stunted, sickly, scorched-looking plants. When the outer sheath of an infested stem is drawn apart, numerous bugs of all growth stages are seen attached to the stem. Mealy bugs are always found in colonies attached to the rice stem covered by the outer sheathing leaves. The damage is caused by direct sucking of the plant sap. The infested plants get stunted and turn pale yellow. There are no accurate figures on the extent of damage by this pest; however, a conservative average estimate of loss in the Aus crop would be 20 per cent or more in the affected fields.

*Life History.* Mealy bugs are characterized by the degenerate apterous females, which are obscurely segmented with waxy or powdery coating. Reproduction is oviparously as well as viviparously parthenogenetic. The eggs and the nymphs, which are laid simultaneously, are protected in various ways. They are sometimes enclosed in an ovisac of

waxy threads and sometimes beneath the body of the female or between wax plates secreted from the end of the abdomen. The first stage nymphs remain for two to three days under the body of the female or are enclosed in the waxy threads covered by the leaf sheath. The nymphs crawl out of the egg sac and move, often by wind action, to the upper part of the plant or to the nearby plants. Subsequent nymphal instars and adult females become immobile for the rest of their lives by attaching themselves with their proboscises to plant stems under the leaf sheaths.

A single female can produce 58 to 289 individuals. Expulsion of the nymphs and eggs continues for five days, after which the female dies. Eggs hatch within three hours. Eggs and nymphs are polished white and are 0.3 mm and 0.4 mm long, respectively. The mealy bug completes its life cycle in 17 to 37 days. There are 12 generations in a year.

A long drought with moderately high temperatures favors an outbreak. The insect is active beginning in April to early July and causes severe damage to the Aus crop. It also is sometimes found on the Amon crop at its young stage.

Some eulophid and encyrtid parasites have been recorded from this pest, but their specific identities have not yet been established. Predatory ants, *Monomorium latinoda* Meyrick and *Tetramorium simillimum* Sm. (*Formicidae: Hymenoptera*), and several species of lady beetles have been recorded as predators of this pest.

### Recommended Control Methods

*Control*

Spraying once with 0.04 per cent malathion, 0.03 per cent ethyl or methyl parathion, and 0.03 per cent dimecron at the rate of 50 gal per acre has satisfactorily controlled this insect.

## SCHEDULE OF INSTRUCTION CONCERNING RICE PESTS IN EAST PAKISTAN

*January.* In the infested areas, the hibernating larvae and pupae of rice stem borers and the larvae of swarming and ear-cutting caterpillars remain in the stubble. Collect the stubble after harvest and burn it in the field. This will destroy the pests during their stages of hibernation and check new infestations.

*February.* Plough up the infested land to expose the soil to the sun. This will kill the pupae of swarming and ear-cutting caterpillars sheltered under the soil.

*March.* Look for hispa on the Boro crop. Apply control measures as outlined earlier in this paper.

*April.* Look for hispa on the Boro and early Aus crops. Apply control measures as outlined earlier in this paper.

*May.* Apply preventive measures against rice hispa on the Aus crop.

*June.* Apply preventive control measures for hispa and borers on the Aus crop. Also, spray Amon seed beds to guard against stem borer attack. Look for swarming caterpillars, mealy bugs, and leafhoppers and apply the control measures outlined earlier in this paper.

*July.* Spray the Aus crop and Amon seed beds to control hispa, stem borers, swarming caterpillars, leafhoppers, leaf rollers, mealy bugs, and grasshoppers. Apply the control measures outlined earlier in this paper.

*August.* Time for stem borers, swarming caterpillars, caseworms, and leaf rollers. Apply control measures.

*September.* Same as in August.

*October.* Apply control measures for stem borers and ear-cutting caterpillars.

*November.* Apply control measures for ear-cutting caterpillars.

*December.* Collect and burn the stubble after harvest.

## DISCUSSION

M. Z. ALAM, *East Pakistan*

*Questions*

M. Q. KHAN (*India*): The cultural control of *Spodoptera mauritia* is reported to be effective. What are these cultural methods? There are no available records to indicate the emergence of moths from the pupae, as they are heavily damaged by the natural parasites. So far no cultural method of control has been recommended for the control of these pests.

*Answer:* In some localities, especially in highland areas, adult emergence seems to be considerable. As the mature larvae overwinter in the stumps, they are collected and burned, giving good control in future generations.

D. B. REDDY (*India*): The occurrence of the rice leaf gall fly *Oscinella frit* is very interesting. This insect is a serious wheat pest in England, and this is the first time a frit fly is reported from rice.

As the rice gall midge *Pachydiplosis oryzae* is found in West Bengal, it might also occur in East Pakistan. Is it possible that the identity is mistaken or the name is misprinted? Are the symptoms produced by *Oscinella frit* similar to those produced by *Pachydiplosis oryzae*?

*Answer:* I held the idea that the insect might be *P. oryzae*, but C. I. E. London identified it (twice) as *O. frit*. They might have made a mistake in identification.

G. T. LEW (*Taiwan*): (1) When highly toxic insecticides such as metasystox and parathion are used for practical control, is any difficulty encountered in inviting wide participation by local rice growers? (2) Is the rice mealy bug attended by, or, say, does it live in partnership with field ants?

*Answer:* (1) In highland areas we also recommend metasystox for borer control. Difficulties may arise, so that insecticides should be used with caution. (2) The ants have been found to take the mealy bug in their mouths, and, in other cases, to predate larvae of caterpillar pests.

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