



BIO-EFFICACY OF SOME NEW CHEMISTRY INSECTICIDES AGAINST SUGARCANE TOP BORER, *SCIRPOPHAGA NIVELLA* (FABRICIUS) UNDER FIELD CONDITIONS

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ABSTRACT

The present research work was conducted to evaluate the toxic potential of chlorantraniliprole 0.4% G, chlorantraniliprole + thiamethoxam 0.6% G, chlorantraniliprole 20% SC, fipronil 0.3% G and carbofuran 3 G against sugarcane top borer, *Scirpophaga nivella*. Current study was carried out in 2018-19 at Research Farm of Sugarcane Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan. The insecticides were applied at dose rates of 4 kg/acre (chlorantraniliprole 0.4% G), 8 kg/acre (chlorantraniliprole + thiamethoxam), 100 ml/acre (chlorantraniliprole 20% SC), 8 kg/acre (benfuracarb) and 9 kg/acre (carbofuran). Data regarding insect pest infestation were noted as percentage dead hearts. The results revealed that highest average damage percentage was found in untreated plot, i.e. 40.53%. Chlorantraniliprole 0.4% G was found better among all with 3.40% dead hearts after 30 days. Chlorantraniliprole 20% SC was the next effective one with 3.67% dead hearts followed by chlorantraniliprole + thiamethoxam 0.6% G (3.89%) whereas increased in dead hearts percentage (13.45-20.45%) and (12.10-19.45%) was recorded in fipronil 0.3% G and carbofuran 3% G, respectively after 30 days exposure period. Results regarding relative contents of different qualitative parameters in the attacked sugarcane variety disclosed that relatively higher sucrose contents i.e. 26.105 and 25.56% were sustained in chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC, respectively whereas relatively lower contents were noted in sugarcane blocks treated with other insecticides. Quantitative characteristics of canes treated with chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC were improved over the control. Overall outcomes disclosed that these two insecticides can be more useful for the control of sugarcane top borer compared to other insecticides.

KEYWORDS: *Saccharum officinarum*; insecticide; dead hearts; quantitative characteristics; sucrose contents; Pakistan

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INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is an important cash crop of Pakistan and in 2018-19, the crop was cultivated on 1,102 thousand hectare and the production was 67,174 million tonnes. It parts value added as 2.9% and GDP as 0.5% (GoP, 2019). Its main involvement is in sugar industry and delivers feed stock for ethanol, paper and clip board industries. Sugarcane is the key source of purified sugar in Pakistan; it ranks as 4th main crop afterward cotton, rice and wheat. Sugar industry is known as the 2nd biggest industry next to textile and accounts 2% in the country's GDP (Ashraf, 2003). The average cane yield of Pakistan which ranges from 44-47 t/ha is ample under the contending countries like India (69 t/ha), USA (80 t/ha) and Egypt (107 t/ha) (Gul *et al.*, 2010). Besides the climatic factors, lack of irrigation, plant diseases, improper cultural practices,

uncertified seed, imbalance nutrition, late sowing and harvesting, insect pests and bad rationing are the key factors which results in reduction of sugarcane yield (Sajjad *et al.*, 2013). Owing to these restraints, the current sugarcane yield of the country is approximately 80% less compared to revealed attainable potential (Akbar and Gheewala, 2020). Insect pest infestation is a main causative agent in reduced yield of sugarcane (Gul *et al.*, 2008). Sugarcane crop is being infested by many insect pest species like *Chilo infuscatellus* (Snellen), *Cavelerius excavatus* (Dist.), *Pyrilla perpusilla* (Walker), *Aleurolobus barodensis* (mask.) and *Oligonychus sacchari* (McGregor) (i.e. mite) (Rosa, 2005; Way *et al.*, 2012; Xavier and Merlindayana, 2012; Tan *et al.*, 2011; Riaz, 2003).

In Pakistan, twelve insect pest species of sugarcane crop have been described (Chaudhry and Ansari,

1988). Amongst all insects, borers are more destructive to cane crop by building tunnels in internodes and stubbles. As a result of the tunneling, the availability of food to aerial parts gets restricted (Chaudhary, 2008). Furthermore, the tunnels also pave way for the ailments. Gupta and Singh (1997) noticed that decrease in cane weight up to 25% by 3rd and 4th broods of sugarcane borers. Borers are the severe insect pests of sugarcane (Mehla *et al.*, 2002). Amongst the borers, sugarcane top borer, *Scirpophilla novella* is an imperative insect pest. In young canes, the attack resulted in “dead heart” which triggers the germination of the lateral buds giving a “bunchy top” look (Anwar *et al.*, 2004; Khaliq *et al.*, 2005). From May to December, about 12.06 to 36.51% crop damage happens as a result of the insect pest infestation which causes low yield (Rana *et al.*, 2011). Madan (2001); Anwar *et al.* (2004); Khan and Khan (2006) and Gul *et al.* (2008) also practiced different control approaches against the sugarcane borers and attained healthy results. In Pakistan Furadan 3% G (Carbofuran) was first registered in 1979 as insecticides against the borers of sugarcane crop. Furadan 3% G is a granular insecticide, used against the borers of maize and sugarcane crops (Bhavni, 2016; Munira *et al.*, 2020). Therefore, the current research work was performed to confront the problematic situation of sugarcane top borer through some new formulations of insecticides. Altered dose rates of carbofuran 3G, chlorantraniliprole + thiamethoxam 0.6% G, chlorantraniliprole 0.4% G, chlorantraniliprole 20% SC and fipronil 0.3% G against *Scirpophaga nivella* were assessed to check the best application rate to control the top borer and finally its effect on yield.

MATERIALS AND METHODS

The projected research trial was executed during 2018-19. Sugarcane variety, CPF-246 was sown in the research area of Sugarcane Research Institute, Ayub Agricultural Research Institute, Faisalabad. The experiment was consisted on 6 treatments (Table 1).

Methodology

The research trial was laid out under randomized complete block design (RCBD). The plot size was 6m

× 10.5m. Results regarding insect pest attack were recorded two times in May and June because of the maximum insect pest attack period while June was noted after an interval of one month. At harvesting stage, sampling was done by 10 arbitrarily nominated sugarcane stalks from every research plot (under study) and the canes were riven longitudinally and every cane was thoroughly investigated for the borer infestation and aggregate inter-node injury by the borer was recorded. Results concerning to yield information in tonnes/hectare was noticed for the treatments at the end of the crop season. The treatments were used two times. First was used at 15 days afterward planting as foliar spray in all treatments. Whereas, 2nd was applied at 30 days afterward sowing of sugarcane for the top borer control.

Infestation Percentage

The data of *S. nivella* infestation was recorded from 4 middle rows in every plot of the tested sugarcane field. Results of dead hearts were noticed up to 25th June whereas infestation data was noted from 25th April to the end of September (Kumar and Alam, 2017).

Statistical analysis

The research findings were examined by means of M Stat-C computer programme and the treatment means were compared through the DMR-test (Salkind, 2010).

RESULTS AND DISCUSSION

Findings pertaining to cane damage, number of tillers and effect on cane yield were recorded. The results regarding the crop infestation were noted as percentage dead hearts resulted by the attack of sugarcane top borer as Table 2. Results depicted that maximum percent dead-hearts i.e. 40.53% were observed in control plot. Chlorantraniliprole 0.4% G was found best among all with 3.40 % dead hearts after 30 days followed by 3.67 % (chlorantraniliprole 20% SC), 3.89% (chlorantraniliprole + thiamethoxam 0.6% G) whereas increased in dead hearts percentage (13.45-20.45%) and (12.10-19.45%) was recorded in fipronil 0.3% G and carbofuran 3% G, respectively after 30 days exposure period. Chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC gave better control of borers compared over other insecticides.

Table 1. Treatments description along with recommended application dose rates

Treatments	Treatment description	Dose rate
T ₁	Chlorantraniliprole 0.4% G	4 kg/acre
T ₂	Chlorantraniliprole+Thiamethoxam 0.6% G	8 kg/acre
T ₃	Chlorantraniliprole 20% SC	100 ml/acre
T ₄	Fipronil 0.3% G	8 kg/acre
T ₅	Carbofuran 3 G	9 kg/acre
T ₆	Control	--

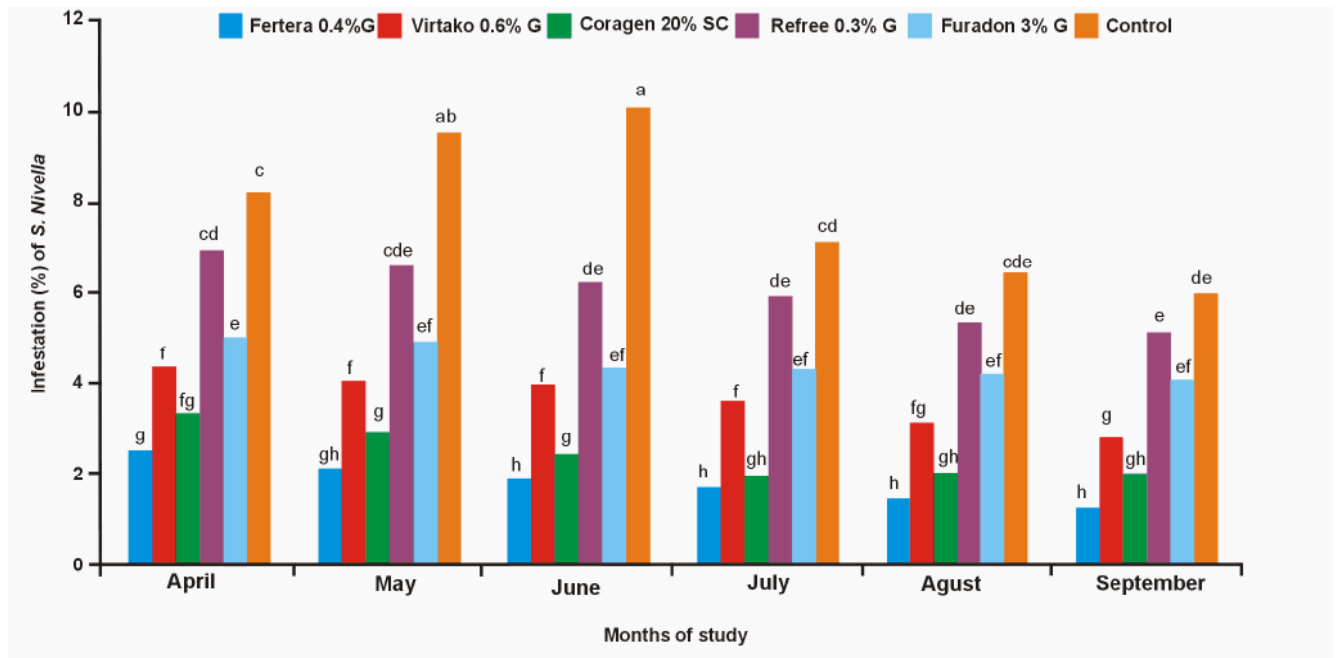


Fig. 1. Comparative efficacy of selected insecticides against the *Scirpophaga nivella* in the sugarcane field during April-September

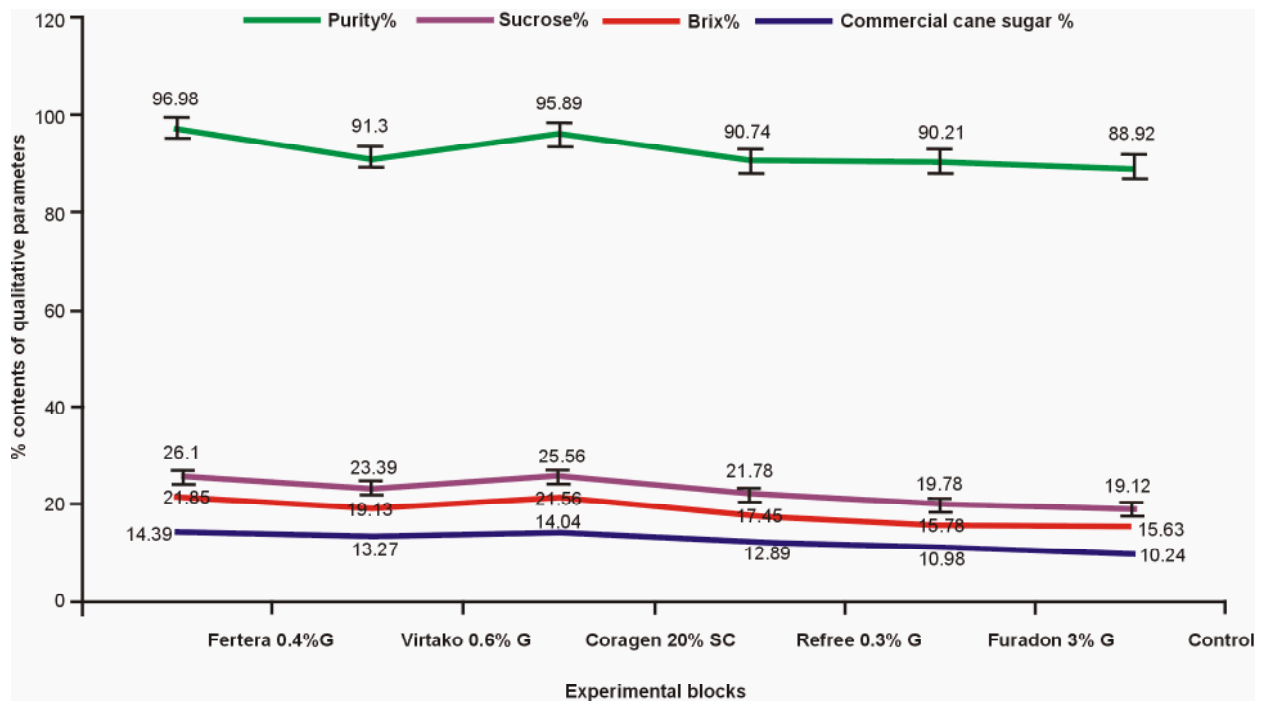


Fig. 2. Impact of the insecticides on the qualitative parameters of the sugarcane variety

Results of percent infestation of *S. nivella* were (Fig.1) displayed that relatively lowest mean infestation (1.24%) was noticed in chlorantraniliprole 0.4% G during April-September followed by chlorantraniliprole 20% SC and chlorantraniliprole + thiamethoxam 0.6% G, carbofuran 3 G and fipronil 0.3% G. Control was the least effective amongst all as highest mean percent

infestation (10.1%) was recorded in control. Results regarding relative contents of different qualitative parameters in the attacked sugarcane variety were given in Fig. 2. Data disclosed that highest sucrose contents (26.105%) were sustained in chlorantraniliprole 0.4% G treated blocks shadowed by chlorantraniliprole 20% SC (25.56%) whereas

Table 2. Percentage dead hearts (Pre-treatment and Post-treatment data) due to sugarcane top borer

Treatments	Application (rate/acre)	Dead hearts (%)		
		Pre-treatment data	Post-treatment data	
			After 15 days	After 30 days
Chlorantraniliprole 0.4% G	4	10.68 ef	3.46 h	3.40 h
Chlorantraniliprole + Thiamethoxam 0.6% G	8	11.57 de	3.89 fg	3.89 fg
Chlorantraniliprole 20% SC	100	11.04 e	5.62 f	3.67 g
Fipronil 0.3% G	8	11.45 e	13.45 c	20.45 c
Carbofuran 3 G	9	10.31 ef	12.10 cd	19.45 c
Control		11.45 e	35.29 b	40.53 a

Means sharing similar lettering are not statistically different from each other at ($p=0.05$).

Table 3. Impact of different insecticides on quantitative characteristics of the sugarcane variety

Treatments	Number of internodes	Cane girth (cm)	Cane length (m)	Single cane wt (kg)
Chlorantraniliprole 0.4% G	23.10 a	2.91 f	2.76 f	1.61 i
Chlorantraniliprole + Thiamethoxam 0.6% G	20.56 b	2.67 fg	2.42 g	1.32 i
Chlorantraniliprole 20% SC	22.47 ab	2.79 f	2.45 g	1.55 i
Fipronil 0.3% G	18.33 c	2.51 fg	2.30 gh	1.28 i
Carbofuran 3 G	16.26 d	2.40 g	2.25 gh	1.24 i
Control	15.40 e	2.12 ghi	2.20 gh	1.19 i

relatively lower contents were sustained in sugarcane blocks treated with other insecticides. In case of purity percentage, relatively greater purity i.e. 96.98% and 95.89% was noted, respectively. Similar results of percentages of sucrose and brix contents were also relatively better in canes treated with these two insecticides as compared to the other insecticides.

Data concerning to variation in quantitative characteristics of canes in treated blocks was given in **Table 3**. Results depicted that highest number of internodes (23.10%) were observed in canes treated with chlorantraniliprole 0.4% G (23.10%) followed by chlorantraniliprole 20% SC (22.47%), chlorantraniliprole + thiamethoxam 0.6% G (20.56%), fipronil 0.3% G (18.33%), carbofuran 3 G (16.26%) while relatively lowest i.e. 15.40% were noted in case of un-treated blocks (control). The similar trends were noted in cane girth, length and weight of single cane. Overall results revealed that chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC proved relatively more effective than other tested insecticides.

The attack of borers on sugarcane initiates when the height of the crop was one (1) foot and it remained up to September, in specific, the attacks of stem borers. For the effective control of the borers in this extended period of crop growth, the findings displayed that application of chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC along with other insect pest management tactics would be a better option for effective control the stem borer in particular. The cost benefit ratio of the two insecticides vs yield upsurge comes out was 1:18 and 1:25 which was exhilarating and for the maximum

sugarcane crop produce, farmers can practice these two insecticides for the maximization of crop profits (Table 4). The chlorantraniliprole 0.4% G was found better among all with 3.40 % dead hearts after 30 days. chlorantraniliprole 20% SC was the next effect one with 3.67 % dead hearts followed by chlorantraniliprole + thiamethoxam 0.6% G (3.89%). Khan and Khan (2006) also tested nonchemical and chemical methods against sugarcane borers including gurdaspur borer and reported that yield parameters were non-significantly improved compared to check plots. Highest significant cane and sugar yield amongst all treatments were recorded in T_6 , which was the 2nd combination of chlorantraniliprole 0.4% G, cultural and mechanical control. The reason of such highest yield was the share of an insecticide (carbofuran 3 G) combined treated with other non-chemical methods. Significant yield losses in sugarcane were observed by infestation of dissimilar type of borers from June to July (Bashir et al., 2007). The outcomes of study are supported by Ullah et al. (2012). Efficacy of basudin 60 EC and carbofuran 3 G along with a bio-control agent, *Trichogramma chilonis* with against *Chilo infuscatellus* but recorded slightly greater values as compared to my research. This difference between the values of this study and my research may be due to combined approach and different borer species on the both studies. Results of decreased in percent damage by the borers after the insecticidal application and prolonged exposure period are in accordance with Pandey (2014) who assessed the relative toxic potential of few insecticides against the shoot borer. Decreased infestations percentage of *Chilo infuscatellus* after application of some synthetic

Table 4. Impact of different insecticides on quantitative parameters of the sugarcane variety

Treatments	Yield during 2018-2019 (t/ha)	Increase in yield over control unit (t/ha)	Increase in value/ha (Rs.)	Application cost of insecticides (Rs.)	Cost benefit ratio
Chlorantraniliprole 0.4% G	88.67	10.30	48925.00	2700	1:18
Chlorantraniliprole + Thiamethoxam 0.6% G	80.54	7.13	33867.50	2100	1:16
Chlorantraniliprole 20% SC	85.12	9.72	46170.10	1790	1:25
Fipronil 0.3% G	76.85	5.37	25507.50	2660	1:10
Carbofuran 3 G	61.58	4.18	19855.00	2500	1:7
Control	55.19	0.00	0.00	-	

insecticides was noticed by Bhawar *et al.* (2016). Findings of my research work are in line with Mandal *et al.* (2014) results revealed that the application of insecticides i.e. endosulfan 35 EC and chlorpyrifos, reduced death-hearts and infestation of top borer up to 11.29%. Furthermore, reduction in death-hearts was found increased over the longer period. The similar trend was recorded in my research. The reduction in death-hearts increased the cane yield as was recorded in my research work. Current research results regards percent infestation were supported by Deka and Sharma (2005) and Sharma *et al.* (2011) where highest incidence and infestation was recorded from June to July as was recorded in present research.

CONCLUSION








The study concluded that the sugarcane borer infestation started after the 2nd week of June and reached to its peak in the mid of July. Highest infestation was recorded in the months of June and July. Use of chlorantraniliprole 0.4% G and chlorantraniliprole 20% SC can be helpful in better control of the top borer. Awareness should be created among the growers through extension workers and training workshops about different sugarcane borers, their life cycle, time of damage and use of management practices. Resistant varieties should be grown to minimize economic losses

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Sr. No.	Author's name	Contribution	Signature
1.	Muhammad Yasir Umar	Conducted the research and wrote up the manuscript	
2.	Sarwat Zia	Supervised the research work	
3.	Masood Ahmad	Supervised the execution of the experiment	
4.	Qurban Ali	Provided the technical guidance during research work	
5.	Habib Anwar	Reviewed the manuscript	
6.	Muhammad Faheem Akhtar	Performed the statistical analysis and helped in write-up the manuscript	
7.	Muhammad Umar Qasim	Reviewed and proof read the manuscript	
8.	Asad Aslam	Helped in on field crop management and data collection	