Vol. 13, No. 1, pp. 33-38 (2013)
Journal of Agricultural Physics
ISSN 0973-032X
http://www.agrophysics.in

Research Article

Agronomic Performance and Variation of Flower Characteristics of Gerbera under Varying Soil Condition and Open Field Cultivation

ROKOLHUII KEDITSU*

Department of Horticulture, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema-797 106, Nagaland

ABSTRACT

Gerbera has been one the most popular flower crop to Floriculturist from several angles. Raising flower yield by manipulating the planting time in order to exploit upon variation in soil moisture attracted the top priority. Under humid tropical conditions of Nagaland, studies carrying eight different dates of planting (15th March - 15th October) were carried out on Alfisol through randomized complete block design during 2006-09 in open field conditions. The differences in the planting time of Gerbera brought about a statistically significant difference in performance of Gerbera, primarily due to the difference in soil moisture content (153.2 g/kg during May planting to 301.6 g/kg during August planting , coinciding linearly with the amount of rainfall received). However, June date of planting produced the best response in terms of number of leaves at flowering (15.96), leaf area (138.78 cm^2) and plant height at flowering (27.09 cm). The June date of planting further showed the best response on the flower characteristics viz., flower size (9.12 cm) and stalk length (35.77 cm). These parameters collectively imparted higher number of flowers (220.1 /m^2) and flower yield (2.95 kg/m^2) with June planting compared to number of flowers (179.7-197.4 /m^2) and flower yield (1.45-2.25 kg/m^2) with rest of the other dates of planting. The study, therefore, suggested that an effective benchmark of optimum soil moisture content (201.0 g/kg i.e. 82.8% of 33 KPa soil moisture) is necessary to harness suitable planting time in order to enhance the performance of Gerbera under rainfed open field conditions.

Key words: Soil moisture, Planting time, Vegetative growth, Flower yield, Alfisol, Gerbera

Introduction

Gerbera (*Gerbera jamesonii* Bolus ex Hook) is the latest sensation to Indian Floriculture, commercially grown throughout the world in a wide range of climatic conditions. According to the global trends in floriculture, Gerbera occupies the 4th place among cut flowers (Sujatha *et al.,* 2002). Variation in soil moisture in relation to planting time poses the most profound effect on both vegetative as well as reproductive features of the crop. In a 3- year- trial on Gerbera conducted by Parthasarathy and Nagaraju (2003), it was observed that flower bud initiation, growth, development and flowering were faster during warmer period (April – May and June – July), whereas the longevity of flower is more during October – November. Similarly, studies conducted at Dharwad to evaluate the best planting time for Gerbera cv. Sath Bata showed a profound influence of staggered planting on vegetative as well as reproductive attributes, with July planting resulting in maximum flower size (Singh, 2001).

The North Eastern Region (NER) has been identified as the potential belt for the development

*Corresponding author,
Email: rokokdts@yahoo.com

of floriculture, as the region has distinct climatic variations, the rapid changes in the topography within a short distance, making it one of the most ideal climate for the commercial cultivation of floricultural crops. The major constraint lies in the extended trade of Gerbera, on account of limited availability of flowers in the market, without any genuine efforts to extend their availability throughout the year. Studies on deferred planting time to extend number of harvestings in Gerbera is one such promising option. The present study was therefore carried out with this sole objective since the desired information is extremely limited in the context of humid sub - tropical conditions of Nagaland.

Material and Methods

Experimental Set-up

A field experiment under humid sub - tropical climate (33.9 – 22.5^{0}C as maximum temperature and 10.9 – 27.4^{0}C as minimum temperature, 1100 mm rainfall and 80.6 – 91.7% relative humidity) was conducted during 2006-09 at a private nursery (25^{0}45´43´´N latitude; 93^{0}53´44´´E longitude at an elevation of 210 m above mean sea level in Dimapur, Nagaland. The experimental soil belonged to Alfisol type (sand 594.0 g/kg, silt 241.5 g/kg, clay 164.5 g/kg, 33 KPa 242.6 g/kg, 1500 KPa 104.3 g/kg, soil pH 5.2, $KMnO_4$-N 148.6 mg/kg, Bray's-P 4.2 mg/kg and neutral NH_4OAc-K 98.9 mg/kg.

The experimental plot was ploughed deeply and thoroughly harrowed to a fine tilth. Individual beds of 1·2 m × 1·2 m size, raised to a height of 15 cm were prepared. At the time of final land preparation, 7 tons of FYM/ha was incorporated into the soil. The recommended dose of fertilizer consisting of 60 kg N (urea) – 40 kg P_2O_5 (single superphosphate) and 60 kg K_2O/ha were applied uniformly at the time of planting. Healthy suckers of *Gerbera jamesonii* cv. Red Gem were collected from experimental farm of Assam Agricultural University, Jorhat, Assam and were used as the planting material for the research. The individual healthy suckers were separated from the clump, the leaves and roots were trimmed off. Thereafter, the suckers were planted with utmost care not to cover the crown with soil. The suckers were planted at a spacing of 30 × 30 cm, accommodating around 16 plants in each experimental plot. Planting was done in the evening hours, and followed immediately by applying irrigation. The plots were kept free from weeds throughout the growing period by manual weeding. For proper growth and development of the plants, various intercultural operations such as irrigation, earthing up, removal of dried leaves and flowers etc. were done at regular intervals.

Eight treatments consisting of M_1 (15th March date of planting), M_2 (15th April date of planting), M_3 (15th May date of planting), M_4 (15th June date of planting), M_5 (15th July date of planting), M_6 (15th August date of planting), M_7 (15th September date of planting) and M_8 (15th October date of planting) replicated three times were tested in a randomized complete block design.

Plant Observations

The number of leaves per plant was recorded from each sample plant and the average was taken. The observation was taken at the time of first flowering. Five numbers of leaves of various sizes were collected from each sample plant and area were measured with the help of Leaf area meter and the average was recorded in cm^2. The plant height was measured with the help of a linear scale and expressed in centimeter. The observations were taken at the time of first flowering from the base of the plant to the tip of the longest leaf.

Days taken from planting to the visibility of the flower bud (pea sized) at the ground level, days taken from planting to the date when the bud first begins to open, number of days taken from bud emergence to bud burst stage, days taken from the date of planting to the full opening of disc floret, diameter of the flower (measured with the help of linear scale at full bloom stage and expressed in centimetre), length of flower stalk (measured in centimeter with the help of linear scale from the base of the stalk to the point where the head is joined to the tip of stalk), girth of flower stalk (measured at the mid portion of the stalk with the help of vernier caliper and

expressed in centimetre), The flowers were harvested when the outer rows of the disc floret were perpendicular to the stalk. Harvesting was done in the morning hours by giving a sideward pull at the base of the flower stalk. Immediately after harvesting, the stem end is immersed into a container half filled with clean water.

Soil Moisture Analysis

Soil samples (0-15 cm depth) collected at flowering stage were subjected to thermo-gravimetric analysis (Chopra and Kanwar, 1986).

Statistical Analysis

Critical Difference (CD) was calculated using the standard procedure. Linear coefficient of correlation (r = sxy/sx**.** sy, where sx and sy are the standard deviations of x and y, respectively, and sxy the covariance) and regression analyses (y = a + bx, where y, a, b and x stand for dependent variable, intercept, regression coefficient and independent variable) were used to screen the soil properties significantly affecting the flower yield and quality (Rangaswamy, 1995).

Results and Discussion

Variation in Soil Moisture

Different dates of planting from March to October displayed a significant variation in soil moisture from 153.2 g/kg during May date of planting to 301.6 g/kg during August date of planting. Considering the field capacity (33 KPa) soil moisture, the August and September dates of planting maintained a significantly higher soil moisture, while March, April and May registered the soil moisture level close to 1500 KPa. Correlation matrix developed for soil moisture variation versus all the vegetative growth and yield parameters suggested strong influence of soil moisture on performance of selected variety of Gerbera.

Statistically significant correlations of soil moisture with number of leaves (r =0.512, $p = 0.01$) , leaf area(r= 0.632, $p = 0.01$), plant height (r =0.714, $p = 0.01$), flower size (r= 0.489, $p = 0.01$), stalk length (r = 0.382, $p = 0.05$), number of flowers (r = 0.716, $p = 0.01$) and flower yield (r = 0.743, $p = 0.01$) were observed. Correlation studies carried out by Kannan and Ramdas (1990) showed that flower yield/plant was significantly and positively correlated with the period of flower retention on the plant whereas number of leaves had significantly positive correlation with number of sucker production/plant and girth of the flower stalk.

Number of Leaves/Plant, Leaf Area Response and Plant Height

The time of planting inflicted a significant response on number of leaves/plant as is evident from Table 1. The maximum number of leaves/ plant (15.96 leaves/plant) was observed when planting was undertaken in the month of June followed by July month of planting (11.76 leaves/ plant), and statistically at par for April – May months of planting (10.99-10.78 leaves/plant). Least number of leaves (9.17 leaves/plant) were observed in March planting which was statistically at par with rest of the other months of planting from August to October recording 10.08-9.94 leaves/plant. Therefore, the most effective and least effective treatments were clearly observed as M_4 (15.96 leaves/plant) and M_1 (9.17 leaves/plant), respectively.

The maximum leaf area was observed as 138.78 cm^2 with treatment M_4 when planting was done in June. While minimum leaf area of 74.97 cm^2 was observed with treatment M_8 when planting was done in October. The other dates of planting such as March, August and September were found to be not so effective in developing leaf area.

Height of the plant is another effective index of measuring the magnitude of vegetative growth. Pooled data on plant height for both the seasons were analyzed and results obtained were almost of the same magnitude compared to data when analyzed season wise. The treatment M_4 (27.09 cm with June date of planting) continued its supremacy over rest of the other treatments. While M_7 and M_8 were observed as least effective treatment. From the pooled data analysis, June-July date of planting produced the best response

Table 1. Effect of planting time on the vegetative growth parameters of Gerbera cv. Red Gem

Treatments	Soil moisture (g/kg)	Number of leaves/plant	Leaf area (cm^2)	Plant height (cm)
M_1(March)	182.3	9.17	89.31	19.88
M_2(April)	164.6	10.99	111.97	23.10
M_3(May)	153.2	10.78	103.87	25.09
M_4(June)	201.0	15.96	138.78	27.09
M_5(July)	284.3	11.76	120.61	24.08
M_6(August)	301.6	10.08	66.59	20.86
M_7(Sept.)	284.3	9.80	87.71	19.56
M_8(Oct.)	204.1	9.94	74.97	19.71
CD (p=0.05)	9.3	3.36	11.54	1.67

Pooled data of 2006-09.

for plant height followed by April – May and September -October date of planting, respectively.

Time of Bud Emergence, Bud Burst and Bud Emergence to Bud Burst

The treatment M_4 and M_2 took 101.82 days and 113.45 days respectively, for bud emergence from planting time. Incidentally, these treatments suggested the most effective and least effective treatments, respectively. The same treatment M_4 and M_2 demonstrating as most effective and least effective treatments, respectively (Table 2) for reaching to bud burst stage from planting time. However, other treatments showed some variation in response when compared between the seasons.

Time taken from bud emergence to bud burst holds a strong promise in the context of readiness to full bloom. Number of days taken from bud emergence to bud burst significantly ($p \leq 0.05$) influenced by different dates of planting (Table 2). The treatment M_4 took minimum days of 7.49 days when planted in the month of June, closely on par with other treatments such as M_5. However, M_4 was significantly superior to other treatments including M_6, M_{-7}, $M_{8,}$ M_1, M_2 and M_3.

Time to Full Bloom from Planting Time

This is the most important criterion deciding the time of harvest which triggers a profound influence on vase life of the cut flowers. Influence

Table 2. Days taken to flowering in response to different planting time and flowering characteristics in Gerbera

Treatments	Soil moisture (g/kg)	Days to bud emergence	Bud burst stage from planting time	Bud emergence to bud burst	Full bloom from planting time	Flower size (cm)	Stalk length (cm)
M_1(March)	182.3	108.96	118.32	9.36	128.20	8.25	26.46
M_2(April)	164.6	113.45	122.56	9.11	130.44	8.09	26.35
M_3(May)	153.2	58.92	112.56	9.05	121.63	9.05	31.99
M_4(June)	201.0	101.82	109.31	7.49	116.56	9.12	35.77
M_5(July)	284.3	102.21	110.57	8.36	120.10	8.75	36.17
M_6(August)	301.6	109.70	119.07	9.37	129.96	8.61	29.89
M_7(Sept.)	284.3	110.60	119.98	9.38	130.53	8.15	27.72
M_8(Oct.)	204.1	112.53	122.03	9.50	133.56	7.82	27.65
CD (P=0.05)	9.3	1.93	1.93	0.69	2.20	0.30	2.42

Pooled data of 2006-09.

of change in planting time significantly affected the time taken (number of days) in attaining full bloom from planting time. The time taken for attaining full bloom from planting time varied from minimum of 116.56 days (with June date of planting) to maximum of 133.56 days (with October date of planting) coinciding with most effective and least effective treatment, respectively. Hence, simply by changing the date of planting, the Gerbera flowers can be harvested earlier by 17.02 days, keeping all other cultural practices of cultivation same.

Flower Size and Stalk Length

The time of planting showed a significant affect on the size of flowers, which varied from minimum size of 7.82 cm, in treatment M_8 to the maximum flower size of 9.12 cm in treatment M_4. Pooled data analysis also demonstrated the similar pattern of response, where M_8 (7.82 cm) and M_4 (9.12 cm) establishing themselves as least and most responsive treatments, respectively and treatment M_4 maintaining a clear cut superiority over rest of the treatments. However, other treatments like M_7 versus M_1, M_2 versus M_3 or M_3 versus M_4 showed no significant differences (Table 2).

In cut flowers, higher length of flower stalk is a desirable feature. The stalk length was significantly ($p \leq 0.05$) affected by various planting time, irrespective of whether or not comparisons were made season wise or pooled data analysis. During both the seasons, treatments such as M_7, M_8, M_1 and M_2 showed no significant response amongst themselves. Pooled data analysis responded almost through the same magnitude and pattern of response on stalk length in relation to differential date of planting. The maximum (36.17 cm) and minimum (26.16 cm) stalk length was recorded with treatment M_5 and M_2, respectively, however, M_5 was at par with M_4, suggesting, thereby, the suitability of June-July as most suitable time of planting (Table 2).

Number of Flowers and Flower Yield

Changing the time of planting, has brought significant changes in both number of flowers and flower yield. The highest number of flowers (220.1/m^2) and flower yield (2.95 kg/m^2) were observed in treatment M_4 with June date of planting (Fig.1). Incidentally, this date of planting proved to be highly superior to rest of the other dates of planting. For example difference of 50.4 flowers/m^2 was observed between least effective treatment M_7 (179.7 flowers/m^2 with September date of planting) and most effective treatment M_4 (220.1 flowers/m^2 with June date of planting). Likewise, variation in flower yield between most effective treatment M_4 (2.95 kg/m^2) and least effective treatment M_7 (1.45 kg/m^2) was highly

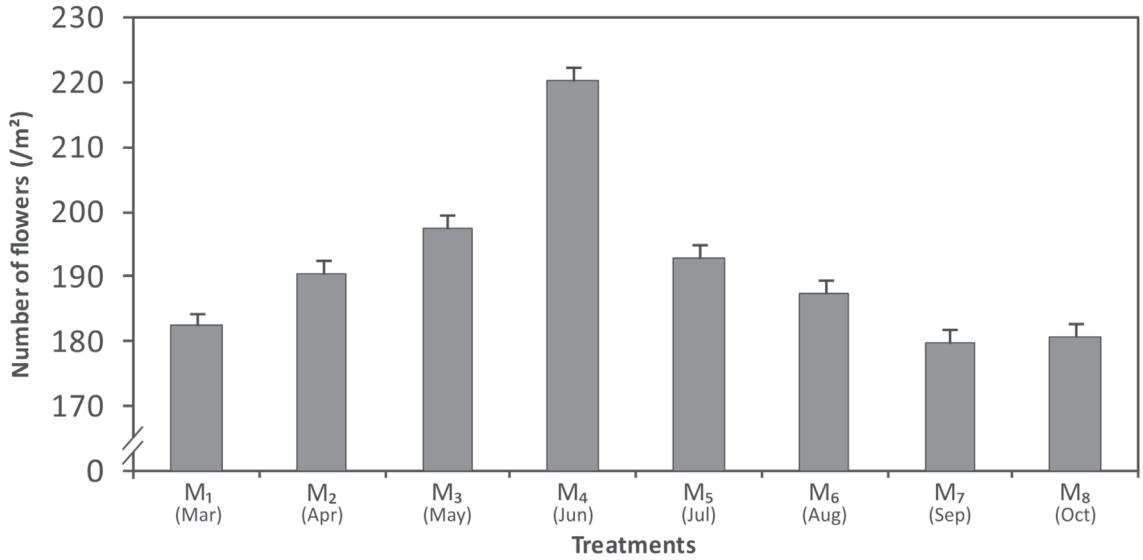

Fig. 1. Effect of different planting time on number of flowers in Gerbera (Pooled data of 2006-09)

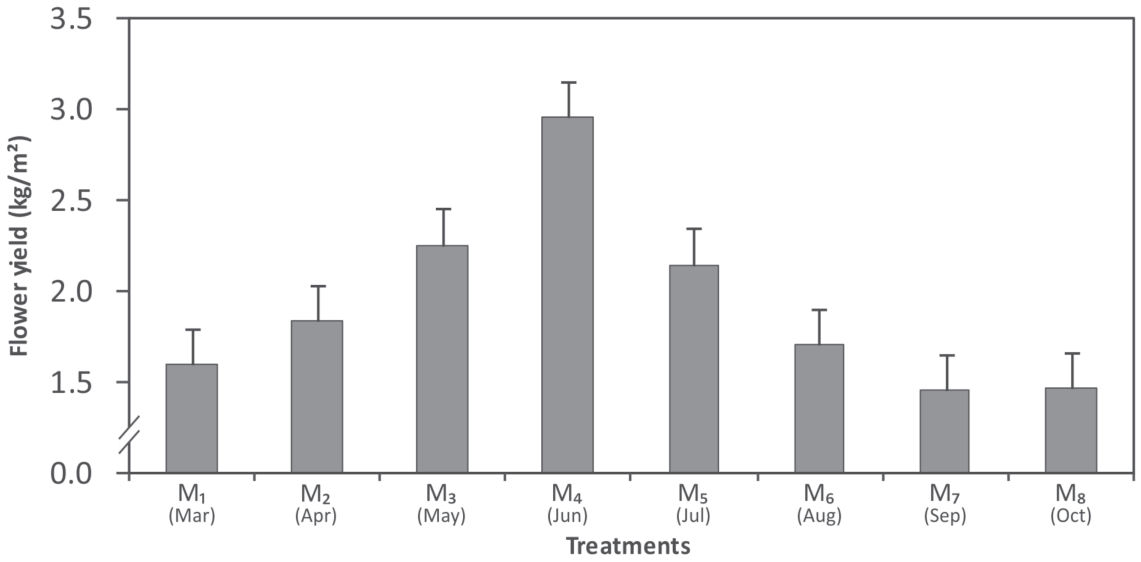

Fig. 2. Effect of different planting time on flower yield of Gerbera(Pooled data of 2006-09)

significant (Fig.2). The treatment M_4 with June date of planting far exceeds in the flower yield by 1.50 kg/ m^2 as compared with M_7 with September date of planting. Rogers (1973) earlier reported that turgidity in plants induced by variation in soil moisture and number of florets depended on the balance between the rate of water loss, by the plant and water supply within the rhizosphre.

The above results clearly bring out that simply changing the time of planting and using the available soil moisture but keeping all other cultural practices uniform, much improvement in terms of both number of flowers as well as flower yield in addition to other desired necessary features of Gerbera flower can be realized. Planting Gerbera in June and July appears to be commercially most advantageous.

References

Chopra, S.L. and Kanwar, J.S. 1986. Soil analysis (in) Analytical Agricultural Chemistry, pp. 162-190. Kalyani Publishers, Ludhiana, Punjab.

Kannan, M. and Ramdas, S. 1990. Variability and heritability studies in gerbera *(Gerbera jamesonii). Progressive Horticulture* **22**(1-4): 72-76.

Parthasarathy V.A. and Nagaraju V. 2003. Evaluation of gerbera under mid-hills of Meghalaya. *Journal of Ornamental Horticulture* **6**(4): 376-80.

Rangaswamy, R. 1995. A Text Book of Agricultural Statistics. Wiley Eastern Limited, New Delhi, pp. 142-201.

Rogers, M.N. 1973. A historical and critical review of post harvest physiology research on cut flowers. *Hort. Science* **8**: 189-194.

Singh, K.P. 2001. Agro-techiques for gerbera cultivation in India. *Floriculture Today* **5**:9-13

Sujatha K., Gowda, J.V.N. and Khan, M.M. 2002. Effects of different fertigation levels on gerbera under low cost greenhouse. *Journal of Ornamental Horticulture* **5**(1): 54-59.

Received: 26 June 2012; Accepted: 26 August 2012