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The evaluation of insecticides against *Leucinodes orbonalis* on Brinjal (*Solenum melongena*) Crop

Ankita Sahu, Dwarka and R Pachori

Abstract
On the basis of overall mean fruit damage, all the insecticidal treatments recorded significantly less fruit damage as compared to control (19.94%). Among the treatments Emamectin benzoate (7.75%) maintained superiority followed by Chlorantraniliprole (9.05%). The next best treatments were Flubendiamide (10.11%) followed by Indoxacarb (10.75%) and Lambda cyhalothrin (11.00%) but were found to be at par with each other. Other treatments were least effective but superior over control. All the insecticidal treatments recorded significantly higher fruit yield as compared to control (132.06 q/ha). Highest yield 265.61 q/ha was recorded with treatment Emamectin benzoate 5 SG @ 200 g /ha.

Keywords: Fruit damage, Lambda cyhalothrin, Chlorantraniliprole, Emamectin benzoate and Flubendiamide

Introduction

Brinjal, *Solanum melongena* L. is one of the most important vegetables grown in South-East Asia where hot and wet climate prevails (Thapa, 2010) [26]. It belongs to the family Solanaceae. India is the second largest producer of vegetables in the world, next to China. It is rich in nutritive value and contains vitamins, proteins, minerals and carbohydrates. Brinjal is known to have ayurvedic properties and is good for diabetic patients. It has also been recommended for those suffering from liver complaints. It is available everywhere at reasonable price. Hence, is known as "poor man" vegetable (Wankhede and Kale, 2010) [27]. Brinjal is the most consumed vegetable. In India pesticide application is also highest in brinjal. It is one of the main sources of cash crop for many farmers (Daniel miller, 2007) [9]. In Madhya Pradesh, it occupies an area 50.57 thousand ha with a production of 918.78 thousand tonnes and productivity of 24.96 tonnes/ha. (Anonymous, 2017) [2]. The managing pests population of *Solanum melongena* different methods have been used, but to keep the population below the economic injury level chemical control is one of the common practices, many of the insecticides applied are not effective in the satisfactory control of these pest. Chemical insecticides are used as the frontline defense sources against insect pests in India. However, their indiscriminate use creates a number of problems like residues causing health hazards, phytotoxicity symptoms like burning of leaves, wilting and chlorosis on plant resulting in reduction of yield. There is a need to replace the insecticides with newer chemicals with lesser dose of few grams per hectare maintaining high toxicity to insect pests. Emamectin benzoate (avermectins-microbial insecticides), Imidacloprid (neo-nicotinyl group insecticide), Indoxacarb (oxadiazine group), Lambda-cyhalothrin (fourth generation synthetic pyrethroid) are broad spectrum insecticides and reported to be effective and economical in controlling the insect- pests of *S. melongena* (Chandan, 2018) [8]. Therefore, it is necessary to evaluate these insecticides, which would be effective for control of *L. orbonalis* with least or no adverse effect on plants.

2. Material and methods

The observations were recorded 24 hours before spraying and post treatment observations were recorded at 3, 7 and 10 days after application of treatment. Observations on brinjal sucking pests were recorded on 5 randomly selected plant/plot. The population density of sucking pests was recorded on 6 leaves / plant (2 upper, 2 middle and 2 lower leaves). Observation on shoot and fruit borer *Leucinodes orbonalis* was recorded on 5 randomly selected plant/plot. For fruit damage observation was recorded on healthy and damaged fruits and percent fruit damage was recorded at each picking before and after treatment. The per cent shoot and fruit infestation was expressed by using following formulas:

$$\text{Shoot damage (\%)} = \frac{\text{Number of shoots infested per plant}}{\text{Total number of shoots per plant}} \text{X } 100$$

$$\text{Fruit damage (\%)} = \frac{\text{Weight of infested fruits}}{\text{Total weight of infested and healthy fruit}} \text{X } 100$$

The percentage data on damaged fruits data was transformed to arc sin transformation and statistically analyzed following the method suggested by Snedecor and Cochran (1967) [25].

2.1. Observation for avoidable losses:
Avoidable losses were calculated by comparing protected and unprotected:

$$\text{Avoidable losses (\%)} = \frac{\text{Yield protected plots} - \text{Yield unprotected plots}}{\text{Yield protected plots}} \text{X } 100$$

3. Result and discussion
The results on evaluation of insecticides against *Leucinodes orbonalis* Guen. are presented in this objective.

3.1. Evaluation of insecticides against *Leucinodes orbonalis* on *S. melongena.*
3.1.1. Overall effect
All the insecticidal treatments were significantly superior over untreated control (19.94). Emamectin benzoate (7.75%) maintained superiority followed by Chlorantraniliprole (9.05%). The next best treatments were Flubendiamide (10.11%) followed by Indoxacarb (10.75%) and Lambda cyhalothrin (11.00%) but were found to be at par with each other. Other treatments were least effective but superior over control.

Table 1: Evaluation of insecticides against *Leucinodes orbonalis* on *S. melongena.*

Treatment	Treatment details	Dose/ha	Per cent fruit damage per picking (Mean of three replications)							
			Pre - treatment	Pickings						
				First	Second	Third	Fourth	Fifth	Sixth	Over all mean of 3 sprays
T_1	Indoxacarb 14.5 SC	350 ml	20.54 (26.93)	11.57 (19.87)	11.30 (19.75)	10.92 (19.29)	10.67 (19.06)	10.38 (18.78)	9.68 (18.10)	10.75 (19.13)
T_2	Emamectin benzoate 5 SG	200 g	20.81 (27.12)	9.15 (17.60)	8.73 (17.18)	8.05 (16.47)	7.66 (16.05)	6.68 (14.97)	6.21 (14.41)	7.75 (16.12) **L**
T_3	Chlorantraniliprole 18.5 SC	175 ml	19.96 (26.52)	10.58 (18.67)	10.11 (18.59)	9.35 (17.80)	8.81 (17.23)	7.88 (16.29)	7.59 (15.97)	9.05 (17.47)
T_4	Acetamiprid 20 SP	50 g	20.72 (27.06)	15.06 (22.83)	15.13 (22.88)	14.32 (22.22)	14.42 (22.31)	13.29 (21.36)	12.64 (20.81)	14.14 (22.07)
T_5	Flubendiamide 20 WDG	150 g	20.48 (26.89)	11.47 (19.78)	11.22 (19.79)	10.56 (18.95)	9.90 (18.30)	9.29 (17.71)	8.25 (16.66)	10.11 (18.51)
T_6	Imidacloprid 17.8 SL	100 ml	20.32 (26.77)	15.11 (22.86)	15.26 (22.98)	14.67 (22.51)	14.77 (22.59)	13.46 (21.50)	12.59 (20.77)	14.31 (22.21)
T_7	Lambda cyhalothrin 5 EC	400 ml	19.40 (26.12)	11.92 (20.18)	11.78 (20.06)	11.15 (19.49)	10.94 (19.30)	10.49 (18.89)	9.72 (18.14)	11.00 (19.35)
T_8	Control	---	18.50 (25.46)	18.93 (25.78)	19.27 (26.00)	19.94 (26.51)	20.30 (26.77)	20.23 (26.72)	20.98 (27.24)	19.94 (26.51) H
	SEm±		0.53	0.26	0.38	0.24	0.35	0.42	0.40	0.35
	CD at 5%		NS	0.80	1.14	0.71	1.06	1.26	1.21	1.07

() Figure in parentheses are arc sin transformed values NS = Non-significant, L- Lowest, H- Highest

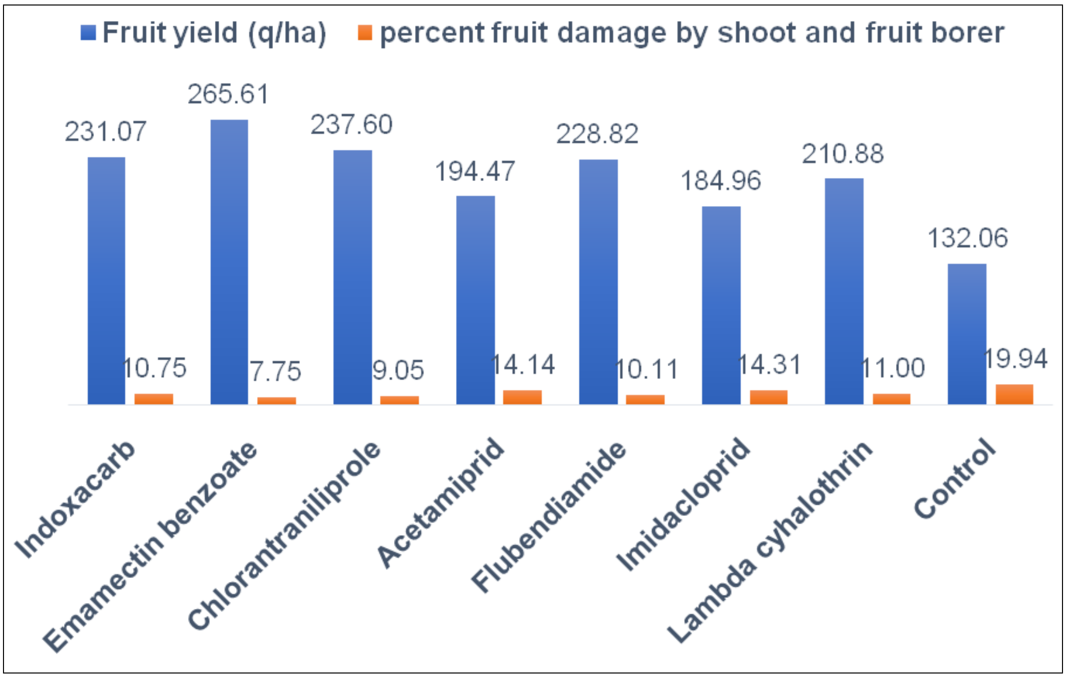

Fig 1: Evaluation of insecticides against *Leucinodes orbonalis* on *S. melongena.*

3.2. Evaluation of insecticides against Jassid *(A. biguttula biguttula)* on *S. melongena*
3.2.1. Overall mean of 3 sprays
On the basis of overall mean of three sprays all the insecticidal treatments significantly reduced the jassid population as compared to control (26.23 jassids/ 6 leaves). Among the treatments Imidacloprid 17.8 SL @ 100 ml/ha was found to be most effective as it recorded lowest jassid population (6.07 jassids/ 6 leaves), followed by Acetamiprid 20 SP @ 50 g/ha (7.99 jassids/ 6 leaves) and Chlorantraniliprole 18.5 SC @ 175 ml/ha (10.69 jassids/ 6 leaves). The next better treatments were Indoxacarb 14.5 SC @ 350 ml/ha (12.31 jassids / 6 leaves) followed by Emamectin benzoate 5 SG @ 200 g/ha (13.23 jassids/6 leaves), Flubendiamide 20 WDG @ 150 g/ha (13.90 jassids/ 6 leaves) and Lambda-cyhalothrin 5 EC @ 400 ml/ha (14.12 jassids/ 6 leaves) but were found to be at par with each other.

Table 2: Evaluation of insecticides against Jassid (*A. biguttula biguttula)* on *S. melongena.*

Treatment	Treatment details	Dose/ha	Mean population of Jassid / sample (six leaves of each plant)										
			Pre-treatment	Post treatment									
				After 1st spray			After 2nd spray			After 3rd spray			Over all mean of 3 sprays
				3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
T_1	Indoxacarb 14.5 SC	350 ml	22.73 (4.82)	14.87 (3.92)	15.07 (3.95)	15.13 (3.94)	11.77 (3.50)	11.83 (3.51)	12.23 (3.57)	9.87 (3.22)	9.97 (3.23)	10.07 (3.25)	12.31 (3.57)
T_2	Emamectin benzoate 5 SG	200 g	23.13 (4.86)	15.87 (4.05)	15.97 (4.06)	16.07 (4.07)	12.87 (3.66)	12.93 (3.67)	12.97 (3.67)	10.70 (3.35)	10.87 (3.37)	10.87 (3.37)	13.23 (3.69)
T_3	Chlorantraniliprole 18.5 SC	175 ml	24.20 (4.97)	13.43 (3.73)	13.43 (3.73)	13.50 (3.74)	10.53 (3.32)	10.60 (3.33)	10.80 (3.36)	7.87 (2.89)	7.97 (2.91)	8.10 (2.93)	10.69 (3.33)
T_4	Acetamiprid 20 SP	50 g	24.03 (4.95)	11.30 (3.43)	11.40 (3.45)	11.40 (3.45)	6.70 (2.67)	6.80 (2.70)	6.90 (2.72)	5.73 (2.50)	5.80 (2.51)	5.87 (2.52)	7.99 (2.89)
T_5	Flubendiamide 20 WDG	150 g	24.80 (5.03)	16.83 (4.16)	17.00 (4.18)	17.27 (4.21)	13.83 (3.79)	13.93 (3.80)	14.00 (3.81)	10.63 (3.34)	10.70 (3.35)	10.90 (3.38)	13.90 (3.78)
T_6	Imidachloprid 17.8 SL	100 ml	24.87 (5.04)	10.07 (3.25)	10.17 (3.27)	10.20 (3.27)	5.40 (2.43)	5.37 (2.42)	5.47 (2.44)	2.67 (1.78)	2.63 (1.77)	2.67 (1.78)	6.07 (2.49) L
T_7	Lambda cyhalothrin 5 EC	400 ml	22.77 (4.82)	16.93 (4.17)	16.90 (4.20)	17.03 (4.19)	14.00 (3.81)	14.13 (3.82)	14.20 (3.83)	11.20 (3.42)	11.27 (3.43)	11.37 (3.44)	14.12 (3.81)
T_8	Control	---	24.33 (4.98)	25.87 (5.13)	25.93 (5.14)	26.07 (5.15)	25.97 (5.14)	26.20 (5.17)	26.40 (5.19)	26.50 (5.20)	26.63 (5.21)	26.73 (5.22)	26.23 (5.17) H
	SEm±		0.08	0.05	0.03	0.03	0.05	0.06	0.05	0.04	0.04	0.05	0.13
	CD at 5%		NS	0.16	0.09	0.08	0.14	0.17	0.14	0.15	0.12	0.16	0.38

() Figures in parentheses are $\sqrt{x}$ square root transformed values, NS = Non-significant, L- Lowest, H- Highest

3.3. Evaluation of insecticides against whitefly (*Bemisia tabaci*) on *S. melongena.*

3.3.1. Over all mean of three sprays

All the insecticidal treatments significantly reduced the whitefly population as compared to control (22.17 whiteflies/ 6 leaves). Among the treatments Imidacloprid 17.8 SL @ 100 ml/ha was found to be most effective as it recorded lowest whitefly population (4.29 whiteflies/ 6 leaves), followed by Acetamiprid 20 SP @ 50 g/ha (5.92 whiteflies/ 6 leaves). The next effective treatments were Chlorantraniliprole 18.5 SC @ 175 ml/ha (7.38 whiteflies/ 6 leaves) and Indoxacarb 14.5 SC @ 350 ml/ha (8.57 whiteflies/ 6 leaves) but both were found to be at par with each other followed by Emamectin benzoate 5 SG @ 200 g/ha (11.21 whiteflies/ 6 leaves). The next better treatments were Flubendiamide 20 WDG @ 150 g/ha (12.36 whiteflies/ 6 leaves) and Lambda-cyhalothrin 5 EC @ 400 ml/ha (12.63 whiteflies/ 6 leaves) but both were found to be at par with each other.

Table 3: Evaluation of insecticides against Whitefly (*Bemisia tabaci)* on *S. melongena.*

Treatment No.	Treatment details	Dose (g/ml/ha)	Mean population of whitefly/ sample (six leaves of each plant)										
			Pre-treatment	Post treatment									
				After 1st spray			After 2nd spray			After 3rd spray			Over all mean of 3 sprays
				3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
T_1	Indoxacarb 14.5 SC	350 ml	19.00 (4.42)	11.80 (3.51)	11.83 (3.51)	11.93 (3.53)	8.30 (2.96)	8.27 (2.96)	8.37 (2.98)	5.57 (2.46)	5.50 (2.45)	5.60 (2.47)	8.57 (2.98)
T_2	Emamectin benzoate 5 SG	200 g	18.97 (4.41)	13.47 (3.74)	13.47 (3.74)	13.53 (3.75)	11.00 (3.39)	10.97 (3.39)	11.07 (3.40)	9.07 (3.09)	9.10 (3.10)	9.20 (3.11)	11.21 (3.41)
T_3	Chlorantraniliprole 18.5 SC	175 ml	20.27 (4.56)	9.77 (3.20)	9.77 (3.20)	9.90 (3.22)	7.53 (2.83)	7.43 (2.81)	7.53 (2.83)	4.87 (2.31)	4.77 (2.29)	4.87 (2.31)	7.38 (2.78)
T_4	Acetamiprid 20 SP	50 g	18.07 (4.30)	7.90 (2.89)	7.97 (2.90)	8.17 (2.93)	6.10 (2.57)	6.23 (2.59)	6.27 (2.60)	3.47 (1.99)	3.50 (1.99)	3.60 (2.02)	5.92 (2.51)
T_5	Flubendiamide 20 WDG	150 g	19.60 (4.48)	13.93 (3.80)	13.97 (3.80)	14.13 (3.82)	12.20 (3.56)	12.27 (3.57)	12.37 (3.59)	10.76 (3.35)	10.73 (3.35)	10.83 (3.37)	12.36 (3.58)
T_6	Imidacloprid 17.8 SL	100 ml	19.03 (4.41)	6.40 (2.62)	6.33 (2.61)	6.47 (2.64)	4.67 (2.27)	4.60 (2.26)	4.77 (2.29)	1.83 (1.53)	1.73 (1.49)	1.80 (1.51)	4.29 (2.14) **L**
T_7	Lambda cyhalothrin 5 EC	400 ml	21.40 (4.68)	14.07 (3.82)	14.10 (3.82)	14.33 (3.85)	12.67 (3.63)	12.77 (3.64)	12.83 (3.65)	10.90 (3.38)	11.00 (3.39)	11.03 (3.40)	12.63 (3.62)
T_8	Control	---	20.30 (4.56)	21.43 (4.68)	21.70 (4.71)	21.77 (4.72)	22.03 (4.75)	22.23 (4.77)	22.47 (4.79)	22.43 (4.79)	22.70 (4.82)	22.80 (4.83)	22.17 (4.76) **H**
	SEm±		0.10	0.08	0.09	0.09	0.08	0.07	0.07	0.05	0.10	0.08	0.12
	CD at 5%		NS	0.23	0.28	0.27	0.24	0.22	0.22	0.17	0.29	0.23	0.36

() Figures in parentheses are $\sqrt{x}$ square root transformed values, NS = Non-significant, L- Lowest, H- Highest

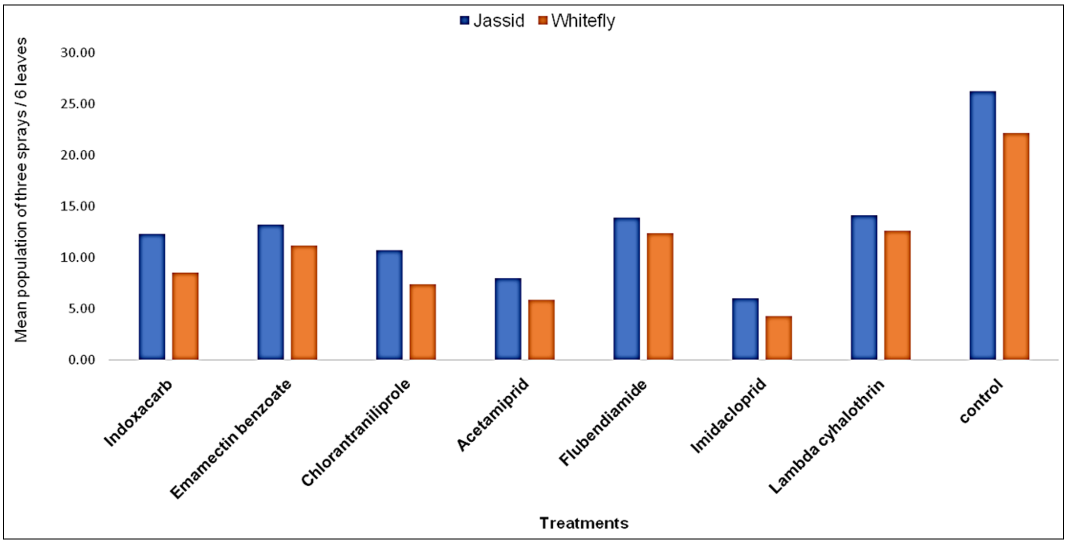

Fig 2: Evaluation of insecticides against jassid and whitefly on *S. melongena* (Mean of three sprays).

3.4. Yield of marketable fruits.

Table 4: Mean marketable fruit yield (q/ha) and percent avoidable losses.

Treatment details	Dose/ha	Yield (q/ha)	Percent avoidable losses
Indoxacarb 14.5 SC	350 ml	231.07	42.84
Emamectin benzoate 5 SG	200 g	265.61	50.28
Chlorantraniliprole 18.5 SC	175 ml	237.60	44.52
Acetamiprid 20 SP	50 g	194.47	32.09
Flubendiamide 20 WDG	150 g	228.82	42.28
Imidacloprid 17.8 SL	100 ml	184.96	28.60
Lambda cyhalothrin 5 EC	400ml	210.88	37.37
Control	-	132.06	-
SEm±		4.97	-
CD at 5%		15.03	-

Table 5: Economics of different insecticides on fruit yield of *S. melongena* during *rabi*, 2018-19.

Treatment No.	Treatment details	Dose (g/ml/ha)	Fruit yield (q/ha)	Increase in yield over control	Cost	Cost increased yield over control @ Rs. 500/- per quintal	Net Profit (Rs/ha.)	Cost benefit ratio
T_1	Indoxacarb 14.5 SC	350 ml	231.07	99.01	4842	49505.56	44663.56	1:9.22
T_2	Emamectin benzoate 5 SG	200 g	265.61	133.56	3702	66777.78	63075.78	1:17.04 **H**
T_3	Chlorantraniliprole 18.5 SC	175 ml	237.60	105.54	10302	52770.83	42468.83	1:4.12 **L**
T_4	Acetamiprid 20 SP	50 g	194.47	62.41	2082	31205.56	29123.56	1:13.99
T_5	Flubendiamide 20 WDG	150 g	228.82	96.76	4422	48381.94	43959.94	1:9.94
T_6	Imidacloprid 17.8 SL	100 ml	184.96	52.90	2172	26448.61	24276.61	1:11.18
T_7	Lambda cyhalothrin 5 EC	400 ml	210.88	78.82	2742	39409.72	36667.72	1:13.37
T_8	Control	-	132.06	-	-	-	-	-

L= Lowest H= Highest

3.5. Cost involved during the experiment

1. Rate of labour per day Rs. 317/- (2 labours required for spraying 1 ha Brinjal crop in 1 day)
2. Cost of insecticide /ha.

Indoxacarb 14.5 SC
= Rs. 2862/l Emamectin benzoate 5 SG
= Rs. 3000/kg Chlorantraniliprole 18.5 SC
= Rs. 13000/l Acetamiprid 20 SP
= Rs. 1237/ kg Flubendiamide 20 WDG
= Rs. 5600/kg Imidacloprid 17.8 SL
= Rs. 997/l Lambda cyhalothrin 5 EC
= Rs. 700/l

3.6. Per cent shoot and fruit damage by *L. orbonalis* and fruit yield.

The result showed that Emamectin Benzoate 5 SG @ 200g/ha was found to be most effective against shoot and fruit borer followed by Chlorantraniliprole 18.5 SC @ 175 ml/ha. Dutta, *et al.*, (2007) [11] reported that Emamectin benzoate showed moderate level of efficacy providing 62.8% reduction of brinjal shoot and fruit borer population over control, Sudarshan Chakraborti and Sarkar (2011) [7] also reported that application of new generation pesticide molecules like Rynaxypyr and Emamectin benzoate, fairly good, healthy yields were produced. Similar findings have been reported by Sharma and Sharma (2010) [22] in terms of reduction in fruit infestation, Emamectin benzoate was highly effective. Anwar *et al.*, (2015) [3] reported that Emamectin benzoate was most effective against brinjal shoot and fruit borer and resulted in lower infestation (40.1%). In contrary to present finding Mathirajan *et al.*,

(2000) [16] reported that Lambda-cyhalothrin @ 30 g *a.i.*/ha was found to be effective against shoot and fruit borer in brinjal. Whereas Kameshwaram and Kumar (2015) [13] reported that lowest mean per cent shoot damage was recorded in the treatment with Chlorantraniliprole 20 SC @ 40 g *a.i.*/ha.

Patel *et al.* (2015) [19] reported that Emamectin benzoate @ 10 g *a.i.*/ha showed highest fruit yield. Whereas Sharma and Sharma (2010) [22], Pareet and Basavanagoud (2012) [18], Ghosal and Chatterjee (2013) [12], Shah *et al*., (2014) [21] and Wankhede and Kale (2010) [27], reported that Emamactin benzoate 5 SG at the rate of (0.002%, 0.2 ml, 18 g *a.i.*/ha, 0.0025%) respectively were found significantly effective in reducing the per cent fruit damage and increasing the healthy fruit yield against shoot and fruit borer in brinjal.

The present findings further revealed that the mean per cent fruit damage caused by shoot and fruit borer was highest at the beginning of picking season and as the number of pickings increased there was an increase the fruit damage except last two picking, in which the damage percentage was low.

3.7. To study the evaluation of insecticides against Jassid (*A. biguttula biguttula)* on *S. melongena*

The results of present study indicated that among all the insecticides Imidachloprid 17.8 SL @ 100 ml/ha was found to be most effective, followed by Acetamiprid 20 SP @ 50 g/ha and Chlorantraniliprole 18.5 SC @ 175 ml/ha. The next better treatments were Indoxacarb 14.5 SC @ 350 ml/ha followed by Emamectin benzoate 5 SG @ 200 g/ha, Flubendiamide 20 WDG @ 150 g/ha and Lambda-cyhalothrin 5 EC @ 400 ml/ha but were found to be at par with each other.

While Bhargava *et al.* (2003) [5] reported that Imidacloprid @ 20 g *a.i.*/ha reduced *A. biguttula biguttula* population effectively in brinjal. Similarly Mhaske and Mote (2005) [17] found that Imidacloprid (18 g/ha) was effective against jassids. Sinha and Sharma (2008) [24] found that Acetamiprid/Imidacloprid @ 20g *a.i.*/ha effectively reduced leafhopper population. Bharati *et al.* (2015) [4] reported that Imidacloprid 0.004 per cent was the most effective insecticide in controlling brinjal jassids. Bisht (2017) [6] reported that Lambda cyhalothrin 5 EC @ 25 ml *a.i.*/ha was least effective against jassids. Kumar *et al.*, (2017) [15] reported that Imidacloprid 17.8 SL (0.5 ml/lit) was found most effective against sucking insect pest of brinjal.

3.8. To study the evaluation of insecticides against Whitefly (*Bemisia tabaci)* on *S. melongena*

The results of present study indicated that among all the insecticides Imidacloprid 17.8 SL @ 100 ml/ha was found to be most effective followed by Acetamiprid 20 SP @ 50 g/ha. The next effective treatments were Chlorantraniliprole 18.5 SC @ 175 ml/ha followed by Indoxacarb 14.5 SC @ 350 ml/ha but both were found to be at par with each other followed by Emamectin benzoate 5 SG @ 200 g/ha. The next better treatments were Flubendiamide 20 WDG @ 150 g/ha and Lambda-cyhalothrin 5 EC @ 400 ml/ha but both were found to be at par with each other.

Singh and Jaglan (2001) [23], Anandkumar *et al.* (2003) [1] and Mhaske and Mote (2005) [17] reported the effectiveness of Imidacloprid against whitefly in brinjal. Ghosal and Chatterjee (2013) [12] reported that Imidacloprid 17.8 SL @ 50 g *a.i.*/ha was found superior against whiteflies. However Das and Islam (2014) [28] reported that Emamectin benzoate moderately effective against whitefly. Kar (2017) [14] reported that Imidacloprid @175 ml/ha was the most effective treatment in controlling whitefly population. Kumar *et al.* (2017) [15] reported that Imidacloprid 17.8 SL (0.5 ml/lit) was found most effective against sucking insect pest of brinjal.

3.9. Economics of treatments

Maximum increase in fruit yield of brinjal over the control was registered in Emamectin benzoate 5 SG @ 200 g/ha (265.61 q/ha), it was followed by Chlorantraniliprole 18.5 SC (237.60 q/ha), Indoxacarb 14.5 SC (231.07 q/ha), Flubendiamide 20 WDG (228.82 q/ha), Lambda cyhalothrin 5 EC (210.88 q/ha), Acetamiprid 20 SP (194.47 q/ha) and Imidacloprid 17.8 SL (184.96 q/ha), respectively. Maximum net profit was registered in Emamectin benzoate 5 SG @ 200 g/ha (Rs. 63,075.78) this was followed by Indoxacarb 14.5 SC @ 350 ml/ha (Rs. 44,663.56), Flubendiamide 20 WDG @ 150 g/ha (Rs. 43,959.94), Chlorantraniliprole 18.5 SC @ 175 ml/ha (Rs. 42,468.83), Lambda cyhalothrin 5 EC @ 400 ml/ha (Rs. 36,667.72), Acetamiprid 20 SP @ 50 g/ha (Rs. 29,123.56) and Imidacloprid 17.8 SL @ 100 ml/ha (Rs. 24,276.61).

Maximum cost benefit ratio per was registered in Emamectin benzoate 5 SG @ 200 g/ha (1:17.04), this was followed by Acetamiprid 20 SP @ 50 g/ha (1:13.99), Lambda cyhalothrin 5 EC @ 400 ml/ha (1:13.37), Imidacloprid 17.8 SL @ 100 ml/ha (1:11.18), Flubendiamide 20 WDG @ 150 g/ha (1:9.94), Indoxacarb 14.5 SC @ 350 ml/ha (1:9.22) and Chlorantraniliprole 18.5 SC @ 175 ml/ha (1:4.12).

Similarly to present findings, Patel *et al*. (2015) [19] reported that highest net profit was obtained from Emamectin benzoate @ 10 g *a.i.*/ha in brinjal. Shah *et al.* (2012) [20] also reported that Emamectin benzoate (0.0025%) obtained highest cost benefit ratio which is similar to the present findings.

4. Conclusion

Among the various molecules evaluated Emamectin benzoate 5 SG @ 200 g/ha against shoot and fruit borer (*L. orbonalis* Guen.) and Imidachloprid 17.8 SL @ 100 ml/ha against jassid (*Amrasca biguttula biguttula* Ishida) and whitefly (*Bemisia tabaci* Genn.) found significantly more effective on *Solanum melongena* during *Rabi* 2018-2019. Maximum cost benefit ratio was registered in Emamectin benzoate 5 SG @ 200 g/ha (1:17.04), this was followed by Acetamiprid 20 SP @ 50 g/ha (1:13.99), Lambda cyhalothrin 5 EC @ 400 ml/ha (1:13.37), Imidacloprid 17.8 SL @ 100 ml/ha (1:11.18), Flubendiamide 20 WDG @ 150 g/ha (1:9.94), Indoxacarb 14.5 SC @ 350 ml/ha (1:9.22) and Chlorantraniliprole 18.5 SC @ 175 ml/ha (1:4.12).

5. References

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