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A Study on the Effect of Growth Substances on Chrysanthemum *(Chrysanthemum indicum* Linn.)

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ABSTRACT

Studies were undertaken during 1970-72 to investigate the effects of MH, CCC, GA and TIBA at varying concentrations on the growth and flowering of two chrysanthemum varieties. The results revealed that plant treated with GA at concentrations ranging from 100 to 400 ppm showed an increase of the plant height, internode length and flower stalk length. A marked early flowering was noted with GA in all concentrations while marked delay in flowering was noted with MH at 1000 ppm and 2000 ppm. The longest duration of flowering and the highest yield were recorded by GA. Reduction in yield was noted with MH and CCC (all concentrations) and TIBA (200 ppm) in the variety Yellow, and MH 1000 ppm and 2000 ppm, CCC 5000 ppm and 15000 ppm and TIBA 100 ppm and 200 ppm in the variety White.

A great deal of interest has been shown in recent years on the use of growth substances to manipulate growth and flowering of ornamental plants. Studies by Srivastava and Bajpai (1964) on calendula and Sen and Maharana (1972) on chrysanthemum and carnation have indicated that MH reduced plant height and internode length. Delay in flowering and reduction in yield due to MH applications have been reported in asters (Jauhari and Amarjit, 1960), in flowering annuals (Sen and Sen, 1968) and in chrysanthemum and carnation (Sen and Maharana, 1972). Growth reductions due to CCC has been observed in chrysanthemums (Lemper, 1964) and in dahlia (Bhattacharjee and Bose, 1972). Delay in flower bud formation and flowering due to CCC was noted by Crittendon *et al.* (1965) in azaleas, Cathey and Stuart (1961) in hydrangea and geranium. A review by Cathey (1964) has shown that flower and fruit yields of most of the horticultural plants were decreased with increase in dosage of CCC.

Observations by Kljuka (1963), Mittal (1967) and Sen and Sen (1968) on various flower crops revealed that GA induced elongation of stem, internode and stalk and increased more number of basal branches. Earliness in flowering due to GA has been reported in azaleas (Martin *et al.* 1961), chrysanthemum (Matukin and Maksimova,1960),dahlia(Mathur and Sharma, 1969) and rose (Kljuka, 1963). Experiments by Singh (1966), Mittal (1967), Sen and Sen (1968), and Parups (1969) indicated higher yields in cineraria, dahlia, flowering annuals and snapdragons respectively. Carpenter and Carlson (1970) found that TIBA

Abbreviations used in the text are: MH = Maleic hydrazide, CCC = (2-chloroethyl) trimethyl ammonium chloride, GA = Gibberellic acid, TIBA = 2, 3, 5 - Tri iodo benzoic acid.

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reduced plant height and stimulated early flowering in geraniums.

The present paper deals with the results of study of some growth substances on field chrysanthemum *(C. indicum)*.

MATERIALS AND METHODS

The investigations were carried out during 1970-72 using White and Yellow varieties of chrysanthemum. The experiments were conducted with potted plants adopting a factorial design with two replications. The treatments consisted of MH at 500, 1000 and 2000 ppm, CCC at 5000, 10000 and 15000 ppm and GA and TIBA at 100, 200 and 400 ppm. The chemicals were sprayed thrice on the plants on the 30th, 45th and 60th day after planting.

Data were recorded on plant height, internodal length, flower stalk length, time of first flowering, total duration of flowering, size of flowers and yield of flowers on five randomly selected representative plants in each treatment. The increase in plant height is obtained from the difference between initial height at planting and final height at the end of flowering. The internodal length was recorded 120 days after planting by measuring the 3rd, 4th and 5th nodes from top and working out the mean values. Flower size represented the diameter of fully developed flowers from middle harvests. Data were collected for two seasons and were statistically analysed.

RESULTS

GA closely followed by TIBA showed significant increase in height in both the varieties. MH produced the shortest plants, the effect being more pronounced with MH at 2000 ppm (vide Table). GA consistently increased the internode length in both varieties, the effect being more prominent at 400 ppm. MH has in general suppressed the internode length. The results with other chemicals were somewhat erratic. The difference among treatments showed that all concentrations of GA proved to be superior while other chemicals exhibited wide variations. In variety White, TIBA at 200 ppm increased the flower size markedly while in variety Yellow, the largest flower size was noted under MH 2000 ppm. CCC in general has consistently reduced the flower size in both the varieties while the results with others were erratic. CCC at 1500 ppm caused yellowing of the leaves and stunting of the plants ultimately resulting in premature defoliation and death in both the varieties.

A markedly earlier flowering was noted with GA in all concentrations while markedly delayed flowering was noted with MH at 1000 ppm and 2000 ppm. The delaying effect was the most pronounced with MH at 2000 ppm while GA at 400 ppm caused the earliest flowering in both the varieties compared to other treatments. The other chemicals did not show consistent results (vide Table). The longest duration of flowering was recorded by GA and the effect of the growth substance was thus to prolong the flowering phase. GA at 200 ppm and 400 ppm was more effective in prolonging the flowering phase in White and Yellow varieties respectively. The duration

was more than control in all the treatments but none showed as interesting a result as GA. In general, the other growth substances showed an inconsistent trend between the two varieties. GA at 100 ppm registered the highest yield with an increase of 14.7 and 12.0 flowers over control in White and Yellow varieties respectively. The greatest yield suppression was observed with MH at 2000 ppm in both the varieties (vide table). Reduction in yield was also noted with MH and CCC (all concentrations) and TIBA (200 ppm) in the variety Yellow and MH 1000 ppm and 2000 ppm, CCC 5000 ppm and 15000 ppm and TIBA 100 ppm and 200 ppm in the variety White.

DISCUSSION

The internodal elongation and consequent increase in plant height resulting from GA application is a well-known effect recorded in several ornamental plants (Mittal, 1967; Sen and Sen, 1968; Parups, 1969; and Sen and Maharana, 1972). Increase in yield due to GA and earliness in flowering have also been noted in annuals by Singh (1966) and Sen and Sen (1968), in snapdragons by Parups (1969), in chrysanthemum and carnation by Sen and Maharana (1972) and in dahlia by Mathur and Sharma (1969).

The growth and yield suppression and delayed flowering by MH and CCC in the present studies generally conformed to earlier results reported by Sen and Sen (1968) and Sen and Maharana (1972). Reduction in internodal length due to MH is attributable to the suppression of apical dominance completely by inhibiting the cell division on the apical meristem, thereby resulting in short internodes (Cathey, 1964). The effects of CCC and TIBA have not, however, shown consistent trends in the present studies in respect to the time of flowering, duration of flowering and yield although Coyne (1969) found CCC to promote early flowering in short day plants. In carnations, Sen and Maharana (1972) found delay in flowering and increase in yield at higher levels of CCC. The present studies have shown a contrary trend in chrysanthemum. Slightly advanced flowering has been noted with TIBA in the present studies with small yield increase with TIBA 400 ppm but not to the same extent as has been claimed for other ornamentals like geranium (Carpenter and Carlson, 1970.)

It is apparent that these two growth retardants have not been as effective with this crop as claimed by several others. According to Chailakhyan (1968), short day plants like chrysanthemum are less sensitive to growth retardants and inadequate or higher concentrations will result only in limited growth responses. The differential performance of the two chrysanthemum varieties to the same set of treatments is indicative of the varying response of cultivars of chrysanthemum.

One practical result of the present study is that GA at concentrations from 100 to 400 ppm can be used for improving the growth and yield and to promote earlier flowering in the commercial chrysanthemum varieties grown on field scale in this part of the country.

Effect of growth substances on the growth and flowering of chrysanthemum varieties

Chemicals	Concentration (ppm)	Increase in height (cm)		Internode length (cm)		Flower stalk length (cm)		Size of flowers (cm)		No. of days for first flowering		Duration of flowering (days)		Yield (No. of flowers	
		White	Yellow	White	Yellow	White	Yellow	White	Yellow	White	Yellow	White	Yellow	White	Yellow
—	Control	39.89	26.37	2.02	2.65	4.6	6.2	3.70	4.20	96.00	96.0	45.4	60.5	31.9	30.
MH	500	33.54	24.73	2.50	2.45	5.3	5.2	3.80	3.45	96.00	101.0	57.0	83.0	34.9	27.
MH	1000	33.13	20.28	2.45	2.10	4.5	5.3	3.90	3.70	104.75	115.5	70.5	63.5	31.7	13.
MH	2000	24.44	16.21	2.45	1.70	4.2	5.4	3.80	4.50	115.00	131.0	74.0	49.0	19.6	14.
CCC	5000	27.04	29.38	2.10	2.40	5.0	4.9	3.60	3.60	95.00	98.0	57.0	85.5	22.3	27.
CCC	10000	35.18	22.92	2.20	2.55	4.8	5.1	3.50	3.45	94.00	93.5	52.0	96.0	32.1	26.
CCC	15000	32.66	32.88	1.90	2.70	5.1	5.1	3.80	3.50	97.25	99.0	59.5	83.0	29.2	30.
GA	100	49.91	47.88	3.85	3.55	8.3	11.8	3.90	3.90	85.25	82.0	98.5	109.0	46.6	42.
GA	200	56.02	37.06	3.95	3.50	8.7	11.1	3.75	4.05	85.25	86.0	99.5	108.5	45.7	42
GA	400	57.38	41.00	4.00	4.55	9.3	11.5	3.70	4.30	84.00	81.5	95.5	110.0	44.3	42
TIBA	100	45.93	29.01	2.90	2.55	5.1	7.4	3.75	3.45	94.50	94.5	62.0	71.5	25.9	31
TIBA	200	49.84	34.65	2.90	2.66	4.7	7.5	4.05	3.70	95.25	98.5	55.5	78.5	28.4	28
TIBA	400	39.70	29.41	2.10	2.95	4.5	7.7	3.95	4.10	93.00	95.0	55.5	64.0	36.5	34
'F' test		Significant		Significant		Significant		Significant		Significant		Significant		Significant	
CD (P=0.05)		7.02		0.171		2.552		0.232		3.48		10.56		7.83	

The delay in flowering induced by MH at 1000 ppm and 2000 ppm is also of value in crop regulation but the reduced yield detracts from its practical application.

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