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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; 10(3): 441-445

www.thepharmajournal.com
Received: 02-01-2021
Accepted: 05-02-2021

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Effect of varieties and plant growth regulators on vegetative growth 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-I entitled "Effect on different concentrations of plant growth regulators on growth, flowering, yield and quality of China Aster" was conducted during winter season of 2018-19 and 2019-20. The experimental field was laid out in (Factorial Randomized Block Design) (FRBD) with 3 replications. There were 14 treatment combinations of two varieties *viz*. Arka Shashank and Arka Archana as factor A and three plant growth regulators with two doses each *i.e,* Cycocel @ 1500, 1000 ppm, NAA @ 50, 100 ppm and GA_3 @150, 200 along with water spray (control) as factor B.
Under transitional Chhattisgarh plains, there is a need to standardize production technology involving systematic research to evaluate acceptable variety and to evaluate the effect of plant growth regulators on growth, flowering, yield and quality of China aster flower production under the Chhattisgarh plains.
The result were indicated that China aster cv. Arka Archana performed superior as compare to Arka Shashank and the treatment P_6 (GA_3 @ 200 ppm) performed significantly better in growth characters *viz.* plant height(cm), plant spread (cm), maximum number of primary and secondary branches plant^{-1}, number of leaves /plant, leaf area and leaf area index.

Keywords: Arka shashank and Arka Archana, Chhattisgarh plains, vegetative growth, China Aster

1. Introduction
China aster (*Callistephus chinensis* (L.) Nees) belongs to the family compositae and its origin is China. China aster is one of the most important annual flower crops used commercially as cut flower, and for interior decoration. It is also used for bedding and potting purpose. Flowers are used for decoration, landscaping, in window boxes and used as loose flower in worship. China aster are usually propagated by seeds. seedlings are raised in seed beds. The plants need rich porous well drained loamy soil. It loves the sun and hence it should be grown in an open sunny environment. Proper fertilizer applications help in better growth and flowering, watering should be done in the morning or in the evening. The flowers of aster have wide range of type, size, shape, colour and have good keeping quality. Most of the colours except pure yellow are present in aster. The latest variations of pink, primrose, light blue, mauve, black, scarlet, creamy white, plain white and violet are available in different sizes, styles and a wide variety of colour ranges. (Dua and Pal 2003,) [3].

Genus *Callistephus* derived from two Greek words, '*Kalistos'* and '*Steophos*' which means beautiful and crown respectively. It was introduced in Europe in 1731 by Jesult missionary. French florist contributed much in development of quilled flowers. The comet type introduced in 1886 subsequently replaced by Quilled flowers. China aster is short day plant and it requires less than 12 hrs light for improved vegetative growth and early flowering. Flower initiation took place at a temperature of 15 ^{o}C above. Flowers show geitanogamous type of self-pollination. Plant growth regulators are unique in action, i.e. the behaviour and reaction of each type of plant according to the concentration and composition of compounds is found to be highly variable. Many products with active ingredients have been produced as commercial products and, in compliance with the instructions, may be used for specific purposes. It has been found that plant growth regulators are rapidly absorbed into the various parts of the plant. There are different methods for using plant growth regulators. The most widespread is foliar use. It is simple, convenient, cheap and economical.

Over the last three quarters of a century, technical developments relating to growth regulators have advanced rapidly. Plant growth regulators can, when used in small amounts, alter or monitor physiological processes in the plant. Plant growth regulators are found to be absorbed easily by the various parts of the plant. In practice, there are different strategies for using growth regulators. The foliar application is the most common because it is simple, convenient, inexpensive and economical. By modifying the growth, flowering, seed set and seed yield of plants, it has played a significant role.

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. Geographically, Raipur is situated in the transitional tract of Chhattisgarh at 21.29 North latitude and 81.82 East longitude at an altitude of 250-300 m above the mean sea level. 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. The maximum and minimum temperatures were 40.8°C in 3rd week of April and 8.5°C in 1st week of January, respectively during (2018-19). The maximum and minimum temperatures were 35.1°C in 4th week of April and 10.8 °C in 2nd week of January, respectively during (2019-20). The average wind velocity ranges from 3.8-4.4 (Kmph) during (2018-19) and 3.9-4.5 (Kmph) during (2019-20) respectively. The weather conditions during the course of investigation remained favourable for the growth, development and production of China Aster.

The experimental field was laid out in Factorial Randomized Block Design (FRBD) with three replications. There were 14 treatment combinations of two varieties *viz*. Arka Shashank and Arka Archana as factor A and three plant growth regulators with two doses each *i.e.,* Cycocel @ 1500,1000 ppm, NAA @ 50, 100 ppm and GA_3 @150, 200 along with water spray (control) as factor B. 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 seven PGR doses which were applied in two varieties of China Aster, hence there are 14 treatments combinations. V_1P_0 (Arka Shashank + Control), V_1P_1 (Arka Shashank+ Cycocel @ 1000ppm), V_1P_2 (Arka Shashank+ Cycocel @ 1500 ppm), V_1P_3 (Arka Shashank+ NAA @ 50 ppm), V_1P_4 (Arka Shashank+ NAA @ 100 ppm), V_1P_5 (Arka Shashank+ GA_3 @ 150 ppm) V_1P_6 (Arka Shashank + GA_3 @ 200 ppm), V_2P_0 (Arka Archana + Control), V_2P_1 (Arka Archana + Cycocel @ 1000ppm), V_2P_2 (Arka Archana + Cycocel @ 1500 ppm), V_2P_3 (Arka Archana + NAA @ 50 ppm), V_2P_4 (Arka Archana + NAA @ 100 ppm), V_2P_5 (Arka Archana + GA_3 @ 150 ppm), V_2P_6 (Arka Archana + GA_3 @ 200 ppm).

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) [10].

Results and Discussion

The data on plant height at 45, 75 and 105 DAT influenced by varieties of China aster and plant growth regulators are presented in Table 1.

Cultivars shows significant response on plant height at 45, 75 and 105 DAT, during both the years as well as in pooled mean basis. The maximum plant height respectively was observed in cultivar (V_1) Arka Shashank. Whereas, the minimum plant height was found in cultivar (V_2) Arka Archana. The variation in plant height between China aster varieties might be due to congenial environment to plant that express the dominant genes in the genotypes and different genetic makeup of the varieties. The observations are in conformity with the findings of Bhanu Pratap *et al.* (1999) [1], Sreekala *et al.* (2002) [14], Rao *et al.* (2005) [11], Nursude *et al.* (2010) [9] in African marigold and Namita *et al.* (2008) [7] in French marigold.

The perusal of the data reveals that at 45, 75 and 105 DAT there was significant difference on plant height due to plant growth regulators during both the year and on pooled mean basis. The maximum plant height was recorded under the treatment P_6 (GA_3 200 ppm). The minimum plant height was noticed in P_3 (CCC 1500 ppm) under this investigation. The interactions between cultivar and growth regulators were found significant for plant height during both the years and pooled mean basis.

The maximum plant height was obtained by spraying with GA_3@ 200 ppm This might be due to the fact that an application of gibberellic acid at different concentrations might have enhanced the plant height by increasing the internodal length as a result of increased cell elongation and faster cell division which may be enhance the plant growth and ultimately increases the plant height. The results are in conformity with the findings of Kadam *et al*. (2002) [5], Nandre *et al*. (2009) [8], Gupta *et al*. (2015) [4] and Kumar *et al*. (2015) in China aster, Palei *et al*. (2016) in African marigold and Sajid *et al*. (2016) in *Chrysanthemum morifolium*.

The result on plant spread was influence by cultivars and plant growth regulators are presented in Table 2.

At 45, 75 and 105 DAT variety showed significant influence on plant spread during both the years as well as pooled mean basis. The plant spread were found maximum in cultivar (V_2) Arka Archana in both the years and pooled mean basis and minimum plant was found in cultivar (V_1) Arka Shashank.. The difference in plant spread per plant is a varietal trait as it is governed by the genetical makeup of the plant. Similar variations in plant spread among varieties were also observed in china aster reported by Rao and Negi (1990) [11] and Ravikumar (2002).

Maximum plant spread was observed in treatment P_6 (GA_3 200 ppm) during this investigation and the minimum plant spread was found in the treatment P_0 (control) at 45, 75 and 105 DAT.

The interactions between two cultivar and growth regulators were found non-significant at 45 and 75 DAT for plant spread and it was found significant at 105 DAT.

Maximum spread of plant might be due to the favorable environment to express the dominant genes in the genotypes and different genetic makeup of the variety. The chlorophyll content in leaves might have increased the synthesis of carbohydrates, amino acids etc. from which phytochrome may have been synthesized resulting in increase in vegetative characters. The present research work confirms the findings of Bhanu Pratap *et al.* (1999) [1], Nand- Kishore and Mohanti (2002), Sreekala *et al.* (2002) [14], Rao *et al.* (2005) [11] and Nursude *et al.* (2010) [9] in African marigold.

The results on number of primary branches plant^{-1} were significantly influenced by varieties and application of growth regulators are presented in Table 3 and Table 4.

The perusal of the data on the influence of varieties on number of primary and secondary branches per plant revealed that at 75 and 105 DAT, it showed significant effect during both the year as well as pooled mean basis of investigation. The maximum number of primary and secondary branches plant^{-1} was recorded under cultivar (V_2) Arka Archana as compared to cultivar (V_1) Arka Shashank. From the above findings, significantly maximum number of primary and secondary branches was observed in Arka Archana at all the growth stages, and the increasing in primary branches might be due to the pleasant environment to express the dominant genes in the genotypes and different genetic makeup of the variety. The present research work confirms with the findings of Bhanu Pratap *et al.* (1999) [1], Nand- Kishore and Mohanti (2002), Sreekala *et al.* (2002) [14], Rao *et al.* (2005) [11] and Nursude *et al.* (2010) [9] in African marigold

In case of Plant growth regulators, it showed significant impact on number of primary and secondary branches plant^{-1} at 75 and 105 DAT. The highest number of primary and secondary branches per plant was observed in treatment P_6 (GA_3 200 ppm. Lowest number of primary and secondary branches plant^{-1} was recorded under treatment P_0 (Control). The interaction between the varieties and plant growth regulators shows non- significant impact on number of primary branches plant^{-1} at 75 and 105 DAT during both the tested year as well as pooled mean analysis.

Maximum number of branches were found with GA_3 at 200 ppm compared to all other treatments. The increase in number of primary branches per plant with application of GA_3 seems to be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with higher dry matter accumulation in the plant. Similar results were reported by Lal and Mishra (1986) [6] in aster and marigold, Shivaprasad Shetty (1995) [12] and Doddagoudar(2002) [2] in China aster.

The data on number of leaves per plant at different growth stages are presented in Table 5. The perusal of the data revealed that at 45, 75 and 105 DAT there was significant effect on number of leaves per plant due to cultivars during both the years and on pooled mean basis. The maximum number of leaves was observed in cultivar (V_2) Arka Archana as compared to cultivar (V_1) Arka Shashank during this investigation. Maximum number of leaves was found with the GA_3 treatment at 200 ppm compared to all other treatments and this is due to the increase in plant height and number of branches per plant. Similar results were recorded by earlier research workers (Lal and Mishra, 1986 and Shyamal *et al.* (1990) [6, 13] in aster.

Table 1: Effect of Varieties and plant growth regulators on Plant height (cm)

	45 days			75 days			105 days		
Treatments	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**
V_1	18.3	18.8	18.6	46.9	48	47.5	54.3	54.4	54.3
V_2	17.5	17.8	17.6	36.8	37.5	37.2	47.5	46.8	47.1
SEm±	0.24	0.28	0.17	0.52	0.57	0.57	0.55	0.65	0.69
CD at 5%	0.7	0.83	0.5	1.53	1.67	1.67	1.61	1.89	2.02
P_0	15.6	16.8	16.2	34.7	36	35.3	44.1	43.9	44
P_1	15.4	16	15.7	33.5	34	33.7	42	41.8	41.9
P_2	13.9	14.2	14	32.1	34.6	33.3	41	41.3	41.1
P_3	17.9	18.2	18.1	41.8	42.9	42.3	49.9	48.9	49.4
P_4	19	19.6	19.3	44.2	44.3	44.3	51	49.6	50.3
P_5	20.8	21.4	21.1	52.2	53.3	52.7	63.8	63.2	63.5
P_6	22.6	22.1	22.3	54.7	54.6	54.6	64.5	65.5	65
SEm±	0.45	0.53	0.32	0.98	1.07	1.07	1.03	1.22	1.3
CD at 5%	1.32	1.56	0.93	2.87	3.12	3.13	3.01	3.55	3.78
V_1 P_0	15.13	17.36	16.25	36.17	36.43	36.3	42.6	44.4	43.5
V_1 P_1	14.90	16.13	15.51	35.13	37.17	36.15	40.53	42.4	41.47
V_1 P_2	13.93	14.36	14.15	32.9	34.73	33.82	39.8	40.1	39.95
V_1 P_3	18.50	18.53	18.51	48.1	48.33	48.22	53.53	52.4	52.97
V_1 P_4	20.26	20.16	20.21	51.1	50.17	50.63	55	54.33	54.67
V_1 P_5	21.26	22.23	21.75	61.5	63.87	62.68	73.93	72.37	73.15
V_1 P_6	23.9	23.13	23.51	63.63	65.63	64.63	74.5	74.93	74.72
V_2 P_0	16.06	16.26	16.16	33.17	35.47	34.32	45.57	43.3	44.43
V_2 P_1	15.80	15.86	15.83	31.83	30.73	31.28	43.5	41.23	42.37
V_2 P_2	13.83	13.93	13.88	31.3	34.4	32.85	42.23	42.43	42.33
V_2 P_3	17.23	17.93	17.58	35.47	37.43	36.45	46.23	45.47	45.85
V_2 P_4	17.73	19.03	18.38	37.27	38.5	37.88	46.97	44.8	45.88
V_2 P_5	20.36	20.46	20.41	42.80	42.67	42.73	53.67	54.07	53.87
V_2 P_6	21.33	21	21.16	45.77	43.47	44.62	54.43	56.13	55.28
SEm±	0.64	0.76	0.45	1.39	1.52	1.52	1.46	1.72	1.84
CD at 5%	1.86	NS	NS	4.06	4.42	4.43	4.26	5.02	5.43

Table 2: Effect of Varieties and plant growth regulators on Plant Spread (cm)

	45 days			75 days			105 days		
Treatments	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**
V_1	17.6	17.93	17.77	22.1	21.6	21.85	25.97	26.49	26.23
V_2	21.69	21.74	21.72	27.92	28.1	28.01	36.48	36.4	36.45
SEm±	0.50	0.63	0.40	0.50	0.55	0.37	0.52	0.53	0.37
CD at 5%	1.03	1.29	0.8	1.02	1.13	0.74	1.06	1.08	0.74
P_0	15.20	14.98	15.09	18.66	18.16	18.42	22.9	22.76	22.83
P_1	20.18	20.3	20.24	25.61	26.21	25.92	31.93	30.43	31.18
P_2	21.46	21.25	21.36	27.16	26.86	27.02	33.25	31.88	32.57
P_3	16.28	17.03	16.66	22.81	22.05	22.43	27.9	27.86	27.88
P_4	18.98	19.43	19.21	24	23.35	23.68	28.98	29.7	29.34
P_5	22.22	22.33	22.28	27.81	27.98	27.9	36.16	37.8	36.98
P_6	23.2	23.56	23.38	29.03	29.33	29.18	37.46	39.7	38.58
SEm±	0.94	1.17	0.75	0.93	1.03	0.69	0.97	0.98	0.69
CD at 5%	1.92	2.41	1.5	1.92	2.11	1.39	1.99	2.02	1.38
$V_1 P_0$	12.3	12.03	12.17	15.53	15.06	15.3	19.16	19.26	19.22
$V_1 P_1$	18.56	18.96	18.77	23.4	22.36	22.88	26.73	26.2	26.47
$V_1 P_2$	20	19.8	19.9	24.43	23.26	23.85	28.46	27.86	28.17
$V_1 P_3$	13.73	14.93	14.33	20.5	19.63	20.07	23.46	23.3	23.38
$V_1 P_4$	16.63	17.03	16.83	21.63	20.33	20.98	24.23	23.43	23.83
$V_1 P_5$	20.33	20.86	20.6	24	24.36	24.18	28.8	31.83	30.32
$V_1 P_6$	21.66	21.93	21.8	25.26	26.16	25.72	30.93	33.53	32.23
$V_2 P_0$	18.1	17.93	18.02	21.8	21.26	21.53	26.63	26.26	26.45
$V_2 P_1$	21.8	21.63	21.72	27.83	30.06	28.95	37.13	34.66	35.9
$V_2 P_2$	22.93	22.7	22.82	29.9	30.46	30.18	38.03	35.9	36.97
$V_2 P_3$	18.83	19.13	18.98	25.13	24.46	24.8	32.33	32.43	32.38
$V_2 P_4$	21.33	21.83	21.58	26.36	26.36	26.37	33.73	35.96	34.85
$V_2 P_5$	24.13	23.8	23.97	31.63	31.6	31.62	43.53	43.76	43.65
$V_2 P_6$	24.73	25.2	24.97	32.8	32.5	32.65	44	45.86	44.93
SEm±	1.32	1.66	1.06	1.32	1.45	0.98	1.37	1.39	0.98
CD at 5%	NS	NS	NS	NS	NS	NS	2.81	2.86	1.96

Table 3: Effect of Varieties and plant growth regulators on Number of primary branches

	75 days			105 days		
Treatments	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**
V_1	15.11	15.13	15.12	22.23	22.44	22.34
V_2	17.88	17.78	17.83	27.15	26.98	27.07
SEm±	0.38	0.55	0.34	0.55	0.59	0.40
CD at 5%	0.77	1.14	0.67	1.13	1.22	0.81
P_0	11.86	11.60	11.73	16.26	16.05	16.16
P_1	16.76	16.86	16.82	25.10	25.43	25.27
P_2	18.60	17.83	18.22	26.86	27.48	27.18
P_3	13.01	13.55	13.28	21.2	20.01	20.61
P_4	14.80	14.28	14.54	22.88	23.35	23.12
P_5	19.60	19.43	19.52	29.33	28.86	29.10
P_6	20.85	21.63	21.24	31.20	31.81	31.51
SEm±	0.71	1.04	0.63	1.03	1.11	0.76
CD at 5%	1.45	2.13	1.26	2.11	2.28	1.52
$V_1 P_0$	10.90	11.50	11.20	15.76	14.86	15.32
$V_1 P_1$	15.23	15.16	15.20	21.70	22.63	22.17
$V_1 P_2$	16.66	15.70	16.18	22.83	24.46	23.65
$V_1 P_3$	12.03	12.96	12.5	18.86	17.5	18.18
$V_1 P_4$	13.83	13.83	13.83	19.9	20.8	20.35
$V_1 P_5$	17.63	16.83	17.23	27.10	26.66	26.88
$V_1 P_6$	19.50	19.93	19.72	29.46	30.20	29.83
$V_2 P_0$	12.83	11.70	12.27	16.76	17.23	17.00
$V_2 P_1$	14.00	14.13	14.07	23.53	22.53	23.03
$V_2 P_2$	15.76	14.73	15.25	25.86	25.9	25.88
$V_2 P_3$	18.30	18.56	18.43	28.50	28.23	28.37
$V_2 P_4$	20.53	19.96	20.25	30.90	30.50	30.70
$V_2 P_5$	21.56	22.03	21.80	31.56	31.06	31.32
$V_2 P_6$	22.20	23.33	22.77	32.93	33.43	33.18
SEm±	1.00	1.47	0.89	1.45	1.57	1.07
CD at 5%	NS	NS	NS	2.99	NS	NS

Table 4: Effect of Varieties and plant growth regulators on Number of Secondary branches

	75 days			105 days		
Treatments	**2018**	**2019**	**Pooled**	**2018**	**2019**	**Pooled**
V_1	19.30	19.80	19.55	27.84	28.57	28.21
V_2	22.48	22.60	22.54	30.07	31.70	31.39
SEm±	0.43	0.45	0.31	0.65	0.69	0.47
CD at 5%	0.89	0.93	0.63	1.33	1.42	0.95
P_0	16.28	15.85	16.07	23.05	22.95	23.00
P_1	21.10	21.41	21.26	29.81	30.43	30.13
P_2	22.43	23.50	22.97	30.81	31.36	31.09
P_3	19.71	19.38	25.85	26.78	26.32	19.71
P_4	20.43	20.25	27.91	28.28	28.10	20.43
P_5	23.26	23.43	23.35	33.96	33.88	33.93
P_6	24.06	24.05	24.06	34.78	37.28	36.03
SEm±	0.81	0.84	0.58	1.21	1.29	0.89
CD at 5%	1.66	1.74	1.17	2.49	2.66	1.78
$V_1 P_0$	15.83	16.36	16.10	21.70	22.43	22.07
$V_1 P_1$	19.43	20.20	19.82	27.46	28.46	27.97
$V_1 P_2$	20.36	21.76	21.07	28.03	29.90	28.97
$V_1 P_3$	17.56	17.93	17.75	25.66	25.26	25.47
$V_1 P_4$	18.56	18.5	18.53	26.56	27.06	26.82
$V_1 P_5$	21.26	22.23	21.75	32.16	32.166	32.17
$V_1 P_6$	22.13	21.60	21.87	33.30	34.73	34.02
$V_2 P_0$	16.73	15.33	16.03	24.40	23.46	23.93
$V_2 P_1$	20.53	21.50	21.02	26.03	28.30	27.17
$V_2 P_2$	21.56	22.36	21.97	29.26	29.50	29.38
$V_2 P_3$	22.76	22.63	22.70	32.16	32.40	32.28
$V_2 P_4$	24.50	25.23	24.87	33.60	32.83	33.22
$V_2 P_5$	25.26	24.63	24.95	35.76	35.60	35.68
$V_2 P_6$	26.00	26.50	26.25	36.26	39.83	38.05
SEm±	1.15	1.19	0.83	1.71	1.83	1.25
CD at 5%	NS	NS	NS	NS	NS	NS

Conclusion

The plant height increased when first foliar application of GA_3 @200 ppm was done at 45, 75 and 105 DAT. Whereas, taller plants were observed in Arka Shashank as compared to Arka Archana. The number of branches was produced more with the application of GA_3 200 ppm followed by 1500 ppm cycocel at 45, 75 and 105 DAT and it was also more in cv. Arka Archana. The plant spread were observed more with the application of GA_3@200 ppm followed by cycocel @1500 ppm. Whereas, higher plant spread were observed in Arka Archana as compared to Arka Shashank.

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