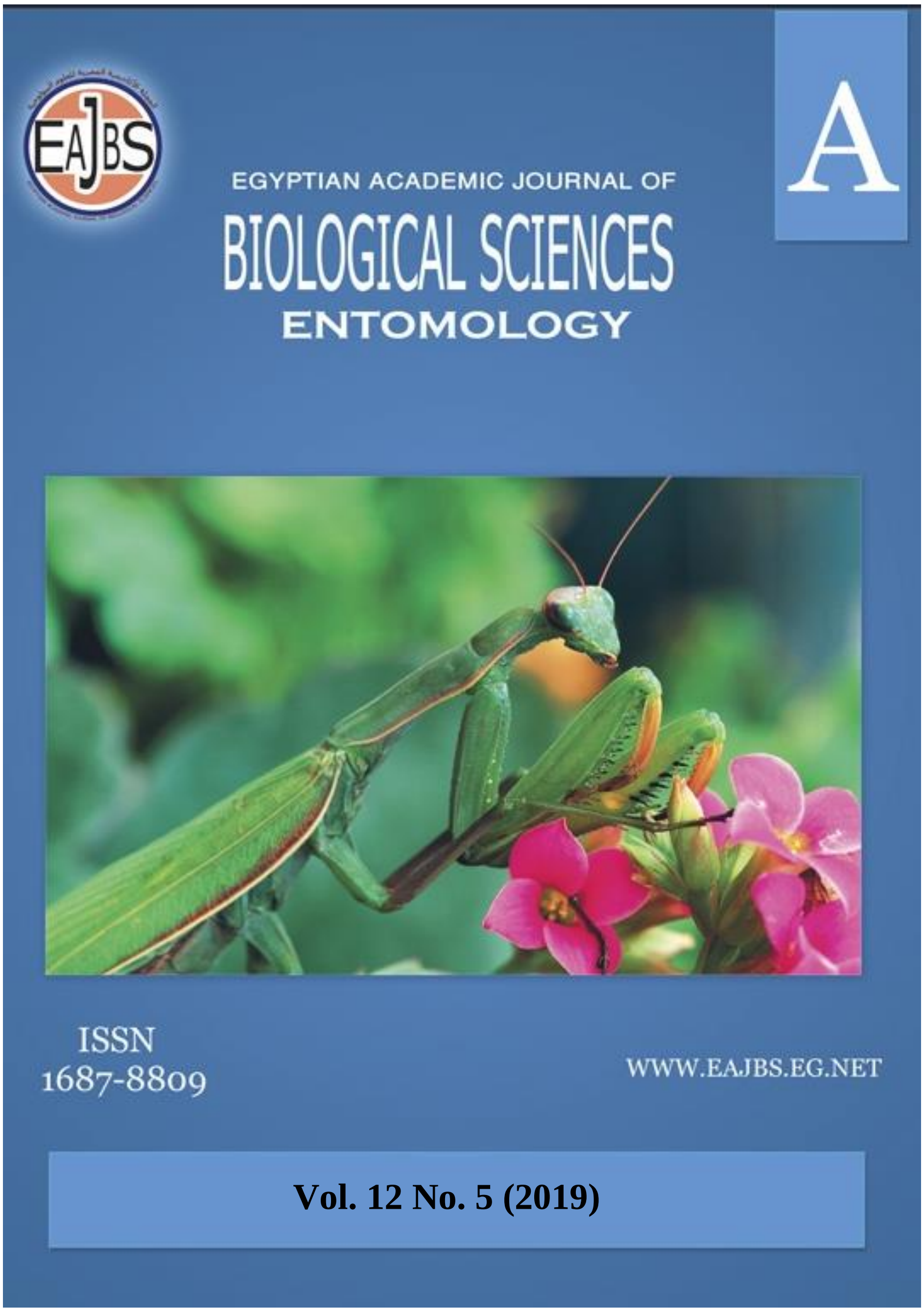

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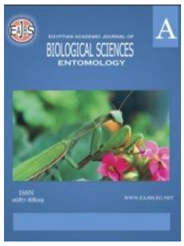

Interaplant Distribution of the Citrus Rust Mite, *Phyllocoptruta oleivora* (ASHMEAD) on Citrus Trees

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ABSTRACT

Experiments were conducted to evaluate the preferring location of the citrus rust mite, *Phyllocoptruta oleivora* inhabiting citrus trees on different heights level, high, medium and low and four sides of the citrus tree locations east, north, west and south. One orange cultivated area Balady variety was chosen for the experimental study at Enshas region located in Sharkia Governorate (latitude 52°38'11.7"N and longitude 5°49'37.66"E). The lower, medium and high trees levels were selected at 80cm, 80-150cm., and more than 150 cm. from the ground level, respectively. The study was conducted during two successive years starting from January 2017 till end of December 2018.The results showed that *P. oleivora* preferred the warmth and high relatively humid conditions, allocated at tree surfaces near the soil on contrast the plant surfaces far of soil. That is where the steaming rate of irrigation water provides the predator with the optimal high humidity for population increase. In addition, the study indicates that the citrus rust mite prefers living the east side of the tree was exposed to sunlight more than the other sides

INTRODUCTION

Citrus fruits export in the world was total economic valued by US$ 6,935 million (Faostat, 2008). Egypt's orange exports increased to reach 6.803 thousand tons during 2011 with a total economic value of 433 million dollars, which represented 6% of world trade-economic volume.

The citrus trees occupy a prominent position in the Egyptian national economy for either local consumption or exportation. The cultivation of citrus trees is prevalent in most regions of Egypt, although it is concentrated in the governorates of Al Sharqiya, Beheira, Qalyubia, Monufia, Gharbia, and Ismailia. Washington navel, Balady and Valencia oranges varieties are considered the most important varieties cultivated in Egypt that occupied cultivated areas reached 150, 40 and 50 thousand feddan/each verity, respectively.

Thirteens pecies of Eriophyidae have been recorded on citrus in the world (Amrine and Stasny, 1994; Childers and Achor, 1999; Gerson, 2003; Dhooria *et al.*, 2005; Vacante, 2010). The citrus rust mite, *Phyllocoptruta oleivora* (Ashmead), is a major pest of citrus in many parts of the world (Denmark 1963; Childers &Achor 1999).In addition; it has been studied on global scales (Quayle, 1938; Bodenheimer, 1951; Ebeling, 1959; Chapot and Delucchi, 1964; Talhouk, 1975; Jeppson, 1978, 1989; Smithand Peña, 2002). Although the authors were in conflict with the major causes of the signs of infestation, they agreed that the fruit signs of infestation resulting from large population numbers of *P. oleivora* feeding on the outer layers of cells, including either epidermal and hypodermal cells of citrus leaves.Unfortunately, there is lack of information relative to the actual feeding process and its effect on the physiological and histological of fruit signs of infestation. The citrus rust mite attacks all citrus varieties, preferring lemons and limes. Damage on these fruits appears as silvery patches, whereas on oranges and grapefruits it is rust-like. As infestations proceed the entire fruit face becomes scaly and blackish, the fruit remaining small with low juice content(Allen *et al.*, 1994; Chiaradia, 2001; Moraes & Flechtmann, 2008; Mendonça & Silva, 2009). Fruit surface discoloration (russet) was associated with the formation of lignin and probable oxidation of some substances of the cytoplasm within epidermal cells. In July and August, a wound periderm was formed 16–21 days after russeting first appeared on fruit surfaces. Concurrently, lipids accumulated in the wound periderm cell walls. Injury to fruit after growth termination did not lead to wound periderm formation in late November. Without control measures indicated that 100% of the fruit may be lost. Feeding on the leaves is seen as small dark spots, followed by bronze. The citrus rust mite female produces about 20-30 eggs, which are laid into pits and depressions, preferentially on the fruits but also on leaves or in small cracks in the bark of twigs. There are two larval stages, called protonymph and deutonymph. The generation time is about one week in summer and 2 weeks in winter, so the population density can soar under favorable conditions. The mites prefer warm and humid weather. However, all developmental stages can be found throughout the year; only reproduction is temporarily suspended during periods with low temperatures.

This study aims to assess the large population distribution density of *P. oleivora* within the specific citrus tree.

MATERIALS AND METHODS

One of orange cultivated area Balady variety was chosen for the experimental study at Enshas region located in Sharkia Governorate (latitude 52°38'11.7"N and longitude 5°49'37.66"E)from January 2017 till end of December 2018. The variety was represented by 20 trees, each was divided into four sides of the citrus tree, (east, north, west, and south) and three levels; the lower was at 80cm. height from the soil surface, the middle at 80-150cm., and the upper level were at more than 150 cm. from the ground level. Samples were collected monthly at random and composed of 100 leaves and 10 fruits from each side of the citrus tree and level. Collected samples were kept into polyethylene bags and then transferred to plant protection research institutes, fruit acarology laboratory for examining under stereomicroscope, at each sampling zone. Counts were collected for all moving stages of *P. oleivora* on fruits and lower surface of leaves. Prevailing conditions of temperature and relative humidity, in Sharkiya Governorate were obtained from the Meteorological center at Abbasia.

RESULTS

Population dynamics of *P. oleivora* (Ashmead) on four citrus tree sides of the citrus tree during two years 2017 and 2018 on fruits and leaves of Balady orange at Sharkia Governorate is presented in figure 1. One peak of the citrus rust mite, *P. oleivora* was observed on citrus fruit and leaflets during the first year from January to December. This peak was in August with 16326, 7247, 4686 and 1975 *P. oleivora* individuals /10 fruits and

100 leaves at east, west, north and south sides of the citrus trees, respectively. The second-year results didn't show significant differences. One peak was in August with 12769, 6256, 5517and 2661*P. oleivora* individuals /10 fruits and 100 leaves at east, west, north, and south sides of the citrus trees, respectively.The population of the citrus rust mite, *P. oleivora* appeared with low density during the winter season and slightly increased in spring season, then sharply increased on summer season and returned decreased on autumn season at the four sides of the citrus tree.

The east side of the tree showed the highest population number of the citrus rust mite, *P. oleivora* during the two successive years compared with the other three sides of the tree.The west side of the tree comes second in terms of population number of the citrus rust mite, *P. oleivora* during the two successive years.

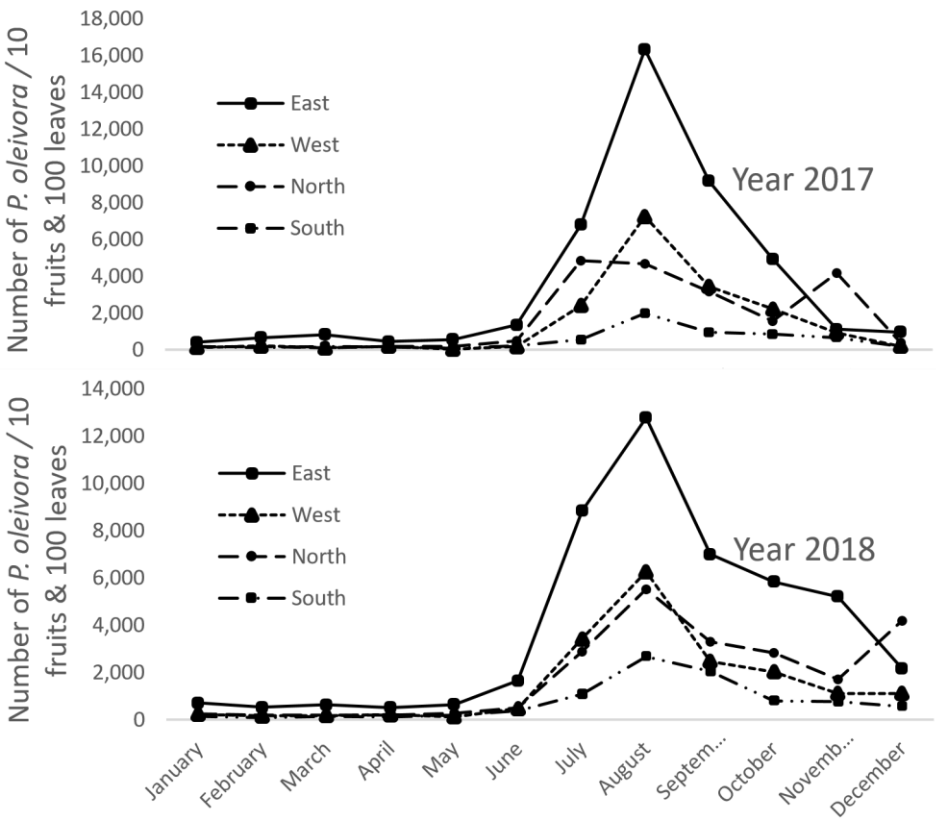

Fig. 1: Population dynamics of *P. oleivora* (Ashmead) on four citrus tree sides of the citrus tree during two years 2017 and 2018 on fruits and leaves of Balady orange at Sharkia Governorate

Population dynamics of *P. oleivora* (Ashmead) on three citrus tree levels during two years 2017 and 2018 on fruits and leaves of Balady orange at Sharkia Governorate is presented in figure 2. One peak of the citrus rust mite, *P. oleivora* was observed on citrus fruit and leaflets during the first year from January to December. This peak was in August with 12391, 7557 and 1703*P. oleivora* individuals /10 fruits and 100 leaves at lower, middle and upper levels of the citrus trees, respectively. The second-year results didn't show significant differences. One peak was in August with 12410, 8474 and 2492 *P. oleivora* individuals /10 fruits and 100 leaves at lower, middle and upper levels of the citrus trees, respectively.The population of the citrus rust mite, *P. oleivora* appeared with low-density direction during the winter season and slightly increased in spring season, then sharply increased on summer season and returned decreased on autumn season at the three levels of the citrus tree.

The lower level of the tree showed the highest population number of the citrus rust mite, *P. oleivora* during the two successive years compared with the other two levels of the tree. The middle level of the tree comes second in terms of population number of the citrus rust mite, *P. oleivora* during the two successive years.

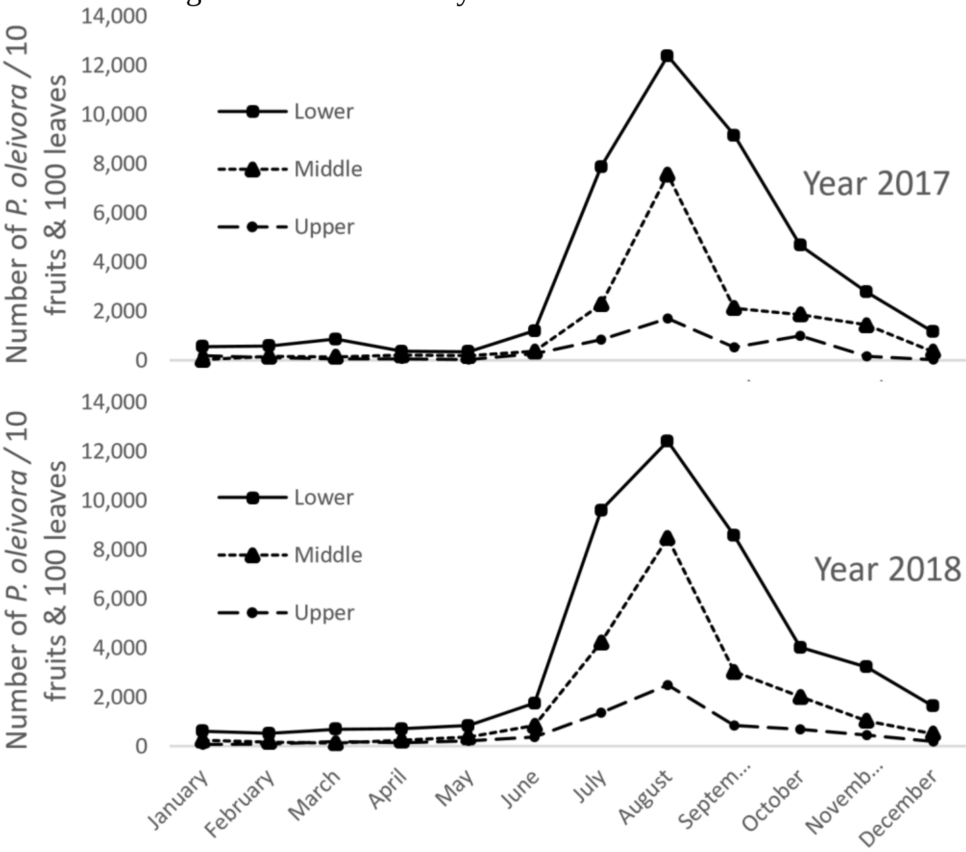

Fig. 2: Population dynamics of *P. oleivora* (Ashmead) on three citrus tree levels during two years 2017 and 2018 on fruits and leaves of Balady orange at Sharkia Governorate

DISCUSSION

The citrus rust mite, *Phyllocoptruta oleivora* preferred the east side of the tree to the north,west or south during two successive years. This difference might be attributed to the fact that the eastern side of the tree was exposed to sunlight more than the other side.The fluctuating-temperature effects on the citrus rust mite development rate similar to the development rates under constant temperatures within the ‘linear region’ of a development-rate function (Campbell *et al.*, 1974). Therefore, the daily temperature plays an important role in arthropod development(Hogg, 1985; Roltsch *et al.*, 1990; Worner, 1992). It's worth to mention that the daily temperature fluctuation, which exceeds upper or lower threshold, effects either decreasing mortality or increasing development rate (Beck, 1983). Unfortunate, there is lack of information on the potential effects of fluctuating temperature on the developmental rate, reproduction, and morality of the citrus rust mite. Yang *et al.,* 1997 indicated that under the laboratory conditions, 18 % of eggs, protonymphs, and deutonymphs of citrus rust mites were considered more likely to die as a result of the absence of pathogenic agents.They added that the undamaged fruit surface was assumed to be equally suitable for citrus rust mite development, reproduction, and survival over the entire fruit growing season. Food quality for citrus rust mite might decline toward fruit maturity. Although citrus rust mite prefers fruit areas where there is enough sunlight, it avoids direct sunlit area and shaded parts of the fruit surface (Yothers and Mason, 1930; Allen and McCoy, 1979).Hely (1947) indicated that the citrus rust mite living on those parts of the trees that were most exposed to the sun (48°C). In fact, the citrus rust mite tends to infest sun-exposed part sofa trees, including fruits, more severely than the unexposed parts (Binney,1934), outer trees of an orchard more than inner ones (Bodenheimer,1951),exterior leaves more than interior ones ,and thinned orchards more than untinned ones (Swirski,1962) is more likely to be an indirect effect. Dense and shaded leaves and fruits remain wet longer after being moistened by deworrain, which consequently may interfere with the molting of the mites. In the late season, the overweight fruit tends to bring fruit into the canopy, and existinga new flushes will shaded the fruit, resulting fruit drop and providing less surface for the mite feed. On the other hand, following fruit-set in the spring, mites either migrate to the fruit from other locations on the tree or come in contact with the fruit through wind dispersal (Yothers and Mason 1930).As the fruit begin to develop and increase in size, the mite population density also begins to increase. Since biotic factors have little effect in the regulation of mitepopulations at this time (McCoy *et al.* 1969), in addition, during the fruit growth season, the citrus rust mites are found on fruit, leaves, and young twigs, though most mites are found on fruit (Yang, 1994) and the migration of citrus rust mite can be achieved by wind or active crawling..McCoy (1979) observed that mites were well-established on new flush before they were detected on new fruit. Actually, temperature, humidity, rainfall, and wind are the main a bioticfactors that affect the survival of citrus rust mite under open-field conditions.At the eastside of the citrus trees,one or all the previous reasons may be provide the citrus rust mitewith appropriate a biotic factors in terms of where there is wind’s North-West direction, suitable temperature and the direct sunlight existed which leads to a high population density of the citrus rust mite. It is also possible that at extreme high densities, mites on fruit will tend to migrate to leaves or to disperse by wind. On the other hand, the relative humidity strongly played an important role ininfluencing the ability of the citrus rust mite to increase in population numbers (Hobza and Jeppson 1974). Yothers & Mason (1930) and Swirski (1962). They found that mites were more abundant on the lower leaf surface so for age trees that were at least one year old.Yothers & Mason (1930)also reported that during periods of rain, the rust mites crawl to the lower surfaces of the leaves, to shelter fromrain.The results showed that citrus rust mite preferred high relatively humid, conditions, which located at plant surfaces near the soil on contrast the plant surfaces far of soil. This is where the steaming rate of irrigation water provides the citrus rust mite with the highly humidity for its population increase.

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