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TS Panwar
Department of Entomology, Dr. B.R. Ambedkar University of Social Science Mhow, Indore, Madhya Pradesh, India

VK Garg
Dean, JNKVV, College of Agriculture, Ganjbasoda, Vidisha, Madhya Pradesh, India

Satyendra Patel
Manager-Product Development, ADAMA India Pvt. Ltd., Hyderabad, Telangana, India

S Balpande
Department of Entomology, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

Corresponding Author:
VK Garg
Dean, JNKVV, College of Agriculture, Ganjbasoda, Vidisha, Madhya Pradesh, India

Biorational management of *Leucinodes orbonalis* on brinjal

TS Panwar, VK Garg, Satyendra Patel and S Balpande

Abstract
Five biorational insecticides *viz., Azadiractina* 1% (1000ppm) Neem oil, *Beauveria bassiana* 1% WP, *Bacillus thuringiensis* var *kurstaki* 5% WP, *Metarhizium anisopliae* 1.0% WP and NSKE were tested against Shoot and fruit borer (*Leucinodes orbonalis* Guenee) larvae on brinjal. The two-year experiment was conducted during *Rabi* 2018-19 and 2019-20 at the Rehti Farm of school of agriculture, Mhow, BRAUSS, (MP). The efficacy of these biopesticides was recorded in terms of percent shoot damage, percent shoot drooping and percent fruit damage. At the end of two sprays in respective years, the results proved that the microbial pesticides *viz., B. thuringiensis* var *kurstaki* 5% WP, *B. bassiana* 1% WP, *M. anisopliae* 1% WP were the best. The results recorded for the percent shoot damage showed *B. thuringiensis* var *kurstaki* 5% WP (9.5%), *B. bassiana* 1% WP (8.83%), *M. anisopliae* 1% WP (9.50%) in 2018-19 and during 2019-20, *B. thuringiensis* var *kurstakii*5% WP (8.17%), *B. bassiana* 1% WP (10.50%), *M. anisopliae* 1% WP (10.67%). The percent shoot drooping showed that *B. thuringiensis* var *kurstakii*5% WP (25.28%), *Beauveria bassiana* 1% WP (35.57%), *M. anisopliae* 1% WP (37.72%) in 2018-19 and during 2019-20, *B. thuringiensis* var *kurstakii* 5% WP (27.06%), *B. bassiana* 1% WP (36.62%), *M. anisopliae* 1% WP (37.06%). The percent fruit damage recorded lowest in *B. thuringiensis* var *kurstakii*5% WP (5.94%), *B. bassiana* 1% WP (10.87%), *M. anisopliae* 1% WP (13%) in 2018-19 and during 2019-20, *B. thuringiensis* var *kurstakii* 5% WP (6.82%), *B. bassiana* 1% WP (10.35%), *M. anisopliae* 1% WP (12.15%).

Keywords: Brinjal, *L. orbonalis Azadiractina, B. thuringiensis* var *kurstaki, B. bassiana, M. anisopliae*

Introduction

Brinjal (*Solanum melongena* L.) or eggplant belongs to the family Solanaceae and is a species of night shade which in British English is commonly known as aubergine (Tsao and Lo 2006) [15]. It is one of the chief solanaceous vegetables it is rich in vitamins, antioxidants and phenols grown throughout the world (Gürbüz *et al.*, 2018) [3]. After tomato, brinjal secures its place as the second most grown vegetable belonging to family Solanaceae, in major parts of India in all cropping seasons; except at very high altitudes. It is one of the most highly consumed vegetables in India, Nepal and other South Asian countries (Thapa, 2010) [13]. India cultivated over 760,000 ha. of land with an average annual production of 126,95,000 metric tonnes with a productivity of 16.70 t/ha. West Bengal, Orissa, Andhra Pradesh and Gujarat are the leading producer states in the country for cultivation of Brinjal. In Madhya Pradesh cultivated over the 54372.3 ha. of land and production 1135041.61 (DA&FW 2019-20) [1]. One of the major factors which is responsible for low productivity of brinjal is a variety of insect pests which not only reduce the yield but quality also with brinjal of which the brinjal shoot and fruit borer (*L. orbonalis* G.), aphids (Aphis gossypi Glover), brinjal leaf roller (*Eublemma olivacea* Walker), brinjal mealy bug (*Phenacoccus insolitus* Green), jassid (*Amrasca biguttula biguttula* Ishida and *Amrasca devastans* Distant), white flies (*Bemisia tabaci* Gennadius and *Trialeuro desvaporariorum* Westwood), hadda beetle (*Henosepilachna vigintioctopunctata* (Fabricius), are found to be abundant on this crop (Patial and Mehta, 2008) [8]. Among these all-insect pests brinjal shoot and fruit borer has been reported to severe infesting pest which is reduces the crop yield up to 60 - 70% and inflicts the huge loss in production (Singh and Nath, 2010) [12]. A number of chemical insecticides have been reported to be effective against this pest (Gautam *et al.*, 2019 and Tiwari *et al.*, 2009) [2, 14], but they are regarded as ecologically unacceptable. Brinjal being a vegetable crop, use of chemical insecticides will leave considerable toxic residues on the fruits. The use of bio-pesticides has come up into vogue during the last two decades. Bio-pesticides have target selectivity, environmental compatibility, economic-feasibility, novelize mode of action and considered as much safer for the environment and other living organisms as well as rational approach at a long run. Identifying and appreciating the needs of decayable goods for safer and biodegradable products, emphasis is in favour of bio-pesticides (Patel *et al.*, 1993) [7]. The new era of organic farming has driven the search for effective and eco-friendly tactics for pest management. Several scientists have explored the utility of bio-pesticides as a potential source to manage the shoot and fruit borer. Therefore, there is an increased social pressure to replace them gradually with biopesticides which are safe to human and non-target organisms. In this context, present studies were undertaken during *Rabi* of 2018-19 and 2019-20.

Materials and Methods

The experiment was laid out in simple Randomized Block Design (RBD) with six treatments including untreated control, using four replications. The plot size was 6.0 × 4.5 m^2 keeping row to row and plant to plant distance of 60 cm and 45 cm, respectively on evaluation of bio-pesticides against fruit and shoot borer on brinjal during 2018-19 and 2019-20 at experimental field of Department of Entomology, Rehti Farm of school of agriculture Mhow, BRAUSS, (MP) The seeds of variety Samidha (VNR) was sown on 1 October of 2018 and 2019. There were six treatments including control. All the five bio pesticides treatments were applied as foliar spray. The untreated (control) plot was also maintained for the comparison with water spray. The first spray was given on economic threshold level of the fruit and shoot borer, whereas, the second spray was given after one fortnight of the first spray. Observations on BS&F were recorded one day before each spray as pretreatment and after 3, 7 and 14 days up to two spraying at weekly interval observation number of drooping shoots, percent shoot infestation and percent fruit damage by counting of healthy and damaged fruits from 5 plants/plot. The dropping of the brinjal plant was recorded by counting of total number of drops shoot per block. The data recorded on different parameters were calculated using the following formula-

$$\%\ \text{shoot/fruit infestation} \frac{\text{Number of shoot/fruit damage}}{\text{Total number of shoot/fruit observed}} \times 100$$

Results and Discussion

Percent shoot damage

During *Rabi* 2018-19, the mean data recorded at the end of first spray indicated that *B. thuringiensis* 5% WP was significantly better with 3.92 per cent shoot damage and which was at par with *B. bassiana* 1% WP (5.08%) and *M. anisopliae* 1% WP (5.33%). The NSKE 5% was observed 8.08% shoot damage and which was found second best and it was at par with neem oil 1% (8.17%). The maximum 10.40% shoot damage was noted in untreated control. The pooled mean data noted at the end of second spray indicated that *B. thuringiensis* 5% WP was found significantly superior (9.50%) over rest of the treatments except *B. bassiana* 1% WP (8.83%) and *M. anisopliae* 1% WP (9.50%). The NSKE 5% and neem oil was recorded least effective in term of shoot damage. The maximum 18.58% shoot damage was observed in untreated control (Table 1).

In the *Rabi* 2019-20, the overall mean data after first spray noted that *B. thuringiensis* 5% WP @ 300 gm/ha (4.50%) again proved better and it was statistically significant differed from all other treatment. The *B. bassiana* 1% WP @ 3000 gm/ha (6.50%) was found second best in activity and which was at par with *M. anisopliae* 1% WP @ 3000 gm/ha (6.67%), NSKE 5% @ 2500 gm/ha (7.17%) and neem oil @ 1500ml/ha. (7.75%). The maximum 11.17% shoot infestation was recorded in untreated control. In general mean observations at the end of second spray have revealed that *B. thuringiensis* 5% WP @ 300 gm/ha (8.17%) again proved better and it was statistically significant from all other treatment. The *B. bassiana* 1% WP @ 3000 gm/ha (10.50%) was found second best in activity and which was at par with *M. anisopliae* 1% WP @ 3000 gm/ha (10.67%). Rest of the treatments showed similar trends to mean data of first spray (Table 1).

Percent shoot dropping

During *Rabi* 2018-19, the observation noted at end of first spray showed that *B. thuringiensis* 5% WP was significantly superior over all other treatments (7.91) including untreated control. The *B. bassiana* 1% WP was found second best (10.74%) and which was at par with *M. anisopliae* 1% WP (11.48%), NSKE 5% (11.67%) and Neem oil (12.90%). The mean observation noted after second spray showed that *B. thuringiensis* 5% WP was recorded minimum percent shoot dropping with 25.28 and it was significantly superior over rest of the treatments. *B. bassiana* 1% WP was found second best being 35.57 per cent shoot dropping. Although, activity of *M. anisopliae* 1% WP was observed as next best being 37.72 per cent shoot dropping but at par with Neem oil (32.24%) and NSKE 5% (39.52%).The maximum 44.59 percent shoot dropping was noticed in untreated control (Table 1).

In the *Rabi* season 2019-20, the results at the end of first spray indicated that on the whole mean observation noted that *B. thuringiensis* 5% WP was significantly proved better over all other treatments with 9.16 per cent shoot dropping including untreated control. The *B. bassiana* 1% WP was found second best (12.41%) and which was at par with *M. anisopliae* 1% WP (12.94%), NSKE 5% (13.43%) and Neem oil (13.62%). At the end of second spray, the maximum 19.43% shoot dropping was found in untreated control. The mean minimum per cent shoot dropping was noted in plot treated with *B. thuringiensis* 5% WP (27.06%) and it was significantly superior over rest of the treatments. Although, activity of *B. bassiana* 1% WP was observed as next best with 36.62 per cent shoot dropping but at par with *M. anisopliae* 1% WP (37.06%), NSKE 5% (39.39%) and Neem oil (40.47%). The maximum 44.64 percent shoot dropping was noticed in untreated control (Table 2).

Percent fruit damage

During *Rabi* season 2018-19, the overall mean observations reported at the end of two sprays indicated that the plot treated with *B. thuringiensis* 5% WP was found significantly superior (8.81%) followed by *B. bassiana* 1% WP (11.42%), *M. anisopliae* 1% WP (11.29%) NSKE 5% (12.67%) and Neem oil (14.11%).

In the *Rabi* 2019-20, the overall performance of biopesticides were found to be that *B. thuringiensis* 5% WP again proved the most effective and significantly superior (6.82%) over rest of the treatments. The *B. bassiana* 1% WP was recorded 10.35% fruit damage and it was at par with *M. anisopliae* 1% WP (12.15%) followed by NSKE 5% (14.49%) and neem oil (15.43%).

Present study was strongly supported with the finding of Yin (1993), Patnaik and Singh (1997), Puranik *et al.* (2002) and Mathur *et al.* (2012) [16, 9, 10, 6] they reported that *B. thuringiensis* gave better protection against *L. orbinalis*in in comparison to others biopesticides. Raja *et al.* (1998), Krishnakumar and Krishnamurthy (1998) [11, 5] also agreed to present results and they found that NSKE was effective for control of *L. orbinalis* whereas Jay Pratap *et al*. (2018) [4] contradicted with present finings and they noted that NSKE 5% was most effective followed by *B. thuringiensis, V. lecanii* and *B. bassiana.*

Table 1: Bio-efficacy evaluation of biopesticides against damage of brinjal shoot and fruit borer during *Rabi* 2018-19 and 2019-20

Treatment name	Formulation (gm/ml)	2018-19			2019-20		
		Shoot Damage (%)	Shoot Drooping (%)	Fruit damage (%)	Shoot Damage (%)	Shoot Drooping (%)	Fruit damage (%)
Azadiractina 1%(1000 ppm) Neem oil	1500	14.25 (22.18)	38.24 (38.20)	14.11 (22.06)	14.67 (22.52)	40.47 (39.51)	14.09 (22.05)
Beauveria bassiana 1% WP	3000	8.83 (17.29)	35.57 (36.61)	11.45 (19.78)	10.50 (18.91)	36.62 (37.24)	11.64 (19.95)
Bacillus thuringiensis/var *kurstaki* 5% WP	3000	7.33 (15.71)	25.28 (30.19)	8.81 (17.27)	8.17 (16.61)	27.06 (31.35)	8.83 (17.28)
Metarhizium anisopliae 1.0% WP	2500-5000	9.50 (17.95)	37.72 (37.89)	12.25 (20.48)	10.67 (19.06)	37.06 (37.5)	12.16 (20.41)
NSKE 5%	25 kg	13.17 (21.28)	39.52 (38.95)	13.03 (21.16)	12.75 (20.92)	39.39 (38.88)	13.62 (21.66)
Untreated Control		18.58 (25.54)	44.59 (41.9)	16.50 (23.97)	20.00 (26.57)	44.64 (41.92)	16.40 (23.81)
SEm±		0.77	0.39	0.59	0.57	0.35	0.55
CD (p=0.05)		2.45	1.22	1.85	1.81	1.10	1.72

() Figures in parenthesis are square root transformed value

Conclusion

It can be concluded from present finding that the B. *thuringiensis*.

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