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Research Article

EFFECT OF DIFFERENT CONCENTRATIONS OF GIBBERELIC ACID, NAPHTHALENE ACETIC ACID AND MALEIC HYDRAZIDE ON VEGETATIVE, FLORAL ATTRIBUTES AND SEED YIELD OF CHINA ASTER [*CALLISTEPUS CHINENSIS* L *NEES*] CV. POORNIMA

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Abstract: The present investigation was conducted to evaluate the vegetative, floral attributes and seed yield of China aster cv. Poornima in response to different concentrations of GA_3, NAA (100, 150, 200 and 250 ppm, each) and MH (500, 600, 700 and 800 ppm) at Floriculture and Landscaping Block, College of Horticulture, VCSG, UUHF, Bharsar, Pauri Garhwal (Uttarakhand) from March to August 2016. The experiment was laid in randomized block design which replicated thrice. The results revealed that plants sprayed with GA_3 @ 200 ppm produced maximum plant height (85.69 cm), number of secondary branches per plant (35.83) and plant spread (33.95 cm). With respect to floral attributes, minimum number of days taken to first flower bud initiation and flower bud opening (57.19 and 83.56, respectively) and maximum duration of flowering (28.11 days), stalk length (39.82 cm), flower diameter (8.80 cm), flower weight (5.16 g), number of flowers per plant and per plot (48.76 and 418.56, respectively) were also found in same treatment. Among seed yield parameters, test weight (1.58 g), seed yield per plant and plot (6.38 g and 55.86 g) were recorded highest from plants sprayed with GA_3 200 ppm. The results also showed that application of different concentrations of MH was effective in reducing plant height and improving various quality traits in plants as compared to control.

Keywords: China aster, GA_3, NAA and MH

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Introduction

China aster (*Callistephus chinensis* L. *Nees*) is one of the important commercial flower crop. It belongs to the family Asteraceae and native to China. The name of the genus Callistephus is derived from two Greek words kalistos meaning most beautiful and stephos means a crown, referring the flower head. It is a half hardy winter annual crop generally grown for cut as well as loose flower purpose. Among annual flower crops, it ranks next to chrysanthemum and marigold. The flowers are used for various purposes like preparation of bouquets, buttonholes and garland. In landscaping it is used as bedding plants, pot plant and herbaceous border. A wide variety of colour, an easy ease of its cultivation and good vase as well as shelf life make it popular flower crop among grower. Among the various factors, which contribute to the growth, flower quality and yield plant bio-regulators are important aspect of crop production. They are the organic chemical compounds which modify or regulate physiological processes in plants. They are readily absorbed and move rapidly through tissues when applied to different parts of the plant. The exogenous application of growth regulators stimulate flowering, pollination, fertilization and seed setting to yield better quality seeds [1]. The growth retardants helps in producing dwarf plants with compact shape flowers as well improving the flower longevity [2].The various study indicated that pre-harvest application of plant growth regulators and chemicals helps in prolonging the vase life of flowers by reducing senescence in many ornamental crops. The most widely available plant growth regulators are GA_3 and NAA which increase the plant growth by enhancing the cell division and cell elongation in meristematic tissues whereas MH is a growth retardant which slows down the cell division and cell elongation.

Keeping the above points in view, a comprehensive study was conducted to assess the effect of foliar spray of different concentrations of GA_3, NAA, and MH on vegetative, floral attributes and seed yield of China aster cv. Poornima.

Materials and methods

The experiment was conducted at the College of Horticulture, Veer Chandra Singh Garhwali, Uttarakhand University of Horticulture and Forestry, Bharsar, District Pauri Garhwal (Uttarakhand) from March to August 2016. The experiment was laid out in Randomized Complete Block Design with 13 treatments and replicated thrice. Treatments consist of T_1-Control , T_2-GA_3 (100 ppm), T_3-GA_3 (150 ppm), T_4-GA_3 (200 ppm), T_5-GA_3 (250 ppm), T_6-NAA (100 ppm), T7-NAA (150 ppm), T_8-NAA (200 ppm), T_9-NAA (250 ppm), T_{10}-MH (500 ppm), T_{11}-MH (600 ppm), T_{12}-MH (700 ppm) and T_{13}-MH (800 ppm). Uniform size seedlings of China aster cv. Poornima were transplanted in field at a spacing of 30 cm x 30 cm. The treatments were imposed as foliar sprays at 25 and 50 days after transplanting. Standard cultural practices were followed uniformly for all the experimental plots. The observations on vegetative, floral and seed yield were recorded and analysed statistically as per the procedure [3].

Results and Discussion

The data pertaining to the various observations recorded on vegetative attributes are presented in Table 1. The data revealed that maximum plant height (85.69 cm) and found statistically at par with treatment GA_3 @ 150 ppm (82.46 cm). However, the plants grown in control plots recorded plant height of 65.80 cm.

Table-1 Effect of different concentrations of GA3, NAA and MH on vegetative and floral attributes of China aster cv. Poornima

Treatments	Plant height (cm) ± S.E(m)	No. of secondary branches plant^{-1} ± S.E(m)	Plant spread (cm) ± S.E(m)	No. of leaves plant^{-1} ± S.E(m)	Leaf area (cm^2) ± S.E(m)	Days taken to flower bud initiation ± S.E(m)	Days taken to first flower bud opening ± S.E(m)
T_1 (Control)	65.80 ± 0.62	18.73 ± 0.44	22.88 ± 0.69	240.24 ± 3.24	11.32 ± 0.72	70.20 ± 1.31	99.86 ± 1.22
T_2 (GA_3 100 ppm)	79.90* ± 2.27	27.19* ± 0.93	29.87* ± 0.68	256.53 ± 6.96	12.68 ± 1.47	58.00* ± 0.30	85.29* ± 0.66
T_3 (GA_3 150 ppm)	82.46* ± 1.36	25.80* ± 1.42	29.09* ± 0.40	264.51* ± 7.74	10.58 ± 1.16	58.10* ± 0.25	85.16* ± 0.34
T_4 (GA_3 200 ppm)	85.69* ± 2.77	35.83* ± 0.43	33.95* ± 0.73	315.18* ±13.73	11.60 ± 0.65	57.19* ± 0.52	83.56* ± 1.16
T_5 (GA_3 250 ppm)	76.59* ± 1.38	32.50* ± 0.55	31.95* ± 0.41	322.76* ± 8.64	10.59 ± 2.01	60.46* ± 0.17	87.33* ± 1.04
T_6 (NAA 100 ppm)	66.18 ± 0.65	20.51 ± 1.04	25.53* ± 1.08	293.73* ± 7.84	10.22 ± 0.97	72.80* ± 0.72	102.40* ± 1.10
T_7(NAA 150 ppm)	69.59 ± 1.42	19.60 ± 0.66	24.45 ± 0.63	269.99* ± 7.45	10.75 ± 0.78	73.91* ± 0.90	102.33* ± 0.69
T_8 (NAA 200 ppm)	70.46* ± 2.37	18.77 ± 0.50	24.67 ± 0.63	320.45* ± 14.22	8.45 ± 1.39	72.33* ± 0.69	104.06* ± 0.72
T_9 (NAA 250 ppm)	72.10* ± 2.01	21.20* ± 0.95	25.72* ± 1.60	303.12* ± 12.71	11.81 ± 1.32	75.23* ± 0.52	107.39* ± 0.57
T_{10} (MH 500 ppm)	59.18* ± 1.00	30.68* ± 0.80	28.73* ± 1.57	230.32 ± 11.34	9.63 ± 1.82	63.73* ± 0.43	92.91* ± 0.34
T_{11} (MH 600 ppm)	57.74* ± 0.99	28.06*± 0 .26	27.07* ± 1.71	220.77 ± 8.94	8.82 ± 0.52	64.82* ± 0.06	91.86* ± 0.77
T_{12} (MH 700 ppm)	55.74* ± 0.95	24.33* ± 0.92	25.96* ± 0.67	198.08* ± 3.5	11.03 ± 1.36	66.37* ± 0.23	93.10* ± 0.37
T_{13} (MH 800 ppm)	53.38* ± 1.11	20.73 ± 0.82	25.84* ± 0.77	189.38* ± 3.27	10.18 ± 1.03	64.30* ± 0.55	93.36* ± 0.39
S.E(d)	2.10	1.09	1.09	9.94	1.64	0.88	0.90
$C.D_{(0.05)}$	4.34	2.25	2.26	20.51	3.38	1.83	1.88

*Significant at 5% level of significance with control

Table-2 Effect of different concentrations of GA3, NAA and MH on floral attributes of China aster cv. Poornima

Treatments	Duration of flowering (days) ± S.E(m)	Stalk length of flower (cm) ± S.E(m)	Flower diameter (cm) ± S.E(m)	Flower weight (g) ± S.E(m)	Number of flowers plant^{-1} ± S.E(m)	Number of flowers plot^{-1} ± S.E(m)	Vase life (days) ± S.E(m)	Shelf life (days) ± S.E(m)
T_1 (Control)	15.67 ± 0.89	29.51± 0.88	7.57 ± 0.14	3.96 ± 0.17	23.87 ± 1.38	207.86 ± 10.43	6.66 ± 0.33	1.66 ± 0.33
T_2 (GA_3 100 ppm)	23.41* ± 1.04	36.27* ± 1.18	8.57* ± 0.17	4.58* ± 0.12	42.29* ± 1.74	378.64* ± 13.27	10.00* ± 0.57	3.00* ± 0.00
T_3 (GA_3 150 ppm)	23.99* ± 1.28	37.95* ± 0.77	8.66* ± 0.20	4.73* ± 0.49	39.88* ± 0.69	341.31* ± 12.40	10.00* ± 0.00	3.33* ± 0.33
T_4 (GA_3 200 ppm)	28.11* ± 1.58	39.82* ± 0.29	8.80* ± 0.05	5.16* ± 0.12	48.76* ± 1.05	418.56* ± 6.12	10.33* ± 0.66	3.33* ± 0.33
T_5 (GA_3 250 ppm)	24.68* ±1.04	37.94* ± 0.28	8.27* ± 0.09	4.44* ± 0.14	38.86* ± 1.26	351.07* ± 10.95	10.66* ± 0.33	3.66* ± 0.33
T_6 (NAA 100 ppm)	22.53* ± 0.92	31.57* ± 0.91	7.42 ± 0.25	3.89 ± 0.02	30.32* ± 3.20	264.54* ± 26.32	10.00* ± 0.57	2.66* ± 0.33
T_7(NAA 150 ppm)	22.07* ± 0.77	32.43* ± 0.91	7.51 ± 0.16	3.79 ± 0.04	26.72 ± 0.57	230.54 ± 4.74	9.66* ± 0.33	2.33 ± 0.33
T_8 (NAA 200 ppm)	20.55* ± 0.15	33.02* ± 0.97	7.53 ± 0.19	3.82 ± 0.07	25.20 ± 0.49	221.46 ± 2.38	8.66* ± 0.33	3.00* ± 0.00
T_9 (NAA 250 ppm)	20.09* ±0.75	33.29* ± 0.58	7.63 ± 0.13	4.10 ± 0.13	27.22 ± 1.11	235.31± 8.79	9.00* ± 0.00	2.66* ± 0.33
T_{10} (MH 500 ppm)	19.45* ± 0.69	27.87 ± 0.53	6.54* ± 0.20	3.83 ± 0.08	33.69* ± 1.56	295.24* ± 14.29	7.33 ± 0.66	2.00 ± 0.00
T_{11} (MH 600 ppm)	18.21* ± 0.55	27.21* ± 1.00	6.48* ± 0.13	3.64* ± 0.04	31.87* ± 2.00	283.49* ± 24.77	7.66 ± 0.33	2.33 ± 0.33
T_{12} (MH 700 ppm)	18.80* ± 0.50	26.74* ± 0.44	6.51* ± 0.15	3.52* ± 0.13	29.64* ± 2.40	266.82* ± 28.59	8.00* ± 0.00	2.66* ± 0.33
T_{13} (MH 800 ppm)	17.78 ± 0.37	26.19* ± 0.23	6.24* ± 0.11	3.38* ± 0.09	33.14* ± 2.80	291.98* ± 22.85	8.33* ± 0.33	2.33 ± 0.33
S.E(d)	1.07	0.80	0.23	0.15	2.57	23.86	0.54	0.41
$C.D_{(0.05)}$	2.21	1.66	0.48	0.31	5.35	49.55	1.13	0.85

*Significant at 5% level of significance with control

Table-3 Effect of different concentrations of GA3, NAA and MH on seed yield of China aster cv. Poornima

Treatments	Seed yield plant^{-1}(g)± S.E(m)	Seed yield plot^{1}(g)± S.E(m)	Test weight (g)± S.E(m)
T_1(Control)	3.16 ± 0.14	25.74 ± 1.15	0.99 ± 0.01
T_2 (GA_3 100 ppm)	5.44* ± 0.13	45.62* ± 2.08	1.41* ± 0.04
T_3 (GA_3 150 ppm)	5.60* ± 0.12	47.40* ± 1.09	1.43* ± 0.02
T_4(GA_3 200 ppm)	6.38* ± 0.23	55.86* ± 1.41	1.58* ± 0.03
T_5(GA_3 250 ppm)	6.04* ± 0.05	52.42* ± 1.39	1.48* ± 0.02
T_6(NAA 100 PPM)	5.14* ± 0.24	44.76* ± 1.32	1.36* ± 0.02
T_7(NAA 150 ppm)	5.07* ± 0.13	43.82* ± 0.89	1.38* ± 0.01
T_8(NAA 200 ppm)	4.95* ± 0.15	40.48* ± 0.82	1.34* ± 0.01
T_9(NAA 250 ppm)	4.69* ± 0.23	38.46* ± 0.28	1.30* ± 0.01
T_{10}(MH 500 ppm)	3.44 ± 0.25	28.98* ± 1.34	1.01 ± 0.01
T_{11}(MH 600 ppm)	3.73* ± 0.12	30.20* ± 0.42	1.02 ± 0.02
T_{12} (MH 700 ppm)	4.09* ± 0.13	33.97* ± 1.13	1.17* ± 0.02
T_{13} (MH 800 ppm)	4.34* ± 0.23	35.29* ± 1.52	1.24* ± 0.02
S.E(d)	0.18	1.41	0.03
$C.D_{(0.05)}$	0.37	2.92	0.07

*Significant at 5% level of significance with control

Data also showed that plant sprayed with different concentrations of MH produced dwarf plant. The minimum plant height (53.38 cm) was recorded from the plant sprayed with MH 800 ppm and statistically at par with MH 700 ppm (55.74 cm). The increase in plant height under GA_3 treatment might be due to that application of gibberellins helps in increasing the level of auxin in tissues. It also enhances the conversion of tryptophan to IAA which causes cell division and cell elongation. This can also be due to the increased plasticity of cell, promotion of protein synthesis coupled with higher apical dominance as an effect of GA_3. Similar result was reported by Doddagoudar *et al*. [4] in China aster. Minimum plant height was recorded in MH @ 800 ppm might be due to MH act as anti auxin which causes nullification of apical dominance i.e., inhibition of cell division and cell elongation in meristem tissues that finally lead to dwarfing effect on plant growth. These findings corroborate the results reported by Navale *et al*. [5] in chrysanthemum.The maximum number of secondary branches per plant (38.83) and plant spread (33.95 cm) were recorded from the plants sprayed with GA_3 200 ppm followed by GA_3 250 (32.50 and 31.95 cm, respectively). Data showed that minimum number of secondary branches per plant (18.73) was found in control and statistically at par T_7, T_8 and T_{13} (19.60, 18.77 and 20.73, respectively). In case of plant spread, minimum plant spread was recorded in T_1 (22.88 cm). All the applied treatments significantly increase the plant spread as compared to control. The increase in number of secondary branches per plant with the application of GA_3 might be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with high dry matter accumulation in the plants. Similar, results was reported by Nandre *et al*. [6] in China aster. Increase in number of secondary branches under MH treatments might be due to its inhibitory effect on cell division of the apical bud which subsequently might have retarded the growth of the main axis and this in turn would have accelerated the growth of lateral buds and enhanced the number of branches. These finding is in accordance with report of Parwal *et al*. [7] in Damask rose. Increase in plant spread under GA3 200 ppm might be due to production of more number of branches as well as leaves under this treatment. This finding was in accordance with the results obtained by Singhrot *et al*. [8] in chrysanthemum. Data depicted in Table 1 showed that plants applied with GA_3 @ 250 ppm produced maximum number of leaves per plant (322.76) which was found statistically at par with the plants applied with treatment NAA @ 200 ppm, GA_3 @ 200 ppm and NAA @ 250 ppm (320.45, 315.28 and 303.12 respectively). This might be due to the increase in plant height and number of branches per plant. Similar result was recorded by earlier research worker Padaganur *et al*. [9] in tuberose. Plants sprayed with different concentrations of MH produced minimum numbers of leaves per plant (189.38) in MH @ 800 ppm which was found statistically at par with MH @ 700 ppm (198.08). Reduction in number of leaves due to Maleic Hydrazide over control in this trial is in contrary with the findings of Kumar *et al*. [9].With respect to leaf area, data showed that application of different concentrations of GA_3, NAA and MH had showed at par results with the control. The data pertaining to the days taken to first flower bud initiation and opening of China aster cultivar Poornima is depicted in Table 2. Data revealed that minimum days taken to flower bud initiation (57.19) and opening (83.56) were recorded from the plants sprayed with GA_3 @ 200 ppm (T4) which was found statically at par with GA_3 @ 100 ppm and GA_3 @ 150 ppm (58.00 days, 58.10 days for bud initiation and 85.29 days, 85.16 days for opening respectively). Minimum days taken for bud initiation and flower bud opening in China aster in gibberellic acid treated plants might also be due to the increase in the endogenous gibberellins level in the plant which normally promotes flowering by reducing the juvenile period and the shoot apical meristem instead of producing leaves and branches starts producing buds. The result is in accordance Patel *et al*. [10] in chrysanthemum. Maximum days taken to first bud initiation (75.23) and opening (107.39 days) were recorded in plants applied with NAA @ 250 ppm. The delay in flowering might be attributed to the resultant enhanced apical dominance, which promotes the vegetative phase and ultimately delays flowering. Similar findings were also recorded by Palei *et al*. [11] in African marigold. The maximum flowering duration (28.11 days) was recorded from the plants sprayed with T_4. However, minimum duration of flowering (15.67 days) was observed from the plants grown in the T_1 and was statistically at par with T_{13} (17.78 days). The result is in accordance with Kumar *et al*. [12]. Data presented in Table 2 data revealed that maximum stalk length of the flower (39.82 cm) was observed from plants sprayed with GA_3 @ 200 ppm. This might be due to the fact that gibberellic acid promotes cell division and cell elongation resulting in longer stalks. The minimum flower stalk length (26.19 cm) was recorded from the plants grown in plots applied with MH @ 800 ppm. The maximum flower diameter (8.80 cm) and flower weight (5.16 g) were recorded from T_4 followed by T_3 (8.66 cm and 4.73 g) and T_2 (8.57 cm and 4.58 g). The result is in conformity with Sainath *et al*. [13] annual chrysanthemum. Increase in weight of flower in treated plants might be attributed to the fact that GA_3 promoted the efficacy of plants in terms of photosynthetic activity, uptake of nutrients and their translocation, better partitioning of assimilates into reproductive parts. This result is in agreement with those reported by Gopichand *et al*. [14] in African marigold. The minimum flower diameter (6.24 cm) and flower weight (3.38 g) were recorded from T_{13}. The decrease might also be due to inhibitory activity of MH on cell division at the growing tips, as an auxin antagonist. The result is in conformity with the observations of Sethy *et al*. [15]. Data recorded on total number of flowers per plant depicted in Table 2 revealed that the maximum number of flowers per plant (48.76) and number of flowers per plot (418.56) were recorded from T_4. Minimum number of flowers plant^{-1} (23.87) and numbers of flowers plot^{-1} (207.86) were noticed T_1. The increase in the number of flowers per plant as well as per plot might be due to the increase in the number of branches. Greater dry matter accumulation might be another reason which is certainly suggestive to better photosynthetic activity, other metabolic activities and uptake of nutrients from soil. Therefore, the growth promoting substances might have positive influence on the yield of flowers. The present finding is in conformity with the results of Chopde *et al*. [16] in gladiolus. On perusal of data presented in Table 2 that maximum vase life (10.66 days) and shelf life (3.66 days) were found from flowers harvested from the plants sprayed with GA_3 @ 250 ppm (T_5). The plant treated with GA_3 200, 150 and 100 ppm showed statistically at par results with T_5 with respect to vase and shelf life. Minimum vase life (6.66 days) and shelf life (1.66 days) was recorded from flowers harvested from the plants grown in control. Improvement in vase life of flowers owing to the application of GA_3 might be attributed to the maintenance of higher levels of RNA in leaves thus delaying senescence. The results were in conformity with the findings of Vaghasia and Polara [17] in chrysanthemum. The data pertaining to the effect of different concentrations of GA_3, NAA and MH on the seed yield is presented in Table 3. The application of GA_3 @ 200 ppm registered significantly maximum seed yield plant^{-1}(6.38 g), seed yield plot^{-1} (55.86 g) and test weight (1.58 g). Minimum seed yield plant^{-1} (3.16 g), seed yield plot^{-1} (25.74 g) and test weight (0.99 g) was noticed in (T_1) i.e. control. The above results are in conformity with the findings of Swaroop *et al*. [18] in African marigold. Increase in seed yield plant^{-1} and seed yield plot^{-1} could be attributed to increase in number of primary and secondary branches plant^{-1}, number of flowers plant^{-1} and number of flowers plot^{-1} under this treatment. The increase in test weight might be due to increase in individual seed weight by the application of GA_3.The result is in line with the reports of Kumar *et al*. [19] and Kumar *et al*. [20] in China aster.

Conclusion

It can be concluded that two foliar sprays of GA_3 @ 200 ppm at 25 and 50 days interval were found more effective in bringing significant improvement in vegetative, floral and seed yield attributes of China aster *cv*. Poornima. However, application of MH @ 800 ppm was found effective in reducing plant height.

Application of research: China Aster is one of the important commercial flower crops of India. Its flower is used both as cut and loose flower purpose. The use of plant growth regulator helps in improving the quality and quantity of plant which helps the farmers for getting the higher return

Research Category: Horticulture

Abbreviations GA_3= Gibberellic Acid, NAA = Naphthalene Acetic Acid, MH= Maleic Hydrazide, CD= critical difference, g= gram, cm= centimetre

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