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## Evaluation of NPK doses and varieties on vegetative and floral characters of offshoot propagated gerbera (*Gerbera jamesonii*) plants under shade net conditions

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### Abstract

The experiment was conducted during March 2013 to April 2014 in two factorial Randomized Block Design to evaluate the response of NPK application and varieties on growth and flowering of offshoot generated gerbera under shade net conditions. The experiment comprised of three treatments and seven varieties, replicated six times. Offshoot produced plants of different varieties of gerbera were planted at a spacing of 35×25cm and macro nutrients NPK (19:19:19) fertilizers were applied at the rate of 0, 30, 45 g per m<sup>2</sup> per month at 15 days interval resulted that the var. Dune had maximum duration of flowering, number of flowers per plant and stalk thickness whereas var. Rich had maximum number of petals per flower, length of petal and flower diameter when treated with 45g/m<sup>2</sup>/month of NPK application. The var. Zingard recorded quickest to bud opening with highest vase life at 45g/m<sup>2</sup>/month of NPK.

**Keywords:** Gerbera, Shade net, Offshoot, NPK.

### Introduction

Gerbera (*Gerbera jamesonii* Bolus ex Hooker F.), a member of family Asteraceae, originated from South Africa, and commonly known as Transvaal daisy, is one of the important cut flowers, grown for domestic as well as for export market. It is used in different floral arrangement, beds, border, pots and rock garden. The commercial important varieties of gerbera are Jaffa, Sangria, Rosula, Oprab, Romana, Salina, Tecora and Scarlet Light (Mishra and Pathania, 2000) [11] under low cost polyhouse and shade net conditions. In other study, the varieties Ruby Red, Dalma, Essence and Dune were found promising for commercially cultivation under protected conditions (Singh and Srivastava, 2008) [16]. Gerbera is stem less, perennial herb (Bose *et al.*, 2003) [4]. The flowers may be single, double or semi double. The flower head called capitulum consists of thin, long and conspicuous (ray florets) one or two outer whorls and short and sometimes tubular (disc flowers) inner rows. Flower stalks are thin, long, slender and leafless. Gerbera is commercially propagated through micro propagation which ensures rapid, true-to-type, disease free and round the year available planting materials which facilitate easy transportation but the tissue culture plants are costly and demand high initial investment. Among the alternatives, division of offshoots is another means of mass multiplication of planting material which ensures easy establishment and varietal uniformity besides being cheaper. The growth, yield and quality of the flowers of gerbera in protected cultivation are influenced by application of growth regulators and fertigation. Fertigation is very important for plant growth, development and production of flowers. The levels of fertilizer application through fertigation significantly influence the flower yield. Therefore, the present investigation was carried out to assess the performance of offshoots generated plants of different varieties of gerbera, assessment of NPK levels on vegetative growth and flowering of offshoot multiplied gerbera plants and assessment of varietal behavior of offshoot generated gerbera plants towards vegetative and flowering characters as influenced by fertilizers doses.

### Materials and Methods

The experiment was conducted at the Model Floriculture centre, G. B. Pant University of Agriculture and Technology, Pantnagar situated in the *Tarai* region at 29° N latitude and 79.3° E longitudes in the foot hills of the Himalaya at an altitude of 243.84 m above mean sea level.

The climate of Pantnagar is humid subtropical with hot dry summer and cool winter. During the period of present investigation, maximum temperature ranged from 33.1<sup>o</sup> C-39.2<sup>o</sup> C in summer and minimum temperature 2.5 °C to 11.7 °C in winter with the mean relative humidity (at 7.0 pm) remains 80-90 per cent from mid June to end of February and then it steadily decreased to 50 per cent by first week of May and remained so till mid June. The soil of Pantnagar comes under Mollisols. The properties of the soil of the experimental field were EC- 1.68 dSm<sup>-1</sup>, pH- 6.8, available nitrogen- 172.48 kg/ha and Phosphorus- 45.03 kg/ha and the experiment was laid out in two factorial randomized design involving seven varieties and three levels of NPK doses, i.e. 0g NPK, 30g NPK and 45g NPK given in two split doses at 15 days interval. Thus, total twenty-one treatments were included in six replications. The various observations on vegetative and floral characters were recorded on five plants randomly selected from net plot area and tagged. The data collected for all the characters studied were subjected to statistical analysis by adopting 'Analysis of Variance' (ANOVA) technique for factorial randomized block design as suggested by Panse and Sukhatme (1967) [13].

### Results and Discussion

A perusal of the data in Table 1-3 clearly indicated that the different varieties and various NPK levels significantly influenced vegetative and floral characters of off-shoot propagated gerbera plants.

The important attributes related to vegetative characters viz., plant height, number of leaves, length of lower leaves and breadth of lower leaves at 60, 90 and 120 DAP and the floral characters viz., days to bud appearance, days to opening of bud, duration of flowering, flower stalk length, flower diameter, number of petals, length of petals, breadth of petals, water uptake during vase life, diameter of flower during vase life, vase life, stalk thickness, number of flowers per plant and flower yield per m<sup>2</sup> were significantly influenced by various varieties of gerbera. The maximum plant height (31.04 cm), number of leaves at 60 days after planting (7.20), average duration of flowering (16.47 days) and number of petals (76.12) were recorded in Cherany variety which was significantly higher than the rest of the varieties, whereas, maximum length (14.52 cm) and breadth (5.88 cm) of lower leaf at 60 DAP and maximum flower stalk length (57.08 cm) was reported in Zingard variety. The minimum days to bud appearance (74.16 days) was found to be with Balance variety while minimum days to opening of bud (11.91 days) reported in Pink elegance. The duration of flowering was recorded maximum (16.47 days) in var. Cherany which was significantly higher than rest of the varieties. The average flower stalk length was recorded maximum (57.08 cm) in var. Zingard which was statistically at par with Dune (V<sub>5</sub>). However, the minimum flower stalk length (41.64 cm) was recorded in Balance (V<sub>7</sub>). The average flower diameter (9.80 cm) and length of petals (3.57 cm) was recorded maximum in var. Rich. However, the minimum flower diameter (8.40 cm) and the maximum number of petals (76.12) was recorded in Cherany (V<sub>1</sub>). However, the minimum number of petals (51.03) was recorded in Balance (V<sub>7</sub>). The average breadth of petals was recorded maximum (1.02 cm) in var. Balance which was significantly higher than all the varieties and the minimum average breadth of petals (0.49 cm) was recorded in Cherany (V<sub>1</sub>). The water uptake by spikes was recorded maximum (29.82 ml) in var. Dune, while the minimum water uptake by spikes (22.07 ml) was recorded in Goliath (V<sub>2</sub>). The

diameter of flower during vase life was recorded maximum (9.15 cm) in var. Rich which was statistically at par with var. Pink Elegance (V<sub>4</sub>) and the minimum diameter during vase life (8.04 cm) was recorded in Cherany (V<sub>1</sub>). The vase life was recorded maximum (16.05 days) in var. Dune which was statistically at par with Cherany (V<sub>1</sub>) and the minimum vase life (13.00 days) was recorded in Balance (V<sub>7</sub>). The vase life showed significant variation among different gerbera varieties. This may be due to the differences in the senescing behaviour of the varieties by producing higher amount of ACC, ethylene forming enzymes and ethylene (Accati and Jona, 1989 [2] and Wu *et al.*, (1991) [21] and genetic makeup of the varieties (Abdel-Kader and Rogers, 1986 and Gelder, 1989). The stalk thickness was recorded maximum (7.61 mm) in var. Dune which was statistically at par with var. Rich (V<sub>6</sub>). However, the minimum stalk thickness (5.32 mm) was recorded in Balance (V<sub>7</sub>). The maximum number of flowers was recorded in variety Dune (13.95) whereas which was statistically at par with all the varieties except Cherany (V<sub>1</sub>) which recorded minimum (12.52) flowers/plant. Likewise, the maximum flower yield/ m<sup>2</sup> was recorded in variety Dune (83.70) which was statistically at par with variety Zingard (81.45) and Goliath (81.36) and Pink Elegance (79.60) and Rich (79.50) whereas it was minimum (75.13) in Cherany (V<sub>1</sub>). The results are in accordance with the findings of Nair and Medhi (2002) [12] in gerbera under protected conditions. It is evident from the data that NPK application had significant effect on various vegetative and floral parameters studied under the experiment. All the vegetative parameters viz., plant height (27.46 cm), number of leaves (7.15), length of lower leaves (14.39 cm) and breadth of lower leaves (6.38 cm) was found to be maximum with the treatment T<sub>3</sub> (with 45g/m<sup>2</sup>/month). The days to bud appearance decreased from 86.21 days to 77.02 days with increasing dose from T<sub>1</sub> (0 g/m<sup>2</sup>) to T<sub>3</sub> (30 g/m<sup>2</sup>) (T<sub>2</sub>). However, further increase in dose from 30 g/m<sup>2</sup> to 45 g/m<sup>2</sup> (T<sub>3</sub>), the days to bud appearance increased to 79.53 days. There was decrease in days to bud opening from 15.91 days in T<sub>1</sub> to 12.20 days in T<sub>3</sub> treated plants. There was increase in parameters from T<sub>1</sub> to T<sub>3</sub> treated plants viz. duration of flowering (from 12.87 days to 15.77 days), stalk length (from 44.81 cm to 53.79 cm), number of petals (from 53.11 to 67.77), average length of florets (from 3.15 cm to 3.62 cm), average breadth of florets (from 0.71 cm to 1.00 cm), water uptake by spikes (from 22.63 ml to 28.71 ml), diameter of flower during vase life (from 7.97 cm to 9.24 cm), vase life (from 12.40 days to 15.64 days), stalk thickness (from 5.78 mm to 6.82 mm), number of flowers per plant and yield per hectare (from 12.30 and 73.80 to 14.69 and 88.16). There is a close relationship between vase life and water uptake in cut flowers. The high vase life of cultivars is associated with the high water uptake and minimum vase life has lower water uptake, these results are in agreement with Meeteren (1978) [10] in gerbera. The increase in flower size may be attributed to enhanced utilization and translocation of metabolites required for growth with increase in levels of applied N, P and K (El-Naggar, 2009) [5] in carnation. application of potassium is associated with carbohydrate metabolism and translocation as well as stimulation of water uptake which in turn enhanced the longevity of spike in vase. This finding is in conformity with the finding of Talukdar *et al.* (2003) [19]. N and K promotes the growth of tender growing parts, adjust stomata movement and balance water relationship. The increase in flower spike diameter by higher doses of N has also been reported by Singh and Bijimol (2000) [17] in gladiolus crop and Kumar and

Singh(1998) [9] on tuberose. NPK nutrition enhances nutrient levels leads to better photosynthetic activity and production of carbohydrate, which helped in better portioning of nutrients from source to sink. These results are in agreement with the results of Higaki *et al.* (1992) [7] and Jawaharlal *et al.* (2001) [8]. Similar results were found by Verma (2003) [20], Ahmad *et al.*, (2007) [3] and Singh (2003) [18].

### Interaction Effect

Interactions had significant effect on plant height, number of leaves, breadth of lower leaves, days to bud appearance, days to opening of bud, duration of flowering, flower stalk length, flower diameter, number of petals, breadth of petals, diameter of flower during vase life, vase life, stalk thickness, number of flowers per plant and flower yield per m<sup>2</sup>. In case of no NPK application (T<sub>3</sub>), the variety Cherany (V<sub>1</sub>) recorded maximum (34.48 cm) plant height, which was significantly higher than all other varieties and plant height was minimum (21.48 cm) in var. Rich (V<sub>6</sub>); the variety Cherany (V<sub>1</sub>) recorded maximum (8.20) number of leaves, which was statistically at par with Goliath (8.09) whereas number of leaves was minimum (6.51) in var. Dune (V<sub>5</sub>) and Balance (V<sub>7</sub>). The breadth of the lower leaf was maximum (6.99 cm) in T<sub>3</sub>V<sub>1</sub> which was statistically at par with T<sub>3</sub>V<sub>5</sub> and T<sub>3</sub>V<sub>3</sub>. However, it was followed by T<sub>3</sub>V<sub>7</sub> and T<sub>3</sub>V<sub>6</sub> whereas it was minimum (4.50 cm) in T<sub>1</sub>V<sub>1</sub>. Days taken to bud appearance was maximum (95.98 days) in T<sub>1</sub>V<sub>5</sub> which was significantly higher than all other treatment combinations whereas it was minimum (71.81 days) in T<sub>3</sub>V<sub>7</sub>. Days taken to bud opening was minimum (10.28 days) in T<sub>3</sub>V<sub>3</sub> which was at par with T<sub>3</sub>V<sub>4</sub>, T<sub>3</sub>V<sub>6</sub>, T<sub>2</sub>V<sub>6</sub> and T<sub>3</sub>V<sub>7</sub>. However, the opening of bud took maximum (21.50 days) days in treatment combination of T<sub>1</sub>V<sub>1</sub>. The duration of flowering was maximum (17.58 days) in T<sub>3</sub>V<sub>1</sub> which was statistically at par with T<sub>3</sub>V<sub>2</sub> followed by T<sub>2</sub>V<sub>2</sub> and T<sub>3</sub>V<sub>5</sub> whereas it was minimum (9.31 days) in T<sub>1</sub>V<sub>4</sub>. The flower stalk length was recorded maximum (63.50 cm) in T<sub>3</sub>V<sub>3</sub> which was statistically at par with T<sub>3</sub>V<sub>5</sub> and followed by T<sub>2</sub>V<sub>5</sub>, T<sub>3</sub>V<sub>1</sub> and T<sub>2</sub>V<sub>3</sub>. However, flower stalk length was minimum (32.13 cm) in T<sub>1</sub>V<sub>7</sub>. Flower diameter was recorded maximum (11.16 cm) in T<sub>3</sub>V<sub>6</sub> treatment combination which was statistically at par with other combinations whereas it was minimum (7.63 cm) in T<sub>1</sub>V<sub>1</sub>. The maximum (80.51) number of petals was recorded in T<sub>3</sub>V<sub>6</sub> which was statistically at par with T<sub>3</sub>V<sub>1</sub>, T<sub>3</sub>V<sub>4</sub>, T<sub>2</sub>V<sub>4</sub> and T<sub>2</sub>V<sub>1</sub> whereas it was minimum (43.33) in T<sub>1</sub>V<sub>7</sub> in treatment combination. The flower diameter during vase life was recorded maximum (9.88 cm) in

T<sub>3</sub>V<sub>6</sub> which was at par with T<sub>3</sub>V<sub>4</sub>, T<sub>3</sub>V<sub>5</sub> and T<sub>3</sub>V<sub>3</sub> whereas it was minimum (7.56 cm) in T<sub>1</sub>V<sub>3</sub> treatment combination. The vase life was recorded maximum (16.98 days) in T<sub>3</sub>V<sub>3</sub> which was statistically at par with T<sub>3</sub>V<sub>5</sub>, T<sub>3</sub>V<sub>1</sub>, T<sub>2</sub>V<sub>1</sub> and V<sub>2</sub>V<sub>5</sub> whereas it was minimum (10.50 days) in T<sub>1</sub>V<sub>4</sub> treatment combination. The stalk thickness was recorded maximum (7.86 mm) in T<sub>3</sub>V<sub>5</sub> which was statistically at par with T<sub>3</sub>V<sub>6</sub>, T<sub>2</sub>V<sub>5</sub>, T<sub>2</sub>V<sub>6</sub>, T<sub>1</sub>V<sub>6</sub> and T<sub>1</sub>V<sub>5</sub> whereas it was minimum (4.35 mm) in T<sub>1</sub>V<sub>7</sub> treatment combination. The no. of flowers/plant and yield of flowers/m<sup>2</sup> was maximum (16.56 and 99.40) in T<sub>3</sub>V<sub>5</sub> which was statistically at par with T<sub>3</sub>V<sub>3</sub> whereas it was minimum (11.76 and 70.60) in T<sub>1</sub>V<sub>1</sub> treatment combination.

### Conclusion

On the basis of present investigation, it can be concluded that the NPK application and choice of variety are beneficial for better crop production from offshoot gerbera plants. Based on the overall performance, the varieties Rich, Dune and Zingard with 45 g/m<sup>2</sup>/month NPK (19:19:19) application could be recommended for cultivation under shadenet conditions. Similar results were advocated by Radhakrishna *et al.* (2003) [15] and Pant and Lal (1991) [14].

**Table 1:** Effect of varieties and NPK levels on vegetative parameters in 60 days after planting off-shoot propagated gerbera plants.

Treatments	Plant Height	Number of leaves	Length of lower leaf	Breadth of lower leaf
<b>Factor- Variety</b>				
V <sub>1</sub> (Cherany)	31.04	7.20	13.05	5.56
V <sub>2</sub> (Goliath)	24.58	6.62	12.55	5.28
V <sub>3</sub> (Zingard)	25.15	6.82	14.52	5.88
V <sub>4</sub> (Pink Elegance)	24.70	6.81	13.55	5.51
V <sub>5</sub> (Dune)	22.89	5.94	13.38	5.79
V <sub>6</sub> (Rich)	22.32	5.36	13.94	5.72
V <sub>7</sub> (Balance)	24.86	5.40	13.08	5.31
S.Em.±	0.54	0.14	0.35	0.14
C.D. at 5%	1.51	0.39	0.99	0.39
<b>Factor- Npk Doses</b>				
T <sub>1</sub> (0 g NPK)	22.86	5.54	12.50	4.89
T <sub>2</sub> (0 g NPK)	24.90	6.24	13.44	5.46
T <sub>3</sub> (0 g NPK)	27.46	7.15	14.39	6.38
S.Em.±	0.35	0.93	0.23	0.91
C.D. at 5%	0.99	0.26	0.65	0.25
<b>Interaction (V X T)</b>				
S.Em.±	0.93	0.24	0.61	0.24
C.D. at 5%	2.63	0.69	ns	0.68

**Table 2:** Effect of varieties and NPK levels on floral parameters of off-shoot propagated gerbera plants.

Treatments	days to bud appearance (Days)	Days to opening of bud (Days)	Duration of flowering (Days)	Flower stalk length (cm)	Stalk thickness (mm)	Flower diameter (cm)	Number of petals	Length of petals (cm)	Breadth of petals(cm)
<b>Factor- Variety</b>									
V <sub>1</sub> (Cherany)	77.16	17.44	16.47	51.00	5.59	8.40	76.12	3.34	0.49
V <sub>2</sub> (Goliath)	80.11	13.47	16.20	43.87	5.87	8.80	54.38	3.28	0.87
V <sub>3</sub> (Zingard)	80.91	12.36	15.19	57.08	5.83	9.07	53.94	3.30	0.89
V <sub>4</sub> (Pink Elegance)	84.83	11.91	11.79	49.58	6.35	9.50	70.93	3.28	0.82
V <sub>5</sub> (Dune)	90.14	14.52	15.06	56.09	7.61	8.94	57.83	3.32	0.83
V <sub>6</sub> (Rich)	79.12	13.33	12.58	47.80	7.56	9.80	64.36	3.57	0.86
V <sub>7</sub> (Balance)	74.16	15.08	13.76	41.64	5.32	8.77	51.03	3.50	1.02
S.Em.±	1.14	0.49	0.16	1.08	0.10	0.13	1.41	0.07	0.04
C.D. at 5%	3.20	1.37	0.47	3.03	0.29	0.38	3.98	0.19	0.11
<b>Factor- Npk</b>									
T <sub>1</sub> (0 g NPK)	86.21	15.91	12.87	44.81	5.78	8.26	53.11	3.15	0.71
T <sub>2</sub> (0 g NPK)	77.02	14.37	14.66	50.14	6.32	9.02	62.80	3.34	0.77
T <sub>3</sub> (0 g NPK)	79.53	12.20	15.77	53.79	6.82	9.84	67.77	3.62	1.00

S.Em.±	0.74	0.32	0.11	0.70	0.69	0.90	0.92	0.04	0.02
C.D. at 5%	2.09	0.90	0.30	1.98	0.19	0.25	2.60	0.13	0.07
<b>Interaction (V x T)</b>									
S.Em.±	1.97	0.85	0.29	1.87	0.18	0.24	2.45	0.12	0.07
C.D. at 5%	5.55	2.38	0.81	5.26	0.51	0.67	6.89	NS	0.19

**Table 3:** Effect of varieties and NPK levels on floral parameters of off-shoot propagated gerbera plants.

Treatments	Water uptake during vase life (ml)	Diameter of flower during vase life (cm)	Vase life (Days)	Number of flowers per plant	Flower yield per m <sup>2</sup>
<b>Factor- Variety</b>					
V <sub>1</sub> (Cherany)	28.72	8.04	15.47	12.52	75.13
V <sub>2</sub> (Goliath)	22.07	8.27	13.94	13.56	81.36
V <sub>3</sub> (Zingard)	25.02	8.69	14.43	13.57	81.45
V <sub>4</sub> (Pink Elegance)	23.06	9.09	13.05	13.26	79.60
V <sub>5</sub> (Dune)	29.82	8.81	16.05	13.95	83.70
V <sub>6</sub> (Rich)	27.98	9.15	13.66	13.25	79.50
V <sub>7</sub> (Balance)	23.33	8.19	13.00	13.23	79.43
S.Em.±	0.57	0.08	0.26	0.26	1.57
C.D. at 5%	1.62	0.24	0.75	0.73	4.41
<b>Factor- Npk</b>					
T <sub>1</sub> (0 g NPK)	22.63	7.97	12.40	12.30	73.80
T <sub>2</sub> (0 g NPK)	25.80	8.60	14.65	13.01	78.11
T <sub>3</sub> (0 g NPK)	28.71	9.24	15.64	14.69	88.16
S.Em.±	0.37	0.05	0.17	0.17	1.03
C.D. at 5%	1.06	0.16	0.49	0.48	2.89
<b>Interaction (V x T)</b>					
S.Em.±	1.00	0.15	0.46	0.45	2.72
C.D. at 5%	ns	0.43	1.30	1.27	7.64

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