BIOLOGY OF SWEETPOTATO BUG, *Physomerus grossipes* Fabr. (Coreidae, Hemiptera)

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ABSTRACT

Eggs of the sweetpotato bug are laid in groups on the underside of leaves. The eggs have an incubation period of 15.82 days and hatchability of 86.8%. There are five nymphal instars. Total mean developmental period is 85.45 days for males and 87.69 days for females. Adult males and females are similar in general appearance except that the last abdominal segment of the male is more pointed than that of the female and the hind leg of the male has a characteristic spine. The bugs are normally most abundant from January to April and least from July to August. One parasitic species of wasp belonging to family Eulophidae (Order Hymenoptera) was observed on field-collected eggs. Plant species namely, *Ipomoea aquatica, Ipomoea triloba* and *Bacella rubra* could serve as alternate hosts ofthe insects.

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KEY WORDS: Biology. Sweetpotato bug *(Physomerus grossipes Fabr.)*.

INTRODUCTION

Growing sweetpotato is not difficult but obtaining high yield is a problem. Damage caused by insect pests and disease-causing microorganisms may be considered as one of the major constraints in sweetpotato production.

Among the insect pests that attack the crop, the sweetpotato bug, *Physomerus grossipes* Fabr., is considered as a major one. According to Esguerra and Gabriel (1969), the nymphs and adults of this insect pierce the stem and suck the juice of sweetpotato and extrude toxic saliva which causes young plants to wither and die. Considering that *P. grossipes* is an important pest of sweetpotato, a study of its biology was done in order to formulate an effective control program for this insect. Additional information

on its natural enemies was also gathered as this might be very useful in future biological control work.

MATERIALS AND METHODS

Preparation of host plants

Sweetpotato (BNAS 51) cuttings obtained from the experimental field of the Philippine Root Crop Research and Training Center (PRCRTC) were planted singly in clay pots (30.48 cm dia.) filled with sterilized soil. The plants were watered daily and fertilized twice during the growing period to promote vigorous growth. Cuttings of the same sweetpotato variety were also planted monthly in the field for four consecutive months to determine the seasonal abundance of the bug and its natural enemies.

Behavior and life history

Nymphal sweetpotato bugs collected from the field were allowed to develop into adults to start a stock culture in the laboratory. A pair of adult (male and female) bugs was introduced into a nylon tulle cage wrapped around the stems of potted sweetpotato plant and allowed to mate and lay eggs. Several cages were prepared.

Newly laid eggs were carefully taken from the potted plants. The eggs laid by each female inside the nylon cage were counted daily and transferred to Petri plates lined with moist tissue paper. The incubation period was recorded and change in the color of the eggs during pre-eclosion development was observed under a stereomicroscope. The eclosion process was closely observed.

The biology of the bug was studied for two generations. One hundred newly hatched nymphs from each generation were individually reared on undetached stems of the host. To prevent their escape pieces of nylon cloth big enough to be formed into cages and allow the insect to move freely inside (about 14 cm long and 27 cm wide) were wrapped around the stems of potted sweetpotato plants. Both ends of the nylon cloth were tied to prevent predators and other insects from interfering with the culture (Fig. 1).

The behavior and morphological changes of the nymphs at various stages of development were observed. The end of each nymphal stage was determined by the presence of exuviae in the nylon cages after each molt. To be able to observe their mating behavior, male and female adult bugs

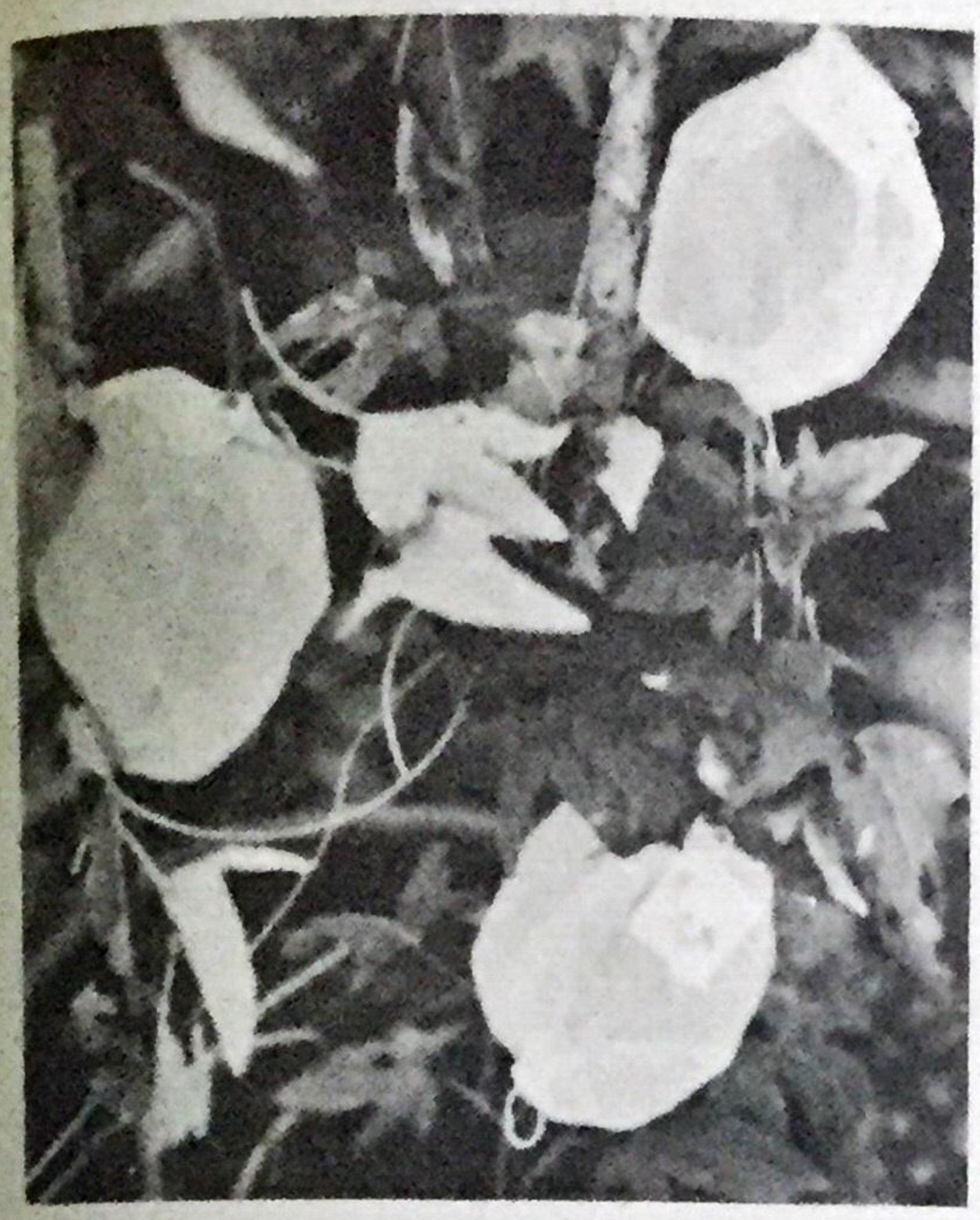

Figure 1. Improvised rearing cages made of nylon cloth wrapped around the stem of sweetpotato plant to facilitate the study of the biology of the bug, *Physomerus grossipes* Fabr.

were kept in a glass jar and allowed to mate. Fecundity of the female and the life span of the adults were also noted.

Natural enemies

Eggs, nymphs and adults collected from the fields were confined in bottles and kept in the laboratory for observation of whatever parasite they might have. Adult parasites that emerged were examined and identified. Predators of the bug at different stages of development were also collected and determined.

Host range

Stems of nine species of plants commonly associated with sweetpotato in the field were collected and individually placed in glass jars containing five nymphs of the sweetpotato bug. These plants were: alugbati *(Bacella rubra)*, centrosema *(Centrosema pubescens)*, calopogonium *(Calopogonium mucunoides)*, gabi *(Colocasia esculenta)*, squash *(Cucurbita maxima)*, kangkong *(Ipomoea aquatica)*, aurora *(Ipomoea triloba)*, carabao grass *(Paspalum conjugatum)* and kudzu *(Pueraria phaseoloides)*. A moistened cotton wad was placed inside each glass jar to keep the stem fresh for a few days. Plants fed upon by the nymphs after 24 hrs as evidenced by feeding punctures in the leaves were considered potential hosts.

Seasonal abundance

Weekly counts of the bugs present in field-planted sweetpotato were done starting from one week after planting up to harvest for a period of four months for each of the four plantings. Twenty randomly selected sweetpotato plants were used as samples in determining the number of bugs each sampling time.

RESULTS AND DISCUSSION

Life history and behavior

The duration of the different developmental stages of the sweetpotato bug reared for two generations on undetached stems of BNAS-51 sweetpotato is shown in Table 1. The total developmental period varied slightly between sexes with a mean of 85.45 days for the male and 87.69 days for the female. These results conform with the earlier report of Esguerra and Gabriel (1969) that one generation of the bug could be completed within 3 months.

Oviposition. The female bugs started laying eggs 10-18 days after copulation. The eggs were laid in batches along the veins on the underside of the sweetpotato leaf particularly near the tip (Fig. 2). In the field, the eggs were also laid on leaves of other plants associated with sweetpotato and sometimes even on the petioles of gabi plants. The eggs were glued

Table 1. Developmental period (days) of sweetpotato bug, *Physomerus grossipes* Fabr. reared on undetached stems of sweetpotato planted in pots[1].

Developmental Period	Male (77 individuals)		Female (56 individuals)	
	Range	Mean	Range	Mean
Incubation period	11-21	15.76±2.90	11-21	15.82±2.98
Nymphal period				
First instar	4-6	5.04±0.71	4-6	5.00±0.64
Second instar	14-21	17.24±0.90	14-22	17.60±0.28
Third instar	14-20	15.00±0.72	15-19	14.90±0.33
Fourth instar	12-20	16.15±1.21	12-21	17.06±0.95
Fifth instar	10-21	17.51±0.45	10-22	18.20±1.01
Total nymphal period	60-85	70.60±2.14	63-89	72.84±1.19
Total developmental period	74-76	85.45±0.67	76-99	87.69±1.83

[1]Data based on 110 and 88 individuals reared on first and second generations, respectively.

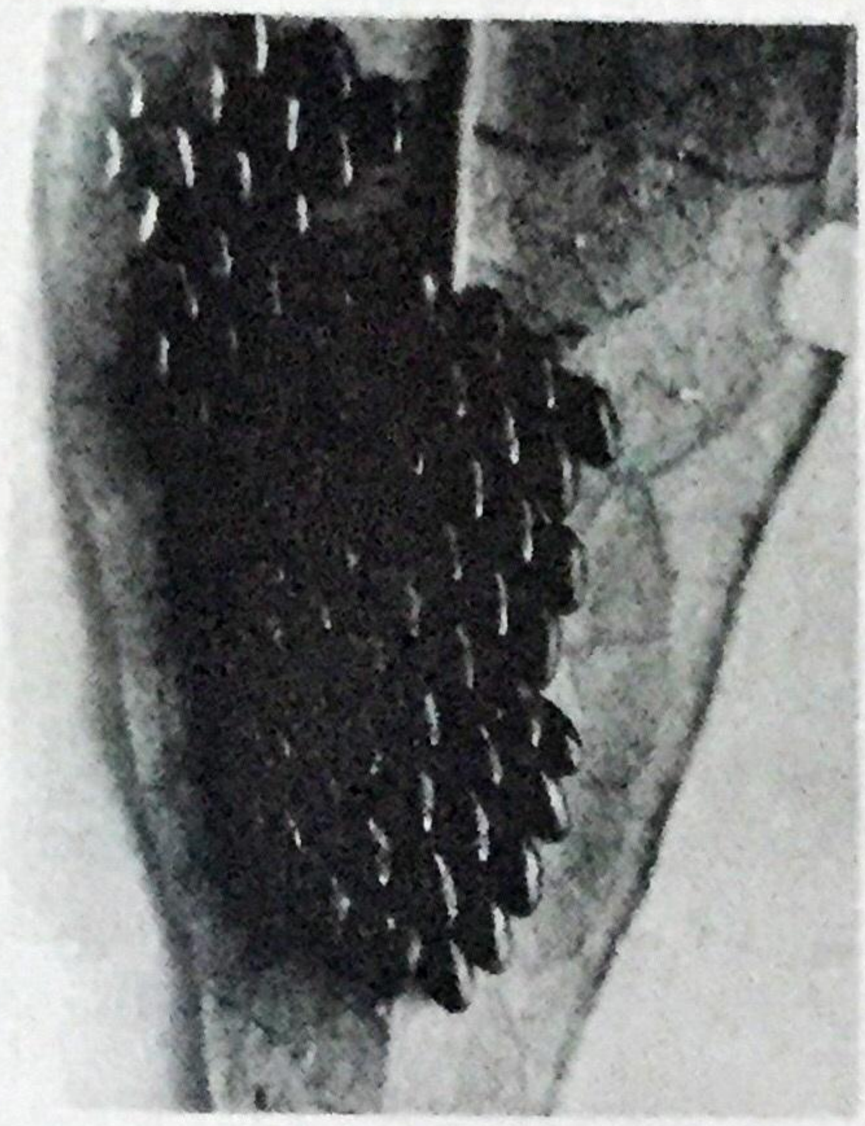

Figure 2. An egg mass of the sweetpotato bug, *Physomerus grossipes* Fabr. laid near the tip of a sweetpotato leaf.

together to the leaf surface by a sticky colorless substance secreted by the female during oviposition. The eggs were usually laid close to each other although they were sometimes laid separately. The female adults laid from 59-697 eggs with an average of 360.1 eggs in 2-8 batches.

Egg development, incubation period and eclosion. The eggs are oval with one end tapering, and light brown when newly laid but turn dark bronzy-brown after a few days. Six days before hatching, a cap is formed around the rim of the dorsal region of the egg. This is pushed by the emerging nymph. Upon removal of the cap, the pronotum of the nymph comes out first and the head is bent towards the ventral side of the abdomen. The nymph finally extricates itself through a series of movements. It usually takes 5-8 min for a nymph to completely come out of the egg case. Some nymphs die while still in the egg shell.

The incubation period lasted from 11-21 days with an average of 15.82 days (Table 1). Egg hatchability ranged from 28.1 to 91.2% with an average of 68.6%. In few cases, however, it was observed that some batches of eggs failed to hatch.

Nymphal development. There were five nymphal instars (Fig. 3) with duration ranging from 5.04 days (first instar) to 18.20 days (fifth instar). The total nymphal period was 70.60 days for the male and 72.84 days for the female (Table 1). These results differ from those obtained by Metcalf (1951) wherein 6-8 wks lapsed from the time the eggs hatched until the nymphs became adults. Difference in the duration observed could be due to differences in the environment and the host used.

The nymphs are gregarious but they remain close to the empty egg shell until the first molting. Under field conditions, however, newly hatched nymphs disperse on the growing tips of the host plants. During hotter times

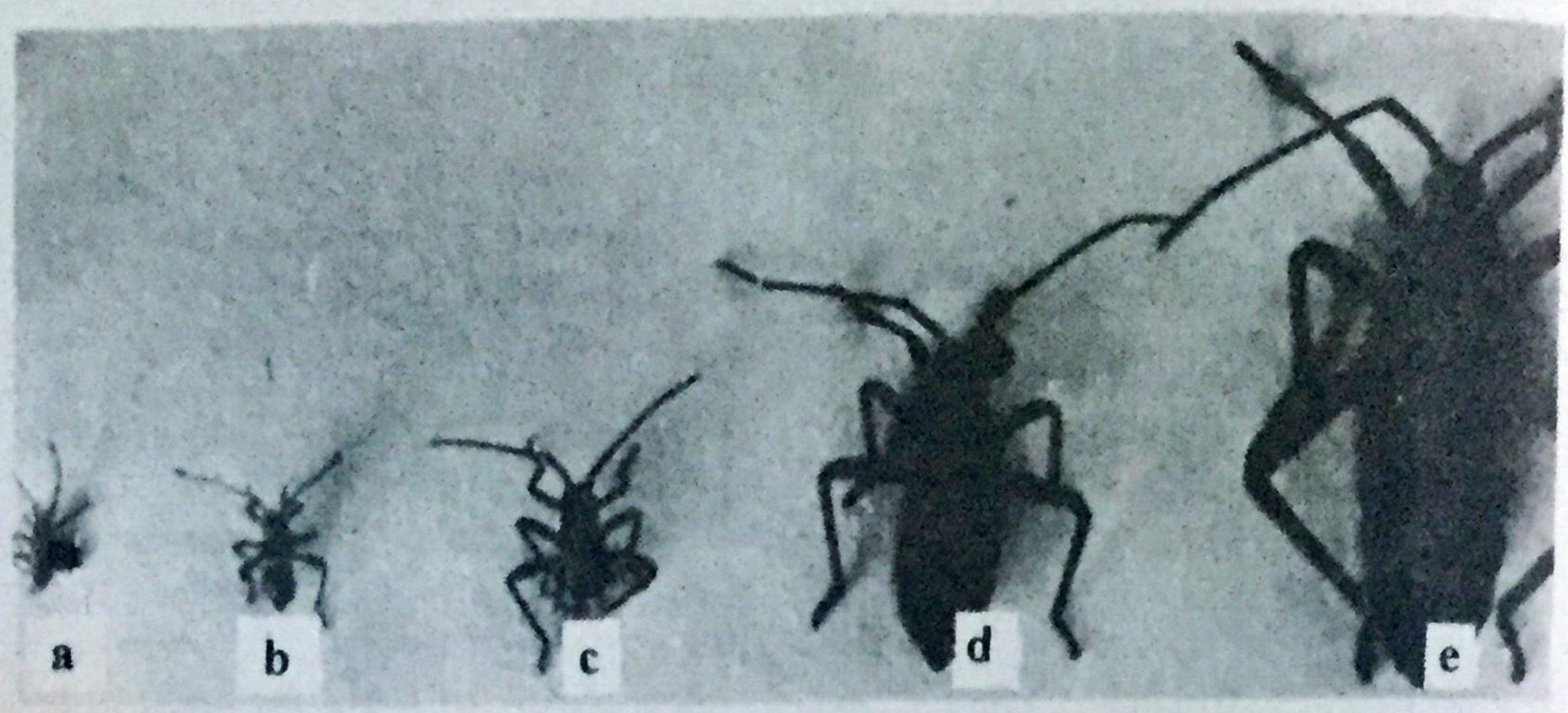

Figure 3. Different nymphal instars of *Physomerus grossipes* Fabr.: First instar (a), second instar (b), third instar (c), fourth instar (d), and fifth instar (e).

of the day, especially at noon, the nymphs stay on the underside of the leaves.

Immediately before molting, the nymphs become very dark, move down to the lower part of the stem, and become less active with its head thrust downward. After the pronotum has cracked, the nymphs jerk their bodies slowly and slide out to free themselves from the exuviae. It usually takes 10-15 min for the insects to complete ecdysis. Some individuals die during molting. After molting, the nymphs remain motionless for a short time near their exuviae, then move farther from these and resume feeding.

Emergence of adults and sex ratio. The last molting marks the emergence to adult stage. The manner of adult emergence is similar to the nymphal molting. After emergence, the adults remain motionless for a short time allowing their wings to dry, then start moving and begin to feed. Out of 133 individuals which reached the adult stage, 77 were males and 56 were females, giving a sex ratio of 1.38:1.00.

The male and female adult bugs are very similar in general appearance except that the male has a more pointed abdomen than the female, and also has a spine on the tibia of the metathoracic leg (Figs. 4-5).

Mortality. Out of 198 bugs reared individually on undetached stems, only 133 (67.2%) reached the adult stage. Mortality was 32.8% (Table 2). The highest mortality of the sweetpotato nymphs was observed during the first instar when gregarious, newly hatched nymphs were separated

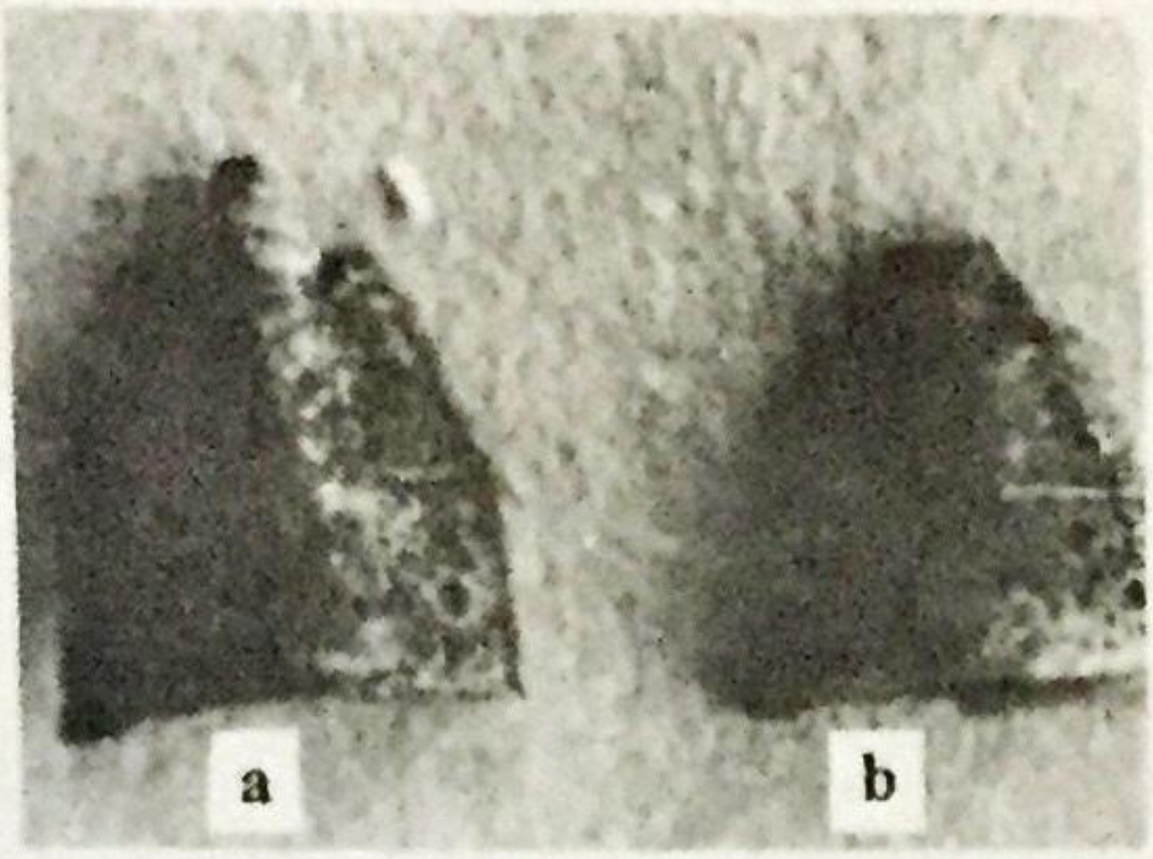

Figure 4. Adults of *Physomerus grossipes* Fabr. The male (a) has a characteristic spine on the tibia of the metathoracic leg.

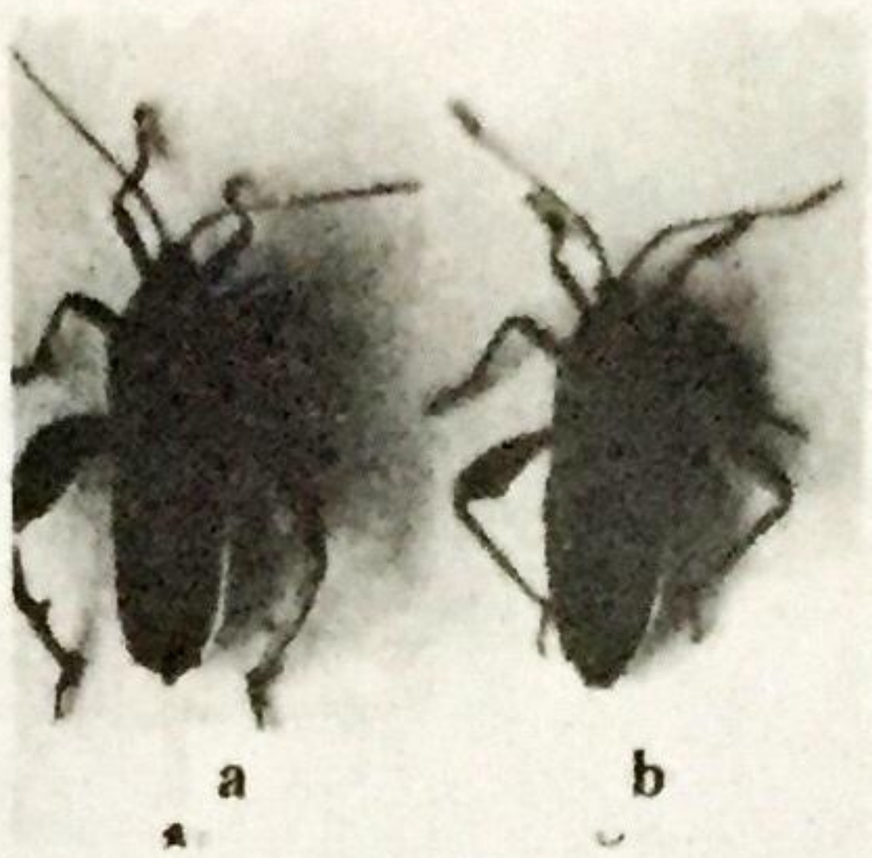

Figure 5. Last abdominal segment of male (a) and female (b) *Physomerus grossipes* Fabr. The male has a more pointed tip.

individually. The high mortality rate during the first and second instars could have been caused also by the ants that preyed on newly molted motionless individuals. Mortality decreased during later nymphal stages. The lowest mortality was observed during the fifth instar.

Longevity of adults. The average longevity of the sweetpotato bug was 3 months although a few individuals lived up to 4 months after emergence.

Table 2. Comparison of percent mortality at different nymphal instar of the sweetpotato bug, *Physomerus grossipes* Fabr., when reared individually on undetached stems of sweetpotato planted in pots[1].

Developmental Stages	No. of Alive Individuals	No. of Dead Individuals	Mortality (%)
First Instar	166	32	16.2[2]
Second Instar	146	20	10.1[2]
Third Instar	139	7	3.5
Fourth Instar	135	4	2.0
Fifth Instar	133	2	1.0
Total		65	32.8

[1]Data based on 198 individuals reared for two generations.
[2]Predation by ants could have contributed to high mortality during the early instars.

Mating behavior and fecundity of adult female bugs. After 8-12 days from emergence, mating took place at any time of the day but mostly during night time. Metcalf (1951) reported that in some adult bugs, mating took place 2-3 wks after their emergence. Mating sometimes lasted up to 2 days, and may be repeated 2-3 times during the lifetime of the adult female. Before mating, the male performs some sort of courtship ritual. The male moves around the female while the latter remains motionless. Then the male passes at the back of the female, sometimes staying there for a short time, then starts moving towards the tip of the abdomen of the female. When their abdomens touch each other, the male tries to mount the female. If unsuccessful, the male repeats the courtship process until he succeeds. During copulation, the male and female face opposite directions.

Adult female bugs lay about 10-38 eggs per day. If the female is disturbed, egg laying stops but is resumed after 1-2 days.

Feeding behavior of nymphs and adults

Physomerus grossipes feeds by sucking the sap of the plant. Nymphs start feeding in groups 2-3 days after the first molting. Later instar nymphs and adults could also be seen feeding in groups (Fig. 6).

Host range

Out of nine species of plants tested as possible hosts, only three species were fed on by the bug. One was alugbati and the other two plants belonging to Family Convolvulaceae, kangkong and aurora.

Natural enemies and seasonal abundance

Parasitic wasp belonging to Family Eulophidae of the Order Hymenoptera was reared from field-collected eggs of the sweetpotato bug. Of the 178

Figure 6. Nymphs and adults of *Physomerus grossipes* Fabr. feeding on sweetpotato stem.

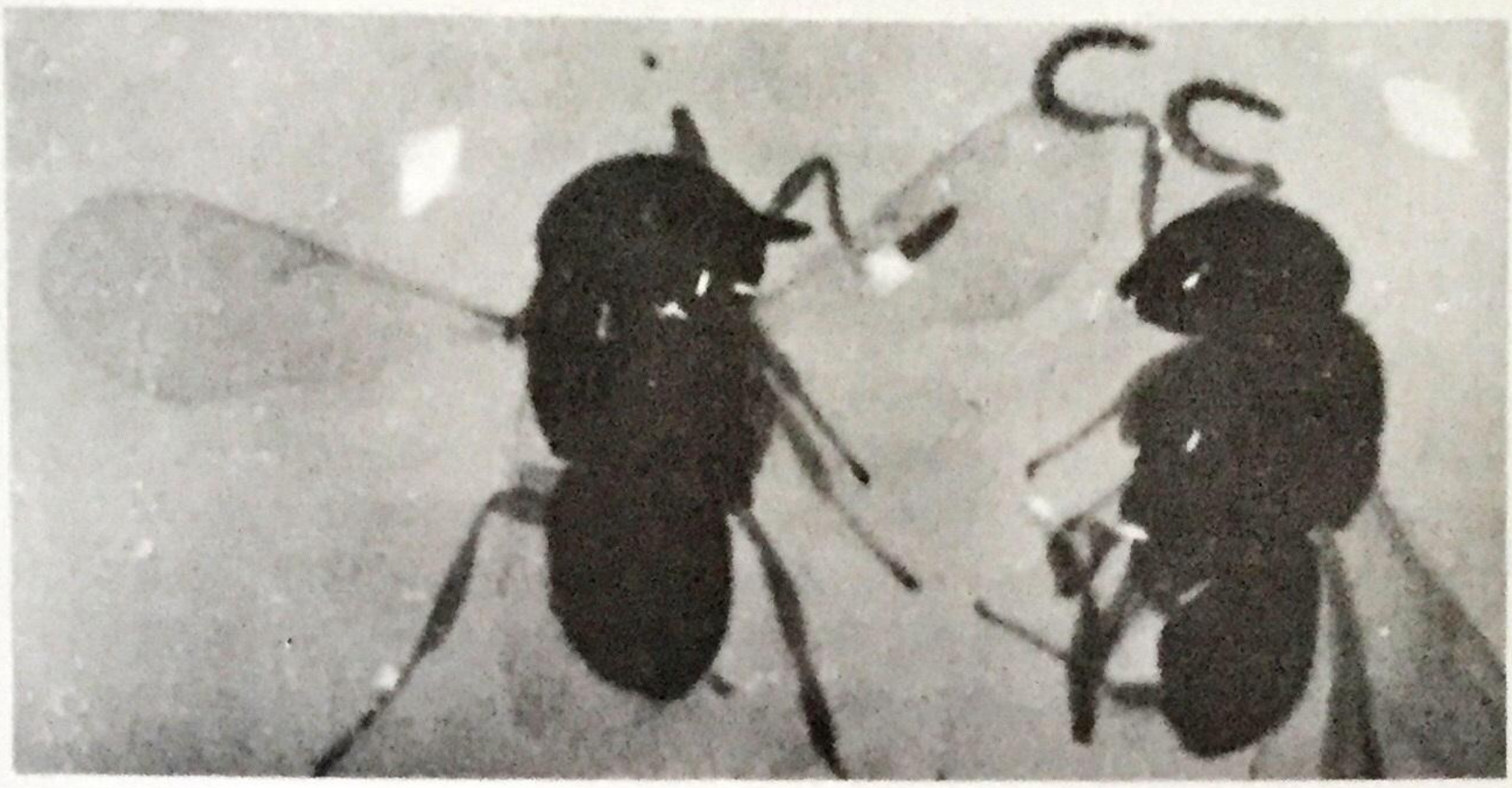

Figure 7. Eulophid parasite of the eggs of the sweetpotato bug (x=40).

eggs collected, 49% were parasitized by the wasp. It was further observed that only one parasite emerged from each egg (Fig. 7). The first instar nymphs were often preyed upon by a certain species of ant.

Approximately 10-15 bugs per plant could be observed feeding on sweetpotato in ViSCA from January to April. During the months of July to August, the bugs could hardly be observed feeding on the plant.

An important information also obtained in the present study was the presence of a parasite that preyed on the eggs of the sweetpotato bug. Since the parasite may help reduce the population of the bug in the field as a biological control agent, this should be identified and studied to determine if this yields readily to mass production in the laboratory. If the result is positive, mass production of the parasite can be done and inoculative releases can be made when the population of the bug in the field starts to build up.

The ants that were observed to feed on early instar nymphs should also be studied because they could be potential biological control agents.

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