POPULATION DYNAMICS OF THE VINE MEALYBUGS, *PLANOCOCCUS FICUS* SIGNORET (PSEUDOCOCCIDAE: HOMOPTERA) ASSOCIATED WITH GRAPEVINE IN FAYOUM GOVERNORATE, EGYPT

Solaiman, R.H.A. [1]; Abd El-Gayed, A. A.[1]Shoeb, Mona A.[2]; and Ahmed, Manar M. [2]

1- Department of Plant Protection, Faculty of Agriculture, Fayoum University, Egypt.

2- Plant Protection Research Institute, Agriculture Research Center, Giza, Egypt.

ABSTRACT:

The vine mealybug, *Planococcus ficus* Signoret (Pseudococcidae: Homoptera) is considered a primary vineyard pest. The presented work was carried out at a grapevine Feddemin at Village Fayoum Governorate, cultivated with the variety Ghribi to shed the light on seasonal fluctuation of population density, number and duration of generations of the vine mealybug, *P. ficus* as well as the effects of the main weather factors on the insect population . Regular biweekly samples from trunks, leaves and bunches of grapevine were taken for two successive years, from Nov. 2015 to Oct. 2017. The obtained data showed that *P. ficus* individuals were found throughout the year beneath the bark of grapevine trunk where the nymphs of the mealybug recorded six peaks in both investigated years. Adult females had five peaks during the first year and eight peaks in the second year. The highest numbers of *P. ficus* on trunks were recorded at the end of Aug. and in mid of Sep. for first and second year respectively. *P. ficus* infested only mature bunches and the highest numbers of the mealy bug on bunches were recorded at the end of Aug. in both years. The effect of maximum and minimum temperature on total individuals of the mealybug was positive and insignificant in the first years and positive highly significant in the second year. The effect of mean relative humidity was negative and insignificant. The combined effect of main weather factor on total individuals of the mealybug was insignificant in the first year while it was significant in the second year of investigation.

Key words: *Planococcus ficus*, population dynamics, weather factors, grapevines and population fluctuation.

INTRODUCTION:

The common grapevine mealybug, *Vitis vinifera* L. is a native plant tap sucking insect to the Mediterranean region, central Europe, and southwestern Asia. There are currently between 5,000 and 10,000 varieties of *V. vinifera* grapes though only a few are of commercial significance for table production. Grapes can be eaten fresh as table grapes or can be incorporated in agricultural industries.

Vineyards in Egypt are usually infested by several insect pests such as butterflies, scale insects, mealybugs, aphids and thrips. Mealybugs (subfamily Pseudococcinae) are considered one of the most important pests in grape production area **(Daane *et al*., 2018)**. The vine mealybug, *Planococcus ficus* Signoret is the primary vineyard pest in the Middle East, regions *i.e.*, Iran **(Williams and Moghaddam, 2000)**; Iraq, Israel, Lebanon, Libya, Egypt **(Attia, 2003)**, Turkey **(Kaydan *et al*., 2005)** and Syria, Tunisia **(Mahfoudhi and Dhouibi, 2009)**. It was found on trunk, canes, leaves, clusters, cordons and within developing buds **(Malakar *et al*., 2001).**

P. ficus, along with other vineyard mealybugs species affect crop quality and yield by excreting honeydew that promotes the growth of sooty molds and many consignments are rejected prior to shipment as a result of infestations and phytosanitary concerns. Serious mealybugs infestations reduce photosynthetic activity in leaves **(De Lemos Filho and Sousa Paiva, 2006)**. Moreover this pest can inhibit the normal ripening of grapes, generates off-flavor, color and leads to the eventual withering of grape bunches and increase the risk of ochratoxin, contamination on grapes **(Chiotta *et al*., 2010).**

Moreover, *P. focus* can vector a number of viral diseases, *e.g.*, grapevine leaf-roll associated virus and corky bark disease **(Rosciglione and Gugerli, 1989; Tanne *et al*., 1989**). Infestation of the growing point with other mealybug species than *P. ficus, i.e. Maconellicoccus hirsutis* Green results in malformation of leaves and shoot tips **(Mani and Shivaraju, 2016).**

The present work aims to study seasonal fluctuation of mealybug, *P. ficus* in Egypt, i.e., Fayoum Governorate as an example.

MATERIAL AND METHODS

1. Ecological studies:

Ecological studies on the mealybugs on grapevine were carried out at a groove about 2 feddans. This groove is located at Feddemin village, Fayoum Governorate, cultivated with the variety Ghribi. No control measures were undertaken. The grapevine trees were two meters apart and 20 years old, and groove was irrigated with flooding irrigation system, all the grapevines received the same agricultural practices.

To determine the seasonal fluctuation in population density, number and duration of generations as well as the effects of the main weather factors on the insect population, 10 grapevines, *V. vinifera*, var. Ghribi of the same size, height, shape and vegetation were chosen to represent the groove. Regular biweekly samples were taken for two successive years, from mid of Nov. 2015 to the end of Oct. 2017.

At tree bark was peeled off in area of 30 cm of the vine trunk to permit the accurate inspection of trunk. Colonies of mealybugs were first counted in situ then removed by fine brush and bagged in plastic containers and transferred to laboratory for examination. Samples of 30 leaves and 10 bunches were collected randomly from the selected grapevines and put in polyethylene bags and transferred to the laboratory for counting purpose under a stereomicroscope. The counting was carried out on the whole area for both leaves and bunches. Different alive stages, *i.e.* immature (first, second and third nymphal instars) and mature females (including; non-ovipositing and ovipositing females were kept (, **Attia, 2003; Abdel-Rahman et al.,2007** and **Mohamed, 2013)**.

For roots mealybug samples from Dec. to Jan.; were surveyed on vine roots by digging to a depth of 30 cm at the region of the main stem in close proximity to vines. Mealybugs were kept in ethanol 70% +5% glycerin to identification to species and in Plant Protection Research Institute, Agriculture Research Centre.

Records of the meteorological factors, mainly the daily means, maximum and minimum temperature as well as relative humidity were obtained from the nearest

meteorological station at Fayoum Governorate. The daily records of these factors were grouped into biweekly averages to correspond with insect sampling.

2. Statistical analysis

Data were subjected to statistical analysis to determine simple correlation and simple regression between nymphal stage, adult females and total population of *P. ficus* and biweekly weather factors. The precise determination of the effect of each factor when interacting with other examined factors, not on their own, was achieved by calculation of partial regression described by **Senedecor and Cochran (1980).** Data of the biweekly counts of total numbers of *P. ficus* were used as dependant (y), whereas the main climatic factors were taken as independent variables; X1 for maximum temperature, X2 for minimum temperature, X3 for relative humidity. The amount of variability in the population would be determined by the tested factors; naturally the remaining unexplained would be due to the influence of other factors inheritance, environmental or biological in addition to experimental error. Correlation and regression analysis were conducted using SPSS program Version 16.

RESULTS AND DISCCUTION

1. Population fluctuation of *P. ficus* during 2015/2016 season:

1.1. On trunk

Data in Fig (1) showed that *P. ficus* individuals were found throughout the year. The population density existed with relatively high numbers (116 individuals/10vines) on mid of Nov. 2015. The population had five peaks per year. At the end of Nov., the population decreased gradually till mid-Jan. then increased to record its first peak (158 individuals/10vines) in mid-Mar. After gradually decrease, population increased suddenly to reach its 2nd and lowest peak (80 individuals/10 vines) in mid-May. Afterwards the population increased quickly to record the 3rd peak in the end of Jun. with 97 individuals/10vines. The 4th and highest peak (186 individuals/10vines) occurred in the end of Aug.. Then the numbers decreased but finally increased again to reach its 5th peak at the end of Sep..

Concerning nymphal stages, as showed in Fig (1), six peaks were recorded. The 1st peak in mid-Dec. (45 nymphs/10vines) and the 2nd peak (94 nymphs/10 vines) by the end of Mar. After that, nymph's density decreased gradually to reach its lowest population (4nymphs/10vines) in mid-May and then increased quickly to record its 3rd peak with 21nymphs/10vines by the end of May. The fourth peak of nymphs was recorded in mid-Jul. with 52 nymphs/10vines, while the 5th and highest peak with 110 nymphs/10vines was noticed at the end of Aug.. After that, the population density decreased ,while increased quickly to record the 6th peak (26nymphs/10vines) by the end of Sep..

Regarding adult female's population, (non and oviposition females), obtained data illustrated in Fig. (1) show that these stages were found throughout the year and had five peaks. The population density of adult females existed with relatively high numbers then decreased till mid-Jan., after that, the population increased gradually and recorded its 1st peak in mid-Mar. with 71 adult females/10vines. The 2nd and 3rd peaks were observed with 76 adult females/10vines in mid-April and mid-May for both

peaks, respectively. After that, female's number decreased to its lowest density (11 adult females/10vines) at mid-Jun. and then increased quickly to record the 4th and the lowest peak by the end of Jun. with 70 adult females/10vines. In mid-Jul. the population declined sharply and then increased gradually to reach the 5th and highest peak with 88 adult females/10vines by the end of Sep.. The variation in peaks number and percentages of population density of nymphs, adult females and total population may be due to the movement of the nymphs from dry leaves and leaving bunches after harvesting to the trunks.

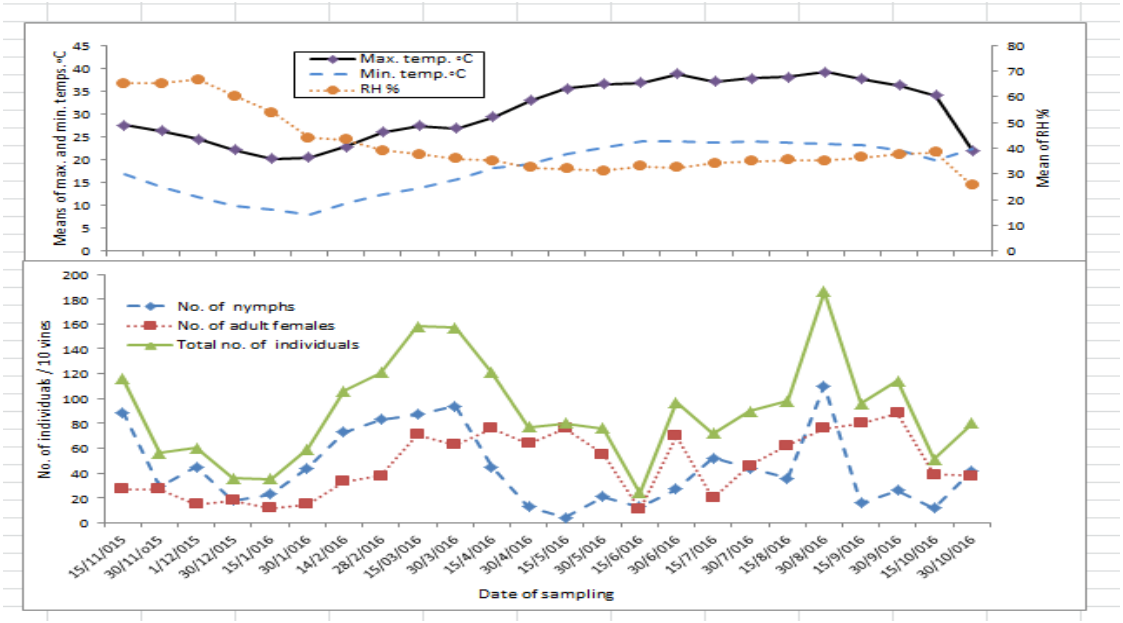

Fig. (1): Bi-weekly counts of nymphal and adult stages of *P. ficus* on trunks of grapevine with corresponding mean of weather factors during 2015-2016 season at Fayoum Governorate.

On the other hand, the percentages of *P. ficus* stages varied according to season of growth. Generally, the nymphal stages were the dominant, where they represented the highest percentage from the end of Nov. to the end of Mar. while adult females represented the highest percentage from mid-April to the end of Oct.

1.2. On leaves and bunches

Results in Fig. (2) indicated that nymphal stages were found on leaves from mid-April to mid-Oct., but adult females were not detected on leaves till mid-Aug.. Generally, the infestation of grapevine leaves of the investigated variety (Ghribi) with mealybug was relatively low.

During 1st season 2015-2016, data showed that the infestation of grapevine leaves with *P. ficus* individuals coincided with the beginning of vegetation period of grapevines during mid- April, where all the recorded individuals were nymphs that moved from trunks however, this period coincided the 2nd generation of tested mealybug on trunks.

Population density of nymphs and total population recorded three peaks; The 1st peak (20 individuals/30 leaves) was at the end of Jun.. After that, the population decreased gradually and increased again to reach the second and highest peak at the end of Aug. with 29 and 42 individuals/30 leaves for nymphs and total population respectively. The 3rd peak was recorded at the end of Sep. with 17 and 35 individuals/30leaves. Then population decline and disappeared completely by the end of Oct.. Adult females recorded only one peak (18 individuals/30 leaves) at the end of Sep..

Concerning bunches, data of the present study showed that *P. ficus* infested only mature bunches, as the Ghribi var. is a late ripening class. As showed in Fig (2), infestation with *Planococcus* individuals started in mid-Aug. and only two peaks were recorded. The 1st peak occurred in the end of Aug. with 19 and 33 individuals /10bunches for nymphs and adult stages respectively. The population decreased and quickly increased to reach the 2nd peak (15 and 29 individuals/10 bunches) for nymphs and total population, respectively at the end of Sep. Also, adult females peaked twice; the 1st peak was recorded in mid-Aug. with 16 adult females/10vines and the 2nd one (14 adult females/10 bunches) at the end of Sep.. After that the population of the mealybug decreased by mid-Oct. to 5 individuals/10bunches and no individuals were secured from the left bunches on trills by the end of Oct..

2. Population fluctuation of *P. ficus* during 2016/2017 season:

2.1. On trunk

Data in Fig. (3) show that the population of *P. ficus* had seven peaks. The population density started with relatively small numbers 41 individuals/10vines on 1st Nov. then increased gradually to reach its 1st peak (75individualls/10vines) on 1st Dec.. After that the population decreased, but increased to record its 2nd peak (114 individuals/10vines) on the 2nd Feb. The 3rd peak was observed one month later by the end of Mar. (132individuals/10vines). The population decreased suddenly two weeks later and resumed increasing to reach its 4th peak (114individuals/10vines) by the end of April. The population curve fluctuated to record the 5th peak in the end of Jun. The population density of the pest decreased during the next twomonths and then increased gradually to record its 6th peak (149 individuals/10vines) at mid-Aug.. The 7th and the highest peak of the (303 individuals/10vines) were recorded in mid of Sep., then the population decreased gradually till the end of the season.

Population of nymphal stage recorded 6th peaks; the 1st one was at mid-Dec. with 69 nymphs/10vines, then the population decreased sharply from mid-Dec. to the end of Jan. The population increase gradually from mid-Feb. to record its 2nd and smallest peak (42nymphs/10vines) at the end of Feb.. The 3rd peak was recorded one month later at the end of Mar. with 91 nymphs/10vines. The 4th peak was recorded at the end of April with 61 nymphs/10vines. Later on, the population density of nymphal stage fluctuated to reach its 5th peak by the end of Jul. with 87nymphs/10vines. The density of nymphal stage decreased gradually then resumed gradual increasing to reach the 6th and the highest one at the end of Sep. with 170 nymphs/10vines, and then the population curve of density decreased gradually till the end of the season.

Population of adult females recorded eight peaks during the second season. The 1st peak was recorded earlier at the end of Nov. with 58 adult females/10vines, after that the population density decreased, then the gradual increase returned to reach the 2nd peak 72 adult females/10vines by the end of Feb.. One month later, in the end of Mar., the 3rd peak was recorded with 41 adult females/10 vines. The 4th peak with 53 adult females/10 vines was observed at the end of April. During the next two weeks, the population density decreased and returned to increase quickly to reach the 5th peak with 76 adult females/10vines. The 6th peak (95 adult females/10 vines) was recorded in the end of Jun. Later on, the population density of adult females decreased then resumed increase to reach the 7th peak being represented by 87 adult female/10vines at mid-Aug. The 8th and the highest one (150 adult female/10 vines) were recorded in mid-Sep.

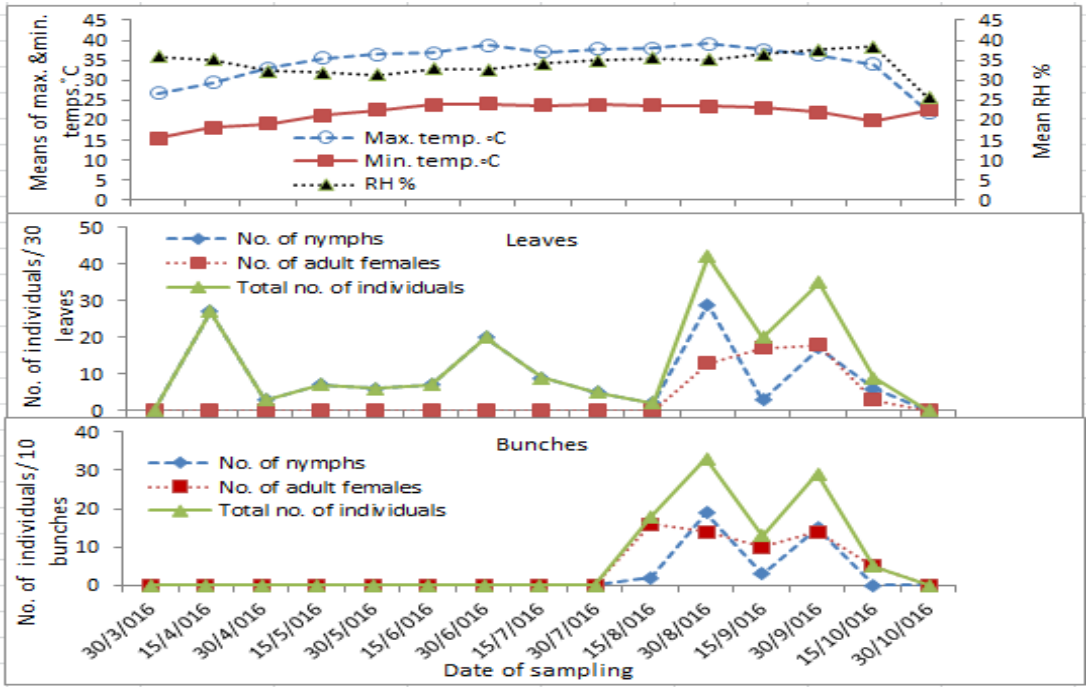

Fig. (2): Bi-weekly counts of nymphal and adult stages of *P. ficus* on leaves and bunches of grapevines with corresponding mean of weather factors during 2015-2016 season at Fayoum Governorate- Egypt

Comparing the percentage of nymphal stages with those of adult females, data showed that the nymphal stages were dominant during the 2nd season, where it representing 53.8% while adult females (non-ovipositing and ovipositing females) represented 46.2%. The highest percentage of nymphal stages (92%) was recorded mid-Jan. while the highest percentage of adult females (89.2%) was recorded at the end of Nov.

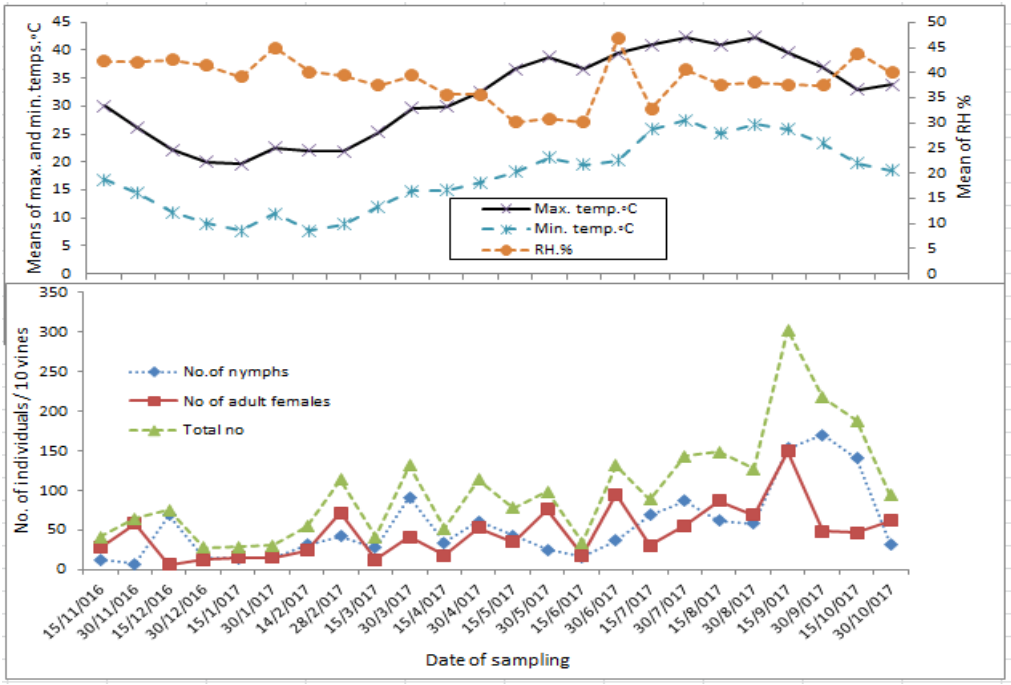

Fig. (3): Bi-weekly counts of nymphal and adult stages of *P. ficus* on trunks of grapevine with corresponding mean of weather factors during 2016-2017 season at Fayoum Governorate-Egypt

2.2. On leaves and bunches

During the 2nd season, 2016-2017, population density of nymphal stage, adult females and total population recorded 3 peaks on leaves as shown in Fig. (4). The 1st peak was recorded in mid-May with 21, 2 and 23 individuals/30 leaves for nymphs, adult females and total population, respectively. The 2nd peak (31, 3 and 34 individuals /30 leaves) was in mid-Jul. By the end of Sep., the population of nymphal stages and total population reached their third peak with 20 and 21individuals/30 leaves, while the 3rd peak of adult females was recorded in mid- Oct. with 4 adult females/30 leaves.

Contrast with first season, data of the second season showed that *P. ficus* was more active on bunches than in the first one. The infestation of bunches with mealybug during the second season started earlier in mid- Jul. The population of nymphal stages, adult females and total population recorded two peaks. The 1st peak was recorded in mid-Jul. with 66, 70 and 136 individuals/10 bunches for nymphs, adult females and total population respectively. Then the population density decreased sharply, and rein creased to reach its second peak at the end of Aug. with 105, 69 and 174

individuals/10 bunches after that the population density decreased gradually till the end of the season.

From the afore-mentioned results, nymphs of *P. ficus* recorded 6 peaks in both investigated years, adult females and total individuals of the mealy bug had 6 peaks during the first year and eight peaks in the second year. Such variations in peaks occur from year to year are generally due to differing temperatures, for example, with cool early summer temperatures delaying the upward migration of the colonies and hence resulting in a delayed population peak **(Walton and Pringle, 2004)**. In the present study the highest numbers of *P. ficus* were recorded during by the end of Aug. and in mid of Sep. for first and second year respectively. In California (USA), *P. ficus* revealed two peaks; the first one was in April, then a second low one in Aug. In California (San Joaquin Valley), three distinct peaks of density of adult vine mealybug were observed during summer and fall seasons **(Malakar *et al.*, 2001).**

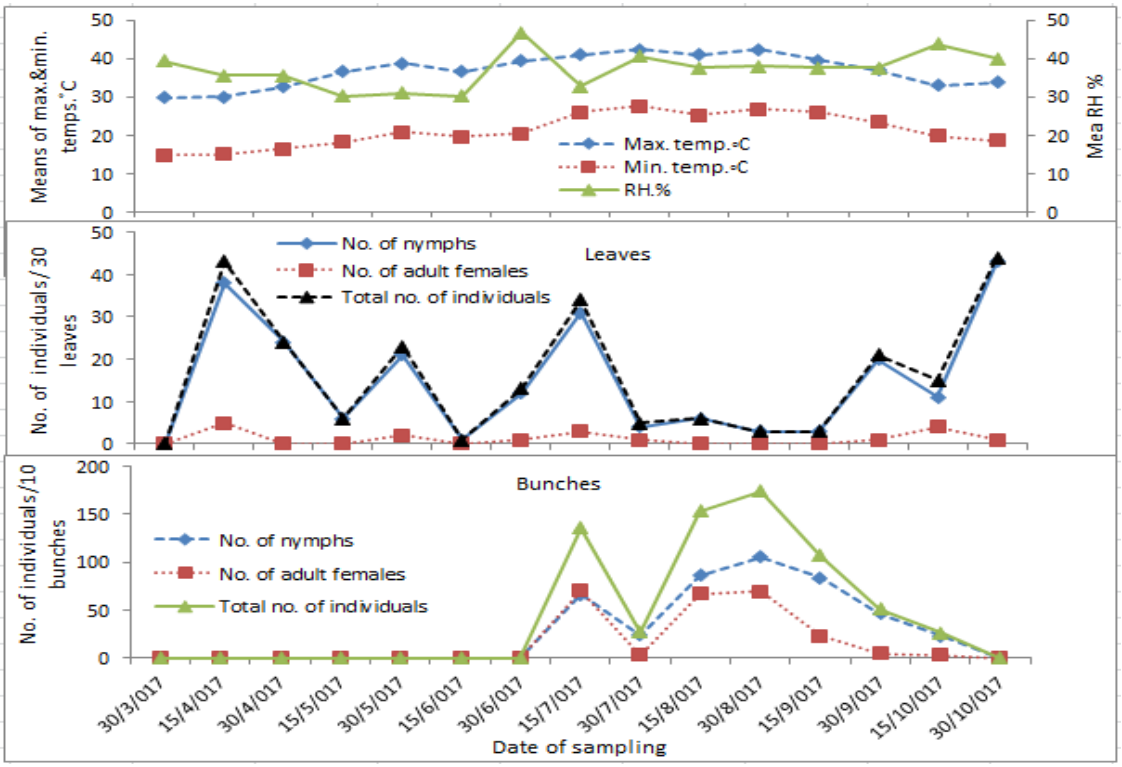

Fig. (4): Bi-weekly counts of nymphal and adult stages of *P. ficus* on leaves and bunches of grapevines with corresponding mean of weather factors during 2016-2017 season at Fayoum Governorate- Egypt.

The present findings are in general agree with those **(Attia**, **2003)** who mentioned that in an Egyptian vineyard, the appearance of *P. ficus* on leaves was in mid-Jun., and the population recorded one peak in the first of Aug. Regarding bunches, the same author mentioned that the mealy bug infested only mature bunches which agrees with the present results. The infestation appeared on bunches in Jun. or Jul. and recorded one peak of incidence in the first of Aug., which disagrees with the present results. Similarly, (**Mohamed *et al*., 2012)** demonstrated that adult females of *P. ficus* started to appear in 15 Jun. They recording one peak in the first of Aug. This peak was followed by a decrease till Oct. 15. During Nov. no individual was detected**.** The infestation of bunches began in 1 Jun.; reaching its highest count in Jul.15. Afterwards, the population decreased till no individual was detected. **Mohamed (2013)** recorded four species of mealybug infesting grapevine. The same author demonstrated that these species are different in peaking numbers and time, where five peaks for *P. vitis* were found during the two years of investigation the highest average numbers for *P. vitis*was recorded in the second week of Oct. in the first year and in the last week of Nov. in the second year of study.

Regarding the generations of *P. ficus*, the bi-weekly counts of oviposting females was considered as presence of egg stage and it was found to estimate the activity period of this mealybug on grapevine's trunk. This phenomenon was used to determine the end of each generation and the beginning of the next one **(Bakry, 2009).** Our results showed that *P. ficus* had three overlapping generations throughout the year and all stages of this pest can be found at any time beneath the bark of grapevine`s trunk throughout the year under the local conditions at Fayoum Governorate. At the 1st year, the first and the longest generation about 22 weeks occurred from mid- Nov. to mid-April, coinciding the leaves fall and the dormancy period of grapevine until the beginning of vegetation .The majority of mealybug population of this generation occupied the trunks of grapevines until the appearance of individuals on leaves started lately during mid of April. The second activity period was occurred in early summer and lasted for 14 weeks (from mid-April to mid-Jul.), although the individuals of this generation were distributed between trunks and leaves still trunks remained the main location of infestation. However, through this generation a noticeable great number of ovipositing females 74 individuals/10 vines was recorded in mid of May and secured all from trunks, representing 92.5% of the population during this period. The 3rd generation was occurred in summer and expanded to autumn (from the end of Jul. to the end of Oct.) and lasted for 12 weeks. The most active period of *Planococcus* individuals was occurred at the of Aug., represented by 261 individuals/10 vines, these individuals were distributed between trunks, and exposed parts of grapevine including leaves and bunches. By Oct. the population in trunk started to increase gradually from mid- Oct. where the individuals started to move from the left bunches and dried leaves to settle on trunk.

Results of the 2nd season, 2016-2017, showed that *P. ficus* followed the same trend of the 1st season and recorded three overlapping generations with few variations in durations. The first and longest activity period lasted for 20 weeks from mid of Nov.

to the end of Mar. The second generation was occurred from mid of Mar. to mid of Jul. and lasted for 18 weeks. The third generation lasted for 16 weeks from the mid of Jul. to end of Oct. Unlike the 1st year, the highest number of ovipositing females was recorded during this period represented by 67individuals/10 vines in the mid of Sep.

These findings are compatible with those obtained by **Vieux and Malan (2013)** which demonstrated that unlike other mealybug species, *P. focus* does not diapauses through winter, resulting in all life stages being found in any given season. Regarding the annual generation's number of *P. ficus*, there were different records exist in the literature, e.g. **(Walton, 2003; Cid *et al.*, 2010).** These studies recorded through five to six generations per year, while in Italian vineyards'(**Duso, 1989**; **Lentini *et al.*, 2008; Franco *et al.*, 2009)** recorded only three generations per year. The variations in generation numbers that have been observed in different regions are possibly related to the mean temperature differences **(Walton and Pringle, 2004)**. The number of generations of the mealybug varies with the species, locality and climatic factors; In Egypt **(Yossef**, **1991**) recorded three overlapping generation of the same species on grapevine.

3. Effects of the main climatic factors on population fluctuation of *P. ficus* on grapevine.

3.1. On trunks

The correlation between maximum temperature and total individuals of the mealybug was positive insignificant in the first year and positive highly significantly in the second year. Minimum temperature effected positively and insignificantly in the first year and highly positive significantly in the second year. The effect of mean relative humidity on adult females was negative highly significant effect in the first year and had a negative insignificant effect in the second year; however, the correlation between the same factor and total individuals of the mealybug was negative and insignificant in both investigated years.

Results of analysis of variance, , showed that combined effect of three weather factors on adult females was significant in the first year and the numerical relation between adult females density and weather factors was $Y^* = 36.090 + 0.743x1 + 0.864x2 - 0.683x3$. The combined effect of weather factors on nymphs and total population was insignificant. In the second year, the combined effect of weather factors was significant on nymphs and adult females and highly significant on total individuals of the mealy bug.

3.2 On leaves

The effect of maximum temperature on total individuals of the mealybug was positive and insignificant in the first year while the same factor showed negative and insignificant effect on total population in the second one. The correlation between minimum temperature and total individuals of the mealybug was positive and insignificant in the first year, the same factor showed a negative and insignificant effect on total population in the second year. The simple correlation coefficient between total individuals of the mealybug and relative humidity was positive and insignificant for first and second year respectively. Analysis of variance showed that

combined effect of the tested three weather factors on different stages of *P. ficus,* on leaves of grapevine, was insignificant in both investigated years.

3.3 On bunches

Correlation between maximum temperature and total individuals of the mealybug was positive and insignificant in the first year and negative insignificantly in the second year. Minimum temperature and different stages of *P. ficus* in the first year was positive and insignificant. In the second year, the effect of this factor was positive and insignificant with nymphs and total individuals of the mealybug, while it had a negative insignificant effect on adult females of the mealybug. In the first year, the correlation between mean relative humidity and different stages of the mealybug was positive and insignificant. But in the second year, this factor had a miscellaneous effect on the different stages of the mealybug. Results of analysis of variance showed that combined effect of three weather factors on different stages of *P. ficus* on bunches of grapevines was insignificant in both investigated years.

Investigating the factors affecting insect pest populations is of vital importance in developing an effective management program. Abiotic factors play a significant role in seasonal development of mealybugs besides the phenology of the crop. Temperature and relative humidity are the key abiotic parameters that influence the occurrence and the density of maybugs (**Mani and Shivaraju, 2016).** Although trunk of grapevine considered a refuge and protective sites from extreme temperatures, considerable effects of different climatic factors were revealed in the present investigation**.** In a study conducted by **(Berlinger, 1977),** it was demonstrated that early summer temperatures delayed upward migration of *P. ficus,* which consequently delayed the population rise. However, maximum temperature showed significant positive correlation with the mealybug population**. (Attia, 2003)** demonstrated the correlation between nymphs and adult stages and temperature on trunks, leaves while the correlation was positive and insignificant between different stages of the mealy bug and temperature. **Katke *et al.*,2009** observed that mealybug incidence on grapevine correlated positively and significantly with maximum temperature. **(Daane *et al.*, 2012)** had pointed to seasonal development of vine mealybug as a temperature-dependent and based on region and climatic conditions. Several studies had demonstrated the positive effect of temperature on *I. seychlarum* on different host plants *i.e.* palm; **Abdel-Rahman *et al.*, 2007** on mango; **(Osman, 2005)** on mulberry; **Nabil *et al.*, 2013** on coffee and **Ghanim *et al.*, 2013** who studied the population of *Planococcus citri* and *I. seychlarum* on mandarin. The outcome of the present investigation is in close agreement with the findings of **Angu *et al*. (2017)** who opined that the weather factors had a substantial influence on the incidence of *Maconellicoccus hirsute* on grapevine as maximum temperature had significant positive influence on the pest while minimum temperature had a negative and insignificant effect, which explains the high incidence levels in summer months. **Also, Yossef (1991)** demonstrated that the combined effects of the three main climatic factors on the population of *M. hirsutis* on grapevine had a greater effect than the single effect which partially agrees with the present results.

REFERENCES

Abdel-Rahman, M. M.; Salem, M. S.; Moussa, S. F. M.; Nour, M. E. and Maha I. E. L. Said (2007): Seasonal fluctuation of Seychelles fluted scale, *Icerya seychellarum* Westwood on four mango cultivars in Egypt. Egypt. J. Agric. Res., (1): 77 – 88.

Angu, A. R.; Reddy, C. N.; Kumari, D. A.; Ramesh, S. (2017): Seasonal incidence of mealybug *Maconellicoccushirsutis* (Green) on grape. Int. J. Curr. Microbiol. App. Sci., 6(2): 1629-1635.

Attia, A. R. (2003): Ecological and Biological studies on the vine mealybug, *Planococcus ficus* Signoret and its associated parasitoids, Ph. D. Thesis, Cairo univ., 262pp.

Bakry, M. M. S., (2009): Studies on some scale insects and mealybugs infesting mango trees in Qena Governorate. M. Sc. Thesis, Fac. Agric., Minia Univ., 240pp.

Berlinger, M.J. (1977): The Mediterranean vine mealybug and its natural enemies in southern Israel. Phytoparasitica. 5: 3-14.

Chiotta, M. L.; Ponsone, M. L. ;Torres, A. M. ;Combina, M. and Chulze, S. N. (2010): Influence of *Planococcus ficus* on *Aspergillus* section *Nigri* and ochratoxin A incidence in vineyards from Argentina. Lett. Appl.Microbiol., 51: 212–218.

Cid, M.; Pereiro, S.; Cabaleiro, C. and Segura, A. (2010): Citrus mealybug *Planococcuscitri* (Hemiptera: Pseudococcidae) movement and population dynamics in arbor-trained vineyard, Econ. Entomol., 103: 619-630.

Daane, K. M.; Vincent, C.; Isaacs, R.; Ioriatti, C. (2018): Entomological opportunities and challenges for sustainable viticulture in a global market. Annu. Rev. Entomol., 63:193-214.

Daane, K.M.; Almeida, R.P.P.; Bell, V.A.; Walker, J.T.S.; Botton, M.; Fallahzadeh M.; Mani, M.; Miano, J. L.; Sforza, R.; Walton, V. M. and Zaviezo, T. (2012): Biology and management of mealybugs in vineyards. (eds. Bostanian, N. J., Isaacs, R. and Vincent, C.): 271-307. Springer, Dordrecht. The Netherlands.

De- Lemos Filho, J. P. and Sousa Paiva, E. A. (2006): The effects of sooty mold on photosynthesis and mesophyll structure of mahogany (Swietenia macrophylla King. Meliaceae). Bragantia 65: 11–17Godfrey, K., J. Ball, D. Gonzalez, and E. Reeves. 2003. Biology of the vine mealybug in vineyards in the Coachella Valley, California, Southwest. Entomol. 28: 183–196.

Duso, C. (1989): Indigenous bioecology of *Planococcus ficus*,Sign., in the Veneto region).Boll. Lab. Entomol. Agraria 'Filippo Silvestri' 46:3-20.

Franco, J.C.; Zada A. and Mendel, Z. (2009): Novel approaches for the management of mealybug pests. Pages 233-278 in *I. Ishaaya*, and A.R. Horowitz, editors. Biorational control of arthropod pests: application and resistance management programs. Springer, New York, New York, USA.

Ghanim, A. A.; Abdel-Salam, A. H.; Elkady, H. A.; El-Nagar M. E. and Awadalla, H. S.S. (2013): Ecological studies on some mealybug species attacking mandarin trees and their predatory insects at Mansoura district, J. Plant Prot. and Path., Mansoura Univ., 4 (3): 303 – 315.

Katke, M.; Balikai, R. A. and Venkatesh, H. (2009): Seasonal incidence of grape mealy bug, *Maconellicoccus hirsutus* Green and its relation with weather parameters, Pest Manage. Hort. Ecosys. 15(1): 9-16.

Kaydan, M.B.; Kilincer, N. and Kozar, F. (2005): Studies on Pseudococcidae (Hemiptera Coccoidea) fauna of urban ecosystem of Ankara Province, Turkey. Boll. Zool. Agrar. Bachic. 37:85–95.

Lentini, A. G.; Serra, S. O. and Delrio, G. (2008): Seasonal abundance and distribution of *Planococcus ficus* on grape vine in Sardinia. IOBC/WPRS Bull. 36: 267–272.

Mahfoudhi, N. and Dhouibi, M.H. (2009): Survey of mealybugs (Hemiptera: Pseudococcidae) and their natural enemies in Tunisian vineyards. Afr.Entomol. 17:154–160.

Malakar, K. R.; Daane, K.; Bentley ,W.; Yokota ,G.; Martin, L.; Godfrey, K. and Ball, J.(2001): Population dynamics of vine mealybug and its natural enemies in the Coachella and San Joaquin Valleys. University of California Plant Protection Quarterly 11: 1–4.

Mani, M. and Shivaraju, S. (2016): Mealybugs and their Management in Agricultural and Horticultural crops,1st edition. New Delhi, Springer, https://doi.org/10.1007/978-81-322-2677-2.

Mohamed, G. H.; Badr, S. A. and El-Amir, S.M. (2012): The efficiency of different materials for controlling vine mealybug, *Planococcus ficus* Signoret (Hemiptera: Pseudococcidae)on grapes during the period of Investigation, Egypt. Acad. J. Biolog. Sci., 4 (1): 69- 75.

Mohamed, Nadia, E. (2013): Ecological studies on some mealybug species infesting grapevine trees and their associated predatory insects at Mansoura district.J. Plant Prot. and Path., Mansoura Univ., (10):821-836.

Nabil , Dalia Z.; Amin, A. H.; Y. Abdallah, E. Y. and Nagwa, A. H. (2013): Certain ecological aspects for *Iceryaseychellarum* (Westwood) on coffee plants Coffea Arabica in Egypt, J. Plant Prot. and Path., Mansoura Univ., 4 (3) 265 – 277.

Osman, E. A. (2005): Studies on homopterous insect pests infesting mulberry tree in relation with *Bombyx mori*, L. (Bombycidae: Lepidoptera) silk production. Ph. D. Thesis, Fac. Agric., Cairo Univ.; 160pp.

Rosciglione, B., and Gugerli, P. (1989): Transmission of grapevine leafroll disease and an associated closterovirus to healthy grapevine by the mealybug *Planococcus ficus*. Phytoparasitica 17: 63.Etude des Cochenilles et des antagonistes qui leursontassociés dans des vignoblesen Bourgogne et en Alsace de 2000 à 2002. Bull. OILB/SROP 26(8): 247-252.

Senedecor, G.W. and **Cochran,W.G.(1980):** Statistical methods, 7th Ed. 570 pp.,

Iowa Stat., Univ. Press., Ames, Iowa, USA.

Tanne, E.; Ben-Dov, Y. and Raccah, B. (1989). Transmission of the corky-barkdisease by the mealybug *Planococcus ficus*,Phytoparasitica 17: 55.

Vieux, P. D. and Malan, A. P. (2013): An overview of the vine mealybug (*Planococcus ficus*) in South African vineyards and the use of entomopathogenic nematodes as potential biocontrol agent. South Afr. J. Enol. Vitic. 34(1):108-118.

Walton, V.M and Pringle, K.L. (2004): A survey of mealybugs and associated natural enemies in vineyards in the Western Cape Province, South Africa. South Afr., J. Enol. Viticul. 25: 23-25.

Walton, V.M. (2003): Development of an integrated pest management system for vine mealybug, *Planococcus ficus* Signoret, in vineyards in the Western Cape Province, South Africa. Ph.D. Thesis, Stellenbosch. Univ., South Africa.141p.

Williams, D.J. and Moghaddam, M. (2000): Mealybug species of the genus *pseudococcusferris* in Iran (Homoptera: Coccoidea: Pseudococcidae) with a discussion of *Planococcus vovae*Nasonov, J Entomol Soc Iran 18(1/2):32–43 .

Yossef, A. S. E. (1991): Studies on some mealybugs infesting grapes in Egypt, M.Sc. Thesis, Fac. Agric. Ain Shams Univ., 101 pp.

تذبذب تعداد بق العنب الدقيقي (Pseudococcidae: Homoptera) *Planococcus ficus* علي العنب في محافظة الفيوم-مصر

ربيع حسن عوض سليمان[١]- عاطف أحمد عبد الجيد[١]- مني عبد الحميد شعيب[٢] – منار محمد أحمد[٢]

١- قسم وقاية النبات- كلية الزراعة- جامعة الفيوم – مصر

٢- معهد بحوث وقاية النباتات- مركز البحوث الزراعية- مصر

بق العنب الدقيقي من الآفات المهمة التي تصيب العنب وفي هذا العمل الذي اجري في محافظة الفيوم (قرية فيديمين) علي كرمات العنب (صنف غريبي) القي الضوء علي تقلبات الكثافة العددية وعدد و مدة أجيال بق العنب الدقيقي فضلا عن تأثير العوامل الجوية الرئيسية علي تعداد هذه الحشرة. تم أخذ عينات نصف شهرية منتظمة من الجذوع و الاوراق و العناقيد لمدة عامين من نوفمبر ٢٠١٥ الي نهاية أكتوبر م ٢٠١٧م وقد أظهرت النتائج ان الاطوار المختلفة لبق العنب الدقيقي تتواجد علي الجذوع طوال العام حيث سجلت حوريات بق العنب ٦ قمم للتعداد خلال عامي الدراسة بينما سجلت الاطوار الكاملة للاناث ٥ قمم للتعداد خلال السنة الاولي و٨ قمم خلال السنة الثانية وقد سجل اعلي تعداد للحشرة في آخر شهر أغسطس ومنتصف شهر سبتمبر خلال العام الأول والثاني علي التوالي كما أظهرت النتائج ان بق العنب الدقيقي يصيب العناقيد الناضجة فقط وسجل أعلي تعداد للحشرة علي العناقيد في آخر أغسطس وكان تأثير كل من الحرارة العظمي و الصغري علي التعداد الكلي لبق العنب موجبا و غير معنوي خلال العام الأول للدراسة بينماكان التأثير موجبا وعالي المعنوية خلال العام الثاني و كان تأثير الرطوبة النسبية علي التعداد الكلي للحشرة سالبا و غير معنوي خلال عامي الدراسة،اما التأثير المشترك للعوامل الجوية الثلاثة علي التعداد الكلي للحشرة فكان غير معنوي خلال العام الأول بينما كان معنويا علي الأطوار المختلفة للحشرة خلال العام الثاني للدراسة.