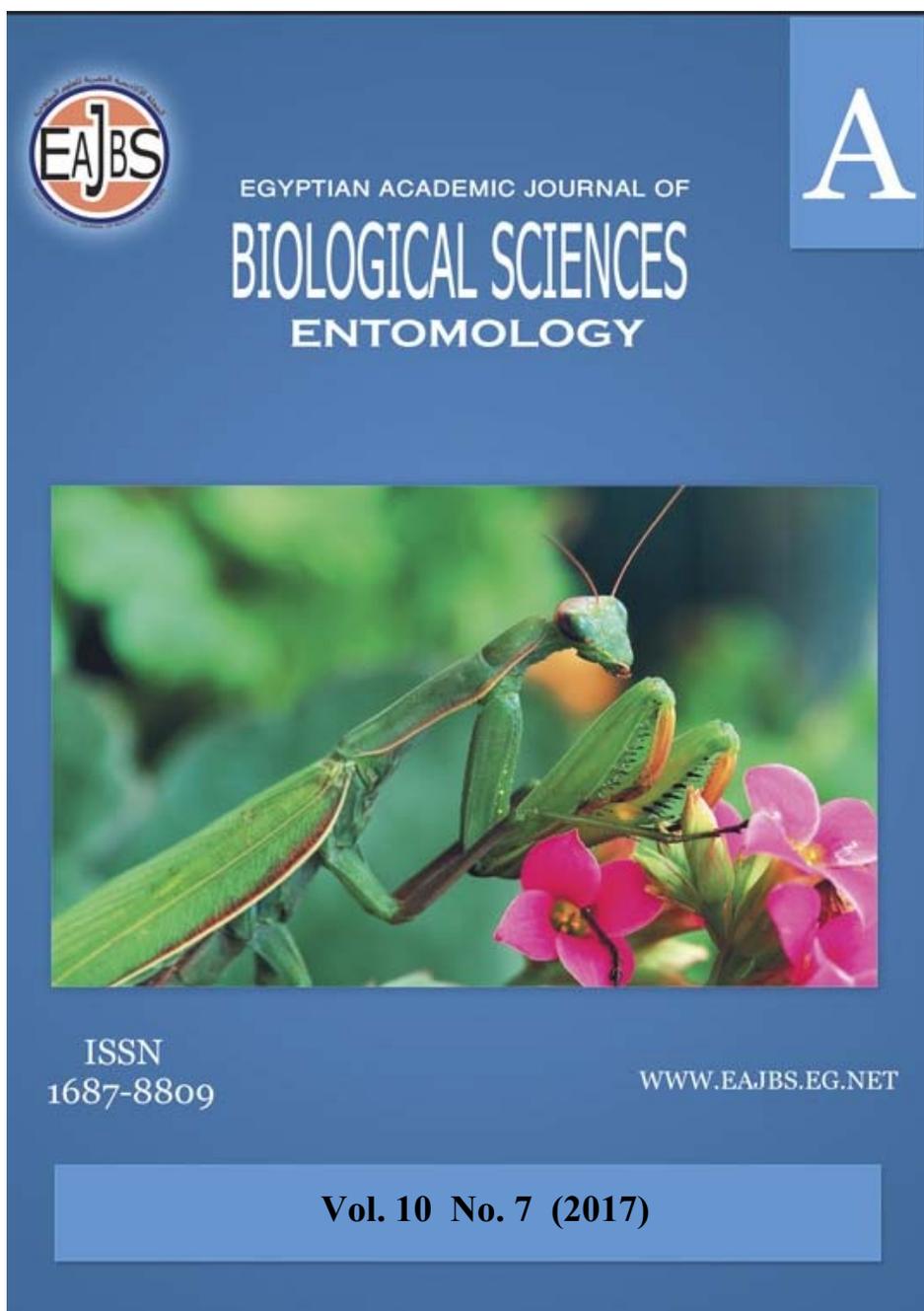


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Ecological Studies on *Aulacaspis tubercularis* (Hemiptera: Diaspididae) and Its Associated Natural Enemies on Mango Trees at Qaliobiya Governorate, Egypt.

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ABSTRACT

Studies on some ecological aspects of *Aulacaspis tubercularis* Newstead (Hemiptera: Diaspididae) and its associated parasitoids and predators on mango trees were carried out at Benha district, Qaliobiya Governorate, Egypt, during two successive years (2014-2015 and 2015- 2016). The obtained results showed that *A. tubercularis* had four peaks of activity during April, June, September and January and also, had four overlapping generations in the two seasons of study. Three species of predators were *Chrysoperlla carnae* (Stephens), *Hemisarcophytes coccophagus* (Meyer) and *Chilocorus bipustulatus* (Linnaeus) and three parasitoids species were *Habrolepis* sp. *Encarsia* sp. and *Aphytis* sp. were found associated with *A. tubercularis* on mango leaves. The highest population was in autumn and summer and lowest population was in winter. The heaviest infestations of *A. tubercularis* were recorded in south and east directions and the upper leaf surface was preferable compared with the lower.

INTRODUCTION

Mango trees *Mangifera indica* L. (Anacardiaceae) are one of the most widespread tropical fruits trees in Egypt and came after citrus and grapes in terms of production, marketing and consumption. The importance of this crop increase after yield (Kawiz, 1999 and Radwan 2003). In Egypt the total area cultivated with mango reached 209000 feddans. The fruiting area is 151000 feddans, producing 506000 ton fruits. (Ministry of Agriculture and Land Reclamation Statistics report, 2010). Mango is being worldwide in distribution in the world, which produced in more than 100 countries throughout both tropical and the subtropical regions, where in many of these countries it is produced as an export crop. (Gallardo, 1983 and Sauco, 1997). Several insects infest mango trees such as *Aulacaspis tubercularis* which attack mango trees at high level of infestations, causing considerable damages and consequently reduce mango production as well as bring down the marketing value and decreasing quantity and quality of fruits (Elwan, 2005 and Kawiz, 2009). Heavy infestation of such pests cause defoliation and drought branches. Therefore, the present work was carried out to study some ecological aspects of the *A. tubercularis* infesting mango trees and its associated parasitoids and predators, in Egypt (Radwan, G. and A. R. Attia 2103).

MATERIALS AND METHODS

Field experiments were carried out in mango orchard located in Benha district, at Qaliobiya Governorate, Egypt during two seasons of study 2014- 2015 and 2015-2016. The selected orchard for the present investigation did not receive any chemical control treatments and the selected area was one feddan for Balady variety of mango trees. Five mango trees (*Mangifera indica* L.) were selected in each districts for carrying out this study. Samples were taken at 14 day intervals sample size was 100 leaves collected in polyethylene bags and immediately transferred to laboratory for inspection by the aid of a stereoscopic microscope. Scale insects on the upper and lower surface of leaves were individually sorted into alive nymphs, adult females and gravid females then counted and recorded. Number of generations and durations of *A.tubercularis* were arranged during two seasons of study according to the method of Auddemard & Miliar (1975) and Iacob (1977). The associated predators and parasitoids of scale insects were also identified and recorded. All emerged parasitoids and predators were identified by Prof. Dr. S. Abd-Rabou, Plant Protection Research Institute.

RESULTS AND DISCUSSION

Seasonal fluctuations of white mango scale insect, *Aulacaspis tubercularis* and its associated parasitoids and predators during seasons 2014- 2015 and 2015- 2016:

The first year of study (2014/ 2015):

Data represented in Fig.(1) showed that, the number of this insect started to increase gradually to reach the first peak in April where 5616 individuals/100 leaves were recorded, then the insect population decreased in May. Thereafter, the population increased continuously to reach the second peak that was recorded in June when the individuals reached 6651 individuals/100 leaves. Once again, the population decreased in July and increased gradually to reach the third peak in September, when 12274 individuals/ 100 leaves. Thereafter, the population decreased during October and November when 4937, 333 individuals/100 leaves, respectively. Again, the population increased to reach the fourth peak when 2930 individuals/100 leaves were recorded during January. These results are in agreement with the finding of **Ascher, *et al.*(1995)** who reported that the population peaks of *A. tubercularis* occurred during different periods of the years in South Africa.

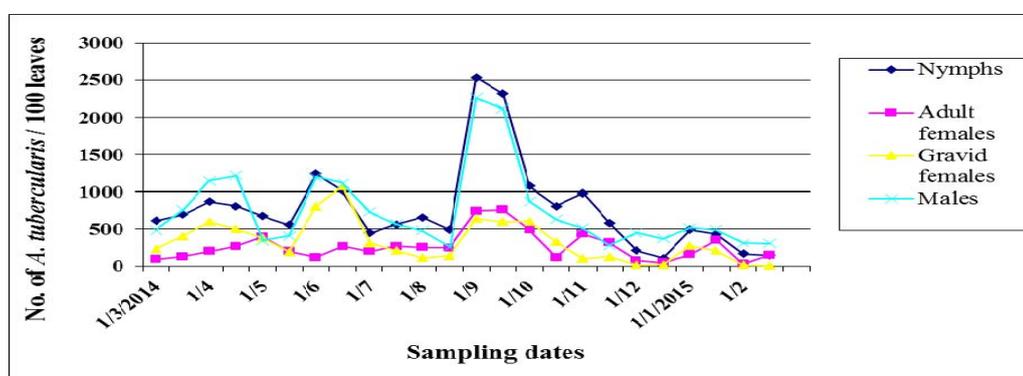


Fig.(1) : Seasonal fluctuations of the scale insect, *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2014- 2015.

With regard to data graphed in Fig. (2) during the first year of study three species of predators were recorded associated with *A. tubercularis* on mango leaves. The predators were *Chrysoperlla carnea* (Stephens), *Hemisarcoteles coccophagus* (Meyer) and *Chilocorus bipustulatus*(Linnaeus). It was observed that *Chrysoperlla carnea* had three peaks during in April, June and August when the population densities were 5, 16 and 25 individuals/ 100 leaves, respectively. While, *Hemisarcoteles coccophagus* had three peaks during in March, April and September when the population density were 60, 103 and 31 individuals, respectively. As well as *Chilocorus bipustulatus* had also, three peaks were April, May and August when the population density were 48, 71 and 68 individuals, respectively.

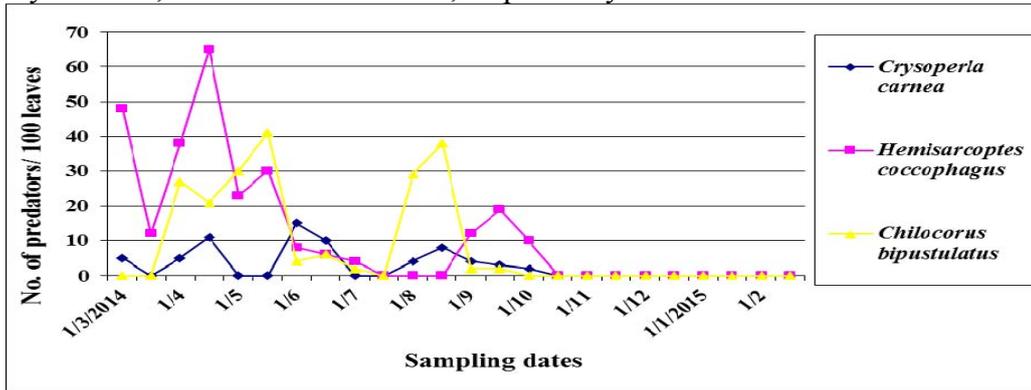


Fig. (2): Seasonal fluctuations of the predator species associated with *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2014-2015.

As shown in Fig. (3) there were three species of parasitoids associated with *A. tubercularis* on mango leaves during the first year of study. There were *Habrolepis* sp, *Encarsia* sp. and *Aphytis* sp. The species *Habrolepis* sp had three peaks were May, June and October with a population density of *Habrolepis* sp. were 16, 28 and 48 individuals, respectively. When, *Encarsia* sp. had three peaks were May, July and October. The population density of *Encarsia* sp. were 23, 21 and 46 individuals, respectively. Finally, *Aphytis* sp. had Also three peaks were April, September and October with a population density of were 19, 14 and 42 individuals, respectively. These results were agree with the finding of **Kamel et al. (2003)** who reported that there were 18 species of genus *Aphytis* from Egypt, observed on ten host plants infested with 11 armored scale insects species (diaspidids) .

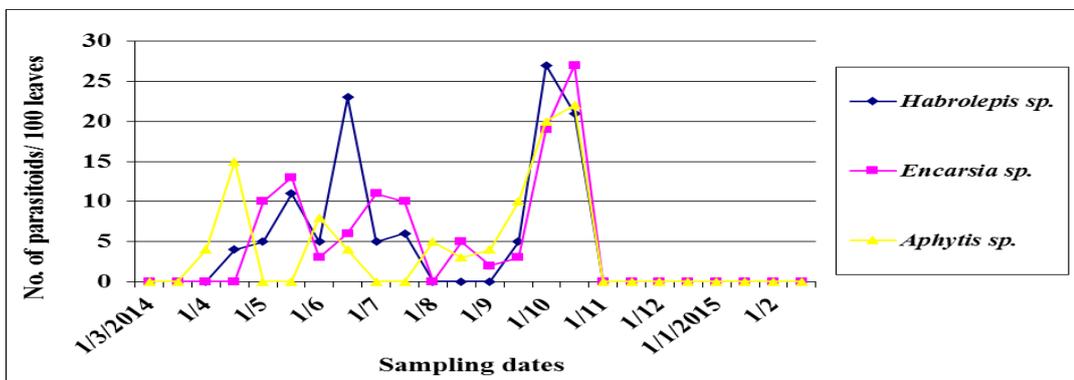


Fig. (3): Seasonal fluctuations of the parasitoid species associated with *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2014-2015.

Data in Fig.(4) showed that, the highest population for nymphs was in autumn (8301 individuals), Adult females (2875 individuals), gravid females (2669 individuals) , Males (6679 individuals) were in spring and summer and Total population (20262 individuals) was in autumn. The least population density of Nymphs (1551 individuals), adult females (813 individuals) was in winter and gravid females (536 individuals), males (4355 individuals) was recorded in winter and total population (5352) was in also in winter, Kawiz (1998& 2009) and Bautista, *et al.* (2013): reported that autumn was the optimum season for *A.tubercularis* activity

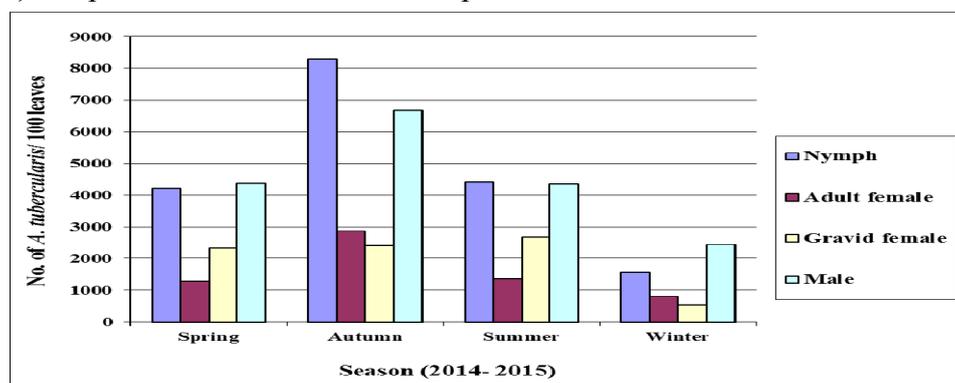


Fig. (4): Population densities of the scale insect, *Aulacaspis tubercularis* on mango trees at Benha district, Qaliobiya Governorate during season 2014-2015.

Data in Fig. (5) showed that there were four overlapping generations in the first seasons 2014- 2015. However, the insect appeared in the first generation during Early March and continued until Mid-May (about 105 days) with total population of 12115 individuals/100 leaves. While in the second generation extended from Early July to Mid-August (about 90 days) with total population of 24683 individuals/100 leaves. The third generation appeared from Early September to mid-November (about 75 days) and the total population size was 43563 individuals/100 leaves, the last generation was from the first of December to mid-February (about 75 days) and the population size was 50269 individuals/100 leaves. These data were decided by the findings of Shahein, *et al.* (1987), Kawiz (2009) and Nagwan, M.H.Ibrahim (2017): in Egypt, they reported that the white mango scale insect the lowest population of *A.tubercularis* was occurred in the mid of July. Also, data clearing showed that *A. tubercularis* had four overlapping annual generations during seasons of study.

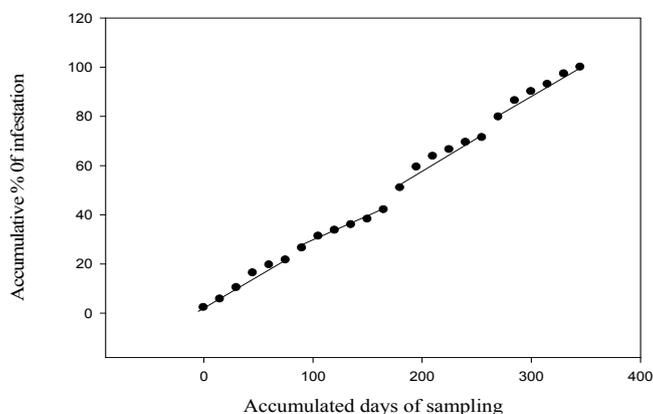


Fig. (5): Sequence and number of annual generations of the scale insect, *Aulacaspis tubercularis* counted on 100 mango leaves, at Benha district, Qaliobiya Governorate during season 2014-2015.

The second year of study (2015/ 2016):

Data illustrated in Fig. (6), reported that, the pest had four peaks, the first peak in April where 7179 individuals/100 leaves were recorded. The second peak was recorded in June when the individuals reached 9763 individuals/100 leaves. The third peak was in September, when 13942 individuals/ 100 leaves. Thereafter, the population increased to reach the fourth peak 5858 individuals/100 leaves were recorded at January.

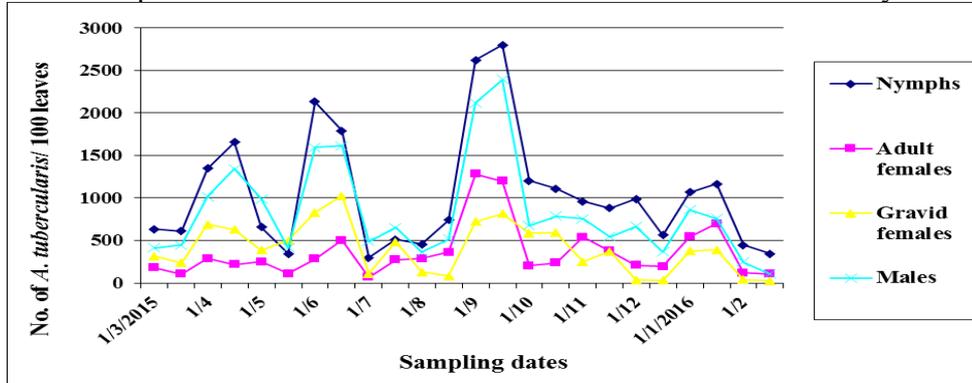


Fig. (6): Seasonal fluctuations of the scale insect, *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2015-2016.

During the second year of study as shown in Fig. (7) three species of predators were recorded associated with *A. tubercularis* on mango leaves. The predators were *Chrysoperlla carnae* (Stephens), *Hemisarcoptes coccophagus* (Meyer) and *Chilocorus bipustulatus*(Linnaeus). It was observed that, *Chrysoperlla carnae* had three peaks were during March, April and September when the population density was 23, 16 and 20 individuals/ 100 leaves, respectively. When, *Hemisarcoptes coccophagus* had three peaks in March, April and September when the population density was 38, 26 and 21 individuals, respectively. *Chilocorus bipustulatus* had also, three peaks in April, July and October when the population density were 19, 10 and 19 individuals, respectively. The parasitoid species associated with *A. tubercularis* on mango leaves during the second year of study were *Habrolepis* sp., *Encarsia* sp. and *Aphytis* sp. *Habrolepis* sp. had three peaks during July, September and October and the population density of *Habrolepis* sp. were 18, 24 and 11 individuals, respectively. When, *Encarsia* sp. had three peaks in July, September October. The population density of *Encarsia* sp. were 12, 20 and 11 individuals, respectively. Finally, *Aphytis* sp. had also three peaks were June, September and October. The population density of *Aphytis* sp. were 6 ,8 and 4 individuals, respectively, Fig.(8).

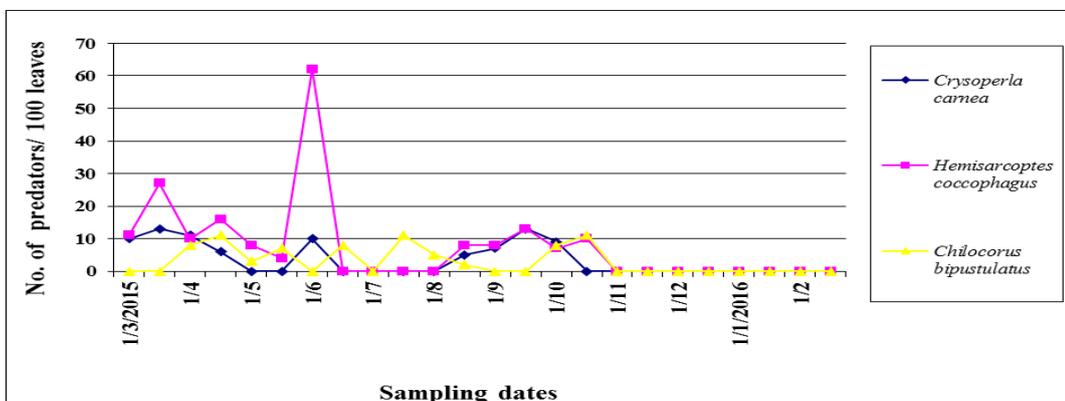


Fig. (7): Seasonal fluctuations of the predator species associated with *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2015-2016

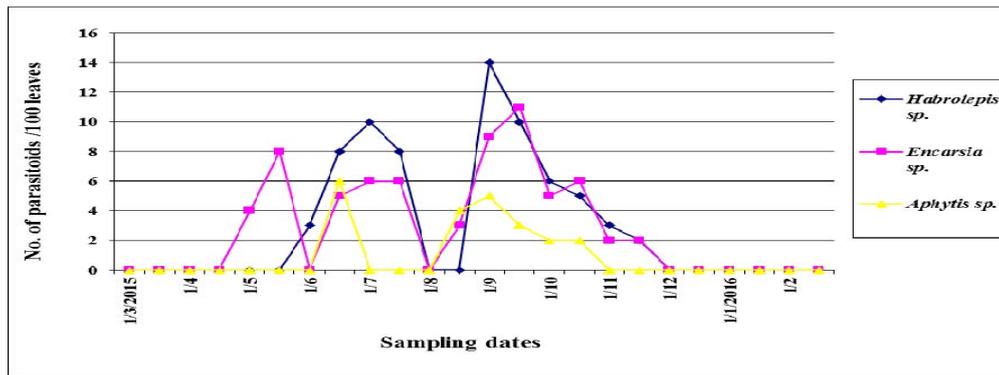


Fig. (8): Seasonal fluctuations of the parasitoids species associated with *Aulacaspis tubercularis* on mango trees, at Benha district, Qaliobiya Governorate during season 2015-2016.

Abd-Rabou (1997&2012), Sawsan and Attia (2103): they reported that were several species of parasitoids and predators were associated with *A. tubercularis* on mango leaves. As well as, These data for parasitoids and predators associated with *A. tubercularis* were discussed in these findings of Kawiz (1998): in Egypt, found that the scale insect, *Insulaspis pallidula* was found with its parasitoid, *Aphytis lepidosaphes* on zebda and dabsha mango varieties during May, July and August in Fayoum governorate. On the other Hand, *Lindingaspis floridana* and *Aulacaspis tubercularis* were found without parasitoids. In addition, *Parlatoria olea* was found parasitized by *Aphytis maculicornis* and *Aphytis linganesis*, as high and low infestation on zebda and hindy varieties during summer and spring. Also, *Kilifia acuminata* and *Icerya seysshellarum* were found parasitized by Encyrtidae and *Aphytis maculicornis*, respectively on zebda and dabsha varieties. As well as, Morgan, *et al.* (1998): in U.S.A , stated that *Aphytis melinus* (Hymenoptera: Aphelinidae) was used as a biological control agent of diaspid scale insect . Also, Hassan, *et al.* (2001): in Egypt, mentioned that, *Aphytis sp.*, *Marieta (Marietta) picta* and *Aspidiotiphagus sp* were the most dominant parasitoids on *H. lantaniae* on pear trees in Egypt.

Data in Fig. (9) showed that there were also four overlapping generations in the second seasons. The first generation was the longest but the third and the fourth generations were shortest. However, in the second season 2015-2016, it had also four overlapping generations. The first was in Early March to until Early June (about 105 days) with total population of 20485 individuals individuals/100 leaves. The second generation extended from Mid- June to Early October (about 120 days - the longest generations) with total population of 47828 individuals/100 leaves. The third generation appeared from Mid-October to Early January with duration of 90 days and its total size averaged 61121 individuals/100 leaves. Finally, the fourth was from mid-January to mid- February about 45 days (the shortest generation) with total population about 65555 individuals/100 leaves.

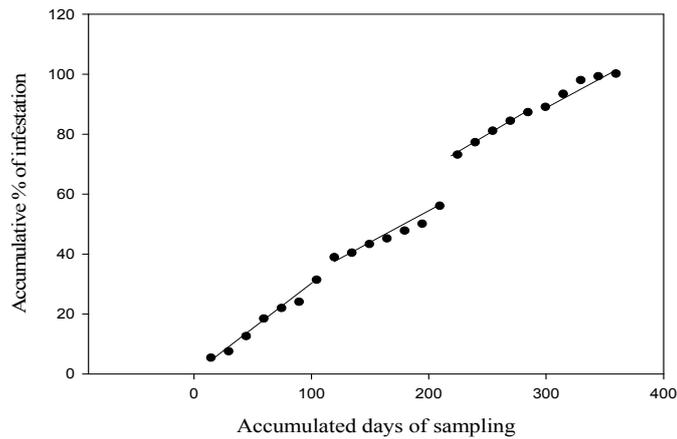


Fig. (9): Sequence and number of annual generations of the scale insect, *Aulacaspis tubercularis* counted on 100 mango leaves, at Benha district, Qaliobiya Governorate during season 2015-2016.

The effect of cardinal directions on the population density of *A. tubercularis* on mango trees during two season 2014 – 2015 and 2015- 2016 is shown on Fig. (10) from which the, south and east directions were the heaviest infestation (585 and 278 scales/leaf) in first year of study and (382 and 294 scales/leaf) in second year of study north , west and core directions were the least infestation in two seasons. Whereas, Data in Fig. (11) showed that the upper leaf surface during first season of study was heavier compared with the lower. The upper value was 1683 and the lower value was 982 individuals/leaf, respectively. While, the second season were (2892 and 793 individuals/leaf), respectively. **Ascher, et al.(1995)**: stated that the highest infestation rate of *A. tubercularis* occurred on the shady south. Facing lower aspect of the tree. Population peaks of the pest occurred during different periods of the year in the two regions monitored. The population peak at Kaapmuiden with a higher mean temperature, occurred in November and September. As well as, **Peña, et al.(1998) and Radwan (2003)**: they reported that high infestation of scale insects were found on the lower surface of leaves than the upper surface on mango trees. **Nabil, H. A, et al. (2012)**: in Egypt, reported that the upper surface of mango leaves was heavier infestation compared with lower surface as well as, *A. tubercularis* was concentrated in eastern side of the mango trees during seasons of study.

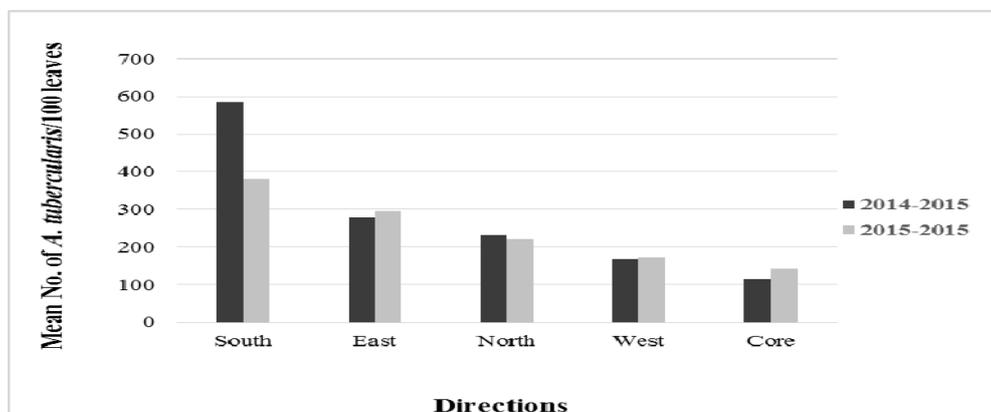


Fig. (10): Total numbers of the scale insect, *Aulacaspis tubercularis* at different directions on mango trees at Benha district, Qaliobiya Governorate during seasons 2014- 2015 and 2015- 2016.

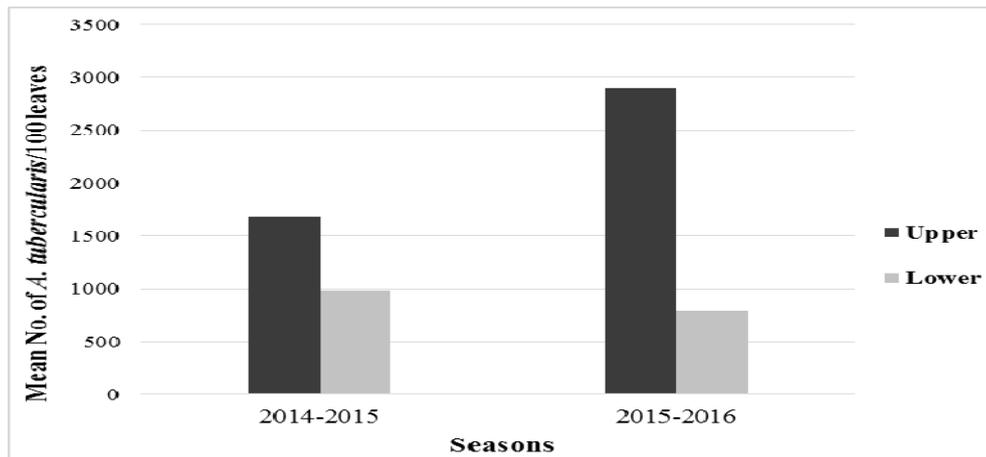


Fig. (11): Total numbers of the scale insect, *Aulacaspis tubercularis* on leaf surfaces of mango trees at Benha district, Qaliobiya Governorate during seasons 2014- 2015 and 2015-2016.

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ARABIC SUMMARY

دراسات ايكولوجية على حشرة المانجو القشرية البيضاء والأعداء الحيوية المصاحبة لها على أشجار المانجو بمحافظة القليوبية - مصر.

مروه السيد سند^١ و محمد سالم عبد الواحد^٢ و حمدي السعيد محمد حنفي^٢ و نهي حسين أحمد^١

١- معهد بحوث وقاية لنبات - مركز البحوث الزراعيه - مصر

٢- قسم وقاية النبات - كلية الزراعة - جامعه عين شمس - مصر

أجريت هذه الدراسة بمنطقة مدينه بنها محافظه القليوبيه علي صنف بلدي خلال عامي الدراسه ٢٠١٤- ٢٠١٥ و ٢٠١٥- ٢٠١٦ وذلك لدراسه بعض النواحي البيئيه لحشرة المانجو القشرية البيضاء وتحديد ذروه النشاط لها والاعداء الحيويه المصاحبه لها وكانت النتائج المتحصل عليها كالآتي:- وجود اربع مواعيد لذروه النشاط الموسمي الحشره وهي ابريل و يونيو و سبتمبر واخيرا يناير خلال عامي الدراسه وايضا وجود اربع اجيال متداخله للحشره خلال عامي الدراسه و قد تم تسجيل ٣ انواع من المفترسات المصاحبه للحشره وهي *Hemisarcoptes coccophagus* (Meyer) *Chilocorus* و *Chrysoperlla carnae* (Stephens) *bipustulatus* (Linnaeus) الي جانب تم تسجيل ٣ انواع من الطفيليات المصاحبه لها وهي *Habrolepis* *Aphytis* sp. و *Encarsia* sp. وجد ان اعلي تعداد للافه تم تسجيله في الخريف والصيف و اقل تعداد سجل في الشتاء وايضا سجل ان الاتجاه الشمال الشرقي هو الاتجاهات الاكثر اصابه وايضا سجل ان السطح العلوي للورقه كان اكثر اصابه مقارنة بالسطح السفلي.