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Evaluation of *Chrysanthemum morifolium* Ramat genotypes for loose flower, cut flower and pot mums

J Suresh**Abstract**

Investigation was carried out in 58 genotypes of chrysanthemum (*Chrysanthemum morifolium* Ramat) collected from diverse geographical origins and was assessed for different morphological and biochemical traits. Among the 58 genotypes, Indira registered the highest value for the traits viz., plant height, plant spread and number of lateral branches, number of flower clusters per plant, flower yield per plant, early bud appearance and days taken for full bloom from bud appearance. Whereas the highest shelf life and individual flower weight was noticed in Pusa Centenary. Based on the per se performance, the genotypes viz., Indira and Chandhini were identified to be suitable for loose flower production with high yield. The promising genotypes suitable for cut flower production are Pusa Centenary, Ravikiran and Lalith. The genotypes which are suitable for garden display as pot mums are Meera White, Red Stone, Acc.116, Dolly Orange, Lalpark and Little Pink.

Keywords: Chrysanthemum, genotypes, biodiversity, commercial usage

Introduction

Chrysanthemum (*Chrysanthemum morifolium* Ramat) belongs to the family Asteraceae and is one of the most important traditional flower crops used as both loose and cut flowers (Lone and T.A. Shah, 2013.) [6]. It ranks 2nd in Indian loose flower market. In India, chrysanthemum is produced in Andhra Pradesh (95.97 MT), Karnataka (66.50 MT) and Maharashtra (12.00 MT) (NHB, 2013). In Tamil Nadu, chrysanthemum is cultivated in different locations viz., Salem, Dharmapuri, Krishnagiri, Hosur, Dindigul, Thovazhai, Nagercoil and Coimbatore.

The genus *Dendranthema* comprises of huge biodiversity in their growth habitat, flowering behaviour, flower and foliage colour, shape and size. Based on the flower head size, it is classified into three major groups viz., large flowered (eight types), small flowered (ten types) and mini chrysanthemums (Banerji *et al.*, 2011) [2]. Currently more than thousands of varieties are under cultivation in different countries with various shades of white, cream, red, yellow, bronze, maroon, pink or purple (Lone and Shah., 2013) [6]. The dwarf and compact growing once on the other hand, were suitable for front row planting or as pot mums. There are two types of chrysanthemum, spray and standard types. In North India, standard types are primarily grown for cut flower and as potted flowering plant for exhibition and decoration. While, in Southern parts of the country, spray types are grown mainly as loose flowers for garland, making hair adornment and also religious offerings (mostly preferred in pooja season in the month of October).

Though it is a commercially cultivated crop, the location specific cultivars are not available to maximize the yield. Systematic work on chrysanthemum breeding has been taken up at various research institutes and the objective of breeding is mostly on regional preferences. In South India, spray types with high yielding genotypes are preferred for loose flower purpose. In North and East India, standard types are primarily grown for cut flower and potted plant types are highly suitable for exhibition purpose. Hence, the present study was taken up to identify suitable genotypes to be used for loose flower, cut flower and pot mum types under Coimbatore conditions.

Materials and Methods

The present investigation was carried out at the Botanical Garden, Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural

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University, Coimbatore during the year 2013-2014. The weather condition at Coimbatore was moderately warm with hot early summer months. In open field condition, the maximum temperature fluctuated between 29 °C and 32 °C with the mean of 30 °C. Relative humidity ranged from 60 to 90 per cent with a mean of 75 per cent. The experimental design adopted was Randomized Block Design (RBD). The fifty-eight genotypes of chrysanthemum were laid out in three replications with sixteen plants per replication.

Varietal source: Fifty-eight genotypes of *Chrysanthemum morifolium* Ramat were collected from different sources viz., IARI, New Delhi; BCKV, Kalyani; private nurseries at Bangalore and the germplasm collections at Department of Floriculture and Landscaping, TNAU, Coimbatore.

Characters evaluated: The vegetative characters like plant height (cm), number of lateral branches (nos.) and number of leaves (nos.) were recorded at 45 days after planting. Flower characters such as the duration of flowering period, the longevity of flowers (from the first flower opening to the 50 per cent petals fading), flower diameter (cm), number of ray florets (nos.), number of flowers per plant (nos.), flower colour (RHS colour chart value), individual flower weight (g) and flower yield per plant (g) were observed. The chlorophyll content of the leaves was quantified following the protocol put forth by Yoshida *et al.* (1971)^[11]. The data were subjected to statistical analysis as per the method of Panse and Sukhatme, 1961. The genetic parameters like variability, GCV, PCV, heritability, genetic advance and genetic advance as per cent of mean were calculated.

Results and Discussion

Comparison of vegetative characters: The highest plant height was recorded in Indira (43.13 cm), whereas Sadbhavana recorded the lowest plant height of 5.16 cm. Increase in plant height over other genotypes may be associated with rapid meristematic activity, probably due to rapid cell division and elongation during the tender growth period. The mean maximum number of lateral branches was recorded for Indira as 44.30 and the variety CO.1 recorded minimum as 3.77. The mean maximum number of leaves per plant was recorded for Autumn Joy as 366.20 and Baggi recorded minimum value as 20.32 (Table 1). The difference in the number of branches and leaf production could be due to

the influence of genetic makeup of the genotypes and prevailing environmental conditions.

Comparison of flowering characters: Early flowering was noticed for Swapna (26.33) and maximum days taken for Chandhini (72.67 days) and Rani (79.21). The variation for early or late bloom seems to be the varietal character (Behera *et al.*, 2002)^[3]. Ravikiran produced flowers of the largest diameter of 11.40 cm which is on par with Pusa Centenary at 11.20 cm. Lowest flower diameter was registered in Calimero red (1.7 cm) which is on par with genotypes viz., Bodego Red (1.7 cm) and Calimero pink (1.8 cm). The flower diameter is directly correlated with weight of individual flower and flower yield per plot. The variation in flower size in these genotypes may be attributed to the inherent genetic characters of the individual cultivars and environmental factors (Singh and Ramachandran, 2002)^[10]. The genotype, Indira significantly registered the highest number of ray florets (242.60), whereas the lowest number of ray florets (17.99) was recorded in Rennila. There was significant difference observed in shelf life among the genotypes evaluated. The shelf life was maximum for Pusa Centenary at 18.21 days. The least shelf life was registered at 8.31 days in Neon and 8.33 days in Lilyput, Cindrella and Sadbhavana. The reason for the longest shelf life may be due to reduced rate of evaporation and transpiration, prevailing low temperature and low wind velocity. The flower colour of different genotypes was observed and recorded as per the RHS chart. The most common flower colour exhibited was registered as yellow followed by red, white and orange (Table 2).

The mean maximum number of flowers per plant was registered in Indira (224.0) and the mean minimum value was recorded in Arka Ravi (29.0). The highest individual flower weight was recorded in Pusa Centenary (7.53 g), whereas the lowest individual flower weight of 0.43 g was registered in Mother Teresa. The highest flower yield of 745.9 g was recorded in Indira and was on par with genotype Aparajitha (712.8 g). While, the lowest flower yield per plant (19.9 g) was registered in Mother Teresa (Table 2). Yield is mainly dependent on the number of flowers per plant and individual flower weight. The varietal differences for yield potential are attributed to additive gene effect (Behera *et al.*, 2002, Kulkarni and Reddy, 2004)^[3,5].

Table 1: *Per se* performance of chrysanthemum genotypes for vegetative characters

| Genotypes | Plant height (cm) | Number of lateral branches | Number of leaves |
|----------------|-------------------|----------------------------|------------------|
| Meera White | 15.27 | 9.43 | 337.7 |
| Red Gold | 36.57 | 7.21 | 57.83 |
| Arka Ravi | 19.73 | 6.00 | 48.40 |
| Indira | 43.13 | 44.30 | 98.73 |
| Shanthi | 23.47 | 6.03 | 36.53 |
| CO.2 | 25.22 | 9.22 | 71.73 |
| Basanthi | 19.43 | 14.00 | 46.07 |
| CO.1 | 22.12 | 3.77 | 66.42 |
| Shymal | 22.53 | 6.92 | 67.41 |
| Sel.4 | 20.92 | 6.87 | 50.24 |
| Sel.5 | 19.41 | 9.97 | 80.33 |
| Ravikiran | 41.17 | 25.41 | 228.2 |
| Rani | 25.83 | 15.20 | 28.00 |
| Baggi | 25.27 | 7.33 | 20.32 |
| Sel.6 | 28.03 | 5.53 | 31.97 |
| Chandhini | 25.07 | 17.13 | 172.6 |
| Acc116 | 12.83 | 11.91 | 64.97 |
| Pusa Centenary | 41.32 | 19.42 | 137.1 |
| Pusa Anmol | 16.37 | 24.12 | 46.73 |
| Neon | 9.83 | 12.13 | 24.67 |

| | | | |
|-----------------|-------|-------|--------|
| Cindrella | 16.67 | 6.12 | 56.62 |
| Rennila | 13.87 | 5.33 | 149.5 |
| Vasanthika | 8.22 | 10.31 | 44.73 |
| Cal Pink | 16.91 | 15.42 | 23.97 |
| Calimero red | 14.23 | 19.43 | 26.43 |
| Calimero Sunny | 20.31 | 20.31 | 24.97 |
| Calimero pink | 14.63 | 12.92 | 24.23 |
| Terror | 13.77 | 6.57 | 35.17 |
| Bodego Red | 10.67 | 13.71 | 28.33 |
| Tornata | 10.27 | 9.62 | 25.82 |
| Tequila | 11.63 | 13.13 | 22.37 |
| Punch | 15.23 | 6.43 | 34.07 |
| Saradmala | 30.21 | 29.92 | 33.83 |
| Swetha Singar | 25.03 | 12.00 | 26.82 |
| Sadbhavana | 5.16 | 12.21 | 80.83 |
| Pinkstar | 12.57 | 12.12 | 70.37 |
| Punjab Anuradha | 35.73 | 22.93 | 93.03 |
| Dundi | 26.37 | 10.72 | 38.13 |
| Winter Queen | 37.47 | 10.00 | 80.57 |
| Megami | 13.22 | 8.03 | 77.93 |
| Garden Beauty | 35.33 | 12.00 | 66.83 |
| Statesman | 24.72 | 7.82 | 55.97 |
| Autumn Joy | 39.37 | 15.21 | 366.20 |
| Redstone | 12.93 | 13.42 | 77.73 |
| Aparajitha | 26.97 | 10.71 | 158.40 |
| Jublee | 18.63 | 10.12 | 45.62 |
| Flirt | 26.43 | 15.82 | 66.43 |
| Teri | 16.53 | 20.63 | 179.30 |
| Lalpark | 22.47 | 28.44 | 172.40 |
| Dolly Orange | 20.43 | 11.33 | 162.80 |
| Little Pink | 23.62 | 38.22 | 189.20 |
| Lalith | 37.33 | 17.73 | 191.30 |
| Yellow charm | 35.92 | 24.94 | 35.92 |
| Mother Teresa | 13.87 | 24.23 | 81.53 |
| Jaya | 23.43 | 12.34 | 178.20 |
| Lilyput | 8.43 | 7.23 | 64.77 |
| Swapna | 26.93 | 8.37 | 25.67 |
| Bc- 47-101 | 24.83 | 14.00 | 28.03 |
| Mean | 22.16 | 13.9 | 84.05 |
| SE(d) | 2.39 | 1.84 | 5.53 |
| CD (P=0.05) | 4.75 | 0.42 | 10.95 |
| CV% | 13.26 | 7.20 | 8.06 |

Table 2: *Per se* performance of chrysanthemum genotypes for flower and yield parameters

| Genotypes | Duration of flowering (days) | Flower diameter (cm) | Number of ray florets | Longevity (days) | Flower Colour | Number of flowers per plant | Individual flower weight (g) | Flower yield per plant (g) |
|----------------|------------------------------|----------------------|-----------------------|------------------|---------------------------------|-----------------------------|------------------------------|----------------------------|
| Meera White | 55.33 | 3.8 | 56.66 | 9.00 | White (155 D) | 213.3 | 0.47 | 100.2 |
| Red Gold | 43.33 | 4.9 | 23.96 | 12.33 | Red with yellow centered (46 A) | 54.6 | 0.83 | 45.3 |
| Arka Ravi | 51.42 | 5.6 | 28.68 | 12.67 | White (NN 155) | 29.0 | 2.43 | 70.4 |
| Indira | 42.67 | 6.1 | 242.6 | 12.67 | Yellow (22 A) | 224.0 | 3.33 | 745.9 |
| Shanthi | 36.23 | 5.8 | 44.51 | 8.667 | White (155 D) | 49.6 | 2.19 | 108.7 |
| CO.2 | 47.01 | 6.7 | 34.90 | 9.667 | Purple violet (N80 B) | 68.0 | 0.78 | 53.0 |
| Basanthi | 41.67 | 3.8 | 25.63 | 13.33 | Yellow (5 A) | 62.0 | 1.82 | 112.8 |
| CO.1 | 67.33 | 5.0 | 128.10 | 12.00 | Yellow (6) | 68.0 | 2.19 | 148.9 |
| Shymal | 58.67 | 4.7 | 26.01 | 15.00 | Red (179 A) | 70.6 | 2.84 | 200.6 |
| Sel.4 | 34.67 | 6.5 | 152.00 | 14.21 | White (155 A) | 46.0 | 2.36 | 108.5 |
| Sel.5 | 61.42 | 7.5 | 19.66 | 12.67 | White (155 B) | 43.6 | 2.89 | 126.1 |
| Ravikiran | 40.12 | 11.4 | 182.20 | 16.67 | Orange red (N 34) | 30.6 | 5.95 | 182.4 |
| Rani | 72.67 | 4.9 | 53.62 | 14.11 | Purple (76 B) | 70.0 | 1.98 | 138.6 |
| Baggi | 34.42 | 5.7 | 169.10 | 12.67 | White (NN 155 D) | 80.6 | 3.70 | 298.4 |
| Sel.6 | 66.23 | 6.8 | 25.67 | 10.67 | White (155 A) | 39.3 | 2.90 | 114.0 |
| Chandhini | 79.21 | 4.2 | 187.20 | 13.20 | Yellow (14 A) | 176.0 | 1.00 | 176.0 |
| Acc116 | 43.43 | 2.9 | 74.75 | 12.33 | Yellow (12 A) | 78.3 | 0.66 | 51.7 |
| Pusa Centenary | 54.11 | 11.2 | 242.30 | 18.21 | Yellow (5 B) | 57.6 | 7.53 | 434.2 |
| Pusa Anmol | 31.67 | 4.7 | 223.50 | 11.33 | Red purple (A 6) | 36.3 | 1.28 | 46.5 |

| | | | | | | | | |
|-----------------|-------|------|--------|-------|-----------------------------------|-------|------|--------|
| Neon | 54.22 | 5.4 | 32.95 | 8.31 | Red purple (Gr.64A) | 75.0 | 0.74 | 55.5 |
| Cindrella | 38.24 | 5.6 | 81.70 | 8.33 | Yellow (A 6) | 51.6 | 2.12 | 109.5 |
| Rennila | 45.67 | 3.7 | 17.99 | 9.02 | Red purple (71 A) | 50.0 | 1.97 | 98.5 |
| Vasanthika | 57.33 | 2.9 | 82.97 | 13.11 | Yellow (12 A) | 114.3 | 0.84 | 96.0 |
| Cal Pink | 64.67 | 2.5 | 175.50 | 11.00 | Greyed pink (Gr.186 C) | 65.0 | 0.56 | 36.4 |
| Calimero red | 61.67 | 1.7 | 123.50 | 11.67 | Orange red (Gr. 31 C) | 84.0 | 0.67 | 56.2 |
| Calimero Sunny | 64.33 | 2.6 | 174.70 | 12.33 | Yellow (Gr. 4D) | 82.3 | 0.61 | 50.2 |
| Calimero pink | 67.32 | 1.8 | 173.70 | 12.11 | Purplish pink (0 Pale pink) | 81.6 | 0.69 | 56.3 |
| Terror | 54.23 | 5.6 | 27.98 | 15.32 | Red (53 A) | 39.6 | 1.48 | 58.7 |
| Bodego Red | 49.67 | 1.7 | 28.93 | 11.00 | Red (53 B) | 46.0 | 1.52 | 69.9 |
| Tornata | 55.67 | 3.8 | 24.35 | 10.01 | Orange red (Gr.34 C) | 52.0 | 1.74 | 90.4 |
| Tequila | 43.67 | 2.9 | 33.72 | 13.67 | White with purple center (NN 155) | 61.3 | 1.82 | 111.6 |
| Punch | 64.67 | 6.2 | 33.28 | 15.67 | White (155 A) | 47.0 | 1.46 | 68.6 |
| Saradmala | 31.33 | 4.5 | 34.68 | 8.667 | Creamy white (155 C) | 40.0 | 4.52 | 180.8 |
| Swetha Singar | 45.33 | 3.9 | 36.65 | 14.67 | Yellow (8 A) | 205.3 | 2.13 | 437.3 |
| Sadbhavana | 33.33 | 2.5 | 34.44 | 8.333 | Red (187 C) | 33.3 | 0.85 | 28.3 |
| Pinkstar | 35.33 | 3.2 | 46.36 | 10.32 | Pink (62) | 56.0 | 0.82 | 45.9 |
| Punjab Anuradha | 42.34 | 4.7 | 128.90 | 16.33 | Yellow (12 A) | 61.6 | 1.84 | 113.4 |
| Dundi | 54.33 | 4.0 | 95.86 | 14.12 | Yellow (6 A) | 57.0 | 5.78 | 329.4 |
| Winter Queen | 34.33 | 4.3 | 33.34 | 16.33 | Pink (155 B) | 43.3 | 0.93 | 40.2 |
| Megami | 43.67 | 4.5 | 130.60 | 15.67 | Purple (76 B) | 32.0 | 4.50 | 144.0 |
| Garden Beauty | 35.34 | 6.1 | 129.10 | 16.67 | Pink (76 C) | 36.6 | 2.03 | 74.4 |
| Statesman | 27.01 | 8.8 | 46.09 | 11.67 | Yellow (12 B) | 30.6 | 5.01 | 153.6 |
| Autumn Joy | 39.33 | 3.7 | 76.56 | 15.31 | Red (NN 55 A) | 138.3 | 2.58 | 356.9 |
| Redstone | 49.33 | 3.7 | 63.57 | 17.33 | Red (187 B) | 89.3 | 2.74 | 244.7 |
| Aparajitha | 41.00 | 3.8 | 88.36 | 13.00 | Yellow (3 A) | 218.0 | 3.27 | 712.8 |
| Jublee | 35.67 | 6.8 | 136.90 | 12.67 | Golden yellow (9 A) | 32.6 | 2.37 | 77.4 |
| Flirt | 30.67 | 3.4 | 108.80 | 13.12 | Purple (59 A) | 63.0 | 2.28 | 143.6 |
| Teri | 30.33 | 3.7 | 36.18 | 8.667 | Yellow (7) | 97.3 | 2.87 | 279.3 |
| Lalpark | 53.67 | 4.1 | 63.70 | 16.43 | Greyed purple (186) | 178.6 | 0.57 | 101.8 |
| Dolly Orange | 50.00 | 4.5 | 124.10 | 17.11 | Orange (167) | 87.3 | 1.17 | 102.1 |
| Little Pink | 42.00 | 4.5 | 117.10 | 17.33 | Yellow (7 A) | 210.0 | 3.21 | 674.1 |
| Lalit | 36.33 | 2.3 | 126.30 | 18.00 | White (NN 155 C) | 95.6 | 4.85 | 463.9 |
| Yellow charm | 27.33 | 9.8 | 54.75 | 13.67 | Yellow (14 B) | 210.0 | 0.92 | 193.4 |
| Mother Teresa | 30.67 | 3.7 | 36.57 | 12.00 | Cream with lemon centre (155 B) | 46.3 | 0.43 | 19.9 |
| Jaya | 34.67 | 3.6 | 183.80 | 16.67 | Greyed purple (185 A) | 128.0 | 1.70 | 217.6 |
| Lilyput | 27.21 | 4.1 | 33.62 | 8.333 | Yellow (14 B) | 33.6 | 0.83 | 27.9 |
| Swapna | 26.33 | 3.5 | 133.10 | 9.667 | Yellow (NN 155 A) | 37.3 | 1.93 | 72.0 |
| Bc- 47-101 | 30.00 | 4.1 | 82.54 | 9.333 | Purple (N 78) | 70.3 | 2.01 | 141.3 |
| Mean | 46.10 | 4.76 | 88.7 | 12.7 | | 81.80 | 2.20 | 160.74 |
| SE(d) | 4.76 | 0.32 | 11.4 | 0.20 | | 4.16 | 0.17 | 23.19 |
| CD (P=0.05) | 9.44 | 0.64 | 22.64 | 0.41 | | 8.24 | 0.33 | 45.94 |
| CV% | 12.66 | 8.36 | 15.72 | 7.08 | | 6.23 | 9.45 | 17.67 |

Comparison of biochemical parameters: Chlorophyll 'a', chlorophyll 'b' and total chlorophyll content for the promising genotypes ranged from 1.042 to 0.184 mg g⁻¹, 0.588 to 0.122 mg g⁻¹ and 1.767 to 0.374 mg g⁻¹ respectively. Interestingly, the mean maximum chlorophyll 'a' content was recorded in Little Pink and the mean minimum was recorded in Lalith, while, the mean maximum chlorophyll 'b' and total chlorophyll content was recorded in Lalith and the mean

minimum was recorded in Aparajitha (Table 3). The variation in chlorophyll content of leaf among the varieties might be attributed to genetic constitution Shiragur *et al.*, (2004)^[9] and Anitha *et al.*, (2000)^[11].

Table 3: Quantum of chlorophyll 'a', chlorophyll 'b' and total chlorophyll (mg g⁻¹) in chrysanthemum genotypes at vegetative stage

| Genotypes | Chlorophyll 'a' | Chlorophyll 'b' | Total Chlorophyll |
|-----------------|-----------------|-----------------|-------------------|
| Meera White | 0.978 | 0.561 | 1.536 |
| Indira | 0.184 | 0.588 | 1.767 |
| Ravikiran | 0.519 | 0.244 | 0.761 |
| Rani | 0.850 | 0.431 | 1.280 |
| Chandhini | 0.285 | 0.133 | 0.414 |
| Pusa Centenary | 0.590 | 0.280 | 0.869 |
| Swetha Singar | 0.730 | 0.335 | 1.064 |
| Punjab Anuradha | 0.449 | 0.263 | 0.711 |
| Autumn Joy | 0.305 | 0.139 | 0.436 |
| Redstone | 0.665 | 0.312 | 0.874 |
| Lalpark | 0.489 | 0.285 | 0.771 |
| Aparajitha | 0.254 | 0.122 | 0.374 |
| Dolly Orange | 0.416 | 0.222 | 0.636 |
| Little Pink | 1.042 | 0.583 | 1.616 |
| Lalith | 0.593 | 0.294 | 0.884 |
| Mean | 0.55 | 0.32 | 0.93 |
| SE(d) | 0.02 | 0.01 | 0.03 |
| CD (P=0.05) | 0.04 | 0.02 | 0.07 |
| CV% | 5.17 | 5.04 | 5.04 |

Genetic variability, heritability and genetic advance for vegetative characters (Table 4): For the parameter plant height at 45 DAP the genotypic (GCV) and phenotypic coefficient of variations (PCV) was recorded as 41.94 and 43.98 per cent respectively. Whereas, the heritability was recorded as 90.92 per cent and the genetic advance as per cent of mean was registered as 82.37. The number of lateral branches per plant registered GCV and PCV as 56.61 and 58.89 per cent respectively. Whereas, the heritability was recorded as 92.39 per cent and the GA as per cent of mean was registered as 112.10. The number of leaves per plant registered GCV and PCV as 88.21 and 89.56 per cent respectively. Whereas, the heritability was recorded as 97.00 per cent and the GA as per cent of mean was registered as 178.96.

Genetic variability, heritability and genetic advance for flowering characters (Table 4): The GCV and PCV registered for the duration of flowering are 27.76 and 30.57 per cent respectively. The estimates of genotypic coefficient of variation were less than the estimates of phenotypic coefficient of variation, indicating that the apparent variation is not only due to the genotypes but also due to the influence of environment. The result is in consonance with the interpretations of the works of Mishra *et al.* (2006). The heritability was registered as 82.47 per cent and the GA as per cent of mean was registered as 51.94. The GCV of the flower diameter, number of ray florets per flower, number of flowers per plant, shelf life, individual flower weight and yield of flowers per plant is recorded as 42.66, 71.46, 68.17, 21.20, 70.64 and 93.77 per cent respectively. The PCV of the flower diameter, number of ray florets per flower, number of flowers per plant, shelf life, individual flower weight and yield of flowers per plant is registered as 43.47, 72.24, 69.15, 24.37, 70.78 and 95.42 per cent respectively. A perusal of data showed that there was a close relationship between PCV and GCV which was low for all the characters indicating less influence of environment for most of the characters (Deka, K.K. and L. Paswan. 2002) [4]. The heritability of the flower diameter, number of ray florets per flower, number of flowers per plant, shelf life, individual flower weight and yield of flowers per plant is recorded as 96.31, 97.86, 97.19, 75.72, 99.62 and 96.57 per cent respectively. In the present study, high heritability values have been recorded for all considered characters suggesting that these characters might be highly heritable and it may be worthwhile for selecting cultivars on the basis of these characters. The genetic advance of the flower diameter, number of ray florets per flower, number of flowers per plant, shelf life, individual flower weight and yield of flowers per plant is recorded 86.25, 145.62, 138.46, 38.01, 145.25 and 189.83 per cent of mean respectively.

Table 4: Variability parameters of chrysanthemum genotypes

| Traits | GCV (%) | PCV (%) | Heritability (%) | GA (%) |
|------------------------------|---------|---------|------------------|--------|
| Plant height (cm) | 41.94 | 43.98 | 90.92 | 82.37 |
| Number of lateral branches | 56.61 | 58.89 | 92.39 | 112.10 |
| Number of leaves per plant | 88.21 | 89.56 | 97.00 | 178.96 |
| Duration of flowering (days) | 27.76 | 30.57 | 82.47 | 51.94 |
| Flower diameter (cm) | 42.66 | 43.47 | 96.31 | 86.25 |
| Number of ray florets | 71.46 | 72.24 | 97.86 | 145.62 |
| Shelf life (days) | 21.20 | 24.37 | 75.72 | 38.01 |
| Number of flowers per plant | 68.17 | 69.15 | 97.19 | 138.46 |
| Individual flower weight (g) | 70.64 | 70.78 | 99.62 | 145.25 |
| Flowers yield per plant (g) | 93.77 | 95.42 | 96.57 | 189.83 |

Conclusion

Chrysanthemum occupies a place of pride, both as commercial flower crop and as a popular exhibition flower. It comprises of a huge biodiversity in their growth habitat, flowering behaviour, flower and foliage colour, shape and size. The study was taken up to evaluate and identify the genotypes suitable for loose flower, cut flower and pot mum type. From this study, it is concluded that the genotypes viz., Indira and Chandhini are better suited for loose flower production, Pusa Centenary, Ravikiran and Lalith are the most suitable for cut flower production and Meera White, Red Stone, Acc.116, Dolly Orange, Lalpark and Little Pink are ideal for garden displays.

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