# A Review on efficacy effect of newer insecticides and biopesticides against brinjal shoot and fruit borer [*Leucinodes orbonalis* (Guenee)]



**Abstract**:-

Eggplant Solanum melongena is one of the most important vegetable of hot and wet climatic zones. There are 26 insects-pests species and few non insect pests species infesting brinjal shoot and fruit borer *Leucinodes orbonalis* major pest considered the main constraint as it damages the crop throughout the year. The loss of yield due to the pest ranges from 70 to 92 percent. This situation has posed a hindrance to the farmers in commercial cultivation of brinjal . After reviewing the research papers, It was found that Newer insecticide and biopesticides were significantly superior, such as spinosad 45SC, followed by Indoxacarb 14.5SC and Emmaectin benzoate 0.5SG .

INTRODUCTION

Brinjal cultivation in India faces significant challenges from a variety of pests at different stages of growth. severely by number of pests, shoot and fruit borer (*Leucinodes orbonalis*), epilachna beetle (*Epilachna vigintioctopunctata* Fab.), jassid (*Amrasca biguttula biguttula* Ishida), aphid, thrips and white flies (*Bemicia tabaci* Gennadius). Among these pests, the shoot and fruit borer, Leucinodes orbonalis G.,is widely regarded as the most destructive pest affecting brinjal crops in India.The infestation on brinjal can be as high as 75 to 92% Brinjal crop is attacked regularly or Brinjal in India is sporadically attacked by at least 50 insect pests, with Aphids, Jassids, Whiteflies, and Shoot and Fruit Borers being categorized as major pests that regularly afflict the crop. **(Pooja and Kumar, 2022)** Among the insects pest the most important *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae). It stands out as the most destructive and consistently recurring pest, inflicting significant crop losses. (**Umapathy *et al*., 1991**) and furthermore liable for weakening of natural product this characteristic ultimately impacts the market value of organic produce (**Mathiranjan *et al*., 2000)** and (**Das *et al*., 2008**). The infestation intensity by the pest can reach levels as high as over 90% (Bhutani *et al*., 1976; Kalloo *et al*., 1988). Yield losses have been estimated to range from 86% (Naresh *et al*., 1986) in Haryana to approximately 83 to 91% in Uttar Pradesh (Patel *et al*., 2021).

DAMAGING PATTERN AND BIOLOGY OF *Leucinodes orbonalis*

At beginning phase of the crop, the female moth lays eggs generally on the lower side of the leaves close to midrib, at the highest point of shoot or some of the time even on delicate shoots itself (**Basu *et al*., 1968; Singh and Singh 2003**). Drooping, wilting or withering of shoots are typical symptoms of shoot damage during the beginning phase of growth (**Srinivasan *et al*., 1998; Rakibuzzaman *et al*., 2019)**. After fruit formation larvae generally enter from the underside of the calyx or bud or fruit (**Briere *et al*., 1999**). The holes observed on the fruits are indeed the exit points of the larvae. (**Singh and Singh, 2003**). Significant harm is noticed each year, influencing antagonistically, the quality and yield of the harvest (**Colinet *et al*., 2015).**

It alone results in damage as high as 85.90%, with instances of up to 100% damage also documented. The larvae bore into tender shoots, causing wilting and dead heart. In later stages, they bore into the tender fruits, rendering them unsuitable for human consumption. So far, (*Leucinodesorbonalis*) is considered as a major pest of brinjal as shoot and fruit borer in established crop in main field **(Halder *et al*., 2015)**

The flat-oval eggs were laid most frequently at night. The average number of eggs laid perfemale was 121.5 ± 0.449 and of these 79.24% were viable. There were 6 larval instars. The egg, larval and pupal periods were 6.0 ± 0.058, 15.38 ± 0.214 and 11.5 ± 1.11 days, resp. The average longevities of males and females were 4.0 ± 0.707 and 7.5 ± 0.267 days, respectively. It's also reported that there will be a reduction in vitamin C levels. content to an extent of 68 per cent in the infestedfruits. It was reported that the shoot and fruit borer (on shoot) were more prevalent during the vegetative phase of crop. **(Yadav *et al*., 2015)**.

Damage is caused by caterpillars that are creamy white when young but become light pink as they mature. when full grown having length 18-23 mm. Generally larva undergoes 5 -6 instars, (**Raina and Yadav 2017)**

It seems to match the developmental stages of Leucinodes orbonalis, the eggplant fruit and shoot borer, quite closely. Let's break down the stages:

**Newly hatched larva**: Tiny, creamy or dirty white in color with a dark brown or light black head. It has three pairs of thoracic legs and five pairs of pro legs. This is typical of many moth larvae, including Leucinodes orbonalis, upon hatching.

**2nd instar larva**: Resembles the first instar larva but is larger in size and may appear somewhat darker in color. This is also common in many moth larvae as they molt and grow between instars.

**3rd instar larva**: Longer than the 2nd instar larva and darker in color. The prothoracic legs, the legs near the head, are dark brown in color. This stage represents further growth and development.

**4th instar larva**: Takes on a more pinkish coloration. This could indicate changes in the larva's diet or metabolism as it progresses through its development.

**5th instar larva**: Has a pinkish-brown color with three distinct segments of the thorax and five pairs of well-developed prolegs. This is likely the final instar before pupation.

These descriptions align well with the developmental stages typically observed in Leucinodes orbonalis larvae. Monitoring these stages can be crucial for implementing control measures effectively and managing infestations in eggplant crops.**(Shaukat *et al*.,2018)**

The pupal period of BSFB varies: in summer, it lasts for 7-10 days, while in winter, it extends to 13-15 days pupation **(Shaukat *et al*.,2018).** Pupation of this pests takes place generally in soil and also in dried shoots, leaves or plant refuse or derbies fallen on the ground. **(Butani and Verma 1976)** The BSFB moth is white in colour with a blackish-brown spot on the dorsum of the thorax and abdomen. Whitish wings and pinkish brown tinge and are tinged ringed with small hair along the apical and anal margin(**Raina and Yadav 2018)**

**Table 1. Newer insecticides and their mode of actions on insect pests**

| S.No. | Newer insecticides | Mode of action |
|---|---|---|
| 1 | Chlorantraniliprole | Coragen binds to a specific receptor in muscles known as the ryanodine receptor. When chlorantraniliprole attaches to this receptor, it prompts muscle cells to release calcium, resulting in abnormal muscle function. This resultsin paralysis and eventual demise of the insect. The ryanodine receptor differs between insects and mammals, with coragen binding much more strongly to the insect receptor (Cordova *et al*., 2006 & Sattele *et al*., 2008). It primarily affects insects when ingested (FHHERA, 2019). Additionally, coragen is toxic to insect eggs, larvae, and pupae upon contact (Brugger *et al*., 2018 & Krishan *et al*., 2021). |
| 2 | Flubendiamide | Masaki *et al.* (2006) showed that FBD stimulates Ca2+ pump activity is hindered by reducing the coupling between RyRs and the pump, leading to a decrease in internal calcium concentration. This particular mode of action of FBD causes various disruptions in muscle function in the target insect, resulting in symptoms of poisoning such as rapid cessation of feeding and contractile paralysis and regurgitation leading to the death of insect. |
| 3 | Thiacloprid | Thiacloprid is an insecticide of the neonicotinoid class.Its mechanism of action is akin to other neonicotinoids and entails disrupting the insect's nervous system through. stimulating nicotinic acetylcholine receptors(USEPA.2012 & Schuld and Schmuck, 2000). |
| 4 | Carbofuran | It is a systemic insecticide,Carbofuran also has contact activity against pests. It is one of the most toxic pesticides still in use (APDM 2020). |
| 5 | Indoxacarb | Insecticidal activity occurs via blockage of the sodium channels in the insect nervous system and the mode of entry is via the stomach and contact routes(USEPA 2000). |
| 6 | Emmamectin benzoate | When sprayed to foliage, emamectin benzoate penetrates the leaf tissue and forms reservoir within treated leaves, which provides residual activity against pests that feed on foliage and ingest the substance when feeding. The proposed formulation is intended to translocate within the tree's vascular system upon injection (USEPA 2009). |
| 7 | Spinosad | The specific mode of action of spinosad is to alter the function of nicotinic and GABA-gated ion channels, causing rapid excitation of the insect's nervous system, resulting in involuntary muscle. contractions, tremors, paralysis, and death (Fulton *et al*., 2013) |

**Table 2. Bio pesticide and their mode of action on insect pest**

| S.No. | Bio pesticide | Mode of action |
|---|---|---|
| 1 | Bt | The most approved and widely accepted primary mode of action of the Bt toxin is the lysis of epithelial cells in the midgut of the insect. The toxin acts from the exterior of the cells and enters the plasma membrane, but it does not. enter the cytoplasm. (Liu *et al*. 2018) |
| 2 | *Beauveria bassiana* | Insect death is caused by starvation as the fungus takes over the internal structures of the insect, ultimately resulting in outward penetration of the cuticle and sporulation on the mummified body of the host (Urquiza *et al*.,2015). |
| 3 | *Metarhizium anisopliae* | The fungus Metarhizium anisopliae strain F52 infects insects that come in contact with it. Once the fungus spores attach to the outer surface of the insect, they germinate and begin to grow. Upon penetrating the external exoskeleton of the insect, they proliferate rapidly inside, including the insect to die(USEPA 2003). |
| 4 | Neem oil | Most active component for repelling and killing pests (USEPA.,2012) |

**Efficacy of various insecticides and biopesticides**

Studies on chemical control of *L. orbonalis* revealed that, treatments of Emamectin benzoate 5% SG and Coragen 18.5% SC proved to be the most effective. The insecticides viz., Azadirachtin 5% EC and *Bacillus thuringiensis* 5% WP were found least effective against shoot and fruit borer. The remaining treatments viz., Spinosad 45% SC, Lambda cyhalothrin 5% EC, Pyriproxyfen 5% EC + Fenpropathrin 15% EC were found moderately effective(Vinayaka *et al*.,2019) Naik and his co-workers study resulted that the results of chemical control trial profenofos @ 0.1% and spinosad @ 0.015% were most effective in reduction of shoot infestation of *L. orbonalis* besides recording higher brinjal fruit yield. Among the 15 treatments tested, profenofos proved to be the most effective, followed by spinosad individually. Their combinations with novaluron and Azadirachtin were highly effective in reducing the population as well as in giving higher yields (Naik *et al.,* 2008). Reults of another trail stated that Emamectin benzoate 5SG @ 50gm/lit was found most effective and showed (8.71%) shoot infestation and per cent fruit infestation (7.22%) followed by Spinosad 45 SC @ 0.02ml/lit (10.13) and (7.69), Cypermethrin 25 EC @ 2ml/lit (11.51) (Shyamrao *et al.*,2018)**.** The treatments, namely chlorantraniliprole 18.5 SC (0.4ml/l), spinosad 45 SC (0.5ml/l), chlorpyriphos 10 SC (2ml/l), indoxacarb 14.5 SC (1ml/l), *Bacillus thuringiensis* (Bt) (2g/l), Azadirachtin 0.03EC (5ml/l), *Metarhizium anisoplae* (2.5g/l), *Beauveria bassiana* (2.5g/l) and chlorpyriphos 20EC (2.5 ml/l) were applied thrice at fifteen days interval starting from initiation of BSFB infestation. Mean shoot infestation was lowest in coragen plots (6.32%) followed by spinosad, chlorpyriphos indoxacarb. Among bio-pesticides, *Beauveria* and *Bt* were identified as effective treatments in reducing shoot infestation. Coragen achieved the lowest fruit infestation (8.25%) and highest marketable fruit yield (250.30q/ha) followed by spinosad and chlorpyriphos. (Tripura *et al.,* 2017). the different insecticidal treatments, by application of Emamectin benzoate 25 WG@0.4gm/lit recorded lowest fruit damage of 6.95% with highest yield of 351.46 qt/ha. However, it was at par with Spinosad 45 SC@0.5 ml/lit with fruit damage of 8.06% and yield of 341.75 q/ha. (Mane and Kumar 2020). The bio-insecticides and botanicals tested included: Emamectin benzoate 5 SG @ 75 g a.i/ha, Spinosad 45 SL @ 18 g a.i/ha, NSKE 5%, Karanj seed extract 5%, Onion extract 5%, Garlic extract 5%, Tobacco extract 5%, Cannabis (bhang) leaf extract 5%, Wood ash 10 g/ plant and compared with control. Results showed that Emamectin benzoate 5 SG (75 g a.i/ha) treated plots exhibited the lowest infestation and resulted in higher fruit yield (313.85 q/ha) followed by Spinosad 45 SL (18 g a.i/ha) and NSKE (5%) which gave 300.58 and 284.33 q/ha fruit yield respectively. The least effective treatment was Wood ash (10 g/plant), yielded only 225.14 q/ha healthy fruits. The highest cost-benefit ratio was obtained from Emamectin benzoate 5 SG 75 g a.i/ha (1:21.23) treated plots. Tobacco leaf extract 5% treated plots though ecofriendly but gave least cost-benefit ratio (1:1.27). This study suggests the utilization of bio-insecticides and botanicals as they demonstrate significant efficacy in managing the brinjal shoot and fruit borer infestation (Verma *et al.*, 2021).

(Jat and Shrivastva 2023) revealed that all the treatments were found significant superior over control. The economics pattern of newer insecticides viz., Spinosad 45 SC, followed by Indoxacarb 14.5 SC and Emamectin benzoate 5 SG. It can be concluded that the most effective control of brinjal shoot and fruit borer was achieved with the insecticide Spinosad 45 SC after two sprays at the recommended intervals and doses.

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