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# HISTORICAL PERSPECTIVE OF DEVELOPING EFFICIENT PHEROMONE TRAP FOR SPODOPTERA LITURA (F.)

Entomology

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## ABSTRACT

The trap development for the Tobacco bud worm Spodoptera litura is still long way to go for perfecting for trapping with higher efficiency. (YASHIMA and TAMAKI,1974) started the developing a trap for this insect when TAMAKI et al.,1973 first identified its pheromone chemical. Later, based on the recommendation of TDRI, London, it was PAWAR et al.,1984 and 1988 perfected a trap for Helicoverpa armigera at ICRISAT. When RANGA RAO joined ICRISAT, he developed a procedure for trapping this insect. Further, on the above observations, NANDAGHOPAL and RATHOD (2007) reported a tarp with higher efficiency.

## KEYWORDS:

sex Pheromone, Pheromone trap, Spodoptera litura, trap, India

### INTRODUCTION

Spodoptera litura (F.) commonly known as the tobacco caterpillar is considered as a pest of national importance since it is polyphagous attacking several agricultural and horticultural crops. It has been reported from 51 countries causing damage to more than 120 species of plants belonging to 44 families. In India it feeds on 74 species of cultivated crops and some wild plants. Besides groundnut, it attacks tobacco, cotton, pulses and several vegetable crops (SINGH and JALALI,1997).

In India, the crop losses have declined from 23.3 per cent in post-green revolution era to 17.5 per cent at present. In terms of monetary value, the Indian agriculture currently suffers an annual loss of about Rs 8,63,884 million due to insect pests (DHALIWAL et al.,2010). In recent years farmer's income has declined substantially due to increase in the cost of inputs particularly in plant protection and adoption of inappropriate pest management practices. Use of pheromones under field conditions has been discussed in a book (NANDAGOPAL et al.,2008).

### ECONOMIC IMPORTANCE

Due to feeding of larvae during the seedling or flowering stage can result in 20% yield loss in groundnut. Severe outbreak of the pest can result in 30-40% loss in pod formation. At Dharwad, the pod loss was to an extent of 66.6% due to S. litura (KULKARNI, 1989). Studies at ICRISAT Centre indicated that the groundnut crop is vulnerable to defoliation during the early phase of the crop. In the first 50 days of seedling emergence, if the defoliation is <25% and after 50 days of crop age if the defoliation is around 50%, there would not be any effect on yield. However, there were a number of instances where total crop failures were reported despite intensive pest management practices (WIGHTMAN and RANGA RAO, 1993).

To manage this insect pesticides are resorted to such as cypermethrin resulting resistance ranging from 0.22 to 197 fold, fenevelerate 8 to 12 folds, endosulfan 1 to 13 folds, methomyl 0.7 to 19 folds; quinolphos 1 to 29 folds and monocrotophos 2 to 362 folds among the 22 strains of S. litura collected from different locations from Andra Pradesh (Arms et al., 1994;1997) . Hence, the atlternate techniques of this insect management was attempted (NANDAGOPAL et al.,1990; NANDAGOPAL and SONI,1993; NANDAGOPAL and GHEWANDE, 2004) and use of pheromones (PRASAD et al.,1985; RAO et al.,1989,1991; SINGH and SACHAN, 1991, 1993, 1993a; NANDAGOPAL and RATHOD,2007;PRASANNAKUMAR et al.,2012). In the rainy season, males of this insect started responding to pheromone traps soon after the sunset, with a small peak around 2000 hr (contributing only 10% of the total catch), and a small proportion continued to fly all through the night, with a peak around 0300 hr (19% of the catch). The same trend was noticed in the summer, with a peak activity around 0300 hr (24% of the total catch), but the initial activity was a little delayed. The observation with Rustrak flight detector fitted to a pheromone trap in summer also showed the same pattern, with a small peak at 2000 hr and the major activity at 0300 hr. The observation with night vision goggles also revealed the same trend, with 7% of the catch at 2000 hr and 41% of the catch around 0300 hr. it seems that under normal conditions the, optimum; male activity would be around 0300 hr, irrespective of the season. Similar studies conducted at Tamil Nadu Agricultural University, Tamil Nadu, India by DANDAPANI (1985) with this species showed. highest catch between 2000 and 2200. hr, while BALASUBRAMANIAN et al. (1985) reported peak catch at 2300-0000 hr and 0300-0400 hr. This could be due to the different chemical composition of the pheromone itself.

### TRAPPING OF MALES

In general, groundnut is grown mostly as monocrop in post rainy season, while it is grown as either intercropping with groundnut (4 to 6 rows) with castor or pigenpea one or two rows (in Saurashtra,Gujarat) or mono or mixed strip cropping in Saurashtra or in AP. , Tamil Nadu, Karnataka. As we know the S.litura occurs in groundnut as much as in castor.

Which type of trap would be better for trapping of males using pheromone in a suitable dispenser?. Before going in far designing the trap for trapping the attracted males in a pheromone trap, it is better to know the development of trap in India.

Tamaki et al.(1973) identified the pheromone components first and they again visualized the type of trap to be used. The authors (YASHIMA and TAMAKI,1974) designed two types of traps to try the synthesized pheromone components in the field conditions. As per their description of the traps, Type I was a box trap (34.5 X 24 X 23.5cm) having a rectangular window (3 X 6 or 3 X 9cm) on each side. A net cage (24 X 15 X 10cm) was held on the top inside the box to enclose virgin females or synthetic pheromone sources. Type II trap was a cylindrical (20 X 8 cm) having 4 windows (6cmi9n

diameter). The traps were filled with a dilute detergent solution (3% Gramin *, Sankyo Ltd,Tokyo) to prevent the escape of the males attracted. Traps were located at least 50m apart from adjacent traps and 1m above the ground level.

The same authors reported their results as with 1 µg 50 males were trapped during 11-12th of September month, while, there was only 4 males trapped during 10-11th of the September month. The drastic reduction in the catch, they attributed, for the high wind velocity. These authors coined the name of the lure as "Litlure". They also fixed the correct dose for Japan ecosystem as 39:1 ratio of the above two components of the pheromones, which could attract 318 males at 1 µg kept for 6 nights in 3 traps. Even 10:1 ratio of the two pheromone chemicals of S.litura could attract 305 males in the similar set up. They have also finalized the dose and time of retention of the chemicals as 1milligram in rubber septa as dispenser for 2 months period under field conditions.

SATO YASHUO et al.(1978) developed a dry trap for field catch of the S.litura. The trap was a box (30 X 25 X 8 cm) made of polyvinyl chloride plates. The trap had two ducts (section:3cm X 3 cm) the opening of which were attracted to the perforated end walls. On the shut end of the duct, a valve made of perforated thin plates was hung to lead the incoming males and to prevent their escape.

The authors have found that the weight of the valves had profound influence on the trapping of the males. Lower the weight of the valve (0.4g) more the % males trapped(80%), which means the valves as planned, retained the attracted males and not allowed for their escape. When they increased the weight of valves to 2 grams, there was no males could be trapped, probably, these highly weighed valves prevented the very entry of the attracted males. Interestingly, the width of splits in the valves do affected the trapping of males. In no split valves, there was no moths trapped, as no entry, while in3 mm split, there was 2 males and in 6 mm split, there was 51 males, while with 12 mm split, the males trapped were a little less (48.5 males).

It was Pawar et al.,(1984) who have constructed a trap from locally available materials, that was modeled upon a trap supplied by TDRI, London, was found to be more effective. The thus attracted was collected in a plastic bag through a funnel. This trap was designated as ICRISAT standard Trap.

The TDRI, London supplied a sleeve trap with a clearance space of 2.5 cm (entry space). But due to operation difficulties ( fitting of lure after every 4 weeks-probably), they have changed the clearance space to 5 cm.

Probably that was the reason why there was not much encouragement in the trapping of males. When Dr.G.V.Ranga Rao took over the research on S.litura at ICRISAT, he adopted the trap (RANGA RAO et al.,1991a,b) that was used by PAWAR et al.,(1984,1988).

RANGA RAO (1991a) published a excellent work on "development of standard pheromone trapping procedure for S.litura" They have screened four types of traps for this purpose. They have observed the mobility of the moths for 14 nights. In the results, They have reported that there was no difference between single funnel or double funnel in trapping equally higher males. When they have used 16 traps/ha, there was no significant increase in trap (690/week) compared to 571 males with 8 traps and 445 males with 4 traps (CD:264.7). The most important observation they made was the escape of males after trapping. In small and big sleeves there was escape of trapped males (70 and 62), whereas, in in double funnel and single funnel there was no escape of trapped males. For monitoring of S.litura they recommended 1m height in the initial and the data exhibits 4 m height also good at trapping the males (RANGA RAO et al. 1991b). Unfortunately, they have concluded that pheromone trap monitoring will not make the rightful impact on future pest control strategies. Also they have expressed a opinion that though double funnel trap was used, there was no significant moth catch.

**WHAT WE SHOULD KNOW IN DESIGNING AN EFFICIENT TRAP WITH PHEROMONE DISPENSER?**

As suggested by RANGA RAO et al.(1991a) that one needs to look for a better trap than this to ensure an efficient monitoring system". This has to understanding the actual mobility ( flying in and out). So, find out the facts about the mobility of this insect, a team was formed with author, three SRFs (trained in pheromone research in a ICAR scheme) visited the Main oilseeds research station at Tindivanam under TNAU, Coimbatore. One mg lure (rubber septa) was used in a two trap traps, one with 2 cm clearance space and another with 6 cm clearance space, keeping all other aspects, traps were prepared. Two traps were installed at 10 m distance and at each trap two persons were deployed for observation. The traps were installed at 1 night. Within a span of few minutes the males were started flying near the trap. More males were attracted to the trap. The entry of males by flying, landing and walking were observed. Males landed on the periphery and moved in to the trap, males entered in to the trap through flying, males moved out by flying, males moved out by walking were recorded. Entomologist know the insects and their activities. The following is the table which gives the males responded to the pheromone in two different traps with different clearance spacing. Our observation ended just 30 minutes past 5 am.

| Behaviour of male | 2cm (Clearance) | % to the trapped | % to the attracted | 6 cm (Clearance) | % to the trapped | % to the attracted |
|---|---|---|---|---|---|---|
| Males landed on the periphery and moved in to the trap | 52 | 91.2 | | 34 | 94.4 | |
| Males entered in to the trap through flying | 5 | 8.8 | | 2 | 5.6 | |
| Total males | 57 | | | 36 | | |
| Males moved out by flying | 1 | | 1.7 | 9 | | 15.8 |
| Males moved out by walking | 2 | | 3.3 | 12 | | 21.9 |
| Over all escape of moths | 3 | | 5 | 21 | | 36.8 |
| Total moths attracted | 60 | | | 57 | | |

Observed in one single night between 0100h to 0600h (Table is modified after the verification of original data on escape of males)(NANDAGOPAL and RATHOD,2007) - The clearance spacing was given 3 cm, the cut cylinder is of 4.5 height.

When they have observed the mobility of males, about 91 % males moved towards the lure and landed on the periphery to the trap in 2 cm clearance spacing, while it was 94% males landed on the trap with 6cm clearance spacing. The loss caused by escape of attracted moths are higher in the trap with 6cm clearance spacing i.e., 36.8%.The important point to be noted is that the escape from the attracted males are more in the 6 cm clearance trap. So the deciding factor is retaining the attracted males lies in the clearance spacing. If it is less the males attracted could not escape and it was only 5% in 2 cm clearance. The above given table shows the mobility of the males towards and away from the trap. Keeping this observation, we have modified the trap keeping the importance of clearance spacing in retaining the attracted males, a trap with 3.5 cm clearance spacing and 4.5 half cut funnel, and 55 cm sleeve length which facilitated the males moved in by walking and got trapped (NANDAGOPAL and RATHOD,2007). Based on the return movements of the males the below given trap is fabricated using the already available traps.

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