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Variability among genotypes of gerbera in the north eastern region of India

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ABSTRACT

Gerbera is an important commercial flower crops and its climatic requirement is very suitably met in the northeast India for production of quality flowers and suckers under natural open conditions. Out of several collections and hybridization attempts being made at ICAR Research Complex for NEH Region, Umiam, about 37 genotypes were evolved, conserved and evaluated (2013-18). Results showed significant variation among genotypes for growth and flowering characteristics ($p \leq 0.05$). Flower stalk length was highest in RCGH 117 (45.44±1.07 cm) which was at par with Alesmera, RCGH-22, RCGH-114 and RCGH-12. Maximum flower diameter was noted in Alesmera (10.89±0.66 cm), RCGH-114, RCGH-97, RCGH-117 and RCGH-22. Highest number of flowers was obtained in RCGH-2 (31.28±3.43/plant) and RCGH 114. Sucker production was highest in RCGH-3 (21.00/plant/year) and vase-life in Alesmera (5.95±0.69 days), RCGH-117, RCGH 12, RCGH-114 and RCGH-22. Quantitative traits analysis showed significant correlation; leaf number had positive relationship with sucker number (0.770^{**}) and flower number (0.488^{**}), however, had negative correlation with flower stalk length (-0.393^{*}) and vase life (-0.350^{*}). Flower number had negative correlation with stalk diameter (-0.498^{**}) but positively correlated with sucker number (0.524^{**}). Flower diameter showed positive correlation with stalk length (0.327^{*}) and stalk diameter (0.351^{*}). Vase-life exhibited negative relationship with number of leaves (-0.350^{*}) and yield (-0.694^{**}) but positively correlated with stalk diameter (0.732^{**}). A diverse variation among the genotypes for flower quality and yield attributes can be further utilized in the crop improvement of gerbera. RCGH-12, RCGH-22, RCGH-114, RCGH-117 and Alesmera are potential genotypes for commercial flower production.

Key words: Gerbera, genetic variation, growth, flowering, open conditions,

INTRODUCTION

Gerbera (*Gerbera jamesonii Bolus ex. Hook f.*) is an ornamental plant native to South Africa, Madagascar, and tropical Asia. It is an important commercial cut flower crop in the global floricultural industry, occupies the 5^{th} position in the international flower trade (Hedau *et al*., 3). In India, it ranked 06^{th} among commercial flowers and occupies an area of 1150.05 ha and production of 25554.76 MT (NHB, 7). Gerbera flowers are durable, attractive geometrical shape and presenting a wide variety of colors, which is one of the main morphological traits of breeding attention. Gerbera flowers are highly demanding in the international and domestic market for their ability to endure long transportation.

Commercial production of gerbera in India including NEH region, in general, is practiced under protected structures (Low cost poly houses). Its cultivation in open field especially for domestic market, however, is feasible. The weather condition of the region is very suitable for growth and flowering of gerbera. The region has good market for flowers owing to the consumption during number of festivals being celebrated in the region. Keeping this in mind, a breeding programme in gerbera was initiated in ICAR Research Complex for NEH Region in the 1990s with the main objective to evolve varieties/ hybrids suitable for domestic consumption and export. Out of collections and several hybridization attempts, about 37 gerbera varieties/ genotypes were evolved and conserved in the field gene bank of ICAR Research Complex for NEH Region. Analysis of genetic variability in gerbera is a pre-requisite for breeding programs to generate data on the genetic relationships existing among the genotypes. Among various approaches, phenotypic traits are relatively simple for evaluating genetic variability. In this context, the present study aimed to evaluate the genetic variation and determine a relationship among individual quantitative morphological traits for identification of unique traits for further utilization in breeding programme.

MATERIALS AND METHODS

The experiment was conducted at ICAR Research Complex for NEH Region, Umiam, Meghalaya during the year 2013-2018. The study area is situated at 25^{0} 41' N latitude, 91° 55' E longitude and 1010 m altitude above mean sea level. Soil of the experiment site is clay loam to sandy clay loam. Soil is acidic in nature with pH 4.9, P-deficient & falls in acid alfisols category

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with an initial value of various soil parameters, *viz*., SOC (1.77%), exchangeable Al^{+++} (148.6), Ca^{++} (240.5), Mg^{++} (120), K^{+} (66.7), Bray's P2-P (1.2) and available B (0.9 mg kg^{-1}) (Dhyani and Tripathi, 2). Climatic conditions of the experimental site is humid subtropical. Mean maximum temperature of 26.16°C and mean minimum (14.0°C) was recorded during the study period with maximum temperature was recorded during the month of July (28.57 °C) and minimum in January (5.68 °C). Total annual rainfall of 2273.8 mm with more than 90% falling during April to October, maximum during August (495.8 mm) and minimum during December (7.1 mm). Relative humidity (RH) ranged between 77.18-88.12% (maximum) and 46.00-75.70% (minimum), respectively. Weather characteristics of the study location are depicted in figure 1.

The study consists of 37 hybrids/ genotypes/ accessions of gerbera developed/ collected and maintained in the Field gene bank of Horticulture Division, ICAR Research Complex for NEH Region, Umiam, Meghalaya. The experimental design was randomized block design, with 37 treatments (accessions/ genotypes) and replicated thrice. Planting was done at a spacing of 30 cm × 30 cm in a raised bed of 30 cm height and size of 1.5 m × 1.5 m under open field conditions. Each replication consisted of twenty five uniform sized (4-5 leaves) suckers of respective genotype planted during August. Package

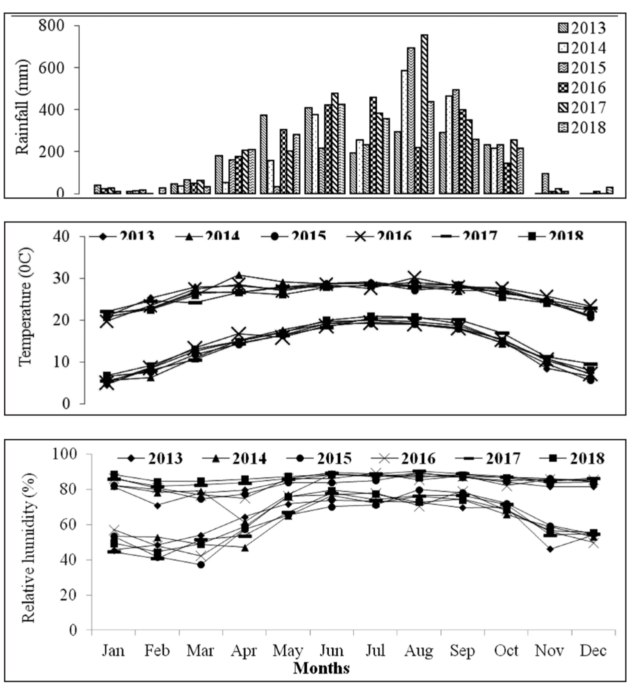

Fig. 1. Weather characteristics of experimental sites (2013-2018).

of practices as per standard procedures (Rymbai *et al*., 90) was followed for all the treatments

Vegetative characteristics such as number of leaves, leaf length, leaf width and plant spread were recorded at full bloom stage (120 days after planting). A full grown leaf were measured using aluminium ruler from tip of leaf lamina to end of petiole as length and width was measured at the broadest lamina lobes. Plant spread was the average of East-West and North-South direction of plant using measuring tape. Flower attributes were recorded at full bloom stage. The number of days taken from flower bud (pea size) appearance till budbreaking was estimated as days to bud burst, and till opening of floret as days to flower opening. Flower stalk length was measured from base to neck of the stalk and diameter was measured in the mid portion of the stalk using digital vernier caliper (INSIZE SL-A1108-150). Flower head diameter was measured across two extreme points of the fully developed capitulum. Flower colour was determined visually using Royal Horticultural Society Colour Chart (6th edition, 2015). Number of flowers was recorded and removed as and when at the optimum desired harvest stage for six months (November – April) and number of suckers was taken during the month of August. Flowers were harvested early in the morning when outer floret are fully opened and perpendicular to stalk. The flowers were pre-cooled for 1 hour at 5°C temperature and then stalks were cut prior to placing them in a container holding tap water at room temperature. Vase life was recorded from day of harvesting till more than 1/3rd of outer petals of flowers turning brown/ wilted. The pooled data of five years were statistically analysed in triplicates and data of ten plants from each replication was presented as mean ±SD using one way ANOVA ($p \leq 0.05$) of Tukey's Test. The possible relationship among vegetative and flowering traits was analysed through Pearson's correlation coefficient. The data was subjected to IBM SPSS programming (Version 26.0) software for all the analysis.

RESULTS AND DISCUSSION

A significant variation was observed for vegetative traits among genotypes of gerbera ($p \leq 0.05$, table 1). Number of leaves was highest in RCGH-3 (98.87±2.52) and minimum in RCGH-89 (20.41±3.07). Similarly, leaf length ranging from 20.10±2.55 cm in RCGH-51 to 39.44±4.77 cm in RCGH-23, leaf width varies from 4.54±0.80 cm in RCGH-76 to 11.02±2.06 cm in Alesmera and plant spread from 26.45±1.31 cm (RCGH-60) to 61.73±5.46 cm (RCGH-1). The results suggested diversity among different genotypes for this important yield promoting components. Our results corroborated the findings of Sane and Gowda (11) and Rajiv Kumar and Yadav (8) who reported a wide variation in vegetative traits among gerbera. The differences in various growth characters might be attributed to genetically influenced and inherent genetic characters of the cultivars in China aster

Table 1. Growth characteristics of gerbera genotypes under open field conditions

Genotype	Leaf No.	Leaf length (cm)	Leaf width (cm)	Plant spread (cm)
RCGH 1	83.40±4.98	34.82±2.95	8.92±1.28	61.73±5.46
RCGH 2	91.20±2.77	31.62±0.70	6.70±0.71	52.80±3.19
RCGH 3	98.87±2.52	34.60±2.69	5.38±0.61	56.96±3.62
RCGH 5	71.80±8.50	34.50±3.04	6.34±1.55	44.00±2.02
RCGH 7	33.37±1.75	37.86±0.47	7.14±1.07	49.58±3.98
RCGH 9	50.80±8.87	23.60±2.25	5.54±1.15	37.72±5.12
RCGH 10	50.00±5.70	26.90±2.89	8.12±0.76	41.58±3.47
RCGH 12	25.24±1.54	26.40±1.62	6.81±0.16	31.37±0.88
RCGH 19	68.20±5.55	25.22±1.40	8.10±0.98	42.95±4.14
RCGH 20	34.40±3.96	20.96±1.33	5.03±0.09	35.54±2.87
RCGH 22	24.54±1.25	22.58±1.09	7.30±0.18	32.58±1.18
RCGH 23	90.42±6.11	39.44±4.77	8.74±0.84	57.98±9.61
RCGH 28	68.80±5.36	36.18±2.91	10.10±0.65	58.22±4.73
RCGH 32	28.63±8.38	21.77±1.57	6.43±0.09	38.51±6.75
RCGH 33	37.88±7.84	25.20±1.15	6.75±0.46	45.29±3.21
RCGH 38	30.99±6.31	20.60±2.08	5.49±0.13	31.80±1.41
RCGH 42	26.83±5.68	20.76±3.17	5.93±0.12	31.39±3.43
RCGH 51	20.57±5.94	20.10±2.55	6.28±1.54	34.95±6.17
RCGH 60	24.37±4.15	20.43±3.08	5.73±0.16	26.45±1.31
RCGH-65	31.60±4.10	29.16±0.94	8.70±0.87	40.30±5.10
RCGH 76	26.84±6.73	21.32±3.00	4.54±0.80	30.87±2.03
RCGH 86	35.82±2.24	21.72±1.34	7.27±0.20	38.30±5.66
RCGH 89	20.41±3.07	20.69±0.74	6.27±0.84	35.85±3.22
RCGH 90	30.45±5.63	21.71±2.78	6.02±0.59	33.07±1.50
RCGH 93	23.35±4.53	20.77±0.96	5.99±0.38	34.20±1.63
RCGH 95	28.58±10.92	20.76±0.57	5.65±0.74	32.42±1.93
RCGH 97	21.86±5.49	21.10±1.53	6.84±0.11	37.8±1.15
RCGH 100	22.43±6.88	22.03±2.72	7.22±0.37	30.31±3.41
RCGH 109	26.25±9.13	22.08±1.95	5.73±0.36	27.83±1.57
RCGH 113	27.18±7.42	22.38±5.59	7.97±0.26	35.46±6.10
RCGH 114	28.55±5.08	21.90±1.24	7.08±0.11	34.46±1.00
RCGH 117	32.66±1.32	22.60±1.51	8.15±0.29	32.30±0.63
RCGH 128	31.06±10.29	23.48±1.79	5.80±0.35	29.74±0.80
RCGH 172	23.19±4.04	21.20±3.20	6.38±0.53	32.37±4.48
RCGH 226	25.72±3.27	22.61±0.98	6.90±0.73	35.39±1.60
Alesmera	38.75±1.91	36.56±0.61	11.02±2.06	51.12±6.49
CSA Collection	27.88±5.66	20.29±2.98	4.82±1.18	29.48±2.09
CD ($p \leq 0.05$)	8.02	4.62	0.92	5.46

(Zosiamliana *et al.*, 14) and gerbera (Singh and Ramachandran, 12; Rymbai *et al.*, 10).

The inflorescence characters exhibited significant differences among genotypes ($p \leq 0.05$, table 2). Inflorescence capitulum had a broad range of attractive and appealing colour which is an important trait for floriculture industry. Minimum days to bud burst and days to flower opening was

Table 2. Flowering characteristics of gerbera genotypes under open field conditions.

Genotype	Colour of inflorescence capitulum	Days to bud burst	Days to flower opening	Stalk length (cm)	Stalk diameter (mm)	Flower head diameter (cm)	Disc diameter (cm)
RCGH 1	52 A (Vivid Red)	7.85±0.86	4.44±1.82	35.98±1.53	4.13±0.11	9.60±0.33	1.02±0.02
RCGH-2	55 A (Deep Purplish Pink)	9.60±0.24	4.82±0.81	33.51±0.87	4.37±0.08	10.09±0.08	1.29±0.07
RCGH 3	49 A (Strong Pink)	9.35±0.34	4.33±0.92	36.46±3.33	4.04±0.03	9.67±0.15	1.24±0.05
RCGH 5	19 B (Light Yellowish Pink)	10.38±0.44	6.14±1.19	38.18±1.24	4.35±0.07	9.72±0.97	1.32±0.06
RCGH 7	24 B (Strong Orange)	11.75±0.7	6.72±2.45	34.59±1.68	5.05±0.05	10.63±0.17	1.58±0.27
RCGH 9	50 B (Deep Pink)	8.95±0.26	4.98±0.54	36.68±1.53	5.11±0.76	10.46±0.40	1.49±0.19
RCGH 10	52 C (Deep Pink)	10.63±1.13	5.57±1.91	37.08±0.77	5.06±0.30	10.25±0.14	1.36±0.08
RCGH 12	46D (Deep Yellowish Pink)	7.32±0.72	6.56±1.74	41.48±5.24	5.27±0.12	10.12±0.18	2.42±0.22
RCGH 19	48 C (Strong Pink)	10.42±0.15	4.59±1.63	34.67±1.91	3.68±0.06	9.93±0.27	0.81±0.14
RCGH 20	48D (Strong Pink)	8.84±1.31	3.68±1.49	31.22±1.38	4.52±0.32	9.88±0.24	1.07±0.04
RCGH 22	32 A (Vivid Reddish Orange)	8.73±0.86	5.43±0.58	44.13±1.26	5.15±0.27	10.47±0.20	2.84±0.08
RCGH 23	48 A (Deep Pink)	9.06±0.41	4.72±0.46	36.03±0.49	5.08±0.43	9.90±0.08	1.37±0.03
RCGH 28	N30 A (Vivid Reddish Orange)	10.59±0.41	6.37±0.73	28.33±1.07	5.26±0.13	9.49±0.48	1.41±0.25
RCGH 32	150A (Brilliant Yellow Green)	11.86±0.46	6.52±0.81	42.71±1.28	4.87±0.47	9.95±0.28	1.20±0.02
RCGH 33	1A (Brilliant Greenish Yellow)	11.28±0.59	5.95±1.22	40.67±0.08	4.86±0.17	10.17±0.28	1.37±0.07
RCGH 38	24C (Light Orange Yellow)	8.74±0.57	4.52±0.50	31.59±1.07	5.04±0.15	9.99±0.33	1.61±0.21
RCGH 42	42 A (Vivid Reddish Orange)	7.65±1.34	3.74±1.79	40.84±1.15	5.51±0.45	10.04±0.38	1.65±0.37
RCGH 51	51 1A (Strong Red)	12.53±4.01	7.24±2.38	34.06±1.35	5.09±0.21	9.33±0.23	2.16±0.14
RCGH 60	30 B (Vivid Yellowish Orange)	7.38±0.46	3.57±0.71	30.45±2.04	4.75±0.31	9.56±0.31	1.48±0.10
RCGH-65	45 B (Moderate Red)	8.00±0.24	4.55±0.39	41.77±1.44	4.54±0.06	10.56±0.10	2.26±0.08
RCGH 76	29 A (Brilliant Orange)	9.28±0.70	4.27±0.48	40.13±1.67	5.11±0.06	9.85±0.27	1.30±0.10
RCGH 86	N2 5A (Strong Orange	9.75±0.28	5.46±0.90	34.73±1.00	4.94±0.22	10.03±0.67	1.83±0.04
RCGH 89	10 B (Light Yellow)	9.86±0.14	5.82±0.66	35.19±2.17	5.12±0.17	10.74±0.66	1.36±0.17
RCGH 90	47 C (Deep Yellowish Pink)	10.74±0.37	6.02±0.75	38.31±1.05	4.69±0.15	9.39±0.65	1.06±0.03
RCGH 93	30 C (Vivid Reddish Orange)	7.75±1.48	4.72±0.95	39.75±1.42	4.48±0.16	9.33±0.26	1.19±0.07
RCGH 95	44 C (Vivid Reddish Orange)	7.45±0.42	3.86±0.66	37.07±1.14	4.60±0.22	10.33±0.51	1.46±0.23
RCGH 97	50 B (Deep Pink)	9.49±0.44	5.33±1.51	37.03±1.11	5.19±0.03	10.57±0.20	1.79±0.17
RCGH 100	8 B (Light Greenish Yellow)	11.64±0.41	5.62±1.21	41.97±1.16	4.61±0.21	9.94±0.33	2.32±0.20
RCGH 109	13 B (Brilliant Yellow)	11.39±0.76	6.48±0.9	40.13±1.29	5.22±0.28	9.62±0.31	1.46±0.03
RCGH 113	N 30A (Vivid Reddish Orange)	9.64±0.26	5.71±1.76	39.77±1.72	5.32±0.10	8.73±0.09	1.43±0.13
RCGH 114	40 A (Vivid Reddish Orange)	9.26±0.41	6.32±2.12	42.77±1.28	5.23±0.12	10.65±0.21	2.92±0.05
RCGH 117	24 A (Strong Orange)	10.35±0.85	6.40±3.61	45.44±1.07	5.42±0.09	10.51±0.09	3.06±0.12
RCGH 128	44A (Vivid Red)	10.28±1.31	6.45±0.92	39.79±0.59	5.12±0.18	9.48±0.11	1.27±0.21
RCGH 172	50A (Strong Red)	12.28±1.82	6.82±2.23	41.76±0.92	4.59±0.34	10.31±0.18	1.05±0.06
RCGH 226	13A-B (Vivid Brilliant Yellow)	8.58±0.66	4.08±1.63	31.11±1.51	4.72±0.39	9.87±0.68	1.26±0.04
Alesmera	N30 B (Vivid Reddish Orange)	8.49±1.44	5.18±0.79	44.97±4.57	6.12±0.31	10.89±0.53	3.08±0.28
CSA collection	44 A (Vivid Red)	9.38±0.43	3.96±0.66	34.58±1.02	3.94±0.14	9.03±0.04	1.48±0.10
CD ($p \leq 0.05$)	n.a.	0.66	n.s.	4.45	0.61	0.89	0.17

n.s. - non significant

recorded in RCGH-12 (7.32±0.72 days) and RCGH-60 (3.57±0.71 days), respectively. While, RCGH-51 had maximum days to bud burst (12.53±4.01 days) and to flower opening (7.24±2.38 days). A great variation in respect of days to bud burst and days to flowering indicates potential for classification of the germplasm into early, medium and long duration varieties. Nineteen genotypes were found to be early duration varieties (<15 days flower opening from bud emergence), 11 genotypes were medium duration types (15-17 days) and 07 genotypes were long-duration types (>17 days). Genotypes of different durations can be utilized effectively to prolong availability of flowers for local and international markets. Stalk length was highest in RCGH 117(45.44±1.07 cm) which was at par with Alesmera (44.97±4.57 cm), RCGH-22 (44.13±1.26 cm) and RCGH-114 (42.77±1.28 cm) and RCGH-12 (41.48±5.24 cm), while minimum stalk length was noted in RCGH-28 (28.33±1.07 cm). Similarly, flower stalk diameter was maximum in Alesmera (6.12±0.31 mm) followed by RCGH 42, RCGH 117, RCGH 12, RCGH-28 and RCGH 114. Our results indicate that gerbera genotypes under the present study had shorter stalk length in comparison to those reported by Kumari *et al*., 5 (53.00–62.95 cm) and Benemann *et al*. (1) (11.27-57.00 cm) under protected conditions. This might be due to each varieties had unique genetic identity and additive effect of environmental conditions. Maximum diameter of flower headwas noted in Alesmera (10.89±0.53 cm) followed by RCGH-89, RCGH-114, RCGH-7, RCGH-97, RCGH-117 and RCGH-22, and minimum in RCGH 113 (8.73±0.09 cm). Sixteen genotypes produced large flower head (diameter, >10 cm) which is an important trait in hybridization. Flower disc diameter was obtained highest in Alesmera (3.08±0.28 cm) followed by RCGH-117, RCGH 114, RCGH 22, RCGH 12 and RCGH-100, which also exhibited large flower dimension.

Yield and vase-life significantly differed among genotypes (*p ≤0.05,* fig 2). Genotype RCGH-2 produced highest number of flowers (31.29±1.05 per plant) which was followed by RCGH-3, RCGH 1, RCGH 19, RCGH 97 and RCGH 114. Minimum number of flowers was observed in Alesmera (18.17±1.84 per plant). Fourteen (14) genotypes under the present study had recorded higher number of flowers (>25 per plant) than earlier reports by Kumari *et al*. (5) (3.77–10.59 flowers) and Rajiv Kumar and Yadav, 8 (2.80-3.85 flowers), which indicates a high yield potential of these genotypes under NEH conditions. This might be due to unique genetic traits of the genotype which further enhanced in the expression of traits under congenial environmental conditions in the region (Fig 1) in comparison to northern India which had extreme weather such as high temperature during summer and frost during winter and coastal India with frequent occurrence of cyclone. Sucker production was highest in RCGH-3 (21.01±2.03 per plant per year) followed by RCGH-2 (20.84±3.81 per plant per year) and lowest in RCGH-109 (10.98±1.84 per plant per year). The present results showed a higher sucker production than those previously reported by Kumari *et al*.(5) (2.54–4.88 suckers per plant per year), Rajiv Kumar and Yadav (8) (1.16-2.00 suckers per plant per year). This indicates that genotypes under the present study had high propensity for rapid multiplication of planting material which is a desirable trait.

Vase-life was highest in Alesmera (5.95±0.24 days) which was at par with RCGH-117, RCGH 12, RCGH-28, RCGH-114 and RCGH-22. The genotypes in the present study had shorter vase-life in contrast to earlier reports which indicated a vase-life of 6.03–10.11 days (Kumari *et al*., 5) and 9.0-21.0 days (Javad *et al*., 4) under protected and preservative holding solutions. This might be due to genetic constitution of each genotype and influences of environmental conditions. Although, these genotypes may have

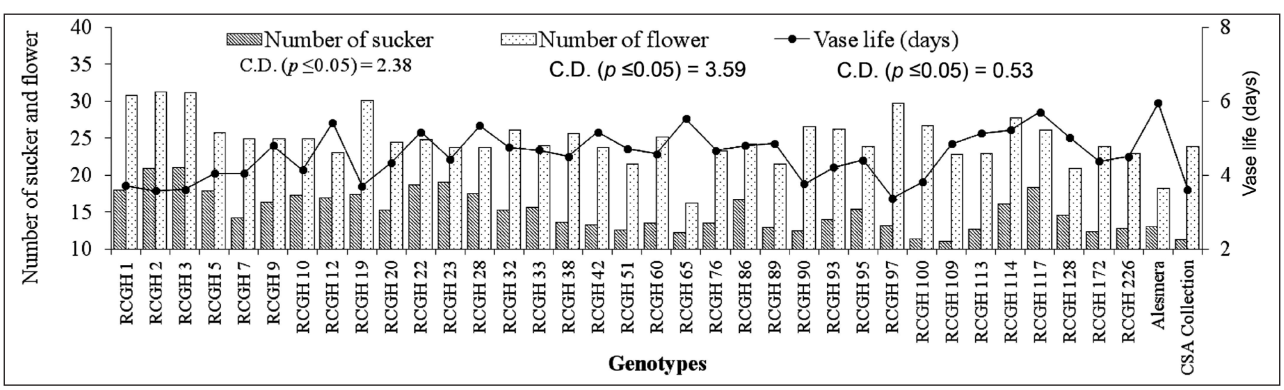

Fig. 2. Yield and vase-life of gerbera genotypes under open field conditions.

shorter vase-life but they can be marketed in local markets due to its relatively low cost of production and higher yield. Further, unique traits of these genotypes may be utilized in gerbera improvement programmes for imparting desirable characters to an improved variety.

A signification correlation was found among quantitative traits of 37 genotypes (Table 3). Number of leaves had significant positive correlation with leaf length (0.754**) and plant spread (0.836**), number of sucker (0.770**) and number of flowers (0.488**). This indicates that higher leave production might be contributed to an increased vegetative growth and yield attributes including sucker and flowers production in gerbera. However, number of leaves showed negatively correlated with flower stalk length (-0.393*) and vase-life (-0.350*) and other flower quality attributes. Number of leaves may enhance yield attributes but had inversely affected the duration of flowering and quality attributes. Number of suckers had negative influence on flowering attributes. Similar is the case with number of flowers in relation to stalk length and stalk diameter (-0.498**), while number of flowers had positive correlation with number of suckers (0.524**). This indicates that yield and quality are inversely related; higher the number of suckers and flower production lower is the quality of flowers. A positive correlation between flower productions of seedling plants with number of leaves per flower has been reported in gerbera (Leffring, 6). Flower diameter had significant positive correlation with stalk length (0.327*) and stalk diameter (0.351*). This indicates that flower diameter and stalk characteristics are the main attributes of capitulum qualities in gerbera. Similarly, Sane and Gowda (11) have identified varieties possessing large flower head diameter with higher stalk length and diameter in gerbera. Long flower stalk with thicker stalk and neck diameter producing sturdy stalk is important parameters for prolonging the postharvest longevity of cut flowers. Vase-life had negative correlation with number of leaves (-0.350*), plant spread (-0.151*) and yield (-0.694**) but had positive correlation with flower stalk length (0.416*), stalk diameter (0.732**) and disc diameter (0.605**). Higher vegetative growth and flower yield inversely affected flower qualities and vase-life, while good stalk characteristics may prolong vase-life of flower. Higher number of flowers lead to reduction of the flower capitulum dimension and greatly affected the vase-life, which might be due to reduction in stalk length and diameter as major photosynthates might have utilized in increasing the number of flowers but without sturdy stalks. These differences in cut flower quality parameters might be due to inherent characters of the individual cultivars

Table 3. Correlation coefficient among growth and flowering attributes of gerbera genotypes under open field conditions.

Trait	No. of leaves	Leaf length	Leaf breadth	Plant spread	Days to bud burst	Days to flower opening	Flower stalk length	Flower stalk dia.	Flower dia.	Flower disc dia	No. of suckers	No. of flowers	Vase-life
No. of leaves	1.000	0.754**	0.297	0.836**	-0.048	-0.182	-0.292	-0.393*	-0.120	-0.318	0.770**	0.488**	-0.350*
Leaf length		1.000	0.597**	0.884**	-0.007	0.068	-0.105	-0.020	0.128	-0.012	0.515**	0.076	-0.044
Leaf breadth			1.000	.582**	0.006	0.211	0.154	0.304	0.256	0.370*	0.223	-0.157	0.035
Plant spread				1.000	0.026	-0.026	-0.236	-0.152	0.086	-0.172	0.602**	0.285	-0.191
Days to bud burst					1.000	0.720**	0.075	-0.008	-0.073	-0.123	-0.143	0.053	-0.172
Days to flower opening						1.000	0.345*	0.362*	0.094	0.258	-0.044	-0.133	0.261
Flower stalk length							1.000	0.349*	0.327*	0.541**	-0.086	-0.197	0.416*
Flower stalk dia.								1.000	0.351*	0.569**	-0.194	-.498**	0.732**
Flower dia.									1.000	0.479**	0.138	-0.106	0.278
Flower disc dia.										1.000	-0.015	-0.291	0.605**
No. of suckers											1.000	0.524**	-0.098
No. of flowers												1.000	-0.694**
Vase-life													1.000

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

as reported by Singh and Ramachandran (12) and Soni and Godara (13) in gerbera. Therefore, selection for yield and quality traits is possible in an early stage based on related characters.

The variability among the germplasm is enormous with respect to growth, yield and flowering parameters. All the desirable traits may not be found in each genotype. Therefore, genotypes are categorized as higher flower quality types (RCGH-117, RCGH-114, RCGH-12, RCGH-22, Alesmera and RCGH- 42); and high yielding (> 25 nos. of flowers per plant) genotypes (RCGH 2, RCGH 3, RCGH 1, RCGH 19, RCGH 97, RCGH 114, RCGH 100, RCGH 90, RCGH 93, RCGH 32, RCGH 117, RCGH 5, RCGH 38 and RCGH 60). High quality genotypes may be recommended for cut flower production under mid hills elevation of the north eastern India targeting domestic markets, and high yielding genotypes may be carried out for further studies for its suitability for bedding purpose. The diversity in the germplasm evaluated indicated great scope for improvement; however, we found that most productive genotypes did not necessarily possess the most desirable characteristics. It is advocated for clonal selection of each genotype for yield, striking colour and form. Furthermore, unique genotypes identified for flower quality and yield attributes including early/ late flowering can be employed in inter-varietal hybridization to obtain commercially viable hybrids.

AUTHORS' CONTRIBUTION

Conceptualization of research (HR); Designing of the experiments (HR); Contribution of experimental materials (HR); Execution of field/lab experiments and data collection (HR); Analysis of data and interpretation (HR, AKJ, HDT); Preparation of the manuscript (HR, AKJ).

DECLARATION

The authors declare no conflict of interest.

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