EFFECT OF CERTAIN AGRICULTURAL PRACTICES ON POPULATION DENSITY OF THE RED STRIPED SOFT SCALE, *PULVINARIA TENUIVALVATA* (NEWSTEAD) (HOMOPTERA: COCCIDAE).

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ABSTRACT:

The present investigation was carried out to study the efficiencies of agricultural practices *i.e.* rowing space, fertilization, irrigation system, ratoons, varieties and host range on the population density of red striped soft scale, *Pulvinaria tenuivalvata* (Newstead) at Nagada, Armant and Luxor City, Qena governorate during two successive seasons 2002 and 2003 where the results clearly showed that planting sugarcane on 7 rows space, using the recommended nitrogen fertilizer 200 units with 100 kg potassium per feddan, using modern irrigation, and choosing PH 8013 variety were considered the proper agricultural practices which decreased the population of *P. tenuivalvata*, and resulted in the increasing of both sugarcane yield and juice.

Key words: Soft scale, *Pulvinaria tenuivalvata*, Ecology, Sugarcane, Agricultural practices.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important sources of sugar production that should be grown in large scale in tropical and sub tropical countries. In Egypt, sugarcane is the second most important economic crop. Numerous and serious pests invade sugarcane plants and cause a lot of damage which affect sugarcane yield and juice quality, **(Willams, 1970; Mohalkar *et al.*, 1973 and Campos, 1997)** the main sucking insect the red striped soft scale, *Pulvinaria tenuivalvata* (Newstead), are considered recently the Key pests of sugarcane production in Egypt. **(Ali *et al.*, 2000 Watson & Foldi, 2001 and Shalaby, 2002).**

The chemical control of the insect pests had caused environmental pollution and serious harmful side effects to humans, domestic animals and natural enemies. The efficiency of agriculture practices on the population density could be taken into consideration as a mean of control measure of the major sugarcane insect pest **(Raghunath, 1983; Rae & Jones, 1992; Parsana *et al.*, 1994; Ali *et al.*, 2000; Besheit *et al.*, 2002 and Shalaby 2002).** Therefore, the current investigation was planned to study the effect of certain agriculture practices such as planting spaces, level of fertilization, irrigation system, plant crop & ratoon plant sugarcane varieties and host range on the population dynamics of *Pulvinaria tenuivalvata*

MATERIAL AND METHODS

An area about one and half feddan were cultivated by C9/54 sugarcane variety at Nagada, Armant and Luxor City, Qena governorate in 30 of March in both 1st and 2nd seasons (2002 and 2003) Split–split plot and randomized complete block designs with three replicates were used. Samples of 90 leaves of 10 plants were inspected in the field at three different levels of plant height (i.e. upper, middle and lower) after 90 days from planting and continued at 15 days intervals during the period experiment. The number of nymphs and adults found on both surfaces of each leaf was counted and recorded to express the population size of this insect pest.

Rowing space and fertilization.

This experiment carried out as plant crop and its first ratoon during 2002 and 2003 seasons, respectively aimed to study the effect of rowing space (7 recommended, 9 and 11 rows) and levels of nitrogen fertilizer (150, 200 recommended and 250 units/fed.) under two levels of Potassium fertilizer (without and 100 kg /fed.) on population fluctuation of *P.tenuivalvata* and relationship of them on sugarcane yield and juice production quality. The rowing space were arranged in the sub-plots and level of Nitrogen fertilizer were distributed in sub-sub plots.

The area of each sub plot was 70 m^2 (7x10m.) represented 1/60 fed. Nitrogen fertilizer was added, as Urea (46.5%) and divided into two equal doses, the first application at full germination stage, after one month from planting, the second dose was added after one month later. Potassium fertilizer was added as Potassium sulphate (48%) was applied with the second dose of Nitrogen. The phosphorus fertilizer was added as one dose during the land preparation. Meanwhile, three replicates with the same size were prepared and distributed randomly within the experimental as check.

All other agronomical practices for sugarcane crop were adapted as recommended in Qena Governorate.

Irrigation systems.

Two irrigation systems were used, the first one was drown system, while the second one was modern system, each system area represented 420 m² was cultivated by C9/54 sugarcane variety. Divided to three replicates 70 m² for each, all the experimental plots received the normal agricultural treatments and no chemical control measurements were applied.

Plant crop and ratoon plant.

Plant crop and four ratoons (1st, 2nd, 3rd and 4th ratoon) were selected in an area about 1050 m², divided to 3 replicates for each treatment. (210 m² for each). All other agronomical practices for sugarcane crop were adapted as recommended..

Certain sugarcane varieties

PH 8013, F 160 and commercial variety C 9/54 were cultivated in 210 m² for each variety. Divided into 3 replicates (70 m² for each). The randomized complete block design was followed in the whole experimental area. The tested varieties were exposed to normal field condition without using insecticides during the experimental period

Host range

Inspection of sugarcane plant and other field crops associated with the sugarcane plant and weeds were occurred during three successive seasons started from, 15 October 2001 until late of December 2004 seasons. Forty plants for each crop or weed represented one feddan were randomly chosen, each 15 days intervals. Careful examination of these plant was done to clarify the existence of different stages of the soft scale *P.tenuivalvata*.

RESULTS AND DISCUTION

Effect of planting spaces.

Effect of planting space on infestation of sugarcane plants by the soft scale *P. tenuivalvata* through 2002 and 2003 seasons was shown in Tables (1 and 2). The trend in number of this pest was decreased when spacing between rows was increased. In the 1st season the total number of individuals was increased from 2461individuals in 7 rows followed by 2736 and 2782 individuals in 9 and 11 rows, respectively. In case 200 nitrogen units per feddan which treated with Potassium fertilizer. On the other hand in the same treatment without Potassium, the space 11 rows recorded the highest number 2937 individuals followed by 9 and 7 rows which recorded 2741 and 2531 individuals, respectively. The same trend was evident in the 2nd season (2003) but with a few number of individuals. The space 11 rows were the highest value in both cases treated and untreated with Potassium 142 and 175 individuals followed by 9 and 7 rows which recorded 139 & 175 individuals and 131 & 171 individuals, respectively. Statistical analyses of data showed that there were significant differences between the space 11 and both 7 and 9 rows for insect individuals while non significant differences between 7 and 9 rows in both test seasons.

Effect of nitrogen levels.

Data presented in Tables (1 and 2) indicated that, application of different levels of nitrogen fertilizer increased of *P. tenuivalvata* populations. The infestation was lowest in sugarcane fields which treated with 150 units of nitrogen per feddan (2200, 2441 and 2615 individuals) in 7, 9 and 11 rows, respectively and increased by treated with 200 nitrogen units to 2461, 2736 and 2782 individuals in 7, 9 and 11 rows, respectively. The highest number was in case treated with 250 nitrogen units which recorded 2533, 2709 and 2749 individuals in 7, 9 and 11 rows, respectively.

The same trend was done in the 2nd season. The highest number recorded in level 250 nitrogen units (136, 132 and 151 individuals) in 7, 9 and 11 rows, respectively. Followed by level 200 nitrogen units which were 131, 139 and 142 individuals respectively. While the lowest number was occurred in level 150 nitrogen units 115, 120 and 136 individuals, in 7, 9, 11 rows, respectively. Statistical analyses of these data showed that. There were significant differences in number insect individuals between 150 units of Nitrogen fertilizer and 200 & 250 units as well as non significant between 200 & 250 units of Nitrogen fertilizer in both seasons.

Table 1

Table 2

Effect of potassium fertilizer

Effect of potassium fertilization on population density of soft scale, *P. tenuivalvata* was shown in Tables (1 and 2). The lowest infested by *P. tenuivalvata* was recorded on plant cane treated with potassium fertilization at rate of 100 kg/feddan. In the 1st season. (2002) the total number of individuals were 2461, 2736 and 2782 individuals in 7, 9 and 11 rows, respectively in addition of 200 units of nitrogen per feddan compared with untreated treatment which recorded 2531, 2741 and 2937 individuals in 7, 9 and 11 rows, respectively. Whereas the total number of individuals, in the 2nd season (2003) were recorded lower density in general than the 1st season. The treated with Potassium were 131, 139, 142 individuals in 7, 9 and 11 rows, respectively, with 200 units of nitrogen per feddan. The number of individuals increased in untreated plots which received 171, 175 and 175 individuals in 7, 9 and 11 rows, respectively. Analyses of variance of data showed significant difference between the plots which treated and untreated with Potassium fertilizer.

Irrigation systems

Effect of irrigation systems of sugarcane plants (Drown and Modern) were investigated in this work to determine the top rated of irrigation system which can reduced of population density of ***P. tenuivalvata*** as one of methods of sugarcane protection system .It was evident in Table (3) the population of *P. tenuivalvata* was height in Drown system in both seasons which recorded 136 and 44 individuals per 90 leaves for 1st and 2nd seasons, respectively compared with Modern system which recorded 108 and 38 individuals /90 leaves. Statistical analysis of data showed significant differences between Drown and Modern system in 1st season (2002) while was non significant in the 2nd season (2003).

Table (3): Effect of Irrigation systems in sugarcane fields on population density of *P. tenuivalvata* /90 leaves during 2002&2003 seasons.

Date	2002 season		2003 season	
	Modern	Drown	Modern	Drown
12/08/	0	3	0	0
27/08/	3	15	0	0
11/09/	20	15	3	3
26/09/	20	15	15	22
11/10/	22	19	16	15
26/10/	26	36	4	4
10/11/	17	33	0	0
Total	108	136	38	44
Mean	15.42	19.42	9.5	11
T. calculated	5.26*		3.48 ns	

Effect of plant crop and ratoon plant.

Results presented in Table (4) showed the infestation by *P. tenuivalvata* on plant crop and ratoons plant started in August in both season. The number of *P. tenuivalvata* /90 leaves was lowest on plant crop which received 98 and 33 individuals in 1st and 2nd seasons, respectively, then the population increased progressively in the following ratoons which received 112, 136, 149

Table 4

and 209 individuals in 1st, 2nd, 3rd and 4th ratoons, respectively in the 1st season, while in the 2nd season the population of *P. tenuivalvata* was 37, 41, 44 and 47 in 1st, 2nd, 3rd and 4th ratoons, respectively. Statistical analysis of the date appeared that in the 1st season the data showed different significant in number of individuals between the plant crop and other ratoons also there were significant between the 1st ratoon, 3rd and 4th ratoons. Moreover there were significant differences between 2nd and 4th ratoons while did not significant differences between 2nd and 4th ratoons. In the 2nd season the data showed different significant between the plant crop and 3rd & 4th ratoons also between 1st ratoon and the 4th ratoon. While non significant differences between plant crop and 1st & 2 nd ratoon also between 1st , 2nd and 3rd ratoons.

Susceptibility of certain sugarcane varieties to soft scale insect *P. tenuivalvata* infestation

As shown in Table (5) the data indicated that C 9/54 sugarcane variety was the most susceptible to *P. tenuivalvata* infestation in both seasons (2003 and 2004) with 161 and 109 individuals /90 leaves, respectively. Followed by F160 variety which received 84 and 55 individuals /90 leaves. While PH 8013 variety was the least susceptible to insect infestation which received 62 and 46 individuals per 90 leaves during (2003 and 2004) seasons, respectively. Statistical analysis of this data showed significant differences between three sugarcane varieties through two seasons.

Table (5): Effect of certain sugarcane varieties on the population density of *P.tenuevalvata* / 90 leaves during 2003 and 2004 seasons.

Date	2003 season			2004 season		
	C9/54	PH8013	F160	C9/54	PH8013	F160
13/07/	5	0	0	0	0	0
28/07/	7	0	1	5	1	1
12/08/	8	2	3	14	3	3
27/08/	13	5	8	15	6	4
11/09/	18	7	9	18	7	15
26/09/	20	8	10	25	9	12
11/10/	23	15	15	17	13	10
26/10/	45	18	28	10	5	7
10/11/	17	5	9	5	2	3
25/11/	5	2	1	0	0	0
Total	161	62	84	109	46	55
Mean	16.1 a	6.2 c	8.4 b	12.11 a	5.11 c	6.11 b
F-value	426.68*			387*		
LSD at level 0.05	3.29			2.27		

Host range

Host range of sugarcane soft scale, *P. tenuivalvata* was conducted on sugarcane field and other plant which existent in or surround sugarcane fields throughout three successive seasons from 2002 to 2004 seasons. The data showed in Table (6) indicated that ten host plants were belonged to family Graminaceae. They were as follows; 4 field crop plant (maize, sorghum, sugarcane and wheat) and 6 weed (Conogn grass, Common reed, Elephant grass, Green foxtail, Eerennial ryegrass and Large crabgrass). All soft scale insect stages were recorded on 5 plant species (Conogn grass, Maize,

Sorghum, sugarcane and wheat). While observed three nymphs instars on 3 plant species (Common reed, Elephant grass and Green foxtail). Moreover received Eerennial ryegrass and Large crabgrass the 1st and 2nd nymphl instars only. On the other hand frequency of *P. tenuivalvata* individuals were highly abundant on sugarcane and Conogn grass plant and abundant on Common reed, Eerennial ryegrass and Large crabgrass. while were rared on maize, sorghum, wheat, Elephant grass and Green foxtail.

Results obtained in this study agreed with those recorded by different authors. **Shalaby (2002)** showed that a negative correlation and relationship was found between row spacing and population density of scale, *Pulvinaria tenuivalvata*, so the number of scale per leaf significantly decreased as the space between rows increased.

Beckham (1970) noticed there was an indication that more aphids occurred on leaves as the rate of nitrogen was increased. On the contrary **Washburn *et al.*, (1987)** reported no significant correlation was found between the amount or form of nitrogen addition and survivorship of *Pulvinaria delotto,* and **Rae & Jones (1992)** found that nitrogen did not have a detectable effect on the population size of *Saccharicoccus sacchari* on sugarcane. **Shalaby (2002)** observed that application of potassium with nitrogen decreased in the density of *Pulvinaria tenuivalvata* infesting sugarcane leaves.

Maareg *et al.*, (1992) showed that the ratoon cane were the worst affected by scale insect infestation. The same meaning cleared **Ravindranath and Subbaratnam (1998**) that ratoon crops had a higher level of infestation than plant crops, while **Besheit *et al.*, (2002)** reported that the severe infestation of soft scale, *Pulvinaria tenuivalvata* on the first and second ratoon was less effect on most juice quality and the average stalk weight, reducing sugar and glucose ratio of plant cane were less effective under heavy infestation compared with ratoon crop.

Parsana *et al.*, (1994) observed that the highest population levels of *Saccharicoccus sacchari* were recorded in the traditional flood method of irrigation.

Table (6): Host range of the strip soft scale, *P.tenuivalvata* existent in or surround sugarcane fields in Nagada region during three successive seasons from 2002 to 2004.

Common name	Scientific name	Family	Frequency	insect stage
Maize	*Zea mays* L.	Graminaceae	A	all stages
Sorghum	*Sorghum bicolor* L.	Graminaceae	A	all stages
Sugarcane	*Saccharum officinarum* L.	Graminaceae	Ha	all stages
Wheat	*Triticum aestivum* L.	Graminaceae	A	all stages
Conogn grass	*Imperata cylindrica* L.	Graminaceae	Ha	all stages
Common reed	*Phragmites australis* Trin.	Graminaceae	R	II ,III nymphs
Elephant grass	*Pennisetum purpureum* Schu.	Graminaceae	A	II ,III nymphs
Green foxtail	*Setaria viridis* (L.)	Graminaceae	A	II ,III nymphs
Eerennial ryegrass	*Lolium perenne* L.	Graminaceae	R	II nymph
Large crabgrass	*Lolium perenne* L.	Graminaceae	R	II nymph
Common name	*Digiaria sanguinalis* (L.)	Graminaceae	R	II nymph

Ha : Highly abundant A : abundant R : Rare

REFERENCES

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

Beckham, C.M. (1970): Effect of nitrogen fertilization on the abundance of cotton insect. J. Econ. Ent. 63 (4): 1219-1224.

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

Campos, M.S. (1997): *Pulvinaria spp*. On sugarcane under insectary conditions. Cited R.A.E. Ser. A .85 (5): 624.

Maareg, M. F.; M. A. Hassanein and A. M. Abu Dooh (1992): Preliminary survey of the scale insects attacking sugarcane in Egypt. Com. in Sci. & Dev. Res. 498 : 223-230.

Moholkar, P. R.; S.T. Ranaive and O.V. Jawalekar (1973): Effect of scale insect, *Melanaspis golmerata* G. of sugarcane on the quality and recovery of jaggery (gur). Proc. Conr. Deccan. Sug. Technol. Assoc., 25: 41-44.

Parsana, G.J; D.D. Malavia and D.J. Koshiya (1994): Effect of drip irrigation on incidence of insect pests of sugarcane. Gujarat, Agric. Uni. Res. J. 20 (1): 15-17.

Rae, D.J. and R.E. Jones (1992): Influence of host nitrogen levels on development, survival, size and population dynamics of sugarcane mealybug, *Saccharicoccus sacchari* (Cockerell) (Hemiptera: Pseudococcidae). Australian Journal of Zoology 40 (3): 327-342.

Raghunath, T. (1983): Leaf nitrogen as a possible factor in resistance of sugarcane varieties to the scale insect *Melanaspis glomerata* G. Maharashtra Sugar 8 (11): 69-71.

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

Shalaby, M.S.I. (2002): Ecological and biological studies on the sugarcane scale *Pulvinaria tenuivalvata* (Newstead) infesting sugarcane in Giza Governorate. Ph.D. Sci. Thesis, Fac. of Agric., Al-Azhar Univ.,Cairo, Egypt. 209 pp.

Washburn, J.O.; J.K. Grace and G.W. Frankie (1987): population responses of *Pulvinariella mesembryanthemi* and *Pulvinaria delottoi* (Homoptera: Coccidae) to nitrogen and water conditions of their host plant. Environ. Entomol. 16 (1): 286-295.

Watson, J.W. and I. Foldi (2001): The identify of red -striped soft scale, on sugarcane in Egypt, *Pulvinaria tenuivalvata* (Newstead) (Homoptera : coccidae) Bull. Ent. Soc. Egypt, 79:

Williams, J.R. (1970): Studies on the biology, ecology and economic importance of the sugarcane scale insect, Aulacaspis tegalensis (Zhnt.) (Diaspididae) in Nauritius. Bull. Ent. Res.60: 61-95.

تأثير بعض الممارسات الزراعية على الكثافة العددية لحشرة القصب القشرية الرخوة *Pulvinaria tenuivalvata*

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أجرى هذا البحث لدراسة تأثير بعض العمليات (الممارسات) الزراعية مثل مسافات الزراعة، المعدلات السمادية، نظم الري، الأصناف، عدد الخلفات لمحصول قصب السكر على الكثافة العددية لحشرة القصب القشرية الرخوة وذلك في مناطق نقاده، ارمنت ومدينة الأقصر- محافظة قنا. خلال موسمين ٢٠٠٢ ، ٢٠٠٣ وقد أوضحت النتائج أن أفضل مسافة لزراعة القصب هى ٧ خطوط/ قصبتين مع إضافة ٢٠٠ وحدة نيتروجين مخلوطة بـ ١٠٠كجم بوتاسيوم للفدان تحت نظام الري المطور مع استخدام صنف القصب PH 8013 يؤدى ذلك إلى خفض في تعداد هذه الآفة الخطيرة مما ينعكس على زيادة كمية محصول القصب وزيادة جودة العصير الناتج.