Journal of Phytopathology and Pest Management 8(1): 64-70, 2021
pISSN: 2356-8577 eISSN: 2356-6507
Journal homepage: http://ppmj.net/

Evaluation of some safe alternative agents against the pink stem borer, *Sesamia cretica* Lederer infesting sugarcane at Sohag governorate, Egypt

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Abstract

Some different control methods, mechanical, biological and four plant extracts were tested individually against the pink stem borer, *Sesamia critica* Lederer (Lepidoptera: Noctuidae) in both plant and ratoon crops of sugarcane during 2018 and 2019 at Sohag governorate, Egypt. Data were recorded on the basis of the percent infestation (dead hearts) of *S. critica* from April to June, while the infestation reduction percentage and population density were recorded based on the percent of infestation. The results showed that, all the control methods significantly reduced borer infestation as compared with control plots. Data demonstrated that water extracts of marjoram and rosemary achieved the lowest infestation (2.18 - 3.02%) and (1.42 – 2.00%), while the highest infestation was recorded in biological control treatment (18.00 – 13.47%) in two seasons 2018 and 2019 respectively. These results could be used in integrated pest management (IPM) programs for the pink stem borer, *Sesamia critica* control in sugarcane.

Keywords: sugarcane, *Sesamia cretica*, *Trichogramma evanescens*, *Rosmarinus officinalis*, roguing.

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1. Introduction

Sugarcane (*Saccharum officinarum*) is the main field crop for white sugar production in Egypt and about 69 countries in tropical and subtropical regions of the world (Humbert, 1968). The areas cultivated of sugarcane in Egypt reached about 323 thousand feddans and the total amount of sugar production was about 15.82 million tons. In Sohag governorate, about 13.5 thousand feddans (about 4.18%) while the total amount of sugar was 600 thousand tons (3.8% at 2018). The commercial variety Giza - Taiwan 9-54 (Q9) grows more than 95% of the cultivated area (Sugar Crop Board Annual Report, 2019). About 103 insects are related with sugarcane crop (kumarasinghe, 1999). Various insect pests like borer stem, termites, pyrilla, whitefly, bugs, insect scale and mealy etc. attack this crop and cause heavy losses in terms of low yield and quality. Without some effective measures, the crop cannot be protected from the ravages of insect pests specially borers. According to Gupta and Singh (1997), damage due to 3rd and 4th brood of sugarcane borers may result more than 25% reduction in weight. Sugarcane is severity attacked by the pink borer (PB), *S. cretica* which threat sugarcane grown in upper and middle Egypt. It has been historically categorized as a shoot borer which enters shoots at ground level, eat young tissues and destroy the growing point, thereby, causing the formation of characteristic "dead hearts" (Fahmy, 2017). Irshad and Shah (1982) studied the mechanical control of *Acigona stenieltus* H. in sugarcane and they recommended that roguing and cutting for controlling it. Sardana (2000) studied the integrated management of sugarcane root borer Emmalocera depressella S. and found that, different techniques like release of *Trichogramma chilonis* effectively managed root borer in sugarcane. Saroj and Jaipal (2000) applied mechanical control removal of borers infested sugarcane plants, roguing and release of parasitoid in sugarcane fields and recommended that, commutative applied of these techniques significantly reduced borers damage and increased cane yield. Mechanical methods (Handpicking from plants) involve motion and force such as trapping or crushing insects by hand, tool, or machine. Tillage by plow and harrow is a cultural control practice, but insects die from mechanical crushing (Heinrichs, 1994). Manual methods of controlling the insects are among the oldest and most labor intensive but these methods decline in usage as labor costs rise and less expensive alternative methods become available. The biological and ecological knowledge of pest helps to determine the most appropriate procedure/method (How), timing (when) and place (where) for effective use of any technology and economically effective management of any pest (Buurma, 2008). The use of natural products from plant origin is a new trend as certain plant families are rich sources of natural substances that could be utilized in the development of alternative safe methods for pest control (Wheeler and Isman, 2001). The deleterious effects of plant extracts on insects are manifested in several ways including, growth retardation, feeding inhibition, oviposition deterrence and reduction of fecundity and fertility (Sadek, 2003). El-Hefny (2011) stated that, plant extracts – derived from the leaves of two plants sweat marjoran and rosemary were applied in the maize field during the early summer plantation, for controlling the pink stem borer *S. cretica*. Keeping in view the importance of pink sugarcane borer, this experiment was carried out to study the effect of some

different safe alternative control methods on sugarcane borer, *S. cretica* in both sugarcane plant and ratoon crops.

2. Materials and methods

The experiment was conducted at Sohag governorate, Upper Egypt on both plant and ratoon crops of sugarcane. Variety Giza-Taiwan (G.T. 54-9) was sown in February as plant crop during 2018 and the date of harvesting the planting cane was considered as the beginning of the first ratoon crop during March 2019. The experiment comprised of seven treatments including control was laid out in randomized complete block design having three replications. Plot size was maintained as 9 × 5 m^2. The experiment was repeated twice for confirmation of the results. Different control methods were applied in both plant and ratoon crops.

2.1 Mechanical Control

Plants infested by pink stem borer (dead hearts) were rouged from April to June once a month in both two seasons 2018 and 2019.

2.2 Biological control

In these plots, parasite *Trichogramma evanescens* was released @ 30000 parasitized pupae / feddans pasted on carton cards were applied from April to June one time per month during the first and second seasons. This parasitoid was cultured on eggs of *Sitotroga cereallela* in the laboratory at the mass rearing unit of *Trichogramma*, Plant Protection Research Institute (PPRI), in Assuit. as per required procedure.

2.3 Plant extracts

Two plant species were chosen in the present investigation, *Majorana hortensis* M. and *Rosmarinus officinalis* L. both of them are belonging to family labiatae, were obtained from local market. The plants were extracted in the laboratory. Plants were washed by water and dried in laboratory by electric fan, then grained in a high-speed blender. Extracts prepared in the laboratory by water or acetone at ratio 1 gm. Powder: 3 cm^3 solvent and then filtered similar to the mentioned method with Afifi et al. (1988). A volume of 50 cm^3 of water was added to both of the filtrate extracted similar to Emara et al. (1994). Plant extracts were applied together three times, the first time after month of planting, the second time after two months of planting, and the third time was after three months of planting on April, May and June in both two seasons 2018 and 2019. Dead hearts count technique and evaluation percent infestation, reduction and population density were calculated according to the following formulas:

$$Dead\ heart\ (\%) = \frac{Number\ of\ dead\ heart}{Number\ of\ plant} \times 100$$

(Maareg et al., 1993).

$$\text{Reduction } (\%) = \frac{Control - Treatment}{Control} \times 100$$

(Abott, 1925)

$$\text{Population density} = \text{Number of dead harts}$$

Analysis of variance (ANOVA) was performed for the obtained data according to test multiple groups by Waller and Duncan (1969).

3. Results and Discussion

Results in Table (1) showed significant values in most treatments in two seasons 2018 and 2019 to infestation percentage of *S. cretica* at 45, 60, 75, 90 and 105 days of plant age compared with control. The minimum values of average infestation percentage were recorded in water extract of Marjoram extracted (1.25, 6.25, 2,92,0.83 and 0.00%) and (1.00, 4.33, 0.67, 0.00 and 0.00%) in two seasons 2018 and 2019, respectively, while the maximum values of average infestation percentage were recorded in biological control treatment with (9.17, 23.75, 22.08, 15.83 and 7.50%) and (7.67, 16.33, 15.00, 9.67 and 5.00%) in two seasons 2018 and 2019, respectively compared with control. Meanwhile, data based on the general mean showed different significantly in all treatments with lowest infestation percent arranged by following (T3, T5, T4, T6, T1, T2 and T7) and (T3, T5, T6, T4, T1, T2 and T7) in two seasons 2018 and 2019, respectively.

Table 1: Percent infestation of sugarcane stem borer, *S. cretica* in different control methods at Sohag governorate, Egypt during 2018 and 2019.

Plant Crop (2018)	Plant age (Days)					Mean
	45 (10 April)	60 (25 April)	75 (10 May)	90 (25 May)	105 (9 June)	
Mechanical control (T1)	4.17bc	12.08bc	8.33c	5.00c	1.25b	6.17C
Biological control (T2)	9.17b	23.75a	22.08b	15.83b	7.50a	15.67B
Marjoram water ex. (T3)	1.25c	6.25c	2.92c	0.83c	0.00b	2.25E
Marjoram acetone ex. (T4)	2.08c	9.17c	7.08c	2.92c	0.83b	4.42D
Rosemary water ex. (T5)	2.08c	10.00bc	5.42c	0.83c	0.00b	3.67DE
Rosemary acetone ex. (T6)	2.08c	15.42b	6.67c	1.67c	0.00b	5.17CD
Control (T7)	15.42a	30.42a	36.25a	23.75a	8.33a	22.83A
Ratoon Crop (2019)	45 (18 April)	60 (3 May)	75 (18 May)	90 (2 June)	105 (17 June)	Mean
Mechanical control (T1)	2.33abc	5.67c	2.67c	2.67b	0.67b	2.80C
Biological control (T2)	7.67ab	16.33b	15.00b	9.67a	5.00a	10.73B
Marjoram water ex. (T3)	1.00c	4.33c	0.67c	0.00b	0.00b	1.20D
Marjoram acetone ex. (T4)	1.00c	6.67c	4.67c	1.00b	0.00b	2.67C
Rosemary water ex. (T5)	1.00c	5.33c	2.67c	0.67b	0.00b	1.93CD
Rosemary acetone ex. (T6)	1.67bc	6.67c	4.33c	0.00b	0.00b	2.53C
Control (T7)	8.33a	21.67a	25.67a	13.00a	5.67a	14.87A

In columns having same letters are non-significant at $\alpha = 0.05$.

According to data presented in Table (2) reefed average infestation reduction percentage of *S. cretica* during 2018 and 2019 seasons, data showed that the highest value of infestation reduction was recorded at Marjoram water extract with (91.96 and 93.08%) in two seasons 2018 and 2019, respectively. The lowest value of infestation reduction was recorded in Biological agent with (28.97 and 22.32%) in two seasons 2018 and 2019, respectively. Moreover, the highest infestation reduction (100%) based on plant age at 105 days in 2018 was (T3, T5 and T6), while in 2019 was (T3 and T6) at 90 days and (T3, T4, T5 and T6) at 105 days. The lowest infestation reduction (10.00%) was recorded in T2

at 105 days from plant age in 2018, while in 2019 the lowest infestation reduction was (8.00%) at 45 days from plant age in T2.

Table 2: Percent reduction of dead hearts by *S. cretica* in different control methods on sugarcane at Sohag governorate, Egypt during 2018 and 2019.

Plant Crop (2018)	Plant age (Days)					Mean
	45 (10 April)	60 (25 April)	75 (10 May)	90 (25 May)	105 (9 June)	
Mechanical control (T1)	72.97	60.27	77.01	78.95	85.00	74.84
Biological control (T2)	40.54	21.92	39.08	33.33	10.00	28.97
Marjoram water ex. (T3)	91.89	79.45	91.95	96.49	100.00	91.96
Marjoram acetone ex. (T4)	86.49	69.86	80.46	87.72	90.00	82.91
Rosemary water ex. (T5)	86.49	67.12	85.06	96.49	100.00	87.03
Rosemary acetone ex. (T6)	86.49	49.32	81.61	92.98	100.00	82.08
Control (T7)	0	0	0	0	0	0
Ratoon Crop (2019)	45 (18 April)	60 (3 May)	75 (18 May)	90 (2 June)	105 (17 June)	Mean
Mechanical control (T1)	72.00	73.85	89.61	79.49	88.24	80.64
Biological control (T2)	8.00	24.62	41.56	25.64	11.76	22.32
Marjoram water ex. (T3)	88.00	80.00	97.40	100.00	100.00	93.08
Marjoram acetone ex. (T4)	88.00	69.23	81.82	92.31	100.00	86.27
Rosemary water ex. (T5)	88.00	75.38	89.61	94.87	100.00	89.57
Rosemary acetone ex. (T6)	80.00	69.23	83.12	100.00	100.00	86.47
Control (T7)	0	0	0	0	0	0

Table 3: Population density of *S. cretica* based on the number of dead hearts in different control methods on sugarcane at Sohag governorate, Egypt during 2018 and 2019.

Plant Crop (2018)	Plant age (Days)					Mean
	45 (10 April)	60 (25 April)	75 (10 May)	90 (25 May)	105 (9 June)	
Mechanical control (T1)	3.33bc	9.67bc	6.67c	4.00c	1.00b	4.93C
Biological control (T2)	7.33b	19.00a	17.67b	12.67b	6.00a	12.53B
Marjoram water ex. (T3)	1.00c	5.00c	2.33c	0.67c	0.00b	1.80E
Marjoram acetone ex. (T4)	1.67c	7.33bc	5.67c	2.33c	0.67b	3.53D
Rosemary water ex. (T5)	1.67c	8.00bc	4.33c	0.67c	0.00b	2.93DE
Rosemary acetone ex. (T6)	1.67c	12.33b	5.33c	1.33c	0.00b	4.13CD
Control (T7)	12.33a	24.33a	29.00a	19.00a	6.67a	18.27A
Ratoon Crop (2019)	45 (18 April)	60 (3 May)	75 (18 May)	90 (2 June)	105 (17 June)	Mean
Mechanical control (T1)	2.33abc	5.67c	2.67c	2.67b	0.67b	2.80C
Biological control (T2)	7.67ab	16.33b	15.00b	9.67a	5.00a	10.73B
Marjoram water ex. (T3)	1.00c	4.33c	0.67c	0.00b	0.00b	1.20D
Marjoram acetone ex. (T4)	1.00c	6.67c	4.67c	1.00b	0.00b	2.67C
Rosemary water ex. (T5)	1.00c	5.33c	2.67c	0.67b	0.00b	1.93CD
Rosemary acetone ex. (T6)	1.67bc	6.67c	4.33c	0.00b	0.00b	2.53C
Control (T7)	8.33a	21.67a	25.67a	13.00a	5.67a	14.87A

In columns having same letters are non-significant at $\alpha = 0.05$.

Data in Table (3) revealed that mean population density of pink stem borer at both plant and tillering stage was significant in all treatments from (April to June) during 2018 and 2019. The highest population density was observed

in biological control treatment with (19.00 and 16.33) in 25 April and 3 May at 60 days from plant age in 2018 and 2019 respectively, while the lowest population density 0.00 was recorded in both marjoram and rosemary water extracts and rosemary extracted in acetone in 9 June at 105 days during 2018, also in 2019 the lowest value 0.00 was recorded in 2 June at 90 days and 17 June at 105 days. These findings are in agreement with Gul et al. (2008) who found that mechanical control method significantly reduced borer infestation in sugarcane. Also, El-Hefny (2011), concluded that the best effective plant extracts for controlling the pink stem borer *S. critica* was in both marjoram and rosemary extracted in water and acetone. Biological control method was ineffective to reduce the pink stem borer population this is due to the fact that it did not reduce the level of economic damage. In conclusion, tested plant extracts and mechanical control showed significant best control of pink stem borer. Keeping in view the above study, these control methods should be disseminated among the growers to avoid economic losses in sugar industry.

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