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Original Research Article

Effect of Nitrogen and Phosphorus on Plant Growth, Yield and Flower Quality of China aster Under Allahabad Agro-Climatic Condition

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Keywords

China Aster, Nitrogen, Phosphorus, Growth, Yield and Quality

A B S T R A C T

An experiment was carried out at research station, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad, India, during 2011-12 rabi season. The experiment was laid out in factorial randomized block design with 16 treatments in three replications. The treatments comprised of 4 levels of both Nitrogen (0, 50, 100 and 150 kg/h) and Phosphorus (0, 30, 60 and 90 kg/h) in different combinations. Observations were recorded on plant growth, flower yield and quality characters at different days intervals. The results revealed that among all the treatments, the interaction of N_3P_3 (150kg/h N and 90kg/h P) produced significantly tallest plant (20.55cm), highest plant spread (21.33cm) with maximum number of branches (15.33) and more number of leaves per plant (15.33), earliest in days of first flower bud initiation (40.33) with maximum number of flowers (24.67), whereas maximum flower diameter (7.67cm), maximum fresh weight of flower (17.27gm) and dry weight of flower (1.67gm) was also recorded with the interaction of N_3P_3 (150kg/h N and 90kg/h P). The interaction of N_3P_3 (150kg/h N and 90kg/h P) also produced significantly maximum flower yield per plant, per plot and per hectare, respectively (179.34gm, 2.15kg and 19.93t/ha, respectively) as compared to control (To).

Introduction

Present status of floriculture is very profitable as a money spinner industry through worldwide. India has a long tradition of cultivating flowers and these are being cultivated throughout the country on small holdings. Among the flowers China aster is one of the most popular garden flowers grown throughout the world. It is a showy and free blooming annual and is grown in pots, beds and herbaceous border. China aster (*Callistephus chinensis* L. Nees) is an annual flower belonging to the family Asteraceae. It is a half hardy annual, native of China and Japan. China aster is commercially grown in southern states especially in Karnataka, Tamilnadu, Maharashtra and Andhra Pradesh. In Karnataka it accounts for 5% of the total area and 8% of the total flower production.

The flowers are commercially used as cut flowers for Interior decoration as well as for flower arrangement and religious offerings. Some strains are used for edging and in window boxes. The wide spectrum of colour ranges (blue, purples, pink and white)

available in aster with long vase life has made aster a very popular cut flower (Tembhare *et al.,* 2016).

Agricultural prosperity of any region is attributed to fertility status of soil of that region. An ideal fertile soil is not only characterized by optimum physical properties and chemical constituents conductive for plant growth but also by microbiological process, which are maintains equilibrium. In fact, wild ecosystem have sustained through centuries by means of such natural inter conversions of essential element. The modern day intensive crop cultivation requires extensive use of chemical fertilizers but fertilizers are not only in short supply but they are expensive in developing countries.

Nutrients play an important role in the improvement of vegetative growth, flowering, seed yield and quality parameters in China aster (Chezhiyan *et al.,* 1986). At present, due to lack of scientific knowledge, growers are not able to boost the productivity of China aster. In view of this fact and overriding need was felt to conduct research on to find out the of nitrogen and phosphorus fertilizers for higher production in China aster. Hence, this study was conducted to optimize the response of nitrogen and phosphorus on flowering, seed yield and quality of China aster.

Materials and Methods

The research work was carried out under the Allahabad agro climatic conditions at the experimental field of the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, in the month of November to March during winter season, 2011-12. The experiment was laid out in factorial randomized block design with 16 treatments in three replications. The treatments comprised of 4 levels of both Nitrogen (0, 50, 100 and 150 kg/h) and Phosphorus (0, 30, 60 and 90 kg/h) in different combinations i.e. T_0 (Control, N_0P_0), T_1 [N.P. (0:30) kg/ha (N_0P_1)], T_2 [N.P. (0:60) kg/ha (N_0P_2)], T_3 [N.P. (0:90) kg/ha (N_0P_3)], T_4 [N.P. (50:0) kg/ha (N_1P_0)], T_5 [N.P. (50:30) kg/ha(N_1P_1)], T_6 [N.P. (50:60) kg/ha (N_1P_2)], T_7 [N.P. (50:90) kg/ha (N_1P_3)], T_8 [N.P. (100:0) kg/ha (N_2P_0)], T_9 [N.P. (100:30) kg/ha (N_2P_1)], T_{10} [N.P. (100:60) kg/ha (N_2P_2)], T_{11} [N.P. (100:90) kg/ha (N_2P_3)], T_{12} [N.P. (150:0) kg/ha (N_3P_0)], T_{13} [N.P. (150:30) kg/ha (N_3P_1)], T_{14} [N.P. (150:60) kg/ha (N_3P_2)], T_{15} [N.P. (150:90) kg/ha (N_3P_3)]; which allocated randomly in each replications. Observations were recorded on following growth and flowering parameters i.e. plant height (cm), plant spread (cm), number of primary branches, number of leaves per plant, days taken two first bud initiations, flower diameter (cm), fresh weight of flower (gm) and dry weight of flower (gm), number of flowers per plants, flower yield per plant (gm), per plot (kg) and per hectare (t/ha). The statistical analysis of data collected was done by following standard procedure described by Panse and Sukhatme (1967).

Results and Discussion

Effect of Nitrogen

The data presented in table 1 revealed that the better plant growth was observed might be due to the beneficial effect of nitrogen, while the decrease in the plant growth may be due to unavailability of sufficient nutrients at critical stages to plant for luxuriant growth (Chaitra, 2006). An increasing level of nitrogen in N_3 (150kg N/ha^{-1}) significantly influenced the plant height (18.33cm), plant spread (18.88cm),

number of branches per plant (12.51) and number of leaves per plant (13.40). The growth parameters were increased due to higher photosynthesis and N is a very important constituent of nucleic acid protoplasm. Like growth characteristics minimum days taken to first flower bud initiation (42.67) and maximum number of flower per plant (34.76), flower diameter (7.33 cm), fresh weight of flower (5.88g) and dry weight of flower (1.28g) were recorded as maximum flowering values (table 2) with the application of N_3 (150kg N/ha^{-1}); whereas enhanced yield is also noted as yield per plant (125.3 g), yield per plot (1.50 kg) and total yield (13.92 t/ha) with the application of N_3 (150kg N/ha^{-1}) as depicted in table 2. While control N_0 (0kg/ha) was performed lowest as compared to N_3. These results are in closer conformity with Nagaich *et al.,* (2003) and Muktanjali *et al.,* (2004) in China aster.

Effect of Phosphorus

A perusal of data (table 1 and table 2) reveals that an increased level of Phosphorus in P_3 (90kg P/ha^{-1}) significantly influenced the plant height (18.82cm), plant spread (19.36cm), number of branches per plant (13.11) and number of leaves per plant (13.86). Growth characters influenced due to phosphorus application as it is the essential component of protoplasm and chlorophyll which caused conversion of photosynthates into phospholipids resulting adequate vegetative growth. Like growth characteristics minimum days taken to first flower bud initiation (42.74) and maximum number of flower per plant (21.25), flower diameter (6.78 cm), fresh weight of flower (6.08 g) and dry weight of flower (1.32g) were recorded as maximum values with the application of P_3 (90kg P/ha^{-1}); whereas enhanced yield is also noted as yield per plant (133.3 g), yield per plot (1.60 kg) and total yield (14.81 t/ha) with the application of P_3 (90kg P/ha^{-1}). While control P_0 (0kg/ha) was performed lowest as compared to P_3. Similar results were reported by Muktanjali *et al.,* (2004) and Nath *et al.,* (2010) in China aster.

Interaction effect

Data illustrated in both table (table 1 and 2) indicated that most of the vegetative, flowering and yield attributes studies were significantly increased with increasing level of nitrogen (upto 150 kg ha^{-1}) and phosphorus (upto 90 kg ha^{-1}) due to their interaction effects simultaneously. Application of 150 kg N + 90 kg P was the most favorable combination to perform highest values regarding plant height (20.55cm), plant spread (21.33cm), number of branches per plant (15.33), number of leaves per plant (15.33) and minimum days taken to first flower bud initiation (40.33). The interactive effects of higher levels of nitrogen and phosphorus also found to be significant in case of maximum number of flower per plant (24.67), flower diameter (7.67 cm), fresh weight of flower (7.27 g) and dry weight of flower (1.67 g). The interaction of N_3P_3 (150kg/h N and 90kg/h P) also produced significantly maximum flower yield per plant, per plot and per hectare (179.34gm, 2.15kg and 19.93t/ha, respectively) as compared to control (To). Increase in most of the quality and yield attributing traits of China aster was due the synergistic effects of most of the essential growth elements which increased the plant growth and yield contributing attributes by synthesis of assimilates and their translocation to sink. The findings are in conformity with the results of Kishore *et al.,* (2010). They revealed that, an application of nitrogen at 150 kg ha^{-1} in combination with phosphorus at 80 kg ha^{-1} had recorded maximum values.

Table.1 Effect of nitrogen and phosphorus on plant growth of China aster

Treatments	Plant Height (cm)	Plant spread (cm)	Number of primary branches	Number of leaves per plant	Days to first flower bud initiation
N_0	15.47	15.68	7.99	10.29	48.83
N_1	17.53	17.97	11.40	12.57	44.00
N_2	17.86	18.35	11.86	12.97	43.33
N_3	18.33	18.88	12.51	13.40	42.67
SeD	0.04	0.04	0.06	0.05	0.12
CD	0.08	0.08	0.11	0.09	0.24
P_0	16.02	16.35	8.89	10.84	47.00
P_1	16.79	17.19	10.17	11.70	45.26
P_2	17.57	17.97	11.60	12.83	43.83
P_3	18.82	19.36	13.11	13.86	42.74
SeD	0.04	0.04	0.06	0.05	0.12
CD	0.08	0.08	0.11	0.09	0.24
$N_0 P_0$	15.00	15.00	7.33	9.88	50.44
$N_0 P_1$	15.33	15.55	7.67	10.17	48.88
$N_0 P_2$	15.67	15.88	8.27	10.44	48.33
$N_0 P_3$	15.88	16.27	8.67	10.67	47.67
$N_1 P_0$	16.07	16.44	9.00	10.88	47.00
$N_1 P_1$	17.00	17.44	10.33	11.67	44.67
$N_1 P_2$	17.88	18.33	12.27	13.17	42.67
$N_1 P_3$	19.17	19.67	14.00	14.55	41.67
$N_2 P_0$	16.33	16.77	9.33	11.17	45.55
$N_2 P_1$	17.27	17.77	11.00	12.27	44.17
$N_2 P_2$	18.17	18.67	12.67	13.55	42.33
$N_2 P_3$	19.67	20.17	14.44	14.88	41.27
$N_3 P_0$	16.67	17.17	9.88	11.44	45.00
$N_3 P_1$	17.55	18.00	11.67	12.67	43.33
$N_3 P_2$	18.55	19.00	13.17	14.17	42.00
$N_3 P_3$	20.55	21.33	15.33	15.33	40.33
F- test	S	S	S	S	S
SeD	0.08	0.08	0.11	0.09	0.24
CD (5%)	0.16	0.17	0.23	0.19	0.48

Table.2 Effect of nitrogen and phosphorus on flower quality and yield of China aster

Treatments	Number of flower per plant	Flower diameter (cm)	Fresh weight of flower (g)	Dry weight of flower (g)	Yield per plant (g)	Yield per plot (kg)	Total yield per (t/ha)
N_0	13.67	5.01	4.10	0.81	56.12	0.67	6.24
N_1	19.09	6.25	5.36	1.12	104.09	1.25	11.57
N_2	19.82	6.42	5.54	1.17	111.40	1.34	12.38
N_3	20.89	6.69	5.88	1.28	125.30	1.50	13.92
SeD	0.22	0.02	0.04	0.01	1.71	0.02	0.19
CD	0.45	0.05	0.08	0.02	3.50	0.04	0.39
P_0	15.26	5.44	4.53	0.92	69.84	0.84	7.76
P_1	17.39	5.86	4.89	1.01	86.38	1.04	9.60
P_2	19.56	6.29	5.37	1.13	107.39	1.29	11.93
P_3	21.25	6.78	6.08	1.32	133.30	1.60	14.81
SeD	0.22	0.02	0.04	0.01	1.71	0.02	0.19
CD	0.45	0.05	0.08	0.02	3.50	0.04	0.39
N_0 P_0	12.67	4.77	3.88	0.75	49.19	0.59	5.47
N_0 P_1	13.33	4.93	4.00	0.78	53.36	0.64	5.93
N_0 P_2	14.00	5.07	4.17	0.82	58.40	0.70	6.49
N_0 P_3	14.67	5.27	4.33	0.87	63.54	0.76	7.06
N_1 P_0	15.33	5.44	4.55	0.92	69.77	0.84	7.75
N_1 P_1	17.67	6.00	5.07	1.05	89.63	1.08	9.96
N_1 P_2	20.67	6.55	5.55	1.17	114.76	1.38	12.75
N_1 P_3	22.67	7.00	6.27	1.33	142.18	1.71	15.80
N_2 P_0	16.17	5.67	4.77	0.97	77.15	0.93	8.57
N_2 P_1	18.55	6.17	5.17	1.08	95.93	1.15	10.66
N_2 P_2	21.55	6.67	5.77	1.23	124.37	1.49	13.82
N_2 P_3	23.00	7.17	6.44	1.41	148.14	1.78	16.46
N_3 P_0	16.88	5.88	4.93	1.02	83.24	1.00	9.25
N_3 P_1	20.00	6.33	5.33	1.12	106.61	1.28	11.85
N_3 P_2	22.00	6.88	6.00	1.29	132.02	1.58	14.67
N_3 P_3	24.67	7.67	7.27	1.67	179.34	2.15	19.93
F- test	S	S	S	S	S	S	S
SeD	0.44	0.05	0.08	0.02	3.43	0.04	0.38
CD (5%)	0.89	0.09	0.16	0.03	6.99	0.08	0.78

Wani *et al.,* (2013) also, reported that 30 g/m^2 nitrogen and 20 g/m^2 phosphorus noted maximum flowering duration in China aster cv. American Beauty. On the basis of the above findings, it is concluded that interaction in treatment T_{15} (N_3P_3) is best, in terms of the growth, yield and flower quality of China aster as compared to other treatments.

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