Original Research Article

Efficacy of some insecticides, biopesticides and botanicals against shoot and fruit borer (*Leucinodes orbonalis* G.) on brinjal (*Solanum melongena* L.)

Abstract

A field experiment was conducted during *kharif* 2020 at Sakri Dist. Dhule Maharashtra (India) to determine efficacy of some insecticides, biopesticides and botanicals against shoot and fruit borer (*Leucinodes orbonalis* Guenee.) on brinjal (*Solanum melongena* L.). The efficacy result showed that the Emamectin benzoate 5% SG (10.35% and 15.91%) found most effective followed by Cypermethrin 25%EC (11.49 and 17.32%), Spinosad 45%SC (14.06 and 18.77%), NSKE 5% (15.43 and 20.31%), *Bacillus thuringiensis* var *kurstaki* 54% (15.96 and 22.30%) and *Beauveria bassiana* 1×10^8 CFU (16.53% and 23.45%) was next effective treatment. Among all the treatments Garlic Bulb extract 3% (17.15% and 24.69%) is found be least effective but comparativelysuperior over the control. The best and most economical treatment was Emamectin benzoate 5%SG (1:3.3), followed by Cypermethrin 25% EC (1:3.1), Spinosad 45% SC (1:2.6), NSKE 5% (1:2.5), *Bacillus thuringiensis* var *kurstaki* (1:2.4), *Beauveria bassiana* 1×10^8 CFU (1:2.1), Garlic Bulb extract 3% (1:1.9) as compared to control (1:1.1). Emamectin benzoate 5%SG (179q/ha) followed by Cypermethrin 25% EC (163q/ha).

Keywords: B iopesticides, botanicals, Emamectin benzoate, *Leucinodes orbonalis* Guenee and *Solanum melongena*.

Introduction

Vegetable cultivation is one of the most profitable and dynamic branch of agriculture. It has become an important source of income for both farmers and field labours, serving as a vehicle for reducing poverty in rural areas. Brinjal (*Solanum melongena* L.) also known as eggplant is referred as the “King of vegetables” originated from India and now grown as a vegetable throughout the tropical, sub-tropical and warm temperate areas of the world. Brinjal is one of the most important common vegetable grown around the year under intensive cultivation practices. The major constraint in cultivation of brinjal is infestation of shoot and fruit borer.

(*Leucinodes orbonalis* Guenee.)

"It is an important vegetable grown in all the seasons. Due to its nutritive value, consisting of minerals like iron, phosphorous, calcium and vitamins like A, B and C, unripe fruits are used primarilyas vegetable in the country. It is also used as a raw material in pickle making and as an excellent remedy for those suffering from liver complaints. It has been reported as Ayurvedic medicine for curing the diabetes. In addition, it is used as a good appetizer, good aphrodisiac, cardio tonic, laxative and reliever of inflammation" (Nawale *et al*., 2018).

"Brinjal (*Solanum melongena* L.) is one of the popular vegetables favored by the people of many countries *viz*., Central, South and South East Asia, some parts of Africa and Central America" (Harish *et al.*, 2011). "Apart from India, the other major brinjal growing countries are China, Turkey, Japan, Italy, Indonesia, Iraq, Syria, Spain, and Phillippines. Brinjal is one of the most commonly grown vegetable crop in the country" (Yadav and Tayde, 2018).

"Amongst the solanaceous vegetables, brinjal is one of the most common, popular, principle annual crop grown in all the three seasons and economically important vegetable among small-scale farmers as it is a source of cash income for resource poor farmers. The major brinjal growing states in India are, Andhra Pradesh, Karnataka, West Bengal, Tamil Nadu, Maharashtra, Orissa, Uttar Pradesh, Bihar and Rajasthan. In India, West Bengal contribute highest area 181.5 million hectare and production 2877 million tonnes, Karnataka has highest productivity 25.4 million tonnes per hectare. In Uttar Pradesh, the area under cultivation of brinjal is 3430 hectare producing 111.70 MT and the productivity is 8 MT/ha" (Yadav *et al.*, 2015).

"Though brinjal is a summer crop, it is being grown throughout the year under irrigated condition. Hence, it is subjected to attack by number of insect pests right from nursery stage till harvesting" (Regupathy *et al.*, 1997). "Among the insect pests infesting brinjal, the major ones are shoot and fruit borer, *Leucinodes orbonalis* (Guenee), whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Amrasca biguttula* (Ishida), and non-insect pest, red spider mite, *Tetranychus macfurlanei.* Of these, *L.orbonalis* is considered the main constraint as it damages the crop throughout the year. It is known to damage shoot and fruit of brinjal in all stages of its growth. The yield loss due to the pest is to the extent of 70-92 per cent" (Reddy and Srinivas, 2004; Chakraborti and

Sarkar, 2011; Jagginavar *et al* 2009). “The infested fruits become unfit for consumption due to loss of quality and hence, lose their market value. It is also reported that there will be reduction in vitamin C content to an extent of 68 per cent in the infested fruits” (Hemi, 1955).

“Damage to fruits particularly in autumn, is very severe and the whole crop can be destroyed. It alone causes damage as high as 85.90% and even up to 100% damage is also recorded. The larvae boreinto tender shoots and cause wilting and dead heart and in later stage, they bore the tender fruits rendering them unfit for human consumption. So far, *L. orbonalis* Guenee is considered as a majorpest of brinjal as shoot and fruit borer in established crop in main field” (Nawale et al., 2018). “ It is also reported that there will be reduction in vitamin C content to an extent of 68 per cent in the infested fruits. It was reported that the shoot and fruit borer (on shoot) were more prevalent during vegetative phase of crop. The yield loss by this pest varied from 0.08-1.11 q/ha on the basis of inconsumable pest of damaged fruits and 0.46- 3.80 q/ha when whole of the damaged fruits were taken into consideration. It was reported that the borer infestation was 78.66% on top shoots in vegetative phase and then shifted to flowers and fruits with infestation reaching 66.66% in fruiting phase”. **(Nawale *et al*., 2018).**

The major pest of this economically important crop, farmers always apply the potent toxicant with unnecessarily high frequency during the total cropping duration. Thus, the insecticides which were potent to the pest at the beginning become ineffective due to the resistance development among the pest population. This has promoted the necessity for the development and use of new safer and more ecologically acceptable biorational insecticides as a part of IPM programs affecting specifically harmful pests, while sparing beneficial insect species and other organisms. Keeping this in view, the present study was carried on the field evaluation of effectiveness of biorational insecticides against *Leucinodes orbonalis* (Guenee) on brinjal and on yield **(Devi *et al*., (2015). (Alam *et al*., 2003)**, pollution and health hazards **(FAO, 2003).** Again the question of residual toxicity of pesticides in brinjal is another big threat to our vegetable exports in the foreign markets **(Islam *et al*., 1999)**. Therefore, environment friendly management approaches to manage pests and diseases in agriculture using botanicals (Javaid *et al*., 2020; Khan *et al*., 2020; Jabeen *et al*., 2021) and biocontrol agents (Javaid *et al*., 2018; Khan and Javaid, 2022) are highly necessary to reduce environment and health hazards . "Various non-chemical approaches like biopesticides, botanicals, clean cultivation, mechanical control like hand picking and destroying of infested plant parts particularly shoots and fruits are common practices used for suppressing the insect pests" **(Hassan, 1994). "**Due to lack of knowledge and unavailability of non- chemical pest management approaches, growers of Bangladesh mostly depend on insecticides to keep the crop production steady. Appropriate knowledge and availability of botanical pest management approaches and their integration with selective chemicals may give better results against brinjal shoot and fruit borer. Considering the circumstances, the present study was conducted to evaluate the effectiveness of some ecofriendly management approaches against *L. orbonalis* in brinjal field"**. (Chowdhury *et al*., 2017).**

"New generation biorational pesticide molecules have been claimed to be effective as well as safer for non-target organisms" **(Sontakke *et al*., 2007; Misra, 2008)**. "Journal of Entomology and Zoology Studies With a view on the climate change projections for India, an attempt has been made here to study the impact of the likely changes in weather factors in relation to shoot and fruit borer on brinjal crop under Western UP agroclimatic conditions". **(Saran *et al*., 2018).**

Materials and methods

The experiment was conducted at during the *kharif* season 2020. The site selected uniform, cultivable with typical sandy loam soil having good drainage. The Brinjal seedlings of variety 'Gallan' were transplanted after 35days at 60 cm x 60 cm spacing. The experiment was laid down in randomized block design (RBD) with eight treatments replicated thrice with each plot size of 2m X 2m and proper irrigation was provided. The treatments comprising of Emamectin benzoate 5%SG Cypermethrin 25%EC , Spinosad 45%SC , NSKE 5% , *Bacillus thuringiensis* var *kurstaki* 54% and *Beauveria bassiana* 1×10^8 CFU Garlic Bulb extract 3% and were applied two times using knapsack sprayer in 15 days of interval. From each plot five plants were selected randomly and labeled for recording observations. As soon as the infestation of pest was initiated, the observations on total number of larvae on brinjal of five observational plants from each treatment replication wise were recorded at 3^{rd}, 7^{th} and 14^{th} days after imposing treatments. The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of

RBD experiment. After harvesting of brinjal from each individual plots produce were calculated to work out the yield of the treatments. Yield of healthy heads was converted into quintal per hectare.

The observations on the larval population were recorded visually per plant from five randomly selected and tagged plants in each plot. The insecticides were sprayed at recommended doses when larval population reaches its ETL level. Larvae count was taken 24 hours before spraying at tagged plant at 5 tagged plants per treatment, which was further converted into per plant population and subsequent observation was recorded at 3rd, 7th and 14th days after spraying on same plants.

The healthy marketable yield obtained from different treatments was collected separately and weighted. The cost of insecticides and biopesticides used in this experiment was obtained from nearby market. The total cost of plant protection consisted of cost of treatment, sprayer, rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from the total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

Results and discussion

The results after 1st and 2nd spray revealed that all the treatments were significantly superior to control in managing the pest infestation of *Leucinodes orbonalis* Guenee.) on brinjal. The data on the Per cent (%) infestation of shoot borer on third, seventh and fourteenth day after spray revealed that all the treatments were significantly superior over control. Among all the treatments lowest Per cent (%) shoot, infestation was recorded in Emamectin benzoate 5% SG followed by Cypermethrin 25% EC followed by Spinosad 45%SC and NSKE 5%, then treatments *Bacillus thurimgiensis* var. *kurstaki* 54% and *Beauveria bassiana* 1×10^{8} CFU followed by treatments Garlic bulb extract 3%, were found be least effective but significantly superior over the control. Treatments T6 and T7 are non- significant to each other, Treatments T7 and T5 are non-significant to each other, Treatments T5, T1, T3 and T4 are non-significant to each other, T1, T3, T4 and T2 are non-significant to each other

The data on the Per cent (%) infestation of shoot borer on third, seventh and fourteenth day after second spray revealed that all the treatments were significantly superior over control. Among all the treatments lowest Per cent (%) shoot, infestation was recorded in Emamectin benzoate 5% SG followed by Cypermethrin 25% EC followed by Spinosad 45%SC and NSKE 5%, then treatments *Bacillus thurimgiensis* var. *kurstaki* 54% and *Beauveria bassiana* 1×10^{8} CFU followed by treatments Garlic bulb extract 3%, were found be least effective but significantly superior over the control. Treatments T6 and T7 are non- significant with each other, treatments T7 and T5 are non-significant with each other, treatments T5 and T1 are non-significant with each other and Treatments T3, T4 and T2 are non-significant with each others.

Table 1 : Percent shoots and fruit infestation of Earias vittella

Treatments		Percent shoots and fruit infestation of *Earias vittella*							
		First spray				Second spray			
		3rd DAS	7th DAS	14th DAS	Mean	3rd DAS	7th DAS	14th DAS	Mean
T_0	Untreated	20.35	22.65	29.91	24.30	25.00	28.14	33.31	28.82
T_1	NSKE 5%	15.94	14.20	16.14	15.43	20.70	18.00	22.23	20.31
T_2	Garlic Bulb extract 3%	17.68	15.26	18.52	17.15	24.20	23.09	26.79	24.69
T_3	*Bacillus thuringiensis* var. *kurtaki* 54%	16.69	14.52	16.68	15.96	21.91	20.85	24.15	22.30
T_4	*Beauveria bassiana* 1×10^{8} CFU	17.31	14.54	17.76	16.53	22.65	21.65	26.04	23.45
T_5	Spinosad 45% SC	14.46	12.84	14.88	14.06	19.68	16.63	20.00	18.77
T_6	Emamectin benzoate	11.20	8.84	11.01	10.35	17.11	12.88	17.73	15.91

	5% SG								
T7	Cypermethrin 25%EC	11.54	10.01	12.92	11.49	18.28	14.82	18.85	17.32
Overall Mean		15.64	14.11	17.23	15.66	21.19	19.51	23.64	21.44
F-test		S	S	S	S	S	S	S	S
C.D		1.678	1.452	1.833	2.915	1.644	1.440	1.835	2.558
SE(m)		0.548	0.474	0.598	0.952	0.537	0.470	0.599	0.835
SE(d)		0.775	0.671	0.846	1.346	0.759	0.665	0.847	1.181
C.V		6.065	5.821	6.015	10.525	4.387	4.173	4.389	6.744

CONCLUSION

Treatment Emmamectin benzoate was found to be most effective when consideredfrom view point of per cent shoot and fruit damage and benefit cost ratio BCR (if all thetreatment produced were sold at equal price). Emmamectin benzoate belongs to the chemicalgroup semi Synthetic Avermectin. The specific mode of action of Emmamectin benzoateit inhibits muscle contraction, causing a continuous flow of chlorine ions in the GABA and H-Glutamate receptor sites. The resistance risk is assessed to be low moderate because of thecurrent pest situation and the intended use of Emmamectin benzoate in India and it was one ofinsecticide that showed negligible effect on predator, pollinators and parasitoids. Thisselectivity beneficial to arthropods makes Emmamectin benzoate a strong tool for Integrated Pest Management programs.

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