

INSECTS INJURIOUS TO RICE IN SIAM.¹

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The insects injurious to the rice plant (paddy) in Siam are no less numerous than in other countries but very few of them ever become so destructive as to reach the status of pests. The most important rice-growing area is the great Central Plain and the deltas of the large rivers that empty into the Gulf of Siam. The average annual rainfall is from 1,000–1,500 mm., most of which falls between the months of May and November. There is a long dry period, commencing in November and sometimes extending well into May, during which there is no precipitation except an occasional light shower in March. During this period the paddy fields are baked bone-hard and the soil is cracked to a depth of 30 cm. or more. The grass is dried up and nothing remains but a few woody plants scattered on the bunds, and some sedges near the sites of what in the wet season are swamps and ponds. The effect of this dry period is to interpose a sharp break in the development of insect life and to oppose an effectual check on the numbers of insects reaching such proportions as to become a deadly menace to the rice crop.

The following list represents those insects that have come under the personal observation of myself and my assistants and have been identified. A few species are still in the hands of specialists for identification.

ORTHOPTERA. GRASSHOPPERS, LOCUSTS, ETC.

ACRIDIDAE (Short-horned grasshoppers). Destructive to leaves.

Aiolopus tamulus F.

Locusta migratoria L.

Trilophidia cristella St.

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Trilophidia annulata Thnbg.
Oxya diminuta Wlk.
Oxya minuta Carl.
Oxya intricata St.
Oxya chinensis Thnbg.
Atractomorpha crenulata Blanch.
Atractomorpha psittacina Haan.
Patanga succincta L.
Quilta oryzae Uvarov.

LOCUSTIDAE (Long-horned grasshoppers). Destructive to leaves.

Xiphidion longipenne (De Haan).
Xiphidion affine Redtenbacher.
Xiphidion maculatum Le Guillou.

THYSANOPTERA (Thrips). Destructive to leaves.

Bagnallia oryzae and other species.

HEMIPTERA. BUGS.

VASSIDAE. Destructive to leaves and stem.

Nephotettix apicalis Motsch.
Euscelis indicus Dist.

APHIDIDAE (Aphids). Destructive to leaves.

Species not yet identified.

PENTATOMIDAE. Destructive to stem.

Scotinophara coarctata F.

COREIDAE. Destructive to grain.

Leptocorisa acuta Thub.
Leptocorisa varicornis F.

LEPIDOPTERA. MOTHS AND BUTTERFLIES.

NOCTUIDAE.

<i>Sesamia inferens</i> Walk.	Stem borer.
<i>Cirphis unipuncta</i> Haw.	Leaf eater.
<i>Cirphis irregularis</i> Walk.	" "
<i>Cirphis loreyi</i> Dup.	" "

<i>Spodoptera mauritia</i> Boisd.	Leaf eater.
<i>Spodoptera pecten</i> Guen.	" "
<i>Prodenia litura</i> Fabr.	" "

PYRALIDAE.

<i>Diatraea auricilia</i> Dudg.	Stem borer.
<i>Schoenobius incertellus</i> Wlk.	" "
<i>Schoenobius dodatella</i> Wlk.	" "
<i>Cnaphalocrocis medinalis</i> Guen.	Leaf roller.
<i>Nymphula fluctuosalis</i> Zell.	" "
<i>Nymphula leucostola</i> Hmps.	" "
<i>Nymphula dicentra</i> Meyr.	" "
<i>Nymphula responsalis</i> Walk.	" "

SATYRIDAE. Destructive to leaves.

Melanitis leda ismene Cram.

HESPERIIDAE. Destructive to leaves.

Padraona sunias tropica Plotz.

Padraona dara serina Plotz.

Boaris mathias Fabr.

Boaris guttatus bada Moore.

Boaris bevani Moore.

COLEOPTERA. BEETLES.

HISPIDAE. Destructive to leaves.

Hispa armigera Oliv.

ELATERIDAE (Wire worms). Destructive to roots.

Species not yet identified.

HALTICIDAE. Destructive to leaves.

Chaetocnema basalis Baly. (Flea beetle).

DIPTERA. FLIES.

CECIDOMYIDAE. Destructive to stem.

Pachydiplosis oryzae Wood. (Gall midge or stem fly).

I will now give a brief description of the more important of these insects,

ORTHOPTERA. GRASSHOPPERS.

Neither the Acrididae nor the Locustidae have ever become a serious pest on rice in Siam, although they can always be found in the paddy fields and levy a steady toll on the leaves of the plant. A new species of *Quilta* was collected in the paddy fields near Bangkok in 1924 and was described by Uvarov as *Quilta oryzae*.

THYSANOPTERA (Thrips).

Bagnallia oryzae.—This small insect is often very destructive to the seedlings in the nursery. It pierces the green leaves and sucks out the juices, so that the leaf dries up and dies. More than 100 may be found on one leaf.

Distribution.—It has been noticed in Petriu, Prachin, Ratburi, and Surat.

Occurrence.—Mostly observed only in the beginning of the paddy season. The pest is most serious in years when there is a long and unusual break in the rains. We have observed that nurseries treated with an ammonium phosphate fertilizer such as Nicifos or Leunaphos are immune, or at least very much more resistant to the attack of thrips than untreated nurseries.

HEMIPTERA. BUGS.

The most important of the bugs are the paddy-grain bugs *Leptocorisa acuta*, *Leptocorisa varicornis*, and *Scotinophara coarctata*.

Leptocorisa varicornis.—*Life history.*—The dark brown eggs are oval and flattened, and laid in rows of about 15 on the leaves or panicles of the plant. The incubation period is 8-10 days. One female will lay 200-300 eggs. The young nymphs are pale green but the insects darken in colour to a dull green in the later instars. The bugs push their proboscis into the tender undeveloped grain of paddy, sucking up the milky contents and thus destroying the grain, which turns white. The nymphs as well as the adults feed on the grain but the latter sometimes feed on the flowering shoots. Nymphal period 16-18 days, with 5 moults.

Distribution.—*L. acuta* is common all over Siam but rarer in the Central Plain. *L. varicornis* has been found only in Eastern Siam.

Occurrence.—The insect occurs commonly in long grass or vegetation at all times of the year but is most numerous when the paddy crop is in bearing.

Parasites.—None recorded.

Alternative food plants.—Grasses, particularly the coarser varieties.

Scotinophara coarctata.—Black bug of paddy.

When full grown this insect looks like a small black beetle with a flattened back and sloping head, giving it the appearance of a boat bottom upwards. The bug pushes its proboscis into the stem of the paddy as near the roots as possible, sucking the juices and preventing the nourishment from reaching the growing parts of the plant, which soon dies of starvation.

Life history.—The eggs are light green, cylindrical, with reticular marking, and are laid in groups of 20 or more on the leaves of the paddy or on any other plant growing near the crop, or even on the ground if it is dry enough. When the insect first emerges it has a brown head and greenish body with black spots, the colour quickly changing to reddish brown and finally black. The full grown insect is about 9 mm. long and 4.5 mm. across the broadest part of the back. Its total life period is about 200 days.

Distribution.—Reported only from Southern Siam, Trang, and Surat.

Occurrence.—In Malaya it has been observed that the insect likes to live in the presence of plenty of water, and if the ground is dry or only slightly muddy the full grown insects will burrow down into the ground in search of more water, whereas in Siam it is found in great abundance on hill paddy where the soil is merely moist, and causes complete destruction of the crop in comparatively dry situations. Alternative food plant are grasses and sedges.

Parasites.—Chalcidoid parasites were obtained from eggs collected in the fields. Probably it is the same form as that found in Malaya.

LEPIDOPTERA.

PADDY CUT-WORMS AND ARMY-WORMS.

These are caterpillars of various species of moths, the most important being *Cirphis unipuncta*, *Spodoptera mauritia*, *S. pectens*, and *Prodenia litura*, all of which have been known as mild pests of paddy in Siam for many years, the violence of their attack varying from year to year according to seasonal conditions. I shall describe the first two only.

***Cirphis unipuncta*.**—*Life history*.—The eggs are laid in masses on the leaf, the margins of which are folded and glued together so that the eggs are completely or partially covered. The eggs are laid mostly on the older and drier leaves. The female moth lays on an average 600 eggs but under laboratory conditions as many as 1,000 from one individual have been observed.

The eggs hatch in 3 to 4 days but in some cases the incubation period is as short as 2 days. The tiny caterpillars do not feed for the first 24 hours, they then delicately nibble at the green tissues of the leaf surface, and when a week old and about 3 mm. long they start eating the whole leaf, cutting in from the margins to the midrib and then working parallel to this until the leaf is cut off. The midrib itself is generally left untouched. This method of feeding is extremely wasteful so that one caterpillar will do damage quite out of proportion to its size. The pest is most harmful when the crop is in bearing, as the caterpillars feed on the spikelets and cut off the ears. The young caterpillars usually lie hidden inside rolled-up leaves but when they get bigger they hide in cracks in the soil, or, if the land is flooded, in the bases of the stems under the shade of the leaves, or sometimes under grass and fallen leaves near the bunds. They are very active at night, coming out after dusk to feed on the crop, moving freely all over the plants and eating voraciously. After eating for 25 to 27 days the caterpillars pupate either in the ground, low down the stems of the plants, or under dried grass, paddy leaves, or weeds on the bunds. The pupal period is 10 to 12 days. In captivity it is found that the female starts laying after 4 or 5 days and continues for 8 days. The complete life history takes from 47 to 52 days.

Bainbrigge Fletcher describes the caterpillar thus:—

The full-grown larvae is about 35–40 mm. long, moderately stout, smooth, dull-greenish or purplish with a broad longitudinal paler stripe along the side and a narrower lighter stripe below the spiracles; head pale yellow-brown, ventral surface and legs pale-greenish, prolegs with a plate above each sucker foot.

Distribution.—It was first recorded in Siam in 1929 and has been observed in Chiangmai in the north, Cholburi and Chantaburi in the south-east, Korat in the east, Ratburi in the south of the Central Plain, and Prachin in the north-east of the Central Plain. In the district of Phanom (Prachinburi) 30,000 rai (12,000 acres) of paddy were destroyed by this pest in 1932. The low-lying areas in the Central Plain near Bangkok with their stiff clayey soils are free from this pest.

Occurrence.—We have found no regular intervals between attacks. It occurs uninterruptedly throughout the paddy season. Investigation of outbreaks, particularly when the crop is in bearing, reveals every stage of development of the insect from egg to adult moth. However the appearance of the caterpillars in such very large numbers as to constitute a menace to the crop is very sudden. Serious outbreaks do not occur every year. They may be expected particularly in years in which there are early rains and a dry period followed by heavy rains. The caterpillars can feed on maize and all kinds of grasses, and the moths therefrom fly long distances and may lay eggs far from their birthplace. The cultivator usually notices the insects only when they are well grown and in large numbers, so their appearance is greeted as an unpleasant miraculous visitation.

Parasites and natural checks.—Birds do useful work in the destruction of the caterpillars. Tachinid, ichneumonid, and chalcid parasites have been collected, all of which have been bred in captivity but so far undetermined. The tachinid is a larval parasite while the ichneumonid and chalcids are pupal parasites.

Chalcid A is a large insect measuring 8 mm. in length. Only one parasite emerges from each pupa infested but one female is able to infest 30 or more pupae. The adult parasite emerges 14–16 days after the egg has been deposited.

Chalcid B is a small insect, the female measuring slightly over 1 mm. in length. The infestation of the pupae is very high, 100-400 parasites being obtained from each pupa. With the larger number the insects are much smaller than usual. The male is always smaller than the female, but a female from a high infestation may be smaller than the male from a low infestation.

Alternative food plants.—Maize and grasses.

Spodoptera mauritia.—*Life history.*—The eggs are laid on the leaves or stems of the food plant in masses, covered by the buff-coloured hairs from the hinder portion of the body of the female moth. A total of 200-300 may be laid. The period of incubation is from 3-4 days. For the first few days of their life the tiny caterpillars feed only at the surface of the leaf, eating only the green tissue, but once they have attained a length of 4 mm. they devour the leaf as a whole. The caterpillar stage lasts from 20-24 days. The full grown caterpillar is 30-38 mm. long, green dorsally and greenish-yellow below, with a reddish-brown stripe along the sides. The caterpillars feed at night, keeping themselves hidden during the day in the lower portions of the plants or, if the land is sufficiently dry, in cracks in the soil. It pupates in the lower leaf sheaths. The pupal period varies from 7 to 10 days with the later broods. The pupae are reddish-brown and average 13 mm. in length.

Distribution.—Throughout Siam, but more common in the Central Plain.

Occurrence and importance.—It occurs in swarms only during June and July and disappears in August when the south-west monsoon is well set. It does most damage in the seed beds and has seldom been reported as a serious pest in the field.

Parasites.—Four tachinids as yet undetermined.

Alternative food plants.—All varieties of grasses.

PADDY STEM-BORERS.

These are among the worst pests of paddy in Siam and are the most difficult to control. The most important are *Schoenobius incertellus*, *S. dodatellus*, *Sesamia inferens*, and *Diatraea auricilia*.

Schoenobius incertellus.—As only a few systematic observations of these pests have been recorded and their mode of attack and effect on the plant are very similar, we shall consider *Schoenobius incertellus* as an example of the group. The moths are prominent throughout the paddy season, the numbers reaching their maximum about September or October. *Schoenobius incertellus* is much the most common and unlike the others comes readily to light.

Life history.—The female moth lays eggs on the leaves of the plants in an oval-shaped raised mass covered with light brown hairs from her anal tuft. The number of eggs in the mass is variable, from 20–150 having been counted. The eggs hatch in 5–8 days. Soon after emergence the tiny larvae spread all over the rice plant and sometimes suspend themselves by silk threads and are carried by the wind to neighbouring plants. The newly-hatched caterpillars quickly make their way into the leaf sheaths and start boring into the stem, inside which they live and thrive at the expense of the food material that is being conveyed to the growing part of the plant. Many larvae may feed in a single stalk and under artificial conditions in pot cultures the culms have been so overpopulated that the plants have died. Pagden has observed that in the Federated Malay States the larvae sometimes change their environment if it becomes unsuitable and they have been noticed swimming from one plant to another. The larvae are cannibalistic and one method of reducing overcrowding is to devour their companions.

The caterpillar pupates in the stem but just before pupation it cuts a small hole in the stem, leaving only the thin green tissue, so that when the moth emerges from the pupa it can escape easily. The presence of a full grown caterpillar or pupa is indicated by this hole, and a brownish band round the stem of the paddy, usually noticed just above the surface of the water. Until quite recently the loss of crop following the occurrence of this brown band, and the empty white panicles consequent on the attack of borers, was attributed by the cultivators to supposed impurities in the water supplied by the Royal Irrigation Department. Whenever I have taken a stem and demonstrated the presence of the real criminal the cultivators have been overcome by surprise.

The whole period of the life history varies from 45-55 days, of which the larval stage occupies 35-45 days.

The insect hibernates both as a nearly full-grown larva and in the pupal form.

Distribution.—General, but more prevalent in the Central Plain and South Siam.

Occurrence and importance.—Three swarms have been observed during the paddy season, between the months of May and November; the numbers reaching their maximum some time between late September and the middle of October, depending on the nature of the rainy season.

Symptoms of attack.—Plants attacked early in their life period soon become stunted and useless through the destruction of the inner heart leaf or growing tip. Those plants attacked when nearing maturity produce no seed but display white heads of empty grain; rarely the panicle is not entirely barren, a few mature grains being noticed here and there.

Parasites.—An ecto-parasite, *Tetrastichus schoenobii* (Ferrière) is a most important check on the multiplication of this pest. With the later broods as many as 90 per cent and seldom less than 75 per cent of egg masses are infested with this parasite.

An undetermined braconid with a particularly long ovipositor is parasitic on *Schoenobius* and *Diatraea* larvae while they lie hidden in the paddy stems.

Alternative food plants.—Many varieties of grass and sedges.

RICE CASE-WORMS (*Nymphula* and *Cnaphalocrocis* spp.)

There are many species of rice case-worms causing damage to rice especially when the plants are young and in the nurseries. The moths are very small and fragile, with delicately-marked wings.

The caterpillar of some species is almost white whereas others are light green or brownish. They are semi-aquatic and live in small cases made of short pieces of leaf which they cut off and roll into a tube. In the nursery or soon after the paddy is transplanted, one frequently notices these little tubes floating on the surface of the water or attached to the plant. The caterpillar is able to propel its floating tube over the surface of the water by wriggling the body.

Unlike other caterpillars, on their sides they have filaments, thin hair-like appendages, which act as gills and enable them to breathe while under the surface of the water in a manner similar to fishes.

Symptoms of attack.—The most prominent symptoms to be observed are the cut leaves, the tops of which fade and die, and also white patches on those that are standing. The caterpillar does not eat the leaf bodily but just feeds on the green tissue, leaving the frame work, which appears as white patches.

Occurrence and distribution.—These insects are distributed all over Siam but are particularly prevalent in the transplanted areas. No especial phenomena connected with its appearance have been observed.

RICE HISPA (*Hispa armigera*).—*Description and life history.*—A small black insect, almost flat, with the sides of the elytra parallel, and the integument with regularly arranged spines. The life history has not been worked out in Siam, but the general outline is that the egg is laid in the tissues of the leaf, and the larva, which is flattened, mines in the leaf and pupates there. The adult feeds on the leaf surface, eating away the green tissues, leaving characteristic thin whitish lines.

Occurrence and distribution.—It has been found only in the low-lying areas of the great Central Plain and apparently prefers very moist conditions for its environment. It was particularly serious in 1930 at Klong Rangsit where from an area of half an acre over 6 pounds of the adult beetles were collected.

Parasites.—A tiny chalcid attacks the grubs.

DIPTERA.

THE RICE GALL-MIDGE (*Pachydiplosis oryzae*).—*Description.*—The fly belongs to the family Cecidomyiidae, and is a serious pest on rice at Prae, North Siam, and Trat in South-east Siam. This insect resembles a mosquito but is red and the wings are broader. The males are blackish and smaller than the females.

Life history and symptoms of attack.—The eggs are laid on the rice plant near the ligules or on the tender leaves. The eggs are red, elongate, tapering at both ends, and measure less than a milli-

meter in length. The young maggots after hatching make their way between the stem and the leaf sheath until the dormant bud is reached. The tiny maggots feed at the base of the young shoot. The dormant shoot thus affected gets a pathological stimulus and the result is a small gall which grows surrounding the tiny larva. The gall then elongates and shoots out a hollow tube which is dirty white or pale green. This hollow tube or the gall is known as the "silver shoot". The larva pupates in the gall and pushes itself up to a certain point in this hollow-shoot whence it emerges as a fly, boring a small hole for exit. The portion of the shoot above this hole generally falls off and appears as if it were cut. Where many of the tillers are effected it appears as if they had been grazed by cattle.

Parasites.—Various parasites are known to keep this fly pest under control, and at Prae four different species have been found. Three of these belong to the family Chalcididae, while the fourth is a braconid fly which was caught in great numbers at light in the fields.

Many stems ("silver shoots") were cut open for examination and nearly 60 per cent were found to contain pupae of the fly which had already been parasitised. Shoots or galls containing the insect already parasitised by chalcid flies are generally thick and short, measuring from three to four inches, while the rest are thinner and longer. In certain cases galls two feet in length have been observed.

Since this paper was presented some of the parasites of *Cirphis unipuncta* have been determined by the Imperial Bureau of Entomology, London, as follows:—

TACHINIDAE.

Carcelia kockiana Towns.
Dolichocolon paradoxum B. B.
Eutachina civiloides Baranoff.
Alsomyia anomala Villeneuve.
Gaediogonia jacobsoni Towns.

CHALCIDIDAE.

Brachymeria euploae Westw. (A, p. 167.)

EULOPHIDAE.

Tetrastichus sp. (B, p. 168.)

BRACONIDAE.

Microbracon sp.

ICHNEUMONIDAE.

Aglaojoppa sp.