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Moth Traps for the Tobacco Budworm[1,2]

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ABSTRACT

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A nonelectric trap that has an efficiency of ca. 25% for capturing *Heliothis virescens* (F.) was designed and tested. This trap can be baited with synthetic pheromone or virgin females and is portable, inexpensive, and simple to install and operate.

The detection of insect pests and surveys of their distribution are essential to an integrated pest management program. Not only does one have to detect the presence of the pest but also the present and potential population level. Once these levels are determined, an established "economic threshold" can be used to determine if and what kinds of treatments are necessary.

BL electric insect traps and pheromone as bait in electric grid traps are presently used to determine daily population levels of the bollworm, *Heliothis zea* (Boddie), and the tobacco budworm, *H. virescens* (F.) (Hartstack et al. 1976, 1977). These populations estimates along with environmental data are used to initiate computer-oriented population models to forecast timing of future population peaks.

Hollingsworth et al. (1978) described various designs of electrical and nonelectrical traps using virelure (Tumlinson et al. 1975), the synthetic sex pheromone of the female tobacco budworm, as bait. They reported that a nonelectric trap referred to as trap 3HB was capable of capturing ca. 50% as many males as a standard electric grid trap (Wolf et al. 1972) when both traps were baited with 20 mg of virelure.

Our objective was to investigate the effect of various trap types, components, and designs on the catch of tobacco budworm males and to develop a simple, inexpensive trap that will capture a large percentage of attracted moths.

Materials and Methods

The 3HB trap (Fig. 1) (Hollingsworth et al. 1978) was constructed of galvanized wire (hardware cloth, 8×8 mesh). Both diam and height of the inverted cone were 50.0 cm. The glass jar was replaced by a galvanized wire cage (35.5 cm high and 20.3 cm diam) with an inverted cone in the bottom, with the same slope as the trap cone so that the cage would fit snugly on top of the trap. The cage had a removable top for removing the moths. This trap is the "cone" trap used by Lingren et al. (1978) in their trap efficiency study. This trap will be referred to here as "cone-50" (the 50 refers to the size of the opening at the bottom of the cone). All traps described and tested in these experiments were baited with 20 mg of virelure contained in 1.3×2.5-cm laminated plastic[3]. The baits were placed in ca. the center of each of the circular grids, 5 cm below the base of the cone ca. in the center of the cone traps. The bait was changed every 2 wk since no appreciable reduction in catch results (Hendricks et al. 1977) over this period of time. The traps were placed so the bait would be ca. 1 m above ground or a few centimeters above the crop canopy. All tests were conducted in the Brazos River Valley, Burleson Co., TX.

Trial 1

To further compare the standard electric grid trap and the cone-50 trap, 49 cone-50 traps and 7 electric grid traps were operated from Mar. 1 to Aug. 31, 1978. The cone-50 and grid traps were located within a 186-km² area of typical Brazos bottom farmland. The traps were dispersed throughout this area so that both types of traps were located near all types of crops and should have similar populations of moths. The traps were serviced daily and tobacco budworm males were counted.

Trial 2

Two regular cone-50 traps were compared with 2 cone-50 traps equipped with baffles[4]. The 2 baffles on each trap were made of 8×8 wire mesh and placed in the open portion of the cone or bottom of the trap. The baffles, each measuring 32.5×50 cm, extended 12.5 cm above and 15 cm below the base of the cone and divided the open basal area of the cone into quarters. The virelure was mounted at the intersection of the baffles, ca. 5 cm below the base of the cone. The traps were operated at 4 locations (ca. 150 m apart) along the N side of a county road. Two locations had cotton on the N and S sides of the road and the other 2 had cotton on the S side and sorghum on the N. The traps were rotated daily so that each trap was tested at each location once every 4 days. This was repeated for 10 replications or 40 nights from June 13 to July 22, 1978.

Trial 3

Three regular cone-50 traps were compared with 3 cone-75 and 3 cone-100 traps. The cone-75 trap is identical to the cone-50 trap, except that it is 75.0 cm in diam and height. The cone-100 trap is 100.0 cm in diam and height. The traps were located at 3 sites, i.e., one trap of each type at each site. Each site had 3 trap locations ca. 400 m apart. The traps were rotated among locations every 7 days. The traps were operated for 63 nights so each type of trap was tested at each location for 21 nights. This test was conducted from May 31 to Aug. 1, 1978.

Trial 4

Lingren et al. (1978) reported that the cone trap (ca. the size of the cone-50) and other types of moth traps were inefficient in capturing the moths that came to them. They observed that only ca. 6% of the attracted tobacco budworm males were captured. We found sim-

[1] Lepidoptera: Noctuidae.
[2] In cooperation with the Tex. Agric. Exp. Stn., Texas A&M Univ., College Station. Received for publication Jan. 25, 1979.
[3] Formulated by Herculite Protective Fabrics Corp., New York, NY 10010.
[4] Suggested by personal communication with Earl Stadelbacher, Bioenvironmental Insect Control Laboratory, USDA, SEA, AR, Stonevlle, MS.

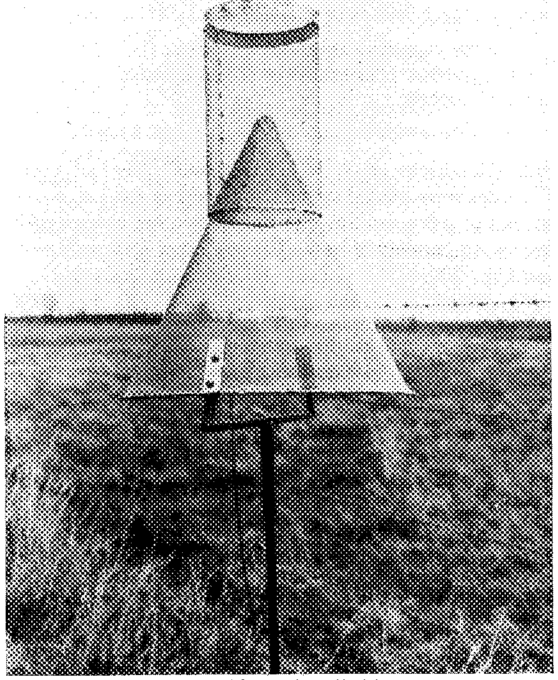


FIG. 1.—3HB or cone-50 trap installed in the field; note location of bait on cross-arm at base of cone.

ilar capture rates after 2 nights of observations with an image-intensifying device at College Station. A total of 661 tobacco budworm males was observed to be attracted within 1 m of the virelure bait, and 5.59% were captured in the cone-50 trap. An estimated 40–50% of the males entered the cone but most came back out and were not captured. The moths seemed to fly close to the side of the cone and gradually move downward and out.

This behavior of the moths resulted in our designing the cone-50-25, cone-75-25, and cone-75-50 traps. These traps were identical to the cone-50 and cone-75 traps, except they had an additional cone or rim of 8×8 wire mesh placed at their bottom. Fig. 2 and 3 show the cone-75-50, a regular cone-75 with an inside rim limiting the opening to 50.0 cm. The rim was designed as a flattened inner cone with a diam of 75.0 cm and height of 12.7 cm. The cone top was then removed to create the 50.0-cm opening and the remaining rim of cone was wired inside the cone-75 trap. The rim for the cone-75-25 was the same as that for the cone-75-50 except the hole at the cone top was 25.0 cm in diam. The rim for the cone-50-25 was an inner cone with a 50-cm radius and a height of 8.5 cm with a 25-cm opening. One each of these 3 traps, as well as a regular cone-50, was placed at each of 4 locations. The traps were rotated daily so that each type of trap was tested at each location once every 4 nights. The traps were operated for 36 nights or for 9 replications. The test was conducted from Aug. 15 to Sept. 20, 1978.

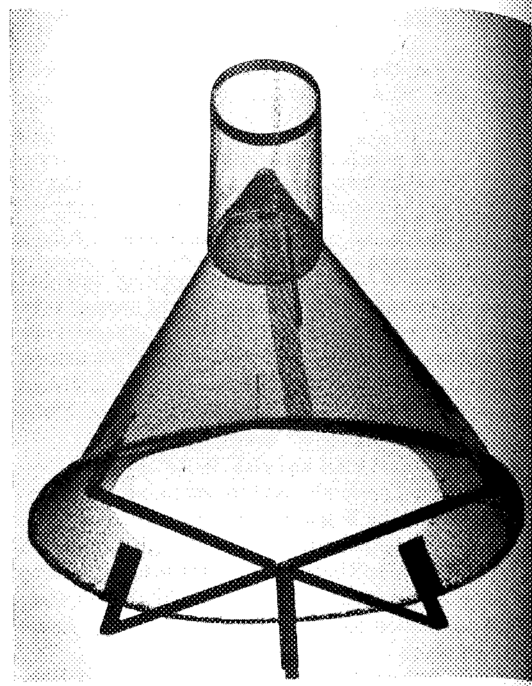


FIG. 2.—Bottom view of cone-75-50 trap.

Trial 5

Further comparisons were made of the cone-75-50 and cone-50-25 traps with the regular cone-50. The 3 traps were set up at 3 different locations and rotated daily so that each trap was tested at each location once every 3 days for 30 nights or 10 replications. The test was conducted from Aug. 23 to Sept. 21, 1978.

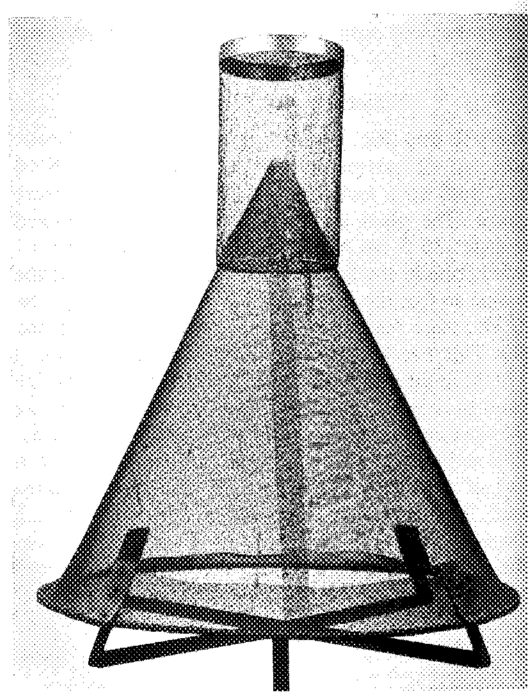
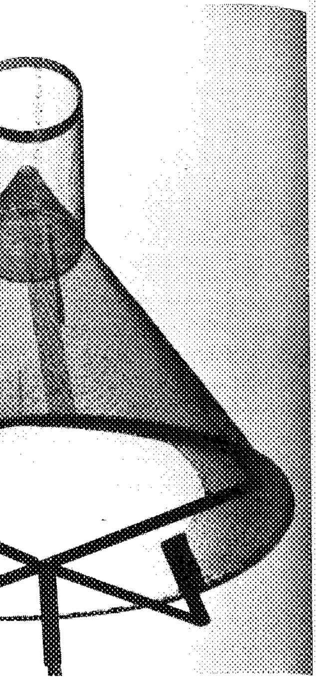


FIG. 3.—Side view of cone-75-50 trap; the bait is located where the 2 support arms cross, ca. 5 cm below base of trap.



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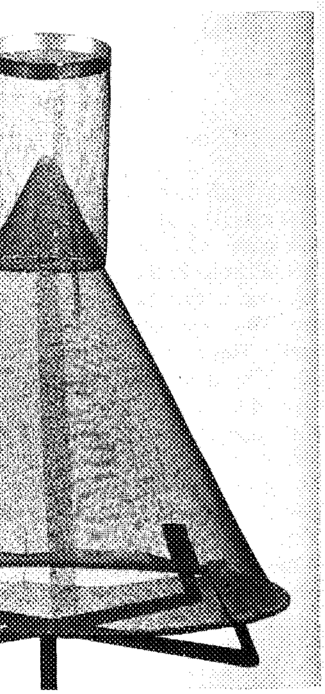

f cone-75-50 trap; the bait is located
s cross, ca. 5 cm below base of trap.

Table 1.—Summary of the seasonal catch of tobacco budworms in cone-50 and electrical grid traps (mean moths per trap per night).

Dates	Cone-50		Standard electric grid	
	Range	Mean	Range	Mean
Before May 1	0.053– 1.559	0.511	0– 0.767	0.116
May	0.290– 4.516	1.643	0– 3.388	0.573
June	0.400– 19.448	4.596	0.793–14.655	4.280
July	0.710– 43.258	12.346	1.036–63.968	21.481
Aug.	2.839–113.961	40.156	7.719–96.871	52.192
Season	1.099– 30.946	10.696a[a]	2.300–26.072	16.090b

[a] Mean values not followed by a common letter are significantly different at the 1% level according to Duncan's multiple range test.

Results and Discussion

Trial 1

From Mar. 22 to Aug. 31, 79,891 males were captured in the 49 cone-50 traps for avg catch of 10.69 moths/trap/night. In comparison, the 7 standard electric grid traps captured 16,138 for an avg of 16.09 moths/trap/night for a 50% greater catch than the cone-50 (Table 1). This difference in catch was significant at the 1% level. Seasonal comparison of the 2 types of traps indicated that the cone-50 trap might be superior to the grid trap early in the year when the populations are low, but as the season progresses, they gradually became less effective so that the grid trap was superior in July and Aug. (Table 1). Observation of traps at night led us to conclude that interference between moths trying to enter the cone-50 trap could cause this decrease in trap efficiency.

Moth populations increased from May through Aug. The cone traps had a 24.4-fold increase while the grid traps had a 91.1-fold increase. This again indicated the loss in trap efficiency of cone traps when populations increased.

A large range in catch between traps throughout the season as well as during specific periods emphasized the effect of trap locations (Table 1). One of the primary causes of this variation is the host crop surrounding a specific trap.

Trial 2

The traps equipped with the baffles caught 24% more moths than did the standard cone-50 trap (Table 2). This increase was not statistically significant; however, both traps with baffles caught more male moths than did the 2 without baffles which leads us to assume that the baffles effectively increased the catch somewhat.

Trial 3

Increasing the size of the cones significantly increased the catches by 50 and 62% for the cone-75 and cone-100 traps, respectively, over that for the cone-50 (Table 2). The small increase in catch of the cone-100 over the cone-75 probably cannot justify their use because of the additional cost and large size of the trap. The cone-75 trap is as large as a survey trap can be and remain portable and inexpensive.

Trial 4

The results revealed a major breakthrough in trap design. The moths per trap per night were increased 200, 316, and 354% for the cone-50-25, cone-75-25, and cone-75-50, respectively, over that for the cone-50. This increased capture indicates a trap capture efficiency in the range of 25–30% rather than the 5 or 6% of that of the cone-50. During this series of tests, the moths per trap per night in the cone-75-50 trap ranged from 51 to 818. Apparently, the capacity of the cage to hold moths had been reached, therefore, the efficiency of the cone-75-50 might even be higher if a larger cage were used.

Table 2.—Mean catch per night per trap of tobacco budworm males.[a]

Type of trap	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Cone-50	10.69 a	8.69a	8.98a	87.94a	24.77a
Standard grid	16.090b				
Cone-50 w/baffle		10.78a			
Cone-75			13.51b		
Cone-100			14.59b		
Cone-50-25				263.06b	61.57b
Cone-75-25				366.25c	
Cone-75-50				399.50d	110.33c

[a] Mean values not followed by a common letter are significantly different at the 1% level by Duncan's multiple range test.

Trial 5

To verify the results of trial 4 another comparison of the cone-50, cone-50-25, and the cone-75-50 traps was conducted. The cone-50-25 and the cone-75-50 were again much better than the cone-50 trap at capturing male tobacco budworms. Significant increases of catches resulted (149 and 345% for the cone-50-25 and the cone-75-50).

Preliminary trials with the cone-75-50 trap, using 3–5 bollworm and tobacco budworm virgin females as bait, indicated that the trap with females will capture ca. 26% more males than a cone-75-50 with virelure.

There are many configurations and sizes of cones that can be tried and a more efficient trap can be designed. However, the cone-75-50 trap is sensitive enough to detect very low populations of tobacco budworms, and it captured significant numbers of males to permit estimates of adult population levels. This same trap can be used equally well with virgin females as bait or other lures such as looplure, the synthetic pheromone for the cabbage looper, *Trichoplusia ni* (Hübner).

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