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Effect of Growth Medium and Calcium Nano-Fertilizer on Quality and Some Characteristics of *Gerbera* Cut Flower

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Abstract

In order to evaluate the effect of medium and spraying calcium nano-fertilizer on quality of cut gerbera flowers, an experiment was conducted as factorial in completely randomized design with 7 media and 3 calcium nano-fertilizer concentrations with 3 replications. The media included cocopeat + perlite (1:1), peat moss + perlite (1:1), mushroom compost + perlite (1:1), peat moss + cocopeat + perlite (1:1:2), mushroom compost + peat moss + perlite (1:1:2), mushroom compost + cocopeat + perlite (1:1:2) and mushroom compost alone. The concentrations of calcium nano-fertilizer were 0, 1 and 2 mgL^{-1}. Results demonstrated that different media had significant influence on flower diameter, neck flower diameter and vase life. The highest diameter of flower and neck flower were observed in peat + perlite (1:1), the highest flower fresh weight in cocopeat + mushroom compost + perlite (1:1:2) and the greatest vase life in peat + cocopeat + perlite (1:1:2) media. Calcium nano-fertilizer had a significant effect on vase life and flower quality, so that vase life was increased by enhancing the concentration of calcium nano-fertilizer. In interactions between medium and nano-calcium fertilizer, the highest flower number was observed in peat + mushroom compost + perlite (1:1:2) medium without nano-calcium fertilizer, and the greatest anthocyanin was related to peat + cocopeat + perlite (1:1:2) medium without nano-calcium fertilizer. There was no significant interaction in other traits.

Keywords: Anthocyanin, Cocopeat, Mushroom compost, Perlite, Peat moss.

INTRODUCTION

Gerbera (*Gerbera jamesonii*) belongs to Asteraceae family. It is one of the popular cut flowers in the world used for decoration of gardens and landscape. One of the most important requirements of hydroponic systems is the recognition of a suitable medium by using available and cheap materials. Gerbera is usually grown in cocopeat medium. But, this medium in Iran should be imported from other countries, resulting in the exit of foreign exchange. In addition, proper fertilization is one of the effective factors on flower quality (Karimi *et al.*, 2008).

Calcium is the most important element in increasing and keeping quality of cut flowers. Calcium in plant tissues invigorates polymeric connections between pecto-cellulose membranes, which consolidates the network of cell walls and increases the mechanical resistance in tissues (Hepler, 2005). Besides, it is one of the most important cell wall elements with an important role in pot life of the flowers. This element is relatively non-mobile and is absorbed as Ca^{2+} ion (Clarkson, 1984). Calcium cause cell membrane to stabilize and has an important role in postharvest quality and resistance to diseases. This is responsible for the stability of cell wall and cell membrane as well as cell development (Pilbeam and Morely, 2007). Given the recommendations on the reduction or elimination of chemical fertilizations, the application of nano-fertilizers has been considered because they are less harmful and more efficient.

Nano-fertilizers allow the plants to use nutrients optimally because they are released gradually (Ghahramani *et al*., 2013). In spite of the fact that plant cell walls act as a barrier against the entrance of external agents into plant cells, nano-particles can readily pass through the pores of the cell wall because of their smaller diameter. Furthermore, these particles pass through stomatal pores on leaf area and then, they are mobilized to different tissues (Nair *et al.*, 2010). Fakhri et al. (1995) evaluated the effect of three media including perlite, peat-perlite (1:1) and pumice on yield and quality of three gerbera cultivars and found that yield and flower quality were better in peat-perlite (1:1) medium but the lowest yield was obtained from pumice medium. An evaluation the effect of perlite, zeolite and the mixture of perlite + zeolite (1:1 v) on yield of gerbera showed that incorporation of zeolite to perlite significantly increased yield and quality of gerbera (Issa *et al.*, 1999). Twelve gerbera cultivars were planted in cocopeat and a mixture of cocopeat + perlite. The number of flowers in both media was equal, but flower quality was higher in the mixture of cocopeat + perlite (Baheer, 1997). Some of the most important studies on nano in ornamental plants have focused on the application of nano-silver for enhancing vase life of carnation, gerbera and rose, whose results have shown the improvement of the flower's postharvest life (Liu *et al.,* 2009). The present study was performed to reduce application of imported media, to explore the feasibility of the utilization of domestic materials, and to evaluate the interactions between media and calcium nano-fertilizer for quantitative and qualitative characteristics of gerbera.

MATERIALS AND METHODS

In order to evaluate the effect of various media and different levels of calcium nano-fertilizer (CNF) on yield of gerbera cut flower in soilless culture system, an experiment was performed as a factorial arrangement in a Completely Randomized Design with seven media and three CNF concentrations in three replications and three pots in each replication in research greenhouses of Agriculture Faculty of Islamic Azad University, Isfahan (Khorasgan) Branch. The media consisted of cocopeat + perlite (1:1), peat moss + perlite (1:1), mushroom compost + perlite (1:1), peat moss

Table 1. Chemical properties of the used media.

Medium	K (%)	P (mg kg^{-1})	pH	EC (dS m^{-1})
Cocopeat	1.00	798.37	6.6	1.24
Peat moss	0.17	546.63	6.5	0.78
Mushroom compost	2.65	862.18	7.9	2.36

Table 2. The formula of the modified Hoagland nutrient solution for gerbera flower.

Stock solution (g L-1)	**60**	**50**	**200**	**150**	**250**	**12**	**1.3**	**0.45**	**0.064**	**2**	**0.09**
Component	NH_4NO_3	$NH_4H_2PO_4$	KNO_3	$Ca(NO_3)^2$- $4H_2O$	$MgSO_4$-$7H_2O$	FeEDTA	$MnCl_2$- $4H_2O$	$ZnSO_4$-$7H_2O$	$CuSO_4$-$5H_2O$	H_3BO_3	H_2MoO_4-H_2O

Table 3. Analysis of variance of the effect of medium and calcium nano-fertilizer (CNF) and their interaction on the evaluated traits

S.o.V	**df**	**Mean Squares**							
		Flower diameter	**Flower number**	**Flower fresh weight**	**Flower neck diameter**	**Vase life**	**Stem curvature**	**Flower quality (permanently)**	**Antho-cyanin**
Medium (A)	6	1.69**	15.52***	107.51***	0.58**	4.81**	0.94**	2.41*	0.0030***
CNF (B)	2	0.48ns	1.71ns	31.17ns	0.25ns	7.11**	1.37**	3.50*	0.0006ns
AB	12	0.26ns	3.51*	15.17ns	0.22ns	0.83ns	0.17ns	0.43ns	0.0010*
Error	42	0.43	1.46	10.37	0.13	1.24	0.22	0.78	0.0005

ns, *, **, *** not significant, significant in the levels of 5, 1 and 0.1 %, respectively.

+ cocopeat + perlite (1:1:2), peat moss + mushroom compost + perlite (1:1:2), mushroom compost + cocopeat + perlite (1:1:2) and mushroom compost alone. The concentrations of CNF were 0, 1 and 2 mg L^{-1}.

After preparing the media, the tissue cultured gerbera plants having four leaves were planted in 4-liter pots and a drip irrigation system was set up for them. Protection operations including irrigation and fertilization were equally done for all experimental units. In this period, maximum day/night temperature regime was set at 27/15°C. Irrigation and fertilization were performed as fertigation system by which the modified Hoagland (Hoagland and Arnon, 1950) nutrient solution (Table 2) was applied during growing season. Depending on the temperature, irrigation was performed two or three times a day so that in each time 120 ml solution was used for each pot. Electrical conductivity of the solution was 1.4 mmos and its pH was adjusted at 5.6 by adding nitric acid. CNF with 'Khazra' commercial brand was prepared in 'Sodoor Ahrar' company, whose net calcium content was 6.6%. CNF was sprayed once seven days and totally four sprays were done pre-harvest on stems of flowers.

At the end of the experiment, the traits including flower number, flower diameter, flower neck diameter, anthocyanin content of the petals (by the procedure described in Chen *et al*., 2004), amount of stem curvature in the flower neck (10th days after harvest by using protractor), flower fresh weight (by using weighting machine 0.001 g) and vase life (the number of days from harvest until loss of commercial value; Nikbakht *et al*., 2007) were measured. The obtained data were analyzed by using SAS 9.1 software package and the means were compared by using Duncan's multiple range test (DMRT).

RESULTS

Results of analysis of variance indicated that the effect of medium treatment was significant ($p<0.01$) on flower diameter, but the effect of calcium nano-fertilizer (CNF) and interaction between them were not significant on flower diameter (Table 3). Means comparison showed that although flower diameter in peat moss + perlite medium was higher than other treatments, the difference in flower diameter in above medium was not significant between peat moss + cocopeat + perlite (1:1:2) and mushroom compost + cocopeat + perlite (1:1:2) (Table 4).

Table 4. Means comparison for the evaluated traits as influenced by substrate compounds

Substrate compounds \ Traits	Flower diameter (cm)	Flower number	Flower fresh weight (g)	Flower neck diameter (mm)	Vase life (day)	Stem curvature (score 1-5)	Flower quality (permanently) (day)	Anthocyanin (mg/g)
Cocopeat + Perlite (1:1)	10.10^{bc}	6.44^{e}	23.18^{de}	3.91^{b}	8.33^{ab}	2.21^{b}	6.06^{ab}	0.15^{b}
Peat Moss + Perlite (1:1)	11.13^{a}	10.11^{a}	28.21^{ab}	4.53^{a}	8.33^{ab}	2.21^{b}	6.06^{ab}	0.19^{a}
Mushroom compost + Perlite (1:1)	9.84^{c}	6.89^{de}	20.13^{e}	3.89^{b}	7.00^{c}	2.82^{a}	5.09^{c}	0.20^{a}
Peat Moss + Cocopeat + Perlite (1:1:2)	10.58^{ab}	9.33^{ab}	24.13^{cd}	4.41^{a}	8.44^{a}	2.16^{b}	6.14^{a}	0.18^{a}
Peat Moss + Mushroom compost + Perlite (1:1:2)	10.25^{bc}	8.89^{bc}	27.02^{bc}	4.17^{ab}	7.11^{c}	2.77^{a}	5.17^{bc}	0.19^{a}
Mushroom compost + Cocopeat + Perlite (1:1:2)	10.62^{ab}	8.67^{bc}	30.55^{a}	4.41^{a}	6.78^{c}	2.87^{a}	5.01^{c}	0.19^{a}
Mushroom compost alone	10.08^{bc}	8.00^{cd}	24.58^{cd}	4.29^{a}	7.22^{bc}	2.72^{a}	5.25^{abc}	0.19^{a}

Means in each column, having same letters have no significant difference ($P<0.05$) according to DMRT.

Regarding flower number, the results demonstrated significant interaction between media and CNF ($P<0.05$). According Fig. 1, the highest flower number was observed in the medium containing peat moss + mushroom compost + perlite (1:1:2) without spraying CNF. This treatment had no significant difference with some treatments such as peat moss + perlite (1:1) and 1 mg L^{-1} CNF.

In relation to fresh weight of flowers, the results showed the significant influence ($P<0.001$) of medium type on flower fresh weight. The effect of CNF and interaction of medium and CNF were not significant on flower fresh weight (Table 3). Means comparison indicated that flower fresh weight was higher in cocopeat + mushroom compost + perlite medium (1:1:2) than other media. This treatment had no significant difference with peat moss + perlite.

Despite the fact that the effect of medium type was significant on flower neck diameter ($P<0.001$), the effect of CNF and the interaction of two factors was not significant on this trait (Table 3). Results revealed that although flower neck diameter in peat moss + perlite medium was higher than other media, no significant difference ($P<0.05$) was observed between the media (Table 4).

According to the results of variance analysis, the effect of medium type and CNF was significant ($P<0.01$) on vase life, but there was no significant interaction between two factors (Table 3). Vase life in peat moss + cocopeat + perlite (1:1:2) medium was longer than other media, but this medium had no significant difference ($P<0.05$) with cocopeat + perlite and peat moss + perlite media (Table 4). Vase life was extended as CNF concentration was increased, so that vase life in

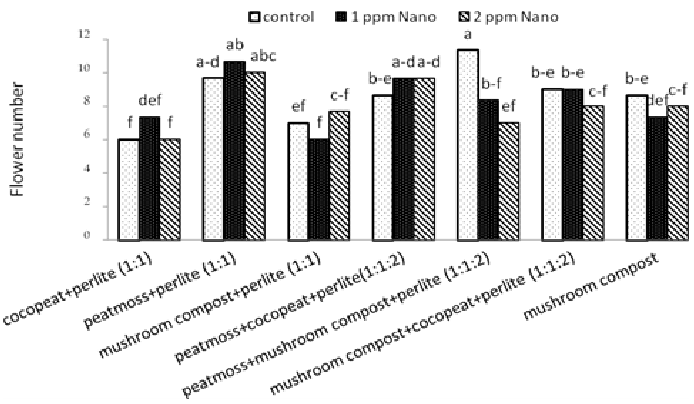

Fig. 1. Interaction between medium and CNF for flower number.

Means having same letter(s) have no significant difference ($P<0.05$) according to DMRT.

Table 5. Means comparison of vase life, stem curvature and flower quality as influenced by different concentrations of CNF.

CNF concentration (mg L^{-1})	Vase life (day)	Stem curvature (score 1-5)	Flower quality (permanently)(day)
Cocopeat	1.00	798.37	6.6
Peat moss	0.17	546.63	6.5
Mushroom compost	2.65	862.18	7.9

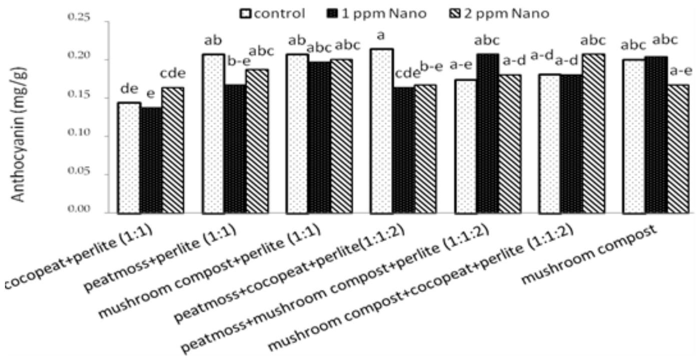

Fig. 2. Interaction between medium and CNF for anthocyanin content.
Means having same letter(s) have no significant difference (P<0.05) according to DMRT.

2 mg L^{-1} CNF was significantly higher than control and 1 mg L^{-1} CNF (Table 5).

Despite the effect of media and CNF was significant (P<0.01) on stem curvature, the interaction between them was not significant (Table 3). Stem curvature in cocopeat + perlite, peat moss + perlite and peat moss + cocopeat + perlite was significantly lower than that in other media (Table 4). Furthermore, by increasing CNF concentration, stem curvature decreased so that stem curvature in 2 mg L^{-1} CNF was significantly lower than that in control and 1 mg L^{-1} CNF (Table 5).

According to the results of variance analysis, medium and CNF had significant influence (p<0.05) on flower quality, but their interaction was not significant (Table 3). Flower quality (permanently) was higher in peat moss + cocopeat + perlite (1:1:2) than in other media. However, flower quality in this medium had no significant difference (p<0.05) with that in mushroom compost alone, cocopeat + perlite and peat moss + perlite (Table 4). Flower quality was improved by enhancing CNF concentration, so that flower quality in 2 mg L^{-1} CNF was significantly higher than that in control and 1 mg L^{-1} CNF (Table 5).

The effect of medium type was significant (P<0.001) on anthocyanin content, but the effect of CNF was not significant on this trait. Interaction between two factors was significant (P<0.05) for the anthocyanin content (Table 3). Anthocyanin content was lower in cocopeat + perlite than in other media (Table 4). Means comparison for the interaction between media and CNF showed that the highest anthocyanin was observed in peat moss + cocopeat + perlite (1:1:2) without CNF. However, in some cases it had no significant difference with other media + CNF treatments (Fig. 2).

DISCUSSION

Results showed that the medium had been a significant influence on flower diameter and flower neck diameter. The highest flower diameter and flower neck diameter was observed in peat moss + perlite medium, which could be due to the existence of organic matter and improved physical and chemical characteristics of the medium. Fakhri *et al*. (1995) evaluated yield and quality of three gerbera cultivars including Fime, Rezabla and Sunspath in perlite, peat + perlite (1:1) and pumice and obtained the highest flower diameter and the highest yield from Fime in peat + perlite, while the lowest yield and quality and the tallest stem of flower was observed in Sunspath and pumice that is consistent with Maloupa *et al*. (2001). In the present study, there was significant interaction between media and CNF in relation to flower number. The highest flower number was observed in peat moss + mushroom compost + perlite medium without CNF. Rezaee *et al.* (2010) obtained the highest rose flower number in net cocopeat or cocopeat + perlite media. Fascella and Zizzo (2005) planted five rose cultivars in net perlite and perlite + cocopeat media and obtained the highest flower number and the tallest stems from perlite + cocopeat medium. They related this finding to the enhancement of water holding and CEC in cocopeat medium.

Medium type had a significant effect on flower fresh weight. The highest flower fresh weight was observed in cocopeat + mushroom compost + perlite medium. Manzari-Tavakoli *et al.* (2014) compared different levels of media including cocopeat, perlite, peat, zeolite and vermicompost and reported that the highest flower number, flower diameter, flower neck diameter, stem length and flower fresh weight obtained in net cocopeat medium. They explained that the proper physical and chemical properties of this medium led to better uptake of water and nutrients. Because of susceptibility of gerbera to flooding and weak drainage of medium, it needs a medium with high water retention capacity and sufficient pores for root aerating (Noorani *et al.*, 2013). It is possible for this medium to supply the plant's requirement.

According to the results of the present study, the effect of media and CNF was significant ($P<0.01$) on vase life and stem curvature, but their interaction was not significant for these traits. Vase life in peat moss + cocopeat + perlite (1:1:2) medium was longer than that in other media. By enhancing CNF concentration, vase life and flower quality (permanently) were increased, so that vase life in 2 mg L^{-1} CNF was significantly higher than that in control and 1 mg L^{-1} CNF. Probability, these media provide suitable conditions for better growth of root and better absorption of water and nutrient, thereby improving postharvest life of gerbera (Manios *et al*., 1995). Manzari-Tavakoli *et al*. (2014) reported the highest vase life in net cocopeat medium and the lowest in peat + perlite (75% + 25%). Calcium has a role in delaying senescence process and enhancing cut flowers permanently by various mechanisms. Inhibitory effects of calcium on ACC-oxidase activity is among these mechanisms and its following reduction of ethylene production by petals, activity of proton pumps existing in membrane, increasing flowers fresh weight (Torre *et al*., 1999), increasing water absorption and reduction of transpiration during postharvest period. Calcium enhances tissue resistance to bacteria and fungi via controlling microbial activity in cut flowers (Nowark and Rudnicki, 1990) and increasing firmness of cell wall by making complex between cell wall and poly-galacturonic acid of middle lamella (Aguayoa *et al*., 2006). Calcium accumulation facilitates the connection between pectin polymers for raising mechanical ability of plant cell wall. Calcium leads to increase flower permanently by preventing the flower stem and its curvature to become soft (Demarty *et al.,* 1984). Nikbakht *et al.* (2007) found that during gerbera stem curvature, the cells dropped on each other and vascular bundles exited from their nature situation and the cells became irregular. Consequently, water mobilization to inflorescence was disrupted, leading to early flower senescence.

According to Chen *et al.* (2004), 10 mg/ml calcium increases water absorption, fresh weight and vase life of gerbera flower. In Ghahramani *et al*. (2013)'s study, different treatments of potassium and calcium nano chelate fertilizer improved the yield of sweet basil as compared to control. In the present study, there was significant interaction between CNF and medium for anthocyanin pigment. According to Shin *et al.* (2013), signaling of calcium between cells leads to the absorption of sugar in the cell and the accumulation and formation of anthocyanin. Calcium induced the production of phenolic components and anthocyanin joined to phenolic component in the presence of glucose, which prevented its decomposition. In a study to evaluate the effect of calcium sulphate at the rates of 0, 10 and 20 Mm on enhancing vase life of gerbera and the effect of this salt on some physiological processes of gerbera cut flowers, the results indicated that 20 Mm calcium sulphate can raise flavenoeids content as compared to control treatment (Hatamzadeh and Shafiei Masooleh, 2011).

CONCLUSION

At present, producers and growers of gerbera cut flower have no uniform and same formula for suitable culture media and whichever use a special type of medium. Therefore, to achieve a general formula for culture media, it is necessary to examine their performance. Cocopeat is usually used as the culture medium for gerbera, but it is imported from foreign countries resulting in the exit of foreign exchange from our country. Furthermore, peat moss is the most current media for ornamental flowers and plants and is used as the main material in the commercial media. High cost, scarcity and environmental concerns about the damage of peat moss mines lead to investigate for replacing this material. Likewise, the effect of calcium nano-fertilizer as suitable nutrition was considered for gerbera flower and interaction between media and calcium nano-fertilizer was evaluated on quality of the flower. Generally, different media had significant influence on flower diameter, neck flower diameter and vase life. The highest diameter of flower and neck flower were observed in peat + perlite (1:1), the highest flower fresh weight was observed in cocopeat + mushroom compost + perlite (1:1:2) and the greatest vase life was observed in peat + cocopeat + perlite (1:1:2) media. Calcium nano-fertilizer had a significant effect on vase life and flower quality so that vase life was extended as calcium nano-fertilizer concentration was increased. In interactions between medium and nano-calcium fertilizer, the highest flower number was observed in peat + mushroom compost + perlite (1:1:2) without nano-calcium fertilizer, and the greatest anthocyanin was related to peat + cocopeat + perlite (1:1:2) without nano-calcium fertilizer.

Literature Cited

Aguayoa, E., Jansasithorn, R. and Kader, A. 2006. Combined effects of l-methyl cyclopropane, calcium chloride dip, and/or atmospheric modification on quality changes in fresh cut strawberries. Postharvest Biology and Technology, 40: 269-278.

Baheer, R. 1997. Yield and postharvest quality of 12 *Gerbera* cultivars grown in two coco-peat based substrates on a hydroponic culture system. AGRIS Record. Record number: QC1999200259.

Chen, D.S., Li, N.H., Wang, J.M., Ding, Y.X. and Wang, X.J. 2004. Effect of calcium chloride on preservation of cut flowers of *Gerbera hybrida* (in Chinese). Acta Botanica Yunnanica, 26: 345-348.

Clarkson, D.T. 1984. Calcium transport between tissues and its distribution in the plant. Plant Cell Environment., 7: 449-456.

Demarty, M., Morvan, C. and Thellier, M. 1984. Calcium and the cell wall. Plant Cell Environment., 7: 441-448.

Fakhri, M., Maloupa, E. and Gerasopoulos, D. 1995. Effect of substrate and frequency of irrigation on yield and quality of three *Gerbera jamesonii* cultivars. Acta Horticultruae, 408: 41-45.

Fascella, G. and Zizzo, G.M. 2005. Effect of growing media on yield and quality of soilless cultivated rose. Acta Horticulturae, 697: 133-138.

Ghahramani, A., Akbari, K. and Yousofpour, M. 2013. Evaluation the effect of application calcium and potassium nano chelate fertilizers on quantitative and qualitative traits of sweet basil. The First National Conference of Nanotechnology Applications in Industry, Mine, Agriculture and Medicine, Karaj, Research Institute of Materials and Energy. (In Farsi)

Hatamzadeh, A. and Shafiei Masooleh, S.V. 2011. Effect of calcium sulphate on increasing gerbera vase life. 7th Iranian Horticultural Sciences Congress, Isfahan Industrial University, pp. 2399-2401. (In Farsi)

Hepler, P. 2005. Calcium: A central regulator of plant growth and development. The Plant Cell, 17:2142-2155.

Hoagland, D.R. and Arnon, D.I. 1950. The water-culture method for growing plants without soil. Circular 347. Agricultural Experiment Station, University of California, Berkeley.

Issa, M., Maloupa, E. and Gerasopoulos, L. 1999. Effect of the substrate on yield and quality of two gerbera varieties grown under protection. Cahier Option Mediterranean, 31: 365-369.

Karimi, M., Hassanpour-Asil, M., Samiezadeh-Lahiji, A. and Talesh-Sasani, S. 2008. Effects of temperature and different chemical treatments to increase life duration of Lily cut flower c.v Pica. Journal of Agricultural and National Resources Sciences and Techniques, 43: 1-9. (In Farsi)

Liu, J., He, S., Zhang, Z., Cao, J., Lv, P., Cheng, G. and Joyce, D. 2009. Nano-silver pulse treatments inhibit stem-end bacteria on cut gerbera cv. Ruikou flowres. Postharvest Biology and Technology., 54: 59-62.

Maloupa, E., Aboou-Hadid, A., Prasad, M. and Kavafakis, C. 2001. Response of cucumber and tomato to different substrates mixtures of pumice in substrate culture. Acta Horticulturae, 550: 593-599.

Manios, V.I., Papadimitriou, M.D. and Kefakis, M.D. 1995. Hydroponic culture of tomato and gerbera at different substrates. Acta Horticulturae, 408: 11-15.

Manzari-Tavakoli, M., Roosta, H. and Hamidpour, M. 2014. Selection of suitable culture medium to reduce bad effects of sodium bicarbonate on gerbera flower in soilless culture. Journal of Greenhouse Cultures Sciences and Techniques, 5(17): 39-51. (In Farsi)

Nair, R., Varghese, S., Nair, B., Maekawa, T., Yoshida, Y. and Sakthi Kumar, D. 2010. Review nano-particulate material delivery to plants. Plant Science., 179: 154-163.

Nikbakht, A., Kafi, M., Babalar, M., Etemadi, N., Ebrahimzadeh, H. and Shiai, P. 2007. Effect of humic acid on absorption of calcium in postharvest physiological manner of gerbera. Journal of Iranian Horticultural Sciences and Techniques, 8(14): 237-248. (In Farsi)

Noorani, S.H., Kafi, M. and Mahboub Khamami, A. 2013. Effect of date palm wastes compost as alternative for peat on growing of *Dieffenbachia amoena.* Journal of Greenhouse Cultures Sciences and Techniques, 4(15): 89-99. (In Farsi)

Nowark, J. and Rudnicki, R.M. 1990. Postharvest handling and storage of cut flowers, florist, greens and potted plants. Timber Press, Inc., 199 p.

Pilbeam, D.J. and Morely, P.S. 2007. Calcium. p. 121-144. *In*: A.V. Barker and D.J. Pilbeam (eds.). Handbook of Plant Nutrition, CRC Press, New York, NY.

Rezaee, A. 2010. Effect of different media on yield and quality of rose cut flower in greenhouse. Horticultural M.Sc Thesis, Isfahan Industrial University, 74 p. (In Farsi)

Shin, D.H., Choi, M.G., Lee, H.K., Cho, M., Ohoi, S.B. and Choi, G. 2013. Calcium dependent sucrose uptake links sugar signaling to anthocyanin biosynthesis in *Arabidopsis.* Biochemistry and Biophysics Research Community, 430: 634-639.

Torre, S., Borochov, A. and Halevy, A. 1999. Calcium regulation of senescence in rose plants. Plant Physiology, 107: 214-219.

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