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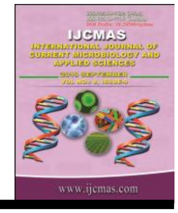

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Post Harvest Life of Gladiolus Spikes as Influenced by Preharvest Application of GA_3, Carbendazim and Mancozeb

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A B S T R A C T

The present investigation was conducted at Horticulture Research Farm, Institute of Agricultural Sciences, whereas all the postharvest parameters were carried out in Postharvest Laboratory of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the year 2017-18. The experiment was laid out in a Randomized Block Design (RBD) with twelve treatments i.e., control, GA_3 50 ppm, GA_3 100 ppm, carbendazim 0.4 %, mancozeb 0.4 %, carbendazim 0.4 % + mancozeb 0.4 %, GA_3 50 ppm + carbendazim 0.4 %, GA_3 50 ppm + mancozeb 0.4 %, GA_3 50 ppm + carbendazim 0.4 % + mancozeb 0.4 %, GA_3 100 ppm + carbendazim 0.4 %, GA_3 100 ppm + mancozeb 0.4 %, GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % and three replications. Results revealed that maximum length of spike after 6^{th} and 9^{th} days in vase was registered with pre-soaking treatment of cut corms in GA_3 50 ppm (53.65 cm and 54.00 cm). Whereas, maximum weight of spike was found with pre-soaking treatment of GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % and carbendazim 0.4 % + mancozeb 0.4 % treatments after 6^{th} (36.23 g) and 9^{th} day (31.63 g) of observation in vase solution, respectively. A significant effect was found with diameter of 1^{st}, 3^{rd} and 5^{th} florets in vase due to various concentrations of GA_3, carbendazim 0.4 % and mancozeb 0.4 % as pre-soaking treatment. Maximum water uptake by gladiolus spikes resulted with GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % after 3 days (26.00 ml) and with GA_3 100 ppm + carbendazim 0.4 % after 9 days (37.25 ml) in vase solution. However, prolonged vase life of spikes was registered with pre-soaking treatment of carbendazim 0.4 % + mancozeb 0.4 % (14.33 days).

Keywords

Gladiolus, Pre-soaking, Cut corms, GA_3, Carbendazim and mancozeb

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Introduction

An easy to grow crop that belongs to bulbous group is gladiolus. Being a popular cut flower in the industry of floriculture, its popularity is also ascribed to its diverse shapes, colours and hues, unique arrangement of flowers and ease of culture. The longevity in gladiolus varies from cultivar to cultivar. Though the flower is perishable in nature due to rapid wilting of florets (He *et al.*, 2006), many research has been conducted to extend the longevity of gladiolus spikes. Apart from external quality of flowers, vase life is also a key factor for consumers. Typical vase life of individual floret is just 4-6 days that differs from variety to variety. The senescent florets remain attached at the bottom of spikes even after opening of other florets (Yamada *et al*., 2003). However some post harvest problems like low water uptake and absorption of water, rapid darkening and change in colour of florets, abscission or senescence have been noted in gladiolus. All the developmental as well as senescence processes in cut flowers are under hormonal control. The control over floral characteristics and flowering time in relation to demand of market has been achieved in many cut flowers by adopting use of plant growth regulators (PGRs) (Rashmi and Deen, 2017). The application of plant growth regulators has now became a part of their cultural practices in many ornamental plants including gladiolus for manipulating the vegetative and floral characters in field as well as postharvest condition. It helps in regulating physiological processes in plants even if used in very small concentrations. The application methods of PGRs include foliar application, pre-soaking, drenching, etc. In gladiolus, pre-soaking of corms in GA_3 or any other growth regulators is now becoming a common method among commercial growers for enhancing growth and flowering yield in gladiolus (Schnelle *et al*., 2005 and Singh, 2006). But the important fact is that to grow healthy spikes with flowers that are free from any disease infestations. Gladiolus is mostly attacked by fungal diseases like fusarium wilt, botrytis rot, neck rot, etc. that generates a poor quality spikes with small distorted flowers and even produce reduced quality corms. Pre-storage or pre-planting treatment of corms with carbenzamin (0.1%) or mancozeb is effective in reducing the incidence (Singh and Sisodia, 2017). Therefore, the present investigation was proposed to study the postharvest performance of single bud section of gladiolus influenced by various concentrations of GA_3, carbendazim and mancozeb.

Materials and Methods

The present investigation was conducted at Horticultural Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the year 2017-18. Experiment was laid out in a Randomized Block Design (RBD) with twelve treatments *viz*., Control, GA_3 50 and 100 ppm, carbendazim 0.4 %, mancozeb 0.4 %, carbendazim 0.4 % + mancozeb 0.4 %, GA_3 50 ppm + carbendazim 0.4 %, GA_3 50 ppm + mancozeb 0.4 %, GA_3 50 ppm + carbendazim 0.4 % + mancozeb 0.4 %, GA_3 100 ppm + carbendazim 0.4 %, GA_3 100 ppm + mancozeb 0.4 %, GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % and three replications. The planting material taken was single bud section of gladiolus cut corms cv. Punjab Morning for this experiment. Pre-soaking treatment of various concentrations of GA_3, carbendazim, mancozeb were applied to the cut sections of gladiolus corms for 24 hours including control (distilled water). The cut corms were raised in a plot of size 2.70 × 1.25 m with spacing 30 × 25 cm having proper drainage of water. Well rotten FYM and vermicompost were applied before planting followed by uniform cultural practices. Spikes were harvested when 2-3 florets showed colour and then placed in distilled water for observing the postharvest characters. Postharvest observations include length and weight of spikes at various days, diameter of 1st floret, water uptake and vase life of spikes and then were subjected to statistical analysis.

Results and Discussion

The performance of gladiolus spikes for postharvest studies were evaluated and observed for different concentrations of GA_3, carbendazim and mancozeb at different days interval (Table 1). At the stage harvesting, various concentrations of GA_3, carbendazim 0.4 % and mancozeb 0.4 % failed to exert any significant effect on spike length in cut corms of gladiolus. Maximum spike length was noticed with treatment GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (53.87 cm), while minimum with treatment mancozeb 0.4 % (38.16 cm). A persual of the result clearly evidents a significant difference on weight of spikes after 6th and 9th day of observation; and length of spike after 3rd, 6th and 9th day of observation in vase solution (distilled water) due to the pre-soaking treatment of various concentrations of GA_3, carbendazim and mancozeb on gladiolus cut corms. Length of spike was found maximum after 3 and 6 days in vase solution with cut corms pre-soaked in GA_3 50 ppm (53.30 cm and 53.65 cm, respectively) which found statistically at par with GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (50.57 cm and 50.42 cm), GA_3 100 + mancozeb 0.4 % (47.60 cm and 47.60 cm), GA_3 50 ppm + mancozeb 0.4 % (52.00 cm and 52.10 cm), carbendazim 0.4 % + mancozeb 0.4 % (51.83 cm and 49.60 cm) and control (47.50 cm and 47.93 cm) and significant to other treatments. While at 9th day of observation, maximum spike length was registered with cut corms pre-soaked in carbendazim 0.4 % treatment (54.13 cm) which found statistically at par with GA_3 50 + mancozeb 0.4 % (52.10 cm) followed by GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (51.70 cm), carbendazim 0.4 % + mancozeb 0.4 % (49.90 cm), GA_3 100 + mancozeb 0.4 % (48.00 cm), GA_3 100 + carbendazim 0.4 % (45.17 cm) and significant to other treatments. Application of GA_3 in lower concentration helps in promoting shooting (Singh and Jauhari, 2005) in zinnia, in lily (Singh *et al*., 2018), in gladiolus cormels (Padhi *et al*., 2018) and in balsam (Singh and Karki, 2003). While in higher concentration, it seems to a reverse effect of it. GA_3 application helps in increasing growth attributes regarding spike length which might be due to increase in level of auxin causing increased cell division and cell elongation (Taiz and Zieger, 1998). The mechanism entails starch hydrolysis resulting from the production of GA_3 induced α-amylase which might increase the concentration of carbohydrates, thereby inclining the osmotic pressure of cell wall (Macleod and Millar, 1962), contributes to cell elongation and promotes growth. Although, other reason for increased spike length might be due to high rate of cell division due to the application of GA_3 that helps in promoting cell elongation. The GA_3 involvement stem elongation process was reported by Sun and Gubler (2004), Vijay *et al.,* (2006) in gladiolus, Sharifuzzaman *et al.,* (2011) in chrysanthemum and Chopde *et al.,* (2012) in gladiolus.

Single bud section of gladiolus corms cv. Punjab Morning in different concentrations of GA_3, carbendazim and mancozeb failed to exert any significant effect on weight of spike at harvesting stage and after 3rd day of harvesting in vase solution. Maximum spike weight at harvesting stage and after 3rd day of harvesting in vase solution was recorded with GA_3 50 ppm (29.61 g) and GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (37.48 g), respectively. While minimum weight of spike after harvesting and after 3 days of harvesting was recorded with GA_3 100 + mancozeb 0.4 % (22.24 g) and mancozeb 0.4 % treatment (26.52 g), respectively in vase solution. However, on 6th and 9th day of postharvest studies, maximum weight of gladiolus spike in vase solution were registered with GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (36.23 g) and carbendazim0.4 % + mancozeb 0.4 % (31.63 g), respectively which were found statistically at par with GA_3 50 (33.40 g and 26.60 g), GA_3 50 ppm + carbendazim 0.4 % + mancozeb 0.4 % (31.46 g and 25.66 g), carbendazim 0.4 %

(31.15 g and 25.44 g), and GA_3 100 + carbendazim 0.4 % (30.53 g and 25.94 g) and significant to other treatments; while minimum was recorded with mancozeb 0.4 % treatment (22.08 g and 17.44 g, respectively). Since use of PGRs like GA_3 might help in promoting cell division in cut corms that helps in producing more vegetative parts as well as elongation in spikes of gladiolus. The increase in length directly influences the weight of spikes in gladiolus. The increased rate of cell division due to the application of GA_3 was resulted by Sindhu and Verma (1997) in gladiolus, Bhalla and Kumar (2008) in gladiolus, Singh *et al.,* (2017) in marigold and Al-Khassawreh *et al.,* (2006) in black iris. However pre-soaking treatment of fungicides like carbendazim and mancozeb individually might help in avoiding infestation of cut corms as well as spikes in vase solution. This also helps in maintaining the weight of spikes free from any postharvest losses.

Pre-soaking treatment of cut corms in various concentrations of GA_3, carbendazim, mancozeb have been studied and illustrated for all the postharvest parameters (Table 2). Data revealed for a non significant difference that was exerted on 6th day of volume uptake by gladiolus spikes due to various concentrations of GA_3, carbendazim 0.4 % and mancozeb 0.4 % treatments. Maximum uptake of water was observed on 6th day with treatment GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (31.00 ml) while minimum with mancozeb 0.4 % (19.00 ml) treatment. However, all the parameters regarding volume uptake at different days interval exhibited a significant effect on flower diameter (1st, 2nd and 3rd floret) and vase life of spikes attributable to different concentrations of GA_3, carbendazim 0.4 % and mancozeb 0.4 %. Cut corms pre-soaked in treatment GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % (26.00 ml) exhibited maximum water uptake by gladiolus spikes on 3rd day which was found statistically at par with GA_3 100 + carbendazim 0.4 % (25.75 ml), carbendazim 0.4 % + mancozeb 0.4 % (20.66 ml), GA_3 50 ppm (20.00 ml), GA_3 100 ppm + mancozeb 0.4 % (20.00 ml) and found significant to other treatments; while minimum was obtained with GA_3 50 ppm + mancozeb 0.4 % (13.00 ml) treatment. On 9th day, maximum volume uptake in vase solution was observed with GA_3 100 + carbendazim 0.4 % (37.25 ml) treatment which was found statistically at par with GA_3 100 + carbendazim 0.4 % + mancozeb 0.4 % (33.00 ml), GA_3 50 ppm (31.00 ml), carbendazim 0.4 % + mancozeb 0.4 % (30.00 ml), GA_3 100 + mancozeb 0.4 % (30.00 ml) and found significant to other treatments; while minimum was noted with mancozeb 0.4 % treatment. Water uptake from vase solution remains longer the flower freshness through maintaining an improved vase status and rescues the cut flowers from pre-aging and senescenece. Gibberellic acid persuades the flower longevity with improved water status either by increasing water uptake or reducing excess water loss by lowering transpirational water loss (Goszczynska *et al*., 1990 and Saeed *et al*., 2014).

Data pertaining to the flower diameter studies revealed a significant difference on diameter of 1st, 3rd and 5th florets owing to various treatments of GA_3, carbendazim and mancozeb. Cut corms pre-soaked with GA_3 50 ppm + mancozeb 0.4 % (10.35 cm) solution obtained for a maximum diameter of 1st floret in vase solution which found statistically at par with GA_3 100 + mancozeb 0.4 % (9.75 cm) treatment and found significant to other treatments; while minimum was noted with GA_3 100 + carbendazim 0.4 % (8.55 cm). However, maximum diameter of 3rd floret in vase solution was recorded with cut corms pre-soaked with GA_3 50 ppm + carbendazim 0.4 % + mancozeb 0.4 % treatment (9.47 cm), which found statistically at par with treatments like GA_3 50 ppm + mancozeb 0.4 % (9.35 cm) and carbendazim 0.4 % + mancozeb 0.4 % (8.91 cm) and found significant to other treatments

Table.1 Effect of GA_3, carbendazim and mancozeb on length and weight pf spikes during postharvest studies in gladiolus

Treatment	Length of spike				Weight of spike			
	Length of spike at harvesting (cm)	Length of spike after 3 days in vase (cm)	Length of spike after 6 days in vase (cm)	Length of spike after 9 days in vase (cm)	Weight of spike at harvesting time (g)	Weight of spike at 3 days in vase (g)	Weight of spike at 6 days in vase (g)	Weight of spike at 9 days in vase (g)
Control	46.81	47.50	47.93	47.93	25.07	30.28	27.87	22.61
GA_3 50 ppm	52.75	53.30	53.65	54.00	29.61	37.45	33.40	26.60
GA_3 100 ppm	44.71	44.73	45.65	46.16	24.60	31.45	27.66	21.09
Carbendazim 0.4 %	52.44	53.22	53.36	54.13	26.54	33.91	31.15	25.44
Mancozeb 0.4 %	38.16	38.46	39.33	39.20	20.40	26.52	22.08	17.44
Carbendazim 0.4 % + Mancozeb 0.4 %	47.93	51.83	49.60	49.90	26.41	35.10	35.60	31.63
GA_3 50 ppm + Mancozeb 0.4 %	50.00	52.00	52.10	52.10	22.40	26.56	27.39	24.28
GA_3 50 ppm + Carbendazim 0.4 %+ Mancozeb 0.4 %	44.90	45.30	45.75	46.65	25.30	31.70	31.46	25.66
GA_3 100 ppm + Carbendazim 0.4 %	42.40	43.40	44.27	45.17	23.14	30.73	30.53	25.94
GA_3 100 ppm + Mancozeb 0.4 %	47.10	47.60	47.60	48.00	22.24	30.03	25.65	21.41
GA_3 100 ppm + Carbendazim 0.4 % + Mancozeb 0.4 %	53.87	50.57	50.42	51.70	28.24	37.48	36.23	30.28
C.D. at 5%	NS	9.11	7.74	7.16	NS	NS	7.86	7.00

Table.2 Effect of GA_3, carbendazim and mancozeb on water uptake, flower diameter and vase life during postharvest studies in gladiolus

Treatments	**Volume of water absorbed by spike**			**Diameter of 1st, 3rd and 5th florets**			**Vase life of spike (days)**
	Volume of water uptake by spike at 3 days in vase (ml)	**Volume of water uptake by spike at 6 days in vase (ml)**	**Volume of water uptake by spike at 9 days in vase (ml)**	**Diameter of 1st floret in vase (cm)**	**Diameter of 3rd floret in vase (cm)**	**Diameter of 5th floret in vase (cm)**	
Control	19.33	21.58	28.33	8.98	8.45	7.81	11.75
GA_3 50 ppm	20.00	27.50	31.00	9.10	8.85	7.35	13.50
GA_3 100 ppm	16.33	22.50	26.50	8.85	8.75	8.32	12.00
Carbendazim 0.4 %	17.11	25.44	28.88	9.36	8.47	7.57	13.88
Mancozeb 0.4 %	14.66	19.00	20.66	8.86	8.10	8.10	11.33
Carbendazim 0.4 % + Mancozeb 0.4 %	20.66	27.33	30.00	9.31	8.91	8.42	14.33
GA_3 50 ppm + Mancozeb 0.4 %	13.00	21.00	29.00	10.35	9.35	0.00	13.00
GA_3 50 ppm + Carbendazim 0.4 %+ Mancozeb 0.4 %	16.50	22.50	28.50	9.37	9.47	8.30	12.50
GA_3 100 ppm + Carbendazim 0.4 %	25.75	26.75	37.25	8.55	8.43	7.98	12.25
GA_3 100 ppm + Mancozeb 0.4 %	20.00	26.00	30.00	9.75	9.45	8.45	11.00
GA_3 100 ppm + Carbendazim 0.4 % + Mancozeb 0.4 %	26.00	31.00	33.00	9.20	9.28	8.37	12.75
C.D. at 5%	6.03	NS	7.57	0.88	0.68	0.45	1.81

. Pre-soaking of cut corms in GA_3 100 ppm + mancozeb 0.4 % (8.45 cm) resulted maximum diameter of 5th floret in vase solution which found statistically at par with carbendazim 0.4 % + mancozeb 0.4 % (8.42 cm), GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % (8.37 cm), GA_3 100 ppm (8.32 cm), and GA_3 50 ppm + carbendazim 0.4 % + mancozeb 0.4 % (8.30 cm), mancozeb 0.4 % (8.10 cm) and found significant to other treatments. While minimum diameter of 3rd and 5th florets in vase solution was resulted with treatments mancozeb 0.4 % (8.10 cm) and GA_3 50 ppm + mancozeb 0.4 % (0.00 cm), respectively. Gibberellins are suggested to be involved in starch hydrolysis into glucose and fructose whic helps in opening of flowers (Emongor, 2004). However, it is more promising when used at lower concentration. In gladiolus floral opening is more complex mechanism involving various genes (Kumar *et al*., 2008). The floral opening involves the GA_3 dependant pathway (Cong *et al*., 2013). The lower concentration used in pre-soaking of cut corms might help in slow opening of florets with enlarged flower size in present study. This could be the reason that low GA_3 concentration might help in increasing the levels of reducing sugar in stems and flower heads of cut spikes increased the osmotic potential and turgidity of flower heads and hence facilitates the expansion of flowers (Emongor, 2004 and Saeed *et al*., 2014). Use of fungicides might help in maintaining the disease free growth of spikes as well as flowers. An extending vase life was came to notice when various concentrations of GA_3, carbendazim and mancozeb treatments Regarding vase life study, a significant effect was noticed with gladiolus spikes raised in pre-soaking of various concentrations of GA_3, carbendazim 0.4 % and mancozeb 0.4 % treatments. In present study, application of carbendazim 0.4 % + mancozeb 0.4 % (14.33 days) was found more effective to prolong the vase life of gladiolus spikes which found statistically at par with carbendazim 0.4 % (13.88 days) followed by GA_3 50 ppm (13.50 days), GA_3 50 ppm + mancozeb 0.4 % (13.00 days) and GA_3 100 ppm + carbendazim 0.4 % + mancozeb 0.4 % (12.75 days) while minimum with GA_3 100 ppm + mancozeb 0.4 % (11.00 days) in vase solution. Here, observations revealed an antagonistic effect of gibberellic acid to abscisic acid that helps in retarding the ABA activity. Also GA_3 at lower concentration delays the flower opening in vase which would be beneficial for the display cut flowers longevity (Anjum *et al*., 2001). It retained the CAT activity higher which might be as a result of stress tolerance response of gibberellic acid in plants. This CAT (catalase) activity might help in enhancing the vase life of gladiolus by scavenging ROS (Reactive oxygen species) (Ezhilmathi *et al*., 2007 and Saeed *et al*., 2014). In accordance to GA_3 treatment, use of carbendazim and mancozeb might help in avoiding disease infestation of cut spikes in vase solution that also helps in prolonging vase life of gladiolus spikes.

References

Al-Khassawneh, N.M., N.S. Karam and R.A. Shibli, 2006. Growth and flowering of black iris (*Iris nigricans* Dinsm.) following treatment with plant growth regulators. *Sci*. *Hort*., 107: 187-193.

Anjum, M.A., Naveed, F., Shakeel, F. and Amin, S. 2001. Effect of some chemicals on keeping quality and vase life of tuberose (*Polianthes tuberosa* L.) cut flowers. *J*. *Res*. *Sci*., 12(1):1-7.

Bhalla, R. and Kumar, A. 2008. Response of plant bio-regulators on dormancy breaking in gladiolus. *J.Orn*. *Hort*., 11(1): 1-8.

Chopde, N., Gonge, V.S. and Dalal, S.R. 2012. Growth, flowering and corm production of gladiolus as influenced by foliar application of growth regulators.

Plant Arch., 12(1), 41-46.

Cong, H., Li, L. and Xu, L. 2013. Characterizing developmental and inducible differentiation between juvenile and adult plants of *Aechmea fasciata* treated with ethylene by transcriptomic analysis. *Pl. Growth Regul*., 69: 247-257.

Emongor, V.E. 2004. Effects of gibberellic acid on postharvest quality and vase life of gerbera cut flowers (*Gerbera jamesonii*). *J. Agron*., 3(3): 191-195.

Ezhilmathi, E., Singh, V.P., Arora, A. and Sairam, R.K. 2007. Effect of 5-sulfosalicylic acid on antioxidant activity in relation to vase life of gladiolus cut flower. *Pl. Growth Regul*., 51(2): 99-108.

Goszczynska, D.M., Zieslin, N., Mor, Y. and Halevy, A.H. 1990. Improvement of postharvest keeping quality of 'Mercedes' roses by gibberellin. *Pl. Growth Regul*., 9: 293-303.

He, S., Joyce, D.C., Irving, D.E. and Faragher, J.D. 2006. Stem end blockage in cut Grevillea 'Crimson Yul-lo' inflorescences. *Post. Bio. Tech*., 41(1): 78-84.

Kumar, N., Srivastava, G.C. and Dixit, K. 2008. Role of sucrose synthase and invertases during petal senescence in rose (*Rosa hybrida* L.). *J. Hort. Sci. Biotech*., 83: 520-524.

Macleod, A.M. and Millar, A.S. 1962. Effect of gibberellic acid on barley endosperm. *J. Inst. Brewing*, 68: 322-332.

Padhi, M., Sisodia, A., Pal, S., Kapri, M. and Singh, A.K. 2018. Growing media, GA_3 and thiourea stimulates growth and rooting in gladiolus cormels cv. Tiger Flame. *J. Pharmacognosy and Phytochemistry*, 7(3): 1919-1922.

Rashmi and Deen, B. 2017. Effect of presoaking of corms into plant growth regulators on growth and flowering of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty. *Int. J. Curr. Microbiol. App. Sci*., 6(12): 455-460.

Saeed, T., Hassan, I., Abbasi, N.A., and Jilani, G. 2014. Effect of gibberellic acid on the vase life and oxidative activities in senescing cut gladiolus flowers. *Pl. Growth Regu*., 72(1): 89-95.

Schnelle, R., Cerveny, C. and Barrett, J. 2005. Factors affecting PGR liner dips. *Gre. Pro. News*, 15: 106-107.

Sharifuzzaman, S.M., Ara, K.A., Rahman, M.H., Kabir, K. and Talukdar, M.B. 2011. Effect of GA_3, CCC and MH on vegetative growth, flower yield and quality of chrysanthemum. *Int. J. Expt. Agr*. 2(1): 17-20.

Sindhu, S.S. and Verma, T.S. 1997. Effect of different size of cormels and various treatment in gladiolus cv. White Oak. *Resent Hort*., 4: 69-70.

Singh, A.K. 2006. Flower Crops: Cultivation and Management, New India Publishing Agency, New Delhi. p. 157.

Singh, A.K. and Jauhari, S. 2005. Effect of pre-sowing treatment of GA_3 and BA on seed germination and seedling growth in zinnia. *Abst.* Nat. Symp. on Sustainable Production and Export of Horticultural Crops, Society for Advancement of Horticulture, 2-4 December, BCKV, Kalyani, p. 40.

Singh, A.K. and Karki, K. 2003. Effect of grading and GA_3 on germination and seedling growth attributes in balsam. *Progressive Hort*., 35(2): 158-160.

Singh, A.K. and Sisodia, A. 2017. Textbook of Floriculture and Landscaping. New India Publishing Agency, New Delhi. p.350.

Singh, A.K., Kapri, M., Sisodia, A. and Padhi, M. 2018. Effect of GA_3 and BA (Benzyladenine) on growth and bulb production in lily (*Lilium longiflorum*). *Int. J. Curr. Microbiol. App. Sci.*, 7(6): 1236-1240.

Singh, A.K., Kumar, P., Sisodia, A., Pal, A.K., Singh, H.V. and Padhi, M. 2017. Effect of pinching, urea and GA_3 on growth, flowering and seed attributes in African marigold (*Tagetes erecta* L.). *J. Ornamental Hort*., 20(1&2): 34-39.

Sun, T.P. and Gubler, F. 2004. Molecular mechanism of gibberellin signaling in plants. *Ann. R. Plant Bio*., 55: 197-223.

Taiz, L. and Zeiger, E. 1998. Plant Physiology. 2nd Edition. Sinauer Associate Inc. Publishers. Oxford University Press, U.S. p. 792.

Vijay, K.U., Singh, R.P. and Singh, A.R. 2006. Influence of ethrel and sand on growth and corm yield of gladiolus cv. Congo Song. *Progressive Agricul*., 6: 143-145.

Yamada, T., Takatsu, Y., Manabe, T., Kasumi, M. and Marubashi, W. 2003. Suppressive effect of trehalose on apoptotic cell death leading to petal senescence in ethylene-insensitive flowers of gladiolus. *Plant Sci*., 164(2): 213-221.

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