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Effect of pre-harvest application of bio-stimulants on post-harvest quality and longevity of cut foliage of dracaena (*Dracaena reflexa* Lam.) under different growing conditions

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Abstract
The experiment was conducted on the effect of pre harvest application of bio-stimulants on post- harvest quality and longevity of cut foliage of Dracaena (*Dracaena reflexa* Lam.) under different growing conditions at College of Horticulture, Rajendranagar, SKLTSHU, Hyderabad during the year 2022. The experiment was laid out in FCRD with three replications and fourteen treatment combinations. Among the different treatment combinations evaluated, dracaena plants treated with Arka microbial consortium @ 4 g/pot (B_4) recorded significantly maximum shoot length, number of leaves per plant under 50% UV stabilized shade net condition at 30 & 60 days after application when compared to control. However, application of humic acid @ 4 ml/pot in *Dracaena reflexa* Lam. was found to be best treatment for improving the vase life (17 days) and has also recorded maximum chlorophyll content and visual scoring under shade net condition.

Keywords: Bio-stimulants, shade net, AMC, humic acid

Introduction
The term "cut foliage ’or “cut greens” refers to all cultivated or non-cultivated foliage that is cut from growing plants and used for decorative purposes. Cut greens are important components of the floriculture industry, which are mostly used as fillers in floral compositions for decoration. They add freshness, color, and variety to arrangements and bouquets (Pacifici *et al.*, 2007) [9].

In recent years, the cut foliage industry has made a breakthrough in the floriculture business. The majority of the foliage plants are native to tropical and subtropical regions. Cut greens are used extensively for decoration, either alone or in association with flowers in bouquets. It is becoming more popular as a result of the diversification of flower and nursery production costs in comparison to flower production. As a result, there is always an increasing demand for fresh foliage in the flower market. The Netherlands is the world’s largest exporter (33%) as well as the largest importer of (19%) cut greens. Dracaena (*Dracaena reflexa* lam.) a popular ornamental foliage plant is valued and cultivated mainly for its richly variegated leaves. It is widely used in landscaping purposes as well as a household plant. It is commonly referred to as the ‘Song of India’. It belongs to the family Asparagaceae. With increased demand for flowers and foliage in event management and decorations, attractive greens play a vital role in making decorations, completely fuelling the demand for greenery. The quality of the foliage and the increase in vase life characteristics are essential in any economically important cut foliage.

In recent times there is increased usage of bio-stimulants in floriculture because they have been found to reduce the need for fertilizers and increase plant growth, and impart resistance to water and abiotic stresses, thereby favouring the good performance of the plant’s vital processes and allowing high yields and good quality produce. Bio-stimulants are biological products that increase plant productivity due to novel or emergent properties of the complex constituents. Arka microbial consortium is a carrier-based product that combines N fixing, P and Zn solubilizing, plant growth promoting microbes in a single formulation. (Aswathi *et al.*, 2020) [3]. Humic substances-based bio-stimulants are known as vigorous growth bio-stimulant and they are a nutritive means of protecting various crop plants from environmental

stresses. Arbuscular mycorrhizal (AM) fungi are common in all soils and colonize the roots of many plant species. The most well -known benefit of inoculating arbuscular mycorrhizal (AM) fungi is increased plant growth (Ikiz *et al.*, 2009) [6] and crop yield (Dasgan *et al.*, 2008) [4]. AM fungi stimulates growth regulating substances, photosynthesis, improving osmotic adjustment under drought and salinity stresses, and increases pest resistance (Al-Karaki, 2006) [2]. This experiment was undertaken to study the effect of bio-stimulants on quality and vase life of cut foliage of Dracaena (*Dracaena reflexa* Lam.).

Material and Methods

The experiment was carried out at college of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Ranga Reddy district of Telangana during Rabi season of 2022. The experiment was laid out in factorial completely randomized design consisted of 14 treatments with three replications viz., T_1: shade net condition AMF/VAM @2 g/pot, T_2: shade net condition AMF/VAM @ 4 g/pot, T_3: shade net condition AMC @ 2 g/pot, T_4: shade net condition AMC@ 4 g/pot, T_5 : shade net condition humic acid @ 3 ml/pot, T_6 : shade net condition humic acid @ 4 ml/pot, T_7 : open conditions AMF/VAM @ 2 g/pot, T_8 : open conditions AMF/VAM @ 4 g/pot, T_9 : open conditions AMC @ 2 g/pot, T_{10} : open conditions AMC @ 4 g/pot, T_{11} : open conditions humic acid @ 3 ml/pot, T_{12} : open conditions humic acid @ 4 ml/pot, T_{13} : shade net condition control (distilled water), T_{14}: open conditions control (distilled water).The preharvest application of bio-stimulants was done on potted plants of dracaena at 30 and 60 days interval and observations were taken on growth and vase life of cut foliage shoots of dracaena such as shoot length (cm), number of leaves per plant, chlorophyll content (SPAD value), Vase life (days) and visual scoring of cut foliage shoots.

Visual score

The cut foliage quality is determined visually on the following scale:

a. Fresh appearance/no blemish = 4
b. Slight loss in freshness/slight yellowing = 3
c. Moderate loss of freshness/moderate yellowing = 2
d. Severe loss of freshness/severe yellowing =1

Results and Discussion

Shoot length (cm)

The mean data on the length of the shoot (cm) of dracaena as influenced by the pre-harvest application of bio-stimulants and growing conditions at 30, and 60 days after the application (Table 1) showed that the interaction effect of growth conditions and bio-stimulants (GxB) was significant on shoot length. The maximum length of the shoots (cm) was recorded in T_4 *i.e.*, AMC @ 4 g/pot (38.20 cm and 46.36 cm) shade net condition where as minimum length of the shoots (cm) was recorded in T_{14} *i.e.*, control under open conditions (24.67 cm and 26.67 cm) at 30 and 60 days after treatment respectively.

The increase in shoot length with application of AMC@ 4 g/pot was a result of the plant growth promoting bacteria in AMC which might have greatly boosted the cell division and nitrogen fixation and phosphorus and zinc solubilizers might have assisted in the more nutrient absorption from soil. These results are in conformity with the findings of Airadevi (2010) [1] and Pandey *et al.* (2010) [10] as reported in chrysanthemum.

Number of leaves per plant

The number of leaves per plant of dracaena as influenced by the pre-harvest application of bio-stimulants and growing conditions at 30 and 60 days after the application (Table 2) shows that there was a significant interaction effect of growth conditions and bio-stimulants (GxB) on the number of leaves per plant. The maximum number of leaves per plant was recorded in T_4 *i.e.*, application of AMC @ 4 g/pot (44.44 and 54.63) under 50% shadenet while the minimum number of leaves per plant was recorded in T_{14} *i.e.*, control (distilled water) under open conditions (25.67 and 29.11) at 30 and 60 days after application respectively.

The application of bio-stimulant AMC @ 4 g/pot resulted in the greatest number of leaves in this study. The Arka microbial consortium (AMC) aid in nitrogen fixation and phosphorus, zinc solubilizing via nitrogen-fixing, phosphorus and zinc solubilization bacteria respectively. The increase in vegetative growth of the plants may be due to a higher nitrogen intake with the aid of nitrogen-fixing bacteria. Similar findings were reported by Jayashree *et al*. (2016) [7] in brinjal.

Vase life (days)

The data furnished on vase life (days) of dracaena as influenced by the pre-harvest application of bio stimulants and growing conditions at 30, and 60 days after the application showed that (Table 3) the interaction effects between the growth condition and bio-stimulants (GxB) was found significant for vase life (days). Among the treatments humic acid at 4 ml/pot 50% Shadenet recorded maximum vase life of 17days while minimum vase life of 8.11 days was recorded in T_{14} *i.e.*, control (distilled water) under open condition.

The improved vase life in the current studies contradicted previous reports by Stamps and chandler, (2008) [12]. Such differences in response to shade nets may occur due to the relative performance of dracena in response to different outdoor environments depending on whether they are grown in tropical, subtropical, or temperate areas.

Vase life is an important parameter for cut foliage production of dracaena. Humic acid holds calcium and other micro nutrients in forms that are easy for uptake of plants. The presence of calcium with humic acid may have slowed respiration, decreased membrane permeability, maintained membrane integrity and turgidity, and prevented cellular disintegration by preserving protein and nucleic acid synthesis in dracaena and thus improved vase life. These results are in confirmation with the findings of Nikbakht *et al*. in Gerbera.

Chlorophyll content (SPAD value)

The data in table 4.4 show that application of humic acid @ 4 ml/pot on dracaena plants maintained under 50% shade net conditions recorded maximum chlorophyll content (55.25 SPAD units) when compared to control (26.04 SPAD units) maintained in open condition with distilled water spray.

In this study the maximum values of chlorophyll content was found in plants treated with humic acid at 4 ml/pot. The presence of iron would have enhanced the functioning of the photosystem, ultimately increasing the chlorophyll content in the leaves, and the humic acid sprayed on the leaves might have translocated to other parts of the plants, including the roots. This could be attributed to increased chlorophyll content in the leaves, resulting in increased photosynthetic efficiency and a more perfect influx of photosynthates to the sink. Furthermore, similar results was earlier reported by Fan

et al. (2015) [5] in chrysanthemum cut flowers.

Visual score

The mean data furnished on visual scoring during the vase life period of dracaena as influenced by the pre-harvest application of bio-stimulants and growing conditions was recorded at 4th, 8th, and 12th day is presented in Table 5.S

The interaction effect of growth conditions and bio-stimulants (GXB) related to vase life of dracaena was found significant. The maximum score was recorded in treatment with humic acid @ 4 ml/pot under 50% shadenet condition (T_6) (4.00=fresh appearance/no blemish), (3.55 =slight loss in freshness/ slight yellowing) on the 8th and 12th day respectively) which was on par with T_5 *i.e.*, shade net condition with application of humic acid @ 3 ml/pot (3.89 and 3.00 slight loss in freshness/ slight yellowing) at 8th and 12th day respectively. Whereas, significantly lowest score was recorded in T_{14} *i.e.*, control (distilled water) under open conditions (1.00 = severe loss of freshness/severe yellowing) on 8th day. On the 12th day, there was no change in scoring and observed that the foliage shoots collected from the control terminated in vase life.

Table 1: Effect of pre-harvest application of bio-stimulants and growth environment on shoot length (cm) of dracaena under shade and open conditions

Growth environment	Bio-stimulants								G	B	G*B
	B1	B2	B3	B4	B5	B6	B7				
	30 days										
G1	32.99^{f}	34.53^{e}	35.91^{c}	38.20^{a}	34.92^{d}	37.07^{h}	28.92^{i}	SEm±	0.12	0.22	0.32
G2	27.50^{j}	29.44^{h}	31.96^{g}	34.61^{d}	31.07^{h}	33.03^{f}	24.67^{k}	CD at 5%	0.35	0.65	0.91
	60 days										
G1	35.17^{f}	37.20^{e}	40.17^{c}	46.36^{a}	38.33^{d}	43.62^{b}	31.00^{h}	SEm±	0.13	0.24	0.34
G2	32.53^{g}	34.04^{f}	35.00^{f}	38.33^{d}	34.58^{f}	36.23^{e}	26.67i	CD at 5%	0.37	0.70	0.99

Table 2: Effect of pre-harvest application of bio-stimulants and growth environment on number of leaves per plant of dracaena under shade and open conditions

Growth environment	Bio-stimulants								G	B	G*B
	B1	B2	B3	B4	B5	B6	B7				
	30 days										
G1	31.67^{c}	33.00^{c}	35.78^{c}	44.44^{a}	33.67^{c}	40.00^{b}	27.33^{e}	SEm±	0.20	0.37	0.52
G2	30.67^{d}	31.44^{c}	34.00^{c}	38.67^{c}	32.33^{c}	36.11^{c}	25.67^{f}	CD at 5%	0.57	1.07	1.51
	60 days										
G1	38.23^{f}	40.33^{f}	47.66^{c}	54.63^{a}	42.28^{e}	49.96^{b}	31.67^{i}	SEm±	0.23	0.44	0.62
G2	35.22^{h}	37.37^{g}	41.25^{e}	45.52^{d}	38.40^{f}	43.26^{e}	29.11^{j}	CD at 5%	0.68	1.27	1.79

Table 3: Effect of pre-harvest application of bio-stimulants and growth environment on vase life (days) of dracaena grown under shade and open conditions

Growth environment	Bio-stimulants								G	B	G*B
	B1	B2	B3	B4	B5	B6	B7				
G1	12.85^{d}	13.22^{d}	13.89^{c}	15.55^{b}	15.89^{b}	17.00^{a}	9.11^{f}	SEm±	0.11	0.21	0.29
G2	10.11^{f}	10.33^{f}	12.00^{e}	12.66^{d}	13.11^{d}	14.55^{c}	8.11^{g}	CD at 5%	0.32	0.60	0.85

Table 4: Effect of pre-harvest application of bio-stimulants on chlorophyll content (spad value) on of cut foliage shoots of dracaena under shade and open conditions

Growth environment	Biostimulants										
	B1	B2	B3	B4	B5	B6	B7		G	B	G*B
G1	44.73^{f}	46.24^{e}	49.56^{d}	51.77^{c}	53.58^{b}	55.25^{a}	38.07^{h}	SEm±	0.16	0.30	0.43
G2	32.37^{k}	33.55^{k}	35.02^{j}	36.52^{i}	38.72^{h}	40.48^{g}	26.04^{l}	CD at 5%	0.47	0.88	1.25
Mean	38.55^{f}	39.90^{e}	42.29^{d}	44.14^{c}	46.15^{b}	47.86^{a}	32.06^{g}				

G_1: Shade net conditions, G_2: Open conditions

B_1- VAM @ 2 g/pot, B_2- VAM @ 4 g/pot, B_3- AMC @ 2 g/pot, B_4- AMC @ 4 g/pot, B_5- humic acid @3ml/pot, B6- humic acid @ 4 ml/pot, B_7- control

Table 5: Effect of pre-harvest application of bio-stimulants and growth environment on quality scoring of dracaena cut foliage shoots

	Bio-stimulants								G	B	G*B
Growth environment	B1	B2	B3	B4	B5	B6	B7				
				8th day							
G1	2.89^{c}	3.00^{c}	3.55^{b}	3.77^{a}	3.89^{a}	4.00^{a}	1.89^{f}	SEm±	0.04	0.07	0.10
G2	2.22^{e}	2.44^{d}	2.55^{d}	3.11^{c}	3.55^{b}	3.89^{a}	1.00^{g}	CD at 5%	0.11	0.20	0.29
				12th day							
G1	1.77^{c}	2.00^{c}	2.22^{c}	2.44^{b}	3.00^{a}	3.55^{a}	0.00	SEm±	0.06	0.12	0.16
G2	0.00	0.00	2.00^{c}	2.11^{c}	2.78^{b}	3.33^{a}	0.00	CD at 5%	0.18	0.33	0.47

G_1: Shade net conditions, G_2: Open conditions

B_1- VAM @ 2 g/pot, B_2- VAM @ 4 g/pot, B_3- AMC @ 2 g/pot, B_4- AMC @ 4 g/pot, B_5- humic acid @3ml/pot, B6- humic acid @ 4 ml/pot, B_7- control

Conclusion

In the present study the growth and visual quality of *Dracaena reflexa* plants was best when grown under 50% shade net when compared to open conditions. Further dracaena plants responded well with application of Arka microbial consortium at 4 g/pot and has shown good vegetative growth while the application of Humic acid at 4ml/pot resulted in maximum increase in vase life with good visual score for cut foliage shoots.

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Conflict of interest

None.

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