NOTE

TWO MODIFICATIONS FOR INCREASING CAPTURES IN *HELIOTHIS VIRESCENS* (LEPIDOPTERA: NOCTUIDAE) PHEROMONE-DISPENSING CONE TRAPS[1,2]

J. L. Hayes[3] and T. C. Lockley[4]

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The cone-shaped hardware cloth trap described by Hollingsworth et al. (1978, USDA, ARS-S-173) has proven to be an effective *Heliothis* spp., *H. virescens* (F.) and *H. zea* (Boddie), capture device. Fitted with an inside rim which limits the opening to 50 cm (Hartstack et al., 1979, J. Econ. Entomol. 72: 519-22), the 75 cm diameter cone is recognized as the standard *Heliothis* trap (e.g. Goodenough et al., 1988, J. Econ. Entomol. 81: 1624-30; Slosser et al., 1987, Environ. Entomol. 16: 1296-1301). Research on chemical composition of lures and dispensers used in these traps has brought about considerable improvement in trap capture (Lopez et al., 1988, Proc. Beltwide Cotton Prod. Res. Conf.: 209-13 and references therein). Although a wide variety of modifications have been implemented to make the trap easier to use, it has not been demonstrated that these alterations have improved trap effectiveness (e.g. Hartstack et al., 1979, J. Econ. Entomol. 72: 519-22). The predictive benefit of numerical improvements in trap captures is problematic without further understanding of the relationship between the number of male moths captured in traps and developing field populations of damaging immatures; nevertheless, improving the sensitivity of these widely used monitoring devices is desirable and necessary in order to assure accurate calibration.

While conducting nocturnal observations of *Heliothis* activity around traps, we frequently noted moths flying into the side of the trap cone. These moths occasionally found their way into the trap opening, but were more likely to immediately fly away or fly up along the contour of the cone and away. Since loss of a even few individuals during periods of low population density may reduce trap sensitivity, we made and tested two trap modifications, one structural and one operational, to attempt to capture these escaping insects. Although the sample size was small, the resulting increases in trap captures were sufficiently dramatic to warrant reporting these findings.

Double-cone trap—The standard cone trap was fitted with an outer shorter cone (43 cm ht, 55 cm diam., Fig. 1) to entrap moths that hit the side of the cone. The collection cylinder was adapted to trap insects moving up the inside of either cone.

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[2] This article reports the results of research only. Mention of any proprietary product does not signify endorsement or recommendation by the USDA.

[3] USDA-ARS, P.O. Box 346, Stoneville, MS 38776.

[4] USDA-APHIS, 3505 25th Ave., Gulfport, MS 39501.

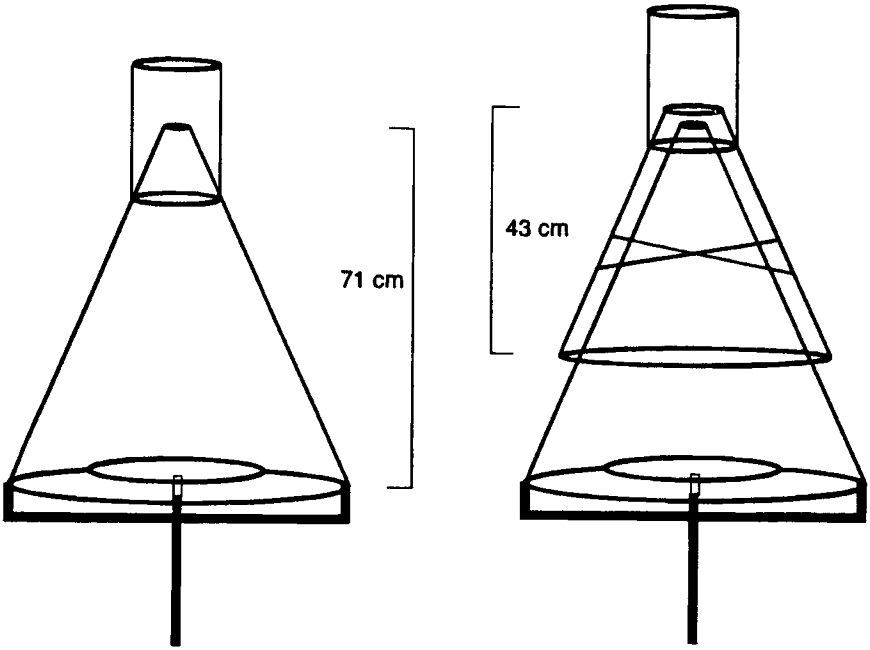

Fig. 1. Schematic diagram of standard 75-50 cone trap and modified double-cone trap.

Lower lure positioning—In order to draw insects under the trap, the pheromone lure was lowered to rest ca. 5 cm below the crossbar supporting the cone (ca. 10 cm below the cone opening). Typically, lures are positioned at just above the level of the crossbar, ca. 5 cm below the cone opening (Hartstack et al., 1979, J. Econ. Entomol. 72: 519-22).

The test was conducted in the delta region of Mississippi, 25 km southeast of Leland, Washington Co, from September to October 1987, during the final adult flight of *H. virescens*. Traps were positioned, with the cone base ca. 1 m above the ground and no less than 100 m apart, at the four corners (NE, NW, SE, SW) of a 1 ha. cotton field. Two double-cone traps and two standard traps were operated for 37 days, (day of year 248 to 285). Pheromone height adjustments were made on one double-cone and one standard trap from DOY 260 through 285. Each trap was moved to a different corner ca. weekly during the course of the evaluation period. Moths were removed every 24 h (except DOY 255 and 276) and lures were changed every 2 weeks.

Both trap modifications had highly significant impact on trap capture (trap type $F = 16.90$, $P < 0.0001$; lure position $F = 6.48$, $P < 0.0131$), and no significant interaction was found between the two modifications ($F = 0.02$, $P < 0.8890$, ANOVA, SAS Institute Inc., 1985). The ANOVA was performed assuming a completely randomized block (= day) design, given that trap locations were changed frequently and day-to-day fluctuations in moth abundance were much greater than trap-to-trap variability.

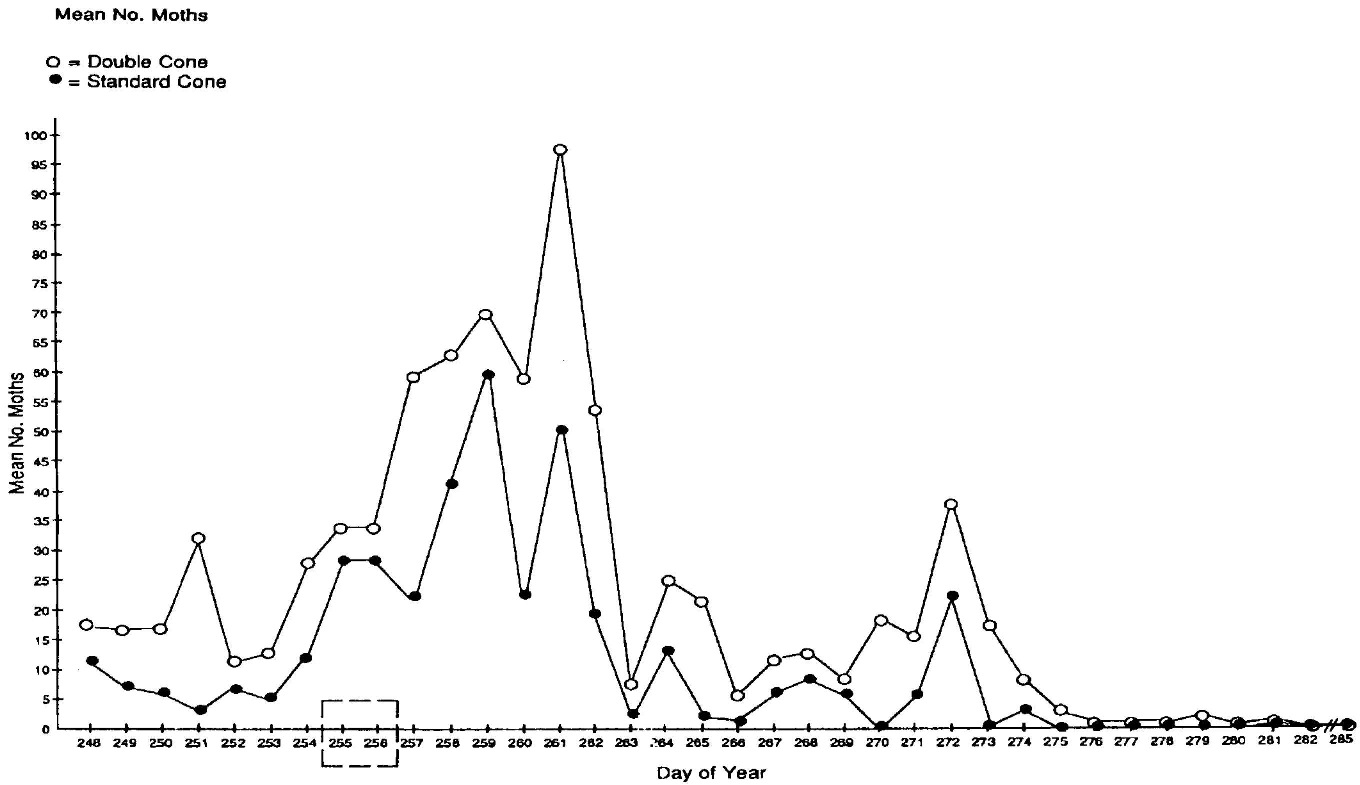

Fig. 2. Mean number of adult male *H. virescens* captured per night in two standard 75-50 cone pheromone traps and two modified double-cone pheromone traps.

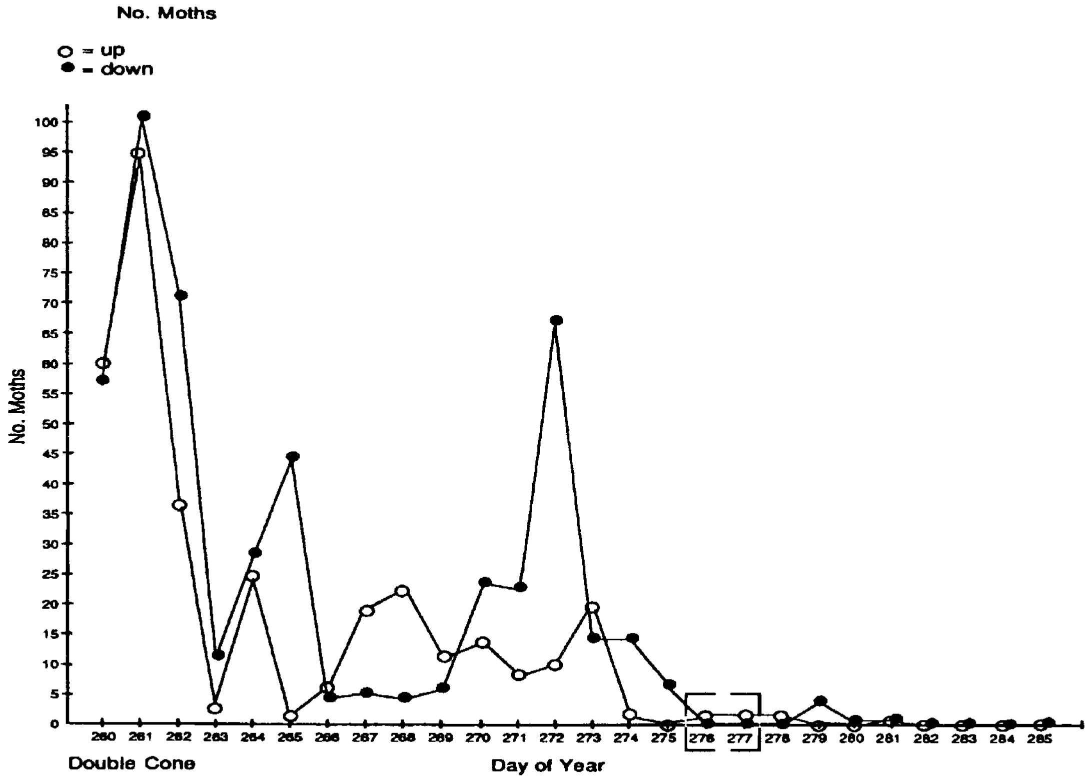

Fig. 3a. Number of adult male *H. virescens* captured per night in a modified double-cone trap with the pheromone lure 5 cm below the trap opening (= open circles) and with the lure 10 cm below the trap opening (= closed circles).

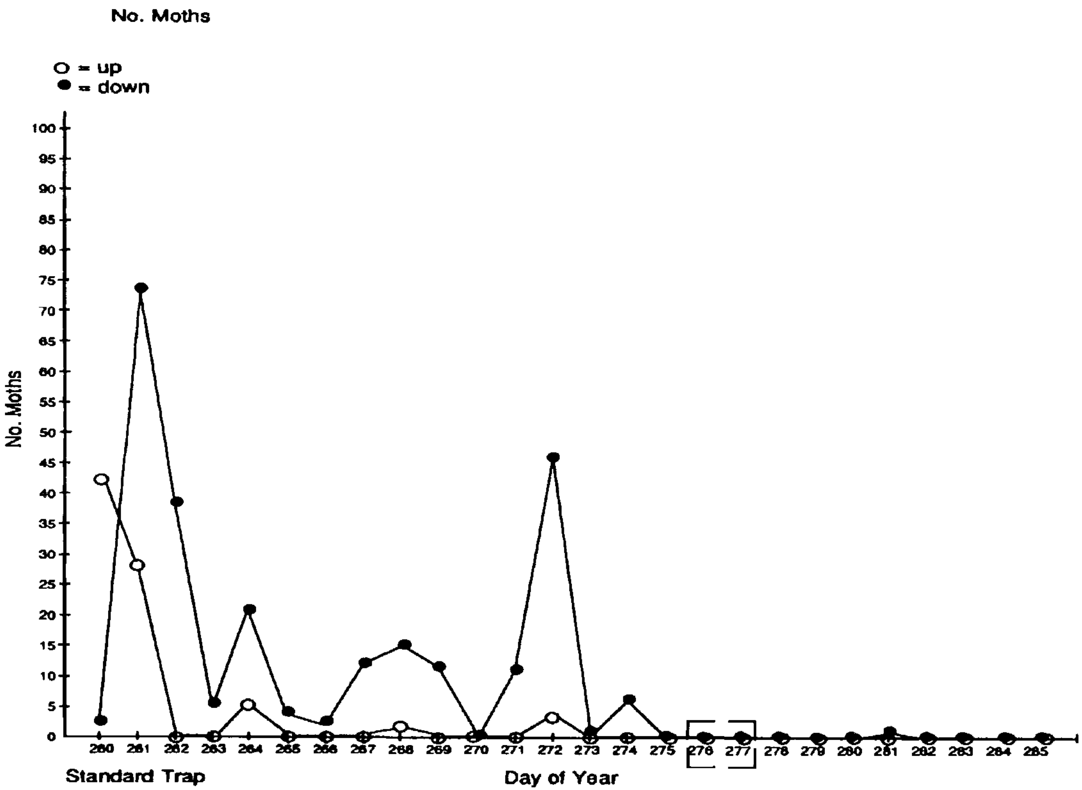

Fig. 3b. Number of adult male *H. virescens* captured per night in a standard 75-50 cone trap with the pheromone lure 5 cm below the trap opening (= open circles) and with the lure 10 cm below the trap opening (= closed circles).

Over the evaluation period, a 105% difference was found in the number of moths captured in the double-cone traps compared to the standard traps (Fig. 2). This difference was found regardless of trap position or population density, as was evident in the highly significant correlation between performance of the two trap types over time. ($r = 0.9101$, $p < 0.0001$; Fig. 2).

Traps with lures positioned 10 cm below the trap opening captured 73% more moths than traps with standard lure positioning. The double-cone trap with a lower lure consistently (corr. $r = 0.7919$, $p < 0.0001$) captured more moths (43%) than the double-cone with the standard lure height (Fig. 3a). The standard trap with a lower lure captured nearly 200% more moths than the standard trap with standard lure height (Fig. 3b). For the standard traps, the difference on each collection date was not as consistent as with the double-cone traps (corr. $r = 0.3930$, $p < 0.0513$), in part due to the significantly lower trap capture numbers for the standard vs. double-cone traps (Fig. 2).

In both cases the modifications tested here led to higher capture numbers than the standard trap, even at low population densities, thus showing potential for increasing sensitivity of measurement. Additionally, our findings indicate that care must be taken in lure positioning in order to assure standardization of trap results. Although additional replication of these tests with larger sample sizes is necessary, these results suggest that significant improvement in captures can be achieved. In particular, as indicated by Lingren et al. (1978, Bull. Entomol. Soc. Am. 24: 206-12), further nocturnal observations of moth behavior relative to traps may lead to other improvements in trap design.

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