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Evaluation of yield characters of marigold (*Tagetes* species) genotypes under summer condition in alluvial Gangetic plains of North India

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ABSTRACT

A study was conducted at the Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur, to evaluate 26 marigold (*Tagetes* species) genotypes, including 23 experimental lines and three controls during summer season of 2016. The experiment followed a randomized complete block design with three replications. There were highly significant differences ($p<0.05$) among genotypes for various growth, flowering, and yield-related traits. Among the genotypes, BRMG 113 exhibited the best performance in terms of number of flowers/plant (394.98), duration of flowering (76.80 days), flower yield (39.98 kg/plot), and overall yield (53.31 tonnes/ha). The genotype Super Red showed the minimum number of days for appearance of first flower (48.20 days) and 50% flowering (65.73 days). On the other hand, BRMG 113 had maximum flowering duration (76.80 days), number of flowers/plant (394.98), and flower yield (1599.21 g/plant). The genotype MDU 1 recorded significantly highest number of days for appearance of first flower (95.73 days), while Pusa Arpita had shortest flowering duration (29.07 days). The genotype BRMG 113 shows promising characteristics for summer season, particularly in terms of flower yield and duration of flowering. Super Red also exhibited early flowering, which may be desirable in certain contexts.

Key words: Morphological characters, High temperature, Summer season, Yield

Marigold (*Tagetes* species) is a highly significant commercial flower crop belonging to the family Asteraceae. It holds immense importance due to its diverse uses, (Shilpa *et al*., 2022). In India, marigold is cultivated on approximately 68.33 thousand hectares, with a production of 608.96 thousand metric tones. in (NHB, Gurgaon, 2019). However, there is a lack of suitable varieties for summer season. Therefore, there is a great opportunity to capture this market by introducing varieties specifically suited for summer cultivation. Therefore, an evaluation of marigold genotypes was conducted to assess their growth and flowering characteristics suitable for the summer season.

MATERIALS AND METHODS

A field trial was conducted at the Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur during 2016. The experiment comprised 23 experimental lines and 3 control treatments, arranged in a randomized complete block design with three replications. Seedlings were initially grown in plug trays. At the 4-6 leaf stage, which typically occurs after four weeks, seedlings were transplanted into plots measuring 3m × 2.5m in February. The plants were planted 50 cm within rows and 60 cm apart between rows.

Observations were taken from five selected plants within each replication, after discarding the border plants at both ends of the plot. Data were recorded for plant height (cm), plant spread (cm), stalk length (cm), stem diameter (cm), number of primary branches, number of secondary branches, number of flowers/plant, days to first flower, days to 50% flowering, fresh weight/flower (g), flower diameter (cm), duration of flowering (days), flower yield/plot (kg), and yield/hectare (t/ha). The data were subjected to analysis of variance as per Panse and Sukhatme (1967).

Plant height was measured by determining the distance from the base to the top of plant at the time of flowering. The measurements were taken for multiple plants, and the average height was calculated. The number of days to first flowering was recorded by counting the number of days from the date of transplanting to appearance of first flower. To determine the days to 50% flowering, number of days from date of transplanting to when 50% of the plants in each plot had their initial flower

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open was calculated. For plant spread, maximum horizontal spread of plants within each replication was measured in both East-West and North-South directions. The duration of flowering was calculated by subtracting the number of days to first flower from the number of days to last flowering. To determine the number of flowers/plant, total number of flowers on five randomly selected plants within each replication was counted and recorded. Flower diameter was measured at the time of full opening of flower.

Individual flower weight was calculated for each flower. For flower yield, total number of flowers was counted, and the total yield was calculated based on this count.

RESULTS AND DISCUSSION

There was a wide variation among genotypes. Plant height showed significant variation, ranging from 26.33 cm to 87.58 cm. BRMG 414 HG had tallest plants at the first flowering stage, while Cross China had the shortest plants. The variation in vegetative attributes can be attributed to differences in growth rate and genetic make-up of the genotypes (Thakur *et al.*, 2013; Singh *et al*., 2014; Swaroop *et al*., 2019).

Plant spread also exhibited significant variation, ranging from 20.43 cm to 68.31 cm. BRMG 414 HG showed maximum spreading in plants, followed by BRMG 714 and China 2, while Pusa Basanti Gainda had minimum spread.

Vandana had maximum number of primary branches/plant (12.40), while Hooghly yellow and Pusa Basanti Gainda had least number of primary branches (5.07). The differences in branch production can be attributed to inherent genetic factors, as suggested by Bharathi and Jawaharlal (2014).

The number of secondary branches/plant also showed significant variation among marigold genotypes, ranging from 14.53 to 32.60. Shyam China had maximum number of secondary branches (32.60), while MDU 1 had minimum. The number of secondary branches/plant is likely primarily governed by genetic make-up of genotypes. It was observed that maximum number of secondary branches/plant significantly increased after pinching of the plant, which stimulated the auxiliary buds to flourish well. This finding is consistent with those of Munikrishnappa *et al.* (2013).

The stalk length varied among genotypes, with 'Hooghly 1 (O)' recording the maximum stalk length (9.00 cm), followed by Light (8.38 cm) and Shiv (8.35 cm), while 'Pusa Arpita' had the minimum stalk length (4.88 cm) (Namita *et al.*, 2009). The stem diameter also showed variation, ranging from 1.25 cm to 2.48 cm. BRMG 114 had maximum stem diameter (2.48 cm), followed by Shyam China, New China (2.35 cm), Tapur Basanti (2.37 cm), BRMG 113 (2.21 cm), and Pusa Narangi Gainda had minimum (1.25 cm). The variation in stem diameter could be attributed to both their genetic make-up and environmental conditions.

The BRMG 113 had maximum number of flowers/plant (394.98), followed by BRMG 114 (271.87), New China (265.25), and China 2 (18.48). The variation in number of flowers can be attributed to both genetic and environmental factors. Genotypes with more branches/plant tend to have a higher number of flowers. The number of flowers/plant may increase with an increase in number of branches/plant (Laishram *et al*., 2013). Furthermore, variations in photosynthetic efficiency among genotypes can lead to increased food accumulation, resulting in enhanced plant growth and a higher number of flowers/plant (Sunitha *et al.*, 2007).

Super Red was the earliest to flower (48.20 days), followed by BRMG 113 (55.53 days) and Light (52.53 days). The maximum number of days taken for flowering was recorded in MDU1 (95.73 days), followed by Pusa Basanti Gainda (90.33 days) and Pusa Arpita (82 days). The variation in early and late blooming among genotypes is likely a genetically controlled trait. Similar observations have been reported by Negi *et al.* (2015). For 50% flowering, Super Red took 65.73 days, followed by Gones Yellow (69.07 days) and Light (63.40 days). The maximum number of days taken for 50% flowering was recorded in Pusa Basanti Gainda (106.80 days) and MDU 1 (102.53 days).

The variations in flowering time can be attributed to different time periods required by different genotypes based on their genetic make-up. This finding aligns with the study by Namita *et al*. (2011). BRMG 113 had a longer flowering period (76.80 days), similar to Gones Yellow (71.20 days) and Ball (72.13 days). The minimum flowering duration (29.07 days) was recorded in Pusa Arpita. The variation in duration of flowering can be attributed to differences in genetic make-up. Similar findings have been reported by Choudhary *et al.* (2014) and are in line with the studies by Raghuvanshi and Sharma (2011) and Panwar *et al.* (2013).

The flower diameter ranged from 2.20 cm to 5.67 cm. The largest flower size (5.67 cm) was observed in

BRMG 714, followed by BRMG 414 HG (5.65 cm) and Pusa Basanti Gainda (2.20 cm). The variation in flower size can be attributed to the inherent characteristics of the genotypes (Panwar *et al*., 2013).

The fresh weight per flower also showed significant variation, with the maximum weight observed in Local Jalbhara (6.74 g), followed by Tapur Basanti (6.23 g), Local Yellow (5.56 g), and Pusa Narangi Gainda (1.91 g). This variation may be due to differences in number of ray florets and the effect of the season. Similar results have been reported by Kumar *et al.* (2014).

Significant differences were found in flower yield per plot, ranging from 1.48 kg to 39.98 kg. The maximum flower yield per plot was recorded in BRMG 113 (39.98 kg), followed by Hooghly1 Orange (33.06 kg/plot), BRMG 114 (30.55 kg/plot), and Pusa Arpita (1.48 kg/plot). Similar findings have been reported by Bharathi and Jawaharlal (2014), and Raghuvanshi and Sharma (2011) observed significant variation in flower yield (1.69 kg to 8.27 kg/m2). The variation in flower yield can be attributed to the intrinsic capacity of the genotypes to produce flowers (Narsude *et al*., 2010a).

The BRMG 113 exhibited the maximum flower yield (53.31 tonnes/ha), followed by Hooghly1 Orange (44.07 tonnes/ha), BRMG 114 (40.73 tonnes/ha), and Pusa Arpita (1.97 tonnes/ha). The increase in flower yield may be attributed to higher number of flowers/plant and longer duration of flowering during summer season.

CONCLUSION

Thus, BRMG 113 showed maximum flower yield (53.31 tonnes/ha) under summer conditions. This genotype can be considered a good option for marigold farmers.

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