EFFECT OF CERTAIN INSECTICIDES AGAINST SUGAR BEET BEETLE *Cassida vittata* (VILL.) (COLEOPTERA: CHRYSOMELIDAE) INHABITING SUGAR BEET FIELDS.

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ABSTRACT

The objective of present work was to compare the field efficiency of three tested pesticides, Selecron (profenofos), Marshal (carbosulfan) and Radiant (spinetoram), against larvae and adults of the tortoise beetle *Cassida vittata* (Vill.) inhabiting sugar beet fields in Sharkia Governorate during 2008/2009 and 2009/2010 sugar beet growing seasons. Data obtained revealed that when mortality rates were considered, Selecrone and Marshal were the most efficient compounds against larvae and adults of *C. vittata.* However, Radiant demonstrated a moderate toxic effect.

Marshal and Selecrone showed an increase in sugar percentage (16.75 % and 14.5 % respectively) and total soluble solids (TSS %) (18 %, 17 % respectively) in the first season, while in the second season the increase in sugar percentage were (19.8 % and 19.10 % respectively), and TSS % was (22 % and 20 %, respectively). In the second season Radiant showed less percentages of sugar and (TSS) which are 16.70 % and 18.50 %, respectively.

Keywords: *Beta vulgaris, Cassida vittata*, insecticides, profenofos, carbosulfan, spinetoram, sugar percentage, total soluble solids.

INTRODUCTION

Sugar beet, *Beta vulgaris* L. is one of two strategic sugar crops in Egypt. Because of its lower consumption of irrigation water and its shorter growing season, sugar beet is planted in extending area with decreasing area of sugar cane crop in Egypt. Sugar beet plants attract a considerable number of insect pests among most important of them is the tortoise beetle, *Cassida vittata* (Coleoptera: Chrysomelidae).

Mahmoud *et al.* (1973) and Youssef (1994) recorded that larvae and adults of *C. vittata* are leaf feeders. Crop loss occurs due to leaf feeding and reduction in sugar content of infested plants. Abo-Aiana (1991) mentioned that *C. vittata* reduced both quantity and quality of sugar beet. El-Sebae *et al.* (1985) found that lannate alone had no reliable effect against *C. vittata* control, but mixtures of lannate/dimilin or lannate/sir-8514 were the most effective. Hano (1983); Ali *et al.* (1993) and Saleh (1994) stated that, some conventional insecticides, *i.e.* pirimiphos-methyl, monocrotophos, profenofos, methomyl were comparatively more effective against *C. vittata* under field conditions. El-Khouly and Omar (2002) evaluated the efficiency of profenofos, carbosulfan and chlorfenapyr against eggs, larvae, pupae and adults of the tortoise beetle *Cassida vittata* (Vill.).

The present work was carried out to evaluate certain conventional and untraditional insecticides against *C. vittata* infesting sugar beet plants and their effect on Juice quality,   root yield and sugar yield of sugar beet at Sharkia Governorate during two successive growing seasons.

MATERIALS AND METHODS

1- **Field experiment:**
Field studies were conducted at Kafr El-hamam village, Zagazig district Sharkia Governorate, during the two successive seasons, 2008/2009 and 2009/2010. The sugar beet variety used was Baraca, sowed at Mid. of November. The normal agriculture practice was followed.

2- **Pesticides treatments:**
Three treatments including control were used in the first season. While, in the second season four treatments including control in complete randomized block design were used. Each treatment has been divided   into four plots (replicates). The area of each plot was 42 m^2 (6 x 7 m^2);   so that the area of each treatment was 168 m^2 (6 x 28 m^2).

Each chemical was used separately in a single treatment contain   four replicates. Sprayer provided with motor spray (20 liter) (Kubota) has proved to be sufficient to give good coverage of the tested sugar beet plants. Spraying was carried out when the number of insect pests   were increased in the end of sugar beet season to save sugar beet   plants from severe infestations. Sugar beet was sprayed with the tested insecticides after five months (April) from sowing. Normal agricultural practices were followed; barriers were left between treatments to avoided drift.

Five sugar beet plants were chosen randomly from each replicate   (20 plants per treatment) to estimate the number of *C. vittata* adult and larvae before and after 1, 3, 5, 7, 9 and 11 days of spraying.

Percentage of reduction (R %) was estimated according to the formula of Henderson and Tilton (1955)   as follows:

$$\% \ R = 1 - \left(\frac{\text{Insect No in check before spray}}{\text{Insect No in check after spray}} X \frac{\text{Insect No in treatment after spray}}{\text{Insect No in treatment before spray}} \right) X \ 100$$

3- Tested compounds:
a. Marshal (25% WP) (800gm / fed):
Common name: Carbosulfan.
Chemical name: 2,3-dihydro-2,2-dimethyl-7-benzofuranyl[(dibutylamino) thio] methylcarbamate.
Empirical formula: C20 H32 N2 O3 S.
b. Selecron (72% EC) (750cm^3 / fed):
Common name: profenofos.
Chemical name: *O*-(4-bromo-2-chlorophenyl) *O*-ethyl *S*-propyl phosphorothioate.
Empirical formula: C11 H15 Br Cl O3 PS.
c. Radiant (12% SC) (100 cm^3 / fed):
Common name: spinetoram.

Chemical name: (2*R*,3a*R*,5a*R*,5b*S*,9*S*,13*S*,14*R*,16a*S*,16b*R*)-2-[(6-deoxy-3 *O*-ethyl-2,4-di-*O*-methyl-α-L mannopyranosyl)oxy]-13-[[(2*R*,5*S*,6*R*)-5-(dimethylamino)tetrahydro-6-methyl-2*H*-pyran-2-yl]oxy]-9-ethyl 2,3,3a,4,5,5a,5b,6,9,10,11,12,13,14,16a,16b-hexadecahydro-14-methyl-1*H-as*-indaceno[3,2-*d*]oxacyclododecin-7,15-dione

Mixed with: (2*S*,3a*R*,5a*S*,5b*S*,9*S*,13*S*,14*R*,16a*S*,16b*S*)-2-[(6-deoxy-3-*O*-ethyl-2,4-di-*O*-methyl-α-L-mannopyranosyl)oxy]-13-[[(2*R*,5*S*,6*R*)-5-(dimethylamino)tetrahydro-6-methyl-2*H*-pyran-2-yl]oxy]-9-ethyl-2,3,3a,5a,5b,6,9,10,11,12,13,14,16a,16b-tetradecahydro-4,14-dimethyl-1*H-as*-indaceno[3,2-*d*]oxacyclododecin-7,15-dione.

Empirical formula: $C_{42} H_{69} NO_{10} + C_{43} H_{69} NO_{10}$.

4- **Juice quality, root yield and sugar yield determinations:**

For estimating the effect of tested insecticides on sugar beet yield quantity and percentage of sugar at harvest, 20 plants were taken (from each treatment) and the leaves were cut-off. The roots were cleaned and weighted to calculate the root yield. Sugar extractable was determined at the Department of Pesticide, Faculty of Agriculture, Mansoura University. Juice quality and sugar yield were calculated as follow:

1. Total soluble solids (TSS %) which was determined using handle refractometer. according to Simon *et al.* (1980).
2. Sucrose percentage (%) was determined in fresh roots polarmetrically using lead acetate according to the methods of Le-Docte (1927).
3. Purity percentage was calculated according to the following formula: apparent purity % = sucrose% / TSS % X 100. According to Poschenok (1976).
4. Sugar yield (ton/fed) = root yield X sugar extractable %.

5- **Statistical analysis:**

Statistical analysis were carried out to determine the differences between treatment and days after spraying by using one way analysis of variance (ANOVA) (Costat, 1990). Duncan's multiple range test (Duncan, 1955) was applied at 5% probability level.

RESULTS AND DISCUSSION

1- Efficiency of tested pesticides against adults and larvae of *Cassida vittata*:

A. season 2008/2009:

Results presented in table (1) showed that Marshal was more effective than Selecron against adults of *C. vittata* recording 75.15% and 99.06% reduction while, Selecron caused 67.85% and 95.05% as initial kill (after one day) and mean residual effect, respectively.

Regarding the reduction percent at different time intervals, Marshal and Selecron caused (99.23% and 97.36%), (100% and 97.24%), (100% and

95.68%) and (100% and 93.96%) reduction after 5, 7, 9 and 11 days of application, respectively.

Data in table (2) demonstrated that tested materials had generally great effect against larvae of *C. vittata*, where Marshal showed higher initial effect than Selecron (93.05% and 81.48% reduction, respectively).

There were no significant differences between Marshal and Selecron as residual effect caused (95.19% and 100%), (96.04% and 94.72%) and (96.79% and 95.65%) reduction at 7, 9 and 11 days after application, respectively. According to the mean of residual effect tested insecticides caused 98.07% and 97.60% for Selecrone and Marshal, respectively.

B. season 2009/2010:

As indicated in the result given in table (3) Radiant and Selecron were more effective than Marshal against adults of *C. vittata* in which reduction percentages were 64.80%, 64.25% and 41.33% after one day of spraying (initial kill), respectively.

With the respect to residual effect, Selecron had the highest effect, recording 100% reduction after 5, 7, 9, 11 days of pesticides application.

As means of residual effect, tested insecticides were arranged in descending order as follow: Selecron (98.67%) > Marshal (93.46%) > Radiant (90.76%).

Data in table (4) showed that Selecron was the most effective compound recording 97.66% and 100% reduction followed by Marshal 77.38% and 100% reduction as initial kill (after one day) and residual effect, respectively. While, Radiant was the least potent one where caused 75.25% reduction as initial kill (after one day) and 99.51% reduction as residual effect. Comparing, the effect of the tested materials on larvae and adults of *C. vittata*, data in fig (1) showed that the tested insecticides were more effective against larvae than the adult of *C. vittata* during the two seasons; it was more clearly in season 2009/2010 than 2008/2009.

These results are in agreement with data obtained by Bassyony and Bleih (1996) who found that Marshal and Selecron were the best compounds in reducing the adults of *C. vittata*. El-khouly (1998)   stated that Selecrone was the most effective insecticides against the immature stages of *C. vittata.* He added that successful reduction in adult population also recorded by spraying infested sugar beet plants with Selecron and Marshal. Abo El-Naga (2004) found that Selecrone was the most effective insecticides followed by Marshal as they induced high initial and long residual effect against both adults and larvae of *C. vittata*. Gehan (2009) found that Marshal was the most effective against *C. vittata* compared with the other four compounds where, Marshal caused 82.3% decrease in the adult population followed by Achook (68.5%). the efficiency of tested compounds can be arranged as follows: Marshal > Achook > Bancol > Pymetozine > Alkanz.

1-2

3-4

2008/2009

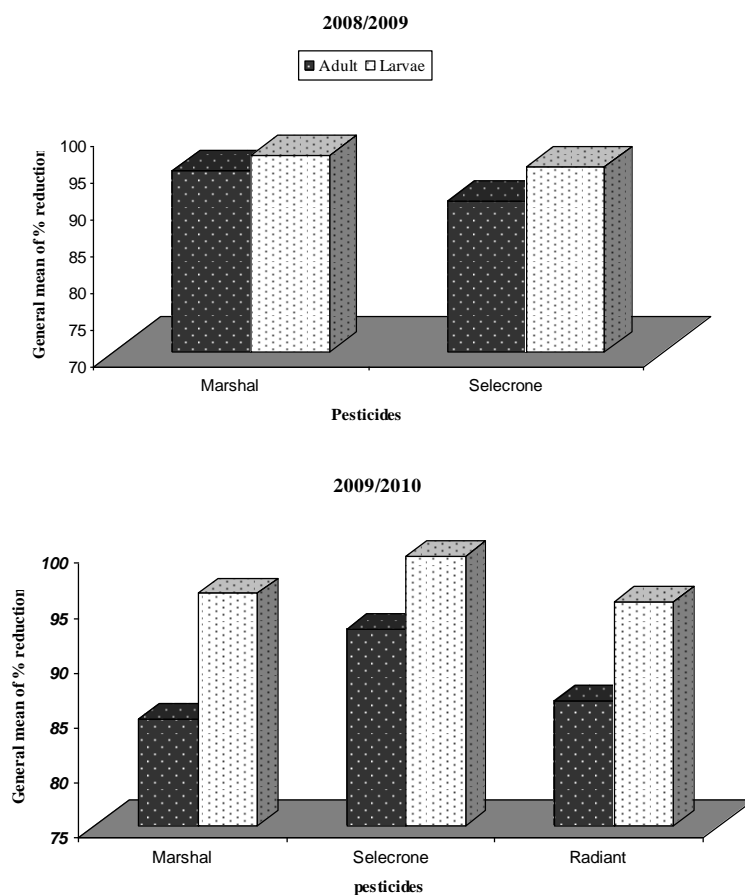■ Adult □ Larvae

2009/2010

Fig. (1): General mean of reduction in sugar beet beetle adults and larvae of *Cassida vittata* on sugar beet leaves during 2008/2009 and 2009/2010 seasons.

2- Efficiency of insecticides on Juice quality, Root yield and Sugar yield:
a. Season 2008/2009:-

Data in table (5) indicated that there was significant increase in percent of sugar extractable, root yield, and sugar yield in sugar beet plants treated with Marshal compared with Control. On the other hand there were no significant differences in case of Selecron treatment. As shown in   fig (1) Marshal and Selecron showed an increase in sugar percentage (16.75 % and 14.5 % respectively) and total soluble solids (TSS) (18 %, 17 % respectively) compared with Control which showed (12.65% and 14.5%) for percentages of sugar and (TSS), respectively. The highest juice purity percentage obtained with Marshal was 93.05 % compared with Control which

was 87.24%, while Selecron was significantly the lowest one in purity percentage.

Data also stated that Marshal increased the sugar and roots yields (Ton / fed.) comparing with other treatments.

Table (5): The side effect of tested insecticides on Juice quality, Root yield and Sugar yield of treated sugar beet plants during season 2008/2009.

insecticides	Root weight (kg)/20plants	Sucrose (%)	TSS (%)	Purity (%)	Roots yield Ton/Fed	Sugar yield Ton/Fed
Selecron	22.50	14.50	17.0	85.29	31.500	4.88
Marshal	30.65	16.75	18.0	93.05	42.910	7.61
Control	20.90	12.65	14.5	87.24	29.260	3.70
L.S.D$_{0.05}$	1.64*					

TSS = total soluble solids.

Table (6): The side effect of tested insecticides on Juice quality, Root yield and Sugar yield of treated sugar beet plants during season 2009/2010.

insecticides	Root weight (kg)/20plants	Sucrose (%)	TSS (%)	Purity (%)	Roots yield Ton/Fed	Sugar yield Ton/Fed
Selecron	26.35	19.10	20.00	95.50	36.890	7.05
Marshal	32.83	19.80	22.00	90.00	45.962	9.10
Radiant	23.60	16.70	18.50	90.27	33.040	5.52
Control	19.15	14.70	16.75	87.76	26.810	3.94
L.S.D$_{0.05}$	1.61**					

TSS = total soluble solids.

b. Season 2009/2010:-

Data in table (6) and fig (2) illustrated that Marshal and Selecron increased the percentage of sugar extractable significantly than Control (19.8%, 19.10% and 14.70%, respectively). According to the sugar and (TSS) percentages the tested insecticides were arranged in descending order as the follows: Marshal > Selecron > Radiant. On the other hand, the juice purity percentage was arranged in descending order as the follows: Selecron > Radiant > Marshal.

Data also stated that Marshal and Selecron increased the sugar and roots yields (Ton / fed.) comparing with Control which recorded 9.10, 7.05 and 3.94 (ton/ fed.), respectively.
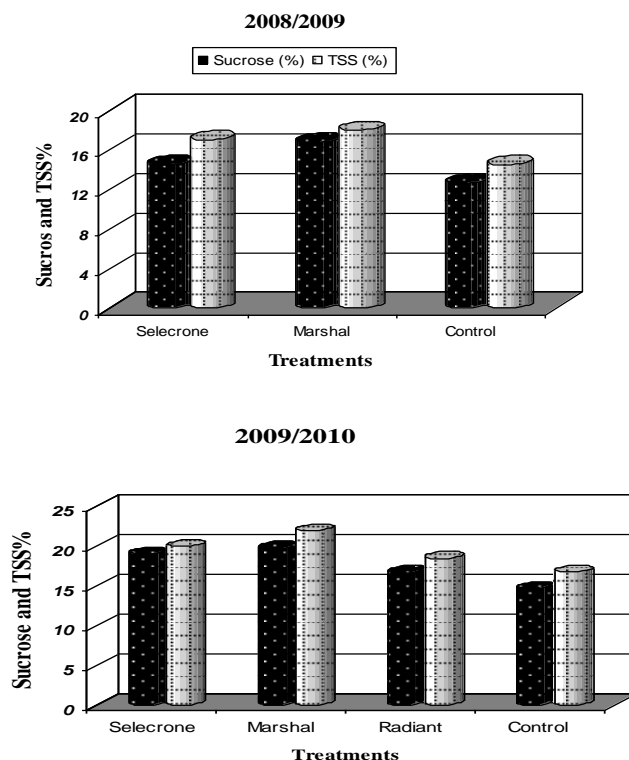
2008/2009

2009/2010

Fig. (2): Effect of certain insecticides on sugar content and total soluble solids during 2008/2009 and 2009/2010.

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تأثير بعض المبيدات الحشرية ضد حشرة خنفساء البنجر السلحفائية التى تقطن حقول بنجر السكر

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** معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقى- جيزة- مصر.

هـذه الدراسـة تهـدف الـى تقيـيم كفـاءة كـل مـن مركبـات السـليكرون ، المارشـال والراديانت على أطوار اليرقة والحشرة الكاملة لخنفساء البنجر السلحفائية Cassida vittata (Vill.) التى تصيب محصول بنجر السكر فى محافظة الشرقية خلال الموسمين ٢٠٠٨ و ٢٠٠٩.

أظهرت النتـائج أن السليكرون و المارشـال كانوا أكثر المركبـات كفاءة على اليرقة والحشرة الكاملة لخنفساء البنجر السلحفائية بينما كان تـأثير الراديانت متوسطا فى مكافحـة هذه الآفة الحشرية.

أيضا تمت دراسة تأثير هذه المبيدات على نسبة السكر والمواد الصلبة الذائبة، حيث تبين أن مركبات المارشال والسليكرون أدت الى زيادة نسبة السكر (١٦.٧٥% و ١٤.٥%) وايضـا المـواد الصـلبة الذائبـة (١٨% و ١٧% علـى التـوالى)خلال الموسـم الاول. وكذلك خـلال الموسـم الثـانى كانـت هنـاك زيـادة فـى نسـبة السـكر (١٩.٨ % و ١٩.١%) والمـواد الصـلبة الذائبـة (٢٢% و ٢٠% علـى التـوالى) أمـا مركـب الراديانـت الـذى تـم اختبـاره فـى الموسـم الثـانى اظهـر انخفاضـا فـى النسـبة المئويـة للسـكر وكذلك فى المـواد الصـلبة الذائبـة (١٦.٧% و ١٨.٥% على التوالى).

قام بتحكيم البحث

أ.د / سلوى السعيد نجم	**كلية الزراعة ــ جامعة المنصورة**
أ.د / وحيد محمود حسين دسوقى	**مركز البحوث الزراعية**

Table (1): Efficiency of tested pesticides against adult of *Cassida vittata* on sugar beet leaves during 2008/2009 at Sharkia Governorate.

Treatment	One day before application Mean	Initial effect (after one day) Mean	Reduction	3 Mean	Reduction	5 Mean	Reduction	7 Mean	Reduction	9 Mean	Reduction	11 Mean	Reduction	Mean of residual effect	General mean of % reduction	L.S.D 0.05
						%Reduction at time intervals — In days (residual effect)										
Marshal	34.50A^a ±8.10	8.00B^b ±6.16	75.15	1.25B^c ±1.25	96.08	0.25B^c ±0.5	99.23	0.00B^c ±0.00	100	0.00B^c ±0.00	100	0.00B^c ±0.00	100	99.06	95.08	5.71**
Selecrone	30.00A^a ±2.16	9.00B^b ±3.55	67.85	2.50B^c ±3.10	90.99	0.75B^c ±0.95	97.36	0.75B^c ±0.95	97.24	1.25B^c ±1.25	95.68	1.75B^c ±1.70	93.96	95.05	90.51	3.21**
Control	30.00A^a ±9.05	28.00A^a ±8.86	—	27.75A^a ±9.06	—	28.50A^a ±7.14	—	27.25A^a ±7.04	—	29.00A^a ±6.87	—	29.00A^a ±7.11	—	—	—	11.67NS
L.S.D 0.05	11.39N.S	10.80**	—	8.93**	—	6.67**	—	6.56**	—	6.45**	—	6.76**	—	—	—	—

*Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).

Table (2): Efficiency of tested pesticides against larvae of *Cassida vittata* on sugar beet leaves during 2008/2009 at Sharkia Governorate.

Treatment	One day before application Mean	Initial effect (after one day) Mean	Reduction	3 Mean	Reduction	5 Mean	Reduction	7 Mean	Reduction	9 Mean	Reduction	11 Mean	Reduction	Mean of residual effect	General mean of % reduction	L.S.D 0.05
						%Reduction at time intervals — In days (residual effect)										
Marshal	4.00B^a ±2.16	0.25B^b ±0.5	93.05	0.00B^b ±0.00	100	0.00B^b ±0.00	100	0.25B^b ±0.5	95.19	0.25B^b ±0.5	96.04	0.25B^b ±0.5	96.79	97.60	96.85	1.32**
Selecrone	6.00B^a ±1.82	1.00B^b ±0.81	81.48	0.00B^b ±0.00	100	0.00B^b ±0.00	100	0.00B^b ±0.00	100	0.50B^b ±1.00	94.72	0.50B^b ±1.00	95.65	98.07	95.31	1.36**
Control	12.50A^{cd} ±6.45	11.25A^{cd} ±6.29	—	8.50A^d ±4.43	—	13.75A^{bcd} ±1.70	—	16.25A^{bc} ±1.25	—	19.75A^{ab} ±4.34	—	24.00A^a ±2.94	—	—	—	6.41**
L.S.D 0.05	6.51*	5.87**	—	4.09**	—	1.57**	—	1.25**	—	4.14**	—	2.91**	—	—	—	—

*Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).

Table (3): Efficiency of tested pesticides against adult of *Cassida vittata* on sugar beet leaves during 2009/2010 at Sharkia Governorate.

Treatment	One day before application Mean	Initial effect (after one day) Mean	Reduction	3 Mean	Reduction	5 Mean	Reduction	7 Mean	Reduction	9 Mean	Reduction	11 Mean	Reduction	Mean of residual effect	General mean of % reduction	L.S.D 0.05
								%Reduction at time intervals — In days (residual effect)								
Marshal	٢.٢٥Aᵃ ±0.95	١.٥٠Bᵃᵇ ±1.29	41.33	0.75Bᵇᶜ ±0.96	76.34	٠.٠٠Bᶜ ±٠.٠٠	100	0.00Bᶜ ±0.00	100	0.00Bᶜ ±0.00	100	0.75Bᵇᶜ ±0.5	90.95	93.46	84.77	1.08**
Selecrone	8.00Aᵃ ±6.16	3.25ABᵇ ±2.22	64.25	0.75Bᵇ ±0.5	93.35	0.00Bᵇ ±٠.٠٠	100	0.00Bᵇ ±0.00	100	0.00Bᵇ ±0.00	100	0.00Bᵇ ±0.00	100	98.67	92.93	3.65**
Radiant	3.75Aᵃ ±1.5	1.5Bᵇ ±1.29	64.80	1.25Bᵇ ±1.26	76.34	0.75Bᵇ ±1.5	88.42	0.50Bᵇ ±1.00	94.47	0.00Bᵇ ±0.00	100	0.75Bᵇ ±0.5	94.56	90.76	86.43	1.66**
Control	5.50Aᵈ ±4.65	6.25Aᵈ ±4.71	—	7.75Aᶜᵈ ±5.12	—	9.50Acᵈ ±4.65	—	13.25Aᵇᶜ ±3.59	—	16.25Aᵃᵇ ±2.22	—	20.25Aᵃ ±4.27	—	—	—	6.28**
L.S.D 0.05	6.11N.S	4.25N.S	—	4.15**	—	3.77**	—	2.87**	—	1.71**	—	3.34**	—	—	—	—

*Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability   (Duncan's Multiple Rang Test).

Table (4): Efficiency of tested pesticides against larvae of *Cassida vittata* on sugar beet leaves during 2009/2010 at Sharkia Governorate.

Treatment	One day before application Mean	Initial effect (after one day) Mean	Reduction	3 Mean	Reduction	5 Mean	Reduction	7 Mean	Reduction	9 Mean	Reduction	11 Mean	Reduction	Mean of residual effect	General mean of % reduction	L.S.D 0.05
								%Reduction at time intervals — In days (residual effect)								
Marshal	٤٩.٧٥Aᵃ ±2.63	١١.٢٥Bᵇ ±2.87	77.38	0.00Bᶜ ±٠.٠٠	100	0.00Bᶜ ±٠.٠٠	100	٠.٠٠Bᶜ ±0.00	100	٠.٠٠Bᶜ ±٠.٠٠	100	0.00Bᶜ ±٠.٠٠	100	100	96.23	2.16**
Selecrone	٤٢.٧٥Aᵃ ±3.77	١.٠٠Cᵇ ±1.15	97.66	0.00Bᵇ ±٠.٠٠	100	0.00Bᵇ ±٠.٠٠	100	٠.٠٠Bᵇ ±٠.٠٠	100	0.00Bᵇ ±٠.٠٠	100	0.00Bᵇ ±٠.٠٠	100	١٠٠	99.61	2.19**
Radiant	٤٩.٥Aᵃ ±9.25	12.25Bᵇ ±4.34	75.25	١.٢٥Bᶜ ±0.95	97.56	٠.٠٠Bᶜ ±٠.٠٠	100	٠.٠٠Bᶜ ±٠.٠٠	100	٠.٠٠Bᶜ ±٠.٠٠	100	٠.٠٠Bᶜ ±٠.٠٠	100	٩٩.٥١	95.47	5.71**
Control	41.75Aᵃ ±4.35	٤١.٧٥Aᵃ ±4.35	—	٤٣.٢٥Aᵃ ±4.57	—	٤٠.٢٥Aᵃ ±3.09	—	٣٨.٠٠Aᵃᵇ ±3.74	—	٣٤.٢٥Aᵇᶜ ±2.87	—	٣٠.٢٥Aᶜ ±3.59	—	—	—	5.65**
L.S.D 0.05	8.64N.S	4.49**	—	3.59**	—	2.38**	—	2.88**	—	2.21**	—	2.76**	—	—	—	—

*Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).