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Incidence and management of *Helicoverpa armigera* (Hubner) on tomato, *Lycopersicon esculentum* Miller at Trans Yamuna region Prayagraj (U.P)

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Abstract
A field experiment was conducted during 2018-19 at the Agricultural Research Farm of Prayagraj College of Agriculture, Sam Higginbottpm, University of Agriculture, Technology and Sciences" Prayagraj. Synthetic insecticides and Bio pesticides reduced pod borer damage significantly. The results on the percent infestation of pod borer on mean (7^{th} and 14^{th}) days after spraying revealed that all the treatments were significantly superior over control (8.13) per cent infestation. Among the various treatments, least number of larvae (0.35 larvae/plant) was observed at 14 days spray in *Cypermethrin.* The lowest percent infestation (10.02%) of pod borer was recorded in *Cypermethrin* followed by *Beauveria bassiana* (12.92%) which proved to ne next best effective treatment in evaluating the least fruit damage The highest fruit yield (146.81 q/ha) was recorded with the treatment Cypermethrin which was significantly higher than other treatments. However, *Beauveria bassiana* recorded second highest fruit yield (142.58 q/ha) which proved to be second best and effective treatments. The lowest yield of 107.25 q/ha was found in Sixer but higher than control (75.07 q/ha). The maximum B:C ratio was found in the treatment of Cypermethrin (1: 2.51) followed by *Beauveria bassiana* (1:2.43) and *Verticillium lecanii* (1:2.22). The other treatments was profitable over control.

Keywords: Chemicals, insecticides, *Helicoverpa armigera*, tomato

Introduction
Tomato (*Lycopersicon esculentum*) is an important vegetable crop grown all over the world and is subjected to attack by a number insect pest which are one of the major limiting factors in the profitable cultivation of the crop. Among the various pests, the tomato fruit borer, *Helicoverpa armigera* (Hubner. (Lepldoptera: Noctuidae) is the most destructive. It is found round the year all over our country causing damages to a variety of host plants *viz.*, pulses, millets, cotton, vegetables. Tomato fruit borer, *Helicoverpa armigera* is an important pest which causes considerable losses in quantity as well as quality of tomato fruits.

The production and productivity of the crop is greatly hampered by the fruit borer, Helicoverpa armigera (Hübner) which causes damage to the developing fruits and results in yield loss ranging from 20 to 60 percent (Tewari and Krishnamoorthy, 1984; Lal and Lal, 1996) [6, 7]. The indiscriminate use of synthetic chemical pesticides to control this pest resulted in development of resistance (Armes *et al.*, 1992, 1994) [8, 9] and harmful pesticide residues in fruits. The presence of residues of DDT, HCH, endosulfan, malathion and primisphos-methyl in market samples of tomato has been reported (Dikshit *et al*., 1992;) [10]. Microbials and neem formulations have been reported to reduce the H. armigera population and fruit damage in tomato (Praveen, 2000 and Thilagam, 2003) [11].

Material and Methods
Experiments were laid out in Randomized block design with fourteen treatments including treated and untreated control and replicated in 2 x 2 m^2plot size, the data was recorded from 5 plants in 16.0 m Length of experimental area at 5 different location in each plot were randomly selected and the mean i.e larvae/5 plant were done during two consecutive years of 2014-2015 and 2015-2016 in *Rabi* seasons, at Central Research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, U.P. India. The tomato variety Pusarubi was transplanted during the week of November by following all the recommended agronomical practices. Two sprays were applied during the crop season with hand operated

knapsack sprayer with a spray volume of 500 litre per hectare, treatments were initiated as soon as the infestation of *Helicoverpa armigera* was reached up to ETL (at 1 larva/meter row (at 1 larva/meter row length). Number of tomato fruit borer larvae were counted one day before and 7th day, 14th days after each application and percent fruit damage over control was calculated.

Result and Discussion

The results showed that all the treatments were recorded significantly superior over control. The result revealed that pre-treatment count for tomato fruit borer varied from 0.76-1.12 larvae per plant. The data on the mean (7 and 14 DAS) infestation of larvae population over control of tomato fruit borer after spray revealed that the all treatments were significantly superior over control. On the perusal of the data obtained in Table 1 during the experimentation suggested that the average larval population ranged from 0.59 to 1.21 which was significantly different from the control. Cypermethrin recorded minimum incidence and found most superior treatments (0.59 larvae/plant) followed by *Verticillium lecanii* and *Beveria bassiana* 0.78 larvae/plant and the *metarhiziumanisoplea* (0.80 larvae/plant), Neem oil and spinosad 45EC treatment *Verticillium lecanii* (T2) and *Beauveria bassiana* (T5) and *metarhiziumanisoplea* (T4) are non – significant to each other. Similarly *metarhiziumanisoplea* (T4) and sixer (T3), infestation was control treatment (T0) which recorded 1.21 larvae/plant. Whereas second spray the similar trend showed that all the treatments were recorded significantly superior over control was second spray.

Cypermethrin is a synthetic pyrethroid insecticide that has high insecticidal activity, low avian and mammalian toxicity, and adequate stability in air and light. It is used to control many pests including lepidopterous pests of cotton, fruit, and vegetable crops (Jones, 1995). Sub lethal effects may be manifested as reductions in life span, development rates, fecundity, changes in sex ratio, and changes in behaviour (Croft, 1990; Stark and Banks, 2003). Research on the use of plant products and microbial has been shown that botanicals may hold a key to increase the susceptibility of the target pest. The general principal of its use is to apply the agents simultaneously of sequentially for a synergistic response. The present study confirms the above mentioned results. The impact of the insecticide cypermethrin on the functional response, predatory behavior and mating behavior of *Helicoverpa armigera*. The intensity of abnormal behavior increased as the concentration of cypermethrin was increased. The insecticide negatively affected the functional response events such as attack ratio, handling time and rate of discovery. Sudharani and Rath (2011) [3] revealed role of neem based products in management of tomato fruit borer, *H. armigera*. They observed that neem oil- Bt- neem oil alternation was superior over Bt- Bt- Bt with 56.00 and 37.40 per cent reduction in number of fruit infestation over control, respectively. Sreekanth and Seshnamahalakshmi (2010) [4] reported that the percent inflorescence damage due to legume pod bores was lowest in spinosad. Ahmady and Kumar (2014) [5] tested efficacy of chemicals and bio- pesticides against *H. armigeraon* tomato and revealed that spinosad 45 SC was the most effective and gave maximum (90.83%) per cent population reduction of *H. armigera* followed by cypermethrin 25 EC (79.49%). Neem oil with 57.84 per cent population reduction was least effective among all treatments.

Table 1: Influence of different treatments on extent of fruit damage (%) by *Helicoverpa armigera* in Tomato (*Lycopersicon esculentum* Mill.)

Treatment Name	Dose	1st spray Percent fruit damage				2nd spray Percent fruit damage			
		Pre treatment count larval/5 plant 1DBS	7DAS	14DAS	Mean	Pre treatment count larval/5 plant 1DBS	7DAS	14DAS	Mean
T_1 Cypermethrin	0.01%	0.76	0.66	0.35	0.59	17.82	15.36	10.02	14.40
T_2 *Verticillium lecanii*	5%	0.96	0.75	0.57	0.76	20.22	16.44	14.05	16.91
T_3 (Alphamethrin 10EC) sixer	2ml/l	1.07	0.89	0.57	0.84	22.41	19.82	19.37	20.53
T_4 *Metarhizium anisopliae*	0.05%	0.98	0.78	0.63	0.80	20.86	16.66	14.35	17.29
T_5 *Beauveria bassiana*	1x10^{11} conidia/ha	0.95	0.69	0.69	0.78	19.21	16.40	12.92	16.18
T_6 Neem Oil	5%	1.01	0.88	0.76	0.88	21.17	17.94	14.38	17.83
T_7 Spinosad 45 EC (Tracer)	200ml/ha	1.07	0.88	0.76	0.90	22.38	19.26	15.89	19.18
T_0 Control	water spray	1.12	1.17	1.35	1.21	23.25	23.47	25.68	24.14
F-Test		S	S	S	S	S	S	S	S
S.Ed (±)		0.04	0.05	0.01	0.02	0.79	0.06	0.12	0.27
C.D (P=0.05)		0.08	0.10	0.03	0.04	1.69	0.12	0.26	0.59

Harshita *et al*. (2018) [2] finds that peak infestation of *H. Armigera* (6.06 and 6.30 larvae per plant) was recorded during March. The larvae attained maximum population of 6.06 larvae per plant on 22nd March 2016. During 2016-17, the first incidence of fruit borer was noticed on 17th January' 2016 with a mean population of 0.9 larvae per plant and larval population gradually increased till the harvest of the crop. According Chula *et al*. (2017) [1] revealed that the occurrence of tomato fruit borer commenced from 8 standard weeks (February third week) with an average population of 2.04% infestation. The tomato fruit borer, *Helicoverpa armigera* (Hub.) population increased and gradually reached its weak level of infestation 48.14% at 13st standard weak (March second weak) there after declined trend was observed as temperature decreased. Gradually till the crop was matured in last week of April.

Influence of different treatments on Fruit yield (q/ha) in Tomato (*Lycopersicon esculentum* Mill.)

The data on fruit yield tomato as influenced by various treatments of management of *Helicoverpa armigera* are presented the fruit yield varied ranged from 75.07 to 146.81 q/ha which was significantly varied from control among all the treatments Cypermethrin recoded maximum fruit yield 146.91 q/ha which was non-significantly superior than other treatments the second highest yield of tomato was observed with *Beauveria bassiana* 142.58 q/ha. However treatment *Verticulium lecanni* recorded 1129.42 q/ha fruit yield which was significantly higher than *Metarhizium anisopliae* 117.90, neem oil and spionosad 45EC (tracer) and sixer over control. Treatment *Metarhizium anisopliae* 117.80 and neem oil recorded higher fruit yield than sixer which was found non-significantly to each other. Among all the treatment sixer

recorded lowest fruit yield 107.25 q/ha which was significantly higher than control 75.07 q/ha. Minimum fruit yield 75.07 q/ha was observed which was lower than other treatments. Shown on Table.2.

Table 2: Influence of different treatments on fruit yield of Tomato (*Lycopersicon esculentum* Mill.)

Treatment No.	Insecticide	Fruit yield (q ha^{-1})
T_1	Cypermethrin 25EC	146.81
T_2	*Verticillium lecanii*	1129.92
T_3	(Alphamethrin 10EC) sixer	107.25
T_4	*Metarhizium anisopliae*	117.80
T_5	*Beauveria bassiana*	142.58
T_6	Neem Oil	116.74
T_7	Spinosad 45 EC (Tracer)	112.17
T_0	Control	75.07
	F- test	S
	S. Ed.(±)	1.94
	C. D. (P = 0.05)	4.16

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