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The male inhibition technique . . . CABBAGE LOOPER CONTROL by confusing sex pheromone communication

Confused males—and effective control of cabbage looper—resulted from the uniform placement of synthetic sex pheromone stations spaced about 100 m apart in field tests. The synthetic sex pheromone of the cabbage looper, Trichoplusia ni **(Hübner) (Noctuidae) was continuously evaporated from uniformly spaced sources in a field at a rate of about 1 mg per hectare per night. Males of this species were almost completely prevented from locating pheromone-releasing females. This male inhibition technique offers considerable promise for the control of insect pest populations.**

MOTHS OF MANY SPECIES are apparently dependent on sex pheromone communication to bring the sexes together for mating. A sexually mature female extrudes a specialized gland, allowing the evaporation of the secreted attractant (pheromone) into the air. Receptive males that are located downwind are stimulated to fly toward the source of the odor, thus locating the female. This research was directed toward the blocking of this method of communication in a pest species, by the distribution of synthetic sex pheromone in the environment.

Although a number of researchers have suggested that populations of pest insects might be controlled by the permeation of the air with sex pheromones, the feasibility of the technique had been demonstrated only once in the field, in a small-plot (0.1 hectare) experiment with the night-flying cabbage looper moth, *Trichoplusia ni* (Hübner). Two new experiments (see table experiments B and C) have been conducted with this insect, evaluating the effect of greatly reduced quantities of pheromone (about 1 mg per hectare each night) over greatly increased land areas (up to 2.6 km^2). Pertinent data concerning the early small-plot experiment are also included in the table (experiment A), for comparative purposes.

In each experiment, synthetic cabbage looper pheromone volatilized into the air from evaporators held 1 m above the soil surface on wooden stakes. The evaporators were disc-shaped reservoirs with raised edges. Pheromone was added to the evaporators as necessary to maintain a constant liquid film. Pheromone release rates were measured by direct weighing. The evaporators were arranged in square arrays in the field. For instance, the 64 evaporators in experiment C (table) were positioned in an 8 × 8 array, with adjacent evaporators separated by 200 m.

A trap baited with 10 virgin sexually mature females was placed at an elevation of 1 m in the center of the plot. The number of cabbage looper males caught in the traps, relative to the number caught in identical traps located in untreated areas, was used for calculating per cent male inhibition (this criterion defining the degree of communication interruption).

The 99 per cent male inhibition recorded in experiment B probably represents a degree of communication control that would cause most of the females within the treated area to remain unmated. If the treated area were sufficiently large to prevent the immigration of mated females from the outside, then a reduction in population levels of crop-damaging caterpillars of the next generation would probably result. On the other hand, the 82 per cent inhibition in experiment C might not result in adequate control of the next generation. Individual males and females that are kept separate and virgin are capable of mating on almost any night they are allowed to come together, during their few weeks of adult life. Accordingly, an 80 to 90 per cent reduction in mating on any given night still leaves the probability that most females will be located by males and inseminated at some time during their life span.

Reasons for the differences in male inhibition obtained in experiment B vs C are not obvious. Further research is required to determine how this inhibition is affected by a number of interacting variables, including the spacing of evaporators in the field, the evaporation rate of pheromone, micrometeorological conditions and insect population densities.

Compared with the quantities of conventional insecticide chemicals that are usually employed for the control of pest insects, negligibly small amounts (1 to 3 mg per hectare each night) were expended in experiments B and C. This represents a chemical cost of less than $0.01 per hectare each night. Thus, the major expenses anticipated in a large-scale male-inhibition effort for this species will be involved with engineering, producing, distributing, and servicing the evaporators.

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INHIBITION OF MALE RESPONSES TO PHEROMONE-RELEASING FEMALE CABBAGE LOOPER MOTHS BY THE USE OF EVAPORATORS RELEASING SYNTHETIC PHEROMONE

	Experiment		
	A	B	C
Array of evaporators	10 × 10	4 × 4	8 × 8
Distance between evaporators (m)	3	100	200
Total area (hectares)	0.1	16	256
No. replicates	6	10	3
Release rate:			
per evaporator each min (μg)	1	1	20
per hectare each night (mg)	700	0.7	3
Total males captured in control	102	98	246
Mean % male inhibition	100	99	82 ± 11*

* Mean ± standard error; significantly greater than 0% inhibition at $P < 0.05$.