

**Studies on the population fluctuations and distribution of the white mango scale insect, *Aulacaspis tubercularis* Newstead within the canopy of the mango trees in eastern of Delta region at the north of Egypt**

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**ABSTRACT**

Population fluctuations of the white mango scale insect, *Aulacaspis tubercularis*, Newstead, (Coccoidea: Diaspididae) had been studied in mango orchards located at two governorates, (Damietta and Gharbya) in the northern of Egypt during 2010. The obtained data revealed that *A. tubercularis* recorded three peaks at Damietta governorate; these peaks were recorded during February, June and August 2010 when 35.5, 39.1 and 127.1 individuals/leaf were recorded, respectively. At Gharbya governorate two peaks during April 2010, (48.9 individuals/leaf) and July 2010, (32.6 individuals/leaf). The variables of temperature and relative humidity had slight effects on *A. tubercularis* population. On the other hand, *A. tubercularis* preferred south direction than the other cardinal directions (north, east and west) and center of mango tree canopy. Also, this pest preferred the upper surface of leaves during cold month (winter months) and preferred the lower surface of leaves during the hot months (summer months). The sex ratio had been recorded as 34.6:1 (male: females) at Damietta district, while, at Gharbayia governorate, it had been recorded as 20.5:1.

**Key words:** *Aulacaspis tubercularis*, Population fluctuations, Distribution, Sex ratio

**INTRODUCTION**

The white mango scale insect, *Aulacaspis tubercularis* Newstead (Coccoidea: Diaspididae) has been recorded mainly from hosts plants belonging to four plant families: Palmae, Lauraceae, Rutaceae and Anacardiaceae (Borchsenius, 1966). This insect is a serious pest in mango (Fam.: Anacardiaceae) especially on the late cultivars (Daneel & Dreyer, 1998).

*A. tubercularis* is mentioned on quarantine lists (Burger & Ulenberg, 1990). Williams & Watson, (1988) considered *A. tubercularis* to be a potential pest of mango in the South Pacific region, and emphasized the need for strict quarantine procedures. Strict controls on movement of infected planting material and fruits are required if *A. tubercularis* is to be prevented from colonising the rest of the South Pacific area and other tropical countries (Williams & Watson, 1988). *A. tubercularis* injures the leaves and fruits, affecting the commercial value of the fruits and their export potential. Infested mango fruits have conspicuous pink blemishes around the feeding sites of the scales. In nurseries, severe early-stage infestation retards growth. Young trees are particularly vulnerable to excessive leaf loss and death of twigs due to scale infestation, during hot dry weather. *A. tubercularis* presents significant pest problems on mangoes in South Africa, (Colyn & Schaffer, 1993; Joubert *et al.*, 2000 and Daneel & Joubert, 2009). It is also a problem on mangoes in Australia, East and West Africa, North and South America and the Caribbean Islands, (Peña *et al.*, 1997). In Egypt, *A. tubercularis* were the one of the most serious scale insect pests of the scale

insects on mango trees. It recorded 27.5% of the scale insects on mango trees at Qaliobiya governorate (Bakr *et al.*, 2009).

The different methods used to control insect population must be integrated by a strategy addressed towards greater protection of the cultures with respect to ecological, toxicological and economic principles. (Neuenschwander & Paraskakis, 1980).

The purpose of the present contribution is to broaden and more closely examine current knowledge concerning the population fluctuations of *A. tubercularis* in mango orchards in relation to some weather factors in addition to the distribution of this pest within the canopy of mango tree.

## MATERIAL AND METHODS

The experiments of the present study were carried out in two governorates cultivated with mango orchards at the north eastern of Delta region at the north of Egypt. These districts were Damietta (N; 31, 25" E; 31, 46) and Gharbya (N;31,7" E;31, 13).

Five mango trees, (*Mangifera indica* L.) homogenous in size and age were selected and marked at each district for the present study. Samples were collected monthly during the period from January till December 2010. Each sample consisted of 100 leaves (20 leaves/tree) collected from the cardinal directions (north, south, east and west) and center of the trees (four leaves/direction). For each direction, leaves were covered with polyethylene bag on the tree and then pulled up and transferred to the laboratory for examination. Leaves of each direction were investigated on both surfaces by the aid of stereomicroscope.

*A. tubercularis* were recorded as nymphs, adults female and gravid females in addition to adult males.

To represent the effect of some weather factors on *A. tubercularis* population, daily records of maximum, minimum and mean of both temperature and relative humidity in each district were obtained from the Central Laboratory of Climatic Research. The daily records of each weather factor were grouped into monthly means according to the sampling dates.

Minitab computer program, (1998) was used to compute the effect of weather factors on the population fluctuations of *A. tubercularis* population.

## RESULTS AND DISCUSSION

### 1. Population fluctuations of *A. tubercularis*

Population fluctuation of *A. tubercularis* in mango orchards had been studied at two governorates Damietta and Gharbyia at the northern of Egypt) and illustrated in Fig. (1).

#### 1.1. At Damietta governorate:-

The obtained data of the total population indicated that the highest peak occurred at August 2010 when 127.1 individuals/leaf are recorded. There are two high peaks occurred at February and June 2010 when 35.5 and 39.1 individuals are recorded. The least total population recorded 11.1 individuals /leaf at March 2010, 18.7 individuals were recorded at December 2010. Then the total population increased to reach the first peak at February with 35.5 individuals /leaf. The total population fluctuated during the next month to reach the second peak (39.1 individuals / leaf) at June. At July the total population recorded 30.1 individuals/ leaf. The highest peak recorded

127.1 individuals at August 2010, then the total population fluctuated when recorded 19.7, 21.2, 22.7 and 18.7 individuals / leaf at September, October, November and December 2010, respectively.

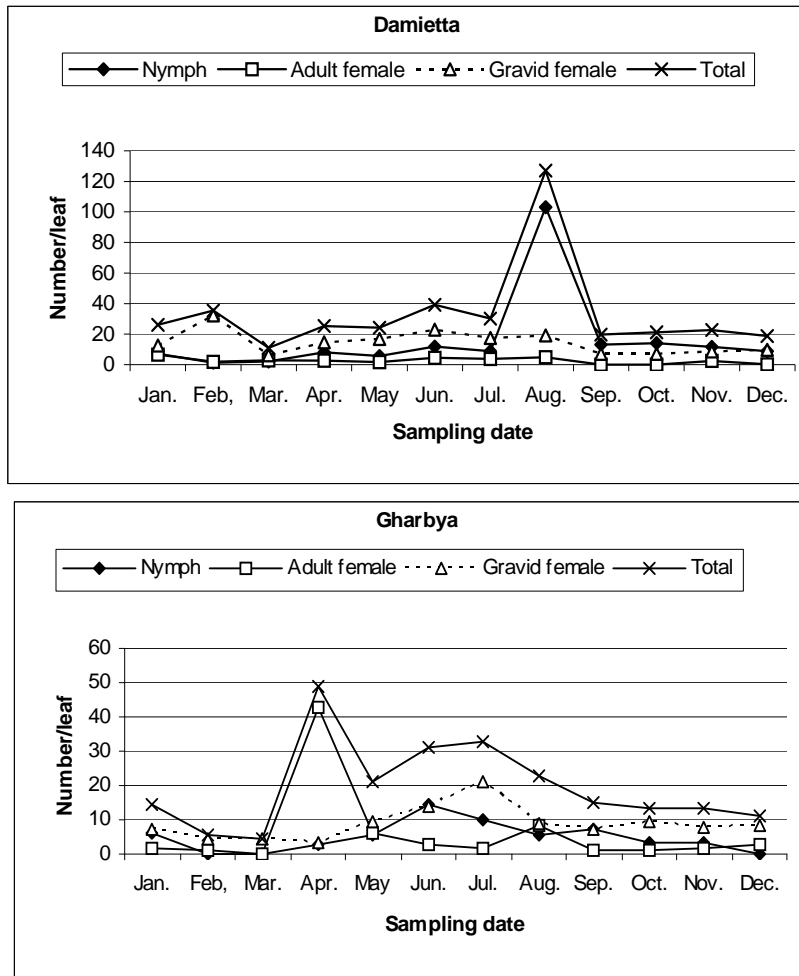


Fig.1: Population fluctuations of *A. tubercularis* stages in mango orchards at Damietta and Gharbyia governorates during 2010 year.

Regarding the nymphal population, 7.1 individuals / leaf were recorded at January. Then it decreased to reach 1.4, 1.2 and 8.0 individuals / leaf were recorded at February, March and April 2010. The population the nymphal fluctuated to reach the highest peak with (103 individuals) at August. Then it charply decline to 13.1 individuals / leaf at September. The nymphal population recorded 14, 11.6 and 8.9 individuals / leaf at October, November and December 2010, respectively.

The population of adult female recorded 6.5 individuals / leaf at January, then it recorded a peak of 4.9 individuals at August. The least population occurred at September and October 2010 with 0.05 individuals/ leaf. Regarding the population of the gravid female recorded a peak with 32.2 individuals / leaf at February. The second peak recorded 22.8 individuals / leaf at June. The least population was recorded at March with 6.1 individuals / leaf.

**1.2. At Gharbyia governorate:-**

The obtained data of population fluctuation at Gharbyia governorate showed that the highest population was occurred during April 2010 when the population reached

48.9 individuals / leaf, while the lowest population was occurred at March 2010 when the population was 4.6 individuals / leaf.

The total population density reached 14.5 individuals / leaf at January 2010, then these number decreased to 5.8 and 4.6 individuals / leaf, respectively. The first peak occurred at April 2010, when 48.9 individuals/ leaf were recorded. The total population declined to 20.9 at the next month. The population gradually increased to reach the second peak with 32.6 individuals / leaf occurred at July 2010. The total population decreased gradually to reach 10.9 individuals/leaf recorded at December 2010. Concerning the population of nymph recorded 6.1 individuals / leaf at January 2010. Then the nymphal stage population fluctuated from 0.2 to 0.00, 2.8 and 5.7 individuals / leaf at February, March and April, respectively. The first peak recorded at June 2010, when 14.5 individuals / leaf were recorded. Then the population of the nymph decreased again to reach the minimum population.

Regarding the population of the adult female recorded 1.4 individuals / leaf at January 2010 and then fluctuated to recorded the first peak at April 2010 when 42.9 individuals were recorded.

The population of the adult female fluctuated throughout the next period. The population of the gravid female recorded 7.1 individuals, then fluctuated to reach the first peak when 21.2 individuals at July 2010. The gravid female population fluctuated during the following period, while the least gravid female population recorded 4.3 individuals / leaf at February 2010.

As shown in Fig. (1), in Gharbyia governorate, the total population of this pest recorded two peaks with 48.9 and 32.6 individuals at April and July. While in Damietta governorate these were three peaks recorded at February, June and August when 35.5, 39.1 and 127.1 individuals /leaf were recorded.

With respect to the effect of some weather factors on *A.tubercularis* population

Table, (1) showed the correlation coefficient between some weather factors and the monthly counts of *A. tubercularis* in mango during 2010. Data in this table declared that the variables of temperature and R.H.% were slight effect on *A. tubercularis* and not reach the significant level except the effect of maximum R.H % in Damietta was high significant and minimum R.H % was significant.

Table1: Simple correlation coefficient between *A. tubercularis*, temperature and relative humidity in mango orchards during 2010 at Damietta and Gharbyia governorates.

Weather Variables	Damietta		Gharbaya	
	r	P	r	P
Maximum Temp.	-0.427	0.166	0.055	0.865
Minimum Temp.	-0.593	0.042	0.072	0.825
Mean Temp.	-0.509	0.091	0.066	0.838
Maximum R.H	0.909	0.00	-0.246	0.441
Minimum R.H.	-0.611	0.035	-0.125	0.698
Mean R.H.	0.490	0.106	0.080	0.804

Similar conclusion was obtained by Urías-López *et al.*, (2010) in Mexico, who mentioned that the low population of *A. tubercularis* had been recorded during the period of rainy season (September to December).

## 2) Distribution of the scale population within the canopy of mango trees:-

### 2.1. Direction within the canopy:

#### 2.1.1 At Damietta governorate:-

The highest population occurred at the east direction was 41.5/leaf and 38.5 individuals presented at April, December 2010 (Fig., 2). While the least population occurred at January, September and October 2010 with 0.0, 6.5 and 6.5

individuals/leaf, respectively. At the west direction, the highest population was 39 and 38.5 individuals/leaf presented at November and June, respectively, while the least population occurred at March and December 2010 with 5.5 and 4.5 individuals/leaf, respectively. The highest population occurred in the north direction was 52.5 and 48.8 individuals / leaf, at February and June 2010, while the least population occurred in January and November with 6.0 and 5.0 ,individuals/leaf. At the south direction, the highest population was occurred at January and November with 93.0 and 44.5 individuals/leaf, respectively. While the least population occurred at March with 9.5 individuals/leaf.

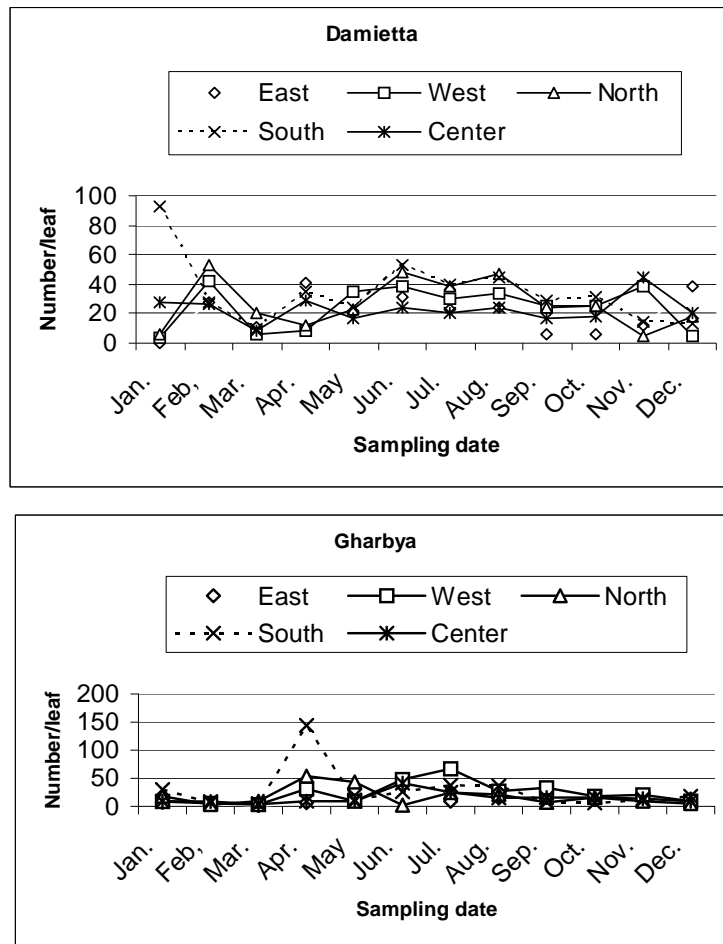


Fig. 2: Population fluctuations of *A. tubercularis* at different cardinal directions of mango tree canopy at Damietta and Gharbya governorates during 2010 year.

In the central core of the mango trees, the highest population occurred at November with 44.0 individuals/leaf, while the least population occurred at March with 8.5 individuals/leaf. The highest population was 7.08 individuals/leaf occurred at February 2010, while the least population was recorded at March with 1.92 individuals/leaf.

**2.1.2 At Gharbya governorate:-**

The highest population of this insect at east direction was 30.5 and 37.5 individuals/leaf recorded at May and June 2010, while the least population was occurred at March with 1.0 individuals. At west direction 48.0 and 67.0 individuals/leaf were considered as the highest population, which recorded at June and July. The least population was 3.5 individuals/leaf were recorded at March. At

north direction, the least population was 3.0 individuals/leaf were occurred at February while, 54.0 and 43.5 individuals were considered as the highest population recorded at April and May 2010. At south direction 144.0, 37.5 and 36.5/leaf individuals as the highest population were recorded at April, July and August 2010, respectively, While the least population occurred at March with 5 individuals. In the center core of the mango tree, the highest population were 41.5 and 25.0 individuals/leaf recorded June and July. The least population was 4.0 individuals/leaf recorded at March.

As shown in (Fig., 2) at the east direction, the highest population was higher in Gharbyia governorate 41.0 individuals than Damietta governorate (37.5 individuals/leaf). The same trend occurred with the least population. At the west direction the highest population was higher in Damietta (67) than Gharbaya (38.5). The same trend could be noticed at North and south directions and central core of the mango trees.

As shown in Fig. (3), *A. tubercularis* population was high in in south direction in Damietta governorate represented by 26% of the total collected population, followed by north 21%, west 19%, center 18 and east represented 16%, while, at Gharbyia governorate, the highest population was occurred in population was high in south direction represented by 29 % of the total collected population, followed by west (24%), North (18%), center (15%) and east (14%).

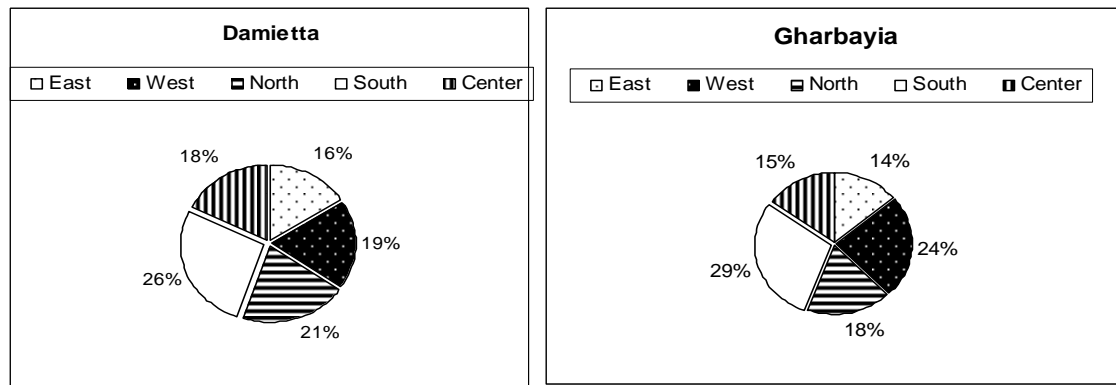


Fig. 3: Present of *A. tubercularis* at different cardinal directions (north, south, east and west) and center of mango tree canopy all over 2010 year at Damietta and Gharbyia Governorates.

So, *A. tubercularis* preferred south direction than other cardinal directions and center of mango tree canopy. Baker *et al.*, (2009) mentioned that *A. tubercularis* preferred east and west direction during cooler and summer weather. The differences between the results and the present may be attributed to the variation between some weather factors and /or agro-ecosystem.

## 2.2. Surfaces of leaves:-

### 2.2.1. At Damietta governorate.

As shown in Fig. (4), the highest population occurred at the upper surface of the mango leaf was 21.8 individuals presented at February 2010, while the least population occurred at the upper surface was 8.4 individuals presented at March 2010. In the lower surface of the mango leaf, 25.6 individuals recorded as the highest population presented at June, while the least population occurred at the lower surface was 0.6 individuals presented at December 2010.

### 2.2.2. At Garbayia governorate.

In the upper surface of the mango leaf, the highest population occurred at April 2010 with 28.1 individuals, while the least population occurred at March 2010 with 1.0 individuals. In the lower surface of the of the mango leaf, the highest population

occurred at April 2010 with 20.8 individuals, while the least population occurred at February with 0.4 individuals.

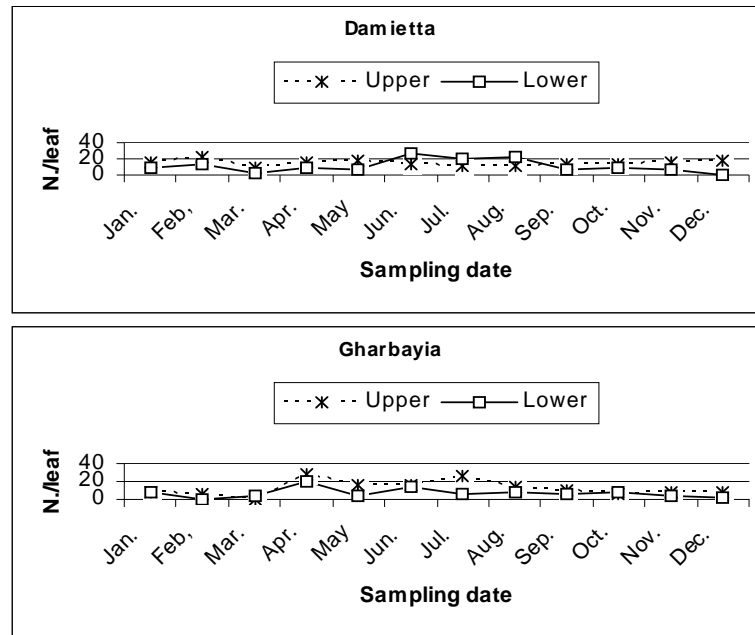


Fig.4: Population fluctuation of *A. tubercularis* in Mango orchards in repressence to leaf surfaces at Damietta and Gharbyia Governorates during 2010 year.

The mean all over the year was 14.6 and 11.9 individuals in upper and lower surface of mango leaf at Damietta governorate, while at Gharbayia governorate was 12.3 and 7.1 individuals/leaf, respectively.

From the above mentioned of view, it could be concluded that, *A. tubercularis* preferred the upper surface of leaves during the cold months and preferred the lower surface of leaves during the hot months, This may be attributed to the adrese effect of the sun rise during the hot months. Also, statistical analysis shows that there were negatively correlations between the fluctuations of *A. tubercularis* population and temperature degrees. Similar conclusion was obtained by Baker *et al.*, (2009).

**3. Sex –Ratio**

Data presented in Table, 2 showed that, sex ratio between the adult male population and female population in the seasonal occurrence of this pest in the two above mentioned districts. It could be concluded that sex ratio ranged between 4.9 and 172.5 in Damietta governorate with a mean of 34.6 all over the year. While, at governorate district, sex ratio ranged between 1.2 and 71.07 with a mean of 20.5 all over the year. At Ghana, Van Haltern, (1970) mentioned that, the sex ratio of *A. tubercularis* was 11:1 (male:female).

Table 2: Sex ratio of *A. tubercularis* in mango orchards at Damietta and Gharbayia governorates during 2010 year.

Districts	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
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<b>Damietta</b>	19.3	54.7	8.0	14.1	11.4	5.8	5.3	4.9	50.0	50.0	19.5	172.5	34.6
<b>Gharbyia</b>	49.6	71.1	8.9	1.2	4.6	37.7	25.5	6.9	16.7	15.7	4.5	3.2	20.5

## REFERENCES

- Bakr, F. A.; Badawy, R. M.; Mousa, S. F.; Hamooda, S. L. and Sahar A. Atteia, (2009). Ecological and taxonomic studies on the scale insects that infest mango trees at Qaliobiya governorate. Egypt. Acad. J. biolog. Sci., 2 (2): 69- 89. Entomology.
- Borchsenius, N. S. (1966). A catalogue of the armoured scale insects (Diaspidoidea) of the world. (In Russian.) Nauka, Moscow, Leningrad, Russia. 449 pp.
- Burger, H. C. and Ulenberg, S. A. (1990). Quarantine problems and procedures. In: D. Rosen (ed.), Armoured scale insects, their biology, natural enemies and control. Vol. 4B. World Crop Pests. Elsevier, Amsterdam, the Netherlands: 313-327.
- Colyn, J. and B. Schaffer (1993). The South African mango industry. Fourth international mango symposium, Miami, Florida, USA, 5-10 July 1992. Acta Horticulturae 341: 60-68.
- DANEEL, M. S. and Dreyer, S. (1998). Biological control of the mango scale, *Aulacaspis tubercularis*, in South Africa. Yearbook-South African Mango Growers' Association. 18: 52-55. 4 ref.
- Daneel, M. S. and Joubert, P. H. (2009). Biological control of the mango scale, *Aulacaspis tubercularis* newstead (Coccidea: Diaspididae) by a parasitoid *Aphytis, chionaspis* ren (Hymenoptera: Aphelinidae). Acta Horticultural, 820: 567-574.
- Joubert, P. H.; Daneel, M. S.; Grove, T. and Pichakum, A. (2000). Progress towards integrated pest management (IPM) on mangoes in South Africa. Acta Horticulturae No. 509: 811-817.
- Neuenschwander, P. and Paraskakis, M. (1980). Studies on distribution and population dynamics of *Saissetia oleae* (Oliv.) (Hom., Coccidae) within the canopy of the olive tree. Z. ang. Ent., 90:366-378.
- Peña, J. E.; Mohyuddin, A. I. and Wysoki, M. (1997). The current mango pests management in the tropics and subtropics. Acta Horticulturae 455: 812-820.
- Urias-López, M. A.; Osuna-García, J. A.; Vázquez-Valdivia†, V. and Pérez-Barraza, M. H. (2010). Fluctuation poblacional y distribución de la escama blanca del mango, (*Aulacaspis tubercularis* Newstead) en nayarit, México. Año: 2010, Volumen XVI, Número 2 : mayo-agosto, p. 77-82
- Van Halteren, P. (1970). Notes on the biology of the scale insect *Aulacaspis mangiferae* Newst. (Diaspididae, Hemiptera) on mango. Ghana Journal of Agricultural Science 3: 83-85.
- VIGGIANI, G.; Battaglia, D. and Jesu, R. (1986). The mating of *Physcus testaceus* Masi (Hym. Aphelinidae), with preliminary notes on the structure of the male antennal scape. Bollettino del Laboratorio di Entomologia Agraria "Filippo Silvestri", Portici 43: 3-6.
- Williams, D. J. and Watson, G.W. (1988). The scale insects of the tropical South Pacific region. Part 1 The armoured scales (Diaspididae). CAB International, Wallingford, UK. 290 pp.

## ARABIC SUMMARY

دراسات على التذبذب العددي وتوزيع حشرة المانجو القشرية البيضاء في بيئة شجرة المانجو

مصطفى مهران المتولي- صابر فهيم محمود موسى - نبيل محمد غانم  
معهد بحوث وقاية النباتات - مركز البحوث الزراعية



تعتبر حشرة المانجو القشرية البيضاء من أشد الآفات ضرراً بأشجار المانجو حيث تؤدي الإصابة إلى اصفرار الأوراق وجفافها وبالتالي سقوطها نتيجة امتصاص العصارة النباتية وفي حالة شدة الإصابة فإن الإصابة تنتقل إلى الثمار وتسبب تشوهات في الثمار مما يؤدي إلى تقليل القيمة التسويقية لهذه الثمار. تمت دراسة تذبذبات التعداد لهذه الآفة في حدائق أشجار المانجو على مدار موسم كامل من يناير - ديسمبر ٢٠١٠ في محافظتي دمياط والغربية.

ولقد أظهرت نتائج الدراسة أن لحشرة المانجو القشرية البيضاء ثلاث قمم في محافظة دمياط تم تسجيلهم في أشهر فبراير (٣٥,٥ أفراد)، يونيه (٣٩,١ أفراد) وشهر أغسطس ٢٠١٠ (١٢٧,١ أفراد) بينما سجلت لهذه الحشرة عدد ٢ قمة في محافظة الغربية في شهري إبريل (٤٨,٩ أفراد) ويوليو ٢٠١٠ (٣٢,٦ أفراد). وقد لوحظ أن درجات الحرارة والرطوبة لها تأثير خفيف على تعداد الحشرات.

لوحظ أن حشرة المانجو القشرية البيضاء تفضل الاتجاه الجنوبي للأشجار على الاتجاهات الأخرى (الشمال، الشرق، الغرب، الوسط) كذلك تفضل الحشرة السطح العلوي للأوراق في الشهور الباردة (فصل الشتاء) والسطح السفلي للأوراق في الشهور الحارة (فصل الصيف) كما أن النسبة الجنسية لهذه الحشرة في دمياط (٢٠,٥ : ١) وفي الغربية (٣٤,٦ : ١) (ذكور: إناث).