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Bioefficacy of insecticides against fall armyworm *Spodoptera fergpirda* on maize crop under field condition of Tandojam, Sindh

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ABSTRACT

Fall armyworm (*Spodoptera fergpirda*) is one of the destructive insect pests of agricultural crops, particularly maize in the field condition. It has severely damaged the maize in the early stage of crops. The efficacy of different insecticides such as Emamectin Benzoate 019EC, Chlorantraniliprole + Thiamethoxome 14% WDG, Lufeneron 05EC, Chlorantraniliprole + Thiamethoxome 17.5%SC, Chlorantraniliprole 20SC and control were used in the study. In the first spray maximum population reduction of S. fergpirda (90.377 %) was recorded for Chlorantraniliprole 20SC followed by Chlorantraniliprole+Thiamethoxome 14%WDG (68.287%), Chlorantraniliprole + Thiamethoxome 17.5%SC (58.283 %), Emamectin Benzoate 019EC (53.117%), and Lufeneron 05EC (37.800%), whereas minimum population reduction of S. fergpirda was observed from control treatment. Similarly in the second spray highest population of S. fergpirda reduction was determine for Chlorantraniliprole 20SC (91.680%) followed by Chlorantraniliprole +Thiamethoxome 14% WDG (78.307%), Chlorantraniliprole +Thiamethoxome 17.5%SC (63.683%), Emamectin Benzoate 019EC (54.823%), Lufeneron 05EC (34.797%) and lowest population reduction was recorded in control treatments. Therefore, findings of the current study Chlorantraniliprole 20SC was found more effective for the management of S. fergipirda on maize crop under field condition.

INTRODUCTION

Maize (*Zea mays* L.) belongs to the family Gramineae and one of the most important cereal crops after wheat and rice in Pakistan (Bukhsh et al. 2011), The maize crop is used all over the world for both food and feed, it contains high-value food for humans as well as stockpiles for animal feed. (Abebe and Feyisa, 2017; Adnan, 2020). The nutrition is found in the grains of Maize as it contains 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar, and 1% ash. (Chaudhary, 1983).
The various factors involved in low maize production in Pakistan. Maize crop is infested by a number of insect pests such as armyworm (*Spodoptera fergipirda*), stem borer (Chilopartellus), thrips (Thrips tabaci), aphid (*Rhopalosiphum maidis*), shoot fly

(*Atherigona soccata*) and termite are main pest causing significant losses (Arabjafari and Jalai, 2007; Nabeel et al., 2018). Among all insect pests, the fall armyworm *Spodoptera fergipirda*, is one of the main destructive and serious pests for maize. (Assefa and Ayalew, 2019). Fall Armyworm *S. fergpirda* originated in the United States, but recent reports from the Asia Pacific and Africa. The Fall Armyworm has caused great international concern since its destruction in Asia in 2018 and Africa in 2016 (Deshmukh et al. 2021). Its damage has been reported from more than 80 crops such as maize, millet, rice, sugarcane, millet, and cotton being the main hosts of fall armyworm S. fergipirda (Abrahams et al. 2017; Cock et al. 2017; Montezano et al. 2018). The damage caused to the maize crop by the S. fergipirda has been recorded at about 15-73%. (Hruska and Gould, 1997; Lima et al., 2010). Many generations of *S. fergipirda* in a year and temperature have a significant role in its development (Belay, 2011). The larvae are the harmful stage of *S. fergipirda* because the first and second instars usually consume one side of the leaves and make them into skeletons, while the last instars eat all parts of their hosts (Abrahams et al. 2017). According to several reports, many of these pesticides have not been effective. Therefore, in addition to these pesticides, some new pesticides need to be re-examined for effective management of S. fergipirdas.

MATERIALS AND METHODS

The experiment was carried out in the field of Plant Protection Research Institute, Tandojam, in 2021. The experiment was arranged Randomized Complete Block Design (RCBD) where each treatment replicates three times. The six insecticides Emamectin Benzoate, Chlorantraniliprole + Thiamethoxome 17.5%SC, Lufeneron 05EC, Chlorantraniliprole + Thiamethoxome 14% WDG, Chlorantraniliprole 20SC and control were tested against *S. fergipirda* and subsequent application of insecticides was given at 20 days interval with help of hand knapsack sprayer. The size of the each replicated plot 50×33 sq ft. The data were taken population of S. fergipirda larvae based on the appearance and fresh body waste in the leaf whorl of 25 plants randomly from the experimental plot. The data was recorded before spray and after 48 hours, 96 hours and after one week. The collected data was analyzed using (ANOVA) Analysis of Variance and (LSD) least square difference with computer software STATISTIX 8.1. Moreover, the percentage reduction in pest population after the application of various insecticides was calculated using Abbots (1925) formula as given below:

$$\text{Corrected \%} = \left(1 - \frac{\text{n in T after treatment}}{\text{n in Co after treatment}}\right) * 100$$

RESULTS

First spray

The results showed (Table 1) that all the treatments were found significantly different from the control in reducing the larval population of *S. fergipirda* in the first spray at 48, 96, and one week after spray. The data indicated that the larval population before spray was non-significant (F = 0.55; P = 0.7375) difference among all treatments. The *S. fergipirda* larval population after 48 hours of spray, showed highly significant (F = 60.38; P = 0.0000) differences among the treatments. The minimum population of fall armyworm *S. fergipirda* (3.61±0.56/25 plants) was recorded for Chlorantraniliprole 20SC followed by Chlorantraniliprole + Thiamethoxome 14 % WDG (8.13±0.69/25 plants), Chlorantraniliprole + Thiamethoxome 17.5%SC (11.29±0.80/25 plants), Emamectin Benzoate 019EC (13.97±0.83/25plants) and Lufeneron 05EC (19.45±0.80/25 plants). The data showed that the maximum larval population of fall army worm *S. fergipirda* (24.05±1.65/25 plants) was found on the control treatment. The results indicated that the population of *S. fergipirda* after 96 hours of spraying showed (F = 108.34; P<=0.0000) a highly significant difference in all treatments. The lowest population (1.92±0.32/25 plants) of fall army worm *S. fergipirda* was observed on Chlorantraniliprole 20SC followed by Chlorantraniliprole + Thiamethoxome 14% WDG (8.58 ± 0.64/25 plants), Chlorantraniliprole + Thiamethoxome 17.5%SC (10.7 ± 0.82/25 plants), Emamectin Benzoate 019EC 019EC (11.09±0.86/25plants) and Lufeneron 05EC (14.61±0.79/25 plants). However, the highest population of fall army worm *S. fergipirda* (27.56±1.25) was recorded on control treatment. The data observed on the population of fall army worm *S. fergipirda* after one week of spray reveal a highly significantly difference (F = 75.31; P=0.0000) in the treatments. The results showed that the spray of Chlorantraniliprole 20SC found lowest population (2.06±0.44/25 plants) of fall army worm *S. fergpirda*, followed by Chlorantraniliprole + Thiamethoxome 14% WDG (9.01±0.63/25plants), Chlorantraniliprole + Thiamethoxome 17.5%SC (11.65±1.09/25 plants), Emamectin Benzoate 019EC 019EC (12.53±0.74/25 plants) and Lufeneron 05EC (15.64 ± 1.03/25 plants). While the highest population (29.68±1.82/25 plants) of fall armyworm *S. fergipirda* was found on Control treatment.

The (Figure 1) showed that the corrected percentage of the population fall armyworm *S. fergipirda* reduction after 1st spray was recorded the highest reduction of pest population (84.98 %) was recorded for Chlorantraniliprole 20 SC treatments after 48 hours of spray, followed by Chlorantraniliprole ± Thiamethoxome 14 % WDG (66.18 %), Chlorantraniliprole ± Thiamethoxome 17.5 %SC (53.05%), Emamectin Benzoate 019EC 019 EC (41.81%) and Lufeneron 05EC (19.12 %). Moreover, overall maximum reduction percentage of population fall army worm *S. fergpirda* (90.377%) was found on Chlorantraniliprole 20SC followed by Chlorantraniliprole ± Thiamethoxome 14 % WDG (68.287 %), Chlorantraniliprole ± Thiamethoxome 17.5%SC (58.283 %), Emamectin Benzoate 019 EC 019EC (53.117 %) and Lufeneron 05EC (37.800 %) respectively.

Table 1: Efficacy of different insecticides against fall army worm S. fergperda on maize crop in 1st spray

Treatment	Dose/acre	Pre-Treatment	Post Treatment			Reduction Percentage
			48 hours	96 hours	One week	
Emamectin Benzoate 019EC	200g/acre	24.53±1.65a	13.97±0.83c	11.09±0.86c	12.53±0.74c	53.117%
Chlorantraniliprole+Thiamethoxome 14% WDG	150ml/acre	26.30±1.82a	8.13±0.69e	8.58±0.64d	9.01±0.63d	68.287%
Lufeneron 05EC	200ml/acre	24.37±1.78a	19.45±0.80b	14.61±0.79b	15.64±1.03b	37.800%
Chlorantraniliprole+Thiamethoxome17.5%SC	200ml/acre	27.13±2.15a	11.29±0.80d	10.7±0.82cd	11.65±1.09cd	58.283%
Chlorantraniliprole 20SC	50ml/acre	27.65±1.97a	3.61±0.56f	1.92±0.32e	2.06±0.44e	90.377%
Control	----	22.61±1.92a	24.05±1.65a	27.56±1.25a	29.68±1.82a	----

LSD values @ $P < 0.05$ [Pre-spray = 5.0848; 48-Hours = 2.6693; 96-Hours = 2.2770; One week = 2.9407

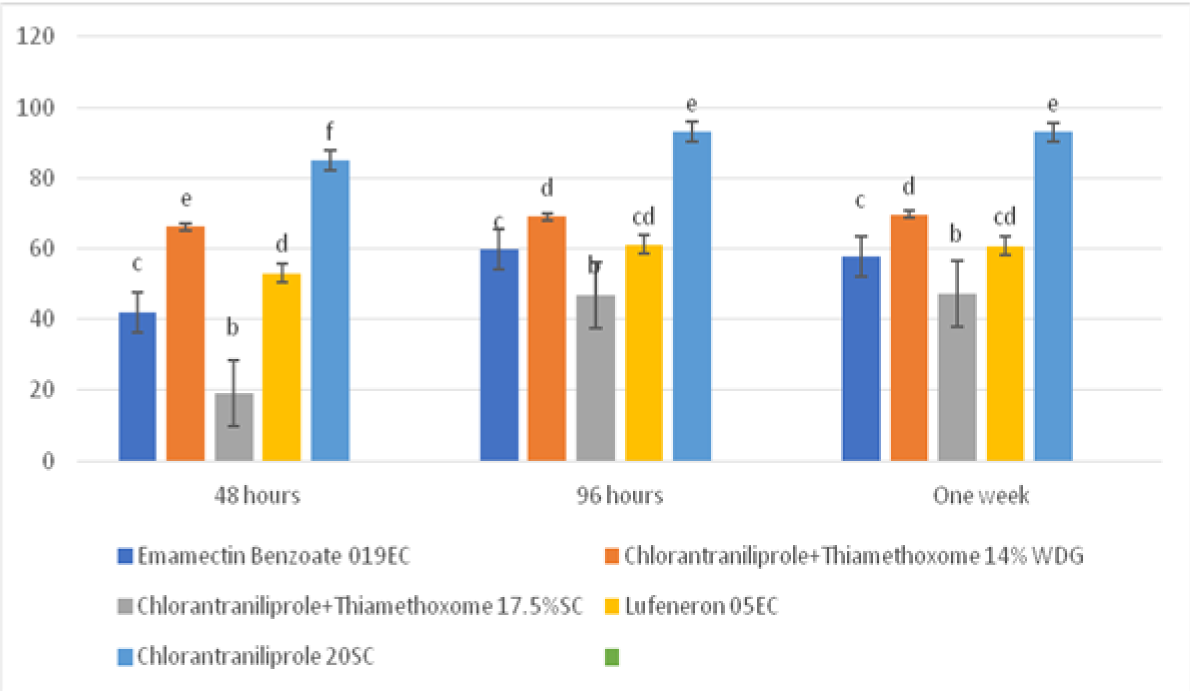

Figure 1: Corrected percentage population reduction of *S. fergipirda* on maize after 1st spray

Second Spray

The results of the second spray showed (Table 2) pre-treatment observation revealed that the non-significant difference (F=0.84; P = 0.5214) as the population of *S. fergipirda* ranged between (12.06±1.61 to 13.48±1.31/25 plants). Similarly, in the first spray data indicated that highly significant difference (F=40.71; P=0.0000) among all treatments after 48 hours of spray. The lowest *S. fergipirda* population (1.54±0.37/25 plants) was recorded for Chlorantraniliprole 20SC followed by Chlorantraniliprole± Thiamethoxome 14% WDG (3.18±0.53/25 plants), Chlorantraniliprole± Thiamethoxome 17.5%SC (5.58±0.82/25 plants), Emamectin Benzoate 019EC 019EC (6.86±0.64/25 plants) and Lufeneron 05EC (10.14±0.80/25 plants). While the highest population (14.48±1.03/25 plants) was recorded from the control treatment. The data indicated that a highly significant difference (F=48.00; P=0.0000) was recorded after 96 hours of spray. The minimum population of *S. fergipirda* (1.01±0.30/25plants) was recorded in Chlorantraniliprole 20SC after 96 hours of spray followed by Chlorantraniliprole ± Thiamethoxome 14% WDG (2.93±0.48/25 plants), Chlorantraniliprole± Thiamethoxome 17.5% SC (5.30 ± 0.68/25 plants), Emamectin Benzoate 019 EC 019 EC (6.18±0.77/25 plants) and Lufeneron 05 EC (9.06±0.76/25 plants) while the highest population (15.10±1.07/25 plants) was recorded on control treatment respectively. The results showed a highly significant difference (F=30.77; P = 0.0000) in the application of various insecticides after one week of spray. The data indicated that the highest population (1.30 ± 0.30/25 plants) of *S. fergipirda* was recorded in Chlorantraniliprole 20 SC followed by Chlorantraniliprole ± Thiamethoxome 14% WDG (4.02±0.53/25 plants), Chlorantraniliprole ± Thiamethoxome 17.5%SC (6.05±0.77/25 plants), Emamectin Benzoate 019EC 019 EC (8.05 ± 0.79/25 plants) and Lufeneron 05 EC (11.18 ± 0.96/25 plants).

The data indicated (Figure 2) that the maximum pest population reduction of *S. fergpirda* (91.680%) was recorded in Chlorantraniliprole 20SC treatment, followed by Chlorantraniliprole ± Thiamethoxome 14 % WDG (78.307 %), Chlorantraniliprole ± Thiamethoxome 17.5 % SC (63.683 %), Emamectin Benzoate 019 EC 019 EC (54.823 %) and Lufeneron 05EC (34.797 %) respectively.

Table 2: Efficacy of different insecticides against fall armyworm *S. fergperda* on maize crop in 2nd spray

Treatment	Dose	Pre-Treatment	Post Treatment			Reduction Percentage
			48 hours	96 hours	One week	
Emamectin Benzoate 019EC	200g/acre	13.48±1.31a	6.86±0.64c	6.18±0.77c	8.05±0.79c	**54.823%**
Chlorantraniliprole±Thiamethoxome 14% WDG	150ml/acre	11.65±1.57a	3.18±0.53d	2.93±0.48d	4.02±0.53de	**78.307%**
Lufeneron 05EC	200ml/acre	10.98±1.57a	10.14±0.80b	9.06±0.76b	11.18±0.96b	**34.797%**
Chlorantraniliprole±Thiamethoxome 17.5%SC	200ml/acre	9.90±1.44a	5.58±0.82cd	5.30±0.68c	6.05±0.77cd	**63.683%**
Chlorantraniliprole 20SC	50ml/acre	10.05±1.37a	1.54±0.37d	1.01±0.30d	1.30±0.30e	**91.680%**
Control	---	12.06±1.61a	14.48±1.03a	15.10±1.07a	17.05±1.89a	---

LSD values @ P < 0.05 [Pre-spray = 4.0761; 48-Hours = 2.0186; 96-Hours = 2.0055; One week = 2.8032]

DISCUSSION

The field experiment was conducted on the efficacy of different insecticides against *S. fergipirda* on maize under field conditions. It has been reported that S. frugiperda is a serious pest of field corn, cotton, and grain sorghum (Hardke et al. 2011). The current study was conducted to test the different insecticides against *S. frugiperda*. The findings of the present study that chlorantraniliprol 20 SC significantly reduced the *S. fergipirda* on maize crops under field conditions. Deshmukh et al. (2020) supported that the chlorantraniliprol 18.5 SC was found most effective pesticides against *S. fergipirda* followed by emmevtin benzoate 5 SG, spinetoram 11.7 SC, flubendiamide 480 SC, indoxocarb 14.5 SC, labdacyhalothrin 5 EC and novaluron 10 EC on maize. Similarly, the application chlorantraniliprol reduced the maximum infestation of *S. fergipirda* on maize whorls followed by Lambda-cyhalothrin, methoxyfenozide and control after 3 days of treatment (Hardke et al. 2012). Thrash et al. (2013)

agreed that the chlorantraniliprol and cyntraniliprol significantly reduce the larval population of *S. fergipirda* in the soybean field. Moreover, the mixture of insecticides chlorfenapyre + chlorantraniliprol and Lufenuron is recommended for the management of S. fergipirda in sugarcane crops in Guangxi, China (Song et al. 2020). Li et al. (2021) mentioned that Chlorantraniliprol is effective against the *S. fruguperda* through drip irrigation and its effect was longer than artificial or drone spray. Furthermore, Chlorantraniliprol had a very strong transport capacity to move from stems to leaves and concentrated in the upper leaves of maize. Chlorantraniliprole was not detected in any plant parts at the time of harvesting. Muraro et al. (2020) agreed that seeds of maize crops treated with Chlorantraniliprol alone or combined with imidacloprid reduce the infestation of *S. fruguperda* under field as well as laboratory conditions. Villegas et al. (2019) mentioned that seeds treated with chlorantraniliprol provide sufficient control against *S. fergipirda*, sugarcane borer and water weevil at an early stage of rice crop. Therefore, these findings that confirm the results of the current study.

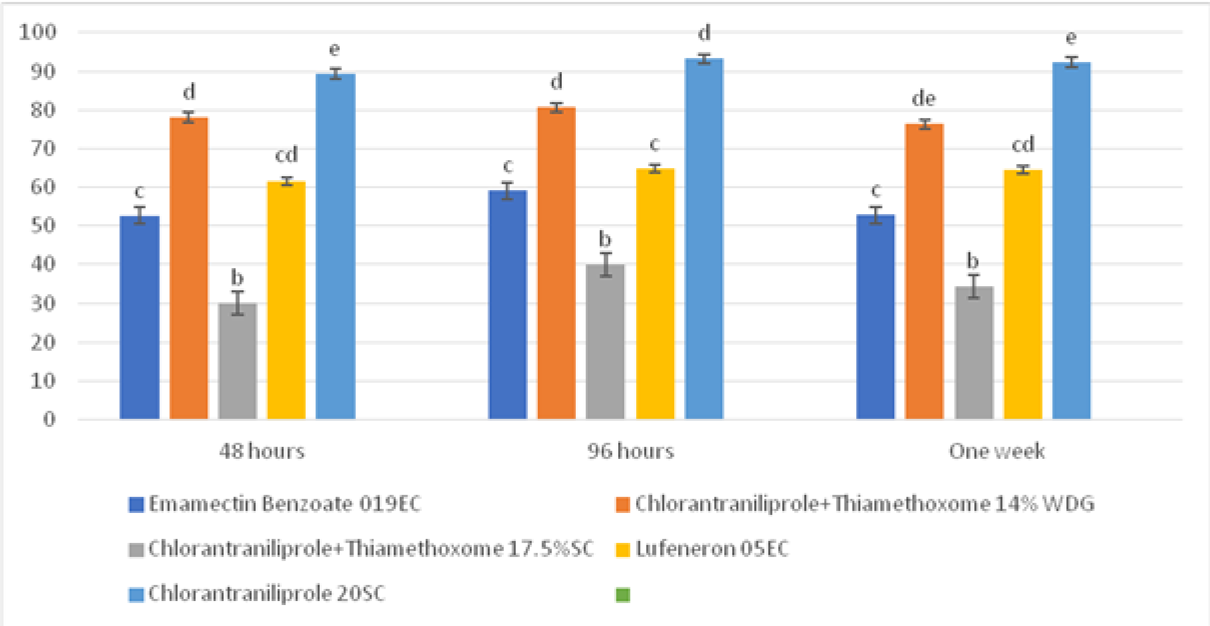

Figure 2: Corrected percentage population reduction of *S. fergipirda* on maize after 2nd spray

CONCLUSION

The present study concluded that among the five insecticides, all the insecticides were more efficient than the control in decreasing the *S. fergipirda* population. However, chlorantraniliprol 20SC insecticides were found most effective for reducing the *S. fergipirda* infestation on Maize.

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