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"Effect of integrated nutrient management on flowering and flower yield of dahlia (*Dahlia Variabillis* L.) Cv. Kenya orange"

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Abstract
An investigation was carried out to study the "Effect of Integrated Nutrient Management on growth, flowering and flower yield of Dahlia (*Dahlia Variabillis* L) cv. Kenya Orange'' at Horticulture Research Farm, Department of Horticulture, National post Graduate College Barhalganj, Gorakhpur, in the months of November 2019 to March 2020. The treatments consisted of RDF (NPK 100:120:100) with different levels of organic manures (FYM, Vermi-compost) and Bio fertilizers (Azotobacter, PSB) which were tested in randomized block design with three replications. Significantly T_6 (PSB 50%+ Azotobacter 50%) recorded best treatment for Days to first flowering (66.63. days) and days to 50% flowering (76.53 days). However, with respect to diameter (22.50cm) and Flower length (25.30) T_{10} (Vermi-compost 50% + Azotobacter 25% + PSB 25%) was observed as best treatment. While for number of flower per plant (11.37), number of flower per plot (133.6), and for flower yield per hectare (494814.81) T_4 (Vermi-compost 75% + PSB 25%) was recorded as best treatment. Whereas in terms of floral vase life (14.66) T_5 (Vermi compost 50% + Azotobacter 50%) showed best effect.

Keywords: Dahlia (*Dahlia Variabillis* L), Kenya orange, INM Bio-fertilizer

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 colours for the beautification of gardens and cut flowers. It is a tuberous rooted, half-hardy herbaceous perennial belonging to the family Asteraceae having its origin in Mexico, which received its name by Cavanilles in the year 1791, to commemorate the work of a Swedish Botanist Dr. Andreas Dahl, a pupil of Linneaus.
Among the twelve species of dahlia commonly found in the higher parts of Mexico, eight species *viz*., *Dahlia Variabillis, D Imperialis, D Exelsa, D Coronata, D Coccinea, D Merkii, D Zuarezii* and *D. rosea* are generally important species. Out of these eight species, *D Variabillis* and *D Rosea* are of horticultural importance, which include showy, fancy types, anemone flowered, cactus and semi cactus types, peony, decorative, ball types, fimbriated, water lily, star type and also the parents of most of the pompon cultivars.
Special characters of Kenya orange Dahlias are Good for cut flowers, Good for screening, Good for Hedges and Borders, Attracts butterflies, Attracts bees, Suitable for road median planting, Grows best in cooler regions and easy to grow both in field and in pot and are extensively used for exhibition, garden display and home decoration. For exhibition and garden display all types of dahlias are used. Dwarf growing types are suitable for beds and borders (pure / mixed borders). Large flowering dahlias in pots are popular for terrace garden or verandas display. The long stemmed flowers of various forms and colours are used in flower arrangement. Cut flowers of pompon and miniature types stay fresh in flower vases for many days and also better to make moderately good garlands. Dahlia is used with advantage for making bouquets and wreaths or vase decorations. 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 phytone and benzoic acid (Singh, 2006) [3].
Concept of Integrated Nutrient Management is Regulated nutrient supply for optimum crop growth and higher productivity. Improvement and maintenance of soil fertility. Zero adverse impact on agro- ecosystem quality by balanced fertilization of organic manures, inorganic fertilizers and bio-inoculants. Advantages of Integrated Nutrient Management are enhances the availability of nutrient demand of the crop with nutrient Supply from native and applied sources provides balanced nutrition to crops and minimizes the antagonistic effects resulting

from hidden deficiencies and nutrient imbalance. Improves and sustains the physical, chemical and biological functioning of soil. Minimizes the Deterioration of soil, water and ecosystem by promotisng carbon sequestration, reducing Nutrient losses to ground and surface water bodies and to atmosphere (Sultana *et al*., 2006) [9].

Method and material

An experiment was carried out at the Horticulture Research Farm, Department of Horticulture, National post graduate college Barhalganj, Gorakhpur, affiliated to Deen Dayal Upadhyaya Goakhpur University, Gorakhpur in the months of November 2019 to March 2020.

The details associated with the materials and methods adopted are presented here; the experimental site is situated at a latitude of 20º and 15º North and longitude of 60º 3" East and at an altitude of 98 meters above mean sea level (MSL). The Gorakhpur District comes under sub-tropical belt in the eastern of U.P. which experience extremely hot summer and fairly cold winter. During the winter months (Dec.-Jan) temperature falls 2-5^{0}C or even low, while in summer months (May-June) it reaches as high as 49^{0}C. Hot blowing winds are regular feature during the summers and an occasional spell of frost may be during winters. It is situated at latitude of 26.2846^0 N and longitude of 83.5066^0 E. The altitude of this place is 84 m from MSL. Most of the rainfall is received in the middle of July to end of September after which the intensity of rainfall decreases. The mean annual rainfall is about 850-1100mm. However, occasional precipitation is also not uncommon during winter months. The average monthly rainfall, maximum and minimum temperature and relative humidity recorded at KVK chargawan Gorakhpur during the observatory.

Dahlia (*Dahlia Variabillis* L C.V Kenya orange) was used for present study. The plot size was 1.8 m × 1.35 m and a spacing of 45 cm × 45 cm. Recommended crop production and protection practices were followed to grow the crop (Anonymous years). The experiment was laid out in a randomized block design with three replications. The treatments consisted of absolute control (T0), Control-RDFZ (T_1), FYM 50% + PSB 50% (T_2), FYM 50% + PSB 50% (T_3), FYM 50% + Azotobacter 50% (T_4), Vermicompost 75% + PSB 25% (T_5), Vermicompost 25% + Azotobacter 75% (T_6), PSB 50% + Azotobacter 50% (T_7), FYM 25% + Vermicompost 25% + PSB 50% (T_8), FYM 25% + Vermicompost 25% + Azotobacter 50% (T_9), FYM 25% + Vermicompost 25% + Azotobacter 25% + PSB 25% (T_{10}), Vermicompost 50% + Azotobacter 25% + PSB 25% (T_{11}), Vermicompost 75% + Azotobacter 25%.

Results and discussions

The following observations were recorded. Days to first flowering, Days to 50% flowering, diameter of flower, length of flower, vase life of cut flower, Number of flower per plant, Average number of flower per plot, Average number of flower per hectare and vase life of flower.

1. From data presented in the given Table observed that different combinations of RDF, FYM, Azotobacter and vermicompost produced significant effect on days to first flower bud emergence. Minimum number of days (66.63) for first flower bud emergence (earliness) was recorded in the treatment (T_6) with PSB 50 % + Azotobacter 50% followed by T_8 (67.10 days, FYM 25% + Vermicompost 25% + Azotobacter 50% & T_7 (67.73) days, FYM 25% + Vermicompost 25 % + PSB50%. Maximum number of days (74.25) for first flower bud emergence (earliness) was recorded in treatment (T_0) control.
2. Data in respect of Days to 50% flowering of dahlia plant as influenced by different bio fertilizers INM and organic manure application are presented in the given table.

It is evident from the data that, Days to 50% flowering was significantly affected by different bio fertilizers, INM and organic manure. The least Days of 50% flowering was found in treatment T_6PSB 50% + Azotobacter 50% (76.53) followed by T_8FYM 25% + Vermicompost 25% + Azotobacter 50% (77.87) and T_7FYM 25% + Vermicompost 25% + PSB50% (79.50). Maximum Days of 50% flowering was found in treatment T_0 (84.23) control.

The time taken for first flower bud appearance is an important character which exhibits their early flower yield. The better performance in the treatment (T_4) with 75%RDF+ AZ @ 2.5 kg/ha +FYM @ 10 t/ha +VC @ 10 t/ha might be due to the beneficial effect of vermicompost with 75% recommended dose of fertilizers (RDF). Similar findings were reported by Ahmed *et al.* (2004) [1] in dahlia and Airadevi (2010) [2] in chrysanthemum.

3. The diameter of flower recorded under different treatments is shown in Table given below which reveals that the effect of different treatments was significant where, the effect was significant and superior at T_{10} (22.50cm) Vermicompost 50% + Azotobacter 25% + PSB 25% followed by T_3 FYM 50% + PSB 50% and T_6 (21.32) cm PSB 50% + Azotobacter 50%, whereas minimum diameter of flower (15.06cm) was recorded in treatment T_0 (Control).
4. The data regarding the length of flower (cm) as influenced by the use of bio fertilizers and organic manure is presented in Table given below. It was found that, maximum length flower (cm) was observed in treatment T_{10} Vermicompost 50% + Azotobacter 25% + PSB 25% (25.30 cm) as compared to remaining treatment While lowest length of flower (cm) was found in treatment T_0 (12.43cm) control.

Similar findings were reported by Sheergojri *et al* (2013) [10]. The increase in flower diameter in the treatment applied with 75% RDF+ AZ @ 2.5 kg/ha +FYM @ 10 t/ha +VC @ 10 t/ha might be due to better nutrients availability, translocation of higher amounts of photosynthates and maintenance of proper physiological activity of the plants result in more food which in turn might have been utilised for better development of flower size.

5. The no of flower per plant recorded under different treatments is shown in Table given below, which reveals that the effect of different treatments was significant, where, Maximum no. of flower per plant (11.13) was recorded in treatment T_4 Vermicompost 75% + PSB 25% followed by T_1(9.82), FYM 50% + Vermicompost 50% & T_8 (9.47, FYM 25% + Vermicompost 25% + Azotobacter 50% and lowest no of flower per plant (7.20) was recorded in T_0 (control).
6. From data presented in the given table it is recorded that different combinations of RDF, Azotobacter, FYM & Vermicompost produced significant effect on average number of flowers per plot. Significantly maximum average number of flowers per plot (133.60) were recorded in treatment (T_4) with Vermicompost 75% + PSB 25% followed by T_1 (117.88), FYM 50% + Vermicompost 50% and T_8 (113.60), FYM 25% + Vermicompost 25% + Azotobacter 50% Lowest average

number of flowers per plot (86.40) was recorded in treatment (T_0) control.

7. From data presented in given Table it is recorded that different combinations of RDF, Azotobacter, FYM & Vermicompost produced significant effect on average number of flowers per hectare. Significantly maximum average number of flowers per hectare (494814.81) were recorded in treatment (T_4) with Vermicompost 75% + PSB 25% followed by T_1 (436592.92)**,** FYM 50% + Vermicompost 50% and T_8 (420740.75), FYM 25% + Vermicompost 25% + Azotobacter 50%.Lowest number of flowers per hectare (320000) was recorded in treatment (T_0) control.

Increase in flower yield per plant might be due to integrated approach through vermicompost, Azotobacter and inorganic fertilizers which resulted in easy balanced availability of nutrients to plants by vermicompost for better root proliferation enhanced microbial activity excellent uptake of NPK due to improved biological characteristics, enhancement of photosynthetic activity. Similar results were obtained by Warade *et al* (2007) [12].

8. It is evident from the given table that, maximum days of Vase life of cut spike (days)was observed in treatment T_5Vermicompost 50%+Azotobactor50% (14.66 days) as compared to remaining treatment and followed by T_4 (13 days), T_1 (12.68 days) and T_2 (12 days). While lowest days of Vase life of cut spike (days) was found in treatment T_0 (7.34 days) control.

This is probably due to the best treatment by which optimum dose of bio fertilizers and organic manure supplied to the plants. Similar results were also reported by found in African marigold.

Effect of integrated nutrient management on flower emergence of Dahlia (*Dahlia Variabillis* L.) at 120 DAT

Treatments No.	Days to 1st flowering	Days to 50% flowering	Flower diameter (cm)	Length of flower (cm)	Number of flowers per plant	Average number of flower per plot	Average number of flower per hectare	Vase life of flowers
T_0	74.27	84.23	15.67	12.43	12.43	86.40	320000.00	7.33
T_1	70.2	81.30	16.98	13.93	13.93	117.88	436592.59	12.67
T_2	68.4	79.77	21.33	23.00	23.00	103.20	382222.22	12.00
T_3	70.2	81.03	18.38	16.73	16.73	109.20	404444.44	11.00
T_4	69.6	81.00	17.47	17.27	17.27	133.60	494814.81	13.00
T_5	69.97	81.67	17.28	15.60	15.60	97.20	360000.00	14.67
T_6	66.64	76.53	21.32	21.33	21.33	89.20	330370.38	9.00
T_7	67.74	79.50	19.43	20.33	20.33	97.60	361481.47	8.67
T_8	67.1	77.87	18.82	18.97	18.97	113.60	420740.75	10.00
T_9	70.01	80.20	18.50	19.50	19.50	109.60	405925.94	10.33
T_{10}	69.5	81.73	22.50	25.30	25.30	102.40	379259.25	9.33
T_{11}	71	81.77	20.05	17.83	17.83	107.20	397037.03	11.00
F-test	S	S	S	S	S	S	S	S
C.D. (5%)	1.06	0.44	0.30	0.46	0.46	5.45	20106.57	0.58
S.Ed (±)	3.12	1.29	0.533	1.36	1.36	15.92	58970.33	1.69

Conclusion

On the basis of present investigation, it is concluded that the floral parameters in dahlia with respect to earliness treatment T_6PSB 50% + Azotobacter was recorded as the best treatment. However the maximum length of flower (25.30cm), maximum diameter of flower (22.50cm) was highest in T_{10} (22.50cm) Vermicompost 50% + Azotobacter 25% + PSB 25%. highest flower yield was recorded in treatment (T_4) with Vermicompost 75% + PSB 25% whereas maximum days of Vase life of cut flower (days) (14.66 days) The treatment T4 FYM 50% + Azotobacter 50% was observed as best treatment.

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