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Impact of integrated pest management strategies for shoot and fruit borer in brinjal

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Abstract
Shoot and fruit borer, *Leucinodes orbonalis* Guen is the major pest of brinjal and cause heavy economic loss to brinjal growers. To avoid ill effects of insecticides, Integrated Pest Management strategies had been promoted through front line demonstrations in 10 farmers field in Tiruvallur District during 2014 - 15 and 2015-16. IPM strategies include clipping and disposal of infested shoots, removal of fruits with boreholes, installation of pheromone traps @ 12/ha, release of *Trichogramma chilonis* @ 8 cc/ha for 4 times at weekly interval, spraying of *Bacillus thurinjiensis* @ 1 kg/ha and Flubendiamide 20 WDG 7.5 g /10 lit. The mean of the parameters in 10 demonstrations during 2014-15 and 2015-16 revealed that shoot and fruit borer damage at vegetative phase as shoot damage was 13.6 per cent in IPM field and 19.6 in farmers practice (only insecticides). Fruit damage was found to be low 15.9 per cent in IPM field while in farmers practice it was 25.0 per cent. Fruit yield was found to be high, 32.8 t/ha in IPM field when compared to farmers practice (Non IPM). Benefit Cost Ratio also was found to be high (4.05) in IPM field where as the ratio is low (3.1) in farmers practice.

Keywords: *Leucinodes orbonalis*, *Solanum melongena*, integrated pest management, cultural practice, *Trichogramma chilonis*

1. Introduction
Brinjal eggplant, *Solanum melongena* (L.) is one of the most popular vegetables grown in different parts of India. Even though, the crop covers considerable area the productivity is low [7]. The main reason for yield loss is attributed to attack by shoot and fruit borer (*Leucinodes orbonalis* Guen.). The pest causes extensive yield loss varying from 37 to 63 per cent in various states of India [5]. Brinjal is grown in an area of 261 ha in Tiruvallur district in Tamil Nadu. Larvae bore inside the shoots at vegetative phase of crop growth and fruits at reproductive phase and thus it adversely affect plant growth, yield and fruit quality. Farmers rely only on insecticides to combat brinjal shoot and fruit borer damage [10, 17]. About 47 per cent insecticides are used for management of fruit and shoot borer out of the total pesticide consumed in vegetables. The indiscriminate and injudicious application of synthetic insecticides is the cause for the problems viz., increased production costs, residual toxicity, and development of pesticide resistance, resurgence, secondary pest outbreak, health risk environmental threats and destruction of natural enemies [6]. The scarcity of natural sources of resistance in Solanum species against shoot and fruit borer has been a major challenge to breed cultivars resistant to shoot and fruit borer [18]. Any single method of pest management cannot achieve a level of control acceptable to producers in the region. In this context, promotion of IPM strategy for brinjal shoot and fruit borer was made by the conduct of front line demonstrations in ten farmers field in Sorancheri village of Tiruvallur district during 2014-15 and 2015-16.

2. Materials and Methods
2.1 Integrated pest management strategy for shoot and fruit borer
Integrated Pest Management strategies (IPM) has been demonstrated in 10 farmers fields through front line demonstrations in Sorancheri village of Poonamallee block in Tiuvallur District, Tamil Nadu during 2014 -15 and 2015-16. Each farmer raised Ujala variety in an area of 0.1 ha. The IPM strategies viz., clipping and disposal of affected shoots, removal of fruits with boreholes, installation of pheromone traps @ 12/ha, release of *T.chilonis* @ 8 cc/ha for 4 times at weekly interval, spraying of *Bacillus thurinjiensis* @ 1 kg/ha and spraying of Flubendiamide 20 WDG 7.5 g /10 lit.

were demonstrated in the farmers field and all the 10 farmers adopted the technology.

Adjacent to the IPM field, another plot was maintained as control wherein farmers applied only insecticides and called as farmers practice. Farmers sprayed insecticides viz., monocrotophos, cypermethrin, lambda cyhalothrin, imidacloprid etc. Paired plot design was adopted. Observation on healthy shoots and shoots drooped at vegetative phase and healthy fruits and fruits with bore hole during each harvest were made and then per cent shoot and fruit damage was calculated.

$$\text{Per cent Shoot damage: } \frac{\text{No. of shoots drooped}}{\text{Total no. of shoots}} \times 100$$

$$\text{Per cent fruit damage: } \frac{\text{No. of fruits with borehole}}{\text{Total no. of fruits}} \times 100$$

For yield assessment, fruits were picked on weekly basis from demo plot and also in farmers practice during the entire growing period, weighed and the cumulative per plot yield of all the pickings were taken and transformed into total yield in tons per hectare.

2.2 Statistical analysis

The data collected were subjected to paired t test.

3. Results and Discussion

3.1. Integrated pest management strategy for shoot and fruit borer done during 2014-15

The mean of the demonstrations conducted during 2014 – 15 in 10 farmers field at Sorancheri village in Tiruvallur District revealed that the shoot and fruit borer damage assessed at vegetative phase as shoot damage was 14.2 per cent in IPM field and 19.7 in farmers practice (Non IPM). Fruit damage was found to be low 16.0 per cent in IPM field while in farmers practice it was 24.8 per cent. Fruit yield was found to be high, 33.4 t/ha in IPM field when compared to farmers practice which recorded the fruit yield of 27.1 t/ha. Since calculated t value 3.55 was more than table t value (2.282), the treatment was found to be significant. Benefit Cost Ratio also was found to be high in IPM field (4.0), where as the ratio is low (3.1) in farmers practice (Table 1).

Table 1: Shoot and Fruit damage, yield and economics during 2014-15

Treatment	Shoot damage (%)	Fruit damage (%)	No. of sprays	Yield (t/ha)	Net income (Rs.)	BCR
IPM plot	14.2	16.0	5.9	33.4*	301226	4.0
Farmers Practice	19.7	24.8	10.1	27.1	221934	3.1
SE (d)				0.50		
Calculated t value				3.55		
Table t value				2.282		

*Significant at 5 % level

3.2. Integrated pest management strategy for shoot and fruit borer done during 2015-16

The mean of 10 demonstrations conducted during 2015 – 16 in 10 farmers field revealed that shoot damage due to attack by shoot and fruit borer damage was 12.7 per cent in IPM field and in farmers practice it was 19.4 per cent. Fruit damage was found to be low 15.7 per cent in IPM field while in farmers practice it was 27.1 per cent. Fruit yield was found to be high, 32.1 t/ha in IPM field when compared to farmers practice which recorded the fruit yield of 26.2 t/ha. Since calculated t value 3.94 was more than table t value (2.282), the treatment was found to be significant. Benefit Cost Ratio also was found to be high in IPM field (4.1), where as the ratio is low (3.1) in farmers practice (Table 2).

Table 2: Shoot and Fruit damage, yield and economics during 2015-16

	Shoot damage (%)	Fruit damage (%)	No. of sprays	Yield (t/ha)	Net income (Rs.)	BCR
IPM plot	12.7	15.7	6.7	32.1*	301882.5	4.1
Farmers Practice	19.4	27.1	12.2	26.2	223609.0	3.1
SE (d)				0.38		
Calculated t value				3.94		
Table t value				2.282		

*Significant at 5 % level

The average data on 20 demonstrations conducted during 2014-15 and 2015-16 revealed that shoot and fruit borer damage during vegetative phase as shoot damage was 13.6 per cent in IPM field and 19.6 in farmers practice. Fruit damage was found to be low 15.9 per cent in IPM field while in farmers practice it was 25.0 per cent. Fruit yield was found to be high, 32.0 t/ha in IPM field when compared to farmers practice which recorded the fruit yield of 26.8 t/ha. Benefit Cost Ratio also was found to be high in IPM field (4.05), where as the ratio is low (3.1) in farmers practice (Fig. 1).

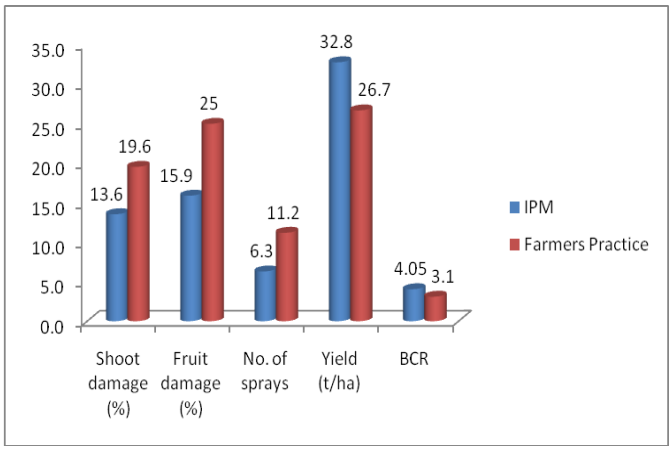

Fig 1: Average shoot and fruit damage, yield and BCR during 2014-15 and 2015-16

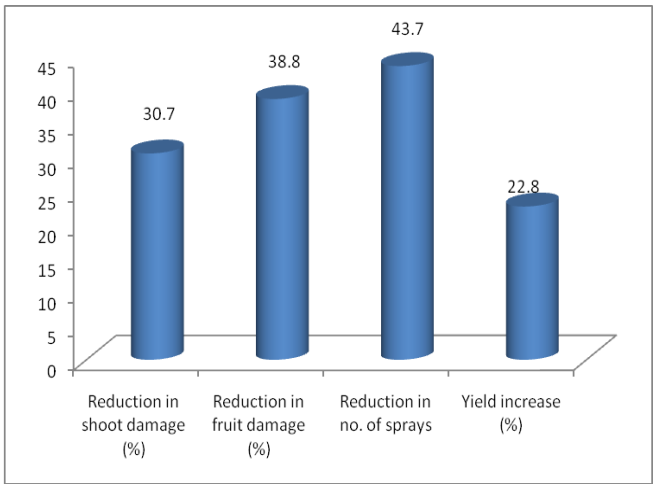

Fig 2: Impact of adoption of IPM strategies during 2014-15 and 2015-16

Adoption of IPM strategies resulted in reduction in the shoot damage (30.7 %) and fruit damage (38.8 %) which lead to the increased fruit yield of 22.8 per cent (Fig. 2). It was coincided with the results of Satpathy *et al.* [12] that adoption of IPM strategies viz., clipping and disposal of affected shoots, removal of fruits with boreholes, installation of pheromone traps @ 12/ha and release of *T.chilonis* and spraying of insecticide reduced the shoot and fruit borer damage. Alam *et al.* [1] and Cork *et al.* [4] revealed that in Asia, now-a-days, major emphasis is being given on biological control as an alternate to the insecticides for management of the pest. Khorsheduzzaman *et al.* [8] reported that more than a dozen parasitoids and three pathogens have been recorded as natural enemies of *L. orbonalis*. Inundative release of bio agents, particularly egg parasitoids in pest management may be more advantageous.

The adult activity was monitored using sex pheromone traps and the moth catch was found to be high (15 moths / trap/ week) during second week of January, 2015. This is inconformity with the results of the Alam *et al.* [1] and Cork *et al.* [4], who reported that sex pheromone traps as a component of IPM significantly reduced the fruit damage and increased the yield of brinjal in South Asia. Besides, Srinivasan [14] reported that sex pheromones are important component of IPM programmes and they are mainly used to monitor as well as mass-trap the male insects. The study is in conformity with the results of Srinivasan and Babu [13] who revealed that significantly high numbers of male moths in India and Bangladesh were caught by the use of pheromone trap. Delta traps, water traps and funnel traps could be used for the shoot and fruit borer sex pheromone lures in field conditions. However, the trap design that would attract more numbers of insects will vary from one location to the other. Hence, it had to be confirmed in repeated field experiments.

Srinivasan and Huang [15] and Srinivasan and Babu[13] suggested that pruning and prompt disposal of infested brinjal shoots at regular intervals up to the first harvest is an important component in the shoot and fruit borer IPM strategy. Removal and prompt destruction of the infested shoots and fruits at regular intervals have been suggested as an effective strategy to manage the shoot and fruit borer on brinjal in South and Southeast Asia [9, 2]. This pruning is especially important in early stages of the crop growth, and this should be continued until the final harvest. This will be more effective when it is being followed by the whole community in a particular region than an individual grower. In addition, this pruning will not adversely affect the plant growth as well as yield [16].

Egg parasitoid *T. chilonis* was found to be effective against *L. orbonalis*. The efficacy of *T. chilonis* may further be enhanced by improving the release technique and better integration with other tactics [11]. Adoption of IPM strategies for brinjal shoot and fruit borer resulted in less no. of insecticide spray, less plant protection cost, more fruit yield and high benefit cost ratio.

Adoption of IPM strategies resulted in reduction in the no. of sprays 43.7 per cent (Fig. 2) which is inconformity with the finding of Baral *et al.* [3] who reported that IPM adopters sprayed pesticides 52.6% less often than non –IPM farmers.

4. Conclusion

Shoot and fruit borer causes extensive yield loss in brinjal. Its management practices by the farmers are by and large limited to frequent sprays of chemical insecticide without much impact on the yield. Such practice of pesticide usage is detrimental to environment, also increases the cost of production and chances of insecticide residues in the fruit. The adoption of IPM strategies in brinjal particularly for shoot and fruit borer reduced the shoot and fruit damage and also reduced the pesticide usage by 43.7 per cent, which lead to increase in fruit yield by 32.8 per cent and higher benefit cost ratio. Besides, adoption of IPM strategies alleviated the above said problems without altering the insect fauna (predators and parasitoids) which automatically maintains the pest defender ratio in brinjal ecosystem.

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