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Effect of gibberellic acid and cycocel on growth, flowering and yield of chrysanthemum (*Dendranthema grandiflora* ramat) cv. birbal sahni

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Abstract
The present investigation was carried out at experimental field was laid out at Horticulture Research Farm, Chaudhary Charan Singh University, Meerut with seven treatments like GA_3 applied with three treatment combination *viz*. G_1 (50 ppm), G_2 (100 ppm), G_3 (150 ppm) and CCC applied with three treatment combination *viz*. C_1 (1000 ppm), C_2 (5000 ppm) and C_3 (10000 ppm) and T_0 (control). Maximum height of plant, plant spread, diameter of main stem, number of branches and leaves were recorded with 150 ppm concentration of GA_3 in comparison to control and lower level of GA_3, while minimum plant height and maximum other growth parameters were recorded, under 5000 ppm concentration of CCC. Minimum number of days required for first flower bud appearance was recorded with 100 ppm concentration of GA_3 over to control, while maximum number of days required for first flower bud appearance with 5000 ppm concentration of CCC. Minimum number of days required for flowering was recorded, with 100 ppm concentration of GA_3 over to control, while maximum number of days required for flowering with 5000 ppm concentration of CCC. Maximum number of flowers per plant, flower stalk length, flower size, flowers yield and shelf life were recorded under the treatment of GA_3 150 ppm concentration, followed by 5000 ppm concentration of CCC, while minimum number of flowers was recorded under control.

Keywords: Gibberellic acid, Cycocel, growth, flowering, yield and chrysanthemum

Introduction
Chrysanthemum flower symbolized as royalty and national flower of Japan. It reached in India and other countries in early 19th century. In India National Research Centre and Registration Centre on Chrysanthemum established at National Botanical Research Institute, Lucknow, (U.P.). Chrysanthemum Society of India established at New Delhi. Chrysanthemum is a very popular commercial flower crop in India and abroad. It is belonging to the family compositae. The chrysanthemums are now becoming popular day by day due to its imparalled diversity in shape, size, colour and it has a wide range of growth habit and post harvest life. Chrysanthemum universally popular due to very fascinating flowers of extremely beautiful and colourful form of florets and pretty foliage. They are grown invariably as annuals in landscape gardens for mass effect in around cities and in farmer's field for the sale of cut flowers in the market. The chrysanthemum is commonly grown in gardens both in the urban and rural areas. They are ideal for garden display and cut flowers, particularly for garlands. Chrysanthemum can be successfully grown in the pots too and are used in mixed borders and beds. They are also ideal for growing in a newly planted shrubbery to provide colour, and for planting in blank spots in the gardens. The present day chrysanthemum is often referred to as "Guldaudi or Guldawari" but during the early part of this country scientists classified as a short day plant. The standard chrysanthemum varieties have the genetics potential to produce single bigger sized bloom on long sturdy stems and have good keeping quality whereas, flower of spray type varieties of chrysanthemum are grown for cluster of uniform sized flowers. Plant growth regulators and nutrients such as nitrogen, phosphorus and potassium play an important role in respect to growth, flowering and flower yield of chrysanthemum. Normal plant growth and development is controlled by endogenous plants hormones, the chemicals produced by plant itself. Information on physiology and metabolism is neither extensive nor comprehensive and the processes which go on within the plant are very difficult to test. However, some of the studies conduct with regards to occurrence of growth substances suggests that the gibberellins are involved in the developmental physiology of ornamental plants. Growth substances and various other chemicals have been found to regulate growth and flowering in chrysanthemum.

Gibberellic acid (GA_3) has been show to marked variation in response to growth and development depending mainly on the time of application and stage of growth. It is now a well established fact that hormones play a major role indirecting the movement of organic metabolites and in establishing sinks. Application of GA_3 also supplemented low temperature requirement and promoted flowering. Gibberellins are able to manipulate the growth and flowering in plants, but their relative effectiveness varies greatly. The growth regulating chemicals are also becoming extremely important and manipulating growth and flowering of many ornamental plants. For producing dwarf and attractive pot plants some of the growth retardants like Cycocel, B-Nine, Phosphon and Anacymidal have been tried in chrysanthemum, poinsettia, lilium spp. etc. The role of regulating chemicals has to be understood for large scale commercial production. Proper assessment of these chemicals for induction of flowering at desired times and improvement in quality and yield of flower are yet to be made. Cycocel is a synthetic compound which reduces the growth of stem and extended the shelf-life of flowers. Foliar application of CCC at higher concentration caused phytotoxicity although growth retardation was more pronounced with increased concentration. There is also need for more work on growth regulators to replace the long period of low temperature necessary for forcing the plants. The role of regulating chemicals has to be understood for large scale commercial production.

Methods and Materials

The present investigation was carried out at experimental field was laid out at Horticulture Research Farm, Chaudhary Charan Singh University, Meerut with seven treatments like GA_3 applied with three treatment combination *viz*. G_1 (50 ppm), G_2 (100 ppm), G_3 (150 ppm) and CCC applied with three treatment combination *viz*. C_1 (1000 ppm), C_2 (5000 ppm) and C_3 (10000 ppm) and T_0 likely used as (control) when absolutely no plant growth regulators used. The soil was pulverized and the grasses, stubbles and residues of previous crop were removed. Finally, the entire experimental area was leveled according to experimental plan. Transplanting of terminal cuttings of one month old at 10-15 cm. height were treated with 0.2 % bavastin and transplanted at a distance of 30×30 cm. Each plot sixteen cuttings were transplanted. The operation of transplanting was carried out in the afternoon which followed by a light irrigation on the same day with a view to encourage establishment of cuttings. Foliar application of desired concentration of GA_3 and CCC according to the treatment was sprayed on experimental crop 30 and 45 days after transplanting, respectively. The control plants were sprayed with distilled water.

The spraying operation was done through hand atomizer in the early morning hours without wetted by dew. The spraying was continued till the sprayed solution in excess started dripping. Stock solution of GA_3 was prepared by dissolving 150 mg of GA_3 in a small quantity of N/10 sodium hydroxide separately. The P^H of solution was adjusted to 7.0 by adding N/10 hydrochloric acid.

The distilled water was added in solution to make total volume to one liter resulting in to 150 ppm stock solution. The solution of cycocel in various concentrations according to treatment was prepared in distilled water. Cycocel was available in liquid form and used of 50 % strength; therefore, the amount of this chemical dissolved in 1000 ml solution were 1, 5 and 10 ml.

Results and Discussion

Effect of growth regulators on vegetative growth parameters

Plant Height (cm): The finding of present investigation clearly indicates that plant height was increased significantly by the spraying of GA_3. Height of plant is one of the most important parameter of plant growth. Generally, chrysanthemum cultivar Birbal Sahni plant attains about 45 cm height, at the peak stage. All growth regulators showed effects on height of chrysanthemum plant. GA_3 at all concentration showed positive effect on height of plant. The maximum height of plant was recorded 57.49 cm and 58.60 cm from 150 ppm concentration of GA_3 dose which was significantly superior over control and other growth regulators. The capacity of GA_3 to increase plant height has been attributed mainly to it's promontory effects on cell elongation and to a lesser extent due to increase in meristematic activity, is in agreement with the findings of Mohariya *et al.* (2003) and also Talukdar & Paswan (1998) in chrysanthemum. Cycocel showed negligible effect on plant height at various level of concentration. The plant attained height 31.70 cm and 31.61 cm during both the years, which was lowest with 5000 ppm concentration of CCC. The reason may be that the plant heights reduced due to inhibitory effect of cycocel on cell division and expansion because cycocel reduce the utilization of photosynthesis for top growth, as a result bio-mass growth reduce. The favourable effect of CCC in reducing plant height might be, due to the fact, that CCC sprayed reduced growth of plant. A critical examination of the Table 1 showed that GA_3 150 ppm concentration produced maximum height of plant and CCC 5000 ppm concentration was found minimum height of plant of chrysanthemum. Statistically, GA_3 150 ppm concentration proved significantly superior over control and other growth regulators as it produce maximum height of plant. These results are also in support of the work done by (Sharma *et al.* 2000), who reported increased the plant height by GA_3 and reduced plant height with CCC by Talukdar *et al.* (1994).

Plant Spread (cm): The plant spread was measured in this experiment with the help of meter scale at the full bloom stage. The statistical significances of the various treatments of GA_3, cycocel and inorganic fertilizers on this growth attribute. Obviously, the entire three variables affected the plant spread significantly. All concentration of GA_3, tested, promoted this growth measurement invariably. As a result, the spread of plant increased progressively with successive increase in the level of the GA_3 dose. The maximum plant spread (31.16 and 31.79 cm) was significantly under the treatment G_3 with 150 ppm concentration of $GA_{3,}$ followed by (18.70 and 19.22 cm) control. The promotory effect of GA_3 on plant spread, associated, with efficient mobilization capacity, might have been improved vegetative growth. The findings are in conformity with the observation of Dutta *et al.* (2003) in chrysanthemum. The application of CCC was associated, with a sumptuous increase in the spread of plant. The treatments of CCC expansion the plant spread over control. The level of C_2 more expensive the plant spread (22.28 and 22.69 cm) with 5000 ppm concentration of CCC, followed by other level of cycocel C_1 (1000 ppm) and C_3 (10000 ppm) in this experiment. Shah *et al.* (1994) in chrysanthemum reported more plant spread with CCC. The promotive effect of CCC on plant spread may be inferred that apical dominance is usually nullified and convert plants bushy. The results are in agreement with the findings of Talukdar & Paswan (1998).

Table 1: Effect of plant growth regulators on vegetative growth parameters

Treatments	Plant Height (cm)	Plant Spread (cm)	Diameter of Main Stem (cm)	Number of Branches/Plant	Number of Leaves/Plant
G_1	51.20	25.78	1.68	12.82	180.45
G_2	54.79	29.12	1.85	15.73	199.89
G_3	58.60	31.79	1.94	17.22	219.74
C_1	34.13	20.54	1.86	13.61	178.51
C_2	31.61	22.69	1.99	15.14	200.59
C_3	33.93	21.69	1.87	12.39	175.67
T_0 (Control)	41.52	19.22	1.55	11.18	153.71
SEm±	0.44	0.48	0.03	0.68	0.86
CD @ 5%	1.31	1.43	0.09	2.04	2.58

Diameter of Main Stem (cm): Diameter of plant was another important parameter of plant growth with the height of plant concerned. The diameter of plant was also measured at peak stage of plant life. All growth regulators affects the diameter of main stem of plant, normally plant attains (1.53 cm) diameter of main stem, which similar to control (1.53 and 1.55 cm) during both years. GA_3 at all concentration showed positive significant effect over control. GA_3 at 150 ppm concentration showed increasing trend with the increasing concentration of growth regulators for main stem diameter of plant. GA_3 150 ppm concentration statistically, proved to be significantly superior over control and other growth regulators treatments as it produced maximum diameter of main stem (1.92 and 1.94 cm) was recorded, with 150 ppm concentration of GA_3, The reason may be that the diameter of main stem due to in directing the movement of organic metabolites and in establishing sink, is in agreement with the work of Rakesh *et al.* (2005) in chrysanthemum and Dahiya and Rana (2001) also reported the beneficial effect of GA_3 in improving the diameter of main stem. CCC at all concentration showed significant effect on diameter of chrysanthemum plant. CCC 5000 ppm concentration produced maximum diameter of plant 1.97 and 1.99 cm. It's was maximum diameter recorded with all concentration of CCC, while minimum diameter of plant was recorded (1.53 and 1.55 cm) with control. The diameter of main stem is increased due to reduced apical dominance under cycocel treatment and exhibited numerous changes in the growth and production characters. These observations are in accordance with the findings of Koriesh *et al.* (1989) in chrysanthemum. A critical examination of the data presented in Table 1 reveals that maximum diameter of plant (1.97 and 1.99 cm) was recorded, with 5000 ppm concentration of CCC, which was superior over control and all concentration of GA_3. Therefore, it has been concluded that 5000 ppm concentration of CCC significantly increased the diameter of chrysanthemum cv. Birbal Sahni. Talukdar *et al.* (1994) also reported the beneficial effect of GA_3 and CCC for more diameter of main stem.

Number of Branches/Plant: The observations made on the number of branches per plant clearly reveal that the application of GA_3 resulted in the maximum number of branches per plant, followed by the use of CCC concentration, during the period of study. Presented data clearly indicate that the 150 ppm concentration of GA_3 recorded maximum number of branches (16.57 and 17.22 cm). The increase number of branches per plant may be due to promotion of stem elongation, increasing vegetative growth and overcoming the genetic and physiological dwarfism. The above findings are in conformity with the observation made by Gautam *et al.* (2006), who reported increased number of branches in chrysanthemum by GA_3. The various concentration of CCC showed effect on number of branches per plant as the maximum number of branches (14.81 and 15.14 cm) was recorded, with 5000 ppm concentration of CCC. GA_3 and CCC showed superior effect over control. Cycocel show very divergent effects on vegetative growth of various plants regarding number of branches per plant. A critical examination of Table 1 showed the average number of branches per plant that GA_3 150 ppm concentration produced maximum number of branches of chrysanthemum plant. Statistically, GA_3 150 ppm concentration proved significantly superior over control and all concentration of CCC as it produced maximum number of branches. Mehar *et al.* (1999) also reported more number of branches in chrysanthemum with the concentration of GA_3 and CCC.

Number of Leaves/Plant: The number of leaves per plant, an additional parameter of growth is greatly influenced by growth regulators. The effect of growth regulators on number of leaves was observed, at peak stage of plant. The perusal of the data recorded for number of leaves clearly indicates the positive significant effect of growth regulators on number of leaves of chrysanthemum plant. The maximum number of leaves per plant (216.62 and 219.74) was recorded with 150 ppm concentration of GA_3. The promotory effect of GA_3 in increase the number of leaves per plant may be due to the abolition of apical dominance, as gibberellins have been categorically, shown to be instrumental in lifting apical dominance. The above findings are in conformity with the observation of Moond *et al.* (2006). Similar results have also been reported by Rakesh *et al.* (2005. CCC at all concentration showed proved effect on number of leaves as the maximum number of leaves (198.56 and 200.59) was observed with 5000 ppm concentration of CCC. GA_3 and CCC showed slightly superior effect over control. The number of leaves increase due to increased mitotic activities in the apical meristem. The results are in agreement with the findings of Shah *et al.* (1994). A critical examination of Table 1 showed the average number of leaves that GA_3 150 ppm concentration produced maximum number of leaves per plant. CCC at 5000 ppm concentration produced maximum number of leaves of chrysanthemum plant, followed by control. Statistically, GA_3 150 ppm concentration proved significantly superior over control and other concentration of plant growth regulators as it produced maximum number of leaves per plant. Talukdar and Paswan (1998) and Sharma *et al.* (2000) in chrysanthemum reported same view.

Effect of Growth Regulators on Flowering and Yield Parameters

Days Taken to First Flower Bud Appearance: Days required for first flowering bud is an important parameter for flower development of chrysanthemum. It is evident from presented findings that growth regulators favorably effected due to, the days taken to first flowering buds. Generally, plant takes (70 days) for first flowering bud as similar to our control. The experiment was managed under good conditions and the control plant took (70.63 and 70.76 days) for opening the first flower buds. GA_3 hastened the differentiation of flower primordial in chrysanthemum and also reached at this conclusion that gibberellins causes flower initiation indirectly through the production of other flower promoting factors. Similar results were observed by Moond *et al.* (2006). GA_3 at all concentrations showed positive effect on early first flower bud appearance. GA_3 100 ppm concentration produced (62.36 and 62.29) earlier flower bud appearance in comparison to control which increased. In contrary to GA_3, higher concentrations of CCC showed reverse effect of first flower bud appearance. Maximum delayed flower bud appearance (76.27 and 76.39) was observed, with 5000 ppm concentration of CCC. The formation of flowering buds was delayed under the influence of cycocel treatment, possibly due to prolonged vegetative growth. The present findings are in agreement with the observations made by Dahiya and Rana (2001) in chrysanthemum. The perusal of data presented in Table 2 showed that GA_3 100 ppm concentration proved to be superior over control and all concentrations of CCC as produced earliest opening of first flower buds; while CCC 5000 ppm concentration produced maximum delayed the first flowering buds. Similar findings were observed by Talukdar *et al.* (1994) and Koriesh *et al.* (1989) in chrysanthemum.

Days Taken to Flowering: The observations made on the days required for flowering clearly indicate that the application of plant growth regulators advanced the flowering as compared to control, during the period of investigation. The results obtained clearly depict that the application of GA_3 at 100 ppm observed significantly the minimum days (90.50 and 90.23) required for flowering. The present findings are in agreement with the observations made by Sharma *et al.* (2000) in chrysanthemum. It might be due to the fact that gibberellins induce the flowering in long day plants with specific day length requirement. Similar results were also obtained by Mohariya *et al.* (2003). However, the application of CCC at all concentration delayed the flowering in the present investigation. CCC at 5000 ppm concentration required maximum days for flowering (104.61 and 104.59). It was maximum days recorded, with all concentration of CCC, while minimum days for flowering were recorded (98.83 and 98.72), with control. Further the cycocel treatments delayed flowering but extended the periodicity of flowering as compared to untreated plants. A critical examination of the data presented in Table 2 reveals that minimum days required for flowering was recorded, with 100 ppm concentration of GA_3 which was superior over control and all concentration of CCC. Therefore, it has been concluded that CCC 5000 ppm concentration significantly increased the days for flowering of chrysanthemum cv. Birbal Sahni. Similar results were observed by Dahiya and Rana (2001) in chrysanthemum.

Table 2: Effect of plant growth regulators on flowering and yield parameters

Treatments	Days Taken to Appearance of First Flower Bud	Days Taken to Flowering	Number of Flowers/Plant	Flower Size (cm)	Flower Stalk Length (cm)	Flower Weight/ Plant	Flowers Yield Q/Ha	Shelf Life of Flowers (Days)
G_1	64.84	92.29	61.29	3.67	5.37	82.36	91.42	15.24
G_2	62.29	90.23	66.84	3.99	7.48	87.44	97.28	15.87
G_3	65.71	93.18	69.53	4.29	8.46	92.06	102.31	18.29
C_1	72.37	100.72	55.36	3.22	4.86	75.34	83.59	15.95
C_2	76.39	104.59	60.10	3.89	6.19	77.32	86.02	18.63
C_3	74.56	102.68	57.43	3.62	5.31	76.34	84.73	16.73
T_0 (Control)	70.76	98.72	48.17	2.78	4.52	68.46	76.43	13.82
SEm±	0.81	0.58	2.69	0.28	0.49	0.76	0.73	0.54
CD @ 5%	2.44	1.73	1.40	0.86	1.48	2.29	2.20	1.61

Number of Flowers/Plant: The number of flowers per plants is another vital parameter of plant growth as stated in Table 2. Generally, under good management conditions, the chrysanthemum plants usually, have 40 to 45 flowers similar to our control but they increased positively, with increasing dose of growth regulators. Maximum number of flowers was recorded (68.69 and 69.53) with 150 ppm concentration of GA_3. The increase in number of flowers per plant may be due to the abolition of apical dominance, as gibberellins have been categorically, shown to be instrumental in lifting apical dominance. These results corroborate with the findings of Gautam *et al.* (2006) who, reported that GA_3 150 ppm concentration increased number of flowers. CCC at all concentration showed effect on number of flowers (58.49 and 60.10) was recorded, with 5000 ppm concentration of CCC. The treatments of cycocel enhanced the manifold improved in the development of bio-mass and hereby increase number of flowers per plant. So far, it has been concluded that GA_3 at 150 ppm concentration statistically proved superior as produced maximum number of flowers.

Flower Size (cm): Flower size is also an important parameter of flower yield especially for marketing point of view. Generally, under good management condition plant attains (2.65 cm) diameter of flower, which similar to our control (2.66 and 2.78 cm) was recorded. It is evident from the present findings that growth regulators effect favorably, on the diameter of flower. Maximum size of flower (4.38 and 4.29 cm) was observed with GA_3 at 150 ppm concentration. The enhancement in flower size with GA_3 may have been due to a close parallelism between vegetative growth and flowering and it is possible that promontory effect of GA_3 on vegetative growth associated with efficient mobilization capacity. Similar finding were observed by Moond *et al.* (2006). All concentration of CCC showed significantly effect on size of flower. Maximum size of flower (3.80 and 3.89 cm) was observed, with 5000 ppm concentration of CCC. The importance of GA_3 and CCC in promoting flower size in chrysanthemum has been emphasized by many workers. Due to increase rate of photosynthesis and ultimately higher manufacture of photosynthetic increase the flower size. A critical examination of the data presented in Table 2 indicates that GA_3 at 150 ppm concentration produced maximum size of flower comparison to control. Therefore, it can be concluded that GA_3 150 ppm concentration proved significantly superior over control and CCC. Shah *et al.* (1994) reported same results.

Flower Stalk Length (cm): From marketing point of view, length of flower stalk is important parameters of flower growth. It is evident from the data presented in Table 2 that growth regulators favourably, affect the length of flower stalk.

Generally, flower stalk attains (4.50 cm) length close agreement over control (4.47 and 4.52 cm) during both years. The chrysanthemum plants show attendance to increase the stalk length of flower with increasing level of GA_3. GA_3 at all concentration increases the length of flower stalk. Maximum length of flower stalk (8.35 and 8.46 cm) was observed, with 150 ppm concentration of GA_3. The reason may be that the flowers stalk length due to indirecting the movement of organic metabolism and in establishing sink. Similar findings were observed by Deotale *et al.* (1994). CCC at all concentrations significantly affected the flower stalk length. The maximum flower stalk length (6.14 and 6.19 cm) was recorded, with 5000 ppm concentration of CCC. The flower stalk length increased due to reduced apical dominance under cycocel treatment and also increased mitotic activities in the apical meristem. The above findings are in agreement with the observations of Talukdar and Paswan (1994) in chrysanthemum. Therefore, it can be concluded that GA_3 150 ppm concentration proved the beneficial dose over control and all concentration of CCC as produced maximum flower stalk length.

Flowers Weight / Plant (g): The effect of growth regulators on average weight of flowers is shown in Table 2. The perusal of data showed the growth regulators significantly effect the weight of flower per plant. Maximum weight of flower per plant was recorded (89.12 and 92.06 g) with 150 ppm concentration of GA_3. The enhancement in weight of flowers per plant with GA_3 may have been due to a close parallelism between vegetative growth and flowering, and it is possible that promontory effect of GA_3 on vegetative growth, associated with efficient mobilization capacity. The above findings are in agreement with the observations of Moond *et al.* (2006). In case of CCC showed positive effect on weight of flowers. CCC at 5000 ppm concentration produced weight of flowers per plant (76.82 and 77.32 g). The weight of flowers increased due to in addition rate of photosynthesis is also accelerated by earlier formation of flower buds with cycocel, which provides the sink for accepting the surplus assimilates and avoids the accumulation of photosynthetic. Mohariya *et al.* (2003) was recorded the same view in chrysanthemum, who found that the use of CCC for improving the flower weight in chrysanthemum. GA_3 at 150 ppm concentration statistically, proved superior over control and all concentration of CCC during. Now, it was observed from the findings that GA_3 at 150 ppm concentration proved to be more effective dose as it produced the maximum weight of flowers per plant. These findings are in accordance with the finding of Koriesh *et al.* (1989).

Flowers Yield (q/ha): Yield of flowers is important parameters of flower growth. Generally, cultivar Birbal Sahni plant produced flower yield about 75q/ha under favourable conditions which was significantly affected by growth regulators. The control produced (73.94 and 76.43 q/ha) flowers, during the courses of investigation. GA_3 at all concentrations produced significant increase on yield of flowers. Lower concentration of GA_3 produced slight effect, while higher concentration of GA_3 150 ppm produced positive significant effect on flowers yield (99.05 and 102.31 q/ha) during both the years. The enhancement in weight of flowers per plant with GA_3 may have been due to a close parallelism between vegetative growth and flowering, and it is possible that promontory effect of GA_3 on vegetative growth, associated with efficient mobilization capacity. The above findings are in conformity with the observations made by Gupta and Dutta (2001). In case of CCC maximum flowers yield was recorded (84.74 and 86.03 q/ha), with 5000 ppm concentration of CCC. Due to increased rate of photosynthesis and ultimately higher manufacture of photosynthesis increased the flower yield per ha. These results confirmed with the finding of Shah *et al.* (1994), who observed CCC 5000 ppm concentration produced maximum yield of flowers. Therefore, it can be concluded that GA_3 150 ppm concentration statistically, proved significantly superior over control and all concentration of CCC as produced maximum yield of flowers. Similar facts were observed by Dahiya and Rana (2001).

Shelf Life (days): The data presented in Table 2, showed significant effect of growth regulators on shelf life of flowers, during both years. The maximum shelf life (17.61 and 18.29 days) was recorded, with GA_3 150 ppm concentration. The improvement in flower shelf life might have been due to the increase activity of amylase enzyme by $GA_{3,}$ which hydrolyzed the extensive starch reserves and released the reducing sugar. Reducing sugars being osmotic ally active cause an influence of water, resulting in increased shelf life of flowers. CCC at 5000 ppm concentration showed significant effect on shelf life of flowers (18.20 and 18.63 days) was recorded, while minimum number of days on shelf life of flowers (13.25 and 13.82) was observed, under control in same years. The shelf life of flowers is also increased by CCC application due to greater accumulation of photosynthetic; utilization of minerals and translocation of assimilates. The findings are in accordance with the finding of Rakesh *et al.* (2006). Therefore, GA_3 150 ppm concentration proved to be more effective dose produce maximum enhancing the shelf life of flowers over control and all concentration of CCC. Similar results were observed by Koriesh *et al.* (1989). They confirmed that GA_3 150 ppm concentration increase the shelf life of flowers.

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