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Horticulture

Genetic variability, Heritability, Genetic Advance and Correlation Coefficient for Vegetative and Floral Characters of Gerbera (*Gerbera jamesonii*)

Sunil Kumar

Department of Horticulture, North Rastern Hill University, Tura Campus, Chandmari-794 002, West Garo Hills District, Meghalaya, INDIA.

Corresponding author: sunu159@yahoo.co.in

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Abstract

The study was conducted on genetic variability, heritability, genetic advance and correlation coefficient for vegetative and floral characters of gerbera during April 2011 to March 2012. Nine varieties namely, Rionegro, Manizales, Galileo, Marinila, Palmira, Figaro, Teresa, Pia and Tecala were selected for their evaluation. The range of variation was high for number of flowers per sq. m per year followed by number of ray florets and plant spread. Highest phenotypic and genotypic variances were observed for number of flowers per sq. m per year. The estimates of phenotypic coefficient of variation were higher than genotypic coefficient of variation for all the traits. Maximum phenotypic coefficient of variation and heritability was observed for vase life. Genotypic coefficient of variance showed a range of variation from 2.58 to 32.01 for diameter of neck and vase life, respectively. However, the maximum genetic advance was observed in number of flowers per sq. m per year. The high heritability was associated with high genetic advance percentage of mean for vase life indicating the possible role of additive gene action. The magnitude of genotypic correlation was higher than their corresponding phenotypic correlation for most of the traits, indicating a strong inherent linkage between various traits under study. At genotypic level, number of leaves per plant exhibited positive significant correlation with diameter of flower and number of flowers per sq. m per year but highly significant and positive correlation with number of flowers per sq. m per year at phenotypic level.

Highlights

- Nine gerbera cultivars were selected for the study of genetic variability, heritability, genetic advance and correlation coefficient
- Highest phenotypic and genotypic variances were observed for number of flowers per sq. m per year
- Maximum heritability and genetic advance was recorded for vase life and number of flowers per sq. m per year, respectively
- Cultivars Marinilla, Palmira and Figaro may have scope for evolving noble colour and elite varieties in Pasighat, East Siang District, Arunachal Pradesh.

Keywords: Gerbera, polyhouse, genetic variability, heritability, genetic advance, correlation

Gerbera (Gerbera jamesonii Bolus ex Hooker F) is an important commercial cut flower and has a very good export potential because of its graceful appearance, hardiness and ability to withstand during transportation and long shelf life. Crops are extensively grown in Assam, Meghalaya, Arunachal Pradesh, Nagaland, Tripura, Sikkim and Manipur covering an area 17,034 ha. The commercial cultivation of gerbera for cut flower is gaining much popularity among flower growers for their various colour and form. The introduction and popularization of high yielding cultivars of gerbera is gaining importance which is beneficial for high yield and better quality under polyhouse condition. A huge quantum of variability exists in this crop with respect to shape, size, growth habit, flowering behaviour, vase life etc. In spite of such variability, very few are having desirable characters for yield, vase life and flower quality. So, there is an urgent need for selection as well as maintenance of good germplasm. The interrelationship of various characters in the form of correlation is an important aspect in crop breeding. Knowledge of correlation studies helps the plant breeder to ascertain the components of yield and provide an effective basis of selection. The characters contributing significantly to desirable traits can be significantly identified and used as alternate selection criteria in crop improvement programme. For effective breeding programme, knowledge of the mean performance, magnitude of genetic variability, heritability and genetic advance is essential. Heritability gives a measure of transmission of characters from one generation to the other, enabling a plant breeder in isolation of elite selection in the crop. Genotypic and phenotypic coefficient of variation, heritability and genetic advance constitute the important genetic parameters which frequently applied in plant breeding for crop improvement. Coefficient of variation allows meaningful comparison of the variation of several traits of plants belonging to the same population as well as a comparison of the variation of same trait as expressed by different population. Heritability tells us about the additive genetic variance and phenotypic variance (Nyquist, 1991). Now a day, climatic condition of north eastern region is highly variable due to climate change and introduced varieties vary in performance. Performance of gerbera genotypes varies with the region, season, and other growing conditions (Horn *et al.,* 1974). Therefore, it becomes essential to develop varieties suited to specific climatic condition which can be further utilized for genetic improvement of gerbera. However, no systematic efforts were made in the past to identify the suitable genotypes of gerbera for cut flower production and crop improvement programme under agro-climatic condition of Pasighat. Hence, the present study on different varieties was undertaken to assess their genetic variability, heritability, genetic advance, correlation coefficient and suitability in crop improvement under agro-c1imatic conditions of Pasighat, Arunachal Pradesh.

Materials and Methods

The study was carried out at Instructional Farm, Department of Floriculture, College of Horticulture & Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh from April 2011 to March 2012. The experiment was laid out in randomized completely block design (RCBD) with three replications and nine treatments namely, Rionegro, Manizales, Galileo, Marinila, Palmira, Figaro, Teresa, Pia and Tecala for their evaluation under polyhouse condition. Gerbera suckers were planted on raised bed comprised with recommended nutrient mixtures and adequate watering was supplied to the plants during entire investigation. Other standard cultural practices were followed as per need for successful crop. Observations were recorded for number of leaves per plant, length of leaf, breadth of leaf, plant spread, diameter of flower, diameter of disc, flower stalk length, length of ray floret, days to flower open after bud emergence, days to harvest stage after flower open, shelf life, diameter of flower stalk, diameter of Neck, number of suckers per plant per year, vase life, weight of flower head, number of ray florets, number of flowers per sq. m per year and data were analyzed as suggested by Gomez and Gomez (2010). Phenotypic and genotypic coefficient of variation was calculated as per formula described by Burton (1952) and Burton and Devane (1953). Heritability in broad sense was worked out according to formula suggested by Allard (1960) and genetic advance as per cent of mean was calculated following method by Johnson *et al.,* (1955). Phenotypic and genotypic correlation was computed as suggested by Al Jibouri *et al.,* (1958).

Results and Discussion

Mean performance, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and genetic gain

The extent of variability with respect to eighteen quantitative characters in nine gerbera genotypes were measured in terms of mean performance, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and genetic gain are presented in table 1. The range of variation was high for number of flowers per sq. m per year (102.00-190.00) followed by number of ray florets (52.20-81.20) and plant spread (33.56-57.04), respectively. Highest phenotypic and genotypic variances were observed for number of flowers per sq. m per year (1351.02 and 1198.23) followed by number of ray floret (85.70 and 80.82) and flower stalk length (53.46 and 53.24) at both the level, respectively, whilst lowest were observed for diameter of disc (0.11 and 0.09) at phenotypic and genotypic level, respectively. Karuppaiah and Kumar (2011) and Kavita and Anurbani (2010) also reported higher genotypic variation with number of flowers per sq. m per year in African marigold. The better idea can be gained by comparing the relative amount of phenotypic and genotypic coefficient of variance for the actual strength of variability. The estimates of phenotypic coefficient of variation were higher than genotypic coefficient of variation for all the traits studied which is an indicator of additive effect of the environment on the expression of the trait. Maximum phenotypic coefficient of variation was observed for vase life (33.19) followed by field life (28.45) and number of suckers per plant per year (24.01), while, minimum was recorded in number of leaves per plant (5.26). Genotypic coefficient of variance showed a range of variation from 2.58 to 32.01 for diameter of neck and vase life, respectively. Maximum genotypic coefficient of variance was noticed with vase life (32.01) followed by field life (26.12) and number of flowers per sq. m per year (23.06). Burton (1952) has suggested that genetic coefficient of variation together with heritability estimates would give adequate information for extent of advancement through selection. A vast variation was recorded for heritability (broad sense) in different quantitative characters of gerbera genotypes. High heritability was observed for all the traits under study. Nair and Shiva (2003) and Chobe *et al.,* (2010) also reported high heritability for most of the quantitative traits in gerbera. Maximum heritability was recorded for vase life (98.94 per cent), while, minimum was noted for diameter of neck (8.36 per cent). High heritability showed the possibility of effective base on the phenotypic expression. Vase life is a potential character for selection in gerbera cultivars; the environmental influence was considerable for this trait which could be observed from the differences between genotypic and phenotypic coefficient of variation. Most of the traits indicated the dominance of additive gene effect, hence direct selection of such traits may lead to improvement of quality. The minimum genetic advance was recorded in diameter of neck (0.10), however, the maximum genetic advance was observed in number of flowers per sq. m per year (67.15). A range of variation i.e 1.54 and 67.64 was recorded for diameter of neck and vase life, respectively. High heritability associated with high genetic advance proves more useful for efficient improvement of a character through selection. The high heritability was associated with high genetic advance percentage of mean for vase life (98.94 and 67.64) indicating the possible role of additive gene action. The parallelism between the magnitude of heritability and degree of genetic gain has been due to additive gene playing a predominant role and therefore, this was more reliable for effective selection. These results are in accordance with the observations made by Kumar and Sharma (2013) in Dendrobium orchids.

Correlation coefficient analysis

Correlation measures the degree of association between the characters. Information on correlation between the important economic traits are of considerable help in the selection programme, because correlation ensures simultaneous improvement in one or two or more variables and negative correlations bring out the need to obtain a compromise between the desirable traits. The analysis of variance revealed significant variation among all the nine genotypes of gerbera for all eighteen attributes (table 2 and 3). In general, phenotypic correlations are smaller than genotypic correlation. This could occur when genes governing two traits are similar and environmental conditions pertaining to the expression of these traits have small and similar effects. A positive correlation between desirable characters is favourable to the plant breeder because it helps in simultaneous improvement of both the characters. High positive correlation between the traits indicates that selection for improvement of one character leads to the simultaneous improvement in the other characters depending upon the magnitude of association between them. The characters are considered to be independent when weak correlation exists between them and selection for a character may not affect the other (Falconer, 1981). Whereas, genotypic correlation provides a measure of genetic association between characters and is generally used in selection for one character as a measure of improving another. The genotypic correlation in the true sense may be interpreted as the correlation of breeding value. The magnitude of genotypic correlation was higher than their corresponding phenotypic correlation for most of the traits, indicating thereby, a strong inherent linkage between various traits under study. Similar trend has been observed by Anuradha (1998) in gerbera for most of the characters; these findings indicate that though there is strong inherent association between various characters, the phenotypic expression is reduced under the influences of environment. In some cases, phenotypic and genotypic correlations were very close indicating less environmental influences. Anuradha and Gowda (2002) and Magar *et al.,* (2010) have also reported higher genotypic correlation coefficient than phenotypic correlation coefficient among the various traits in gerbera.

Genotypic level

At genotypic level, number of leaves per plant (table 2) exhibited positive significant correlation with diameter of flower (0.309) and number of flowers per sq. m per year (0.504) but on the other hand, attained highly significant but negative correlation with length of leaf (-0.530), days to harvest stage after flower open (-0.542), diameter of flower stalk (-0.394), diameter of neck (-0.390). The number of leaves per plant also showed significant negative correlation with days to flower open after bud emergence (-0.348) and number of ray florets (-0.315). However, plant spread, diameter of disc, flower stalk length, shelf life, vase life and fresh weight of flower head were not significantly correlated with number of leaves per plant. Nair and Shiva (2003) also observed positive correlation between numbers of leaves with flower diameter in gerbera. Length of leaf was highly significant and positive correlation with breadth of leaf (0.625), plant spread (0.647), flower stalk length (0.582), days to harvest stage after flower open (0.568), diameter of neck (0.527) and number of ray florets (0.544) but highly significant negative correlation with shelf life (-0.746), vase life (-0.426) and fresh weight of flower head (-0.396) was observed. However, breadth of leaf was highly significant and positive correlation with plant spread (0.582), flower stalk length (0.377), number of suckers per plant (0.376) and number of flowers per sq. m per year (0.408). While, highly significant but negative correlation with diameter of disc (-0.383) and shelf life (-0.419) were noticed. Plant spread showed highly significant and positive correlation with diameter of flower (0.500), flower stalk length (0.772), length of ray floret (0.797), diameter of neck (0.702) and number of ray florets (0.519). Singh and Kumar (2008) also reported highly significant and positive correlation plant spread and diameter of flower in marigold.However, highly significant but negative correlation was associated with shelf life (-0.597). Diameter of flower was highly significant and positively correlated with diameter of disc (0.433), flower stalk length (0.556), length of ray floret (0.714), diameter of flower stalk (0.625), diameter of neck (0.446), fresh weight of flower head (0.577) and positively significant with number of ray florets (0.348), while, vase life showed highly significant with negative correlation (-0.459) but significant with negative correlation was associated with shelf life (-0.306). Similar findings have also been reported by Baweja (2000) in china aster and Verma *et al.,* (2008) in rose. Sirohi and Behera (1999) also observed flower diameter had positive and highly significant association with number of ray florets in chrysanthemum. Diameter of disc was highly significant and showed positive correlation with shelf life (0.428) and fresh weight of flower head (0.516), whereas, significant but positive correlation was observed with number of ray florets (0.330). Flower stalk length had highly significant but positive correlation with length of ray floret (0.614) and diameter of neck (0.577), whereas, shelf life (-0.832) and vase life (-0.533) showed highly significant and negative correlation. Length of ray floret was highly significant and positive correlation with days to flower open after bud emergence (0.375), diameter of flower stalk (0.422), diameter of neck (0.689) and fresh weight of flower head (0.670). However, shelf life (-0.292) and number of suckers per plant (-0.323) was significant but negatively correlated. Days to flower open after bud emergence had highly significant and positive correlation with days to harvest stage after flower open (0.873), diameter of flower stalk (0.770), number of ray florets (0.652) while, number of flowers per sq. m per year showed highly significant and negative association (-0.836) but significant and negative association was observed with shelf life (-0.298) and number of suckers per plant (-0.324). Aswath and Parthasarathy (1994) also noticed positive correlation between days taken to flower head with flower stalk diameter in gerbera. Shelf life was highly significant and positive correlation with vase life (0.570) and fresh weight of flower head (0.542). However, diameter of flower stalk (-0.555) and diameter of neck (-0.980) showed highly significant but negative correlation. Whereas, diameter of flower stalk had significant and positive correlation with number of ray florets (0.328). Similar findings were reported by Baweja (2000) in china aster. Diameter of neck was highly significant and positive correlation with number of suckers per plant (0.771), vase life (0.443) and number of ray florets (0.533), while, number of flowers per sq. m per year was highly significant but negative correlation (-0.837). Number of suckers per plant per year showed highly significant and negative correlation with vase life (-0.719) and significant negative correlation with fresh weight of flower head (-0.367), whereas, number of flowers per sq. m per year showed significant and positive correlation (0.330). Significant and positive correlation of vase life was associated with fresh weight of flower head (0.386), while, number of ray florets had significant and negative correlation with number of flowers per sq. m per year (-0.318) and fresh weight of flower head showed highly significant and negative correlation with number of flowers per sq. m per year (-0.495). However, the number of flowers per sq. m per year exhibited highly significant and showed positive correlation with number of leaves per plant, breadth of leaf and number of suckers per plant. Anuradha and Gowda (2002) reported the positive correlation of flower yield with number of leaves in gerbera.

Phenotypic level

At phenotypic level, number of leaves per plant attained highly significant and positive correlation with number of flowers per sq. m per year (0.451). Similar findings were observed by Kumar *et al.,* (2012) in gerbera which reveals that cut flower production can be increased by selecting for number of leaves. Whereas, highly significant but negative correlation with length of leaf (-0.440) and days to harvest stage after flower open (-0.468) was observed (table 3). Length of leaf had highly significant and positive correlation with breadth of leaf (0.577), plant spread (0.616), flower stalk length (0.573), days to harvest stage after flower open (0.554) and number of ray florets (0.527) but highly significant and negative correlation was obtained with shelf life (-0.686) and vase life (-0.425). Breadth of leaf showed highly significant and positive correlation with plant spread (0.551) and number of flowers per sq. m per year (0.378), while, flower stalk length (0.362), length of ray floret (0.319), days to harvest stage after flower open (0.294) and number of suckers per plant per year (0.333) attained significant and positive correlation. However, diameter of disc (-0.298) and shelf life (-0320) were showed significant and negative association. Plant spread was highly significant and positive correlation with diameter of flower (0.376), flower stalk length (0.751), length of ray floret (0.636) and number of ray florets (0.507), whereas, shelf life (-0.541) attained highly significant but negative correlation. Diameter of flower showed highly significant and positive association with flower stalk length (0.429), length of ray floret (0.520) and diameter of flower stalk (0.452), while, diameter of disc (0.334) and fresh weight of flower head (0.398) attained significant and positive association. Balaram and Janakiram (2009) also reported positive and significant relationship of floret diameter with spike length in gladiolus. However, vase life noted significant and negative association (-0.348). Diameter of disc had highly significant and positive correlation with shelf life but showed significant and positive correlation with fresh weight of flower head (0.378), whereas, diameter of neck attained significant and negative correlation (-0.288). Flower stalk length was highly significant and positive association with length of ray floret (0.496) but had highly significant and negative correlation with shelf life (-0.754) and vase life (-0.547). Length of ray floret was highly significant and positive association with fresh weight of flower head (0.518) and had significant and positive correlation with days to flower open after bud emergence (0.296) and number of ray florets (0.299). Days to flower open after bud emergence showed highly significant and positive association with days to harvest stage after flower open (0.868), diameter of flower stalk (0.559) and number of ray florets (0.636) but had highly significant and negative association with number of flowers per sq. m per year (-0.776). However, diameter of neck (0.333) showed significant positive correlation and number of suckers per plant per year (-0.302) had significant negative correlation. Days to harvest stage after flower open was highly significant and positive correlation with diameter of flower stalk (0.459) and number of ray florets (0.756), while it had significant and negative correlation with shelf life (-0.305) and number of flowers per sq. m per year (-0.628). Shelf life attained highly significant and positive correlation with vase life (0.513) and fresh weight of flower head (0.397), while, diameter of flower stalk showed significant and negative association (-0.305). However, diameter of flower stalk had highly significant and negative correlation with number of flowers per sq. m per year (-0.572). Number of suckers per plant per year was significant and positive correlation with number of flowers per sq. m per year (0.295).Whereas, vase life attained highly significant and negative correlation (-0.671). However, number of ray florets showed highly significant and negative correlation with number of flowers per sq. m per year (-0.417). Number of flowers per sq. m per year was highly significant and positive correlation with number of leaves per plant, breadth of leaf and had significant and positive correlation with number of suckers per plant per year. These results are in conformity with the findings of Kumar and Kumar (2010) in snapdragon. However, it showed highly significant and negative correlation with days to flower open after bud emergence, days to harvest stage after flower open and diameter of flower stalk.

Conclusion

On evaluation of nine different varieties of gerbera and their genetic variability and correlation coefficient, cultivars Marinilla, Palmira and Figaro may be recommended for commercial cultivation and also have scope for evolving noble colour and elite varieties in Pasighat, East Siang District, Arunachal Pradesh.

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