Journal of Crop Nutrition Science
ISSN: 2423-7353 (Print) 2538-2470 (Online)
Vol. 6, No. 1, 2020
http://JCNS.iauahvaz.ac.ir
OPEN ACCESS

Assess Effect of Foliar Application of Seaweed Extract and Amino Acids on Morpho-physiological Characteristics of *Gerbera jamesonii* Var. Stanza Cut Flowers

Maral Tavakoli[1] and Hossein Ali Asadi-Gharneh[2]*

1- MSc. Graduated, Department of Horticulture, Faculty of Agriculture, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran.
2- Assistant Professor, Department of Horticulture, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran.

RESEARCH ARTICLE

ARTICLE INFO.
Received Date: *22 Dec. 2019*
Received in revised form: *21 Jan. 2020*
Accepted Date: *24 Feb. 2020*
Available online: *30 Mar. 2020*

To Cite This Article: Maral Tavakoli and Hossein Ali Asadi-Gharneh. Assess Effect of Foliar Application of Seaweed Extract and Amino Acids on Morphophysiological Characteristics of Gerbera jamesonii Var. Stanza Cut Flowers. ***J. Crop. Nutr. Sci.,*** 6(1): 1-11, 2020.

ABSTRACT

BACKGROUND: Biofertilizers, like amino acids, are used to reduce drought stress damage to plants and improve physiological factors, thereby increasing plant yield in arid and semi-arid regions. Seaweed extract has a beneficial effect on plant growth due to its growth hormones and elements such as iron, copper, zinc, cobalt, molybdenum, manganese and nickel, vitamins and amino acids.

OBJECTIVES: Current research was conducted to investigate the effect of foliar application of seaweed and amino acids and their interaction on the morphophysiological characteristics of cut flowers of Gerbera cultivar Stanza and determine the relationship between the use of these two substances on the quantity and quality of morphological and physiological characteristics of this plant.

METHODS: This study was done via factorial experiment based on completely randomized design with three replications along 2015 year. The treatments included amino acids (A_1: Control, A_2: 1, A_3: 1.5 and A_4: 2 gr.L^{-1}) and seaweed extract (S_1: Control, S_2: 0.25, S_3: 0.5 and S_4: 1 gr.L^{-1}).

RESULT: According to the results of the present study, it can be said that amino acid treatment at concentrations of 1.5 and 2 gr.L^{-1}, as a suitable pre-harvest treatment, has the highest production in amount of flower diameter, flowering stem diameter, flowering stem length, anthocyanin, chlorophyll b, carotenoids and leaf greenness. Seaweed extract treatment at concentrations of 0.25 and 1 gr.L^{-1}, as a suitable pre-harvest treatment, had the highest amount of flower diameter, flowering stem diameter, anthocyanin, chlorophyll b, total chlorophyll, carotenoids and leaf greenness.

CONCLUSION: Also, the simultaneous use of 2 gr.L^{-1} amino acid along with 1 gr.L^{-1} seaweed extract, had the highest amount of chlorophyll a, chlorophyll b, total chlorophyll, carotenoids and leaf greenness and it can be advised to producers. In general, the results of this study indicate that seaweed and amino acid biofertilizers can improve the quantity, quality and post-harvest life of gerbera flowers by increasing nutrient uptake and the presence of plant hormones.

KEYWORDS: *Anthocyanin, Biofertilizer, Carotenoid, Chlorophyll, Morphology.*

***Corresponding Author:** Hossein Ali Asadi-Gharneh ✉ h.asadi@khuisf.ac.ir

1. BACKGROUND

Gerbera is one of the ten most popular cut flowers around the world and its production is increasing (Ghayoor Karimiani *et al*., 2010). In Iran, the tendency to cultivate gerbera is increasing due to its beauty, color variety, long post-harvest life, high yield and short interval between harvest periods (Akbari, 2012). The emergence of economic and environmental problems due to the improper use of chemical fertilizers has caused that one of the most important and most applied fields of research in modern scientific studies is the effort to produce biofertilizers. Therefore, the use of biofertilizers is of particular importance in increasing the quantitative and qualitative yield of the crop and maintaining sustainable soil fertility (Sharma, 2003). Nutritional solutions are one of the most important factors in increasing the quantity and quality of gerbera flowers (Barakatain *et al*., 2013). Amino acids are effective on plant growth and yield by increasing resistance to environmental stresses, increasing chlorophyll concentration and thus photosynthesis (Haj Seyed Hadi *et al*., 2011). Biofertilizers, like amino acids, are used to reduce drought stress damage to plants and improve physiological factors, thereby increasing plant yield in arid and semi-arid regions (Poorabthaj *et al*., 2012). Seaweed extract has a beneficial effect on plant growth due to its growth hormones and elements such as iron, copper, zinc, cobalt, molybdenum, manganese and nickel, vitamins and amino acids (Haqparast *et al*., 2012). Its application also increases plant growth, stimulates root growth, delays aging and improves tolerance to environmental stresses such as drought, salinity and temperature, so it is used as a biofertilizer (Ludwig-Muller, 2000).

2. OBJECTIVES

The aim of this study was to investigate the effect of foliar application of seaweed and amino acids and their interaction on the morphophysiological characteristics of cut flowers of Gerbera cultivar Stanza and determine the relationship between the use of these two substances on the quantity and quality of morphological and physiological characteristics of this plant.

3. MATERIALS AND METHODS

3.1. Greenhouse and Treatments Information

This research was carried out via factorial experiment based on completely randomized design with three replications along 2015 year. Place of research was located in Research Laboratory of Islamic Azad University, Isfahan Branch (Khorasgan) in Isfahan province (Central of Iran). The treatments included Amino Acids (A_1: Control, A_2: 1, A_3: 1.5 and A_4: 2 gr.L^{-1}) and Seaweed Extract (S_1: Control, S_2: 0.25, S_3: 0.5 and S_4: 1 gr.L^{-1}). This experiment had 36 plastic pots (4L) with 20cm height.

3.2. Greenhouse Management

The gerbera cultivar used was Stanza cultivar. The planting medium was a combination of Coco peat and perlite in a ratio of 3: 1. In every spry at first the Seaweed Extract was sprayed and after amino acid was used. Spraying was done evenly on the leaves and behind the leaves.

3.3. Measured Traits

The length of the flower stem was measured in centimeters with a ruler with an accuracy of 0.1 mm, from below the under curvature to the point of attachment to the crown, in centimeters unit. The diameter of the flower stem was measured by a digital caliper with an accuracy of 0.01 mm, three times in three areas under the inflorescence, at the point junction with the crown and in the middle of the stem, after averaging; it was reported as a number in millimeters unit. The diameter of the flower was measured three times in three different directions by a ruler with an accuracy of 0.1 mm and after averaging, it was reported as a number in centimeters unit. Greenness was measured 15 days after the last foliar application with using CL-01 chlorophyll meter (SPAD). For this purpose, two leaves were selected from the middle leaves of each plant and then the amount of greenness was read in each leaf at three different points and after averaging, it was reported as a number. Lichtenthaler (1987) method was used to measure the amount of chlorophyll and carotenoids. For this purpose, 0.5 g of fresh plant leaves were poured into a mortar and pounded with 50 ml of 80% acetone and crushed well. The extract obtained from Whatman No. 2 filter paper was then passed through a funnel. Pour the resulting clear solution into a fork and refill to 20 ml with 80% acetone. The solution was then poured into a spectrophotometer and the adsorption values were read separately at 663 nm for chlorophyll a, 646 nm for chlorophyll b and 470 nm for carotenoids. Finally, the read numbers were included in the following formulas and the amount of chlorophyll a, b, total chlorophyll and carotenoids in $mg.gr^{-1}$ fresh weight of the sample was obtained.

Equ.1. $Chla. = 12.25\ A_{663.2} - 2.79\ A_{646.8}$

Equ.2. $Chlb. = 21.21\ A_{646.8} - 5.1\ A_{663.2}$

Equ.3. $Total\ Chl. = Chl_a + Chl_b$

Equ.4. $Car. = (1000 A_{470} - 1.8\ Chl_a - 85.02\ Chl_b)/198$

Wagner (1979) method was used to measure the amount of anthocyanin. For this purpose, 0.1 g of the petal tissue was thoroughly ground in a porcelain mortar with 10 ml of acidic methanol (pure methanol and pure hydrochloric acid in a volume ratio of: 1: 99) and the extract was poured into capillary test tubes and wrapped in foil. It was kept in the dark for 24 hours at a temperature of 25°C. The extract was then poured into the falcons and centrifuged at 4,000 rpm for 10 minutes, and the adsorption of the supernatant at 550 nm was read by a UV-2100 spectrophotometer. Concentration was calculated using the following formula, taking into account the extinction coefficient of 33,000 $cm.mol^{-1}$.

Equ. 5. $A = \varepsilon bc$

ε: extinction coefficient 33000 $cm.mol^{-1}$,
A: Absorption, b: The width of cell,
c: The desired solution concentration.

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via MSTAT-C software and Duncan multiple range test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. *Flowering stem length*

The results of analysis of variance showed that the effect of amino acid treatment on stem length was significant at 1% probability level, but the effect of seaweed extract and interaction effect of treatments was not significant (Table 1). The mean comparison of different level of amino acid treatments showed that the highest stem length (37.8 cm) was observed in the treatment of 1.5 $g.l^{-1}$, which was not significantly different from the treatment of 2 $g.l^{-1}$ and the lowest one (31.05 cm) was for control (Table 2). These findings were consistent with the results of Goshenizjani and Khoshkhooi (2011) on increasing the stem length of Gerbera flower (Saltino cultivar and Kiser cultivar) and Nahed *et al*. (2010) on increasing the length of the cypress branch. Amino acids accelerate the process of stem and leaf formation (Araujo *et al*., 2011). The amino acid tryptophan produces the hormone auxin, which plays an important role in cell division and elongation, so the amino acid can increase stem length (Fageria, 2009).

Table 1. Result analysis of variance of studied traits

S.O.V	df	Flowering stem length	Flowering stem diameter	Flower diameter	Leaf greenness	Chlorophyll a
Amino Acids (A)	3	94.74^{**}	0.36^{*}	1.43^{**}	388.56^{**}	0.00006^{ns}
Seaweed Extract (S)	3	26.23^{ns}	0.39^{*}	1.71^{**}	202.20^{**}	0.00015^{ns}
A × S	9	14.96^{ns}	0.18^{ns}	0.39^{ns}	21.17^{**}	0.00003^{ns}
Error	32	11.42	0.10	0.31	5.69	0.00015
CV (%)	-	9.71	4.91	5.20	8.54	16.39

$^{ns, *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 1.

S.O.V	df	Chlorophyll b	Total Chlorophyll	Carotenoids	Anthocyanin
Amino Acids (A)	3	0.00017^{**}	0.0001^{ns}	0.0026^{**}	0.016^{**}
Seaweed Extract (S)	3	0.00065^{**}	0.0008^{**}	0.009^{**}	0.0055^{**}
A × S	9	0.000082^{**}	0.00076^{**}	0.00055^{**}	0.0095^{**}
Error	32	0.00001	0.0002	0.000003	0.00079
CV (%)	-	15.09	14.38	2.13	10.73

$^{ns, *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Table 2. Mean comparison effect of different level of amino acid on studied traits

Amino acids ($gr.L^{-1}$)	Flowering stem length (cm)	Flowering stem diameter (mm)	Flower diameter (cm)	Leaf greenness (Spad value)	Chlorophyll a ($mg.gr^{-1}$)
Control	31.05 c	6.31 b	10.36 c	20.77 c	0.078 a
1	34.74 b	6.33 b	10.60 bc	26.04 b	0.073 a
1.5	37.80 a	6.68 a	11.16 a	31.95 ab	0.078 a
2	35.57 ab	6.52 ab	10.87 ab	33.04 a	0.076 a

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.

Continue Table 2.

Amino acids ($gr.L^{-1}$)	Chlorophyll b ($mg.gr^{-1}$)	Total chlorophyll ($mg.gr^{-1}$)	Carotenoids ($mg.gr^{-1}$)	Anthocyanin ($mmol.gr^{-1}$)
Control	0.021 c	0.100 a	0.095 b	0.226 c
1	0.025 b	0.104 a	0.076 c	0.291 ab
1.5	0.022 c	0.099 a	0.068 d	0.235 b
2	0.029 a	0.101 a	0.099 a	0.297 a

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.

4.2. Flowering stem diameter

Result of analysis of variance revealed effect of amino acid and seaweed extract on flowering stem diameter was significant at 5% probability level but interaction effect of treatments was not significant (Table 1). The mean comparison effect of different level of amino acid treatments showed that the highest flowering stem diameter (6.68 mm) was observed in the treatment of 1.5 $g.l^{-1}$, which was not significantly different from the treatment of 2 1.5 $g.l^{-1}$ amino acid at 5% level. The lowest amount of mentioned trait was for control (Table 2). Amino acids can increase the uptake of nitrogen, phosphorus, potassium and micro elements in both shoots and stems (Tejada and Gonzalez, 2003). So, it can be concluded that amino acids by increasing the uptake of minerals such as phosphorus and seaweed with large amounts of phosphorus led to increase stem diameter. Mean comparison different level of seaweed extract treatments revealed the highest flowering stem diameter (6.64 mm) was for control which was not significantly different from other treatments such as 0.25 and 1 $g.l^{-1}$ seaweed extract at 5% level and the lowest one (6.26 mm) belonged 0.5 $g.l^{-1}$ treatment (Table 3).

4.3. Flower diameter

According result of analysis of variance effect of amino acid and seaweed extract on flower diameter was significant at 1% probability level but interaction effect of treatments was not significant (Table 1). The mean comparison of different level of amino acid treatments indicated that the highest amount of flower diameter (11.16 cm) was observed in 1.5 $g.l^{-1}$ treatment, which was not significantly different with the treatment of 2 $g.l^{-1}$ at the level of 5% and the lowest one (36.10 cm) belonged to control treatment which was not significantly with the treatment of 1 $g.l^{-1}$ amino acid (Table 2).

Table 3. Mean comparison effect of different level of Seaweed extract on studied traits

Seaweed extract ($gr.L^{-1}$)	Flowering stem length (cm)	Flowering stem diameter (mm)	Flower diameter (cm)	Leaf Greenness (Spad value)	Chlorophyll a ($mg.gr^{-1}$)
Control	34.15 ^{a}	6.64 ^{a}	10.59 ^{b}	23.40 ^{c}	0.074 ^{a}
0.25	33.40 ^{a}	6.59 ^{a}	10.57 ^{b}	26.75 ^{b}	0.081 ^{a}
0.5	34.78 ^{a}	6.26 ^{b}	10.52 ^{b}	28.38 ^{ab}	0.073 ^{a}
1	36.84 ^{a}	6.36 ^{ab}	11.31 ^{a}	33.26 ^{a}	0.076 ^{a}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.

Continue Table 3.

Seaweed extract ($gr.L^{-1}$)	Chlorophyll b ($mg.gr^{-1}$)	Total chlorophyll ($mg.gr^{-1}$)	Carotenoids ($mg.gr^{-1}$)	Anthocyanin ($mmol.gr^{-1}$)
Control	0.014 ^{c}	0.088 ^{b}	0.054 ^{d}	0.237 ^{c}
0.25	0.025 ^{b}	0.106 ^{a}	0.074 ^{c}	0.253 ^{b}
0.5	0.028 ^{ab}	0.102 ^{ab}	0.091 ^{b}	0.277 ^{ab}
1	0.031 ^{a}	0.107 ^{a}	0.120 ^{a}	0.283 ^{a}

*Means with similar letters in each column are not significantly different by Duncan's test at 5% probability level.

As for Duncan classification made with respect to different level of seaweed extract showed that the highest amount of flower diameter (11.31 cm) was observed in the treatment of 1 $g.l^{-1}$. There was no significant difference between control and 0.25 and 0.5 $g.l^{-1}$ treatments at 5% level (Table 3). Regulatory substances in seaweed extract such as gibberellins, auxins, betaine and cytokines affect cell elongation, cell differentiation and cell division (Patil, 2015). Therefore, it can be concluded that the hormone gibberellin in seaweed has increased the diameter of the flower.

4.4. Leaf greenness

Result of analysis of variance revealed effect of amino acid, seaweed extract and interaction effect of treatments on leaf greenness was significant at 1% probability level (Table 1). Evaluation mean comparison result indicated in different level of amino acid the maximum leaf greenness (33.04) was noted for 2 $g.l^{-1}$ and minimum of that (20.77) belonged to control treatment (Table 2). Mean comparison result of different level of seaweed extract revealed that maximum leaf greenness (33.26) was noted for 1 $gr.l^{-1}$ and minimum of that (23.40) belonged to control treatment (Table 3). Assessment mean comparison result of interaction effect of treatments indicated maximum leaf greenness (39.28) was noted for 2 $gr.l^{-1}$ amino acid with 1 $gr.l^{-1}$ seaweed extract and lowest one (18.06) was related to control treatment (Fig.1).

4.5. Chlorophyll a

According result of analysis of variance effect of amino acid, seaweed extract and interaction effect of treatments on chlorophyll a was not significant (Table 1).

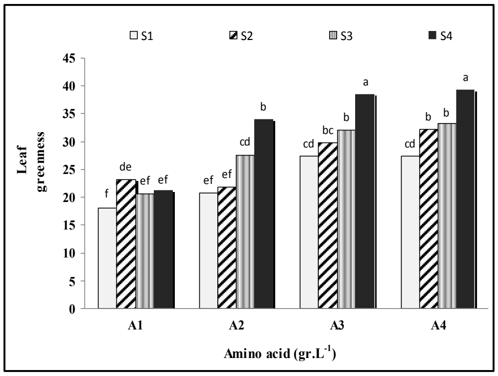

Fig. 1. Mean comparison interaction effect of treatments on leaf greenness by Duncan's test at 5% probability level.

4.6. Chlorophyll b

Result of analysis of variance revealed effect of amino acid, seaweed extract and interaction effect of treatments on chlorophyll b was significant at 1% probability level (Table 1). Mean comparison result of different level of amino acid indicated that maximum chlorophyll b (0.029 $mg.gr^{-1}$) was noted for 2 $gr.l^{-1}$ and minimum of that (0.022 $mg.gr^{-1}$) belonged to control treatment which was not significantly different with the treatment of 1.5 $g.l^{-1}$ (Table 2). As for Duncan classification made with respect to different level of seaweed extract maximum and minimum amount of chlorophyll b belonged to 1 $gr.l^{-1}$ (0.031 $mg.gr^{-1}$) and control (0.014 $mg.gr^{-1}$) (Table 3). Evaluation mean comparison result of interaction effect of treatments indicated maximum chlorophyll b (0.034 $mg.gr^{-1}$) was noted for 1 $gr.l^{-1}$ amino acid with 1 $gr.l^{-1}$ seaweed extract and lowest one (0.008 $mg.gr^{-1}$) was related to control treatment (Fig.2). Amino acids improve the quantity and quality of agricultural products by increasing the amount of chlorophyll in the plant and increasing the ratio of C to N in fruit trees, as a source of nitrogen, they are also an essential compound in the production of plant proteins and chlorophyll. Glycine and glutamic acid are two essential amino acids in the process of chlorophyll formation and increasing the amount of green tissue in plants. These amino acids increase chlorophyll synthesis and increase its concentration in plants, which increase light absorption and consequently increase photosynthesis. They also prevent the accumulation of chlorophylls in one part and direct them in a regular and organized way, so the agricultural products that are created by the direct use of amino acids are much greener and healthier (Takar, 2016).

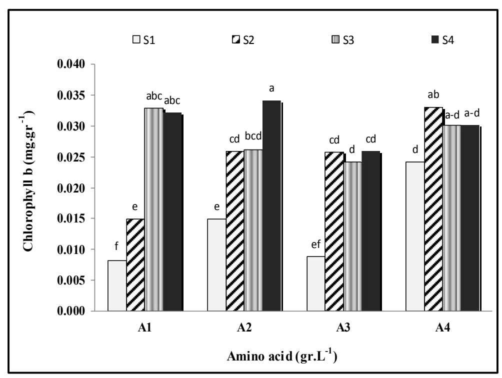

Fig. 2. Mean comparison interaction effect of treatments on chlorophyll b by Duncan's test at 5% probability level.

4.7. Total Chlorophyll

The results of analysis of variance showed that the effect of amino acid on total chlorophyll was not significant, but the effect of seaweed extract and interaction effect of treatments was significant at 1% probability level (Table 1). Mean comparison result of different level of seaweed extract revealed that maximum total chlorophyll (0.107 $mg.gr^{-1}$) was noted for 1 $gr.l^{-1}$ and minimum of that (0.88 $mg.gr^{-1}$) belonged to control treatment (Table 2). Assessment mean comparison result of interaction effect of treatments indicated maximum total chlorophyll (0.0126 $mg.gr^{-1}$) was noted for nonuse of amino acid with 0.5 $gr.l^{-1}$ seaweed extract and lowest one (0.057 $mg.gr^{-1}$) was related to control treatment (Fig.3).

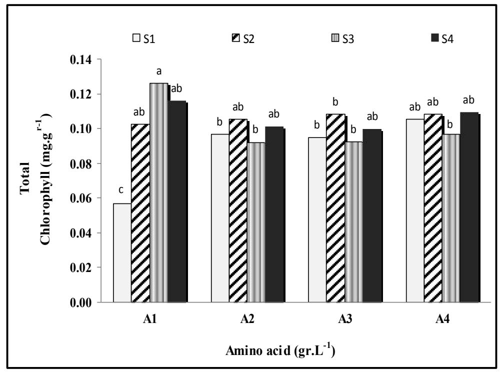

Fig. 3. Mean comparison interaction effect of treatments on total chlorophyll by Duncan's test at 5% probability level.

4.8. Carotenoids

Result of analysis of variance revealed effect of amino acid, seaweed extract and interaction effect of treatments on carotenoids was significant at 1% probability level (Table 1). Evaluation mean comparison result indicated in different level of amino acid the maximum carotenoids (0.099 $mg.gr^{-1}$) was noted for 2 $g.l^{-1}$ and minimum of that (0.068 $mg.gr^{-1}$) belonged to 1.5 $g.l^{-1}$ treatment (Table 2). Mean comparison result of different level of seaweed extract revealed that maximum carotenoids (0.120 $mg.gr^{-1}$) was noted for 1 $gr.l^{-1}$ and minimum of that (0.054 $mg.gr^{-1}$) belonged to control treatment (Table 3). Evaluation mean comparison result of interaction effect of treatments indicated maximum carotenoids (0.034 $mg.gr^{-1}$) was noted for 2 $gr.l^{-1}$ amino acid with 1 $gr.l^{-1}$ seaweed extract and lowest one (0.008 $mg.gr^{-1}$) was related to 1.5 $gr.l^{-1}$ amino acid with 0.25 $gr.l^{-1}$ seaweed extract treatment (Fig.4). Cytokinin prevents chlorophyll degradation and stimulates chloroplast maturation when exposed to light, which speeds up chlorophyll production.

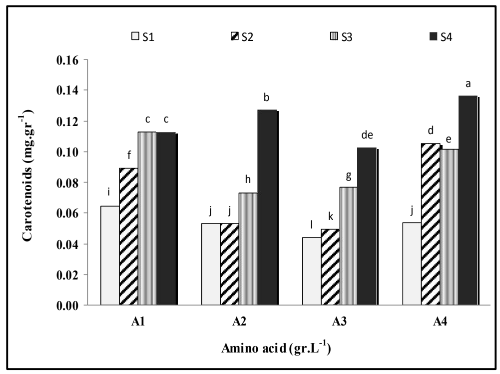

Fig. 4. Mean comparison interaction effect of treatments on carotenoids by Duncan's test at 5% probability level.

Cytokinins are also effective in maintaining and preventing the degradation of carotenoid pigments. Because seaweed contains large amounts of minerals and growth-regulating hormones, it can increase chlorophyll, carotenoids, and leaf greenness (Karami, 2011).

4.9. Anthocyanin

According result of analysis of variance effect of amino acid, seaweed extract and interaction effect of treatments on anthocyanin was significant at 1% probability level (Table 1).

Mean comparison result of different level of amino acid indicated that maximum anthocyanin (0.297 mmo.gr^{-1}) was noted for 2 gr.l^{-1} and minimum of that (0.226 mmo.gr^{-1}) belonged to control treatment which was not significantly different with the treatment of 1.5 g.l^{-1} (Table 2). Mean comparison result of different level of seaweed extract revealed that maximum anthocyanin (0.283 mmo.gr^{-1}) was noted for 1 gr.l^{-1} and minimum of that (0.237 mmo.gr^{-1}) belonged to control treatment (Table 3). Assessment mean comparison result of interaction effect of treatments indicated maximum anthocyanin (0.336 mmo.gr^{-1}) was noted for 2 gr.l^{-1} amino acid with 1 gr.l^{-1} seaweed extract and lowest one (0.217 mmo.gr^{-1}) was related to control treatment (Fig.5).

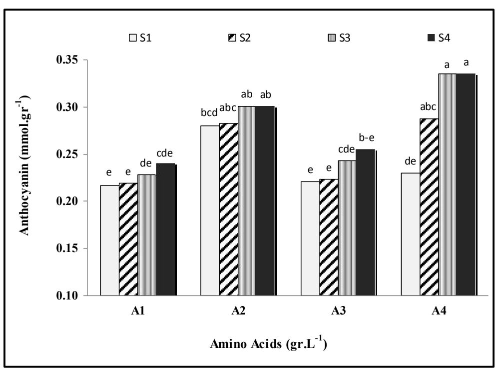

Fig. 5. Mean comparison interaction effect of treatments on Anthocyanin by Duncan's test at 5% probability level.

Anthocyanins are composed of a compound of sugar and ring compounds called anthocyanins. The formation of anthocyanins in plants is usually associated with the accumulation of sugar in the tissue, and any factor that increases the sugar content in the tissue often improves the production of anthocyanins in the tissues (Harborne and Williams, 2000). Due to the fact that amino acids improve the quality of the plant by activating the process of sugar formation and increasing the amount of protein in the plant, led to improves quality features such as color. Seaweed extracts also contain amino acids, proteins and carbohydrates and can increase their anthocyanins by increasing the sugar content in the petals (Aminpor, 2010).

5. CONCLUSION

According to the results of the present study, it can be said that amino acid treatment at concentrations of 1.5 and 2 gr.l^{-1}, as a suitable pre-harvest treatment, has the highest production in amount of flower diameter, flowering stem diameter, flowering stem length, anthocyanin, chlorophyll b, carotenoids and leaf greenness. Seaweed extract treatment at concentrations of 0.25 and 1 gr.l^{-1}, as a suitable pre-harvest treatment, had the highest amount of flower diameter, flowering stem diameter, anthocyanin, chlorophyll b, total chlorophyll, carotenoids and leaf greenness. Also, the simultaneous use of 2 gr.l^{-1} amino acid along with 1 gr.l^{-1} seaweed extract, had the highest amount of chlorophyll a, chlorophyll b, total chlorophyll, carotenoids and leaf greenness and it can be advised to producers. In general, the results of this study indicate that seaweed and amino acid biofertilizers can improve the quantity, quality and post-harvest life of gerbera flowers by increasing nutrient uptake and the presence of plant hormones.

ACKNOWLEDGMENT
The authors thank all colleagues and other participants, who took part in the study.

FOOTNOTES
AUTHORS' CONTRIBUTION: All authors are equally involved.
CONFLICT OF INTEREST: Authors declared they had no conflict of interest in current study.
FUNDING/SUPPORT: This study was done by scientific support of Department of Horticulture, Islamic Azad University, Isfahan (Khorasgan).

REFRENCES

Akbari, R. 2012. Phytochemical study of flower color in gerbera, study of staining mechanism and the role of factors affecting it. Msc. Thesis. Agri. Sci. Univ. Guilan. Iran. (Abstract in English)

Aminpor, Z. 2010. Evaluation medicinal and traditional applications of seaweed. The first Seminar on Medicinal Plants. Tehran. Iran. (Abstract in English)

Araujo, W. L., T. Tohge, K. Ishizaki, C. J. Leaver. and A. R. Fernie. 2011. Protein degradation: an alternative respiratory substrate for stressed plants. J. Trends in Plant Sci. 16: 489-498.

Barakatain, L., A. Nikbakht, N. Etemadi. and J. Khajeh Ali. 2013. Effect of source and method of silica application on some of the quantitative and physiological characteristics of *Gerbera jamesonii* L. 4(1): 39-47.

Fageria, N. K. 2009. The use of nutrients in crop plants. Boca Raton. CRC Press. USA. 430 p.

Ghayoor Karimiani, Z., A. Bagheri, M. J. Khani Kermany. and Gh. Davarynejad. 2010. Effects of TDZ and kinetin on regeneration and proliferation of Gerbera hybrid cv. Red Explosion. J. Horti. Sci. 24(2): 170-174. (Abstract in English)

Goshenizjani, N. and M. Khoshkhooi. 2011. Effect of mixed foliar application of amino acids on morphological characteristics and postharvest life of Saltino cultivar. 7th Iranian Horti. Sci Cong. Isfahan. Isfahan Univ. Tech. Sep. 5-17. Iran. (Abstract in English)

Haj Seyed Hadi, M R., M. T. Darzi; GH. Riazi, Z. Ghandehari Alavijeh. 2011. Effects of Amino acid spraying and vermicompost application on some morphological traits and flower yield of Chamomile. J. New Finding Agri. 5(2): 147-158. (Abstract in English)

Haqparast, M., S. Maliki Farahani, J. Massoud Sinki. and Q. Zaraei. 2012. Reducing the negative effects of drought stress in chickpeas with the use of humic acid and algae extract. J. Crop Prod. Environ. Stress. 4(1): 59-71.

Harborne, J. B. and Ch. A. Williams. 2000. Advances in flavonoid research since 1992. J. Phytochemistry. 55(6): 481-504.

Karami, F. 2011. Effect of foliar application of amino acids and growth hormones on physiological characteristics and postharvest life of Gerbera cultivar Saltino. 7th Iranian Horti. Sci. Cong. Isfahan Univ. Tech. Sep. 5-17. Iran. (Abstract in English)

Lichtenthaler, H. K. 1987. Chlorophylls and carotenoids: Pigments of photosynthetic biomembranes. Methods in Enzymology. 148: 350-382.

Ludwig-Muller, J. 2000. Indole-3-butyric acid in plant growth and development. Plant Growth Regulation. 2(3): 219-230.

Nahed, G., A. Abdel, A. Azza, M. Mazher. and M. M. Farahat. 2010. Response of vegetative growth and chemical constituents of *Thuja orientalis* L. plant to foliar application of different amino acids at Nubaria. J. Am. Sci. 6(3): 295-301.

Patil, A. 2015. The effect of seaweed extract and growth regulator on some physiological traits and shelf life of Gerbera cultivar Mix cultivar. Msc. Thesis. Faculty Agri. Tara Univ. 121 pp.

Poorabthaj, M., D. Habibi, F. Paknejad, F. Fazeli. and M. Davoodifard. 2012. The effect of growth-promoting bacteria and foliar application of silicic acid and amino acids on the activity of antioxidant enzymes under drought stress in barley. J. Agri. Plant Breed. 8(2): 147-160. (Abstract in English)

Sharma, A. K. 2003. Biofertilizers for sustainable agriculture. India: Agrobios. 654 pp.

Takar, R. 2016. Study of the effect of amino acid and seaweed on chlorophyll content of gerbera. Master Thesis. Faculty Agri. Sci. Univ. Panal. 111 pp.

Tejada, M. and J. L. Gonzalez. 2003. Influence of foliar fertilization with amino acids and humic acids on productivity and quality of asparagus. Biol. Agric. Hort. 21(3): 277-291.

Wagner, G. J. 1979. Content and vacuole/extra vacuole distribution of neutral sugars, free amino acids and anthocyanins in protoplast. Plant Physiol. 64: 88-93.