Population Dynamics of *Capitophorus Elaeagni* (Hemiptera: Aphididae) and Its Associated Predators on Artichoke Plants in El-Behera

Reda M. Tabikha [1*] and Khalil A. Draz[1]

ABSTRACT

Globally marketing of artichoke is regulated by strict-safety and quality standards. It could be obtained throughout successfully integrated pest management which minimize using of pesticides and maximize role of bio-control agents on artichoke cultivations especially during harvest period. *Capitophorus elaeagni* was considered as a main common aphid species on artichoke plants. Therefore, monitoring population size of *C. elaeagni* and associated predators is essential, that it was achieved during current field study. It was conducted along artichokes harvest time (Mid-December to Mid-May) in two consecutive cultivation seasons (2017-2018 and 2018-2019) in El Behera Governorate which has largest cultivated area of artichoke in Egypt. Obtained results revealed that high numbers of aphid were observed on artichoke leaves during spring, which the aphid population grew rapidly in Mid-April. Therefore it is recommended to complete artichoke harvest before May. Water yellow traps could capture high numbers of *C. elaeagni* and little numbers of *Aphis gossypii* and *Acyrthosiphon pisum*. It is recommended to orient those traps to northeast direction with approximated angle from 26 to 35º East to capture highest numbers of aphid. *Chrysopa vulgaris* was the most dominant predator (84%) followed by coccinellids (13%) then *Eupeodes corolla* (3%). Each of maximum, minimum and mean temperatures had positive significant effect on population densities of *C. elaeagni*, Coccinellids and *Chrysopa vulgaris*, while relative humidity had negative significant effect on aphid density. *C. elaeagni* had 8-9 consecutive generations, whereas generations of autumn and spring characterized with short duration (7-19 days) while winter generations were longer (14-26 days).

Keywords: *Capitophorus elaeagni, Cynara scolymus*, El-Behera Governorate, Predators, Population dynamic, Traps.

INTRODUCTION

The globe artichoke, *Cynara scolymus* L., (Asteraceae) is an herbaceous perennial thistle in the family Asteraceae originating in southern Europe around the Mediterranean (Rottenberg and Zohary, 1996). It is becoming one of the most important vegetable crops grown for both local consumption and export (Mansour, 1983; Tawfik, 1994). During the period from 2005 to 2019 the average cultivated area of artichoke in Egypt was around 275400 feddans (feddan= 4200 m^2) that yielded nearly 246000 tons yearly (9.02 ton/ feddan). Thus Egypt comes in second rank after Italy which the latter was considered as the largest artichoke producer in the world (387000 ton) in 2017 (FAO, 2019). In Egypt, Most of cultivated area of artichoke locate in North Egypt especially in El-Behera, Matrouh, Gharbia and Kafr El Sheik Governorates. El- Behera Governorate is ranking the first order with its cultivated area 39170 feddans (51.44%) that yielded 179910 ton (51.43%) in 2019 but with low productivity per feddan (8.75 ton / feddan) comparing with other producing governorates (Anonymous, 2019).

Insect pests of artichoke and their management are one of significant reason for low productivity of cultivated area in El-Behera governorate (Adlan, 2016; Mostafa *et al.,* 2021). Artichoke plants are attacked by several economic insect pests such as aphid, thrips, leafminers, (Larraín *et al.,* 2013), cotton whiteflies *Bemisia tabaci*, and cotton leaf worm *Spodoptera littoralis* Biosd, *Empoasca discipiens* Poal, and *Autographa gamma* Linn (Taha *et al.,* 2012). Different aphids' species were recorded on globe artichoke in Egypt that causing considerable damage to plants (Afify *et al.,* 2004; Fadel and Hady, 2006). Artichoke aphid, *Capitophorus elaeagni* Del Guercio, 1894 (Hemiptera : Aphididae), which has other common names include the thistle aphid and oleaster-thistle aphid, is one of major insect pest on artichoke in El-Behera Governorate (Tabikha, 2008; Amin *et al.,* 2013) because of their spectacular proliferation regarding and their biological characteristics such as polymorphism and alternating kinds of reproduction (Robert, 1988). This species is globally distributed in temperate regions of the world, but probably is European origin (Blackman and Eastop, 2000 and 2006; Voegtlin *et al.,* 2003; Foottit *et al.,* 2006; Skvarla *et al.,* 2017). Generally, it has host preference toward thistles (Asteraceae), while during the sexual phase of its lifecycle, it switches to *Elaeagnus* (Elaeagnaceae) (Pirone, 1978; Holman, 2009).

Exportation of fresh or prepared artichoke buds to European or Arab countries was regulated by product safety parameters, that free of pesticide residue is one of

DOI: 10.21608/asejaiqjsae.2022.230544
[1]Plant Protection Department, Faculty of Agriculture, Damanhour University, Damanhour, Egypt.
* Corresponding author: Reda.Tabikha@agr.dmu.edu.eg
Received March 10, 2022, Accepted, April 12, 2022.

the most limited parameters, although presence of the previous mentioned pests which attack artichoke plants in fields and may cause losing of yield. Thus successfully integrated pest management of *C. elaeagni* minimize the use of pesticides and maximize the role of biological control agents, which include lady beetles (Coleoptera : Coccinellidae) and flower flies (Diptera : Syrphidae) (Capinera, 2001). Thus, they are considered as main predators for artichoke aphid. Therefore it is recommended and necessary monitoring populations sizes of artichoke aphid and its associated predators by using traps or direct field counts especially during the wide artichoke harvest period (throughout winter and spring) (Larraín *et al.*, 2013) to avoid pesticide application during this critical period, which was considered during the current study.

MATERIAL AND METHODS

Locality:

All field studies for aphid species infesting artichoke (*Cynara scolymus*) plants c.v. France were carried out at artichoke fields, Kom El-Berka Village, at Kafer El-Doawar, El-Behera Governorate (31º 06' 03"N, 30º 06' 05"E). An area of ½ feddan was chosen for experimental field works. This area was divided into four replicates. Records of main climatic factors were obtained from the nearest metrological station of El-Bossaly district, near to Rashid city. Field experiments were conducted along artichokes harvest time which extended from Mid-December to Mid-May in two consecutive years (from December, 2017 to May, 2018 and from December, 2018 to May, 2019).

Survey aphid species and associated predators in artichoke fields:

Alate and Apterus forms of aphid species, habitat artichoke plants or captured winged forms of aphid species in water yellow traps in artichoke fields were identified according taxonomic keys of Habib & El-Kady (1961) and Blackman & Eastop (2000). In addition, the insect predators, associated aphid species on artichoke plants, were also surveyed.

Monitoring population fluctuation of artichoke aphid and associated predators:

For monitoring population fluctuation of *C. elaeagni*, sample of 100 artichoke leaves were picked randomly from four cardinal directions as well as from the middle of experimental field (20 leaves from each direction), and investigated by pocket lens 15X. Numbers of alate and apterus forms (nymphs + adults) were counted in 1 inch^2 of leaf area. Sampling procedures were carried out 7 days intervals. On other hand, numbers of coccinellid, syrphus and winglace predators, found associated with aphid on whole artichoke plants, were also recorded throughout the sampling procedure.Experimental area was received recommended agricultural practices without any insecticide applications. Records of daily maximum and minimum, mean temperatures and relative humidity were obtained from nearest metrological station in El-Bossaly district, near to Rashid city.

Estimating numbers and duration of aphid generations

To estimate numbers and duration of artichoke aphid generations at artichoke field, obtained data of aphid population densities throughout investigation periods were used for this purpose. The weekly numbers of artichoke aphid were subjected to formula of Audemard and Millaire (1975) and emended by Iacob (1977) which accumulated numbers of aphid could be calculated then graphically illustrated on semigaussian paper (scale gausses).

Monitoring activity of winged form of aphids in artichoke fields:

For monitoring different aphid species and population density of artichoke aphid alate forms that soar in and around artichoke field, the experimental artichoke field was provided with four yellow water pan traps that was distributed in borders of artichoke field at the four cardinal directions (North, South, East and West) and situated at 30 cm height from ground level. Each trap, made of plastic pan with 15 cm in diameter, was fallen with one liter of water and changed when it was needed. Regular inspection procedures for traps were conducted at 7 days intervals during period of the study. Numbers of captured aphid winged forms were counted and preserved in 70% ethanol for further identification process.

Calculations and statistical analysis:

Numbers of *C. elaeagni* individuals on 100 inch^2 of artichoke leaf were calculated from 100 leaves for each sampling date to represent the population density index of aphid. Weekly total numbers of the associated predators was also estimated per sample size of 100 plants. To clarify the simultaneous effects of both biotic and climatic factors (independent factors) on artichoke aphid population (dependent factor), simple correlation analysis was conducted. Whereas, all statistical analysis of obtained data were conducted by using COSTAT (2008) statistical software computer program.

To detect destination of the aphid alate forms in the experimental field, angle of resultant and the abscissa was estimated which it was based on recorded numbers of aphid alate forms in water pan traps situated in different cardinal directions. This angle was calculated by dividing F2/ F1 (F2= capture mean number of alate forms in the northern traps - capture mean number of alate forms in the southern direction "reverse is applied

if the numbers on south direction is higher"), (F1 is capture mean number of alate forms in eastern trap-capture mean number of alate forms in western trap " it is reserved if the western trap is higher").

$F_1 = E - W$ $F_2 = N - S$ $\text{Tan } \theta = F_2 / F_1$

RESULTS AND DISCUSSION

RESULTS

Survey aphid species and associated predators in artichoke fields:

Surveying process of aphid species that habitat artichoke fields, during two successive seasons (from December, 2017 to May, 2018 and from December, 2018 to May, 2019) showed that *Capitophorus elaeagni* was the most dominant aphid species on artichoke plants along the inspection dates, which attacked upper and new leaves of artichoke. On the other hand, little numbers of *Aphis gossypii* Glover and *Acyrthosiphon pisum* Harris were captured with the alate forms of *C. elaeagni* in water yellow traps that surrendering the artichoke field, the first two species were not recorded on artichoke host along inspection periods.

The associated insect predators to aphid species on artichoke plants, were *Chrysopa vulgaris* (Neuroptera : Myrmeleonidae), coccinellids (*Coccinella undecimpunctata* Linnaeus, 1758 and *Coccinella septempunctata* Linnaeus, 1758) (Coleoptera: Coccinellidae) and *Eupeodes corollae* Fabricius, 1794 (Diptera : Syrphidae). Generally, from illustrated data in Figures (3) and (4) it is clear that *Chrysopa vulgaris* was the most dominant species (84%) followed by coccinellids (13%) and *Eupeodes corolla* (3%), respectively.

Population dynamics of *C. elaeagni* and its associated predators:

As illustrated in Figures (1) and (2), shown that mean weekly numbers of artichoke aphid during season of 2017-2018 (139.39 individual/ 100 inch^2/ week) was higher than season of 2018-2019 (68.96 individual/ 100 inch^2/ week), despite aphid population fluctuations trend was nearly similar in the both seasons. Whereas, low population density of artichoke aphid were observed on artichoke leaves in winter of the both consecutive seasons (74.93 and 34.36 individual/ 100 inch^2/ week, respectively). On contrary, high population densities of artichoke aphid were recorded on artichoke leaves during inspection dates of spring season in both seasons (239.67 and 122.78 individual/ 100 inch^2/ week, respectively). Near end of winter (End-February), aphid population began to increase gradually to harbor first moderated increasing peaks which were observed in 1-March, 2018 and 21-February, 2019. In Mid-April, rapid aphid population growth was observed thus the highest population densities of artichoke aphid were observed in the next month (May) (525 individual/ 100 inch^2 in 17th May, 2018 and 338 individual/ 100 inch^2 in 2nd May, 2019). Therefore it is recommended to complete artichoke mature flower buds harvest before May for avoiding negative effects of artichoke aphid existence on their quality and quantity, and save the flower buds without any residue of insecticides, which are essential for international marketing of the final product.

On the other hand, as shown in illustrated Figures (3) and (4), population fluctuation of aphid's predators (*C. vulgaris*, coccinellids and *S. corolla*) associated with *C. elaeagni* on artichoke plants along the two consecutive seasons declared that mean weekly numbers of pre-mentioned predators during 2017-2018 (25.28, 7.09 and 0.96 individual/ 100 plant/ week, respectively) was also higher than season of 2018-2019 (14.83, 2.43 and 0.57 individual/ 100 plant/ week, respectively). The lowest numbers of the predatory insects were also observed on artichoke plants in winter of the both consecutive seasons were mean weekly numbers of those predators were 4.64, 0.71 and 0.5, individual/ plant/ week, respectively in season 2017-2018, and 6.21, 0.79 and 0.57 individual/ plant/ week, respectively in season 2018-2019. While, The highest numbers of the predatory insects were 24.90, 3.95 and 0.94, individual/ plant/ week, respectively in spring season of 2017-2018, and 28.22, 5.00 and 0.56 individual/ plant/ week, respectively in spring season of 2018-2019. On the other hand, from the third week of February, numbers of *C. vulgaris* increased gradually to achieve highest numbers in 5th, 19th April, and 15th May, 2018 or more in season of 2019. While the adequate numbers of coccinellids were observed later, near end of April of both seasons. Finally, highest numbers of *E. corolla* (10 individual/ 100 plant) was only recorded in 1st week of April, 2018 or as scattered peaks (2 individual/ 100 plant) along inspection dates in the growing season of 2019.

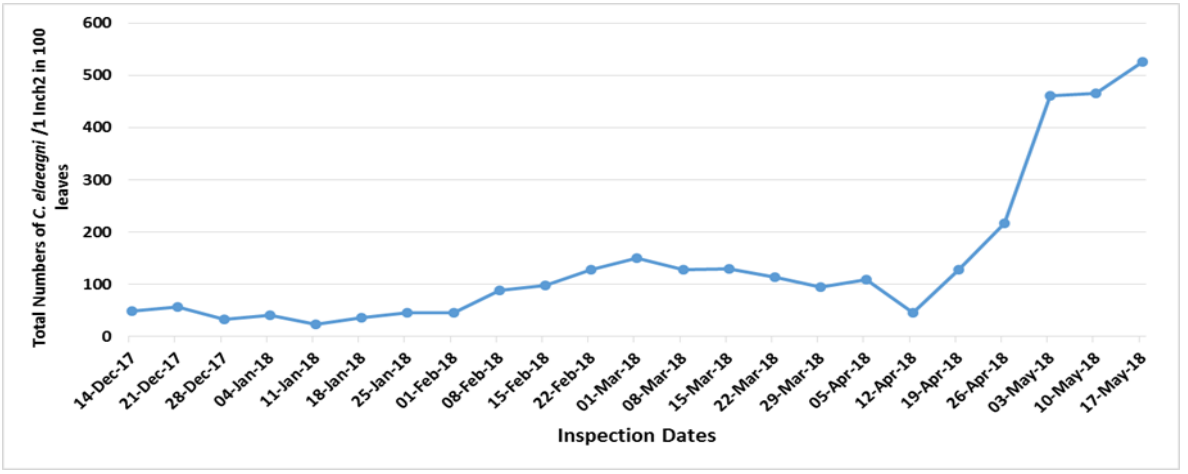

Fig. 1. Weekly population fluctuation of *C. elaeagni* on artichoke leaves during growing season of 2017-2018 in El-Behera Governorate

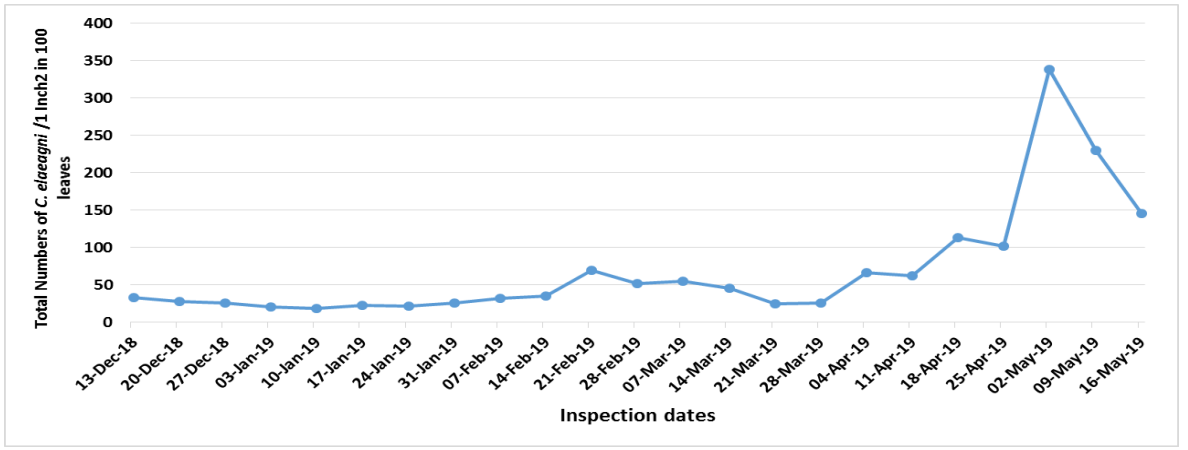

Fig. 2. Weekly population fluctuation of *C. elaeagni* on artichoke leaves during growing season of 2018-2019 in El-Behera Governorate

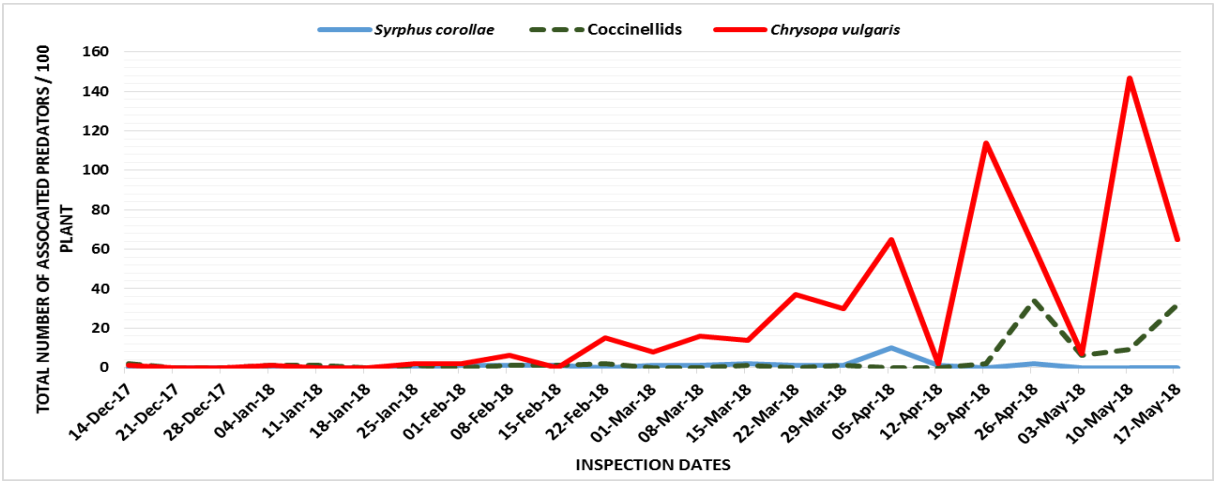

Fig. 3. Weekly population fluctuation of predatory insects that associated with aphid on artichoke plants during growing season of 2017-2018 in El-Behera Governorate

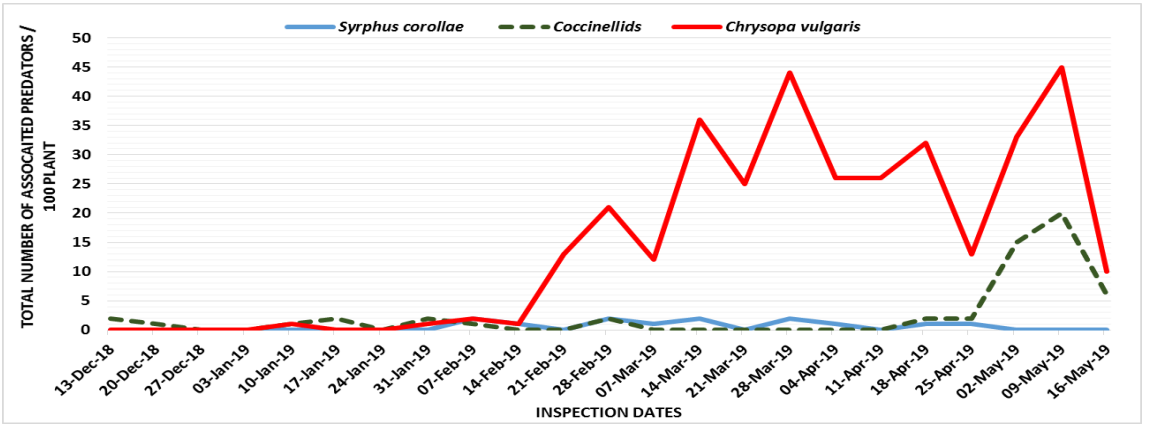

Fig. 4. Weekly population fluctuation of predatory insects that associated with aphid on artichoke plants during growing season of 2018-2019 in El-Behera Governorate

Numbers and duration of *C. elaeagni* generations

Depending on accumulated weekly total numbers of *C. elaeagni* per 100 inch^2 of artichoke leaves, numbers and durations of the aphid generations could be graphically estimated as shown in Figures (5A and 5B). The obtained data, as presented in Table (1), revealed that *C. elaeagni* had 8-9 consequent generations on artichoke plants from Mid-December to Mid-May (flower buds harvest time). Generations of autumn and spring generations characterized with short generation duration (7-19 days) while winter generations may be extend to 14-26 days. Durations of second and seventh generations were 7-14 days during growing seasons of 2017-2018 and longer (14-26 days) during growing season of 2018-2019.

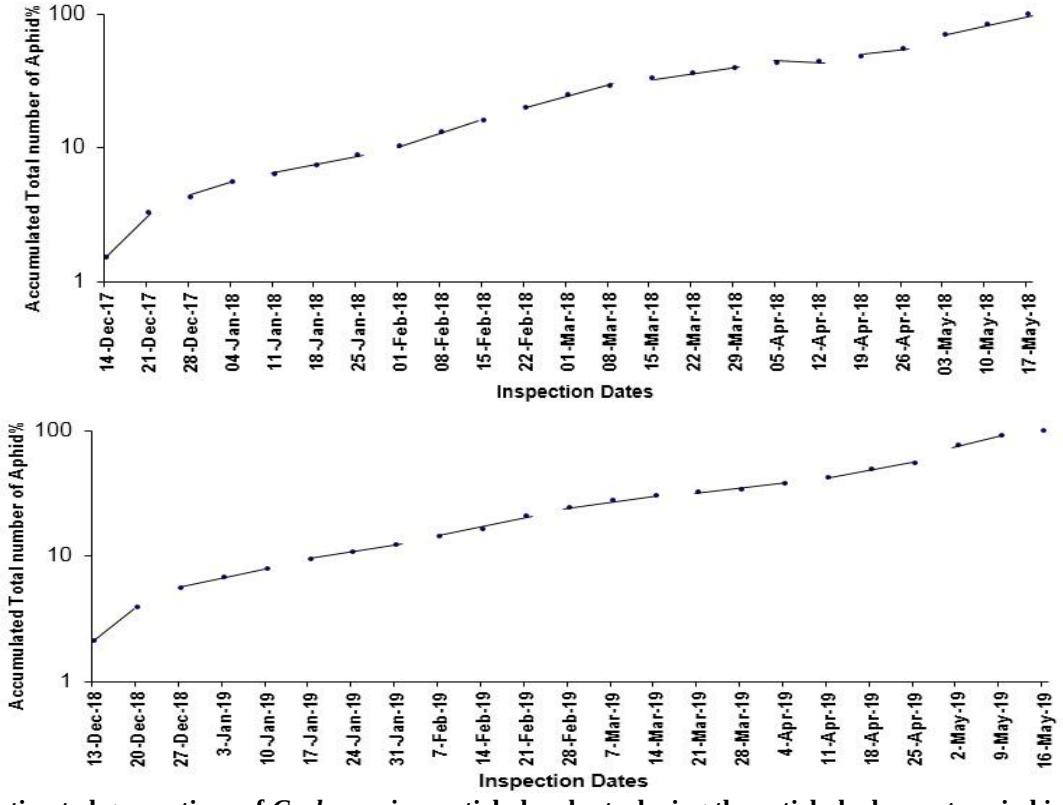

Fig. 5. Estimated generations of *C. elaeagni* on artichoke plants during the artichoke harvest period in growing seasons of 2017-2018 (A) and 2018-2019 (B) in El-Behera Governorate

Table 1. Estimated numbers and durations of *C. elaeagni* on artichoke plants in El-Behera Governorate, according to Audemard and milaire (1975) and Iacob (1977)

No. Generation seasons	Generation durations during growing season of 2017-2018			Generation durations during growing season of 2018-2019		
	From(1)	To(2)	Duration(3)	From(1)	To(2)	Duration(3)
G1 Autman	14-Dec-17	21-Dec-17	7	13-Dec-18	20-Dec-18	7
G2 Winter	28-Dec-17	04-Jan-18	7	27-Dec-18	10-Jan-19	14
G3 Winter	11-Jan-18	25-Jan-18	14	17-Jan-19	31-Jan-19	14
G4 Winter	01-Feb-18	15-Feb-18	14	07-Feb-19	21-Feb-19	14
G5 Winter	22-Feb-18	08-Mar-18	14	28-Feb-19	14-Mar-19	14
G6 Winter-Spring	15-Mar-18	29-Mar-18	14	21-Mar-19	04-Apr-19	14
G7 Spring	05-Apr-18	12-Apr-18	7	11-Apr-19	25-Apr-19	14
G8 Spring	19-Apr-18	26-Apr-18	27	02-May-19	09-May-19	7
G9 Spring	03-May-18	17-May-18	7	-	-	-

For avoiding time gapping among separated Generations.
(1): Time of begging generation may be started earlier with 0 to 6 day.
(2): Time of end generation may be extended for 0 to 6 day.
(3): 0 to 12 days may be added to all generation duration values.

Water yellow traps orientation and artichoke aphid destination

Obtained numbers of *C. elaeagni* alate forms in artichoke fields, which were recorded by using water yellow traps, situating in four cardinal borders of artichoke fields throughout harvest time of flowering buds in the two examined growing season, were shown in scattering charts of Figures (6) and (7). The illustrated data revealed that highest numbers of alate forms were observed from beginning of April coincidence increasing aphid population density on artichoke leaves, whereas high significant correlation was observed between numbers of captured alate forms in traps and numbers of *C. elaeagni* on artichoke leaves (r = 0.791*** and 0.763*** in both growing seasons, respectively). During growing seasons of 2017-2018, situated traps in eastern direction captured highest numbers of alate individuals during winter seasons, while located traps in northern and southern directions captured the highest numbers in spring as shown in Figures (6). Despite catches numbers in growing season of 2018-2019 was higher than of 2017-2018, numbers of captured individuals in different traps were closed especially in winter of 2019. While northern trap attracted highest numbers of *C. elaeagni* in spring of 2019 as shown in Figures (7). Results of statistical analysis declared that there were significant effect of traps locations on numbers of capture aphid ($F=5.367^{**}$, $LSD_{0.05}= 1.342$) ($F=4.212^{**}$, $LSD_{0.05}= 3.213$) in the artichoke growing seasons of 2017-2018 and 2018-2019, respectively. Whereas the traps located in northern and eastern borders of artichoke fields attract highest numbers of alate that they recorded mean weakly numbers 6.21 and 6.61 individual/trap/week in season of 2017-2018 and 11.26 and 8.26 individual/trap/ week in season of 2018-2019. Thus, best water trap orientation could be detected according illustrated pooled effect of trap location in Figures (8A and 8B), that it is recommended orient water traps to northeast direction with approximated angle from 26 to 35^{o} East.

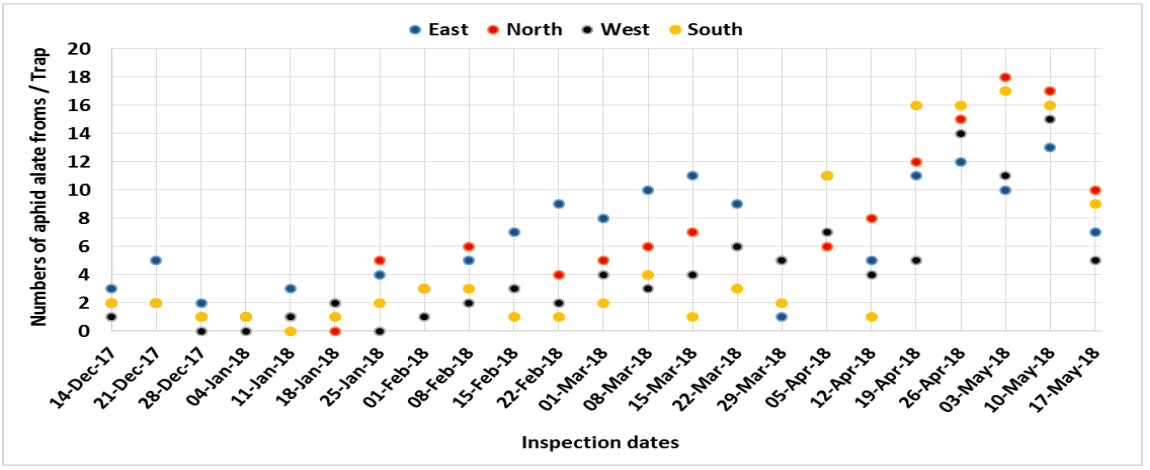

Fig. 6. Weekly numbers of captured alate aphids in water yellow traps located in four cardinal direction of artichoke field in El-Behera Governorate during growing season of 2017-2018

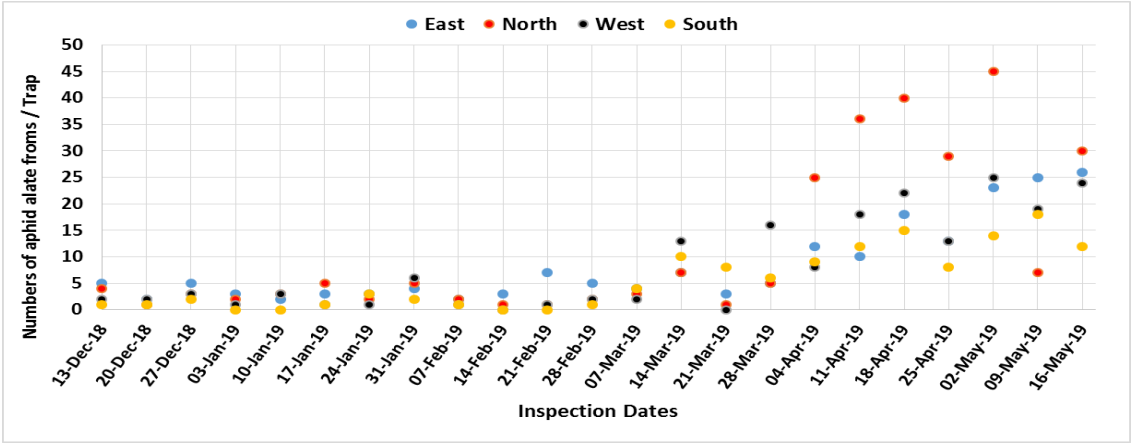

Fig. 7. Weekly numbers of captured alate aphids in water yellow traps located in four cardinal direction of artichoke field in El-Behera Governorate during growing season of 2018-2019

Fig. 8. The pooled effect of attracted *C. elaeagni* alate to water yellow traps situated in the four cardinal borders of artichoke field in El-Behera Governorate during growing seasons of 2017-2018 (A) and 2018-2019 (B)

Impact of biotic and climatic factors on population density of *C. elaeagni* and associated predators.

Each of maximum, minimum and mean temperatures had positive significant effect on population density of *C. elaeagni* on artichoke plants during growing seasons of 2017-2018 (r= 0.776***, 0.834*** and 0.818***, respectively) and 2018-2019 (0.731***, 0.581** and 0.690***, respectively), while relative humidity had negative significant effect on population density of *C. elaeagni* in both seasons (r= -0.413* and -0.706***, respectively). Population growth of *C. elaeagni* had positive significant effects on population growth of Coccinellids and *Chrysopa vulgaris* (r= 0.642*** and 0.578**, respectively, during seasons of 2017-2018) and (r= 0.876***and 00.523*, respectively, during seasons of 2017-2018). There were also positive relationship between densities of Coccinellids and *Chrysopa vulgaris* populations along growing seasons of 2017-2018 (r= 0.444**) and 2018-2019 (r= 0.416**). On other hand, each of maximum, minimum and mean temperatures had positive significant effect on population density of Coccinellids during growing seasons of 2017-2018 (r= 0.613**, 0.686*** and 0.658***, respectively) and 2018-2019 (r= 0.658***, 0.544** and 0.630***, respectively). Those thermal factors had also positive significant effects on population densities of *Chrysopa vulgaris* during season of 2017-2018 (r= 0.691***, 0.650*** and 0.691***, respectively) and season of 2018-2019 (r= 0.576**, 0.445* and 0.538**, respectively). Although relative humidity had negative effects on populations of Coccinellids and *Chrysopa vulgaris*, those effects were disparate. Where it had significant effect on Coccinellid populations (r= -0.701***) during season of 2018-2019 and insignificant effect (r= -0.384^{ns}) during season of 2017-2018, in contrary it had significant effect on *Chrysopa vulgaris* population (r= -0.556***) during season of 2017-2018 and insignificant effect (r= -0.341^{ns}) during season of 2018-2019.

DISCUSSION

Five species of winged aphids (*Aphis gossypii, A. fabae, Brachycaudus cardui, Capitophorus elaeagni*, and *Myzus persicae*) were captured in yellow cylindrical bowls traps in artichoke fields in Tunsia (Guesmi *et al.*, 2010) while Blackman and Eastop (1984) surveyed also pre-mentioned species in addition to *A. craccivora, A. maidis, C. carduinus, C. horni, , Protrama radicis,* and *Trama togolodytes* on artichoke plants. Moreover, *Brachycaudus helichrysi* was also recorded on artichoke (Chaux and Foury, 1994). The male of the artichoke aphid, *C. elaeagni* was recorded for first time in Egypt on the treasure flowers, *Gazania splendens* at Cairo Governorate. It was existed from the beginning of March till the end of May (El-khouly, *et al.*, 2007). It was considered as the most damageable species infesting artichoke plants in Tunisia (Guesmi *et al.*, 2010). It was also considered as a serious problem on perennial artichoke in California, during summer, whereas among the most common predators of artichoke aphid are lady beetles and their larvae, lacewing larvae, and syrphid fly larvae (Anonymous, 2009). At least 29 species of insect predators, belonging to 25 genera under 5 families (Anthocoridae, Coccinellidae, Ceccidomyiidae, Syrphidae, Chrysoperlidae) commonly occur and feed on aphid species on vegetable crops in Jammu and Kashmir (bhat *et al.*, 2020).

Increasing population density of *C. elaeagni* in spring may be due to high temperature and relative humidity which are suitable for its proliferation (Bari, 1998). This species reached also a maximum population in October, in the central zone of Chile (Larraín and Araya, 1994). Favorable climatic conditions in the coastal area of the Coquimbo Region, Chile enabled the development of *C. elaeagni* which could become a problem when colonies cover 30% of the leaves or more, it reached their highest populations in October, but was also present throughout the year (Larraín *et al.*, 2013).

Population dynamic of *C. horni* on globe artichoke plantations during two successive seasons 2007/2008 and 2008/2009, at Dakahlia Governorate, took different population growth trend, that it started with few numbers in December then increased sharply to reach its maximum in January, and moderated numbers in Mid-March then decreased to lowest level in May. Highest increasing peaks observed in January, 2008 and April, 2009. Moreover, Maximum, minimum temperatures and relative humidity had insignificant effect on aphid population (Taha *et al.*, 2012). While, three seasonal peaks of *Aphis gossypii* on globe artichoke could be recorded during November, December and January (Afify *et al.*, 2004) and peak in December-January at Zeinean, Giza (Fadel and Hady, 2006).

Our finding agree with Guesmi *et al.* (2010) who reported that winged morphs of *C. elaeagni* increased in October to disseminate on the whole artichoke culture, in December, winged individuals declined considerably and disappeared in February and March; in the spring, a new winged morphs appeared again to disperse and colonize the plantations again. The observed over flights winged *C. elaeagni* in spring result possibly from overpopulation (Hardie, 1989 and Müller *et al.*, 2001) and the environmental conditions (Dixon, 1985). Mean generation time of *Brachycaudus cardui* was18.92 days on artichoke leaves (Mazhar and Sadeghi, 2015). Finally, Weekly mean numbers of aphid on globe artichoke were affected by methods of planting where

aphid infestations were generally low or moderate on globe artichoke when using the crown pieces comparing with the others (Fadel *et al.*, 2018).

CONCLUSION

Capitophorus elaeagni was the most dominant aphid species on artichoke plants during harvest period of flower buds. Aphid populations begin to increase gradually in End-February, and the rapid population growth is observed from Mid-April, thus highest population densities of artichoke aphid were observed in May. Therefore it is recommended to complete harvest of artichoke mature flower buds before May for avoiding negative effects of artichoke aphid on quality and quantity of yield, and save the flower buds without any residue of insecticides. It is also recommended to situate yellow traps in northern and eastern borders of artichoke fields.

REFERENCES

Adlan T. M. 2016. Economic study for production, marketing and manufacturing artichokes in El-Behira Governorate. Alexandria Science Exchange Journal. 37: 229-246. DOI: 10.21608/asejaiqjsae.2016.154019

Afify M.M., A. S. El-Khouly, M. M. Metwaly, and L.I. Ibraheem. 2004. Ecological and biological studies on some insect pests infesting g. artichoke plant. M.Sc. Thesis Fac. of Agric. Al-Azhar Univ., Egypt

Amin A.H., K.A. Draz, K.A. Soliman, and R.M. Tabikha. 2013. Genetic fingerprints and phylogenetic relationships of eighteen aphid species from Egypt (Hemiptera: Sternorrhyncha: Aphididae). Munis Entomol. Zool. 8: 387-406.

Anonymous. 2009. UC IPM Pest Management Guidelines: Artichokes. https://www2.ipm.ucanr.edu/agriculture/artichoke/Artichoke-Aphid/

Anonymous. 2019. Bulletin of Agricultural Statistics - Economic Affairs Sector - Ministry of Agriculture and Land Reclamation, Egypt, Issue of 2019.

Audemard H., and G. Millaire. 1975. Le piegeage du carpocapce sexual de syntheses: primers results utilisables pour L. estimation des populations conduite de la lutte. Ann. Zool. Ecol. Anim.7: 61 – 80.

Bari M.A. 1998. Artichoke. UC IPM Pest Management Guidelines: University of California Division of Agriculture and Natural Resources. http://www.ipm.ucdavis.edu/

Bhat D.M., S.A. Khan, F.A. Ahanger, and M.A. Sheikh. 2020. Diversity of Aphid Pests (Homoptera: Aphididae) and theirNatural Bio-Control Agents in Vegetable Crop Ecosystems of Jammu & Kashmir, India. Int.J.Curr.Microbiol.App.Sci. 9(5): 2529-2546. DOI: 10.20546/ijcmas.2020.905.290

Blackman R.L., and V.F. Eastop. 1984. Aphids on the world's crops: an identification guide. John Wiley & Sons Limited. 2nd edition. NewYork, USA, 476 pp.

Blackman R.L., and V.F. Eastop. 2000. Aphids on the World's Crops, Second Edition. John Wiley & Sons with the Natural History Museum, London. x + 466 pages, 58 figures, 51 plates.

Blackman R.L., and V.F. Eastop. 2006. Aphids on the World's Herbaceous Plants and Shrubs. Volume 2 The Aphids. John Wiley & Sons with the Natural History Museum, London. viii + pages 1025-1439.

Capinera J.L. 2001. Handbook of Vegetable Pests. 1St Edition. Academic Pres. 800pp. ISBN: 9780080533261

Chaux C., and C. Foury. 1994. Productions légumières. Agriculture d'aujourd'hui. Lavoisier, Paris, 639 pp.

Costat Software. 2008. Version 6.3. 798 Lighthouse Ave, PMB 320, Monetery, CA93940, USA: CoHort.

Dixon A.F.G. 1985. Aphid Ecology. Blackie & Son Limited. 1st edition. 155 pp.

El–Khouly A.S., M.M. Nour El–Din, S.A. Hammad, and S.M.S. Darbin. 2007. Male of Capitophorus elaeagni (del – Guercio) (Aphididae : Homoptera) as a new record in Egypt. J. Agric. Sci. Mansoura Univ. 32: 4849 – 4852. DOI: 10.21608/jppp.2007.219642

Fadel A.M., A.K. Rahouma, A.M. El Rouby, and M.S. Hayam. 2018. Effect of Propagation Methods and Sowing Dates on Aphid Infestation and Flower Heads Characters in Globe Artichoke Plants. Journal of Applied Plant Protection; Suez Canal University. 7: 11-18. DOI: 10.21608/japp.2018.57957

Fadel A.M., and S.A. Hady. 2006. Effect of infestation with certain sucking insects on gross chemical composition and apicultural lipids in leaves of two local globe artichoke cultivars. J. Agric. Sci. Mansoura Univ. 31: 7391-7398.

FAO.org. 2019. Major food and agricultural commodities and producers – countries by commodity.

Foottit R.G., S.E. Halbert, G.L. Miller, E. Maw and L.M. Russell. 2006. Adventive aphids (Hemiptera: Aphididae) of America north of Mexico. Proc. Ent. Soc. Wash. 108: 583-610.

Guesmi J., M. Ben Halima-Kamel, and B. Almohandes-Dridi. 2010. Identification and population evolution of aphids infesting artichoke in Tunisia. Tunisian Journal of Plant Protection. 5: 83-89.

Habib A., and E.A. El-Kady. 1961. The Aphididae of Egypt. Bull. Soc. En. Egypte. 45: 110 – 119.

Hardie J. 1989. Visual responses of flying aphids and their chemical modification. Physiol. Entomol. 14: 41-51.

Holman J. 2009. Host Plant Catalog of Aphids, Palaearctic Region. Pages 7-651 "The Aphids and their Host Plants". Springer Science -Business Media

Iacob N. 1977. UN model matimatic pentera stabilirea limitelor economic de lolyrenta a atacaluimolilor fructilorin lupte integrate. Analele I. C. P. D 15 – 179, Romania.

Larraín P., and J. Araya. 1994. *Capitophorus elaeagni* (Homoptera: Aphididae) in artichokes crops in La Platina, Santiago, Chile. Rev. per. Ent. 37: 103-104.

Larraín P.S., C.F. Salas, A.C. Jana, and S.F. Graña. 2013. Major artichoke pests (*Cynara cardunculus* sub. *scolymus* l.) in coquimbo region, Chile. Acta Hortic. 983: 301-305. DOI: 10.17660/ActaHortic.2013.983.42

Mansour A.S. 1983. Effect of some growth regulators on some physiological characters and the yield of globe artichoke. M. Sc. Thesis, Fac. Agric. Cairo Univ. 88pp

Mazhar A.R.R., and E. Sadeghi. 2015. Some life table parameters of the aphid, *Brachycaudus cardui* L. on artichoke, *Cynara scolymus* L. in laboratory conditions Iranian Journal of Forest and Range Protection Research.12: 153-158. DOI: 10.22092/ijfrpr.2015.13256

Mostafa A.F.; O.A. Melouk, G.A. Mohamed, and F.A. Abdel Malek. 2021. The Production and Economic Efficiency of Artichoke in El-Beheira Governorate. Alexandria Science Exchange Journal. 42: 1929-1946. DOI: 10.21608/asejaiqjsae.2021.205327

Müller C., I. Williams, and J. Hardie. 2001. The role of nutrition, crowding and interspecifc interactions in the development of winged aphids. Ecol. Entomol. 26: 330-340. https://doi.org/10.1046/j.1365-2311.2001.00321.x

Pirone P.P. 1978. Diseases and pests of ornamental plants, 5th Edition. Wiley, 584 pp ISBN 9780471072492.

Robert Y. 1988. Particularités éthologiques des aphides: Cycles, comportement de vol. Pages 61-70. In Journées d'information sur les invertébrés vecteurs d'agents phytopathogènes. October 14-16, 1987, Hérault, France.

Rottenberg A. and D. Zohary. 1996. The wild ancestry of the cultivated artichoke. Genet. Res. Crop Evol. 43: 53–58. https://doi.org/10.1007/BF00126940

Skvarla M.J., S.E. Halbert, R.G. Foottit, A.S. Jensen, et al. 2017. An Update to the Adventive Aphids (Hemiptera: Aphidoidea) of America North of Mexico, with Notes on Intercepted Species. Proceedings of the Entomological Society of Washington. 119: 90–111. https://doi.org/10.4289/0013-8797.119.1.90

Tabikha R.M. 2008. Taxonomical studies on some aphid species by using modern techniques. Ph.D. in Economic Entomology, Plant Protection Department, Faculty of Agriculture, Alexandria University, Damanhour Branch.

Taha M.A., H.A. AbdEl-Wahab, H.I. Mahmoud, and G.E.S. Abdel Hamed. 2012. Population density of some insect pests infesting globe artichoke plantations in relation to certain ecological factors at Dakahalia Governorate. J. Plant Prot. and Path., Mansoura Univ. 3: 347 – 353. DOI: 10.21608/jppp.2012.83774

Tawfik A.M. 1994. Morphological and physiological studies on globe artichoke. Ph.D. Thesis, Fac. Agric. Cairo Univ. 150 p.

Voegtlin D., W. Villalobos, M.V. Sanchez, G. Saborio and C. Rivera. 2003. A Guide to the Winged Aphids of Costa Rica. International Journal of Tropical Biology and Conservation 51,1-199. PMID: 15260169.

الملخص العربي

التذبذب العددى لعشيرة حشرة من الخرشوف *Capitophorus* (Hemiptera : Aphididae) *elaeagni* و المفترسات الحشرية المصاحبة لها على نبات الخرشوف بمحافظة البحيرة

رضا محمد منصور طبيخة ، خليل عبد الله دارز

يخضع التسويق العالمي للخرشوف لمعايير سلامة وجودة صارمة، تتحقق من خلال ادارة ناجحة ومتكاملة لاهم الافات على نبات الخرشوف تضمن تقليص استخدام مبيدات الآفات وتعظيم دور عوامل المكافحة الحيوية. ويعتبر من الخرشوف *Capitophorus elaeagni* من اكثر الافات الحشرية شيوعا علي نباتات الخرشوف، وخاصة خلال فترة الحصاد الطويلة والتى قد تمتد خلال فصلى الشتاء والربيع. لذلك كان من الضروري رصد تغير حجم عشيرة حشرة المن والمفترسات الحشرية المصاحبة لها. ولذلك أجريت هذه الدراسة الحقلية خلال فترة حصاد الخرشوف (من منتصف ديسمبر إلى منتصف مايو) فى موسمين زراعيين متتاليين (٢٠١٧-٢٠١٨ و ٢٠١٨-٢٠١٩) وذلك في محافظة البحيرة التي تضم أكبر مساحة مزروعة من الخرشوف في مصر. وقد اشارت النتائج الى انه تم رصد أعداد كبيرة من حشرات المن على أوراق الخرشوف خلال فصل الربيع ، والتي تتزايد اعداده بشكل سريع بداية من منتصف إبريل. لذلك يوصى باتمام جمع نورات الخرشوف الناضجة قبل شهر مايو. وكان للمصائد الصفراء المائية دور واضح فى صيد أعداد كبيرة من *C. elaeagni* وأعداد قليلة جدًا من *Aphis gossypii* و *Acyrthosiphon pisum*. كما اشارات النتائج بضرورة توجيه المصائد إلى الاتجاه الشمالي الشرقي بزاوية تقدر بـ ٢٦-٣٥ درجة شرقًا لالتقاط أكبر عدد ممكن من حشرة المن. من ناحية اخرى كانت حشرة اسد المن *Chrysopa vulgaris* من المفترسات الحشرية الاكثر انتشارا (٨٤٪) يليها مفترسات ابى العيد coccinellids (١٣%) ثم ذبابة السرفس *Eupeodes corolla*(٣%). كما كان لكل من درجات الحرارة العظمى والصغرى والمتوسطة تأثير معنوي إيجابي على الكثافة العددية لكل من حشرة من الخرشوف و مفترسات ابى العيد و اسد المن، بينما كان للرطوبة النسبية تأثير معنوي سلبى على كثافة أعداد المن على نباتات الخرشوف. واخيرا تم تسجيل ٨-٩ اجيال متتالية لمن الخرشوف بداية من منتصف ديسمبر إلى منتصف مايو حيث كانت مدة الجيل فى الخريف والربيع قصيرة (٧-١٩ يوم) بينما كانت مدة الجيل أطول (١٤-٢٦ يوم) على نباتات الخرشوف خلال الشتاء.

الكلمات الكاشفة: الخرشوف – حشرة من الخرشوف – مفترسات – تذبذب عددى – مصائد – محافظة البحيرة.