Evaluate the efficacy of different Biopesticides with Imidacloprid against maize spotted stem borer (*Chilo partellus swinhoe*) on maize under field conditions

ABSTRACT

An experiment of Maize stem borer *Chilo partellus* using different Bio-pesticides in field condition was carried out during *Kharif* 2022-2023 at central Research field SHUATS Prayagraj,UP., India. The management of Maize stem borer was done using 8 different treatments and benefit cost ratios of all the treatments were calculated. Total two sprays were applied to protect the crop from *Chilo partellus* using randomized block design with three replications. The observations of *Chilo partellus* 24 hours before (Pre-treatment) and 3rd, 7th and 14th day after spraying (post-treatment) were recorded for computing the percent of larval population reduction. The data were subjected to statistical analysis after appropriate transformation for interpretation. The treatment with recommended insecticide cost benefit ratio and yield is in Imidacloprid 200 SL (T_7) (1:5.01) (40.49q/ha) followed by *Beauveria bassiana* (2 CFU×10^8 ml) (T_1) (1:4.53) (38.45q/ha), *Bacillus thuringiensis* (10^8 CFU/ml) (T_4) (1:4.41) (37.7q/ha), *Metarhizium anisopliae* (T_2) (1:4.20) (36.79q/ha), *NPV* (T_3) (1:4.03) (35.98q/ha), NSKE @ 5% (T_5) (1:3.97) (34.6q/ha), Azadirachtin 0.03% (T_6) (1:3.85) (33.57q/ha) Lest monetary return and yieldwas obtained with control (T_0) (1:3.52) (28.4q/ha).

KeyWords: Biopesticides, *Chilopartellus*, Management, Maize stem borer, Imidacloprid 200SL

INTRODUCTION

"Maize (*Zea mays* L.) has become a staple food in many parts of the world, with total production surpassing that of wheat or rice. It is an important staple food crop in Asia and Africa. Maize occupies a pride place among cereal crops in India and due to its high yield potential is called the queen of cereals" **(Kumar and Alam, 2017)**.

"Maize grain has elevated nutritive value as it contains about 72% starch, 10% protein,4.8% oil, 5.8% fibreand 3% sugar. At present, out of the total maize produced, 55% is used forfood purpose, about 14% for livestock, 18 % for poultry feed, 12 % for starch and one percentas seed" **(Krishna and Kumar, 2018). "**It is cultivated in nearly 201 m/ha with a production of1162 m tonnes and productivity of 5754.7 kg/ha all over the world, having wider diversity ofsoil, climate, biodiversity and managementpractices" **(FAOSTAT 2020)**. "India produced 31.51million tonnes in an area of 9.9 million hectares in 2020-21, whereas in *kharif* 2021-22, maizeproduction was 21.24 million tonnes (1st advance estimates) in an area of 8.15 million hectares.

Out of 66 insects reported in maize field, there are 14 major pests such as Maize stem borer *Chilo partellus* Swinhoe), Fall Armyworm (*Spodoptera frugiperda* Smith), White grub etc. among which Maize stem borer *Chilo partellus* is more complex now a days". **(Pokharel *et. al.*, 2021)**.

Chilo partellus was first mentioned by **Charles Swinhoe in 1885 (CABI 2019).** *Chilo partellus* is cosmopolitan in nature having its origin in Asia and its severity was also reported in the African region. **(Pokharel *et. al.*,2021)**. "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 tassel emergence and grain formation are severely affected" **(Addo-Bediako and Thanguane,2012)**. *Chilo partellus*, popularly known as stalk borer that occurs during monsoon season is a major pest throughout the country. *Chilo partellus* lays eggs 10-25 days after germination on the lower side of the leaves. The larva of the *Chilo partellus* enters the whorl and causes damage to the leaves. The losses ranging 26.7to 80.4 per cent have been reported due to *Chilo partellus* Swinhoe.

"Out of them, *Chilo Partellus* (Swinhoe) is a serious pest of maize throughout India during *kharif* season causing grain yield loss of 24.3 to 36.3 percent. Almost 75% damage of the crop occurs dueto attack of maize stem borer" **(Dinesh *et al*., 2018).**

"The applications of various insecticides with different modes of action strengthen insecticide resistance management strategy. Thus, to demonstrate these promising tools of pest management at farmers' fields and economic comparison of different insecticidal treatments is

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Necessary" **(Anonymous 2016).**

MATERIALS AND METHODS

The present investigation was conducted at the Central Research Farm, SHUATS, Prayagraj during *kharif season* 2022-23. The experiment was conducted during the *kharif* season 2022 at SHUATS, Central research farm, Prayagraj, is situated at 25.27°C north latitude 80.50°C East longitude. The research trails was laid out during the *Kharif* season of 2022 in Randomized Block Design (RBD) with three replications, seven treatments and untreated control.

In the experiment maize variety, Aarhoee was sown, The site selected was uniform, cultivable with typical sandy loam soil having good drainage. Each block were sub-divided into 2m×1m with maintaining 30cm bordersas bund and the treatment were assigned randomly. The field trail was conducted with seven insecticides + biopesticides treatments in which include (T_1) *Beauveria bassiana* 10^8 CFU/ml@1g/lit, (T_2)*Metarhizium anisopliae@2*.5ml/lit, (T_3)Nuclear polyhedrosis virus @400-500ppm, (T_4) *Bacillus thuringiensis* 10^8CFU/m@750ml/ha,(T_5)Neem seed kernel extract 5% @5 ml/lit, (T_6) Azadirachtin 0.03%@5.0ml/l,(T_7) Imidachloropid 200SL 0.5ml/lit, (T_0) Control.

Application of treatments for the management of the *Chilo partellus* was initiated as soon as 5% ETL of Larval population observed in experimental field. Subsequent application was under taken at an interval of 3, 7, 14 days were made during experimental period. The observation was recorded on weekly intervals throughout the cropping season. To assess the incidence of stem borer at weekly intervals the total number of plants and number of plants Larval population observed was counted from each plot.

The Larval population observed of the maize stem borer was calculated according to the following equation:

$$\text{Larval population} = \frac{\text{No. of larvae}}{\text{Total no. of plants}}$$

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 effect of various treatments on the reduction of larval population of Maize spotted Stem borer *Chilo partellus* (Swinhoe) after 1st and 2nd spray overall mean revealed that All the insecticides were significantly superior over control in reducing the larval population of stem borer which were recorded after insecticidal application Imidacloprid 200SL was found significantly superior (3.37) Over other treatments **(Haq *et al.*, 2018)** , followed by *Beauveria bassiana* (3.75), *Bacillus thuringiensis* (4.22) **(Hegde *et al.*, 2017)**, *Metarhizium anisopliae* (4.71) **(Adhikari *et. al.*, (2021)**, *Nuclear polyhedrosis virus* (5.17)) **Tayde A.R and Ramesh,M 2022).** Neem seed kernel extract (5.60), Azadirachtin (6.06) **(Rani *et al.*, 2018)** as compared to control (8.96).

The data showed that the highest grain yield Imidacloprid (40.49q/ha) these findings are similar with **Neupane *et. al., (*2016)** with the result of (3.38t/ha), followed by the *bassiana* (38.45q/ha) and these findings are similar with **Adhikari *et al.*, (2021)** with the of (42.50q/ha *),* The next best treatment is *Bacillus thuringiensiss* (37.70q/ha) these findings are supported by **Dhaliwal *et al., (*2018)** with the result of (34.86q/ha), the next best treatment *Metarhizium anisopliae* (36.79q/ha) are similar with **Hegde *et al., (*2017)** with the result (35.46q/ha), the next best treatment is *Nuclear polyhedrosis virus* (35.98 q/ha). Neem seed kernel extract (34.60 q/ha) and these findings are very close to **Dinesh *et al.*, (2018)** with result (32.70q/ha). The next best treatment is Azadirachtin (33.75 q/ha) these findings are similar to **Dinesh *et. al.*, (2018)** with the result of (33.70 q/ha) as compared to control (28.40 q/ha).

When the cost benefit ratio is worked out, interesting result was achieved. Among the treatments studied, the best and economical treatment was Imidacloprid (1:5.01) and was found significantly superior over rest of the treatments and these findings are similar to **(Reddy and kumar,2021)** with the result of (1:4.89). Which was followed by *Beauveria bassiana* with (1:4.53) these findings are similar to **Babu and kumar(2022)**with the result of (1:3.31) , the next best treatment is *Bacillus thuringiensis* (1:4.41) these findings are similar to ***Hegde et al* 2017)** with the result (1:3:5) , *Metarhizium anisopliae* (1:4.20) these finding similar to **Divya and mariappan(2019)** with the result (1:3.8), *Nuclear polyhedrosis virus* with (1:4.03), these findings similar to ***Ramesh et. al., (2022)*** with the result (1:3.60) the next best treatment is seed kernel extract (1:3.97) these findings are close with **Babu and Kumar (2022)** with the result of (1:2.39) and Azadirachtin 0.03% with (1:3.85) these findings are supported by **Dinesh *et al., (*2018)** with the result of (1:1.33) and untreated control (1:3.52).

Table 1: Efficacy of different biopesticides with imidacloprid against maize spotted stem borer (*Chilo partellus swinhoe*) (1st and 2nd spray):

S. No.	Treatments	Dosage	Larval Population of *chilo partellus*										Yield(q/ha)	C:B Ratio
			First spray					Second spray				Overall mean		
			1DBS	3DAS	7DAS	14DAS	Mean	3DAS	7DAS	14DAS	Mean			
T_1	*Beauveria bassiana* (10^8 CFU/ml)	1g/lit	7.200 (15.43)	5.000^{e} (12.89)	4.000^{e} (11.69)	4.600^{ef} (12.34)	4.533^{fg} (12.34)	3.533e (10.82)	3.133e (10.18)	2.267^{g} (8.63)	2.978^{fg} (9.71)	3.756^{de} (11.11)	38.45	1:4.53
T_2	*Metarhizium anisopliae*	2.5ml/lit	6.133 (14.32)	5.667 (13.74)	5.267^{c} (13.23)	5.467^{cd} (13.49)	5.467^{de} (13.51)	4.533^{d} (12.28)	4.133^{d} (11.72)	3.200e (10.29)	3.955^{de} (11.44)	4.711^{bcd} (12.49)	36.79	1:4.20
T_3	*Nuclear polyhedrosis virus*	400-500ppm	6.667 (14.94)	6.133^{c} (14.31)	5.600^{c} (13.65)	5.867^{c} (13.98)	5.867^{cd} (14.01)	5.133^{c} (13.09)	4.600^{d} (12.10)	3.733d (11.12)	4.489^{cd} (12.21)	5.178^{bcd} (13.12)	35.98	1:4.03
T_4	*Bacillus thuringiensis* (10^8CFU/m)	750 ml/ha	6.400 (14.59)	5.400^{d} (13.43)	4.533^{d} (12.26)	5.000d^{e} (12.89)	4.978^{ef} (12.88)	4.133^{d} (11.72)	3.600e (10.61)	2.667^{f} (9.37)	3.467^{ef} (10.68)	4.223^{cde} (11.81)	37.70	1:4.41
T_5	Neem seed kernel extract @5%	5 ml/lit	6.867 (15.18)	6.533^{b} (14.79)	6.133^{b} (14.32)	6.400^{b} (14.46)	6.355^{bc} (14.59)	5.533c (13.60)	4.867c (12.74)	4.133c (11.71)	4.844^{c} (12.68)	5.600^{bc} (13.65)	34.60	1:3.97
T_6	Azadirachtin (0.03%)	5 ml/lit	7.467 (15.84)	6.800^{b} (14.95)	6.400^{b} (14.63)	6.533^{b} (14.77)	6.578^{b} (14.85)	6.400^{b} (14.49)	5.467b (13.51)	4.800b (12.64)	5.556^{b} (13.60)	6.067^{b} (14.24)	33.57	1:3.85
T_7	Imidachloropid 200SL	0.5 ml/lit	6.200 (14.32)	4.667^{e} (12.44)	3.800^{e} (11.18)	4.400^{f} (12.06)	4.289^{g} (11.93)	3.133e (10.18)	2.467^{f} (9.02)	1.800^{h} (7.67)	2.467^{g} (8.97)	3.378^{e} (10.49)	40.49	1:5.01
T_8	Control	-	7.667 (16.06)	7.800^{a} (16.20)	8.767^{a} (17.22)	8.900^{a} (17.35)	8.489^{a} (16.91)	9.200^{a} (17.65)	9.400a (17.85)	9.733^{a} (18.17)	9.444^{a} (17.89)	8.967^{a} (17.41)	28.40	1:3.52
F-Test			NS	**S**	**S**	**S**	S	**S**	**S**	**S**	S	S		
S.Ed.(±)			NS	0.16	0.23	0.22	0.26	0.23	0.24	0.17	0.29	0.91		
CD (0.05)			NS	0.33	0.48	0.48	0.583	0.49	0.504	0.360	0.623	1.87		-

2.1 Cost benefit Ratio of Treatments

Gross returns was calculated by multiplying total yield with market price of the produce. Cost of cultivation and cost of treatments was deducted from the gross returns, to find out returns and cost benefit of ratio by following formula,

$$BCR = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

Where,

BCR=Benefit cost ratio

CONCLUSION

From the present study, the results showed that Imidacloprid 200 SL (T7), is the most effective treatment against maize stem borer and produces maximum yield, and recorded the highest Cost-Benefit ratio compared to other treatments. From the critical analysis of the present findings it can be concluded that maize stem borer increases with maximum temperature and decreased with decline in minimum temperature. Insecticides like *Beauveria bassiana* 1×10^{8}CFU/ml (T1) and *Bacillus thuringiensiss* (T4), was found significantly superior than other treatments. Followed next effective treatment found was *Metarhizium anisopilae* (T2), *Npv* (T3). However, NSKE @5% (T5) *and Azadirachtin* 0.03% (T6) found to be least effective in managing maize stem borer (*Chilo patellus*) as an effective tool under chemical control. Hence, it is suggested that effective insecticides may be alternated along with biopesticides with the existing Integrated pest management programs to avoid the problems associated with insecticidal resistance, pestresurgence etc.

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