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Effect of chemical fertilizers and bio fertilizers on vegetative growth, flowering parameter on dahlia (*Dahlia variabilis* L.) cv. Kenya orange

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Abstract
The present investigation entitled, "Effect of chemical fertilizers and bio fertilizers on vegetative growth, flowering parameter on Dahlia (*Dahlia variabilis* L.) cv. Kenya Orange was under taken in the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, *(Allahabad).* During rabi season (2018-2019). The experiment was layout in Randomized Block Design (RBD) with 13 treatments and each treatment replicated thrice. The treatments consist of different combinations of chemical fertilizers (N, P and K) and bio fertilizers (*Azotobacter and PSB*) and control (No fertilizers and manures). The treatment T_3 (N_{80} +P_{100}+ K_{100} + Azotobacter @ 2.0 kg/ha) was found the statistically significant compared to other treatment combination, which recorded highest plant height (109.39 cm), plant spread (64.41cm), Number of leaves (46.40), Number of branches (6.26), Days to first flower bud initiation (46.33days), total number of flower per plant (8.13) followed by T_9 (N_{100} + P_{80} + K_{100} + PSB @ 3.0 kg/ha) and lowest yield was obtained from T_0 (control).

Keywords: Dahlia, nitrogen, phosphorus, potash (potassium), *Azotobacter* and PSB

Introduction
Dahlia is one of the most popular bulbous flowers grown in many parts of the world for its beautiful ornamental blooms of varying shades of colors for the beautification of gardens and cut flowers. It is belonging to the family *Asteraceae* having its origin in Mexico (Wells, 1990) [9] which received its name by Cavanilles in the year 1791. Dahlia (*Dahlia variabilis*) is a very beautiful flower which by virtue of extra-ordinary quality has attained attention of many people all over the world. It is a perennial, half hardy, herbaceous plant with tuberous root system and erect growing habit (Marina, 2015) [5]. In India it is mostly grown as winter flower because of severe climatic conditions during summer. As a member of the *Asteraceae* the flower head is actually a composite (hence the older name *Compositae*) with both central disc florets and surrounding ray florets. Each floret is a flower in its own right, but is often incorrectly described as a petal, particularly by horticulturists. In the language of flowers, Dahlias represent dignity and instability, as well as meaning my gratitude exceeds your care (Connolly, 2004) [2]. Number of chromosomes to (*Dahlia variabilis*) 2n =64.

Dahlia has many ornamental characteristics such as wide range of plant height (varies from 30 -180 cm), single and collaret varieties, decorative in various sizes with double flowers having broad petals and cactus varieties (double with narrow petals) show a pompon Dahlia have ball-like flowers and these are orchid- flowered and anemone flowered types. Dahlia offers a most extensive color range with two colors in same flower, because of accumulation of anthocyanidin and other flavonoids in their ray florets. There are certain medicinal and nutritional uses of dahlia. Tubers of this plant contain significant amount of insulin and fructose and small quantities of medicinally active compounds such as phytin and benzoic acid. An insulin extract from tuber of dahlia is used in diagnosis of renal function. Seeds of dahlia are a good source of fats and proteins. Seeds contain more than 16 per cent oil and 20.9 to 47.0 per cent protein. Like Holland, India also can develop an industry of dahlia which will enable us to earn more coveted foreign exchange by exporting tubers, seeds and flowers. In India due to the great diversity in soil and climatic conditions the flowers can be raised for trading during a long spell of the year.

The growth retardants has been exploited commercially to reduce the plant height and it use made available plants of various sizes and shapes and evolved new plants types like using B-Nine to improving the quality of flower in shorter stalk. Bio-fertilizers improve the quantitative and qualitative characters of many plants. Inoculation of soil with beneficial bacteria helps in providing more balance nutrition for plants and improves root uptake of nitrogen and phosphorus due to interaction between phosphate solubilizing and nitrogen fixing bacteria. Phosphorus solubilizing microorganisms also produce metal chelating agents i.e. Siderophores, which have a great impact on plant growth promotion, iron nutrition and phytopathogen suppression. Siderophore producing rhizobacteria have been recognized as potential bio control agents for controlling plant diseases by suppressing major phytopathogens and providing iron nutrition to the crops, thereby promote plant health.

Plant associated *Pseudomonas* live as saprophytes and parasites on plant surfaces and inside plant tissues. Many plant associated Pseudomonas promote plant growth by suppressing pathogenic micro-organisms, synthesizing growth stimulating plant hormones and promoting increased plant disease resistance.

Azotobacter is a non-symbiotic N-fixing bacterium. *Azotobacter* fixes the atmospheric nitrogen when inoculated to plants, which help to save the application of N fertilizers to an extent of 20-25 per cent. *Azotobacter* is a genus of usually motile, oval or spherical bacteria that form thick walled, cysts and may produce large quantities of capsular slime. They are aerobic, free living soil microbes which play an important role in the Nitrogen cycle in nature, binding atmospheric Nitrogen which is accessible to plants and releasing it in the form of ammonium ions into the soil. Phosphorus mobilizing or phosphorus solubilizing bio fertilizers/microorganisms (bacteria, fungi, *Mycorrhiza* etc.) converts insoluble soil phosphate into soluble forms by secreting several organic acids and under optimum conditions they can solubilize/ mobilize about 30-50 kg P_2O_5 /ha due to which crop yield may increase by 10-20%.

Materials and Methods

The present investigation entitled "Effect of chemical fertilizers and bio fertilizers on vegetative growth, flowering parameter on Dahlia (*Dahlia variabilis* L.) cv. Kenya Orange" was carried out at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P) in during the Rabi season of the year 2018-2019. The experiment was laid out in randomized block design with 13 treatments replicated three. The treatments involved were T_0- Control, T_1- N_{70} +P_{100} +K_{100} +Azotobacter @ 3.0 kg/ha, T_2- N_{75} +P_{100} +K_{100} + Azotobacter @ 2.5 kg/ha, T_3- N_{80} +P_{100}+ K_{100} + Azotobacter @ 2.0 kg/ha, T_4- N_{85} + P_{100} + K_{100} + Azotobacter @ 1.5 kg/ha, T_5- N_{90} + P_{100} + K_{100} + Azotobacter @ 1.0 kg /ha, T_6- N_{95} +P_{100} + K_{100} + Azotobacter @ 0.50 kg/ha, T_7- N_{100} +P_{70} + K_{100} + PSB @ 4.50 kg/ha, T_8- N_{100} +P_{75} + K_{100} + PSB @ 3.75 kg/ha, T_9- N_{100} +P_{80} + K_{100} +PSB @ 3.0 kg/ha, T_{10}- N_{100} +P_{85} + K_{100} +PSB @ 2.25 kg/ha, T_{11}- N_{100} +P_{90} +K_{100} +PSB@ 1.50 kg/ha, T_{12}- N_{100} +P_{95} + K_{100} +PSB @ 0.75 kg/ha.

Results and Discussion

Growth parameters

The data revealed that the combination of different chemical fertilizers and bio fertilizers affected growth parameter like Plant height, Plant spread, Number of branches per plant and number of leaves per plant of Dahlia as shown in (Table 1). Significant difference in the Plant height, Plant spread, Number of branches per plant and Number of leaves per plant was recorded due to application of different combinations of chemical fertilizers and bio-fertilizers. The treatment T_3 recorded the maximum plant height (109.39 cm), followed by T_9 (107.70 cm) and the maximum Plant spread T_3 (64.41), followed by T_9 (63.33) the maximum number of leaves per plant T_3 (46.40), followed by T_9 (45.53) and the maximum number of branches per plant was T_3 (6.26), followed by T_9 (5.86) which differed significantly from each other as well from other treatments. Where in RDF: Recommended Dose of fertilizers, Bio-fertilizer: PSB, Azotobacter. The plot size was 1.8m x 1.35 m and spacing followed was 45 x 60 cm. the land was brought to a fine tilth by through ploughing and tillage. Irrigation channels and bunds were maintained properly and 23 days old healthy and uniform seedlings were collected from I.A.R.I. New Delhi & transplanted on 18th December2015. Light irrigation was given after transplanting. The organic manures were applied one week before transplanting, for proper decomposition, full dose of nitrogen, phosphorus and potassium Bio-fertilizers PSB, Azotobacter, as per treatment were applied just before the transplanting. All cultural practices were followed regularly during crop growth and observations were recorded on growth characters i.e., plant height, plant spread, number of leaves per plant, number of branches per plant and flowering parameter like Days to flower, flower diameter, flower weight were recorded from time to time. It was noticed that plant spread, number of branches per plant, number of leaves per plant increased with increasing plant height successively with the increasing levels of chemical fertilizer and bio-fertilizer. Combination of chemical fertilizer and bio-fertilizer also recorded maximum plant height, plant spread, number of branches and number of leaves also which helped the plants in better photosynthesis to attain vigor. The findings of the present investigation are in conformity with the reports of as reported Ahmed *et al*. (2004) [1], Dalve *et al.* (2009), Zhang *et al*. (2010) [11], Sheergojrl *et al*. (2013) [6] in dahlia.

Flowering parameters

The data revealed that the combination of different chemical fertilizer and bio fertilizer affected various flowering parameters as shown in (Table 1.) The maximum days to first flower bud initiation was observed in T_3 (46.33) Followed by T_9 (49.93) and the total number of flower per plant was observed in T_3 (8.13) Followed by T_9 (8.06). The days to first flower bud initiation and highest number of flower per plant in treatment T_3 Might be due to luxuriant vegetative growth and better translocation of nutrients to the aerial parts. Minimum days to first flower bud initiation and total number of flower per plant in T_0 (Control) might be due to non-availability of nutrients. Similar findings were reported by Javid *et al.* (2005) [3], Pandey *et al.* (2017) [7], Warade *et al.* (2007) [10], Meshram *et al.* (2008) [4] in dahlia.

Table 1: Effect of chemical fertilizers and bio fertilizers on vegetative growth, flowering parameter on Dahlia (*Dahlia variabilis* L.) cv. Kenya Orange at different intervals (days)

Treatments	Plant height(cm)				Plant spread(cm)				No. of leaves per plant				No. of branches per plant			Days to first flower bud initiation (earliness)	Total number of flower per plant
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	60 DAT	90 DAT	120 DAT		
T_0 Control	6.94	25.28	43.62	71.38	10.36	23.53	31.98	44.48	7.13	13.53	22.06	38.20	2.06	3.73	4.06	64.86	4.06
T1 N70 +P100 +K100 +Azotobacter @ 3.0 kg/ha	12.78	35.69	66.10	104.42	13.67	30.31	42.78	60.92	9.86	19.73	32.33	42.00	3.56	4.43	5.33	50.93	7.60
T2 N75 +P100 +K100 + Azotobacter @ 2.5 kg/ha	12.19	34.05	65.85	104.71	14.34	30.74	41.26	60.79	10.20	20.40	30.53	42.93	3.83	4.76	5.53	50.13	7.80
T3 N80 +P100+ K100 + Azotobacter @ 2.0 kg/ha	14.76	36.67	75.84	109.39	16.53	35.00	43.80	64.41	13.06	25.46	33.53	46.40	4.23	5.26	6.26	46.33	8.13
T4 N85 +P100 + K100 + Azotobacter @ 1.5 kg/ha	12.91	35.78	66.97	103.92	14.04	29.98	42.38	61.46	8.46	20.33	30.33	43.40	2.03	4.76	4.86	55.66	6.50
T5 N90 +P100 + K100 + Azotobacter @ 1.0 kg /ha	11.52	35.31	66.24	100.40	12.50	28.83	42.49	60.88	10.36	20.00	31.46	38.80	2.86	4.73	5.20	53.60	6.30
T6 N95 +P100 + K100 + Azotobacter @ 0.50 kg/ha	11.54	35.18	64.79	98.80	13.06	29.51	42.45	62.30	9.36	18.70	32.16	42.06	3.43	4.80	5.26	54.93	6.73
T7 N100 +P70 + K100 + PSB @ 4.50 kg/ha	11.72	33.80	65.12	97.32	13.26	29.35	41.70	61.80	9.33	19.73	30.96	44.80	2.23	4.63	5.20	56.63	6.53
T8 N100 +P75 + K100 + PSB @ 3.75 kg/ha	12.74	35.99	65.51	96.64	13.48	29.27	41.64	62.06	10.26	19.20	29.86	41.63	3.43	4.46	4.90	56.23	6.60
T9 N100 +P80 + K100 +PSB @ 3.0 kg/ha	12.82	36.46	70.18	107.70	14.94	32.96	42.85	63.33	11.13	23.06	32.30	45.53	4.13	5.03	5.86	49.93	8.06
T10 N100 +P85 + K100 +PSB @ 2.25 kg/ha	12.44	35.83	62.96	98.97	13.02	29.24	42.76	62.04	9.40	20.33	30.63	41.60	3.23	4.60	5.33	54.56	7.46
T11 N100 +P90 +K100 +PSB@ 1.50 kg/ha	11.68	34.48	64.74	100.28	14.36	29.12	42.37	61.13	10.20	19.43	30.50	38.73	2.93	4.53	5.03	57.06	6.26
T12 N100 +P95 + K100 +PSB @ 0.75 kg/ha	10.05	34.41	65.78	102.18	13.75	28.69	42.30	61.26	10.00	20.73	30.40	42.40	3.16	4.63	5.30	53.03	6.86
F- test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed. (±)	1.08	2.26	2.13	2.66	0.50	1.29	1.17	0.73	0.70	1.8	0.69	2.37	0.33	0.19	0.28	2.90	0.44
C. D. at 5 %	2.22	4.66	4.39	5.49	1.03	2.67	2.41	1.52	1.45	2.45	1.44	4.89	0.68	0.40	0.58	6.00	0.90

Conclusion

On the basis of present study, it is concluded that the application of T_3 (N_{80} +P_{100}+ K_{100} + Azotobacter @ 2.0 kg/ha) resulted in maximum Plant height, Plant spread, Number of leaves per plant, Number of branches per plant, Days to first flower bud initiation, Number of flower per plant was found in maximum and the minimum was observed in T_0 (control).

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