

## Performance Evaluation of Biological Control of Sugarcane Stem Borers Wasp (*Telenomus busseolae*)

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**Abstract:** The sugarcane stem borer, *Sesamia cretica* Led. is the most important pest of sugarcane in Iran. The egg parasitoid wasp, *Telenomus busseolae* is the most important natural enemy of *Sesamia spp.* in Khuzestan province that play an important role in regulating populations of sugarcane stem borers. In order to evaluate the efficiency of *T. busseolae* on sugarcane borer, population fluctuations of parasitoid wasp were studied during three consecutive years (2008 - 2011). This study was done in Debel-Khozai Agro-Industry in south of Khuzestan province. For this purpose, three commercial varieties of sugarcane (cp57-614, cp48-103 and cp69-1062) were selected to evaluate the effectiveness of this parasite on them. Experiments were conducted in 5 fields ratoon and plant. Since the best way to remove sugarcane borers is to use the biological control and release of the parasitoid wasp takes a considerable role in controlling the pest is established. *Telenomus busseolae* were grown in Hairdressing and released in infected fields. Results showed that contor rate in cp48-103 cultivar using *Telenomus busseolae* was 98%. Thus, the linear regression model used well being parasitized eggs *sesamia cretica* in biological control by *Telenomus busseolae* wasp. in early variety, cp57-614, correlation of variables is equal to 88%. Results also showed that *Telenomus busseolae* could not parasitized well *sesamia* eggs in this the early variety. According to Table of F statistics, the zero assumption can be rejected and concluded that there is linear regression relationship between the independent variable (*Telenomus busseolae*) and dependent variable (*sesamia* eggs). But the sig in this variety is more than 5% Thus, zero assumption can be rejected [1]. From all evaluations according to independent variables and constant variance and normal range of the data, we can conclude that the method of releasing *Telenomus busseolae* can be used for parasitizing *sesamia* egg in cp 69-1062 and cp 48-103 varieties. Since this method is generally a biological struggle but cp57-614 variety does not respond well to this method.

**Key words:** Sugar cane • *Telenomus busseolae* • Biological control • *Sesamia* pest • Linear regression

### INTRODUCTION

Sugarcane is consistent to a range of tropical and subtropical climates [2]. The highest level of sugarcane cultivation in Iran is located in Khuzestan province (47°42' to 50°39' E, 29°58' to 32°58' N) [3]. Sugarcane cultivation in this region is approximately 89,244 hectares. Sugarcane plant in this the climate around 4-5 months of growth period (from mid-autumn to early spring) is in slow growth. The rapid growth of sugarcane in Khuzestan, is in the spring and summer. This plant is located in c4

Group and a characteristic of these plants is which photosynthesis at high temperature is continued. While photosynthesis in c3 plants at temperatures 33°C usually stops, the amount of photosynthesis can be doubled. This operation with temperatures above 48°C and more also continues.

A number of moth stalk borers of sugarcane are endemic to Khozestan, Iran, such as *Sesamia spp* (Lepidoptera: Noctuidae) that being economically important at Debel Khozai-Iran Sugar estate. This stem borer has become a serious pest of sugarcane (*Saccharum*

hybrids) at the Debel Khozai-Iran Sugar estate, with cane losses as high as 31 t/ha [4]. Bored cane not only depresses cane yields, but also interferes with efficient extraction of sugar in the factory [4]. *Sesamia* is considered one of the major constraints to sugar production in Debel Khozai-Iran [5].

Most species that were collected from sugar cane fields of Khuzestan were the two species *Sesamia cretica* and *Sesamia nonagrioides* [6]. These two stem borer species in the region of Khuzestan are 4-5 generations per year. The initial stage of sugarcane growth (in the fall and spring), the larvae feed on young stems, cavities occur in the plant growth points and signs of damage as the death of the central bud is appeared. Also in the later stages of infection, larvae feed is done from the stems and product quality and quantity can be reduced. Also, the hole caused by larval feeding is a suitable environment for fungi and microorganisms such as saprophyte and these factors affect the quality of sugar cane and can exacerbate the damage. Generally the borer larvae during the feeding of young stems of sugar cane make a significant decrease in product.

Seraj [7, 8] investigated the amount of borer damage caused by *Sesamia* on two varieties of sugarcane in southern Khuzestan and his results indicated that the average percentage of infected nodes and internodes (perforated by the larvae) in varieties CP 57-614 was 30.7%. Based on the above report, for each 1% of stem perforated and rotten, caused by harmful insects, sugar extraction is reduced about 0.11 ton per hectare.

The most important natural enemy of the sugarcane borer is *Telenomus busseolae*, [9] that it acts as an egg parasitoid. *Telenomus busseolae* Gahan (Hymenoptera: Scelionidae) is one of the most important natural enemies of the maize and sugarcane stem borers, *Sesamia* spp. and *Busseola fusca* (Fuller) (Lepidoptera: Noctuidae) [10]. This is due to its ability to locate hosts successfully and its specialization for parasitizing concealed egg masses [11]. Earlier studies indicate low parasitism on *S. nonagrioides* eggs by *T. busseolae* in Greece and Turkey range between 12 and 65%. This suggests that periodic releases of mass produced parasitoids are necessary to increase percent parasitism in the nature [10]. In order to use *T. busseolae* in biological control programs against its hosts, its storage amenability should be studied to produce large numbers of the parasitoid for augmentative releases.

The sugarcane stalk borer, *Sesamia cretica* (Lefebvre) (Lepidoptera: Noctuidae), is a major multivoltine pest of sugarcane in Iran [10, 12]. Besides causing significant crop losses in maize and sugarcane, it

reduces the nitrogen/ protein content of grain by tunneling into stem and cobs where they likely interfere with uptaking of plant nutrients [11]. Furthermore, mycotoxigenic fungi associated with the pest often invade wound sites and can greatly depreciate the crop value [12]. Chemical controls are not very effective because almost the whole life cycle of pest takes place inside the host plant [13]. The highest densities of the pest generally coincide with reproductive stages of maize (silking, tasseling and milky stages). Insecticides applied as foliar sprays do not provide ideal control due to its cryptic nature. Results obtained in the last few years in southern Khuzestan showed that *S. cretica* species was more resistant to heat and dry air than others species. So that this species makes up the dominant population in sugar cane fields in the summer. Due to the presence of parasitoids (*Telenomus busseolae*) in sugarcane fields in these areas and the Natural successful Control against borer was seen by the bees. Studies on the breeding of this bee and its release for biological control of pests seem to be necessary. So, the goal of this study was to evaluate the effectiveness of this parasite on *Sesamia* in three commercial varieties of sugarcane (cp57-614, cp48-103 and cp69-1062), that cultivated in this area [14].

## MATERIALS AND METHODS

In order to evaluate the efficiency of *T. busseolae* on sugarcane borer, population fluctuations of parasitoid wasp were studied during three consecutive years (2008 and 2011). This study was done in Debel-Khozai Agro-Industry in south of Khuzestan province. For this purpose, three commercial varieties of sugarcane (cp57-614, cp48-103 and cp69-1062) were selected to evaluate the effectiveness of this parasite on them. Experiments were conducted in 5 fields ratoon and plant. Parasitoid was grown in insectarium of Debel-Khozai Station (total of 30 farms). Sampling method was 500 stems per farm and the five stations (100 stem per station) [15, 16]. Sampling was done, based on the percentage of infected internodes in the late season and simultaneously with the harvest. In this study, the distance between two nodes where the entrance hole and the effects of larval activity is seen as an internode was considered. At each stem, the total number of infected internode and internode number was counted and recorded separately. The research was performed during four consecutive years, from 2008 to 2011. Because, the best way to combat with sugarcane borer is the use of biological control, at this station, breeding and releasing a significant amount of the

parasitoid wasp was done. For understand the process and the establishment of parasitoid activity in sugarcane fields in peak spawning time of butterflies, at the start of each generation, coinciding with the first decade of October that the fourth generation borer pest is present, collect the eggs *Sesamia* in commercial varieties of sugarcane were attempted. In each study, from each of the commercial varieties 10 farms (30 farms) infected to *Sesamia*, including a new plant and ratoon farms were selected in such a way that they are representative of the entire farm. In each sample, 100 station, were selected randomly. From each station, five stems due to presence of a faction eggs, were studied. Factions of egg collected after transport to the Laboratory, were counted [17].

## RESULTS AND DISCUSSION

Outputs obtained from the software SPSS that related to cp48-103 cultivar is shown in the tables 1 and 2. One of the criteria used to assess the fitness, is the F statistic. This statistic showed that the independent variable, the percentage of success *T. busseolae* bee in the parasite eggs *sesamia*, as a biological control of sugarcane borer on CP48-103 cultivar is well acted. Here, in the this cultivar, the independent variable, *T. busseolae* bee, showed a linear relationship with the dependent variable, *sesamia* butterfly eggs. According to analysis of variance.

Table (Table 2) ( $f = mst / mse$ ) zero assumption is rejected. The result indicated is that there is a linear relationship between independent variable, success rate of *T. busseolae* bee and dependent variable, the percentage of eggs parasitized of *Sesamia*, in this variety. Also, the correlation between the variables that is equal to 98%, shows a linear regression model with high accuracy justified this relationship. Based on the Table 3 that shows the t-test results, sig is smaller than 5%, so zero assumption at 0.05 level of significance cannot be rejected and regression equation is no slope[1]. According to Table 4, the coefficient of determination analysis shows that 99% of *T. busseolae* effect on the sugarcane CP69-1062 cultivar via the independent variable *T. busseolae*, parasited and is justified, hence independent variable, *T. busseolae*, had a linear relationship with the dependent variable, *Sesamia* eggs. According to analysis of variance table (Table 5) ( $F = MST/MSE$ ) zero assumption is rejected. The results indicated that there is a linear relationship between independent variable, success rate of *T. busseolae* bee and dependent variable, the percentage of eggs parasitized of *Sesamia*, in this variety. Also, the correlation between the variables that is equal to 98% shows a linear regression model with high accuracy justified. Based on the Table 6 that shows the t-test results, sig is smaller than 5%, so zero assumption at 0.05 level of significance cannot be rejected and regression equation is no slope [1].

Analysis varieties cp48-103

Table 1: Summary statistics of multiple regression in a variety cp48-103

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.983(a)	.966	.949	.54243

a Predictors: (Constant), percentnoise

Table 2: Analysis of variance in the number of variables parasitoid cp48-103

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.811	1	16.811	57.135	.017(a)
	Residual	.588	2	.294		
	Total	17.399	3			

a Predictors: (Constant), percentnoise b Dependent Variable: paratzismcp48

Table 3: Multiple regression coefficients varieties cp48-103

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1						
(Constant)	-5.776	12.946			-.446	.699
percentnoise	1.077	.143	.983		7.559	.017

a Dependent Variable: paratzismcp48

Analysis varieties cp69-1062

Table 4: Summary statistics of multiple regression in a variety cp69-1062

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999(a)	.999	.998	.12131

a Predictors: (Constant), percentnoise

Table 5: Analysis of variance in the number of variables parasitoid cp69-1062

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	27.096	1	27.096	1841.325	.001(a)
	Residual	.029	2	.015		
	Total	27.126	3			

a Predictors: (Constant), percentnoise

b Dependent Variable: paratzismcp69

Table 6: Multiple regression coefficients varieties c p69-1062

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
1	(Constant)	-34.315		-11.852	.007
	percentnoise	1.368	.999	42.911	.001

a Dependent Variable: paratzismcp69

Analysis varieties cp57-614

Table 7: Summary statistics of multiple regression in a variety cp57-614

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.886(a)	.784	.676	.53472

a Predictors: (Constant), percentnoise

According to Table 7, the coefficient of determination analysis shows that 78% of *T. busseolae* effect on the sugarcane CP57-614 cultivar via the independent variable *T. busseolae*, parasited and is justified.

The output from the software SPSS, the following Table 1 and 2 are shown. One of the criteria used to assess the fit of the F criterion. The benchmarks show that the independent variable success rate in *Telenomus* bee moth egg parasite *Sesamia* as a means of biological control of sugarcane borer is at varieties CP48-103 review, the independent variables Bee *Telenomus* linear relationship with the dependent variable *Sesamia* butterfly eggs on the vaudeville shows. The ANOVA table (Table 2) statistic ( $F = \text{MST}/\text{MSE} = 57.135$ ) null hypothesis is rejected and it is concluded that the success rate between the independent variables and the dependent variable was the percentage of egg parasitism by P. Bee *Telenomus sesamia* the linear varieties there. Furthermore, the correlation between variables, which is equal to 98%, indicating that the linear regression model,

a butterfly egg parasitism by wasps in biological control *Sesamia Telenomus*, this variety is justified. Data tabulated in Table 3 shows that the t-test results, sig is smaller than 5%, so the null hypothesis is not rejected at the significance level of 0.05. The regression equation has no gradients [1].

According to statistic analysis summary Table 4, the coefficient of determination shows that 99% of the plant's influence on clay cane cultivar CP69 *Telenomus* bee by bee *Telenomus* independent variable, parasitism and is justified by the way independent variable in a linear relationship with the dependent variable *Telenomus* bee moth eggs *sesamia* show. The ANOVA Table 5 statistic ( $F = \text{MST}/\text{MSE} = 1841.325$ ) null hypothesis is rejected and it is concluded that the success rate between the independent variables and the dependent variable was the percentage of egg parasitism by the wasp moths *Sesamia* linear relationship exists. Furthermore, the correlation between variables, which is equal to 0.99, indicating that the linear regression model, a butterfly egg parasitism by the wasp *Telenomus sesamia* in biological control, is justified. Data summarized in Table 6 shows the results of the t test, sig is smaller than 5%, so the null hypothesis is not rejected at the significance level of 0.05. The regression equation has no gradients [1].

Table 8: Analysis of variance in the number of variables parasitoid cp57-61.

a Predictors: (Constant), percentnoise

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.077	1	2.077	7.264	.114(a)
	Residual	.572	2	.286		
	Total	2.649	3			

b Dependent Variable: paratizismcp57

Table 9: Multiple regression coefficients varieties cp57-614

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta	B		
1	(Constant)	56.591			4.434	.047
	percentnoise	.379	.141	.886	2.695	.114

a Dependent Variable: paratizismcp57

Also the Table 7, determine the factor analysis of statistics shows that only 78% of the sugarcane borer moths bee *Telenomus* eggs to parasitize CP57. On the other hand, the correlation between the variables is only equal to 88%, which represents a linear regression model CP57 as a figure very early varieties of bees in is n *Telenomus* of timely *sesamia* butterfly eggs to parasitize. The ANOVA table (Table 8) statistic ( $F = \text{MST}/\text{MSE} = 2.077/0.286 = 7.264$ ) is zero can be rejected and the result is that the independent variable and dependent variable *Telenomus* bee butterfly eggs *sesamia* linear relationship exists. Results presented in Table 9 shows that the t-test results, sig is more than 5%, so assuming zero can be rejected[1]. And the regression equation and the number of eggs parasitized by wasps *Telenomus sesamia* license has been steep and the figure being unripe cane has little impact on this campaign and thus need another a way to fight off pests sugarcane borer moths will find. In general, the assessment of the independent variables and constant variance and normal range of the data, one can conclude that cp69 and cp48 amount of fiber in the lower stem (*sugarcane* that are of interest pest borer). The proliferation of pest population and can result in a greater number of wasp parasitism *sesamia* butterfly eggs to be used in a fight is purely biological But for a variety of cp57 early due to the relatively high amount of fiber *sugarcane* does not shoot it well.

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