Vol 1 No 4 December 2020 Pages 6-12 e-ISSN 2708-5694

Journal of Agriculture, Food and Environment (JAFE)

Journal Homepage: http://journal.safebd.org/index.php/jafe

http://doi.org/10.47440/JAFE.2020.1402

Original Article

Effects of varieties and inorganic fertilizers on growth and flowering of gerbera (*Gerbera jamesonii*)

M. R. Rayhan and M. H. A. Rashid*

Department of Horticulture, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

Article History

Received: 18 September 2020

Revised: 05 November 2020

Accepted: 25 December 2020

Published online: 31 December 2020

***Corresponding Author**

M. H. Rashid, E-mail: harun_hort@bau.edu.bd

Keywords

Gerbera, variety, inorganic fertilizers, growth, flowering

A B S T R A C T

An experiment was conducted at the Landscaping Section of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from November 2017 to May 2018 to investigate the effect of varieties and inorganic fertilizers on growth and flowering of gerbera. The experiment consisted of two factors viz., Factor A: varieties ($V_{1=}$ Mini Daisy, V_2= Aladin) and Factor B: Different levels of inorganic fertilizers (T_0 = 0, T_1 = N 300 kg/ha, T_2 = P 275 kg/ha, T_3 = K 225 kg/ha, T_4= N+P+K 300+275+225 kg/ha). The experiment was laid out in Randomized Complete Block Design with three replications. Varieties and different levels of inorganic fertilizers had significant effect on plant height, number of leaves per plant, spread of leaves, days to first flower bud emergence, days to harvest maturity, total number of flowers produced and spread of flowers and field life of gerbera. Total number of flowers per plant (10.89) was recorded from Aladin (V_2), which was higher than that of Mini Daisy (V_1) (10.16). The highest number of flowers per plant (12.44), while, the lowest number of flowers (9.10) was obtained from T_0 (control). Considering the combined effect, the maximum number of flowers per plant (12.87) was obtained from the treatment combination of V_2T_4 (Aladin+N+P+K), while, the lowest number of flowers per plant (8.67) was recorded from V_1T_0 (Control). Therefore, combined application of N, P and K fertilizers along with variety Aladin was found to be better in respect of growth and flowering of gerbera.

Introduction

Gerbera (*Gerbera jamesonii*) belongs to the family Asteraceae, a popular cut flower grown throughout the world in a wide range of climatic conditions. It is popularly known as 'Barberton daisy' or 'Transvaal daisy'. Genus Gerbera consists of 30 species, which are of Asiatic and South African origin. Among the different species, *Gerbera jamesonii* is the only species under cultivation. Modern gerbera arose from *Gerbera jamesonii* hybridized with *Gerbera viridifolia* and possibly other species (Leffring, 1973). Gerbera is one of the most natural beautiful creations because of having excellent flowers with exquisite size, shape and attractive colours. It's found utility in garden beds, borders, rock gardens and pot culture. Gerbera produces attractive flowers known as 'head' or 'capitulum'. The leaves are petioled, radical, entire or pinnatilobed, lanceolate, narrower at the base and wider at the top, coarse or sometimes tubular and two lipped. The flower heads are solitary, many flowered with conspicuous rays in one or more rows, those of inner rows when present are very short, sub tubular and two tipped. The daisy like flower is grouped into single, semi double and double types. The double types having bicoloured flowers are very attractive. The flower stalks are long and leafless (Das and Singh, 1989).

The colour variation, their meaning, size of flowers, long lasting behavior and wide adoptability for culture made gerbera a flower of choice for cultivation in Bangladesh. Gerbera has great demands in European markets during winter and almost throughout the year in Bangladesh. It stands fifth position among the top ten cut flowers of the world flower trade. Since Bangladesh is situated comparatively closer to major flower using countries than its Asian counter parts, it has very good scope and potential in the flower trade, Severe winter in major flower producing European countries is also an advantageous factor to Bangladesh, specially cities like Jessore, Rajshahi, Sylhet, Bogra, etc. which enjoy moderate climate all through the year besides cheap availability of land and labor has got a

great potential for producing gerbera on commercial scale. It is, however, difficult to get exportable quality cut blooms under open condition.

It is difficult to get good quality cut flowers of gerbera under open-field conditions (Pattanashetti, 2009). Its magnificent inflorescence with a variety of colour has made it attractive for use in garden decorations, such as herbaceous borders, bedding, pots and for cut flowers as a long vase life (Bose *et al*., 2003). The flower growers of Bangladesh are now cultivating the traditional flower crops. In Bangladesh, gerbera was introduced recently and it is gaining popularity. It has great potential for local as well as export market. In Bangladesh, gerbera is mainly grown in the winter. Gerbera cannot tolerate extreme high temperature, cold and heavy rainfall, when are very harmful for plant growth and development. It can be grown on all types of soil but loam soil with moist condition is better for its desired development. There is no released variety of gerbera with high yield potential and better quality in Bangladesh.

Inorganic fertilizers are a complex fertilizer comprised primarily of the three primary nutrients required for healthy plant growth. The most three important nutrients, without any one of which plants could not survive, are referred to as the primary micronutrients: Nitrogen (N), Phosphorus (P) and Potassium (K). Each of the primary nutrients is essential in the plant nutrition, serving a critical role in the growth, development and reproduction of the plant. Nitrogen is primarily responsible for vegetative growth. In particular, nitrogen is vital to chlorophyll, which allows plant to carry out photosynthesis (the process by which they take in sunlight to produce sugars from carbon dioxide and water). Nitrogen is also significant component in amino acids, the basis of proteins. Nitrogen also aids in the compounds that allow for storage and use of energy. Phosphorus also plays role in an array of functions necessary for healthy plant growth, contributing to structural strength, crop quality, seed production and more. Phosphorus also encourage the growths of roots, promotes blooming and in essential in DNA and RNA. Potassium is also vital in a variety of other processes that contribute to growth and development. Potassium is often referred to as the "quality element" because of its contribution to many of the characteristics we associate with quality, such as size, shape and colour, among others. Therefore, the present investigation has been carried out to determine the effects of varieties and inorganic fertilizers on growth and flowering of Gerbera.

Materials and Methods

Experimental site, climate and soil

An experiment was carried out at the Landscaping Section of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh to study effect of variety and inorganic fertilizers on growth and flowering of gerbera (*Gerbera jamesonii*) during the period from November 2017 to May 2018. The experimental location was situated at 24.6° N latitude and 90.5° E longitude (Edris *et al.* 1979). The experimental site was situated in the subtropical climatic zone and characterized by heavy rainfall during the month of April to September while scanty rainfall during the rest of the year (Anonymous, 1979). Meteorological data related to the temperature, relative humidity, rainfall and sunshine during the period of the experiment was collected from the Weather Yard, Department of Irrigation and Water Management, BAU, Mymensingh. The soil of the experimental area was silty loam in texture belonging to the Old Brahmaputra Flood Plain of AEZ (UNDP, 1988) having non-calcareous Dark Grey Flood Plain soil (FAO, 1988). The selected plot of the land was medium high land. It was fertile and well drained and slightly acidic with the P^H varying from 5.5 to 6.8 (BRAC, 1989)

Land preparation

The experimental plot was opened in the first week of November 2017 and then it kept open to sun for seven days. Afterwards it was prepared by laddering. The weeds and stubbles were removed after each laddering. Simultaneously, the clods were broken and the soil was made into good tilth. The basal dose of manures and fertilizer were mixed into the soil during the final land preparation.

Sources of planting materials

The seedlings of two gerbera varieties were collected from a commercial nursery of Jessore, Bangladesh.

Treatments of the experiment

The experiment consisted of two cultivars viz., Variety 1 (V_1) = Mini Daisy (Red), Variety 2 (V_2) = Aladin (Pink), and four inorganic fertilizers viz., T_0 = Control (no fertilizers), T_1: Nitrogen (N) @ 300 kg/ha, T_2: Phosphorus (P) @ 275 kg/ha, T_3: Potassium (K) @ 225 kg/ha, T_4: Combined treatment (N+P+K @ 300+275+225 kg/ha).

Experimental design and layout

The two-factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Each block was divided into 10 plots, where two varieties and five fertilizers treatments were allocated at random. So, the total number of experiment plot was 30 (2× 5× 3). The size of each plot was 1 m× 1 m. The distance between blocks l m and between plots 0.5 m were made to perform intercultural operation.

Application of manures and fertilizers

Urea, Triple super phosphate (TSP) and Muriate of potash (MoP) were used as the sources of nitrogen, phosphorus and potassium, respectively. Full dose of cowdung (20 t/ha), TSP and MoP were incorporated during the final land preparation according to treatments. Urea was applied in three equal installments at 30, 60 and 90 days after transplanting, respectively.

Intercultural operations

Weeding was done manually as and when necessary from the experimental plots. Irrigation water was applied as and when necessary to maintain appropriate level of soil moisture for gerbera cultivation. After each irrigation soil crust was broken down to maintain better soil aeration and conserve soil moisture.

Disease and pest management

Diseases are a major factor limiting gerbera production. Gerbera was mainly infected by mites during the growing stage. The mite was controlled by spraying Omite @ 1.5 ml/L. The insecticide was sprayed one time after 7 days of planting of suckers. The experimental plant was also attacked by "Powdery mildew" during the early growing stage. The disease was controlled by spraying "Dithane M-45". The fungicide was sprayed two times at 15 days interval.

Harvesting

Flowers were harvested when outer two rows of disc florets were open. The flower stalk was bent on either side and plucked. The spikes were harvested from April 2018, when the flower reached commercial stage (two whorls of ray florets open).

Data collection

Data on various parameters such as plant height, number of leaves per plants, length of leaves, spread of leaves, days for first flower bud emergence, days for first flower opening, total number of flowers produced, diameter of flower, length of the flower stalk, diameter of flower stalk, total number of flowers produced, days to harvest maturity, field life (days) per plot and hectare were recorded from the sample plants during experimentation. Three plants were randomly selected for this purpose from each plot.

Statistical analysis

Collected data for various characters were statistically analyzed using MSTAT-C computer package program. Analysis of variance (ANOVA) technique was used to test significance of differences among varieties and treatments. Means were separated using least significant difference test (Gomez and Gomez, 1984).

Results and Discussions

Effect of variety on vegetative growth

Between the two varieties studied, the higher plant height (29.96 cm) was recorded in V_2 and the lower plant height (28.02 cm) was observed from V_2 at 120 days after planting (table 1). The variation might be due to the fact of genetically make up of these varieties which encouraged more vegetative growth through rapid cell elongation leading to the highest length (Rashid, 2017). The present result is also supported by the report of Singh and Ramchandran (2002), and The higher number of leaves (18.58) was produced by the V_2 at 120 days after planting and the lower number of leaves (18.30) was recorded from V_1 at DAP (table 1). This is occurred may be due to the genetical characteristics. Wankhede and Gajbhiye (2013) suggested that variation in number of leaves among the varieties might be due to varietal characters. Significant variations in number of leaves plant^{-1} was earlier observed by Kandpal *et al*. (2003), Nair and Medhi (2002), and Sane and Gowada (2001). They conducted experiments with different varieties of gerbera and found significant variation in the number of leaves per plant. The longer leaf (18.91 cm) was recorded in the V_2 at 120 DAP and the shorter leaf (18.52 cm) was recorded from V_1 at 120 DAP (Table 1). The variation might be due to the faster vegetative growth through rapid cell elongation leading to the highest length. Similar results regarding mean leaf length were also obtained by Dhane *et al*. (2004), Sema *et al*. (2010) and Sarmah *et al*. (2014). The spreader leaf (7.71 cm) was recorded in the V_2 at 120 DAP; while the lower (7.18 cm) was recorded in the V_1 at 120 DAP (table 1). Das *et al*. (2012), and Wankhade and Gajbhiye (2013) also reported variations in leaf breadth among gerbera varieties.

Table 1. Main effect of variety on vegetative growth at 120 days after transplanting of gerbera

Variety	Plant height (cm)	Number of leaves per plants	Length of leaf (cm)	Spread of leaf (cm)
V_1	28.02	18.30	18.52	7.18
V_2	29.96	18.58	18.91	7.71
$LSD_{0.05}$	0.43	0.19	0.12	0.08
Level of significance	*	*	*	*

* = 5% level of probability, DAS = Days after planting, V_1 = Mini Daisy, V_2 = Aladin

Main effect of inorganic fertilizers on vegetative growth

Among the five-treatment studied, the results revealed that the highest plant height (33.43 cm) was obtained from of T_4 followed by T_1 (30.90 cm) and the lowest plant height (24.60 cm) was recorded from control (T_0) at 120 days after planting (table 2). Plant height showed a general trend of gradual increase with the increasing levels of fertilizer. The tallest plants at the higher doses of inorganic fertilizers were found possibly due to the plants received more nutrients which might have encouraged more vegetative growth. Fertilizer doses contain important element like nitrogen, phosphorus and potassium, which help in carry out many important physiological activities, which enhance the vegetative growth in plant body. Several workers like Terangpi and Paswan (2003), Renuka *et al*. (2005) and Barad *et al*. (2010) also reported difference in plant height among inorganic fertilizers and they suggest that the differences might be due to the variations in plant height. The number of leaves per plant showed a gradual increase with the increasing rates of nitrogen. The maximum number of leaves (19.77) was produced from the treatment of T_4 followed by T_1 (19.14) at 120 days after planting, while it was minimum (16.95) from control (T_0) at 1230 DAP (table 2). The highest doses of inorganic fertilizer substances in plant body, which have a function in cell organelles and create balance and more cell division, result more vegetative growth. Significant variations in number of leaves plant^{-1} were earlier observed by Nayak *et al*. (2005) and Renuka *et al*. (2005). Comparatively higher number of leaves with increasing rates of nitrogen may be attributed to vigorous vegetative growth of plant. The highest length of leaf (19.93 cm) was produced by T_4 followed by T_1 (19.44 cm) at 120 days after planting and the lowest length of leaf (16.72 cm) was recorded from control (T_0) at 120 DAP (table 2). The tallest plants at the higher doses of inorganic fertilizers were found possibly due to the plants received more nutrients which might have encouraged more vegetative growth. Similar results regarding mean leaf length were also obtained by Singh and Kumar (2008). The highest spread of leaf (8.55 cm) was produced by of T_4 followed by T_1 (7.97) at 120 days after planting and the lowest spread of leaf (6.27 cm) was produced by the control (T_0) at 120 DAP (table 2). The variation might be due to the fact of environmental factors of these which encouraged more vegetative growth through rapid cell expansion and cell division leading to the leaf spread and Singh and Kumar (2008) and Barad *et al*. (2010) also found maximum leaf spread applying N, P, K fertilizers in their experiment.

Table 2. Main effect of inorganic fertilizers on vegetative growth at 120 days after planting of gerbera

Treatment	Plant height (cm)	Number of leaves per plants	Length of leaf (cm)	Spread of leaf (cm)
T_0	24.60	16.95	16.72	6.27
T_1	30.90	19.14	19.44	7.97
T_2	29.17	18.37	18.94	7.55
T_3	26.86	17.99	18.56	6.89
T_4	33.43	19.77	19.93	8.55
$LSD_{0.05}$	0.68	0.31	0.20	0.12
Level of significance	*	*	*	*

* = Significant at 5% level of probability, T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha.

Combined effects of varieties and inorganic fertilizers on vegetative growth:

In ten treatment combinations studied, the highest plant height (34.07 cm) was recorded from the treatment combination of V_2T_4 at 120 days after planting followed by V_1T_4 (32.80 cm) and the lowest plant height (24.10 cm) was found V_1T_0 (Table 3). The maximum number of leaves (19.85) was produced with the treatment combination of V_2T_4 at 120 days after planting followed by V_1T_4 (19.68 cm). The minimum number of leaves (16.65) was recorded with the treatment of V_1T_0 at 120 days after planting (Table 3). The highest length of leaf (20.10 cm) was produced due to the treatment combination of V_2T_4 followed by V_1T_4 (19.75 cm) at 120 days after planting and the lowest length of leaf (16.45 cm) was produced in case of V_1T_0 at 120 DAP (Table 3). The highest spread of leaf (8.73 cm) was recorded in the treatment of V_2T_4 followed by V_1T_4 (8.37 cm) at 120 days after planting and the lowest spread of leaf (6.07 cm) was found V_1T_0 at 120 DAP (table 3).

Table 3. Combined effects of varieties and inorganic fertilizers on vegetative growth at 120 days after planting of gerbera

Treatment combination	Plant height (cm)	Number of leaves per plants	Length of leaf (cm)	Spread of leaf (cm)
V_1T_0	24.10	16.65	16.45	6.07
V_1T_1	29.93	19.08	19.20	7.67
V_1T_2	27.77	18.25	18.85	7.27
V_1T_3	25.50	17.85	18.37	6.50
V_1T_4	32.80	19.68	19.75	8.37
V_2T_0	25.10	17.25	16.98	6.47
V_2T_1	31.87	19.20	19.67	8.27
V_2T_2	30.57	18.48	19.03	7.83
V_2T_3	28.23	18.13	18.75	7.27
V_2T_4	34.07	19.85	20.10	8.73
$LSD_{0.05}$	0.96	0.43	0.28	0.17
Level of significance	*	NS	NS	*

* = Significant at 5% level of probability, NS = Not significant, V_1 = Mini Daisy, V_2 = Aladin, T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha.

Main effect of variety on flower and flower contributing characters growth

The early time (74.16 days) was required by the plants of V_2 to emergence of bud and the late time (74.38days) was needed to emergence the first bud by the V_1 (Table 4). The variations in days to first bud emergence in different gerbera varieties were possible due to their varietal traits. This result is in conformity with Similar findings were obtained by Wankhede and Gajbhiye (2013). They observed that the period of first bud varied from variety to variety. Sane and Gowada (2001) also reported similar result. Shorter days required to harvest maturity (17.11 days) was recorded in V_2 and longer time required (17.45 days) to reach harvest maturity was V_1 (Table 4). Longer stalk length (40.27 cm) was recorded in the V_2 and shorter stalk length (38.51 cm) was found in the V_1 (Table 4). The variation might be due to the fact of genetically make up of these varieties which encouraged more growth through rapid cell elongation leading to the highest stalk length. Sarkar and Ghimiray (2004) opined that stalk length is a genetic factor and expected to vary among the cultivars. The results were in accordance with the findings of Kandpal *et al*. (2003), who reported a variation in stalk length among genotypes and opined that this variation might be due to the genetic characters of particular genotypes. Stalk diameter has been found that as the diameter of the stalk increases the carbohydrates content of the stalk also increases which helps in increasing the stability of the vase life of cut flowers. The plant from V_2 produced the higher diameter of stalk (.50 cm) and the lower diameter of stalk (0.46 cm) was noticed from the V_1 (Table 4). Sankar (2003) also reported variations in stalk diameter and length among variety of Ruble and Mammut. The maximum number of flowers produced (10.89) was found to be V_2, whereas the minimum (10.16) was V_1 (Table 4). The variation in the number of flowers per plant among the gerbera varieties was probably due to the varietal characteristics. Barooah and Choudhury (2009) evaluated gerbera varieties under Assam conditions and found that number of flowers plant-1 varied among varieties. Ahlavath *et al*. (2011) also reported variation in yield meter-2 among varieties. The Spread of flower (7.42 cm) was produced from the V_2, while the minimum (6.99 cm) was produced from the V_1 (Table 4). Malik *et al*. (2013), and Singh and Ramachandran (2002) suggested that the bigger size of flowers was due to larger ray florets and inherent characters of individual flowers.

Table 4. Main effect of variety on flower and flower contributing characters of gerbera

Variety	Days to first flower bud emergence	Days to harvest maturity	Stalk length (cm)	Stalk diameter (cm)	Total no. of flowers produced	Spread of flower (cm)
Mini Daisy	74.38	17.45	38.51	0.46	10.16	6.99
Aladin	74.16	17.11	40.27	0.50	10.89	7.42
$LSD_{0.05}$	0.11	0.15	0.42	0.02	0.13	0.07
Level of significance	*	*	*	*	*	*

* = Significant at 5% level of probability, V_1 = Mini Daisy, V_2 = Aladin

Effect of inorganic fertilizers on flower and flower contributing characters growth:

The early flower bud emergence period (72.53 days) was required by T_4. The late flower bud emergence time (75.12 days) required first flower bud emergence was found from control (T_0) (Table 6). This effect may be occurred in varietal and climatic condition of the results showed that higher fertilizer doses caused early bud emergence. Jadhav *et al*. (2010), Mantrova *et al*. (1982), Dalal *et al*. (2005), Renuka *et al*. (2005) also found that high nitrogen level caused early bud emergence. The lowest period (15.97 days) was required by of T_4. The maximum time (19.15 days) required for days to harvest maturity was found from control (T_0) (Table 5). The treatment of T_4 produced maximum spike length (42.40 cm), while it was minimum (36.45 cm) at control (T_0) (Table 5). It may be due to the favourable nutrients availability to the crop for stalk formation. According to Malik *et al*. (2013), more reserved food will be present in the long stalk, which will later be available to the flower for longer time period. The highest stalk diameter (.55 cm) was obtained from T_4. On the other hand, the lowest stalk diameter (0.42 cm) was recorded from the control (T_0) (Table 5). The result was similar with the previous findings of Pimple *et al*. (2006) and Nayak *et al*. (2005). Also, this result is partially similar with the result of Singh and Kumar (2008). The maximum number of flowers produced (12.44) was obtained from T_4 and the minimum (9.10) was under the control (T_0) (Table 5). The tallest plants at the higher doses of inorganic fertilizers were found possibly due to the plants received more nutrients which might have encouraged more flower per plant. Terangpi and Paswan (2003), Barad *et al*. (2010), Dalal *et al*. (2005), Kamel *et al*. (1977) also found total number of flowers produced per plant by using N, P, K fertilizers. The highest Spread of flower (8.15 cm) was obtained from the treatment of T_4. On the other hand, the lowest Spread of flower (6.30 cm) was recorded from the control (T_0) (Table 5). Gaurav *et al*. (2004) reported that different nutritional levels significantly influenced the yield and quality of gerbera cv. Sunway. The overall assessment suggested that the application of 20:20:15 g N, P and K per m2 per month was found to be effective in producing good quality and higher number of flowers in gerbera.

Table 5. Main effect of inorganic fertilizers on flower and flower contributing characters of gerbera

Variety	Days to first flower bud emergence	Days to harvest maturity	Stalk length (cm)	Stalk diameter (cm)	Total no. of flowers produced	Spread of flower (cm)
T_0	75.12	19.15	36.45	0.42	9.10	6.30
T_1	74.31	16.53	40.60	0.51	11.10	7.48
T_2	74.57	17.13	39.35	0.47	10.44	7.28
T_3	74.82	17.64	38.15	0.45	9.55	6.83
T_4	72.53	15.97	42.40	0.55	12.44	8.15
$LSD_{0.05}$	0.17	0.24	0.67	0.04	0.20	0.11
Level of significance	*	*	*	*	*	*

* = Significant at 5% level of probability, T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha.

Combined effects of variety and inorganic fertilizers on flower and flower contributing characters of gerbera were statistically significant (Table 6). The lowest time required for bud emergence (72.53 days) was observed in the treatment combination of V_2T_4 followed by V_1T_4 (72.83 days) and the highest time to bud emergence (75.17days) was found in V_1T_0 combination (Table 6). The lowest time required for days to reach harvest maturity of flower (15.80 days) was observed in the treatment of V_2T_4 followed by V_1T_4 (16.13 days) and the highest time to days to harvest maturity (19.57 days) was found to be treatment combination of V_1T_0 (Table 6). The maximum stalk length (43.03 cm) was produced by the treatment combination of V_2T_4 followed by V_1T_4 (41.77 cm) while it was the minimum (35.40 cm) in the treatment combination of V_1T_0 (Table 6). The maximum stalk diameter (.56 cm) was produced from the treatment combination of V_2T_4 followed by V_1T_4 (.51 cm), while the minimum (0.41 cm) was in case of the treatment combination of V_1T_0 (Table 6). The treatment combination of V_2T_4 produced maximum number (12.87) of flowers produced followed by V_1T_4 (12.00), while it was minimum (8.67) in the treatment combination of V_1T_0 (Table 6). The highest flower spread (8.27 cm) was produced by the treatment combination of V_2T_4 followed by V_1T_4 (8.03 cm) and the lowest (6.13 cm) was in the treatment combination of V_1T_0 (Table 6).

Table 6. Combined effects of variety and inorganic fertilizers on flower and floral contributing characters of gerbera

Treatment combination	Days to first flower bud emergence	Days to harvest maturity	Stalk length (cm)	Stalk diameter (cm)	Total no. of flowers produced	Spread of flower (cm)
V_1T_0	75.17	19.57	35.40	0.410	8.67	6.13
V_1T_1	74.35	16.63	39.63	0.480	10.63	7.20
V_1T_2	74.63	17.23	38.57	0.460	10.10	7.03
V_1T_3	74.93	17.70	37.20	0.440	9.40	6.60
V_1T_4	72.83	16.13	41.77	0.510	12.00	8.03
V_2T_0	75.07	18.73	37.50	0.430	9.53	6.47
V_2T_1	74.27	16.43	41.57	0.530	11.57	7.77
V_2T_2	74.50	17.03	40.13	0.480	10.77	7.53
V_2T_3	74.71	17.57	39.10	0.450	9.70	7.07
V_2T_4	72.23	15.80	43.03	0.580	12.87	8.27
$LSD_{0.05}$	0.24	0.33	0.95	0.05	0.29	0.15
Level of significance	*	*	NS	NS	*	*

*= Significant at 5% level of probability, NS =Non-Significant, V_1 = Mini Daisy, V_2 = Aladin, T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha.

Field life

The effect of varieties was found to be time required for field life was significantly influenced by the varieties. The longer field life (18.22 days) was recorded in V_2 and lesser time required (17.45 days) was found in V_1 (Figure 1). The variation might be due to the fact of genetically make up and soil factors of these varieties which encouraged more longevity leading to the field life.

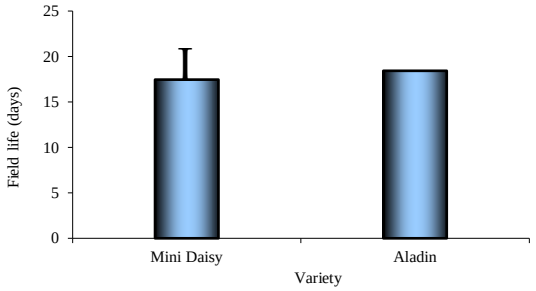

Figure 1. Main effect of variety on field life of gerbera. Vertical bar represents LSD at 5% level of significance [V_1 = Mini Daisy (Red), V_2 = Aladin (Pink)]

The effect of inorganic fertilizers on the observation of time recorded on field life of flower in the experimental field was found to be significant. T_4 produced maximum field life (20.15 days) after maturity, while it was minimum (16.28 days) at control (T_0) (Figure 2). It might be due to the availability of nutrients to plant that forced towards the growth of vegetative parts then it takes time to complete wilting as compared to control treatment. These results are in agreement with the findings of Singh *et al.* (2014). Based on the field experiment it could advised that the application of NPK @ 20:20:15 NPK g/m^2 may resulted better quality growth, flowering and yield of the gerbera under shade net condition.

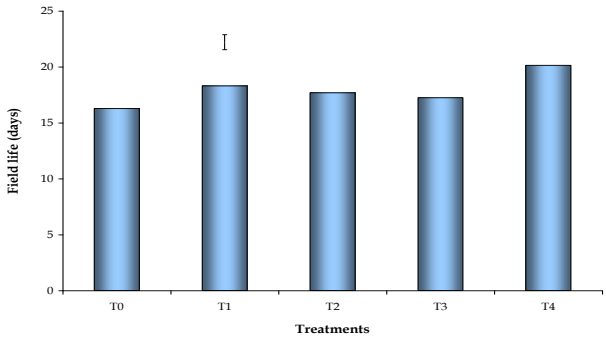

Figure 2. Main effect of inorganic fertilizers on field life of gerbera. Vertical bar represents LSD at 5% level of significance (T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha).

Combined effects of varieties and different doses of inorganic fertilizers on the time required for field life of flower in the experimental field was statistically significant. It was found to be the maximum time required for field life (20.77 days) was observed in the treatment combination of V_2T_4 followed by V_1T_4 (19.53 days) and the minimum time to field life (15.53 days) was found to be the treatment combination of V_1T_0 combination (Figure 3).

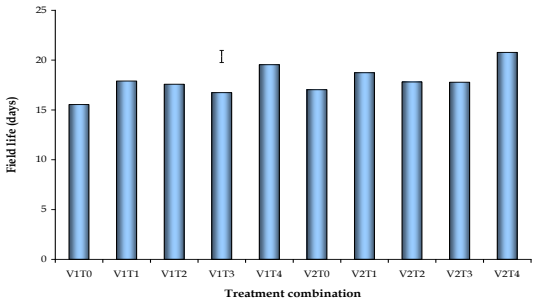

Figure 3. Main effect of variety and inorganic fertilizers on field life of gerbera. Vertical bar represents LSD at 5% level of significance (V_1 = Mini Daisy, V_2 = Aladin, T_0 = Control, T_1 = N @ 300 kg/ha, T_2 = P @ 275 kg/ha, T_3 = K @ 225 kg/ha, T_4 = N+P+K @ 300+275+225kg/ha).

Conclusions

In the present investigation, the maximum plant height as well as the maximum number of leaves per plant, maximum leaf length, maximum leaf spread, minimum days to first flower bud emergence, minimum days to harvest maturity, maximum stalk length, maximum stalk diameter, maximum number of flower per plant, maximum flower spread and maximum field life were obtained from V_2T_4 treatment and the minimum plant height as well as the minimum number of leaves per plant, minimum leaf length, minimum leaf spread, maximum days to first flower bud emergence, maximum days to harvest maturity, minimum stalk length, minimum stalk diameter, minimum number of flower per plant, minimum flower spread and minimum field life were obtained from V_1T_0 i.e.; in control condition treatment. Therefore, it can be concluded that combined application of N, P, K fertilizers was found along with variety Aladin to be better for higher growth and flowering of gerbera.

References

Ahlawat TR, Barad AV, Jat GR, Makwana AN (2011). Evaluation of gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.) cultivars under naturally ventilated polyhouse. Haryana Journal of Horticultural Science 40 (1 & 2) 80-81

Barad AV, Nandre BM, Sonwalkar NH (2010). Effect of NPK levels on gerbera cv. Sangria under net house conditions. Journal of Horticulture 67(3):421-424.

Barooah L, Choudhury MT (2009). Evaluation of gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.) cultivars under agro-climatic conditions of Jorhat, Assam. Journal of Ornamental Horticulture 12(2):106-110.

Bose TK, Yadav LP, Pal P, Pathasarathy VA, Das P (2003). Commercial Flowers, Vol-2. 2nd Rev. ed. Nayaprokash, Calcutta, India pp.163-202.

Dalal S, Gonge VS, Pimple AG, Deshmukh R, Utgikar S (2005). Response of phosphorus levels to growth, flowering, yield and flower quality of gerbera under polyhouse. Annals of Plant Physiology 19(1):120-121.

Das P, Singh PKS (1989). Gerbera, In Bose T K, Yadav LP (eds), Commercial Flowers, Naya Prokash. Kolkata. pp. 601-605.

Dhane RA, Patil PV, Dhane AV, Jagtap KB (2004). Performance of some exotic gerbera cultivars under naturally ventilated poly house conditions. *Journal* of the Bangladesh *Agricultural University* 29(3): 356-358.

Edris KM, Islam AMAT, Chowdhury MS, Haque AKMM (1979). Detailed soil survey, BAU Farm, Mymensingh,

Department of Soil Survey, Government of the People's Republic of Bangladesh. pp. 118.

FAO (1988). A Report of Food and Agricultural Organization of United Nations, Rome, Italy 52:59-60.

Gaurav B, Katwate, Sabale RN, Kakade DS, Dhane AV (2004). Effect of nutritional levels on yield and quality of gerbera. Journal of Ornamental Horticulture 7:226-229.

Gomez KA, Gomez AA (1984). Statistical Procedures for Agricultural Research (2nd Ed). John Wiley & Sons, New York. pp. 28-192.

Jadhav A, Tamgadge S, Deshmukh A, Telgote N, Bodakhe, V (2010). Effect of nitrogen levels and gibberellic acid on growth and yield of gerbera under polyhouse condition. The Asian Journal of Horticulture 5(2):341-343.

Kamel HA, IbrahimAA, Bispara AP, Nada AK (1977). Studies on the effect of different levels of NPK on the flower of *Gerbera jamesonii* var. Superba. Technical-Bulletin, -Qubba-Botanic-Garden. 178.

Kandpal K, Kumar S, Srivastava R, Chandra R (2003). Evaluation of gerbera (*Gerbera jamesonii*) cultivars under Tarai conditions. Journal of Horticultural Science & Ornamental Plants 6:252-255.

Leffring L (1973). Flower production in gerbera, Correlation between shoot, leaf and flower formation in seedlings. Scientia Horticulturae 1:221-229.

Malik AM, Ahmad N, Khan MSA (2013). Comparative evaluation of growth, yield and quality characteristics of various gerbera (*Gerbera jamesonii* L.) cultivars under protected condition. Journal of Ornamental Horticulture 3(4):235-241.

Mantrova EZ, Nikolaeva TV, Dvortsova VV (1982). Effectiveness of app.lying fertilizers to gerberas, Byulleten'-Glavnogo-Botanicheskogo-Sada. 126:51-57

Nair SA, Medhi RP (2002). Performance of gerbera cultivars in the Bay Islands. Indian Journal of Horticulture 59(3):322-325.

Nayak D, Mandal T, Roychowdhury N (2005). Effect of NPK nutrition on growth and flowering of *Gerbera jamesonii* L. cv. Constance. Orissa Journal of Horticulture 33(2):11-15.

Pattanashetti CN (2009). Evaluation of gerbera cultivars under protected conditions. MS Thesis, University of Agricultural Sciences, Dharwad. pp. 48.

Pimple AG, Dalal SR, Nandre DR, Ghawade SM, Swarupa Utgikar (2006). Yield and quality of gerbera influenced by nitrogen and phosphorus levels under polyhouse conditions. International Journal of Agricultural Sciences 2(2):320-321.

Rashid MHA (2017). Performances of gerbera (*Gerbera jamesonii* L.) varieties under shade house. Journal of the Bangladesh Society for Agricultural Science and Technology, 14 (1-4): 119-124.

Renuka M, Deshpande SR, Dalal VS, Gonge S, Mohariya AD, Anuj AA (2005). Effect of phosphorus and potash on growth, flowering and yield of gerbera under polyhouse conditions, Crop Research (Hisar). 29(2):268-271.

Sane A, Gowada JVN (2001). Characterization of gerbera (*Gerbera jamesonii*) cultivars using morphological characters. The *Plant Genetic Resources Newslette* 128:64-67.

Sankar M (2003). Varietal evaluation of gerbera (*Gerbera jamesonii* Bolus) under low cost greenhouse, MS (Hort.) thesis, Kerala Agricultural University, Thrissur. pp. 65.

Sarkar I, Ghimiray TS (2004). Performance of gerbera under protected condition in hilly region of West Bengal. Journal of Ornamental Horticulture 7(3&4):230-234.

Sarmah D, Kolukunde S, Mandal T (2014). Evaluation of gerbera varieties for growth and flowering under poly house in the plains of West Bengal. International Journal of Science and Research 3(12):135-136

Sema A, Singh A, Maiti CS (2010). Performance of exotic gerbera cultivars grown under protected condition in Nagaland [abstract]. In: Abstracts, Fourth Indian Horticulture Congress, "Horticulture, Horticulture Business and Economic Prosperity" New Delhi, 18-21st November, 2010. pp. 187.

Singh KP, Ramachandran N (2002). Comparison of greenhouses having natural ventilation and fan and pad evaporative cooling systems for gerbera production. Journal of Ornamental Horticulture 5(2):15-19.

Singh MK, Kumar S (2008). Effect of NPK on flower production of gerbera under polyhouse conditions, Book of abstracts: National conference on floriculture for livelihood and profitability, 16-19 March, IARI, New Dehli. pp. 139.

Terangpi H, Paswan L (2003). Effect of NPK on growth and flowering of gerbera. Journal of Ornamental Horticulture (New Series) 6(1):71-72.

UNDP (1988). Land Resource App.raisal of Bangladesh for Agril. Dev. Report 2. Agro-ecological Region of Bangladesh, FAO, Rome, Italy. pp. 577.

Wankhede S, Gajbhiye RP (2013). Evaluation of gerbera varieties for growth and flowering under shadenet. *International Journal* of *Horticulture* 3(9):42-45.

Wankhede S, Gajbhiye RP (2012). Performance of gerbera varieties for flowering, yield and quality parameters under shade net. Indian Journal of Horticulture 69(1):98-100.