Effect of biofertilizers and carbolizer on population density of green peach aphid *Myzus persicae* on *Gerbera jamesonii*(bolus)in greenhouse

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Abstract

This study was conducted to investigate the effect of some bio-fertilizer bacteria (*Azotobacter chroococcum* and *Bacillus subtilus*), mycorrhiza *(Glomus mosseae)* and combination of both (bacteria and mycorrhiza) and carbolizer with two levels (1.5 ml. L^{-1} and 2.5 ml. L^{-1}), a combination of Bacteria and/or Mycorrhiza with each level of carbolizer and their combination together, plus the control on the population dynamics of *Myzus persicae*, which infest Gerbera plants under greenhouse condition. The results revealed that inoculation of jerbera plants with bacteria and micorrhiza gave the values of aphid population of 11.45 and 9.78 aphid.plant^{-1}, respectively, with significant differences. However, foliar application of carbolizer with 1.5 and 2.5 ml.L^{-1} gave the values 8.34 and 8.22 aphid.plant^{-1}, respectively with no significant differences. The combination of both mycorrhiza 2.5 ml. L^{-1} and carbolizer significantly lowered the aphid population to 3.11 aphids. plant $^{-1}$ in comparison with the control 16.83 aphids. plant $^{-1}$.

Keywords: Bacteria; Mycorrhiza; Carbolizer; *Gerbera jamesnll*, Aphid and population dynamics.

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Introduction

Green peach aphid (*Myzus persicae* Sulz.) (Hemiptera: Aphidiae) is one of the most distributed insects worldwide attacking more than 400 plant species belong to 40 plant family, *M. persicae* is an important pest that can cause direct damage by piercing and sucking sap from attacked parts, and cause indirect damage by exposing tissues to bacterial, viral and fungal pathogens (11). In addition to the capability of sooty mould on honeydew and the transmission of over 100 plant virus diseases infesting many economical crops (5 and 8).

Gerbera jamesonii (Bolus) belongs to Asteraceae family distributed widely in Asia and Africa (17). Gerbera plants are used as floricultural plants, their cutting flowers are well known in most counties, (19). Gerbara plays an important environmental role in the removal of chemical fumes and toxic gases according to a study NASA (16). Gerbera plants are attacked by different insect pests including aphids, spider and mites in greenhouse and open fields, consequently various malformations would occur to the flowers in addition to the reduction of their cosmetic values(18). *M. persicae* is one of these insects that have critical roles in infesting plants (15). A research conducted on the role of biofertilizers on the growth performance of faba bean and aphid population, it was revealed that biofertilizers (Rhizobia, Pseudomonas and Micorrhiza) caused good reduction percentages in aphid population dynamics (6).

In addition, organic fertilizer may cause the increase of plant resistance against some insects and pathogens as well as the improvement of physical and chemical properties of the soil and thus the increase of yields (10). Moreover, it was shown that the fertilizer would not affect only the aphids feeding on the fertilized plants, but also affects the size and population density of the insects feeding on the aphids (4). Furthermore, chemical and organic fertilizers had a significant role in reducing tomato leaf miner (*Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) population through their adverse effects via the reduction of the reduction of the number of canals as well as the number of larvae in the infested leaves (2).

The aim of the current study was to evaluate the effect of some biofertilizers and carbolizer as well as their combinations on the population density of aphid piercing sucking mouth parts pests on Gerbera plants under greenhouse condition.

Material and Methods

The study was carried out in the greenhouse at College of Agricultural Engineering Sciences, University of Sulamani, Kurdistan Region Iraq during (2016- 2017) in order to study the effect of some biofertilizers included, bacteria (*Azotobacter chroococcum* and *Bacillus subtilus*) and mycorrhiza (*Glomus mosseae)* and a mixture of Bacteria and Mycorrhiza as well as Carbolizer (1.5 and 2.5) ml. L^{-1} with their combination in addition to the control treatment on the population dynamics of *M. persicae* attacking Gerbera plants. Seedling of Gerbera were germinated in seed trays. After 10 days, seedling with 3-4 leaves were transplanted individually into (10 cm) polyethylene bags containing 1:1 ratio of peat-moss and perlite with the rate of a

seedling per bag. The seedlings were protected for two weeks in a small glass house before planting in permanent plots within a greenhouse.

Greenhouse preparation and seedling planting:

Before planting, the plots were well-prepared mechanically on August-27-2015 and soil was mixed, manure and sandy loam was added to the plots by rotivator. Seedlings were planted on September-22-2015 in 12 plots for each block with a distance (1x1.2m) for the plots and seedlings per plot. Therefore, the total number of seedlings was 216 for the whole experiment.

Agricultural practices such as weeding, removing dry leaves from the base of the plants, and drip irrigation were conducted. The greenhouse was sprayed with calcium carbonate ($CaCO_3$) and covered with nylon to protect plants from severe sunlight.

Temperatures were adjusted in the greenhouse with both air cooler and heaters when needed. Maximum and minimum temperatures as well as relative humidity were measured in the greenhouse as shown in Table 3-2. Temperatures and humidity were recorded using Auriol temperature station with external sensor and radio control device (IAN 102607, Model/ Z31743A-RX, Version: 09/2014).

Layout of the Experiment**:**

Factorial experiment with two factors; biofertilizers including bacteria, mycorrhizal fungi and a mixture of both bacteria and mycorrhizal fungi as well as carbolizer organic liquid fertilizer (1.5 and 2.5) ml. L^{-1} with their combinations in addition to the control was used , so the number of treatments was 12.

Factorial experiment was applied with two factors; biofertilizers and carbolizer, and three replicates according to Randomized Complete Block Design (R.C.B.D.), therefore, the number of the total treatments was 36. Specifically, the biofertilizers included bacteria and mycorrhizal fungi. Also, two levels of carbolizer organic liquid fertilizer was used (1.5 and 2.5) ml. L^{-1}. Additionally, mixtures of bacteria and/ or mycorrhizal fungi with each level of the carbolizer combinations were conducted besides the control to have 12 treatments per replicate. Samples were taken on weekly basis from March 15 up to April 19, 2016. The data collected were subjected to analysis of variance at 0.05 level, the treatment means were compared according to Duncan's Multiple Range Test using XLSTAT, 2010 software program (1).

Inoculation of Biofertilizers**;**

Biofertilizer inoculants included two types of bacteria; *Azotobacter chroococcum* and *Bacillus subtilus* as well as mycorrhizal fungi (*Glomus mosseae*) with peatmoss carrier brought from laboratories of biotechnology, Alzaafarania, Baghdad, Iraq. *G. jamesonii* cv. Stanza seedlings were inoculated with the biofertilizers. For this purpose, 31 grams bacteria and 40 mg. L^{-1} mycorrhizal fungi inoculants were added to the bottom of the hole prepared for each seedling before planting (a soil application). Before planting, the roots were cleaned well from the residues of the peat-moss around the root tips (14). Three days after the first inoculation, by using sterilized syringes (20 ml), the seedling were injected with the liquid inoculant

bacteria (16 ml/plant), so that proper inoculation would be achieved.

Results and Discussion

Table (1) indicates that the number of the *M. persicae* ., ranged from 1.00 aphid/ plant for mycorrhiza + carbolizer (2.5 ml. L^{-1}) treatment on April 19-4-2017 up to 19.66 aphids in control treatment on April 12-4-2017. With regard to the treatments; the highest population of the aphid was recorded in the control which gave 16.83 aphids compared to 3.11 aphids for bacteria + mycorrhiza + carbolizer (2.5 ml. L^{-1}) and these two values were significantly different at 0.05 level.

On the other hand, April 12 resulted in 10.78 aphids compared to 4.06 aphids on April 19 giving the lowest number of aphids also the two values were significantly different at the same level. The above results were consistent with. (9) and with (13) which found that biofertilizers and some nutrient reduced the number of *M. persicae* and *Bemesia tabaci* and *Tetranychus urticae* attacking pepper plants (*Capsicum chinense*).

Consequently, the reduction in the number of sucking insects on plants under the impact of biofertilizer may be due to the cell wall hardening or altering the plant juice taste but not appetite for insects, (7).

Table [1]: Effect of different treatments of fertilizer on the population density of aphid, *M. persicae* (Sulz.) tested on Gerbera plants during 2017.

Treatments	Date of Sampling						Mean
	15 / March	22 / March	29 / March	5 / April	12 / April	19 / April	
Control	15.67	17.67	19.33	18.00	19.66	10.67	16.83 A
Carbolizer (1.5 ml. L^{-1})	8.67	10.67	12.00	6.67	8.33	3.67	8.34 C
Carbolizer (2.5 ml.L^{-1})	6.67	8.00	9.67	8.00	11.00	6.00	8.22 C
Bacteria	9.00	10.33	12.00	11.67	16.67	9.00	11.45 AB
Bacteria + Carbolizer (1.5 ml. L^{-1})	6.00	8.00	10.33	9.33	11.00	2.67	7.89 CD
Bacteria + Carbolizer (2.5 ml. L^{-1})	5.00	6.67	9.00	7.33	10.67	3.00	6.95 CDE
Mycorrhiza	8.67	10.00	13.00	10.33	12.67	4.00	9.78 BC
Mycorrhiza+ Carbolizer (1.5 ml. L^{-1})	1.33	5.00	6.67	6.00	9.00	1.33	4.89 EF
Mycorrhiza+ Carbolizer (2.5 ml. L^{-1})	4.33	5.67	6.00	6.33	9.33	1.00	5.44 DEF
Bacteria + Mycorrhiza	5.33	8.33	10.00	7.00	10.67	4.67	7.67 CDE
Bacteria + Mycorrhiza+ Carbolizer (1.5 ml. L^{-1})	2.00	3.67	5.33	4.67	5.00	1.67	3.72 F
Bacteria + Mycorrhiza + Carbolizer (2.5 ml. L^{-1})	3.00	2.33	3.67	3.33	5.33	1.00	3.11 F
Mean	6.31 D	8.03 C	9.75 A	8.22 B	10.78 A	4.06 E	

Figure (1) and table (1) showed that bacteria + mycorrhizae treatment interacted with both carbolizer levels (1.5 and 2.5) ml. L^{-1} and gave the best result in reducing population density of the aphids (3.72 and 3.11) respectively, which were significantly different compared with other treatments. The result agreed with (12) who revealed that applying fertilizer (biofertilizers, organic manure, compost El- Wadi and chemical fertilizer) on broad bean, *Vicia faba* caused the reduction of leaf miner and parasite numbers.

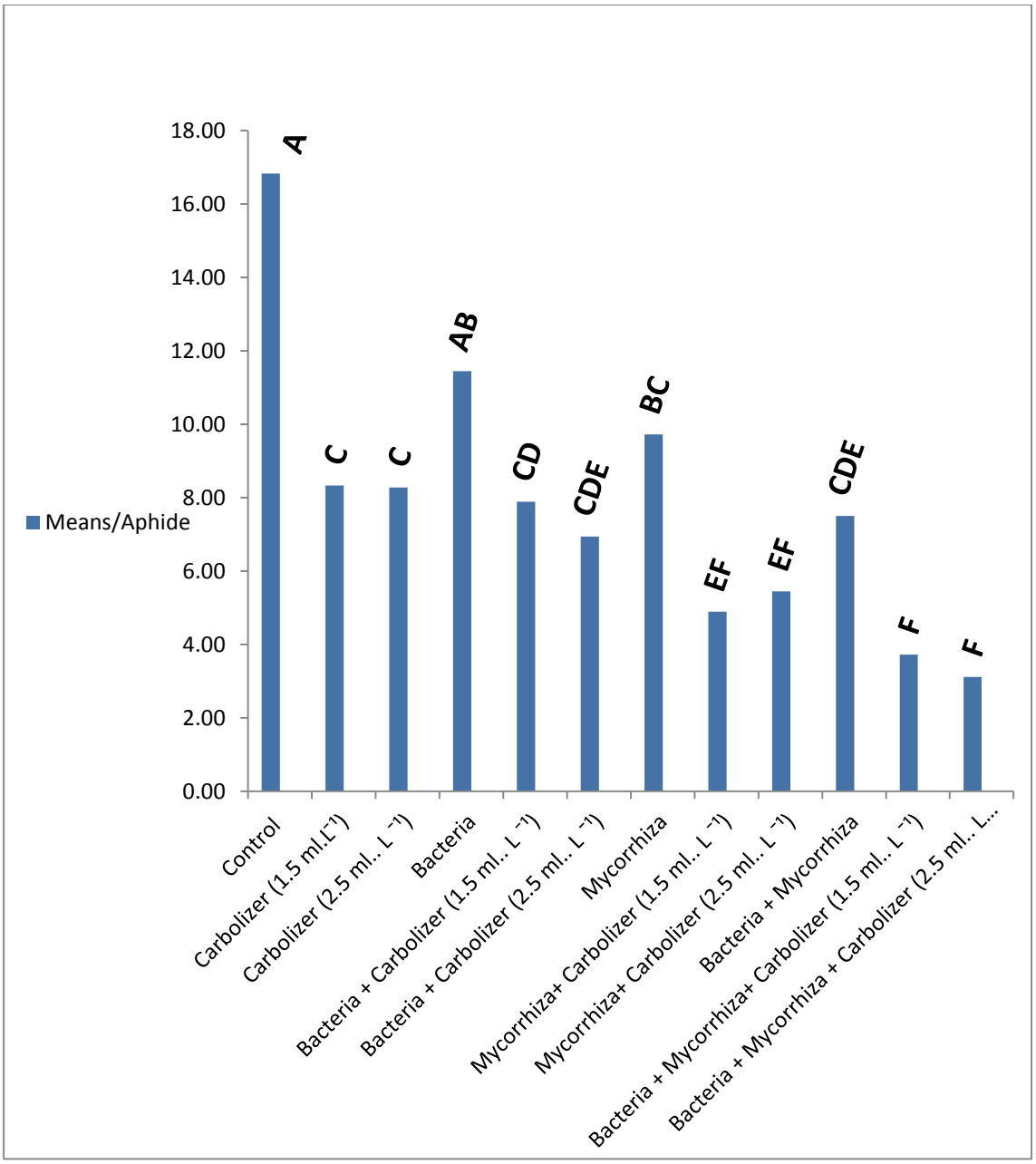

Figure (1) shows different treatments and combinations of (Bacteria, Mycorrhiza , Carbolizer and Control) affecting the mean number of aphids tested on Gerbera plant.

Table (2) showed no significant correlation between population densities of aphid and temperature as well as relative humidity conditions. For instance, in the first two weeks, population density of the aphid was proportional to the increase of temperature. While in the third week, when temperature somehow decreased, population density of the aphid increased. When the temperature increased on the fourth date the aphid population density decreased. On the contrary, temperature increase for the fifth week caused an increase in the aphid population density, while the temperature increase for the last week resulted in an obvious decrease in the aphid population density. Also an irregular pattern was noticed with the correlation between

relative humidity and population density. Hence, there may be a common relationship between both temperature and relative humidity on aphid population density. Study reported that there was a positive relationship between environmental factors and population of aphids, spider mites, thrips and whitefly at cucumber pests under protected cultivation (3). The general mean of aphids is proportionally increased to the mean temperature and humidity degree in a greenhouse at (5%).

Table (2) the relationship between aphid numbers and climate conditions including temperature and humidity during 2017.

Date of Sampling	No. of Aphids	Temperature (c٥)	R.H. (%)
15/3/2017	6.31	20.50	51.02
22/3/2017	8.03	22.16	56.14
29/3/2017	9.75	21.10	60.38
5/4/2017	8.22	23.77	50.32
12/4/2017	10.78	24.00	50.39
19/4/2017	4.06	24.89	51.29

Conclusion:

Applying biofertilizers such as *A. chroococcum* and *B. subtilus* as well as mycorrhizal fungi (*G. mosseae*) plus carbolizer enhanced the growth of Gerbera plants in addition to the reduction of the aphid population density/plant (3.11 aphid /plant) as compared to the control (16.83 aphid/ plant).

References:

1. Addinsoft. 2017. XLSTAT 2010. Data analysis and statistics software for Microsoft Excel. Available at (www.xlstat.en/ho).

2. Al-Khaboori A. H. and S. H. Sabr. 2015. The role of chemical and organic fertilization of tomato in reducing the infestation of tomato leaf miner *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), The Iraqi Journal of Agricultural Sciences, 46(4):539-544.

3. Amna, M. H.; S.M. Abolmaaty; M. K. Hassanein and Abd El-Ghafar N. Y. 2012. Impact of type of greenhouse cover sheets on certain Major cucumber pests under protected cultivation. New York Science Journal,5(7):19-24. https://html2f.scribdassets.com/57ztiiqssg4edqod/images/1-2f78e71193.png.

4. Aqueel, M. A.; C. M. Collins; A. M. Raza; S. Ahmad; M. Tariq and Leather S. R. 2104. Effect of plant nutrition on aphid size, prey consumption, and life history characteristics of green lacewing. Insect Science, 21(1):74-82. doi: 10.1111/1744-7917.1

5. Colin, R.T.; G. Powell and Hardie J.2002. Maternal reproductive decisions are independent of feeding in the black bean aphid, *Aphis fabae*. Journal of Insect Physiology, 48(6):619-629. doi: 10.1016/s0022-1910(02)00084-7.

6. El-Wakeil N. E. and T. N. El-Sebai. 2007. Role of Biofertilizer on Faba Bean Growth, Yield, and its Effect on Bean Aphid and the Associated Predators. , 3(6): 800-807. Res. J. Agric. & Biol. Sci.

7. FNCA Biofertilizer Project Group. 2006. Biofertilizer Manual. Forum for Nuclear Cooperation in Asia (FNCA). Japan Atomic Industrial Forum (JAIF). ISBN4-88911-301-0 C0550. p.138. http://www.fnca.jp/english/index.html.

8. Jarjees S. J. and M. A. Karim. 1992. Orchard Insects. Dar Al-Kutaibe, Printing and Publishing. University of Mosul. Ministry of High Education and Scientific Research. Iraq. pp. 559.

9. Karungi J.,; P. Agamire; J. Kovach and Kyamanywa S. 2010. Cover cropping and novel pesticide usage in the management of pests of hot pepper (*Capsicum chinense*). Int. J. Trop. Insect Sci.,30(2):84-92. DOI:10.1017/S1742758410000160.

10. Mottaghian A.; H. Pirdashi; M. A. Bahmanyar and Abbasian A. 2008. Leaf and seed micronutrients accumulation in soybean cultivars in response to integrated organic and chemical fertilizers application. Pak. J. Biol. Sci.,11(9):1227-1233. doi: 10.3923/pjbs.2008.1227.1233.

11. Moawad S. S.; H. El-Behery and Ebadah, I.M. 2016 . Evaluation role of some types of plant fertilizers toward leaf miners insect and its parasitoid on broad bean *Vicia faba* (L.). Journal of Advances in Agriculture, 3(3):198-204. www.cirjaa.com.

12. Shafeek M.R.; A. Y. M. Ellaithy and Helmy Y.I. 2014. Effect of Bio Fertilizer and some Microelements on Insect and Mite Pest Infestation, Growth, Yield and Fruit Quality of Hot Pepper (*Capsicum annum*, L.) Grown under Plastic House Condition. Middle East J. Agric. Res., 3(4): 1022-1030.

13. Simarmata T. 2013. Tropical Bioresources to Support Biofertilizer Industry and Sustainable Agriculture in Indonesia. Invited and presented Paper for International Seminar on Tropical Bio-resources for Sustainable Bioindustry from Basic Research to Industry, 30 – 31st October in West and East Hall – ITB-Bandung Indonesia. https://www.researchgate.net/profile/Tualar_Simarmata/publications/?linkType=fulltextFile&ev= prf_pubs_file

14. Sujatha K; J. V. N. Gowda and Khan M.M. 2002. Effects of different fertigation levels on gerbera under low cost greenhouse. J. Ornamental Horticulture New Series, 5(1): 54-59.

15. Plant Care and Gardening Tips.2012. http://hortchat.com

16. Tjia B. and R. J. Black. 2008. Gerberas for Florida. Florida cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.USA. http://edis.ifas.ufl.edu/mg 034.

17. Robb, K. L. 1989. Analysis of Franklinidentalis Pergande as a pest of Horticulture crops in California greenhouses .Ph.D. dissertation.. University of. California. Riverside. USA.

18. Vasanthakumar K. and M. Bulti.2017. A Handbook on Floriculture and Landscaping, Program of Horticulture School of Plant Sciences. Haramaya University. Belgium pp. 111.