FIELD AND LABORATORY EVALUATION OF DIFFERENT CONTROLLING AGENTS AGAINST THE TORTOISE BEETLE, *CASSIDA VITTATA* VILL.AND THE RIB MINER, *SCROBIPALPA OCELLATELLA* BOYD INFESTING SUGAR BEET IN EGYPT

HANY A. S. ABD EL-GAWAD

Biological Control Research Dept., Plant Protection Institute, A.R.C., Dokki, Giza, Egypt

(Received 28 -7-2007)

INTRODUCTION

Sugar crops (sugar-beet and sugar-cane) receive great attention in Egypt because of their strategic and industrial values. In the year 2005, Egypt produced 1,497,745 tons of sugars (1,048,337 tons from cane and 449,418 tons from beet) while the consumption reached 2,200,000 tons that created a 800.000 tons gap which is filled by the importation from the international market. Sugar-beet has received special attention in the last two decades in Egypt because of its great value in sugar extracting (15-20 %) from the roots (Fathy *et al.,* 1986) and the use of its by-products in producing untraditional animal food, as well as many other secondary products.

As a new crop in the Egyptian agro-ecosystem, newly emerged insect pests appeared causing economic damage to the sugar-beet. The tortoise beetle, *Cassida vittata* Vill. was recorded early in Egypt feeding during larval and adult stages on leaves of table beet (Willcock,1922). Recently, it was reported as a defoliator and major pest for sugar-beet in the delta (Salama *et al.*, 1991). The gelechiid rib miner, *Scrobipalpa ocellatella* Boyd was recorded in Egypt among the Egyptian insect fauna (Willcock, 1922). As sugar-beet was introduced into Egypt, this pest was recorded as a common pest on the crop (Hammad, 1968). Ten years later, it became a destructive pest for sugar-beet allover the production areas causing high economic damage (Hammad, 1968; Akil, 1974; Abo-Saied, 1987 and El- Zoghbey, 1999).

Chemical insecticides are usually used to control the sugar beet pests (Abelentseva and Kreminiskaya, 1986; Kasza, 1996 and Sabluk *et al.*, 2002).

Oils give multiple effects such as increased adult mortality, lowered oviposition rate or interfere with larval development and adult emergence (Messina and Renwick, 1983). It is generally agreed that insect mortality from vegetable oils is not only due to oxygen starvation from the physical blockage of respiration but also to insecticidal effects of some oil components particularly the triglycerides, oleic, linoleic and arachidonic acids. Singh *et al.*, (1978) proposed that oil causes progeny mortality through partial or complete failure of embryos development in the eggs rather than reduced oviposition and increased adult mortality. The use of edible oils is the most suitable because of its commercial availability, low cost besides being non-toxic to humans and do not affect seed germination and do not create off flavors in cooked products (Abdel-Latif, 2003).

The entomopathogenic fungi have long been known to cause epizootic among certain insects under both laboratory and field condition (Watson *et al.*, 1996 and Reithinger *et al.*, 1997). As an alternative to chemical control or as part of IPM programs, there is resurgence to the use of microbial insecticides for biological control of insect pests (Castillo *et al.*, 2000).

The present study deals with bioassay of garlic oil (plant extract), Selecron (chemical insecticide) and *Nomuraea rileyi* (entomopathogenic fungi) in controlling larvae (L3) and adults of C. *vittata* and larvae (L3) of *S. ocellatella*. Application of Selecron, garlic oil and *N. rileyi* against *C. vittata* and *S. ocellatella* was carried out in an experimental field of sugar- beet at two governorates, (Kafr El – Sheikh and Gharbia) during 2006-2007 and their effects was studied on the predators (*Coccinella udecimpunctata* L. *Chrysoperla carnea* Steph., and *Paederus alfierii* Koch.) and parasitoids (*Monorthochaeta niger* and *Agathis* sp.).

MATERIAL AND METHODS

Laboratory studies:

Insect culture:

a- *Cassida vittata*: A colony of the tortoise beetle, *C. vittata* was reared on sugar-beet plants (*Beta vulgaris*) as described by Abdel-Raheem, 2005.

b- *Scrobipalpa ocellatella* : A colony of the gelechiid rib miner, *S. ocellatella* was reared on sugar-beet plants (*Beta vulgaris*) as described by Mansour, 1999.

Isolation and propagation of entomopathogenic fungi:

Preparation of fungus inoculums: Entomopathogenic fungi *N. rileyi* originally was isolated by Abd El-Gawad, 2000. Conidiospores suspension was sprayed on *C. vittata* and *S. ocellatella* larvae and incubated at 25 °C and 65± 5 % R.H. Following the host death and sporulation, conidiospores were harvested from cadavers and then transferred to Petri dishes containing potato – dextrose agar media (PDA). Isolated fungus was grown using autoclaved potato – dextrose agar media (PDA) enriched with 1% peptone, 4% glucose, 2% yeast and 5 gm streptomycin (Rombach *et al.*, 1988).

The cultures were incubated at 25 °C for 10 days. Cultures with fully developed conidiospores were washed by sterilized distilled water mixed with 0.05 % Tween – 80 to obtain the stock spore suspension. Spores suspended in sterilized water were counted with a haemocytometer.

Production of conidiospores for field application: Fungal conidia were produced on a rice substrate which contained 50 gm of rice, 35 ml distilled water and 2 ml pressed sun flower oil. The rice mixed with water and oil was autoclaved in Erlenmeyer flasks (300 ml) for 20 min at 121 °C. Immediately after the lumps of grain were destroyed by shaking the flasks vigorously, the flasks were cooled to room temperature and inoculated with 1 ml of conidia suspension with10^6 spores/ml, then incubated for 2-3 weeks in the dark at 25±1 °C. The conidia were harvested by suspending them in 50 ml of 0.05% Tween 80. The suspension was filtrated through a double layer of muslin and the desired concentration for field application was obtained by the addition of sterile distilled water. Total spores were counted before application in the field using a haemocytometer.

Treatments: The three experimental treatments evaluated were the plant extract (pure garlic oil); chemical insecticide (Selecron 72 % EC) and entomopathogenic fungi (*N. rileyi)* on the tortoise beetle, *C. vittata* (larvae and adults) and the gelechiid rib miner, *S. ocellatella* larvae. Five desired serial concentrations of 0.25, 0.5, 1.0, 2.0 and 4.0 % for plant extract; 0.5, 1.0, 1.5, 2.0 and 2.5 % for chemical insecticide and 10^4, $5x10^4$, 10^5, $5x10^5$ and 10^6 spores/ ml for entomopathogenic fungi were prepared.

The following procedures were followed:

1-The experimental design consisted of four replicates, each of ten (3rd instar larvae and 1 day old of adults) of the tortoise beetle, *C. vittata* and ten 3rd instar larvae of the gelechiid rib miner, *S. ocellatella.*

2-In case of the treatments either by plant extract and chemical insecticide the larvae or adults were allowed to feed on treated sugar-beet leaves which were dipped for one minute in the tested concentrations and then left to air dry before being offered to tested larvae and adults for a feeding period of 48 hours in the case of plant extract and 24 hours for chemical insecticide. The larvae and adults were starved for 6 hours before exposure to treated leaves, in order to obtain rapid simultaneous ingestion. Surviving larvae after experimental treatments were transferred to other clean cups containing untreated sugar-beet leaves until pupation.

3-For the treatments with entomopathogenic fungi, the tested larvae and adults were immersed for 10 seconds in the tested concentration. Then, larvae and adults were transferred onto untreated sugar-beet leaves.

4-Control tests were conducted using the same source of food, but dipped in water only.

5-Experiments on the plant extract and chemical insecticide were carried out under laboratory conditions of 26±2 °C and 65±5 % R.H., while experiments with entomopathogenic fungi were carried out at 26±2 °C and 85±5 % R.H. and all replicates were checked daily to estimated percent larval mortality.

6-The effectiveness of the different treatments was expressed in terms of LC_{50} and Slope values at 95 % fiducially limits. Statistical analysis of the obtained data was made based on the analysis of variance and linear regression analysis (Finney, 1971). In addition, polynomial regression procedure in COSTAT program was carried out.

Field studies: An area of about half feddan was chosen at each of Kafr El – Sheikh and Gharbia governorates. This area was divided into 3 treatments and a control. Sugar-beet seeds (Farida variety) were sown on November, 20th and 22nd in Kafr El – Sheikh and Gharbia governorates, respectively during 2006. All plots received the normally recommended agricultural practices. Experimental treatments started on March, 24th and 25that Kafr El – Sheikh and Gharbia governorates, respectively. The plant extract (pure garlic oil) at rate of 2 % and recommended dose of chemical insecticide (Selecron 72 % EC) (750 ml/feddan) were applied once; except the entomopathogenic fungi *N. rileyi (N.r.)* was repeated 4 times at 15-days intervals by a rate of 10^7 spores / ml for controlling the tortoise beetle, *C. vittata* and the gelechiid rib miner, *S. ocellatella*. Sampling started (after application compared with the control) on March, 31st and on April, 1st and continued weekly until May, 19th and 20th in Kafr El – Sheikh and Gharbia governorates, respectively. The efficacy of different treatments was measured on the number of survived larvae and adults for the tortoise beetle, *C. vittata* on 20 plants and the number of survived larvae for the gelechiid rib miner, *S. ocellatella* on 10 plants (Infested).

Yield Assaments:

Data presented yield weight in kgs for treated and untreated plots.

Effect of different treatments of the numbers of predators: Weekly numbers of each predaceous species was taken by direct count on 20 plants, at random, from each treatment.

Effect of different treatments of the rate of parasitism: Samples of the tortoise beetle, *C. vittata* eggs and larvae of the gelechiid rib miner, *S. ocellatella* were randomly collected weekly from the different treatments. Eggs or larvae were kept individually in glass vial and larvae were provided daily with sugar-beet plants through out their developmental period until reaching the pupal stage. Vials were examined daily for emergence of any parasitoids to estimate rate of parasitism by the formula:

$$\text{Percentages of parasitism} = \frac{\text{Total No. of parasitized eggs or larvae}}{\text{Total No. collected eggs or larvae}} \times 100$$

The formula of Henderson and Tilton (1955) was used to calculate the reduction rate among populations of the targeted sugar-beet pests in the field after application with the three tested treatments.

RESULTS AND DISCUSSION

Insecticidal effect:

1- Effect of garlic oil and Selecron:

Obtained results presented in Table (1) show the daily corrected mortality percentages due to the treatments by the plant extract (garlic oil) and chemical insecticide (Selecron) on 3rd instar larvae and 1 day old of adults of the tortoise beetle, *C. vittata* and 3rd instar larvae of the gelechiid rib miner, *S. ocellatella*. The percent mortality after 6 and 5 days post treatment on larvae (L) and adults (A) of *C. vittata* ranged from 40.0 and 32.5 to 92.5 and 82.5 % and from 52.5 and 50.0 to 100.0 and 100.0 % at concentrations of 0.25 to 4.00 % and 0.5 to 2.5 % of the plant extract (garlic oil) and chemical insecticide (Selecron), respectively. Also the percent mortality after 6 and 5 days post treatment on larvae (L) of *S. ocellatella* ranged from 42.5 to 97.5 % and from 70.0 to 100 % at concentrations of 0.25 to 4.00 % and 0.5 to 2.5 % of the plant extract (garlic oil) and chemical insecticide (Selecron), respectively. It is evident from Table (1) that the percent mortality increased as a result of increasing the concentration of either plant extract and chemical insecticide used, *i.e.,* the plant extract and chemical insecticide exhibited toxic effect against the tested larvae and adults with different concentrations. The LC_{50} values for larvae and adults of *C. vittata* and larvae of *S. ocellatella* were calculated after 3 and 4 days from treatment as (0.85 and 1.44) and 0.64; and (0.57 and 0.92) and 0.48 % for plant extract, while the LC_{50} values were calculated after 1 day from treatment as (1.45 and 1.68) and 1.23 % for chemical insecticide, respectively (Table 2). Moreover, the obtained data also showed that chemical insecticide was more toxic than that of plant extract (Table 1). The obtained results are in agreement with the findings of El-kholy (2001) who studied the effectiveness of some insect growth regulators [the anti-moulting agent (Teflubenzuron) and the Neem seed kernel extract (Azadirachtin)] against all stages of the tortoise beetle *C. vittata* infesting sugar-beet plants. This evaluation was conducted in comparison with one of the recommended organophosphorus insecticide (*i.e.,* profenofos). The obtained results showed that, profenofos were the most effective compound against *C. vittata*. Ebieda (1987) studied the effect of some insecticides that were effective against moth beet (*S. ocellatella.*).

2- Effect of the entomopathogenic fungi (*N. rileyi*):

The daily corrected mortality percentages resulting from the treatment of 3^{rd} instar larvae and 1 day old of adults of the tortoise beetle, *C. vittata* and 3^{rd} instar larvae of the gelechiid rib miner, *S. ocellatella.* are shown in Table (1). Larval and adult moralities at higher concentrations of $5x10^5$ and 10^6 spores/ ml. after 6 days post treatment were (75.0 and 67.5) and 72.5 and (85.0 and 77.5) and 90 %, respectively. At lower concentrations of 10^4, $5x10^4$ and 10^5 spores/ ml. the larval and adult moralities were (32.5 and 27.5) and 37.5, (47.5 and 40.0) and 52.5 and (62.5 and 57.5) and 67.5 %, respectively. After 4 and 5 days (at which the LC_{50} was calculated), the percent mortality ranged between (20.0 and 12.5) and 22.5 to (70.0 and 60.0) and 75.0 and (27.5 and 20.0) and 32.5 to (82.5 and 70.0) and 85 % when using the concentrations of entomopathogenic fungi (*N. rileyi*) at 10^4 to 10^6 spores/ ml., respectively. The LC_{50} was recorded as ($2.1x10^5$ and 5.10073E+05) and $1.35x10^5$ and (655780.78 and 1.63927E+05) and 43540.97 spores/ ml., respectively (Table 2). These larvae and adults were susceptible to fungal infection. Besides, as the concentrations of the fungus *N. rileyi* increased, the larval and adult moralities were also increased. These results are in complete accordance with those previously shown by Marie (2004) of the *C. vittata* on larvae, pupae and adults and El- Safty (1987) on *S. ocellatella* larvae.

TABLE (I)

Corrected mortality percentages for 3[th] instar larvae and adults of *Cassida vittata* and 3[th] instar larvae of *Scrobipalpa ocellatella* fed on sugar-beet leaves treated with the plant extracts or chemical insecticide and also for pest larvae dipped in different concentrations of the entomopathogenic fungi.

Larvae and adults of *Cassida vittata*													
Concentration	**% cumulative mortality after days of treatment**												
	1		**2**		**3**		**4**		**5**		**6**		**8**
	Garlic oil (Plant extract)												
%	L	A	L	A	L	A	L	A	L	A	L	A	**Surviving larvae reached the pupal stage**
0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	2.5	0.0	5.0	0.0	5.0	
0.25	10.0	10.0	17.5	12.5	25.0	20.0	27.5	22.5	35.0	27.5	40.0	32.5	
0.5	15.0	15.0	25.0	20.0	37.5	32.5	50.0	42.5	57.5	50.0	62.5	57.5	
1.00	17.5	17.5	37.5	30.0	60.0	47.5	65.0	57.5	75.0	65.0	77.5	70.0	
2.00	25.0	20.0	50.0	40.0	67.0	57.5	77.5	62.5	82.5	70.0	90.0	77.5	
4.00	30.0	25.0	60.0	50.0	75.0	62.5	82.5	70.0	90.0	77.5	92.5	82.5	
%	**Selecron (Chemical insecticide)**												
	L	A	L	A	L	A	L	A	L	A	L	A	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5			
0.5	12.5	10.0	30.0	27.5	42.5	40.0	50.0	47.5	52.5	50.0			
1.0	22.5	20.0	45.0	42.5	60.0	57.5	72.5	67.5	77.5	75.0			
1.5	47.5	45.0	67.5	65.0	80.0	75.0	87.5	80.0	90.0	87.5			
2.0	65.0	60.0	80.0	77.5	90.0	(87.5	95.0	90.0	97.5	95.0			
2.5	82.5	70.0	90.0	87.5	95.0	92.5	100.0	95.0	100.0	100.0			
Spores/ml	***Nomuraea rileyi*** **(Entomopathogenic fungi)**												
	L	A	L	A	L	A	L	A	L	A	L	A	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	2.5	0.0	
10^4					12.5	7.5	20.0	12.5	27.5	20.0	32.5	27.5	

Table (I) cont.

5x10⁴					22.5	12.5	30.0	20.0	42.5	32.5	47.5	40.0	
10⁵					30.0	22.5	42.5	32.5	57.5	47.5	62.5	57.5	
5x10⁵					42.5	32.5	57.5	47.5	72.5	62.5	75.0	67.5	
10⁶					52.5	45.0	70.0	60.0	82.5	70.0	85.0	77.5	

Larvae of *Scrobipalpa ocellatella*

%	**Garlic oil (Plant extract)**					
0.0	0.0	2.5	2.5	2.5	5.0	5.0
0.25	15.0	20.0	27.5	32.5	37.5	42.5
0.5	22.5	32.5	42.5	52.5	60.0	70.0
1.00	27.5	45.0	57.5	67.5	77.5	85
2.00	32.5	57.5	70.0	80.0	87.5	92.5
4.00	40.0	67.5	82.5	85.0	92.5	97.5

%	**Selecron (Chemical insecticide)**					
0.0	0.0	0.0	0.0	2.5	2.5	
0.5	17.5	22.5	45.0	62.5	70.0	
1.0	30.0	47.5	65.0	82.5	87.5	
1.5	57.5	70.0	82.5	90.0	95.0	
2.0	75.0	82.5	95.0	97.5	100.0	
2.5	90.0	92.5	97.5	100.0		

Spores/ml	***Nomuraea rileyi* (Entomopathogenic fungi)**					
0.0	0.0	0.0	0.0	0.0	2.5	2.5
10⁴			15.0	22.5	32.5	37.5
5x10⁴			25.0	35.0	47.5	52.5
10⁵			32.5	47.5	62.5	67.5
5x10⁵			45.0	62.5	77.5	72.5
10⁶			57.5	75.0	85.0	90.0

TABLE (II)

Values of LC_{50} and slopes for the tested compounds.

Treatments	Days after treatment	LC_{50}	Slope	Fiducial limits at 95% of LC_{50}	
				Lower	Upper
***Cassida vittata* (larvae)**					
Garlic oil	3	0.85 %	1.15	0.66	1.07
	4	0.57	1.29	0.44	0.71
Selecron	1	1.45	3.02	1.07	2.01
N. rileyi	4	$2.1x10^5$	0.68	$1.42x10^5$	$3.28x10^5$
	5	655780.78 Spores/ml	0.76	43601.72	93531.56
***Cassida vittata* (adults)**					
Garlic oil	3	1.44	0.98	1.1	1.98
	4	0.92	1.00	0.70	1.20
Selecron	1	1.68	2.79	1.52	1.87
N. rileyi	4	5.10073E+05	0.70	3.32192E+05	9.14641E+05
	5	1.63927E+05	0.69	1.11808E+05	2.47423E+05
***Scrobipalpa ocellatella* (larvae)**					
Garlic oil	3	0.64 %	1.26	0.5	0.8
	4	0.48	1.26	0.35	0.60
Selecron	1	1.23	3.05	0.77	1.75
N. rileyi	4	$1.35x10^5$	0.70	91977.36	$2.01x10^5$
	5	43540.97 Spores/ml	0.75	27195.10	63550.23

Field studies:

1- Application of the garlic oil, Selecron and *N. rileyi* against *C. vittata* and *S. ocellatella* in sugar-beet field:

It is clear from obtained results (Figs. 1, 2 and 3) that damage caused to sugar-beet plants by the tortoise beetle, *C. vittata* and the gelechiid rib miner, *S. ocellatella* was higher in control than any of the tested 3 treatments. The overall average of damage caused by *C. vittata* (larvae and adults) was reduced by [(18.30, 28.53), (28.89, 43.28) and (51.56, 70.86)] and [(21.62, 32.40), (32.92, 49.79) and (59.54, 79.29)] % due to the applications of the *N. rileyi*, garlic oil and Selecron in Kafr El – Sheikh and Gharbia governorates, respectively during 2006-2007. In case of *S. ocellatella* (larvae), the resultant damage in the three treatments took the same trend as reduced by (34.28, 48.86 and 68.49) and (39.90, 54.13 and 76.49) in Kafr El

– Sheikh and Gharbia governorates, respectively during 2006-2007. The tortoise beetle, *C. vittata* and the gelechiid rib miner, *S. ocellatella* that traditionally controlled by chemical insecticides Saleh, (1994a&b) and Ebieda and Badr (1998). El-kholy (2001) evaluated the effectiveness of some insect growth regulators [the anti-moulting agent Teflubenzuron and the Neem seed kernel extract (Azadirachtin)] against all stages of the tortoise beetle infesting sugar-beet plants at Kafr El-Sheikh governorate during two successive seasons (1999/2000 and 2000/2001). This evaluation was conducted in comparison with one of the recommended organophosphorus insecticide (*i.e.*, profenofos). The obtained results showed that, profenofos were the most effective compound against *C. vittata*. Ebieda (1987) studied the effect of insecticides against insect pests of sugar-beet. Tested insecticides were effective against beet moth *S. ocellatella.*

The entomopathogenic fungi have been used in the protection of sugar-beet plants. In this respect El- Saufty (1987) showed that *B. bassiana* was efficient against beet moth *S. ocellatella*. Abo-Aiana (1991) indicated that *B. bassiana* was effective against *C. vittata* larvae, since larval mortality depended on concentration. Mansour (1999) found that populations of *C. vittata* and *S. ocellatella* were lowered by the applications of *B. bassiana.*

2- Effect of different treatments of the numbers of predators:

Three predaceous species were concerned in this study, the neuropteran, *Chrysopa carnea* Steph. (Chrysopidae); *Coccinella udecimpunctata* L. (Coccinellidae) and *Paederus alfierii* Koch (Staphylinidae). Obtained results illustrated in (Fig. 4) indicated that the untreated sugar beet plants harbored the highest numbers of entomophagous insects showing mean total numbers of 22.33 and 19.33 predators in 2006 and 2007, respectively. These numbers were insignificantly higher than those recorded from sugar-beet plants received entomopathogenic fungi (*N. rileyi)* applications (20.56 and 16.67), but significantly higher than those counted on plants treated with the plant extract (garlic oil) (17.33 and 13.67) and the chemical insecticide (Selecron) (11.89 and 9.89). It is also clear that the chemical insecticide (Selecron) applications caused significantly percent reduction in the mean total numbers of predators (50.48 and 52.59 %) than that treated with the plant extract (garlic oil) (25.35 and 32.81 %) and entomopathogenic fungi (*N. rileyi)* (9.03 and 15.43 %).

3- Effect of different treatments on the rate of parasitism:

In case of *C. vittata* eggs, obtained results (Fig. 5) indicated that the untreated sugar-beet plants harbored the highest numbers of entomophagous insects

(Mean of 14.82 and 11.85 % parasitism). These numbers were insignificantly higher than those recorded from sugar beet plants received entomopathogenic fungi (*N. rileyi)* applications (*i.e.*, 12.96 and 10.00 %), but significantly higher than those counted on plants treated with the plant extract (garlic oil) (*i.e.*, 8.89 and 6.67 %) and the chemical insecticide (Selecron) (*i.e.*, 4.07 and 3.33 %). It is also clear that the chemical insecticide (Selecron) applications caused significantly percent reduction in the mean total number of predators (77.92 and 77.77 %) than that treated with the plant extract (garlic oil) (47.29 and 51.07 %) or entomopathogenic fungi (*N. rileyi)* (12.81 and 13.66 %). Also in case of *Agathis* sp. on *S. ocellatella* larvae-pupae obtained results (Fig. 6) indicated that the untreated sugar beet plants harbored the highest numbers of entomophagous insects (Mean of 19.11 and 15.11 % parasitism). These numbers were insignificantly higher than those recorded from sugar-beet plants received entomopathogenic fungi (*N. rileyi)* applications (*i.e.*, 16.00 and 12.44 %), but significantly higher than those counted on plants treated with the plant extract (garlic oil) (*i.e.*, 11.56 and 8.44 %) and the chemical insecticide (Selecron) (5.78 and 4.44 %). Selecron applications caused significantly percent reduction in the mean total number of predators (78.30 and 77.29 %) than that treated with the plant extract (garlic oil) (48.69 and 53.75 %) and entomopathogenic fungi (*N. rileyi)* (17.95and 20.63 %). Data presented in this investigation indicated that the entomopathogenic fungi (*N. rileyi)* had least harmful effect on entomophagous insect populations which were significantly lower than those counted in control. The safety of bacterial insecticides to insect parasitoids was mentioned by Dunbar *et al.*, (1973); Kares (1991); and to insect predators by Burges and Hussey (1971); Johanson (1974) and Abd El-Gawad (2000).On the contrary, chemical insecticidal applications reduced, significantly the numbers of predaceous and parasitic species than all other treatment. Similar effect were previously recorded by Shalaby *et al.*, (1986); Kares *et al.*, 1988 and Kares 1990; El-kholy (2001) and El-kholy and Omar (2001).

4- The yield in the experimental field:

Results presented in (Fig. 7) revealed that sugar-beet roots yield was affected by the tested three treatments. The treatment with chemical insecticide at the recommended dose gave the highest rate of sugar-beet roots yield followed by plant extract and entomopathogenic fungi at each of Kafr El – Sheikh and Gharbia governorates during 2006 and 2007 seasons.

SUMARY

A plant extract (pure garlic oil); chemical insecticide (Selecron 72 % EC) and entomopathogenic fungus (*N. rileyi)* were evaluated against the tortoise beetle, *C. vittata* (larvae and adults) and the gelechiid rib miner, *S. ocellatella* larvae. Five serial concentrations of 0.25, 0.5, 1.0, 2.0 and 4.0 % for plant extract; 0.5, 1.0, 1.5, 2.0 and 2.5 % for chemical insecticide and 10^4, $5x10^4$, 10^5, $5x10^5$ and 10^6 spores/ ml for entomopathogenic fungus were tested. The obtained data showed that chemical insecticide was more toxic than that of plant extract. Also these larvae and adults were susceptible to fungal infection. Besides, as the concentrations of the fungus *N. rileyi* increased, the larval and adult moralities were also increased. Larvae were the most susceptible to the fungus followed by adults. Three treatments as field applications with the plant extract (pure garlic oil) at rate of 2 % and recommended dose of chemical insecticide (Selecron 72 % EC) (750 ml/feddan) were applied once spraying, but the entomopathogenic fungus (*N. rileyi)* was sprayed 4 times at 15-days intervals by the rate of 10^7 spores / ml for controlling the tortoise beetle, *(C. vittata)* and the gelechiid rib miner, (*S. ocellatella).* Spray was conducted during 2006 and 2007 seasons showed efficacy against the tortoise beetle and the gelechiid rib miner and their associated predators (*Coccinella udecimpunctata* L., *Chrysoperla carnea* Steph., and *Paederus alfierii* Koch.) and the parasitoids (*Monorthochaeta niger* and *Agathis* sp.).

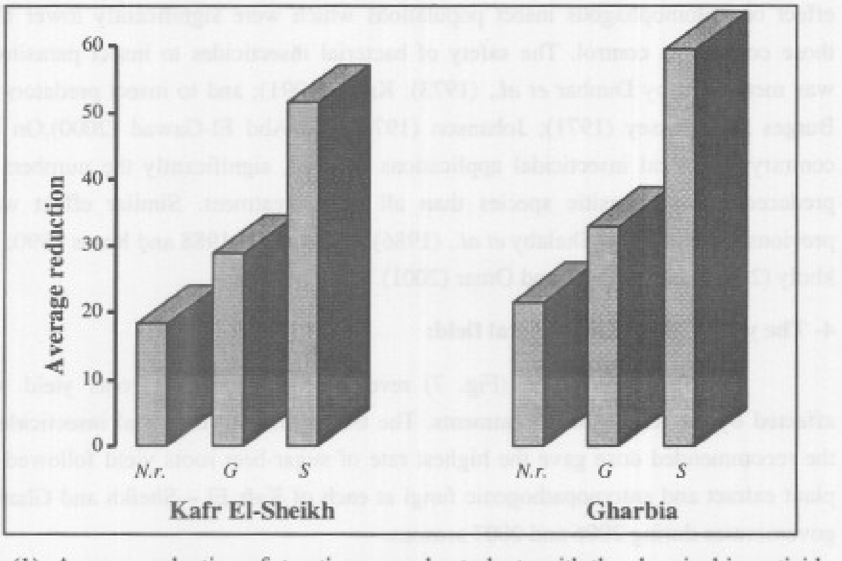

Fig.(1): Average reduction of treating sugar-beet plants with the chemical insecticide, plant extracts and the entomopathogenic fungi on the population density of *C. vittata* larvae in kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons.

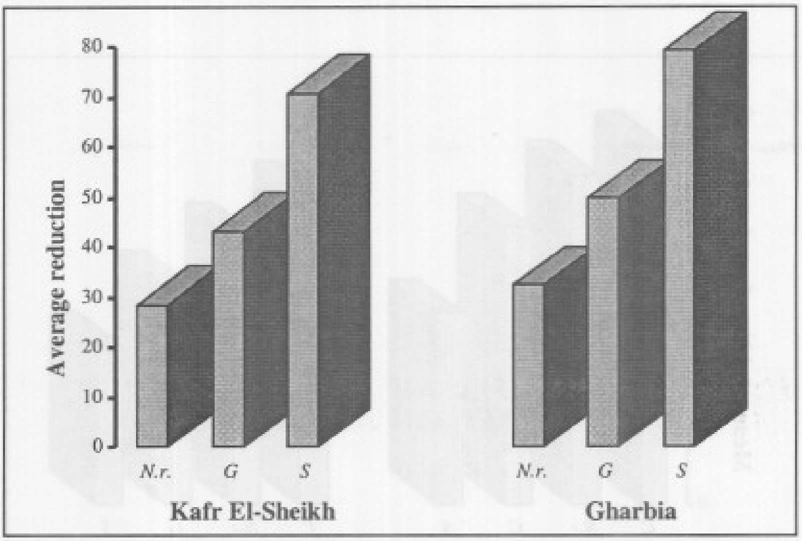

Fig.(2): Average reduction of treating sugar-beet plants with the chemical insecticide, plant extracts and the entomopathogenic fungi on the population density of *C. vittata* adults in Kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons.

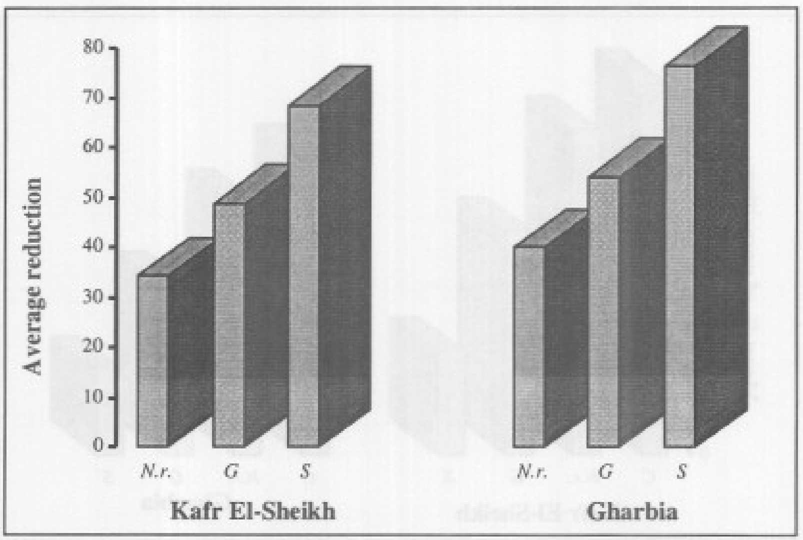

Fig.(3): Average reduction of treating sugar-beet plants with the chemical insecticide, plant extracts and the entomopathogenic fungi on the population density of *S. ocellatella* larvae in Kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons.

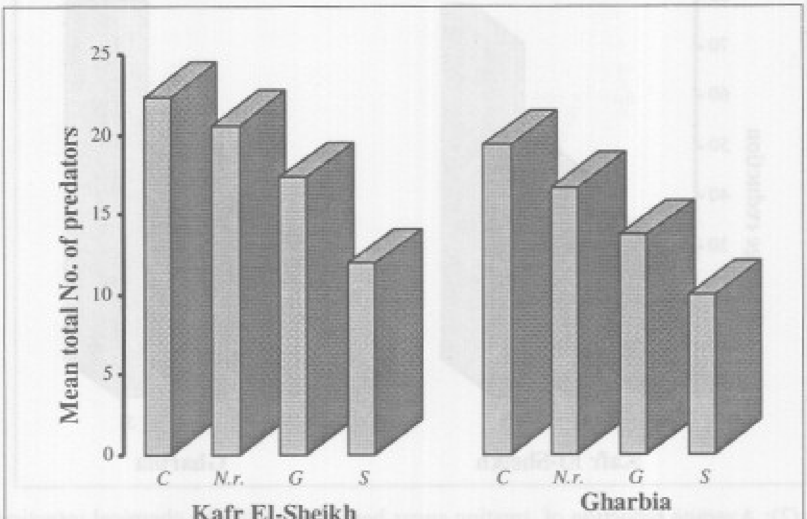

Fig. (4): Mean total numbers of predators in experimental treatments counted from Kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons.

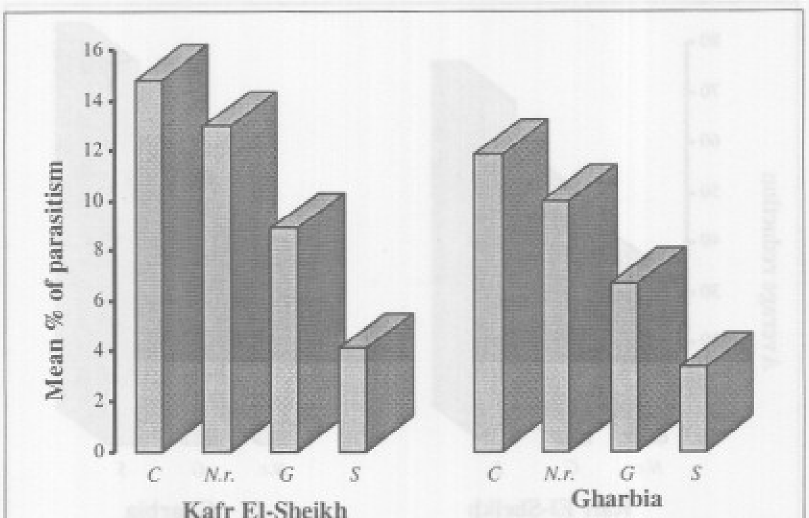

Fig. (5): Mean percentages of parasitism by *Monorthochaeta niger* on *C. vittata* eggs Collected from Kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons.

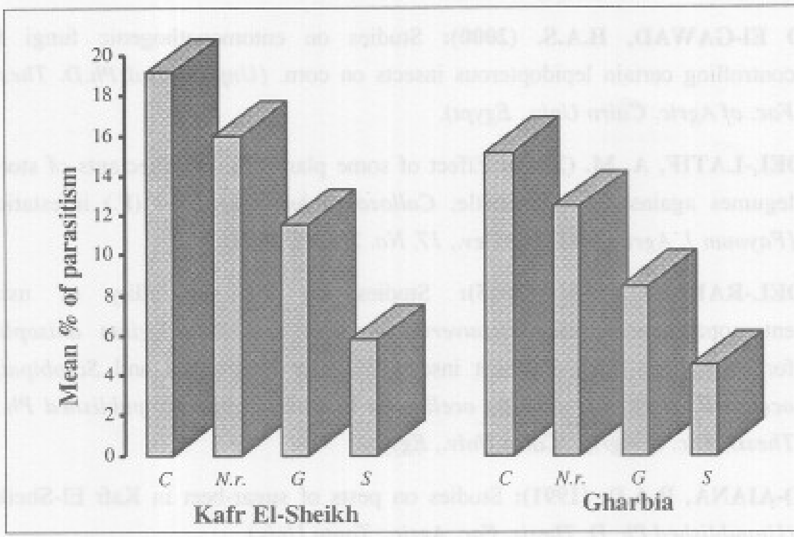

Fig. (6): Mean percentages of parasitism by *Agathis* sp on *S. ocellatella* larvae collected from Kafr El – Sheikh and Gharbia governorates during 2006 and 2007 seasons.

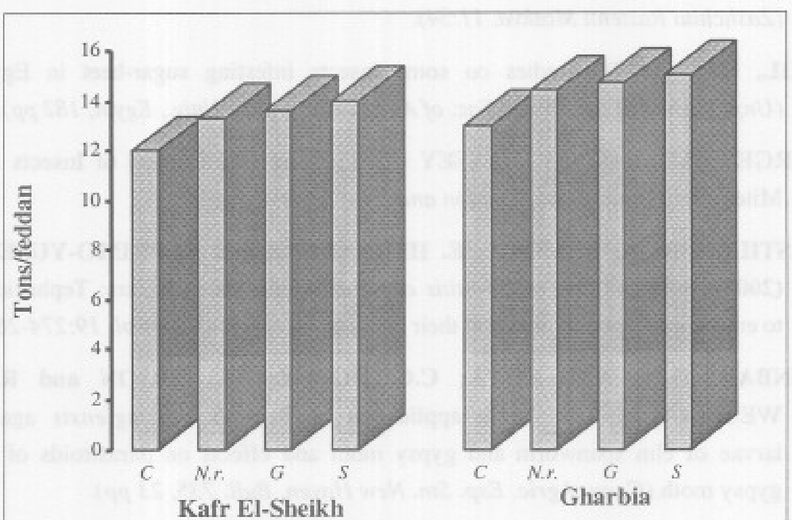

Fig. (7): Yield of sugar-beet roots (tons/feddan) in three treatments in Kafr El-Sheikh and Gharbia governorates during 2006 and 2007 seasons

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