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Standardization of different levels of nitrogen and phosphorus on flowering and yield attributes of China aster (*Callistephus chinensis* (L.) Nees) under Chhattisgarh conditions

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Abstract
The present investigation entitled "Standardization of different concentrations of plant growth regulators and levels of nitrogen, phosphorus on growth, flowering, yield and quality of China Aster (*Callistephus chinensis* (L.) Nees) under Chhattisgarh conditions" was conducted at the Horticultural Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, College of Agriculture, IGKV, Raipur (C.G.).The Experiment-II entitled "Effect on different levels of nitrogen and phosphorus on growth, flowering, yield and quality of China Aster" was conducted during winter season of 2018-19 and 2019-20. The experiment was conducted in Factorial Randomized Block Design with 24 treatments" comprising of two varieties *viz*. Arka Shashank and Arka Archana as factor A and four levels of Nitrogen, *i.e*, (120, 140, 160, 180 kg/ha), and three levels of Phosphorus (100, 120, 140 kg/ha) as factor B. The doses of Nitrogen and Phosphorus were applied in two splits with constant dose of potassium (60kg/ha) were applied in the field.
Plants have to be exposed to proper climatic factors in order to get optimum and economic flower yields. Therefore, under transitional Chhattisgarh plains, there is a need to standardize production technology involving systematic research to evaluate acceptable variety, standardize fertilizer levels on growth, flowering, yield and quality of China aster flower production under the Chhattisgarh plains.

Keywords: Standardization, nitrogen, phosphorus, aster

Introduction
China aster (*Callistephus chinensis* (L.) Nees) belongs to the family compositae and its origin is China. Genus *Callistephus* derived from two Greek words, '*Kalistos'* and '*Steophos*' which means beautiful and crown respectively. Asters have been developed from a single form of wild species. According to Emsweller *et al* (1937) [3] the evolution of China aster was a record of remarkable variations. The original plant had single flowers with blue, violet or white-ray florets in two or four rows. The height was 18 to 24 inches long or medium tall. The prolongation or development of the central florets and the creation of quilted flowers were the first developments in this type of flower. During the 18th century, Germans produced dual forms of aster so they, often referred to as "German asters". This was attributed to the success of the growth of asters and the cultivation of large seeds by the Germans. The introduction of branching forms, tall types, medium tall and dwarf types resulted in the great evolutionary improvement of the aster. Branching forms were introduced in USA, which was the main hub for the growth of this plant as well as for the development of seeds.
Balanced nutrition is very critical in the midst of various factors affecting China aster's growth and flowering. In the growth and development of plants, fertilizers such as nitrogen, phosphorus and potassium play a crucial role. The chemical and biological properties of the soil are enhanced by these essential nutrients, thus increasing plant yields. To enhance their efficiency or productivity, Silberbush *et al*. (2003) [12], Kim *et al*. (1998) [7] and Engelbrecht (2004) [4], have emphasized the need to supply nutrients to the soil during plant development. Generally speaking, growth, development and production rely on their judicious feeding habits. In particular, the focus should be on nitrogen during the early stage (vegetative growth). Throughout the growing cycle, plants require phosphorus and it should be applied as a basal dose. The plant needs potassium till flowering. When applied in the field, China aster responds differently to different doses of fertilizer, either alone or in the combination.

Methods and Materials

The present investigations were carried out at the Horticulture Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during two rabi seasons of 2018-19 and 2019-20. The experimental area comes under the 7th Agro - climatic region of India *i.e.* “Eastern Plateau and Hills” which is classified as sub-humid with hot summer and cold winter. The climate of Chhattisgarh is tropical. It is hot and humid because of its proximity to the Tropic of Cancer and its dependence on the monsoons for rains. Summer temperatures in Chhattisgarh can reach up to 45 °C (113 °F). The atmospheric relative humidity is relatively high during the months of June - October. Chhattisgarh receives an average of 1,29 millimetres (50.9 in) of rain. Winter is from November to January. Winters are pleasant with low temperatures and less humidity.

During both the years of study composite soil samples from 0-15 cm soil depth were collected before start of experiment. After crop harvesting during both the years of experimentation soil samples from 0- 15 cm soil depth from each plot were collected to ascertain the effect of NPK levels on pH, electrical conductivity, organic carbon, available N, P, K. Collected soil samples were air dried in shade and ground with the help of pestle and mortar, passed through 2mm sieve and stored in polythene bags for further analysis as per the method. The soil of the experimental field was clay-loam in texture (vertisols), having good drainage capacity and locally known as “Kanhar”. The soil was neutral in reaction and available nitrogen, phosphorus and potassium content were low, medium and high, respectively.

The experiment was conducted in Factorial Randomized Block Design with 24 treatments” comprising of two varieties *viz*. Arka Shashank and Arka Archana as factor A and four levels of Nitrogen, *i.e*, (120, 140, 160, 180 kg/ha), and three levels of Phosphorus (100, 120, 140 kg/ha) as factor B. The doses of Nitrogen and Phosphorus were applied in two splits with constant dose of potassium (60kg/ha) were applied in the field. 45 days old healthy and uniformly grown seedlings were used for transplanting with a spacing of 30 cm x 30 cm @ one seedling per hill.” There are twelve fertilizer doses which were applied in two varieties of China Aster, hence there are 24 treatments combinations. V_1F_1 (Arka Shashank+ $N_{120:}$ P_{100}), V_1F_2 (Arka Shashank+ $N_{120:}$ P_{120}), V_1F_3 (Arka Shashank+ N_{120}: P_{140}), V_1F_4 (Arka Shashank+ $N_{140:}$ P_{100}), V_1F_5 (Arka Shashank+ $N_{140:}$ P_{120}), V_1F_6 (Arka Shashank+ $N_{140:}$ P_{140}) V_1F_7 (Arka Shashank+ $N_{160:}$ P_{100}), V_1F_8 (Arka Shashank+ N_{160}: P_{120}), V_1F_9 (Arka Shashank+ N_{160}: P_{140}), V_1F_{10} (Arka Shashank+ $N_{180:}$ P_{100}), V_1F_{11} (Arka Shashank+ $N_{180:}$ P_{120}), V_1F_{12} (Arka Shashank+ $N_{180:}$ P_{140}), V_2F_1 (Arka Archana+ $N_{120:}$ P_{100}), V_2F_2 (Arka Archana + $N_{120:}$ P_{120}), V_2F_3 (Arka Archana + N_{120}: P_{140}), V_2F_4 (Arka Archana + $N_{140:}$ P_{100}), V_2F_5 (Arka Archana + $N_{140:}$ P_{120}), V_2F_6 (Arka Archana + $N_{140:}$ P_{140}) V_2F_7 (Arka Archana + $N_{160:}$ P_{100}), V_2F_8 (Arka Archana + N_{160}: P_{120}), V_2F_9 (Arka Archana + N_{160}: P_{140}), V_2F_{10} (Arka Archana + $N_{180:}$ P_{100}), V_2F_{11} (Arka Archana + $N_{180:}$ P_{120}), V_2F_{12} (Arka Archana + $N_{180:}$ P_{140}).

Nitrogen, phosphorus and potassium, respectively, were added in the form of urea, single superphosphate and murate of potash. At the time of transplantation, half a dose of N and the full dose of P and K were applied in a circular band of approximately 3-4 cm around each plant and, after 30 days of transplantation, the crop was top-dressed with the remaining half a dose of N. By repeated ploughing and harrowing, the land was carried to a fine tilth. A spacing of 0.50 m between two replications and 1.00 m between two plots was provided for lying out of irrigation channels and bunds respectively. The entire experimental land was divided into plots measuring 1.5 m x 1.5 m there were totally 42 plots. Timely and effective plant protection steps have been taken to protect experimental plants from pest and disease attacks. Harvesting the flowers for the purpose of observation on flower and yield components was commenced after 100 days of transplanting and only two harvestings were done. The obtained data had statistically analyzed adopting procedure as given by Panse, V.G. and Sukhatme, B.V. (1985).

Results and Discussion

The data on Days to bud initiation were recorded and are presented in Table 1

Amongst the cultivars, there were found significant difference between varieties in both the years as well as pooled mean analysis. Maximum days required for bud initiation (68.61, 69.3 and 68.97) respectively were observed in cultivar (V_1) Arka Shashank. Minimum days required for bud initiation was observed in cultivar (V_2) Arka Archana (64.67, 67.52 and 66.09) during both the tested years and pooled mean data respectively. Nitrogen and phosphorus showed significant influence on days to bud initiation during both the years and pooled mean basis. The earlier bud initiation (60.57, 60.95 and 60.90) was observed in F_2 (N_{120}: P_{120}) in first year, while it was noticed in the treatment F_1 (N_{120}: P_{100}) during second as well as pooled mean analysis respectively.Interaction between both the cultivars and nitrogen and phosphorus showed non-significant variation on days to bud initiation in both the years as well as pooled mean analysis.

The earlier bud initiation was observed in F_2 (N_{120}: P_{120}) in first year, while it was noticed in the treatment F_1 (N_{120}: P_{100}) during second as well as pooled mean analysis respectively. It is quite obvious that an increase in nitrogen supply resulted in vigorous growth of the plants which delayed the bud formation and opening of the flowers as well. Similar findings were observed by (Mengel and Kirkby, 1987) [8] and Gaikwad *et al*. (2004) [5].

It is clear from the data presented in Table 2 that the Days to 1st flowering were significantly influenced by different levels of cultivars and nitrogen and phosphorus.

In case of cultivars, there were found significant difference between cultivars in both the years as well as pooled mean analysis. Maximum days required for 1st flowering (79.05, 79.15, 79.10) respectively were observed in cultivar (V_1) Arka Shashank. Minimum days required for 1st flowering was observed in cultivar (V_2) Arka Archana (77.54, 78.29, 77.92) during both the tested years and pooled mean data respectively. In respect to nitrogen and phosphorus showed significant influence on days to 1st flowering during both the years and pooled mean basis. The days to 1st flowering (71.37, 71.58 and 71.48) was earlier in treatment F_1 (N_{120}: P_{120}) which was found statistically *at par* with treatments F_{10} (N_{180}: P_{100}) and F_{11} (N_{180}:P_{120}) during both the year and pooled mean basis treatments. The maximum days (84.32, 84.6 and 84.46) required for 1st flowering were observed in treatment F_{12} (N_{180}: P_{140}).Interaction between both the cultivars and nitrogen and phosphorus were showed non-significant variation on days to bud 1st flowering in both the years as well as pooled mean analysis.

Earlier flowering was observed in F_1 (N_{120}: P_{120}). The increasing levels of N, P showed significant effect on days taken for first flower opening. Reduction in days taken for flowering due to low level of nitrogen and phosphorus was reported by Singatkar *et al*. (1995) [13] in gaillardia. Early emergence of flower buds might be due to increased availability of nitrogen, easy uptake of nutrients and simultaneous transport of growth-promoting substances like cytokinin's to axillary buds, resulting in breakage of apical dominance and facilitated better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase.

The data on Flowering Duration were recorded and are presented in Table 3. Significantly, maximum flowering duration (31.01, 31.76, and 31.38) were recorded in cultivar (V_1) Arka Shashank as compared to cultivar (V_2) Arka Archana (27.35, 27.56 and 27.45) during both the tested years and pooled mean data respectively. It is vivid from the data that the flowering duration was significantly influenced by nitrogen and phosphorus during both the year and on pooled mean basis. The maximum flowering duration (32.82, 33.48 and 33.15 respectively) was observed under treatment F_{12} (N_{180}: P_{140}) and it was observed statistically similar with the treatment F_{10} (N_{180}: P_{100}) and F_{11} (N_{180}: P_{120}). The minimum flowering duration (26.06, 26.70 and 26.38) respectively was recorded in treatment F_1 (N_{120}: P_{100}).The interaction between variety and nitrogen and phosphorus were found significant for first year as well as pooled mean analysis. The maximum flowering duration (35.57 and 35.76) respectively were recorded under treatment combination (V_1F_{11}) during first year and pooled mean basis. The minimum flowering duration (25.44 and 25.56) respectively was recorded in (V_2F_1) under first year and pooled mean basis. Interaction effect was found non-significant for second year.

The duration of bloom of individual variety might be due to different genetic makeup of varieties and prevailing favourable environment. Similar findings were also noticed by Pattnaik and Mohanti (2002) [9], Singh *et al*. (2003), Khanvilkar *et al*. (2003) [6], Ra *et al*. (2005) in African marigold, and Raghuvanshi and Sharma (2011) in French marigold.

The data on number of flowers per plant are presented in table 4 revealed that the cultivar and nitrogen and phosphorus and their interaction exhibited significant impact on number of flower per plant.

In, case of cultivars, they show significant influence on number of flowers per plant. The highest number of flowers (59.64, 61.92 and 60.78) respectively was observed in cultivar (V_2) Arka Archana. The lowest number of flowers per plant (52.90, 53.06 and 52.98) respectively was obtained from cultivar (V_1) Arka Shashank during both the years as well as pooled mean basis. As far as, application of nitrogen and phosphorus showed significant response on number of flowers per plant, during both the years as well as pooled mean analysis. The maximum number of flowers (67.92, 67.88 and 67.90) respectively were recorded under treatment F_{12} (N_{180}: P_{140}) and it was observed statistically similar with F_{11} (N_{180}: P_{120}). The minimum number of flowers (47.84, 47.39 and 47.61) respectively was recorded under treatment F_1 (N_{120}: P_{100}) during this investigation. The interaction between variety and application of nitrogen and phosphorus were found non-significant during both the years as well as pooled mean analysis.

The two years results indicated that there was highly significant difference in number of flowers plant per plant within the varieties. The maximum number of flowers was obtained from Arka Archana. It could be stated that variation within the varieties for number of flowers plant^{-1} might be due to genotypic and environmental differences. Similar results were reported by Choudhary *et al*. (2013) [2] Nursude *et al*. (2010) [10], Beniwal and Dahiya (2012) [1], Singh *et al*. (2004) [14] and Singh and Misra (2009) in marigold.

It was evident from data presented in Table 5 that there was a significant difference in respect to yield of flower per plant due to cultivars and nitrogen and phosphorus.

In case of cultivar, the maximum yield of flower per plant were observed in cultivar (V_2) Arka Archana (170.63, 174.01 and 172.32) and minimum yield of flower per plant (143.59, 148.75 and 146.17) respectively were recorded in cultivar (V_2) Arka Shashank in both the years as well as pooled mean analysis. In respect to nitrogen and phosphorus, the highest yield of flowers per plant (190.63, 195.24 and 192.93) was observed under treatment F_{12} (N_{180}: P_{140}) and it was observed statistically similar with the treatment F_{11}(N_{180}: P_{120}) during both the years as well as pooled mean analysis and it showed significant difference with rest of the other treatments. Whereas, the minimum yield of flowers per plant (128.07, 127.06 and 127.57) respectively was recorded under treatment F_1 (N_{120}: P_{100}). The interaction between cultivars and application of nitrogen and phosphorus was found significant during both the years as well as pooled mean basis under this investigation.

The highest yield of flowers per plant was observed under treatment F_{12} (N_{180}: P_{140}). The increase in levels of N and P exerted the significant effect on flower yield. The increase in flower yield might be attributed to the greater leaf area and more number of leaves per plant as well as plant spread would have resulted in production and accumulation of maximum photosynthates, resulting the production of more number of flowers. Similar finding have been reported by Deshmukh *et al*. 2008 in gaillardia, Meshram *et al*. 2008 in chrysanthemum, Ravindra *et al*. 2013 and Maheta *et al*. 2016 in China aster.

Table 1: Effect of Varieties and Nitrogen and phosphorus on Days to bud initiation

Treatments	2018	2019	Pooled
V_1	68.61	69.32	68.97
V_2	64.67	67.52	66.09
S.Em±	0.92	0.77	0.60
CD at 5%	1.86	1.55	1.19
F_1	60.85	60.95	60.9
F_2	60.57	62.33	61.45
F_3	64.60	63.57	64.08
F_4	65.27	65.22	65.24
F_5	65.82	67	66.41
F_6	67.35	68.95	68.15

F_7	68.53	70.43	69.48
F_8	67.05	71.35	69.2
F_9	68.2	72.42	70.31
F_{10}	69.45	72.48	70.97
F_{11}	70.88	72.6	71.74
F_{12}	71.1	73.73	72.42
S.Em±	2.26	1.88	1.47
CD at 5%	4.55	3.79	2.92
V_1F_1	59.2	60.33	59.77
V_1F_2	59.9	62.23	61.07
V_1F_3	67	63.37	65.18
V_1F_4	66.43	66.3	66.37
V_1F_5	68.43	68.33	68.38
V_1F_6	70.13	71.3	70.72
V_1F_7	71.73	71.8	71.77
V_1F_8	69.07	72.4	70.73
V_1F_9	71.73	73.9	72.82
V_1F_{10}	72	73.67	72.83
V_1F_{11}	73.37	73.57	73.47
V_1F_{12}	74.33	74.63	74.48
V_2F_1	62.5	61.57	62.03
V_2F_2	61.23	62.43	61.83
V_2F_3	62.2	63.77	62.98
V_2F_4	64.1	64.13	64.12
V_2F_5	63.2	65.67	64.43
V_2F_6	64.57	66.6	65.58
V_2F_7	65.33	69.07	67.2
V_2F_8	65.03	70.3	67.67
V_2F_9	64.67	70.93	67.8
V_2F_{10}	66.9	71.3	69.1
V_2F_{11}	68.4	71.63	70.02
V_2F_{12}	67.87	72.83	70.35
S.Em±	3.19	2.67	2.08
CD at 5%	NS	NS	NS

Table 2: Effect of Varieties and Nitrogen and phosphorus on Days to first flowering

Treatments	2018	2019	Pooled
V_1	79.05	79.15	79.10
V_2	77.54	78.29	77.92
S.Em±	0.73	0.79	0.54
CD at 5%	1.47	1.58	1.06
F_1	71.37	71.58	71.48
F_2	72.52	72.75	72.63
F_3	74.07	75.43	74.8
F_4	76.4	77	76.7
F_5	77.43	77.03	77.23
F_6	79.23	79.43	79.33
F_7	79.67	79.42	79.54
F_8	80.25	80.42	80.33
F_9	79.48	80.67	80.08
F_{10}	82.17	82.67	82.42
F_{11}	82.63	83.55	83.09
F_{12}	84.32	84.6	84.46
S.Em±	1.78	1.93	1.31
CD at 5%	3.59	3.88	2.61
V_1F_1	72.07	73.1	72.58
V_1F_2	74	73.8	73.9
V_1F_3	75.17	75.17	75.17
V_1F_4	76.87	77.77	77.32
V_1F_5	77.43	77	77.22
V_1F_6	79.97	80.47	80.22
V_1F_7	82.23	81.9	82.07
V_1F_8	82.43	81.17	81.8
V_1F_9	80.23	81.6	80.92
V_1F_{10}	82.4	81.67	82.03
V_1F_{11}	82.03	82.43	82.23
V_1F_{12}	83.77	83.73	83.75

V_2F_1	70.67	70.07	70.37
V_2F_2	71.03	71.7	71.37
V_2F_3	72.97	75.9	74.43
V_2F_4	75.93	76.23	76.08
V_2F_5	77.43	77.07	77.25
V_2F_6	78.5	78.4	78.45
V_2F_7	77.1	76.93	77.02
V_2F_8	78.07	79.67	78.87
V_2F_9	78.73	79.73	79.23
V_2F_{10}	81.93	83.67	82.8
V_2F_{11}	83.23	84.67	83.95
V_2F_{12}	84.87	85.47	85.17
S.Em±	2.52	2.72	1.86
CD at 5%	NS	NS	NS

Table 3: Effect of Varieties and Nitrogen and phosphorus on flowering duration

Treatments	**2018**	**2019**	**Pooled**
V_1	31.01	31.76	31.38
V_2	27.35	27.56	27.45
SEm±	0.37	0.44	0.29
CD at 5%	0.75	0.88	0.57
F_1	26.06	26.70	26.38
F_2	27.07	27.56	27.31
F_3	27.44	27.71	27.57
F_4	27.66	27.75	27.70
F_5	28.54	28.69	28.62
F_6	28.93	29.11	29.02
F_7	28.43	29.89	29.16
F_8	29.63	30.00	29.82
F_9	29.92	30.72	30.32
F_{10}	31.28	31.60	31.84
F_{11}	32.41	32.66	32.54
F_{12}	32.82	33.48	33.15
SEm±	0.91	1.07	0.70
CD at 5%	1.84	2.15	1.39
V_1F_1	26.67	27.72	27.20
V_1F_2	28.10	29.08	28.59
V_1F_3	28.65	29.01	28.83
V_1F_4	28.37	29.17	28.77
V_1F_5	29.40	30.47	29.94
V_1F_6	30.56	31.03	30.79
V_1F_7	31.18	32.47	31.83
V_1F_8	31.23	32.31	31.77
V_1F_9	32.93	33.25	33.09
V_1F_{10}	34.31	34.35	34.33
V_1F_{11}	35.57	35.94	35.76
V_1F_{12}	35.11	36.28	35.69
V_2F_1	25.44	25.67	25.56
V_2F_2	26.03	26.04	26.04
V_2F_3	26.22	26.41	26.31
V_2F_4	26.94	26.34	26.64
V_2F_5	27.67	26.92	27.29
V_2F_6	27.29	27.19	27.24
V_2F_7	25.67	27.30	26.49
V_2F_8	28.02	27.69	27.86
V_2F_9	26.92	28.19	27.55
V_2F_{10}	28.26	28.86	28.56
V_2F_{11}	29.25	29.38	29.32
V_2F_{12}	30.53	30.69	30.61
S.Em±	1.29	1.51	0.99
CD at 5%	2.60	NS	1.97

Table 4: Effect of Varieties and Nitrogen and phosphorus on No. of flowers per plant

Treatments	2018	2019	Pooled
V_1	52.90	53.06	52.98
V_2	59.64	61.92	60.78
S.Em±	0.89	0.73	0.58
CD at 5%	1.80	1.47	1.14
F_1	47.84	47.39	47.61
F_2	49.48	50.23	49.85
F_3	47.06	51.57	49.31
F_4	50.91	52.10	51.51
F_5	53.55	53.70	53.62
F_6	55.48	53.81	54.64
F_7	57.36	55.98	56.67
F_8	57.12	60.29	58.71
F_9	62.22	64.07	63.14
F_{10}	62.21	64.00	63.73
F_{11}	64.13	67.59	65.86
F_{12}	67.92	67.88	67.90
S.Em±	2.19	1.78	1.41
CD at 5%	4.40	3.59	2.80
V_1F_1	42.99	43.73	43.36
V_1F_2	44.52	45.82	45.17
V_1F_3	45.40	46.53	45.96
V_1F_4	47.01	46.88	46.95
V_1F_5	50.88	47.38	49.13
V_1F_6	53.89	48.89	51.39
V_1F_7	55.07	51.56	53.32
V_1F_8	53.82	57.04	55.43
V_1F_9	54.64	59.99	57.32
V_1F_{10}	61.37	61.36	61.37
V_1F_{11}	62.15	63.17	62.66
V_1F_{12}	63.03	64.33	63.68
V_2F_1	52.68	51.04	51.86
V_2F_2	54.43	54.63	54.53
V_2F_3	48.72	56.60	52.66
V_2F_4	54.81	57.32	56.06
V_2F_5	56.21	60.02	58.11
V_2F_6	57.07	58.73	57.90
V_2F_7	59.64	60.41	60.02
V_2F_8	60.42	63.54	61.98
V_2F_9	69.80	68.14	68.97
V_2F_{10}	63.05	69.14	66.10
V_2F_{11}	66.11	72.00	69.06
V_2F_{12}	72.80	71.44	72.12
S.Em±	3.09	2.52	2.00
CD at 5%	NS	NS	NS

Table 5: Effect of Varieties and Nitrogen and phosphorus on Yield of flower per plant

Treatments	2018	2019	Pooled
V_1	143.59	148.75	146.17
V_2	170.63	174.01	172.32
S.Em±	1.66	1.46	1.11
CD at 5%	3.35	2.94	2.20
F_1	128.07	127.06	127.57
F_2	134.39	136.31	135.35
F_3	136.46	138.10	137.28
F_4	141.92	146.92	144.42
F_5	148.99	149.35	149.17
F_6	155.03	158.79	156.91
F_7	157.87	163.62	160.74
F_8	163.18	169.49	166.33
F_9	167.73	176.21	171.97
F_{10}	177.25	182.18	179.71
F_{11}	183.86	193.31	188.58
F_{12}	190.63	195.24	192.93
S.Em±	4.08	3.58	2.71
CD at 5%	8.20	7.21	5.39

V_1F_1	112.53	110.92	111.72
V_1F_2	119.94	118.85	119.40
V_1F_3	122.99	124.58	123.79
V_1F_4	129.92	133.53	131.73
V_1F_5	133.13	133.00	133.07
V_1F_6	138.51	144.63	141.57
V_1F_7	140.42	150.66	145.54
V_1F_8	146.19	157.69	151.94
V_1F_9	151.03	168.88	159.96
V_1F_{10}	165.36	175.76	170.56
V_1F_{11}	177.42	181.98	179.70
V_1F_{12}	185.65	184.54	185.10
V_2F_1	143.62	143.20	143.41
V_2F_2	148.83	153.77	151.30
V_2F_3	149.92	151.63	150.78
V_2F_4	153.91	160.30	157.11
V_2F_5	164.84	165.71	165.27
V_2F_6	171.55	172.96	172.26
V_2F_7	175.31	176.57	175.94
V_2F_8	180.16	181.30	180.73
V_2F_9	184.43	183.54	183.99
V_2F_{10}	189.14	188.59	188.86
V_2F_{11}	190.29	204.63	197.46
V_2F_{12}	195.60	205.94	200.77
S.Em±	5.76	5.06	3.84
CD at 5%	NS	NS	NS

Conclusion

On the basis of two years study, it was concluded that optimum doses of nitrogen and phosphorus are necessary for maximizing growth, yield and quality of China aster under Chhattisgarh condition. Among the treatments, the treatment F_{12} (N_{180}: P_{140}) recorded days to bud initiation, days to first flower opening, days to 50% flowering, duration of flowering, flower weight, number of flowers per plant and flower yield per plant.

The study suggested that China aster cv. Arka Archana performed superior as compare to Arka Shashank and application of NPK @ 180:140 and 60 kg ha^{-1} is the most appropriate dose for attaining high growth, yield and quality of these cultivar of China aster under Chhattisgarh condition.

The interactions between two cultivar and application of nitrogen and phosphorus were found mostly non- significant for different growth and flowering and yield attributes of China aster. This may be due to the similar effect of nitrogen and phosphorus on both the varieties of China aster under Chhattisgarh conditions.

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