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Effect of directions and weather factors on seasonal abundance of pink sugar cane mealybug, *Saccharicoccus sacchari* (Hemiptera: Pseudococcidae) in Nage Hamade, Egypt

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Abstract:

The pink sugar cane mealybug *Saccharicoccus sacchari* (Cockerell) (Hemiptera: Pseudococcidae) is serious pest on sugarcane (*Saccharum officinarum* L.). This study was carried out in Nage Hamade, Egypt, through two successive years (2016/2017 and 2017/2018). Obtained results indicated that east direction is highly population then north, west and finally south in two years of study. Nymph of *S. sacchari* on the east recorded four peaks, the highest one on end of August whereas the lowest one in middle of December in first year. While the adult recoded three peaks, the highest one on first week of November 2017. Second year of study both of nymph and adult stage had four peaks. The population of nymph and adult was positive with temperature and negative with RH% in two years of study.

Introduction

Sugarcane *Saccharum officinarum* L. (Poaceae) is considered the main materials for sugar processing. It is cultivated of large areas in Upper Egypt, especially in Qena Governorate persisting half of total sugarcane in Egypt (Bakry *et al.*, 2012). Sugarcane in Egypt is subject of seven major pests and 24 other minor pests (Abd-Rabou and Parker, 2008).

Saccharicoccus sacchari (Cockerell) (Hemiptera: Pseudococcidae) is the major pest in Egypt and the world. It lives on sugarcane both under-ground and on aerial stem tissue. Crawlers infest upper internodal tissue behind leaf sheaths and develop through a series of juvenile instar stages before becoming adult. It obtains nutrition from the plant's phloem and excess carbohydrate is exuded as honeydew. Previous studies of *S. sacchari* have found that numbers increase as stem tissue develops (Inkerman *et al*. 1986). The effect heavy infestations of *S. sacchari* have on crop performance has seldom been quantified, but a negative one is often suspected (Beardsley 1960). Atiqui and Murad (1992) and Mohamed *et al*. (2009) have demonstrated significant loss of total dissolved solids (Brix) and sucrose as estimated by polarimetry in juice from infested compared with uninfested cane. Combined with the potential for exudates to cause problems during sugar manufacture (Inkerman *et al.* , 1986), observations of poor growth of sugarcane when heavily infested with *S. sacchari* summarized by (Dick, 1969), the damage

when highly infested is associated with a reduction in juice quality (brix, purity, and polarization), vigor and yield of culms (Mohamed *et al*., 2009) and the ability of *S. sacchari* to transmit virus particles (Lockhart *et al.*, 1992) make *S. sacchari* an insect pest of continued commercial interest. *S. sacchari* outbreak occurred in last years to change temperature, and temperature had a positive correlation with incidence. Therefore, we examined the influence of directions and weather factors on the seasonal abundance of pink sugar cane mealybug, *S. sacchari* on sugarcane in Qena Governorate.

Materials and methods

The present study was carried out *S. sacchari* on sugarcane *S.officinarum* at Nage Hamade**,** Qena**,** Governorate, Egypt during a tow growing years (2016/2017) and (2017/2018) (i.e. from April, 2016 to March, 2018).

1. Seasonal activity of *Saccharicoccus sacchari*:

The design of experiment was as follows: An area of about one feddan (i.e. 4200 m^2) was divided into four direction north, east, west and south. A sample of 5 internodes were chosen at random from each direction and replicated 4 times. The samples were examination, using a magnifying glass biweekly basis. Alive stages found on each sample were recorded as: nymph and adult females.

2. Effect of weather factors on the abundance of sugarcane mealybug *Saccharicoccus sacchari:*

Weather factors maximum, minimum temperatures, mean % and relative humidity (RH %) was obtained from the Egypt-Weather Underground https:// WWW.Wunderground.com/global/EG.html. The biweekly maximum and minimum temperatures as well as relative humidity were calculated. Multiple regressions were conducted for weather factors combined. The obtained determination factor (R2) of E.V. % was used to explain the effect of testing factors. Process Correlation and Regression were used in SAS to analysis they obtained date (**SAS Institute, 1998**).

Results and discussion

1. Seasonal activity of *Saccharicoccus sacchari*:

The seasonal activity of *S. sacchari* for fourth direction (West, north, east and south) as nymphs and adults was illustrated in (Figures 1 and 2) for two seasons of study (2016/2017 and 2017/2018). In both year of study nymphs and adults of *S. sacchari* were recorded high population in east, north, west and south, respectively. In the first year of study nymphs of *S. sacchari* were recorded fourth peaks in (27^{th} of August, 22^{nd} of October, 17^{th} of December 2016 and 22^{nd} of April 2017, respectively, in all direction (Figure, 1 B). The highest peak of *S. sacchari* nymphs were in 27^{th} of August by (780 individuals /sample) while the lowest one in 17^{th} of December 2016 by (240 individuals /sample) for east direction. Whereas the south direction the highest peak recorded (138 individuals /sample) in 27^{th} of August and the lowest one in 17^{th} of December 2016 by (28 individuals /sample).

Adults of *S. sacchari* was recorded three peaks in (13^{th} of August, 8^{th} of October 2016 and 25^{th} of March 2017, respectively in all direction (Figure 1 A). The highest peak of *S. sacchari* adults were in 13^{th} of August by (152 individuals /sample) while the lowest one in 25^{th} of March 2017 by (100 individuals /sample) for east direction. Whereas the south direction the highest peak recorded (31individuals /sample) in 13^{th} of August and the lowest one in 25^{th} of March 2017 by (20 individuals /sample).

In the second year of study nymphs of *S. sacchari* was recorded fourth peaks in (27^{th} of August, 22^{nd} of October, 17^{th} of December 2017 and 22^{nd} of April 2018, respectively in all direction (Figure 2 B). The highest peak of *S. sacchari* nymphs were in 27^{th} of August by (800 individuals /sample) while the lowest

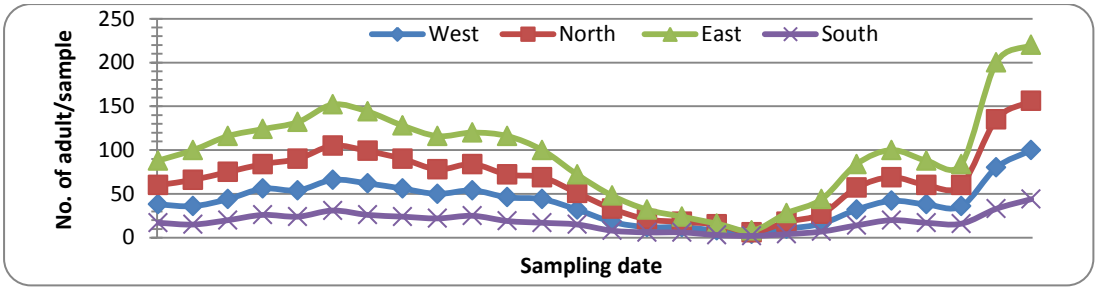
one in 17th of December 2017 by (260 individuals /sample) for east direction. Whereas the south direction the highest peak recorded (143 individuals /sample) in 27th of August and the lowest one in 17th of December 2017 by (33 individuals /sample).

Adults of *S. sacchari* was recorded three peaks in (13th of August, 8th of October 2017 and 25th of March 2018, respectively in all direction (Figure 2 A). The highest peak of *S. sacchari* adults were in 13th of August by (172 individuals /sample) while the lowest one in 25th of March 2018 by (120 individuals /sample) for east direction. Whereas the south direction the highest peak recorded (36 individuals /sample) in 13th of August 2017 and the lowest one in 25th of March 2018 by (25 individuals /sample).

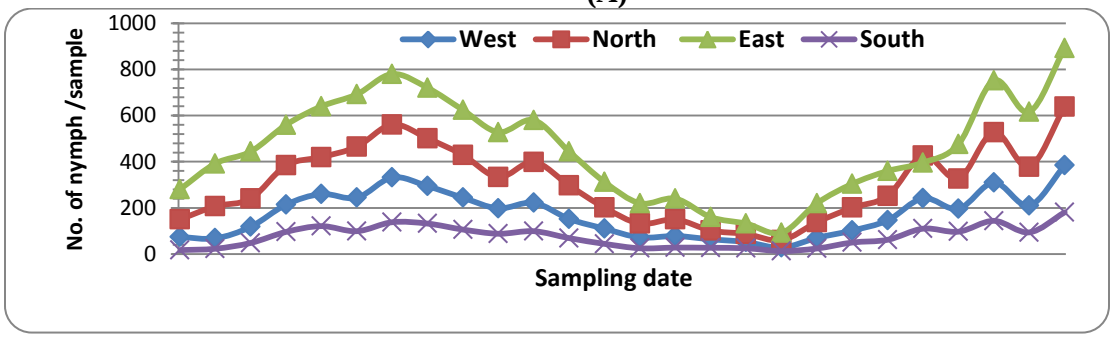
These results agree with Abou Dooh *et al.* (1999) population of *S. sacchari* was high during July and September and low from December to March. Hafez and Salama (1969) recorded the peak populations in August-September. When the average monthly temperatures were 26.6-27.3 C. The insect had four generations/ year. Tohamy *et al.* (2008) found three peaks and four falls in the first season, while five peaks and six falls occurred in the second season. Moreover, showed that the pink sugarcane mealybug 3 to 5 annual generations, most of them occur during the summer, since they are mainly warm climatic insects. Borges Filho *et al*. (2019), was found during most year of Brazil, but infestation levels were highest in March.

2. Effect of weather factors on the abundance of *Saccharicoccus sacchari*:

We studied the effect of weather factors maximum, minimum, average temperature and relative humidity were illustrated Figure (3 A, B) for two years of study. Correlation, regression analysis and multi regression between weather factors and population of *S. sacchari* was in liner degree, two years of study 2016/2017 and 2017/2018. Statistically, the results represented in Tables (1 and 2) showed the effect of the weather factors (maximum, minimum, average temperature and relative humidity) activity on *S. sacchari* to first and second year of study (2016/2017 and 2017/2018). With the respect to weather factors had significant effect on the population of the nymph stage *S. sacchari* in both years of study, for west direction, while east direction had highly significant effect on the population with maximum temperature (Tables, 1 and 2). The common effect of temperature and relative humidity was responsible for (56.83 %, 62.62%, 75.22% and 56.48 %) of the nymph to west, north, east and south, respectively Table (1). While the E.V for the adult stage of *S. sacchari* was (68.16 %, 68.17%, 70.02% and 66.92 %) of the adult to west, north, east and south, respectively Table (1) in first year of study (2016/2017). The common effect of temperature and relative humidity was responsible for (66.45 %, 69.97%, 78.73% and 65.70 %) of the nymph to west, north, east and south, respectively, Table (2) in second year. While the E.V. for the adult stage of *S. sacchari* was (67.71 %, 67.48%, 68.94% and 66.51 %) of the adult to west, north, east and south, respectively Table (2) in the second year of study (2017/2018).

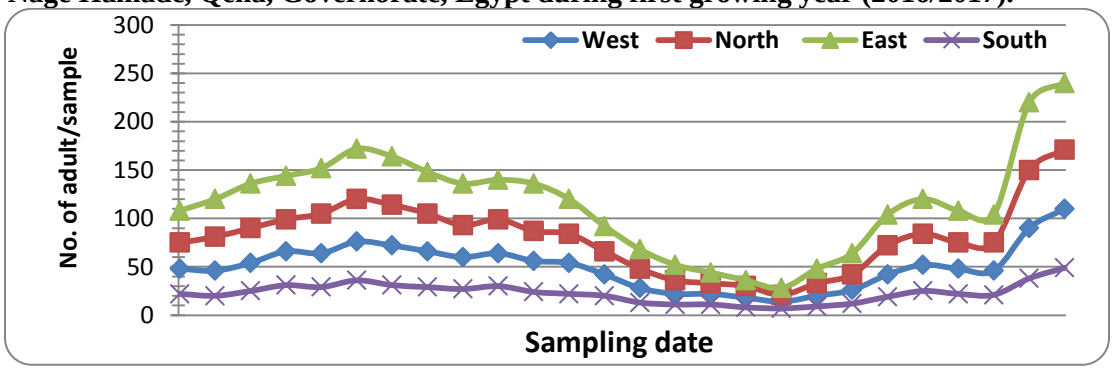


(A)

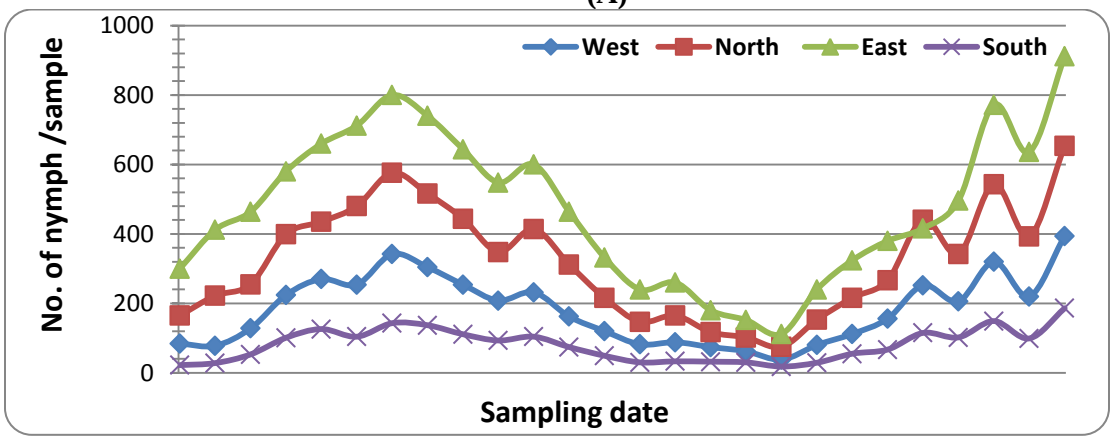


(B)

Figure (1 A,B): Number of adults (A) and nymphs (B), *Saccharicoccus sacchari* at Nage Hamade, Qena, Governorate, Egypt during first growing year (2016/2017).

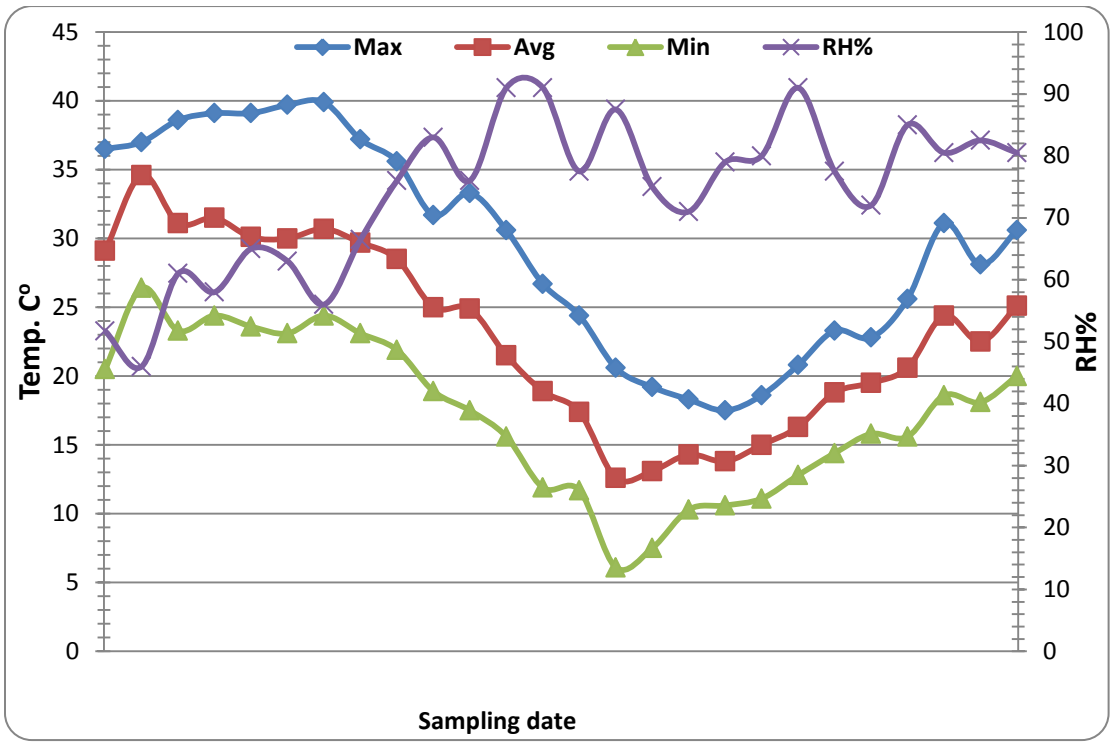


(A)

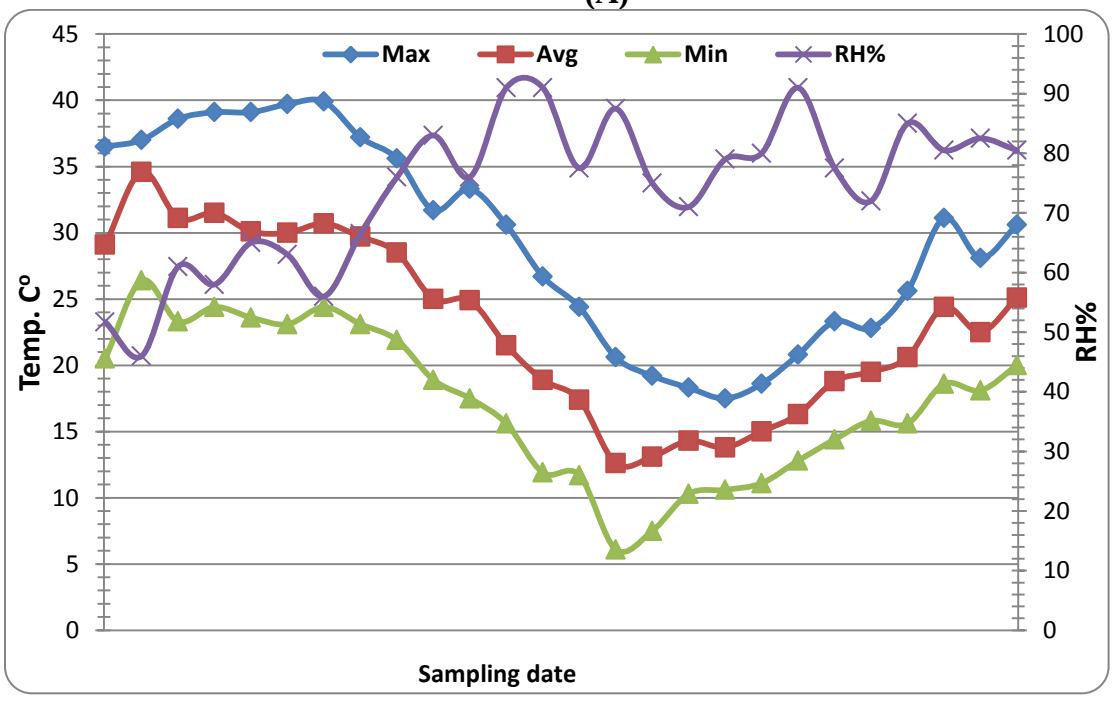


(B)

Figure (2 A,B): Number of adults (A) and nymphs (B), *Saccharicoccus sacchari* at Nage Hamade, Qena, Governorate, Egypt during second growing year (2017/2018).



(A)



(B)

Figure (3 A, B): Weather factors maximum, minimum temperatures and mean % relative humidity (RH.%) at Nage Hamade, Quena, Governorate, Egypt during a tow growing years (2016/2017) (A) and (2017/2018) (B).

Table (1). The simple correlation and regression coefficients and multiple regressions between the different stages of *Saccharicoccus sacchari* and weather factors in first year (2016/2017).

Factors			Simple correlation and regression			Multiple regression
			R	**B**	**P**	**E.V.%**
Nymph	West	**T max.**	0.56	7.20	0.0028	56.83
		T avg.	0.57	8.78	0.0016	
		T min.	0.60	10.25	0.0013	
		R.H.%	-0.08	-0.64	0.6989	
	North	**T max.**	0.62	12.91	0.0008	62.62
		T avg.	0.65	15.73	0.0004	
		T min.	0.66	18.46	0.0003	
		R.H.%	-0.13	-1.71	0.5245	
	East	**T max.**	0.72	20.49	0.0001	75.22
		T avg.	0.74	24.53	0.0001	
		T min.	0.74	28.15	0.0001	
		R.H.%	-0.18	-3.16	0.3843	
	South	**T max.**	0.50	3.05	0.0089	56.48
		T avg.	0.53	3.76	0.0051	
		T min.	0.55	4.50	0.0035	
		R.H.%	-0.01	-0.05	0.9464	
Adult	West	**T max.**	0.68	2.06	0.0001	68.16
		T avg.	0.71	2.48	0.0001	
		T min.	0.71	2.89	0.0001	
		R.H.%	-0.21	-0.39	0.3058	
	North	**T max.**	0.68	3.24	0.0001	68.17
		T avg.	0.71	3.93	0.0001	
		T min.	0.72	4.61	0.0001	
		R.H.%	-0.23	-0.67	0.2690	
	East	**T max.**	0.70	4.81	0.0001	70.02
		T avg.	0.73	5.83	0.0001	
		T min.	0,74	6.83	0.0001	
		R.H.%	-0.24	-1.01	0.2477	
	South	**T max.**	0.69	0.90	0.0001	66.92
		T avg.	0.71	1.09	0.0001	
		T min.	0.71	1.28	0.0001	
		R.H.%	-0.22	-0.18	0.2790	

Table (2). The simple correlation and regression coefficients and multiple regressions between the different stages of *Saccharicoccus sacchari* and weather factors in second year (2017/2018).

Factors			Simple correlation and regression			Multiple regression
			R	B	p	E.V. %
Nymph	West	T max.	0.56	7.20	0.0028	66.45
		T avg.	0.53	7.87	0.0050	
		T min.	0.60	10.25	0.0013	
		R.H.%	-0.08	-0.64	0.6989	
	North	T max.	0.62	12.91	0.0008	69.97
		T avg.	0.60	14.42	0.0012	
		T min.	0.66	18.46	0.0003	
		R.H.%	-0.13	-1.71	0.5245	
	East	T max.	0.72	20.49	0.0001	78.73
		T avg.	0.69	22.78	0.0001	
		T min.	0.74	28.15	0.0001	
		R.H.%	-0.18	-3.16	0.3843	
	South	T max.	0.50	3.05	0.0089	65.70
		T avg.	0.48	3.36	0.0130	
		T min.	0.55	4.50	0.0035	
		R.H.%	-0.01	-0.05	0.9464	
Adult	West	T max.	0.68	2.06	0.0001	67.71
		T avg.	0.68	2.34	0.0001	
		T min.	0.71	2.89	0.0001	
		R.H.%	-0.21	-0.39	0.3058	
	North	T max.	0.68	3.24	0.0001	67.48
		T avg.	0.68	3.73	0.0001	
		T min.	0.72	4.61	0.0001	
		R.H.%	-0.22	-0.67	0.2690	
	East	T max.	0.70	4.81	0.0001	68.94
		T avg.	0.70	5.55	0.0001	
		T min.	0,74	6.83	0.0001	
		R.H.%	-0.24	-1.01	0.2477	
	South	T max.	0.69	0.90	0.0001	66.51
		T avg.	0.68	1.03	0.0001	
		T min.	0.71	1.26	0.0001	
		R.H.%	-0.22	-0.18	0.2790	

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