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Studies on Seed Production of China aster as Influenced by Nitrogen and Phosphorus

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Abstract

A field experiment was carried out at the farm of Horticulture section, College of Agriculture, Nagpur during the years 2016-17 and 2017-18 in Factorial randomized block design to find out the most suitable dose of nitrogen and phosphorus for increasing seed yield and obtaining better quality seed of China aster with nine treatment combinations and three replications. The treatments comprised of three levels of nitrogen *viz*., 150, 187.5 and 225 kg ha^{-1} and three levels of phosphorus *viz*., 50, 62.5 and 75 kg ha^{-1}. The results revealed that, significantly maximum flowers plant^{-1}, seeds flower^{-1}, germination % of seed, seed yield plant^{-1} and ha^{-1} and test weight of seed were registered with the individual treatments of 225 kg nitrogen and 75 kg phosphorus ha^{-1}. However, the treatment combination of 225 kg nitrogen + 62.5 kg phosphorus ha^{-1} was found to be the best treatment as compared to others for obtaining maximum seed yield and good quality seed in China aster.

1. Introduction

China aster (*Callistephus chinensis* L. Nees), a member of the family Asteraceae, is one of the important commercial flowers of our country. It is annual flower crop grown in many part of the world for cut flowers as well as loose flowers. It has many commercial varieties, which are useful in landscape garden for colorful effect in herbaceous borders, bedding, potted plant in home garden for display, making bouquets, button holes and garlands. 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. The demand for flowers of China aster is increasing day by day in Vidharbha region of Maharashtra state. The best way to grow annual flowers like China aster in large scale is by seeds. One of the major constraints in commercial cultivation of aster is availability of good quality seed in the region. Thus, there is vast scope for seed production of aster in Vidharbha region. Chezhiyan *et al*. (1986) reported that, the nutrients play an important role in the improvement of vegetative growth, flowering, seed yield and quality parameters in chrysanthemum. Nitrogen is one of the very important major plant nutrients which directly affect the plant growth and flowering behavior. Similarly, phosphorus is one of the important elements for plant growth and metabolism. It plays key roles in many plant processes such as energy metabolism, the synthesis of nucleic acid and membranes, photosynthesis, respiration, nitrogen fixation and enzyme regulation. Adequate nitrogen and phosphorus nutrition enhances many aspects of plant development including flowering, fruiting, root development as well as seed development.

At present, due to lack of proper scientific knowledge, flower growers are not able to boost the productivity of China aster. In view of this fact an overriding need was felt to conduct research in order to find out the most suitable dose of nitrogen and phosphorus fertilizers for higher seed production in China aster. Hence, the present investigation was conducted to find out the most suitable dose of nitrogen and phosphorus for increasing seed yield and obtaining better quality seed of China aster.

2. Materials and Methods

A field experiment on 'Studies on seed production of China aster as influenced by nitrogen and phosphorus' was carried out at the farm of Horticulture section, College of Agriculture, Nagpur during the years 2016-17 and 2017-18 in Factorial randomized block design with nine treatment combinations and three replications. The treatments comprised of three levels of nitrogen *viz*., 150, 187.5 and 225 kg ha^{-1} and three levels of phosphorus *viz*., 50, 62.5 and 75 ha^{-1}.

The experimental plot was brought to fine tilth by ploughing,

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clod crushing and harrowing. At the time of land preparation, well-rotted FYM @ 10 t ha^{-1} was mixed uniformly in the soil before last harrowing. The field was then laid out with flat beds of the dimension 1.50 m × 2.40 m. As per the treatment, uniform and healthy seedlings of China aster variety 'Poornima' were transplanted in the prepared plots at the spacing of 30 cm × 30 cm. The dose of fertilizers for flower production of China aster recommended for Vidharbha region by Dr. PDKV, Akola is 150:50:50 kg nitrogen, phosphorus and potassium respectively $hectare^{-1}$. Treatment wise half the dose of nitrogen was applied in the form of urea before transplanting of seedlings and the remaining half dose of nitrogen was top dressed after 30 days of transplanting. However, the full dose of phosphorus as per treatment and 50 kg potassium ha^{-1} as a constant dose for each plot were applied in the form of single super phosphate and muriate of potash, respectively at the time of transplanting. All the cultural operations *viz.*, weeding, irrigation, pest control etc. were carried out as and when required. Various observations on flowering, seed yield and quality parameters like flowers $plant^{-1}$, seeds $flower^{-1}$, seed yield $plant^{-1}$, seed yield ha^{-1}, test weight of seed (Weight of 1000 seeds) and germination % of seed were recorded at proper stages and the data was statistically analyzed by the method suggested by Panse and Sukhatme (1995) for both the years separately. Two years data were then pooled together and statistically analyzed.

3. Results and Discussion

The data presented in Table 1 and 2 revealed that, different levels of nitrogen and phosphorus had significant effect on all flowering, seed yield and quality parameters studied during I year, II year and for pooled results.

Table 1: Effect of nitrogen and phosphorus levels on flowering, seed yield and seed quality of China aster.

Treatment	Flowers $plant^{-1}$			Seeds $flower^{-1}$			Germination %		
	I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
Nitrogen Levels (N)									
N_1- 150 kg ha^{-1}	29.39	30.15	29.77	174.84	168.69	171.77	68.36	66.42	67.39
N_2- 187.5 kg ha^{-1}	30.56	33.48	32.02	183.01	177.44	180.23	72.07	69.98	71.02
N_3- 225 kg ha^{-1}	31.34	34.62	32.98	204.94	186.04	195.49	75.64	73.02	74.33
SE (m) ±	0.63	0.67	0.59	3.25	2.67	1.72	0.83	0.94	0.75
CD at 5%	1.89	2.01	1.78	9.82	8.08	5.20	2.52	2.85	2.28
Phosphorus Levels (N)									
P_1- 50 kg ha^{-1}	29.06	30.19	29.62	175.38	170.39	172.88	69.32	66.91	68.12
P_2- 62.5 kg ha^{-1}	30.51	33.77	32.14	186.97	180.54	183.76	72.96	70.77	71.86
P_3- 75 kg ha^{-1}	31.72	34.30	33.00	200.44	181.25	190.84	73.79	71.73	72.76
SE (m) ±	0.63	0.67	0.59	3.25	2.67	1.72	0.83	0.94	0.75
CD at 5%	1.89	2.01	1.78	9.82	8.08	5.20	2.52	2.85	2.28
Interaction Effect (NXP)									
SE (m) ±	1.08	1.20	1.02	5.62	4.63	2.98	1.44	1.63	1.30
CD at 5%	-	-	-	-	-	-	-	-	-

The data from table 1 revealed that, during the I and II year as well as pooled results, the treatment of N_3 i.e. 225 kg nitrogen ha^{-1} was found to be significantly superior in respect of number of flowers $plant^{-1}$ (31.34, 34.62 and 32.98 respectively) and it was statistically at par with the treatment of N_2 i.e. 187.5 kg nitrogen ha^{-1} (30.56, 33.48 and 32.02 respectively). Similarly, number of seeds $flower^{-1}$ were counted significantly maximum with the treatment N_3 i.e. 225 kg nitrogen ha^{-1} (204.94, 186.04 and 195.49 respectively) as compared to other treatments. Germination % of aster seed was also found significantly highest with the treatment N_3 (75.64, 73.02 and 74.33 % respectively). Nitrogen is an essential element of all the amino acids in plant structures which are the building blocks of plant proteins, important in the growth and development of vital plant tissues and cells like the cell membranes and chlorophyll. Flowering can be increased with increased levels of nitrogen application up to certain limit. These also play a key role in the higher production of flowers and seeds of ornamental flowers. The results are in close conformity with the results of Tembhare *et al*. (2016), who reported significantly maximum number of seeds g^{-1}, flowers $plant^{-1}$ and germination of China aster seed with application of 200 kg nitrogen ha^{-1}. Dorajeerao *et al*. (2012), also revealed that number of flowers $plant^{-1}$ in garland chrysanthemum was found maximum with higher dose i.e. 150 kg nitrogen ha^{-1}.

As regards the effect of phosphorus levels, during I year, II year as well as pooled results, significantly the superior results in respect of flowers $plant^{-1}$ (31.72, 34.30 and 33.00 respectively), seeds flower^{-1} (200.44, 181.25 and 190.84 respectively) and seed germination (73.79%, 71.73% and 72.76% respectively) were noted with the treatment of P_3 i.e. 75 kg phosphorus ha^{-1} than the other levels of phosphorus except P_2 i.e. 62.5 kg phosphorus ha^{-1} which has recorded 30.51, 33.77 and 32.14 flowers plant^{-1}, 186.97, 180.54 and 183.76 seeds flower^{-1} and 72.96, 70.77 and 71.86 % seed germination, during I year, II year and pooled results, respectively. Phosphorus is noted especially for its role in capturing and converting the sun's energy into useful plant compounds. The structures of both DNA and RNA are linked together by phosphorus bonds. Phosphorus is a vital component of ATP, the "energy unit" of plants. The optimum rate of phosphorus application is important in improving yields of most crops. Adequate phosphorus nutrition is critical for root development, increased stalk and stem strength, increased flowering and seed production, uniform and early crop maturity, improved crop quality, and increased resistance to plant diseases. These results are similar to the findings of Mishra *et al*. (2018), who exhibited significantly highest flower yield and quality in China aster with the application of highest dose of phosphorus *i.e.* 90 kg ha^{-1}. However, Kumar and Kumar (2014) noticed that, application of higher dose of phosphorus (200 kg ha^{-1}) enhanced significantly the flower quality and yield of China aster.

However, interaction effect of nitrogen and phosphorus levels on flowers plant^{-1}, seeds flower^{-1} and seed germination in China aster was found to be non-significant.

The data from Table 2 indicated that, the treatment of N_3 i.e. 225 kg nitrogen ha^{-1} recorded significantly highest seed yield plant^{-1} (2.58, 2.64 and 2.61 g) and hectare^{-1} (143.45, 146.43 and 144.94 kg) during I year, II year and pooled results, respectively. The treatment N_2 i.e. 187.5 kg nitrogen ha^{-1} was found statistically at par with N_3 in respect of seed yield plant^{-1} and hectare^{-1} during II year of experimentation (2.49 g and 138.37 kg respectively). Similarly, the test weight of seed was significantly highest with the treatment N_3 i.e. 225 kg nitrogen

Table 2: Effect of nitrogen and phosphorus levels on seed yield and quality of China aster

Treatment	Seed yield plant^{-1}			Seed yield ha^{-1}			Test weight (g)		
	I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
Nitrogen Levels (N)									
N_1- 150 kg ha^{-1}	2.19	2.29	2.24	121.72	127.33	124.52	1.018	1.000	1.007
N_2- 187.5 kg ha^{-1}	2.29	2.49	2.39	127.41	138.37	132.89	1.043	1.047	1.043
N_3- 225 kg ha^{-1}	2.58	2.64	2.61	143.45	146.43	144.94	1.108	1.072	1.091
SE (m) ±	0.04	0.06	0.04	2.28	3.21	2.22	0.010	0.010	0.007
CD at 5%	0.13	0.17	0.12	6.91	9.72	6.71	0.030	0.030	0.020
Phosphorus Levels (N)									
P_1- 50 kg ha^{-1}	2.20	2.29	2.24	122.10	127.16	124.63	1.013	0.999	1.007
P_2- 62.5 kg ha^{-1}	2.36	2.51	2.43	130.94	139.31	135.12	1.054	1.060	1.059
P_3- 75 kg ha^{-1}	2.51	2.62	2.57	139.54	145.66	142.60	1.091	1.060	1.076
SE (m) ±	0.04	0.06	0.04	2.28	3.21	2.22	0.010	0.010	0.007
CD at 5%	0.13	0.17	0.12	6.91	9.72	6.71	0.030	0.030	0.020
Interaction Effect (NXP)									
N_1P_1	2.05	1.88	1.97	114.04	104.29	109.16	0.983	0.940	0.963
N_1P_2	2.09	2.40	2.25	116.12	133.48	124.80	1.017	1.030	1.027
N_1P_3	2.43	2.60	2.51	135.00	144.22	139.61	1.023	1.030	1.030
N_2P_1	2.08	2.47	2.28	115.46	137.48	126.47	1.023	1.023	1.023
N_2P_2	2.28	2.48	2.38	126.80	137.77	132.29	1.040	1.050	1.043
N_2P_3	2.52	2.52	2.52	139.96	139.85	139.91	1.067	1.067	1.063
N_3P_1	2.46	2.51	2.49	136.80	139.70	138.25	1.033	1.033	1.033
N_3P_2	2.70	2.64	2.67	149.89	146.67	148.28	1.054	1.100	1.107
N_3P_3	2.59	2.75	2.67	143.66	152.92	148.29	1.091	1.083	1.133
SE (m) ±	0.07	0.10	0.07	3.95	5.56	3.84	0.017	0.018	0.011
CD at 5%	0.22	0.30	-	11.96	16.83	-	0.053	-	-

ha^{-1} during both the years of experimentation and pooled results (1.108, 1.072 and 1.091 g respectively) as compared to other levels of nitrogen, however, the treatment N_2 i.e. 187.5 kg nitrogen ha^{-1} exhibited at par results during II year (1.047 g). An increase in seed yield of China aster due to application of the highest dose of nitrogen might be due to increased number of flowers produced $plant^{-1}$ and seeds $flower^{-1}$. These findings are in the line with the results of Samoon and Kirad (2013), in calendula who registered that highest seed yield was obtained with the application of highest dose of nitrogen i.e. 150 kg ha^{-1}. The results are also in close conformity with the results of Tembhare *et al.* (2016), who noted that, the seed yield and quality parameters *viz.*, seed yield $plant^{-1}$ and $hectare^{-1}$ and test weight of seed in China aster were recorded significantly maximum with the application of 200 kg nitrogen ha^{-1} followed by 150 kg nitrogen ha^{-1} and 100 kg $nitrogenha^{-1}$.

The effect of phosphorus levels revealed that, the highest dose of phosphorus i.e. P_3 (75 kg phosphorus ha^{-1}) noticed significantly superior seed yield $plant^{-1}$ (2.51, 2.62 and 2.57 g) and $hectare^{-1}$ (139.54, 145.66 and 142.60 kg) during I year, II year and pooled results, respectively than the other levels of phosphorus. The test weight of seed was recorded significantly higher with the treatment P_3 i.e. 75 kg phosphorus ha^{-1} than other treatments (1.091, 1.060 and 1.076 g) during both years and pooled results, however, it was statistically at par with the treatment P_2 i.e. 62.5 kg phosphorus ha^{-1} during II year and pooled results (1.060 and 1.059 g respectively). Similar results are exhibited by Masaye and Rangwala (2009), while studying effect of NPK levels on flower quality of China aster. They revealed that, an application of 100 kg phosphorus ha^{-1} had recorded better quality flowers in terms of diameter and weight of flower. However, Tembhare *et al.* (2016) found that, application of 75 kg phosphorus ha^{-1} significantly produced maximum yield and better quality seed of China aster var. 'Poornima'.

An interaction effect of nitrogen and phosphorus levels on seed yield $plant^{-1}$ and ha^{-1} was statistically significant during both years of study, however, it was non-significant in respect of pooled results. During I year of experimentation, the treatment combination of N_3P_2 (225 kg nitrogen + 62.5 kg phosphorus ha^{-1}) recorded the highest seed yield $plant^{-1}$ and ha^{-1} (2.70 g and 149.89 kg respectively). However, during the II year of experimentation, significantly maximum seed yield $plant^{-1}$ (2.75 g) and ha^{-1} (152.92 kg) were noted with the treatment combination N_3P_3 (225 kg nitrogen + 75 kg phosphorus ha^{-1}) and it was found to be at par with N_3P_2 (2.64 g and 146.67 kg respectively). Similarly, the treatment combination of N_3P_3 i.e. 225 kg nitrogen + 75 kg phosphorus ha^{-1} exhibited significantly maximum test weight of seed (1.091 g) during I year of experiment, whereas, during II year and pooled results the interaction effect of nitrogen and phosphorus on test weight of aster seed was non-significant. Though the interaction effect was non-significant, the highest seed yield $plant^{-1}$ (2.67 g each) and ha^{-1} (148.29 kg each) and test weight of seed in China aster (1.133 and 1.107 g respectively) were recorded with the treatment combinations of N_3P_3 (225 kg nitrogen + 75 kg phosphorus ha^{-1}) and N_3P_2 (2.64 g and 146.67 kg respectively) during II year of experimentation and pooled results, respectively. 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. Similar findings are reported by Tembhare *et al*. (2016), in China aster. They stated that, significantly maximum seed yield $plant^{-1}$, number of seed g^{-1}, test weight and germination percentage of seed were recorded in treatment combination of 200 kg nitrogen + 75 kg phosphorus ha^{-1}. The findings are also in conformity with the results of Mishra *et al*. (2018), who revealed that, the interaction of N_3P_3 (150 kg/ha N and 90 kg/ha P) produced significantly maximum flower yield $plant^{-1}$, $plot^{-1}$ and $hectare^{-1}$ in China aster.

4. Conclusion

Thus, it can be inferred from the present investigation that, 225 kg nitrogen + 62.5 kg phosphorus ha^{-1} is the best treatment combination as compared to others for obtaining maximum seed yield and good quality seed in China aster.

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