AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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Batch #20

1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AH10-0000-0000

B. SECONDARY: Pests of plants

2. TITLE AND SUBTITLE
The biology of the true armyworm,Pseudaletia separata (Walker) (Lepidoptera: Noctuidae)

3. AUTHOR(S)
Cadapan,E.P.; Sanchez,F.F.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1972	10p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Interior

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)
(In The Philippine entomologist,v.2,no.3,p.217-226)

9. ABSTRACT

10. CONTROL NUMBER
PN-RAB-180

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Armyworm?
Insect control
Larvae
Lepidoptera
Life cycles

13. PROJECT NUMBER

14. CONTRACT NUMBER
PASA RA(ID)1-67 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

PASA RA(ID) 1-67 PRS
PN-RAB-180

THE BIOLOGY OF THE TRUE ARMYWORM, PSEUDALETIA SEPARATA (WALKER) (LEPIDOPTERA: NOCTUIDAE)[1]

E. P. Cadapan and F. F. Sanchez[2]

The life history of P. separata was studied. There were 6 larval-instars. The average larval period was 20.6 days. The cycle from egg to egg was 32 days. Twenty-nine host plants were tested for feeding preference by the larvae. Of these eighteen were preferred while the others were only eaten under stress of hunger. In Los Baños, this pest was abundant from August to September during the wet season and from January to February during the dry season. Nine species of natural enemies were recovered, namely, one polyembryonic hymenopterous larval parasite, 1 ichneumonid pupal parasite, 4 tachinid flies, 2 entomogenous fungi and a virus. The first was found to be abundant and the most effective. Nine successive generations of P. separata were reared in the laboratory from July, 1969 to March, 1970.

The true armyworm, *Pseudaletia separata* (Walker) has been recognized for quite some time by local workers as *P. unipuncta* (Haworth) until Francisemont (1951) established the non-occurrence of the true *unipuncta* in the Philippines. Calora (1968) further clarified the status of this species and listed *Leucania consimilis* Moore as synonym. The Pans Manuel (1970), however, listed this armyworm as *Mythimna* (*Pseudaletia*) *separata* (*Walker*) and included *Cirphis unipuncta* (Haw.) and *Leucania unipuncta* (Haw.) as synonyms. This nomenclatural change is not very clear, thus its availability is doubtful.

The pest is known by various common names: cutworm on corn (Uichanco 1959), rice cutworm (Otanes 1925), paddy cutworm (Ramamani 1965), rice armyworm (Pathak 1969), paddy climbing worm on rice and true armyworm on corn (Gabriel 1970). This species is known to local farmers as "u-od sa humay" or "tagustus" in Cebu; "igges ti bonobon" or "arabas" in the Ilocos; "bulalo" in Misamis Oriental; "ulod gueng punlang pale" or "olod gueng punlang pale" in Pampanga; "tagustus" in Panay Visayan; "begis na pagay" in Pangasinan; and "u-od sa/ng punlang palay" in the Tagalog region.

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[1] Contribution No. 57. A portion of a thesis presented by the senior author in partial fulfillment of the requirements for the degree of Master of Science in Entomology, UPCA; Received for publication November 10, 1971.

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REFERENCES

ANONYMOUS, 1963. Instruction for determining the susceptibility or resistance of mosquito larvae to insecticides. *WHO Tech. Rept. Series* No. 265 (2): 51-56.

———. 1963. Instruction for determining the susceptibility or resistance of adult mosquitoes to insecticides. *Ibid.* No. 265 (1): 41-49.

———. 1963. Criteria and meaning of tests for determining susceptibility or resistance of insects to insecticides, *Ibid.* No. 265 (14): 135-138.

———. 1969. International Health Regulations. Chapter III. Yellow Fever. *Official Records of the World Health Organization* No. 176, 25 pp.

BASIO, R. G. and J. C. AZUMA. 1971 On Philippine mosquitoes, VIII. The distribution of *Aedes aegypti* Linnaeus (Diptera: Culicidae), and its relationship to the spread of dengue-haemorrhagic fever. *Philipp. Ent.* 2(6): 183-194.

REISEN, W. K. and R. G. BASIO. 1971. Oviposition trap surveys conducted on four USAF installations in the Western Pacific. *Philipp. Ent.* 2(1):

RUDNICK, A. 1967. *Aedes aegypti* and haemorrhagic fever. *Bull. Wld. Hlth. Org.* 36: 523-534.

SCANLON, J. E. 1965. The distribution of *Aedes aegypti* in Thailand. *Mosq. News* 25(2): 199-203.

SMITH, C. E. G. 1956. The history of dengue in Tropical Asia and its probable relationship to the mosquito *Aedes aegypti*. *Jour. Trop. Med. Hyg.* 59: 243-247.

STASIAK, R. S., R. H. GROTHAUS and W. F. MINER. 1970. Susceptibility of *Aedes albopictus* (Skuse) larvae from South Vietnam to five insecticides, 1969. *Mosq. News.* 30(2): 246-249.

MATERIAL AND METHODS

Mass rearing: A number of sixth-instar larvae were collected from the field to start the laboratory culture. The larvae were confined in suitable cages (6" x 8" x12") and were provided daily with fresh corn leaves (Fig.IA). When fully grown, the larvae were either transferred to another cage with soil as pupating medium or left to pupate amongst the dry corn leaves (Fig.IB). The emerging adults were transferred for oviposition into a ball jar, covered with cheese cloth, containing a folded paper for oviposition (Fig. IC). The moths were fed with saturated sugar solution soaked in bails of cotton. Eggs collected were placed in petri dishes lined with moist tissue paper. The newly-hatched larvae were reared in clean petri dishes provided with fresh corn leaves (from approvimately 30-day-old plants) until they reached the fourth stadium. Then about 50 larvae were transferred to another rearing cage and this procedure maintained a constant stock in the mass culture. The rearing cages were washed thoroughly with soap, then with 70-95% ethyl alcohol, dried under the sun to minimize bacterial infection.

The following pointers were observed in mass rearing: strict sanitation; fresh corn leaves were cleaned and dried of moiture before feeding; the feed were supplied regularly to prevent abnormal growth of larvae; overcrowding was not allowed especially in the last 3 larval stadia.

Life history study: Newly-laid eggs were counted and placed in petri dishes lined with moist tissue paper. The incubation period was recorded and the newly-hatched larvae were individually reared in vials (3/4" diameters, 3" long) provided with strips of fresh corn leaves which were changed as often as necessary. The duration of each stadium was noted. Other biological data and behavioral characteristics of the caterpillar were recorded. When pupation was about to occur, the vials were filled to about one-third capacity with fine, clean and moist soil particles. The emerging adults were paired, transferred to oviposition cages and fed with saturated sugar solution. The life span, fecundity and behavior were recorded.

Relative abundance: Regular observation in the field at the Plant Breeding lot, UPCA Experiment Station in Los Baños was conducted to determine the presence and density of larvae per corn plant selected at random. The observation covered a period of 1 1/2 years.

Natural Enemies: Eggs, larvae and pupae were collected in the field and reared in the laboratory for the emergence of parasites.

Pseudaletia separata is a polyhagous insect. It has been recorded to cause inju to crops such as sorghum, wheat, oats, timothy, millet, blue grass, small grains, some legumes, sugar cane, sweet potato, Irish potato, cabbage, cauliflower, mustard, petchay, radish and lettuce and other non-graminaceous crops (Merino 1949; Capco 1957; Gibson 1915). Uichanco (1959) recorded it on corn. Furthermore, Peang (1969) listed 42 vegetables and field crops as host plants in addition to numerous species of field grass.

This species is geographically recorded throughout Asia, the Australian region, Europe, and North America (Franclemont 1951). Calora (1968) also mentioned that this species occurs in eastern part of the Palearctic region and the Indo-Australian region ranging from Amurland through China, Japan, Philippines, through eastern India, to the east Indies, Australia, New Zealand and Fiji. It is believed to occur throughout the Philippines and its local distribution coincides with that of corn which is grown in almost all the inhabited island in the country (Calora 1968).

In the Philippines, there have been serious outbreaks of armyworm in the the past. Machie (1910) reported an alarming outbreak seriously destroying rice in Batangas and the neighboring provinces. Similar outbreaks also occurred in Iloilo. He described the destructive species and attributed the damage to *Spodoptera mauritia* (Boisduval). However, his external morphological description of the species seems to tally with what we now know as *P. separata*.

One of the most dramatic armyworm outbreak which received considerable attention occurred in 1949 and this event elicited series of publications by Otanes and Sison (1949), Otanes (1949) and Merino (1949) which emphasized the seriousness of the armyworm as a pest. Rice plants in the field were entirely denuded and other crops such as corn, sugar cane, and even pasture grass were devoured by the caterpillars with amazing rapidity covering several hectares in a single day. Otanes (1949) attributed the greatest damage to *S. mauritia* and *Spodoptera litura* (Fabricius) and to some extent to *Cirphis unipuncta* Haw., *Cirphis loreyi* Dup., *Cirphis yu* Guen., and *Cirphis compta* Walker. The cause of armyworm outbreaks is not definitely known. However, Merino (1949) and Otanes (1949) considered that destruction of natural enemies and prolonged droughts may contribute to armyworm outbreaks. In Canada, Gibson (1915) mentioned that armyworm (*C. unipuncta* Haw.) outbreaks occur after a long summer drought.

The life history and behavior of *P. separata* have been partly studied abroad. In the Philippines, only a taxonomic description of the species is available (Calora 1968). In view of this, the present work was conducted to study its life history, host plants, relative abundance and natural enemies.

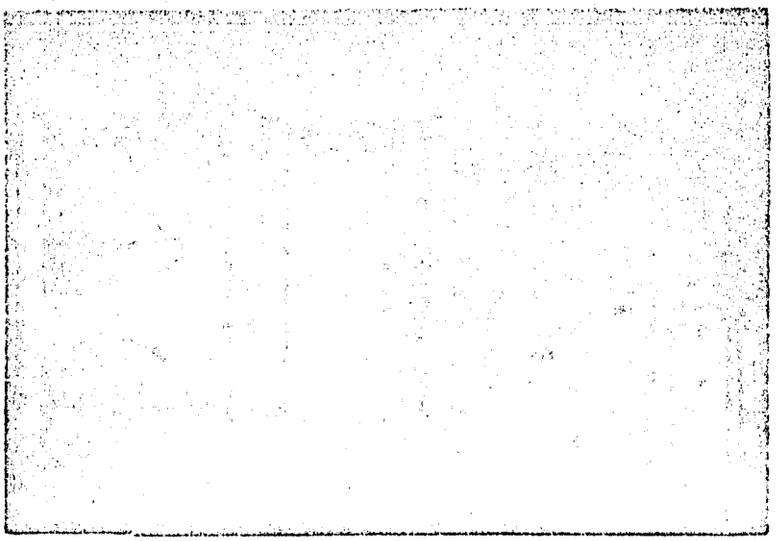

Fig. 1. Mass-rearing setup: *A*. rearing cage; *B*. pupating cage; *C*. ball jars for oviposition of moths.

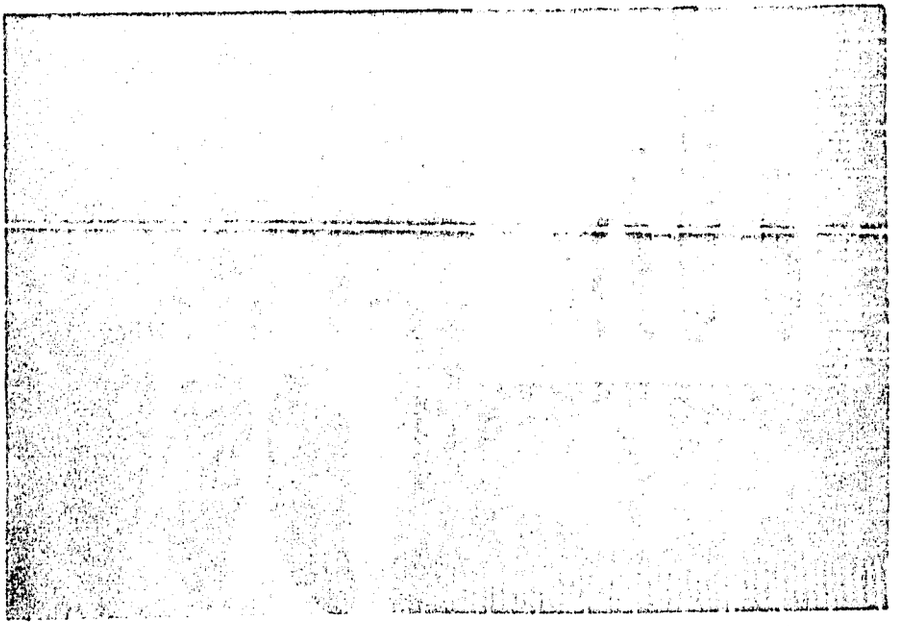

Fig. 2. Life history stages of *Pseudaletia separata*: *upper left*, egg masses; *upper right*, different instar-larvae; *lower left*, pupae; *lower right*, adult moths in *coitu*.

RESULTS AND DISCUSSION

LIFE HISTORY

The Life cycle: Table 1 shows the duration of the different developmental stages of *P. separata*. The different life stages are shown in Fig. 2. The total developmental period of the immature stages did not differ markedly between the two sexes, but the adult longevity was longer for females than males. Comparison of adult longevity when the month where fed with tap water instead of sugar solution revealed that the former averaged 3.6 days for females and 2.9 days for males, representing a reduction of about 4.5 days in adult life span.

TABLE 1. Duration of development stages of P. separata.

Developmental Period	FEMALES 32 individuals			MALES 51 individuals	
	Range (days)		Averages (days)	(days) Range	(days) Averages
Incubation	2-3	2-3	2.4±.23	2-3	2.4±.23
First stadium	2-3	2-3	2.6±.71	2-3	2-6.±.42
Second stadium	2-3	2-3	2.6±.38	2-3	2-6.±.37
Third stadium	2-4	2-4	2.7±.46	2-4	2.6±.51
Fourth stadium	2-4	2-4	2.8±.67	2-4	3.1±.28
Fifth stadium	2-4	2-4	3.2±.33	2-4	2.3±.63
Sixth stadium	4-7	4-7	4.7±.54	4-7	4.5±.47
Total larval period	14-25	14-25	21.0±.46	15-25	20.6±.43
Pupal period	8-11	8-11	9.3±.1.01	7-11	9.5±.73
Egg laying to emergence	24-39	24-39	30.3±.51	23-39	30.1±.46
Pre-oviposition period	1-3	1-3	2.±.27		
Emergence to death	2-17	2-17	9.2±.1.32	2-11	6.8±.1.03
Total duration from egg laying to death	26-56	26-56	40.0±.55	25-50	36.9±.51

The life stages: The newly-laid eggs are smooth, shiny and milky-white or yellowish-white, turning brownish or yellowish-black to dark brown a few hours before hatching. The eggs are spherical, slightly flattened on the dorso-ventral side when laid singly and compressed on both sides when laid in rows.

The first-instar larva: The newly-hatched larva is shiny, yellowish-white with black head. A few hours after hatching, the larvae tend to be gregarious. They hide in folded leaves or stay in the protected parts

Fig. 3. Entomophagous parasites of *Pseudaletia separata*: *upper left*, parasitized larva killed by hundreds of polyembryonic hymenopterous larval parasite; *upper right*, two hymenopterous parasites; *bottom*, four species of tachinid pupal parasites.

of the plant. They begin nibling the leaf surface, leaving the upper epidermal membrane intact, producing transparent streaks on the leaf. The first-instar larvae prefer to stay on the lower surface of the leaf. When disturbed, they drop by hanging on a silken thread. The pale-yellowish-brown when about to molt.

The second-instar larva: After the first molt, the head capsule becomes pale yellowish-brown turning brownish after a few hours. The second-instar moves about in a looping manner similar to the first-instar. Its color turns yellowish-brown to yellowish-green after feeding.

The third-instar larva: The third-instar larvae could eat whole leaf blade leaving only the midribs. The looping movements are no longer apparent at this stage. The color and structure of the newly-molted larva are similar to the first 2 instars.

The fourth-instar larva: The newly-molted fourth-instar larva turns dark-brown to black from transparent yellowish-brown. At this stage, the three lateral lines become distinct until the larva matures. These lines are about 1 mm. wide extending from the prothorax to the posterior end.

From the dorsal side, the first line is reddish-brown, the second is black and the third, pale yellowish-brown. Each line is bordered by a dark

margin about .2mm which makes hte 3 lines mentioned distinct. These were usually observable when the larvae were reared in mass or in crowded condition. But if reared singly, their general color is light yellowish-brown making these lines indistinct.

The fifth-instar larva: The fifth-instar larva is similar to the fourth-instar larva except in size.

The sixth-instar larva: The sixth-instar larva is similar to the fourth and fifth-instar larvae but the lines described for the fourth-instar are more distinct.

Variations in color of the last 3 larval instars were observed. Larvae reared singly in vials were pale yellowish-brown, or brownish-white, while those reared in groups in mass-rearing cages or when food supply was limited, were black with their lateral lines distinctly shown. The former is believed to be the solitary phase and the latter the gregarious phase. The biochemical differences between these phases had been described by Matthee (1945) for locusts and armyworms.

The prepupa: This is the stage when the full-grown larva stops eating and makes its earthen cocoon until the pupa is formed. At the beginning of the prepupal stage, the larva stops eating, becomes restless and when soil is available it burrows into it and makes its earthen cell or cocoon When soil is not available the prepupa conceals itself in-between corn leaves, and makes its cell. The prepupa is about one half times the size of full-grown larva. After shrinking in size it gradually reduces its activity until it only makes a slow nondirectional movement when touched.

The pupa: The young pupa is milky-white and transparent turning reddish, shiny and mahogany-brown with age. The cremaster of the male and female pupae consist as 2 pairs of robust spines on their posterior ends. Out of 143 larval cultures, 92 were females and 51 were males giving a female-male ratio of 1.8: 1.00. The male and female pupae can be readily separated by examining impressions of the genital and anal openings.

Adults: The male and female adults of *P. separata* have been described Calora (1968) and Franclemont (1951). The emergence of adults usually takes place in the evening but it is not uncommon to observe moths emerging during the day especially when the weather is cool. It takes about fifteen to twenty minutes for the appendages and wings to straighten out and dry up after leaving the pupal case. Activity begins at dusk until morning just before sunrise.

The male and female copulate within one to two days after emergence, usually from dusk to early morning but few exceptional adults were observed to mate in the morning. Multiple mating is a general rule.

Egg-laying starts 2 or 3 days after emergence which may extend up to about a week but the greatest number of eggs may be laid on the first and second nights of oviposition. The eggs are either laid singly or several single-layered rows or in masses of rows piled one over the other. The eggs are laid bare, deposited between leaves or leaf-sheaths glued together by a white paste-like substance. Based on observation of 92 females, a female lays an average of 467 eggs (range 30-974) through out its life. The hatching percentage obtained was 98.99%

HOST PLANTS

The species was found to feed on many plants. The following plants are considered preferred hosts: corn, *Zea mays* Linn: rice, *Oryza sativa;* sorghum, *Sorghum vulgare* Linn.; para grass, *Panicum purpurascens;* napier grass, *Pennisetum purpureum* Schum; *Brachiaria mutica* Forsk; *Brachiaria distachya* (L) Stapf; cawit-cawitan *Anchaus echinatus* L.; am r-seco or *Chrysopogon aciculatus* (Retz.) Trin.; krus-krusan or raw food grass, *Dactyloctenium aegyptium* (L) Beauv.; bulang, pulang-puit or jungle grass, *Echinochloa cruspavonis* (H.B.K.) Schult.; balasbakisan, paragis, sabung- sabungan or dog's stail, wire grass, *Eleusine indica* (Z) Gaerta: guinia grass, *Panicum maximum Jasq.;* luya-luyahan, *Panicum repens* L.; lisang-kalabaw, *Paspalidum flavidum* (Retz.); kauad-kawaran, kulape or carabao grass, *Paspalum conjugatum* Berg.; *Paspalum dilatatum* Poir; batadbatadan or Johnson grass, *Sorghum halepense* (L) Pers.

The following plants are considered non-preferred hosts but eaten under stress of hunger: sugar cane, *Saccharum officinarum* Linn.; squash leaf, *Cucurbita maxima* Duch.; ampalaya *Momordica charantia* Linn; cucumber *Cucumis sativus* Linn.; camote, *Ipomoea batatas* (Linn.) Poir, tomato leaves, *Lycopersicon esculentum* (Linn.) Karsten; pet-sai, *Brassica chinensis* (Linn.); cassava, *Manihot maritima* Bohl: bush sitao fruit and leaf, *Vigna sinensis* (Linn.) Sav.; peanut leaf, *Arachis hypogaea* Linn.; aguingay, *Rottboellia exaltata* L.F.

The following plants have been listed as hots of *P. separata* (Deang 1969), but not tested due to lack of time and materials: arugula, cabbage cauliflower, mustard, broccoli, radish, lettuce, melon, water melon, sponge gourds, white-flowered gouds, wax gour, chayote, ampalaya, okra, roselle, eggplant, pepper, Irish potato, mongo, snap bean, pea, lima bean, hyacinth bean, pidgeon pea, carrot, beet, onion, asparagus, and other several grasses.

SEASONAL OCCURRENCE AND ABUNDANCE:

In Los Baños, the larvae of *P. separata* were observed attacking corn and sorghum in the field. Fields planted early in July and those planted late in September for the wet season, and corn crops from January to February

for the dry season sustained the most damage. Larvae were collected as early as the second week of June with the population reaching its peak by August to September, and then declined, and developed another peak in January to February. These are the hottest months of the year and it is suspected that this species must have some mechanisms for surviving this adverse condition. But it is not known whether or not they hibernate.

NATURAL ENEMIES

Some of the parasites recovered from field collected speciments are shown in Fig. 3. There were 4 species of tachinid flies, one ichneumonid pupal parasite and one polyembryonic hymenopterous parasite recovered from field-collected larvae. (Fig. 3).

It is not uncommon to see larvae in the field with eggs of tachinid flies attached at the anterior segment of the host. From two to as many as 9 eggs were observed on the body of one larva. However, only one parasite was observed to mature in each host.

The tiny, black polyembryonic hymenopterous larval parasite is considered to be very effective in controlling this pest. On November, 1968, 27 larvae were collected in the UPCA Experiment Station; 24 of them were parasitized by this species. This parasite was always present in all groups of larvae collected in the field. Parasitism ranged from 30 to 80%

Two entomogenous fungi were collected from the field in January, 1970. These were identified as *Entomophthora* sp. (Gabriel 1970a) and *Specaria* sp. (new record).

The bacterial parasite caused a very serious problem in the laboratory mass-rearing. It attacked seriously the overcrowded and starved larvae. Pupae were also observed to be killed by the bacteria. A disease believed to be caused by a virus was also observed. The diseased larva turned reddish-brown in the advance stage of the disease and the integument of the larva became brittle and odorous after death.

There were no parasites observed on the eggs and adults but it is believed that there must be more parasites attacking the different developmental stage of this species if a more thorough investigation is done.

In the Philippines, Otanes (1949) listed the following parasites and predators of armyworms without reference to any specific species but is mentioned here because *P. separata* is one of those reported in the 1949 outbreak:

Egg parasite (a tiny wasp), larval parasite (a tachinid fly *Chelonus*), ground carabid beetle, bacteria, and a parasitic fungus; pupal parasite (red ground or fire ants, *Solenopsis geminata*), insectivorous birds, chinese starling or "martinez" (*Actheopsar cristatellus*).

THE BIOLOGY OF THE CALIFORNIA RED SCALE, AONIDIELLA AURANTII (MASKELL) (DIASPIDIDAE: HOMOPTERA)[1]

Epifania Q. Perez[2]

The biology of the California red scale, Aonidiella aurantii (Maskell) was studied. The female underwent two nymphal stages in two moltings while the male had four stages in four moltings. The life history of the female was as follows: the first stadium was 5-8 days ($x = 6.60 \pm 0.15$ days); the first molt, 2-9 days ($x = 5.21 \pm 0.07$ days); the second stadium, 3-9 days ($x = 5.44 \pm 0.09$ days); and the second molt, 3-8 days ($x = 5.69 \pm 0.12$ days). The total developmental period was 22-33 days ($x = 27.0 \pm 0.49$ days) and the longevity was 95-142 days ($x = 116.75 \pm 0.94$ days). For the male, the life history was as follows: the first stadium was 5-9 days ($x = 6.40 \pm 0.16$ days); the first molt, 4.7 days ($x = 4.74 \pm$ days); the second stadium, 5-11 days ($x = 7.56 \pm 0.28$ days; the third stadium or prepupal stage, 1-3 days ($x = 1.77 \pm 1.09$ days); and the fourth stadium or pupal stage, 1-5 days ($x = 2.93 \pm 0.14$ days). The total developmental period was 16-28 days ($x = 23.50 \pm 0.36$). The adult male remained inside the scale covering for 1-4 days ($x = 2.12 \pm 0.04$ days) before coming out of it.

The female produced 101-312 crawlers ($x = 195 \pm 11$ crawlers) during its productive life span of 73-120 days ($x = 94.25 \pm 0.09$ days).

In the field, the natural enemies observed were a hymenopterous parasite, Aphytis sp.; a coccinellid, Chilocorus corbarus (Mulsant); and a fungus, Fusarium sp. In the laboratory, one species of ant was observed feeding on the scale insect.

The developmental period of the California red scale was shortest on pomelo and longest on calamansi. The percentage survival was the same on all species of citrus used except on calamansi where it was very low.

The California red scale at the UPCA citrus orchard was found abundant during the months of March, April, June and July, and least during the months of September, October, November and December.

Aside from citrus, the red scale was found on Psidium guajava L., Samanea saman Jacq., Artocarpus communis Forst., Artocarpus integra Thun. Merr., Litsea glutinosa Lour., Diospyrus discolor Willd., Musa sapientum L., Annona muricata L. and Annona squamosa L.

The California red scale, *Aonidiella aurantii* (Maskell), is one of the most injurious insects that infests a variety of plants most especially the citrus group. Like all other diaspidids it sucks the plant sap while it injects a toxic substance into the plant tissue. The toxin accounts for the

[1] Contribution No. 58; Based on a thesis presented by the author for graduation under the direction of Dr. B. P. Gabriel in August 1971 with the degree of Bachelor of Science in Agriculture from the College of Agriculture, University of the Philippines;

REFERENCES

CALORA, F. B. 1966. A revision of the species of the Leucania complex occurring in the Philippines (Lepidoptera, Noctuidae, Hadeninae). *Philipp. Agriculturist.* 52: 693-728.

CAPCO, S. R. 1957. A list of plant pests of the Philippines with special reference to field crops, fruit trees and vegetables. *Philipp. Jour. Agri.* 22(1-4): 1-79.

DEANG, R. T. 1969. An annotated list of insect pests of vegetable in the Philippines. *Philipp. Ent.* 1(4): 313-33.

GABRIEL, B. P. 1970. Guide to the Insect Pests of Rice. Mimeo., UPCA, College, Laguna, p. 4-5.

———. 1970a. Additional records on the microbiota of Philippine insects. *Philipp. Ent.* 1(6): 465-472.

GIBSON, A. 1915. The army worm *Cirphis (Leucania) unipuncta* (Haworth). *Canad. Dept. Agric. Expt'l. Farm Bull.* 9: 1-34.

FRANCLEMONT, JOHN G. 1951. The species of *Leucania unipuncta* group with a discussion of the generic names for the various segregates of the *Leucania* in North America. *Proc. Ent. Soc. Wash.* 53(2): 57-85.

MACRIE, D. B. 1910. An outbreak of destructive caterpillar in Batangas rice field. *Philipp. Agric. Rev.* 3(12): 703-705.

MATTHEW, J. J. 1945. Biochemical differences between the solitary and gregarius phases of locusts and noctuids. *Bull. Ent. Res.* 36: 343-371.

MERINO, G. 1949. An explanation for the extraordinary outbreak of armyworm. *Plant Ind. Digest.* 12(7): 4-5.

OPAMEN, F. Q. 1905. Rice cutworms. *Philipp. Agric. Rev.* 18: 551-554.

———. 1949. Extent of 1949 outbreak. *Plant. Ind. Digest.* 12(7): 2-3.

———. and P. SISON. 1949. A suggested program for the control of rice pests. *Plant Ind. Digest.* 12(7): 240.

PEST MANUAL No. 3. (Rev. Ed. Steele B.). 1970. Pest control in rice. The Ministry of Overseas Development. pp. 165 & 240.

PATHAK, M. D. 1959. Insect pests of rice. The International Rice Research Institute. Los Baños, Laguna, Philippines. p. 30-39. Mimeo 77 p.

RAMAMANI, S. and D. R. SUBBANOV. 1965. On the identity and nomenclature of the paddy worm commonly referred to as *Cirephis unipuncta* Haworth. *India Jour. Ent.* 27(3): 363-365.

TOWER, D. G. 1916. Comparative study of the amount of food eaten by parasitized and non-parasitized larvae of Cirphis unipuncta. *Jour. Agric. Res.* 6: 455-458.

UICHANCO, L. B. 1959. Field Crops. Second Ed. Published by the Coll. of Agric. University of the Philippines. p. 56-57.