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The Major Insect Pests of the Rice Plant

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32 Insect Pests of Rice in the Philippines

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The following are the known insect pests of rice in the Philippines:

Order *Orthoptera*

Acrididae

Ailopus tamulus Fabricius
Locusta migratoria manilensis Meyen
Gastrimargus marmoratus Thunberg
Atractomorpha psittacina de Haan
Trilophidia annulata Thunberg

Tettigonnidae

Mecopoda elongata Linnaeus
Phaneroptera furcifera Stal.
Euconocephalus varius Walker

Gryllidae

Gryllus testaceus Walker
Acheta bimaculata (de Geer)

Gryllotalphidae

Gryllotalpha africana Beauvois

Order *Hemiptera*

Coreidae

Leptocorisa acuta Thunberg
Leptocorisa varicornis (Fabricius)
Leptocorisa discoidalis Walker
Leptocorisa geniculata China

Lygaeidae

Aphanus sordidus (Fabricius)

Pentatomidae

Nezara viridula Linnaeus

Order *Thysanoptera*

Thripidae

Thrips oryzae Williams

Order *Homoptera*

Cicadellidae

Nephotettix apicalis Motschulsky
Nephotettix bipunctatus Fabricius
Cicadella spectra Distant

Delphacidae

Peregrinus maidis Ashmead *Delphacodes*

Derbidae

Proutista moesta Westwood
Nilaparvata lugens Stal.
Nisia atrovenosa Lethierry

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Aphididae

Tetraneura hirsuta (A. C. Baker)
Geoica lucifuga Zehntner

Coccidae

Saccharococcus sacchari (Cockerell)

Order *Coleoptera*

Scarabaeidae

Leucopholis irrorata Chevrolat
Lepidiota blanchardii Dalla Torre
Holotrichia vidua Sharp
Adoretus luridus Blanchard
Anomala humeralis Burmeister
Anomala sulcatula Burmeister

Coccinellidae

Verania crocea Fabricius

Order *Lepidoptera*

Pyrallidae

Cnaphalocrosis medinalis Guenée
Nymphula depunctalis Guenée
Nymphula fluctuosalis Zeller
Chilo suppressalis Walker
Tryporyza incertulas (Walker)
Scirpophaga innotata (Walker)

Noctuidae

Prodenia litura Fabricius
Spodoptera mauritia Boisduval
Spodoptera exempta (Walker)
Sesamia inferens Walker
Leucania loreyi (Duponchel)
Pseudaletia separata (Walker)
Agrotis ypsilon Rott.
Remigia frugalis Fabricius
Anticyra combusta Walker

Hesperidae

Baoris mathias Fabricius
Hesperia philino Motschulsky

Nymphalidae

Melanitis leda Linnaeus
Mycalesis mineus Linnaeus
Discophora ogini Hübner

Order *Diptera*

Anthomyidae

Atherigona seticauda Malloch

Agromyzidae

Agromyza sp.

Of these pests, only the following are of more or less major importance:

Locusta Migratoria Manilensis *Meyen.* (*Oriental Migratory Locust*). Of the *Acrididae*, only the Oriental migratory locust is of real importance. During the Spanish regime in the Philippines, its depredation was at times followed by famine. It is essentially a pest of grasses, although, when driven by hunger, it may also devour leaves of palms and certain legumes. According to Uichanco (1936a), swarms of *L. migratoria manilensis* occur at intervals of about 11 years, the peak more or less following the period of sun-spot minima. The same author (1936 *et seq.*) believed that the east central part of Mindanao bordering the Liguasan marshes is the permanent breeding place of the pest. From there, it emigrates to other areas, in the past sometimes reaching as far north as Taiwan and eastern China, and as far south as Celebes. Otanes (1940), likewise, believes that the main breeding ground is in central and southern Cotabato.

The discovery of the migratory locust phases by Uvarov (1933) and the studies on the Philippine species chiefly by Uichanco (1930a, 1936a, 1936b, 1938b, 1939) and by Otanes (1940, 1945, 1951), as well as the development of effective new insecticides, have enabled the Philippines to cope with the locust situation more effectively than in the past. With a continuing annual appropriation for a campaign against locusts, the Bureau of Plant Industry takes charge of scouting in Mindanao and instituting control measures, chiefly chemical, wherever locust swarms are discovered to be forming. The chemicals used in the past were aldrin, dieldrin, folidol, chlordane, and BHC, either as sprays or as baits. These measures have minimized locust

infestation. The last authentic locust swarms that reached Luzon were in 1922. Today, although the locust is still a menace to rice and corn crops and the pasture areas in Mindanao, swarms have not reached Luzon and the Visayas for many years.

Gryllotalpha africana *Beauvois* (*Mole Cricket*). *G. africana* destroys the roots and base of young rice, and in many instances, has caused as much as 25 per cent damage in lowland rice fields in which no standing water can be maintained. When there is abundant water, the pest is confined to the dikes, doing little damage to the plants.

The control measure usually resorted to when infestation is heavy is the copious flooding of the entire field. Otanes and Sison (1952) also advocate light trapping. Spreading poisoned rice bran bait in infested paddies has also been recommended.

Leptocorisa acuta *Thunberg* (*Rice Bug*). Rice bugs are destructive in some parts of the Philippines where the rainfall is about evenly distributed throughout the year and in irrigated districts. They also seriously damage fields planted early or late in the season. Of the several species of rice bugs in the Philippines, *L. acuta* is the most damaging to rice grains.

Uichanco (1921) studied the biology of *L. acuta* and found that (*a*) the developmental period is 62 days on the average; (*b*) the incubation period, about a week; and (*c*) the nymphal stage, about 20 days. There are five nymphal instars.

The pest infests graminaceous plants only, feeding on the contents of the young grain. It strongly prefers rice, so that it leaves the grass weeds whenever rice is available. Consequently, the earliest- and latest-maturing rice fields in the vicinity are damaged.

Otanes and Sison (1952) enumerated the following measures for controlling rice bugs:

1. Catching the adult bugs with insect nets
2. Collecting and destroying the eggs
3. Light trapping
4. Cleaning the fields of grass weeds when rice is not in season
5. Spraying with soap solution (⅕ to ⅓ kg in 5 gal of water), kerosene emulsion with DDT, derris-soap solution (1/10 to ⅕ kg soap, 20 to 25 spoonsful of derris powder, 5 gal water), or other insecticides
6. Dusting with derris powder
7. Attracting adult bugs with rotten meat and catching them with nets.

A method that has successfully protected the main harvest in fields where the bugs are a serious menace is to let the small area plantings in the field mature ahead of the main crop and spray the bugs that subsequently collect on them with insecticides. Madrid (1949) found bladex, DDT, and DDT-kerosene emulsion sprays to be effective against *L. acuta*. Under laboratory conditions, Rivera (1956) found that parathion followed by TEPP was effective. Calora (1956) stated that parathion is effective against the nymphs.

Two egg parasites of *L. acuta* have been reared, *Oöencyrtus malayensis* Ferriere (*Encyrtidae*) and *Telenomus comperei* Crawford (*Scelionidae*). An unidentified tachinid fly also parasitizes the nymph, but emerges from the adult bug.

Leafhoppers

At least three species of leafhoppers are capable of building up in large numbers—two cicadellids, *Nephotettix apicalis* and *N. bipunctatus*, and a delphacid (possibly a *Delphacodes* sp.). Because they prefer moist conditions, they are more destructive in irrigated than in upland plantings.

N. apicalis *and* bipunctatus. These are grass-green species about 4 mm long, usually found on the nether surface of the leaves and on the young leaf sheaths. The two species have closely parallel life histories. They oviposit in the leaf sheath. According to Abalos (1939), the nymphal stage covers 13 to 19 days, and the female lays eggs 2 to 3 days after emergence. The life cycle of *N. apicalis* is from 23 to 31 days, that of *N. bipunctatus*, from 20 to 31 days.

N. apicalis and *N. bipunctatus* are confined to grass hosts.

Delphacodes *Species*. This is a brown species about 4 mm long. Often infestation is heavy and whole paddies of prebooting rice are killed. Some rice varieties such as Milfor and Peta are especially attractive to this leafhopper. In Calamba, Laguna, in 1959, an attack by this leafhopper completely destroyed all the paddies planted to Milfor, whereas the paddies planted to Malagkit escaped damage. In an outbreak at The International Rice Research Institute fields in April, 1964, Milfor and Peta suffered more damage from this pest than other varieties.

The leafhopper concentrates on the lower portions of the plant just above the water level in the irrigated fields and in the interior of the clustered bases of the tillers, strongly suggesting that the hoppers prefer a humid condition. If this is so, close plantings and weedy fields would favor this leafhopper.

Among the natural enemies of leafhoppers in the Philippines are several species of lady beetles that prey on the nymph and adult stages, and a capsid egg predator, a *Cyrtorhinus* species.

The control measures recommended for leafhoppers (Otanes and Sison, 1952) are:

1. Light trapping the adults and killing them with water and soap or kerosene
2. Catching the insects with nets and hopperdozers
3. Spraying with insecticides—soap solution, nicotine sulfate solution, derris or pyrethrum; also chlorinated hydrocarbons.

Thrips oryzae *Williams*. The rice thrips occasionally damage young rice extensively, both under upland and paddy conditions. The nymph and the adult puncture the tissues of the still-unopened very young leaf, and the leaf consequently fails to expand. Severely damaged plants appear unthrifty, as if suffering, even if standing in water, from drought.

An extensive infestation (300 hectares) of upland plantings was observed in Ala Valley, Cotabato, in June, 1951. This was successfully controlled with bladex spray.

Calora and Ferino (unpublished), in their study on the relation of planting dates to rice insect infestation, showed that the initial infestation of plantings on July 31, January 16, and January 30 were high. The infestations occurred one week after transplanting. However, in all plantings, infestation tended to decrease after the first week. By the third week, the infestation became negligible, and as the plants got older, the pest completely disappeared. This result showed that the thrips are primarily pests of young rice seedlings. It also was found that in October, November, and December, thrips were almost non-existent in the field. Thrips were abundant only during the months of July, August, late September, and January.

Leucopholis irrorata *Chevrolat*. White grub infestation on rice occurs only in upland plantings and never in the wet paddy fields. While there are several species of white grubs in the fields, all serious infestations have been found to be caused by *L. irrorata*. A possible reason for this is that the other species of white grubs occur scattered indiscriminately in the field. On the other hand, *L. irrorata* beetles lay their eggs together in a relatively small area, so that the resultant damage by the many grubs feeding together on the plant roots in a limited area is conspicuous.

Uichanco (1931) noted that *L. irrorata* beetles have habitual breeding areas. These are usually low-lying places in which water collects but does not stay long after heavy rains. Other areas which are rich in decaying leaves also are favored oviposition sites. Undisturbed patches in the habitual breeding area seem to be more favored by the beetles for oviposition than areas that have been plowed. From these oviposition areas, the grubs disperse as they begin to compete with each other for food.

There is only one brood in one year, and development is synchronous in the Philippines, except in such areas as the Maao district in Occidental Negroes, where all stages of the beetle may be encountered in the field

at any time. Swarming and egg laying occur during the early part of the rainy season, usually in late May to June.

The scoliid wasp *Campsomeris collaris quadrifasciata* is an external parasite of *L. irrorata.*

The control measures used against *L. irrorata* have been:

1. Collecting the adult beetles through a well-organized beetle-collecting campaign, although the effectiveness of this method in reducing succeeding beetle populations has been questioned by Uichanco (1931).

2. Collecting the grubs by digging them out or plowing the field. The latter also exposes them to birds and other predatory animals.

3. Use of kerosene-coal tar emulsion applied in trenches around the infested area to curtail the outward migration of grubs.

4. Application of soil fumigants (PDB or CS2) or other insecticides to the infested field.

5. Application of aldrin, dieldrin, heptachlor, and chlordane in areas habitually infested by white grubs. This should be done before planting.

Cnaphalocrosis medinalis *Guenée* (*Rice Leaf Folder*). In heavy infestations, the plants appear as if scorched. The pest seems to be extremely seasonal and partial to plants that are crowded or of dense growth.

The life history of *C. medinalis* (Otanes and Sison, 1952; Lim, unpublished) is as follows.

The flattened, oval, yellow eggs are laid singly or in pairs on the expanded young leaves. The eggs hatch 3 to 6 days, usually 4 days, after oviposition; the larvae pupate 15 to 25 days after hatching; the pupal period is 6 to 8 days. The life cycle is from 25 to 35 days.

C. medinalis feeds on many grass species, including rice, corn, sugar cane, millet, wheat, and sorghum.

Results obtained by Calora and Ferino (unpublished) showed that rice plants were susceptible when still young, up to at most 73 days after transplanting. Beyond this period, the infestation decreased to a negligible extent. Plantings on August 14 and August 28 were both infested. From September, the infestation gradually decreased, until it became almost nil by January.

The following measures have been used to control this pest:

1. Clean culture, that is, the removal of graminaceous weeds
2. Light trapping the moths
3. The use of soap solutions and DDT sprays which have been found effective.

Calora (1956) and Rivera (1956) found parathion, TEPP, and toxaphene to be effective against these insects. In general, insecticides effective against borers are also effective against this pest.

Six hymenopterous parasites have been reared from *C. medinalis*—three braconids, one ichneuomonid, and two chalcids.

Armyworms

Several species of armyworms attack rice, but only the rice armyworm (*Spodoptera mauritia* Boisduval) and the corn, or black, armyworm (*Spodoptera exempta* Walker) are important.

Spodoptera mauritia *Boisduval.* During the early part of the rainy season each year, from June to August, the rice armyworm *S. mauritia* often multiplies and devastates upland rice seedlings in the seed beds or fields. Although primarily a pest of young seedlings, plants as old as the prebooting stage are attacked.

A female may lay hundreds of eggs. The eggs are laid in masses of as many as 800, at about the tip of an upright expanded leaf. The young caterpillars are green and about 2 mm long when newly hatched. As they grow older, they gradually turn brownish or entirely brown, with a dark, crescent-shaped spot on each side of each segment. A fully grown caterpillar may be about 35 mm long.

The insect pupates in the ground. The lack of satisfactory pupating sites may be the

reason that transplanted lowland rice is seldom ravaged by *S. mauritia.*

Otanes and Sison (1952) found the incubation period of *S. mauritia* to be 2 to 4 days, the larval stage, 14 to 23 days, and the pupal stage, 7 to 16 days.

The following entomophagous insects help control *S. mauritia* most of the year.

Hymenoptera

Braconidae. Apanteles ruficrus (Haliday), *Apanteles* species, *Chelonus* species, *Inareolata* species, *Macroplitis manilae* Ashmead, and *Microbracon* species—all on the larvae.

Ichneuomonidae. Charops longiventris Ashmead—on the larvae.

Scelionidae. Telenomus species—on the eggs.

Diptera

Tachinidae. Three unidentified species.

The most efficacious control measure against armyworms is dusting or spraying the infested fields with insecticides. Lead or calcium arsenate was frequently used in the past. DDT has subsequently proved to be effective and economical. Treatment should be made as early as possible, preferably during the first few days after hatching.

Spodoptera exempta *Walker.* The caterpillar of *S. exempta* is black, with a yellow lateral line. It is more common on corn than on rice, although at times, like *S. mauritia,* it infests extensive areas of young upland rice. Its damage on rice is similar to that of *S. mauritia,* but on young corn, where *S. mauritia* never occurs in epidemic numbers, it may completely strip the young plants of their leaves.

The life history of *S. exempta* is similar to that of *S. mauritia.* It lays eggs in masses, but unlike the eggs of *S. mauritia,* they are in a single layer and are not completely covered by silk fibers.

Rimando (1954) found the incubation period of this species to be usually 2 days, the larval period, 17 days in the female and 13 days in the male, and the total life cycle, usually 27 days for the female and 22 days for the male. A female lays an average of 800 eggs within one to three nights. An egg mass contains an average of 500 eggs.

The parasites that attack *S. mauritia* also attack *S. exempta.* The control measures are identical with those used against *S. mauritia.*

Atherigona seticauda *Malloch.* This anthomyid fly infests very young rice of from the two-leaf stage to that about a month old. At times, it may kill an appreciable number of the seedlings in upland plantings. The lemon-yellow maggot of the fly penetrates and destroys the growing point of the tiller. Young plants usually are killed, but infested older plants are able to produce new tillers.

There has been no study of the biology of this species in the Philippines, and no control measures are practiced.

Stem Borers

Borer Species. Four lepidopterous borers infest rice in the Philippines: the pyralids *Chilo suppressalis* (usually referred to as the striped borer), *Tryporyza (Schoenobius) incertulas* (yellow borer), *Scirpophaga innotata* (white borer), and the noctuid *Sesamia inferens* (pink borer). *T. incertulas* and *C. suppressalis* are the more important ones, while *S. innotata* and *S. inferens,* although also economically important, are less serious. The damage they cause is apparent in the "dead hearts" (dead, unopened youngest leaf) in young plants and "white heads" (dried prematurely dead panicle) in mature plants.

Distribution and Relative Abundance of Borer Species in the Philippines. Of the four species of rice stem borers, *C. suppressalis, T. incertulas,* and *S. inferens* are found all over the Philippines. *S. innotata* is of a more restricted distribution. Otanes and Sison (1952) reported it in central Luzon, and occasionally in the Cagayan Valley. It is not found in Laguna or in the Bicol Penin-

TABLE 32-1: Relative Abundance (Per Cent) of Rice Stem Borer Larvae Species in Infested Fields in Laguna (Three years—1958, 1959, 1960)

	1958				1959				1960				Total			
Month	Total	*Chilo*	*T. incertulas*	*Sesamia*	Total	*Chilo*	*T. incertulas*	*Sesamia*	Total	*Chilo*	*T. incertulas*	*Sesamia*	Total	*Chilo*	*T. incertulas*	*Sesamia*
Jan.	318	99.0	0	1.0	544	97.0	0.4	2.6	695	97.7	0.7	1.6	1557	97.9	0.4	1.7
Feb.	318	30.8	67.3	1.9	785	93.3	2.0	4.7	594	100	0	0	1697	74.7	23.1	2.2
Mar.	358	86.6	12.6	0.8	838	94.9	3.1	2.0	1304	98.9	0.7	0.4	2500	93.5	5.5	1.0
Apr.	665	95.8	3.3	0.9	719	97.0	3.0	0	945	98.2	1.8	0	2529	97.0	2.7	0.3
May	339	94.9	2.7	2.4	363	97.0	0.6	2.3	741	99.6	0	0.4	1443	97.2	1.1	1.7
June	378	19.9	78.2	1.9	655	99.0	0.8	0.2	521	98.1	0.2	1.7	1554	72.3	26.4	1.3
July	1009	94.0	6.0	0	243	98.8	1.2	0	295	98.3	4.7	0	1547	97.0	3.0	0
Aug.	359	100	0	0	324	98.1	1.9	0	692	99.4	0.5	0.1	1275	99.2	0.8	0
Sept.	810	96.4	3.1	0.5	507	67.8	19.4	12.8	530	96.8	0	3.2	1947	87.0	7.5	5.5
Oct.	852	99.0	0.6	0.4	830	87.0	8.3	4.7	313	84.3	14.7	1.0	1995	19.1	7.9	2.0
Nov.	468	100	0	0	463	94.0	0.7	5.3	563	98.8	0	1.2	1491	97.6	0.2	2.2
Dec.	207	97.0	3.4	9.6	661	92.4	4.2	3.4	438	100	0	0	1306	93.1	2.4	4.4
Total	6081	86.8	11.2	2.0	6931	92.9	3.9	3.2	7611	98.1	1.1	0.8	20841	92.6	5.4	2.0

sula. It is common in the Visayas and Mindanao.

Observations on the relative abundance of *C. suppressalis* and *S. inferens* were made in Laguna in 1958–60. The results show that *C. suppressalis* is the dominant species in this province: 92.6 per cent of the borer larvae collected from the field during the time was of this species, while only 5.4 per cent was *T. incertulas*, and only 2.0 per cent, *S. inferens* (Table 32–1).

The observation was extended in 1960–61 to include the central Luzon provinces (Bulacan, Nueva Ecija, Pampanga, Tarlac, and Pangasinan). The results show that while *C. suppressalis* is the dominant species in Laguna (85.5 per cent), *T. incertulas* constituted 95.9 per cent of the borer larvae samples collected in central Luzon (Table 32–2).

TABLE 32-2: Relative Abundance (Per Cent) of Rice Stem Borer Species in Laguna and Central Luzon during the 1960–61 Cropping Season

	Laguna			Central Luzon		
Month	*Chilo*	*T. incertulas*	*Sesamia*	*Chilo*	*T. incertulas*	*Sesamia*
1960						
Sept.	96.8	0	3.2	4.7	94.4	0.9
Oct.	84.3	14.7	1.0	0	100.0	0
Nov.	98.8	0	1.2	0	100.0	0
Dec.	100.0	0	0	0	98.6	1.4
1961						
Jan.	56.0	44.9	0	8.9	89.9	1.2
Feb.	100.0	0	0	31.4	68.6	0
Total	85.5	13.5	1.0	3.7	95.9	0.4

TABLE 32–3: Relative Abundance of Rice Stem Borer Species on Identical Rice Varieties in Laguna and Central Luzon, September, 1960–February, 1961

Rice variety	Place	Total larvae	*Chilo*		*T. incertulas*		*Sesamia*	
			No.	%	No.	%	No.	%
Inintiw	Laguna	283	276	97.5	2	0.8	5	1.8
	Central Luzon	1086	0	0.0	1086	100	0	0.0
Peta	Laguna	1026	1005	97.9	5	0.4	18	1.7
	Central Luzon	145	0	0.0	45	100	0	0.0
Raminad	Laguna	212	212	100	0	0.0	0	0.0
	Central Luzon	422	57	13.5	365	86.4	1	0.1

The prevalence of *C. suppressalis* in Laguna and *T. incertulas* in central Luzon could not be attributed to differences in the varieties used (Table 32–3). Even on varieties Inintiw, Peta, and Raminad that these two areas grow in common, the same difference in borer abundance was obtained. As will be shown later in this paper, this difference could be attributed to the fact that the fields in Laguna are irrigated, while those in central Luzon are rain-fed.

The observations were later extended to other parts of the Philippines.[3] The results obtained so far (Table 32–4) seem to show no clear trends except that (*a*) *T. incertulas* and *C. suppressalis* are markedly the two most important borer species in all the localities studied, and (*b*) *T. incertulas* was more abundant than *C. suppressalis* in the Cagayan Valley, the Bicol Peninsula, and Leyte; but in Iloilo, Cebu, and Cotabato, the situation was reversed. There was no consistent trend with respect to the relation of borer abundance to rain-fed or to irrigated fields.

However, when these results and those obtained earlier in Laguna and central Luzon were examined in light of the Philippine climatic types (Table 32–5), they showed some interesting relationships.

[3] Cooperative research project of The International Rice Research Institute and the College of Agriculture, University of the Philippines (still in progress).

The Philippine Weather Bureau divided the Philippines into four areas of different climatic types.

Climate Type I represents areas where there is a distinct dry half of the year (December to May) and a rainy half (June to November). Laguna and central Luzon fall under this type.

All the fields examined in Laguna were irrigated, while those in central Luzon were rain-fed (unirrigated). The collections in these two places showed a pronounced preponderance of *T. incertulas* (95.9 per cent) in the rain-fed (central Luzon) fields, while in the irrigated (Laguna) fields, *C. suppressalis* was preponderant (85.5 per cent). *S. inferens* did not abound, although it seemed to be slightly more common in the irrigated (Laguna) than in the rain-fed fields (central Luzon).

Climate Type II represents areas where there is no dry season and the rains are pronounced from December to February. The Bicol region and Leyte belong to this type.

In both places, *T. incertulas* (with *S. innotata*)[4] outnumbered *C. suppressalis* in the rain-fed fields, but the ratio of the two species (about 4/1) was not as high as that found in type I. In the irrigated fields in

[4] Due to difficulty encountered in the field in distinguishing the immature stages of *S. innotata* and *T. incertulas*, it was decided to group the two species together in the count.

TABLE 32-4: Relative Abundance of Rice Stem Borer Species in Different Parts of the Philippines (1963–64) (A—*Chilo suppressalis*, B—*Tryporyza incertulas*, C—*Scirpophaga innotata*, D—*Sesamia inferens*)

Region	Trips made	Fields examined	Per cent in samples		
			A	(B–C)	D
Cagayan Valley	5				
Rain-fed		24	20.0	58.8	21.2
Irrigated		17	27.1	59.8	13.1
Total		41	23.6	59.2	17.1
Bicol peninsula	5				
Rain-fed		11	16.3	76.7	7.0
Irrigated		21	29.0	68.2	2.8
Total		32	25.2	70.7	4.1
Iloilo	4				
Rain-fed		7	23.5	36.5	40.0
Irrigated		21	65.6	16.8	17.6
Total		28	60.5	19.2	20.3
Leyte	2				
Rain-fed		8	21.4	75.5	3.1
Irrigated		12	36.6	58.5	4.9
Total		20	32.7	62.9	4.4
Cebu	2				
Rain-fed		2	52.6	47.4	0.0
Irrigated		2	50.3	47.1	2.6
Total		6	50.9	47.2	1.9
Cotabato	1				
Rain-fed		1	50.0	43.8	6.2
Irrigated	3		89.8	5.2	5.0
Total	4		88.7	6.3	5.0

both Leyte and Bicol, *T. incertulas* was also more abundant than *C. suppressalis*, but the ratio was less (about 2/1). *S. inferens* was fairly abundant in both the rain-fed and irrigated fields. *S. innotata* was not observed in the Bicol Peninsula, but was present in Leyte.

Climate Type III represents areas where there is no pronounced rainy period and where there is a short (one to three months) dry season. Cagayan Valley and Cebu are in this type.

T. incertulas was slightly more numerous than *C. suppressalis* in both the rain-fed and irrigated fields in the Cagayan Valley. In Cebu, *C. suppressalis* was slightly more abundant in both the rain-fed and irrigated fields. It seems that in Climate Type III, the two species are more or less the same in abundance, with either one or the other only slightly leading.

S. inferens was relatively more abundant in Type III than in Type II and decidedly more so than in Type I.

S. innotata was not abundant in the Cagayan Valley; it was more common in Cebu.

Climate Type IV represents areas where the rainfall is evenly distributed throughout the year. Cotabato and Iloilo fall under this type. In these places, *T. incertulas* (with *S. innotata*) and *C. suppressalis* were more or less equal in abundance in the rain-fed fields. In the irrigated fields, however, *C. suppressalis* was decidedly more abundant. *S. inferens* was relatively abundant, even more so than in Type III. *S. innotata* was common in both Iloilo and Cotabato.

TABLE 32-5: Relative Abundance of Rice Stem Borer Species in the Four Types of Philippine Climate (A—*Chilo suppressalis*, B—*Tryporyza incertulas*, C—*Scirpophaga innotata*, D—*Sesamia inferens*)

Climate type	Region	Rain-fed A	Rain-fed B–C	Rain-fed D	Irrigated A	Irrigated B–C	Irrigated D	Total A	Total B–C	Total D
I[a]	Laguna				85.5	13.5	1.0			
	Central Luzon	3.7	95.9	0.4						
II[b]	Bicol peninsula	16.3	76.7	7.0	29.0	68.2	2.8	25.2	20.7	4.1
	Leyte	21.4	75.5	3.1	36.6	58.5	4.9	32.7	62.9	4.4
	Ave.	18.9	76.2	5.5	32.8	63.4	3.4	29.0	66.8	4.3
III[c]	Cagayan Valley	20.0	58.8	21.2	27.1	59.8	13.1	23.6	59.2	17.2
	Cebu	52.6	47.4	0.0	50.3	47.1	2.6	50.9	47.2	1.9
	Ave.	36.3	53.1	10.6	38.7	53.5	7.9	37.3	53.2	9.6
IV[d]	Cotabato	50.0	43.8	6.2	89.8	5.2	5.0	88.7	6.3	5.0
	Iloilo	23.5	36.5	40.0	65.6	16.8	17.6	60.5	19.2	20.3
	Ave.	36.8	40.2	23.1	77.7	11.0	11.3	74.6	12.8	12.7

[a] Climate Type I—one half of year (December–May) pronouncedly dry, the other half (June–November), rainy.
[b] Climate Type II—no dry season; rainy season pronounced from December–February.
[c] Climate Type III—rainy season (June–February) very pronounced; short dry season (March–May).
[d] Climate Type IV—rainfall evenly distributed throughout the year.

The following may be deduced from the foregoing observations:

T. incertulas and *C. suppressalis* are the two predominant rice stem borer species in all areas of the Philippines.

In the rain-fed (not irrigated) fields, *T. incertulas* is somewhat more abundant than *C. suppressalis*; it is pronouncedly so in areas of Climate Type I, less distinctly so in Type II; *T. incertulas* and *C. suppressalis* are more or less as abundant in Types III and IV.

If the field is irrigated, the relative abundance of these two species is altered, favoring one or the other species to a greater or lesser degree, depending upon the climatic type of the field. In Type I, the relative abundance of *T. incertulas* and *C. suppressalis* is reversed—*T. incertulas*, which composed almost entirely the borer population of unirrigated fields, decreases in number to almost the category of a minor pest if the field is irrigated, while *C. suppressalis*, which is almost insignificant in unirrigated fields, decidedly becomes the preponderant species. In Type II, irrigating the field results in a decrease in the preponderance of *T. incertulas* over *C. suppressalis* (approximately from a ratio between the two species of 4/1 when not irrigated to 2/1 when irrigated). In Type III, there is no perceptible change—the two species remain at about the same abundance whether the field is irrigated or not. In Type IV, *C. suppressalis*, which is about the same in abundance as *T. incertulas*, when the field is not irrigated, decidedly becomes more numerous than *T. incertulas*.

Among the different climatic types, *S. inferens* is least abundant in Type I, fairly abundant in Type II, and most abundant in Types III and IV. Irrigating the field seems to increase the number of this borer only in Type I; in Types II, III, and IV, where there is more rain, irrigating the field does not seem to produce a marked effect on its abundance.

When the intensity of borer infestation (mostly *C. suppressalis*) was considered in relation to various stages of the host planted at different dates, the increase in infestation

in the majority of the cases was high up to the third count (plants 73 days old), and subsequent new infestation became less at the fourth count (plants 87 days old). This shows that the rice plant is vulnerable to the pest mainly during the vegetative, preheading, and heading stages, after which the degree of infestation tapers off. Further, it was observed that the infestation of plants before the 45-day stage is rather low and at times almost negligible. This finding implies that protection could be narrowed to this actual period of only somewhat more than 30 days.

Extent of Borer Damage. The extent of borer damage will naturally vary with such factors as variety used, locality, season, and so on. An unusually heavy borer infestation on ready-to-harvest rice was observed in Calamba, Laguna, in 1953, in which 47.8 per cent of the panicles in the field became "white heads." However, Table 32–6, which shows the percentage of "white heads" in various parts of the Philippines observed at various times, would reflect more closely the usual ratio of "white heads" to sound panicles in the Philippines. Actual counts in 845 hills, picked at random from 16 different fields in the Cagayan Valley, the Bicol Peninsula, and Iloilo, showed that 6.62 per cent, or at least one panicle in every two hills of 10 panicles each, were destroyed by borers and became "white heads."

Actually, however, there was more damage on mature rice than is indicated by the "white heads." Dissection and careful examination of the rice stubble left after harvest showed that there were many more tillers that were actually damaged by borers than was indicated by the "white head." Table 32–7 shows that 27.55 per cent of the tillers in the hill were actually damaged by borers, which is a much higher figure than the percentage (6.62) of "white heads." It is apparent that many tillers, although more or less badly damaged by borers, do not manifest "white heads," and the panicles apparently look normal. The damage on such tillers, however, could result in lighter grains.

Of course, as mentioned earlier, there is also the borer damage on young plants, which results in "dead hearts." If attacked while still in the tillering stage, new tillers may replace the dead tillers, which is hardly the case in the preheading or post-tillering stages. Thus, the rice yield will be depressed, although there has been no detailed quantitative observation on this point.

BIOLOGY OF THE BORERS

Tryporyza incertulas

T. incertulas lay their eggs on the leaf in masses of 36 to 96 eggs, which are covered with short, felt-like silk fibers. On young plants the newly hatched larva travels down the leaf and eats its way into the leaf sheath. Reaching the base of the leaf sheath, it enters and destroys the growing point and gives rise to a "dead heart." On maturing stool, the larva bores into the stalk, just above the highest node, and disconnects the young panicle, resulting in a "white head." In young tillers, the larva may transfer to another tiller as the feed is exhausted, but in maturing plants, the larva, once inside the stem, does not leave. It bores downward along the stem as it grows, until it reaches the base of the stool. By this time, the larva will have become fully developed and about ready to pupate. It then makes an "exit window" for the adult and pupates in a silken cocoon.

Hatching usually occurs early in the morning. Only one larva usually enters a tiller. If the newly hatched larva fails to get into a tiller by 9 A.M., it dies of desiccation and exhaustion. Many potential borers are eliminated in this manner.

Rowan (1923) studied the life history of *T. incertulas* and found that the incubation period was 8 to 9 days, the larval period, 60 to 66 days, the pupal period, 9 to 12 days, and the entire developmental period (oviposition to emergence), 80 to 85 days. The moths lived for 3 to 7 days only. He also found that the species passes through a pe-

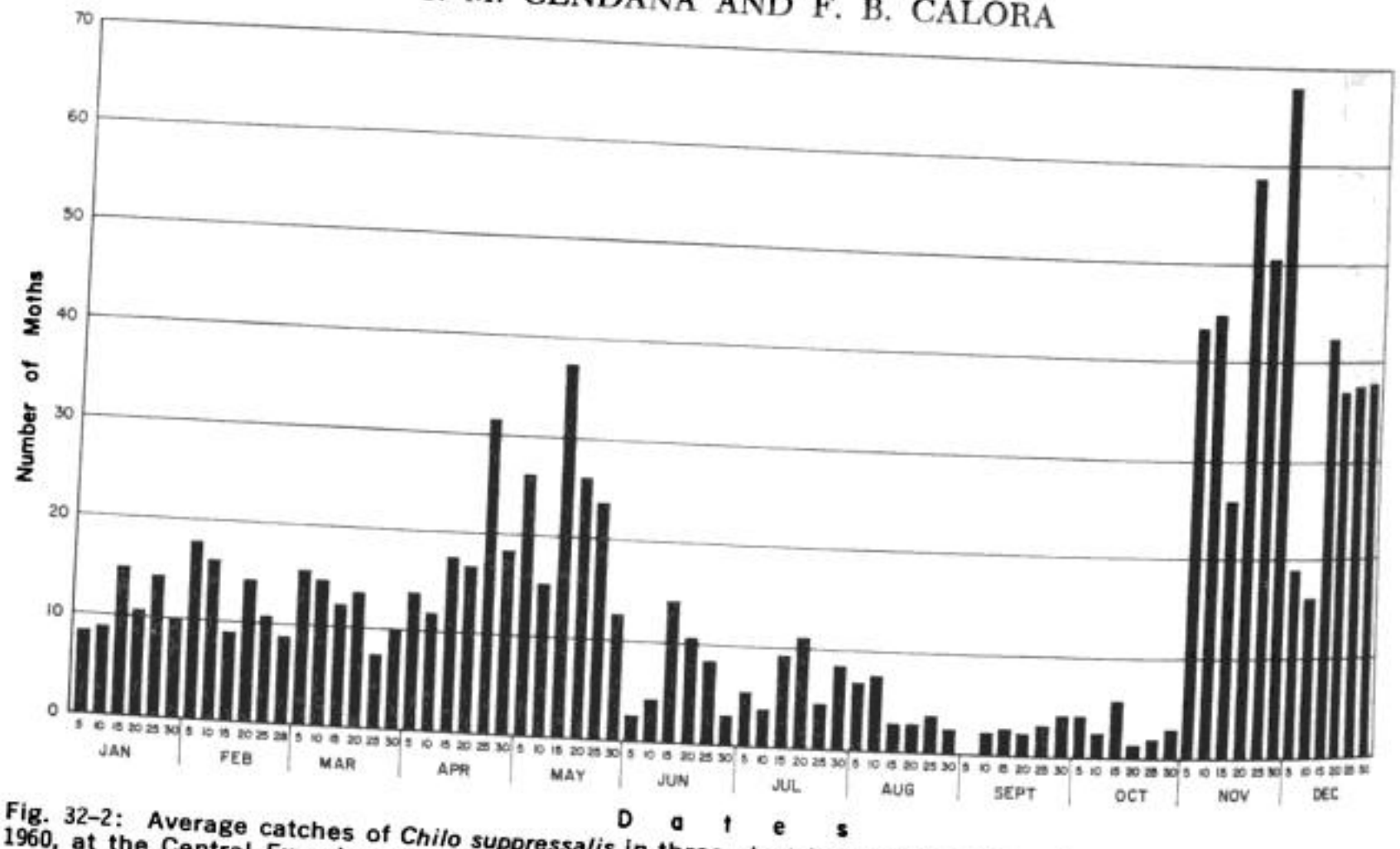

Fig. 32-2: Average catches of *Chilo suppressalis* in three electric light traps from January 1 to December 31, 1960, at the Central Experiment Station, Los Banos, Laguna, the Philippines.

adult emergence, 23 to 35 days. From materials brought in from Iloilo in 1963, our records of the developmental period at Los Baños are as follows:

Developmental Period	*No. of Individuals*	*Duration (days)*		
		Range	*Mode*	*Ave.*
Incubation	60	8	8	8
Larval	60	20–34	22	26.6
Pupal	60	5–13	9	9.0
Oviposition to emergence	60	37–60	39	43.7

TABLE 32-8: Developmental Periods of *Chilo Suppresalis*

Stage or period	No. of individuals	Duration (days)		
		Range	Usual	Average
Incubation	322	4–8	5	5.47
1st stadium	312	2–6	3 and 4	3.85
2d stadium	292	3–7	4	4.58
3d stadium	259	3–7	4 and 5	4.71
4th stadium	224	2–8	5	4.88
5th stadium	174	3–9	5	5.18
6th stadium	140	3–7	5 and 8	7.9
Pupal period	133	6–18	8 and 9	10.09
Total larval period	129	24–43	28–29	31.3
Total development	125	36–57	45	47.1

The young larva of *S. innotata* was observed to have a peculiar habit of getting out of the tiller (if the plant is still young) and transferring to another tiller. To do this, it crawls to the tip of a young leaf, cuts a section about a centimeter long at the tip of the leaf, which it discards, then cuts another more proximal section, with which it wraps itself up. Thus covered, it goes down the plant and bores into the stem of another tiller, with the leaf section left standing perpendicularly on the stem. Shiraki (1917) observed a similar habit on *T. incertulas.*

Sesamia inferens

S. inferens is essentially a pest of preblooting rice, already past the tillering period, when the plant is hardly capable of replacing the destroyed tillers. One larva is capable of destroying many tillers in the hill in the course of its development, so that although it is relatively fewer in number than *T. incertulas* and *C. suppressalis*, it can cause much damage. *S. inferens* is more prevalent in lowland than in upland rice fields.

The eggs are laid in rows within a loosened leaf sheath. The larva enters the plant, feeds on the growing point of the tillers, and produces a "dead heart." When much of the usable portion of the infested tiller has been consumed, the larva transfers to another tiller. On maturing rice, it bores into the stem and feeds on the tissues of the stem, destroying the plant and causing a "white head."

When ready to pupate, the fully grown pink caterpillar usually escapes from the stem and pupates between a dried leaf sheath and the stem. In dead young tillers, it pupates within the base of the leaf sheath.

Otanes and Sison (1952) found the incubation period of this pest to be 6 to 8 days, the larval stage, 31 to 38 days, pupal period, 8 to 11 days, and the total period from oviposition to emergence of adult, 45 to 57 days. The following records were obtained in our studies on the life history of this pest in 1960 at Los Baños:

Stage	*No. of Individuals*	*Duration (days)*		
		Range	*Mode*	*Ave.*
Incubation	310	6–8	7	7.0
1st instar	219	2–5	3	3.1
2d instar	208	2–6	4	3.7
3d instar	192	2–10	4	4.2
4th instar	183	2–6	4	4.0
5th instar	180	3–10	6	5.7
6th instar	179	3–21	9	9.8
Pupa	171	6–16	10	10.5
Oviposition to adult emergence	165	38–65	48	48.5

Control Measures

Otanes (1937b) recommended the following control measures for use against *T. incertulas*, and they have also been used against other species of rice stem borers:

1. Collection of eggs
2. Collection and destruction of infested stems
3. Light trapping adults
4. Clean culture
5. Variety selection
6. Derris spray.

RICE STEM BORER PARASITES IN THE PHILIPPINES

Thompson (1947) listed the following parasites of rice stem borers as having been reported in the Philippines.

On *T. incertulas* (of which 29 parasitic species were then known over the world):

Telenomus dignus (Gahan)

Telenomus beneficiens (Zehntner)

Eripternimorpha accepta schoenobii Vierreck

Bracon chinensis (Szepligeti)

Shirikias schoenobii Vierreck

Stenobracon nicevillei Szepligeti

Trichogramma japonicum Ashmead

On *Sesama inferens* (of which 12 species were then known):

Xanthopimpla stemmator (Thunberg)

None of the eight parasites of *Scirpophaga* was reported as from the Philippines.

The above-mentioned parasites included those previously reported by Rowan (1923) and Otanes (1937b). There were other parasites, such as *Rogas* species on *C. suppressalis* (Uichanco, 1930a), *Tetrastichus schoenobii* Ferriere (Ishii, 1939), and *Amauromorpha accepta metathoracica* (Ishii, 1939), which, however, were not included in the list, although these were reported earlier than 1947 as having been found on rice stem borers in the Philippines.

Delfinado (1959) reported rearing the following species:

Amauromorpha a. schoenobii Vierreck—on *T. incertulas* larvae

Apanteles species—on *T. incertulas* larvae

Bracon chinensis (Szepligeti)—on *C. suppressalis* and *S. inferens*

Cremastus shirakii (Sonan)—on *T. incertulas*

Eriborus sinious Holm. (*Horogenes lineatus* Ishida)—on *C. suppressalis* and *T. incertulas*

Goryphus species—on *T. incertulas*

Sphathius species—on *C. suppressalis* larvae

Stenobracon nicevillei (Binghan)—on *S. inferens* larvae

Tetrastichus species—on *S. inferens* pupae

Topobracon schoenobii (Vierreck) (*Shirakia schoenobii* Vierreck)—on *T. incertulas* and *S. incertulas* and *S. inferens* larvae

Xanthopimpla emaculata Szepligeti—on *C. suppressalis* pupae

X. kuchingensis Cameron—on *C. suppressalis* pupae

X. punctata Fabricius—on *C. suppressalis* pupae

X. stemmator (Thunberg)—on *C. suppressalis* pupae.

The senior author has been gathering more information on rice stem borer parasites in the Philippines, especially those found in Luzon, since 1958.[5] Field-collected larvae and pupae of rice stem borers were confined individually, after definitely ascertaining their species identity, in glass tubes to rear out to the adult stage whatever parasites they may have harbored. If the parasite had already pupated in the field when encountered, the identity of the host was determined from the skin remains of the host, supplemented by the known characteristic manifestations of the host.

The following parasites[6] were encountered during this study.

Braconidae

Apanteles Syleptae Cameron. Several individuals were reared out as parasites of young larvae of *C. suppressalis*, which were collected from Polangui, Albay Province, in April, 1959.

Apanteles *Species.* A common parasite, *Apanteles* species (probably *schoenobi*

[5] Part of the observations in this study, which was incorporated in the Second Progress Report of the Rice and Corn Research Program of the College of Agriculture, University of the Philippines, 1960, was referred to by Nickel's paper, "Biological Control of Rice Stem Borers—A Feasibility Study" (International Rice Research Institute, Los Baños, Laguna, Philippines [1964]).

[6] Except as otherwise indicated, the parasites of the families *Braconidae* and *Scelionidae* were determined by Dr. C. F. W. Mussebeck; those of the families *Ichneumonidiae* and *Pteromalidae*, by Dr. B. M. Walkley; those of the families *Eulopidae* and *Trichogrammatidae*, by Dr. B. D. Burks—all of the Entomological Research Division, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland, to whom the authors are deeply grateful.

Walker), was reared out from the larvae of *C. suppressalis* and *T. incertulas* which were collected in the provinces of Laguna (Los Baños and Bay), Bataan (Lamao), Bulacan (Calumpit and Guiguinto), Nueva Ecija (Gapan), Pampanga (Apalit), Pangasinan (Urdaneta), and Tarlac (Tarlac)—all in Luzon, in different months of the year.

This solitary parasite attacks late-instar caterpillars, pupates in a thin, loosely woven yellow cocoon beside the dried skin of its host in the rice stem. The cocoon is about 6 mm long.

Bracon chinensis *Szepligeti.* Several individuals of this parasite were reared out either as solitary or multiple parasites on caterpillars of *C. suppressalis* and *T. incertulas* which were collected in Los Baños in May and June.

This parasite attacks the late-instar caterpillars. It pupates in a white cocoon that is black at one end. If multiple, the pupae are arranged side by side in the pupal cocoon of the host (in *T. incertulas*) or near the shriveled skin (in *C. suppressalis*).

Rhaconotus schoenobivorus *Rohwer.* Several individuals of this parasite were reared out as solitary or multiple (two or three in one host) parasites from young *C. suppressalis* and *T. incertulas* which were collected in February, March, and April in Laguna (Los Baños), Pampanga (Apalit), and Albay (Polangui).

Stenobracon nicevillei (*Vierreck*). Several individuals were reared out as solitary parasites from old larvae of *C. suppressalis* and *T. incertulas* which were collected in Laguna (Los Baños), Pangasinan (Urdaneta), and Sorsogon (Sorsogon) in April.

Tropobracon schoenobii *Vierreck.* Several individuals were reared out as solitary parasites on *C. suppressalis* and *T. incertulas* larvae which were collected in Laguna (Los Baños), Pangasinan (Urdaneta), and Sorsogon (Sorsogon).

This parasite attacks late-instar larvae and seems to prefer *T. incertulas* as host. It pupates in a smooth, opaque-white cocoon about 8 mm long, placed beside the shriveled skin of its host in the rice stem.

Amauromorpha accepta metathoracica *Ashmead.* Several individuals of this parasite were reared out as solitary larval-pupal parasites of *T. incertulas* which were collected in Laguna (Los Baños), Bulacan (Calumpit), Nueva Ecija (Santo Domingo), Sorsogon (Sorsogon), and Tarlac (Tarlac) in March, October, and November.

Eriborus sinicus (*Shida*) (determined as Horogenes lineatus by *Dr. C. R. Baltazar*). This is a larval-pupal parasite common on *C. suppressalis* (occasionally on *T. incertulas*) which were collected in Laguna (Los Baños and Bay) in practically all months of the year.

Isotima *Species* (*determined by Dr. C. R. Baltazar*) (*probably* dammermani *Rohwer*). Several individuals of the species were reared out as solitary parasites of *C. suppressalis* larvae which were collected in Laguna (Los Baños) in March, April, July, and December. It seems to be more abundant in March and April.

Temelucha philippinensis *Ashmead.* This is a solitary, sometimes multiple (two or three in one host), parasite commonly reared out from larvae of both *C. suppressalis* and *T. incertulas* which were collected in Laguna (Los Baños), Bulacan (Guiguinto), Nueva Ecija (Aliaga, Gapan, Talavera), Pampanga (Dao), Pangasinan (Binalonan), and Tarlac (Tarlac) in practically all months of the year.

Trathala *Species* (*determined by Dr. C. R. Baltazar*) (*probably T.* flavoorbitalis *Cam*). Several individuals were reared out as solitary parasites from larvae of *T. incertulas* which were collected in April, October, March, and December in Bulacan (Calumpit), Nueva Ecija (Aliaga), and Pangasinan (Binalonan).

Xanthopimpla stemmator (*Thunberg*). This is a common species which seems to parasitize almost exclusively *C. suppressalis* in Laguna. The only other collection made of this species outside Laguna was from *T. incertulas* larvae collected in Binalonan, Pangasinan. In Laguna, it has been encountered in

practically all months of the year, but is most abundant from January to July. It attacks the last-instar larvae or the pupae of the host. In another study, it also was found to parasitize certain other lepidoptera.

Pteromalidae

Norbanus rushckae (*Masi*). This parasite is not common. Only one individual was encountered during the study. It was reared out of a young *C. suppressalis* larva that was collected in Camarines Sur (Pili) in April, 1959.

Tetrastychus ayyari *Rohwer.* A number of this multiple parasite have been reared out from pupae of *C. suppressalis* and *S. inferens* collected in Laguna (Los Baños) in January to March.

Tetrastichus schoenobii *Ferriere.* This is a fairly common egg parasite encountered on *T. incertulas* which were collected in Laguna (Los Baños and Bay).

Scelionidae

Telenomus rowani *Gahan.* This egg parasite was reared commonly on *C. suppressalis* and *T. incertulas* which were collected in Los Baños in January, February, and July. It was more common on *C. suppressalis* than on *T. incertulas.*

Trichogrammatidae

Trichogramma japonicum *Zehntner.* This parasite was reared out from eggs of *C. suppressalis* and *T. incertulas* which were collected in Laguna (Los Baños and Bay).

A chloropid fly, *Anastrichus arinaceous* Lw. (determined by Dr. C. R. Baltazar), has been consistently encountered as fully grown larvae associated with dead *T. incertulas* caterpillars. Whether it had something to do with the death of the caterpillars or was a sarcophagous species was not determined.

Nickel (1964) has compiled a world list of rice stem borer parasites. Table 32–9, adapted from Nickel, shows the known parasites of rice stem borers in the Philippines to date.

Field Parasitism

The degree of field parasitism on *C. suppressalis* was observed in Los Baños, Laguna, in 1958 and 1959. From the results (Table 32–10), these deductions can be made:

1. *Eriborus sinicus* (*Horogenes lineatus*), *Temelucha philippinensis*, and *Xanthopimpla stemmator* were the most common and persistent species. They were encountered in almost all months of the year.
2. *Apanteles* species and *Rhaconotus schoenobivorus* seemed to be more abundant during the drier half of the year (December to June).
3. The monthly field parasitism on *C. suppressalis* ranged from 0.46 to 4.24 per cent.

CHEMICAL CONTROL OF THE RICE STEM BORER

Insecticide sprays have been effective in minimizing the incidence of rice stem borers under Philippine conditions. Calora (1956) found that folidol E 605 (parathion) and toxaphene applied three (at bi-weekly intervals) and six (at weekly intervals) times significantly reduced rice stem borer infestation. In the laboratory, parathion killed the borer larvae much faster than toxaphene and bladex (TEPP). Rivera (1956), on the other hand, found that parathion, TEPP, and toxaphene applied three (at biweekly intervals) and six (at weekly intervals) times was effective against the borer under upland conditions. Estioko (1956) studied the timing of parathion application. He found that parathion reduced significantly the occurrence of infested tillers ("dead hearts"), but he was unable to obtain a better yield than the control. Catangui (unpublished) reported the effect of nitrogen fertilization on the intensity of damage caused by rice stem borers and the control of these insects with parathion. It was found that fertilized plants were more heavily attacked by rice stem borers. Furthermore, he said that spraying three or four times with parathion at intervals of one week at the rate of 4.5 cc to a gallon

TABLE 32-9: Rice Stem Borer Parasites in the Philippines (Adapted from Nickel, 1964)

Parasite[a]	Stage	Hosts: *C. suppressalis*	*T. incertulas*	*S. innotata*	*S. inferens*	Reference
HYMENOPTERA						
Fam. *BETHYLIDAE*						
Goniozus indicus Ashmead	L[a]		x			Rao, 1964
Fam. *BRACONIDAE*						
Apanteles flavipes Cameron	L	x	x	x	x	Ishii, 1939
(*A. chilocida*)						
(*A. nonagriae*)						
(*A. simplicis*)						
ruficrus (Haliday)	L					Baltazar, 1964
schoenobii Walker	L		x			Ishii, 1939
syleptae Ferriere	Ly	x				Cendaña, 1964
sp.	Lo	x	x			Cendaña, 1964
Bracon chinensis Szepligeti						
(*Amysoma chilocida*)						
(*A. chilonis*)	Lo	x	x		x	Cendaña, 1964
(*A. chinensis*)						
(*Macrobracon chinensis*)						
(*M. chiloda*)						
(*M. chinensis*)						
Rhaconotus oryzae Walker	Ly	x	x			Ishii, 1939
schoenobivorus Rohwer	Ly	x	x			Cendaña, 1964
(*R. schoenobii*)						
Rogas sp.	L	x				Uichanco, 1930a
Spathius fuscipennis Ashmead	L	x				Delfinado, 1959
Stenobracon nicevillei (Bingh.)	Lo	x	x	x	x	Baltazar, 1964
(*S. trifasciatus*)						
(*S. maculata*)						
(*Macroscentrus javanicus*)						
(*Bracon nicevillei*)						
Tropobracon schoenobii (Vier.)	Lo	x	x	x	x	Baltazar, 1964
(*T. luteus*)						
(*Shirikia dorsalis*)						
(*S. schoenobii*)						
Fam. *ELASMIDAE*						
Elasmus albopictus Crawford	L		x			Rao, 1964
Tetrastichus ayyari Rohwer	P	x			x	Cendaña, 1964
schoenobii Ferriere	E	x	x			Delfinado, 1959
	E					Ishii, 1939
Eriborus sinicus Holm.	L–P	x	x			Cendaña, 1964
(*Angitia lineata*)						Delfinado, 1959
(*A. chelonis*)						Ishii, 1939
(*Nytobia lineata*)						Townes *et al.*, 1961
(*N. chelonis*)						
(*Horogenes lineata*)						
(*Trathala flavopedes*)						
Ischnojoppa luteator Fabricius	L		x			Delfinado, 1959
						Townes *et al.*, 1961
Isotima dammermani Rohwer	L–P		x	x		Cendaña, 1964
Temelucha philippinensis Ashmead	L	x				Cendaña, 1964
shirikia (Sonan)	L	x				Delfinado, 1959
(*Cremastus shirakia*)						
(*Trathala shirokia*)						

TABLE 32–9 (*continued*)

Parasite*	Stage	Hosts: *C. suppressalis*	Hosts: *T. incertulas*	Hosts: *S. innotata*	Hosts: *S. inferens*	Reference
Trachysphyrus sp.	L	x				Pierce, 1928
Trathala flavo-orbitalis (Cam.) (*C. bigutulus*) (*C. hymenias*) (*Tarytia flavo-orbitalis*)	L–P	x				Ishii, 1939
Xanthopimpla emaculata Szepligeti (*X. enderleini*)	L	x				Delfinado, 1959
modesta (Cameron) (*X. kuchingensis*)	L	x				Delfinado, 1959
punctata						Townes and Gupta, 1961
stemmator Thunberg (*X. nursei*)	L–P	x	x			Townes and Gupta, 1961 Cendaña, 1964
Fam. *PTEROMALIDAE*						
Norbanus ruschkae (Masi)	Ly	x				Cendaña, 1964
Fam. *SCELIONIDAE*						
Telenomus beneficiens Zehntner (*Phanurus beneficiens*) (*Cerapron beneficiens*)	E	x	x	x		Uichanco, 1928
dignus (Gahan) (*Telenomus beneficiens*)	E	x	x	x		Ishii, 1939
rowani (Gahan)	E	x	x			Cendaña, 1964 Ishii, 1939 Uichanco, 1930a
Fam. *TRICHOGRAMMATIDAE*						
Trichogramma japonicum Ashmead (*T. chilonis*) (*T. nanum*)	E	x	x			Cendaña, 1964 Ishii, 1939

* Key to the symbols used: x—host; E—egg; L—larvae; Lo—old larva; Ly—young larva; P—pupa.

significantly controlled borer infestation and increased the yield. Valino (1956) also reported the effectiveness of parathion, endrin, malathion, and diazinon. Endrin and parathion were equally effective at 2.37 ml per gallon, while diazinon and malathion were least so. In the laboratory, endrin produced the highest mortality of *C. suppressalis* inside the stem, followed by parathion, malathion, and diazinon. Garcia (1955), thion, and diazinon. Garcia (1955), Tolentino (1956), Malunay (1957), and Reyes (1959) confirmed the effectiveness of EPN 300, endrin, and diazinon.

In a majority of cases, the investigators reported only the significant reduction of infested tillers ("dead hearts") and not an increase in yield.

Recently, Calora and Ferino (1964) tested seven insecticide sprays against rice stem borers. Based on two trials, endrin used at the rate of 5 ml per gallon of water, thiodane at 7.5 ml per gallon, and lebaycid at 7.5 ml per gallon reduced highly the onset of "dead hearts." The foregoing insecticides, as well as EPN 300, zectran, sevin, and folidol M 50, reduced significantly the percentage of "white heads." These insecticides were

TABLE 32–10: Monthly Parasitism on *Chilo suppressalis* in Los Baños by Larval and Pupal Parasites (1958 and 1959)

Parasites	Monthly parasitism (per cent)											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Apanteles sp.	0.06	0.3	0.12	0.04	—	—	—	—	—	—	0.04	—
Bracon chinensis	—	—	0.12	—	0.29	0.09	—	0.17	—	—	0.11	0.25
Rhaconotus schoenobii	—	0.15	0.04	0.29	—	—	—	—	—	—	—	—
Stenobracon nicevillei	—	0.04	0.04	0.12	0.15	—	—	0.17	—	—	0.04	—
Tropobracon schoenobii	—	0.19	0.24	0.12	0.29	0.17	—	—	—	—	—	0.75
Amauromorpha spp.	—	0.04	—	—	—	—	—	—	—	0.06	—	—
Eriborus spp.	0.03	0.68	0.92	1.11	0.88	0.35	—	0.51	0.36	0.38	0.11	0.75
Isotima sp.	—	—	0.04	—	—	—	0.08	0.17	—	—	—	—
Trathala sp.	—	—	—	—	0.73	0.17	0.31	0.17	—	—	—	—
Temelucha philippinensis	—	0.23	0.12	0.16	0.29	1.50	0.31	—	—	0.32	0.08	0.25
Xanthopimpla stemmator	1.20	0.72	0.79	0.36	1.32	0.61	3.21	1.41	0.36	1.20	0.08	1.14
Tetrastichus ayyari	0.15	—	0.12	0.28	—	0.44	0.08	—	—	—	—	—
Total	2.25	2.35	2.55	2.23	4.24	3.23	3.99	2.80	0.72	1.96	0.46	3.64

sprayed four times, starting 45 days after transplanting and twice weekly thereafter. All the insecticides significantly increased the yield, endrin giving the highest increase, followed by thiodane, EPN 300, zectran, lebaycid, sevin, and folidol M 50. The gain in yield ranged from 1 to 2.7 tons per hectare over the control. The highest increase in yield was about 6 tons on the endrin-treated pests and 4 tons only on the control. The workers felt that if the production of "white heads" is prevented effectively, the yield becomes significantly high, even if the preheading infestation is not sufficiently kept under control.

Hocbo (1964) recently showed that five spray applications started 45 days after transplanting and continued at biweekly intervals thereafter with EPN 300, roxion, sevin, and meptox were effective in reducing borer injury on tillers. The second trial, with only three applications using the same insecticides, showed that meptox gave the highest reduction in percentage of "dead hearts," followed by sevin, roxion, and EPN. EPN, meptox, and roxion were effective in that order in forestalling "white heads." The experiment, however, did not show any significant increase in yield.

De Leon (1964) tested endrin, folidol, and thiodane. Endrin used at the rate of 9 ml per gallon of water, thiodane at 7 ml per gallon, and folidol at 5 ml per gallon significantly reduced the production of "dead hearts" in both the first and second trials. During the first trial, endrin was found to be the most effective, followed by thiodane and folidol. On the second trial, however, folidol ranked first, followed by endrin and thiodane. Based on "white heads," thiodane and folidol gave the best control, followed by endrin. However, all insecticides produced only an insignificant apparent increase in yield. In the above experiment, four spray applications were made, starting 60 days after transplanting, at two-week intervals for the first trial and at one-week intervals for the second trial.

DISCUSSION

S. M. Cendaña and F. B. Calora,
Philippines

Questions

K. Kiritani (*Japan*): How does irrigation cause *Chilo* to replace *Tryporyza* under the climatic conditions of Type I?

Answer: It seems that *Chilo* is better where it is more moist. Bringing in irrigation will possibly create this condition.

(ANON.): Have there been any observations as to how the rice stem borer species pass the dry season in areas which have distinct dry and wet seasons?

Answer: Chilo does not aestivate. *Tryporyza* and *T. innotata* were observed to aestivate during the dry season (March to May).

K. KIRITANI (*Japan*): I understand that *Chilo* is now the dominant species at the Institute. Is there any data about the relative abundance of *Tryporyza* and *Chilo* before the Institute was established? Even now, *Tryporyza* becomes dominant in certain months. How do you explain this?

Answer: Before the Institute farm areas and fields of the Central Experiment Station of the University of the Philippines, College of Agriculture, were irrigated, *T. incertulas* was the dominant species. We did not, however, have the exact counts.

M. D. PATHAK (*Philippines*): Is there any irrigated area where *T. incertulas* predominates?

Answer: In the Bicol region, which has Climate Type IV.

(ANON.): Generally, the condition of overlapping rice stem borer generations in the Philippines is attributed to continuous rice cropping throughout the year, which provides these rice pests with a continuous food supply. Have rice stem borer broods ever been observed in places where only one rice crop could be raised a year?

Answer: Not exactly, but there could not be more than three generations for *T. incertulas* if judged by the length of the life cycle of this pest.

L. T. KOK (*Malaysia*): You mentioned that there are four stem borers infesting rice in the Philippines: *T. incertulas, C. suppressalis, S. innotata,* and *S. inferens.* You also mentioned *Chilotraea polychrysa.* In some recent sampling work at the Institute, I came across many rice stem borers which are identical to *C. polychrysa* of Malaya. As I studied this species in Malaya in 1963 and early 1964, I believe that the stem borers found in the Philippines are *C. polychrysa.* The *Chilotraea* population, however, is small compared to *Chilo* and indicates the presence of another borer species in the Philippines. Could you comment?

Answer: We are following the identification done for us from Washington, and we have been using the name *Chilo suppressalis* all along. It is possible that we have *Chilotraea polychrysa.* We shall appreciate it if our colleagues could examine our specimens so that corrections, if any, could be made.

D. B. REDDY (*India*): (1) Are maggots seen on the affected leaves when the rice gall midge attacks maturing paddies? (2) Does this late attack reduce yields to any extent?

Answer: (1) No, maggots are not seen on the affected leaves which the gall midge attacks during the late stage of the paddy plant. We have found pupae at the base of the deformed dark leaf. (2) Yes, it reduces yields.

H. N. BATRA (*India*): (1) Has any work been done on the comparative role of *Gryllotalpha africana* as a predator or pest? In view of its predatory role, is it worthwhile to kill this pest if it appears as a pest in some areas? (2) Have any soil insecticides, such as aldrin, been tried, and if so, how do you rate their effectiveness and economy compared to poison hearts?

Answer: (1) *Gryllotalpha africana* has long been recognized as a pest of rice during the seedling stage. As a predator, it has not yet been studied. If it is more important as a pest, its control is necessary under heavy incidence. However, if its predatory role is more important, by all means, it should not be killed. (2) We are aware that farmers have used the common soil insecticides against *Gryllotalpha,* but the scientific data available does not satisfactorily answer the question.

Comments

C. R. BALTAZAR (*Philippines*): Ferriere is the author of *Ooencyrtus Malayensis*, not Vierreck. *Campsomeris aureicollis* is now known as *Campsomeris* (*Campsomerriella*) *collaris quadrifasciata* (F). There are six other species of *Campsomeris*, two species of *Scolia*, and one species of *Tiphia* reported on *L. irrorata* in the Philippines. *Microbacon* is now known as *Bracon*. *Telenomus nawai* Ashmead is reported as an egg parasite of *S. mauritia* in the Philippines.

Answer: *Ooencyrtus malayensis* Ferriere (not Vierreck). Thank you for the correction. Likewise, the correction will be made for *Campsomeris collaris quadrifasciata* (F) instead of *Campsomeris aureicolis*.

Telenomus nawai will also be adopted. I remember this was introduced from Hawaii by the Sugar Planters Association in about 1923; I am not sure if it has been established in view of the very few specimens liberated. We do not know, however, that a species of *Telenomus* already was present in the Philippines before the introduction was made.

C. R. BALTAZAR (*Philippines*): I presume that your list of known insect pests of rice in the Philippines was taken from Otanes and Sison (1952). Capco's more recent checklist (1957) in the *Philippine Journal of Agriculture* uses the accepted names, for example, (*Cyllo leda*)–*Melanites leda*; (*Verania discolor*)–*V. crocea*.

The hesperids generally differ from what you have, and so on.

Sogatella furcifera (common in Manila in 1963) is not listed as coming from the Philippines (see Paper 27). Also, refer to Z. Metcalf, *Catalog of Hemipterous Insects of the World*.

Answer: The list of Uichanco is the basis of our enumeration. For *Cyllo leda*, we used to use *Melanites leda*, then *ismene*, and finally, *Cyllo leda*. Not being taxonomists, we use Dr. Uichanco as our source for the latest names. We shall add *Sogatella furcifera* in the list of leafhoppers. There are other leafhoppers on rice, the identification of which we still do not have.

C. R. BALTAZAR (*Philippines*): Chalcid parasites of *S. mauritia* in the Philippines are *Brachymeria* species and *Tetrastichus schoenbii* Ferriere. The *Inareolata* species is an ichneumonid, not a braconid. Ashmead is the author of *Trichogramma japonicum*, not Fehntner. Regarding *Anatrichus erinaceus*, this species is reported to be predaceous upon larger larvae of the rice borer *T. incertulas* in Formosa (Clausen's *Entomophagous Insects*, 1940).

Answer: *Brachymeria* species will be adopted in the list. *Inareolata* will be properly identified. Your other suggestions will be acted upon accordingly.

C. R. BALTAZAR (*Philippines*): I have *Apanteles rufierus* (Holiday) listed as a parasite of *Spodoptera mauritia*, not on rice stem borers. Delfinado (1959) was the one who listed an undetermined species of *Apanteles* on *T. incertulas*. She also listed a species of *Spathius* on *C. suppressalis*.

Ishii (1939, 1953) was the one who listed *Spathius fuscipennis* on *C. suppressalis*.

Pierce (1928) listed *Trachysphyrus* species (*cryptus* sp.), a sugar cane borer, on *Topeutes auriflua*, not on *C. suppressalis*.

Answer: *Trachysphyrus* species was identified from the United States. The parasite was reared from *C. suppressalis*. *Spathius fuscipennis* is listed in Table 32-9—reported by Miss Delfinado—as also on *C. suppressalis*.

We have also reared *Apanteles*, which was not designated among those sent to Washington. This is the one referred to as *Apanteles* species in our list.

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