Population Estimates of the White mango scale insect *Aulacaspis tubercularis* (Hemiptera: Diaspididae) on mango trees in Relation to Biotic and Abiotic Factors in Damietta Governorate.

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ABSTRACT:

The white mango scale insect, *Aulacaspis tubercularis* (Diaspididae: Hemiptera) is one of the most dangerous species of scale insects that attack mango trees in Egypt. The purpose of this study is to track changes in the pest's population in mango orchards in the New Damietta region between the 2022–2023 and 2023–2024 seasons. The impact of natural enemies and weather factors (means of temperature °C, relative humidity % and wind velocity km/h in addition to tree directions) on the population density of *A. tubercularis* has been investigated. *A. tubercularis* recorded three peaks of abundance annually that occurred in the months of May, August and February. The summer months had the maximum population of this insect, with average counts of 3908.0 and 3006.2 individuals/125 leaves in the 1st and 2nd years of study, respectively, conversely, the winter months of both seasons saw the lowest of insect population. The overall population of *A. tubercularis* was affected significantly by natural enemies and the daily mean temperature, whereas the overall population of the tested pest was not significantly affected by R.H. % or wind velocity. During the two years of the investigation, *A. tubercularis* prefers the southern direction of the mango tree. Data showed that populations of this insect pest and its natural enemies were occurrence synchronized.

Keywords: *Aulacaspis tubercularis;* mango; directions; biotic and abiotic factors.

INTRODUCTION

Mango trees, *Mangifera indica* L. (Anacardiaceae) considered as one of the most important fruits in Egypt. It has a high percentage of lipids, salts, sugar, protein, and vitamins. Mango plays an important economic role due to its use in manufacturing juices, which are exported to many countries of the world due to the quality of Egyptian varieties. Today, for these reasons, the total areas cultivated with mango in Egypt are increasing. According to Economic Agricultural Report, from Central Administration for Economic Agriculture, Ministry of Agriculture, Egypt, 2007**,** in 2007, the area planted with mangoes amounted to about 129,073 acres, and it produced about 497,771 tons. According to Abdelsalam *et al.* (2018) mango was introduced to Egypt about two hundred years ago. The area cultivated with mangoes reached about 102,071.76 hectares in 2015, most of which is concentrated in Ismailia Governorate.

In many countries of the world, the most important pests that affect mango trees are scale insects especially *Aulacaspis tubercularis* (Diaspididae: Hemiptera), Gallardo (1983), Williams and Watson (1988). According to Colyn and Schaffer (1993), Peña *et al.* (1998) and Joubert *et al.* (2000) the white mango scale insect, *A. tubercularis*, attacks all parts of the mango tree, branches, leaves and fruits, which affects the commercial value of the fruits and the possibility of exporting them. Younger trees are considered the most vulnerable to damage resulting from this pest, as it causes loss of leaves, death of branches, and the ability to produce fruit, especially in dry areas such as South Africa. It also represents the most important problem for mangoes in the continents of Africa, North and South America, the Caribbean islands and Australia.

Ascher *et al.* (1995) mentioned that *A. tubercularis* is one of the most insect pests that attacks mango trees, population peaks occurred during different times of the year. The population peak in the Kapmuiden region, which is characterized by high temperatures, occurred in August, much earlier than in the Nelspruit region, where it occurred in November. In Beni-Swief Governorate, Egypt, Radwan (2003) recorded three generations of *A. tubercularis* population on mango trees. Whereas, Kwaiz (2009) in Egypt recorded three peaks of infestation for *A. tubercularis* population on mango during months of March, June and November, in mid-July the lowest population was recorded.

Therefore, this study was conducted to monitor fluctuations in the numbers of this pest in mango orchards at Damietta Governorate, and to study the effect of environmental factors (temperature, relative humidity, wind speed, and preferred

direction) also, biotic factors (predators and parasitoids) on population of this insect.

MATERIALS AND METHODS

All experiments of the current study were conducted between March 2022 and February 2024 on approximately seven-year-old mango trees (*Mangifera indica* L.) (Anacardiaceae), Ghrawi variety, in an orchard planted with only mango trees, the orchard area is about three feddans, located in the New Damietta area of Damietta Governorate, Egypt. Throughout the study period, no chemical control was applied to the chosen orchard. Every tree was given the same standard horticultural procedures.

Sample size:

To complete this study, five trees in the same orchard were chosen and labeled. The chosen trees for the research were homogeneous in terms of their *A. tubercularis* infestation and comparable in terms of size, shape, height, and vegetation. During the course of the study, samples were taken every two weeks from the middle of each chosen tree as well as the four cardinal directions of north, south, east and west.

A sample of 125 mango leaves was used [i.e., 5 trees × 5 (4 directions + center) ×5 leaves] during the two seasons period. Samples were taken from each direction of the mango tree using garden scissors and immediately packed into plastic bags for same-day examination. To calculate and record the different stages of *A. tubercularis* and its predators (immature and adult stages) in the lab, a stereomicroscope (microscope) was used.

In order to examine the parasitism ratios of *A. tubercularis*, the insects in each sample were divided into two groups: the first were healthy alive insects and the second were parasitized insects that contained larvae or pupae of the parasitoids or emerging holes of adult parasitoids. Every parasitized insect or healthy one was counted and recorded.

Distribution of *A. tubercularis:*

Directional preference of *A. tubercularis* was determined by applying the following equation Al Shidi *et al.* (2018) and Gillison (2006):

F1 = (East – West) F2 = (North – South)

Tan. Q = F2/F1

Where:

F1 = Total numbers of *A. tubercularis* on the (East direction) minus that on the (West direction) if former is higher, and vice versa.

F2 = Total numbers of *A. tubercularis* on the (North direction) minus that on the (South direction) if former is higher, and vice versa.

The tangent is represented by the resulting figure, whose matching value the equation received.

Tan. Q = Tan of the angle between F1 and F2.

During the two study years, the distribution of *A. tubercularis* populations in various seasons was also determined.

Meteorological data:

Central Laboratory for Agricultural Climate provided average air temperature. (°C), and average relative air humidity (R.H. %) and wind velocity km/h, in the experimental area during the study period.

Statistical analysis:

The obtained data were subjected to one-way ANOVA and regression analyses using the SPSS software; if the mean was significant, Duncan's multiple range tests was used to separate the data.

RESULTS AND DISCUSSION

Population fluctuation of the *A. tubercularis* on mango trees:

Data represented in Figure (1) showed that the annual total numbers of male, female and total individuals of *A. tubercularis* were higher in the 1st season than the 2nd one, the total numbers were 40659.4, 7401.4 and 48060.8 individuals / 125 leaves respectively, during the 1st season; these numbers were 31276.5, 5693.3 and 36969.8 individuals / 125 leaves respectively, in the 2nd season. Statistical analysis showed that there were no significant differences between the two seasons tested.

The population fluctuations of *A. tubercularis* on mango trees during the two annual seasons of 2022/23 and 2023/24 are illustrated in Figures (2 and 3). Each of the 1st and 2nd seasons saw three annual peaks for *A. tubercularis* insects. During the 1st year of study 2022/23, the 1st peak of infestation was occurred on 16th of May 2022 and represented by 1355, 247 and 1602 /125 leaves for male, female and total individuals respectively, when the daily mean of temp., relative humidity, and wind velocity of 25.7 °C, 51.5%, and 16.8 km/h, respectively, the second and

highest peak was on 22nd of Aug. 2022 and represented by 4788, 872 and 5660 /125 leaves for male, female and total individuals respectively, with Temp., R.H. and W. 27.1°C, 62.7% and 9.3 km/h, respectively and the third one was on 20th of Feb. 2023 and represented by 1028, 187 and 1215 /125 leaves for male, female and total individuals respectively, with Temp., R.H. and W. 16.9°C, 62.9% and 12.7 km/h, respectively.

The same trend appeared during the second year of the study 2023/24, as the first, second and third peaks for *A. tubercularis* on mango trees occurred at the same months, May, August and February. The first peak was occurred on 15th of May 2023 and represented by 1043, 190 and 1232 /125 leaves for male, female and total individuals respectively, with mean temp., R.H. % and W. 15.9 °C, 69.9% and 9.3 km/h, respectively. The second and highest peak was on 7th of Aug.2023 and represented by 3683, 670 and 4354 /125 leaves for male, female and total individuals respectively, with mean temp., R.H. % and W. 15.9 °C, 69.9% and 9.3 km/h, respectively and the last and lowest peak was recorded on 19th of Feb. 2024 and represented by 791, 144 and 935 /125 leaves for male, female and total individuals respectively, with mean temp., R.H. % and W. 15.9 °C, 69.9% and 9.3 km/h, respectively.

The highest population abundance of *A. tubercularis* during the two seasons was in August Figures (2 and 3).

The results obtained are in line with the findings of Ascher *et al. (*1995), who noted that the population peaks of *A. tubercularis* happened at various times of the year. The insect recorded its peak in the Kapmuiden region, which is characterized by high temperatures, happened in Aug., significantly earlier than in the Nelspruit region, where it happened after three months in November. In Beni-Swief Governorate, Egypt, Radwan (2003) recorded three generations of *A. tubercularis* population on mango trees. Whereas, Kwaiz (2009) in Egypt recorded three peaks of infestation for *A. tubercularis* population on mango during months of March, June and November, in mid-July the lowest population was recorded. Nabil *et al*. (2012) recorded one peak of *A. tubercularis* a live stage yearly in November. The white mango scale, *A. tubercularis* on mango trees recorded three generations per year. Two parasitoids species were recorded as parasitoids of *A. tubercularis* *Encarsia* sp. and *Aphytis* sp. (Family: Aphelinidae), *Habrolepis diaspidi* (Risbec) (Family: Encyrtidae) and one predator, *Cybocephalus micans* Reitter belonging to Family: Nitidulidae was recorded. On mango trees (Hendi varity) the seasonal activity of *A. tubercularis* and its insect parasitoids recorded two peaks in the two studied years Attia, *et al.* (2020).

Effect of meteorological factors on *A. tubercularis* population density:

The data represented in Table (1) showed that the simple correlation (r) and partial regression (b) coefficients between the population density of *A. tubercularis* and a biotic factors, (daily mean of temp., the daily mean of R.H. % as well as wind velocity) and biotic factors (predators and parasitoids) during the two studied years (2022/23 & 2023/24).

The correlation between total numbers of *A. tubercularis* population and the daily mean of temp., was highly significant and positive in the two studied years r = 0.723 and 0.687 in 1st and 2nd years respectively, whereas it was non-significant negative and positive correlation for relative humidity r = -0.052 and 0.079 in 1st and 2nd years respectively. On the other hand the wind velocity showed non-significant negative correlation in the first and second years r = -0.323 and -0.088. The relation between total numbers of *A. tubercularis* and its associated predators and parasitoids were highly significant and positive in the two studied years r = 0.984, 0.984, 0.926 and 0.931 in 1st and 2nd years respectively,

The partial regression data in Table (1) show the exact impact of every meteorological element that was investigated. These numbers demonstrated the same pattern as the simple correlation coefficient. The total impacts of abiotic factors (daily mean of temperature ℃, Relative humidity R.H. % and the wind velocity) and biotic factors (predators and parasitoids) on the total population of *A. tubercularis* during the two successive years were 97.9 and 98.4%, respectively.

The results are in line with the findings of Nabil and, *et al*. (2012) the combined effects of the weather parameters (temp. ℃, relative humidity R.H. %, and light intensity Lux) that were tested over the course of the two years were 63.19 and 40.20 percent in the upper level and 77.66 and 39.44 percent in the lower one. The total number of *A. tubercularis* a live stage was affected by 70.60 and 87.13 percent in the 1st and 2nd years, respectively, by the coefficient of determination (C.D. %) of means of max. and mini. temp. (°C), relative humidity (R.H. %), and solar radiation (MJ/m2). Attia *et al*.

(2020). According to Ascher *et al*. (1995), *A. tuberculosis* peaks occurred at various times of the year. *A. tubercularis* peak occurred during August, in the Kapmuiden district, which is known for its hot temperatures, In contrast to the Nelspruit region, where it happened in November.

The synchronization between populations of *A. tubercularis* and its natural enemies:

Data represented in Figures (4 and 5) showed the total numbers of *A. tubercularis* and its natural enemies; one Coleopterous predator (*Cybocephalus micans* Reitter, Nitidulidae) and two Hymenopterous parasitoid (*Aspidiotiphagus* sp. and *Aphytis* sp.) belonging to family Aphelinidae on mango trees during the two study seasons (2022/23 & 2023/24).

Data represented in (Fig. 4), show the total numbers of the predatory insect, *Cybocephalus micans* had one peak of activity in the first year of study that coincided with the highest peak of *A. tubercularis* population that occurred in 22nd of Aug. 2022 (272 predators/ 125 leaves). The same trend was showed in the 2nd year (Fig. 5), the highest peak of *C. micans* was coincided with the highest peak of *A. tubercularis* that noticed in 7th of Aug. 2023 (209 predators/ 125 leaves).

On the other hand, the highest total numbers of *A. tubercularis* parasitoids was coincided with the highest peak of *A. tubercularis* that recorded in the beginning of Aug. during the two studied years. The total numbers of parasitoids (parasitized individuals of *A. tubercularis*) per 125 plant leaves were 353 and 235 in each of the 1st and 2nd study years, respectively.

It can be concluded that, the white mango scale insect, *A. tubercularis* and its associated natural enemies (predators and parasitoids) took the same trend of the population fluctuation during the 1st and 2nd years. The highest peak number of *A. tubercularis* (5660 and 4354 individuals), predators (272 and 209 predators) and parasitoids (353 and 235 parasitoids) were recorded in Aug. in the 1st and 2nd years, respectively. Whereas, the lowest numbers for the aforementioned pest and associated predators and parasitoids occurred during March during both years of the study.

As shown in Table (1) the population fluctuations of *A. tubercularis* and its natural enemies were confirmed by the simple correlation coefficient results. Throughout the first and second years of the study, each of the predators and the parasitoids population activity synchronized with their host, *A. tubercularis* population activity.

Despite the decrease in the number of biological enemies in this study, their effect on the insect population was significant. This may be attributed to the decrease in the number of females, which are responsible for the resulting offspring.

These findings are in line with those of Kamel *et al.* (2003), Nabil *et al*. (2012), and Hamdy (2016), who investigated the seasonal fluctuation of eighteen parasitoid species classified as genus Aphytis, in Egypt fields on 10 host plants attacked with 11 species of armored scale insects from the family Diaspidids. According to Nabil *et al*. (2012), the highest percentages of parasitism on *A. tubercularis* ranged from 0.8 to 14.6%. The same authors recorded the Coleopterous predator (*Cybocephalus micans* Reitter Family: Nitidulidae) as a predator of *A. tubercularis* for the first time in Egypt. The mean percentages of parasitism on *A. tubercularis* were 2.78 and 7.37% in the 1st and 2nd years, respectively. Two species of Hymenoptera have been identified as *A. tubercularis* parasitoids. These were *Aspidiotiphagus* sp. and *Aphytis* sp. (Aphelinidae), Attia *et al.* (2020).

Distribution of *A. tubercularis* on mango trees:

Results in Figures 6 and 7 show the influence of different directions; south, north, East and west, in addition to the center of mango tree on *A. tubercularis* distribution during the two successive years.

During the 1st and 2nd seasons of study, the southern direction of the mango tree recorded the higher population of the white mango scale insect, *A. tubercularis* in comparing with other directions and represented with seasonal mean 480.6 and 369.7 individuals/ sample in the 1st and 2nd seasons respectively. The second favorite direction was north direction and represented with 388.2 and 298.6 individuals/ sample, followed by the east, with 351.2 and 270.2 individuals/ sample. The center of the tree recorded 332.7 and 255.9 individuals/ sample. On the other hand, lowest *A. tubercularis* population during the study seasons was recorded in the west direction and represented by 295.8 and 227.5 individuals/ sample Fig. (6).

As shown in Fig. (7) the southeast direction was the most preferable direction for the white

mango scale insect, *A. tubercularis* on the mango tree in both years studied, with angel 59.04 degree and 59.03 degree in the first and second years. The majority of *A. tubercularis* species were concentrated in the southeast of the mango tree. This is because the insect has a positive response to light. The insect loves bright sunlight in the southern direction, which explains these results.

Over the course of the study's two years, statistical analysis revealed that there were non-significant variations in the mean counts of *A. tubercularis* between directions.

The results concurred with_El-Metwally *et al. (*2011), who observed that, in Damietta Governorate, *A. tubercularis* preferred the south direction above the other cardinal directions. In Qaliobiya, Egypt, Sanad (2017) found that, in comparison to other directions, the south and east directions of the tree had the highest *A. tubercularis* infestations. Also, Bakry and Tolba (2019), *A. tubercularis* population showed significant differences in each of the mango tree's directions in the Upper Egypt, Luxor Governorate. The grand mean numbers were found to be comparatively higher in the south, followed by the east. On the other hand, the north had the least amount of insect infestation, while the west had a moderate amount. As a result, it may be said that *A. tubercularis* prefers to accumulate on the east and southern sides of mango trees, where it is warmer and more exposed to the sun.

Conversely, *A. tubercularis* perfected east and west directions in summer and cooler conditions, according to Bakr *et al.* (2009). Attia *et al*. (2020) found that the northeastern directions of mango trees are the most favorable for *A. tubercularis* and its associated parasites in Sharkia Governorate. Furthermore, in Sharkia, Egypt, Nabil *et al.* (2012) found that there were notable variations between the four cardinal directions of mango trees and that *A. tubercularis* was primarily found on the northeastern side.

The variance in some weather conditions and/or agro-ecosystem could be the reason for the discrepancies between earlier results and the current ones.

Seasonal distribution of *A. tubercularis*:

As shown in Fig. (8) The influence of different seasons on the population distribution of *A. tubercularis* (male, female and total individuals) in each of the two studied seasons, (2022/23) and (2023/24).

During the 1st season, the highest mean numbers of male, female and total individuals for *A. tubercularis* were recorded in the summer season with 3306.2, 601.8 and 3908.0 individuals /125 leaves respectively, followed by autumn with 1499.4, 272.9 and 1772.4 individuals /125 leaves respectively. On the other hand, spring and winter recorded lower numbers of male, female and total individuals, the insect in the spring represented by 854.1, 155.5 and 1009.6 individuals /125 leaves respectively, while in the winter the insect represented by 724.3, 131.9 and 856.2 individuals /125 leaves respectively.

During the 2nd year of study the same trend shown; the highest mean numbers of male, female and total individuals for *A. tubercularis* were recorded in the summer season with 2543.3, 463.0 and 3006.2 individuals /125 leaves respectively, followed by autumn with 1153.4, 210.0 and 1363.3 individuals /125 leaves respectively. On the other hand, spring and winter recorded lower numbers of male, female and total individuals, the insect in the spring represented by 657.1, 119.6 and 776.8 individuals /125 leaves respectively, while in the winter the insect represented by 557.2, 101.4 and 658.6 individuals /125 leaves respectively.

These results were relatively in agreement with Bakry and Tolba (2019) who mentioned that, the overall mean populations of *A. tubercularis* on mango leaves were highest during autumn months followed by summer months, spring months and winter months in Luxor Governorate, Egypt. *A. tubercularis* is a photopositive insect and because more sunlight reaches the upper surface of the leaf than its lower surface. The above results confirm that: *A. tubercularis* prefers the upper surface of mango leaves than the lower surface also it prefer the more shining direction than the other one. According to Bakry and El-Zoghby (2019), the summer and fall seasons of the year had more favorable weather conditions for the growth and multiplication of *A. tubercularis* insects. Additionally, the optimal times for insect activity differed depending on the research years and the examined stages. Also, Sanad (2017) who found that, in autumn season the *A. tubercularis* insects recorded its largest number in Qalubiya, Egypt.

CONCLUSION:

Population fluctuation of the *A. tubercularis* on mango trees:

A. tubercularis recorded three peaks annually during the 1st and 2nd years; the highest population abundance was occurred in August during the two seasons. The annual numbers of male, female and total individuals for *A. tubercularis* were 40659, 7401 and 48061 individuals /125 leaves respectively, during the 1st season, these numbers were 31276, 5693 and 36970 individuals /125 leaves respectively, in the 2nd season.

The synchronization between populations of *A. tubercularis* and its natural enemies:

The predatory insect, *Cybocephalus micans* Reitter, (Coleoptera Nitidulidae) and two Hymenopterous parasitoid (*Aspidiotiphagus* sp. and *Aphytis* sp., Aphelinidae) on mango trees showed synchronization with *A. tubercularis* population. The highest population of abundance of *A. tubercularis* and its associated natural enemies was occurred in August during the two seasons.

Distribution of *A. tubercularis* on mango trees:

During the studied years, the southern direction of the mango tree recorded the higher population of the white mango scale insect, *A. tubercularis* in comparing with other directions, followed by north east, center directions of the tree while, the lowest population was recorded in the west direction. Over the course of the study's two years, statistical analysis revealed that there were non-significant variations in the mean counts of *A. tubercularis* between directions.

Seasonal distribution of *A. tubercularis*:

The highest mean numbers of male, female and total individuals of *A. tubercularis* were recorded in the summer season followed by autumn. On the other hand, spring and winter recorded lower numbers of male, female and total individuals during the two years of study.

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Table 1: Simple correlation, regression coefficients, and explained variance (E.V.) between the biweekly total of *A. tubercularis* populations and means of evaluated meteorological factors during 2022/23 and 2023/24.

Year	Factor	Simple correlation analysis		Multiple Partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
2022/23	Temp.	0.723	0.000	-26.02	0.066	230.95	0.000	97.9%
	R.H.	-0.052	0.800	-17.45	0.195			
	W. Velocity	-0.323	0.108	39.02	0.107			
	Predator	0.984	0.000	16.151	0.000			
	Parasitoids	0.926	0.000	4.624	0.009			
2023/24	Temp.	0.687	0.000	-27.41	0.013	305.96	0.000	98.4%
	R.H.	0.079	0.701	-2.45	0.777			
	W. Velocity	-0.088	0.667	38.34	0.006			
	Predator	0.984	0.000	17.764	0.000			
	Parasitoids	0.931	0.000	3.857	0.022			

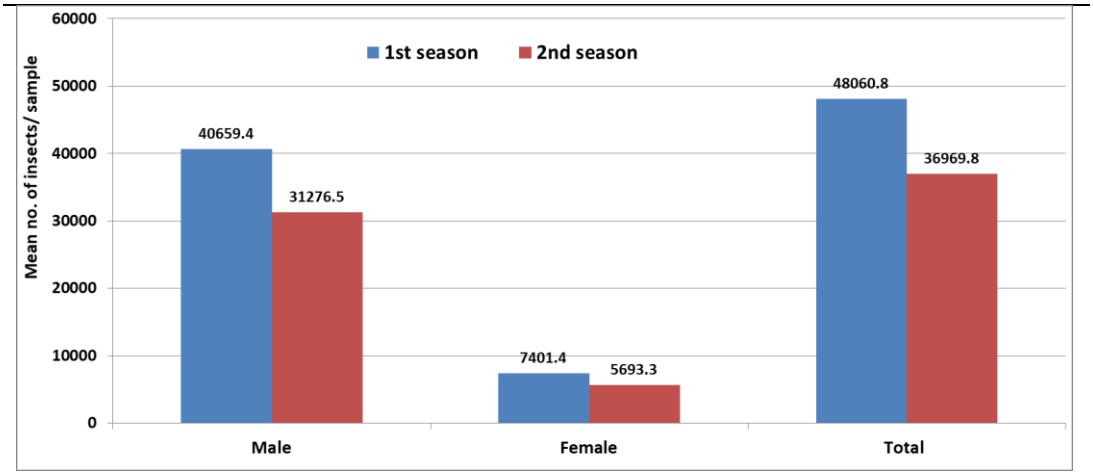


Figure 1: Total numbers of *A. tubercularis*; (males, females and total individuals) on mango tree in the 1st and 2nd seasons at the New Damietta region.

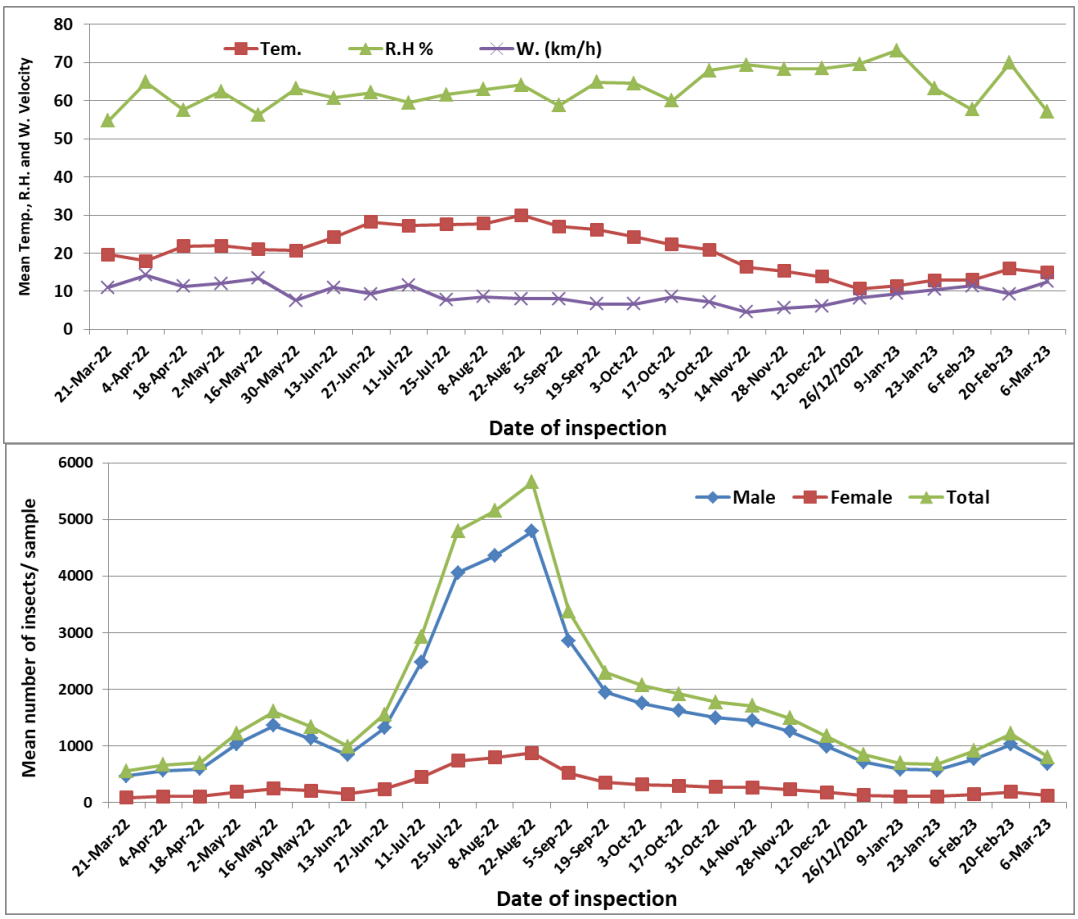


Figure 2: Total numbers of *A. tubercularis* (males, females, and total individuals) per 125 leaves and the related tested climatic parameters for the 1st year of 2022/23 at Damietta Governorate.

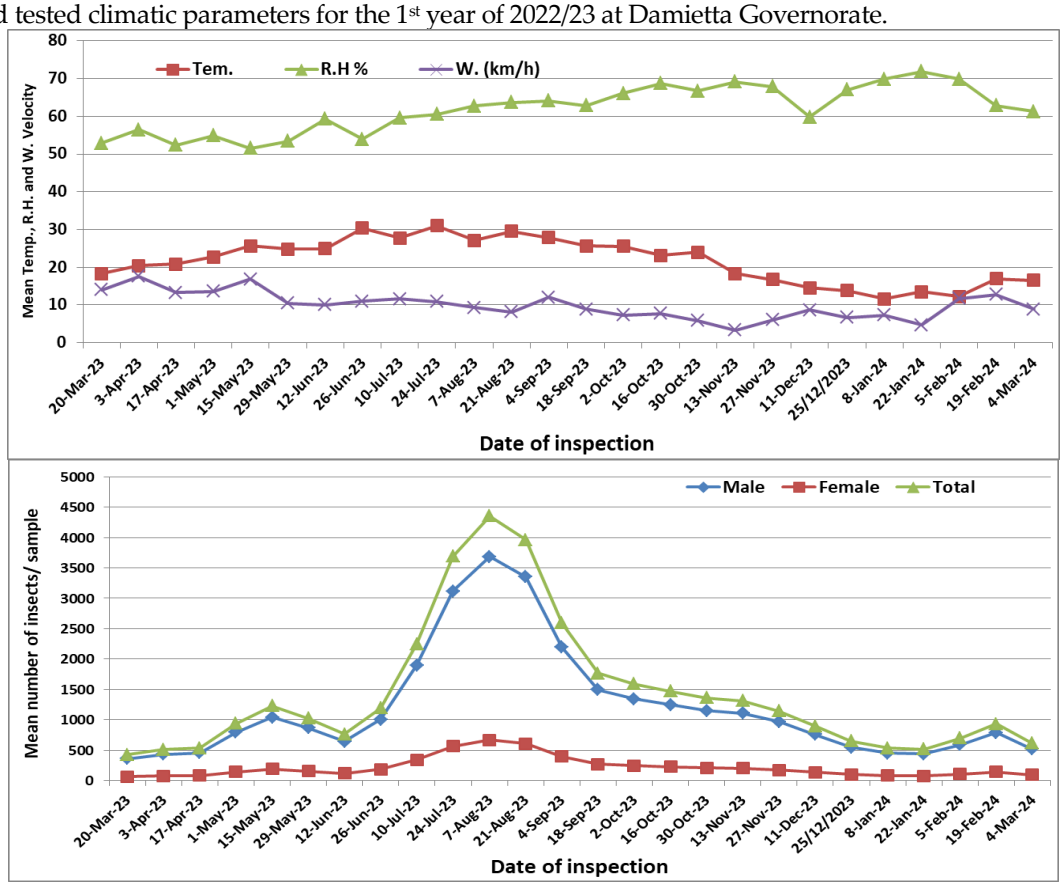


Figure 3: Total numbers of *A. tubercularis* (males, females, and total individuals) per 125 leaves and the related tested climatic parameters for the 2nd year of 2023/24 at Damietta Governorate.

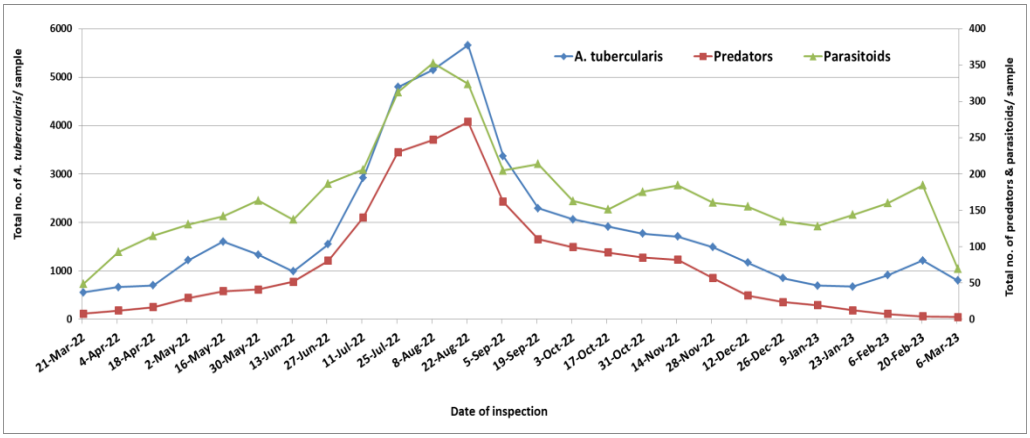


Figure 4: the total numbers of *A. tubercularis* and associated natural enemies/125 leaves in the 1st year of study (2022/23).

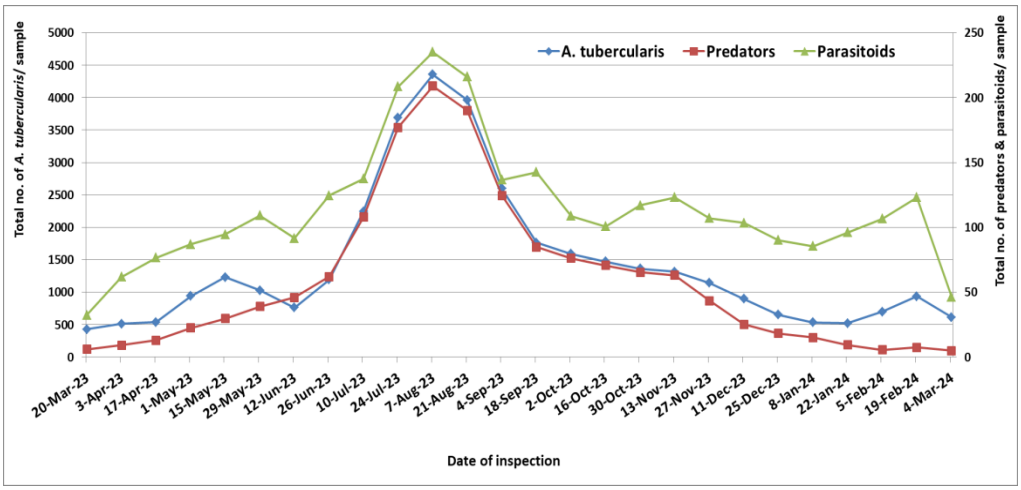


Figure 5: the total numbers of *A. tubercularis* and associated natural enemies/125 leaves in the 2nd year of study (2023/24).

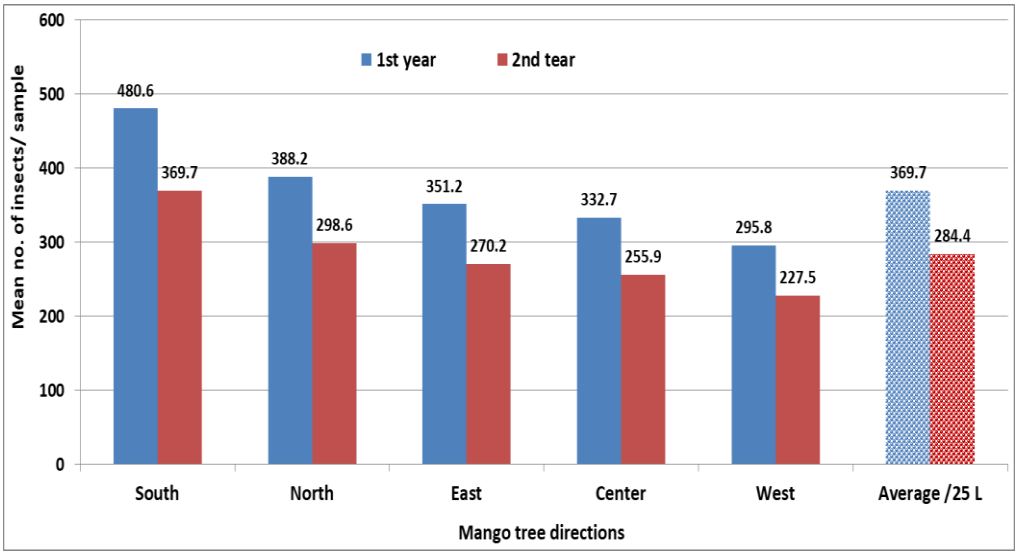
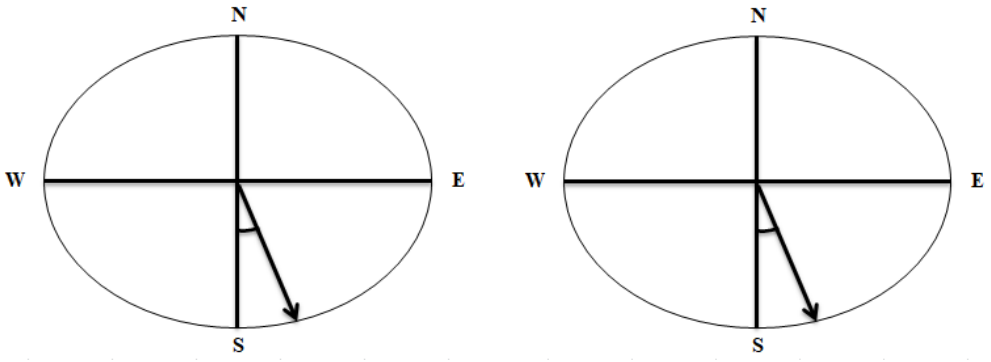


Figure 6: Mean numbers of *A. tubercularis* on mango tree directions in the 1st and 2nd years at the New Damietta region.



Angle = 59.04° Angle = 59.03°
First year 2022/23 Second year 2023/24

Figure 7: Preferred directions for *A. tubercularis* on mango trees during 2022–2023 and 2023–2024 in the New Damietta area.

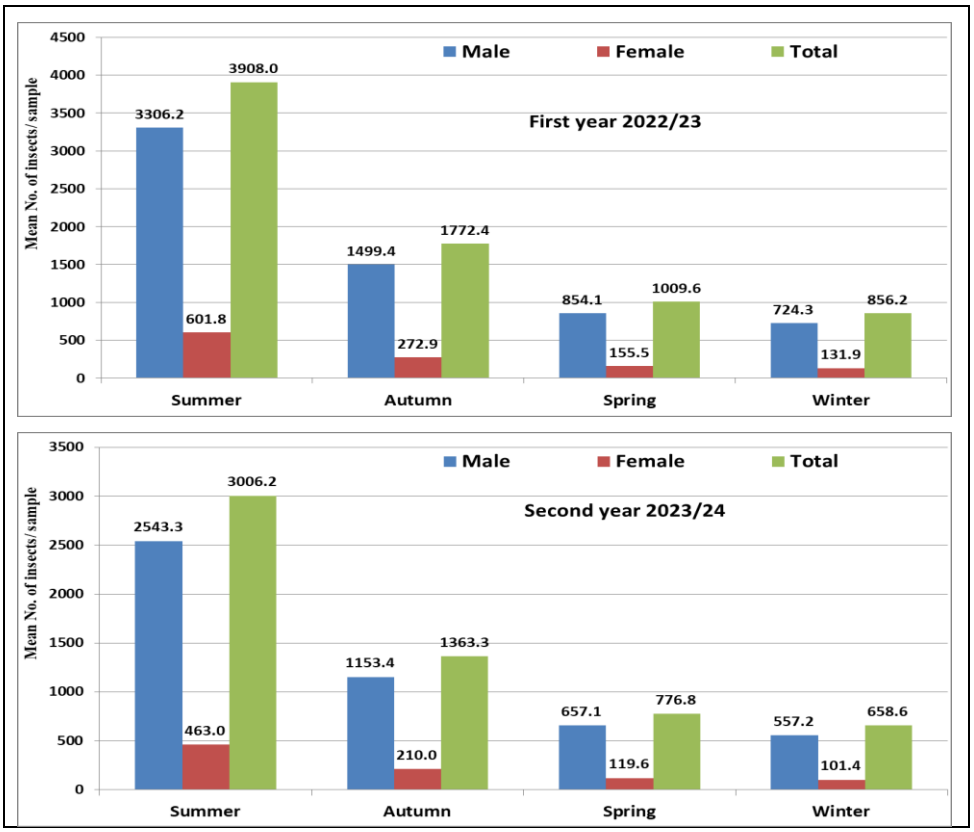


Figure 8: Seasonal distribution of the different stages of *A. tubercularis* on mango trees in the two studied years (2022/23) and (2023/24) at the New Damietta area, Damietta Governorate.

تقديرات تعداد حشرة المانجو القشرية البيضاء على أشجار المانجو وعلاقتها بالعوامل الحيوية وغير الحيوية في محافظة دمياط

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الملخص العربي:

تعتبر حشرة المانجو القشرية البيضاء من أخطر أنواع الحشرات القشرية التي تهاجم أشجار المانجو في مصر. الغرض من هذه الدراسة هو تتبع التغيرات في أعداد الآفة في بساتين المانجو بمنطقة دمياط الجديدة بين موسمي 2022-2023 و2023-2024. تمت دراسة تأثير الأعداء الحيوية الطبيعية والعوامل الجوية (متوسط درجة الحرارة درجة مئوية، الرطوبة النسبية٪ وسرعة الرياح كم/ساعة بالإضافة إلى اتجاهات شجرة المانجو) على الكثافة العددية لهذة الحشرة. سجلت حشرة المانجو القشرية البيضاء ثلاث ذروات للوفرة سنويًا حدثت في أشهر مايو وأغسطس وفبراير. شهدت أشهر الصيف أكبر عدد من هذه الحشرة، حيث بلغ متوسط أعدادها 3908.0 و3006.2 فرداً /125 ورقة خلال العامين الأول والثاني من الدراسة على التوالي، على العكس من ذلك، شهدت أشهر الشتاء في كلا الموسمين أقل عدد من تعداد الحشرات. تأثر إجمالي تعداد هذه الآفه بشكل معنوى بالأعداء الحيوية الطبيعية ومتوسط درجة الحرارة اليومية، في حين أن إجمالي تعداد الآفة لم يتأثر بشكل كبير بالرطوبة النسبية أو سرعة الرياح خلال. عامي الدراسة ، فضلت الحشرة الاتجاه الجنوبي لشجرة المانجو. وأظهرت البيانات أن أعداد هذه الآفة الحشرية وأعدائها الطبيعية كانت متزامنة.

الكلمات الاسترشادية:*Aulacaspis tubercularis* ، المانجو، الإتجاهات، العوامل الحيوية وغير الحيوية.