J. Hortl. Sci.
Vol. 15(2) 191-196 : 2020

Original Research Paper

Effect of putrescine and benzyl adenine on growth, flowering and post-harvest keeping quality parameters in chrysanthemum (*Chrysanthemum morifolium* Ramat.)

Taranjit Singh and Madhu Bala*
Punjab Agricultural University, Ludhiana, Punjab - 141 004
*Corresponding author Email : madhu-flori@pau.edu

ABSTRACT

The experiment was conducted with the objective to study the effect of different anti-senescence compounds like putrescine and benzyl adenine (BA) on vegetative, floral and post-harvest keeping quality of chrysanthemum cv. Punjab Shyamli. The experiment was conducted in randomized block design (RBD) and replicated thrice. Putrescine (@ 50, 100 and 150 ppm) and benzyl-adenine (@ 100, 150 and 200 ppm) were sprayed twice on cv. Punjab Shyamli (spray type and pompon) at bud initiation stage and at fully developed flower buds. Control plants were sprayed with normal water. Floral parameters were delayed and vase life of cut stems was enhanced by benzyl adenine @ 200 ppm. The maximum delay of flower opening stage (116.33 days), number of sprays (5.00) and vase life (27.22 days) was obtained with benzyl-adenine @ 200 ppm treatment. Flower diameter was 4.53 cm with benzyl-adenine @ 200 ppm compared to 2.87 cm in control.

Key words: Anti-senescence compound, Chrysanthemum, Delayed flowering and Vase life

INTRODUCTION

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) belonging to family Asteraceae is one of the most beautiful leading commercial flowering plants grown for its diverse uses including cut flower, loose flower for making garlands, floral ornaments, hair decoration as well as for pot culture and also in garden decoration as bedding plant (Joshi *et al*., 2010). Chrysanthemum is gaining tremendous popularity among floriculture products in the recent times due to wide range of flower colours, diverse forms and their excellent keeping quality. The word chrysanthemum is derived from two Greek words '*chrysos'* referring to gold and '*anthemon'* or '*anthos*' referring to flower (Anderson, 1987). It is believed to be native to the Northern hemisphere chiefly Europe and Asia and it is believed to have originated in China (Bose *et al*., 2002).

Chrysanthemum ranks 3rd in the international flower market next to roses and carnation in terms of both production volume and trading and it also ranks 5th amongst the potted flowering plants in the world flower market (Anonymous, 2017a). In India, the chrysanthemum is commercially cultivated in the states of Karnataka, West Bengal, Tamil Nadu, Madhya Pradesh and Himachal Pradesh on an area of 20.55 thousand ha with about 184.31 thousand MT production of loose flower and 14.64 thousand MT of cut flower (Anonymous, 2017b).

The use of plant growth regulators is becoming a very common practice in agricultural crops. Plant growth regulators act as either inhibiting or promoting agents to govern the plant growth depending upon the concentration of the dose and internal plant characteristics on which these are applied. The application of benzyl adenine and gibberellic acid has been reported to accelerate blooming and increase in number of flowers in lilium (Kioshi, 2003). Application of benzyl adenine resulted in increased length of blooming stem, flower diameter, number of flowers and accelerated blooming in narcissus flowers (Nakhaee *et al*., 2009). Parameters like weight of a leaf, number of leaves, leaf surface and diameter of stem have also been improved with benzyl adenine in croton plant (Ibrahim *et al*., 2010). Increased post-

harvest keeping quality of anthurium flowers and miniature roses and increase in rate of water absorption have also been reported (Serek and Anderson 1993, Paull and Chantrachit, 2001). Exogenous application of putrescine in many plant species has also been reported that resulted in reduction in loss of chlorophyll and thus delay aging of leaves (Lee *et al*., 1997). This effect may be related to the inhibition of peroxidase activity (Ma *et al*.,1996). The main objective of this study was to standardize optimum concentrations of putrescine and benzyl adenine (BA) in chrysanthemum for improvement of growth, flowering and post-harvest keeping quality parameters.

MATERIAL AND METHODS

The study was conducted at the Research Farm, Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, during the year 2016-17 to study the effect of putrescine and benzyl adenine (BA) on vegetative, floral and post-harvest keeping quality parameters of chrysanthemum cv. 'Punjab Shyamli'. It is a pompon-type variety having purple flowers with deep purple, suitable for cut flower production. Healthy terminal stem cuttings (5-7 cm) free from any disease or insect pest symptoms were prepared in the month of July and planted in plug trays filled with burnt rice husk as rooting medium. New roots developed 15-20 days after planting and rooted cuttings were transplanted in the field in the first week of August. Cultural operations like weeding, irrigation and management of insect pest and diseases were performed as per recommended package of practices of Punjab Agricultural University, Ludhiana. Staking was done by using sticks to keep the plants erect and maintain the proper shape of plant and bloom. The experiment consisted of seven treatments *viz*. putrescine (@ 50, 100 and 150 ppm) and benzyl adenine (@ 100, 150 and 200 ppm) along with control. Foliar spray of growth regulator concentrations was done twice, first at bud initiation stage and the other when flower buds developed completely along with control plants that were sprayed with normal water. The observations on various growth and flowering parameters like plant height stem girth, internodal length, leaf chlorophyll content (SPAD), plant spread, days to bud appearance, days to colour showing stage, days to flower opening, flower diameter, duration of flowering, peduncle length, number of branches per plant, length of cut stem, vase life, final flower diameter in vase, days to initiation of flower senescence, days to complete senescence, days to initiation of leaf yellowing and total water absorbed by cut stem. The experiment was conducted in randomized block design (RBD) with seven treatments with three replications per treatment. Data was subjected to statistical analysis by using CPCS-1, software developed by Department of Mathematics and Statistics, Punjab Agricultural University (Ludhiana). The treatment comparisons were made at 5% level of significance.

RESULTS AND DISCUSSION

Foliar sprays with different concentrations of putrescine and benzyl adenine on chrysanthemum cv. Punjab Shyamli did not show any significant effect on various vegetative parameters (Table 1).

Table 1. Effect of different growth regulators on vegetative growth parameters of chrysanthemum cv. Punjab Shyamli

Treatments	Plant height (cm)	Stem girth (cm)	Internodal length (cm)	SPAD	Plant spread (cm)
Control	53.73	0.61	4.60	66.07	20.94
Putrescine @ 50 ppm	54.00	0.57	2.99	72.88	24.61
Putrescine @ 100 ppm	52.27	0.61	3.69	69.28	20.99
Putrescine @ 150 ppm	55.80	0.67	3.55	72.37	21.49
Benzyl adenine @ 100 ppm	59.40	0.63	4.21	67.01	22.66
Benzyl adenine @ 150ppm	54.60	0.57	4.43	72.98	24.61
Benzyl adenine @ 200 ppm	58.60	0.65	3.95	77.90	25.27
CD (P=0.05) SEm±	NS 0.99	NS 0.01	NS 0.21	NS 1.54	NS 0.70

The data on number of days taken to bud appearance, days to flower opening, flowering duration, number of sprays per plant , peduncle length, flower diameter and length of cut stem is presented in Table 2. Results revealed that spray of BA @ 150 ppm and 200 ppm significantly delayed the flower bud appearance as compared to control and other treatments. The minimum numbers of days (87.33 days) were taken by control plants for flower bud appearance. Hence, increase in concentration of putrescine and BA delayed the bud formation in chrysanthemum cv. 'Punjab Shyamli'. It has been reported that nutritional and climatic conditions during the growing period also play a major role to determine the flowering characteristics of plants (Boodley, 1975). Increase in number of days taken to bud appearance in Lilium cv. 'Tiger' by foliar spray of BA @ 50 ppm has also been reported earlier (Attiya *et al*., 2015).

Table 2. Effect of different growth regulators on flowering parameters of chrysanthemum cv. Punjab Shyamli

Treatments	Days to bud appearance	Days to colour showing stage	Days to flowe-ring	Flowe-ring duration (days)	Number of branches/ plant	Peduncle length (cm)	Flower diameter (cm)	Length of cut stem (cm)
Control	87.33	94.33	101.67	29.13	3.73	7.54	2.87	46.40
Putrescine @ 50 ppm	88.00	95.00	103.33	28.00	3.87	7.82	3.11	48.53
Putrescine @ 100 ppm	91.33	96.33	104.67	27.40	4.20	7.57	3.92	49.61
Putrescine @ 150 ppm	92.00	98.33	107.33	27.93	4.53	7.97	3.97	51.48
Benzyl adenine @ 100 ppm	91.33	99.67	109.67	28.93	4.13	8.95	4.10	53.12
Benzyl adenine @ 150 ppm	93.33	100.67	112.67	26.80	4.53	8.49	4.23	54.99
Benzyl adenine @ 200	97.67	105.67	116.33	24.53	5.00	8.24	4.53	56.99
CD (P=0.05)	4.24	1.89	1.87	1.21	0.34	NS	0.13	1.41
SEm±	1.94	0.86	0.87	0.55	0.16	0.31	0.06	0.65

The maximum number of days to colour showing stage (105.67 days) was observed in treatment with BA @ 200 ppm, followed by BA @ 150 ppm with 100.67 days for colour showing stage. The least number of days to colour showing stage (94.33 days) was observed control. Days taken to bud appearance and colour showing stage also determine the earliness or late flowering of any cultivar thus, both habits are helpful in regulating the availability of flowers for longer period in the flower market reported by Behera *et al*. (2002). The maximum delayed flowering for 116.33 days was recorded in treatment where plants were sprayed with BA @ 200 ppm, whereas the earliest flowering was recorded in control (101.67 days). Similar to our study, delayed flowering has been reported by the application of BA in salvia and lilium crops earlier (Carey *et al*., 2013).

Among different concentrations of putrescine and BA, the longest duration of flowering (29.13 days) was obtained in control plants followed by plants treated with BA @ 100 ppm with 28.93 days flowering duration. The minimum duration of flowering (24.53 days) was obtained in treatment comprising of BA @ 200 ppm. Blooming period of flower is an essential criteria for selection of flowering cultivars. Flowering duration is helpful to determine the availability of flowers for a longer time period. Early senescence of tulip flowers, when treated with higher concentrations of BA has also been reported by Kim and Miller (2008). It may be due to increased localization of the cytokinins within the gynoecium which results in early senescence of flower petals. Similar to our findings, results have also been reported in carnation by various workers (Woodson and Brandt, 1991). The maximum number of sprays per plant (5.00) was obtained with BA @ 200 ppm as compared to control (3.73). Besides this, putrescine @ 150 ppm and BA @ 150 ppm treatments were at par with each other having 4.53 sprays per plant in both the treatments. Similar to our research finding, effect of BA on increase in growth characters has also been reported by Asgari *et al*. (2014). The data showed that plant growth regulators did not affect

peduncle length of plants significantly. The maximum flower diameter (4.53 cm) was recorded with treatment BA @ 200 ppm followed by BA@150 ppm with 4.23 cm flower diameter and BA@100 ppm (4.10 cm). The lowest flower diameter (2.87 cm) was reported in control where plants were sprayed with water only. Similar to our findings, flower diameter was increased with BA @ 500 ppm as reported by Asgari *et al.* (2014) in narcissus and Al-Hasnawi (2011) in chrysanthemum. The longest stem length (56.99 cm) was obtained with BA @ 200 ppm BA as compared to control where stem length of 46.40 cm was obtained. There was significant increase in the cut stem length at all levels of putrescine and BA over control. Similarly, benzyl adenine (BA) increased stem length in salvia and tuberose as reported earlier (Kheiry, 2006; Carey *et al,* 2013).

The data on the effect of plant growth regulators on vase life of cut flower in distilled water at room temperature after harvest, water absorbed by cut stem, days to initiation of flower senescence, days to complete senescence and final flower diameter are presented in Table 3. It is clear from the results that different concentrations of putrescine and BA significantly improved the freshness of flower over control. BA @200 ppm significantly improved vase life of cut stems up to 27.22 days, followed by BA @150 ppm (26.45 days) and BA @ 100 ppm (24.44 days) . The minimum vase life (18.11 days) was recorded in control. The reason might be due to the increased protein content in petals or might be due to the ability of plant growth regulators to reduce and delay the production of endogenous ethylene hormone (Lukaszewska, 1994). Similarly, increased vase life with the application of BA @ 150 and 300 ppm has also been reported earlier in gerbera (Chavan *et al.,* 2012). The maximum water absorption (29.44 ml) was observed in cut flowers taken from the plots where plants were sprayed with BA @ 200 ppm followed by BA @ 150 ppm (25.78 ml). The least water absorption (11.89 ml) was observed in cut stems taken from control. In general, water absorption is closely related with persistency of flowers and any factor that improves water absorption rate would be effective. Similarly, results have also been recorded by Nagarja *et al.,* (1999) in tuberose. The cut stems showed sign of senescence in control after 15.89 days where no growth regulator was sprayed on plants at the time of growth phase. Cut flowers harvested from the plants treated with BA @ 200 ppm showed delay in flower senescence up to 29.78 days, followed by BA @ 150 ppm (28.56 days) and BA @100 ppm (26.89 days).The reason might be that cytokinins are responsible for reduction in ethylene sensitivity of plants that delayed flower senescence (Serek *et al.,* 1994). Leaf yellowing is an important factor triggering leaf senescence in plants, the oldest leaves at the bottom of a canopy enter senescence earlier than the upper leaves. In this study, no sign of yellowing of leaves in cut stems of chrysanthemum cv. Punjab

Table 3. Effect of different growth regulators on post-harvest keeping quality parameters of chrysanthemum cv. Punjab Shyamli

Treatments	Vase life (days)	Water absorbed (ml)	Days to initiation of flower senescence	Days to complete flower senescence	Final flower diameter (cm)
Control	18.11	11.89	15.89	21.00	3.63
Putrescine @ 50 ppm	20.56	14.11	17.89	22.33	4.00
Putrescine @ 100 ppm	21.89	16.11	19.00	23.89	4.35
Putrescine @ 150 ppm	22.11	19.55	19.33	24.67	4.72
Benzyl adenine @ 100 ppm	24.44	19.67	21.89	26.89	4.85
Benzyl adenine @ 150 ppm	26.45	25.78	23.55	28.56	5.25
Benzyl adenine @ 200 ppm	27.22	29.44	24.78	29.78	5.75
CD (P=0. 05)	1.51	2.52	1.59	1.01	0.35
SEm±	0.69	1.16	0.73	0.46	0.16

Shyamli was seen till the termination of their vase life. Hence, it can be inferred that putrescine and benzyl adenine (BA) delayed the leaf yellowing of cut stems as reported by (Singh and Bala, 2018) in addition to the important roles of the cytokinins and its derivatives in controlling and stimulating cell division, inhibition of leaf senescence.

The research findings of this study depicted that foliar spray of benzyl adenine (BA) @ 200 ppm (BA) twice i.e., at bud initiation stage and when flower buds were fully developed was found to be the effective treatment in improving the floral parameters and enhancing the vase life of the cut stems of chrysanthemum cv. Punjab Shyamli.

REFERENCES

Anderson, R. L. 1987. Reclassification of genus chrysanthemum. *Hortic. Sci.,* **22**: 313

Anonymous, 2017a. Area and production of chrysanthemum. http: //www.indiastat.com

Anonymous, 2017b. Area and production of chrysanthemum. http: //www.indiastat.com

Al-Hasnawi, A. N. H. 2011. Effect of benzyl adenine and chelated magnesium spraying on growth and flowering of *Chrysanthemum hortorum* Hort. M.Sc. Thesis. University of Kufa, Iraq

Asgari. S., Moradi, H. and Afshari, H. 2014. Evaluation of some physiological and morphological characteristics of *Narcissus tazatta* under BA treatment and nano-potassium fertilizer. *J. Chem. Health Risks,* **4**: 63-70

Attiya, H. J., Naji, D. A. and Askar, H. M. 2015. Effect of plant growth regulators (IBA, BA, and CCC) on some flowering characters of three hybrid lily cultivars of (*Lilium spp.* L.) *Iraqi. J. Sci.,* **56**: 3107-13

Behera, T. K., Sirohi, P. S. and Pal, A. 2002. Assessment of chrysanthemum germplasm for commercial cultivation under Delhi condition. *J. Ornam. Hortic,.* **5**: 11-14

Boodley, J. W. 1975. Plant nutrition and flower quality. *Hortic. Sci.,* **10**: 41-48

Bose, T. K., Yadav, L. P. and Pal, P. 2002. *Commercial Floriculture*. ed 2, pp 463-602. Naya Prokash, Kolkata

Carey, D. J., Fair, B. A., Buhler, W., McCall, I. and Whipker, B. E. 2013. Growth control and flower promotion of Salvia with benzyl adenine foliar sprays. *J. Applied Horti.,* **15**: 87-90

Chavan, M. C., Patel, R. B., Chawla, S. L., Dhaduk, B. K. and Sahare, H. A. 2012. Effect of plant growth regulators on growth and flowering of Gerbera (*Gerbera jamesonii*) under polyhouse. *J. Ornam. Hortic.,* **15**: 238-42

Ibrahim, S. M., Taha, L. S. and Farahat, M. M. 2010. Vegetative growth and chemical constituents of croton plants as affected by foliar application of benzyl adenine and gibberellic acid. *J. American Sci.,* **6**: 126-30

Joshi, M., Verma, L. R. and Masu, M. M. 2010. Performance of different varieties of chrysanthemum in respect of growth, flowering and flower yield under north Gujarat condition. *The Asian J Hort.,* **4**: 292-94

Kheiry, A. 2006. Effects of GA_3 and 6-BA on the quality and essence of tuberose. M.Sc. Thesis, University of Tehran, Iran

Kim, H. and Miller, W. B. 2008. Effects of GA_{4+7} and benzyl adenine application on post-production quality of 'Seadov' pot tulip flowers. *Post-harvest Biol. and Techn.,* **47**: 416-21

Kioshi, O. 2003. Effect of gibberellins and benzyladenine on dormancy and flowering of *Lilium specrosum*. Kanagaw a Horticultural Experimental Station. Ninomiya, Nakagum, Kanagawa, p. 259-61

Lee, M. N., Lee, S. H. and Park, K. Y. 1997. Effect of spermine on ethylene biosynthesis in cut carnation (*Dianthus caryophyllus* L.) flowers during senescence. *J. Pl. Physio.,* **151**: 68-73

Lukaszewska, A. J., Bianco, J., Barthe, P. and Page-Degivry, M. T. 1994. Endogenous cytokinins in rose petals and the effect of exogenously applied cytokinins on flower senescence. *Pl. Growth Regul.,* **14**: 119-26.

Ma, J. Y., Zhou, R. and Cheng, B. S. 1996. Effect of spermine on the peroxidase activity of detached wheat leaves. *J Shandang Agric Univ.,* **27**: 176-80

Nagarja, G. S., Gowda, J. V. N. and Farooqui, A. 1999. Effects of growth regulators on growth and flowering of Tuberosa cv. Single Karnataka. *J. Agric. Sci.,* **12**: 236-38

Nakhaee, F., Khalighi, A., Naseri, M. and Abroomand, P. 2009. Effect of plant growth regulators on morphological traits and essential amaryllis (*Narcissus tazetta* L.). *J. Sustainable Agric.,* **4**: 47-59

Paull, R. E. and Chantrachit, T. 2001. Benzyl adenine and the vase life of tropical ornamentals. *Post-harvest Biol. Tech.,* **21**: 303-10

Serek, M. and Andersen, A S. 1993. AOA and BA influence on floral development and longevity of potted 'victory parade' miniature rose. *Hort Sci.,* **28**: 1039-40

Serek, M., Jones, R. B., Reid, M. S. 1994. Role of ethylene in opening and senescence of *Gladiolus* sp. flowers. *J. Americ. Soc. Hortic. Sci.,***119**: 1014-19

Singh, T. and Bala. M. 2018. Effect of foliar spray of benzyl adenine, gibberellic acid and putrescine on post-harvest keeping quality of chrysanthemum. *Agric. Res. J,.* **55** (2): 386-88

Woodson, W., Brandt, A. 1991. Role of the gynoecium in cytokinin-induced carnation petal senescence. *J. American Soc. Hort. Sci.,* **116**: 676-79

(Received on 04.11.2020 and Accepted on 24.12.2020)