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Effect of chemical fertilizers and bio fertilizers on flower yield, tuberous root yield and quality 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 flower yield, root yield and quality 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 flower diameter (21.88 cm), flower weight (63.80 gm), flower yield per plant (504.59 gm), flower yield per plot (2.850 kg), flower yield per hectare (11.72 t/ha), Vase life in normal tap water (6.53days) followed by T_9 (N_{100} + P_{80} + K_{100} + PSB @ 3.0 kg/ha) and lowest yield. The treatment T_{10} (N_{100} +P_{85} + K_{100} +PSB @ 2.25 kg/ha) was found the statistically significant compared to other treatment combination, which recorded highest weight of single tuber (59.23g) numbers of Tubers per plant (8.56), tuber yield per plant (47.00 gm), tuber yield per plot (2612.33 gm),Yield of Tubers per hectare (10.75 t/ha) followed by T_5(N_{90} + P_{100} + K_{100} + Azotobacter @ 1.0 kg /ha)and lowest yield was obtained from T_0 (control).

Keywords: Nitrogen, phosphorus, potash potassium, Azotobacter, PSB

Introduction
Dahlia (*Dahlia variabilis*) 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) which received its name by Cavanilles in the year 1791. Dahlia (genus *Dahlia*), genus of about 40 species of floweri Hung plants in the aster family (Asteraceae), native to the higher elevations of Mexico and Central America. About six of the species in the *Dahlia* genus have been bred for cultivation as ornamental flowers and are popular in the floral industry and in gardens. The thousands of dahlia cultivars are classed into a variety of types, including single, double, pompon, cactus, waterlily, peony-flowered, and dinner plate dahlias. Dahlias are tuberous perennials, and most have simple leaves that are segmented and toothed or cut. The compound flowers may be white, yellow, red, or purple in colour. 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). 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). 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.

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. 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 flower yield, tuberous root yield and quality 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

Flower yield parameters

The data revealed that the combination of different chemical fertilizers and bio fertilizers affected flowering parameter like flower diameter, flower weight, flower yield per plant, flower yield per plot, flower yield per hectare of Dahlia as shown in (Table 1). Significant difference in the flower diameter, flower weight, flower yield per plant, flower yield per plot, flower yield per hectare, vase life in normal tap water (days) was recorded due to application of different combinations of chemical fertilizers and bio-fertilizers. The treatment T_3 recorded the maximum flower diameter (21.88 cm), followed by T_9 (20.79 cm) and the maximum flower weight T_3 (63.80gm), followed by T_9 (57.26) the maximum flower yield per plant T_3 (504.59gm), followed by T_9 (443.08gm) and the maximum flower yield per plot was T_3 (2.850kg), followed by T_9 (2.376kg) and the maximum flower yield per hectare was T_3 (11.72 t/hac), followed by T_9 (9.77t/hac) which differed significantly from each other as well from other treatments. Where in RDF: Recommended Dose of fertilizers, Bio-fertilizer: PSB, Azoto bacter? 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 December 2015. 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 flowering parameter like flower diameter, flower weight, flower yield per plant, flower yield per plot, flower yield per hectare were recorded from time to time. Combination of chemical fertilizer and bio-fertilizer also recorded maximum flower diameter, flower weight, flower yield per plant, flower yield per plot, flower yield per hectare 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 Chitra *et al.* (2007), Mishra *et al.* (2003) [4], Naik *et al.* (2005) [5], Sultana *et al.* (2006) [6] in dahlia.

Tuberous yield parameters

The data revealed that the combination of different chemical fertilizer and bio fertilizer affected various Tuberous yield parameters as shown in (Table 1.) The maximum weight of single tuber was observed in T_{10} (59.23gm) Followed by T_5 (55.90) and the Number of tuber per plant was observed in T_{10} (8.56) Followed by T_5 (8.40). and the number of tuber per plot was observed in T_{10} (47.00) Followed by T_5 (41.00) and the maximum tuber yield per plant was observed in T_{10} (568.70gm) Followed by T_5 (522.46gm) and the highest tuber yield per plot was observed in T_{10} (2612.33gm) Followed by T_5 (2514.16gm) and the maximum tuber yield per hectare was observed in T_{10} (10.75t/hac) Followed by T_5 (10.34t/hac) and the weight of single tuber, number of tuber per plant, Tuber yield might be increased due to integrated approach through *PSB* and chemical fertilizers which resulted in easy balanced availability of nutrients to plants by Phosphorus for better root proliferation and if it is given before tuber initiation hook stage it leads to more tubers and stronger growth. Similar results were reported by Dalve *et al.* (2009), sheergojri *et al.*

(2013) [7], Sabah *et al.* (2014) [8], Zhang *et al.* (2010) [10] in dahlia.

Quality parameters

Data on quality parameters such as Vase life in normal tap water (days).

Vase life (days)

The maximum vase life in normal tap water (6.53 days) was recorded in (T_3) with (N_{80}+P_{100}+ K_{100}+Azotobacter @ 2.0 kg/ha) followed by (T_9) with (N_{100}+P_{80}+K_{100}+PSB @ 3.0 kg/ha) (6.16 days). Vase life was found to be minimum (4.53 days) in (T_0) Control. The cut flowers are actively metabolizing living plant parts subjected to basic process of aging which depends on amount of respirable substrates, water balance and physiological factors like respiration and transpiration. The cut flowers from the treatment (T_3) with (N_{80} + P_{100} + K_{100} + Azotobacter @ 2.0 kg/ha) might have inhibited ethylene production increase in minerals uptake and reduction in rate of respiration as these are known for inhibition of ethylene biogenesis and ultimately enhanced vase life. Similar findings were reported by Chaudhari *et al.* (2009), Ahmad *et al.* (2004), Ashwini *et al.* (2007) [2], sultana *et al.* (2006) [6] in rose.

Table 1: The maximum weight of single tuber was observed in T10 (59.23gm) Followed by T5 (55.90) and the Number of tuber per plant was observed in T10 (8.56) Followed by T5 (8.40).

Treatments	Flower diameter (cm)	Flower weight (gm)	Flower yield per plant (gm)	Flower yield per plot (kg)	Flower yield per hectare (tons)	Weight of single tuber (g)	Number of tuber per plant	Number of tuber per plot	Tuber yield per plant (g)	Tuber yield per plot (g)	Tuber yield per hectare (tons)	Vase life in normal tap water (days)
T_0 control	16.43	37.53	171.30	0.815	3.35	34.16	5.20	25.00	188.20	941.00	3.87	4.53
T_1 N70 +P100 +K100 +Azotobacter @ 3.0 kg/ha	19.08	50.13	384.34	2.135	8.78	51.76	7.53	37.66	406.13	2030.66	8.35	5.20
T_2 N75 +P100 +K100 + Azotobacter @ 2.5 kg/ha	20.71	51.80	389.27	2.187	9.00	53.76	8.20	39.66	437.86	2189.33	9.00	4.93
T_3 N80 +P100+ K100 + Azotobacter @ 2.0 kg/ha	21.88	63.80	504.59	2.850	11.72	55.36	6.46	34.33	402.56	1631.23	6.71	6.53
T_4 N85 +P100 + K100 + Azotobacter @ 1.5 kg/ha	17.17	54.16	344.45	2.013	8.28	47.64	7.93	39.66	467.60	2042.83	8.40	5.53
T_5 N90 +P100 + K100 + Azotobacter @ 1.0 kg /ha	18.98	53.23	309.76	1.767	7.27	55.90	8.40	41.00	522.46	2514.16	10.34	5.46
T_6 N95 +P100 + K100 + Azotobacter @ 0.50 kg/ha	18.87	48.26	319.86	1.898	7.81	47.31	7.03	32.33	355.26	1843.00	7.58	5.40
T_7 N100 +P70 + K100 + PSB @ 4.50 kg/ha	17.33	49.90	306.20	1.824	7.50	47.20	7.16	32.66	336.73	1683.66	6.92	5.96
T_8 N100 +P75 + K100 + PSB @ 3.75 kg/ha	19.54	50.43	314.51	1.769	7.27	50.26	7.10	33.66	416.46	2082.33	8.56	5.58
T_9 N100 +P80 + K100 +PSB @ 3.0 kg/ha	20.79	57.26	443.08	2.376	9.77	53.23	7.53	40.66	326.24	2342.16	9.63	6.16
T_{10} N100 +P85 + K100 +PSB @ 2.25 kg/ha	17.40	49.56	357.25	1.798	7.40	59.23	8.56	47.00	568.70	2612.33	10.75	5.43
T_{11} N100 +P90 +K100 +PSB@ 1.50 kg/ha	17.51	52.26	320.86	1.676	6.89	51.26	7.03	35.66	460.90	2304.50	9.48	5.76
T_{12} N100 +P95 + K100 +PSB @ 0.75 kg/ha	18.03	53.76	345.54	1.775	7.30	48.03	7.36	39.33	444.33	2221.66	9.14	6.06
F- test	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed. (±)	1.15	2.49	19.28	0.20	0.83	5.18	0.66	3.26	56.32	330.66	1.36	0.44
C. D. at 5 %	2.38	5.15	39.79	0.42	1.73	10.69	1.36	6.73	116.25	682.46	2.80	0.92

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 flower diameter, flower weight, flower yield per plant, flower yield per plot, flower yield per hectare was found in maximum. The application of T_{10} (N_{100} + P_{85} + K_{100} + PSB @ 2.25 kg/ha) resulted in maximum weight of single tuber, number of tuber per plant, number of tuber per plot, tuber yield per plant, tuber yield per plot, tuber yield per hectare, vase life in normal tap water was found in maximum and minimum in T_0 (control).

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