Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www. jppp.journals.ekb.eg

Efficiency of Certain Bio-Insecticides for Reducing the Yield Losses due to the Bean Pod Borer, *Etiella zinckenella* (Treitschke) in Soybean Fields

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ABSTRACT

The pod borer *Etiella zinckenella* (Treitschke) is most destructive insect which infest crops of leguminosae in Egypt. Field experiments were carried out in farm of Agricultural Research Center, Giza governorate during 2017 and 2018 seasons. First experiment was conducted to study seasonal incidence of this insect on soybean and its relation with weather factors under natural conditions. In first season, the larval population increased to make two peaks, that recorded in the 1st and 3rd weeks of September. In second season found one peak on September, 4th. The relationship between population fluctuation and three climatic factors (minimum and maximum temperatures& R.H. %) were studied. Simple correlation of Max. and Min. temperatures were negative but R.H.% gave positive effects. The second experiment was conducted to evaluate efficacy of Biover, MgChl and Dipel 2xfor control of this insect under field conditions in addition the yield. Results showed that, mean reduction of larvae for highest concentrations of tested treatments were arranged descendingly as Biover (63.04%) followed by MgChl (55.52%) and finally Dipel 2x (51.28%) with significant differences between treatments compared with control. Also, depending on highest concentration, Biover was the superior in this respect being registered 45.71% increasing in the yield over the control value followed by MgChl (42.39 %) and Dipel 2x (36.19%). Maximum net return was obtained from Biover (4g/L) (4262.92 /fed.) followed by Biover (2g/L) (4172.92/fed.) and Diple 2x (4g/L) (3749.59/fed.). Biover and MgChl gave highest reduction in population of this insect and best seed yield.

Keywords: Soybean; seasonal incidence; weather factors; *Etiella zinckenell;* bioinsecticides

INTRODUCTION

The Soybean, *Glycine max* (L.) provides more than half of the plant protein consumed by many poor people in the tropics and subtropics regions, it contributes to animal feed and soil nitrogen. Soybean can meet up different nutritional needs as protein, unsaturated fatty acid, minerals like Ca and P including vitamins A, B, C and D (El Agroudy*et al.,* 2011).Now, in Egypt, production of soybean reaches more than 40% from production of world (Naroz *et al.,* 2019).The plants are subjected to attack by several insect pests that cause a great damage to crop. About 22 insect pests species infested soybean plants.(Taghizadeh *et al.*,2012and Zaghlol, 2019).

The bean pod borer, *E. zinckenella* is one of the most serious insects that cause a severe economic decrease both in the quality and the yield (Baliadi *et al.*, 2008). The larvae of this insect cause considerable direct damage and yield losses by feeding on seeds and indirect damage by reducing quality and marketability of infested crops (Edmonds *et al.*, 2000 and Mohamed *et al.*, 2015).The obvious sign of its infestation is the tine hole where the larvae escaped after the damage already has been done, whereas one larva can destroy most of the pod seeds (Tohamy and El-Hafez, 2005&Amro *et al.*, 2007).However, the percent pod damage by this insect reached about 30 – 40% and losses caused to flowering and pod formation stages, the two critical periods, caused 70 % yield loss(Sachan and Katti (1994) &Abdel Rahman, 2004).

Conventional insecticides often show undesirable side effects such as significant toxicity to non-target organisms, residual toxicity, insecticide resistance, pest resurgence, destruction of natural enemies and environmental pollution. The application of environmental friendly tools instead of chemical applications is necessary for integrated pest management. Therefore; some programs were conducted to investigate several integrated management strategies which have shown potential for *E. zinckenella* control. Such strategies would reduce pesticide reliance in Egyptian legume plantations and aid in pesticides resistance management (Helalia *et al.*, 2011).Biopesticides like *Beauveria bassiana* has been reported to cause pathogenicity to legume pod borers (Kulkarni *et al.*, 2005). The crystal inclusions derived from *Bacellus thuringiensis* var. *kurstaki* is generally lepidopteran specific and its effectiveness against the larvae of *Helicoverpa armigera* was reported by Dhaliwal and Arora (1996). A promising alternative to reduce the harmful effects caused by synthetic insecticides is the use of photosensitizers (Lukšienė *et al.*, 2007).

The present work aimed to study population density of *E. zinckenella* on three soybean varieties and evaluate efficiency of certain bioinsecticides against the pod borer and yield losses.

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DOI: 10.21608/jppp.2020.79160

MATERIALS AND METHODS

The experiments were conducted at the farm of the Agricultural Research Center, Giza governorate during the 2017 and 2018 soybean growing seasons. Sowing dates were the 7th and 12th of June for the two respective seasons. These experiments were carried out to study the following aspects:

Population fluctuations

For each season, an area of about 1/4 fed. divided into 3 equal blocks was chosen. Each block was also divided into three equal plots devoted for one variety. The plot has 5 rows, 6 m^2. in length and 60 cm. in width with a distance between hills as 20 cm. The selected varieties were; Giza35 and Crawfourd as recommended commercial ones and Dr-10l as a new genotype. All normal agricultural practices were performed with no use insecticide treatments

Larval population of *E. zinckenella* was recorded at weekly intervals from appear green pods to till the last picking of pods. The sample was 30 green pods collected randomly from the diagonal of each plot, kept in a paper bag and directly transferred to the laboratory to count the larvae. Daily meteorological data on minimum and maximum temperatures (D. Mn. T. and D. Mx. T.) in degree centigrade and relative humidity (D.R.H) (%) were recorded from the Agro-meteorological station of the Ministry of Agriculture, at Dokki, Giza throughout the two studied seasons.

Effect of the bioinsecticides

This experiment was conducted to evaluate efficiency of certain Photosensitizer and bioinsecticides against the pod borer, *E. zinckenella* during the previous seasons. An area of about 1/10 feddan was cultivated with Giza 35variety, at the same dates, during the two seasons. The area was divided,with a randomized complete block design, to 24 plots (9m^{2}for each). Recommended agricultural practices were performed.

The tested treatments are two commercial products of bioinsecticides (Diple-2x, *B. thuringiensis* var. *Kurstaki* and Biover, *B.basiana*), one Suncide Agri-pest (Photosensitizer, Magnesium chlorophylline (Mg-Chl)) , one recommended insecticide (Lannate) as a standard check material in addition to the control (untreated)as shown in Table (l). Spraying was carried out after appearance of pods using a small hand pressure sprayer at the morning in the two seasons. Random samples of 30 pods picked up from each replicate after 3,7,10 and 15 days from application. The pods transferred to the laboratory to count the larvae and calculated the reduction percentages.

Table 1.Tested insecticides

Trade name	Active ingredient	Used rate(g/L)
Diple-2x 6.4% DF	*B. thuringiensis* var. *Kurstaki*	2 4
Biover10 % WP	*B. bassiana*	2 4
SuncideAgri-pest (MgChl)	Mg-Chl Mg-Chl	0.035 0.35
Lannate 25% WP	Methomyl	1
Untreated (control)	-	-

MgChl = Photosensitizer Magnesium Chlorophylline

Effect of bio insecticides on seed yield and their cost benefit ratio throughout 2018 season

At the harvest, the total yield of soybean pods were collected from the all plot of each treatment and air dried, the seeds were separated and weight(kg/plot)and converted to per fedden basis (fedden = 4200 m^2).

Incremental Cost Benefit Ratio

Economic analysis was used to compare costs and returns amongst different target insects control treatments. Average of production costs per fedden was obtained from the Bulletin of the Agricultural Statistics, part II: Summer and Nili Crops (2018).The production costs were 3824pound/fed. and sale price of soybean was 4336pound /ton. The costs of preparing the land for agriculture were 424 pound. The price of seeds was the crisis to cultivate an acre 240 pound/fed. It was estimated that irrigation, fertilization and crop field service treatment required 1495pound/fed. It was found that pest control required 227 pound/fed. The cost of harvesting, transporting the crop and expenses were 626 pound/fed. The costs of renting the land was1316pound/fed. Application of Diple-2x 6.4%DF treatments required 175 and 350 pound/fed for tow concentrations. While application of Biover 10 % WP treatments required 150 and 300 pound/fed. Lannate 25%WP was 300 pound/fed. The market price of the produce was 6 pound/kg.The Photosensitizer Magnesium chlorophylline (MgChl) was not registered commercially and it was difficult to calculate the net return.

Cost of cultivation: Based on the prevailing market price of the produce, cost of insecticides, cost of labourers and cost of inputs, the net profit was worked out.

Net returns: Net returns (pound/fedden) were calculated by subtracting the cost of plant protectionalong with other costs (pound/fedden) from the gross returns.

Benefit Cost ratio: The B:C ratio was obtained by taking the ratio of gross returns to the cost of cultivation including the plant protection measures.

$$\text{B:C ratio} = \frac{\text{Gross returns (pound/fedden)}}{\text{Cost of cultivation (pound/fedden)}}$$

Statistical analyses

Simple Correlation (r), simple regression (b) and partial regression (P. reg) were performed to study effect of each of the three previously mentioned weather factors on the larval population. Also, explained variance (E.V. %) and (F. value) of the combined effect of these factors were calculated. Reduction percentage in the larval infestation was calculated according to the equation of Henderson and Tilton 1955. Mean numbers of alive larvae in each treatment were calculated and compared with each other's by one way ANOVA using F and Duncan tests using SPSS computing program version 20 as described by Snedecor and Cochran(1956). These tests were also used in calculating the significant between yields of different treatments.

RESULTS AND DISCUSSION

Population fluctuations

Data presented in Table (2) and Figs. (1 & 2) showed that, the weekly population fluctuations of *E. zinckenella* and its related weather factors during 2017 and 2018 seasons. In the first season, the larvae were appeared for the first time in few numbers (3 larvae/90 pods) during the second week of August. Thereafter, the number increased to make two peaks, one was recorded in the 1st week of September with 55, 51 and 38 larvae/90 pods for Giza 35, Crawfourd and Dr-10l, respectively when D. Max. T. was 33.41 and D. Min. T. was 23.65°C. The second peak was in the 3rd week of September with 61, 56 and 35 larvae for Giza35, Crawfourd and Dr-10l, respectively at D. Max. T 34.6 and D. Min. T. 23.89°C. While the equivalent R.H. values were 50.3 and 51.0 % at the two peaks, respectively. A relatively lower population was recorded during the 2nd week of September at D. Max. T. 33.89, D. Min. T. 23.89°C and 49.3% R.H. (Table 2 and Fig. 1).

In the second season, the population of larvae make one peak occurred on September, 4thwith 61, 54 and 28 larvae for the same varieties, respectively. The corresponding D. Max. T. was 35.15°C & D. Min. T. of 25.47°C with 60% R.H. (Table 2 and Fig. 2).

Table 2.Weekly mean number of *E. zinckenella* larvae/ 90 pods in relation to temperatures& relative humidity through 2017 and 2018 seasons

Seasons	Sampling date	Giza35	Crawford	Dr 101	Climatic conditions		
					D.Max.T.	D.Min.T	R.H.%
2017	01/08/2017	0	0	0	35.52	25.65	49.30
	07/08/2017	9	7	3	35.56	25.65	50.00
	14/08/2017	23	20	8	35.63	26.67	52.80
	20/8/2017	32	34	14	35.18	25.74	45.90
	27/8/2017	34	41	17	35.16	25.16	48.90
	03/09/2017	55	51	38	33.41	23.65	50.30
	10/9/2017	42	38	21	33.89	23.89	49.30
	17/9/2017	61	56	35	34.6	23.89	51.00
	23/9/2017	53	46	32	33.52	24.44	50.50
	30/9/2017	44	28	26	31.19	21.67	48.50
2018	1/8/2018	2	1	0	37.80	26.26	55.8
	06/08/2018	8	8	5	36.80	26.26	50.00
	13/08/2018	26	18	10	35.63	25.56	56.90
	20/08/2018	29	27	16	35.00	24.76	56.00
	27/08/2018	33	38	18	34.84	25.07	55.50
	04/09/2018	61	54	28	35.15	25.47	57.40
	11/09/2018	43	45	17	34.28	25.32	58.20
	17/09/2018	39	41	25	33.70	23.89	53.70
	23/09/2018	39	39	32	32.69	23.61	55.60
	30/09/2018	40	34	30	32.78	23.33	58.30

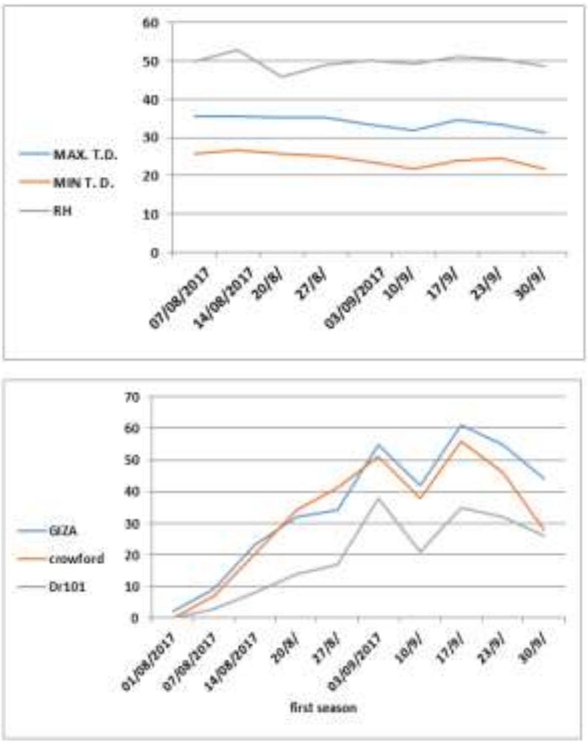

Fig. 1. Population fluctuations of larvae on the varieties in relation to Max. &Min.temperatures and relative humidity during 2017 season.

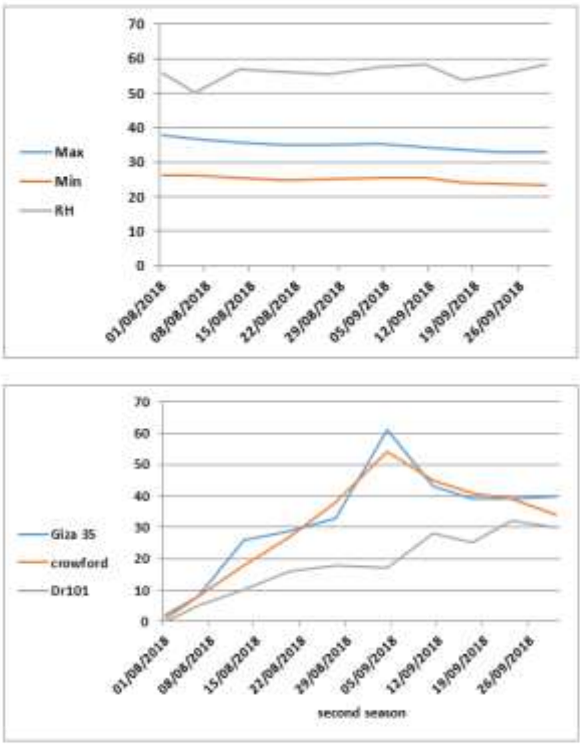

Fig. 2. Population fluctuations of larvae on the varieties in relation to Max. &Min. temperatures and relative humidity during 2018 season.

Effect of maximum temperature

Data presented in Table (3) showed that,there is a negative relationship between D. Mx. T. and population of larvae in both seasons. The simple correlation (r) values were -0.459, -0.315 and -0.514 for Giza35, Crawfourd and Dr-10l variety, respectively at the first season and -0.548, -0.599 and -0.746 at the second season. Also simple regression (b) values were -0.210, 0.136, 0.283 and 0.431, 0.514 & 0.564 for the same varieties, respectively at two the seasons. However the partial regressions (P.reg), in the 1st season, were insignificant positive for Giza35 and Dr-10l varieties(0.210 &0.264) but were significant in Crawfourd variety(0.099).While in the 2nd season, they were insignificantly positive for all varieties.

Effect of minimum temperature

Data in Table (3) showed that, in the two seasons, the simple correlations revealed a negative significant effect relationship between the D. Min. T. and population of larvae for all varieties except Crawfourd and Dr-10l, in the 1st season, that insignificant. The simple regressions revealed a positive insignificant effect for Crawfourd and Dr-10l varieties(0.113& 0.269) in the same season, while a positive significant effect for all varieties(0.178, 0.246 & 0289, respectively) in the 2nd season. However, the partial regressions indicated a positive insignificant effect in both seasons (0.197, 0.103 &0.254 in1st season and 0.178, 0.246 &0.289 in the 2nd season).

Effect of percentage relative humidity.

As shown in Table (3), in the 1st season, the daily relative humidity and the population of the studied insect had positively insignificant simple correlation and regression for Crawfourd and Dr-10l varieties but the partial regression was positively significant at all varieties. In the 2nd season, the previous parameters were positively insignificant for three varieties.

Combined effect of the climatic factors.

The combined effect of the studied climatic factors on the pod borer was insignificant during the two successive seasons. The explained variance (E.V.) values were34.96, 56.83 &23.98%in the 1st season and 34.26, 50.07 &20.13%in the 2ndones in case ofGiza35, Crawfourd and Dr-10l, respectively.

Table 3. Simple correlation (r), simple regression (b) and partial regression (P.reg) values and analysis of variance for the relationship between number of larvae and weather factors on the three varieties during 2017 and 2018seasons.

seasons	Weather Factors			Giza35	Crawford	Dr 101
2017	D. Max. T.	Simple	r	-0.459*	-0.315	-0.514
			b	-0.210	0.136	0.283
			T for b	0.041	0.278	0.320
		Partial	P. reg.	0.210	0.099*	0.264
			T for P. reg.	0.109	0.065	0.109
	D. Min. T.	Simple	r	-0.444*	-0.321	-0.504
			b	0.197*	0.113	0.269
			T for b	0.059	0.250	0.311
		Partial	P. reg.	0.197	0.103	0.254
			T for P. reg.	0.169	0.116	0.174
	R.H.	Simple	r	0.134*	0.077	0.115
			b	0.055	0.061	0.081
			T for b	0.097	0.137	0.205
		Partial	P. reg.	0.0179	0.006	0.013
			T for P. reg.	0.027	0.015	0.109
	Analysis of variance	F		0.563	3.356	1.224
		E.V. %		34.96	56.83	23.98
2018	D. Max. T.	Simple	r	-0.548*	-0.599*	-0.746
			b	0.431	0.514	0.564
			T for b	0.021	0.051	0.158
		Partial	P. reg.	0.431	0.514	0.564
			T for P. reg.	0.300	0.359	0.557
	D. Min. T.	Simple	r	-0.343*	-0.387*	-0.538*
			b	0.178*	0.246*	0.289*
			T for b	0.033	0.077	0.075
		Partial	P. reg.	0.178	0.246	0.289
			T for P. reg.	0.118	0.149	0.078
	R.H.	Simple	r	0.481	0.389	0.356
			b	0.245	0.153	0.152
			T for b	0.207	0.120	0.309
		Partial	P. reg.	0.245	0.153	0.152
			T for P. reg.	0.231	0.152	0.127
	Analysis of variance	F		2.858	0.863	2.552
		E.V. %		34.86	50.07	20.13

*** Significant at 5%**

The present findings are in corroboration with findings of Abdallah *et al.*,(1994) reported that, *E. zinckenella* infested various leguminous crops in the cropping season and showed peak activity in February to March. Dhaka *et al.* (2011b) reported that,the population of the same insect on vegetable pea was negatively correlated with mini. and maxi. temperatures and positively correlated with relative humidity. Vaibhav *et al.* (2018) found that, the larval population of the same insect increases from third week of November to fourth week of February. The peak activity of larvae appeared on 26th February (12.66 larvae/10 plants) when the max.& min. temperatures were 22.07°C& 12.55°C, respectively and relative humidity was 81.07%. The population showed negative correlation with max. temperature (r= -0.007) while positively correlated with min. temperature (r= 0.378) and relative humidity (r= 0.313).Kumar *et al.* (2018) reported that, the larval population of *E. zinckenella* start increased from 1st week of December to make its peak in the 1st week of March. They added that, the correlation of the larval population was negative with maximum temperature (r= -0.187). It was positive correlated with minimum temperature (r= 0.188) and relative humidity(r= 0.277). Kishor *et al.* (2019) revealed that, the incidence of *E. zinckenella*, was observed from 3rdweek of February (4.00%) and the pod damage was gradually increased to its peak on 1stweek of March (14.30%).

Effect of bio insecticides on infestation

In the both seasons, all treatments declined the count of infestation at 3, 7, 10 and 15 days post spraying comparing with control. The results indicated that after 10 days post spray, the high concentration of Biover (4g /L) gave high reduce in larval population followed by high concentration of Mg-Chl(0.35g/L). While Dipel 2x was the lowest reduce (Fig.3 and 4).

The percent reduction of infestation is presented in Tables (4 and 5). The results showed that,all compounds were able to suppress the levels of infestation of *E. zinckenella* in comparison to that of untreated control. Generally, the %reduction was high significant between all treatments. The highest reductions were recorded in high concentration of Biover and Lannat. The reduction % was 76.02&79.27% at the 1st season and 63.04 & 74.62% at the 2ndones.

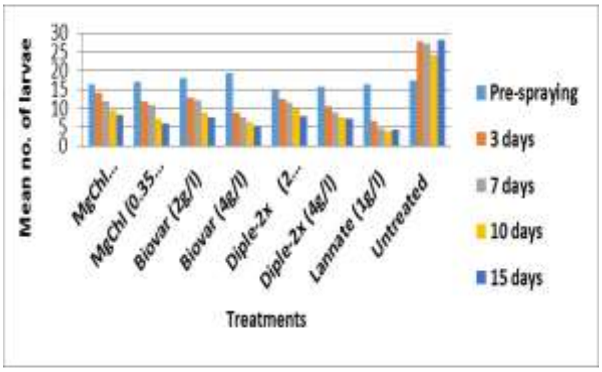

Fig. 3. Average numbers of *E. zinckenella* larvae/30 pods pre and after treatment through 2017season.

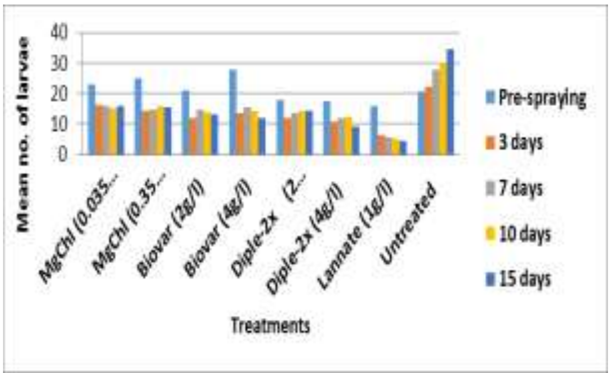

Fig. 4. Average numbers of *E. zinckenella* larvae/30 pods pre and after treatment through 2018 season.

Table 4..Reduction percentages in *E. zinckenella* larval infestation after treatment, 2017 season.

Treatment	Rate (g/L)	Period after treatments (days)				mean
		3	7	10	15	
Photosensitizer (Mg-Chl)	0.035	46.59	54.47	57.90	68.18	56.78c
Photosensitizer (Mg-Chl)	0.35	56.06	60.29	68.31	77.64	65.58b
Biovar	2	55.63	56.31	63.19	72.68	61.95b
Biovar	4	70.77	74.34	79.38	79.57	76.02a
Diple-2x	2	46.73	49.21	50.57	64.22	52.68d
Diple-2x	4	57.47	62.95	64.74	70.65	63.95b
Lannate	1	74.68	79.14	80.75	82.51	79.27a
F. value		12.43*	13.78	8.322	19.60	35.26
P.		0.0001**		0.0006**	0.0000**	0.0000**

Means within a column followed by the different letter are significantly different using Duncan's Multiple Range Test

Table 5. Reduction percentages in *E. zinckenella* larval infestation after treatment, 2018 season.

Treatment	Rate (g/L)	Period after treatments (days)				Mean
		3	7	10	15	
Photosensitizer (Mg-Chl)	0.035	34.41	47.95	55.33	57.69	48.85e
Photosensitizer (Mg-Chl)	0.35	46.77	55.61	56.48	63.24	55.52c
Biover	2	46.68	48.99	54.29	62.21	53.04cd
Biover	4	55.85	57.11	65.35	73.88	63.04b
Diple-2x	2	38.25	41.95	44.64	50.87	43.93e
Diple-2x	4	44.11	49.09	52.18	59.66	51.28d
Lannate	1	62.83	73.92	78.12	83.62	74.62a
F		8.75	16.84	14.43	11.36	11.037
P		0.0001	0.0001	0.0001	0.0001	0.0000***

Means within a column followed by the different letter are significantly different using Duncan's Multiple Range Test.

In the 1st season, three days post spray, the reduction at high concentrations of MgChl, Biover and Dipel2xwas 56.06, 70.77 and 57.47%, respectively. After 15 days post spray, the reduction reached 77.64, 79.57 and 70.65% for the same concentration, respectively (Table4).

In the 2nd season, at all concentrations, the percent reduction was gradually increased at all periods after spray. These reductions were ranged between 38.25 to 73.88 % while Lannate treatment achieved 83.62 %reduction. Generally, the results cleared that the mean of reduction for the tested treatments may be arranged descendingly as Biover (63.04%) followed by MgChl(55.52%) and finally Dipel 2x(51.28%)with significant differences (Table 5).

This is in accordance with the finding of Subhasree and Mathew (2014)found that, the *B. bassiana* (1%), *B. thuringiensis* (0.2%) and Azadirachtin 0.005% caused larval population of *E. zinckenella* below economic threshold level (ETL) starting from 14th day after first spraying till the end of cropping. However, Dhaka *et al.*(2011a)mentioned that, Spinosad, *B. thuringiensis* and Neemarin had lower number of pod borer, *E. zinckenella* larvae on vegetable pea as well as pod and seed infestation than untreated control. Shaalan (2016) stated that,the mortality percentage of *E. zinckenella* was arranged descending as Sumithion (62 %), Tracer (55.3%), Radiant (53.4%), Neemix (35.7%) and finally Dipel 2x (33.7%). Singh *et al.* (2012) studied the effect of microbial insecticides on pod borers of mungbean. The treatments with *B. Bassiana* were most effective and the % pod damage was less than 5.67%.Vinod(2015) determined the efficacy of eleven insecticides against different pod borer complex of cowpea and revealed that, the % reduction was recorded 26.25 and 34.71% when treated with *B. bassiana*(2.0 g/L) and *B. thuringiensis*(1.0g/L).

Effect of the bioinsecticides on seed yield:

Data of seed yield obtained after the different treatments; Photosensitizer (Mg-Chl), Biover, and Diple 2x were presented in Table (6). Results showed that, most of the treatments suppressed the *E. zinckenella* larvae populations and thus positive effects on the yield when compared to the control. However, weight of grains was higher with the treatment Lannat (3.31kg / plot),then Biover (4g/L) (3.06kg / plot) followed by Photosensitizer Mg-Chl 0.35g/L(2.99Kg /plot).Diple-2x (4g/L) gave2.86 Kg /plot compared to weight in the control (2.10Kg /plot).The results also shown that, the highest concentration of Biover was the superior compound in this respect being registered 45.71% increasing in the yield over the control value followed by the highest concentrations of Photosensitizer (Mg-Chl) (42.39%), then the highest concentrations of Diple-2x(36.19%).

These findings are similar with that of Dhaka *et al.*,(2011a) showed that *B. thuringiensis* recorded the highest seed yield comparable control. Vinod (2015) studied the impact of insecticides and biorationals on *E. zinckenella* larval population and seed yield of soybean. He found that, the yield was 1511 and 1449 kg/ha when treated with *B. thuringiensis* (1 g/L) and *B. bassiana*(2g/L), respectively. However, all the treatments recorded significantly a higher seed yield in comparison with the control (1356 kg/ha). Shaalan (2016) reported that, Sumithion 50% EC was significantly effective in minimizing *E. zinckenella* larval population on cowpea plants and increasing the grain yield. The % increasing in the yield over the control value was 53.8% followed by Tracer (43.2 %), Radiant (40.8 %), Neemix (19.7 %) and Dipel 2x (12.7%).

It could be concluded that, application of the compounds used in this study during pod and maturation stages of soybean were necessary in controlling *E. zinckenella* populations, and also yield increasing.

Table 6. Effect of bio insecticides on seeds yield of soybean plants during 2018 season

Treatment	Rate (g/L)	Damaged seeds (%)	Average seeds yield (Kg/plot)	% increase over control
(Mg-Chl)	0.035	17.49	2.89a	37.62
(Mg-Chl)	0.35	14.25	2.99a	42.39
Biover	2	15.98	2.95a	41.43
Biover	4	13.25	3.07a	45.71
Diple-2x	2	19.61	2.75a	30.95
Diple-2x	4	16.79	2.86a	36.19
Lannate	1	7.79	3.14	57.62
Control	---------	26.17	2.10b	-------
L.S.D.			0.58	

Means within a column followed by the different letter are significantly different using Duncan's Multiple Range Test.

Cost economics:

The data from Table (7), indicated that the maximum netreturn was obtained from Lannate (1g/L) (4952.58 pound/fed), Biover (4g/L) (4262.92 pound/fed.), followed by Biover (2g/L) (4172.92 pound /fed.) and Diple 2x (4g/L) (3749.59 pound /fed.).However, lowest net-return was obtained from Diple 2x (2g/L) (3596.26 pound /fed.) and the untreated (2002.94 pound /fed). The highest B:C ratio was recorded in Biover(2.19).

Table 7. Economics of bioinsecticides in soybean for the management of pod borers during 2018 season

Treatment	Rate (g/L)	Seed yield (kg/ fed.)	Gross income (pound/fed.)	Cost of cultivation (pound /fed.)	Net returns (pound/fed.)	B:C ratio
(Mg-Chl)	0.035	1284.43	7706.59	--------	-------	-----
(Mg-Chl)	0.35	1328.87	7973.25	--------	-------	-----
Biovar	2	1319.99	7919.92	3747	4172.92	2.11
Biover	4	1359.99	8159.92	3897	4262.92	2.09
Diple-2x	2	1222.21	7333.26	3737	3596.26	1.96
Diple-2x	4	1271.09	7626.59	3877	3749.59	1.97
Lannate	1	1471.09	8826.58	3874	4952.58	2.28
Control	---------	1155.54	5599.94	3597	2002.94	1.56

The present findings are in line with findings of Mahalakshmi *et al.* (2012) observed the highest seeds yield (312.5kg/feedan) was obtained from treatment with flubendiamide (0.2 ml/l).Rynaxypyr (100 ml/l) excelled in its bio-efficacy in managing the insect pests ofsoybean, which recorded the highest B: C ratio of 1.83. Vinod (2015) fond that, the treatments exposed to biorationals recorded lower net returns in comparison with insecticides.

The maximum net returns was obtained from Novaluron 10 EC (1 ml/l) (` 28719/ha) followed by Nimbecidine 3000 ppm (3 ml/l) (27285/ha). The net return obtained from *B. thuringiensis*(1 g/L) was ` 17369/ha and *B. bassiana*(2g/l) (15377/ ha). The lowest net returns was obtained from the untreated (12641/ha).

CONCLUSION

In this study Biover and photosensitizers (Magnesium chlorophylline) reduced the population of *E. zinckenella*in the soybean fields. The results showed that the high concentration gave the highest reduction in the population and best seed yield. So it is advised to use this concentration in controlling of this pest in the soybean field. So it is suggested to use this concentration in controlling of *E. zinckenella* in the soybean field.

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كفاءة بعض المبيدات الحيوية فى تقليل الفقد فى الوزن الناتج عن الإصابة بدودة قرون اللوبيا *Etiella zinckenella* (Treitschke) فى حقول فول الصويا

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تعتبر دودة قرون اللوبيا *Etiella zinckenella* (Treitschke) من أهم الحشرات التي تصيب العديد من محاصيل البقوليات في مصر. تم إجراء التجارب في مزرعة مركز البحوث الزراعية بمحافظة الجيزة لدراسة تذبذب التعداد لحشرة دودة قرون اللوبيا على فول الصويا وتقييم بعض المركبات الطبيعية فى مكافحتها خلال موسمي 2017 و2018 م . وأجريت التجربة الأولى لدراسة الإصابة الموسمية وتذبذب التعداد وعلاقته بعوامل الطقس تحت ظروف الإصابة الطبيعية. أظهرت النتائج في الموسم الأول ظهور قمتين لنشاط الحشرة في الأسبوعين الأول والثالث من سبتمبر. بينما فى الموسم الثاني وجدت قمة واحدة في 4 سبتمبر. تمت دراسة العلاقة بين تذبذب التعداد وكلاً من درجات الحرارة الدنيا و القصوى والنسبة المئوية للرطوبة. وجد ان هناك علاقة سالبة معنوية بين تذبذب التعداد و درجتى الحرارة الدنيا والقصوى، بينما كانت موجبة مع R.H. ٪ . وأجريت التجربة الثانية لتقييم فعالية Biover و MgChl و Dipel 2x لمكافحة هذه الحشرة فى الحقل بالإضافة إلى تأثيرها على وزن المحصول. أظهرت النتائج أن المركبات الثلاثة لها تأثير فى خفض تعداد الحشرة وأن النسبة المئوية للخفض فى التعداد تزداد بزيادة التركيز لجميع المعاملات، وكان أكثر المركبات تأثيراً Biover (63.04)٪ يليه MgChl (55.52)٪ ثم Dipel 2x (51.28)٪ مع وجود اختلافات معنوية بين المعاملات فيما بينها. إعتمادا على أعلى تركيز ، سجل Biover زيادة في وزن المحصول (45.71%)، يليه MgChl (42.39%) و Dipel 2x (36.19%). تم الحصول على الحد الأقصى لصافي العائد المادى من معاملة Biover (4g / L) (4262.92 / fed.) متبوعًا بـ Biover (2g / L) (4172.92/fed.)و Diple 2x (4g / L) (3749.59 / fed.) وبناء على ما تم التوصل اليه سجل Biover و MgChl أعلى انخفاض في تعدد اليرقات وأعلى محصول من البذور،لذلك يقترح إستخدامهما في مكافحة *E. zinckenella* في حقول فول الصويا.