

benzimidazol fungicides with *T. occidentalis* and *A. fallacis*, although not with *T. pyri* (WEARING and ASHLEY, 1982), and (2) oviposition suppression. MARKWICK (personal communication) found that in a laboratory strain of *T. pyri* with resistance to synthetic pyrethroids (SP), females which survive the SP treatment will not produce eggs on SP-treated leaves for a considerable period of time, even though they commence egg production immediately after being transferred to leaves free from the SP deposits. Other methods should be used to determine factors other than direct mortality; factors that would be affected by the deposition and persistence characteristics of the pesticides.

Under the conditions of the spray program in Japan, where pesticides belonging to different groups have been used in rotation in order to delay the development of resistance in the pest species, there seems to be only a slight possibility that the indigenous species of predator mites will soon develop resistance. As long as there is a strong likelihood that predatory mites from overseas will survive the pesticide applications with only a slight modification of the present system, it would be worthwhile introducing them for further evaluation. A reduction in the use of miticides

through the integration of such predators into the present system would reduce direct costs to the grower and also delay the development of resistance in the mite pests.

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Pre-Mating Flight of Rice Planthopper Migrants (Homoptera: Delphacidae) Collected on the East China Sea¹

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Rice planthoppers show long distance migration to Japan during the Bai-u (rainy) season (KISIMOTO, 1971). Studies have revealed synchronous immigration in different localities in Japan and a close relation between immigration and weather (KISIMOTO, 1971, 1976; HIRAO and ITO, 1980; KISIMOTO et al., 1982; OYA and HIRAO, 1982). This paper reports the results of collection of rice

planthoppers on the East China Sea in 1984 and the mating experience of migrant females.

The author was on board a weather observation ship of the Japan Meteorological Agency, the "Keifu-maru," which stayed on the East China Sea (31° N, 126° E) from June 25 to July 3 1984. Planthoppers were collected in three airborne nets (1 m in diameter) fastened on the main mast. The nets were usually emptied every three hours. Insects attracted to light on board were also collected by an aspirator for studies of endoparasites and mating experience.

The total number of rice planthoppers collected by the three nets in 9 days were as follows: *Sogatella furcifera*, 135 males and 97 females; *Nilaparvata lugens*, 53 males and 32 females; and *Laodelphax striatellus*, 22 males and 29 females. *S. furcifera* is the dominant migratory species on the East China Sea as shown by other authors (HIRAO and

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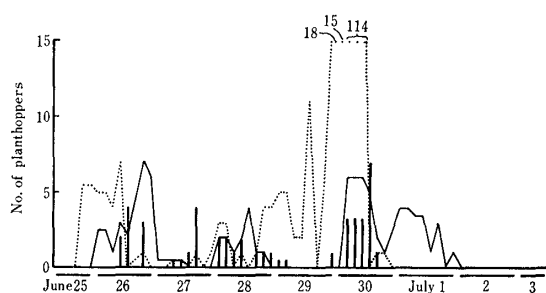


Fig. 1. Number of adult *Nilaparvata lugens* (solid line), *Sogatella furcifera* (dotted line) and *Laodelphax striatellus* (bars) caught at 3-hr intervals by three airborne nets on the East China Sea.

ITO, 1980; OYA and HIRAO, 1982). Figure 1 shows the number of rice planthoppers caught every three hours in the nets. *N. lugens* and *L. striatellus* are considered to immigrate into Japan with *S. furcifera* but are minor in number (KISIMOTO, 1976). On the night of June 26, however, the number of *N. lugens* and *L. striatellus* was larger than that of *S. furcifera*. Moreover, no *S. furcifera* was collected on July 1, whereas twenty *N. lugens* were caught that day. *L. striatellus* was often caught by the nets at the same time as *N. lugens*, but was only trapped on the evening of June 27 and was not observed on July 1. Based on the net catch on the East China Sea, rice planthoppers did not necessarily show concurrent flight.

S. furcifera collected on the night of June 29 were immersed in 70% ethanol and 98 males and 122 females were dissected later to observe endoparasites. Two and 10 Drynid wasps were found in males and females respectively, and one of each sex was parasitized by Strepsipteran.

In order to examine the mating experience, migrant females were dissected on the ship and sperm in the spermatheca was observed under a microscope. None of the females dissected, the total 93 (53 *S. furcifera*, 26 *N. lugens* and 14 *L. striatellus*), possessed sperm. There was no sign

of development of ovaries; only a few oocytes were recognized in each ovariole and no yolk deposition was observed. HIRAO and ITO (1980) noted that it took 4 days on average for *S. furcifera* migrants to oviposit the first egg after collection on the East China Sea, suggesting that migrations take place within the preoviposition period, but they showed no data on insect dissection. Although planthoppers are so far considered to migrate in the young adult stage, some caught by nets or light traps on land are mated and have developed ovaries (KISIMOTO, 1976; CHEN et al., 1979). The present investigation gives proof of the pre-mating migration of rice planthoppers, because the insects were collected on the sea far from land and non-mating was ascertained by direct spermatheca observation.

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