*2012 International Conference on Clean and Green Energy*
*IPCBEE vol.27 (2012) © (2012) IACSIT Press, Singapore*

# Management of Brinjal Shoot and Fruit Borer: Dilemma of Adopting Bt Brinjal over Integrated Pest Management Technology

Anjali Mathur[1+], N.P.Singh[1] and Swaroop Singh[2]

[1]Department of Zoology, University of Rajasthan, Jaipur-302055, India

[2] Department of Entomology, Agricultural Research Station, Durgapura, Jaipur

**Abstract.** Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee is a major pest of brinjal or eggplant which is an important and popular vegetable grown in India. With the advent of novel Bt brinjal, key challenges are raised with Indian perspective. Therefore, integrated pest management (IPM) strategy comes as a direct tool that includes several old and new techniques with alternatives like newer botanicals and microbial formulation and use of female sex pheromones and resistant cultivars to cut down on pest infestations. Field trials were carried out to evaluate different IPM modules for the management of *Leucinodes orbonalis* Guenee. Local brinjal cultivars of semi arid region of Rajasthan like Pusa puple long - 74 and Navkiran were found to be promising varieties with low shoot and fruit infestation. Newer botanical oils of pungam (*Pongamia pinnata* L.) and iluppai (*Madhuca indica*) in IPM modules proved to be quite effective in lowering both shoot and fruit infestation and can thus be utilized in resistance management strategy. In addition, use of female sex pheromone for BSFB resulted in significant number of moth traps. Thus the efforts to expand the use of IPM technology can be beneficial in holistic manner. The current scenario of Bt brinjal can have a great scope if incorporated as part of IPM technology.

**Keywords:** *Leucinodes orbonalis,* plant products, microbial pesticides, botanical oils, IPM

## 1. Introduction

Brinjal eggplant *(Solanum melongena* L.) is an agronomical important, highly cosmopolitan and popular vegetable grown as poor man's crop in India. It contributes 9 percent of the total vegetable production of the country. The area under brinjal cultivation is estimated at 0.51 million ha with productivity of 16.08 t/ha. Among the insect pests the most destructive and serious pest of brinjal is brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee (Lepidoptera: Pyraustidae). It remained a major pest of brinjal since two decades. The main difficulty in evolving a suitable control measure against this pest is that it belongs to one of the most serious categories of insect pest internal feeder. Once the larva bores into petiole and midrib of leaves and tender shoots, it causes dead hearts. In later stages, it also bore into flower bud and fruits. The research and development activities to combat BSFB have largely been confined to screening pesticides to select the most effective chemical and determining the frequency of their use. This has led to increased dependence on pesticides and consequent adverse effects of higher costs of production, environmental pollution, destruction of natural enemies, and development of pesticide resistance in BSFB. The current pesticide use is not only non-sustainable but, if continued, it will adversely affect eggplant and other vegetable production. The advent of genetically modified crops (GMO) has already raised many key challenges in research. With the pros and cons of GM foods still doing the rounds, a new technology called the IPM or Integrated Pest Management is now hitting the headlines. Despite the importance of brinjal and severity of BSFB control measures are still limited to frequent sprays of toxic chemical pesticides. Any single method of pest management cannot achieve a level of BSFB control acceptable to producers in the region. Integrated Pest Management which incorporates several old and new techniques to cut down on pest

[+] Corresponding author. Tel.: 91-9414903311.
*E-mail address*: anjalipcr@yahoo.co.in

infestations can help ensure the growth of healthy crops. The incorporation of biopesticides and IPM technology is also gaining importance in recent years.[1, 2, 3, 4] Thus an attempt has been made for to evaluate various components of Integrated Pest Management (IPM) for the control of *L. orbonalis*.

## 2. Objectives

Our primary objective is therefore to manage this pest so as to bring down pest population to low ebb rather than to totally annihilate the species. Integrated Pest Management comes as a direct tool that includes array of alternatives like exploration of botanicals & microbial formulations. Since, IPM is a continuum that will change with time, present study aims at evaluation of newer botanical oils, like oil of iluppai (*Madhuca indica*), pungam (*Pongamia pinnata*), and microbial formulation like Entomopathogen Fungi, (*Beauveria bassiana)* for the effective management of *L. orbonalis*.

## 3. Study design and Methodology

Field experiment was conducted at Agricultural Research Station (ARS), Durgapura, Jaipur (Rajasthan), (Study area) situated at 450 meters above mean sea level on altitude 26.49˚ and longitude 75.48˚. Bio-efficacy of newer botanicals biopesticides and microbial formulations for the management of *L. orbonalis* were evaluated with Brinjal variety, Krishna Gold in Randomized Block Design (RBD) with three replications. The plot size was 2m × 2m. with 50cm and 50cm spacing. Endosulfan was kept as check insecticide. Water was directly added to all foliar spray of insecticides to get desired concentration. A knapsack sprayer was used for spraying and insecticides were applied @ 500-700 litres per hectare according to the growth stage of the plants. In all treatments there were three foliar sprays in each season, starting after 25 days of transplanting and repeated subsequently at 15 days interval. Care was taken to avoid drifting of insecticides to neighboring plots. The borer infestation was recorded on shoot and fruits on randomly selected five plants from each treatment per plot. The borer damage in shoot was assessed on five tagged plants by counting the number of damaged shoots per plant to total number of shoots of the plant and expressed in percentage. Finally damaged shoots were taken alone for estimation. Shoot damage by *L. orbonalis* was assessed by recording total number of shoots observed as well as affected shoot from each treatment and the percentage of damage was worked out. Fruit borer incidence was estimated by recording the total number as well as weight of the affected and unaffected fruits from each plot separately at every picking and the cumulative per cent damage was worked out. The percentage data for the damaged shoots and fruits were converted into its angular transformation. Data were subjected to analysis of variance (ANOVA).

## 4. Results: IPM modules using resistant cultivars, biopesticides, newer botanicals and microbial formulations and use of female sex pheromones

### 4.1. BSFB resistant cultivars

Insect resistance in crop plants is an important component of integrated pest management (IPM) and is considered as non-monetary input at farmers end. Use of both tolerant and resistant cultivars is helpful in IPM as quantum of insecticide use is reduced and it also improves the performance of natural enemies in plants. Local six brinjal varieties/cultivars studied for resistance to brinjal shoot and fruit borer in semi arid region of Rajasthan revealed that Pusa purple long-74 and Navkiran were fairly resistant with low shoot and fruit infestation (Table-1). None of the six varieties were immune to brinjal shoot and fruit borer. The susceptible varieties were BR-112 and Navneet while remaining varieties were graded as tolerant based on percent fruit damage. Efforts have also been made in India with few dozens of eggplant accessions and they ended with few or none as resistant to EFSB [5, 6,7]

### 4.2. Bioefficacy of botanicals and microbial formulation

The management of insect pests using botanicals and biopesticides are proving to be cornerstone in integrated pest management. There were six treatments in all including control using Iluppai oil (2%), Pungam oil (2%), Pungam oil (1%) + Iluppai oil (1%), Entomopathogen Fungi @ 750ml /ha (*Beauveria bassiana),* and Endosulfan 35 EC ( 1ml/l) as check insecticide. Results as shown in Table-1 revealed that as compared to Endosulfan with 14.23 percent fruit damage, both iluppai oil and pungam oil were significantly effective in controlling shoot and fruit borer with 15.93 percent and 16.3 percent fruit damage respectively. The data for fruit yield also showed that both iluppai oil and pungam oil were able to increase the yield significantly over control and were found to be at par with endosulfan. Efficacy of iluppai oil and pungum oil in management of shoot and fruit borer was also shown by earlier workers.[8] The microbial insecticide *Beauvaria bassiana* was found effective only for control of shoot borer at early stage of plant growth. The high efficacy of microbial formulation of fungi was not observed probably due to lack of high humidity conditions in field as required for growth of fungus which was probably not suitable owing to the semi-arid conditions.

### 4.3. Female sex pheromones as part of IPM module

Sex pheromones are important component of IPM programs and they are mainly used to monitor as well as mass-trap the male insects.(E)-11-hexadecenyl acetate (E11-16: Ac) was identified as the major component of EFSB sex pheromone in China.[9] It was synthesized in the laboratory and used at the rate of 300-500 ug per trap to attract the EFSB males in the field and was also identified from the sex pheromone glands of EFSB in Sri Lanka.[10,11] Delta traps, sticky traps and funnel traps could be used for the EFSB sex pheromone lures in field conditions. The optimal trap height is also important factor and varies with locations. The traps placed at crop canopy level caught significantly more male moths than traps placed 0.5 m above or below the crop canopy in Bangladesh[12] whereas traps installed 0.25 m above crop canopy caught higher moths than either at crop canopy or at 0.25 m below crop canopy in Uttar Pradesh.[13]The traps should be erected at every 10 m or less for effective attraction.[14] Present studies revealed that use of pheromone traps was found effective in reducing shoot damage and fruit infestation with 46.15 percent protection and 25.6 percent protection over control respectively, thus, the BSFB sex pheromone traps as a component of IPM significantly reduced the fruit damage.

### 4.4. Future thrust of IPM technology and biotechnology input: Bt brinjal

A farmer's choice of which crops to plant and thus the ability to select disease and pest resistance ones has always been a cornerstone of IPM. The adoption of IPM application is still low owing to a number of socio-economic, institutional and policy constraints. Crop varieties with disease and pest resistant characteristics which include GM crops have gained quite a controversy. Under prevailing Indian economical and ecological conditions, decision making for the use of novel Bt binjal still needs a serious thought. *Bacillus thuringiensis (Bt)* brinjal has some obvious advantages. It also has some apparent and some potential problems. Sole promotion of GM crops may lead to a monoculture with unpredictable and irreversible environmental and health hazards. At the same time there is an emerging consensus that modern petrochemical- based farming is unsustainable and there is a need to develop and promote ecological approaches to food production.

Current scenario reflects that GM crops can be most effective when they are used as part of IPM strategies. On the same lines the prospects of India's first GM vegetable, Bt brinjal is still under consideration for commercial use. Therefore, resistance management is a primary challenge in the current direction of biotechnology in pest management. IPM promotes a more diversified approach which will limit over reliance on any specific technology and its consequences such as resistance development. Therefore a holistic planning in a synchronized mode will help the farmers to manage biological complex farming systems in a profitable manner.

## 5. Acknowledgements

The first author is thankful to University Grants Commission, New Delhi for providing financial grant to carry out the research work.

## 6. References

[1] Kumar. Prabhat, and Johnsen. Steffen. Life cycle studies on fruit and shoot borer, *Leucinodes orbonalis* and natural enemies of insect pest of eggplant (*Solanum Melongen*a). *J. Appl. Biol*. 2000, 10 (2):178-184

[2] Bajpai. N.K, Swami. Hemant, Kumar. Ashok, and Gupta. I.N. Development of IPM modules for brinjal shoot and fruit borer, *Leucinodes orbonalis Guene*. National conference on Applied entomology: current status, challenges and opportunities. 2005, September 26-28

[3] Sardana. H.R, Bambawale. O.M, Kadu. L. N, and Singh. D.K. Development and validation of adaptable IPM on okra *Abelmoschus esculentus* Moench through farmer's participatory approach. *Ann. Pl. Protec. Sci*. 2004, 13(1):54-59

[4] Srinivasan. R. Integrated Pest Management for eggplant fruit and shoot borer (*Leucinodes orbonalis*) in south and southeast Asia: Past, Present and Future. *Journal of Biopesticides* 2008, 1 (2): 105-112.

[5] Darekar. K. S, Gaikwad. B. P, and Chavan. U. D. Screening of eggplant cultivars for resistance to fruit and shoot-borer. *Journal of Maharashtra Agricultural Universities,* 1991, **16**(3): 366-369

[6] Singh. T. H, and Kalda. T. S. Source of resistance to shoot and fruit borer in eggplant *(Solanum melongena* L.). *PKV'Research Journal,* 1997, **21**(2): 126-128.

[7] Behera. T.K, Narendra. Singh, Kalda. T. S, and Gupta. S.S. Screening for shoot and fruit borer incidence in eggplant genotypes under Delhi condition. *Indian Journal of Entomology*, 1999, 61(4):372-375

[8] Adiroubane, D, and Raghuraman, K. Plant products and microbial formulation in the management of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee). *Journal of Biopesticides* 2008, 1 (2): 124-129.

[9] Zhu. P, F. Kong, S. Yu, Y. Yu, S. Jin, X. Hu. and J. Xu. Identification of the sex pheromone of eggplant borer *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae). *Zeitschrift Fur Naturforschung C-A Journal of Biosciences,* 1987, **43C**:1347-1348.

[10] Attygalle. A. B, Schwarz. J, and Gunawardena. N. E. Sex pheromone of brinjal shoot and pod borer *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae: Pyraustinae). *Z. Naturforsch,* 1988, **43C:** 790-792.

[11] Gunawardena, N. E., Attygalle, A. B, and Herath, H. M. W. K. B. The sex pheromone of the brinjal pest, *Leucinodes orbonalis* Guenee (Lepidoptera): problems and perspectives. *Journal of the National Science Council of Sri Lanka,* 1989, **17**(2): 161-171.

[12] Cork. A, Alam. S. N, Rouf. F. M. A, and Talekar. N. S. Female pheromone of brinjal fruit and shoot borer, *Leucinodes orbonalis:* trap optimization and preliminary mass trapping trials. *Bulletin of Entomological Research,* 2003, **93:** 107-113.

[13] Alam. S. N, Rashid. M. A, Rouf. F. M. A, Jhala. R. C, Patel. J. R, Satpathy. S, Shivalingaswamy. T. M, Rai. S, Wahundeniya. I, Cork. A, Ammaranan. C, and Talekar. N. S. Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia, Technical Bulletin TB28, AVRDC - The World Vegetable Center, Shanhua, Taiwan, 2003, 66 **PP** .

[14] Prasad. H, Singh. H. M, and Singh. A. K. Effective range of sex pheromone of *Leucinodes orbonalis* Guen. *Journal of Applied Zoological Researches,* 2005, **16**(1): 8182

Table 1: IPM modules using resistant cultivars, newer botanicals and microbial formulation

| BSFB resistant cultivars | | | Bioefficacy of botanicals & microbial formulation | | | | |
|---|---|---|---|---|---|---|---|
| cultivars | %shoot damage | % fruit damage( wt. basis) | Treatments | %shoot damage | % fruit damage( wt. basis) | % yield gain(q/ha) | % gain over control |
| Pusa purple long-74 | 1.06(5.91) | 14.29(22.21) a b | Iluppai oil(2%) | 4.72 (12.53) | 15.93 (23.49) | 194.75 | 70.83 |
| Pusa purple cluster | 2.86(9.74) | 31.98(34.44) c d e | Pungam oil(2%) | 4.64 (12.42) | 16.30 (23.77) | 194.13 | 70.28 |
| Pusa anmaol | 3.42(10.66) | 31.34(34.04) c d e | Iluppaioil(1%)+Pungam oil (1%) | 7.64 (16.02) | 19.88 (26.44) | 186.83 | 63.88 |
| BR-112 | 6.99(15.33) | 37.97(38.04) e f | Entomopathogen fungi | 8.52 (16.94) | 22.83 (28.50) | 177.33 | 55.55 |
| Navkiran | 1.05 (5.88) | 11.64(19.95) a | Endosulfan | 4.31 (11.96) | 14.23 (22.13) | 215.33 | 88.88 |
| Krishna | 3.77(11.20) | 34.30(35.85) c d e | Control | 15.50 (23.15) | 37.25 (37.58) | 114.00 | --- |
| Sem | 0.63 | 2.17 | Sem | 0.73 | 1.35 | 6.05 | --- |
| CD at 5% | 1.89 | 6.55 | CD at 5% | 2.25 | 4.14 | 18.56 | --- |
| CV | 11.31 | 12.40 | CV | 8.19 | 8.65 | 5.76 | --- |

* Fig. in parenthesis are arc sine values