J. Agric. Sci. Mansoura Univ., 29 (1): 443 - 449, 2004

EFFICACY OF THE BACTERIUM *Bacillus thuringiensis* (Berl.) AND THE FUNGUS, *Beauveria bassiana* (Bals.) AS BIOLOGICAL CONTROL AGENTS AGAINST SOME SUGAR-BEET INSECTS IN THE FIELD AT KAFR EL-SHEIKH DISTRICT

Metwally, M. M. *, H. M. Mansour* and G. A. Shalaby**
***Plant Protection Research Institute, A.R.C. Giza, Egypt.**
**** Sugar Crops Research Institute, A.R..C. Giza, Egypt**

ABSTRACT

Field experiments were conduced in 2001/02 and 2002/03 sugar-beet seasons at Sakha Agric. Res. Station aiming to study the efficacy of the bacterium, *Bacillus thuringiensis* (Berl.) and the fungus, *Beauveria bassiana* (Bals.) against some sugar-beet insects. Insect population of sugar-beet mining moth, *Scrobipalpa ocellatella* (Boyd.) was reduced by 36.32 and 42.13% twenty days after treatment when Dipel 2x was applied at a rate of 2.5 g/l. in season 2001/02 and 2002/03, respecitlvey. More reductions were recorded using the fungus (Biofly) at a rate of 3 x 10^7 conidia/ml which gave 43.63 and 47.91%, twenty days after treatment in the two seasons, respectively. Reduction in the number of larvae and pupae of the sugar-beet fly, *Pegomyia mixta* (Vill.) were 37.26 and 47.75 by using Dipel 2x while, applying the plants by the fungus gave more reduction, 42.27 and 57.16%, in season 2001/02 and 2002/03, respectively. However, no significant differences in insect reductions were found between the two in biocides. Field experiments indicated that *B. thuringiensis* (Dipel 2 x) and *B. bassiana* (Biofly) could be used efficiently against *S. ocellatella* and *P. mixta* in sugar-beet fields.

Obtained results clearly indicated that the tortoise beetle, *Cassida vittata* (Vill.) is not sensitive to *B. thuringiensis* and *B. bassiana* throughout the period of study. Spraying of *B. thuringiensis* gave 14.91 and 16.42% reduction and *B. bassiana* gave 22.53 and 19.97% reduction in the two seasons, 2000/02 and 2002/03, respectively.

INTRODUCTION

Sugar-beet and sugar-cane are the two main sugar crops in Egypt and the world. Sugar-beet, *Beta vulgaris* L. is planted in Egypt in about 135.623 feddans and about 54.8% of this area is concentrated at Kafr El-Sheikh Governorate (Egyptian sugar crops Council, 2000). This crop is subjected to infestation with various insect pests which cause considerable damage to the plants (Hammad, 1956; Hafez *et al.*, 1970; Hosny *et al.*, 1983; Abo Saied Ahmed, 1987; Abo Aiana, 1991; Abd El-Ghany, 1995; Abd El-Kareim and Awadalla, 1998; El-Khouly, 1998; Talha, 2001 and Shalaby, 2001).

Sugar beet mining moth, *Scrobipalpa ocellatella* (Boyd.), sugar beet fly, *Pegomyia mixta* (Vill.) and sugar beet beetle, *Cassida vittata* (Vill.) were found to be the most abundant insects in sugar beet fields at Kafr El-Sheikh region (Metwally *et al.*, 1987). These insects can cause a significant decrease in plant foliage, root yield and root sugar content (Hosny *et al.,* 1983 and Abo-Saied Ahmed, 1987).

The idea of insect pest control using micro-organisms, so called microbial control, dates back to the middle last century (Steinhaus, 1949). Recently, studies on applied control of insects by entomogenous bacteria, viruses and fungi have received a considerable attention (Jagues, 1970; Smith and Prior, 1980; Mulla *et al.,* 1982; Wulf, 1983; Tuan, 1995; Gomaa, 1998 and Metwally, 2000).

The present study was carried out for two successive seasons; 2001/02 and 2002/03 at Sakha Agric. Res. Station under field condition to evaluate the efficacy of the fungus, *Beauveria bassiana* (Balsamo) (under the commercial name Biofly) and the bacterium, *Bacillus thuringiensis* (Berl.) (Dipel 2x) to control sugar-beet mining moth; *S. ocellatella*, sugar beet fly, *P. mixta* and sugar-beet beetle, *C. vittata*.

MATERIALS AND METHODS

Efficacy of two biocide preparations were tested under field condition against sugar-beet insects in 2001/2002 and 2002/2003 seasons. These are Dipel 2x (6.4% WP, 32000 IU) having *Bacillus thuringiensis* and Biofly (3 x 10^7 conidia/ml) having *Beauveria bassiana*. The experimental field was divided into 9 plots (3 treatments x 3 replicates), each plot measured 1/50 fed. Raspoly sugar beet variety was sown on 15 November in both seasons and all agricultural practices were followed without insecticides. When sugar beet plants reached 4 month-old, the plants were treated with Dipel 2x at a rate of 2.5 g, and Biofly at a rate of 3 x 10^7 conidia/ml, using CP_3 Knapsack sprayer.

The efficacy of treatments was based on the number of survived larvae and pupae of *S. ocellatella* and *P. mixta* and larvae, pupae and adults of *C. vittata* on 10 plants/plot at 5, 10, 15 and 20 days after application compared with the control.

Reduction percentages in population densities were calculated according to Abbott equation (1925). Statistical analysis of variance were done after Duncan (1955) and Snedecor, 1956).

RESULTS AND DISCUSSION

1. Sugar-beet mining moth, *Scrobipalpa ocellatella* (Boyd.):

Data in Table (1) show the reduction of *S. ocellatella* larvae and pupae after treating sugar-beet plants with the bacterium, *B. thuringiensis* (2.5 g/l) in season 2001/02 ranged from 25.91 to 51.23% with average reduction of 36.32% reduction. Treating the plants with the fungus, *B. bassiana* with a concentration of 3 x 10^7 conidia/ml caused higher effect, as the fungus was capable of reducing the population densities by 33.71, 57.31, 43.28 and 40.22%, 5, 10, 15 and 20 days after treatment with an average of 43.63% reduction.

Table (1): Effect of treating sugar-beet plants with *B. thuringiensis* and the fungus, *B. bassiana* on the population density and the percentage of reduction of *S. ocellatella* larvae and pupae.

Year	Treatment	No. of insects/10 plants at days after application								Average reduction
		5		10		15		20		
		No.	Reduction %	No.	Reduction %	No.	Reduction %	No.	Reduction %	
	Control	23.66 a	-	21.33 a	-	25.99 a	-	23.31 a	-	-
	2.5 g/l *B. thuringiensis*	17.13 b	25.91	12.22 b	51.23	18.66 b	35.99	17.31 b	32.14	36.32
2001/02	3 x 10^7 conidia/ml *B. bassiana*	15.91 c	33.71	9.55 c	57.31	13.39 c	43.28	14.62 b	40.22	43.63
	Control	14.31 a	-	19.22 a	-	23.32 a	-	21.34 a	-	-
	2.5 g/l *B. thuringiensis*	11.66 b	29.21	10.26 b	43.22	11.22 b	52.92	10.29 b	43.18	42.13
2002/03	3 x 10^7 conidia/ml *B. bassiana*	9.99 b	32.33	8.36c	51.92	10.21 b	56.23	9.97 b	51.10	47.91

In a column means followed common letter are not significantly different at the 5% level by DMRT.

In 2002/03, the effect of treating the sugar beet plants with *B. thuringiensis* ranged from 29.21 to 52.92 with an average reduction of 42.13%, while the fungus gave more effect, ranging between 32.33 to 56.23% with an average of 47.91%.

These results are in agreement with those of El-Sufty (1978) and Mansour (1999) as they found that *B. bassiana* was effective against *Scrobipalpa ocellatella* and caused a significant reduction in larval population

2. The sugar beet fly, *Pegomyia mixta* (Vill.):

Table (2) revealed that application of Dipel 2x was effective and reduced the population density of larvae by an average of 37.26% whereas Biofly gave 42.27% reduction in the first season 2001/02. In 2002/03 season, both Dipel 2x and Biofly were more effective and caused higher reduction; 47.75 and 54.16%, respectively. The higher reduction occurred between 10^{th} and 15^{th} days after treatment. Comparing these results with those obtained for the beet mining moth, it appears that the two biocides are more effective against *P. mixta* than *S. ocellatella*. However, control of the two insects by these biocides was satisfactory.

The above results are in agreement with those of Mansour (1999) and Shalaby (2001) in a similar study, as they found that the biopreparations of the two compounds were effective against *P. mixta* and caused a significant reduction.

3. The tortoise beetle, *Cassida vittata* (Vill.):

Data in Table (3) indicate that treating sugar beet plants by the bacterium gave 14.91% as an average reduction in 2001/02, while, the fungus gave 22.53%. These results are insufficient when compared to those of *S. ocellatella* and *P. mixta*.

Data of 2002/03 took nearly the same trend. The reduction in *C. vittata* population was low; 16.42, 19.97% when the bacterium and the fungus were applied at concentration of 2.5 g/L, 3 x 10^7 conidia/ml, respectively.

Abo-Aiana (1991) indicated that the fungus, *B. bassiana* was not virulent against *C. vittata* larvae, since larval mortality ranged between 4.4 and 26.8% depending on the fungus concentration.

El-Khouly (1998) evaluated the efficacy of Dipel 2x against different stages of *C. vittata* and found that Dipel 2x reduced the egg population by 49.39 two days after application. In a similar study, Shalaby (2001) found that Dipel 2x reduced *C. vittata* by 27.78%.

These results are promising in controlling these key pests of sugar-beet plants. Furthermore, using these biocontrol agents are safe to human-beings, animals and environment. On the other hand, biocides are less harmful to natural enemies than insecticides (Metwally, 2000 and Shalaby, 2001).

Table (2): Effect of treating sugar-beet plants with, *B. thuringiensis* and the fungus, *B.bassiana* on the population density and the percentage of reduction of *P. mixta* larvae and pupae.

Year	Treatment	No. of insects/10 plants at days after application								Average
		5		10		15		20		reduction
		No.	Reduction %	No.	Reduction %	No.	Reduction %	No.	Reduction %	
	Control	25.24 a	-	28.62 a	-	25.64 a	-	23.31 a	-	-
2001/02	2.5 g/l *B. thuringiensis*	20.35 b	13.14	13.13 b	49.52	14.11 b	38.36	1297 b	48.03	37.26
	3 x 10^7 conidia/ml *B. bassiana*	19.29 b	22.22	12.92 b	52.33	11.00 c	43.22	10.29 b	51.33	42.27
	Control	25.92 a	-	24.34 a	-	28.92 a	-	26.90 a	-	
2002/03	2.5 g/l *B. thuringiensis*	21.02 b	16.92	9.31 b	56.62	8.18 b	59.26	10.22 b	58.22	47.75
	3 x 10^7 conidia/ml *B. bassiana*	20.19 b	18.98	8.33 b	72.22	4.22 c	64.22	11.00 b	61.23	57.16

In a column means followed common letter are not significantly different at the 5% level by DMRT.

Table (3): Effect of treating sugar-beet plants with *B. thuringiensis* and the fungus, *B. bassiana* on the population density and the percentage of reduction of *C. vittata* larvae and pupae..

Year	Treatment	No. of insects/10 plants at days after application								Average
		5		10		15		20		reduction
		No.	Reduction %	No.	Reduction %	No.	Reduction %	No.	Reduction %	
	Control	253.62 a	-	269.06 a	-	277.31 a	-	270.0 a	-	-
2001/02	2.5 g/l *B. thuringiensis*	223.61 b	12.31	210.22 b	15.91	200.60 c	18.22	240.66 c	13.22	14.91
	3 x 10^7 conidia/ml *B. bassiana*	211.02 c	19.22	198.22 c	23.33	165.00 d	26.31	200.67 d	21.29	22.53
	Control	205.91 a	-	210.31 a	-	225.22 a	-	240.62 a	-	-
2002/03	2.5 g/l *B. thuringiensis*	185.66 b	8.20	1789.33 c	19.22	189.31 b	20.33	190.55 c	17.93	16.42
	3 x 10^7 conidia/ml *B. bassiana*	180.31 c	6.28	155.33 d	23.34	143.66 c	26.34	168.09 d	23.92	19.97

In a column means followed common letter are not significantly different at the 5% level by DMRT.

REFERENCES

Abbott, W.S. (1925). A method for computing the effectiveness of an insecticide, J. Econ. entomol, 18: 265-267.

Abd El-Ghany, M.A. (1995). Studies on the beet moth, *Scrobipalpa ocellatella* Boyd. a t K afr E l-Sheikh r egion. M .Sc. T hesis, F ac. o f A gric., Tanta Univ.

Abd El-Kareim, A.I. and S.S. Awadalla (1998). Mortality factors and life-budgets for immature stages of the tortoise beetle, *Cassida vittata* Vill. (Coleoptera: Chrysomelidae). J. Agric. Sci.: Mansoura Univ., 23(7): 3419-3430.

Abo-Aiana, R.. A. D. (1991). Studies on pests of sugar-beet in Kafr El-Sheikh. Ph.D. Thesis, Fac. Agric., Tanta Univ.,

Abo-Saied Ahmed, A. M. B. (1987). Studies on the insects of sugar beet in Kafr El-Sheikh Governorate, Egypt. Ph.D. Thesis, Fac. Agric., Tanta Univ.

Duncan, D. B. (1955). Multiple Range and Multiple F test. Biometrics, II. 42

El-Khouly, M. I. I. (1998). Ecological studies and control of the tortoise beetle *Cassida vittata* Villers in sugar-beet ecosystem. Ph.D. Thesis, Fac. Agric. Al-Azhar Univ.

El-Sufty, R. (1978). Insecticidal activity of a biopreparation of the fungus *Beauveria bassiana* (Bals.) Vuillemin Poverol against the sugar beet mining moth. J. Agric. Res. Tanta Univ., 13(4): 1165-1176.

Gomaa, A.E.A. (1998). Studies on certain insects attacking potato in the field at El-Gharbia Governorate. M.Sc. Thesis, Fac. Agric., Tanta Univ.

Hafez, M.; S. El-Ziady and N.Z. Dimetry (1970). Studies on the bionomics of the beet fly *Pegomyia hyoscymi* in Egypt. Bull. Entomol. Soc. Egypt., 7: 433-449.

Hammad, S. M. (1956). Further additions to the knowledge of some leaf-miners from Egypt. Bull. Entomol. Soc. Egypt., 40: 21-24.

Hosny, K.; S.I.. El-Sherif; A.A. Gaber and H.A. Mesbah (1983). The common harmful pests found on sugar-beet in Alexandria region. Alex. S ci., Exch., 4: 129-134.

Jagues, R. P. (1970). Application of viruses to soil and foliage for control of the cabbage looper and imported cabbage-worm. J. Inverteb. Pathol., 15: 328-340.

Mansour, H.A.M. (1999). Studies on the entomopathogenic fungus *Beauveria bassiana* as a biological control agent for some economic important insects. Ph.D. Thesis, Fac. Agric., Tanta Univ.

Metwally, M. M. (2000). Studies on the important insect pests of maize plants and their natural enemies at Kafr El-Sheikh district. Ph.D. Thesis, Fac. Agric. Tanta Univ.

Metwally, S. M. I.; R. El-Sufty; Nadia El-Dakhakhny and A. Bassouny (1987). Survey and seasonal abundance of insects associated with sugar beet at Kafr El-Sheikh, Egypt. J. Agric. Res., Tanta Univ., 13(4): 1129-1138.

Mulla, M. S.; B. A. Faderici and H. A. Darwazeh (1982). Field evaluation of the microbial insecticide *Bacillus thuringiensis* stereotype H.14 against flood water mosquitoes. Appl. Envrion. Microbial., 43(6): 1288-1293.

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

Smith, E. S. C. and C. Prior (1980). Preliminary note on the use of the entomophagous fungus *Beauveria bassiana* against pentorhytes pests of Cocoa. 3rd Reg. Tech. Meet. Plant Prot. Port Moreby, New Guinea, 36.

Snedecor, G. W. (1956). Statistical methods. Iowa State College press. Ames, Iowa.

Steinhaus, E. A. (1949). Principles of insect pathology. McGraw-Hill Book Comp., Inc., New York, Toronto, London, 757.

Talha, E. A. M. M. (2001). Integrated pest management of sugar-beet insects. M.Sc. Thesis, Fac. of Agric. Mansoura Univ.

Tuan, P. P. (1995). Management of rice bug, *Leptocorisa oratorius* (F.) (Hemiptera: Alydidae) using white muscardine fungus *Beauveria bassiana* (Bals.) Vuill. in upland rice based cropping systems. Ph.D. Thesis, Fac. of Laguna Philippines Univ.

Wulf, A. (1983). Wntersuchungen uberden isnekten pathogenen piez., *Beauveria bassiana* (Bals.) Vuill. als parasit des borkenkalers pityogenes chalcographus L. (Col., Scolytidae). 2 Ang. Ent., 95:34-46.

تقييم فاعلية البكتيريا (باسيلس ثيرونجينسس) وفطر البيوفريا باسيانا كعوامل مكافحة حيوية ضد آفات بنجر السكر الرئيسية حقليا فى منطقة كفرالشيخ

ممدوح محمد متولى* ، حمدى أحمد متولى منصور* ، جمال عبد الجواد شلبى**

***معهد بحوث وقاية النباتات ــ مركز البحوث الزراعية ــ الجيزه ــ مصر**

**** معهد بحوث المحاصيل السكرية ــ مركز البحوث الزراعية ــ الجيزه ــ مصر**

تم تجربة البكتيريا *Bacillus thuringiensis* وفطر *Beauveria bassiana* تحت ظروف الحقل لمكافحة أهم آفات بنجر السكر فى محافظة كفرالشيخ وكانت النتائج المتحصل عليها كالآتى:

فراشة البنجر *Scrobipalpa o cellatella* : فى موسم ٢٠٠٢/٢٠٠١ أدى استخدام المبيد البكتيرى بالتركيز الحقلى الموصى به (٢,٥ جرام/لتر) لخفض تعداد الحشرة على نباتات البنجر بمعدل ٣٦,٣٢% بعد ٢٠ يوما من المعاملة بالمبيد ــ كما أدى استخدام المبيد الفطرى بمعدل ٣ × ١٠ ٧ كونيديا/مل إلى خفض التعداد بمعدل ٤٣,٦٣% فى نفس الموسم.

وفى موسم ٢٠٠٣/٢٠٠٢ كانت النتائج مشابهة للموسم السابق حيث أعطى المبيد البكتيرى خفضا قدره ٤٢,١٣% والمبيد الفطرى ٤٧,٩١% على الترتيب.

ذبابة البنجر *Pegomyia mixta*: أدت المعاملة بالمبيد البكتيرى إلى خفض قدره ٣٧,٢٦% فى تعداد اليرقات فى موسم ٢٠٠٢/٢٠٠١ بعد ٢٠ يوما من المعاملة ــ وفى الموسم الثانى ٢٠٠٣/٢٠٠٢ كانت كفاءة المبيد البكتيرى أعلى حيث أعطت ٤٧,٧٥% ــ بينما عند استعمال المبيد الفطرى كان مقدار الخفض ٤٢,٢٧ ، ٥٤,١٦ فى موسمى ٢٠٠٢/٢٠٠١ ، ٢٠٠٣/٢٠٠٢ على الترتيب.

خنفساء البنجر *Cassida vittata*: انخفض تعداد الآفة فى موسمى ٢٠٠٢/٢٠٠١ ، ٢٠٠٣/٢٠٠٢ بقيم ١٤,٩١% ، ١٦,٤٢% عند استعمال المبيد البكتيرى ، ٢٢,٥٣% ، ١٩,٩٧% عند استعمال المبيد الفطرى خلال الموسمين على التوالى وكانت تلك أقل النتائج بالمقارنة بمكافحة الحشرتين السابقتين.