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Efficacy of certain chemicals and biopesticides against maize stem borer, *Chilo partellus* (Swinhoe)

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Abstract
The research work entitled "Efficacy of certain chemicals and biopesticides against maize stem borer, *Chilo partellus* (Swinhoe)" was undertaken at CRF, Prayagraj, Allahabad, Uttar Pradesh, of eight treatments *viz*., (T1) Neem oil, (T2) NSKE 5%, (T3) *Beauveria bassiana*, (T4) Cypermethrin 25 EC, (T5) Emamectin benzoate 5% SG, (T6) Carbofuran 3G, (T7) Spinosad 45% SC and (T0) Untreated control in RBD with three replications targeting to evaluate the Efficacy of chemicals and biopesticides on the larval population of maize stem borer, Data was taken on Maize Stem borer population. The larval population of Maize Stem borer (*Chilo partellus*) on third, seventh and fourteen days after spraying revealed that the treatment (T6) Carbofuran 3G (7.35) was found superior followed by (T5) Emamectin benzoate 5% SG (8.06), (T4) Cypermethrin 25 EC (9.17), (T7) Spinosad 45% SC (9.71), (T2) NSKE 5% (10.17), (T3) *Beauveria bassiana*, (10.84), and (T1) Neem oil 3% (11.07). When the cost benefit ratio was worked out, the results were quite interesting. Among the treatment studied, the best and most economical treatment was (T6) Carbofuran 3G (1:3.09) followed by (T5) Emamectin benzoate 5% SG (1: 2.93), (T4) Cypermethrin 25 EC (1: 2.78), (T7) Spinosad 45% SC (1: 2.31), (T2) NSKE 5% (1:2.39), (T3) *Beauveria bassiana* (1:2.31) and (T1) Neem oil 3% (1:2.12) as compared to (T0) Untreated control (1:2.01).

Keywords: Biopesticides, chemicals, *Chilo partellus*, efficacy, maize stem borer

Introduction
Maize (*Zea mays* L.) is the third major and most important cereal crop of the world after wheat and rice and is grown in tropical, subtropical and temperate regions of the world (Hussain *et al*., 2016) [3]. It has been referred as the "Queen of cereals" due to its highest yield potential among all the cereals. It has short growing season and is drought resistant that make it very easy to grow everywhere in different climatic conditions of the world. Maize is grown in more than 70 countries of the world including USA, China, Brazil, Mexico, France, Argentina, Romania, India, Italy, Indonesia and South Africa (Chouraddi *et al*., 2017) [2].

Maize has high nutritious value in human diet as well as in poultry and livestock feed due to valuable components such as starch, fiber, protein, fats, oil, vitamins and minerals. It is a good source of high-quality edible oil. Due to high yielding capacity and short growth duration, maize increasingly gaining important position and is also used as a fodder crop for silage. Maize is a principal source of human and livestock dietary carbohydrate and industrial substrate (Iqbal *et al*., 2017) [4].

Maize Stem borer, *Chilo partellus* is the most dominant pest infesting the crop throughout its growth from seedling stage to maturity and causing 90-95 per cent of the total damage. Yield losses of 24-75% have been reported by the attack of this pest in some areas. The crop losses caused by Maize stem borer ranges from 24-84 percent. The yield losses caused by stem borers to maize vary widely in different regions and range from 25-40% according to the pest population density and phenological stage of the crop at infestation (Khan *et al*., 2015) [8].

Among the various insect pests, maize stem borer, *Chilo partellus* is the most dominant contributing 90-95 per cent of the total damage in *Kharif* season (Jalali and Singh 2002) [5]. Maize is most vulnerable to *Chilo partellus* (Lepidoptera: Crambidae) which causes severe losses to it (Songa *et al*., 2001) [14]. A loss of 24-75 per cent has been reported by the attack of this pest alone (Kumar and Mihm [6], 1995, Kumar, 2002) [7]. Stem borer can cause severe damage at different stages in the development of cereal crops from seedling to maturity. When infestation is severe, there is a physiological disruption of plant growth; hence panicle emergence and grain formation are severely affected (Addo-Bediako and Thanguane, 2012) [1].

Materials and Methods

The experiment was conducted at the Central Research Field of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, UP. The research field is situated at the right side of Rewa road at 25° 22’ 15.888” North Latitude and 81° 51’ 31.4712” East Longitude and is about 98m above mean sea level. The climate at Prayagraj is typical subtropical which prevails in the eastern part of UP.

The experiment was laid down in randomized block design (RBD) with 3 replications and 8 treatments using variety SHIVAM in a plot size of (2m x 2m) at a spacing of (45 x 60 cm). The infestation and population of maize stem borer, *Chilo partellus* was recorded on 5 randomly selected and tagged plants from each plot .Two insecticidal applications were applied 15 days interval starting from 45 days after sowing . The chemicals and biopesticide treatments include Neem oil, NSKE 5%, *Beauveria bassiana* (1 x 10^8 CFU/ml), Cypermethrin 25% EC, Emamectin benzoate 5% SG, Carbofuran 3G, Spinosad 45% EC, along with control plot (Untreated). The insecticidal application is done when the pest population reaches ETL level. The population of maize stem borer, *Chilo partellus* was recorded 1day before spraying and on 3rd day, 7th day and 14th day after insecticidal application**.**

Cost benefit ratio of treatments

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment should be worked out by deducting total cost of the treatment from gross returns.

Total cost of production includes both cultivation as well as plant protection charges.

Gross return = Marketable Yield x Market

Price Net return = Gross return – Total cost

$$\text{B: C Ratio} = \frac{\text{Net returns}}{\text{Total cost incurred}} \times 100$$

Results and Discussion

The present study entitled “Efficacy of certain chemicals and biopesticides against maize stem borer, *Chilo partellus* (Swinhoe)” was undertaken the data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are present in the following pages.

The data on the Larval population first spray mean(3rd ,7th and 14th DAS)spray revealed that few treatments were significantly superior over control. Among all the treatments lowest larval population was recorded. The lowest percent of larval population was observed in theT6 Carbofuran 3G(5.63), T5 Emamectin benzoate 5% SG (6.30) ,T4 Cypermethrin 25% EC(6.58), T7 Spinosad 45% EC (7.10) ,T2 NSKE 5% (7.38), T3 *Beauveria bassiana* (1 x 108 CFU/ml) (7.73) ,T1 Neem oil(7.94),T0 Control (8.76) is found to be highest larval population than all treatments and is significally superior over the control T0 (8.76).

The data on the Larval population on second spray mean (3rd, 7th and 14th DAS) revealed that few treatments were significantly superior over control. Among all the treatments lowest larval population was recorded. The lowest percent of larval population was observed in the T6 Carbofuran 3G(5.51), T5 Emamectin benzoate 5% SG (6.05) ,T4 Cypermethrin 25% EC(6.88), T7 Spinosad 45% EC (7.28) ,T2 NSKE 5% (7.63), T3 *Beauveria bassiana* (1 x 108 CFU/ml) (8.73) ,T1 Neem oil(8.13) ,T0 Control (9.18)is found to be highest larval population than all treatments and is significally superior over the control T0 (9.18).is found to be highest larval population than all treatments and is significally superior over the control T0 (9.18).

When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the highest cost benefit ratio in T6 Carbofuran 3G(1:3.09) these results are similarly finding by Prakash *et al.* (2017) [10] ,followed by T5 Emamectin benzoate 5% SG (1:2.93) these results are supported by Rani *et al*. (2018) [12] ,T4 Cypermethrin 25% EC(1:2.78) these results are likely to be in Reddy *et al*.(2021) [13] T7 Spinosad 45% EC (1:2.31) these results are supported by Malav *et al* .(2018) [9],T2 NSKE 5% (1:2.39) these results are supported by Venkata *et al. (*2018) [16] T3 *Beauveria bassiana* (1 x 108 CFU/ml) (1:2.31) these results are similarly findings by Saranya *et al.* (2017) [15] The lowest cost benefit ratio was recorded in T1 Neem oil(1;2.12) these results are supported by Ramanujam *et al* .(2017) [11].when compared to T0 control (1:2.01).

Table 1: Efficacy of chemicals and biopesticides on the larval population of maize stem borer, *C. partellus* during *kharif* season of 2021

S. No	Treatments	Larval Population of *Chilo partellus* (First spray)					Larval Population of *Chilo partellus* (Second spray)					
		Before spray	3DAS	7DAS	14DAS	Mean	DBS	3DAS	7DAS	14DAS	Mean	Overall Mean
T1	Neem oil	8.20	6.93	7.73	8.93	7.86	8.93	7.20	8.27	8.87	11.09	9.47
T2	NSKE 5%	7.93	6.27	7.20	8.13	7.2	8.13	6.40	7.87	8.13	10.17	8.68
T3	*Beauveria bassiana* (1 x10^8CFU/ml)	8.00	6.87	7.53	8.53	7.64	8.53	7.13	8.13	8.73	10.84	9.24
T4	Cypermethrin 25% EC	8.07	4.93	5.87	7.47	6.09	7.47	5.93	6.80	7.33	9.176	7.63
T5	Emamectin benzoate 5% SG	8.13	4.40	5.67	7.00	5.69	7.00	4.40	6.07	6.73	8.06	6.87
T6	Carbofuran 3G	7.93	3.33	4.80	6.47	4.86	6.47	4.00	5.53	6.07	7.35	6.11
T7	Spinosad 45% EC	8.00	5.67	6.80	7.93	6.8	7.93	6.07	7.27	7.87	9.71	8.25
T0	Control	8.33	8.53	8.80	9.40	8.91	9.40	9.53	10.0	10.33	13.08	10.99
	F-test	NS	S	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.42	0.40	0.45	0.28	0.67	0.28	0.33	0.33	0.22	0.21	0.73
	C.D. (P = 0.05)	-----	0.861	0.968	0.604	0.993	____	0.709	0.716	0.477	0.519	1.57

Table 2: Economics of the Cultivation

Sr. No:	Treatment	Yield of q/ha	Cost of yield (₹)	Total cost of yield(₹)	Common cost (₹)	Treatment cost (₹)	Total cost (₹)	B:C ratio
T1	Neemoil	28.12	1870	52584.4	22422	2420	24842	1:2.12
T2	NSKE 5%	31.34	1870	58605.8	22422	2100	24522	1:2.39
T3	*Beauveria bassiana* (1x10^{8}CFU/ml)	29.56	1870	55277.2	22422	2640	25062	1:2.21
T4	Permethrin 25%EC	36.51	1870	68273.7	22422	2320	24742	1:2.78
T5	Emamectin benzoate 5%SG	38.78	1870	72518.6	22422	2250	24672	1:2.93
T6	Carbofuran3G	40.12	1870	75024.4	22422	1810	24232	1:3.09
T7	Spinosad 45%EC	34.42	1870	64365.4	22422	5500	27922	1:2.31
T0	Control	24.12	1870	45104.4	22422	--------	22422	1:2.01

Cost of yield per quintal (₹) 1870

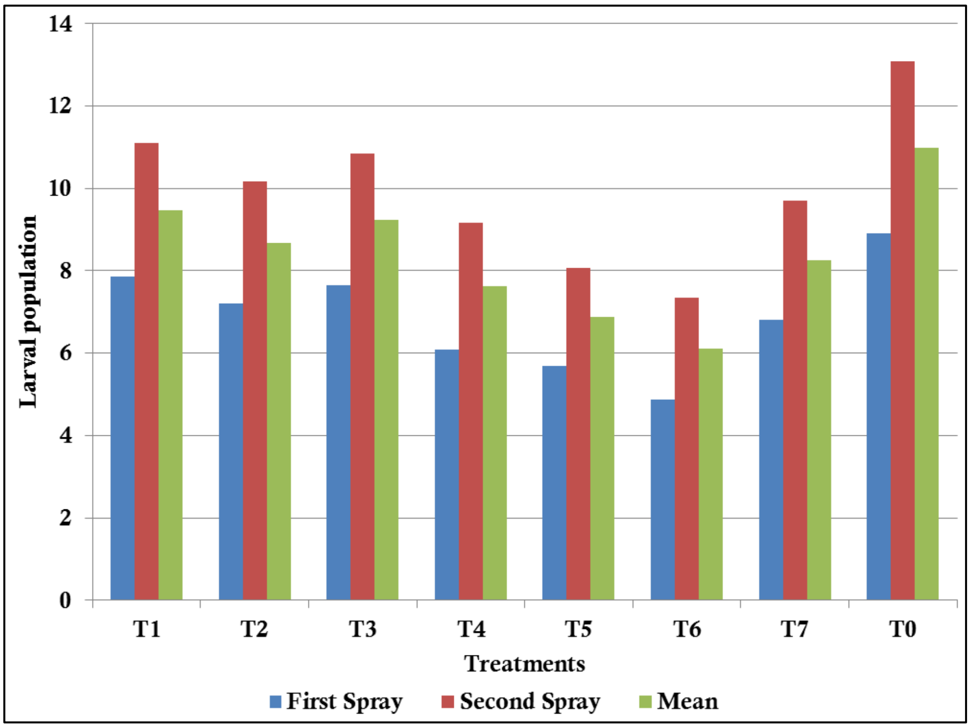

Fig 1: Efficacy of chemicals and biopesticides on the larval population of maize stem borer, *C. partellus* during *kharif* season of 2021 – Larval population (Overall Mean)

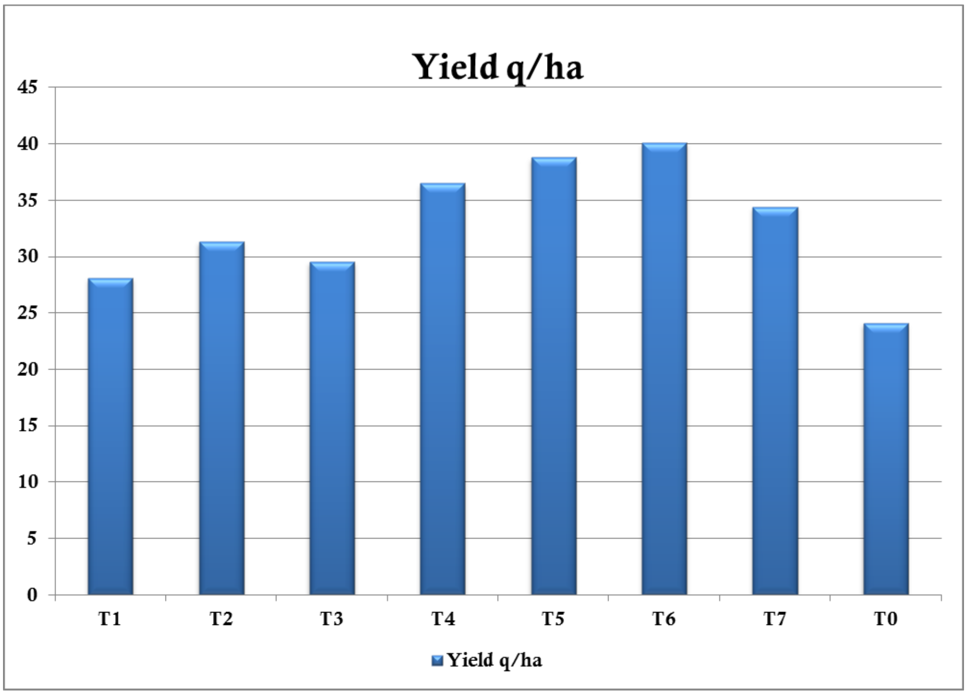

Fig 2: Yield (q/ha) of treated crop (Maize)

Conclusion

When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the highest cost benefit ratio in T6 Carbofuran 3G(1:3.09), followed by T5 Emamectin benzoate 5% SG (1:2.93) these, T4 Cypermethrin 25% EC(1:2.78), T7 Spinosad 45% EC (1;2.31), T2 NSKE 5% (1:2.39), T3 *Beauveria bassiana* (1x 108 CFU/ml) (1:2.31). The lowest cost benefit ratio was recorded in T1 Neem oil (1;2.12) when compared to T0 control (1:2.01).

From the above findings can be concluded that the (T6) Carbofuran 3G is more effective with a lowest larval population and highest benefit cost ratio followed by Emamectin benzoate, Cypermethrin, Spinosad, and Among the botanicals the best treatment with minimum larval population was recorded in NSKE 5% followed by Neem oil, and *Beauveria bassiana* can also be used as an bio agent in order to control the maize stem borer, Hence the insecticides along with the botanicals & bio agents can be incorporated in Integrated Pest Management Programme as an effective tool against gram pod borer as their doses are very low.

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