SHORT COMMUNICATIONS

Spatial Relationship between Wild and Released Sterile Melon Flies, *Dacus cucurbitae* COQUILLET (Diptera: Tephritidae)¹

Ren IWAIZUMI² and Masakazu SHIGA³

Okinawa Prefectural Agricultural Experiment Station,
Naha 903, Japan

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In the application of sterile insect technique (SIT), the successful dispersion and infiltration of released sterile insects into the natural population is of fundamental importance (KNIPLING, 1955). An analysis of the spatial relationship between released sterile insects and wild ones may provide suggestions on how this can best be accomplished.

This paper deals with the results obtained from a field experiment to analyze the distribution pattern of wild and released sterile melon flies, *Dacus cucurbitae*. The field experiment was originally designed to evaluate the effectiveness of a new method of release by Dr. Hiroaki Nakamori and his co-workers of the Okinawa Prefectural Agricultural Experiment Station.

MATERIALS AND METHODS

Flies used in this experiment were reared at the mass-rearing facility of the Fruit Fly Eradication Project Office, Okinawa Prefectural Government, in Naha City. The pupae were irradiated with α -ray (70–120 Gy) three days before eclosion and mixed with fluorescent dye to mark adults. Fluorescent dyes used were Saturn Yellow® for pupal release method with a bucket (IWAHASHI, 1976), Blaze Orange® for an adult release method with a paper bag (KOYAMA, 1980) and Whitex SKC® for another anesthetized-adult release method (KUBA et al., 1982; NAKAMORI et al., 1982; YAMAMOTO, 1985).

The field experiment was carried out on Miyagi

Fig. 1. Map of study area. Hatched area indicates the releasing site. × : Center of the releasing site, ● : Location of traps.

Island (5.0 km²), an islet which is located close to the Island of Okinawa. Using the three methods, 860,000 sterile melon flies were released into the release site shown in Fig. 1. As the dispersal and survival rates of released flies did not differ significantly among the three methods (NAKAMORI et al., unpublished data), analyses were conducted of the total number of sterile flies recaptured in each trap. Fifteen modified Steiner-type traps baited with a mixture of 47.5% cue-lure, 47.5% methyl eugenol and 5.0% BRP (2 mg/trap) were positioned on Miyagi Island (Fig. 1), and flies caught in these traps were collected every week following release. The schedule of release and the observation of traps are shown in Table 1. Trapped sterile flies were distinguished from wild ones by detection of the fluorescent dye. The heads of the flies which were separated from the bodies were crushed on a filter paper with a glass board and a mixture of acetone and ethanol (4:1) was dropped on them. Then, the fluorescent dye was revealed on the filter paper

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² Present address: Naha Plant Protection Station, Naha 900, Japan

³ Present address: Laboratory of Biological Control Agents, National Institute of Agro-Environmental Science, Tsukuba, Ibaraki 305, Japan

Table 1. Schedule of release and trapping of sterile and wild melon flies, *D. cucurbitae*

Date	Item	Days after estimated peak of eclosion
Jul. 28, 1983	Pupal release by bucket method	-1
Jul. 29	Expected peak of eclosion, Arrangement of traps	0
Aug. 1	Adult release by paper bag method	3
Aug. 2	Anesthetized adult release by chilling method	4
Aug. 5-Sep. 16	1st to 7th recovery of trapped flies weekly	7-48

Fig. 2. Relationship between mean crowding ($\bar{X}^*$) and mean ($\bar{X}$) of the frequency distribution of the wild *D. cucurbitae* caught in traps. $\bar{X}^*$ and $\bar{X}$ are the sample estimates of $\bar{m}^*$ and $\bar{m}$, respectively.

Fig. 3. Change in values of C_δ -index between the number of wild flies and that of released sterile flies caught by traps.

under an ultraviolet ray and the number of marked and non-marked heads in each trap were counted.

RESULTS AND DISCUSSION

Mean crowding-mean regression analysis (Iwao, 1968) was applied to the number of wild flies caught in each trap at every recovery (Fig. 2). The distribution pattern of the number of wild male melon flies caught in a trap represented an overdispersed distribution ($\alpha=7.0$, $\beta=5.3$). The value of α was positive, but it had no significant difference from 0. This result suggests that the wild melon flies distributed highly contagiously possibly due to the heterogeneity of environments over the study area.

The infiltration process of the released sterile flies

into such a contagiously distributed natural population may be shown by an index of overlapping in the spatial distribution of sterile and wild flies. For an analysis of the overlapping in the spatial distribution of the two different populations, the C_δ -index (MORISITA, 1959) which is a measure of spatial association between two species was calculated using the frequency distributions of sterile and wild flies caught in traps. Theoretically, the value of C_δ varies from 0 (no overlapping) to 1 (complete overlapping). This coefficient is effective because it is little affected by the mean value and is also applicable unconsciously with spatial distribution patterns.

As shown in Fig. 3, two weeks after release, the C_δ -value increased markedly, and thereafter it in-

creased gradually to an asymptote. This result suggests that the sterile flies which were released in the center of the islet infiltrated into the natural population and began to coexist with wild flies in suitable habitats or patches.

IWAHASHI (1972) reported that marked and released fertile adults of *Dacus dorsalis* he released were recaptured in traps in which wild flies were abundant, and the number of released flies caught in each trap was positively correlated with that of wild flies. He suggested that movement of released flies was strongly influenced by the environment around the release point and that flies released in a favorable habitat tended not to move further. In the case of *D. cucurbitae*, similar results were reported by mark-and-recapture experiments of fertile or sterile flies (HAMADA, 1980; KOYAMA et al., 1982). These facts were confirmed by this study.

SHIGA (1986) pointed out that the natural melon fly populations were distributed more or less patchily and that the manner in which control agents acted on them was important for the prediction and evaluation of the effectiveness of SIT. In relation to this problem, the analysis of spatial distribution adopted in the present study seems useful for investigations of the natural population structure and for the development of quality control of released insects in SIT.

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