Factors Affecting the Orientation Flight of Spodoptera litura (Lepidoptera: Noctuidae) to Its Sex Pheromone in a Wind-Tunnel

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The sex pheromone of Spodoptera litura (Lepidoptera: Noctuidae) was identified as a 9:1 mixture of (Z, E)-9,11-tetracadienyl acetate (compound A) and (Z, E)-9,12-tetracadienyl acetate (compound B) (TAMAKI et al., 1973 a). One milligram of 10:1 mixture of these two compounds in a rubber septum attracted a comparable number of males to 10 caged virgin females in the field (YUSHIMA et al., 1974). Behavioral response of S. litura male to the sex pheromone was analyzed in a laboratory (TAMAKI et al., 1973 b; TAMAKI and YUSHIMA, 1974) and the orientation flight behavior to the compounds was analyzed in the field (KAWASAKI, 1981), but no analysis under a controlled condition has yet been reported. In this paper, the factors affecting the orientation flight of male moths to a sex pheromone source were analyzed in a wind-tunnel.

Moths were reared on an artificial diet at 25°C under 16L:8D photoperiodic conditions. The male pupae were kept under continuous light at 20°C and emerged moths were used for the experiments. The wind-tunnel was 1 x 1 m and 3 m in length; all the air drawn into it was exhausted from the room with a draft. Illumination was made by 4 tungsten lamps diffused by milky plastic plates. Light intensity was controlled by a transformer. In this experiment, 0 lux indicates light off condition. Wind speed was controlled at 0.5 m/sec. In the wind-tunnel, a petri dish 12 cm in diameter filled with soapy water was set 30 cm above the floor and 50 cm downwind of the air intake end. A plastic dispenser loaded with adsorbed 100 ng of compound A and 10 ng of compound B was set about 5 mm above the water surface as an odor source. The sources were aged for 5 days in a draft before use. Purities of compounds A and B were 95.5 and 96.3%, respectively. Fifteen males were placed in a glass container (ϕ=9 cm, 6 cm high) with a glass lid (ϕ=10 cm, 2 cm high). A mesh cylinder (ϕ=8 cm, 5.5 cm high) was installed inside the container. At the release of the moths, the container was turned upside down and placed on the floor of the wind-tunnel 2.5 m downwind from the air intake end, and then the glass container was removed. Thus the wind pass through the mesh cylinder on the glass lid and the males took off freely.

Moths used for experiments were those 3 to 6 days after emergence; they were kept under dark conditions from 2 to 8 hr before the experiment. Light intensity was 0.1 lux at floor level. These conditions were changed one at a time to evaluate the effect on the trapping of males. The trapped number of moths was counted 10 min after release and at least three replications were made.

Figure 1 shows the effect of male age on the trapping. In this case, 0,1 and 2 days after emergence mean 0–12, 12–24 and 24–48 hr after emergence, respectively. Male response seemed to be constant from 3 days to 6 days after emergence. Figure 2 shows the effect of the time after light off on the trapping. Male response was low and unstable from 0 to 1 hr after light off, but it became stable from 2 to 9 hr afterward. These results are consistent with that reported by TAMAKI et al. (1973 b) in which male response was scored by extrusion of clasper and hairpencil. Thus, the males which show copulatory behavior also show sexually activated flight to the sex pheromone.

Fig. 1. Relationship between male age and the capture of males in a pheromone baited trap in a wind-tunnel. Circles with the same letters were not significantly different by DUNCAN's new multiple range test (p≤0.05).

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Light intensity also affected the trapping (Fig. 3). The trap catch was the highest at 0.1 lux and there was significant difference between 0.1 and 1 lux, but there was no significant difference in the other light intensity from 0.05 to 5 lux. No moths were captured in the trap under light off condition (0 lux in Fig. 3). In this case, most of the males did not take off from the cage, suggesting that an optical signal is also required for maintenance of orientation flight behavior. These same phenomena were observed in the Indian-meal moth (Dahm et al., 1971) and the pink bollworm moth (Farkas et al., 1974).

These results show that the age of the male, time after light off, and light intensity affect male orientation flight to a sex pheromone source.

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REFERENCES