Biotypic Variations in the Green Rice Leafhopper, *Nephotettix cincticeps* Uhler (Homoptera: Deltocephalidae), in Relation to Rice Varieties

Akio Sato and Kazushige Sōgawa

Laboratory of Insect Pest, Hokuriku National Agricultural Experiment Station, Inada, Joetsu, Niigata 943-01, Japan

(Received August 4, 1980)

The existence of genetic variability in the ability or inability to overcome crop varietal resistance is a well recognized problem among insect species. Such genetic and physiological strains of insects are commonly referred to as biotypes. Many species of aphids have been found to consist of a complex of biotypes differing in their food plant preference and host resistance-breaking ability (Low, 1973). The most complicated genetic interaction has been demonstrated between the Russian leafhopper, *Nephotettix lugens*, and wheat varieties (Gallun, 1977; Sona, 1978). The practical significance and durability of insect pest resistance in crops depend largely on the occurrence of such host resistance-breaking insect biotypes. The case of the brown planthopper, *Nilaparvata lugens*, has been a recent illustration of the hazard represented by new biotypes for the varietal resistance of rice to this insect pest (IRRI, 1976).

The current experiments were initiated in order to investigate the existence of possible intraspecific variabilities in relation to host plant resistance in populations of the green leafhopper, *Nephotettix cincticeps*, which is an economic pest of rice.

The green rice leafhopper populations from 2 geographic locations were used in the present experiments. One was collected at the Hokuriku National Agricultural Experiment Station, Joetsu, Niigata, and the other at the Kyushu National Agricultural Experiment Station, Chikugo, Fukuoka, about 800 km southwest of the Hokuriku district. They are called the Joetsu and Chikugo populations, respectively, in this paper. Both populations were separately maintained on seedlings of the *japonica* rice variety Nihonbare in a cabinet at a constant temperature of 27°C under 16L–8D illumination at the Hokuriku National Agricultural Experimental Station since 1979.

Two kinds of experiments were conducted to compare the preference behavior for and mortality on different rice varieties for the 2 local populations of green rice leafhopper. For the preference tests, pregerminated seeds of 9 rice varieties, namely Atlai, Dao-ren-qiao, Dee-geo-woo-gen, IR24, Lepedumai, Nihonbare, Pe-bi-hun, Tadukan, and Taichung native 1, were sown in rows 2 cm apart within 31×19×3.5 cm plastic flats. In each row 10 seeds were sown at 1.5 cm intervals. Three days after sowing, they were exposed to a batch of first instar nymphs of the green rice leafhopper, and covered with a 29×17×20 cm translucent plastic cage with 2 nylon mesh windows (17×9 cm) for ventilation at the top. The number of nymphs on each variety was recorded everyday. The mortality tests were carried out by rearing the first instar nymphs on 3 rice varieties: IR24, Lepedumai, and Nihonbare. About 20 pregerminated seeds of each variety were individually sown in a test tube (1.6×18 cm) containing about 3 g of soil and 2 ml of water. Three days after sowing, newly emerged first instar nymphs were individually introduced into each test tube. The test tube was then closed with a sponge stopper. The nymphal mortality was recorded daily. All experiments were conducted at 27°C under 16L–8D illumination.

In the preference tests, nymphs distributed evenly on all test varieties at the beginning of the experiment exhibited distinct behavioral responses to each variety during the subsequent 24 and 48 hr. Dao-ren-qiao, Lepedumai, Pe-bi-hun, and Tadukan were clearly rejected by the nymphs of both the Joetsu and Chikugo populations, while Atlai, Dee-geo-woo-gen, Taichung native 1, and Nihonbare were almost equally accepted by them (Table 1). However, it was noted that the preferential response to IR24 was strikingly different between the 2 local populations (Fig. 1). Nymphs of the Joetsu population did not prefer IR24, and most of the nymphs moved away from it within 48 hr. On the contrary, nymphs of the Chikugo population settled

---

Table 1. Preference of First Instar Nymphs of the Joetsu and Chikugo Populations of Green Rice Leafhopper for 9 Rice Varieties
48 hr after Being Released

<table>
<thead>
<tr>
<th>Variety</th>
<th>Joetsu No. nymphs</th>
<th>Joetsu %</th>
<th>Chikugo No. nymphs</th>
<th>Chikugo %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dao-ren-qiao</td>
<td>2</td>
<td>0.9</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Lepedumai</td>
<td>3</td>
<td>1.3</td>
<td>9</td>
<td>4.8</td>
</tr>
<tr>
<td>Pe-bi-hun</td>
<td>1</td>
<td>0.4</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Tadukan</td>
<td>3</td>
<td>1.3</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>IR 24</td>
<td>12</td>
<td>5.4</td>
<td>31</td>
<td>16.5</td>
</tr>
<tr>
<td>Atlai</td>
<td>54</td>
<td>24.1</td>
<td>19</td>
<td>10.1</td>
</tr>
<tr>
<td>Dee-geo-woo-gen</td>
<td>44</td>
<td>19.6</td>
<td>48</td>
<td>25.5</td>
</tr>
<tr>
<td>Nihonbare</td>
<td>41</td>
<td>18.3</td>
<td>42</td>
<td>22.3</td>
</tr>
<tr>
<td>Taichung native 1</td>
<td>64</td>
<td>28.6</td>
<td>35</td>
<td>18.6</td>
</tr>
</tbody>
</table>

Total no. nymphs on 9 varieties: 224

Fig. 1. Distribution of first instar nymphs of the Joetsu and Chikugo populations of green rice leafhopper on the 3 selected rice varieties, IR24, Lepedumai (LEP), and Taichung native 1 (TN 1).

Fig. 2. Survival trend of green rice leafhopper nymphs of the Joetsu and Chikugo populations on the 3 rice varieties, IR24, Lepedumai (LEP), and Nihonbare (NIHON).

Trends of nymphal development and mortality on Nihonbare and Lepedumai were virtually identical in the 2 local populations.

These preliminary experiments enabled to demonstrate that there are significant intraspecific variations with respect response to rice varieties between the green rice leafhopper populations from the 2 geographic locations. This is the first time that a variety-associated biotypic variation in this species has been demonstrated in Japan. Detailed biological and genetic studies are in progress to distinguish them further.

The authors express their gratitude to Mr. Shingo Oya, Kyushu National Agricultural Experiment Station, for supplying them with the
Chikugo population of green rice leafhopper.

REFERENCES


IRRI (1976) The International Rice Research

Bionomics of *Euplectrus kuwanae* CRAWFORD (Hymenoptera: Eulophidae), a Parasitoid of *Argyrogramma albostriata* (BREMER et GREY)¹

Hideo UEMATSU

Institute of Biological Control,
Faculty of Agriculture, Kyushu University,
Fukuoka 812, Japan

(Received October 8, 1980)

The species of *Euplectrus* are noted for interesting bionomics such as the characteristic clusters of closely packed larvae upon the body of free living hosts and cocoon formation which is rare among the Chalcidoidea. *Euplectrus kuwanae* CRAWFORD is one of the larval parasitoids of *Argyrogramma albostriata* (BREMER et GREY) that has recently been recognized as a dominant defoliator of the goldenrod, *Solidago altissima* L. in Japan (UEMATSU, 1980).

**Life history:** Immatures of *E. kuwanae* on *A. albostriata* feeding on the goldenrod were collected in Fukuoka in autumn 1979 and reared. The progeny were used for observations. The general biology of *E. kuwanae* is quite similar to that of other *Euplectrus* species which has been reported already by several authors (SMITH, 1927; CHATTERJEE, 1945; NESER, 1973; WALL and BERBERET, 1974). Eggs of *E. kuwanae* were deposited in clusters externally on the dorsum of the host caterpillars. The number of eggs per cluster ranged from 3 to 30. The egg was firmly attached to the host integument by a tiny pedicel. The newly deposited egg was white in colour, but it gradually changed to brownish-black as incubation progressed. At 25°C, the average incubation period lasted 3.2 days. The larvae developed externally on the host, and did not leave the original position where the eggs had been laid until they were fully grown. Therefore, as growth proceeded larvae became greatly crowded, and the individuals in the center of the cluster were in a vertical position. The average duration of the larval stage was 3.4 days. The mature larvae left their feeding position and arranged themselves in a single row between the venter of the host and the substrate where they began to spin delicate cocoons. The under surface of goldenrod leaves were usually used as substrate in the field. At 25°C, the average duration of prepupa and pupae was 2.1 and 4.6 days respectively.

At the time of oviposition, female *E. kuwanae* partially paralysed the host larvae. The parasitized hosts did not die until parasitoids developed into fully grown larvae, although they became more or less sluggish and their green bodies gradually faded away. *E. kuwanae* frequently deposited eggs on host larvae about to molting in the test tube. In such cases, parasitoids failed to develop because the hosts died within several days without moulting, although hatching of the parasitoid eggs took place normally.

**Development of ovarian eggs:** *E. kuwanae* females reared on honey without ovipositing at 20 and 25°C were dissected to observe the ovaries. The results are shown in Fig. 1. *E. kuwanae* is a synovigenic species; i.e., no mature eggs in ovarioles at emergence. At 25°C, the maximum number of ripe eggs was observed on the eighth day after emergence, and afterwards oviposition occurred. Then, maturation and resorption took place cyclically until the 30th day. At 20°C, the cycle tended to be considerably slowed.

**Location of egg deposition and survival rate in immature stages:** WILSON (1933) and NESER (1973) suggested that the location of *Euplectrus* eggs on