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Assessment of GA_3 and BA application on gerbera cultivation in soilless culture

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Abstract

This research was carried out to determine the effect of gibberellic acid (GA_3) and benzyladenine (BA) application on yield and quality components (multiplication ratio, flower stem length, flower diameter, vase life, flower stem diameter,) of gerbera. Three different levels of GA_3 (125, 250, 500 ppm) and BA (100, 200, 400 ppm) were applied by foliar spray. Compared to BA application, GA_3 applications gave good results on yield and quality parameters. The maximum yield was obtained by 125 ppm of GA_3 application. It was found that 500 ppm of GA_3 application most effective on stem length and flower diameter. On the other hand, it's determined that 400 ppm BA application significantly increased stem diameter and multiplication ratio. Its concluded that, the GA_3 and BA demonstration interference in growth characteristics of gerbera plant.

Keywords: Gerbera, Soilless culture, Growth regulators, Giberellic acid, Flower quality

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Introduction

Although there are several problems like production and marketing in cut flower industry in Turkey, cut flower sector is important agricultural sector which is still developing. In 2015, the area of cut flower production was 11 046 da in Turkey and 4 333 da in Antalya. The cut flower varieties mostly grown in Antalya are standard and spray carnation, gerbera, rose, gypsophila and solidago. Gerbera production area has reached 1131 da in 2015 (Kazaz et al., 2015).

The main problem in gerbera production is obtaining production materials of good quality in Turkey. The growers depend on foreign materials. To increase the yield and quality in gerbera production, plant growth regulators are used although is not very common (Kaya et al. 2004). To meet the demand of high value cut flower crop of gerbera, it is necessary to enhance the production both in quantitative and qualitative aspects. To overcome the factors limiting the growth and yield to harness maximum profit, growth regulators are used in plant cultivation. Patra et al. (2015) reported that using plant growth regulators in cultivation encourage flowering to get maximum yield. There are several research on the plant growth regulators on cut flower in Turkey.

Sogut and Kucuk (1998) reported that GA_3 applications consisted of *Rosa* sp. (5 mg L^{-1}), *Dianthus caryophylus* (1000 ppm), *Anthurium* (125-500 ppm) and *Chrysanthemum* (3000+2000+500 ppm)-(500+500+2000 ppm) enhanced shoot development whereas GA_3 applications consisted of *Rosa* sp. (100 mg L^{-1}) and *Gypsophila* (250 mg L^{-1}) encouraged flowering.

Kewte and Sable (1997) investigated the effects of GA_3 (100, 200, 300 ppm), and different nutrient elements (N, P, K, Mg, Mn, Fe, B), Na (100 ppm) and % 0.5 triacontanol applications on quality parameters and vase life on Paradise rose variety. The best result was obtained 300 ppm of GA_3 application.

Seker and Sujata (2001) investigated the coir media (coir pith + garden soil + farmyard manure), sawdust media (sawdust + garden soil + farmyard manure), commercial mixture (sand + red soil + farmyard manure), sand media (sand + farmyard manure) and red soil media (red soil + farmyard manure), and sprayed with GA at the dose of 100, 150 and 200 ppm and water (control) on *Gerbera jamesonii* cv. Mammut. GA was applied twice at monthly intervals starting after 90 days planting. The peak number of flower per plant was achieved 200 ppm of GA treatment. The treatment combination consisted of GA at 200 ppm and coir pith media were given the highest yield and quality whereas coir pith media was given the longest vase life.

El-Shafie et al. (1980), applied four spray applications of GA at 50, 100, 150 or 200 ppm and two applications of chlormequat at 500 and 700 ppm at monthly intervals to *Gerbera jamesonii*. Early flowering, number of flowers, flower diameter and flower stem length was promoted by low concentrations of GA, whereas chlormequat delayed flowering. The number of flowers was increased by GA at 100 ppm during the first season and at 100, 150 and 200 ppm in the second one.

Farina et al. (1989) studied GA_3 applications on three gerbera variety cultivated in a low temperature of 12ºC for winter season. They concluded that application at 100 ppm

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of GA_3 from November to February in monthly increase of yield in winter season and give lower yield in the following production season. Different GA_3 levels did not effect on peduncle length but plant regulators levels increased the inflorescence diameter. However, they stated that more research is required to determine the effect of plant variety and growth regulator levels.

Nair et al. (2002) investigated the effect three different levels of gibberellic acid, chlorocholine chloride, malichydrazide and ethepton (50, 100, 150 ppm of GA_3; 400, 600, 800 ppm of CCC; 250, 500, 750 ppm of MH; and 4, 6, 8 ppm of ethepton) on *Gerbera jamesonii* cv. Versace. All treatments were sprayed monthly from January to May (1998-2001) starting from two months after planting. Using 100 ppm of gibberellic acid gave the maximum plant spread and the highest leaf number and suckers and leaf area. While the GA at 100 ppm produced the highest flower number per pot (20.73) in first year, the highest flower number was obtained 100, 150 and 50 ppm GA in second year respectively. The largest flower diameter and vase life were obtained 800 ppm CCC treatments in both years whereas the largest flower stalks were obtained 150 ppm of GA treatments. The highest benefit cost ratio in both years was attributed to 100 ppm GA. In another study, plants of the gerbera cultivars Amber and Quenn Rebecca, raised in vitro, were potted in May and grown under glass in natural photoperiods. Half were sprayed with GA_3 at 50, 100, 200 or 500 mg L^{-1} at seven, fourteen or twenty-one days' intervals. Control plants were sprayed with tap water. Application of 200-500 gL^{-1} GA_3 in variety of *Gerbera jamesonii* cv. Amber raised in flower stem length but had no such effect on *Gerbera jamesonii* cv. Quenn Rebecca. Gibberallic acid application increased inflorescence size, but treatments were reduced vase life in both varieties. The cut flower yield was unaffected by any GA_3 treatment (Pobudkiewicz and Nowak 1992). There is limited literature on the application of BA which is used in this study. Sogut and Kucuk (1998) reported that 250 mgL^{-1} of BA and 500-1000 ppm of BA increased shoot developing on *rosa* spp. and *anthurium* respectively. The applications increased vase life of *dianthus* spp. BA is used in vitro culture nowadays.

This study was carried out to assessment the effects of GA_3 and BA application on yield, quality and multiplication ratio on *Gerbera jamesonii* cv. Sangria planted at glasshouse under Mediterranean conditions.

Materials and Methods

This study was carried out a glass greenhouse located at the Batı Akdeniz Agricultural Research Institute of Antalya, Turkey between 2003-2005. The plant of the Gerbera cultivar Sangria, raised in vitro, was obtained from Florist Firm. This variety has a red color, stem diameter is 11-13 cm, stem length is 65 cm and vase life is 10-12 days according to the catalog data. Yield is about 120-140 per square meter.

The research was designed according to randomized blocks; each treatment had 10 plants and was replicated three times. Rigid plastic black tubes which have 11 m length and 25 cm width 30 cm depth were used in the study. Turf and volcanic tuff (1:1) were used as growing media pH was determined as 7.31 and EC was 510 micromhos respectively.

After the seedlings sunk the funguses, gerbera seedlings were planted on 18 June 2003 in 30x30 cm intervals and each tube have 72 seedlings. To facilitate adaptation of the plants sprinkler irrigation was used in the first month of the study. After that drip irrigation system was located as one dripper for each plant. The nutritional program was made after two weeks planting date. Nutrient solution and their amounts which were used in the researc are given in Table 1.

Table 1. Nutrient elements and quantity used in research

Nutrient	Concentration
NO_3	11.25 mmol L^{-1}
H_2PO_4	1.25 mmol L^{-1}
SO_4	1.25 mmol L^{-1}
NH_4	1.50 mmol L^{-1}
K	5.50 mmol L^{-1}
Ca	3.00 mmol L^{-1}
Mg	1.00 mmol L^{-1}
Fe	35.00 µmol L^{-1}
Mn	5.00 µmol L^{-1}
Zn	4.00 µmol L^{-1}
B	30.0 µmol L^{-1}
Cu	0.75 µmol L^{-1}
Mo	0.50 µmol L^{-1}

The plants were treated against fungal diseases and insects periodically; old and diseased leaves were picked during the study. Greenhouse temperature and humidity were measured via thermo hygrograph.

Three different GA_3 (125, 250, 500 ppm) and BA levels (100, 200, 400 ppm) were applied by foliar spray once a month between October, 2003 and March, 2005. Application doses and dates were determined depending on literature like Farina et al. (1989); Pobudkiewicz and Nowak (1992) and taking production period in Antalya into consideration.

At the end of the study, multiplication ratio (number), flower stem diameter (mm), flower stem length (cm), flower diameter (cm), yield (number $plot^{-1}$), and vase life (day) were determined. Data were subjected to variance analysis and the significance of the differences across means were defined using Duncan's multiple range tests at significance level of p=0.05 (Gomez and Gomez, 1984).

Results and Discussion

The first flowers harvested in 20 September 2003. Because the GA_3 and BA application were started in 01 October 2003, first flowers were not evaluated. Data which is related to study were obtained between 20 October 2003-30 April 2004 in the first year and 20 October 2004-30 April 2005 in the second year of the experiment. Multiplication ratio (number) was determined only second year of the experiment.

The main goal of the gerbera production is to get best export quality flowers in winter months. In these months, the low air and soilless culture temperature, the negatively affect yield and quality in gerbera production (Rogers and Tjia, 1990; Korkut, 1998; Gürsan, 2000; Mercurio, 2002). These negative effects are more pronounced as the plant is getting older (Özzambak, 2004).

The variance analyzes results are presented in Table 2. The effects of different growth regulators levels were statistically significant on the gerbera yield and quality parameters such as flower stem length (cm), flower stem diameter (mm), flower diameter (cm), vase life (day) and multiplication ratio (number). Each plant growth regulators application formed a group in Duncan test (P0.05). Yield an quality parameters values of gerbera are given Figure 1, 2, 3, 4, 5.

Table 2. Variance analyzes results of study

Source of variation	d.f.	Characteristics (variable)					
		Yield (number plot^{-1})	Flower stem length (cm)	Flower stem diameter (mm)	Flower diameter (cm)	Vase life (day)	Multiplication rate (number)
Replication	2						
Treatments (T)	6	**	**	**	**	*	**
Error (T)	5						
Total	17						

*, **, significant at $P< 0.05$, and 0.01, respectively.

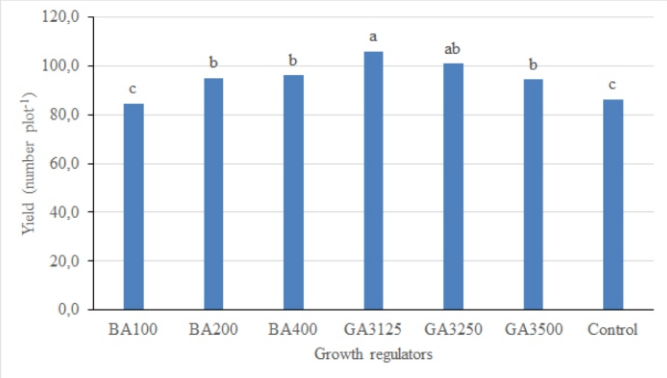

Figure 1. The effects of different GA_3 and BA treatments on yield

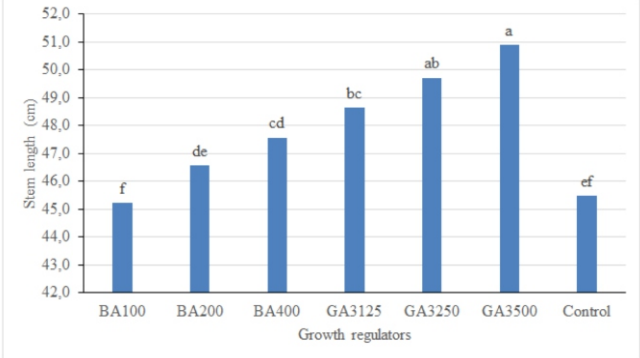

Figure 2. The effects of different GA_3 and BA treatments on stem length

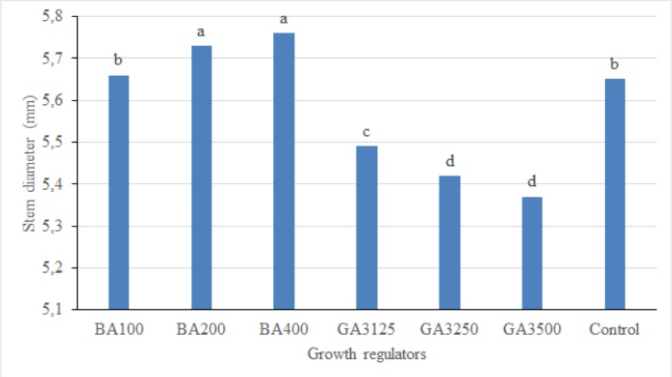

Figure 3. The effects of different GA_3 and BA treatments on stem diameter

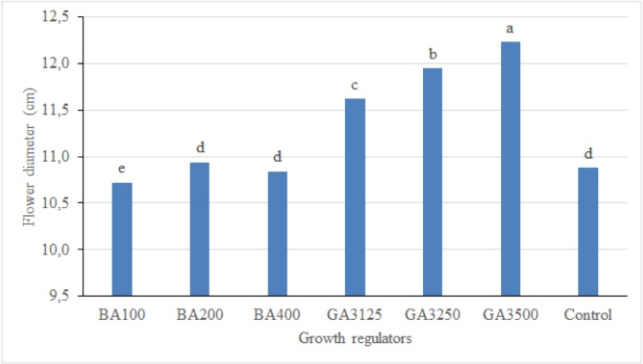

Figure 4. The effects of different GA_3 and BA treatments on flower diameter

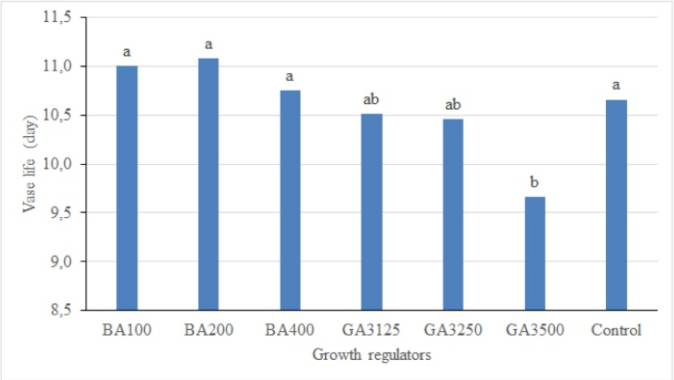

Figure 5. The effects of different GA_3 and BA treatments on vase life

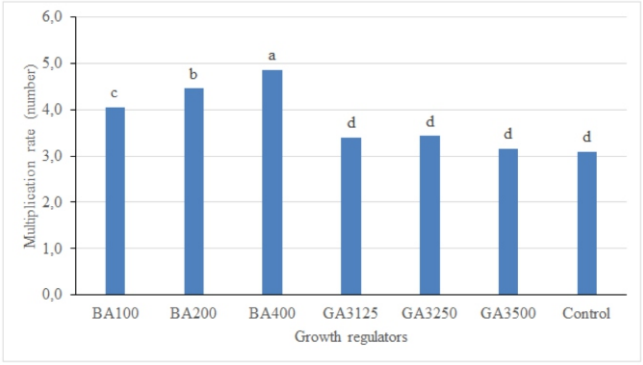

Figure 6. The effects of different GA_3 and BA treatments on multiplication rate

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Application of gibberellin and benzyl adenine growth regulators as two effective and important chemical factors in gaining of more yield in flower production. The highest yield (106 number plot^{-1}) was obtained in 125 ppm of GA_3 and this was followed by 250 ppm of GA_3. No differences were detected between 100 ppm of BA application and control application while 200 ppm and 400 ppm applications increased yield (Figure 1). GA_3 encouraged promotion of flowering which due to increased synthesis as well as translocation of growth and flowering hormone. Chauhan et al. (2014) and Patra et al. (2015) stated that yield, flower stem length, flower stem thickness and vase life increased when level of 100 ppm GA_3 were applied in gerbera production.

These results are in accord with Hertogh and Nard (1993) in zantedeschia, Bhattacharya (1993) in lilium and Nair et al. (2002) in *Gerbera jamessonii* cv. Versace.

The longest flower stem length was obtained 500 ppm of GA_3 treatments which is followed by 250 and 125 ppm of GA_3, BA treatments and control (Figure 2). The highest flower stem diameter was obtained in 400 ppm and 200 ppm of BA treatments. GA_3 treatments were reduced vase life (Figure 3). Patra et al. (2014) concluded that application of GA_3 may possibly successfully impact the growth and flowering performance of the gerbera and rise in the concentration of GA_3 from 25 to 100 ppm increase the stem length and stem diameter. Pobudkiewicz and Nowak (1992), stated that application of GA_3 (500 ppm) and application of BA (400 ppm) increased the flower stem length in the 'Amber' gerbera variety. Salem et al. (2016) concluded that application of 150 ppm GA_3 increased the per plant yield, flower diameter, flower stem thickness and flower stem diameter in gerbera production.

Flower diameter that is one of the most vital quality criteria was affected by plant growth regulators statistically. It has been determined that all GA_3 applications gave best results compared to the BA applications and control in terms of flower diameter in the study. As shown in Figure 4, all GA_3 treatments affected flower diameter compared to BA and control treatments. These results obtained from 125, 250 and 500 ppm of GA_3 treatments are in harmony with Farina et al. (1989). While GA_3 treatments were reduced the flower stem diameter, BA treatments were increased flower stem diameter.

The largest vase life was obtained 200 ppm of BA (11.08 day) (Figure 5). Pobudkiewicz and Nowak (1992) stated that the peduncles of *Gerbera jamesonii* cv. Amber was influenced the GA_3 application, while did not effect on cv. Queen Rebecca. In this study, GA_3 increased the inflorescences diameter, while shortened vase life.

Compared to control plants, the finding of larger flower diameters in GA_3 applications at 500, 250 and 125 ppm doses were obtained. Farina et al. (1989) found that GA_3 application increased flower size. When the effects of the applications on the flower stem thickness were examined, it was determined that GA_3 doses decreased flower stem thickness according to the control and BA applications had an impressive effect. The thickest flower stalk was obtained with an application of 400 ppm of BA with 5.76 mm. Sujatha et al. (2002) reported that GA_3 treatments (100 ppm) from January to May showed best results in terms of flower size in gerbera at monthly interval

The application of BA at 400 ppm showed the best results for the promotion of multiplication ratio of this gerbera variety in this study. The highest multiplication ratio was obtained 400 ppm of BA and this was followed by 200 and 100 ppm of BA. GA_3 treatments did not affect multiplication ratio (Figure 6). The use of concentrations higher than 125 ppm of GA_3 did not increase the multiplication ratio. Chauhan et al. (2014) stated that application of 100 ppm GA_3 at performed better for flower stalk thickness, flowering span, stem length, number of ray florets per flower, yield, regeneration ratio and fresh and dry weight.

Conclusion

According to the results obtained in this study, it was determined that the plant growth regulators applied had effects on all parameters of yield and quality. The maximum yield was found in 125 ppm of GA_3. The highest quality characteristics like stem length and flower diameter were obtained from 500 ppm of GA_3 and this was followed by 250 and 125 ppm of GA_3 whereas the highest multiplication ratio was obtained 400 ppm of BA. GA_3 treatments were reduced vase life. According to the result obtained from the research, it is recommended that *Gerbera jamesonii* cv. Sangria should be treated 125 ppm of GA_3 to get the highest yield. On the contrary, it can be treated as much as 500 and 250 ppm of GA_3 respectively, to get the highest flower diameter and flower stem length. Additionally, it is reported that the GA_3 should be used when the gerbera growth in winter in the glasshouse.

References

Bhattacharjee, S.K. (1993). Studies on the effect of gibberellic acid on growth, flowering, flower quality and postharvest life of Rosa hybrid cv. Raktagandha. Indian Rose Annual, 11:77-83

Chauhan, R.V., Kava, K.P., Babariya, V.J., Pansuria, P.B., Savaliya, A.B. (2014). Effect of gibberellic acid on flowering and cut flower yield in gerbera under protected condition. Asian Journal of Horticulture 9(2): 404-407. [CrossRef] [Google Scholar] [CABI]

El-Shafie, S.A., Hassan, H.A. (1980). Effect of gibberellic acid and clormequat on the growth and flowering of gerbera. Horticultural Abstracts 50(1):43.

Farina, E., Paterniani, T., Volpi, L. (1989). Effect of GA_3 treatments on flowering of gerbera grown for winter production. Acta Horticulturae 246:159-166. [CrossRef] [Google Scholar]

Gomez, K.A., Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. An Int. Rice Res. Inst. Book. John Wiley and Sons, Inc. New York, 680 p. [Google Scholar]

Gürsan, K. (2002). Gerbera Yetiştirme Tekniği. Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü, Yalova, 11 s. (in Turkish).

Hertogh, D., Nard, L.M. (1993). Physiology of Flowering Bulbs, Elsevier, Amsterdam, The Netherlands.

Kaya, A., Karagüzel, Ö., Aydinşakir, K., Arı, E., Özçelik, A. (2004). Pink elegance gerbera (*Gerbera jamessonii*) çeşidinde GA_3 ve BA uygulamalarının kış verimi ve kalitesi üzerine etkileri. Derim 21(2):35-39. (in Turkish). [Google Scholar]

Kazaz, S., Erken, K., Karagüzel, Ö., Alp, Ş., Öztürk, M., Kaya, A.S., Gülbağ, F., Temel, M., Erken, S., Saraç, Y.İ., Elinç, Z., Salman, A., Hocagil, M. (2015). Süs Bitkileri Üretiminde Değişimler ve Yeni Arayışlar. TMMOB Ziraat Mühendisleri Odası Türkiye Ziraat Mühendisliği

VIII. Teknik Kongresi, Bildiriler Kitabı-1, s: 645-672. 12-16 Ocak, Ankara. (in Turkish).

Kewte, M., Sable, A.S. (1997). Influence of growth regulators and foliar nutrients on vase life, grading and economics of rose cv. paradise. Journal of Soils of Crops 7(1):96-98.

Korkut, A.B. (1998). Çiçek Yetiştiriciliği. Hasad Yayıncılık Ltd. Şti. İstanbul, 222 s. (in Turkish).

Mercurio, G. (2002). Gerbera Cultivation in Greenhouse. First Ed. October 2002, Italy, 201 p.

Nair, S.A., Sharma, T.V.R.S., Singh, V. (2002). Effect of plant growth regulators on yield and quality of gerbera under bay island condition. Indian Journal of Horticulture 59(1):100-105. [Google Scholar]

Özzambak, E. (2004). Serada Topraksız Gerbara Yetiştiriciliği. İzmir Ticaret Odası. Yayın No:140, İzmir, 65 s. (in Turkish).

Patra, S.K., Beura, S., Shasani, T. (2015). Efficacy of GA3 on growth and flowering regulation of in vitro raised hybrid gerbera under shade net. Agricultural Science Digest 35(3): 173-177. [Google Scholar]

Pobudkiewicz, A., Nowak, J. (1992). The effects of giberellic acid on growth and flowering of *gerbera jamesonii* bolus. Folia-Horticulturae. 4(2):35-42. [Google Scholar]

Rogers ,M.N., Tjia, B.O. (1990). Gerbera Production. Timber Press, Inc. ISBN 0-88192-172-6, Hong Kong, 109 p. [Google Scholar]

Salem, R.A.A., Saravanan, S., Prasad, V.M. (2016). Effect of benzyl adenine on growth, yield and flowers of gerbera (*Gerbera jamesonii*). International Journal of Engineering Sciences & Research Technology, 5(3), 108–114. [CrossRef]

Sekar, K., Sujata, A. (2001). Effects of growing media and ga_3 on growth and flowering of gerbera (*gerbera jamesonii* h. bolus.) under naturally ventilated greenhouse. Proceedings of a National Seminar, South-Indian-Horticulture 49: 338-341.

Sogut, Z., Kucuk, R. (1998). Süs bitkileri yetiştiriciliğinde büyüme düzenleyicilerinin kullanımı. Türkiye 1. Ulusal Süs Bitkileri Kongresi, Ekim 1998, 6-9 Ekim, Yalova, s:369-375. (in Turkish).

Sujatha, A., Nair, I., Singh, V., Sharma, T.V.R.S. (2002). Effect of plant growth regulators on yield and quality of gerbera under Bay Island conditions. Indian Journal of Horticulture 59 (1): 100-105. [Google Scholar]