Mass trapping –A Promising technique for integrated management of pink bollworm, *Pectinophora gossyipiella* Saunders (Lepidoptera: Gelechiidae) **in cotton**

Abstract:

The management of Pink bollworm, a worldwide pest in cotton is mostly dependent on chemical insecticides which lead to several implications and warrant the exploration of other methods. Use of sex pheromones for management of insect pests is not a new-fangled one but need be studied extensively for effective pest management. Hence, a study was conducted at RARS, Lam, Guntur, Andhra Pradesh for two consecutive seasons to study the effectiveness of mass trapping in pink bollworm management. The experimental results showed that the mean moth catch was highest from sleeve traps when compared to funnel trap and delta traps with sticky liners irrespective of trap densities. The mean number of larvae and locule damage was significantly low coupled with high seed cotton yield from the plots with sleeve traps at trap densities of 50 and 20 traps/ha.

Key words: Pink bollworm, Pheromones, Mass trapping, trap density.

Introduction:

The pink bollworm (PBW), *Pectinophora gossypiella* Saunders (Lepidoptera: Gelechiidae) is a most ruinous pest of cotton worldwide causing colossal pecuniary loss both in terms of quantity and quality of the cotton lint. In India, upto 20.0 per cent yield loss by pink bollworm alone was reported in cotton by Agarwal and Katiyar (1979). Pink bollworm with worldwide distribution is known to adjust to any farming situation with much ease, since the activity of pink bollworm was high in early sown cotton crop (April to May) in North India, as well as is delayed sowings in Southern India (Mahalakshmi and Prasad, 2019). The management of pink bollworm is primarily through insecticidal application only, because of concealed nature of larva within the infested boll itself and hence which is not vulnerable to the activity of natural enemies, as well as to insecticides also to some extent (Athanassiou *et al*., 2002). Hence, farmers are taking up several sprays against pink bollworm which leads to outbreaks of secondary pests and development of insecticide resistance problems. Costly chemical tactics has resulted in economic calamity, destruction of natural enemies and environmental hazards (Ayaz *et al.*, 2020).

Colossal economic loss, elevated chemical control costs and manifestation of secondary pest problems due to more insecticidal interventions warrants the study of

alternative control strategies for sustainable management of pink bollworm. Use of pheromones for mass trapping or mating disruption with synthetic pheromone, use of cultural practices such as early sowing and early termination of crop and use of biocontrol agents has to be studied for their potential role in an integrated pest management program for pink bollworm. Extensive research was done on use of pheromones for management of pink bollworm worldwide. Pheromone is a chemical substance produced and released into the environment by an insect, affecting the behaviour or physiology of others of its same species in which they release a specific reaction or developmental process such as aggregation alarming and mating.

Hummel *et al*. (1973) identified the natural sex pheromone of pink bollworm, a 1:1 mixture of the Z,Z- and Z,E-isomers of 7,11-hexadecadienyl acetate, named ‘‘gossyplure’’. It has been used successfully to suppress PBW populations in commercial cotton fields by disrupting chemical communication among the adult moths (Baker *et al*., 1990). Pink bollworm has been the target of an intensive, long-term and successful mating-disruption effort (Staten *et al*. 1997) inmany cotton growing countries.

A variety of strategies have been employed, including applications of hollow fibres, chopped laminate flakes, sprayable microencapsulated pheromone, twist-tie ropes or laminate membrane dispensers (Welter *et al*., 2005).Mass trapping and disruption of mating communication are the two key methods which can be used for suppression of insect pest population by using pheromones. The principal of mass trapping is to remove enough individuals from the population to significantly reduce the number of matings and thus suppress the population and delay the build-up of subsequent generations. An obvious advantage of mass trapping over mating disruption is that male individuals are removed permanently from the population and thus reduces mating successand delaying the pest population build-up during later generations. Keeping the points in view, a field experiment was conducted to evaluate the efficacy of different traps with different trap densities for mass trapping as a tool for the management of pink bollworm.

Materials and Methods:

The experiment was conducted at Regional Agricultural Research Station, Lam, Guntur for two successive seasons i.e. Kharif 2016-17 and 2017-18. The variety, Suraj was sown in July second fortnight at 105 X 60 cm spacing in large plots. The trial was laid in a randomised block design with seven treatments which were replicated thrice and the treatmental details were given in Table.1. The different pheromone traps were installed

during the first week of November in the treatmental plots. Three different traps such as delta traps with sticky liner, funnel traps and sleeve traps were selected with two different densities such as 50 and 20 traps/ha. The lures such as pectino lure and PBW lures were used for the study. The season long pectino lure was used with low trap density i.e. lure with 120 days long capacity was used in low trap density (i.e 20 traps/ha) in both delta and funnel traps. Whereas the pectino lure was changed at 60 days in traps kept at high trap density (@50 traps/ha). The lure changing period was 45 days for PBW lure in sleeve traps at both the densities (Table.1). One check was maintained with standard funnel trap @ 10 traps/ha which is recommended trap density for monitoring purpose by ANGRAU, Guntur for comparison. The moth catch was recorded daily from all the traps and the larval incidence and locule damage from green bolls was recorded through destructive sampling at weekly interval from all the treatments. The sticky liner in the delta traps was replaced daily along with emptying of sleeve and funnel traps after data recording. The data on seed cotton yield was recorded at the time of harvesting. The experimental plots were protected against sucking pests with selective and relatively safer insecticides to maintain crop healthiness and to avoid yield losses due to sucking pests. The data thus obtained was subjected to statistical analysis after using appropriate transformations.

Locule damage % = (No. of infested locules / Total no. of locules) x 100

Results and Discussion:

The mean moth catch showed wide variation among the different traps with significant statistical differences. The mean moth catch was highest from sleeve traps when compared to funnel trap and delta traps with sticky liners. The highest trap catch of 54.17 moths/trap/week was recorded from the sleeve trap at 50 traps/ha density which was significantly higher over all the other traps and densities. It was followed by sleeve trap at a density of 20 traps/ha with 44.55 moths/trap/week and it was also found significantly superior over the remaining treatments in attracting the male moths of pink bollworm. Among the other two traps, delta traps found better and significantly superior over funnel traps with more adult trap catch. Delta traps recorded around 9.0 moths/trap/week while funnel traps recorded less than 5.0 moths/trap/week at both the densities. The mean trap catch was high from standard trap density of 10 traps/ha with pectino lure with 15 days lure changing period when compared to funnel trap and delta trap with high trap densities. However, the funnel traps

were found better when compared to delta sticky traps. The mean trap catch was 12.50 moths/trap/week from funnel trap at standard trap density used for monitoring and was significantly superior over funnel traps and delta sticky traps with high densities. The low trap catch by funnel and delta traps can be attributed to lower efficacy of lure used in those traps when compared to the lure used in sleeve traps. The results are in contrary with Athanassiou *et al*. (2002) who reported that the Funnel traps caught approximately 4.2 times more pink bollworm adults compared to the delta traps. But the results are in agreement with Shrinivas *et al*. (2019) who reported that sleeve trap was superior over the delta sticky trap. Attique *et al*. (2000), also reported that yellow funnel trap was best among yellow and white funnel, red and white delta traps and universal trap for catching efficiency against pink bollworm. The sleeve trap consists of a long polythene sack bag to seize the male moths that are attracted towards the pheromone source and they can hold huge number of moths and there will be no chance to escape for male moths from sleeve bag which is the reason for more efficiency of sleeve trap over the delta sticky trap was that,. Whereas, the delta sticky trap depends on the sticky liner placed in the trap to catch moths, which soon gets covered easily with the non target insects and there are more chances of escape for the PBW moths with the minimal damages to their legs and wings which do not affect their flight.

Though there were significant and wide differences in trap catch, numerically there was petite variation regarding larval incidence of pink bollworm among the different treatments. However, infestation of pink bollworm in the mass trapping experimental area was above the threshold level because of high pest pressure. The larval incidence was ranged from 6.06 to 11.78 no/10 green bolls among the treatments including standard trap density. The mean number of larvae was below 7.0 no/10 green bolls in sleeve trap erected plots which was significantly low when compared to all the other treatmental plots. Though, the trap catch was low from delta and funnel traps when compared to standard trap density, the larval population in green bolls was less from the plots where the traps were placed at higher densities than from the standard density of 10 traps/ha (Table 1) which can be attributed to the mating disruption at the higher trap densities, hence the larval population was low at higher trap densities. Small field sizes, moth migration or continuous emergence of moths may also influence the trap catch which may not reflect in terms of larval population. Mating disruption was effective in preventing damage when applied early season, but damage levels were not proportionally reduced in relation to the reduction of trap catches (Lykouressis *et al*., 2005). The results are in close proximity with Suthar *et al*., (2019) who reported that installation of 40 pheromone traps/ha, 30 cm above crop height at equidistantly one week

prior to flowering and changing the lure at one month interval till last picking of Bt cotton is found effective and economical for mass trapping of pink boll worm in Bt cotton with low larval densities in green bolls.

The per cent locule damage showed similar trend without significant differences among themselves except from the plots with sleeve traps. The locule damage was below 33.0 per cent in sleeve trap placed experimental plots which was significantly less when compared to all the other treatmental plots which recorded more than 38.0 per cent locule damage in green bolls. The per cent locule damage was high from standard plot (47.64 %) when compared to the plots with higher trap density irrespective of trap type. Patil*et al*., (2007) reported that mating disruption through PB-Rope L was effective which recorded less locule damage in both green bolls and open bolls along with lower larval incidence coupled with significantly higher seed cotton yield in cotton.

The seed cotton yield was ranged from 9.80 to 12.64 q/ha with significant differences among the different treatments. The seed cotton yield was highest from the plots erected with sleeve traps with more than 12.0 q/ha when compared to funnel and delta traps. The plots with higher trap densities recorded numerically high seed cotton yield when compared to lower densities irrespective of trap type. Prasad *et al*. (2009) reported higher seed cotton yield form mating disruption fields through PB Rope L when compared to control fields.

The experimental results showed that there are some significant differences in capture efficacy of different traps. Sleeve traps captured extremely higher number of moths, while funnel and delta traps fail to capture adult moths to considerable extent. Comparatively more number of moths were recorded from Delta traps than from funnel traps. In contrary, Athanassiou *et al*, (2002) reported higher trap catch from funnel trap when compared to Delta traps with sticky liner. However, lure plays a significant role in moth catch rather than trap type. However, the interpretation of trap catches meets with several difficulties, and often higher numbers of captured adults do not always reflect actual levels of population density, because captures are usually influenced by a variety of factors such as time of sunset, wind speed, temperature etc. which do not affect "absolute" sampling through collecting fruiting bodies (Henneberry and Naranjo, 1998). Secondly, different trap designs can provide completely different information about the seasonal abundance of the pink bollworm. As a result, the population fluctuation (as defined by captures) is likely to vary significantly depending on the trapping device used, and hence, traps are often poor indicators for

estimating pink bollworm population densities (Hutchison *et al*., 1991). In general, the main drawback of the use of adhesive traps is that the sticky surface is often "overloaded" with moths, dust or wing scales, which reduces trapping efficacy (Beasley and Adams, 1994a). But the success of population suppression of pink bollworm using mass trapping technique depends upon the constant capture of active males responding to pheromone, which is greatly influenced by various external and environmental factors. The immigration of mated females from vicinal fields still remains the main drawback of the mating disruption. Mating disruption method is reliable, easy to use and effective, but this method is most suitable for area wide pest management, under the IPM principles (Maruthi *et al*., 2020).

Conclusion and Future scope:

Mass trapping using gossyplure has the potential to become a promising technique in integrated management of pink bollworm which is the most alarming pest of cotton. Although the control rates are not very high enough for control of pink bollworm as a single strategy, it can be integrated with other measures. Farmers ought to combine biological control with cultural and pheromone control measures to combat the menace from pink bollworm.

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Table 1. Evaluation of pheromone traps and lures against Cotton Pink Boll worm through mass trapping at RARS, Lam, Guntur

Treatment	Lure	Lure Change Period in days	Trap Density /ha	Mean moth catch/ Trap/ Week *	Mean Number of Larvae/ 10 green bolls *	Per cent Locule damage in green bolls **	Yield (Q/ha)
Delta Trap with replacement sticky liner.	PCI-Pectino Lure	60	50	9.85 (3.29)	8.74 (3.12)	38.75 (38.52)	11.10
Delta Trap with replacement sticky liner.	PCI-Pectino Lure SL (Season Long)	120	20	9.18 (3.19)	8.79 (3.13)	38.84 (38.57)	10.45
Funnel Trap	PCI-Pectino Lure	60	50	4.92 (2.43)	8.71 (3.12)	40.01 (39.26)	10.72
Funnel Trap	PCI-Pectino Lure SL (Season Long)	120	20	4.91 (2.43)	9.29 (3.21)	41.16 (39.93)	10.46
Sleeve Trap	Phero – Sensor TM – SP - PBW LURE	45	50	54.17 (7.43)	6.06 (2.66)	30.97 (33.83)	12.64
Sleeve Trap	Phero – Sensor TM– BP – PBW LURE	45	20	44.55 (6.75)	6.77 (2.79)	32.81 (34.96)	12.14
Standard funnel trap	Phero – Sensor TM – SP - PBW LURE	15	10	12.50 (3.67)	11.78 (3.57)	47.64 (43.67)	9.80
F test				Sig	Sig	Sig	Sig
CD (p=0.05)				0.33	0.22	3.20	0.36
SEM				0.77	0.46	5.42	0.81
CV %				9.55	6.33	6.94	5.42

* figures in parenthesis are √X+1 transformed values

** figures in parenthesis are arcsine transformed values