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Bioefficacy of newer insecticides against natural enemies of insect-pest on brinjal (*Solanum melongena* L.)

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Abstract
The “Bio-efficacy of newer insecticides against natural enemies of brinjal was conducted at the Research Farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, India during *Kharif* 2018-19 by sowing ‘Ajay’ variety. Three insecticidal spray was given during this experiment. The results revealed that control plot contains more number of natural enemies and proved significantly superior overall treated plots followed by chlorantraniliprole 18.5% SC and cyantraniliprole 10% OD. Likewise, cartap hydrochloride 75% SG also better than emamectin benzoate 5% SG and flubendiamide 39.36% SC found less toxic to natural enemies. And lastly, treatment with lambda cyhalothrin 5% SC and fenpropathrin 30% EC were found slightly toxic to natural enemies.

Keywords: Bio-efficacy, brinjal, newer insecticides, natural enemies

Introduction
Brinjal (*Solanum melongena* L.) also called eggplant is a species of nightshade grown for its edible fruit. The Eggplant is a delicate, tropical perennial, often cultivated as a tender or half-hardy annual in temperate climate. India is the second largest producer of vegetables in world after China. Majority of Indians are vegetarian, with a per capita consumption of 135 g per day as against the recommended 300 g per day (Dhanadapani, 2003). There are also several constraints in brinjal production which are responsible for reduction in yield. Insect pest is one of the most important factor among them. Shoot and fruit borer, *Leucinodes orbonalis* (Guen.); stem borer, *Euzophera perticella* (Rag.); hadda beetle, *Henosepilachna vigintioctopunctata* (Fab.); leaf hopper, *Amrasca devastans* (Dist.); lacewing bug, *Urentius echinus* (Dist.); Aphid, *Aphis gossypii* (Glov.); and white fly, *Bemisia tabaci* (Genn.) were designated as major pests (Singh, 1970) [8] of brinjal. Out of these *L. orbonalis* is most important pest of brinjal as it damage crop throughout the year. It is known that, shoot and fruit borer damages in all stages of growth. The yield loss due to the pest is to extend of 70-92% (Eswara Reddy and Srinivas, 2004; Chakrabroti and Sarkar 2011 and Jagginavar *et al.*, 2009) [7, 4]. The population of natural enemies such as ladybird beetles and spiders control insect-pest activity and helps to maintain ecological and environmental balance. But some insecticides proven to be toxic to natural enemies and reduce the population of natural enemies. It is therefore necessary to confirm the effectiveness of novel insecticide molecules available in the market as well as safe for non-target organisms i.e. natural enemies. Hence the present study was undertaken to study the bioefficacy of seven new insecticide molecules on natural enemies of insect-pest of brinjal.

Materials and Methods
The present experiment was carried out at the Research Farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, India during *Kharif* 2018-19. The experiment was laid out in Randomized Block Design (RBD) with three replications and eight treatments in a 3.60 × 3.60 m^2 plot with spacing 60 x 60 cm^2 and Ajay variety of brinjal was selected for study. The insecticides spray was carried out using battery operated knapsack sprayer. All total three sprays were given at an interval of 15 days. Five plants were randomly selected from net plot of each treatment in each replication. The observations for natural enemies were recorded at one day before spraying and 1, 3, 5, 10 and 14 days after spraying. The data obtained in number was analysed statistically and subjected to transformation using Poisson formula $\sqrt{x + 0.5}$.

Results and Discussions
The results obtained from the present investigation as well as relevant discussion had been summarized under following heads:

Bio-efficacy of various insecticides against ladybird beetle (*Coccinella septumpunctata* L.)

Before the first spray of insecticides, number of lady bird beetle was ranged from 1.75 to 1.96 per plants. Pooled data of all 3 spray revealed that control plot recorded higher population of ladybird beetles and prove significantly superior over all treated plots recorded 2.65 beetles per plant followed by chlorantraniliprole 18.5% SC and cyantraniliprole 10% OD recorded (1.44 and 1.34/plant). Likewise, cartap hydrochloride 75% SG also found better and recorded 1.30 beetles per plant (Table 4 & Fig. 1).

Table 1: Bioefficacy of various insecticides against ladybird beetle in brinjal (Pooled 1st, 2nd & 3rd spray)

Tr. No.	Treatments	Concentration (%)	One day before Spray	Mean Population of ladybird beetle			Pooled mean
				1st Spray	2nd Spray	3rd Spray	
T1	Cyantraniliprole 10.26%OD	0.0143	1.96 (1.57)*	1.32 (1.35)	1.28 (1.33)	1.42 (1.39)	1.34 (1.36)
T2	Fenpropathrin 30% EC	0.0204	1.77 (1.51)	0.66 (1.08)	0.66 (1.08)	0.77 (1.13)	0.70 (1.09)
T3	Flubendiamide 39.36% SC	0.0098	1.87 (1.54)	1.04 (1.24)	1.10 (1.26)	1.10 (1.26)	1.08 (1.26)
T4	Cartap hydrochloride 75% SG	0.0750	1.80 (1.52)	1.22 (1.31)	1.37 (1.37)	1.30 (1.34)	1.30 (1.34)
T5	Emamectin benzoate 5% SG	0.0020	1.84 (1.53)	1.18 (1.30)	1.17 (1.29)	1.21 (1.31)	1.19 (1.30)
T6	Lambda Cyhalothrin 5% EC	0.0030	1.75 (1.50)	0.88 (1.17)	0.94 (1.20)	0.92 (1.19)	0.91 (1.19)
T7	Chlorantraniliprole 18.5% SC	0.0074	1.82 (1.52)	1.44 (1.39)	1.38 (1.37)	1.49 (1.41)	1.44 (1.39)
T8	Untreated Control	-	1.80 (1.52)	2.22 (1.65)	2.53 (1.74)	3.20 (1.92)	2.65 (1.77)
S.E. ±		-	0.154	0.140	0.110	0.118	0.210
C.D. at 5%		-	NS	0.433	0349	0.362	0.647

*Figures in parentheses are square root transformed values (√ x + 0.5)
N.S.: Non-significant

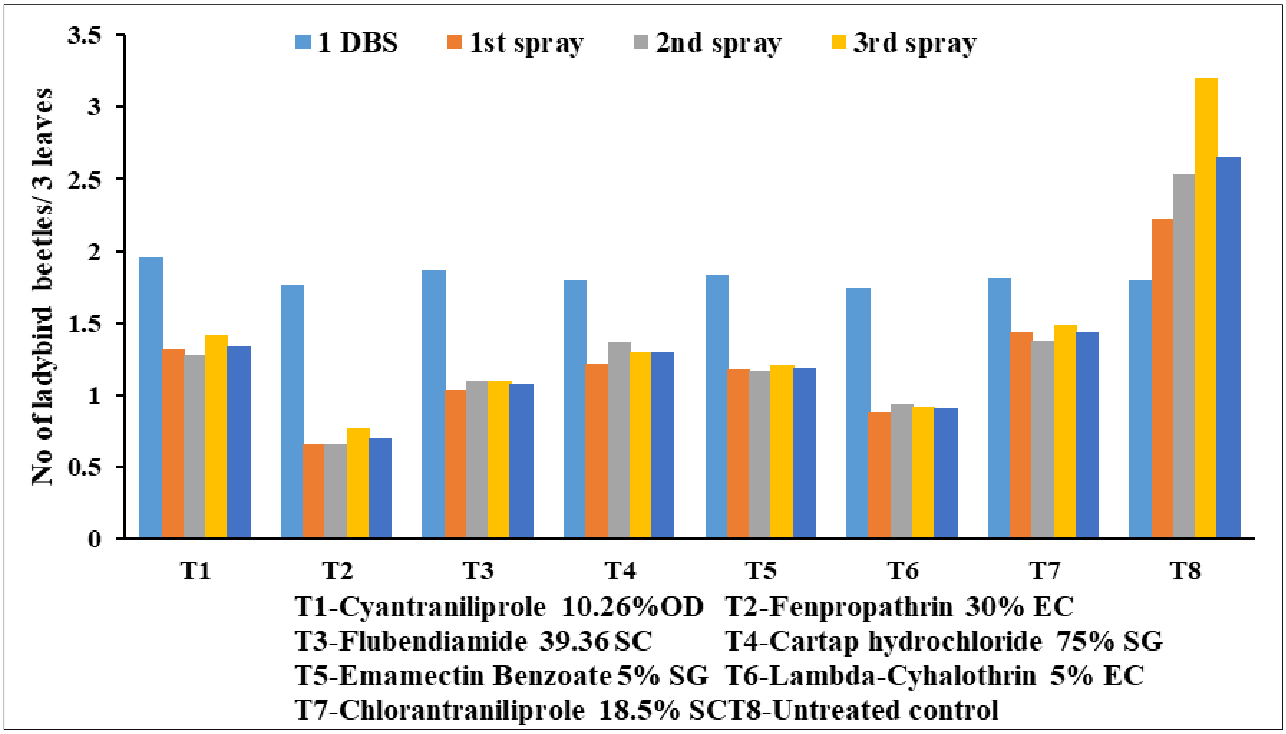

Fig 1: Bio-efficacy of various insecticides against ladybird beetle in brinjal (Pooled 1st, 2nd, 3rd spray)

Bio-efficacy of various insecticides against Spiders (*Oxyopes lineatipes* C.L. Koch)

Before the first spray of insecticides, number of spiders was ranged from 1.91 to 2.10 per plants. Pooled data of all 3 spray revealed that the untreated plot recorded higher population of spiders and prove significantly superior over all treated plots recorded 2.69 spiders per plant followed by chlorantraniliprole 18.5% SC and cyantraniliprole 10% OD recorded (1.12 and 0.98/plant). Likewise, cartap hydrochloride 75% SG also found better and recorded 0.89 spiders per plant (Table 2 & Fig. 2).

Table 2: Bioefficacy of various insecticides against spider in brinjal (Pooled 1st, 2nd& 3rd spray)

Tr. No.	Treatments	Concentration (%)	One day before spray	Mean Population of spider Pooled Data 1st Spray	2nd Spray	3rd Spray	Pooled mean
T1	Cyantraniliprole 10.26% OD	0.0143	2.00 (1.58)*	0.96 (0.98)*	1.02 (1.01)	0.97 (0.98)	0.98 (0.99)
T2	Fenpropathrin 30% EC	0.0204	1.91 (1.55)	0.43 (0.66)	0.35 (0.59)	0.46 (0.68)	0.41 (0.64)
T3	Flubendiamide 39.36% SC	0.0098	1.98 (1.57)	0.68 (0.82)	0.71 (0.84)	0.67 (0.82)	0.69 (0.83)
T4	Cartap hydrochloride 75% SG	0.0750	2.00 (1.58)	0.87 (0.93)	0.92 (0.96)	0.88 (0.94)	0.89 (0.94)
T5	Emamectin benzoate 5% SG	0.0020	1.94 (1.56)	0.78 (0.88)	0.83 (0.91)	0.82 (0.91)	0.81 (0.90)
T6	Lambda Cyhalothrin 5% EC	0.0030	2.10 (1.61)	0.48 (0.69)	0.50 (0.71)	0.59 (0.77)	0.52 (0.72)
T7	Chlorantraniliprole 18.5% SC	0.0074	2.12 (1.62)	1.10 (1.05)	1.14 (1.07)	1.11 (1.05)	1.12 (1.06)
T8	Untreated Control	-	2.05 (1.60)	2.14 (1.46)	2.62 (1.62)	3.32 (1.82)	2.69 (1.64)
S.E. ±		-	0.098	0.105	0.113	0.111	0.125
C.D. at 5%		-	NS	0.325	0.352	0.346	0.388

*Figures in parentheses are square root transformed values ($\sqrt{x + 0.5}$)
N.S.: Non-significant

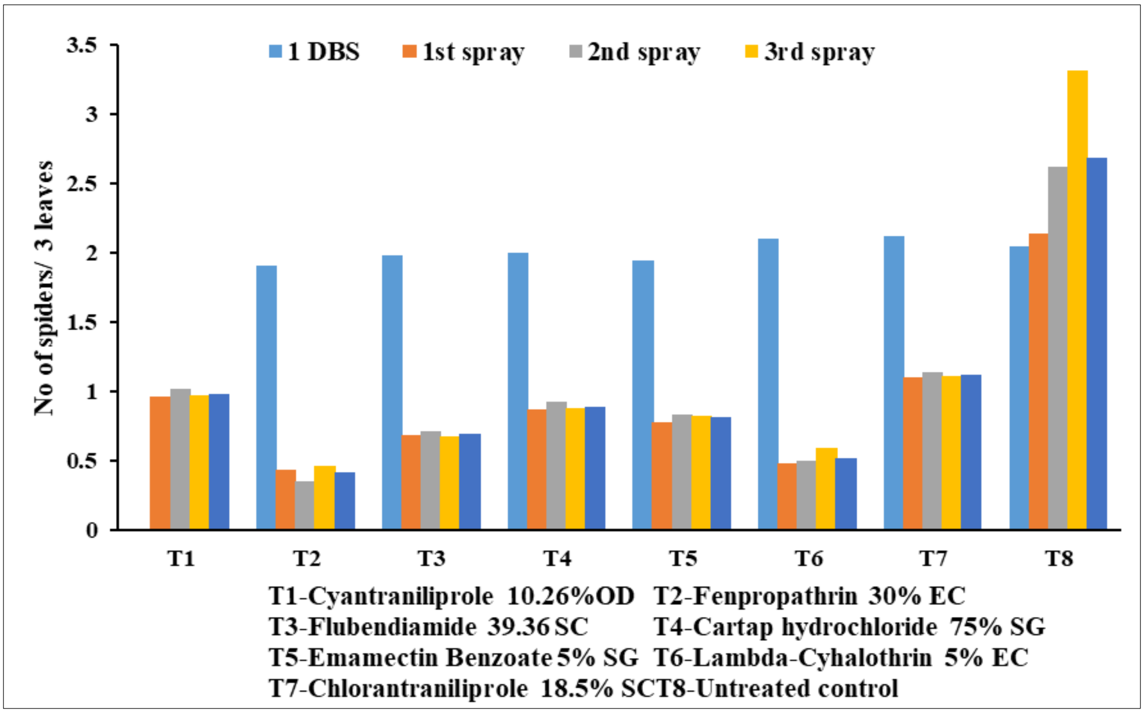

Fig 2: Bio-efficacy of various insecticides against spider in brinjal (pooled 1st, 2nd & 3rd spray)

These findings are in agreement with Natikar *et al*., (2016) reported that and flubendiamide 480 SC @ 0.2 ml/l were found highly toxic to coccinellids as compared to safer chemicals like emamectin benzoate 5 SG @0.25 g/l and chlorantraniliprole 18.% SC. Similarly, Govindan et al., (2013) [3] concluded that the chlorantraniliprole was the most suitable insecticides for control of pink bollworm larvae and less toxic to Natural enemies. Gavkare *et al*., (2013) [2] considered as chlorantraniliprole was safe to non-target insects (parasitoids, predators and pollinators) which supports the present results. Karthik *et al*., (2017) [5] concluded that cyantraniliprole 10% (w/v) OD found least effective against the spiders. Spiders population in cotton ecosystem showed considerable decrease initially in all the treatments, it started increasing in later, support to present finding.

Conclusion
The present study concluded that control plot recorded higher number of natural enemies than treated plot. Among the seven treatments, chlorantraniliprole 18.5% was found comparatively safer to natural enemies followed by cyantraniliprole 10% OD and Emamectin benzoate 5% SG.

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