

EFFECT OF ORGANIC MATTER, BIO-FERTILIZERS AND MAGNETIC WATER ON THE VEGETATIVE GROWTH AND FLOWER QUALITY OF GLADIOLUS (*GLADIOLUS HYBRIDA* L.) VAR. CARTAGO

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Abstract. The experiment was conducted to investigate the effects of poultry manure (without Poultry manure A₀, 2% poultry manure A₁ and 4% poultry A₂), bio-fertilizers (not inoculation corms by bacteria B₀, inoculation corms by bacteria *Azospirillum brasilense* B₁, and inoculation corms by *Bacillus subtilis* B₂) and type of irrigation (tap water C₁ and magnetic water treated by 500 gauss C₂) on cut flowers and vase life of Gladiolus flowers Cartago cultivar in two seasons (autumn 2016 and spring 2017) The field experiment was laid down in a factorial 2*3*3 in Split plot Randomized Complete Block Design (RCBD) with three replications and seven plants for each treatment. Results showed a significant increase in vegetative growth (Plant height, Leaf dry matter, Leaf chlorophyll intensity, N, P and K concentration in the leaves) and flower quality (number of days to flowering, anthocyanin concentration in petals (mg.100 g⁻¹), basal floral diameter and vase life), these due to effect of plants with 2% poultry manure, inoculation by bacteria and irrigation with magnetic water. Decreasing in vegetative and flowering characteristics was also observed, when Poultry manure was used at 4% rate and without inoculation by bacteria and irrigation by tap water. But the magnetic water reduced the negative effect.

Keywords: *Azospirillum*, *Bacillus*, cut flower, soil media, irrigation

Introduction

Gladiolus (*Gladiolus hybrida* L.) belonging to family Iridaceae, it is a monocotyledonous, perennial bulbous flowering plant (Manning and Goldblatt, 2008). are one of the most important flowering plants that are used worldwide for cut flowers production, as they rank among of the top ten best cut flowers due to their different shapes, dazzling colors, varying sizes and excellent vase life. There is a considerable demand in both domestic and export production (Ali et al., 2014). For an amount of 16 million dollars, 60 million gladiolus spikes were sold in the United States of America (Sajjad et al., 2014). The success of gladiolus cultivation depends on many factors like soil fertility, irrigation, planting time, planting density, plant protection, plant growth regulators and some chemicals, these may play major role towards increasing production and quality of gladiolus. But, biofertilizers have positive impact on availability of nutrients (Bhalla et al., 2006). Organic fertilizers including farmyard manure, and poultry manure, sheep manure may be used for the crop production as a substitute of the chemical fertilizer because the importance of the organic manures cannot be overlooked. In recent year organic matter as a suitable source of nutrients to the soil has been replaced by chemical fertilizers that positively affect both the chemical and physical properties of the soil such as soil structure (Bot and Benites, 2005).

The emphasis is now focused on the use biofertilizers like Azotobacter, Azospirillum and phosphate solubilizing bacteria (PSB). Species of *Bacillus* is known to promote plant growth. The principal mechanisms of growth promotion include production of growth

stimulating phytohormones, solubilization and mobilization of phosphate, siderophore production, production of antibiotics, inhibition of plant ethylene synthesis, and induction of plant systemic resistance to pathogens (Gutiérrez-Mañero et al., 2001). *Azospirillum* is a symbiotic N-fixing bacterium. *Azotobacter* and *Azospirillum* fix atmospheric nitrogen when inoculated to plants, which help to save the application of N-fertilizers to an extent of 20-25 percent (Chaitra and Patil, 2007).

The magnetic water technology is wide studied subject throughout the world, especially in major countries like China, USA, and Australia (Hozayn and Qados, 2010). A magnetic field is an unpreventable environmental factor for plants in the soil. However, its impact on plant growth (Eşitken and Turan, 2004). Magnetic treatment results in changes in structure of the water, such as changes the formation of clustering structures from linear and ring hydrogen-bound chains of molecules, the magnetic interaction between these clustering structures and increasing polarization effects of water molecules (Pang and Deng, 2008). Magnetic fields have a positive effect on plant characteristics such as seed germination, seedling growth, agronomic traits and seed yield (Aladjadjiyan, 2002; Tahir and Karim, 2010).

The postharvest longevity of flowers has a critical importance in determining the value of the crop. Cut flowers are highly perishable commodities and are highly vulnerable to postharvest losses. It is estimated that nearly 70% of the potential lasting quality of cut flowers is pre-determined at harvest while postharvest factors influence 30% of the quality. In cut flower trade, it is very important to maintain freshness and original colors of flowers for the longer period, throughout the postharvest chain. Harvesting of flowers at an optimum stage of bud development (Kumari, 2014).

The aim of this study is to determine the effect of various amounts of poultry manure, bio-fertilizer and magnetic water processor on the growth characteristics and flower quality of gladiolus plants of the Cartago cultivar.

Materials and methods

The experiment sites

The experiment was conducted at the College of Agricultural Engineering Sciences, Sulaimani University, Kurdistan, Iraq in greenhouse for two seasons first period in 7th October 2016 to May 2017 (autumn), second study in 5th of March 2017 to August 2017 (spring). The area is located at 35° 32'14" N, 45° 21'97" E, and an altitude of (743.40 M) above sea level, with GPS reading.

The experiment was conducted to investigate the effects of poultry manure, (A₀ without poultry manure, A₁ poultry manure at 2% of soil weight, A₂ poultry manure at 4% of soil weight), biofertilizers (B₀ without inoculation, B₁ inoculation by *Azospirillum brasilense*, B₂ inoculation by *Bacillus subtilis*) and water processor magnetic (C₁ irrigation by tap water, C₂ irrigation by magnetic water) and its impact on the vegetative and flower quality of *Gladiolus hybrida*. These treatments were randomized in a split plot design with three replicates, were irrigation types contributed as the main plots, while interaction of poultry manure and biofertilizers (A*B) were distributed in the sub plots.

The magnetic water treatment was conducted by passing the irrigation water through magnetic flux densities 500 Gauss. A local magnetic device is special magnets spaced a part and parallel to the length of water carrying copper pipe.

Planting the corms

Planting the corms in the plastic bags (4 kg size) were filled from the soil agriculture consisting of the three levels, first was consisting of soil and Peatmoos in equal proportions. The second media was composed of the soil and Peatmoos in equal proportions plus poultry manure at 2% and the third level was consisting of soil and Peatmoss in equal proportions with 4% of poultry manure based on soil weight. Analysis of the physical and chemical properties of three soil media is shown in *Table 1*.

Table1. The main physical and chemical properties of three soil media

Soil properties	Units	Without poultry manure	2% poultry manure	4% poultry manure
Sand	%	34.40	30.40	32.40
Silt		34.00	32.00	46.00
Clay		31.60	37.60	21.60
Texture		Loam clay	Loamy clay	Loamy
EC	dsm ⁻¹	2.52	1.70	2.91
pH		7.33	7.13	7.18
Cation				
Ca ⁺⁺		11.52	9.30	14.00
Mg ⁺⁺		7.81	5.22	10.31
Na ⁺		6.22	2.31	4.34
K ⁺	mq/L	1.14	1.03	1.11
Cl ⁻		17.50	12.50	20.32
HCO ₃ ⁻		2.30	1.50	2.54
CO ₃ ⁼		Nil	Nil	Nil
SO ₄ ⁼		4.98	3.28	5.34
CaCO ₃	%	15.22	30.19	23.41
Organic matter	%	0.79	0.73	0.89
Available nitrogen		23.00	12.00	31.00
Available phosphorus	Mg. kg ⁻¹	15.25	14.70	10.13
Soluble potassium		87.11	79.39	68.93

Data were analyzed in the Central Laboratories of College of Agriculture, University of Baghdad

Source of the corms

The corms of gladiolus var. Cartago were brought from the company of stoop flower bulbs in Holland. Healthy and uniform size 10-12 cm corms are divided in to three groups the first group dipped in the distillates water, second group were dipped in the solution which contain *Azospirillum brasillense* and the third group were dipped in the solution which contain *Bacillus subtilis* for half an hour and dried in shade for 30 min before planting.

Planting one corm in the plastic bags in 8 cm depth (Greving, 1987). Agricultural practices were carried out for all replications, such as weeding and hoeing the surface of the soil, in order to ventilate. Ventilation of the greenhouse was done by opening the doors and slots. Also, air cooler and heater were used to adjust the temperature in the greenhouse in both high and low temperature conditions. Atmospheric condition inside

the greenhouse had been measured by recording maximum and minimum temperatures and relative humidity.

Experimental parameters

The experimental parameters are presented in *Table 2*.

Table 2. Study parameters

Parameters	Methods
Plant height (cm)	Measured from the soil surface to the end of the flower spike length
Leaf dry mater (%)	Dry matter (%) = $\frac{\text{dry weight of leaves}}{\text{fresh weight of leaves}} \times 100$
Chlorophyll (spad unit)	Portable chlorodhyll meter CCM-200 plus. OPTI-SCIENCES
Nitrogen concentration in leaves (%)	Micro-Kjeldahl (Page et al., 1982)
Phosphorus concentration in leaves (%)	Spectrophotometer at (882 nm) wavelength (Olsen et al., 1982)
Potassium concentration in leaves (%)	Flame Photometer (Page et al., 1982)
Number of days for flowering (day)	We have counted the days from the first day of planting unit the first appearance of the basal floret's color
Anthocyanin concentration in flower petals (mg.100 g ⁻¹)	Spectrophotometer (Ranganna, 1977) method
Basal floral diameter (cm)	Digital caliper vernier
Vase life (day)	Measured by the number of days after harvesting the flower as until $\frac{3}{4}$ of the florets are wilted

Preparation of bacterial inoculants

Pure isolated bacteria were taken from the laboratories of the Agricultural Research Center- Baghdad- Zaafaranyah associated to the ministry of Science and Technology, Iraq.

Inoculants corms by bacteria *Azospirillum brasilense* and *Bacillus subtilis*

- Preparation of 1 L of nutrient solution, 25 g of nutrient broth was dissolved in one litter of distilled water and sterilized by using autoclave with the pressure of 1.5 bar at temperature 121 °C for 15 min before adding bacteria.
- Adding 6 cm³ of bacteria to the cultural media (liquid nutrient broth) and shaken for 15 min.
- Then the bacterial culture putted in an incubator at 28 °C for 72 h.
- After inoculation period 3 g of sugar and 2 g of Arabic gum were added to the bacteria suspension shake it for 30-60 min. The bacteria inoculants ready to use.

Description of the experiment

The field experiment was carried out based on the Split plot randomized complete block design (RCBD) with three replications and seven plants for each treatment. The data were analyzed by a computer program Statistical Analysis System (SAS) and the comparisons among means were carried out by the least significant difference (L.S.D) at $P \leq 0.05$ (*Table 2*).

Results

Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on the plant height (cm)

Table 3 illustrates that using A₁ treatment which is 2% of poultry manure has a significant effect on plant height 124.74 and 139.58 cm for autumn and spring respectively compared to control A₀ 120.26 and 134.68 cm. In addition, it was noticed that plant height after using A₁ was significantly different as compared to using 4% of poultry manure A₂ 98.38, 133.91 cm for both seasons respectively.

Regarding the inoculation of gladiolus corms with bacteria *Azospirillum brasilense* and *Bacillus subtilis*, the maximum plant height values are 116.89, 117.11 and 138.85, 137.15 cm in autumn and spring respectively. These results are significantly different from control B₀ (without inoculation by bacteria), which are 109.38 and 132.16 cm in both seasons. With regard to irrigation, using magnetic water C₂ significantly increases plant height 118.07, 138.08 cm as compared to C₁ which gave 110.85, 134.02 cm in autumn and spring season respectively. The significant effect of interaction of organic matter, bio-fertilizers, and magnetic water on plant height of gladiolus shown in the same table, the highest plants 132.88, 145.90 cm were achieved from A₁B₁C₂ for both seasons, respectively. While the lowest plant height 93.49 cm was noticed from A₂B₀C₁ in the autumn and 128.94 cm from A₀B₀C₁ in the spring.

Table 3. *Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on the plant height (cm) in two seasons*

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	110.07	117.00	118.10	115.05	110.85	128.94	132.32	131.44	130.90	134.02		
	A ₁	112.00	122.67	126.00	120.22		131.73	142.67	139.09	137.83			
	A ₂	93.49	99.95	98.40	97.28		131.68	133.33	135.00	133.33			
C ₂	A ₀	118.51	128.86	129.03	125.47	118.07	133.53	141.89	139.94	138.45	138.08		
	A ₁	124.59	132.88	130.27	129.25		137.11	145.90	140.96	141.33			
	A ₂	97.64	99.95	100.86	99.48		130.00	137.00	136.44	134.48			
Interaction of C*B						Interaction of C*B							
C ₁	105.19	113.21	114.17			130.78	136.11	135.18					
C ₂	113.58	120.56	120.06			133.55	141.60	139.12					
Interaction of A*B				A	Interaction of A*B				A				
A ₀	114.29	122.93	123.57	120.26	131.23	137.11	135.69	134.68					
A ₁	118.29	127.78	128.14	124.74	134.42	144.29	140.03	139.58					
A ₂	95.57	99.95	99.63	98.38	130.83	135.17	135.72	133.91					
B	109.38	116.89	117.11		132.16	138.85	137.15						
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
3.53	3.53	2.88	7.99	6.15	12.57	9.22	3.91	3.91	3.19	6.81	5.67	5.65	9.45

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on leaf dry matter %

Table 4 shows that planting the corms in medium containing 2% of poultry manure A₁ has a significant effect on leaf dry matter. The highest value 24.54, 26.95% were found from A₁ for autumn and spring respectively, while the lowest value 20.84% was achieved from A₂ in the autumn and 22.71% was found from A₀ in spring. Inoculation of gladiolus corms with *Azospirillum brasilense* B₁ significantly affected the percentage of the leaf dry matter which were 22.94, 25.71% for both seasons. Also, the inoculation by *Bacillus subtilis* B₂, significantly affected the percentage of the leaf dry matter 23.57, 25.69% as compared to control B₀ 20.50, 21.89% for both seasons respectively.

Table 4. Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on leaf dry matter % of *Gladiolus* in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	18.43	20.52	21.78	20.24	20.97	19.14	21.69	21.87	20.90	22.24		
	A ₁	22.12	23.87	24.17	23.39		21.77	25.51	27.56	24.94			
	A ₂	17.79	19.89	20.12	19.26		17.90	22.63	22.09	20.87			
C ₂	A ₀	20.42	23.74	24.93	23.03	23.71	23.05	25.20	25.31	24.52	26.62		
	A ₁	23.71	26.13	27.20	25.68		26.09	30.46	30.32	28.96			
	A ₂	20.51	23.52	23.20	22.41		23.39	28.78	26.99	26.39			
Interaction of B*C						Interaction of B*C							
C ₁		19.45	21.43	22.02			19.60	23.28	23.84				
C ₂		21.55	24.46	25.11			24.18	28.15	27.54				
Interaction of A*B					A	Interaction of A*B				A			
A ₀		19.43	22.13	23.36	21.64	21.10	23.45	23.59	22.71				
A ₁		22.92	25.00	25.69	24.54	23.93	27.99	28.94	26.95				
A ₂		19.15	21.71	21.66	20.84	20.64	25.71	24.54	23.63				
B		20.50	22.94	23.57		21.89	25.71	25.69					
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
1.16	1.15	0.94	2.65	2.07	2.25	3.08	2.06	2.06	1.68	4.39	3.24	3.27	5.24

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Irrigation by magnetic water C₂ has a significant effect on the leaf dry matter 23.71, 26.62%, while irrigation by tap water C₁ gave 20.97, 22.24% for both seasons, respectively. The significant effect of interaction of poultry manure, bio-fertilizers and magnetic water on leaf dry matter percentage in the autumn shown in the same table. The maximum leaf dry matter value 27.20% in autumn was found from A₁B₂C₂, while the minimum leaf dry matter value 17.79% was observed from A₂B₀C₁. However, the highest value in the spring (30.46%) was achieved from A₁B₁C₂ and the lowest value 17.90% was found from A₂B₀C₁.

Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on the leaf chlorophyll intensity (spad unit)

Table 5 shows the significant effect of using poultry manure on the leaf chlorophyll intensity of gladiolus plant var. Cartago. In both seasons, the maximum leaf chlorophyll intensity 58.18, 58.08 spad unit were noticed from A₁ treatment, while the minimum leaf chlorophyll intensity 50.53, 47.43 spad unit were achieved from A₂ treatment for both seasons respectively.

Table 5. Effect of poultry manure, bio-fertilizers and magnetic water and their interaction on the leaf chlorophyll intensity (spad unit) of gladiolus in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	42.49	50.48	46.05	46.34	49.14	43.13	51.35	49.31	47.93	49.14		
	A ₁	47.49	59.98	54.35	53.94		48.96	60.92	55.95	55.28			
	A ₂	42.20	50.71	48.52	47.14		40.91	49.24	42.47	44.21			
C ₂	A ₀	50.31	64.47	61.50	58.75	58.37	49.83	60.51	53.70	54.68	55.41		
	A ₁	57.02	68.83	61.42	62.42		55.42	67.71	59.50	60.88			
	A ₂	50.25	58.16	53.36	53.92		46.81	58.16	47.05	50.67			
Interaction of B*C						Interaction of B*C							
C1		44.06	53.72	49.64		C1		44.33	53.84	49.24			
C2		52.52	63.82	58.76		C2		50.69	62.13	53.42			
Interaction of A*B					A	Interaction of A*B					A		
A ₀		46.40	57.47	53.78	52.55	A ₀		46.48	55.93	51.51	51.31		
A ₁		52.25	64.41	57.89	58.18	A ₁		52.19	64.31	57.73	58.08		
A ₂		46.22	54.43	50.94	50.53	A ₂		43.85	53.70	44.75	47.43		
B		48.29	58.77	54.20		B		47.51	57.98	51.33			
LSD 0.05						LSD 0.05							
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
4.05	4.05	3.31	8.93	6.76	6.76	10.05	2.42	2.42	1.97	5.56	5.44	5.44	5.74

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

However, the significant effect of using *Azospirillum brasilense* B₁ noticed 58.77, 57.98 spad unit and *Bacillus subtilis* 54.20, 51.33, was found. These results were significantly differed from control B₀ as 48.29, 47.51 spad unit was obtained for both seasons respectively.

Irrigation by magnetic water caused increasing of leaf chlorophyll intensity by giving 58.37, 55.41 spad unit for C₂ as compared to C₁ which gave 49.14, 49.14 spad unit for both seasons respectively. The interaction of poultry manure, bio-fertilizers and magnetic water had a significant effect on the leaf chlorophyll intensity for both seasons as shown in the same table. The maximum value 68.83, 67.71 spad unit were found from A₁B₁C₂, while the minimum value 42.20, 40.91 spad unit were found from A₂B₀C₁.

Effects of poultry manure, bio-fertilizers magnetic water and their interaction on the Nitrogen (%) in the leaves

Table 6 presents the results of application of poultry manure on the nitrogen content in gladiolus leaves and a statistical difference was found in both seasons. It can be noticed that poultry manure at 2% A₁ recorded highest value 2.52, 2.26%, on the other hand, lowest value 1.79, 1.76% were obtained from A₂ for two seasons respectively.

Table 6. Effects of poultry manure, bio-fertilizers magnetic water and their interaction on the concentration of Nitrogen (%) in the leaves of *Gladiolus* in two seasons

Autumn							Spring						
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	1.55	2.00	1.63	1.72	1.83	1.32	1.84	1.54	1.57	1.62		
	A ₁	1.83	2.39	2.06	2.09		1.65	1.87	1.87	1.80			
	A ₂	1.48	1.95	1.58	1.67		1.27	1.78	1.44	1.49			
C ₂	A ₀	1.91	2.44	2.06	2.13	2.33	1.81	2.49	1.99	2.09	2.27		
	A ₁	2.49	3.63	2.72	2.95		2.39	3.40	2.34	2.71			
	A ₂	1.82	2.06	1.89	1.92		1.83	2.43	1.78	2.01			
Interaction of B*C							Interaction of B*C						
C ₁		1.62	2.11	1.76			1.41	1.83	1.62				
C ₂		2.07	2.71	2.22			2.01	2.77	2.04				
Interaction of A*B					A		Interaction of A*B			A			
A ₀		1.73	2.22	1.84	1.93		1.57	2.17	1.76	1.83			
A ₁		2.16	3.01	2.39	2.52		2.02	2.64	2.11	2.26			
A ₂		1.64	2.00	1.73	1.79		1.55	2.11	1.61	1.76			
B		1.84	2.41	1.99			1.71	2.31	1.83				
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
0.24	0.24	0.20	0.53	0.40	0.40	0.60	0.24	0.24	0.2	0.57	0.43	0.43	0.61

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Inoculated corms with bio-fertilizers were affected significantly on concentration of nitrogen in leaves. The maximum nitrogen concentration 2.41, 2.31% were observed from B₁ treatment, while the minimum nitrogen concentration 1.84, 1.71% were noticed from B₀ for both seasons respectively. Moreover, the effect of irrigation by magnetic water on nitrogen content in leaves differences significantly was found in two seasons. The highest concentrations 2.33, 2.27% were observed from C₂, while the lowest concentrations of nitrogen 1.83, 1.62% were found from both C₁ for both seasons respectively.

The interaction between poultry manure, bio-fertilizers and magnetic water on the nitrogen content in gladiolus leaves was statistical difference in both seasons. The maximum values 3.63, 3.40% were achieved from A₁B₁C₂, while the minimum values 1.48, 1.27% were found in both A₂B₀C₁ respectively.

Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the concentration of phosphorus (%) in the leaves

Table 7 gives the results of application of poultry manure on the phosphorus content in gladiolus leaves var. Cartago and a statistical difference was found in both seasons. The highest phosphorus concentrations 0.31, 0.28% were found from A₁, whereas the lowest phosphorus concentrations 0.20, 0.18% were observed from both A₂ respectively.

Table 7. Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the concentration of phosphorus (%) in the leaves of *Gladiolus* in two seasons

Autumn							Spring						
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C1	A ₀	0.20	0.22	0.27	0.23	0.22	0.17	0.19	0.24	0.20	0.20		
	A ₁	0.22	0.25	0.28	0.25		0.21	0.23	0.24	0.23			
	A ₂	0.15	0.19	0.19	0.18		0.15	0.17	0.20	0.17			
C2	A ₀	0.22	0.26	0.30	0.26	0.28	0.21	0.24	0.28	0.24	0.26		
	A ₁	0.30	0.37	0.44	0.37		0.28	0.33	0.39	0.33			
	A ₂	0.19	0.26	0.20	0.22		0.16	0.21	0.22	0.20			
Interaction of B*C							Interaction of B*C						
C1		0.19	0.22	0.25			0.18	0.20	0.23				
C2		0.24	0.30	0.31			0.22	0.26	0.30				
Interaction of A*B					A		Interaction of A*B					A	
A ₀		0.21	0.24	0.29	0.25		0.19	0.22	0.26	0.22			
A ₁		0.26	0.31	0.36	0.31		0.24	0.28	0.32	0.28			
A ₂		0.17	0.22	0.20	0.20		0.16	0.19	0.21	0.18			
B		0.21	0.26	0.28			0.20	0.23	0.26				
LSD 0.05							LSD 0.05						
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
0.02	0.02	0.01	0.06	0.05	0.05	0.05	0.03	0.03	0.03	0.07	0.06	0.06	0.09

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Inoculated corms with bio-fertilizers were affected significantly on phosphorus concentration in leaves. The maximum phosphorus concentrations 0.28, 0.26% were observed from B₂ inoculation, while the minimum phosphorus concentrations 0.21, 0.20% were achieved from control B₀ for both seasons respectively. Although the irrigation by magnetic water C₂ caused significant differences on phosphorus concentrations 0.28, 0.26%, as compared to tap water C₁ which gave 0.22, 0.20%.

The interaction between poultry manure, bio-fertilizers and magnetic water on the phosphorus content in gladiolus leaves was statistical difference in both seasons. The maximum values 0.44, 0.39% were observed from both A₁B₂C₂, whereas the minimum values 0.15, 0.15% were found from A₂B₀C₁.

Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the concentration of potassium (%) in the leaves

The data in Table 8 showed the maximum potassium concentrations due to application of poultry manure at 2% percentage A₁ which were 3.24, 2.95% significantly differed with A₂ resulted 2.55, 2.34% for both seasons respectively. However, the significant effect of bio-fertilizers was noticed with B₁ and B₂ in two seasons without significant differences between them. The highest potassium concentrations 3.19, 2.99% were found from both *Azospirillum brasilense* B₁ followed by *Bacillus subtilis* B₂ which gave 2.92, 2.65% and the lowest potassium concentrations 2.28, 2.12% were resulted from two control B₀ respectively.

Irrigation by magnetic water resulted increasing of potassium concentrations by giving 3.21, 2.92% for C₂ as compared to C₁ which gave 2.37, 2.25% for both seasons respectively.

The interaction between poultry manure, bio-fertilizers and magnetic water on the potassium content in gladiolus leaves was statistical difference in both seasons. The highest concentrations 4.19, 3.81% were achieved from A₁B₁C₂, while the lowest concentration 1.83, 1.83% was noticed from both treatments A₂B₀C₁.

Table 8. Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the concentration of potassium (%) in the leaves of *Gladiolus* in two seasons

Autumn							Spring						
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C1	A ₀	2.01	2.48	2.23	2.24	2.37	1.95	2.44	2.14	2.17	2.25		
	A ₁	2.35	3.40	2.81	2.85		2.23	3.11	2.64	2.66			
	A ₂	1.83	2.18	2.09	2.03		1.83	2.03	1.91	1.92			
C2	A ₀	2.46	3.23	3.09	2.93	3.21	2.06	3.29	2.95	2.77	2.92		
	A ₁	2.92	4.19	3.77	3.63		2.69	3.81	3.23	3.24			
	A ₂	2.11	3.62	3.50	3.08		1.99	3.26	3.01	2.75			
Interaction of B*C						Interaction of B*C							
C1		2.06	2.69	2.38		2.00		2.53	2.23				
C2		2.50	3.68	3.45		2.25		3.45	3.06				
Interaction of A*B					A	Interaction of A*B				A			
A ₀		2.24	2.86	2.66	2.59	2.00	2.87	2.55	2.47				
A ₁		2.64	3.80	3.29	3.24	2.46	3.46	2.93	2.95				
A ₂		1.97	2.90	2.80	2.55	1.91	2.64	2.46	2.34				
B		2.28	3.19	2.92		2.12	2.99	2.65					
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
0.32	0.32	0.26	0.77	0.59	0.59	0.80	0.41	0.41	0.33	0.80	0.64	0.64	1.01

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water.

Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the number of the days for flowering of Gladiolus

Table 9 shows that the numbers of the days required for flowering for gladiolus var. Cartago were affected significantly by application of poultry manure. The use of A₁ resulted of decreasing of the number of the days for flowering 123.95, 84.89 significantly as compared to A₂ treatment which flowered after 132.93, 89.19 days for both seasons, respectively. However, the lowest number of the days for flowering affected by inoculations with both bacteria B₁ 125.55, 85.25 days and B₂ 128.28, 85.99 days as compared to control 130.37, 89.96 days for two seasons, respectively.

Irrigation by magnetic water caused decreasing of the number of the days for flowering by giving 125.63, 85.33 days for C₂ as compared to C₁ which gave 130.50, 88.81 days for two seasons, respectively.

However, the interaction between poultry manure, bio-fertilizers and magnetic water on the number of the days for flowering was found to be significant. In the autumn the minimum numbers of the days required for flowering 120.73, 120.96, 120.99 days were found from A₁B₀C₂, A₁B₁C₂, A₁B₂C₂ without any significant differences between them, while all of them differed significantly with control A₀B₀C₁ 139.18 days. However, in the spring the lowest number of the days required for flowering 82.11, 83.72 days were obtained from A₁B₁C₂ and A₁B₂C₂, while the highest number of the days required for flowering 93.83 days was achieved from A₀B₀C₁.

Table 9. Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the number of the days for flowering of Gladiolus in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	139.18	118.30	133.85	130.44	130.50	93.83	87.44	86.28	89.18	88.81		
	A ₁	129.10	127.32	124.61	127.01		88.72	84.89	83.22	85.61			
	A ₂	134.47	132.32	135.33	134.04		93.89	88.33	92.67	91.63			
C ₂	A ₀	127.27	122.67	122.67	124.20	125.63	88.21	83.22	83.77	85.07	85.33		
	A ₁	120.73	120.96	120.99	120.89		86.66	82.11	83.72	84.16			
	A ₂	131.48	131.72	132.23	131.81		88.44	85.53	86.27	86.75			
Interaction of B*C						Interaction of B*C							
C ₁		134.25	132.64	131.26		92.15		86.89	87.39				
C ₂		126.49	125.12	125.30		87.77		83.62	84.59				
Interaction of A*B					A	Interaction of A*B			A				
A ₀	133.22	120.49	128.26	127.32	91.02	85.33	85.03	87.13					
A ₁	124.92	124.14	122.80	123.95	87.69	83.50	83.47	84.89					
A ₂	132.98	132.02	133.78	132.93	91.16	86.93	89.47	89.19					
B	130.37	125.55	128.28		89.96	85.25	85.99						
LSD 0.05						LSD 0.05							
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
1.23	1.23	1.01	5.86	2.21	4.93	3.01	1.69	1.69	1.38	3.64	3.09	2.96	4.03

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Effect poultry manure, of bio-fertilizers, magnetic water and their interaction on the anthocyanin concentration in flower petals (mg.100 g⁻¹) of gladiolus

Table 10 explains that poultry manure applications A had significant effect on the anthocyanin concentration in flower petals of gladiolus var. Cartago. The highest concentrations 21.99, 19.27 mg. 100 g⁻¹ were found from A₁, whereas the lowest concentrations 15.93, 13.40 mg. 100 g⁻¹ were obtained from A₂ for both seasons respectively.

Table 10. Effect poultry manure, of bio-fertilizers, magnetic water and their interaction on the anthocyanin concentration in flower petals (mg.100 g⁻¹) of gladiolus in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	14.96	16.60	20.87	17.48	17.90	11.62	11.77	12.36	11.92	13.12		
	A ₁	18.82	21.73	23.49	21.35		14.57	16.38	19.17	16.70			
	A ₂	13.94	15.58	15.09	14.87		9.46	10.93	11.84	10.74			
C ₂	A ₀	16.56	19.19	20.86	18.87	19.50	15.23	19.78	21.81	18.94	18.94		
	A ₁	20.26	22.10	25.53	22.63		18.58	22.17	24.76	21.83			
	A ₂	16.34	17.60	17.03	16.99		13.65	17.29	17.24	16.06			
Interaction of B*C						Interaction of B*C							
C ₁		15.90	17.97	19.82			11.88	13.03	14.46				
C ₂		17.72	19.63	21.15			15.82	19.75	21.27				
Interaction of A*B					A	Interaction of A*B					A		
A ₀		15.76	17.89	20.87	17.93	13.42		15.78	17.09	15.43			
A ₁		19.54	21.92	24.51	21.99	16.57		19.28	21.97	19.27			
A ₂		15.14	16.59	16.06	15.93	11.55		14.11	14.54	13.40			
B		16.81	18.80	20.48		13.85		16.39	17.87				
LSD 0.05						LSD 0.05							
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
1.20	1.2	0.97	2.26	2.24	3.11	3.05	1.82	1.82	1.49	4.88	2.96	2.96	4.53

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Also, the significant effect of bio-fertilizers on anthocyanin concentration in flower petals was shown in the same table. In the autumn the maximum value 20.48 mg. 100 g⁻¹ due to inoculation by B₂, while the minimum value 16.81 mg. 100 g⁻¹ was found from control. In the spring there were not significant differences between inoculations of B₁ and B₂ which gave 16.39, 17.87 mg. 100 g⁻¹ whereas both of them differed significantly with control 13.85 mg.100 g⁻¹.

Irrigation by magnetic water C₂ caused increasing of anthocyanin concentration in flower petals which gave 19.50, 18.94 mg.100 g⁻¹ as compared to irrigation by tap water C₁ which achieved 17.90, 13.12 mg.100 g⁻¹ for both seasons, respectively.

However, the interaction between poultry manure, bio-fertilizers and magnetic water on the anthocyanin concentration in flower petals had significant differences. In the autumn the highest concentration 25.53 mg.100 g⁻¹ was noticed from A₁B₂C₂ followed

by A₁B₂C₁ which gave 23.49 mg.100g⁻¹, while the lowest concentration 13.94 mg.100g⁻¹ was achieved from A₂B₀C₁. Also, the interaction of three study factor affected significantly in the spring, the maximum concentration 24.76 mg.100 g⁻¹ was found from A₁B₂C₂ followed by A₁B₁C₂ which gave 22.17 mg.100 g⁻¹ while the minimum concentration 9.46 17 mg.100 g⁻¹ was obtained from A₂B₀C₁.

Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the basal floral diameter (cm) of gladiolus

Results shown in Table 11 indicates that the application of A₁ gave highest values in two seasons 12.16, 10.44 cm were noticed from both A₁, while the lowest values 8.76, 8.86 cm were obtained from both A₂ respectively. Moreover, the floral diameter was affected significantly by inoculations the corms by B₁ and B₂. The maximum floral diameter 11.33, 10.32 cm were found from B₁ followed by B₂ which gave 11.09, 9.97 cm those two treatments varied significantly with both control 9.07, 8.23 cm for two seasons respectively.

The irrigation by C₂ caused increasing in floral diameter in two seasons by giving 11.01, 10.17 cm were found from C₂ as compared to C₁ which gave 9.89, 8.84 cm respectively. However, the interaction between poultry manure, bio-fertilizers and magnetic water gave statistical differences on lower floral diameter. The highest values in the autumn 13.73, 13.54, 13.01 cm were obtained from A₁B₂C₂, A₁B₁C₂, A₁B₂C₁, while the lowest value 7.58 cm was noticed from A₂B₀C₁. In the spring the maximum floral diameter 12.19, 11.99 cm were obtained from A₁B₁C₂, A₁B₂C₂, whereas the minimum floral diameter 6.96 cm was found from A₂B₀C₁.

Table 11. Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the basal floral diameter (cm) of gladiolus in two seasons in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	8.34	10.54	10.29	9.72	9.89	7.88	9.02	8.37	8.42	8.84		
	A ₁	9.76	12.03	13.01	11.60		8.80	10.01	10.47	9.76			
	A ₂	7.58	9.34	8.13	8.35		6.96	9.10	8.92	8.33			
C ₂	A ₀	9.97	12.11	12.17	11.42	11.01	8.27	11.28	10.47	10.01	10.17		
	A ₁	10.89	13.54	13.73	12.72		9.16	12.19	11.99	11.11			
	A ₂	7.88	10.39	9.20	9.16		8.30	10.30	9.58	9.39			
Interaction of B*C						Interaction of B*C							
C ₁		8.56	10.64	10.48		7.88		9.38	9.25				
C ₂		9.58	12.01	11.70		8.58		11.26	10.68				
Interaction of A*B					A	Interaction of A*B				A			
A ₀	9.16	11.33	11.23	10.57	8.07	10.15	9.42	9.21					
A ₁	10.33	12.79	13.37	12.16	8.98	11.10	11.23	10.44					
A ₂	7.73	9.87	8.67	8.76	7.63	9.70	9.25	8.86					
B	9.07	11.33	11.09		8.23	10.32	9.97						
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
1.02	1.02	0.84	1.79	1.68	1.68	2.54	0.98	0.98	0.80	1.77	1.39	1.39	2.36

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the vase life (day) in magnetic water of gladiolus

The effect of poultry manure on the number of the days for vase life of gladiolus var. Cartago is shown in *Table 12*. The highest number of the days 12.12, 9.83 day were noticed from A₁ application for both seasons, while the lowest number of the day 8.88 day in the autumn was obtained from A₂ application and 8.18 day in the spring was noticed from A₀.

However, the inoculation of gladiolus corms with bio-fertilizers significantly affected flowers vase life. The highest vase lives 11.04, 10.45 days were obtained with B₂, B₁ inoculation in the autumn respectively, whereas the lowest vase life 8.85 day was found from B₀. In the spring the highest vase lives 9.62, 9.54 days were found from B₁, B₂, while the lowest vase lives 7.66 days was achieved from B₀. The irrigation by magnetic water caused increasing of vase life significantly. The 11.05, 9.35 day achieved from C₂ as compared to C₁ which gave 9.17, 8.53 day for both seasons, respectively.

Table 12. Effect of poultry manure, bio-fertilizers, magnetic water and their interaction on the vase life (day) in magnetic water of gladiolus in two seasons

Autumn						Spring							
C	A	B ₀	B ₁	B ₂	A*C	C	B ₀	B ₁	B ₂	A*C	C		
C ₁	A ₀	7.13	8.42	9.90	8.48	9.17	6.99	8.17	8.53	7.90	8.53		
	A ₁	9.62	11.22	11.85	10.90		7.50	9.89	9.55	8.98			
	A ₂	6.58	8.66	9.11	8.12		7.41	9.22	9.50	8.71			
C ₂	A ₀	8.97	10.15	11.44	10.19	11.05	7.44	9.28	8.66	8.46	9.35		
	A ₁	11.89	13.89	14.22	13.33		9.11	11.39	11.55	10.68			
	A ₂	8.89	10.33	9.67	9.63		7.52	9.77	9.44	8.91			
Interaction of B*C						Interaction of B*C							
C ₁		7.78	9.43	10.29		C ₁		7.30	9.09	9.19			
C ₂		9.92	11.46	11.78		C ₂		8.02	10.15	9.88			
Interaction of A*B				A		Interaction of A*B				A			
A ₀		8.05	9.29	10.67	9.34	A ₀		7.22	8.73	8.60	8.18		
A ₁		10.76	12.55	13.03	12.12	A ₁		8.31	10.64	10.55	9.83		
A ₂		7.73	9.49	9.39	8.88	A ₂		7.47	9.50	9.47	8.81		
B		8.85	10.45	11.04		B		7.66	9.62	9.54			
LSD 0.05													
A	B	C	A*B	A*C	B*C	A*B*C	A	B	C	A*B	A*C	B*C	A*B*C
0.56	0.56	0.45	1.55	1.22	1.22	1.39	0.65	0.65	0.53	1.22	1.12	1.12	1.60

A is poultry manure, A₀ without poultry manure, A₁ application of poultry manure at 2% of soil weight, A₂ application of poultry manure at 4% of soil weight. B is bio-fertilizers, B₁ is inoculation by bacteria *Azospirillum brasilense*, B₂ is inoculation by bacteria *Bacillus subtilis*, C is type of irrigation, C₁ is irrigation by tap water, C₂ is irrigation by magnetic water

However, the interaction between A, B and C gave statistical differences on vase life in both seasons. The highest vase life 14.22, 11.55 days were found from A₁B₂C₂ followed by A₁B₁C₂ which amounted 13.89, 11.39 days for both seasons respectively, while the lowest vase life 6.58day was recorded from A₂B₀C₁ for autumn season, and 6.99 day was noticed from A₀B₀C₁ for spring season.

Discussion

The reason for the difference of plant height in autumn and spring seasons *Table 3* might be that clay percentage in soil media A₁ is 37.6 compared to soil media A₂ is 21.6 as it is shown in *Table 1*. This effect may be attributed to the physical properties of some ions adhere on the clay soil particles (Mazhar, 2010).

Regarding the inoculation of gladiolus corms with bacteria *Azospirillum brasilense*, it gave the maximum plant height and there were not significant differences with inoculation by *Bacillus subtilis*, while both of them are different from treatment without bacteria. This result is similar to what was obtained by Ali et al. (2014) as they reported that the vegetative growth improved after the application of bacteria *Azospirillum*. Moreover, a significant difference in vegetative growth was observed after using Azotobacter and Phosphate Solubilizing Bacteria (PSB) on growth of gladiolus by Srivastava and Govil (2005). Using magnetic water can improve plant height as it increases the ability of soil to get rid of salt, and it helps to better assimilate nutrients in plants during vegetative growth.

In this study, dry matter percentage in Gladiolus leaves were significantly affected by the application of 2% poultry manure in soil media (*Table 4*). These results could be due to efficient nitrogen availability which led to the improvement of vegetative growth (Shah et al., 2016). Nitrogen as an essential component of protein, nucleic acid and many important substances like chlorophyll, which are required for vegetative growth and might be responsible for the increase in dry matter accumulation in leaves. The soil bacteria belonging to the genera *Bacillus* is more common. The major microbiological means by which insoluble phosphorus compounds are mobilized by the production of organic acids, accompanied by acidification of the medium. The organic and inorganic acids convert tricalcium phosphate to di- and monobasic phosphates with the net result of an enhanced availability of the element to the plant (Yazdani et al., 2009).

The magnetic field can increase ions mobility and ions uptake which leads to a better photo stimulation and growth (Pietruszewski, 1999). Moreover, magnetic field has the ability to change water properties. Thus, this results in the increase of chlorophyll content which leads to increase in fresh weight of leaves and might cause nutrient accumulation in the leaves.

Effects of the interaction A₁B₁C₂ on chlorophyll intensity might be due to effects of each factor on all vegetative growth characteristics of Gladiolus var. Cartago, and it was clearly compact with the high concentration of nitrogen in leaves for both seasons 3.63, 3.40% that is shown in *Table 6*, which had major role of increasing photochemical reduction. These results are close with findings of Al-Khazan et al. (2011) that noticed that photosynthetic pigment and nutrient content of *Simmondsia chinensis* L. enhanced when irrigated by magnetic water. Atak et al. (1997) suggested that the increase of photosynthetic pigments was due to an increase in cytokinin synthesis and this plays an important role on chloroplast development. Magnetic fields are known to induce biochemical changes and affect photo pigments (Dhawi and Al-Khayri, 2009).

Tables 6–8 illustrated that A₁ had significant effect on nutrient concentration in leaves of gladiolus. This may be due to poultry manure which is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients (Garg and Bahl, 2008). The addition of organic fertilizers gives the plant an opportunity to provide more efficiently in the nutrients needed by nitrogen that enters into the composition of a number of important organic compounds in the biological processes in

the plant. It also involves into the synthesis of nucleic acids such as DNA, RNA and helps the building of important proteins that increase division and elongation of cells.

Although, the inoculation corms of *Gladiolus* var. Cartago by each *Azospirillum brasilense* and *Bacillus subtilis* had significant differences in nutrient content in leaves as compared to treatment with control. These results are accordance with (Orhan et al., 2006) who investigated two *Bacillus* strains OSU-142 (N₂-fixing) and M3 (N₂-fixing and phosphate solubilizing) that were tested alone or in combinations on organically grown primo cane fruiting raspberry (cv. Heritage). It was found that bacterial treatment improves nutrient uptake and increase most nutrient element contents P, Ca, Fe, Mn and K in leaves.

Third factor that caused of increasing nutrient element concentration in leaves was irrigation by magnetic water. These results agree with findings of Al-Ma athidi (2006) who investigated the effect of magnetic water on *Gerbera jamesonii* which caused to increasing of nitrogen and magnesium availability in soil solution (Hashemabadi et al., 2015; Abdelaziz and Abdelrazig, 2014).

As indicated in *Tables 9–12*, treatment A₁ had significant effects on most flower characterizes (Number of the days for flowering, anthocyanin concentration in petals, basal floral diameter and vase life) of gladiolus var. Cartago. The results were on line with Jha (2011) findings that the farm yard manure 10 t. ha⁻¹ with 75% RDF gave significant effect on the reducing the number of the days for spike emergence of gladiolus cultivar candyam. In this study, the use of 4% did not have significant effects on the flower attributes which may be because of effects of high Electrical conductivity of A₂ which 2.91 was higher than A₁ 1.70 which might be due to the presence of more salts in the poultry manure at the rate A₂ as shown in *Table 1*.

The bio-fertilizers inoculation gave significant effects on most flowering characterizes as compared to control. The data in *Table 9* indicated that the number of the days required to opening of basal floret was significantly reduced with the inoculation of *Azospirillum barasilense* and *Bacillus subtilis* in two seasons. These results were in close with findings of Singh (2009). The study was carried out to use bio-fertilizers in combination with nitrogen on growth and flowering of *Gladiolus*, to see the effect of *Bacillus* and *Pseudomonas* strains on growth and flowering of gladiolus cultivar American Beauty. Significant increase in spike length, and number of florets per spike and floret diameter was recorded under levels of nitrogen, bio-fertilizers, *Bacillus*, *Pseudomonas* strains and their combinations.

Moreover, irrigation by magnetic water caused improvements in flower quality. The reason for the positive effects of magnetized water could be due to the fact that the magnetic field is dependent on changes in the physical and chemical properties of water, including reducing surface tension, viscosity and water density, making it lighter and easier to absorb. The results were close with findings of Al-Maathidi (2006) in the study of using magnetized water on *Gerbera jamesonii*.

Regarding of vase life, the biofertilizers regulate nutrient uptake process and prolonged vase life phenomenon. Bekheta and Mahgoub (2005) concluded that the increase in nitrogen level lead to change in amino acids quantity and specific proteins in carnation plants. Plants treated with microbial inoculations showed more sugar contents.

Conclusion

The study discusses that the poultry manure at the rate of 2% of soil weight improves vegetative growth of *Gladiolus (Gladiolus hybrida)* as well as flower characteristics. Moreover, inoculation by *Azospirillum brasilense* and *Bacillus subtilis* increases the plant height, chlorophyll intensity, N, P, K uptake and flower quality in autumn and spring seasons. Since the soils of Sulaimani farms are suffering from organic matter deficiency, application of animal residue as poultry manure is used as it improves organic matter content. Furthermore, using biofertilizer is safer than chemical fertilizer to decrease soil pollution, and it costs less. It is clear that the irrigation with magnetic water and using bacteria *Azospirillum* spp. can improve flower production and reduced salinity of the soil. It is recommended for future researches to study the different type of bacteria and mycorrhiza with organic matter.

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