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Effect of Amino Acids Spray on Growth, Flowering and Keeping Quality of *Gerbera jamesonii* L. as a Pot Plant

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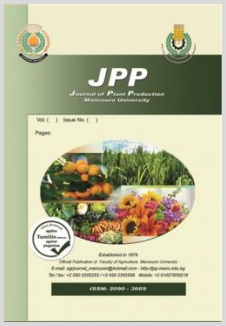

ABSTRACT

The present research was conducted in the greenhouse of the Experimental Station of Horticultural Research Station in Mansoura, Horticultural Research Institute, Agricultural Research Center during the two successive seasons of 2016 and 2017 from February21 to June27. One month old gerbera plants were obtained from a commercial nursery in Mansoura, planted in 20cm pots. This investigation aimed to improve some plant growth, flowering parameters and chemical constituents of gerbera (*Gerbera jamensonii* L.) plants, by using foliar application with some amino acids (glycine, arginine, asparagine, alanine, tryptophan, and a mixture from all of them) at concentrations of 100ppm plus the control (tap water). Application of amino acid treatments began 30days after transplanting then repeated after 14 days intervals. The results showed that spraying gerbera plants with a mixture of amino acids at 100ppm gave the highest values of leaves and roots fresh and dry weights, total leaf area, leaf area/ plant, number of leaves/ plant, chlorophyll (A, B and total), total carbohydrates, N, P and K contents in the leaves and biggest flowers diameters (11.23 and 11.83 cm), followed by plants treated with glycine then tryptophan in the two seasons, respectively. Glycine at 100ppm recorded pronounced significant values in flowers stem length and number of flowers (7.66 and 8.00 flowers/ plant) in both seasons respectively, followed by the tryptophan treatment (7.00 and 7.33 flowers/ plant), the third highest was that of the mixture treatment. The lowest values were obtained when plants treated with tap water (control) in both seasons, respectively.

Keywords: Gerbera (*Gerbera jamesonii* L) plants, amino acid, flowers characters.

INTRODUCTION

Gerbera (*Gerbera jamensonii* L.), a tender perennial herb is valued for its brilliant colored flower. It is a valuable flower cultivated worldwide as a cut flower. It is considered to have originated in South Africa, more particularly Natal, Transvaal province. Gerbera belongs to the family Astraceae, the largest family of flowering plants due to its tremendous variability in respect of flower colour, shape and size. The name "Gerbera" has been given in honour of "Trougott Gerber" a German naturalist of 18th century. The flowers are daisy like 7-10 cm across, but in certain hybrids there may be as large as 15cm across. The flower may be single or double and are available in various self-colored cultivars as well as bicolor. The color may be white, cream, lemon, yellow, brick red, orange, pink, salmon, scarlet, maroon as well as many other shades. The flowers are borne in the long slender stalk. The foliage is arranged in the form of a rosette at the base (Danaee *et al*., 2011).

Using amino acids not only increase growth but also enhance yield quality and quantity. Hadi *et al*. (2011) found that the sprays of amino acids mixture at the budding + flowering stage increased flower head diameter and fresh and dry flower yield of *Matricaria chamomile* L. plant. Ali and Hassan (2013) found that foliar application of amino acids mixture applied as (Algaefol compound) at 3 ml/L increased plant height, branch number, herb fresh and dry weight, flower yield and quality, N, P, and K percentages of marigold (*Tagetes erecta* L.) plants. EL-Naggar *et al*. (2013) mentioned that spraying the two Longiflorum-Asiatic lilies (L.A) hybrids with 900 mg/l amino acid mixture gave the highest significant plant height, leaf number, fresh and dry weights of leaves, chlorophyll and total carbohydrates contents and N, P, K contents in both seasons. Rahmatzadeh *et al*.(2014) found that adding tryptophan at 250 and 350 mg/l into the *in vitro* regeneration medium of *Catharanthus roseus* L. increased shooting and rooting percentages and improved the shoot and root dry and fresh weights. Youssef (2014) indicated that tryptophan and glutamic acid (each at 200 ppm) and/or Fe, Zn and Mn (each at 150 ppm) and their combinations significantly increased fresh and dry herb weights of *Echinacea purpurea* plants. Afifipour and Khosh-Khui (2015) reported that spraying a mixture of amino acids improved all growth characters of two tuberose cultivars. Salama and Yousef (2015) reported that foliar application with various concentrations of amino acids mixture (0.5, 1.5 and 2.5 ml/L) improved number of inflorescences, number of fruit per inflorescences and seed yield of *Ocimum sanctum* L. plants. Wahba *et al*. (2015) showed that foliar application of tryptophan, tyrosin and glutamic at different doses (50, 100 and 150 ppm) increased height of plant, number of branches, weight of herb and yield of seed of *Urtica pilulifera* plants compared with control plants. They found that tryptophan at 100 ppm was the most effective treatment. Also, Geshnizjani and Khosh-Khui (2016) reported that foliar application of a mixture of

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19 essential amino acids at different concentrations (0.25, 0.50 and 0.75 mg/L) and ammonium nitrate (200 mg L-1) as nitrogen source promoted quantity and quality of gerbera flowers (*Gerbera jamesonni* L.) cv. 'Saltino' and improving photosynthesis of plants. Khattab *et al*. (2016) showed that using different concentrations of glycine, methionine or tryptophan gave the highest significant increase in the vegetative growth, total carbohydrates contents, the highest nitrogen content of *Gladiolus grandiflours* cv. "Rose Supreme" plants regardless of the application method. Aim of this investigation was to study the effect of foliar application with some amino acids on some growth parameters, flower characters and chemical properties of *Gerbera jamesonii* L. plants.

MATERIALS AND METHODS

The present research was conducted in the greenhouse of the Experimental Station of Horticultural Research Station in Mansoura, Horticultural Research Institute, Agricultural Research Center during the two successive seasons of 2016 and 2017 from February 21 to June 27. One month old gerbera plants were obtained from a commercial nursery in Mansoura, planted in 20 cm pots filled with mixture of peat moss: sand (1:1 v /v) with 4 holes in the bottom for drain of excess water. The distance between pots was 30 cm and between treatments 40 cm. The plants were watered every one week in February and March and twice every week from April to June. The amino acids were obtained from Al-Gomhoria company (Mansoura branch). The plants were sprayed with different amino acids (arginine, asparagine, alanine, tryptophan, glycine and a mixture from all of them) at concentrations of 100 ppm plus the control (tap water) treatments at 10 am o'clock every two weeks. The plants were fertilized by spraying it with Fert Plus fertilizer produced by Kafr El Zayat Company (NPK 20:20:20) with a concentration of 2 g / L. The experimental design was arranged in a complete randomized block design (CRBD) contained three replicates as each replicate consisted of three pots filled with peat-sand mix (1:1,v.v) each pot contained one.

Data recorded:

Vegetative growth:

Three plants were chosen randomly from each treatment and the following characters were recorded:

1- Leaves fresh and dry weights (g/ plant)
2- Roots fresh and dry weights (g/ plant)
3- Number of leaves per plant.
4- Total leaf area and leaf area (cm^2 /plant)

Flowering characters:

The measurements below were taken at the end of the season experiment of each season (i.e. after one year from the commencement of the experiment) for the following parameters:

1- Number of flowers per plant.
2- Flower stems length (cm).
3- Flowers diameter (cm).

Chemical analysis:

1- Chlorophyll content; was estimated as the method described by Goodwine (1965).
2- Total carbohydrates percentage was estimated as the method described by Hedge and Hofreiter (1962).
3- Total nitrogen percentage was determined according to the method described by A.O.A.C. (1984).Total phosphorus percentage was determined according to the method by Jackson (1973). Total potassium percentage was estimated photometrically according to the method described by Peterburgski (1968).

Statistical analysis:

Data collected from the experiment were statistically analyzed according to (Snedecor and Chochran, 1980), using the new L.S.D. values at 5% level and averages were compared between means of different treatments.

RESULTS AND DISCUSSION

Results

1- Effect of some amino acids on vegetative growth of gerbera plants.

Data presented in Table (1) clearly showed that the highest values of leaves fresh weight (32.54 and 34.35 g/ plant), leaves dry weight (10.10 and 10.85 g / plant) recorded when gerbera plants were sprayed with the mixture of amino acid (T6), when compared with the remaining treatments. The lowest values were obtained when plants sprayed with the control treatment (T7) in both seasons, respectively. In the same table roots fresh and dry weights were significantly affected by some amino acid as compared with the tap water (control) in the two years of study. The maximum significant values of roots fresh and dry weights were obtained from gerbera treating with arginine (T4) gave (28.21 and 29.78 g/ plant) and (8.74 and 9.24 g/ plant) respectively, followed by the mixture treatment (T6) gave (25.65 and 27.02 g/ plant) and (7.89 and 8.37 g/ plant) respectively, during the two seasons.

Table 1. Effect of some amino acids on leaves and roots fresh and dry weights (g/ plant) of gerbera plants during two seasons.

Treatments		Leaves weight (g / plant)				Roots weight (g / plant)			
		fresh		dry		fresh		dry	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
1	Glycine	28.03b	30.57b	8.60b	9.35b	23.42c	24.72c	7.13bc	7.49e
2	Asparagine	21.32e	23.46e	6.55e	7.13d	19.35e	20.56e	6.82bcd	6.22e
3	Alanine	18.68f	20.38f	5.65f	6.25e	18.86e	20.02e	5.66de	6.05f
4	Arginine	23.53d	26.04d	7.16d	7.93c	28.21a	29.78a	8.74a	9.24a
5	Tryptophan	25.67c	28.36c	7.87c	8.99 b	21.01d	23.03d	6.41cd	6.98d
6	Mixture	32.54a	34.35a	10.10a	10.85a	25.65b	27.02b	7.89ab	8.37b
7	Control	15.28g	17.36g	4.57g	5.15f	14.87f	16.34f	4.47e	4.91g
LSD at 5 %		1.64	1.55	0.52	0.77	0.96	0.75	1.20	0.16

*** Means with the same letter are not significantly different at P < 0.05.**

In the same trend in *Gerbera jamesonii*, in particular, vegetative growth of leaves and roots fresh and dry weights /plant could be explained by the fact that amino acids may play a role in plant metabolism and protein assimilation which are necessary for direct cell formation and increase fresh and dry matter by (Chen *et al*. 2004). The obtained results are in agreement with those given by Shehata *et al*. (2011) on celeriac plant; Afifipour and Khosh-Khui (2015) on two tuberose cultivars and Salama and Yousef (2015) on basil (*Ocimum sanctum* L.) plants.

Data illustrated in Table (2) indicated that the highest number of leaves per plant were (23.33 and 24.33 leaves/ plant), recorded when gerbera plants sprayed with the mixture treatment of amino acid (T6), when compared with the remaining treatments. The lowest values were obtained when plants sprayed with the control treatment (T7) in both seasons, respectively. Plants treated with the mixture of amino acids (glycine, asparagine, alanine, argenine and tryptophan) gave the highest values of total leaf area and leaf area per plant. The highest values of total leaf area per plant were (1120.81 and 1157.08 cm^2) and leaf area per plant (48.81and 49.61 cm^2) when compared with the remaining treatments. The lowest values of total leaf area were (522.32 and 525.85 cm^2) and leaf area per plant (33.54 and 34.27 cm^2) obtained when plants sprayed with control treatment (T7) in both seasons, respectively. Similarly, the same trend of results for aboveground plant parts when amino acids were added as a mixture was described elsewhere by Vafaei *et al*. (2015) reported that a foliar application of 300 mg/L amino acid mixture increased leaf area of basil plants. Habba (2003) showed that *Dautura innoxia* Mill. plant treated with foliar spray of 400 ppm ornithine and 200 ppm phenylalanine gave the highest leaf area.

Table 2. Effect of some amino acids on number of leaves/ plant, total leaf area (cm^2) and leaf area/ plant (cm^2) of gerbera plants during two seasons.

Treatments		Number of leaves / plant		Total leaf area (cm^2)		Leaf area (cm^2/ plant)	
		1st season	2nd season	1st season	1st season	1st season	1st season
1	Glycine	21.33b	22.00b	1012.82a	1019.80b	45.57b	46.91b
2	Asparagine	17 66e	18.66d	711.55bc	717.78de	38.54e	39.34e
3	Alanine	16.66f	17.33e	619.48cd	624.87ef	35.86f	36.60f
4	Arginine	19.00d	19.66cd	795.66b	798.67cd	40.37d	41.23d
5	Tryptophan	20.00c	20.66c	849.47b	852.56c	43.48c	44.12c
6	Mixture	23.33a	24.33a	1120.81a	1157.08a	48.81a	49.61a
7	Control	14.33g	15.00f	522.32d	525.85f	33.54g	34.27g
LSD at 5 %		0.69	1.33	137.94	104.12	0.43	0.98

*** Means with the same letter are not significantly different at P < 0.05.** .

2- Effect of some amino acids on flowers characters of gerbera plants

Data presented in Table (3) indicated that spraying gerbera plants with amino acids either alone or as mixture increased flowers characters.

Table 3. Effect of some amino acids on flowers number, flowers stem length (cm) and flowers diameter (cm) of gerbera plants during two seasons.

Treatments		Flowers					
		Diameter (cm)		Number		Stem length (cm)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
1	Glycine	9.21c	9.69c	7.66a	8.00a	43.7a	45.0a
2	Asparagine	7.85e	8.11e	5.00cd	5.33de	33.8e	34.4e
3	Alanine	7.11f	7.5f	4.33de	4.66ef	32.7f	33.2f
4	Arginine	8.41d	8.88d	5.66bcd	6.00cd	35.5d	36.2d
5	Tryptophan	10.11b	10.63b	7.00ab	7.33ab	39.0c	40.1c
6	Mixture	11.27a	11.83a	6.33abc	6.66bc	40.9b	42.3b
7	Control	6.64g	6.90g	3.33e	4.00f	28.4g	29.2g
LSD at 5 %		0.25	0.23	1.51	0.69	0.54	0.45

*** Means with the same letter are not significantly different at P < 0.05.**

The highest values of flowers diameters 11.27 and 11.83 cm recorded when gerbera plants were sprayed with a mixture treatment of amino acid (T6), when compared with the remaining treatments. Also, the data showed that the treatment of glycine (T1) recorded pronounced significant values in number of flowers (7.66 and 8.00), flower stem length (43.7 and 45.0 cm) followed by tryptophan treatment (T5) 7.00 and 7.33 and the mixture treatment (T6) 6.33 and 6.66 which all gave significant increase in number of flowers compared to control in the 1st and 2nd seasons, respectively. The lowest values of leaf area per plant and flowers characters obtained when plants sprayed with tap water (control) treatment (T7) in both seasons, respectively.

The obtained results are in agreement with those given by many researchers, who reported that the sprays of amino acids mixture at the budding + flowering stage increased flower head diameter. Similarly, the same trend of results for number of flowers and stem length of gerbera plants were obtained when amino acids were added as a mixture in a commercial compound was described by Shehata *et al*. (2011) on celeriac, Ali and Hassan (2013) on *Tagetes erecta*. Likewise, much of the same kind of results were found and reported too when amino acids were applied as singular amino acid by El-Fawakhry and El-Tayeb (2003) on chrysanthemum and Abdel Aziz *et al*. (2009) on gladiolus.

3- Effect of some amino acids on chemical constituents of gerbera plants

It is clear from the data in Table (4) that treating gerbera plants with different amino acids (glycine, asparagine, alanine, argenine, tryptophan and the mixture of them) significantly enhanced chlorophyll (A, B and total) and total carbohydrates in the leaves as compared with the untreated (control) plants. The highest values were achieved using the mixture of the five amino acids. The second highest significant values was achieved using glycine, the third highest was of tryptophan, while asparagine, argenine, and alanine produced the least increase in chlorophyll (A, B and total) and total carbohydrates contents in the leaves among all treated

plants. The data, thus, showed that the most effective individual amino acid in increasing chemical constituent's contents in the leaves was glycine followed by tryptophan in both seasons.

Table 4. Effect of some amino acids on chlorophyll A, B, total (mg /g F.W) and total carbohydrates (%) of gerbera plant during two seasons.

Treatments		Chlorophyll (mg/ g F.W)						Total Carbohydrates (%)	
		A		B		Total			
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
1	Glycine	0.725b	0.733b	0.513b	0.521b	1.24b	1.25b	33.89b	34.29b
2	Asparagine	0.666e	0.681de	0.475e	0.481e	1.14e	1.16e	30.95e	31.19e
3	Alanine	0.657e	0.677e	0.455f	0.468f	1.11f	1.15e	29.8f	30.13f
4	Arginine	0.680d	0.697cd	0.486d	0.494d	1.17d	1.19d	31.77d	32.13d
5	Tryptophan	0.706c	0.714c	0.496c	0.506c	1.20c	1.22c	32.63c	33.24c
6	Mixture	0.738a	0.751a	0.529a	0.533a	1.27a	1.28a	34.85a	35.15a
7	Control	0.637f	0.647f	0.443g	0.455g	1.08g	1.12f	28.67g	29.11g
L.S.D at 5 %		0.010	0.017	0.009	0.009	0.013	0.018	0.425	0.321

*** Means with the same letter are not significantly different at P < 0.05.**

The promotive effect of amino acids on chemical constituents of gerbera leaves here could be cleared simply from their important role in the biosynthesis of chlorophyll molecules which in turn affected carbohydrate content as has been explained by EL-Naggar *et al*. (2013) on lillium plant showed that amino acids mixture applied as foliar application caused significant increases in leaf chlorophyll and total carbohydrates contents. Saburi *et al*. (2014) reported that foliar application of tryptophan led to increase in the total chlorophyll and carotenoids content in basil plants. Wahba *et al*. (2015) showed that application of foliar amino acids with tryptophan increased total carbohydrates of *Urtica pilulifera* plants. Khattab *et al*. (2016) reported that using glycine resulted in highest total carbohydrates contents in the produced corms of *Gladiolus grandifloras* and that tryptophan effect was less than that of glycine.

4- Effect of some amino acid on N, P and K content of gerbera plants

The concerned data in Table (5) showed that spraying gerbera plants with amino acids either alone or as amixture of (glycine, asparagine, alanine, argenine and tryptophan) increased the percentage of nitrogen (N), phosphorous (P) and potassium (K) content in leaf compared with the control during the both seasons. Also, the data showed that the treatment of mixture (T6) gave the highest values N, P and K content in leaf in both seasons as compared with other treatments. While, the control (T7) recorded the lowest values compared to plants treated with the other remaining treatments in both seasons. The obtained increase of N, P and K inside dry leaves of *Gerbera amesonii*, could be attributed to the fact that amino acids have roles in enhancing nutrient uptake by roots and their metabolism in treated plants (Hanafy *et al*., 2010). Application of amino acids led to increased total nitrogen, phosphorus and potassium content in some flowering crops such as; Abdul Qados (2010) on mung bean leaves; EL-Naggar *et al*. (2013) on Longiflorum-Asiatic lily (L.A) hybrids; Belal *et al*. (2016) on leaves of Flame seedless grapevines and Goda *et al*. (2016) on *Schefflera actinophylla*.

Table 5. Effect of some amino acids on nitrogen (N), phosphorus (P) and potassium (K) content of gerbera plant during two seasons.

Treatments		N (%)		P (%)		K (%)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
1	Glycine	2.75 b	2.80 ab	0.319 b	0.322 b	3.46 b	3.50 b
2	Asparagine	2.51 e	2.54 ab	0.293 e	0.298 de	3.08 e	3.10 e
3	Alanine	2.42 f	2.68 ab	0.291 e	0.295 e	2.97 f	3.00 f
4	Arginine	2.61 d	2.62 ab	0.302 d	0.306 cd	3.18 d	3.21 d
5	Tryptophan	2.70 c	2.72 ab	0.309 c	0.313 c	3.31 c	3.33 c
6	Mixture	2.83 a	2.88 a	0.329 a	0.332 a	3.82 a	3.84 a
7	Control	2.32 g	2.45 b	0.273 f	0.277 f	2.85 g	2.88 g
L.S.D at 5 %		0.022	0.406	0.004	0.009	0.033	0.049

*** Means with the same letter are not significantly different at P < 0.05.**

Discussion

The effect of amino acids applied on vegetative growth parameters in gerbera (*Gerbera jamesonii* L.) plant, can affect plant growth and development through their influence on gibberellins biosynthesis as has been proved by (Maxwell and Kieber, 2004). Promoting of plant growth in gerbera leaves and root fresh and dry weights /plant could be chaired by the fact that amino acids may play a role in plant metabolism and protein assimilation which is necessary for cell formation and consequently increase fresh and dry matter as made quite apparent by Walter and Nawacki, (1978). The stimulatory effect of amino acids is related to increase in content and activity of endogenous promoters such as gibberellins and indole acetic acid (IAA) which are known as plant growth promoters (Wilkins, 1989). Thus, the GA_3-induced enhancement of internode growth can be due to their effect on cell division, cell expansion or both (Callebaut *et al*. 1982). To elaborate, amino acids increase cell division as well as optimize water uptake (Chen *et al*., 2004). In confirmation, amino acids stimulate plant growth by raising the assimilation of major elements, enzyme activation and /or inhibition, changes in membrance permeability, protein synthesis and finally the activation of biomass production and suggested that their

contents might be important regulators of plant growth (Ulukan, 2008).

Using amino acids not only increase growth but also enhance yield quality and quantity. The promoting effect of amino acids on protecting plant cells from oxidation and all stresses as well as enhancing the biosynthesis of proteins, plant pigments, natural hormones such as indole acetic acid (IAA), gibberellin and ethylene. Cell division is reflected on stimulating vine nutritional status and fruiting. Also, amino acids contain both acid and basic groups which act as buffers that help to maintain favorable pH value within the plant cell (Rai, 2002). Arginine plays an important role in cell division, healing of wounds, removing ammonia from the body, immune function, and release of hormone (Stanislavov and Nikolova, 2003). It serves not only as an important nitrogen reserve and recycling, but also as a precursor of the biosynthesis of polyamines. Polyamines and nitric oxide are important messengers involved in almost all physiological and biochemical processes including regulation of DNA replication, cell division, leaf senescence, development, and adaptation of plants to environmental disturbances (Yang and Gao, 2007). Tryptophan acid plays role in stimulating the plants growth and effect on auxin synthesis.

On the basis of previous results, it can be concluded that gerbera plants sprayed with the mix treatment of amino acids at 100 ppm appeared to be most appropriate and suitable application for harvesting a good crop of flowers followed by glycine and tryptophan treatments under the conditions of this experiment.

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تأثير الرش بالأحماض الأمينية على النمو والإزهار ومواصفات جودة الجربيرا كنبات أصص

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أجري هذا البحث علي نبات الجربيرا فى الصوبة الزراعيه بمحطه بحوث البساتين بالمنصوره – مركز البحوث الزراعيه وذلك خلال موسمين زراعيين (٢٠١٦ و ٢٠١٧). تم الحصول على نباتات الجربيرا من مشتل تجاري بالمنصوره وكانت في عمر شهرومنزرعه فى اوعيه بلاستيكيه بقطر ٢٠سم. تم رش النباتات بالاحماض الامينيه والشتلات في عمر٣٠يوم ثم كل ١٤ يوم اعتبارا من٢١ فبراير وحتى ٢٧ يونيو. تهدف الدراسه الى تحسين نمو النبات والصفات الزهريه وبعض الصفات الكيماويه لنباتات الجربيرا باستخدام الرش الورقى ببعض الاحماض الامينيه (الجليسين - الاسبرجين - الالانين - الارجنين- التربتوفان ومخلوط منهم بتركيز ١٠٠ جزء في المليون) ثم معاملة المقارنة بالماء المقطر(الكونترول). يمكن تلخيص النتائج المتحصل عليها كالاتي:تأثرت صفات النموالخضري والازهار لنباتات الجربيرا بالرش بالأحماض الأمينية سواء كانت فردية أو في مخلوط حيث أعطت معاملة المخلوط من الاحماض الامينية بتركيز ١٠٠ جزء في المليون أعلى القيم بالنسبة الي الوزن الطازج والجاف للاوراق والجذور والمساحة الورقية للاوراق وللورقة الواحدة في النبات وعدد الاوراق للنبات ومحتوي النبات من الكلوروفيل (أ- ب –كلي) والنسبة المئوية للكربوهيدرات الكلية ومحتوى الاوراق من النتروجين والفوسفور والبوتاسيوم وكان أكبر قطر للزهرة (١١,٢٣ – ١١,٨٣سم) يليها معاملة الجليسين ثم التربتوفان في موسمي الزراعة علي التوالي. سجلت معاملة الجليسين زيادة معنوية في قيم طول الشمراخ الزهري وعدد الازهار للنبات (٧,٦٦ – ٨ زهرة /نبات) تليها معاملة التربتوفان ثم معاملة المخلوط خلال موسمى الدراسة علي التوالى مقارنة مع المعاملات الأخرى بينما سجلت أقل القيم بمعاملة الكنترول (ماء مقطر) فى كلا الموسمين. كانت أقل القيم تم الحصول عليها عند رش النباتات بمعاملة الكنترول (ماء مقطر) فى كلا الموسمين على التوالى. وبالتالي نوصي برش نباتات الجربيرا بمعاملة المخلوط عند ١٠٠ جزء في المليون حيث تبدو أكثر ملائمة لإعطاء محصول جيد من الازهار يليه معاملة الجليسين ثم معاملة التربتوفان تحت ظروف هذه التجربة.