LABORATORY EVALUATION OF FOUR STRAINS OF PATHOGENIC NEMATODE SPECIES ON MAJOR INSECT PESTS OF SUGAR BEET.

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ABSTRACT

Evaluation of the entomopathogenic nematodes species, *Steinrnmema rarum, Steinrnmema carpocapsae* (Sc), *Steinrnmema spp* (S6) and *Heterorhabditis* spp (HLs) against the prepupae and pupae of *Pegomya mixta*, larvae and pupae of *Lixus junci* and *Hymenia recurvalis* was carried out at 25 °C and 65% R.H.

Concentration 500 and 250 IJs/ ml were tested and the results indicated that the mortality rate increased with increased dosage of nematodes. The highest mortality was 62.5% for (*S6*) and (*Sc*) against prepual stage of *P. mixta* at 250 IJs/ml, while it was moderate mortality was for *S. rarum* and HLs. The highest mortality of *S. rarum* was against pupal stage for some concentrations and other treatments gave moderate mortality, compared with the control. Also, the mortality percentages were the same for all treatments against prepual and pupal stages at 500 IJs/ml, except for (S6) treatment with 92.5% mortality at the same concentration.

All nematode species tested gave complete mortality (100%) for *L. junci* larvae when applied at either 500 or 250 IJs/ml.

Key words: Laboratory studies; Pathogenic nematode; Insedt pests and Sugar beet.

INTRODUCTION

Sugar beet is an important crop for sugar production, providing approximately a third of all sugar consumed in the world and almost 50% of U.S. sugar production. In addition, the pulp and molasses of sugar beet are widely used as feed supplements for livestock. This economically important plant is subject to attack by more than 150 species of insects and mites (Harry Lange, 1987). Although conventional pesticide application has been effective for the majority of the pests, many of these toxic chemicals are expensive and may be persistent in the environment

As reported by **Guirguis**, 1985 and Ali *et al.* 1993 sugar beet, *Beta vulgaris* L. is one attractive crop to many pests such as *Hymenia recurvalis*, *Pegomya mixta* and *Lixus junci* Boh, due to its prolonged growing season. These pests are responsible for reducing sugar production. Guirguis in Egypt.

Therefore, it was necessary to apply biological pest management using entomopathogenic nematodes that have been registered to be ecologically safe and risk free (**Bedding** *et al.*, **1996 and El-Deeb** *et al.*, **2004**). A large complex of insect pests are found in sugar beet ecosystem whatever the crop is grown. The Hawaiian beet web worm, *Hymenia recurvalis*, (Fab.), the beet fly, *Pegomya mixta* and the beet weevil, *Lixus junci* Boh. are the most important insect pests at Fayoum Governorate (**Hussien**, **2001 and 2005**).

The present study was carried out to evaluate effect of entomopathogenic nematodes against the above mentioned insects. These nematodes are *S6*, *Ss*, *S. ratum* and HLs.

Hussein, S.H.A. et al.,

MATERIALS AND METHODS

Three Steinernematids and one Heterorhabditis entomopathogenic nematode strains were obtained from the Insect Physiology Lab., Plant Protection Research Institute, Dokki, Egypt. *Steinrnmema rarum*, S. *carpocapsae* (Sc) (original from Florida, USA), and *Steinrnmema* spp (S6) and *Heterorhabditis* spp (HLs) isolated from soil taken from EL-Kasaseen ,Ismailia Governorate. The nematodes were reproduced in *vivo* on larvae of the wax worm *Galleria mellonella* L. and maintained in the laboratory using the method of **Woodring and Kaya**, 1988. These nematodes were tested against three sugar beet pests as follows:

1-Pegomya mixta:-

Larva were collected from field infestation of sugar beet plants at EL-Hadkh village, Fayoum Governorate, Egypt. These larvae were placed in plastic cups (10 larvae /cup) on 20 gm of moistened sterilizer soil and transferred to the laboratory.

New larval stage of *P. mixta* were treated with nematodes (Sc. S6, *S. rarum* and HLs at two concentrations (i.e. 250 and 500 IJs ml). Treatments were replicated four times and mortality of the pre-pupa and pupa were calculated after four days.

2- Lixus junci:

These larvae were collected from the necks of infested leaves of sugar beet plants, transferred to the lab., and subjected to two concentrations (500 and 250 IJs/ml) of the chosen nematodes. Mortality of larvae and pupae were calculated after four days of treatments.

3- Hymenia recurvalis:

Seedlings of sugar beet were transported in plastic cups to the lab. Artificial infestation using five larvae $(4^{\text{th}} \text{ instar})$ on each seedling. Each treatment was replicated four times. Seedlings were sprayed by two nematode strains, i.e. Sc and *S. rarum*, at two concentrations 500 and 250 IJs/ml by a handle machine gun. The mortality percentages were calculated by Abbott formula, 1925.

RESULTS AND DISCUSSION

1- The effect of SC, S6, HLs and S. rarum on pre-pupal and pupal stages of *Pegomia mixta*:

The results presented in Table (1) and Fig.(1 & 2) revealed that all the nematodes tested were effective on pre-pupal and pupal stages at two concentrations (500 and 250 IJs/ml). The nematode Sc and S6 strains were more effective on prepupa at 250 IJs/ml concentration 62.5% mortality, while, the same strains were less effective on the pupal stage showing 35 and 37.5% mortality for strain, respectively. The nematode *S. rarum* was more effective, however, with 65% mortality at the same concentration.

On the other hand, all tested nematodes gave higher mortalities of prepupae and pupae at 250 IJs/ml concentration. The results showed that S6 strain was more effective against prepupae at concentration 500 IJs/ml, with 9205 % mortality against the two stages of this insect.

These results suggest that most of the nematode species can be used for controlling *P. mixta* when used at 500 IJs /ml concentration.

LABORATORY EVALUATION OF FOUR STRAINS OF

 Table (1): Mortality of prepupal and pupal stages of *P. mixta* treated with four nematode strains

108

	Concentrations											
Nematode species		250 I.	500 IJs/ml									
	PrepupalStage		Pupal stage		Prepupal Stage		Pupal stage					
	Dead	%	Dead	%	Dead	%	alive	Dead	%			
		Mortality		Mortality		Mortality			Mortality			
SC	25	62.5	14	35	17	67.5	27	13	32.5			
S6	25	62.5	15	37.5	37	92.5	37	3	7.5			
HLs	18	45	22	55	16	40	16	24	60			
S. rarum	12	30	26	65	14	35	14	26	65			
Control	3	7.5	2	5.0	3	7.5	38	2	5.0			

• Nuber of tested larvae = 40 / treatment.



Fig.(1): Effect of different concentrations of entomopathogenic nematode strains on pre-pupal stage of *Pegomya mixta*.



Fig.(2): Effect of different concentrations of entomopathogenic nematode strains on pupal stage of *Pegomya mixta*.

Hussein, S.H.A. et al.,

2- The effect of SC, S6, HLs and S. rarum on pre-pupal and pupal stages of *Lixus junci*:

Data obtained showed that all nematode strains gave complete mortality 100% for *L. junci* larvae when applied at 500 or 250 IJs/ml concentrations.

3- The effect of SC, S6, HLs and S. rarum on pre-pupal and pupal stages of *Hymenia recurvalis:*

Data presented in Table (2) and Fig. 3 indicated that the highest percent of reduction for *H. recurvalis* larvae, 18% and 19%, resulted from using 500 and 250 IJs/ml concentrations of *Sc*, respectively. On the other hand, *S. rarum* strain gave 80 and 60% mortality at same concentrations, respectively.

The obtained results indicates that the nematodes species chosen can be used for controlling *P. mixta*, *L. junci* and *H. recurvalis*, at concentration not less than 250 IJs/ml.

Generally, the entomopathogenic nematode strains were effective against *L. junci* larvae and *H. recurvalis* under laboratory conditions. The four nematode strains were able to kill larvae of *L. junci* before developing into pupae. This finding is in full accordance with **Saleh**, **1995**, **Bader El-Sabah and Azazy**, **2004.** Similar results were reported by **Azazy and Gehad** (**2005**) that the reduction of *H. undelis* was 96.2, 94.5 and 79.5% for Sr. Hbs1, and Sc., respectively.

 Table (2): Effect of direct spray by different nematodes on sugar beet plants infested by Hymenia recurvalis.

	Species									
Concentrations		SC		S. rarum						
IJs/ml	Dood	%	%	dood	%	%				
	Deau	Mortality	Reduction	ueau	Mortality	reduction				
500	19	95	94.7	16	80	-				
250 20		100	100	12	60	-				
Control	1.0	5	-	0.0	0.0	-				

• Number of larvae = 20 /treatment



Fig.(3): Effect of different concentrations of nematodes strains on *H. recurvalis*.

LABORATORY EVALUATION OF FOUR STRAINS OF

The results according with Azazy and Gehad, (2005) show that the mortality of *H. undelis* was 96.2, 94.5 and 79.5% for Sr. Hbs1, and Sc., respectively and was 79.4, 72.2 and 57.7% for *Artogia rapae* treated with Hbs1, Sr and Sc, respectively. Also, nematodes have been applied successfully against soil inhabiting insects (as soil application) as well as above-ground insects (foliar spray) in cryptic habitats (Arthers *et al.*, 2004; Shapiro-Ilan *et al.*, 2006). Most nematodes were more virulent to larvae than to pupae. Adults were less susceptible to nematodes than other stages, and adult males were more susceptible than females. Under field conditions *S. carpocapsae* and *H. bacteriophora* reduced weevil densities up to 83% and 81% on plants treated with the two species, respectively (Jansson *et al.*, 1990). Richter & Fuxa (1990) reported 33-43% infection of *S. frugiperda* by *S. carpocapsae* in corn field. They also found that spraying of nematodes onto corn ears caused up to 71% infection of *S. frugiperda* and they concluded that *S. carpocapsae*, *S. riobrave*, and *H. megidis* have potential for controlling *S. frugiperda*.

The great advantages of using entomopathogenic nematodes as biopesticides for insect pest control are in operator and end-user safety, absence of withholding periods, the advantage of minimizing the treated area by monitoring insect populations, minimal harm to natural enemies and lack of environmental pollution.

In summary, the present results encourage further studies to evaluate possible integration of potential entomopathogenic nematode species in control programs against the pest insects in the field, especially for sugar beet production.

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Hussein, S.H.A. et al.,

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التقييم المعملي لللنيماتودا الممرضة على بعض الحشرات التي تصيب بنجر السكر سيد حسين احمد حسين – ابراهيم عبدالحميد الصباغ – احمد محمد عزازي معهد بحوث وقاية النباتات – الدقى – مركز البحوث الزراعية

تم التقييم المعملي للنيماتودا الممرضة على أطوار مختلفة لبعض حشرات بنجر السكر تحت ظروف معملية من درجة حرارة ٢٥ م ورطوبة نسبية ٦٥%.

تم استخدام تركيزين من النيماتودا الممرضة وهي ٥٠٠، ٢٥٠ وحدة لكل مل تحت مسمى HLs, S. rarum, S.carpocapsae, S6 على أطوار ما قبل العذراء والعذراء لحشرة ذبابة البنجر ، يرقات سوسة البنجر وحشرة خنفساء البنجر

ولقد أفادت النتائج المتحصل عليها بأن نسبة الموت تزداد بزيادة الجرعة وكذلك فان نسبة الموت ارتفعت لتصل إلى ٢٠.٥% وذلك لكل من طور ما قبل العذراء لحشرة ذبابة البنجر خلال التركيز ٢٠٠ وحدة /مل للأنواع SC, S6 بينما كانت نسبة الموت متوسطة على باقى الأنواع لنفس

التركيز (٢٥٠ وحدة). وقد لوحظ أن نسبة الموت ارتفعت في طور العذراء لنفس الحشرة (ذبابة البنجر) بواسطة النوع S. rarum ولكن كانت نسبة الموت متوسطة مع باقى الأنواع بمقارنتها بغير المعامل. وعند التركيز ٥٠٠ وحدة وجد أن أعلى نسبة موت كانت ٥٠٢ % للنوع 65 على طور ما

قبل العذر اء والعذر اء لنفس الحشر ة.

ولقد وضحت النتائج أن هذه السلالات الممرضة أثرت تأثيرا بالغا على كل من يرقات سوسة البنجر وكذلك خنفساء البنجر