

EFFECT OF PGRs AND INORGANIC FERTILIZERS ON VEGETATIVE GROWTH AND FLOWERING BEHAVIOUR OF CHRYSANTHEMUM

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ABSTRACT : An experiment was conducted to investigate the effect of PGRs and inorganic fertilizers on vegetative growth and flowering behaviour in chrysanthemum cv. Birbal Sahni and Julia during 2012-13 at Horticulture Research Farm, J V College, Baraut, Baghpat (UP). The three levels of each of GA₃ (100, 200 and 250 ppm) and Cycocel (1000, 3000 and 5000 ppm) and three levels of inorganic fertilizers (F₁: 100 kg N₂ + 60 kg P₂O₅ + 40 kg K₂O/ha; F₂: 150 kg N₂ + 120 kg P₂O₅ + 80 kg K₂O/ha; and F₃: 200 kg N₂ + 180 kg P₂O₅ + 120 kg K₂O/ha) were applied. All the treatments appreciably improved the vegetative growth and flowering attributes of chrysanthemum. Maximum plant height, plant spread, diameter of main stem, number of branches/plant, number of leaves/plant and flowering parameters such as days taken to first flower bud appearance, days taken to flowering, flower size, flower weight/plant and number of flowers/plant were recorded at 150 ppm level of GA₃ and 3000 ppm level of CCC. The inorganic fertilizers also significantly affected the above characters of chrysanthemum.

Keywords : *Chrysanthemum*, growth regulators, inorganic fertilizers, plant growth, flower quality.

Chrysanthemum (*Dendranthema grandiflora* Ramat), belonging to family Compositae, has a second rank in the international cut flower trade. It is native of China and was growing before 500 B.C. It reached in India and other countries in early 19th century. The name "chrysanthemum" is derived from the Greek words "chrysos (gold) and anthos (flower)". Now chrysanthemum is a very popular commercial flower crop in India and abroad. The chrysanthemums are now becoming popular due to its impearled diversity in shape, size, colour and it has a wide range of growth habit and post harvest life. Chrysanthemum is universally popular due to very fascinating flowers of extremely beautiful and colorful 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 and loose flowers in the market.

Chrysanthemum is commonly known as *guldaudi*, *chandramallika*, queen of the east, glory of the east and grown for cut flowers and loose flower purpose in addition to pot culture. It is commercially propagated through root suckers and terminal stem cuttings. Growth substances and various other chemicals have been found to regulate growth and flowering in chrysanthemum and other ornamental plants (Bhosale *et al.*, 1; Kumar *et al.*, 5). Gibberellic acid (GA₃) has shown a marked variation in response to growth and development in flowering crops. Gibberellins are able

to manipulate the growth and flowering in plants (Kumar *et al.*, 5), but their relative effectiveness varies greatly. The growth regulating chemicals are also becoming extremely important in 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. (Moond *et al.*, 8). The role of regulating chemicals has to be understood for large scale commercial production. Cycocel (CCC) is a synthetic compound which reduces the growth of stem and extends the shelf-life of flowers. Foliar application of CCC at higher concentration caused phytotoxicity although growth retardation was more pronounced with increased concentration. In order to improve the growth and flower production with the doses of inorganic fertilizers, the results of work on cultivars Birbal Sahni and Julia was initiated here.

MATERIALS AND METHODS

The field experiment was conducted at Horticulture Research Farm, Janta Vedic College, Baraut, Baghpat, Uttar Pradesh during 2012-13 in a factorial randomized block design. The experiment was consisted with three replications and 27 treatment combinations. Three concentrations of each of GA₃ (G₁: 100 ppm, G₂: 200 ppm and G₃: 250 ppm), and CCC (C₁: 1000 ppm, C₂: 3000 ppm and C₃: 5000 ppm) were sprayed on standing crop at 30 and 45 days after

transplanting through hand atomizer in the cool morning hours when dew dry up. The application of inorganic fertilizers: F₁ (100 kg N₂ + 60 kg P₂O₅ + 40 kg K₂O/ha), F₂ (150 kg N₂ + 120 kg P₂O₅ + 80 kg K₂O/ha) and F₃ (200 kg N₂ + 180 kg P₂O₅ + 120 kg K₂O/ha) was done as per treatment combination. The entire quantities of farm yard manure, phosphorus and potassium and half dose of nitrogen were applied as basal dressing and remaining half amount of nitrogen was applied in two split doses at 30 days interval. Nitrogen, phosphorus and potash were applied through urea, single super phosphate and muriate of potash, respectively. Intercultural operations like weeding, staking, pinching, irrigation and plant protection measures were done as and when necessary. The observations on different parameters (Table 1 and 2) were recorded and analyzed statistically.

RESULTS AND DISCUSSION

Vegetative Growth Parameters

The data depicted in the Table 1 indicated that spray of GA₃ significantly increased the plant height, plant spread, diameter of main stem, number of leaves/plant and number of branches/plant. The plant height increased with the increase in concentration of GA₃ from 100 to 250 ppm and all the treatments of GA₃ significantly increased the plant height over control and other treatments (CCC and inorganic fertilizers). The importance of growth regulators as gibberellic acid and cycocel in promoting vegetative growth has also been emphasized (Kumar *et al.*, 5;

Moond *et al.*, 8). The differences among various concentration of GA₃ were also found significant. However, maximum plant height (58.60 cm) in cv. Birbal Sahni and 46.78 cm in cv. Julia was recorded in plants sprayed with 250 ppm concentration of GA₃. Highest reduction in plant height (31.61 cm and 27.39 cm) was recorded in cv. Birbal Sahni and Julia, respectively with spray of 3000 ppm CCC, while inorganic fertilizers increased the plant height with every increase in amount of NPK in both cultivars. The increase in plant height with the application of GA₃ can be attributed to longer internodes and increased number of internodes which might be due to enhanced cell division and cell elongation in sub apical meristem, increased photosynthesis and respiration along with enhanced CO₂ fixation as reported by Koriesh *et al.* (4). The maximum plant height (48.19 cm and 43.40 cm in Birbal Sahni and Julia, respectively) was observed under the treatment of F₃ (200 kg N₂ + 180 kg P₂O₅ + 120 kg K₂O/ha) over control. All the GA₃, CCC and NPK treatments affected the plant spread significantly over control. The maximum plant spread (31.79 cm and 28.56 cm in both cultivars, respectively) was recorded with treatment of GA₃ 250 ppm in comparison to control (19.22 cm and 18.05 cm, respectively). It was also found maximum (22.69 cm and 20.44 cm in Birbal Sahni and Julia, respectively) with the spray of CCC @3000 ppm. The increased plant spread in cv. Birbal Sahni (25.82 cm) and in cv. Julia (23.76 cm) was also found with the increasing quantity of inorganic fertilizers. The spray of GA₃ @

Table 1: Effect of growth regulators and inorganic fertilizers on vegetative growth of chrysanthemum cvs. Birbal Sahni and Julia.

Treatments	Plant height (cm)		Plant spread (cm)		Diameter of main stem (cm)		No. of leaves /plant		No. of branches /plant	
	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia
Control (T₀)	41.52	38.02	19.22	18.05	1.55	1.26	180.45	187.45	11.18	13.30
GA₃ (ppm)										
G ₁ (100)	51.20	43.76	25.78	24.87	1.68	1.53	199.89	222.75	12.82	16.33
G ₂ (200)	54.79	44.94	29.12	26.09	1.85	1.68	219.74	234.67	15.73	18.55
G ₃ (250)	58.60	46.78	31.79	28.56	1.94	1.77	178.51	217.98	17.22	20.87
CCC (ppm)										
C ₁ (1000)	34.13	30.23	20.54	18.80	1.86	1.71	200.59	220.36	13.61	15.13
C ₂ (3000)	31.61	27.39	22.69	20.44	1.99	1.82	175.67	214.63	15.14	18.20
C ₃ (5000)	33.93	29.42	21.65	19.49	1.87	1.76	171.16	204.03	12.39	14.93
NPK (kg/ha)										
F ₁	44.24	40.33	23.15	21.34	1.67	1.61	176.47	201.78	11.06	17.42
F ₂	46.52	42.41	24.43	22.52	1.69	1.65	187.62	212.90	14.87	18.17
F ₃	48.19	43.40	25.82	23.76	1.72	1.69	153.71	198.07	16.30	19.12
C.D. (P=0.05)	1.31	1.27	1.43	1.11	0.09	1.15	1.23	1.74	2.04	1.34

250 ppm considerably increased the diameter of main stem (1.94 cm and 1.77 cm in Birbal Sahni and Julia, respectively), while with regard of CCC, maximum diameter of main stem (1.99 cm and 1.82 cm in both the cultivars, respectively) was recorded in plants sprayed with 3000 ppm of CCC. Bhosale *et al.*, (1) and Lodhi *et al.* (6) had also reported the beneficial effects of GA₃ and CCC in flower crops. The cultivar Julia responded well to the spraying of GA₃ which showed significantly maximum number of branches/plant (20.87) and maximum number of leaves/plant (234.67) as compared to cv. Birbal Sahni (17.22 branches/plant) and (219.74 leaves/plant).

Flowering Behaviour Parameters

The data depicted in the Table 2 revealed that treatments of 100 ppm, 200 ppm and 250 ppm GA₃ significantly reduced the duration for days taken to flowering (92.29, 90.23 and 93.18 days, respectively) as compared to control (98.72 days). Spray of 3000 ppm CCC resulted in maximum delay (104.59 days) in flowering of cv. Birbal Sahni. 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.* (7). Further, the cycocel treatments delayed flowering but extended the periodicity of flowering as compared to untreated plants. Similar findings were observed by Ram and Sehgal (10) in chrysanthemum.

Application of inorganic fertilizers (F₁, F₂ and F₃) significantly reduced the duration of flowering showing

97.16 days, 95.57 days and 94.67 days, respectively in cv. Birbal Sahni as compared to cv. Julia (91.37, 93.56 and 95.66 days, respectively) and control as well. Earliness in flowering at lower levels of GA₃ was also reported by Dutta *et al.* (2) and Kumar *et al.* (5). The maximum flower size (4.29 cm in Birbal Sahni, and 3.97 cm in Julia) was recorded with 250 ppm concentration of GA₃ over respective controls. The enhancement in flower size with GA₃ might be due to a close parallelism between vegetative growth and flowering and it is possible that promotory effect of GA₃ on vegetative growth associated with efficient mobilization capacity (Moond *et al.*, 8; Dutta *et al.*, 2). The concentration of CCC @ 3000 ppm recorded maximum flower size (3.89 cm in Birbal Sahni and 3.25 cm in Julia) over control and all respective levels of inorganic fertilizers. Similar findings were also observed by Gautam *et al.* (3). Flower weight in cv. Birbal Sahni (92.06 g/plant) and in cv. Julia (88.90 g/plant) was maximum with treatments of CCC. The maximum number of flowers /plant (69.53 and 62.74 in cv. Birbal Sahni and Julia, respectively) was also found with GA₃ spray as compared to control (48.17 and 42.30 flowers/plant) confirming to the reports of Bhosale *et al.* (1) and Nagarjuna *et al.* (9)

Conclusion

The present results revealed that the 250 ppm concentration of GA₃ and 3000 ppm concentration of CCC was found beneficial for plant height, plant spread, diameter of main stem, number of leaves/plant,

Table 2: Effect of growth regulators and inorganic fertilizers on flowering behaviour of chrysanthemum cvs. Birbal Sahni and Julia.

Treatments	Days taken To appearance of first flower bud		Days taken to flowering		Flower size (cm)		Flower weight /plant (g)		No. of flowers /plant	
	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia	Birbal Sahni	Julia
Control (T₀)	64.84	62.76	98.72	96.89	2.78	2.14	68.46	62.65	48.17	42.30
GA₃ (ppm)										
G ₁ (100)	62.29	60.66	92.29	89.50	3.67	3.22	82.36	78.70	61.29	55.76
G ₂ (200)	65.71	63.52	90.23	87.08	3.99	3.45	87.44	82.51	66.84	59.08
G ₃ (250)	72.37	70.73	93.18	90.75	4.29	3.97	92.06	88.90	69.53	62.74
CCC (ppm)										
C ₁ (1000)	76.39	74.45	100.72	98.04	3.22	2.87	75.34	65.64	55.56	50.50
C ₂ (3000)	74.56	72.33	104.59	100.72	3.89	3.25	77.32	70.52	60.10	56.53
C ₃ (5000)	69.26	67.80	102.68	101.44	3.62	3.04	76.34	67.58	57.43	53.67
NPK (kg/ha)										
F ₁	67.46	65.73	97.16	95.66	2.99	2.35	78.41	72.64	56.65	52.41
F ₂	65.82	63.45	95.57	93.56	3.20	2.99	81.36	77.50	60.18	56.75
F ₃	70.76	68.67	94.67	91.37	3.49	3.08	84.16	80.35	65.26	61.40
C.D. (P=0.05)	2.44	2.23	1.73	1.53	0.86	0.67	2.29	2.81	1.40	1.30

number of branches, number of flowers per plant, flower size and flower weight per plant. GA₃ at 200 ppm showed the better effect in respect to days taken to appearance of first flower bud and day taken to flowering. CCC @ 3000 ppm also resulted in maximum increase in above attributes. The application of inorganic fertilizers @ 200 kg N₂ + 180 kg P₂O₅ + 120 kg K₂O /ha was found better for plant height, plant spread, diameter of main stem, number of branches, days taken to flowering, number of flowers per plant, flower size, flower weight per plant, while inorganic fertilizers @ 150 kg N₂ + 120 kg P₂O₅ + 80 kg K₂O/ha was found beneficial for days taken to appearance of first flower bud and days taken to flowering in chrysanthemum cv. Birbal Sahni and Julia.

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