SHORT COMMUNICATION

Oviposition of the Swallowtail Butterfly, Papilio xuthus L. (Lepidoptera : Papilionidae) in a Deforested Area

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(Received September 11, 1978)

Although the distribution pattern of eggs of the swallowtail butterfly, Papilio xuthus in an even-aged Citrus grove is analyzed by Suzuki et al. (1976), there is little information on the spatial distribution of the eggs in a wild environment, where host trees of various ages often grow together. In a deforested area, P. xuthus oviposits on Zanthoxylum aitlandoides of various ages, and consequently on those of various heights (Watanabe, 1979). The purpose of this paper is to describe the relation between the height of the host trees and the distribution pattern of eggs of P. xuthus in a deforested area.

The distribution of P. xuthus eggs was investigated in 8 experimental plots (5 m x 5 m each) in a deforested area of Mt. Kiyosumi, Chiba Prefecture, by counting the eggs laid on the host trees at 2- to 4-day intervals throughout all generations from 1973 to 1976. This area was 250 m wide and 50 m long with a slope of 30° falling toward WSW. It was deforested in autumn of 1971. Miscanthus sinensis was the dominant vegetation. Host trees (20-280 cm in height) were distributed at random, and they generally sprouted in mid April and defoliolated in early November.

The data obtained in 8 plots were pooled in each year in each generation, and the observed frequency distributions of the eggs per host tree and the theoretical values expected from Poisson distributions are compared in Fig. 1. Here, the 2nd and the 3rd generations were treated as the summer generation, because they often overlapped each other. Each observed distribution was significantly different from the Poisson distribution.

The analysis of m-m relations (Iwao, 1968) on each counting time in respective generations indicated that an egg was a basic component of the distribution (\( \alpha = 0 \)), and that the distributions of such basic components were contagious (\( \beta > 1 \)), though the determination coefficients (\( r^2 \)) on some generations were considerably low (Table 1). This means that the females did not randomly lay their eggs on the hose trees. In other words, contagious egg distributions might be due to the heterogeneity of the oviposition sites.

It was reasonable to consider that the height of the site where the eggs were laid was almost the same as that of the host tree, because the eggs were mostly laid on the terminal buds or on both sides of leaflets near the terminal of the host tree. Here, the trees were classified into three groups, “tall”, “medium” and “short”, according to their relative heights to the surrounding vegetation, as reported by Watanabe (1976). Then, in order to determine the effects of the relative heights of the host trees on the oviposition of females, the relations between the frequency distributions of the relative height of the host trees and the number of eggs per tree were shown in Fig. 2. P-value in each generation is calculated by using chi-square two sample test for the null hypothesis that the frequency distribution of the host trees is identical with that of the eggs. Although the null hypothesis that there is no difference among three levels of the relative height

| Table 1. Distribution Parameters for Eggs of P. xuthus Laid in Some Generations |
|-----------------|---|---|---|
| Generation      | \( \alpha \) | \( \beta \) | \( r^2 \) |
| 1974 1st gen.   | -0.09 | 5.18 | 0.94 |
| Summer gen.     | 0.01 | 3.43 | 0.97 |
| 4th gen.        | -0.16 | 6.26 | 0.44 |
| 1975 1st gen.   | 0.03 | 5.76 | 0.17 |
| Summer gen.     | -0.02 | 15.63 | 0.96 |
| 4th gen.        | 0.77 | 3.39 | 0.43 |
| 1976 4th gen.   | 0.06 | 3.48 | 0.48 |

\( \alpha \) represents the intercept on m-axis.
\( \beta \) represents the regression coefficient for the regression of mean crowding on mean density \( (m-a+\beta m) \) based on the distribution per tree.
\( r^2 \) is the determination coefficient.

in regard to the oviposition has been apparently disproved only in 4 generations, the average number of eggs laid on the tall trees was smaller than that on the short ones in any generations. Thus, it is concluded that the tendency to lay fewer eggs on the taller trees was established.

It is already suggested that the females of *P. xuthus* oviposited preferably on the host tree shorter than its surrounding vegetation (Watanabe, 1976). Leaf of the seedling of *Z. ailanthoides* has plenty of thorns and strong odor, which may be cues for releasing the oviposition behavior of *P. xuthus*. In order to determine such an effect of host tree's characteristics on the oviposition experimentally, three poles equipped with five potted seedlings of the host trees at vertical intervals of 50 cm from the ground were set up near the experimental plots in the 4th generation of 1976 (Fig. 3). The mean height of the vegetation surrounding the poles was about 125 cm. The eggs laid on these seed-
lings were counted at 2-day intervals. The potted seedlings were rotated among heights of their positions at 5- to 7-day intervals.

Result of the experiment on height preference for oviposition of *P. xuthus* was shown in Table 2. Females of *P. xuthus* tended to lay their eggs on the seedlings set out at the lower levels. Thus, the oviposition behavior of *P. xuthus* was not primarily influenced by some characteristics specific to short host trees.

Suzuki et al. (1976) found contagiousness in the spatial distribution of the eggs of *P. xuthus* in a grove of *Citrus unshiu* and attributed one of its causes to

Table 2. Oviposition of *P. xuthus* on Potted Seedlings Fixed to Poles at Different Heights above the Ground.

<table>
<thead>
<tr>
<th>Height (m above ground)</th>
<th>No. of eggs per pole per week (Mean±s.e.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>0.08±0.08</td>
</tr>
<tr>
<td>1.0</td>
<td>0.38±0.38</td>
</tr>
<tr>
<td>0.5</td>
<td>0.45±0.26</td>
</tr>
<tr>
<td>0</td>
<td>0.80±0.46</td>
</tr>
</tbody>
</table>
the females’ preference for young host leaves as oviposition sites. In the deforested area, however, the fact that eggs laid were concentrated on the short host trees might depend upon flying height of females, because it was often observed that they flew slightly below the height of the vegetation. Since the short host trees have thin and soft leaves which are probably suitable for the first instar larvae (Watanabe, unpublished), it seems to be reasonable that females laid their eggs on the short host trees.

I wish to express my sincere thanks to Dr. A. Kokubo of Tokyo University and Prof. T. Hidaka of Kyoto University for critical readings of the manuscript. I am also grateful to the staffs at Fudago of Tokyo University Forest in Chiba for their assistance in the field work.

REFERENCES


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(Received March 5, 1979)

Much information on migration and dispersion of alate aphids in relation to dissemination of plant virus has been reported by many investigators over a long time, but little is known about the movement of apterous. Recently it has become clear that apterous can move further than was previously thought and may play an important role in spread of plant virus (Bjorling et al., 1951).

Movement of apterous on host plants however, has been investigated in connection with population fluctuation by a few workers. The spatial distribution of *Aphis glycines* Matsumura on soy bean were closely related to emergence of young leaves (Itô, 1933) and similar results were obtained in *Myzus persicae* Sulzer (Otake, 1954). Further, it was demonstrated that the emigration of apterae to other plants plays an important role in regulating the overcrowding of the population and that the rate of emigration increases more with adults than larvae (Miyashita, 1954).

In a previous paper (Takeda, 1979), it was reported that the spatial distribution of the apple leaf-curling aphid, *Myzus maliisuctus* Matsumura, and the spirea aphid, *Aphis spiraecola* Patch, are influenced by the population density of aphids and the growth of the host plant. This tendency is marked more in the latter species than the former ones, but the reason was not mentioned.

For this reason, an attempt is made in this paper to clarify the movements of apterous of both aphid species on apple trees.

At the beginning of May, 40 larvae of apterus viviparous females of *M. maliisuctus* were released individually on terminal leaf of apple seedlings. After these larvae reached adulthood, the leaf order of the adults and larvae was recorded every day until the adults died or moved elsewhere. The larvae were removed immediately after observation. On the *A. spiraecola* a similar investigation was conducted at the same time, using the same method.

In this investigation, of the 40 larvae of both aphids, 32 of *M. maliisuctus* and 19 of *A. spiraecola* reached the adult stage. The longest survival time of adult *M. maliisuctus* and *A. spiraecola* was

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2 Contribution No. 93 from the Laboratory of Entomology, Faculty of Agriculture, Gifu University, Gifu, Japan.