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BIO-EFFECTIVENESS OF CERTAIN PESTICIDES AGAINST *CHILO PARTELLUS* (SWINHOE), MAIZE STEM BORER

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H.M.S conducted the experiment and finalize the manuscript, R.A.N helped in collecting and analyzing the data.

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ABSTRACT

The field experiment has been conducted to study the bio-effectiveness of chlorantraniliprole 20 SC, novaluron 10 EC, flubendiamide 480 SC, deltamethrin 2.8 EC, and carbofuran 3G against maize stem borer, *Chilo partellus* at Bux Ali Agriculture farm Khaisana Mori, Near Tandojam Sindh, during Kharif 2019. The minimum and maximum mean % infestation (10.60 and 72.60) as well as mean % dead heart (3.75 and 23.50) were recorded in chlorantraniliprole 20 SC @ 0.3 ml/l followed by carbofuran 3G @ 7 kg/ha and untreated control, respectively.

1. INTRODUCTION

Maize (*Zea mays* L.) is the third most important staple food of India after wheat and rice, grown virtually in every suitable agro-ecological region of the world at different degrees of success. Due to its highest yield, potential among all the cereals maize is referred to as "Queen of cereals" [1]. The average area of maize in India is 9.43 million hectares with an average production of 22.23 million tonnes having average productivity of 2.5 t/ha [2]. Inspite of the increase in acreage, maize production in India remained almost stagnant with constant yield level [3]. Like other cereal crops, maize is also prone to a wide range of biotic and abiotic factors, the incidence of insect pests being one of them. In India, maize crop is attacked by 139 species of insect pests causing the varying degree of damage. However, only about a dozen of these are quite serious cause damage from sowing until storage [4]. Among the various insect pests, maize stem borer, *Chilo partellus* is the key pest contributing 90-95 percent of the total damage in the Kharif season [5]. Maize is most vulnerable to *Chilo partellus* (Lepidoptera: Crambidae) which causes severe losses to it [6].

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For the management of *Chilo partellus*, the application of effective chemicals with a different mode of action at proper crop stage is significant as the pest is an internal feeder. The applications of various Pesticides with a different mode of action strengthen the Pesticide resistance management strategy. Thus to demonstrate these promising tools of pest management at farmer's field and economic comparison of different insecticidal treatments is necessary. The present investigation was, therefore, undertaken with the objective: Ascertaining the field effectiveness of certain Pesticides against *Chilo partellus* (Swinhoe).

2. MATERIALS AND METHODS

Chilo Partellus (Swinhoe) on maize, a field study was performed in the RBD at Bux Ali farm Khaisana Mori, Near Tandojam Sindh, Pakistan during Kharif season in 2019 to assess the field effectiveness of the above-mentioned insecticides used as foliar spraying and granules to monitor maize borers. There was a total of ten treatments and thrice repeated each treatment. The Kashmir gold maize variety was cultivated as a test crop and sowing was done in July 2019. In a plot size of 43 m2, the seed was sown in a row to row and plant to plant 60 cm spacing. Except

for carbofuran 3 G, the spray formulations were made from the commercially available material and all the treatments were applied with manually operated knapsack sprayer whereas carbofuran 3G is applied manually with hands. All crop-raising practices were followed to maintain healthy crop production, and no pesticides were applied except those used in the trial. The treatments have been used twice. The first application was made in all treatments at 15 days after being sown as a foliar spray.While the second application was performed 30 days after sowing, T1 to T4 treatments are applied as a spray in this application, while, Treatments T5 to T9 were used as whorl application in granular form. During each spray, the observation was reported of the number of infested plants and dead heart from four middle rows in each plot. The data thus obtained were combined to obtain cumulative plant infestation / dead heart caused by a borer of maize stem.The mean percentage of plant infestation as well as the dead heart is determined based on these observations. Treatment effect on pest infestation was further determined by using the formula:

$$\% \text{ Plant Infestation} = \frac{\text{Number of infested plants/plot}}{\text{Total number of plants/plot}} \text{X100}$$

Mean (%) reduction in plant infestation/dead heart over untreated control was calculated as follows:

$$\frac{\text{P1} - \text{P2} - \ldots \text{P9}}{\text{P1}} \text{X100}$$

Where P1= plant infestation/dead heart in untreated plot P2....P9= plant infestation/dead heart in the treated plot.

3. RESULTS AND DISCUSSION

Data on mean percentage of plant infestation due to maize stem borer (*C. partellus*) in maize (Kashmir Gold), summarized in table II and illustrated in Fig. 1, A substantial difference was reported between the various treatments under study. The mean percentage of plant infestation caused by stem borer was located in the 2.2 and 72.6 percent range. The minimum and maximum percentage of plant infestation was found in chlorantraniliprole 20 SC treatments at 0.3 ml / l followed by carbofuran 3 G at 7 kg /ha (2.20%) and untreated control (72.60%). Chlorantraniliprole 20 SC foliar application @ 0.3 ml / l, novaluron 10 EC @ 0.1 ml / l, flubendiamide 480 SC@ 0.2 ml / l and deltamethrin 2.8 EC@ 0.4 ml / l registered 10.60, 27.62, 10.40 and 13.75 per cent, respectively. Between the concurrent treatments chlorantraniliprole 20 SC at 0.3 ml / l followed by carbofuran 3 G at 7 kg / ha, a minimum percentage of plant infestation betime at 2.20.Single application of carbofuran 3 G @ 7 kg / ha had plant infestation of 12.80 per cent.Among the different foliar applications, flubendiamide 480 SC@ 0.2 ml / l showed plant infestation of 10.40% and matched chlorantraniliprole 20 SC @ 0.3 ml / l (10.60%) and carbofuran 3 G @ 7 kg / ha (12.80%).Nonetheless, foliar application of chlorantraniliprole 20 SC @ 0.3 ml / l followed by granular application of carbofuran 3 G @ 7 kg / ha reported a minimum percentage of plant infestation (2.20%) and was equal to flubendiamide 480 SC @ 0.2 ml / l followed by carbofuran 3 G @ 7 kg / ha (3.52%).Novaluron 10 EC @ 0.1 ml / l has been found to be least effective in reducing infestation of stem borers.All the insecticidal treatments retained their dominance in reducing C over untreated regulation. Infestation of the *C. partellus* was distinct but within themselves.This was clear from both table II and Fig. 1, the Pesticides have been found to exercise a varying degree of reduction in infestation per cent.Foliar application treatments accompanied by granular usage i.e., chlorantraniliprole 20 SC@ 0.3 ml / l and carbofuran 3 G @ 7 kg / ha, novaluron 10 EC @ 0.1 ml / l and carbofuran 3 G @ 7 kg / ha, flubendiamide 480 SC@ 0.2 ml / lCarbofuran 3 G@ 7 kg / ha and deltamethrin 2.8 EC @ 0.4 ml / l and carbofuran 3 G @ 7 kg / ha resulted in a greater reduction of 96.96, 95.15, 93.97 and 84.38% respectively over untreated control.Application of chlorantraniliprole 20 SC@ 0.3 ml / l, novaluron 10 EC @ 0.1 ml / l, flubendiamide 480 SC@ 0.2 ml / l and deltamethrin 2.8 EC @ 0.4 ml / l as foliar spray resulted in relatively lower performance in reduction of infestation with pests from 85.40 to 61.95 per cent over untreated control.Of these, chlorantraniliprole 20 SC@ 0.3 ml / l (85.40%) and flubendiamide 480 SC @ 0.2 ml / l (85.67%) were found to be the most effective in reducing infestation with pests.In addition, deltamethrin 2.8 EC@ 0.4 ml / l and novaluron 10 EC @ 0.1 ml / l held third and fourth roles, with respect to their field efficacy respectively.Carbofuran application alone showed an 82.36 per cent decrease in pest infestation compared to untreated control.Novaluron 10 EC @ 0.1 ml / l reported the slightest effect (61.95 percent) of all insecticidal treatments in reducing infestation of the pest over untreated control.Foliar applications were found to be more effective in reducing percentage of infestation in sequence with granular application compared to two spraying of different Pesticides alone.Partellus ranged widely between 1.0 and 23.5 per cent in various treatments.All the insecticide treatments maintained their dominance over untreated control in reducing the heart which *Chilo partellus* causes to die.Chlorantraniliprole 20 SC foliar application @ 0.3 ml / l, novaluron 10 EC @ 0.1 ml /

l, flubendiamide 480 SC@ 0.2 ml / l and deltamethrin 2.8 EC @ 0.4 ml / l showed 3.75, 13.55, 4.0 and 6.35 per cent dead hearts respectively.Novaluron spraying 10 EC @ 0.1 ml / l reported the highest percentage of dead heart of all insecticide treatments.Dead heart in foliar spray treatments sequentially with granular application was observed as: chlorantraniliprole 20 SC @ 0.3 ml / l accompanied by carbofuran 3 G @ 7 kg / ha (1.0 per cent), flubendiamide 480 SC@ 0.2 ml / l followed by carbofuran 3G @ 7 kg/ha (1.20%), deltamethrin 2.8 EC @ 0.4 ml/l followed by carbofuran 3G @ 7 kg/ha (1.70%) and novaluron 10 EC @ 0.1 ml/l followed by carbofuran 3G @ 7 kg/ha (3.40%). Single use of 3 G carbofuran @ 7 kg / ha reported 5.70 per cent dead heart.Chlorantraniliprole 20 SC @ 0.3 ml / l reported 3.75 percent dead heart among foliar spray treatments and was 4.0 percent equivalent to flubendiamide 480 SC @ 0.2 ml/l.Chlorantraniliprole treatments 20 SC @ 0.3 ml / l followed by carbofuran 3 G @ 7 kg / ha reported a minimum of 1% dead heart (480 SC @ 0.2 ml / l) followed by carbofuran 3 G @ 7 kg / ha (1.20%) and deltamethrin 2.8 EC @ 0.4 ml / l followed by carbofuran 3 G @ 7 kg / ha (1.70%).

It's evident from the data shown in Table 2 and shown in Fig. 1, That the degree of the reduction of the untreated regulation caused by C in dead heart percent. Owing to the application of different treatments of *C. partellus* had been effectively popular.Additionally, the reduction of dead heart over untreated control due to various treatments varied widely. Based on the reduction of mean percent of dead heart over untreated body, different treatments are arranged in decreasing order of relative efficacy as chlorantraniliprole 20 SC @ 0.3 ml / l followed by carbofuran 3G @ 7 kg/ha (95.74%) > flubendiamide 480 SC @ 0.2 ml/l followed by carbofuran 3G @ 7 kg/ha (94.89%) > deltamethrin 2.8 EC @ 0.4 ml/l followed by carbofuran 3G @ 7 kg/ha (92.76%) > chlorantraniliprole 20 SC @ 0.3 ml/l (84.00%) > novaluron 10 EC @ 0.1 ml/l followed by carbofuran 3G @ 7 kg/ha (85.53%) > flubendiamide 480 SC @ 0.2 ml/l (82.97%) > carbofuran 3G @ 7 kg/ha(75.74%) > deltamethrin 2.8 EC @ 0.4 ml/l (72.97%) > novaluron 10 EC @ 0.1 ml/l (42.34%). Among all the insecticidal treatments, chlorantraniliprole 20 SC @ 0.3 ml/l followed by carbofuran 3G @ 7 kg/ha and flubendiamide 480 SC @ 0.2 ml/l followed by carbofuran 3G @ 7 kg/ha occupied first and the second position, respectively and Excelled in through dead heart formation over all other Pesticides. Following granular application of carbofuran 3 G @ 7 kg/ha, foliar application of pesticides was better in efficiency than foliar application only in terms of reduction in percent dead heart formation. Several workers assessed the efficacy of various Pesticides applied as a foliar and granular application against C. partellus on maize in different parts of the maize growing area of the country [7, 8, 9, 12, 13]. The results obtained with chlorantraniliprole 20 SC and carbofuran 3G among the various Pesticides in the present investigation are near the reports of [8, 9]. The present findings are not in line with several workers, [9] revealed that carbofuran 3G was the most effective followed by fipronil 4G. [10] also reported that granular Pesticides carbofuran 3G was found to be superior in their efficacy against *C.partellus*. These findings did also not agree with that of [11] found that cypermethrin was the most effective against *Chilo partellus* (Swinhoe).

4. CONCLUSION

Of the various pesticides assessed against maize stem borer, the minimum and maximum mean percent of infestation and mean percent of the dead heart were reported in chlorantraniliprole 20 SC@ 0.3 ml / l followed by carbofuran 3 G @ 7 kg/ha and untreated power, respectively.The lowest mean percentage reduction in plant infestation control, as well as the dead heart, was found in novaluron 10 EC @ 0.1 ml / l whereas the highest mean percent reduction in plant infestation control, as well as the dead heart, was reported in chlorantraniliprole 20 SC@ 0.3 ml / l followed by carbofuran 3 G @ 7 kg/ha.The highest and yield was reported in chlorantraniliprole 20 SC@ 0.3 ml / l followed by plot treated with carbofuran 3 G @ 7 kg/ha.In addition to the above-mentioned facts, the pesticides used in this study have long-lasting activity with a new mode of action, effective at the very low dose, low residual effect, and safe for non-target species.Use Pesticides in sequence with a different mode of action decreases the risk of developing resistance in insects and demonstrates greater control of insect pests.

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CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding publication of this article.

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TABLE I. Treatment details

Treatment No.	Pesticide**s**	**Dose**
T1	Chlorantraniliprole (20 SC)	0.3 ml/l
T2	Novaluron (10 EC)	0.1 ml/l
T3	Flubendiamide (480 SC)	0.2 ml/l
T4	Deltamethrin (2.8 EC)	0.4 ml/l
T5	Carbofuran 3G	7 kg/ha
T6	T1 + Carbofuran 3G	
T7	T2 + Carbofuran 3G	
T8	T3 + Carbofuran 3G	
T9	T4 + Carbofuran 3G	
T10	Control	

TABLEII- Effect of Pesticides on damage caused by maize stem borer, *Chilo partellus* in maize during Kharif 2019

Treatment No.	Pesticides/Dose	Mean (%) Plant infestation	Mean (%) dead heart	Mean (%) reduction over control	
				Plant infestation	Dead heart
T1	Chlorantraniliprole (20 SC) @ 0.3 ml/l	10.60 (18.98) *	3.75 (11.15) *	85.40	84.00
T2	Novaluron (10 EC) @ 0.1 ml/l	27.62 (31.68)	13.55 (21.57)	61.95	42.34
T3	Flubendiamide (480 SC) @ 0.2 ml/l	10.40 (18.74)	4.00 (11.51)	85.67	82.97
T4	Deltamethrin (2.8 EC) @ 0.4 ml/l	13.75 (21.73)	6.35 (14.58)	81.06	72.97
T5	Carbofuran 3G @ 7 kg/ha	12.80 (20.89)	5.70 (13.78)	82.36	75.74
T6	T1 + Carbofuran 3G	2.20 (8.49)	1.00 (5.43)	97.96	95.74
T7	T2 + Carbofuran 3G	11.34 (19.65)	3.40 (10.61)	84.38	85.53
T8	T3 + Carbofuran 3G	3.52 (10.49)	1.20 (6.28)	95.15	94.89
T9	T4 + Carbofuran 3G	5.10 (12.99)	1.70 (7.48)	93.97	92.76
T10	Control	72.60 (58.44)	23.50 (28.98)	-	-
SEm (±)		(0.96)	(0.40)		
CD (P=0.05)		(2.86)	(1.20)		

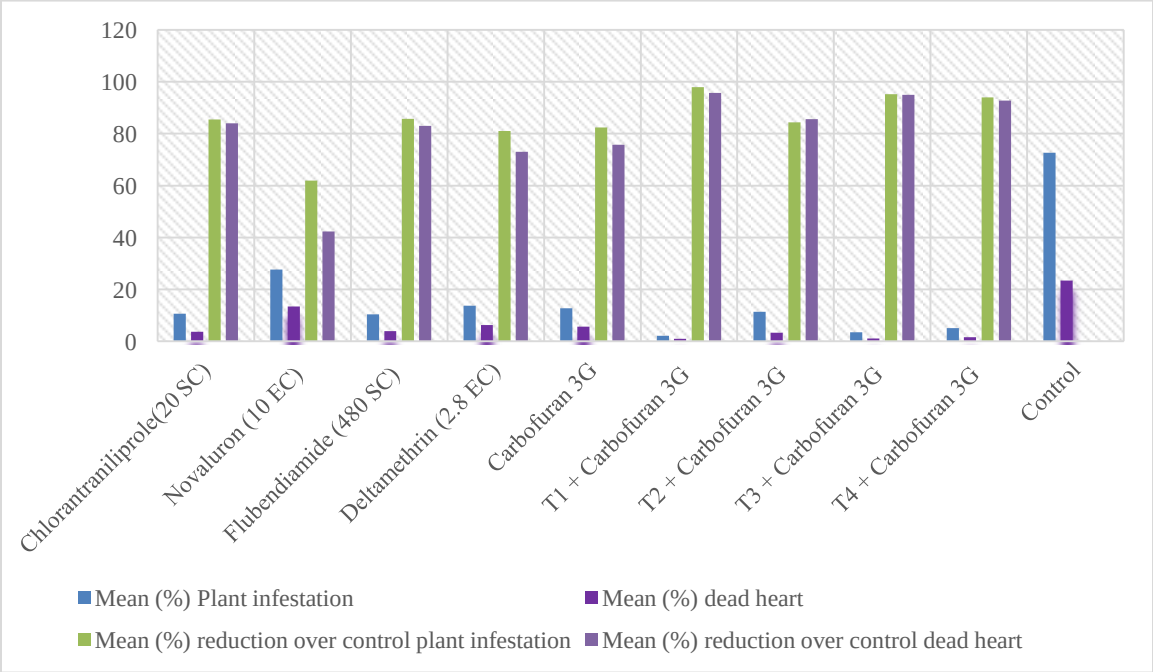

Fig. 1-Effect of pesticides against *Chilo partellus* (Swinhoe) infesting maize during Kharif 2019