AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **11** | Issue 1 | June, 2016 | 132-135
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RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/11.1/132-135

Article history :
Received : 16.04.2016
Revised : 25.04.2016
Accepted : 05.05.2016

Effect of nitrogen and phosphorus on growth, flowering and flower yield of China aster (*Callistephus chinensis* L. Nees) cv. POORNIMA

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ABSTRACT : The present investigation was carried out at Horticulture Research Station, Jambavadi Farm, Junagadh Agricultural University, Junagadh (Gujarat) during October 2014 to March 2015. The experiment was laid out in Factorial Randomized Block Design. The treatments comprised of two factors (1) nitrogen with four level *viz*., 150 kg N ha^{-1}(N_1), 200 kg N ha^{-1}(N_2), 250 kg N ha^{-1}(N_3), 300 kg N ha^{-1}(N_4) and three levels of phosphorus *i.e.* 100 kg P_2O_5 ha^{-1}(P_1), 150 kg P_2O_5 ha^{-1}(P_2), 200 kg P_2O_5 ha^{-1}(P_3) with three replications. Both the highest levels of N and P significantly improved growth parameters *i.e.* plant height (51.56 cm), plant spread (328.67 cm^2), secondary branches per plant (17.67), fresh weight (137.22 g) and dry weight (69.78 g) in treatment N_4 (300 kg N ha^{-1}) whereas, in case of phosphorus the plant height (47.08 cm), plant spread (316.00 cm^2), number of branches per plant (16.92), fresh weight (132.00 g) and dry weight (72 g) was noted in treatment P_3(200 kg P_2O_5 kg ha^{-1}). Maximum flowering span (79.11 days), number of flowers per plant (24.78) and yield of flowers (22.67 t ha^{-1}) were registered in 300 kg N ha^{-1} treatment. Similarly, maximum flowering span (71.58 days), number of flowers per plant (23.58) and yield of flowers (22.08 t ha^{-1}) were registered in P_3 (200 kg P ha^{-1}). Thus, cultivation of China aster in medium black soil, the fertilizer application at the rate of 300 kg N ha^{-1} in two splits (first half as basal application and remaining half at 30 days after transplanting) and 200 kg P_2O_5 ha^{-1} as basal dose has been found the best.

KEY WORDS : China aster, cv. POORNIMA, Nitrogen, Phosphorus

HOW TO CITE THIS ARTICLE : Maheta, Pooja, Polara, N.D. and Rathod, Jyotika (2016). Effect of nitrogen and phosphorus on growth, flowering and flower yield of China aster (*Callistephus chinensis* L. Nees) cv. POORNIMA. *Asian J. Hort.*, **11**(1) : 132-135, **DOI : 10.15740/HAS/TAJH/11.1/132-135.**

China aster [*Callistephus chinensis* (L.) Nees] is annual flower crop belongs to the family Asteracea, to have originated in China. The genus *Callistephus* derived its name from Greek word '*Kalistos*,'means the most beautiful and '*stephus'*, means a crown, referring to the flower head. In present days, China aster has been developed from single form of wild species, *Callistephus chinensis* (L.) Nees. The original plant had single flowers with two to four rows of blue, violet, white ray florets. China aster is one of the most popular of all garden annuals grown throughout the world. It can easily be grown in open field as well as under lathhouse, polyhouse and net house for the production of cut flowers. The vase life of China aster cut flowers, in general, is more than other annuals grown as cut flowers, China aster is also grown for bedding and potting purpose. The dwarf Pompon and Lilliput types can be grown in window boxes and in mixed borders. China aster is excellent as a cut flower. It is widely cultivated in many parts of the country and especially around Bangalore for this purpose. In India, it is being grown on a large scale in Karnataka, Tamil Nadu, Andhra

Pradesh, Maharashtra and West Bengal.

RESEARCH METHODS

The experiment was concluded with two factors considering different levels of nitrogen and phosphorus to study on the growth, flowering and flower yield of China aster. The treatments comprised of two factors (I) Nitrogen in four levels *viz*., 150 kg N ha^{-1}(N_1), 200 kg N ha^{-1}(N_2), 250 kg N ha^{-1}(N_3), 300 kg N ha^{-1}(N_4) and (II) Phosphorus in three levels *viz*., 100 kg P_2O_5 ha^{-1}(P_1), 150 kg P_2O_5 ha^{-1}(P_2), 200 kg P_2O_5 ha^{-1}(P_3) in Factorial Randomized Block Design with three replications. The trial was conducted in Department of Horticulture, Fruit Research Station, Jambuvadi Farm, Junagadh Agricultural University, Junagadh (Gujarat). The agro techniques including land preparation, application of manure and fertilizers, planting material, sowing, transplanting, weeding, staking, irrigation, plant protection measures were followed up to stage of harvest. The collection of experimental data, sampling procedure etc. was adopted as per the scientific method. Five plants in each treatment were randomly selected for measuring the different parameters. Necessary observations like plant height, plant spread, and number of branches per plant, fresh weight and dry weight of plant, flowering span, flower yield were recorded and analyzed statistically.

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Growth:

Significant variation was noted in growth parameters of nitrogen application. Maximum plant height (51.56 cm), plant spread (328.67 cm^2), secondary branches per plant (17.67), fresh weight (137.22 g) and dry weight (69.78 g) was recorded in treatment N_4 (300 kg N ha^{-1}) whereas, in case of phosphorus the plant height (47.08 cm),plant spread (316.00 cm^2), number of branches per plant (16.92), fresh weight (132.00 g) and dry weight (72 g) was noted in treatment P_3(200 kg P_2O_5 kg ha^{-1}) (Table 1). In interaction effect with different levels of nitrogen and phosphorus (N×P) was found non-significant for all growth parameters. The results obtained are in agreement with the findings of Singh and Sangama (2000) they reported the significant effect on plant height of China aster with increasing N application rates from 100 to 300 kg N ha^{-1}. Kumar and Kumar (2014), Chavan (2006) and Sonalnath *et al*. (2010) were also reported similar results in China aster. Maximum plant spread was obtained under the highest level of nitrogen N_4(300 kg N

Table 1 : Effect of nitrogen and phosphorus on plant height, plant spread, number of branches per plant, fresh and dry weight of plant of China aster CV. POORNIMA

Treatments	Plant height (cm)	Plant spread (cm)	Number of branches per plant	Fresh weight of plant (g)	Dry weight of plant (g)
Nitrogen (kg N ha^{-1})					
N_1 = 150	42.44	261.11	14.44	107.22	62.22
N_2 = 200	42.67	263.33	14.67	113.67	64.78
N_3 = 250	44.68	305.78	15.67	127.11	73.67
N_4 = 300	51.56	328.67	17.67	137.22	69.78
S.E. ±	1.14	8.60	0.63	3.85	2.12
C.D. (P=0.05)	3.34	25.63	1.85	11.28	6.22
Phosphorus (kg P_2O_5 ha^{-1})					
P_1 = 100	42.25	276.25	14.50	114.00	64.25
P_2 = 150	46.75	276.92	15.42	117.83	66.42
P_3 = 200	47.08	316.00	16.92	132.00	72.17
S.E. ±	0.99	7.45	0.55	3.33	1.84
C.D. (P=0.05)	2.89	21.85	1.60	9.97	5.39
Interaction (N × P)					
S.E. ±	1.97	14.90	1.09	6.66	3.67
C.D. (P=0.05)	NS	NS	NS	NS	NS
C.V. %	7.52	8.91	12.13	9.51	9.41

NS = Non –Significant

ha^{-1}), might be due to formation of new cells at localized region called meristem and increased in size and more number of cells may produced seems in complete as it should correlated to nitrogen. The results is in line with findings of Singh and Sangama (2000) and Masaye and Rangawa (2009) in China aster.

Flowering and yield:

The similar trend to growth was observed for flowering and yield parameters also where minimum days required for open first flower buds (62.78) and length days required for 50 per cent flowering (68.00) was recorded in treatment N_1 (150 kg N ha^{-1}). Whereas, where maximum days required for open first flower buds (79.11), days required for 50 per cent flowering (88.67) in treatment N_4 (300 kg N ha^{-1}). Maximum flowering span (79.00 days), number of flowers per plant (24.78) and yield of flowers (22.67 t ha^{-1}) were registered in N_4 treatment. In case of phosphorus application, the minimum days required for open first flower buds (66.67) and days required for 50 per cent flowering (73.50) was registered in treatment P_1 (100 kg N ha^{-1}), whereas maximum days required for open first flower buds (71.58) and days required for 50 per cent flowering (79.42) in treatment P_3 (200 kg N ha^{-1}). Maximum flowering span (62.50 days), number of flowers per plant (23.58) and yield of flowers (22.08 t ha^{-1}) were registered in P_3 (200 kg P ha^{-1}) (Table 2). Interaction effect with different levels of nitrogen and phosphorus (N×P) was found non-significant for all parameters except yield t ha^{-1}. In present case, the nitrogen at higher levels might have favored the amino acid metabolism of expenses of carbohydrate metabolism resulting in delayed flowering with the application of higher doses nitrogen as reported by

Table 2 : Effect of nitrogen and phosphorus on days required for open first flower bud, days required for 50 per cent flowering, flowering span, number of flowers per plant and yield of flower of flower in China aster cv. POORNIMA

Treatments	Days required for open first flower buds (days)	Days required for 50 % flowering	Flowering span (days)	Number of flower per plant	Yield of flower (t ha^{-1})
Nitrogen (kg N ha^{-1})					
N_1 = 150	62.78	68.00	53.44	20.22	19.33
N_2 = 200	65.56	72.11	55.78	21.89	20.00
N_3 = 250	66.11	74.78	59.33	22.22	21.22
N_4 = 300	79.11	88.67	71.00	24.78	22.67
S.E. ±	1.57	1.85	1.61	0.74	0.54
C.D. (P=0.05)	4.60	5.42	4.74	2.16	1.59
Phosphorus (kg P_2O_5 ha^{-1})					
P_1 = 100	66.67	73.50	57.17	21.25	20.00
P_2 = 150	66.92	74.75	60.00	22.00	20.33
P_3 = 200	71.58	79.42	62.50	23.58	22.08
S.E. ±	1.36	1.60	1.40	0.64	0.47
C.D. (P=0.05)	3.99	4.70	4.10	1.87	1.37
Interaction (N × P)					
S.E. ±	2.72	3.20	2.80	1.27	0.94
C.D. (P=0.05)	NS	NS	NS	NS	2.76
C.V. %	6.88	7.31	8.09	9.91	7.83

NS=Non-significant

Table 3 : Interaction effect of nitrogen and phosphorus (N×P) on yield of flower per ha (t ha^{-1}) of China aster cv. POORNIMA

	Phosphorus (P_2O_5 kg ha^{-1})		
Nitrogen (N kg ha^{-1})	P_1 = 100	P_2 = 150	P_3 = 200
N_1 = 150	19.00	19.33	19.63
N_2 = 200	21.00	19.33	19.67
N_3 = 250	20.00	20.33	23.33
N_4 = 300	20.00	22.33	25.67
S.E. ±		0.94	
C.D. (P=0.05)		2.76	

Muktanjli *et al*. (2004) in China aster. Similar findings were also reported by Singh *et al*. (2005) in carnation, Joshi and Barad (2002) in chrysanthemum and Sehrawat *et al.* (2003) in marigold.

The flower yield increased as rate of phosphorus increased from 100 to 200 kg P_2O_5 ha^{-1}. In this case, accelerated phosphorus helped the plant to set forth optimum growth. Moreover, phosphorus fertilization also enhanced translocation and pertaining to vegetative to floral parts resulting in improved flower yield. Similar results were found by Kumar and Kumar (2014) in China aster. Increase in flowering span and number of flowers per plant as phosphorus level increased from 100 to 200 kg P_2O_5 ha^{-1}. Similar results were found by Kumar *et al*. (2003) in China aster and Dixit *et al*. (2004) in chrysanthemum.

The interaction effect of higher level of (N×P) increased vegetative growth so, ultimately higher photosynthetic activity occurred and more photosynthesis might may be produced at the source that are used at the sink and increased yield attributes and fresh weight of flower (Table 3). The result regarding yield attributes is in consonance with those of Kumar and Kumar (2014) and Sonalnath *et al*.(2010) in China aster, Gowda *et al* (1991) in tuberose.

Conclusion :

From the results of the experimental data, it could be concluded that for cultivation of China aster in medium black soil the fertilizer application at the rate of 300 kg N ha^{-1} in two splits (first half as basal application and remaining half at 30 days after transplanting) and 200 kg P_2O_5 ha^{-1} as basal dose has been found the best for optimum growth, flowering and yield parameters in China aster cv. POORNIMA under South Saurashtra Agroclimatic conditions during winter season.

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