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AGROPEDOLOGY ON PERFORMANCE OF OPEN FIELD GERBERA

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ABSTRACT

Field experiment on raising Gerbera flower yield by manipulating the planting time was carried out with eight different dates of planting (15th March - 15th October) on Alfisol during 2006-09. Difference in planting time induced a significant difference in performance of Gerbera, due to soil moisture content variation (153.2 g kg^{-1} in May planting to 301.6 g kg^{-1} in August planting, coinciding linearly with rainfall received). However, the treatment with June planting produced the best response in terms of number of leaves/plant(15.96), leaf area(138.78 cm^2), plant height (27.09 cm), flower size (9.12 cm), stalk length(35.77 cm), number of flowers (220.1/m^2) and flower yield (2.95 kg/m^2) compared to rest of the other dates of planting. The study, hence, suggested that an effective benchmark of optimum soil moisture (201.0 g kg^{-1} i.e. 82.8% of 33 KPa soil moisture) is necessary to harness upon the benefits of suitable planting time 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 and opined that the flower bud initiation, growth, development and flowering were faster during warmer period (April – May and June – July). While the longevity of flower was 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 resulted in maximum flower size (Singh, 2001). The northeastern region (NER) has been identified as the potential belt for the development 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 climates for the commercial cultivation of floriculture crop. Such agropedological conditions extensively exist in most of the tropical countries having acidic soils taxonomically belonging to Alfisols and Ultisols. The major constraint lies in the extended trade of Gerbera is on account of limited availability of flower in the market, without any genuine effort to extend its availability throughout the year. Studies on planting time to extend number of harvestings in Gerbera are one such very promising option. The present study was carried out with this sole objective since the desired information is extremely lacking in the context of humid tropical conditions of Nagaland so that such concepts can be replicated elsewhere with similar agropedological analogues.

MATERIALS AND METHODS

Experimental Set-up: A field experiment under humid 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 Government Nursery (25^{0}45´43´´N latitude; 93^{0}53´44´´E longitude at an elevation of 210 m in above mean sea level at Dimapur, Nagaland. The experiment soil belonged to Alfisol (sand 594.0 g kg^{-1}, silt 241.5 g kg^{-1}, clay 164.5 g kg^{-1}, 33 KPa 242.6 g kg^{-1}, 1500 KPa 104.3 g kg^{-1}, soil pH 5.2, $KMnO_4$-N 148.6 mg kg^{-1}, Bray's-P 4.2 mg/kg and neutral NH_4OAc-K 98.9 mg kg^{-1}.

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 planting 7 tons FYM ha^{-1} alongwith recommended dose of fertilizer consisting of 60 kg N (urea) – 40 kg P_2O_5 (single

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superphosphate) and 60 kg K_2O ha^{-1} were applied uniformly. Healthy suckers of Gerbera cv. Red Gem were collected from experimental farm of Assam Agricultural University, Jorhat, Assam which was used as the planting material for carrying out 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 plot. Planting was done in the evening hours, immediately followed by applying irrigation water. 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 (15 March date of planting), M_2 (15 April date of planting), M_3 (15 May date of planting), M_4 (15 June date of planting), M_5 (15 July date of planting), M_6 (15^{th} August date of planting), M_7 (15 September date of planting) and M_8 (15 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 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 linear scale and expressed in centimeter. The observation was 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 as per the standard procedure. Linear coefficient of correlation ($r = \sigma xy/\sigma x.\ \sigma y$, where σx and σy are the standard deviations of x and y, respectively, and σxy 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 fruit yield and quality (Rangaswamy, 1995).

RESULTS AND DISCUSSION

Variation in Soil Moisture

Different dates of planting from March (M_1) to October (M_8) displayed a significant variation in soil moisture from 153.2 $g\ kg^{-1}$ during May date of planting (M_3) to 301.6 $g\ kg^{-1}$ during August date of planting (M_6). Considering the field capacity (33 KPa) soil moisture, the August (M_6) and September (M_7) dates of planting maintained significantly higher soil moisture, while March (M_1), April (M_2) and May (M_3) registered the soil moisture level with nearer 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 Gerbera. Correlation matrix developed for soil moisture variation versus all the vegetative growth and flower yield parameters suggested strong influence of soil moisture on the performance of Gerbera as evident from 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 ($r = 0.743$, $p = 0.01$). Correlation studies carried out by Kannan and Ramdas (1990) showed that flower yield/ plant had significant and positive correlation with a period of flower retention on the plant whereas number of leaves had significantly positive correlation with number of sucker production/plant and flower stalk girth.

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

The time of planting inflicted a significant response on number of leaves/plant during (Table 1). The maximum number of leaves/plant (15.96 leaves/plant) when planting was undertaken in the month of June (M_4) followed by July (M_5) month of planting (11.76 leaves/plant), statistically on par with April – May (M_2-M_3) months of planting (10.99-10.78 leaves/plant). While least number of leaves (9.17 leaves/plant) was observed in March planting (M_1) which was statistically on par with rest of the other months of planting ranging from August (M_6) to October (M_8) recording 10.08-9.94 leaves/plant. Hence, most effective and least effective treatments were observed as M_4 (15.96 leaves/plant) and M_1 (9.17 leaves/plant), respectively.

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

Treatments	Soil moisture (g kg^{-1})	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

The leaf area was observed as 138.78 cm^2 with treatment M_4 when planting was done in June. While on the other hand, 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 (M_1), August (M_6) and September (M_7) were not so effective in developing leaf area. While rest of the other treatments having planting date of July (M_5) and April (M_2) were although responsive on par to each other, but proved effective treatments as second order treatments to June date of planting (M_4) or July date of planting (M_5) as first order effective treatments.

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 on plant height followed by April – May and September -October date of planting.

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

The treatment M_4 (June date of planting) and M_2 (April date of planting) 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 treatment, respectively. The same treatment M_4(June date of planting) and M_2 (April date of planting) demonstrating as most effective and least effective treatment, respectively (Table 2) on bud burst stage from planting time. However, other treatments showed some variation in response when compared in one season versus next season. 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 (June date of planting) took minimum days of 7.49 days when planted in the month of June, closely on par with other treatments such as M_5 (with July date of planting). However, M_8 was significantly superior to other treatments including M_6 (August date of planting), M_7 (September date of planting), M_8 (October date of planting), M_1 (March date of planting), M_2 (April date of planting) and M_3 (May date of planting).

Table 2: Days taken to flowering in response to different planting time and flowering characteristics in Gerbera (Pooled data of 2006-09)

Treatments	Soil moisture (g/kg)	Bud emergence (Days)	Bud burst stage from planting time (Days)	Bud emergence to bud burst (Days)	Full bloom from planting time (Days)	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	9.5	133.56	7.82	27.65
CD(*P=0.05*)	9.3	1.93	1.93	0.69	2.20	0.30	2.42

Time on 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 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, by the changing of date of planting, the flowers can be cut earlier by 17.02 days, keeping all other cultural practices of cultivation same, simply by virtue of variation in soil moisture variation.

Flower Size and Stalk Length

The time of planting showed a significant response on the size of the flower, which varied from minimum size of 7.82 cm, with treatment M_8 (October date of planting). While, the maximum flower size was obtained as 9.12 cm with treatment M_4 (June date of planting). These two treatments M_4 and M_8 were observed as least effective and most effective treatments, respectively, on the basis of responses obtained during both the season. Pooled data analysis 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. The treatment M_4 displayed its clear cut superiority over rest of the treatments. However, the treatments like M_7 versus M_1, M_2 versus M_3 or M_3 versus M_4 showed no significant difference (Table 2).In cut flowers, higher length of flowers 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

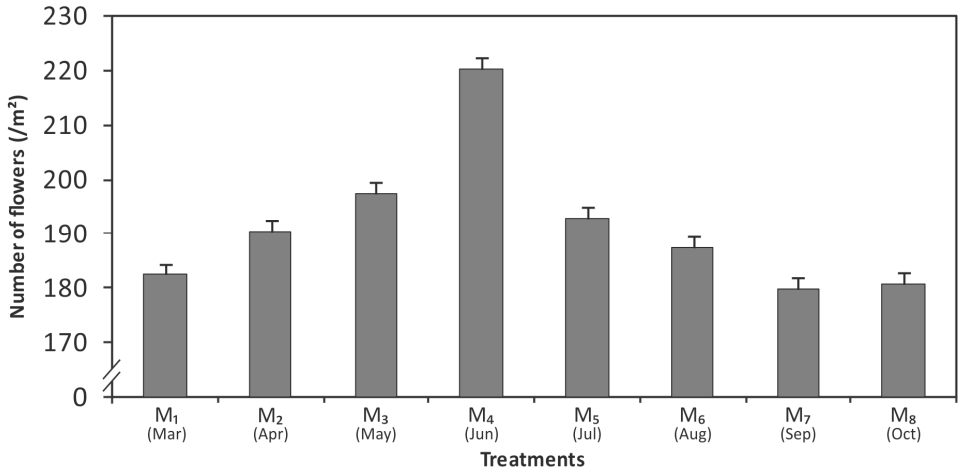

Fig.1: Effect of different planting time on number of flowers in Gerbera (Pooled data of 2006-09)

(26.16 cm) stalk length was recorded with treatment M_5 and M_2, respectively; however, M_5 was on 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 with treatment M_4 with June date of planting (Fig.1). Incidently, 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, with regard to responses of planting time on flower yield, more distinctive responses were observed. The 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 significant (Fig.2). The results accrued through pooled data analysis followed the similar pattern of response. The treatment M_4 with June date of planting improved the flower yield by 1.50 kg/m^2 when 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 rhizosphere.

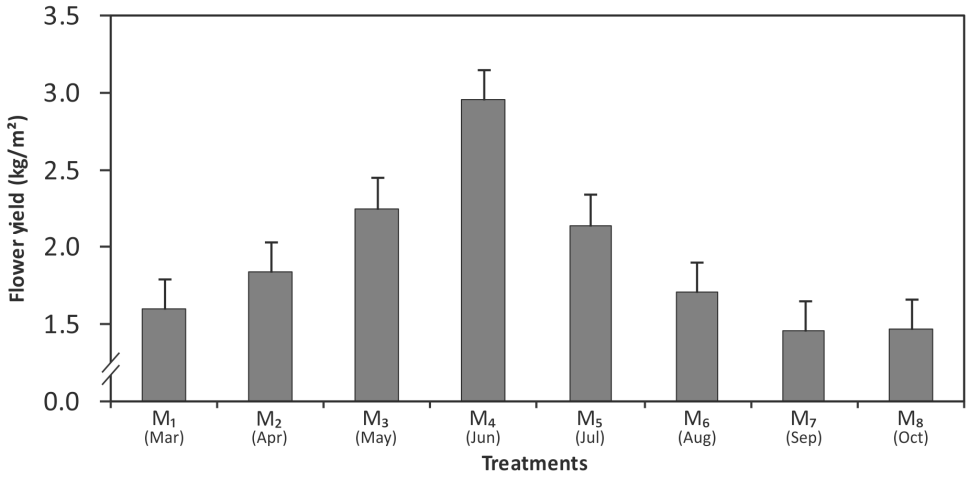

Fig. 2: Effect of different planting time on flower yield of Gerbera (Pooled data of 2006-09)

Conclusion

The response of Gerbera to differential planting time is the impact of prevailing agropedological conditions. The observations made through our studies have strongly warranted that, simply changing the time of planting, in a way, using the available soil moisture supply, keeping all other cultural practices uniform, could bring so much of improvement in crop response in terms of both number of flowers as well as flower yield in addition to other necessary features of Gerbera flower.

REFERENCES

Chopra, S.L. and Kanwar, J.S. (1986) Soil Analysis. In: *Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana, Punjab*, India, pp. 162-190.

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

Parthasarathy, V.A. and Nagaraju, V. (2003) Evaluation of gerbera under mid-hills of Meghalaya. *Journal of Ornamental Horticulture* **6:** 376- 380.

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**: 54-59.