J. Agric. Sci. Mansoura Univ., 28 (7): 5699 - 5712, 2003

Pulvinaria tenuivalvata (NEWSTEAD) AND ITS NATURAL ENEMIES ON RATOON SUGARCANE IN DAKAHLIA GOVERNORATE

Abdel-Baky, N. F.[1*] and A. H. Abdel-Salam[1] ; H. A. El-Fadaly[2]
[1]Economic Entomology Department, [2]Microbiology Department, Faculty of Agriculture, Mansoura University, Mansoura - 35516; EGYPT.
*** Corresponding Author: nafabdel@mans.edu.eg**

ABSTRACT

This work presents the first report about the incidence of the sugarcane scale insect, *Pulvinaria tenuivalvata* Newstead, in the three different regions of Dakahlia Governorate, Talkha, Mit Gammr, and Dikenis. The experiments were carried out during 2001 and 2002 sugarcane growing seasons in these regions. The results indicate that *P. tenuivalvata* was active throughout July in both seasons until harvest in November. Regarding its natural enemies, only aphelinid parasitoid, *Cocophagous scutellaris* Dalman, the two predatory insects, *Scymnus syriacus* and *Paederus alfierii* and certain entomopathogenic fungi were recorded. The role of the aphelinid parasitoid and *P. alfierii* were highly significant biotic factors in 2001 & 2002 growing seasons, followed by *S. syriacus* and the entomopathogenic fungi. The influence of weather factors on *P. tenuivalvata* population density was also discussed.
keyWords: Sugarcane soft scale insect, *Pulvinaria tenuivalvata*, natural enemies, weather factors, entomopathogenic fungi.

INTRODUCTION

The sugarcane, *Saccharum officinarum* L. is one of the most economic agricultural crops distributed widely all over the world. It is a perennial plant cultivated continuously in the Upper Egypt and be able to infestation with several insect pests such as borers, mealybugs, scale insects, as well as, the plant diseases, wilt, smut and redrot (Ganeshan, 2000 and Pandya, 1997). Maareg *et al.* (1992) reported four scale insects namely, *Alucaspis madiuensis, Odonaspis saccharicaulis, Aclerata takahashii* and *Pulvinaria elongata* attacking sugarcane crop in Alexandria and Upper Egypt. In addition, Ali *et al.* (1997) recorded the sugarcane scale insect, *Saccharolecanium krugeri* (Zehntner) for the first time in sugarcane fields of Giza. According to Ali et al., (2000) *S. krugeri* (Zehntner) was re-identified by Gilber Watson in 2000 as *Pulvinaria tenuivalvata* Newstead. This insect is also considered as an important sugarcane crop pest causing economic loss in both sugarcane quantity and quality (Besheit, *et al.*, 2002; Ghabbour *et al.*, 2001). Williams (1982) mentioned that the sugarcane plants in Mauritius were attacked by *Pulvinaria iceryi* (Sign.) and compared between *P. iceryi* and its allies *P. elongata* Newest., *P. saccharia* De lotto, *P. sorghicola* De Lotto and *P. tenuivalvata*. Since 1996, *P. tenuivalvata* emerged as a chronic pest of sugarcane plants at Giza, Bani Suif, El-Menia and Qena Governorates (Ali *et al.*, 1997; Helmy 2001; Helmy *et al.*, 2001).

This pest attacks the sugarcane leaves only. The high infestation hampers plant photosynthesis, reduces the leaf chlorophyll, gives low cane yield, diminishes the juice quality and decreases monetary returns (Ravindranath & Subbaratnam, 1998).

Pulvinaria tenuivalvata is a polyphagous insect which attacks at least 13 plant hosts (Ali *et al.,* 2000). Beside sugarcane, the insect infested the castor oil (*Rumicis ricini* L.), Cogon grass (*Inperata cylindrica* L.), field bindweed (*Convolvulus arvensis* L.), Giant red (*Arunda donax* L.), Jew's mollow (*Corchorus olitorius* L.), Large crabgrass (*Digitaria sanguinalis* L.), Maize (*Zea mays* L.), Elephant grass (*Pennisetum purpuemum* Schmmach), Okra (*Hibiscus esculenus* L.), Perennial ryegrass (*Lolium perenne* L.), Sorghum (*Sorghum bicolor* L.) and sesipan (*Sesipania* sp.) (Ali *et al.*, 1997 & 2000; Williams, 1982).

The insect affects sugarcane yield more than any other insect pests. In Egypt, Besheit *et al.* (2002) studied the effects of *P. tenuivalvata* on sugarcane yield. They reported that the pest reduced the stalk weight, juice extraction percentage, brix (total soluble solid) cane and juice sugar percentage, juice purity percentage, and sugar yield under severe infestation. Meanwhile in India, the sugarcane yield losses due to infestation with the scale insect, *Melanaspis glomerata* were estimated by Upadhyay & Vaidya, (1994). Moreover, Tripathi *et al.* (1987) referred to the reduction in sugarcane germination due to infestation with *M. glomerata*. Dutta and Devaiah (1992) studied the response of the sugarcane varieties to the scale insect infestation and plant characters. They found a relation between resistance and the combined thickness of the epidermis and collenchyma, or the density of vascular bundles.

The environmental factors are believed to be the key reasons of the high dispersal of sugarcane soft scale insect. For example, Tripathi *et al.* (1985) concluded that the wind is an important factor in the dispersal of the pest. They also found that the nymphs emerging from infested sugarcane pieces become airborne. Environmental factors such as temperature and humidity are important in the buildup of epidemics especially when they occur in conjunction with the use of susceptible varieties, the susceptible stage of the crop deficiencies in plant nutrition and certain cultural methods (David & Alexander, 1987; Rao *et al.*, 1991).

Therefore, this study aims to throw some light on the insect seasonal distribution, the natural enemies associated with insect in sugarcane fields and the role of weather factors.

MATERIAL AND METHODS

The study was carried out in Dekernis region, Dakahlia Governorate, during 2001 and 2002 sugarcane growing seasons. The cultivated area of sugarcane plants in Dekerins region reached 64 Feddans. The plants received normal agronomic practices. The following procedures were applied to study the insect and its natural enemies in untreated fields.

I. Insect Survey:

A. Sugarcane soft scale insect:

The adults and nymphs of the sugarcane soft scale insect *P. tenuivalvata* were counted on 25 plants chosen randomly. The samples were taken from the first of June until harvest in November each year. Six leaves were chosen from different parts of each plant. The leaves were picked out from each plant and kept in paper bags for examination in the laboratory. The numbers of adults and nymphs on both lower and upper leaf surfaces were recorded weekly.

Predators and Parasitoid of the sugarcane soft scale insect:

The predatory insects associated with the experimental insect were estimated by visual examination on 25 plants selected at random.

Pieces of sugarcane leaves infested with the insect (100 individuals) were selected then placed in clear plastic cups and replicated five times in biweekly intervals. The cups were incubated at 30°C till the emergence of parasitoid adults. The parasitoid was counted, recorded and kept for identification.

Entomopathogenic fungi infecting the sugarcane soft scale insect:

The following two procedures were used in fungal isolation (Abdel-Baky, 2000):

1- Naturally infected insect cadavers covered with fungi were collected and placed in petri-dishes containing potato dextrose agar (PDA) medium. The inoculated petri-dishes were incubated at 27±2 °C and 75±5% R. H. until further growth of the fungi. Spores of pure cultures were examined under a compound microscope.
2- predicted insects to be infected due to their abnormal movement were surface-sterilized in a 1-% sodium hydrochlorite solution for 30 seconds and washed in distilled water. The insects were then cultivated in petri-dishes (25 insects/dish) on PDA medium and kept in an incubator under the same conditions. The obtained fungal cultures were identified by Nehal Arafat,

V. Weather Factors:

The effect of the weather factors, minimum and maximum temperatures together with their averages and R.H, that affect the incidence of the insect and its natural enemies were studied. The weather factors data were obtained from the authority of Agriculture at Mansoura.

Statistical Analysis:

The data obtained were subjected to proper Statistical Analysis System (SAS, 1992) through computer program. Simple correlation and regression were estimated also to assess the direct relationship between the tested weather factors and insect populations.

RESULTS

A. Seasonal abundance of *Pulivanria tenuivalvata*:

Figures (1 & 2) show that the insect appeared early in July of 2001 growing season. Meanwhile, in 2002 growing season, it occurred during the 2nd week of August, whereas the insect populations increased till harvest in November each season. These figures also represent the seasonal abundance of the insect, expressed as nymphs and adults, on sugarcane plantations in Dekernis region, Dakahelia governorate during the two successive seasons.

Adult and Nymphal populations:

The adult populations were lower in comparison with the nymphal population (Figs; 1 & 2). In July, the adult numbers differed from 9.24 to 17.40 and from 0.00 to 0.85 individuals/sugarcane leaf during 2001 and 2002, respectively. However, it fluctuated between 9.65 individuals/sugarcane leaf in the 4th week and 22.80 individuals/sugarcane leaf in the 3rd week in 2001 growing season. In 2002 season, it fluctuated between 1.05 individuals/sugarcane leaf in the 1st week to 7.60 individuals/sugarcane leaf in the 4th week. The adult population showed its higher numbers, as a number/sugarcane/leaf, in October in 2001 growing season and November in 2002 season. Moreover, Table (1) indicates that the highest adult number observed during August (15.72±0.89 insect/leaf) and November (20.05±1.26 insect/leaf) and during October (41.17±2.18 insect/leaf) and November (20.09±1.79 insect/leaf) in the two successive years, respectively. The significant differences between adult numbers in both seasons may be clear in the same table.

The nymphal populations were higher by about 6.85 and 4.56 times compared to adults in both 2001 and 2002 growing seasons, respectively (Figs. 1 & 2). In 2001 season, the number of nymphs/ sugarcane leaf varied from 5.53 to 34.65 in July, 37.65 to 111.00 in August, 97.55 to 152.50 in September, 116.91 to 163.75 in October and 135.90 to 162.19 in November. Meanwhile, the nymphal population reached its maximum/ leaf during the 4th October (245.75).

Table (1) also indicates that the insect population varied from month to another during the course of study. The statistical analysis reveals a significant difference in nymphal population among the months. Generally, the insect population followed the same trend, showed its highest records in October and November of both seasons (Figs. 1 & 2).

Table (1): Average numbers of *P. tenuivalvatal* sampling/sugarcane leaf/month during the course of study.

Months	2001 Season			2002 Season		
	Nymphs	Adults	Total	Nymphs	Adults	Total
	Mean number±SE			Mean number±SE		
July	20.48±1.65 e	12.26±1.32 cd	32.74±2.51 d	00.27±0.07 e	0.23±0.05 e	0.48±0.11 e
August	73.10±4.35 d	15.72±0.89 b	88.82±4.48 c	07.84±0.71 d	03.50±0.34 d	11.33±0.97 d
September	127.40±5.25 c	11.33±0.39 c	138.73±5.22 b	37.23±2.45 c	16.38±1.01c	53.59±3.24 c
October	136.51±4.16 b	13.30±0.55 d	149.80±4.31 b	204.38±6.53 a	41.17±2.18 a	245.56±6.87a
November	149.37±9.40 a	20.05±1.26 a	169.41±9.20a	164.44±7.80 b	20.09±1.79 b	.54±8.85 b

[a] **Means within the same row followed by the same letter are not significantly different (P=0.05).**

II. The predatory insects and parasitoid:

Two predatory insects namely, *Paederus alfierii* and *Scymnus syriacus* were associated with *P. tunivalvata* at Dekernis during 2001 & 2002 growing season. *P. alfierii* was the most abundant during the two successive seasons (Figs. 3 & 4), whereas, *S. syriacus* exhibited lower population densities. The populations of both species were lower than the other natural enemies.

The aphelinid parasitoid, *Coccophagus scutellaris* was the only parasitoid attacking nymphs and adult stages in sugarcane fields during 2001 & 2002 growing seasons. The parasitism percentages fluctuated between 5.6 and 26.0% and from 2.8 to 15.205 in 2001 and 2002 (Fig.4) growing seasons, respectively. The higher percentages of parasitism were recorded in the first half of September (21.2%), first half of October (21.2%) and the first half of November (26.0%) during 2001. In 2002 season, these percentages occurred late in October (12.4%), and early in November (15.4%).

The lower percentages were recorded early in July 2001 and during July, August, and September 2002 (Fig.5). The results also indicate that the percentage of parasitism was highly more significant during 2001 growing season than in 2002.

III. The Entomopathogenic Fungi: -

Survey Studies:

Five entomopathogenic fungi were isolated from the nymphs and adults of P. *tunivalvata* during the course of this study. Table (2) gives the names and incidence ratio of the entomopathogenic fungi during 2001 & 2002 growing seasons. It can be noted that *Cladosoprium* spp. was the most dominant fungi, which formed 41.25 & 40.50% in the two successive seasons, respectively. Meanwhile, *Verticillium lecanii* came next with 20.70% in the first season and 19.50% in record. There was no significant difference of the incidence ratios between *V. lecanii* and *Alternaria alternata* giving 21.25 and 15.00% in 2001 and 2002 seasons as shown in Table 2. The other entomopathogenic fungi were *Penicillium* sp. (5.62 & 18.33%) and *Aspergillus falvus* (8.13 & 6.67%) in the two experimental years.

Table (2): Names and incidence percentages of the entomopathogenic fungi isolated from the soft scale insect, *P. tenuivalvata* from sugarcane fields.

Season	Incidence %				
	Cladosporium spp.	*Alternaria Sp.*	*Verticillium lecanii*	*Penicillium sp.*	*Aspergillus flavas*
2001	41.25	21.25	20.75	05.62	11.13
2002	40.50	15.00	19.50	18.33	06.67

It maybe clear in figures 6 that the percentages of entomopathogenic fungi fluctuated between 7.00 and 10.5% and 5.00 to 10.0% in 2001 & 2002 growing seasons, respectively.

Laboratory Bioassay Tests:

Two isolated entomopathogenic fungi namely, *Cladosporium* spp and *Verticillium lecanii* were subjected to bioassay tests in the laboratory. Table (3) shows that both bio-agents were capable to induce more over than 50% mortality four days after treatment.

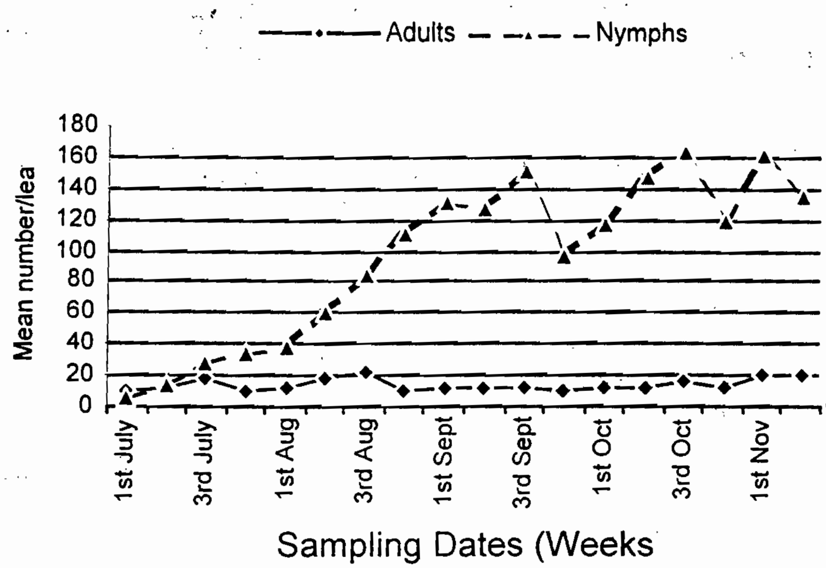

Fig.(1): Seasonal fluctuations of *P. tenuivalvata in sugarcane fields during 2001 growing season.*

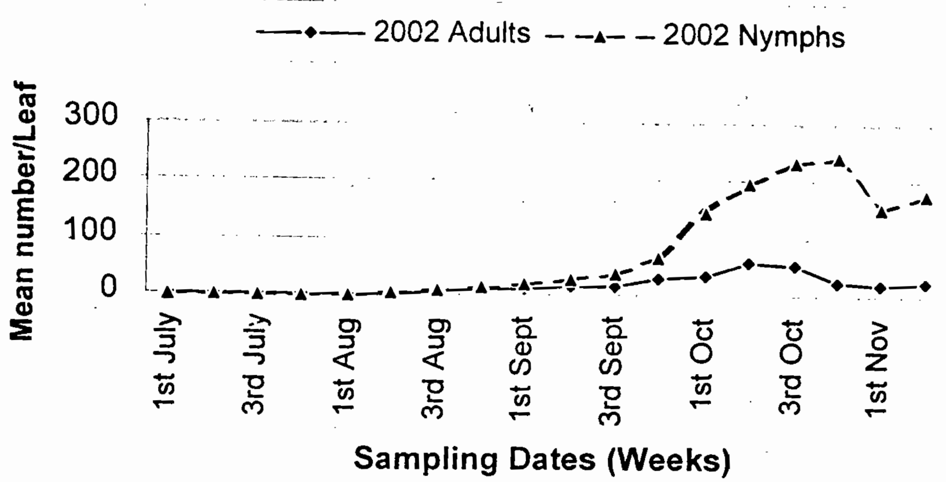

Fig.(2): Seasonal fluctuations of *P. tenuivalvata in sugarcane fields during 2001 growing season.*

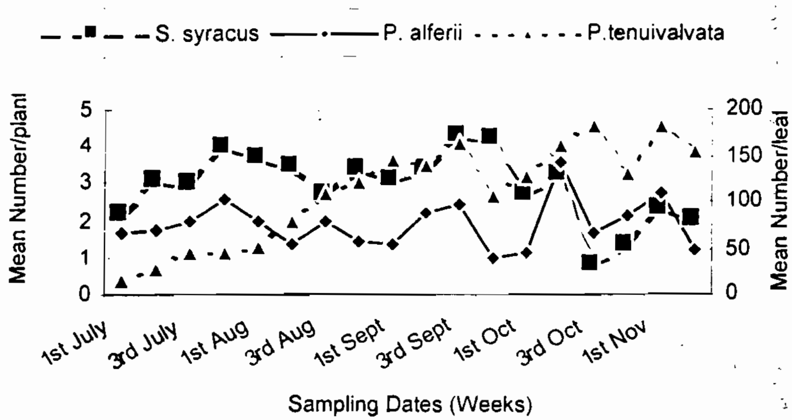

Fig.(3): Population dynamics of *P. tenuivalvata* and two predatory insects in sugarcane fields during 2001 growing season.

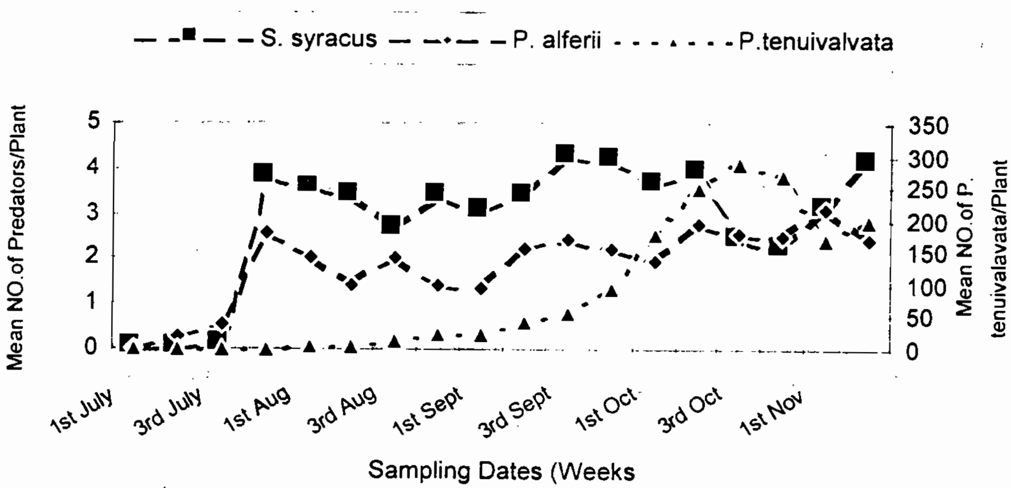

Fig.(4): Population dynamics of *P. tenuivalvata* and two predatory insects in sugarcane fields during 2002 growing season.

Table (4): Correlation coefficients between certain biotic and abotic factors and *P. tenuivalvata* in sugarcane fields in Dakahlia Governortae.

Biotic & Abiotic factors		2001 Season			2001 Season		
		Nymphs	Adults	Total	Nymphs	Adults	Total
Biotic factors	*Scymanus sp.*	0.174* (0.000)**	0.256 (0.000)	0.172 (0.000)	0.042 (0.253)	0.121 (0.001)	0.058 (0.118)
	Paederus alferii	0.365 (0.000)	0.371 (0.000)	0.380 (0.000)	0.193 (0.000)	0.201 (0.000)	0.206 (0.000)
	Cocophagus secutellaris	0.760 (0.000)	0.583 (0.000)	0.758 (0.000)	0.599 (0.000)	0.246 (0.000)	0.578 (0.000)
	Entomopathogenic fungi	0.166 (0.001)	0.206 (0.000)	0.179 (0.001)	0.117 (0.001)	0.117 (0.002)	0.125 (0.001)
Abiotic factors	Maximum Temp.	-0.689 (0.000)	-0.528 (0.000)	-0.686 (0.000)	-0.138 (0.000)	-0.234 (0.000)	-0.163 (0.000)
	Minimum Temp.	-0.628 (0.000)	-0.500 (0.000)	-0.629 (0.000)	-0.346 (0.000)	-0.074 (0.047)	-0.323 (0.000)
	Average Temp.	-0.737 (0.000)	-0.596 (0.000)	-0.740 (0.000)	-0.616 (0.000)	-0.349 (0.000)	-0.610 (0.000)
	Maximum R. H.	0.060 (0.250)	0.112 (0.032)	0.072 (0.170)	-0.163 (0.000)	0.074 (0.000)	-0.134 (0.000)
	Minimum R. H.	0.146 (0.005)	0.047 (0.368)	0.134 (0.010)	0.157 (0.000)	-0.060 (0.000)	0.131 (0.000)
	Average R. H.	0.137 (0.009)	0.053 (0.309)	0.128 (0.015)	-0.0.28 (0.450)	0.055 (0.141)	-0.016 (0.663)

* Means the correlation coefficient value (r)

** When the probability value was equal 0.05 and less to 0.01, this means that the correlation coefficient is significant and when the value reach (000) this means that the r value is highly significant.

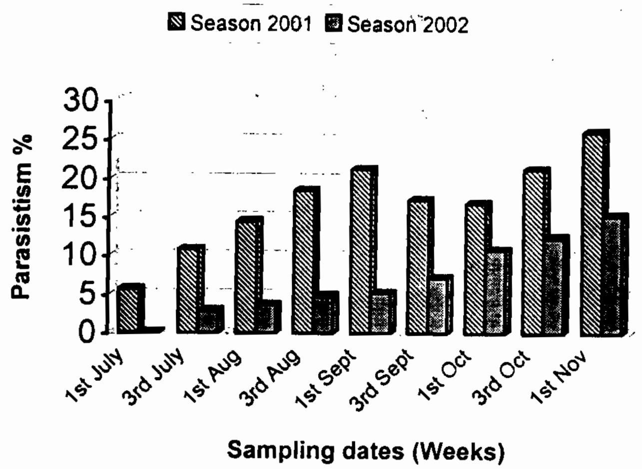

Fig.(5): Percentage of parasitized scales of *P. tenuivalvata* by *Coccophagus* secutellaris in sugarcane fields during 2001 and 2002 growing seasons.

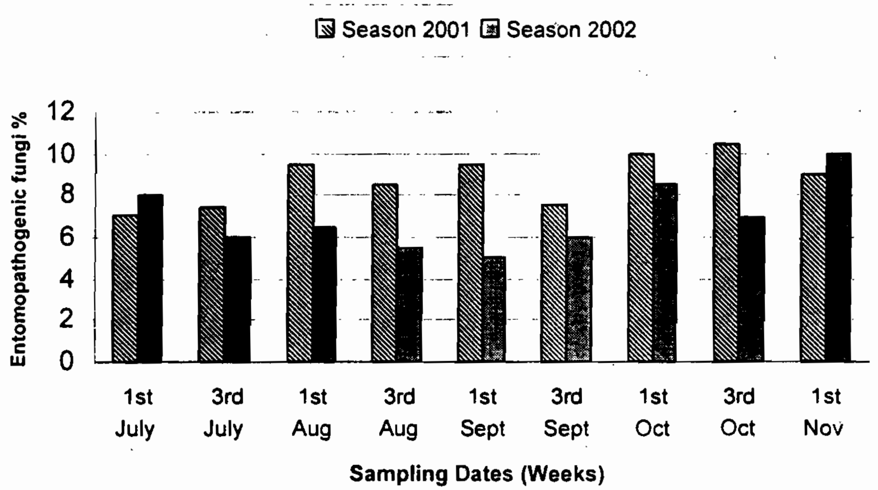

Fig.(6): percentage of the entomopathogenic fungi that detecting parasitism on *P. tenuivalvata* in sugarcane fields during 2001 and 2002 growing seasons.

The mortality percentages of *Cladosporium* spp reached 53.00 and 52.50 at 25°C and 60.00 & 53.33% at 30°C with 6 x 10^6 and 4 x 10^6 concentrations in spores/ml, respectively. Meanwhile, *V. lecanii* caused 49.00 and 63.33% mortality when 6 x 10^6 spores/ml solution was applied for insect inoculation and 54.33 & 56.67% with 4 x 10^6 spores/ml at 25 & 30 °C, respectively. These results reveal that there were no significant differences between the two tested concentrations. The mortality differed significantly with the variations of both temperatures (25 & 30°C).

IV. Influence of natural enemies and weather factors in suppression of *P. tunivalavata* population.

The correlation coefficient analysis in Table (4) reveals that the efficiency of both biotic and abiotic factors on the sugarcane soft scale insect *P. tunivalvata* varied from factor to another. It may be obvious in Table (4) that the natural enemies had a high effect on *P. tunivalvata* (nymphs, adults) in the two successive growing seasons. In 2001 season, the aphelinid parasitoid, *C. secutellarium* and the predator, *P. alfierii* were the most suppressive biotic factors on the pest population, followed by *S. syriacus* and the entomopathogenic fungi. However, in the second growing season, both *C. secutellarium* and *P. alfierii* also played an important role in biological control of the pest. The entomopathogenic fungi were more efficient than *S. syriacus* (Table 4).

Table (3): Pathogencity % of two selected entomopathogenic fungi.

Temperature	Days after treatment	*Cladosporium spp.*		*Verticillium lecanii*	
		6 x 10^6	4 x 10^6	6 x 10^6	4 x 10^6
25 °C	1	00.00	00.00	00.00	00.00
	2	16.70	13.30	06.67	23.33
	3	40.00	40.00	30.00	50.00
	4	53.30	52.50	49.00	54.33
30 °C	1	00.00	00.00	00.00	00.00
	2	26.67	16.67	20.00	30.00
	3	36.67	43.33	43.30	36.76
	4	60.00	53.33	63.33	56.67

V. Efficiency of the weather factors:

The effect of minimum and maximum temperature and their averages was highly significant during 2001 & 2002 growing seasons (Table 4). In addition, the effect of relative humidity (minimum, maximum and average) on the pest was not significant in 2001 growing season, while both minimum and maximum R.H. had a negative influence on *P. tenivulvata* population as shown in Table (4)

DISCUSSION

The sugarcane crop is one of the most important sugar sources and energy supply for humans and animals. Therefore, sugar industry becomes very serious by threatened in Egypt by a newly emerged sugarcane red-stripped soft scale insect (SRSSI) *P. tenivulvata* since 1996 (Ali *et al.,* 1997). According to Ghabbour *et al.* (2001), Karam and Abu El-Kheir (1992) recorded the pest in Egypt early in 1992. This crop is infested by numerous insect pests and diseases worldwide (David & Alexander, 1987). *P. tenivulvata* was a key pest in the last few years in sugarcane fields in both Upper and Middle Egypt (Ali *et al.,* 2000 and Tohamy *et al.,* 2002). In 1997-1998, *P. tenivulvata* appeared in Dakahlia Governorate in 1997-1998 (Abdel-baky, Personal observation) and reached a high level in both 1999 and 2000 growing seasons.

The recent outbreak of this pest may be due to one or more of the following reasons: i) intensive use of chemical pesticides that led to disrupt the natural enemies (Samson *et al.,* 1998), ii) the favor climatic conditions in Upper Egypt (Ali *et al.,* 2002 and Tohamy *et al.,* 2002); ii) Botanical biodiversity that helps the insect survival during the winter months (Ali *et al.,* 2000) and iii) disrupting the agroecosysytem by some agronomic practices, i.e. burning the trash after harvesting (Shukala & Tripathi 1981) and drip irrigation (Parsana *et al.*, 1994).

The insect seasonal distribution (Figs. 1 & 2) differed from one year to another in the experimental area. The data obtained indicated that the pest infestation in Dakahlia was pronounced early in July in 2001, the late in July of 2002 and increased its activity till the end of November. This was not in agreement with results of Thomay *et al.* (2002) in the Middle and Upper Egypt. They indicated that the pest was active from May till February during 2000/2001. The difference in the seasonal distribution between various regions in Egypt may be due to the variations of weather factors. In addition, the infestation is similar to that caused by *M. glomerata,* which occurred in mid-July and reached its peak in November in sugarcane fields in India (Dutta & Devaiah, 1988).

The reduction of predators and parasitoid populations leads to an increase in the pest population. This reduction of natural enemies populations may be due to the intensive pesticides used in sugarcane fields and certain agronomic practices such as burning the stubble. Burning the stubble of recently harvested sugarcane, the overwinterning individuals did not increase the total mortality of the pest, as the scales located below the collar region of the stumps were not affected. Moreover, the burning process is more harmful than its benefit since it is carried out when the natural enemies of the pest are more abundant. Burning the sugarcane leaves and other residue after harvest disrupts the natural balance of the pest and natural enemies for a considerable time (Shukala & Tripathi 1981). The occurrence of the aphelinid parasitoid, *C. secutellarium* and the predator, *P. alfierii* showed high correlation with the insect under the field condition (Table 4).

The present investigation, however is the first record of entomopathogenic fungi, *Cladosprium* spp., *V. lecanii* and *Alternaria alternaria* in controlling the sugarcane scale insect in Egypt. The favor climatic conditions, particularly moderate temperatures and high relative humidities helped in establishing these entomopathogenic fungi in sugarcane fields. To maximize the role of natural enemies, it may be necessary to manipulate the environment through adoption of cultural measures such as weed control and cane trashing (Pandya, 1997 and Ganeshan, 2000).

The data in Table (4) show that there was no effect of weather factors on both insect and its natural enemies. The reasons behind that are correlated with the growers adoption certain agronomic practices such as drip irrigation. Parsana *et al.* (1984) recorded the highest population of the Indian sugar scale insect, *M. glomerata*, in the traditional flood method of irrigation. They noticed a decrease in pest population with low irrigation level.

Finally, the insect has become a very important pest in sugarcane fields in Dakahlia, Middle, and Upper Egypt, which needs some quarantine measures to avoid spreading of dangerous pests, in addition to selection of insect free-seeds, use of resistant varieties and use of integrated control practices.

ACKNOWLEDGMENT

The authors wish to express their thanks to Prof. Dr. Ahmed Raouf Hammed, Biological Control Division, Plant Protection Institute, Dokki, Giza for identification of the parasitoid. Thanks also are due to Miss Nehal Arafat for helping in entomopathogenic fungi identification.

REFERENCES

Ali, M. A.; A. S. El-Kouly and F. E. El-Metwally (1997). First record of the sugarcane scale, *Sacchrolecanium krugeri* (Zehntner) in Giza, Egypt. Bull. Ent. Soc. Egypt, 75: 156-159.

Ali, M. A.; A. S. El-Kouly; F. E. El-Metwally and M. S. I. Shalaby (2000). Occurrence, distribution and host range of the sugarcane soft scale insect, *Pulvinaria tenuivalvata* (Newstead) in Upper Egypt. . Bull. Ent. Soc. Egypt, 78: 243-250.

Besheit, S. Y.; A. A. Abaziad; A. M.E. S. Gomaa and A. S. A. El-Hamd (2002). The influence of the infestation by the soft scale insect, *Pulvinaria tenuivalvata* (Newstead); Coccoiaue, Homoptera, on sugarcane stalk weight, juice quality and sugar yield in Upper Egypt. Assuit J. Agric. Sci., 33(4): 17-28.

David, H. and K. C. Alexander (1987). Integrated pests and diseases management in sugarcane. Plant Prot. Bull., India., 38(1-4) 37-49.

Dutta, S. K. and M. C. Devaiah (1988). Seasonal incidence of sugarcane scale, *Melanaspis glomerata* (Green) and its parasitoid, *Anabrolepis mayurai* Subba Rao in ratoon sugarcane. J. Res. Asaam Agric. Unv., 9 (1-2); 38-42.

Dutta, S. K. and M. C. Devaiah (1992). Response of certain sugarcane varieties to scale insect and association of plant character with infestation. Cooperative Sugar, 23(5): 337-342.

Ganeshan, S. (2000). Biological control of sugarcane pests in Mauritius: current status and future prospects. (*Eds*: Allosop, P. G. & Suasa-Ard, W.,) In: Sugarcane pest management in the New Millennium, 4th sugar Cane Entomology Workshop International Society of Sugar Cane Technologists, Khon Kaen, Thailand, 7-10 February 2000, pp: 3-9.

Ghabbour, M. W.; C. J. Hodgson and G. Pellizzari (2001). The immature stages of *Pulvinaria tenuivalvata* (Newstead) (Hemiptera: Coccidae). Bollettino di Zoologia Agraria e di Bachicoltura, 33 (3): 43-51.

Helmy, E. I. (2001). Efficiency of certain alternative pesticides; local mineral oils against the soft scale insect; *Sacchrolecanium krugeri* (Zehntner) infesting sugar-cane at Giza, Egypt. 1st Conference on Safe Alternative of Pesticides for Pest Management, Assuit Univ., October 28-29: 91-98.

Helmy, E. I.; N. A. Hassan; S. M. El-Imery and H. M. Haris (2001). Miscible oils, I.G.R. and their joint effect as promising safe alternative pesticides control against *Sacchrolecanium krugeri* (Zehntner) infesting sugar-cane at Gena governorate, Egypt. 1st Conference on Safe Alternative of Pesticides for Pest Management, Assuit Univ., October 28-29: 99-105.

Jayanthi, R.; David, H. & Goud, Y. S. (1994). Physical characters of sugarcane plant in relation to infestation by *Melanaspis glomerata* (G.) and *Saccharicoccus sacchari* (Ckll.). J. Entomol. Res., 18(4); 310-314.

Karam, H. H. and Abu El-Kheir, S. S. (1992).first record of *Pulvinaria elogata* Newstead (Homoptera: Coccidea, Coccidae). Alex. J. Agric. Res., 37(1): 587-594.

Maareg, M. F.; M. A. Hassanein and A. M. Abu Dooh (1992). Preliminary survey of the scale insects attacking sugarcane in Egypt. Communications in Science and Development Research, 40: 223-229.

Pandya, H. V. (1997). Control of sugarcane borers, mealy bugs and scale insects in Gujarat. Cooperative Sugar, 28(10): 745-746.

Parasna, G. J.; D. D. Malavia and D. J. Koshiya (1984). Effect of drip irrigation on incidence of insect pests of sugarcane. Gujarat Agric. Univ. Res. J., 6 (1): 15-17.

Rao, V. L. V. P.; N. V. Rao and S. S. Rao (1991). Influence of seasons on buildup of scale insect *Melanaspis glomerata* (G.), insecticidal performance and their effect on yield and quality in sugarcane. Indian J. Plant Prot., 19(1): 19-22.

Ravindranath, K. and G. V. Subbaratnam (1998). Relative susceptibility of some varieties of sugarcane to the scale insect, *Melanaspis glomerata* (Green). Pest Mnag. and Economic Zool., 6(2): 159-161.

Samson, P. R.; P. G. Allsopp; A. J. Brodie; K. Chandler amd L. N. Robertson (1998). Pesticides under pressure – options for sustainable pest management. (*ed.*, Hogarth, D. M.) *In*: Proceedings of the 1998 Conference of the Australian Society for Sugar Cane Technologists, held at Ballina, NSW, Australia, 28th April- 1st May: 90-96.

Shukala, G. S. and N. Tripathi (1981). Effect of trash burning on the management of sugarcane scale insect, *Melanaspis glomerata* (Grenn). Indian J. Entomol., 43(4): 43-47.

Tohamy, T. H.; S. A. Murad; K. A. Mowafi and M. F. Twfik (2002). Ecological studies on the soft scale insect, *Pulvinaria tenuivalvata* (Newstead) on sugarcane fields in Minia region, Middle Egypt. 2nd Int. Conf., Plant Prot. Res. Institute, cario, egypt, 21-24 Dec., 585-593.

Tripathi, N.; A. Omkar and G. S. Shukla (1985). Role of air currents in the dispersal of sugarcane scale insects crawlers. Agric. Sci. Digest, India 5(3): 184-149.

Tripathi, S. R.; P. Tewari and S. Akhtar (1987). Effect of set infestation by *Melanaspis glomerata* (Green), (Diasipidae: Homoptera) on germination of sugarcane. Indian J. Agric. Res., 21(3): 146-150.

Williams, D. J. (1982). *Pulvinaria iceryi* (Singoret) (Hemiptera: Coccidae) and its allies on sugarcane and other grasses. Bull. Entomol. Res., 72(1): 111-117.

Upadhyay, S. and M. S. Vaidya (1994). Losses estimates in sugarcane sue to scale insect *Melanaspis glomerata* (Grenn) in northwestern Madhya Pradesh. Research & Development reporter, 10(1-2): 29 pp.

دراسات على حشرة القصب القشرية الرخوة (*Pulivanria tenuivalvata*) وأعدائها الحيوية فى محافظة الدقهلية.

نجدى فاروق عبد الباقى و عادل حسن عبد السلام[١]، حسين عبدالله الفضالى[٢].
[١]قسم الحشرات الإقتصادية، [٢] قسم الميكربيولوجى، كلية الزراعة – جامعة المنصورة.

ظهرت حشرة القصب القشرية الرخوة لأول مرة فى حقول قصب السكر بمحافظة الدقهلية فى موسم ١٩٩٩/١٩٩٨. وكانت الإصابة خفيفة جدا فى أول موسم، ثم زادت بشدة فى المواسم التالية لدرجة أن الحشرة سببت أضرار فادحة الأمر الذى أدى الى قيام المزراعين بالتخلص من المحصول قبل نضجة.

ولتهدف هذه الدراسة إلى إلقاء الضوء على الكثافة العددية والإنتشار الموسمى للحشرة، دور العوامل المناخية وتأثيرها على الحشرة وكذلك دور الأعداء الحيوية المرتبطة بها فى حقول قصب السكر.

ولقدأظهرت الدراسة أن الحشرة بدأت فى الظهور فى الأسبوع الأول من يوليو ٢٠٠١ والأسبوع الرابع من يوليو ٢٠٠٢م زاد تعدادها إلى أقصى حد حتى الحصاد فى شهر نوفمبر. كما سجل فى الدراسة نوع واحد من الطفيليات (*Cocophagous scutellaris*, Dalman) ونوعان من المفترسات هما *Scymanus sp.* و *Paederus alfierii* وعدة أنواع من المسببات المرضية الفطرية.