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COMPARISON OF PHEROMONE TRAP DESIGNS FOR MONITORING *HELIOTHIS* ARMIGERA (HUB.)

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Comparison of Pheromone Trap Designs for Monitoring *Heliothis armigera* (Hub.)*

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ABSTRACT

In a series of tests, several designs of pheromone traps, including those found most efficient in trapping *Heliothis* spp in the USA, were compared for their efficiency in trapping *H. armigera* male moths at ICRISAT Center in India. Plastic funnel traps in which the moths fell or flew downwards and were trapped in a plastic bag below the spout, were found to trap the most moths. The American designs, in which the moths had to fly upwards to be trapped, caught very few. The catches in the funnel traps were greatly increased by surrounding the pheromone dispenser with a perforated baffle. However, for a pheromone trap network that has been established to monitor *H. armigera* population over the Indian sub-continent, ICRISAT has used the simple funnel traps, for these could be made easily and cheaply from local materials.

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INTRODUCTION

Heliothis armigera is a very damaging pest on many crops throughout much of the Old World, particularly in the semi-arid tropics. This insect is of particular concern to the entomologists at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India for it is a pest of all five ICRISAT's mandate crops - pigeonpea, chickpea, groundnut, sorghum, and pearl millet. From 1975, ICRISAT attempted to monitor population of this insect by using light traps and a network of traps was set up at several locations in India. However, several cooperators encountered difficulties in operating the light traps. The problems included the lack of reliable electricity supplies, difficulties in sorting the catches, particularly during rainy periods, and the cost of replacing bulbs and chokes which frequently fused. Consequently, research was concentrated upon the use of pheromone baited traps as these do not suffer from such problems.

The earliest research, from 1977, tested virgin females in a variety of sticky plate and water-pan traps. Subsequently, in cooperation with the Tropical Development and Research Institute (TDRI) of London, a series of synthetic pheromone were tested. Eventually a synthetic pheromone mix (Nesbitt *et al*. 1980), which attracted y *H. armigera* male moths, was discovered and this was tested in several different traps. In a series of tests a trap, constructed from locally available materials, that was modelled upon a trap supplied by TDRI was found to be very effective. In this trap the pheromone dispenser is suspended below a disc which is fixed above a plastic funnel. The moths that are attracted to the pheromone fly or fall into the funnel and slip down through the spout into a plastic bag, where they are trapped. The trap is now used extensively and is referred to as the ICRISAT standard trap (Pawar _et al_. 1984).

TRAP COMPARISONS

Several trap designs have been tested and the data from one such test are shown in Table 1. Here sex traps, that were fabricated at ICRISAT, were tested in two replicates, one in pigeonpea and the other in a chickpea crop. The traps were supported on rods at 2 meter above soil level and were 30 meters apart. The positions of the traps were interchanged at the end of each week, to minimize location effects. The pheromone dispensers (rubber septa loaded with 1 mg pheromone mix) were renewed at the end of each 4-week period. The trap designs (D) tested were as follows:-

D1 : ICRISAT Standard Trap

D2 : As per D1 but with an inverted, perforated conical baffle surrounding the dispenser.

D3 : As per D1 but with the funnel replaced by a metal cylinder, 8 cm diameter, 4.5 cm tall.

D4 : Similar to D3 but with a 15 cm diameter cylinder.

D5 : As per D1 but with the plastic funnel replaced by one made from galvanized metal.

D6 : As per D1 but inverted and with a plastic box replacing the plastic bag at the end of the spout.

The data (Table 1) show that the traps incorporating the perforated baffle (D2) caught more moths (3297) than the combined total of all the other traps. The inverted traps, in which the moths have to fly or crawl upwards to enter the trap box, caught only one moth over the 12-week test, and so were obviously inefficient.

The inverted trap was included in the test is a result of observations that the most efficient *Heliothis* spp pheromone traps in the USA are those in which the moths move upwards into the traps, in contrast to the ICRISAT standard trap where the moths move downwards to be trapped.

In another test, the ICRISAT standard trap and the baffle modified version of this were compared with two traps fabricated at ICRISAT according to the designs of traps found to be efficient in the USA (Raulston *et al*. 1980). These traps were (a) the Texas Cone Trap (Hartstack *et al*. 1979) and (b) the Wind Vane Trap (Raulston *et al*. 1980). Only one trap of each design was fabricated so the test was unreplicated. The traps were located in a chickpea field; their positions were interchanged weekly and the pheromone dispensers were renewed at the end of each 4-week period.

The catches in these traps over the 12 weeks of the test are shown in Table 2. Here the modified ICRISAT Standard Trap caught far more moths than the Standard trap which in turn caught far more than the USA designed traps.

DISCUSSION

At ICRISAT Center, the traps in which the moths move downwards appear to be far more efficient than the traps, in which the moths must move upwards, which have been found to be efficient in the USA. As was discussed in the International Workshop on *Heliothis* Management (Reed and Kumble 1982), it is unlikely that this difference can be attributed to differences in the behaviour of *H. armigera*, and *H.*

zea and H. virescens, which are the species caught by these pheromone traps in the USA. In that Workshop it was recommended that the range of traps should be tested both in India and in the USA. To the best of our knowledge the ICRISAT type traps have not yet been tested against H. zea or H. virescens. Such a test would clarify whether the Heliothis species differ in their basic responses after attraction to the pheromones.

The incorporation of the perforated baffle into the Standard Trap obviously gives a large increase in trap efficiency. The baffle appears to deflect the moths, which would otherwise fly-on out of the trap, down into the funnel. This modification adds little to the cost of the trap and so appears to be worthwhile. However, the Standard Trap has been used in a large monitoring network spread across India, Pakistan, Bangladesh and Sri Lanka for the past two years, and a change in the trap design at this time would give problems in interpretation of the data across seasons. If an attempt to control H. armigera by mass-trapping was to be initiated, there is no doubt that the modification would be very worthwhile.

We wish to acknowledge the input of our collegues, particularly V.S. Bhatnagar and S. Sithanantham who carried out the earlier pheromone research, and C.P. Srivastava who recorded the trap catches. We are also indebted to the scientists at TDRI who supplied the pheromones and ideas for trap designs.

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Table 1: Mean catches of *Heliothis armigera* male moths, per trap per week, in different designs of pheromone traps at ICRISAT Center in India, 1981-82.

Dates	Trap designs (see text)					
	D1	D2	D3	D4	D5	D6
05-11 Nov.	2.0	5.0	2.0	4.0	1.5	0.0
12-18 Nov.	19.0	39.5	5.0	24.0	7.5	0.0
19-25 Nov.	229.5	459.0	51.0	32.5	32.5	0.0
26-02 Dec.	211.0	423.0	45.5	55.0	22.5	0.0
03-09 Dec.	86.0	122.5	43.0	22.0	8.0	0.0
10-16 Dec.	33.5	66.5	18.0	27.5	4.0	0.0
17-23 Dec.	12.5	29.0	19.5	5.5	2.5	0.0
24-30 Dec.	112.0	247.0	146.0	23.0	12.5	0.0
31-06 Jan.	50.5	123.0	48.5	8.0	6.0	0.0
07-13 Jan.	7.0	37.0	8.0	3.0	3.0	0.0
14-20 Jan.	53.5	56.5	50.0	21.0	18.5	0.5
21-27 Jan.	25.0	40.5	11.5	4.0	0.5	0.0
Means	70.1	137.4	37.3	19.1	9.9	0.0
S.E. of mean±			2.84			

Table 2. Catches of *Heliothis armigera* male moths per week in ICRISAT and USA design traps at ICRISAT Center in India, 1982-83.

Dates	ICRISAT Standard Trap (D1)	ICRISAT Standard trap+Baffle (D2)	USA Wind vane trap	USA Texas cone trap
16-22 Nov.	42	201	22	1
23-29 Nov.	139	349	3	0
30-06 Dec.	217	641	42	4
07-13 Dec.	128	884	19	3
14-20 Dec.	434	1169	47	0
21-27 Dec.	203	935	55	3
28-03 Jan.	113	474	69	6
04-10 Jan.	58	513	119	3
11-17 Jan.	87	284	25	3
18-24 Jan.	26	121	2	0
25-31 Jan.	20	90	12	1
01-07 Feb.	8	25	1	1
Totals	1475	5686	416	25