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Effect of organic manures and biofertilizers on growth and floral attributes of Kamini China aster

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ABSTRACT

The present investigation was carried out during March to July 2016 to find out the effect of organic manures and biofertilizers on vegetative and floral attributes of Kamini China aster. The results of investigation revealed maximum number of primary branches (13.63), plant spread (21.63 cm), number of leaves per plant (162.20), duration of flowering (20.80 days), number of flowers per plant (39.10), number of flowers per m^2 (360.30), vase life (9.73 days) and minimum days taken to bud initiation and flowering (58.43 and 74.43, respectively) from the treatment consisting of FYM @18 ton/ ha (50%) + Vermicompost @ 06 ton/ ha (50%)+ PSB @ (50 ml /15L) + *Azotobacter* @ (30ml/15L) i.e. T_{16}. The quality traits viz., stalk length (34.43 cm), flower diameter (7.73 cm) and average weight of flower (3.38 g) were found maximum from T_{13} Vermicompost @ 9.6 ton/ ha (80%) + PSB@ (50 ml /15L) +*Azotobacter* @ (30ml/15L) followed by T_{16} (34.23 cm, 7.20 cm and 3.37 g). Thus, it can be concluded from the findings that treatment T_{16} was most effective in improving quality and quantity traits of cv. Kamini China aster.

Key words: *Callistephus chinensis*, *Azotobacter*, farmyard manure, phosphate solubilizing bacteria, vermicompost.

INTRODUCTION

China aster (*Callistephus chinensis* (L.) Nees.) is one of the important commercial flower crop of India. It belongs to the family Asteraceae and native to China. It is a winter season half hardy annual flower crop. Among annual flowers, it ranks next to chrysanthemum and marigold. The plants are erect; leaves are arranged alternately on branches and bear solitary type of flowers. Recently cultivation of China aster gets popular among the farmers because of its easy cultivation and wider adaptability to different agro climate. Its spectacular flower, brilliant colour and prolong vase life is also the reason of its high demand in cut flower market. The flowers are extensively use as cut flower for making bouquets and flower arrangements; loose flower for preparation in garlands and buttonholes. In ornamental gardening, it is grown in flower beds, edging plant and making mixed herbaceous border in addition to this it is also sold as a popular pot plant in major commercial nurseries.

Due to increases in demand of flowers and getting higher profitability nowadays farmers are applying excessive amount of chemical fertilizers that has an adverse effect on soil structure as well as available micro flora and fauna. One can get higher yield with the use of chemical fertilizers but they are not economical as well as unsafe and also causes water, air and soil pollution. Continuous use of chemicals not only burden for the farmer's but also responsible to deplete soil fertility and productivity also affected (Sharma *et al.,* 15). Besides this, hike in prices of chemical fertilizers shifted a keen interest of farmers towards the alternate sources i.e., organic manures and biofertilizers. The application of organic manures not only improves soil physical properties and pH, but also adds essential nutrients to the soil. They helps in increasing water holding capacity, supply nutrients and improve soil fertility. Along with organic manures biofertilizers are of great importance as these are microbial inoculants that helps to decompose complex organic matter and fix solubilize unavailable form of nutrients to available form. Muraleedharan *et al*. (10) reported that addition of biofertilizers in soil increases the availability of nutrients and improve the yield by 10-25%. The organic and microbial sources of nutrients have advantage of maintaining ideal C: N ratio as they releases nutrients slowly and consistently (Yadav *et al.*, 19). They are environmentally safe and viable alternative of chemical fertilizers. The use of organic manures and biofertilizers has an advantage of converting unusual surplus or waste into useful products (Khanna *et al.,* 5). Keeping in view all the above background information, the present investigation was undertaken to find out the effect of organic manures and biofertilizers on vegetative and floral attributes of China aster cv. Kamini under hilly region of Uttarakhnad.

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MATERIALS AND METHODS

The present investigation was conducted at Floriculture and Landscape Block, COH, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India during March to July 2016. The experiment was laid out in a Randomized Complete Block Design with 16 treatments and 3 replications. Bharsar is situated at the high hills of Himalayas at 29° 20'-29° 75' N Latitude and 78° 10'-78° 80' E Longitude. The altitude of the place is 1900 meter above the mean sea level. The climate of the place is mild summer, higher precipitation and colder or severe cold prolonged winter. The soil comes under order inceptisols with pH 5.5 and available nitrogen (206.13 kg/ha), medium in available phosphorus (32.42kg/ha) and high in available potassium (243.81kg/ha). The treatments were as follows: T_1 = Control, T_2 = FYM @ 36 t/ha, T_3 = Vermicompost @ 12 t/ha, T_4 = PSB @ 50 ml/15L, T_5 = *Azotobacter* @ 30ml/15L, T_6 = FYM @ 18 t/ha (50 %) + Vermicompost @ 06 t/ ha (50%), T_7= FYM @ 28.8 t/ha (80 %) + PSB @ 50 ml/15L, T_8 = FYM @ 30.6 t/ha (85 %) + *Azotobacter* @ 30 ml/15L, T_9 = Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L, T_{10} = Vermicompost @ 10.2 t/ha (85%) + *Azotobacter* @ 30 ml/15L, T_{11} = PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{12} = FYM @ 18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L, T_{13} = Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30ml/15L, T_{14} = FYM @ 28.8 t/ha (80%) + PSB @ 50ml/15L + *Azotobacter* @ 30ml/15L, T_{15} = FYM @18ton/ha(50%) + Vermicompost @ 06 t/ha (50%) + *Azotobacter* @ 30 ml/15L, T_{16}= FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @50 ml/15L + *Azotobacter* @ 30ml/15L. FYM and Vermicompost were applied as per treatment allocation to the plots and incorporated into the soil one day before transplanting of seedlings. Biofertilizers i.e. *Azotobacter* & PSB solution were prepared by mixing desired quantity of solution in 15 litre of water. Biofertilizers solutions were applied by seedlings dipping method. Roots of the seedlings were dipped in these solutions for 30 minutes as per the treatments and treated seedlings were transplanted in the field. The uniform size seedlings were transplanted after one month interval in the respective plots at the spacing of 30 cm × 30 cm. All the cultural practices were kept uniform for all the treatments and standard practices were adopted. The data were analyzed by simple statistical methods for interpretation of the data using the procedures described by (Panse and Sukathme, 11). The analytical error of individual samples was generally below 5%.

RESULTS AND DISCUSSION

Data showed that tallest plant (76.73 cm) was observed in T_{14} followed by T_{15} (75.46 cm) and T_{16} (73.73). However, maximum number of primary branches (13.63), plant spread (21.63 cm) and number of leaves per plant (162.20) were observed in T_{16} (Table 1). FYM and Vermicompost might have acts as a source of macro (N, P and K) and micronutrients (Zn, Fe, Cu and Mn), enzymes and growth hormones in the early crop growth phase, which in turn encouraged vigorous vegetative growth (Kumar *et al.*, 7). Simultaneously, PSB and *Azotobacter* had helped in converting these nutrients to readily absorbable form thus increasing absorption area of nutrient and water. Improvement in soil structure due to FYM and Vermicompost had leads to improve physiochemical properties of soil that leads to better root growth and ultimately exhibiting better vegetative growth. Koley and Pal (6) stated that PSB, *Azotobacter* or alone or in combination produces growth promoting substances such as IAA or GA like substances Vit B_{12}, thiamine, riboflavin (B_2). Sharma and Thakur (14) reported that integrated approach of nutrient supply through organic matters and biofertilizers like PSB and *Azotobacter* gave better chlorophyll content. All these factors contribute to cell multiplication, cell enlargement and differentiation which could have resulted in better photosynthesis and ultimately exhibited vigorous vegetative growth. These findings are in corroboration with the work of Kameswari *et al.* (4) and Airadevi and Mathad (1) in chrysanthemum.

Among different treatments applied, the maximum leaf area (53.73 cm^2) was observed in (T_{13}) which was found at par with the treatments T_9, T_{10}, T_5, T_6, T_{12}, T_{15}, T_{14} and T_{16} (48.06 cm^2, 48.33 cm^2, 48.60 cm^2, 49.90 cm^2, 50.00 cm^2, 51.33 cm^2, 52.26 cm^2, 52.80 cm^2, respectively). The minimum leaf area (37.60 cm^2) was recorded in control. The increase in leaf area under integration of organic manures with biofertilizers might be due to the increased availability of nitrogen and phosphorous which are important constituent of chlorophyll and protein thus causing more growth. Similar finding was reported by Kumar *et al.* (8) in China aster.

An inquisition of data presented in Table 1 revealed that organic manures and biofertilizers have a significant effect on number of days taken to bud initiation and flowering. Minimum number of days taken to bud initiation and flowering (58.43 and 74.43, respectively) were recorded in T_{16}. This might be due to increased availability of nutrients from FYM and Vermicompost which promoted the translocation of phytohormones to the shoots resulting in the early bud and flower initiation. Subsequently *Azotobacter*

Table 1: Effect of organic manures and biofertilizers vegetative and floral attributes of Kamini China aster.

Treatments	Plant height (cm)	No. of primary branches per plant	Plant spread (cm)	No. of leaves per plant	Leaf area (cm^2)	Days taken to first flower bud initiation	Days taken to first flowering
T_1	62.60	5.26	13.30	147.53	37.60	76.50	93.03
T_2	63.86	5.83	13.76	149.60	43.20	76.10	92.56
T_3	64.20	6.23	14.76	150.26	44.23	74.66	90.43
T_4	64.90	6.66	15.53	151.63	44.50	72.76	88.43
T_5	66.66	6.70	16.30	152.30	48.60	73.40	89.56
T_6	67.66	7.80	16.66	153.33	49.90	71.63	87.40
T_7	66.40	7.33	17.26	154.50	41.46	70.83	86.73
T_8	68.43	8.40	18.26	153.53	47.43	69.46	85.43
T_9	74.44	9.26	20.60	155.50	48.06	70.26	86.30
T_{10}	69.96	9.60	17.76	157.40	48.33	68.76	84.60
T_{11}	71.60	10.80	18.60	156.56	47.13	66.46	82.53
T_{12}	70.80	10.20	19.70	158.33	50.00	64.73	80.26
T_{13}	72.73	12.30	20.23	159.76	53.73	60.26	76.33
T_{14}	76.73	12.66	21.30	161.70	52.26	60.80	76.73
T_{15}	75.46	11.53	19.33	158.70	51.33	62.90	78.46
T_{16}	73.73	13.63	21.63	162.20	52.80	58.43	74.43
S.E(d)	0.34	0.15	0.42	1.24	4.88	0.19	0.24
$C.D_{(0.05)}$	0.69	0.31	0.20	2.55	9.97	0.40	0.49

T_1 = Control, T_2 = FYM @ 36 t/ha, T_3 = Vermicompost @ 12 t/ha, T_4 = PSB @ 50 ml/15L, T_5= *Azotobacter* @ 30 ml/15L, T_6= FYM @ 18 t/ha (50 %) + Vermicompost @ 06 t/ha (50%), T_7= FYM @ 28.8 t/ha (80 %) + PSB @ 50 ml/15L, T_8 = FYM @ 30.6 t/ha (85 %) + *Azotobacter* @ 30 ml/15L, T_9 = Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L, T_{10}= Vermicompost @ 10.2 t/ha (85%) + *Azotobacter* @ 30 ml/15L, T_{11}= PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{12}= FYM @ 18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L, T_{13}= Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{14}= FYM @ 28.8 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{15} = FYM @ 18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + *Azotobacter* @ 30 ml/15L, T_{16}= FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L

and PSB helps in increasing the availability of N and P along with presence of plant growth promoting substances to the auxiliary buds resulting in breakage of apical dominance. Ultimately, they resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase. These finding was in conformity with the findings of Ravindra *et al*. (12) in China aster.

The duration of flowering (20.80 days) was found maximum in T_{16} and found statistically at par with T_{14} (20.36 days). However, minimum duration of flowering (14.46 days) was observed in T_2 and found statistically at par with control (14.73 days) as depicted in Table 2. Similarly, maximum number of flowers per plant and per m^2 (39.10 and 360.30, respectively) were recorded in T_{16}. *Azotobacter* and PSB species like *Pseudomonas striata, Bacillus polymyxa* and *Bacillus megaterium* are also reported to beneficial in increasing the nitrogen and phosphorus availability in soil simultaneously increase the uptake of nutrients by plant and thereby increasing yield (Kumar *et al.,* 9). Singh *et al.*(16) reported that nitrogen increase the protein synthesis, thus promote the development of floral primordial, while phosphorus found to be involved in formation of floral primordial resulting more number of flower obtained in marigold. The increased in flower yield might be attributed to vigorous vegetative growth under the treatment T_{16} that would have also resulted in production and accumulation of maximum photosynthates, resulting the production of more number of flowers. Similar finding has been reported by Ravindra *et al.* (12) in China aster.

Quality traits viz., stalk length, flower diameter and average weight of flower were significantly improved by the use of organic manures and biofertilizers. On perusal of data presented in Table 2 showed that maximum stalk length (34.43 cm) was observed in T_{13} which was found statistically at par with T_{16} (34.23 cm) and minimum stalk length (24.83 cm) was recorded T_1. Increase in stalk length might be due to

Table 2: Effect of organic manures and biofertilizers on floral quality and quantity traits of Kamini China aster.

Treatments	Duration of flowering (days)	Number of flowers/ plant	Number of flowers/ m^2	Stalk length of flower (cm)	Flower diameter (cm)	Average weight of flower (g)	Vase life (days)
T_1	14.73	22.76	204.90	24.83	3.26	0.90	5.13
T_2	14.46	23.36	210.30	25.63	3.63	1.45	5.20
T_3	15.66	25.53	229.80	26.73	3.86	1.50	5.53
T_4	16.76	27.26	245.40	27.63	4.03	1.76	5.80
T_5	16.16	26.46	255.90	28.30	4.20	1.80	6.13
T_6	17.16	28.43	267.00	29.26	4.50	1.98	5.93
T_7	17.73	29.66	286.50	29.70	4.66	2.00	6.76
T_8	18.43	31.83	274.50	31.03	5.63	2.10	7.86
T_9	18.06	30.50	273.43	30.40	5.23	2.06	7.93
T_{10}	18.80	32.46	292.20	31.66	5.73	2.23	8.03
T_{11}	19.23	33.76	303.90	32.13	6.03	2.33	8.40
T_{12}	19.50	34.23	308.10	32.63	6.53	2.86	8.86
T_{13}	20.20	35.70	313.20	34.43	7.73	3.38	9.56
T_{14}	20.36	35.30	312.40	33.70	6.80	3.16	8.73
T_{15}	19.80	34.30	310.10	33.26	6.26	3.06	9.20
T_{16}	20.80	39.10	360.30	34.23	7.20	3.37	9.73
S.E(d)	0.28	0.60	4.81	0.75	0.09	0.41	1.37
$C.D_{(0.05)}$	0.58	1.23	9.88	1.55	0.19	0.85	2.82

T_1= Control, T_2= FYM @ 36 t/ha, T_3= Vermicompost @ 12 t/ha, T_4= PSB @ 50 ml/15L, T_5= *Azotobacter* @ 30 ml/15L, T_6= FYM @ 18 t/ha (50%) + Vermicompost @ 06 t/ha (50%), T_7= FYM @ 28.8 t/ha (80%) + PSB @ 50 ml/15L, T_8= FYM @ 30.6 t/ha (85%) + *Azotobacter* @ 30 ml/15L, T_9= Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L, T_{10}= Vermicompost @ 10.2 t/ha (85%) + *Azotobacter* @ 30 ml/15L, T_{11}= PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{12}= FYM @ 18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L, T_{13}= Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{14}= FYM @ 28.8 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L, T_{15}= FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + *Azotobacter* @ 30 ml/15L, T_{16}= FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L

the better nutrients uptake and photosynthesis under this treatment. The increase in available nitrogen in soil might be due to binding of atmospheric nitrogen by *Azotobacter*, whereas increase in available P might be due to production of organic acids by PSB. These acids act as a chelating agent and form stable complexes with Fe and Al, thereby releasing unavailable forms of P to the soil solution making it available for uptake by the plant (Kumar *et al.,* 7). Vermicompost might have role in supply of macro and micronutrients, enzyme and growth hormones and provide micronutrients such as Zn, Fe, Cu and Mn in an optimum level which help in proper flower development (Vasanthi and Kumarswamy, 18). These findings are matching with those of Kumar *et al.* (8) in China aster.

The maximum diameter (7.73 cm) and average weight of flower (3.38 g) were observed in T_{13} followed by T_{16} (7.20 cm and 3.37 g, respectively). The positive effect of manures added to soil may promote the activity of bacteria which enhances the availability of N, P, K and also improves the nutrients absorption capacity of plant roots (Bertand *et al.,* 2). PSB and *Azotobacter* possess the ability to bring sparingly insoluble inorganic or organic phosphates and nitrates in to the soluble forms by secreting organic acids which lower soil pH and in turn, bring about dissolution of immobile forms of soil phosphate and nitrate (Desai *et al.,* 3) which can also contribute to improving flower diameter. Similar results have been reported by Shankar *et al.* (13) in tuberose, Khanna *et al.* (5) and Ravindra *et al*. (12) in China aster.

The maximum vase life (9.73 days) was recorded in FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ (50 ml/15L) + *Azotobacter* @ (30 ml/15L). It might be due to overall food nutrient status of flowers under this treatment. Application of organic manures and biofertilizers influences flower longevity due to the increased nutrient uptake by plants and greater development of water conducting tissue (Srivastava *et al.,* 17). It might also be due to the presence of ethylene inhibitors or due to the presence of cytokinins which delay senescence of flowers. A similar, beneficial effect of biofertilizers and organic manures on vase life was also reported by Khanna *et al.* (5) in China aster.

From these studies, it could be inferred that combination of FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L was found to be effective in improving the growth and flowering attributes in Kamini China aster.

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