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A BIOLOGICAL STUDY OF *MYZUS PERSICAE* (SULZER) REARED ON DIFFERENT HOST PLANTS[1]

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The life history of Myzus persicae **(Sulzer) was studied on pechay, Chinese cabbage, mustard, lettuce and eggplant under greenhouse conditions in August to October, 1976. Individual aphids were confined in clip-on cages on the leaves of potted host plants. It was observed that nymphal development was prolonged on lettuce and eggplant. High mortality during this period was also observed on aphids reared on these host plants. With pechay, Chinese cabbage and mustard, durations of the first instar nymphs were 1.20, 1.15 and 1.25 days, respectively. The second instar period was 1.33, 1.27 and 1.22 days, respectively. The third instar period was 1.52, 1.46 and 1.56 days. Duratioons of the fourth nymphal instar period were 2.17, 2.00 and 1.75 days. Aphids reared on Chinese cabbage produced a mean of 69.20 nymphs (highest) while those on mustard 54.31 nymphs (lowest). Aphids on pechay produced a mean of 64.58 nymphs. The mean life span of the aphids on pechay, mustard and Chinese cabbage were: 18.82, 18.87 and 19.46, respectively. The different nymphal stages and adult apterous form are described and illustrated.**

The green peach aphid, *Myzus persicae* (Sulzer), is a pest of world-wide importance. It is highly polyphagous attacking almost all sorts fo green vegetation. It has been recorded on 321 species belonging to 67 natural orders of plants from different parts of the world (Patch, 1938). Aside from the direct damage it causes such as foliar and shoot distortion, it is able to transmit over 100 virus diseases of plants on about 30 different families including many major crops such as beans, sugar beet, sugarcane, brassicas, potatoes, tobacco and citrus (Kennedy *et. al.*, 1962).

In the Philippines, it has been reported on *Brassica* spp., cucurbitaceous and solanaceous crops, radish, citrus and tobacco (Calilung, 1969). Calora and Pescador (1967) reported that it is one of the important pests attacking vegetables particularly in the highlands. Baltazar (1963) observed it to infest tobacco plants grown in partial shade in Tubao, La Union.

Calilung (1967) reported two forms of *M. persicae*, the apterous or wingless form and the alate or winged form. She described the wingless form as having a greenish body with occasional delicate pinkish tinge. In the winged form, the head and thorax are black while the abdomen is pale yellowish green. Dark patches are prominent on the dorsal and lateral parts of the abdomen.

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One of the earliest papers dealing with the life history of the green peach aphid was by Weed (1927) in Wisconsin, in which he gave data on apterous metamorphosis and reproduction under controlled conditions of varying temperatures and relative humidity. His data indicated a mean gestation period of 22 hours. The average longevity was 19.87 days, and the period of reproduction ranged from 12 to 20 days with a mean of 16 days. A mean of 54.92 (range 40 to 75) youngs were produced by apterous females in his experiments. He reported a mean reproduction rate of 3.72 youngs per day per female.

Lal (1950) reported that both the apterous and alate forms of *M. persicae* have been observed to pass through four nymphal instars during the course of development.

Varous aspects of the life history of the green peach aphid have also been studied by Barlow (1962) and De Loach (1074). Barlow observed the lower threshold for growth as below 5°C. Between 5°C and 25°C, the populations showed capacity for increase while 25°C and 30°C were the upper threshold. De Loach observed the greatest rate between 5°C and 15°C and the maximum finite rate of increase at 25°C which is 1.32 times.

M. persicae is holocyclic with sexual reproduction in the temperate regions. Blackman (1974) states that although anholocycly is widespread in warm countries there are indications that the potential for sexual reproduction may be retained throughout the whole range of the species. This may support the findings of Corpus-Raros *et al* (1972) who reported the occurrence of male of *M. persicae* at considerably high altitude in the Philippines, a warm climate country. Aside from this reported occurrence of male of *M. persicae* no concrete evidence of sexual reproduction has been discovered. Apparently, reproduction of this aphid in the Philippines is solely by parthenogenesis both in the highlands and in the lowlands.

This study was undertaken to obtain indormation regarding the biology of *M. persicae* in the Philippines with emphasis on its developmental rate, fecundity, longevity and reproduction on five different host plants. All experiments were conducted in the Department of Entomology, U.P. at Los Banos under greenhouse conditions where temperature ranged from 23°C to 43°C during August to October, 1976.

MATERIALS AND METHODS

All individuals of *M. persicae* used in this study were derived from a single aptera collected from pechay (*Brassica chinensis*) near the Entomology greenhouse. Stock colonies were maintained on caged pechay plants planted in clay pots and kept inside the greenhouse. Stock colonies were maintained on caged pechay plants planted in clay pots and kept inside the greenhouse. All plants were grown individually in clay pots 150 cm in diameter containing garden soil. Complete fertilizer mixed with water was applied weekly to the plants.

Small clip-on cages (15 mm in diameter x 10 mm deep) were specifically used to restrict the aphids to a circular section of leaf 15 mm wide. These cages were made from cellulose nitrate specimen vials, a material known to be non-toxic to aphids.

In all cases, the aphids were handled by using a camel's hair brush with its tip slightly moistened with water. Injuries to aphids especially while they were probing were avoided by gently touching them off first with the tip of the brush to induce movement before they were picked-up. Picking up was done by placing the pointed tip of the brush under the aphid's head and letting it walk over the bristles. The brush then placed near the leaf and the aphid was left to walk and transfer itself on the leaf. The aphid was then confined by a clip-on cage.

Five species of plants, pechay, Chinese cabbage (*Brassica pekinensis* var. Tropicana), mustard (*Brassica integrifolia*), lettuce (*Lactuca sativa* var. Slobolt) and eggplant (*Solanum melongena* var. Dingras) were used in the experiment. All of these plants are known hosts of *M. persicae* and is included in the list reported by Calilung 91969). Except for lettuce and eggplant, the present investigator have encountered *M. persicae* in the other host plants quite commonly.

A single fourth-instar aphid nymph was placed on each host plant and confined by a clip-on cage. Observations were started after four days when all of the aphids were already reproducing. All but one newly born aphid was removed from each of the plants. Records were made on the remaining nymphs for moulting, maturation, reproduction and death. All nymphs produced were removed from the cages after recording their numbers. The adult aphids were allowed to reproduce and were kept inside the cages until they die.

An undetermined number of apterous adults were allowed to reproduce on pechay to obtain samples of the different instars to be used as basis for descriptions and measurements. Samples of first-instar nymphs were collected as soon as they were born. The remaining nymphs were confined in groups with clip-on cages after removing all the mother aphids. They were then allowed to moult and were periodically sampled for the different instars. Ten samples of each instar were obtained and were mounted on slide in Canada Balsam. A compound microscope was used in examining the specimens. Measurements were expressed in millimeters using a calibrated ocular micrometer. All drawings of the different life stages were based on selected slides taken from those used in measurements and descriptions.

RESULTS AND DISCUSSION

Life History Studies.

Duration of instars. The mean duration of the various nymphal instars (e.g. first, second, third and fourth) as reared on the different host plants are shown in Table I. In the case of the first nymphal instar, the shortest

TABLE 1. **Mean duration in days of the different life stages of** Myzus persicae **Sulzer) (Aphididae, Homoptera) reared on five species of plants under greenhouse conditions, August to October, 1976.**

	M O S T S				
	PECHAY	CHINESE CABBAGE	MUSTARD	EGGPLANT	LETTUCE
Life Stages					
Nymphal Instar	6.29± 0.77	5.73± 0.70	5.81± 0.65	7.00±0.57	6.75±0.50
First Instar	1.20± 0.41	1.15± 0.36	1.25± 0.44	1.29±0.46	1.26±0.45
Second Instar	1.33± 0.48	1.27± 0.46	1.22± 0.42	1.38±0.50	1.40±0.51
Third Instar	1.52± 0.62	1.46± 0.75	1.56± 0.72	1.72±0.88	2.50±0.54
Fourth Instar	2.17± 1.13	2.00± 1.13	1.75± 1.00	2.57±0.97	2.00±0.00
Adult	12.76± 1.43	13.73± 1.57	12.93± 1.38	–	–
Fecundity					
Daily	5.09± 1.03	5.04± 0.64	4.19± 0.96	–	–
Total	64.58±12.38	69.20±11.27	54.31±13.80	–	–

development was observed on Chinese cabbage ($\bar{X}$ = 1.15 ± .36 days). The longest development was on eggplant ($\bar{X}$ = 1.29 ± .46 days). Development on mustard ($\bar{X}$ = 1.25 ± .44 days) was longer than on pechay ($\bar{X}$ = 1.20 ± .41 days) but shorter than on lettuce ($\bar{X}$ = 1.26 ± .45 days).

In the second nymphal instar, development was fastest on mustard ($\bar{X}$ = 1.22 ± .42 days) while slowest on lettuce ($\bar{X}$ = 1.40 ± .51 days). Development on pechay ($\bar{X}$ = 1.33 ± .48 days) was slower than on Chinese cabbage ($\bar{X}$ = 1.27 ± .46 days) but faster than on eggplant ($\bar{X}$ = 1.38 ± .50 days).

In the third nymphal instar, fastest development was observed on Chinese cabbage ($\bar{X}$ = 1.46 ± .75 days) and slowest on lettuce ($\bar{X}$ = 2.50 ± .54 days). Aphids reared on mustard have longer duration ($\bar{X}$ = 1.56 ± .72 days) than on pechay ($\bar{X}$ = 1.52 ± .62 days) but shorter than on eggplant ($\bar{X}$ = 1.72 ± .88 days).

The development of the fourth nymphal instar was again shortest on mustard ($\bar{X}$ = 1.75 ± 1.00 days) while longest development was observed on eggplant ($\bar{X}$ = 2.57 ± .97 days). Development on Chinese cabbage ($\bar{X}$ = 2.00 ± 1.13 days) was about the same as on lettuce ($\bar{X}$ = 2.00 ± 0.00 days) but shorter than on pechay ($\bar{X}$ = 2.17 ± 1.13 days).

The total length of time required to reach maturity ranged from 5 to 8 days. It was significantly longest on eggplant ($\bar{X}$ = 7.00 ± .57 days) and shortest on Chinese cabbage ($\bar{X}$ = 5.73 ± .70 days). The total development on pechay ($\bar{X}$ = 5.81 ± .65 days) but faster than on lettuce ($\bar{X}$ = 6.75 ± .50 days).

Evidently, the brassica plants (pechay, Chinese cabbage and mustard) were favored by the aphids in this particular experiment shown by their fast development on these hosts as compared to those reared on eggplant (Solanaceae) and lettuce (Compositae). A relatively high survival rate was also observed on aphids reared on the brassica plants. The reason for the differences between host plants are not known. Woodford (1969) showed that the maturation characteristics of alates vary between *M. persicae* reared on Chinese cabbage and those from broad bean, and that alates reared on sugar beet had a teneral period similar to those from bean. It may be that low concentration of some phagostimulant substances or substances, necessary directly or indirectly for the proper growth and nutrition of *M. persicae*, are characteristic of inferior host species.

Reproduction and life span. Table I shows the mean reproduction or nymph production of *M. persicae* on different host plants. All of the aphids reared on eggplant and lettuce died without reproducing. As presented here, the data are based only on surviving individuals that were reared on pechay, mustard and Chinese cabbage.

The aphids on pechay produced the biggest number of nymphs (1,098 from 17 females) fro a mean period of 12.53 days. Least number of nymphs was observed in aphids reared on mustard (869 from 16 females) for a mean period of 13.06 days. Aphids reared on Chinese cabbage produced a total of 1,038 nymphs (based on 15 females) for a mean period of 13.73 days.

The mean reproduction was highest on Chinese cabbage ($\overline{X}$ = 69.20 ± 10.88) and lowest on mustard ($\overline{X}$ = 54.31 ± 13.80). Mean reproduction for aphids reared on Chinese cabbage was 69.20 ± 10.88 nymphs.

There was no significant differences on the mean life span of *M. persicae* reared on the three host plants (pechay, Chinese cabbage and mustard). No aphids survived longer than 22 days. The shortest period that a reproducing adult lived was 16 days. Based on the data obtained, the mean life span of *M. persicae* on the different host plants were: pechay, $\overline{X}$ = 18.82 ± 1.23 days; mustard, $\overline{X}$ = 18.87 ± 1.45 days; Chinese cabbage, $\overline{X}$ = 19.46 ± 1.40 days.

It is reasonable to assume that the brassica plants were the most suitable hosts for *M. persicae*. However, it cannot be suggested here that eggplant and lettuce are unsuitable hosts for *M. persicae*. It was observed that stock plants of lettuce and eggplant were colorized by aphids mass reared and maintain on pechay. This happened when the pechay plant was obviously depleted and the aphids were already in an overcrowded condition. However, when fresh supply of pechay plants were provided the aphids disappeared on the lettuce and eggplants. It is pertinent to point that there was a relatively high mortality rate on both eggplant and lettuce. Evidently, the aphids settled well on Chinese cabbage, mustard and especially on pechay, the original host plant. The settling behaviour of *M. persicae* may depend, there-

fore on immediate previous host experience. Russel (1966) reported that *M. persicae* settles more readily on sugar beet if taken from cultures on beet rather than from cultures on Chinese cabbage. Markkula and rouka (1970) observed changes in response to plants after cultured for prolonged periods on different hosts in some, but not all, races of *Acyrthosiphon pisum* (Harris).

Kennedy, Ibbotson and Booth (1950) suggested that the degree of adaptation of a given aphid to a given plant may be gauged by the extent to which the aphid can colonize the plant's leaves not only when they are growing and senescing but also when they are mature and fully functional.

Description of the Different Life Stages.

First nymphal instar (Fig. 1). The newly born aphid is light green in color. It is oval shaped. The frontal tubercles are rounded and diverging. The antennae are 5-segmented whose segments are concolorous except for the distal part of the processus terminalis which is darker. The third antennal segment is twice as long as the second segment and 1½ times as long as the fifth segment. The processus terminalis is 3 times as long as the base of the penultimate segment. The compound eyes are red and one tubercle each is present on the posterior margin. The ultimate rostral segment reaches the third pair of coxae. The legs are concolorous except for the tarsal claws which are darker. Thick hairs are present on all segments of all legs with the most numbers on the hind femur. The siphunculi are cylindrical with apices slightly flanged and are concolorous with the body. The cauda is obtusely rounded and bears 2 pairs of hairs of about the same sizes.

Second nymphal instar (Fig. 2). The second nymphal instar aphid is similar to the first nymphal instar except for the slightly bigger body size of the former. The antennae are also 5-segmented but are longer in relation to the length of the body. The third antennal segment is 3 times as long as

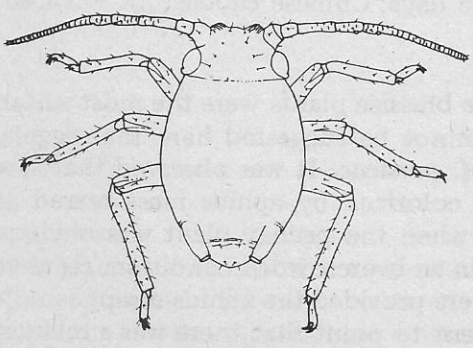

Fig. 1. First instar nymph of *M. persicae* (Sulzer). 70X

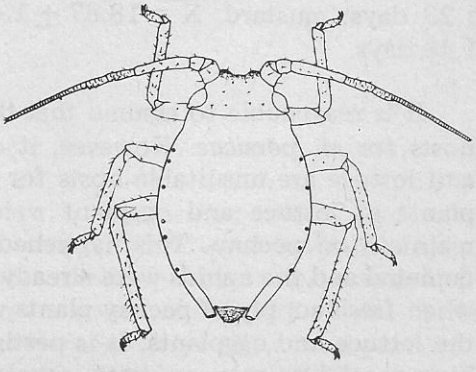

Fig. 2. Second instar nymph of *M. persicae* (Sulzer). 50X

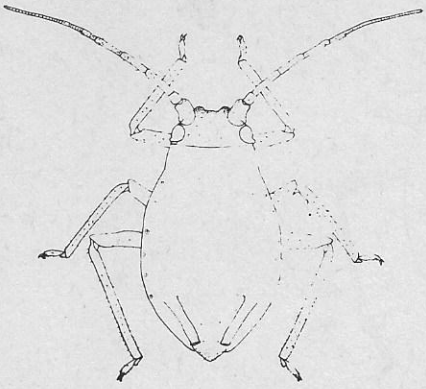

Fig. 3. Third instar of nymph of *M. persicae* (Sulzer). 40X

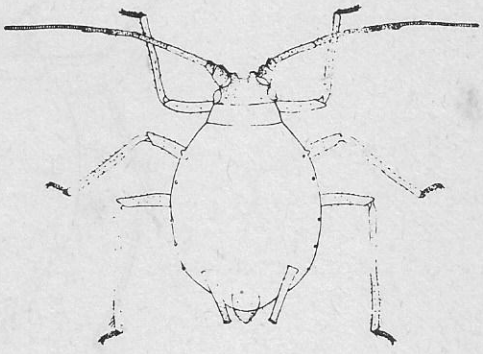

Fig. 4. Fourth instar nymph of *M. persicae* (Sulzer). 30X

the second segment and twice as long as the fifth segment. The processus terminalis is 3 times as long as the base of the penultimate segment. The siphunculi are more slender with apices flanged. The cauda is also obtusely rounded but has 3 paris of hairs.

Third nymphal instar (Fig. 3). The third nymphal instar has the same color of the two earlier stages with difference in the head region which is darker in the third instar. The frontal tubercles are also rounded but converging with 5 hairs on each. The antennae are 6-segmented with the third segment 3 times as long as the second segment and as long as the fourth segment. The processus terminalis is 3½ times as long as the base of the penultimate segment. The rostrum extends beyond the second pair of coxae but barely reaches the third pair. The cauda is triangular with its base broader than its lenth. The siphunculi slightly curve outwards.

Fourth nymphal instar (Fig. 4). The fourth nymphal instar is similar to the third nymphal instar except for their sizes. The third antennal segment is 4 times as long as the second segment and slightly longer than the fourth and fifth segments. The processus terminalis is 4 times as long as the base of the penultimate segment. The siphunculi and cauda are similar to those in the third nymphal instar.

Adult apterous (Fig. 5). The body is 2.354 mm long and 1.130 mm wide. It is light green in color and oval shaped. Fine short hairs are present on the body. The frontal tubercles converge and have 3 hairs on each. The vertex is straight and has 4 hairs. The antennae are 6-segmented, no secondary rhinaria and are shorter than the body. The third antennal segment is longer than the fourth and fifth segments and shorter than the processus terminalis. The processus terminalis is 4 times as long as the base of the sixth antennal segment. The relative lengths in mm of the segments are as follows: 1, 0.91; II, 0.75; III, 0.420; IV, 0.303; V, 0.240; base of VI, 0.117; p.t., 0.482. The number of hairs on the antennal segments are as follows: I, 2-3; II, 2-3;

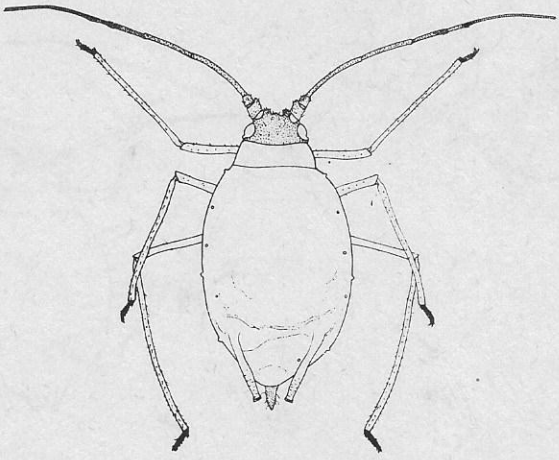

Fig. 5. Adult aptera of *M. persicae* (Sulzer). 20X

TABLE 2. **Anatomical measurements of different developmental stages of** Myzus persicae **with the standard deviations for each. Data are based on 10 individuals for each stage.**

Length (mm)	I N S T A R				
	I	II	III	IV	V
Body	0.712±0.051	0.917±0.060	1.248±0.109	1.778±0.113	2.354±0.125
1st Antennal segment	0.045±0.003	0.045±0.003	0.060±0.004	0.070±0.002	0.091±0.010
2nd " "	0.045±0.003	0.045±0.001	0.054±0.002	0.062±0.002	0.075±0.002
3rd " "	0.096±0.004	0.164±0.005	0.148±0.004	0.249±0.014	0.420±0.006
4th " "	*	*	0.145±0.007	0.194±0.009	0.303±0.004
5th " "	0.064±0.003	0.086±0.011	0.130±0.006	0.165±0.011	0.240±0.002
6th "					
base	0.061±0.020	0.073±0.003	0.089±0.005	0.103±0.003	0.117±0.008
p.t.	0.189±0.016	0.252±0.017	0.317±0.030	0.394±0.013	0.482±0.050
Siphunculus	0.103±0.004	0.147±0.006	0.212±0.015	0.301±0.023	0.462±0.010
Cauda	–	–	–	–	0.186±0.017

*The fourth antennal segment is absent in the 1st and 2nd nymphal instars, being derived from a division of the third antennal segment of the third nymphal instar.

III, 9-5; IV, 10-12; V, 4-7; base of VI, 3; p.t., 3. The width across the compound eyes is 0.412 mm. The rostrum does not reach the third pair of coxae. The siphunculi are 0.462 mm long and 0.034 mm wide. The lower distal half are faintly imbricated. The apices are flanged. The color is slightly darker than the body. The cauda is spoon-shaped, 0.186 mm long and 0.112 mm wide at the base. It has 3 pairs of hair.

Separation of the different instars is difficult under macroscopic level of examination. Both the first and the second nymphal instars have 5-

segmented antennae, whose lengths are closely similar in relation to the length of the body. It was found out that by comparing the lengths of their antennae the two instars can be separated from one another. Thus, the antennae of the first nymphal instar do not reach the siphunculi while those of the second nymphal instar attain the siphunculi. Close examinations revealed that the third antennal segment in the second stage aphid was much longer than its counterpart in the first nymphal instar. It is important to point out that the fourth antennal segment is absent or fused with the third segment in both the first and second nymphal instars but present in the third and fourth nymphal instars as well as in the adult form. Evidently, the fourth antennal segment is derived from the division of the third segment in the second nymphal stage.

Errors are more likely to be encountered when dealing with the third and fourth nymphal instars as these two later stages were more difficult to distinguish from each other. Again, both have 6-segmented antennae whose lengths in relation to the body are very similar. As was observed between the first and second stages, close examinations of their antennal segments revealed that the third and fourth antennal segments in the third nymphal instar have a tendency to be subequal. However, as what can be used as basis for separation in the fourth nymphal instar, the third antennal segment is always longer than the fourth antennal segment.

Aside from the comparative lengths of the antennae in the different nymphal instars, no other criteria was found outstanding that can be used conviniently in seprating one nymphal stage from the other, especially under field conditions when quick instar determintion would be essential. It is only through rearing than any desired nymphal instar can be obtained accurately.

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