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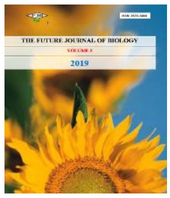

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Spodoptera littoralis (BOISD) LARVAE AS A NEW HOST TO THE PARASITOID *Exeristes roborator* (FAB.) IN EGYPTIAN SUGAR BEET FIELDS

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ABSTRACT: In Egypt, the early plantation (September) in the two seasons of sugar beet suffers from major economic losses by *Spodoptera littoralis* larvae; e.g. Significant defoliation and small roots which causes a shortage of sugar crop. Looking at the associated parasitoids, there is *Exeristes roborator*. This parasitoid's parasitism ability to *Spodoptera littoralis* larvae was not estimated. Thus, the present study was conducted during two successive seasons 2017/2018 and 2018 / 2019 for the first time in Egypt. Also, estimate the reduction in the parasitoid numbers resulting from application of two groups of insecticides represented in ecdysone agonists and conventional ones against *Spodoptera littoralis* larvae. The parasitoid Individuals associated with the cotton leafworm larvae was identified as *Exeristes roborator*. It is a larval ectoparasitoid. Concerning its parasitim ability, the results indicated that the maximum parasitism percentage was 50%. The total parasitism percentage was 21.33% in 2017/2018 season. While the maximum of parasitism percentage reached 100% and the total parasitism percentage was 20.59% in 2018/2019 season. Statistical analysis demonstrated that a significant correlation between *S. littoralis* larvae and this parasitoid during the two seasons. As for the total reductions in parasitoid numbers due to applied ecdysone agonists ranged between 17.72 to 21.67% and 14.57 to 21.52% in 2017/2018 and 2018/2019 seasons, respectively. However, the total reductions due to applied conventional insecticides reached the maximum; 98.39 to 100% in the first season and 98.82 to 100% in the second season. These previously data indicated that the ecdysone agonists (IGRs) are the preferred pesticides to retain the parasitoid.

Key words: *Spodoptera littoralis*, Ectoparasitoid, *Exeristes roborator*, Sugar beet, Biological control.

INTRODUCTION

The cotton leaf worm *Spodoptera littoralis* is one of the most important pests in sugar beet fields **(Jafari *et al.*, 2009)**. The early plantation receives a highly infestation with this insect pest **(Shalaby, 2001 and Bazazo, 2010).** It causes great damage to the sugar beet leaves and roots and consequently a considerable reduction in sugar percentages and roots weight per feddan **(Bassyouny *et al.*, 1991; El-Dessouki, 2014; El-Dessouki, 2019 and Bazazo, 2019).** When it attacks the seedlings, it causes large bare batches in the field and resulted in high economic losses **(Abou-ElKassem, 2010 and El-Mahalawy, 2011).** In the older plants, it leads to significant defoliation **(Ibrahim, 2014).**

Parasitoids are the natural enemies most used around the world for bio control of insect pests **(Sampaio *et al*. 2010).** Parasitoids are an important biological tool used widely in agriculture for suppression of various insect pest species **(Kalyanasundaram and Kamala, 2016).**

Exeristes roborator (Fab.) (Hymenoptera : IChneumonidae) is an Ichneumonid polyphagous parasitoid that develops externally on its host **(Talebi *et al.*, 2005).** The species of this genus are ectoparasitoids of concealed larvae of insects from different orders **(Yu *et al.*, 2012).** The adult female first paralyzes the host larva and then deposits an egg on or in close proximity to it. Little preference is shown in the selection of a host, but only fifth – instar larvae will support the parasitoid to maturity. Hatching and all larval development occur externally upon the host (Baker and Jones, 1934). The dominant hosts of this parasitoid were larvae of lepidoptera, coleoptera and hymenoptera **(Kasparyan and; Gultekin *et al*. 2004; Talebi *et al*. 2005; Rizzo and Massa, 2006; Çoruh, 2010; Tozlu and Çoruh, 2011; Özbek and Çoruh, 2012; Laszlo *et al*. 2016 and El-Husseini *et al*. 2018).**

The IGRs are usually regarded as less harmful to beneficial insects when compared to other chemical groups, even though negative side-effects have been reported **(Santos *et al*., 2006).** Almost it had no effect **(Carmo *et.al*., 2010).**

Yanagi *et al*. (2006) reported that ecdysone antagonists (chromafenozide and Methoxyfenozide) are promising insecticides with high efficacy against lepidopteran larvae and high level safety against parasitoids and have minimum impact on the environment. They are suitable for IPM programs directed against lepidopteran insects.

Thus, this current study aimed to investigate the parasitism ability of the polyphagous parasitoid, *E. roborator* to *S. littoralis* larvae in sugar beet fields for the first time in Egypt. Furthermore, estimate the reduction in the parasitoid numbers resulting from application of two groups of insecticides.

MATERIALS AND METHODS

This study was carried out during the two successive seasons; 2017/2018 and 2018/2019 at the experimental farm of Sakha Agriculture Research Station, Kafr El-Sheikh Governorate. The experimental area (about one feddan) was divided into two plots. Sultan sugar beet variety was cultivated on 2th September and 3rd September during the two seasons, respectively. The two experimental plots were received recommended agricultural practices. One of them did not receive any insecticides application. Samples of that plot were started from 20th September 2017 to 29th November 2018 and from 18 September 2018 to 27 November during the two study seasons, respectively. The weekly samples of the *S. littoralis* fifth-instar larvae were collected and transferred to the laboratory of Economic Entomolgy Department, Faculty of Agriculture, Kafer Elsheikh University. These samples were kept in Petri dishes (9 cm) containing filter papers till to the sixth larval stage under laboratory conditions (25 $\pm$ 2 ºc, 60 - 70% R.H.). When a parasitoid pupae forming, they were transferred into other petri dishes till adult stage emergence. The individuals of parasitoids were counted and the percentages of parasitism were accounted. A sample of adult parasitoids were put into small vials containing ethyl alcohol 70% to identify by insect identification Unit (IIU), Plant Protection Research Institute – Giza. The correlation coefficient values between the number of *S. littoralis* larvae and its parasitoid *E. roborator* were calculated according to **Snedecor and Cochran (1989).**

In the other plot, ten insecticides (Table 1) were applied. Five of them were ecdysone agonists (IGRs) and the others were conventional insecticides to study the effect of the two insecticides groups on the parasitoid population. Each insecticide was replicated four times (10 x 4 = 40 replicates). Each replicate measured 42 m^2, in addition to four replicates as control. Completely randomized block design was assigned. Knap sac sprayer (20 L volume) was used for spraying the insecticides. Date of spraying was 25 September and 27 September throughout the two seasons, respectively. Samples of parasitoid individuals were collected by sweep net method (50 double strikes) to each date **(Varga, 2017).** Number of parasitoids were counted one, three, seven and 10 days after spraying **(Anonymous, 2019).** Reductions in parasitoid populations were calculated by Henderson and Tilton (1955). Differences between the mean numbers of parasitoid after treatment were analyzed using **Duncan test (1955).**

Table 1. Certain insecticides sprayed against *S. littoralis* during 2018 and 2019 seasons

Insecticide		Category	Rate
Common name	**Trade name**		
Methoxyfenozide	Raner 24% Sc	Ecdysone agonist	75 cm^3/fed.
Methoxyfenozide	Abhold 36% Ec	Ecdysone agonist	125 cm^3/fed.
Chromafenozide	Ferto 5% Sc	Ecdysone agonist	400 cm^3/fed.
Methoxyfenozide	Xtreme 36% Ec	Ecdysone agonist	125 cm^3/fed.
Methoxyfenozide	Methobiet 24% Sc	Ecdysone agonist	75 cm^3/fed.
Chlorpyrifos	Dora 48% Ec	Conventional	1L./fed.
Carbosulfan	Marshal 20% Ec	Conventional	250 cm^3/fed.
Chlorfenapyr	Fanty plus 36% Ec	Conventional	90 cm^3/fed.
Methomy1	Diracomel 90% Sp	Conventional	300 cm^3/fed.
Pyridaly1	Pelo 5% Ec	Conventional	100 cm^3/fed.

RESULTS AND DISCUSSION

As shown in Fig. (1), the parasitoid individuals female and male which obtained from cotton leaf worm larvae. The insect identification Unit (IIU), Plant Protection Research Institute – Giza identified them as *Exeristes roborator* (Fab.) (Hymenoptera: Ichneumonidae). It is a larval ectoparasitoid. It has not been mentioned that this parasitoid has previously parasitized against the larvae of the cotton leaf worm, whether in Egypt or the areas where this insect pest is spread.

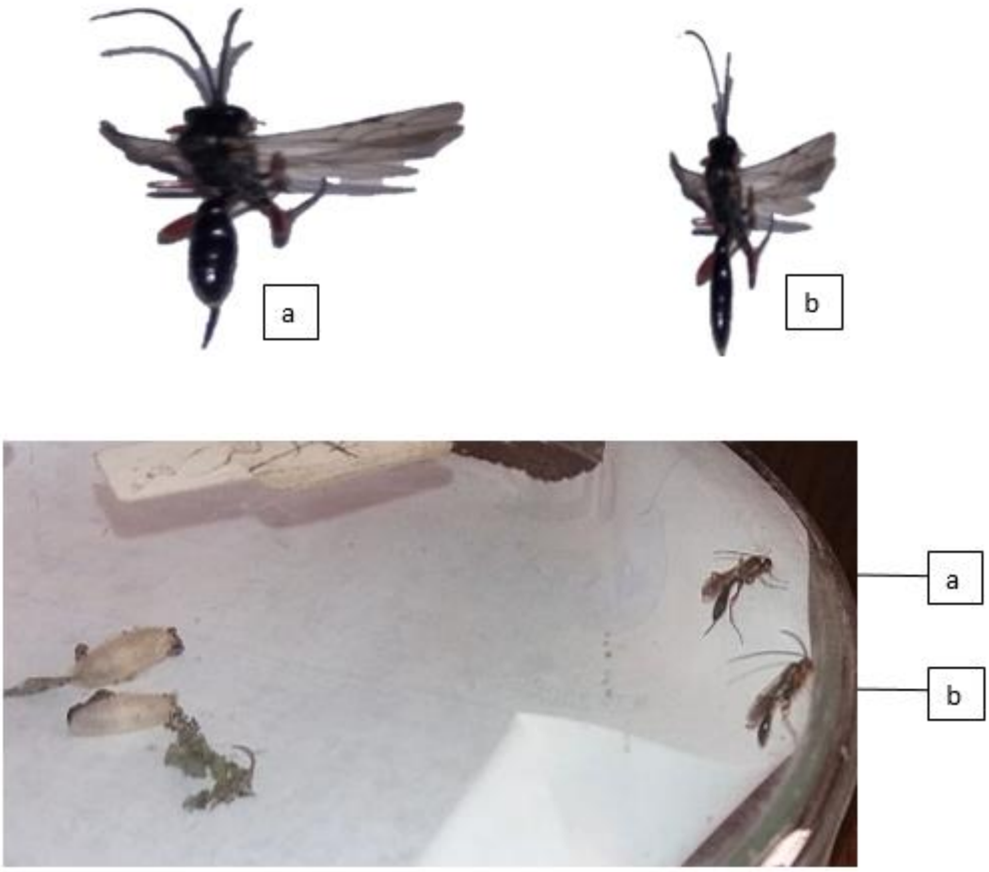

Fig. 1. The adults of the parasitoid *Exeristes roborator* female (a) and male(b).

Data in Fig. (2 and 3) showed that the parasitoid population fluctuated during the tested fife months in 2017/2018 and 2018/2019 seasons. In the first season, the maximum parasitism percentage was 50% at the end of both October and November. 16 parasitoid individuals were obtained from 75 cotton leaf worm larvae. The parasitism percentage was 21.33% (Fig.4). In the second season, the parasitism percentage reached 50% at the end of October. While the maximum was 100% at the end of November. Thus, the total numbers of the parasitoid individuals were 14 obtained from 68 cotton leaf worm larvae achieving 20.59% parasitism (Fig.4). There were no parasitism percentages during December due to the disappearance of the host in both seasons of the study.

The Statistical analysis showed that there was significant correlation between the number of *S. littoralis* larvae and its ectoparasitoid *E. roborator* in the first (0.561*) and second (0.551*) seasons (Table 2).

This data is in harmony with those of **Kasparyan and Gultekin, 2002; Gultekin *et al*. 2004; Talebi *et al*. 2005; Lotfalizadeh *et. al*., 2009; Coruh, 2010; Tozlu and Çoruh, 2011; Özbek and Çoruh, 2012; Laszlo *et al.* 2016 and El-Husseini *et al*. 2018.** They reported that lepidopteran larvae are one of *E. roborator* main hosts (mainly Fifth-instar). **Tozlu and Çoruh (2011)** demonstrated that *E. roborator* was the most numberous parasitoid and accounted for 6.22% of all parasitoids reared from larvae of *Cynaeda gigantea* (wocke) (Lepidoptera: Crambidae), parasitism rate was 10.88%.

Özbek and Çoruh (2012) concluded that *E. roborator* was the most abundant and accounted for 35% of the total ichneumonid records. The total parasitism rate was 33.7%. **Laszlo *et al*. (2016)**

pointed out that *E. roborator* is bio control agent of the European corn borer, honeycomb, pink bollworm and potato tuber larvae. Also, **El-Husseini *et al*. (2018)** concluded that *E. roborator* is distributed in both lower (Delta) and Middle Egypt, as there is no evidence of its occurrence south in the Governorates of upper Egypt. It has 6-15 generations/ year. It attacks only the larval instars.

Many authors, found that a significant correlation between this parasitoid and the larvae of Lepidopetra **(Kasparyan and Gultekin, 2002; Gultekin *et al.* 2004; Talebi *et al*. 2005; Çoruh, 2010; Tozlu and Çoruh, 2011; Özbek and Çoruh, 2012; Laszlo *et al*. 2016 and El-Husseini *et al.*, 2018).**

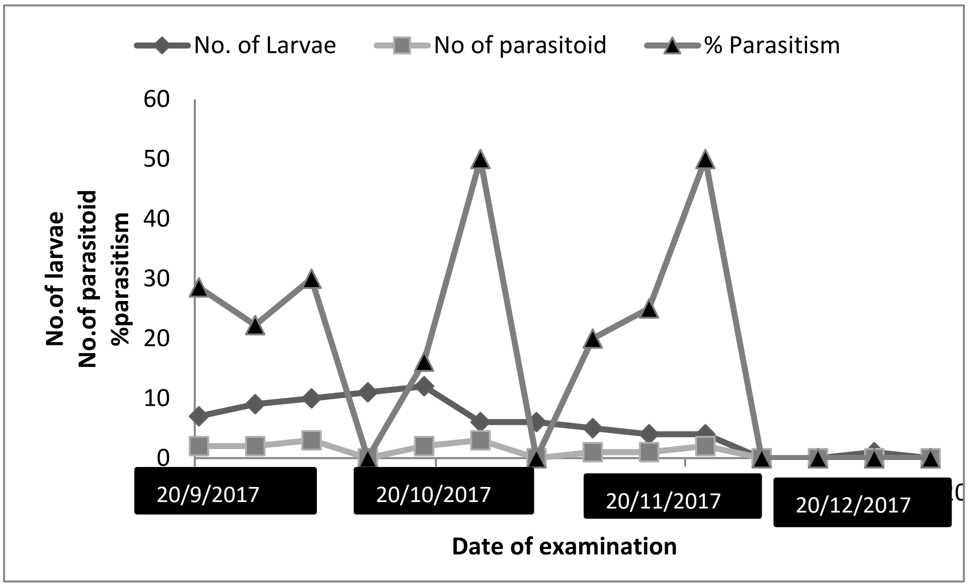

Fig. 2. Parasitism percentages by *Exeristes roborator* on *Spodoptera littoralis* larvae during 2017/2018 season.

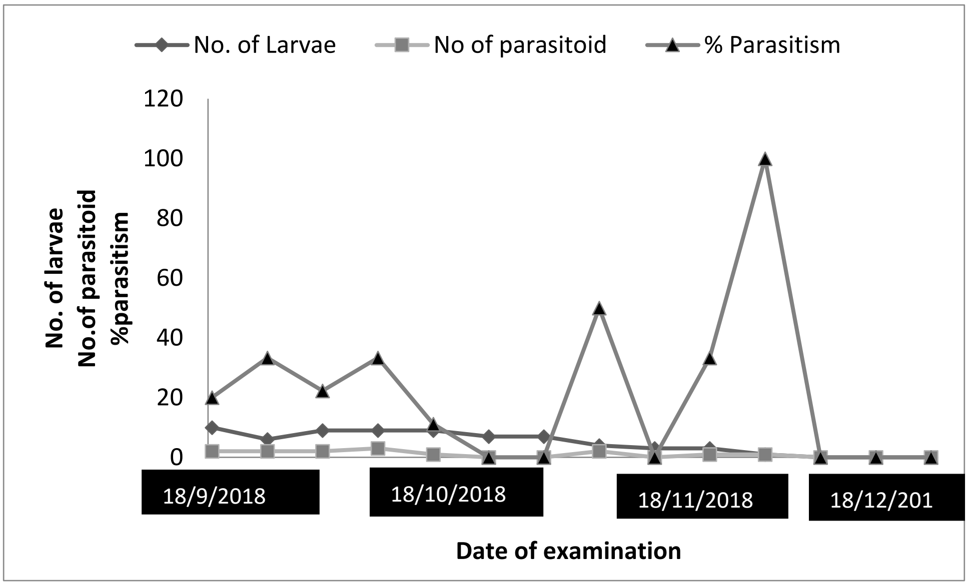

Fig. 3. Parasitism percentages by *Exeristes roborator* on *Spodoptera littoralis* larvae during 2018/2019 season.

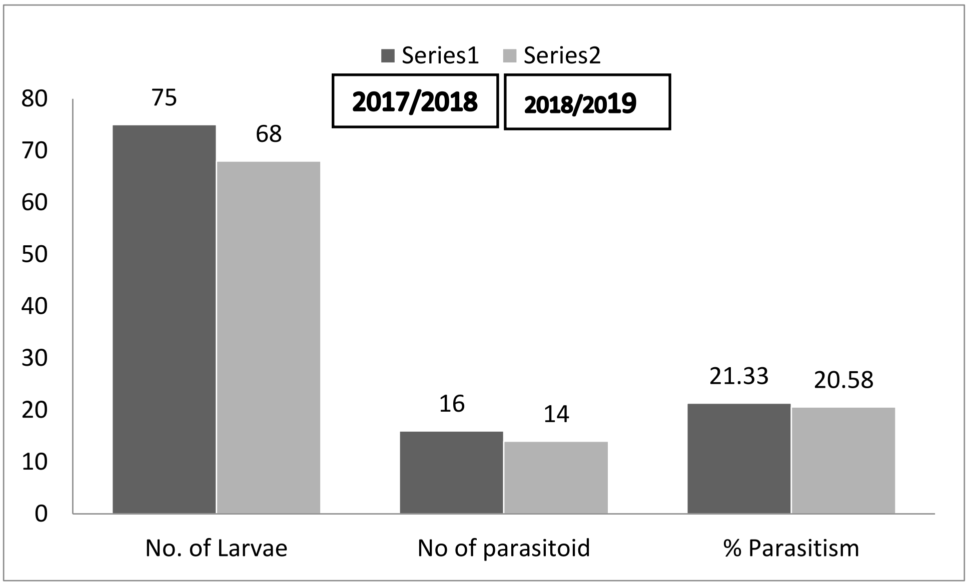

Fig. 4. Total parasitism percentages by *Exeristes roborator* on *Spodoptera littoralis* larvae in 2017/2018 and 2018/2019 seasons.

Table 2. Correlation coefficient values between the number of *Spodoptera littoralis* larvae and its parasitoid, *Exeristes roborator* during 2017/2018 and 2018/2019 seasons

Seasons	"r" value	Status of significance
2017	0.651*	Significant
2018	0.551*	Significant

The Duncan test at level of 5% probability was applied. the mean followed by the same letter do not differ significantly.

Data presented in Tables (3 and 4) elucidate the reduction in the parasitoid numbers resulting from application of two groups of pesticides in the two study seasons. The reduction in the number of parasitoid individuals fluctuated during the examination days (1, 3, 7 and 10 after application) in the case of ecdysone agonists application. In the first season, the lowest reduction was 9.09% and the highest was 32.08%. As well in the second season, the lowest reduction was 11.11% and the highest was 28.88%.

Whereas in the case of conventional insecticides application, 100% reduction were recorded after 1,3,7 and 10 days after application in the two seasons. With the exception of the application with Dora and Pelo. they registered 93.58 and 94.50%, respectively in the first season. While the application with Pelo was registered 98.82% reduction in the second season.

The total reductions due to applied ecdysone agonists were ranged between 17.72 to 21.67% and 14.57 to 21.52% in 2017/2018 and 2018/2019, respectively. However, the total reductions due to applied insecticides reached the maximum; 98.39 to 100% in the first season and 98.82 to 100% in the second season. These results indicate that significant differences in *E. roborator* population reductions due to ecdysone agonists in comparison with conventional insecticides ones.

These results are agree with **Yanagi *et al*. (2006)**, **Schneider *et al* (2008), Shahout *et al*. (2011) and Rani *et al*. (2018)** concluded that ecdysone agonists are promising insecticides with high efficacy against various lepidopteran larvae, at the same time almost non-toxic to parasitoids. It has minimum impact on the environment. Consequently, it would be an ideal agent for Integrated Pest Management (IPM). **Cruz *et al.* (2017)** reported that parasitoids are susceptible conventional insecticides, which may disrupt their efficiency for biological control. Organophosphates are broad – spectrum insecticides with high toxicity for parasitoids. While, insect growth regulators are safer for parasitoids.

Table 3. Reduction in *Exeristes roborator* numbers due to applied ecdysone agonists and conventional insecticides in 2017/ 2018 season

Treatments	Before spray	After one day		After 3 days		After 7 days		After 10 days		Total Reduction (%)
	M.	M.	R.	M.	R.	M.	R.	M.	R.	
Raner	3.50	3.25	15.58	3.25	15.58	3.50	16.66	3.50a	23.07	17.73
Abhold	3.50	3.00	22.07	3.50	9.09	3.50	16.66	3.50a	23.08	17.72
Ferto	3.25	3.00	16.08	3.00	16.08	3.25	16.66	3.25a	23.08	17.97
Xtreme	3.25	3.00	16.08	3.00	16.08	3.00	23.07	3.25a	23.06	19.57
Methobiet	3.75	3.50	15.15	3.50	15.15	3.00	33.33	3.75a	23.07	21.67
Dora	3.00	0.00	100	0.00	100	0.00	100	0.25b	93.58	98.39
Marshal	3.25	0.00	100	0.00	100	0.00	100	0.00b	100	100
Fanty plus	3.25	0.00	100	0.00	100	0.00	100	0.00b	100	100
Diracomel	3.50	0.00	100	0.00	100	0.00	100	0.00b	100	100
Pleo	3.50	0.00	100	0.00	100	0.00	100	0.25b	94.50	98.62
Control	2.50	2.75	--	2..75	--	3.00	--	3.25	--	-----

The Duncan test at level of 5% probability was applied. the mean followed by the same letter do not differ significantly.

Table 4. Reduction in *Exeristes roborator* numbers due to applied ecdysone agonists and conventional insecticides in 2018/ 2019 season

Treatments	Before spray	After one day		After 3 days		After 7 days		After 10 days		Total Reduction (%)
	M.	M.	R.	M.	R.	M.	R.	M.	R.	
Raner	4.00	3.75	11.76	3.75	16.66	4.00	15.78	4.00a	20.00	16.05
Abhold	4.50	4.25	11.11	4.00	20.98	4.00	25.14	4.00a	28.88	21.52
Ferto	4.00	3.75	11.76	3.75	16.66	3.75	21.05	4.00a	20.00	17.36
Xtreme	4.25	4.00	11.41	4.00	16.33	4.00	20.74	4.00a	24.70	18.29
Methobiet	4.25	4.00	11.41	4.25	11.11	4.25	15.78	4.25a	20.00	14.57
Dora	4.00	0.00	100	0.00	100	0.00	100	0.00b	100	100
Marshal	4.00	0.00	100	0.00	100	0.00	100	0.00b	100	100
Fanty plus	4.50	0.00	100	0.00	100	0.00	100	0.00b	100	100
Diracomel	4.50	0.00	100	0.00	100	0.00	100	0.00b	100	100
Pleo	4.25	0.00	100	0.00	100	0.00	100	0.25b	95.29	98.82
Control	4.00	4.25	--	4.50	--	4.75	--	5.00	--	----

The Duncan test at level of 5% probability was applied. the mean followed by the same letter do not differ significantly.

REFERENCES

Abou-ElKassem, A. B. (2010). Ecological and biological studies on insects of sugar beet plants at Kafr El-Sheikh Governorate. Ph. D. Thesis, Fac., of Agric., Kafr El-Sheikh, Tanta Univ., 221pp.

Anonymous (2019). Protocols of evalvating the efficiency of agricultural pest pesticides. Ministry of Agricultural pest pesticides committee. Annual Report.

Baker, W. and Jones, G. (1934). Studies of exeristes roborator (Fab.), a parasite of the European cornborer, in the lake Eri, AREA. Technical Bulletin, 460: 1-28.

Bassyouny, A.; Draz, K. and El-Agamy, F. (1991). Effect of artificial infestation with the cotton leafworm, Spodoptera littoralis (Boisd.) on sugar beet yield in Egypt. J. Agric. Res., Tanta Univ., 17 (2): 501-507.

Bazazo, K. G. (2010). Studies on some insect pests and natural enemies in sugar beet fields at Kafr El-Sheikh region. Ph. D. Thesis, Fac. Agric. Tanta.

Bazazo, K. G. (2019). The role of cotton leaf worms control with certain insecticides in increasing sugar beet productivity. Zagazig J. Agric. Res., 46(6): 2229-2238.

Carmo, E.L.; Bueno, A. F. and Bueno, R. C. O. F. (2010). Pesticide selectivity for the insect egg parasitoid *Telenomus remus* . J. Inter. Organ. Biolo. Cont., 55(4): 455–464.

Çoruh, S. (2010). Composition, habitat distribution and seasonal activity of Pimplinae (Hymenoptera: Ichneumonidae) in North-East Anatolia region of Turkey. Anadolu J. Agric. Sci., 25 (1): 28-36.

Cruz, R.; Zanunico, J. and lacerda, M. (2017). Side – effects of pesticides on the generalist endoparasitoid, *palmistichus elaeisis* (Hymenoptera: Eulophidae). Scientific reports, 7 (10064): 1-8

Duncan, D. (1955). Multiple range and Multiple F – Test. Biometrics, 1: 1-17.

El-Dessouki, W. (2014). Studies on insect natural enemies associated with certain insect pests on sugar beet at Kafr El-Sheikh Governorate. M. Sc. Thesis., Fac., Agric., Al-Azhar Univ., 211pp.

El-Dessouki, W. (2019). Ecological studies on some sugar beet insect pests and their control. Ph. D. Thesis, Fac. Agric., Al-Azhar Univ., 239pp.

El-Husseini, M.; El-Heneidy, A. and Awadallah, T. (2018). Natural enimies associated with some economic pests in Egyptian Argo ecosystem, December. Egyptian J. Biol. Pest Control, 28-78.

El-Mahalawy, N. A. (2011). Ecological and biological. Studies on some sugar beet insects. M. Sc. Thesis, Fac. of Agric., Tanta Univ., 135pp.

Gultekin, L.; Zengin, H. and Hayat, R. (2004). Life history of Lixus bardanae on curly dock (Rumex Crispus) in Turkey. Phytoparasitica, 32 (1): 97-99.

Henderson, G. and Tilton, E. (1955). Test with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161.

Ibrahim, A. M. (2014). Role of insect growth regulators (IGRs) for cotton leafworm, Spodoptera littoralis (Boisd.) and conserving to some predators in sugar beet fields. J. plant Prot. And Path., Mansoura Univ., 5 (12): 1089-1096.

Jafari, M; Norouzi, P.; Malboobi, M. A.; Ghareyazie, B.; Valizadeh, M.; Mohammadi, S. A. and Mousavi, M. (2009). Enhanced resistance to a lepidopteran pest in transgenic sugar beet plants expressing synthetic cry1Ab gene. Euphytica, 165: 333–344.

Kalyanasundaram, M. and Kamala, I. (2016). Parasitoids. In: Ecofriendly pest Management for food security. El-Sevier, 109-138.

Kasparyan, D. and Gultekin, L. (2002). First records of two ichneumonid wasps from Northeatern Turkey (Hymenoptera: Ichneumonidae). Zoological Institute, St. Petersburg.

Laszlo, Z.; Prázsmári, H. and Kelemen, T.I. (2016). *Exeristes roborator* (Fabricuius, 1793) (Hymenoptera: Ichneumonidae) in the parasitoid community of Diploplepis galls in the Carpathian Basin. Folia Entomologica Hungerica, 77: 79-85.

Lotfalizadeh, H; Tabrizi, R. E. and Yazdinejad, A. M. (2009). Diplolepis fructuum (Rübsaamen) (Hym.: Cynipidae) a new host for *Exeristes roborator* (Fabricius) (Hym.: Ichneumonidae) in Iran. Biharean Biologist, 3(2): 171-173.

Özbek, H. and Çoruh, S. (2012). Larval parasitoids and larval diseases of Malacosoma Neustria L. (Lepidoptera: Lasiocampidae) detected in Erzurum Province, Turkey. Turk. J. Zool., 36(4): 447-459.

Rani, G.; Gupta, N.; Redhu, N. and Kumar, S. (2018). Ecdysone receptor present in insects is a novel target for insecticides. Int. L. Curr. Microbiol. App. Sci., 7 (5): 1548-1553.

Rizzo. M.C. and Massa, B. (2006). Parasitism and sex ratio of the bedeguar gall wasp *Diplolepis rosae* (L.) (Hymenoptera: Cynipidae) in Sicily (Italy). J Hymenopt. Res., 15(2):277-285

Sampaio, M.; Bueno, V.; Siveira, L. and Auad, A. (2010). Biological control of insect pests in the tropics. Oxford: Unesco publishing- Eolss, 3: 28-70.

Santos, A.C.; Bueno, A.F. and Bueno, R.C.O.F. (2006). Seletividade de defensivos agrícolas aos inimigos naturais. In: Pinto AS, Nava DE, Rossi MM, Malerbo-Souza DT (eds) Controle Biológico de Pragas na Prática. Piracicaba, 287.

Schneider, M.; smagghe, G.; Pineda, S. and vinuela, E. (2008). Ecological impact of four IGR insecticide in adults of Hyposoter didymator (Hymenoptera: Ichenumonidae). Pharmaco Kinetics Approach Ecotoxicology, 17: 181-188.

Shahout, H.; Xu, J.; Qiao, J. and Jia, Q. (2011). Sublethal effects of Methoxyfenozide in comparison to chloruazuron and beta-cypermethrin on the reproductive characteristics of common cutworm, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). J. Entomol. Res. Soc., 13 (3): 53-63.

Shalaby, G. (2001). Ecological studies on some important sugar beet pests and natural enemies and their control. Ph. D. Thesis, Fac., of Agric., Tanta Univ., 141pp.

Snedecor, G. and Cochram, W. (19889). Statistical Methods. 8th Ed., Iowa State Univ., Press, Ames. Iowa, USA.

Talebi, A. A.; Daneshvar, S.; Fathipour, Y.; Rakhshani, E.; Sadeghi, S.E.; Karimpour, Y. and Horstmann, K. (2005). Report of Orthopelma mediator and *Exeristes roborator* (Hymenoptera: Ichneumonidae), parasitoids of Diplolepis Sp. (Hymenoptera: cynipidae) from Iran. J. Entomol. soci. Iran, 24 (2): 145-146.

Tozlu, G. and Coruh, S. (2011). Parasitoids of *Cynaeda gigantean* (Wocke, 1871) (Lepidoptera: Crambidae), a pest of Anchusa. Leptophylla Roemer and Schultes (Boraginaceae) from the east Anatolia region of Turkey. J. entomol. Res. Soc., 13 (3): 117-124.

Varga, O (2017). A review of the genus *Exeristes* (hymenoptera ichneumonidae, pimplinae) from carpathians, with an illustrated key to western palearcti species. Vestnik zoologii, 51(1): 9–14.

Yanagi, M., Tsukamoto, Y. and Kawagishiu, A. (2006). Development of novel lepidoteran insect control agent, Chromafenozide. J. Pestic. Sci., 31 (2): 163-164.

Yu, D. S.; Van Achterberg, K. and Horstmann, K. (2012). World Ichneumonoidea 2011. Taxonomy, Biology Morphology and Distribution. Avaliable from http://www.taxapad.com/.