Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 1142-1145
Received: 18-05-2018
Accepted: 23-06-2018

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Biorational management of stem borer, *Chilo partellus* in maize

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Abstract
A field experiment was conducted during *kharif* season of 2017-18 at Central Research Field, Department of Entomology, SHUATS, Allahabad, (U.P) to study the evaluate the efficacy of some insecticides and biopesticides, against stem borer (*Chilo partellus*) on maize under field condition. Application of the seven treatments Cypermethrin, Chlorpyrifos, Dimethoate, Azadirachtin, NSKE, Beauveria bassiana (10^8 CFU/ml) and Bacillus thuringiensis reduced the infestation as compared to the untreated control. The minimum percent of infestation were observed in Cypermethrin (10.31%), then followed by Chlorpyrifos (11.7%), Dimethoate (11.7%) which is reported as the next effective treatment. Out of seven different insecticides Cypermethrin recorded significantly highest yield of 41.23 q/ha followed by Chlorpyrifos (36.54 q/ha). The cost benefit ratio (CBR) showed that the application of Cypermethrin 25% EC was economically most viable treatment (1:1.64) followed by Chlorpyrifos (1:1.42).

Keywords: *Chilo partellus*, efficacy, insecticides, biopesticides and maize

Introduction
Maize (*Zea mays* L.) is the most versatile crop adopted to different agro-climatic conditions. It is an important staple food crop in Asia and Africa. It is the most important crop in the world after wheat and rice. The production of maize is constantly increasing because of the rising demand from the industries since maize is used as raw material. It is called as the "Queen of Cereals." It is grown primarily for grain, secondarily for fodder, raw material for industrial process and diversified products. It is a miracle crop with high yielding potential.

It is cultivated on nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36% (782 m t) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35% of the total production in the world and maize is the diversity of the US economy. The USA has the highest productivity (> 9.6 t ha^{-1}) which is double than the global average (4.92 t ha^{-1}). Whereas, the average productivity in India is 2.43 t ha^{-1}. Maize among there cereals rank fifth in total area and third in total production and productivity in India. Maximum area in Rajasthan, Productivity in Andhra Pradesh and Karnataka in higher production.

In Uttar Pradesh, it is grown in an area 8.47 lakh hectare with a production of 11.17 lakh tons and the productivity was 1326 kg/ha in 2016-17 (Anonymous, 2016) [5]. In Uttar Pradesh maize is largely grown in Bulandshahr, Farrukhabad, Meerut, Bahraich, Gonda, Jaunpur, Etah, Manipuri and Kheri districts. Insect- pests are the major factors responsible for low productivity of maize in India. 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 per cent.

The main limiting factor for lowering the productivity of maize is the pest and disease problems among which Lepidoptera insect pest especially maize stem borer *Chilo partellus* are the most destructive ones (Singh and Sharma, 2009) [35]. Almost 75% damage of the crop occurs due to attack of maize stem borer. Control measures have been devised to minimize the economic impact of the damage caused by stemborers. Stemborers have been controlled by cultural, biological, host plant resistance and chemical methods.

When the infestation is severe, the larvae, either in the leaf whorl or in the stem, can cut through the meristematic tissues; the central leaves dry up to produce the 'dead heart' symptom, resulting in the death of the plant (Groote, 2002) [14].

Material and Methods
The field experiment was conducted during *kharif* season of 2017-18 at Central Research Field,

Department of Entomology, SHUATS, Allahabad, (U.P) to evaluate the efficacy of biorational pesticides against the stem borer C. partellus on maize. Composite Sown with 60cm x 20cm plant spacing. The experiment was laid out in completely randomised block design (RBD) with 8 treatments and 3 replications in 2m x 2m size terraced plots. Recommended agronomic practices were adopted for raising the crop excluding the plant protection measures. The treatments of the experiment consisted of,

Chlorpyriphos 20EC @2.5ml per liter of water
Cypermethrin 25EC @ 0.2ml per liter of water
Dimethoate 30EC @1.7ml per liter of water
Azadirachtin@1ml per liter of water
NSKE @ 5ml per liter of water
Bacillis thuringenesis @ 1gm per liter of water
Beauveria bassiana @ 10^8 CFU/ml (Biopower 1.15% WP)
T8. Untreated control plot

The observations on the number of pest made on the plants from each plot and chemicals and bio-pesticides applied. The number of pest per plot calculated based on the number of infected leaves and stalks. The observations are made a day before followed by 3rd, 7th, 14th days after spraying. Observations recorded without disturbing the plants to minimize the observational errors. Population of stem borer recorded from each net plot and the population worked out per leaf and stalk.

During experimentation two sprayings were carried out. The treatments consist of spraying, Chlorpyriphos 20% EC, Cypermethrin 25% EC, Dimethoate 30EC, Azadirachtin, NSKE, Bacillus thuringiensis, Beauveria bassiana, Control (Water Spray). The data obtained were subjected to statistical analysis after appropriate transformation and are presented in tables. The observations and their findings are discussed here with under different evaluation of comparative efficacy of chemical insecticides on the management of maize stem borer *Chilo partellus* (Swinhoe).

The infestation in all the treatment were taken a day before imposition of treatments as indicated in tables.

Assessment of infestation

The comparative efficacy of some insecticides and bio pesticides on the management of maize stem borer *Chilo partellus* (Swinhoe).

$$\text{Percent infestation} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \text{ X } 100$$

(Syed *et al*. 2015) [37]

Result& Discussion

The infestation of (*Chilo partellus*) revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest percent infestation was recorded in Cypermethrin (10.31%) followed by Chlorpyrifos (11.7%) and Dimethoate (11.7%) are at par with each other. Followed by Azadirachtin, (1348%), NSKE (13.47), Beauveria bassiana (10^8 CFU/ml) (14.65%), Bacillus thuringiensis (17.03%) is the least effective among the all treatment.

Among the various insecticides evaluated against stem borer, spray revealed that Cypermethrin was found to be more effective than other treatments, followed by Chlorpyrifos, Dimethoate, Azhadirectin, NSKE, Beauveria bassiana (10^8 CFU/ml) are next effective treatments. And Bacillus thuringiensis is recorded as least effective among the chemical treatments but significant and superior over control.

The yields among the treatment were significant. The highest yield was recorded in T_2 Cypermethrin (41.23 q/ha) followed by T_1 Chlorpyrifos (36.16 q/ha), T_3 Dimethoate (35.10 q/ha), T_4 Azadirachtin, (33.70 q/ha), T_5 NSKE (32.70 q/ha), T_7 Beauveria bassiana (31.52 q/ha), T6 Bacillus thuringiensis (29.30q/ha) as compared to T_8 Control (25.56q/ha). When Cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was T_1 Cypermethrin (1:1.64) followed by T_2 Chlorpyrifos (1:1.42), T_3 Dimethoate (1:1.37) T_4 Azadirachtin (1:1.33), T_5 NSKE (1:1.27), T_7 Beauveria bassiana (1:1.25), T_6 Bacillus thuringiensis (1:1.15) as compared to T_8 Control (1:1.01).

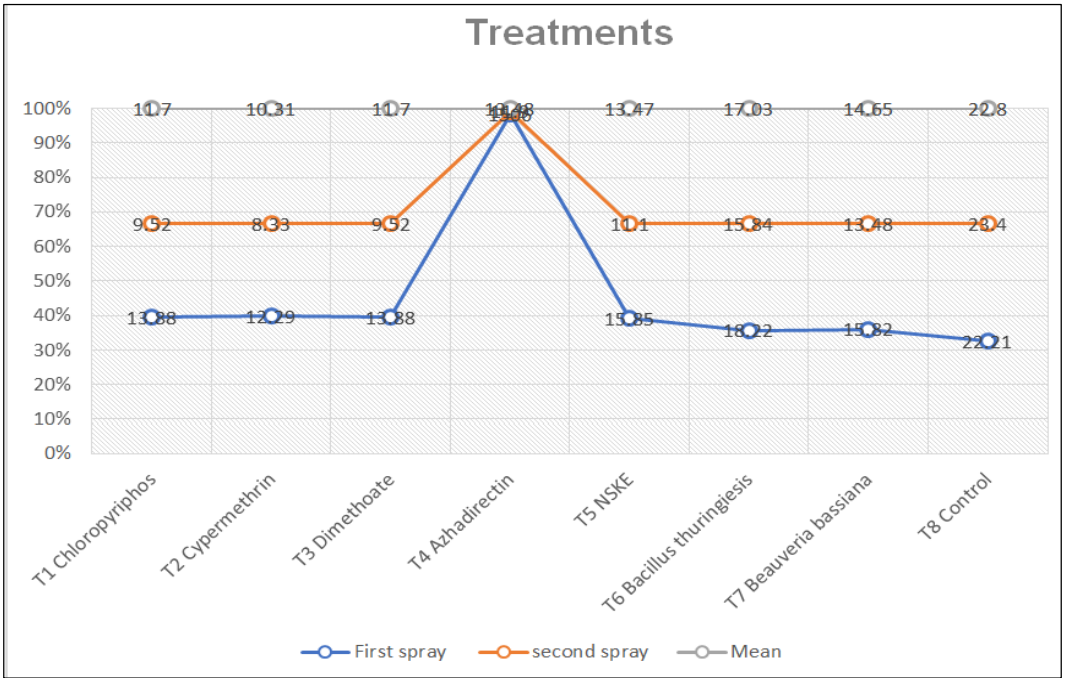

Fig 1: Graphical representation of Efficacy of chemical and some biopesticides on the management of maize Stem borer *Chilo partellus* (Swinhoe). (Overall mean first and second spray)

Table 1: Efficacy of chemical and some biopesticides on the management of maize Stem borer *Chilo partellus* (Swinhoe).

S. No	Treatments	Per cent infestation Overall Mean		
		First spray	Second spray	Mean
T1	Chlorpyrifos 20EC	13.88 (21.96)	9.52 (17.90)	11.7 (19.93)
T_2	Cypermethrin 25EC	12.29 (20.47)	8.33 (16.69)	10.31 (18.58)
T_3	Dimethoate 30EC	13.88 (21.82)	9.52 (17.90)	11.7 (19.86)
T_4	Azadirachtin@1ml\liter of water	15.06 (22.77)	11.9 (20.08)	13.48 (21.42)
T_5	NSKE@ 5ml\liter of water	15.85 (23.43)	11.10 (19.39)	13.47 (21.41)
T_6	Bacillus thuringiensis@ 1gm\liter of water	18.22 (25.21)	15.84 (23.42)	17.03 (24.310
T_7	Beauveria bassiana@ 1.15gm\liter of water	15.82 (23.43)	13.48 (21.16)	14.65 (22.29)
T_8	Control	22.21 (28.1)	23.40 (28.91)	22.80 (28.50)
F- test		S	S	S
S. Ed. (±)		3.87	1.29	1.36
C. D. (P = 0.05)		4.83	3.87	3.22

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