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SURVEY ON IMPORTANT PESTS OF RICE AND VEGETABLES WITH EMPHASIS ON POPULATION TREND AND ITS DAMAGE

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R I N G K A S A N

Telah dilakukan pengamatan tentang komponen serangga dan arthropoda lain pada asosiasi padi dan sayuran. Didapatkan bahwa komponen tersebut masih cukup berarti dari segi rantai interaksi ekologis.

Dilakukan penafsiran terhadap pola populasi penggerek batang padi serta serangga hama sayuran dengan cara sampling stadia muda dan dewasa.

Diketemukan pola populasi yang tidak begitu bervariasi untuk suatu daerah yang luas di Jawa Barat.

A B S T R A C T

The insects and other arthropods components of rice and vegetables association were investigated. It was found that these components were still meaningful from the aspect of ecological interaction.

Estimate of rice-borers population trend and also of the vegetables pests were carried out by means of immatures and matures sampling.

Apparently the variation of the population trend of rice as well as vegetable pests was small within a relatively large area in West Java.

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INTRODUCTION

One of the crucial problems in connection with plant protection and pests management in Indonesia was the problem of contiuous and regular data collection of the pests.

After a relatively long delay, an intensive effort in this direction was started again in 1964 (Soenardi, 1967) with the prime emphasis on the control of rice pests. It was followed later on with a more detail study such as population life table of *Tryporyza incertulas* Walk (Suhardjan, 1973).

Insect ecology is always an interesting subject especially if it deals with insect pests. The following report will be on the ecology of insect pests of rice and vegetable association such as the insects component within a certain area, population trend and parasitism and the damage or infestation of the pests. This preliminary investigation is expected to stimulate further study in the field of insect ecology especially of the insect pests.

MATERIALS AND METHODS

I. RICE INSECT PESTS

1. Insect Composition

The northern part of Java has been subjected to various treatment in relation with the rice intentification program. One of the first steps in this ecological study was to find out the insects composition within the rice field and to compare with the data collected long before the program.

Investigation was carried out from July upto November 1972 (dry season), sponsored by LP_3 Bogor. The location was Ciberes (West Java); the area was planted with local as well as high yielding rice varieties. Insects were collected for a 24 hours period (3 hours interval) from 8, 10, 12, 14 and 16 weeks old crop. At daytime the insects were collected with standard sweeping net of a fine mesh; at night with standard kerosene light trap. One set of sweeping involved 20 m walk to four direction from points of intersection between ricefield dykes selected at random.

2. The population trend of rice-stem borers and gallmidge

At certain areas, rice-stem borers, gallmidge and hoppers had caused considerable lost and even total. To explore the knowledge on the population trend of the important rice pests, an investigation was carried out at Sang Hyang Seri Experimental Station (West Java) during the wet season 1969. Effective area was 360 m2 and from each plot 16 hills were investigated everyday for larvae and pupae. Each plot was selected at random.

3. *Seasonal pattern of borers and gallmidge infestation*

The most common method for rice-borers evaluation has been the assessment on the degree of infestation in the form of white heads and deadhearts. Another symptom suitable for population estimate has been on gallmidge by using the percentage of silvershoots within a hill. Direct counting on larvae will be very tideous.

a. *Susceptibility of various rice varieties*

Example on the influence of rice variety was taken from variety screening investigation located at Bekasi, northern part of West Java. Period of investigation from January upto May 1972. The screened varieties were IR5, IR8, C4-63, IR-532, 1576-2, Dewi Ratih, Pelita I/1, Pelita I/2 and Syntha. Dosage and application of fertilizers was standard, no insecticides were used. Each plot was 10 x 5 m2 with three repetitions for each variety. Hills for whitehead, deadheart and silvershoots investigation were taken from intersection of line 3, 8, 13 and 18 with line 3, 8, 13, 28, 33 and 38 (32 hills) with 7 days interval of observation. The degree of infestation was expressed in $\frac{M - m}{M} \times \frac{N - n}{N} \times 100\%$ (M = number of tillers observed; m = numbers of infected tillers; N = number of hills observed; n = number of infected hills).

b. *The effect of insecticides on borers population*

From hundreds of insecticides experiments took place from all over Java, one experiment from Cirebon (West Java) will be taken as an example. It was a trial of 8 different insecticides and the rice variety was Syntha. Measurement for each plot was 5 x 10 m2 and there were 3 repetitions for each insecticide treatment. Fertilizers application was standard. The period of investigation was January to June 1970. The percentage of borers infestation were calculated from 32 hills from each plot.

II. VEGETABLES INSECTS PESTS

1. *Insects Composition*

Component of insect pests from vegetables association have not been intensively explored. It will be interesting in the first place to reevaluate the importance of insects from this community. The survey area was Lembang (West Java), elevation 900 m. Aside from routine sampling for *Plutella* sp. and *Crosidolomia* sp. a special effort was made to evaluate the other pests from November 1972 to May 1973.

Counting of insects were done on individual crop chosen at random. Samples were taken in plastic bags for insects analysis.

2. *Insects composition and the degree of damage in relation with crop stages*

Cabbage was selected to illustrate a correlation between the development of insects composition and the degree of damage inflicted to the crop as host.

Ten cabbage were selected at random from several locations in Lembang and Pacet (West Java) at weekly interval and kept singly in plastic bags for insects analysis and assessment of damage. The sampling period was during the wet season of 1971/1972.

A more detail investigation was carried out within an area of 0.5 HA with a more controlled conditions. The area was divided into 4 plots, each was 16 x 65 m2. The cabbage variety was Orsena (Denmark). Manura was used in nursery and for protection Dithane-45 (0.2%) and Tamaron 0.1% were used. Each plot consists of approximately 1600 cabbages. Fertilizers used were urea (200 kg) and manure (9.600 kg). One plot was untreated for control and the other three were treated 0.05%, 0.10% and 0.15% Tamaron in 5 days interval. For insects counting, 160 plants were chosen at random and the count was started from 10 days after transplanting upto 65 days with an interval of 5 days.

3. *The problems of parasitism*

Little has been done to evaluate the degree of parasitism on insect pests especially insects pests of vegetables. The difficulties are mostly on the identification of the parasites. Evaluation was done by collecting materials from fields, kept in vials and wait for the emerging parasites. The percentage of parasitism was an expression of how many collected materials being parasitized. Evaluation from pupal stage of several pests during 1972 - 1973 at Lembang area produced meager data on parasitism. We knew e.g. that *Agrotis ypsilon* was parasitized by tachinid at 5% level, which means 5 out of 100 collected pipae from the field were parasitized;

C. binotalis by ichneumonids at 5% level, *P. maculipennis* by *Angitia cerophaga* upto 75%; *P. orichalcea* by ichneumonids and broconids at 10% level and *H. armigera* by ichneumonids at 5% level.

A rather intensive study on paratisims has been carried out with the population of *Plutella maculipennis* and its parasite *Angitia cerophaga*. Assessment on the degree of parasitism of *P. maculipennis* by *Angitia cerophaga* were made several times at Lembang area. First, from November 1968 upto mid 1969. Then from January 1970 upto mid 1970. Sampling were done weekly from 50 cabbages in a plot randomly selected. All stadia of *Plutella* were counted and collected. Percentage of parasitism was calculated from the emergence of *Angitia* from 50 *Plutella* pupae chosen at random.

Data of monthly temperature, humidity, rainfall and numbers of rainy days at Lembang area was obtained from the Directorate of Meteorology and Geophysics for a period from 1951 - 1960; 1968 - 1970.

RESULTS

I. RICE INSECT PEST

1. Insect Composition

From these five times of sampling and each of which within 24 hours of surveillance we have the impression that insect population from rice fields around this area was not very poor. There were more than 10 orders represented in this area (Fig. 1). Furthermore, level of population was relatively high.

2. The population trend of important rice insects

From a total of 33 observations (x 16 hills) on 1, 2, 3 and 4 months old crop, a rather rough population trend of borers was constructed. It was found that borers egg clusters were found throughout the first 3.5 months period of observation and were mostly confined on early stage crop (1 - 2 months). Concentration of egg clusters were spotted from medio February upto early March (Fig. 2). Early instar larvae were found mostly on the first 2.5 months of observation, while late instar larvae and pupae were found mostly in the last half period of observation. Egg clusters reappeared in the last weeks of rice crop season (several days before harvest). From the results of this observation it is assumed that within a single wet season there were three groups of borers population. The first group was a small initial population, the moths flight ended approximately 40 days after transplantation (however it may vary according to the start of rice cultivation in the area). Egg clusters could be spotted until the first month after transplanting (Fig. 2). The second group consisted of accumulations of several broods originated from the surrounding area and from the area itself. Eggs were found for a period of 20 days, early instar larvae for a period of 50 days and late instar larvae plus pupae for the last 30 days.

If it was considered that the wet season rice crop started late November and early December (the start of rainy season in the northern part of West Java) then it is assumed that this type of borers population trend is typical for the northern part of West Java and even part of central Java. From December to medio January, rice crop could accommodate one initial brood of borers. From medio February to medio March egg clusters and early instar larvae were dominant. Light trap catch showed (Fig. 3) that during medio February, moth catch was increasing and reached its first peak. From medio February to medio March early instar larvae were dominant, egg clusters declined. From medio April to medio May (harvest for early varieties) late instar larvae was predominant. Egg clusters were concentrated on late March, April and early May. The pattern of moth catch by light trap showed a very closely related pattern of population of the immatures. First there was an initially low level of moth catch terminated on medio February. The second and the largest moth population within the season started in medio March and after a slight drop in late March it was continuously high until medio April. The third group of moth flights appeared in early May.

Other important rice insects have not been inspected thouroughly. However, from the light trap catch (Fig. 3) we got and impression that several rice insects have a rather similar pattern of population development while monitored from this trap. These are *Nilaparvata* sp., *Nephotettix* sp. and *Inazuma* sp. Rice bugs (*Leptocorisa* and *Podops*) appeared several times but they were rather far-off from the borers pattern op population.

3. Seasonal pattern of infestation

Borers infestation reached its highest peak at approximately 50 days after planting. It may represent the second large population of brood mixture originated from the initial small population. The second highest infestation occured several days before harvest (126 days after planting date). This phenomenon may represent the last brood of borers population within the season. Between the highest infestation at the early season and the second high infestation at late season,

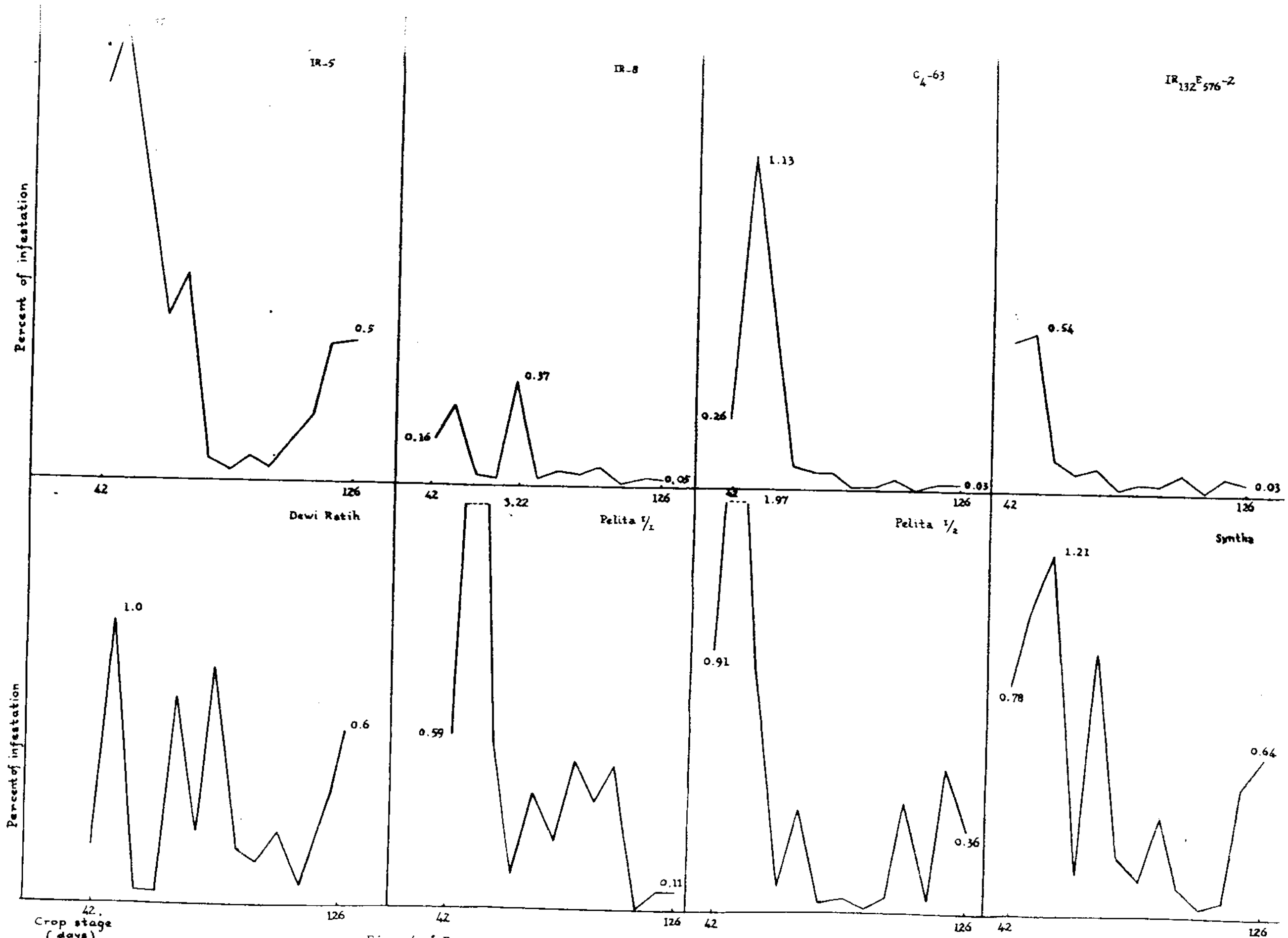

Fig. 4. Pattern of borers infestation on several rice varieties.
(Bekasi, West Java, 1972)

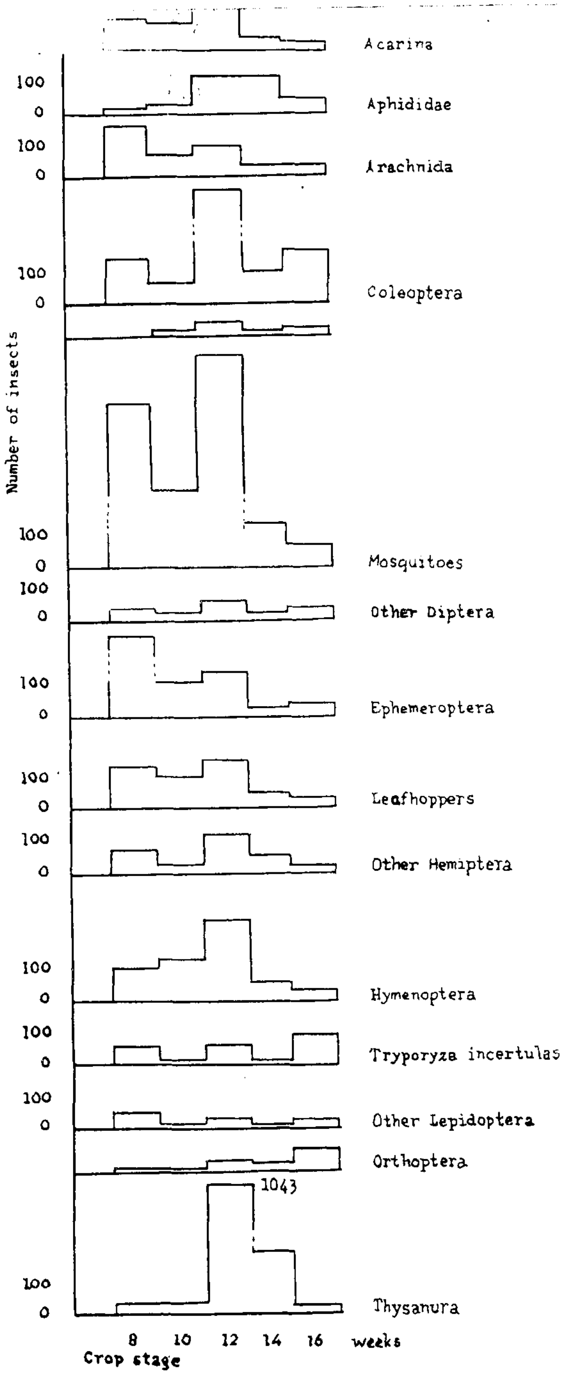

Fig. 1. Insects and arthropods from rice crop (sweeping net and light trap) Gempolsari (West Java) July - November 1972.

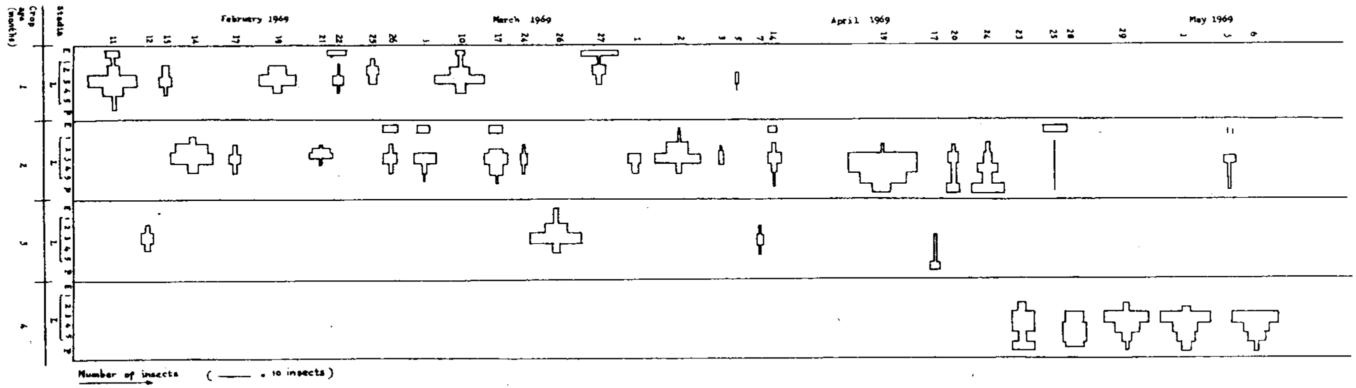

Fig. 2. Composition of immatures borers randomly sampled (16 hills daily) at Sang Hyang Seri Exp. Sta (West Java), February - May 1969.
E = egg clusters
L = larvae (1 - 5 instars)
P = pupae

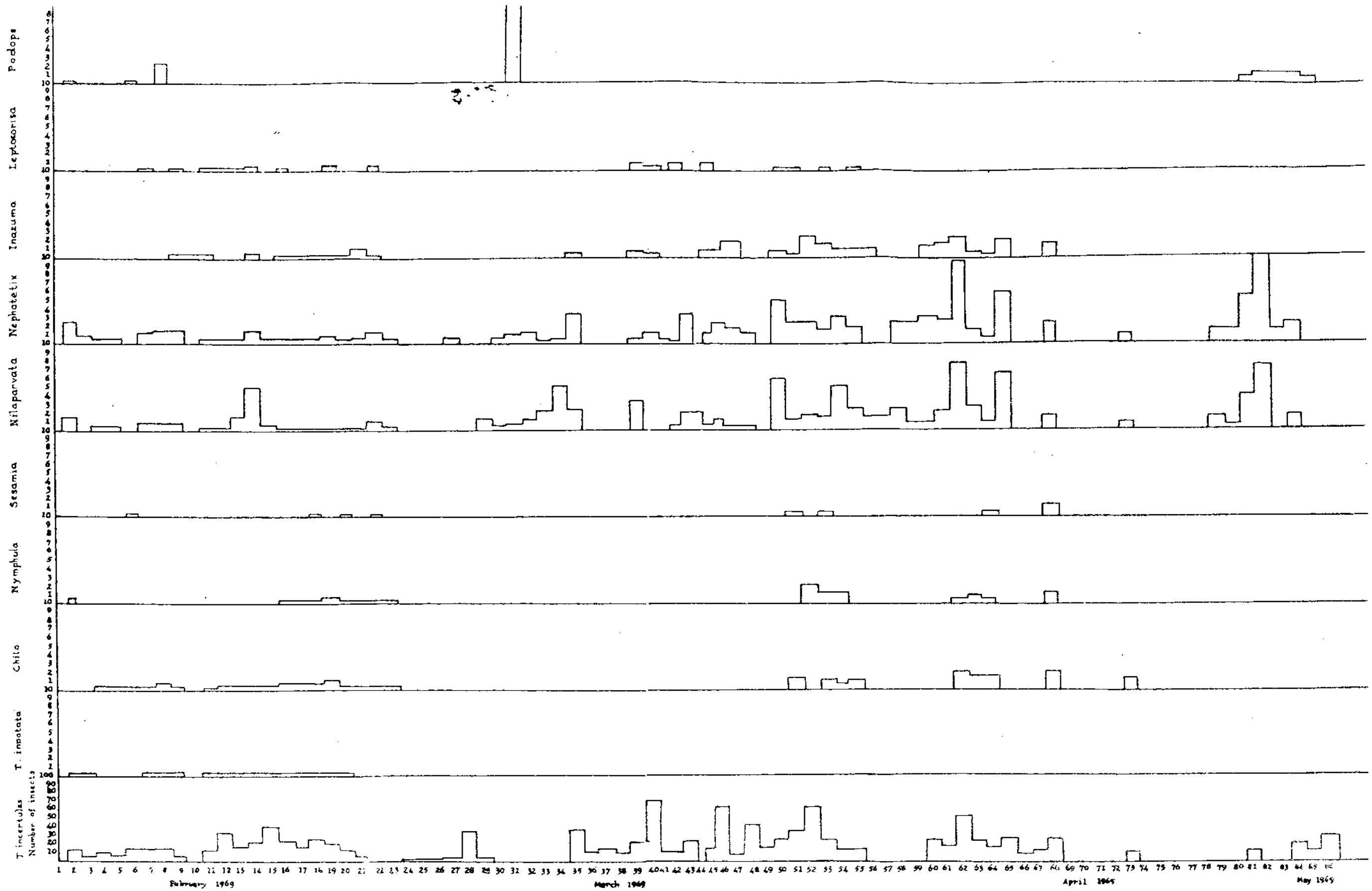

Fig. 3. Light Trap Catch from Sang Hyang Seri Exp. Station, February - May, 1969.

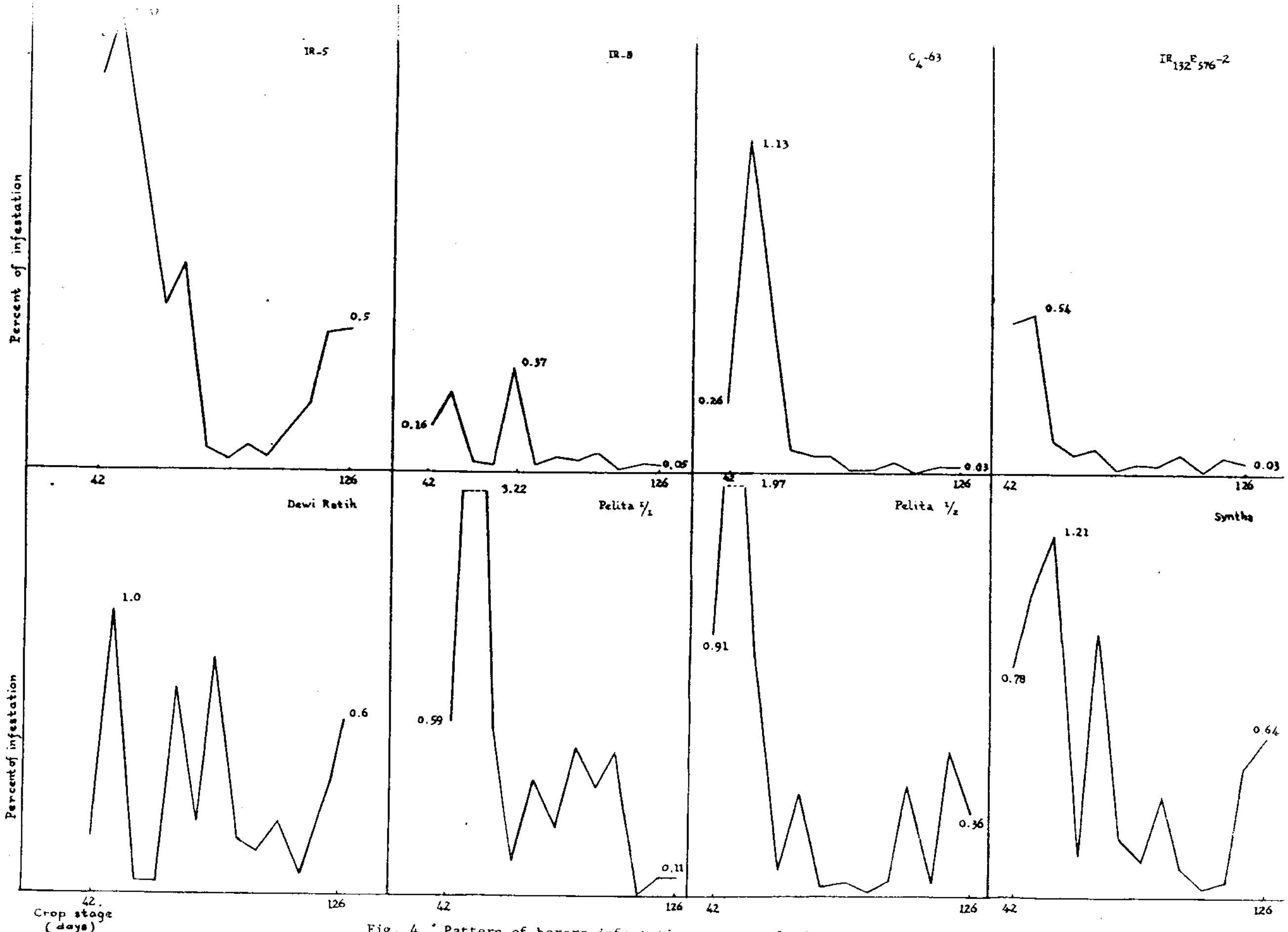

Fig. 4. Pattern of borers infestation on several rice varieties.
(Bekasi, West Java, 1972)

two or three ever decreasing peaks of infestation could occur between 80 - 100 days old crop, the infestation were relativelu low (Fig. 4). Counting of immatures from tillers showed that the high population level were found around 60 and 120 days ald crop (Fig. 5). The pattern of two peaks, one at the early crop stage and the second at the late crop season is similar to the infestation pattern.

Now come the question of whether varietal difference had any effect on borers population trend. From the result of this investigation and if the degree of infestation as well as the population of the immature insects were taken into consideration, it appeared that the pattern of population trend from various varieties was similar (Fig. 4). The difference was on the level of susceptibility toward the insect attack as seen from the level of infestation and also from the content of the immatures. When this infestation level was compared or matched with the light trap catch (Fig. 6), then there was a similar trend such as reported previously.

Results of the observation from the same location told us something about the gallmidge population pattern. It was apparent that there was a rather significant population level infected approximately 50 days old rice crop (Fig. 7). The level decreased on 60 days old crop and increased to a relatively very high population level around 90 days and the level dropped down to very low level. Furthermore the infestation trend of gallmidge on 8 different varieties was similar, the differences was only on the level of infestation.

It was interesting to see from the results of the investigation that the trend of borers infestation was similar for the treated and the untreated crop; and again the difference was only on the level of infestation (Fig. 8).

4. *The general population trend of borers*

Speaking of population trend based on insects infestation and also from immatures and moths catch, it may hereby be concluded that within a certain crop season there was only one trend of borers population that was valid within a relatively large planting area although there were several rice varieties and also subjected to the application of several pesticides. There was an initial borers brood upto 30 - 40 days old crop followed by a second large cumulative brood which is low at 70 days old crop. Finally there is a last group of borers population which will go through a fallow period and which be the initial brood for the next season and reached its peak around 100 days old crop. Moths catch from this area was also similar to the catch pattern from places previously mentioned.

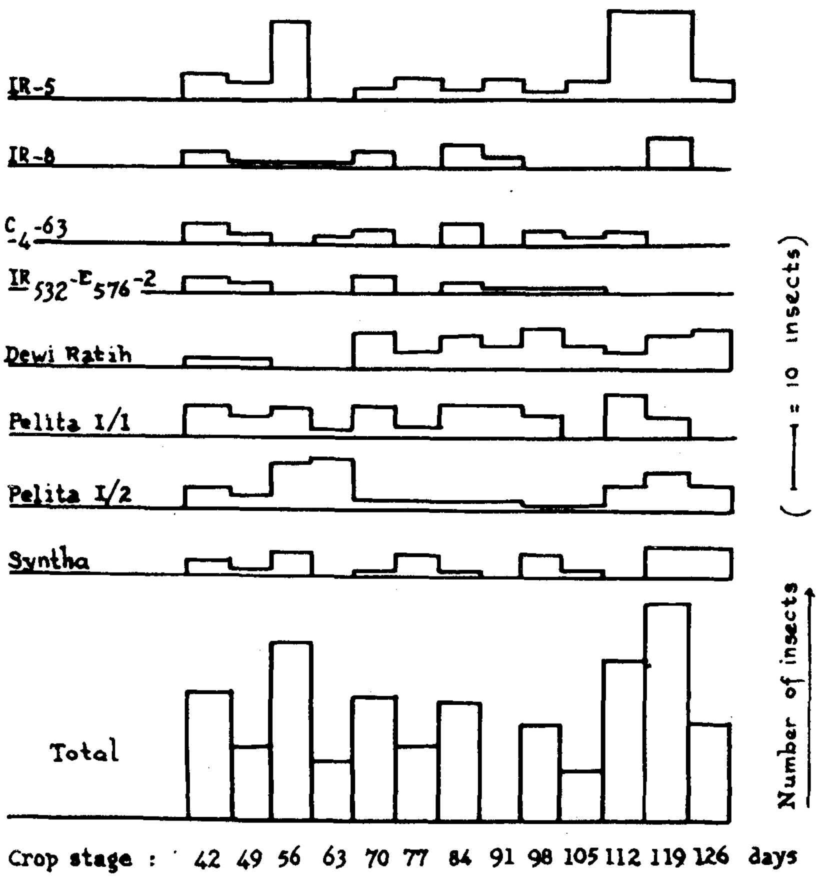

Fig. 5. Immatures borers on 8 different rice varieties.
(Bekasi, West Java, 1972)

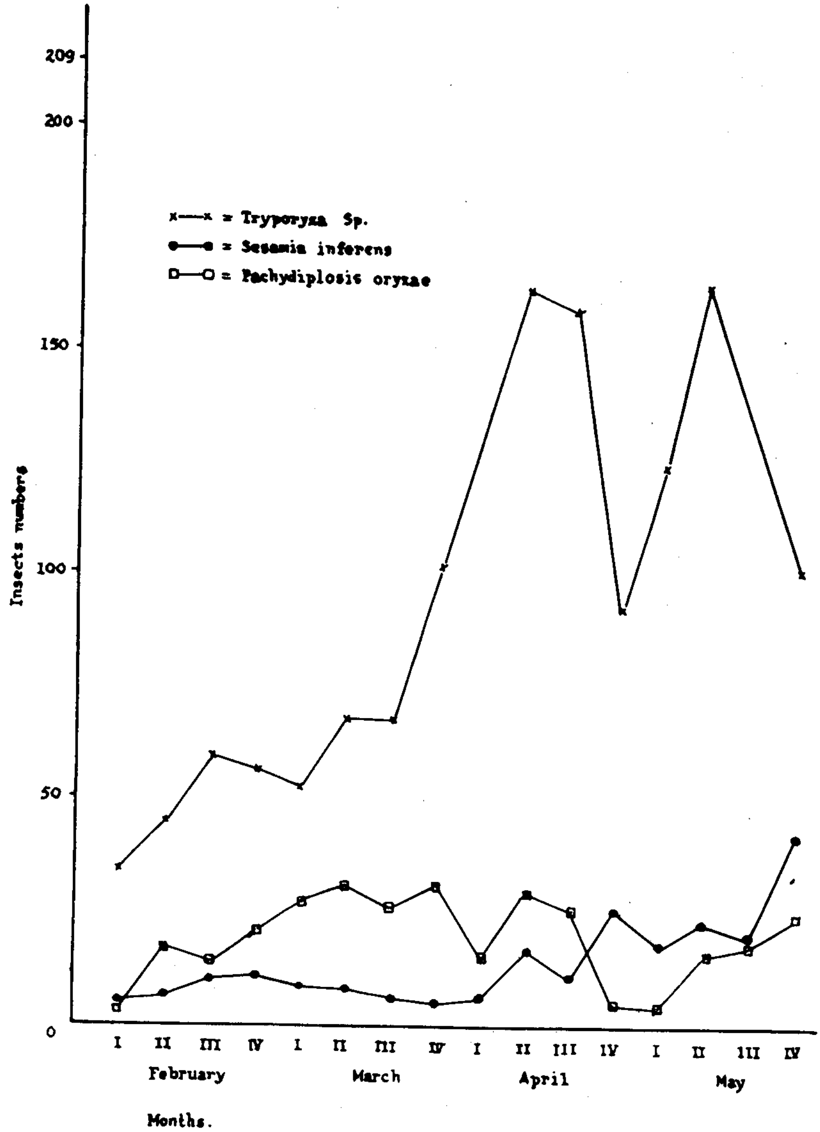

Fig. 6. Light trap catch from the experimental area. (Bekasi, West Java, 1972)

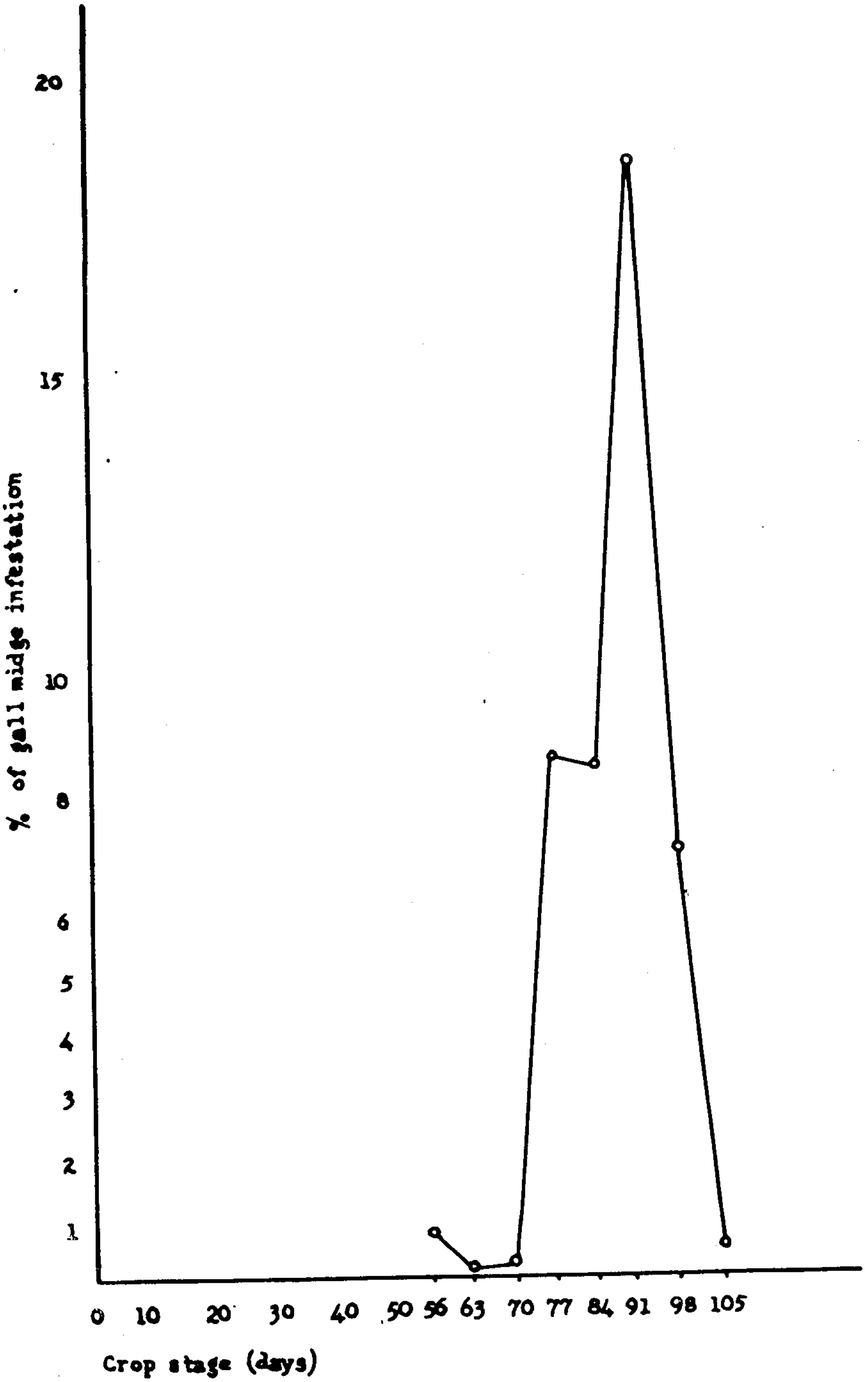

Fig. 7. Pattern of gallmidge infestation.
(Bekasi, West Java, 1972)

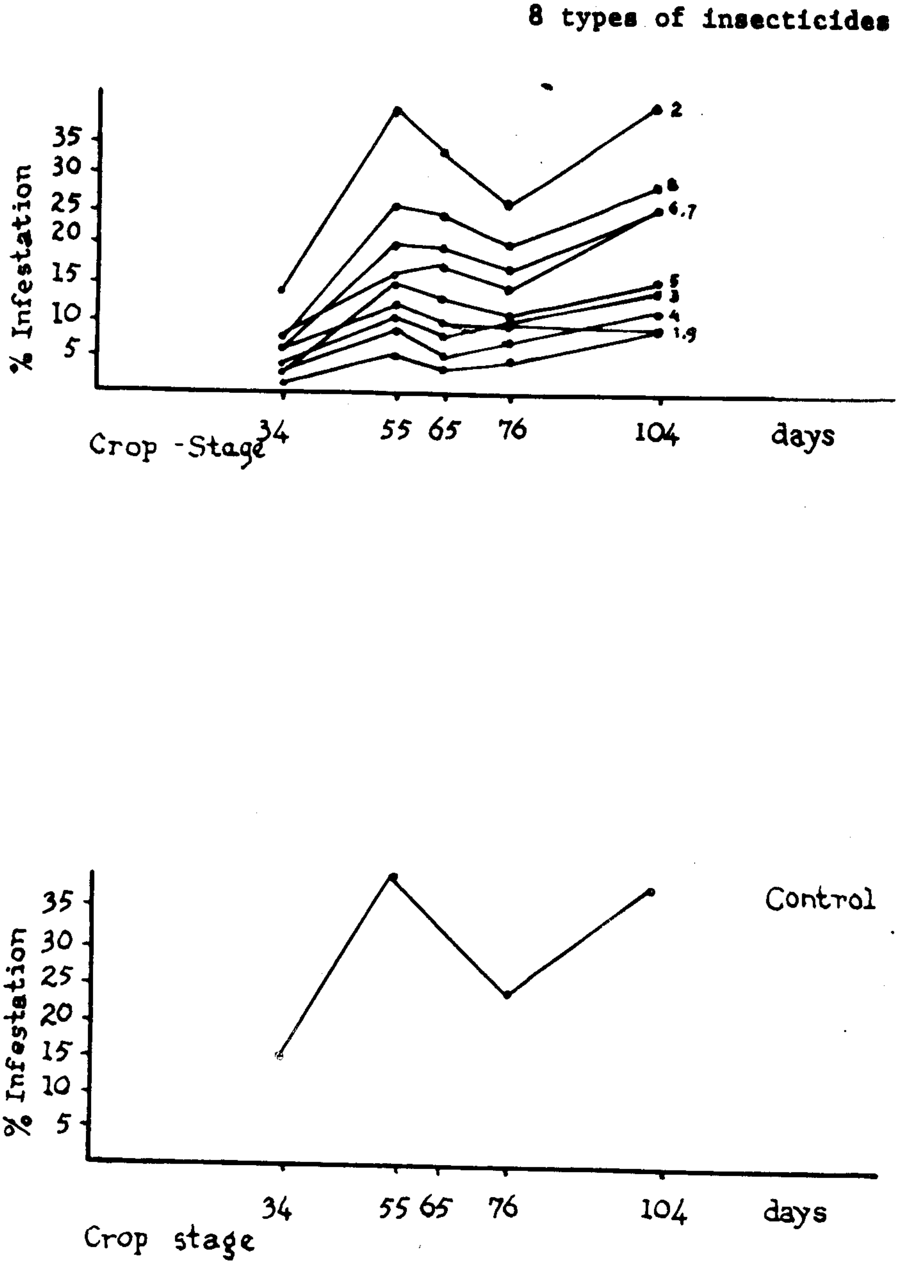

Fig. 8. Pattern of borers infestation on Syntha sprayed by 8 different insecticides.
(Kapetakan, Cirebon, West Java, wet season 1970)

5. *Notes on parasites*

There was no clear picture on the general level on rice pest parasitism throughout Java. Samples from several places at West Java revealed that the level of borers egg parasitism were under 40%. In addition, several borers larvae were also paratisized by nematodes (*Amphimermis* sp.). Gallmidge was mostly parasitized by *Platygaster oryzae.* which averaged 70%. Few eupelmids were also found in gallmidge.

II. *VEGETABLES INSECTS PESTS*

1. *Insect Components*

The following results illustrate the composition of insect pests from vegetables and ranked in the order of importance.

Cabbage

1. *Plutella maculipennis* Zell
2. *Crocidolomia binotalis* Zell
3. Aphids
4. *Agrotis ypsilon* (Hufnagel)
5. *Prodenia littura* (Fabricius)
6. *Plusia orichalcea* Fabricius
7. *Heliothis armigera* (Hurbner)
8. *Hellula undalis* Fabricius
9. *Laphygma exigua* (Hurbner)
10. *Leucania unipunctata* (Haworth)
11. *Plusia chalsites* (Espen)

Tomatoes

1. *Heliothis armigera* Hurbner
2. *Prodenia littura* Fabr.
3. *Plusia orichalcea* Fabr.
4. *Agrotis ypsilon* (Hufnagel)

Potatoes

1. *Phthorimaea opercullea* Zeller
2. *Elimaea chloris* de M
3. *Heliothis armigera* (Hurbner)
4. *Epilachna sparsa* Hrbst
5. *Myzus persicae*
6. *Plusia calchytes* (Esper)
7. *Lygus solani* chu
8. *Nezara viridula* L
9. *Anomala varidis* F
10. *Gryllotalpa africana* Pal

Condition of the field (1972 - 1973)

Mixed crop, several different vegetables were cultivated closely together. Insecticides used by crop growers were Tamaron, Bayrucyl, Antracol, Prolan an Antracol (for tomatoes), fungicide: Dithene - 45. Cabbage was treated with Tamaron, Bayrucyl and Endrine. Information on pesticides application came from the growers. (Some of the pesticides mentioned has not received appoval for release by Indonesia Pesticides Commision).

2. *Insect composition and the degree of damage in relation with crop stages*

In a period of 16 weeks sampling (1 week interval) it was apparent that there were two predominant insects from cabbage: *Plutella maculipennis* and *Crocidolomia binotalis*. After the insects were collected, they were groupped according to the instars. It was possible therefore to construct a kind of population table from several of the vegetables insects. It was apparent that there were two broods of pests within one crop season (Fig. 9). To start with *Plutella* was the first pest appeared on cabbage (*Agrotis* also, but in a Smaller scale). The first generation terminated on the 9th weeks old cabbage, changes from larval composition to pupal started on the 10th weeks old crop. Soon the population multiplied approximately 10 times and it was the second generation. *C. binotalis* appeared later, the group of the 1st instars appeared, already in larger number then *Plutella*, at the 3rd weeks old crop. The second generation terminated later then *Plutella*, but the size of the population was almost similar.

The second point of interest was to see any possible relationship between the development of various insects population, the level of leaves damage and the percentage of infected leaves. Assessment of leaves surface damage were made by transfering the outline of leaves area into cheese paper, including the damage portion. The damage portion were cut out and weight. Percent damage was expressed as the weight of damage portion devided by the intact portion. The overall results as it is presented in Fig. 10, showed the succesive appearance and development of insect pests on cabbage. The optimal number of infected or damage of leaves was on 11 weeks old cabbage. It happened simultaneously with the population increase of the 3rd broods of *Plutella maculipennis* and *C. binotalis* and other insects. Speaking of damage, there were more or less 4 peaks within a season; 3, 4, 12 and 16 weeks old cabbage.

Tomatoes

From intensive pbservations started on November 1972 and ended on May 1973 it was concluded that the insects composition of tomatoes was very much influenced by the surrounding crops. Sampling for each location were done by selecting at random 5 rows of crop. Insects were collected, damage fruits were counted and also total fruits within a row. It was noted that tomatoes located in a heterogenous environment (potatoes, corn, cabbage, sweet potatoes, carrot etc.) were attacked by *Heliothis armigera, P. littura* and *Plusia orichalcea* at a relatively high population level. If only surrounded by one or two types of crops, most likely it was found only *Heliothis armigera* and in a lower population level. Fruit damage were due mostly to *H. armigera* infestation, both in number of fruit as well as on degree of damage.

3. The problems of parasitism

From the available data any correlation between the population level of *Plutella* as host and *Angitia* as parasite and also with the climatic factors was interpreted (Fig. 11).

The population level of *Plutella* in October and November 1968 averaged 50 larvae per crop. The damage due to this insect was high at that time and it was assumed as an outbreak. No cabbage escaped from total damage. Most of the growers expected to overcome the problem by using several organophosphates insecticides. The population level of *Angitia* parasitism was low on both October and November 1968 (Fig. 11). There was no outbreak in 1969 and 1970.

Looking at the population of *Plutella* and *Angitia* monthly within those 3 years of investigation it was found out that the level of parasitism in general was low in August, September and October. On the other hand the population of *Plutella* was high. The population level of *Angitia* increased in October, December, January and February and declined gradudlly to the lower level in August - September (Fig. 11). While the population of *Plutella* was low in March, April, May and June, the population level of *Angitia* was relatively high. Inspection of parasitism plot by plot revealed that from all the collected samples the percentage of parasitism was lower then 60%. Looking at the situation of several climatic factors it seems that rainfall could have any effect on this population problem. No statistical analysis were made however on the relationships between the insects population and the rainfall. It seems, that aside from pesticides used regularly by the growers (without which it will be a total crop damage) rain-

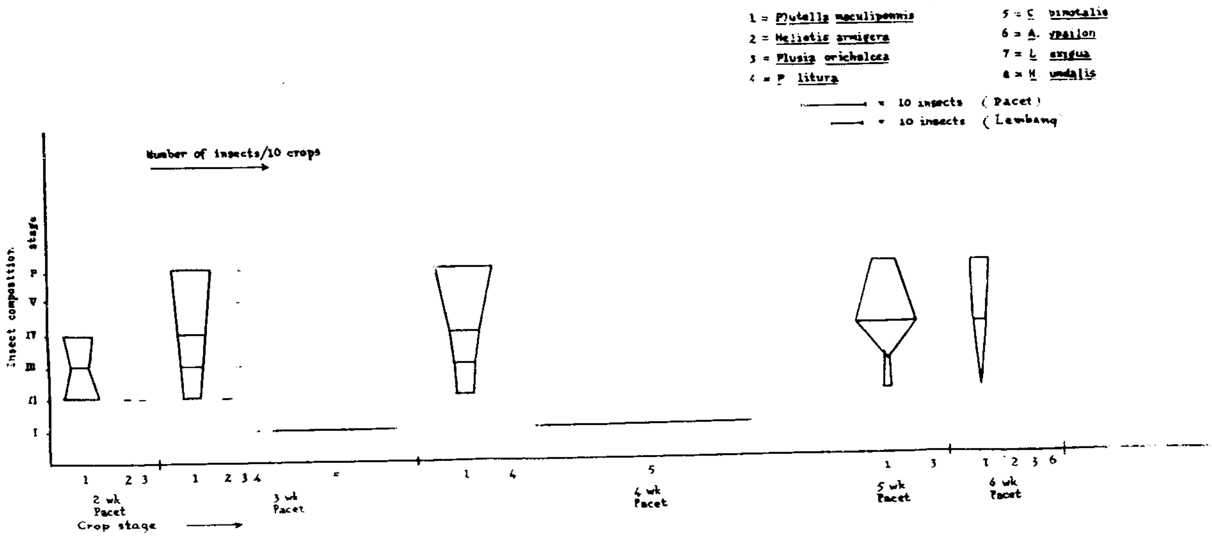

Fig. 9 (1) The development of various insects population feeding on cabbage
(Pacet, Lembang, West Java, 1973)

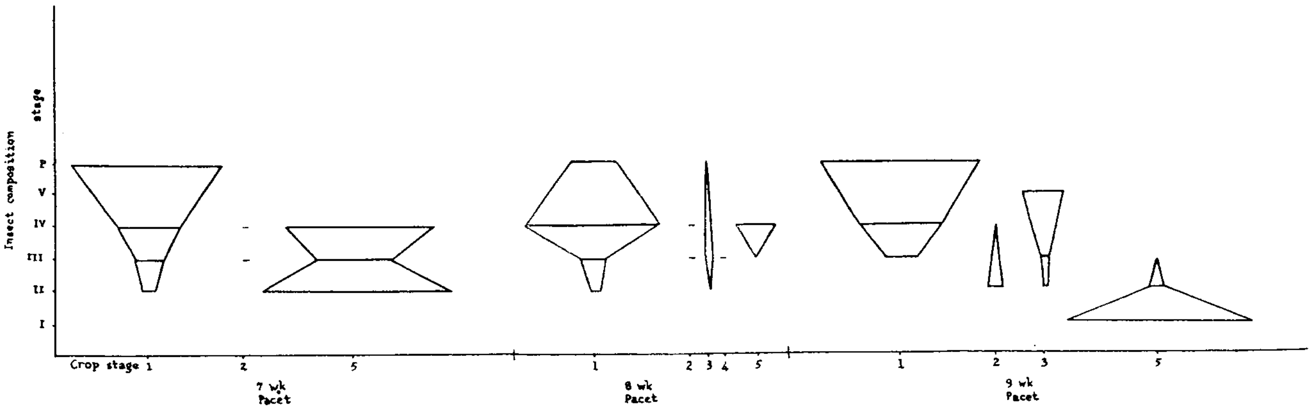

Fig. 9 (2). The development of various insects population feeding on cabbage
(Pacet, Lembang, West Java, 1973)

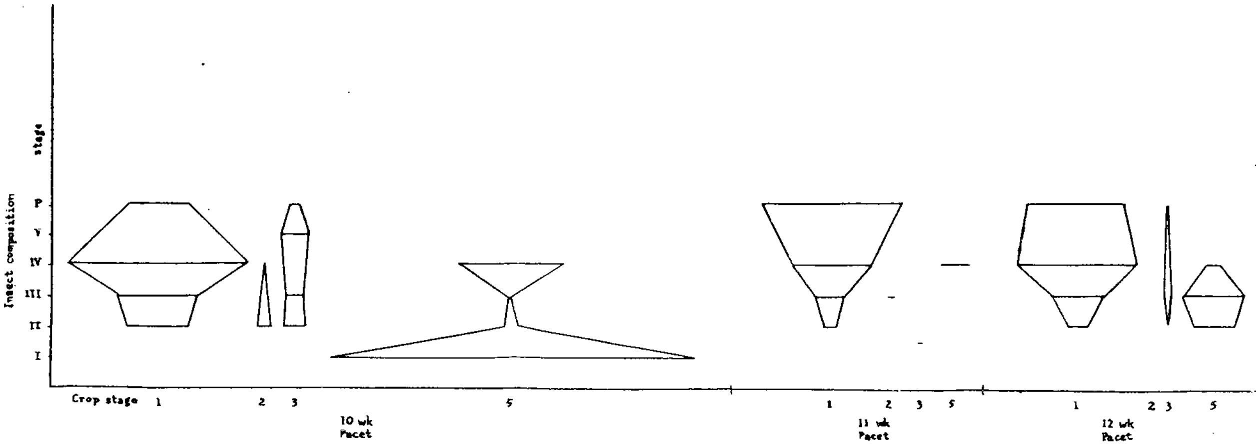

Fig. 9 (3). The development of various insects population feeding on cabbage (Pacet, Lembang, West Java, 1973)

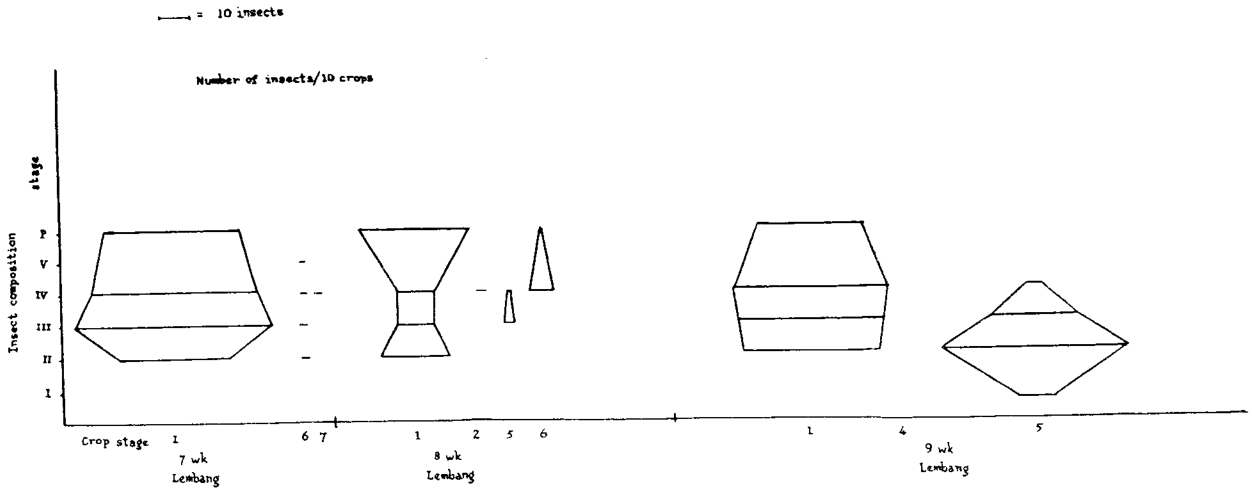

Fig. 9 (4). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

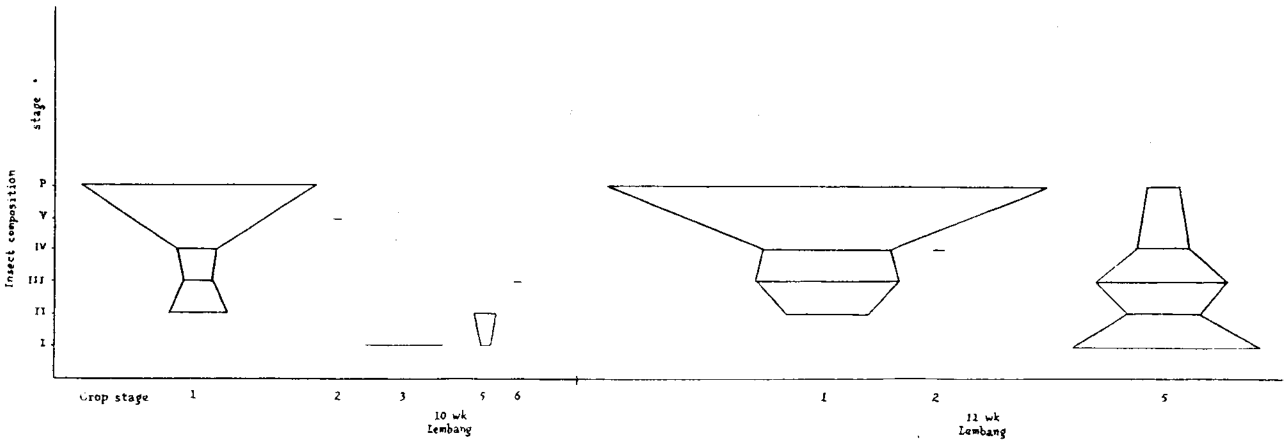

Fig. 9 (5). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

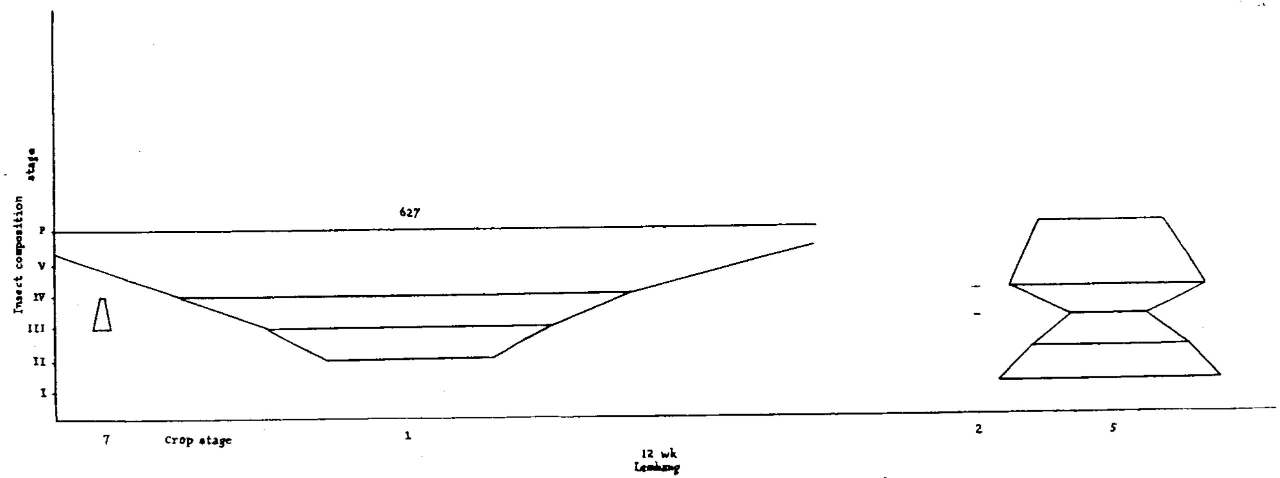

Fig. 9 (6). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

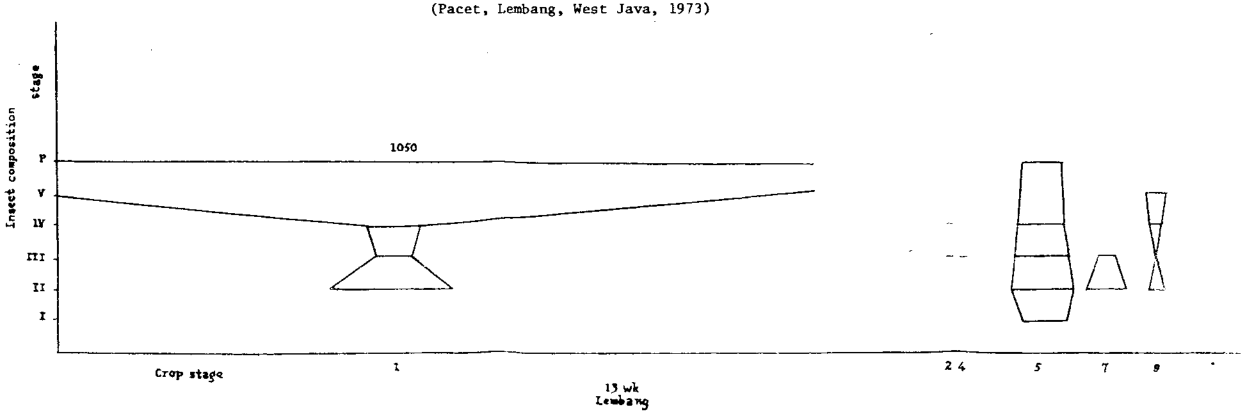

Fig. 9 (7). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

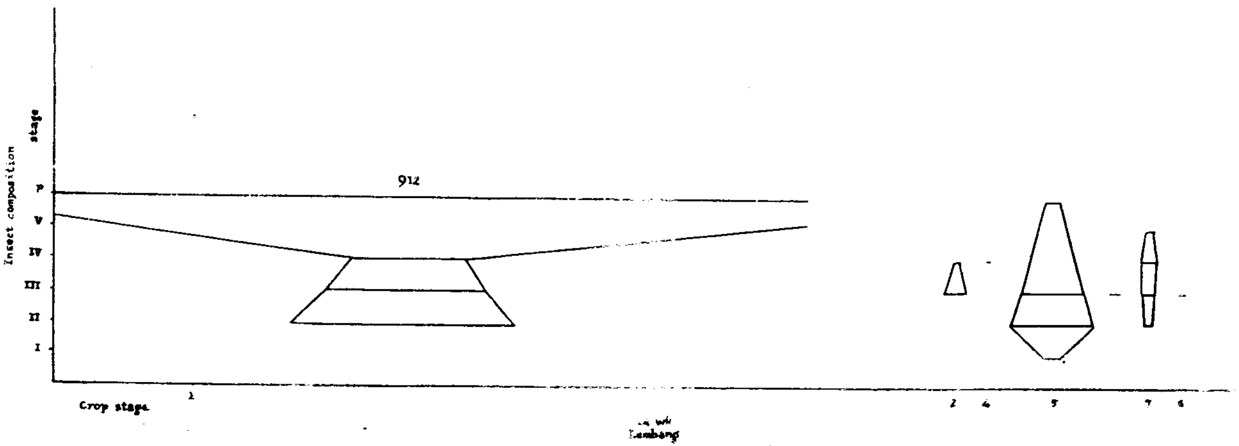

Fig. 9 (8). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

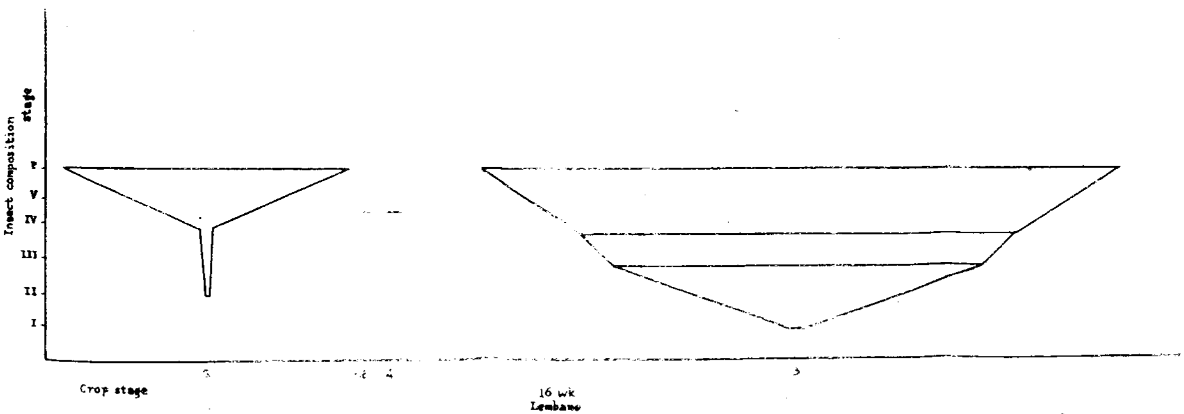

Fig. 9 (9). The development of various insects population feedings on cabbage (Pacet, Lembang, West Java, 1973)

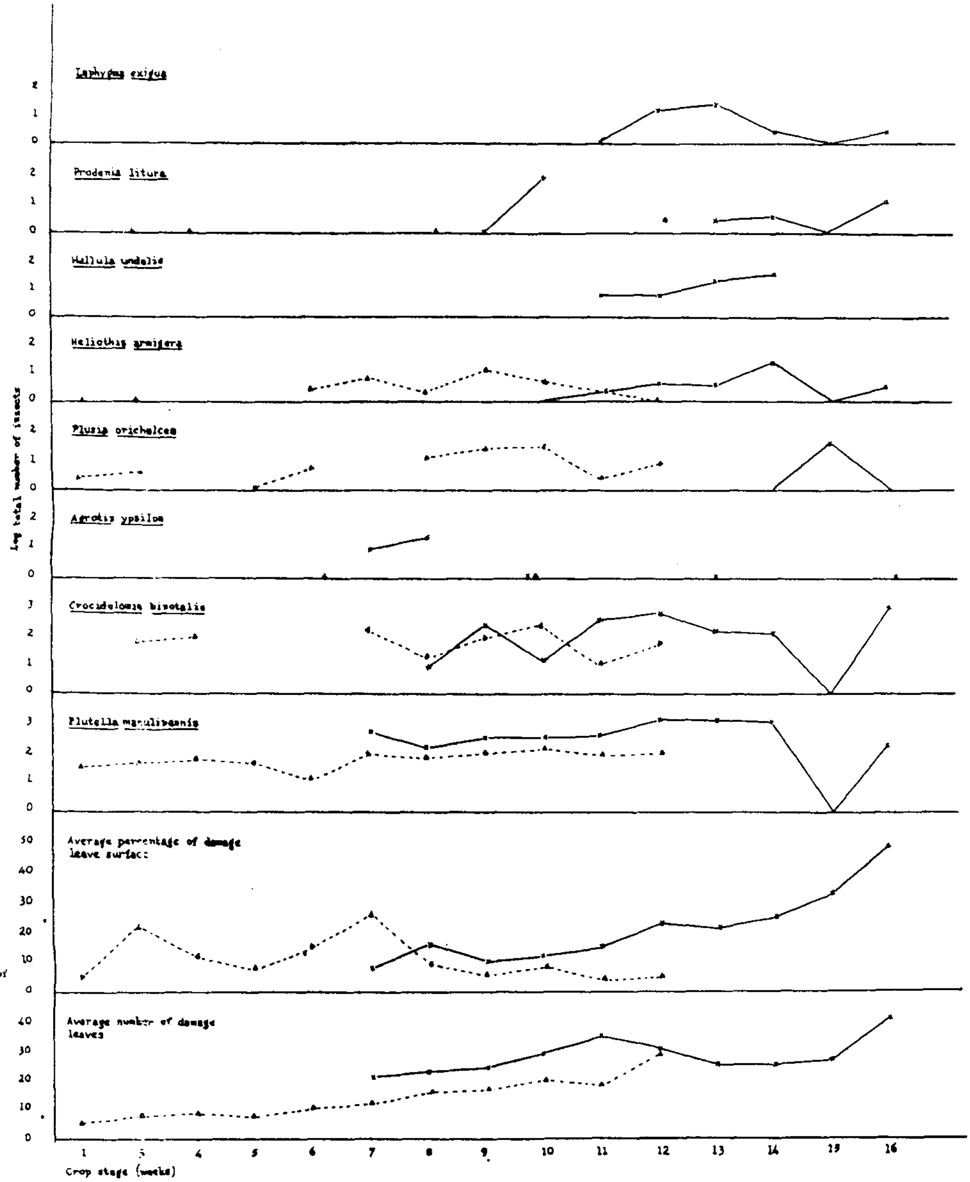

Fig. 10. The development of various insects population Cabbage and the damage on the crop (Pacet, Lembang, West Java, 1972)

parasite *Angitia cerophaga* and the possible effects
of climatic factors.
(Lembang, West Java)

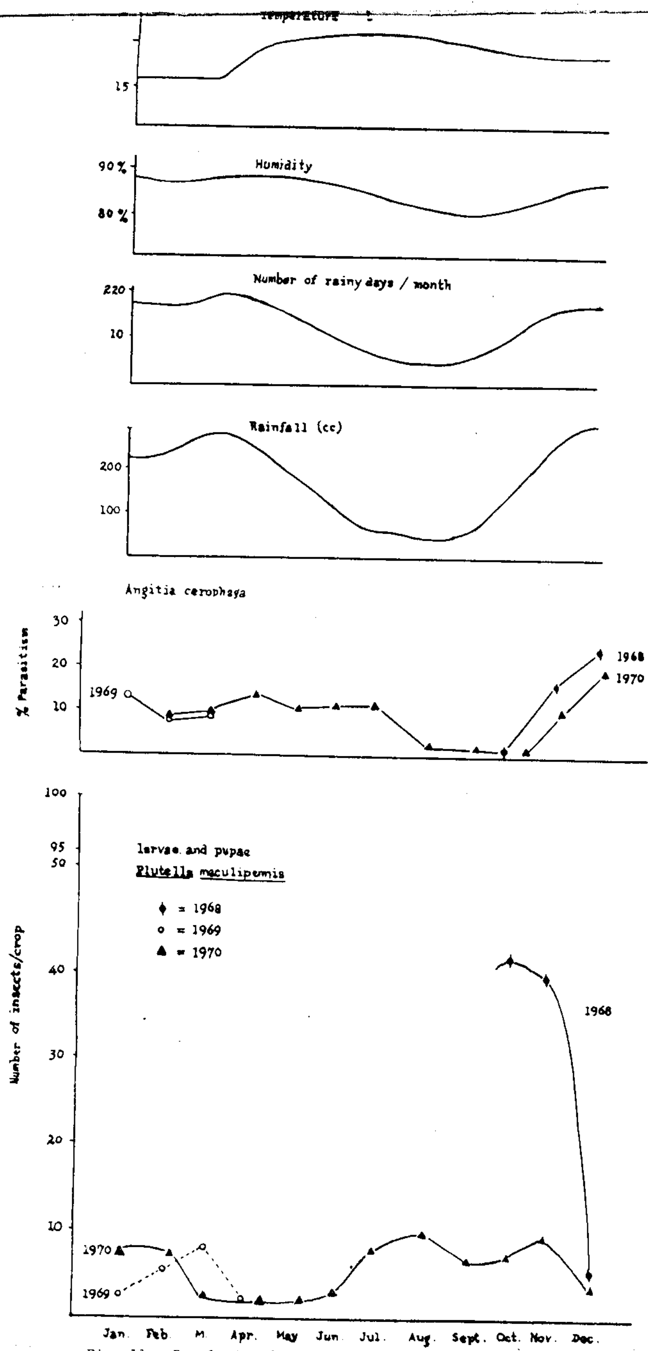

Fig. 11. Population fluctuations of *P. maculippenis* and its parasite *Angitia cerophaga* and the possible effects of climatic factors.
(Lembang, West Java)

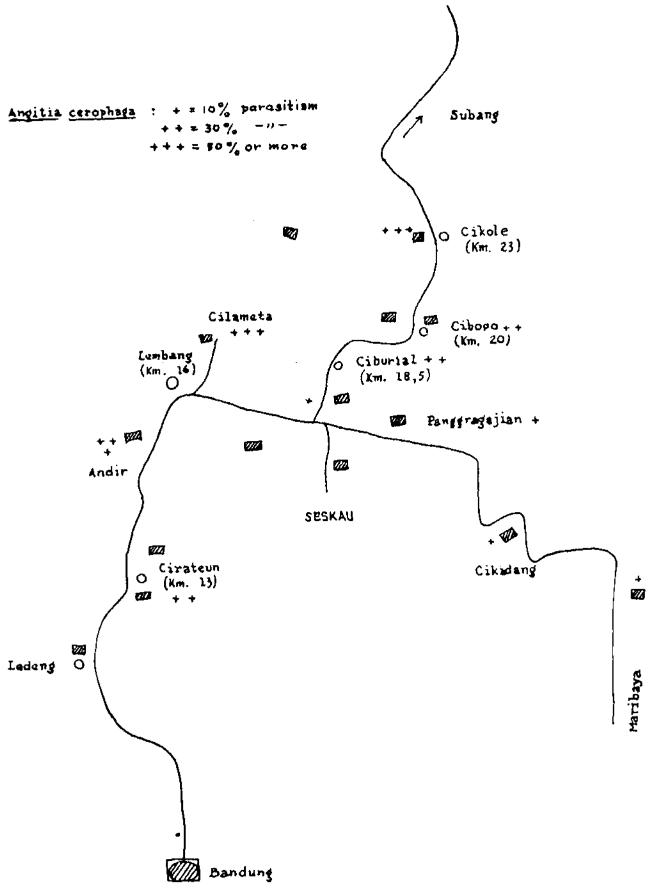

Fig. 12. Distribution of *Angitia cerophaga* as expressed by the level of parasitism from several location at Lembang

fall may be one of the important factors contributed to the reduction of *Plutella* population.

Another interesting point of this parasitic relationships was the problem of *Angitia* distribution. Even within this relatively small area as Lembang the density of *Angitia* was not evenly distributed (Fig. 12). Differences of the surrounding vegetation may have contributed to uneven parasitic distribution.

CONCLUDING REMARK

After going through the ecological as well a bit of biological information of important pests, it is realized that further detail and intensive exploration are still necessary.

The most important step however is to choose the proper direction on investigation in relation with the urgent need of pests control or pests management in Indonesia. Limited fund is one of the reasons why research should be directed into a certain goal. Ideally there should be very extensive and intensive research on agricultural insects such as reviewed by Torii on borers from Japan (Torii, 1971).

At this moment however, bionomics study such as on rice borers and other agricultural pests from Serawak (Rothschild, 1971) should be implemented for a direct support of crop protection in Indonesia. Such an attempt has been started here, especially by Soehardjan with emphasis on the construction of rice borers population table (Soehardjan, 1973). Insecticidal screening on rice pests had been tremendous and these were always expected to be able to support any control program.

While from one investigation it was found out that despite the used of several pesticides (several years back in a rather large amount) the number of arthropods components from the rice field are still significant from the ecological point of view. These components belongs to the hosts, parasites and predator group. Birds as well as amphibians and reptiles were present in significant number.

It is never too late therefore to start a new strategy for rice pests control, as small as possible effecting the community.

From the population side, it was found out a general population trend of rice borers within a crop season which covered a large area. Despite small variation due to varietal differences and pesticides application, this population trend could be valid for a large area e.g. the northern part on West Java.

Models of population trend for other rice pests from other areas should be made and these models will be very usefull for control decision.

Second to the rice pests problems, the vegetable pests began to get more attention. The last extensive work on this pests group has been on *Plutella maculipennis* (Vos, 1963) in relation with the biological control effort.

Our group started to work on these vegetable pests in 1967. After adapting the autecological approach for sometime, we realized at present that such a community study approach (Weir, 1973) will be more appropriate.

From cabbage for instance it is not only *Plutella* contributed to crop damage (and lost), but *Crocidolomia, Agrotis, Plusia* and others did the same and it looked that the pattern of damage coincide with the successive development of the pests population on the crop.

Vegetables cultivation has become a good sector for business investation which means more fertilizers and pesticides to the area. There should be serious attention on control attempt, especially on the residual side.

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