Effective Range for Mating Suppression of *Spodoptera litura* (F.) by Evaporating (Z, E)-9,12-Tetradecadienyl Acetate¹

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Mating of *Spodoptera litura* (F.) is suppressed by evaporation of (Z,E)-9,12-tetradecadienyl acetate (lilture B), the minor component of the female sex pheromone of this species (YUSHIMA et al., 1975; OYAMA, 1977). Although the mechanism of the mating suppression by the pheromone component is not known at present, it is interesting to know the effective range of evaporated lilture B for the mating suppression of *S. litura* in the field from the view point of mode of action of this compound. The tethered-female method of OYAMA (1974) was satisfactorily applied to know the effective range of lilture B in the field.

The females of *S. litura* were obtained from the laboratory colony which were reared on an artificial diet at 25°C. One- to 2-day-old virgin females were tethered on bamboo rods at 1 m above the ground (OYAMA, 1974), and 400 tethered females were evenly distributed at 1.5-m intervals in a 20×20 grid in the field yielding a 812 m² area. Lilture B (Takeda Chemical Ind., Ltd., purity 87.8%) was loaded on absorbent cotton balls (2-cm diameter wrapped with nylon gauze) at the rate of 1 mg of active ingredient. A cotton ball with lilture B fixed on a bamboo rod at 1 m above the ground was set at the center of the area. Control experiment by using the same number of tethered females at 2-m intervals without lilture B was conducted on different day. All the females were fixed on the bamboo rods within 30 min. After sunset, and they were dissected and spermatophores were counted in the next morning. Wind direction and velocity were automatically recorded through the night.

Fig. 1A shows that the unmated females distributed in particular subarea in the treated area. In contrast, the distribution of the unmated females was relatively even in the control area (Fig. 2B). Wind direction (SES) and wind velocity (1.2 m/sec)

Fig. 1. Distribution of unmated tethered females when lilture B was evaporated at the center of the area. One mg of lilture B was loaded on a ball of absorbent cotton. ■, mated female; □, unmated female; D, dead female. A: 400 females at 1.5-m intervals in 20×20 grid (Sept. 27–28); B, C: 625 females at 2-m intervals in 25×25 grid (Oct. 16–17 and Oct. 17–18, respectively).

were stable throughout the night of experiment. Unmated females in the treated area distributed in large number in the leeward of the evaporation point. The effective range for the mating suppression of the tethered females was about 9 m in width

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Fig. 2. Distribution of unmated tethered females without any treatment. 400 females at 2-m intervals in a 20×20 grid (Oct. 15–16). ■, mated female; □, unmated female; D, dead female. A: Distribution of females which began to mate before 20:00; B: Distribution of mated females during the night of experiment.

and more than 15 m, reaching to the margin of the area.

Additional experiments were conducted by using 625 tethered females which were distributed at 2-m intervals by 25×25 grid. The results in this larger area are shown in Fig. 1B and Fig. 1C. They also indicated the dense distribution of unmated females in the leeward of the evaporation source. The range for the mating suppression was estimated to about 18 m in width and 22 m to leeward from the source (Fig. 1B). On the contrary, in the second additional experiment, it again reached to the margin of the area, 24 m from the source of evaporation (Fig. 1C).

Wind velocity of the night greatly affected on the range for the mating suppression. The result in Fig. 1C was obtained at the night of 1.6 m/sec wind velocity. However, the smaller range of mating suppression was obtained when the wind velocity was 0.9 m/sec (Fig. 1B). These results might be explained by the data of NAKAMURA (1976) which indicated that the "deposition effect" of the pheromone component remarkably increased at the wind velocity below 1 m/sec.

Another important factor affecting on the range for the mating suppression seemed to be the population density of wild males during the experiments. The results of experiment on 400 tethered females which was conducted in the season of high population density (64 males were trapped by a virgin female trap in one night) showed a small subarea of unmated females at the upwind part of the evaporation source (Fig. 1A). On the contrary, upwind unmated subarea were apparently larger (Fig.

1B and Fig. 1C) which were the results on 625 tethered females in the season of lower population density (11 and 41 males were captured by a virgin females trap in one night, respectively). Thus, the population density of wild males, the number of tethered females and the size of the area in which the tethered females were distributed, seemed to affect on the range for the mating suppression by litlure B.

Hourly observations on the mating of the tethered females, which were conducted on the control experiment, indicated that the mating began in the marginal part at first (Fig. 2A) and then progressed to the inner part of the area (Fig. 2B). Therefore, the females in the central part of the experimental area remained unmated in the larger experimental area in lower population density of wild males. This appears to be one of the reason of the relatively larger unmated subarea in the upwind part of evaporation source shown in Fig. 1B and Fig. 1C.

Direct effect of litlure B should be also considered as a reason for the upwind unmated area as well as for the leeward area. Wild males approaching to the tethered females from the leeward had to fly through the plume of litlure B from the evaporation source. The contact with litlure B, a pheromone component, probably cause a sensory habituation of the males to the sex pheromone from the females. Pre-exposure of males of the smaller tea tortrix moth to one of their pheromone components greatly suppressed the subsequent response to the virgin females in calling position or to the synthetic pheromone, a mixture of two components

(HIRAI et al. 1974). Similar effect of pheromone component is possibly considered in the case of *S. litura*.

Concerning the inhibition of the mating behavior of *S. litura* by a component of the multi-component pheromone, TAMAKI and NAKAMURA (1976) discussed on the combination of three possible mechanisms such as sensory habituation by a single component, modification of natural signal by the change of natural ratio of the pheromone components, and functional difference in each pheromone component. Although mechanisms of the mating suppression of *S. litura* by evaporating lilture B are not yet elucidated, the results of present experiments on the effective range of the evaporated lilture B for the mating suppression of tethered females in the field provided a clue to the mode of action of the pheromone component of this species. Further detailed observation on the

premating behavior of male moths by using the tethered-female method is of interest.

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