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Research Article

Field evaluation of certain insecticides on *Spodoptera* Spp larvae, associated predators and Sugar beet crop productivity

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Abstract:

The sugar beet fields have several insect predators that should be conserved to keep the natural balance in the fields. In current study the efficiency of certain insecticides on Spodoptera Spp., associated predators and Suger beet productivity. Results indicate that ecdysone agonists are efficient in controlling sugar beet insects; Spodoptera Spp. At the same time, these insecticides are safe to predators in comparison with conventional ones. Over all mean of reduction in Spodoptera Spp. Numbers due to ecdysone agonists (Raner, Abhold, Xtreme, Methobiet and Ferto) were 77.70, 79.13, 77.23, 80.50 and 78.58%, respectively Whereas, conventional insecticides (Dora, Marshal, Fartyplus, Diracomel and Pleo) were 78.51 , 78.03, 77.70, 78.33 and 79.41%, respectively. In such concern predators, ecdysone agonists were induced reduction in predator numbers with 24.78, 25.83, 24.28, 25.94 and 24.52%, respectively While, conventional insecticides caused reduction with 99.05, 100, 100, 98.68 and 100%, respectively. Also, show that highly differences among the plots sprayed with ecdysone agonists and conventional insecticides and untreated plots (control) in Root and sugar yield during the two seasons. Concerning, Spodoptera Spp. root and sugar yield were 9.976 and 1.407, respectively in control plots. Whereas the values were 22.047, 22.023, 22.047, 22.00, 22.047, 22.071, 22.047, 22.00, 22.047 and 22.095 for root yield in plots treated with insecticides. While, sugar yield was 3.750, 3.790, 3.820, 3.790, 3.858, 3.752, 3.926, 3.742, 3.822 and 3.890 for plots treated with insecticides.

1. Introduction

Sugar beet, Beta vulgaris L. (Family: Chenopodiaceae) ranks second as a source of sugar, after Sugar Cane, but since 2013 Season sugar beet has become the first Source of sugar. In 2020/2021 season, the total area planted with sugar beet reached 700000 fedd., from which about 30% was planted at Kafr El-Sheikh Governorate (Anonymous, 2021). The area allocated to sugar beet has expanded from 16900 feddans in 1982 to 700000 fedd. in 2019/2020 (FAO Stat 2020).

Ministry of Agriculture and Land Reclamation is planning to increase areas of sugar beet in the coming decades, which puts more responsibilities on Plant protection specialists to cultivate more sugar beet acteages with less pest damage to enhance the yield potential mean , while less water in comparison with Sugar Cane Sugar beet plants are subjected to attack of several insect pests from Seed germination up to maturity and harvest (Shalaby, 2001; Shalaby, 2012 and Bazazo etal. 2015). The major insect pests in sugar beet fields are cotton leaf worm (Spodoptera littoralis + Spodoptera exigua) beet fly (Pegomyia mixta), beet moth (Scrobipalpa ocellatella),tortoise beetle (Cassida vittata), aphids (Aphis gossypii + Myzus persicae) and green slink bug, Nezara viridula. These insect pests proved to reduce the crop quality and quantity (Mesbah, 2000; Shalaby et al. 2011; Bazazo et al. 2012; El-Dessouki, 2014 and Fayed et al. 2014). one larva of Spodoptera littoralis Consumes 183.6 cm2 of sugar beet leaves during the entire larval stage (Mesbah, 1995). infestation of sugar beet with beet fly reduces root weight, with losses ranging between 2.1 and 35.3%. (Aly et al. 1997), fifth larval instar of C. vittata Consumes an average of 1.337 mm2 leaves, while the adult stage consumes an average of 5.832 mm2 (Guirguis 1985). Fortunately, the sugar beet fields have several insect predators that should be conserved to keep the natural balance in the fields (Talha, 2001 and Hendawy, 2009). Enhancing the role of insect predators in pest control is becoming more and more important because countries around the world are developing national standards for organic farming and for the marketing of organic products (Whipps and Lumsden, 2001). The status of insect predators and parasitoids in sugar beet fields was studied by several authors (Awadalla, 1997 and Bazazo, 2005). Many authors recommended applications of insecticides in controlling sugar beet insects to raise the sugar keet yield (Shalaby et al. 2011; Shareen, 2011; Metwally et al. 2004). Because sugar beet is a food crop, it is wise to avoid or minimize the use of insecticides. The new approach of insect pest control is reducing the applications of conventional insecticides and increasing the application of alternative compounds that are safe to the

environment and natural enemies (Osman, 2014). Intensive use of conventional insecticides led to numerous important drastic problems, i.e. Environmental pollution, destruction of the natural enemies and incidence insect resistant to these insecticides. Ecdysone agonists (methoxyfenozide and chromafenozide) are novel and promising insecticides with high efficacy against various insect at the same time almost non-toxic to natural enemies and environment (Awad et al. 2014).

Thus, the current study was carried out at the experimental Farm of Sakha Agricultural Research Station during 2020/2021 and 2021/2022 to investigate the following items:

1- Efficacy of certain insecticides (different groups) on insect pests and their predators.

2- Investigate the effect of the previous alternative and conventional insecticides on sugar yield (roots weight + sugar) content (%).

2. Materials and Methods

2.1. Insecticides used: -

Ten insecticides used Raner 24% SC 75 cm3 / fed.; Abhold 36 % EC 125 cm3 / fed; Xtreme 36 % EC 400 cm3 / fed; Methobiet 24% SC 125 cm3 / fed; Ferto 5 % SC 75 cm3 / fed; Dora 48 % EC 1000 cm3 / fed; Marshal 20 % EC 250 cm3 / fed; Fantyplus 36% EC 90 cm3 / fed; Diracomel 90 % SP 300 g / fed; Pleo 5 % EC 100 cm3 / fed. Reductions in larvae were calculated by Henderson and Tilton (1955). Differences between the means were analyzed using Duncan test (1955).

Henderson and Tilton (1955) Formula

Reductions % =

$$1 - \left(\frac{\text{No. in control before spray}}{\text{No. in control after spray}} \; x \; \frac{\text{No. in treated after spray}}{\text{No. in treated before spray}}\right) x\ 100$$

* No.in control before spray = Mean numbers of insect in control plots before spray

* No.in control after spray = Mean numbers of insect in control plots after spray

* No.in treated after spray = Mean numbers of insect in treated plots after spray

* No.in treated before spray = Mean numbers of insect in treated plots before spray

2.2. Estimation of root and Sugar yield:

The roots of treated and control plots (168 m2) were weighed after harvest to estimate the root yield per feddan. Also, sugar content (%). was determined by using Sucrometer device according to Association of official Analysis Chemists (1990), at the laboratory of Sugar Crops Research Department. Sakha Agricultural Research Station to estimate sucrose content (%) and calculate the Sugar yield per feddan.

2.3. Determination of sucrose content:

Sucrose content was estimated directly in fresh samples according to Le Docte (1927) as follows:-

Fresh grated sample (26g.) was added to 177.5 ml. of 5 % basic lead acetate and mixed for 5 mints . Percentage of the sucrose content in the filtrate was determined directly by saccharometer . (Sucrometer , D.R. wolfgang kernchen . Optik Elektronik . Automation D-3016 Seelze 2 west Germany)

3. RESULTS AND DISCUSSION

3.1. Insect pests survey.

Insect pests inhabiting sugar beet fields were surveyed for two seasons. The survey was carried out using bag and cut method. The survey revealed the occurrence of 13 insect species, belonging to 9 families and 7 orders (Table 1).Coleoptera constitute (7.69 %) out of total Surveyed . Diptera (7.69 %), Hemiptera (7.69 %), Homoptera (30.76 %); Lepidoptera (30.76 %), Orthoptera (7.69 %) and Thysanoptera (7.69 %).These results are agreement with several authors; e. g. El-Khawass et al. (2013), Sherief et al. (2013), El-Dessouki, (2019), and Bazazo and Ibrahim (2020). These insects cause high reductions in sugar and roots yield especially, tortoise beetle (*Cassidavi ttata*), beet moth (*Scrobipalpa ocellatella*), leaf cotton worms (*Spodoptera littoralis* + *Spodoptera exigua)* and beet fly, *Peomyia mixta*

Table (1): survey of insect pests during 2020 /2021 and 2021/2022.

Order	Family	Species	No. of Species	% out of total species
Coleoptera	Chrysomeildae	*Cassida vittata*	1	7.69
Diptera	Anthomyidae	*Pegomyia mixta*	1	7.69
Hemiptera	Pentatomidae	*Nezara viridula*	1	7.69
Homoptera	Aleyrodidae	*Bemisia tabaci*	4	30.76
	Aphididae	*Aphis gossypii* *Myzus persicae*		
	Cicadellidae	*Empoasca spp.*		
Lepidoptera	Noctuidae	*Agrotis ipsilon* *Spodoptera exigua*		30.76

		Spodoptera littoralis *Scrobipalpa ocellatella*	4	
Orthoptera	Gryllotalpidae	*Gyllotalpa*	1	7.69
Thysanoptera	Thripidae	*Thrips tabaci*	1	7.69
Total	9	13	13	--

$$\text{Percentages of insect species ,Out of total} = \frac{\text{Number of insect population}}{\text{Total numbers, regardless species}} \times 100$$

3.2. Population fluctuations

Data in Tables (2 and 3) show the population densities of major insect pests collected in 7 sampling dates (10 plants each). Thus, the total population density was precented for to plants collected and examined by bag and cut method throughout the two seasons. The greatest populaty density was that of *C. villata* larvae and adults, being 121 individuals / 70 plants, followed by that of S. *ocellatella* larvae (70 individuals) and *S. Littoralis* (54 individuals). *P. mixta* (39 larvae) *Cicad ellidae* (35 indiv.) and aphids (33 indiv.). Low population densities were recorded for *T. Tabaci*, *N. Viridula*, *A. ipsilon* and *G. gryllotalpa* with 21, 19, 11 and 4 individuals respectively. In the second season 2021/2022, the Same Trend was obtained (Table 4). show the population: fluctuations of major insect two seasons. *C. vittata* were not detected on the plants till 5th November. The insect appeared on 5th December, and the population density progressively increased towards the end of the season. *S. ocellatella* were not detected on the plants till 5th October. The insect appeared on 5th November, and the population density progressively increased towards the end of the season. Concerning, *S. litoralis* were noticed on 5th October and the population density progressively decreased towards the end to the season. In the second season (2021/2022), the same trend was obtained. Several authors were recorded the same results (Abou- El-Kassem, (2010); El-Samahy and Salem, 2012 and El-Dessouki, 2019).

Table (2): Population fluctuations of major insect pests during 2020/2021 seasons.

Insect species	No. Of insects /10 plants							Total /70 plants	Percentages of insect species out of total
	5/10	5/11	5/12	5/1	5/2	5/3	5/4		
C.vittata	0	0	3	4	11	41	62	121	29.72
S.ocellatella	0	2	6	9	13	17	23	70	17.19
S. littoralis+exigua	10	14	16	4	3	3	4	54	13.26
P. mixta	0	3	8	11	12	3	2	39	9.58
Cicadellidae	2	3	5	6	6	6	7	35	8.59
Aphids	0	2	4	6	3	8	10	33	8.10
T. tabaci	0	0	0	2	3	7	9	21	5.15
N. viridula	0	0	0	0	1	8	10	19	4.66
A. ipsilon	2	3	0	0	0	4	2	11	2.70
G. gryllotalpa	1	1	0	0	0	1	1	4	0.98
Total	15	28	42	42	52	98	130	407	--

$$\text{Percentages of insect species ,Out of total} = \frac{\text{Number of insect population}}{\text{Total numbers, regardless species}} \times 100$$

Table (3): Population fluctuations of major insect pests during 2021/2022 Season.

Insect species	No. Of insects /10 plants							Total /70 plants	Percentages of insect species out of total
	6/10	6/11	6/12	6/1	6/2	6/3	6/4		
C.vittata	0	0	2	3	9	49	65	128	30.91
S.ocellatella	0	2	5	10	12	18	26	73	17.63
S. littoralis+exigua	9	13	15	5	2	5	2	51	12.31
P. mixta	0	2	9	10	13	3	3	40	9.66
Cicad ellidae	2	4	6	7	7	6	5	37	8.93
Aphids	0	0	5	5	2	12	8	32	7,72
T. tabaci	0	0	2	2	2	8	7	21	5.07
N. viridula	0	0	0	0	0	6	11	17	4.10
A. ipsilon	3	3	0	0	0	3	1	10	2.41
G. gryllotalpa	1	1	1	0	0	2	0	5	1.20
Total	15	25	45	42	47	112	128	414	--

$$\text{Percentages of insect species ,Out of total} = \frac{\text{Number of insect population}}{\text{Total numbers, regardless species}} \times 100$$

3.3. Efficacy of certain insecticides (different groups) on insect pests and their associated natural enemies:

Tables (5,6,7,8,9 and 10) indicate that ecdysone agonists are efficient in controlling sugar beet insects; *Spodoptera* spp. + *S. ocellatella* and *C. vittata*. At the same time, these insecticides are safe to predators me comparison with conventional ones .Overall mean of reduction in *spodoptera* sp. Numbers due to ecdysone agonistes (Raner + Abhold + Xtreme + Methobiet and Ferto) were 77.70, 79.13, 77.23, 80.50 and 78.58%, respectively Whereas, conventional insecticides (Dora + Marshal + Fartypus + Diracomel and Pleo) were 78.51 , 78.03, 77.70, 78.33 and 79.41%, respectively. In such concern, predators, ecdysone agonists were induced reduction in predator numbers with 24.78, 25.83, 24.28, 25.94 and 24.52%, respectively While, conventional insecticides caused reduction with 99.05, 100, 100, 98.68 and 100%, respectively. *ocellatella*, ecdysone agonists were caused reductions with 84.72, 83.08, 83.47, 82.51 and 85.66%, respectively. while, conventional ones (85.15, 85.98, 84.51, 86.23 and 87.51%, respectively. Concerning, predators, ecdysone agonist caused reduction with 25.35, 28.38 , 26.64, 25.75 and 25.67%, respectively. While, convent oral insecticides caused reduction with 100, 100, 98.48, 98.39 and 100%, respectively. *vittata*, ecdysone agonists were caused reduction with 75.04, 74.03, 76.18 , 78.19 and 76.84%, respectively. While, conventional ones 78.87, 79.99, 78.10 , 77.52 and 77.82%, respectively. Concerning predators, ecdysone agonists caused reduction with21.67,21.62, 21.40, 21.40 and 21.67%, respectively. While, conventional insecticides caused reduction with 100, 98.96, 98.06, 100 and 100%, respectively. While season (2021/2022) Tables (5,6,7,8,9 and 10) indicate that ecdysone agonists are efficient in controlling sugar beet insects; *Spodoptera* spp. + *S. ocellatella* and *C. vittata.* At the same time, these insecticides are safe to predators me comparison with conventional ones .Overall mean of reduction in *spodoptera* sp. Numbers due to ecdysone agonistes (Raner + Abhold+ Xtreme+ Methobiet and Ferto) were 75.96, 75.90, 77.14, 78.58 and 78.48 respectively Whereas, conventional insecticides (Dora+ Marshal+ Fartypus+ Diracomel and Pleo) were 81.84 , 82.35, 83.80, 84.43 and 85.74%, respectively.In such concern, predators, ecdysone agonists were induced reduction in predator numbers with 25.31, 25.62, 26.91, 27.29 and 25.97%, respectively While, conventional insecticides caused reduction with 98.78, 97.57,98.55, 100 and 100%, respectively. *ocellatella*, ecdysone agonists were caused reductions with 85.81, 86.78, 84.93, 85.64 and 86.51 %, respectively. while, conventional ones (86.70,88.17, 89.62, 88.62 and 90.65%, respectively. Concerning, predators, ecdysone agonist caused reduction with 26.73, 24.00 , 28.23, 24.14 and 26.62%, respectively. While, convenhoral insecticides caused

reduction with 98.79, 98.79, 100, 100 and 100%, respectively. *vittata*, ecdysone agonists were caused reduction with 72.87, 72.16, 72.64 , 74.21 and 74.17%, respectively. While, conventional ones 79.70,79.40,79.87, 78.20and 81.33%, respectively. Concerning predators, ecdysone agonists caused reduction with 24.77,26.04, 16.13 , 24.92 and 27.70%, respectively. While, conventional insecticides caused reduction with 98.58 , 100, 98.72 , 98.85 , and 100%, respectively.

Table (5) Reduction in *Spodoptera* Spp. Numbers due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022**.**

Compounds	Before	After (day)								Overall mean of reduction
		1		3		7		10		
	M.	M.	Red.	M.	Red.	M.	Red.	M.	Red.	
Raner	10.50	-	-	5.5	66.66	4.75	73.61	1.75	91.66	77.70[a]
Abhold	10.50	-	-	5.25	68.18	4.25	76.38	1.5	92.85	79.13[a]
Xtreme	10.25	-	-	5.5	65.85	4.5	74.39	1.75	91.46	77.23[a]
Methobiet	10.25	-	-	5.0	68.75	4.25	75.81	1.5	96.74	80.50[a]
Ferto	10.25	-	-	5.5	65.85	4.0	77.23	1.5	92.68	78.58[a]
Dora	10.25	4.75	62.57	-	-	3.25	81.50	1.75	91.46	78.51[a]
Marshal	10.25	4.75	62.57	-	-	3.5	80.08	1.75	91.46	78.03[a]
Fantyplus	10.50	5.00	61.53	-	-	4.0	77.77	1.25	94.4	77.78[a]
Diracomel	10.50	4.5	65.38	-	-	3.75	79.16	2.00	90.47	78.33[a]
Pleo	10.50	4.75	63.46	-	-	3.25	81.94	1.5	92.85	79.41[a]
Control	10.50	13.00	-	16.50	-	18.00	-	21.00	-	-
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	9.75	-	-	6.0	63.26	4.5	75.38	2.25	89.26	75.96[b]
Abhold	9.75	-	-	6.0	63.26	4.75	74.01	2.0	90.45	75.90[b]
Xtreme	9.50	-	-	5.75	63.86	4.25	76.14	1.75	91.43	77.14[b]
Methobiet	9.75	-	-	5.75	64.79	4.0	78.11	1.5	92.84	78.58[b]
Ferto	9.50	-	-	5.75	63.86	3.75	78.94	1.5	92.65	78.48[b]
Dora	9.75	4.5	63.80	-	-	2.25	87.69	1.25	94.03	81.84[a]
Marshal	10.0	4.0	64.7-	-	-	2.0	89.33	1.5	93.02	82.35[a]
Fantyplus	9.50	4.25	64.91	-	-	1.75	90.17	0.75	96.32	83.80[a]
Diracomel	10.0	4.5	64.70	-	-	1.75	90.66	0.5	97.67	84..43[a]
Pleo	9.75	4.0	76.82	-	-	1.5	91.79	0.5	97.61	85.74[a]
Control	10.0	12.75	-	16.75	-	18.75	-	21.5	-	-

M.= mean of larvae /10plants

Red. = Reduction in larvae number due to spraying insecticides

In a column, the average numbers followed by the different letters are significantly difference at 5% level.

Table (6) Reduction in predator's numbers due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022.

Compounds	Before	After (day)								Overall mean of reduction
		1		3		7		10		
	M.	M.	Red.	M.	Red.	M.	Red.	M.	Red.	
Raner	5.00	-	-	4.5	22.27	4.75	21.52	44.75	30.57	24.78[a]
Abhold	5.25	-	-	4.75	21.86	4.75	25.25	5.0	30.40	25.83[a]
Xtreme	5.5	-	-	5.0	21.48	5.25	21.14	5.25	30.24	24.28[a]
Methobiet	5.0	-	-	4.75	17.95	4.5	25.65	4.5	34.23	25.94[a]
Ferto	5.25	-	-	4.75	21.86	5.0	21.32	5.0	30.40	24.52[a]
Dora	5.75	0.0	100	-	-	0.0	100	0.25	97.15	99.05[b]
Marshal	5.0	0.0	100	-	-	0.0	100	0.0	100	100[b]
Fantyplus	5.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Diracomel	5.25	0.0	100	-	-	0.25	96.06	0.0	100	98.68[b]
Pleo	4.75	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	4.75	5.0	-	5.5	-	5.75	-	6.5	-	-
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	4.75	-	-	4.5	14.73	4.25	26.79	4.5	34.41	25.31[a]
Abhold	4.5	-	-	4.25	15.0	4.0	27.27	4.24	34.61	25.62[a]
Xtreme	4.5	-	-	4.25	15.0	4.0	27.27	4.0	38.46	26.91[a]
Methobiet	4.5	-	-	4.0	20.0	4.0	27.27	4.25	34.61	27.29[a]
Ferto	4.25	-	-	4.0	15.29	3.75	27.80	4.0	34.84	25.97[a]
Dora	4.75	0.0	100	-	-	0.0	100	0.25	96.35	98.78[b]
Marshal	4.75	0.0	100	-	-	0.0	100	0.5	92.71	97.57[b]
Fantyplus	4.0	0.0	100	-	-	0.0	100	0.25	95.67	98.55[b]
Diracomel	4.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Pleo	4.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	4.5	4.75	-	5.0	-	5.5	-	6.5	-	-

In a column, the average numbers followed by the different letters are significantly difference at 5% level

Table (7) Reduction in *S. Ocellatella* Populations due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022.

Compounds	Before	After (day)								Overall mean of re-duction
		1		3		7		10		
	M.	M.	Red.	M.	Red.	M.	Red.	M.	Red.	
Raner	9.00	-	-	4.0	91.64	2.0	86.94	0.75	95.59	84.72[a]
Abhold	9.25	-	-	4.25	70.68	2.25	85.71	1.25	92.85	83.08[a]
Xtreme	9.50	-	-	4.5	71.46	2.5	84.54	1.0	94.43	83.47[a]
Methobiet	9.00	-	-	4.5	68.10	2.25	85.31	1.0	94.12	82.51[a]
Ferto	9.25	-	-	4.0	72.41	1.75	88.88	0.75	95.71	85.66[a]
Dora	9.5	3.75	68.92	-	-	1.5	90.72	0.75	95.82	85.15[a]
Marshal	9.75	3.75	61.72	-	-	1.5	90.96	0.5	97.28	85.98[a]
Fantyplus	9.00	3.5	69.38	-	-	1.75	88.58	0.75	95.59	84.51[a]
Diracomel	9.25	3.75	68.08	-	-	1.25	92.06	0.25	98.57	86.23[a]
Pleo	9.50	3.25	73.06	-	-	1.25	92.27	0.5	97.21	87.51[a]
Control	9.25	11.75	-	14.5	-	15.75	-	17.5	-	-
Compounds	**Before**	**After (day)**								**Overall mean of re-duction**
		1	**3**	**7**	**10**	**1**	**3**	**7**	**10**	
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	10.0	-	-	4.0	74.60	2.25	86.95	0.75	95.89	85.81[a]
Abhold	10.0	-	-	4.0	74.60	1.75	89.85	0.75	95.89	86.78[a]
Xtreme	9.75	-	-	4.25	72.32	2.0	88/10	1.0	94.38	84.93[a]
Methobiet	10.25	-	-	4.25	73.76	2.25	87.27	0.75	95.99	85.64[a]
Ferto	10.25	-	-	4.5	72.12	1.75	90.10	0.5	97.32	86.51[a]
Dora	9.75	3.5	71.84	-	-	1.5	91.08	0.5	97.19	86.70[a]
Marshal	10.0	3.25	74.50	-	-	1.25	92.75	0.5	97.26	88.17[a]
Fantyplus	10.5	3.25	75.72	-	-	1.0	94.47	0.25	98.69	89.62[a]
Diracomel	10.25	3.0	77.04	-	-	1.5	91.51	0.5	97.32	88.62[a]
Pleo	10.25	2.75	78.95	-	-	1.0	94.34	0.25	98.66	90.65[a]
Control	10.0	12.75	--	15.75	-	17.25	-	18.25	-	-

In a column, the average numbers followed by the different letters are significantly difference at 5% level

Table (8) Reduction in Predators numbers due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022.

Season 2020/2021										
Compounds	**Before**	**After (day)**								**Overall mean of re-duction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	4.25	-	-	3.75	25.0	4.0	23.80	4.0	27.27	25.35[a]
Abhold	4.25	-	-	4.0	20.0	3.5	33.33	3.75	31.81	28.38[a]

Xtreme	4.25	-	-	3.75	25.0	3.75	28.57	4.0	27.27	26.64[a]
Methobiet	4.0	-	-	3.5	25.62	3.75	24.10	3.75	2.55	25.75[a]
Ferto	4.0	-	-	3.75	20.31	3.5	29.16	3.75	27.55	25.67[a]
Dora	4.5	0.0	100	-	-	0.0	100	0.0	100	100[b]
Marshal	4.5	0.0	100	-	-	0.0	100	0.0	100	100[b]
Fantyplus	4.25	0.0	100	-	-	0.0	100	0.25	95.45	98.48[b]
Diracomel	4.0	0.0	100	-	-	0.0	100	0.25	95.17	98.39[b]
Pleo	4.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	4.25	4.5	-	5.0	-	5.25	-	5.5	-	-
Season 2021/2022										
Compounds	**Before**	**After (day)**								**Overall mean of re-duction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	5.0	-	-	4.5	21.73	4.75	24.0	4.75	34.48	26.73[a]
Abhold	5.25	-	-	5.0	17.18	5.0	23.80	5.25	31.03	24.00[a]
Xtreme	5.5	-	-	5.25	16.99	5.0	27.27	4.75	40.43	28.23[a]
Methobiet	5.0	-	-	4.75	17.39	4.75	24.0	5.0	31.03	24.14[a]
Ferto	5.0	-	-	4.75	17.39	4.5	28.0	4.75	34.48	26.62[a]
Dora	4.75	0.0	100	-	-	0.0	100	0.25	96.37	98.79[b]
Marshal	4.75	0.0	100	-	-	0.0	100	0.25	96.37	98.79[b]
Fantyplus	4.5	0.0	100	-	-	0.0	100	0.0	100	100[b]
Diracomel	4.5	0.0	100	-	-	0.0	100	0.0	100	100[b]
Pleo	4.0	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	5.0	5.25	-	5.75	-	6.25	-	7.25	-	-

In a column, the average numbers followed by the different letters are significantly difference at 5% level

Table (9) Reduction in *C. Vittata* numbers due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022.

Season 2020/2021										
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	8.5	-	-	5.5	59.55	4.25	77.56	2.5	88.03	75.04[a]
Abhold	8.5	-	-	5.75	57.72	4.25	77.56	2.75	86.83	74.03[a]
Xtreme	8.75	-	-	5.5	60.71	4.0	79.48	2.5	88.37	76.18[a]
Methobiet	8.75	-	-	5.0	64.28	3.75	80.76	2.25	89.53	78.19[a]
Ferto	9.0	-	-	5.5	61.80	4.0	80.05	2.5	88.69	76.84[a]
Dora	8.5	4.25	58.33	-	-	2.75	85.48	1.5	92.81	78.87[a]
Marshal	9.0	4.25	60.64	-	-	2.75	86.28	1.75	92.08	79.66[a]
Fantyplus	9.0	4.5	58.33	-	-	3.0	85.04	2.0	90.95	78.10[a]
Diracomel	8.75	4.5	57.14	-	-	2.75	85.89	2.25	89.53	77.52[a]
Pleo	8.25	4.25	57.07	-	-	2.75	85.04	1.75	91.36	77.82[a]
Control	8.75	10.5	-	14.0	-	19.5	-	21.5	-	-

Season 2021/2022										
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	9.25	-	-	5.25	58.23	4.0	74.82	2,50	85.56	72.87[a]
Abhold	9.25	-	-	5.5	56.24	4.25	73.25	2.25	87.00	72.16[a]
Xtreme	9.25	-	-	5.5	56.24	4.25	73.25	2.0	88.44	72.64[a]
Methobiet	9.5	-	-	5.75	35.46	3.75	77.02	1.75	90.15	74.21[a]
Ferto	9.5	-	-	5.75	55.46	4.0	75.49	1.5	91.56	74.17[a]
Dora	9.75	4.0	63.63	-	-	2.5	85.07	1.75	90.41	79.70[a]
Marshal	9.75	4.25	61.36	-	-	2.5	85.07	1.5	91.78	79.40[a]
Fantyplus	10.0	4.25	62.32	-	-	2.75	83.99	1.25	93.32	79.87[a]
Diracomel	10.0	4.5	60.11	-	-	3.0	82.53	1.5	91.98	78.20[a]
Pleo	9.75	3.75	65.90	-	-	2.75	83.58	1.0	94.52	81.33[a]
Control	9.75	11.0	-	13.25	-	16.75	-	18.25	-	-
Raner	9.25	-	-	5.25	58.23	4.0	74.82	2,50	85.56	72.87[a]
Abhold	9.25	-	-	5.5	56.24	4.25	73.25	2.25	87.00	72.16[a]
Xtreme	9.25	-	-	5.5	56.24	4.25	73.25	2.0	88.44	72.64[a]

In a column, the average numbers followed by the different letters are significantly difference at 5% level

Table (10) Reduction in Predators numbers due to applied ecdysone agonists and conventional insecticides in 2020/2021 and 2021/2022.

Season 2020/2021										
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	
Raner	5.5	-	-	5.0	2.94	5.25	20.45	5.25	23.63	21.67[a]
Abhold	5.5	-	-	5.25	16.99	5.0	24.24	5.25	23.63	21.62[a]
Xtreme	5.75	-	-	5.5	16.82	5.25	23.91	5.5	23.47	21.40[a]
Methobiet	5.75	-	-	5.5	16.82	5.25	23.91	5.5	23.47	21.40[a]
Ferto	5.5	-	-	5.0	20.94	5.25	20.45	5.25	23.63	21.67[a]
Dora	5.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Marshal	5.25	0.0	100	-	-	0.0	100	0.25	96.19	98.96[b]
Fantyplus	5.0	0.0	100	-	-	0.0	100	0.25	96.00	98.66[b]
Diracomel	5.0	0.0	100	-	-	0.0	100	0.0	100	100[b]
Pleo	5.0	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	5.0	5.25	-	5.75	-	6.0	-	6.25	-	-
Season 2021/2022										
Compounds	**Before**	**After (day)**								**Overall mean of reduction**
		1		**3**		**7**		**10**		
	M.	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	**M.**	**Red.**	

Raner	4.75	-	-	4.5	20.42	4.5	26.31	4.75	27.58	24.77[a]
Abhold	4.75	-	-	4.5	20.42	4.5	26.31	4.5	31.39	26.04[a]
Xtreme	4.75	-	-	4.25	24.84	4.5	25.98	4.75	27.58	16.13[a]
Methobiet	4.5	-	-	4.25	20.66	4.25	26.54	4.5	27.58	24.92[a]
Ferto	4.5	-	-	4.25	20.66	4.0	30.86	4.25	31.60	27.70[a]
Dora	4.25	0.0	100	-	-	0.0	100	0.25	95.74	98.58[b]
Marshal	4.5	0.0	100	-	-	0.0	100	0.0	100	100[b]
Fantyplus	4.75	0.0	100	-	-	0.0	100	0.25	96.18	98.72[b]
Diracomel	5.25	0.0	100	-	-	0.0	100	0.25	96.55	98.85[b]
Pleo	5.25	0.0	100	-	-	0.0	100	0.0	100	100[b]
Control	5.25	5.75	-	6.25	-	6.75	-	7.25	-	-

In a column, the average numbers followed by the different letters are significantly difference at 5% level

3.4. Effect of ecdysone agonists and conventional insecticides on root and sugar yield:

Tables (11, 12 and 13) show that highly differences among the plots sprayed with ecdysone agonists and conventional insecticides and untreated plots (control) in Root and sugar yield during the two seasons. Concerning, *spodoptera spp*. root and sugar yield were 9.976 and 1.407, respectively in control plots. Whereas the values were 22.047, 22.023, 22.047, 22.00, 22.047, 22.071, 22.047, 22.00, 22.047 and 22.095 for root yield in plots treated with insecticides. While, sugar yield were 3.750, 3.790, 3.820, 3.790, 3.858, 3.752, 3.926, 3.742, 3.822 and 3.890 for plots treated with insecticides. The same results were recorded in *S.ocellatella* and *C. vittata*. The same results were attaned during the second season. These results demonstrated that the importance of insecticides in protecting sugar and root yield. Also, the results show that no differences among plots sprayed with conventional and plots treated with ecdysone agonists in root and Sugar yield. Metwally *et al*, (1987) showed that the severe infestation of sugar beet with *C.vittata* and *S. ocellatella* caused significant reduction of 34.0 and 38.2% in root weight and 44.2 and 52.4% the sugar content for the two pests, respectively. Shairra, (2010) Indicated that the cotton leaf worm, *Spodoptera* spp. is one of the most notorious chewing insect Pests that causes heavy losses in early sugar beet plantation. Also, Shaheen (2011) showed the importance of insecticides im Increasing root yield (45.96 ton /ha.) and sugar yield, (3.99 ton / ha.).

Table (11): Effect of ecdysone agonists and conventional insecticides applied against *Spodoptera Spp*. On sugar beet productivity.

Insecticides	**2020/2021**				**2021/2022**			
	Root weight kg. /168 m^2	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield Ton/fed**	**Root weight kg. /168 m^2**	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield ton/fed**
Raner	926	22.047	17.0	3.750	931	22.166	17.00	3.768
Abhold	925	22.023	17.21	3.790	933	22.214	17.11	3.800
Xtreme	926	22.047	17.33	3.820	931	22.166	17.12	3.794
Methobiet	924	22.00	17.23	3.790	932	22.190	17.31	3.841
Ferto	926	22.047	17.50	3.858	930	22.142	17.31	3.832
Dora	927	22.071	17.00	3.752	930	22.142	17.00	3.764
Marshal	926	22.047	17.81	3.926	933	22.214	17.00	3.776
Fantyplus	924	22.00	17.01	3.742	933	22.214	17.14	3.807
Diracomel	926	22.047	17.34	3.822	935	22.261	17.21	3.831
Pleo	928	22.095	17.61	3.890	937	22.309	17.41	3.883

Control	919	9.976	14.11	1.407	418	9.952	13.81	1.374

Sucrose % = percentage of sucrose in sap of sugar beet roots

Sugar yield = weight of total sugar

Yield per feddan = root weight ton /fed ×sucrose (%) /100×100

Root weight ton /fed = root weight Kg /168×4000/168×100

Table (12): Effect of ecdysone agonists and conventional insecticides sprayed against *S. ocellatella* On sugar beet productivity.

Insecticides	**2020/2021**				**2021/2022**			
	Root weight kg. /168 m^2	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield ton/fed**	**Root weight kg. /168 m^2**	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield ton/fed**
Raner	941	22.404	17.11	3.833	939	22.357	17.21	3.847
Abhold	941	22.404	17.21	3.855	939	22.357	17.31	3.869
Xtreme	942	22.428	17.22	3.862	938	22.333	17.32	3.848
Methobiet	941	22.404	17.31	3.878	938	22.333	17.11	3.821
Ferto	943	22.238	17.11	3.804	938	22.333	17.21	3.843
Dora	941	22.404	17.22	3.857	940	22.380	17.13	3.833
Marshal	942	22.428	17.23	3.864	940	22.380	17.22	3.853
Fantyplus	942	22.428	17.00	3.812	939	22.357	17.10	3.823
Diracomel	940	22.380	17.00	3.804	939	22.357	17.20	3.845
Pleo	944	22.476	17.13	3.850	937	22.309	17.41	3.883
Control	960	10.952	13.11	1.435	455	10.833	12.00	1.299

Yield per feddan = root weight ton /fed ×sucrose (%) /100×100

Root weight ton /fed = root weight Kg /168×4000/168×100

Table (13): Effect of ecdysone agonists and conventional insecticides applied against *C. Vittata* larvae On sugar beet productivity**.**

Insecticides	**2020/2021**				**2021/2022**			
	Root weight kg. /168 m^2	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield ton/fed**	**Root weight kg. /168 m^2**	**Root weight ton /fed.**	**Sucrose %**	**Sugar yield ton/fed**
Raner	934	22.238	17.61	3.916	936	22.285	17.21	3.835
Abhold	933	22.214	17.62	3.914	937	22.309	17.22	3.841
Xtreme	935	22.261	17.52	3.900	936	22.585	17.31	3.909
Methobiet	933	22.214	17.51	3.889	935	22.261	17.23	3.835
Ferto	934	22.238	17.42	3.873	937	22.309	17.24	3.846
Dora	936	22.285	17.45	3.888	934	22.238	17.15	3.813

Marshal	934	22.238	17.40	3.869	934	22.238	17.15	3.813
Fantyplus	935	22.261	17.40	3.873	937	22.309	17.61	3.928
Diracomel	931	22.166	17.43	3.863	937	22.309	17.50	3.904
Pleo	930	22.142	17.61	3.899	935	22.261	17.62	3.922
Control	417	11.214	13.13	1.472	438	10.428	13.00	1.355

Yield per feddan = root weight ton /fed ×sucrose (%) /100×100

Root weight ton /fed = root weight Kg /168×4000/168×100

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