

Evaluation of Different Germplasm of African Marigold (*Tagetes erecta* L.) for Phenotypic Performance and Floral Yield under the Bundelkhand Condition

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ABSTRACT

The present study was conducted to evaluate the performance of six genotypes of African marigold (*Tagetes erecta* L.) for phenotypic performance and floral yield on under Bundelkhand region (Banda, Uttar Pradesh). The experiment was layout in Randomized Block Design (RBD) with three replications at Instructional Farm of Department of Floriculture and Landscape Architecture, College of Horticulture, Banda during the 2019-2020t. With recommended cultural practices were adapted for raise the crops for successful. Observation plant height, plant spread, No of primary branches per plant, No of secondary branches per plant, days to first bud appearance, days

taken to first flowering, days to 50% flowering, flower diameter, flower weight, duration of flowering, shelf life of flower peduncle length of flower (mm), No of flower per plant flower yield per plant (g), flower yield per plot (kg) and flower yield (t/ha) were recorded and statistically analyzed. All of the genotypes showed significant variation in growth, flowering and yield parameters. The maximum plant height and maximum secondary branches per plant were found in Pusa Basanti Gaiinda. Maximum plant spread, maximum number of primary branches per plant, maximum flower diameter and highest peduncle length were recorded in NS-104. Earliest first flower bud appearance, fifty percent flowering, minimum days to first flowering and maximum number of flowers per plant were found in variety Pusa Narangi Gaiinda. Maximum flower weight per plant, longest duration of flowering, longest shelf life, maximum flower yield per plant, maximum flower yield per plot, maximum flower yield per hectare, maximum gross return and net return were recorded in Bidhan Marigold-2.

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INTRODUCTION

African marigold (*Tagetes erecta* L.) is an immensely popular annual flower widely grown throughout the world. It belongs to the family Asteraceae and is native to the South and Central America and Mex-

ico, from where it spread to different countries in the world during the early 16th century. It is diploid ($2n = 2x = 24$) with basic chromosome no. $x = 12$. In India, marigold covered maximum area and highest production among the loose flowers followed by chrysanthemum, jasmine, tuberose and crossandra. In India, area under marigold cultivation is 64,000 ha with the production of 608.97 MT. Karnataka covered largest area (9100 ha) of marigold in India, with the production of 87.37 MT. Madhya Pradesh has maximum production (94 MT) from an area of 7780 ha. Production of marigold in Uttar Pradesh is 7.20 MT. As it is one of the popular loose flower crops in Uttar Pradesh, cultivated extensively to fulfill the demands in the market. Marigold is one of the dominating flowers in Uttar Pradesh also, which fetches high price in local market. Though potential as well as demand of marigold in Bundelkhand region is high but low productivity is one of the major constraints in its commercial cultivation yet. In view of this the present investigation was undertaken to evaluate the different germplasm of African marigold for phenotypic performance and floral yield under the Bundelkhand condition.

MATERIALS AND METHODS

The field experiment was conducted in Randomized Block Design (RBD) with three replication at Instructional Farm of Department of Floriculture and Landscape Architecture, College of Horticulture, Banda during season of 2019 – 2020. Total six varieties of marigold viz., Pusa Narangi Gaiinda, Pusa Basanti Gaiinda (collected from IARI New Delhi.) NS- 104, NS-66, NS-119 (from Bangalore) and remaining one varieties Bidhan Marigold-2 (collected from BCKV, West Bengal) used for the studies. The recommended cultural practices were used for raise the crop. The following observation to be recorded viz., Plant height, plant spread, No of primary branches per plant, No of secondary branches per plant, days to first bud appearance, days taken to first flowering, days to 50% flowering, flower diameter, flower weight, duration of flowering, shelf life of flower peduncle length of flower (mm), No of flower per plant flower yield per plant (g), flower yield per plot (kg) and flower yield (t/ha) were recorded and statistically analyzed.

RESULTS AND DISCUSSION

The results of the experiment are summarized in following three parameters.

Growth parameters

Significant differences were found among the six varieties for various characters studies (Table 1). The maximum plant height was recorded in Pusa Basanti Gaiinda (50.53 cm) followed by NS-104 (45.53 cm), where as minimum plant height was recorded with NS-66 (37.13 cm) followed by NS-119 and Pusa Narangi Gaiinda. Plant height is attributed to be an important varietal character that depends upon the genetic constitution. The variation in plant height among the various genotypes might be due to genotypic differences in phenotypic expression of plant height and variations in different genotype-environmental interaction effects on plant height (Bharathi and Jawaharlal 2014). Similar variation in plant height due to genotypes was also reported by Rao *et al.* (2005), Kumar *et al.* (2019), Suvija *et al.* (2020) in marigold.

Maximum plant spread was recorded in NS-104 (50.76 cm) followed by Pusa Basanti Gaiinda (45.78 cm) and Bidhan Marigold-2 (45.16 cm), where as the minimum plant spread was recorded in NS-66 (36.77 cm) followed by NS-119 (38.99cm) and Pusa Narangi Gaiinda (43.14 cm). The observations are in

Table 1. Mean performance of African marigold genotypes for vegetative parameter.

Sl. No.	Genotypes	Plant height (cm)	Plant spread (cm)	No. of primary branches per plant	No. of secondary branches per plant
T ₁	Pusa Basanti Gaiinda	50.53	45.78	8.33	50.13
T ₂	Pusa Narangi Gaiinda	38.93	43.14	7.00	35.76
T ₃	Bidhan Marigold	41.66	45.16	6.06	41.76
T ₄	NS-119	37.20	38.99	7.46	25.96
T ₅	NS-66	37.13	36.77	7.60	25.36
T ₆	NS-104	45.53	50.76	9.26	49.40
	CD at 5%	7.25	5.05	1.67	3.09

line with the finding of Raghuvanshi and Sharma (2011) and Choudhary *et al.* (2014) in marigold, who also observed variation in plant spread in different genotypes of marigold due to the inherent character of marigold genotypes. Similar views were also expressed by Narsude *et al.* (2010) in marigold and Poonam and Kumar (2007) in chrysanthemum.

The maximum number of primary branches per plant was observed in NS-104 (9.26) followed by Pusa Basanti Gaiinda (8.33), where as minimum number of primary branches was found in genotype Bidhan Marigold-2(6.06) and NS-66 (7.60), NS-119 (7.46). The variation in number of primary branches per plant might be due to their different genetic composition and varied rate of growth among the varieties of marigold Narsude *et al.* (2010). Similar variations for number of branches were also observed by Gobade *et al.* (2017), Rao *et al.* (2005), Gulia *et al.* (2017), Kumar *et al.* (2015) in marigold.

Maximum number of secondary branches per plant was observed in variety Pusa Basanti Gaiinda (50.13) followed by NS-104 (49.40), where as minimum number of secondary branches was recorded in NS-66 (25.36). The numbers of secondary branches per plant may have increased due to pinching of plant which might have forced the auxiliary buds to thrive well. Similar results were observed by Gulia *et al.* (2017), Mahantesh *et al.* (2018), Netam *et al.* (2019).

Earliest days for first bud appearance were recorded in variety Pusa Narangi Gaiinda (70.73 days) followed by NS-104 (73.33 days), genotype NS-119 (73.66 days) and NS-66 (77.40 days). Maximum days taken to first flower bud appearance observed in Bidhan Marigold-2 (112.93 days). The variation for early or late flowering is an important varietal character in marigold that might be directly governed by the genetic makeup of the varieties leading to varying growth rate Mahantesh *et al.* (2018). The similar observation was also made by Beniwal and Dahiya (2012) in marigold.

The data on days required for first flowering revealed that, variety Pusa Narangi Gaiinda recorded minimum days to first flowering (96.86 days) followed by NS-104 (105.46 days), where as maximum

days taken for first flowering observed in genotype Bidhan Marigold-2 (138.66 days) followed by varieties Pusa Basanti Gaiinda (117.40 days). The results showed that Pusa Narangi Gaiinda is early variety as compared to other varieties. The different days are required to first flower from sowing in marigold genotypes might be due to varied growth rate and the genetic makeup of the genotypes (Srinivas and Rajasekhram 2020).

The data of days required for 50% flowering revealed that, variety Pusa Narangi Gaiinda recorded minimum days to complete 50% flowering (123.86 days) followed by NS-104 (132.46 days) and genotype NS-119 (133.06 days). Maximum days to get 50% flowering were recorded with varieties Bidhan Marigold-2 (170 days). The differences in 50 % flowering might be because of different time period taken by the different varieties based on their genetic constitution. These findings also related with the findings of Palai *et al.* (2008) in chrysanthemum and Singh and Mishra (2008) in marigold.

Quality parameters

The genotype NS-104 recorded maximum flower diameter (8.65 cm) followed by genotype NS-66 (8.59 cm) and NS-119 (7.89 cm), where as the minimum flower diameter (5.89 cm) was recorded in genotype Pusa Basanti Gaiinda followed by Bidhan Marigold-2 (6.62 cm). The variation in flower diameter might be due to genetic makeup of genotypes and more number of leaves which may have led to more dry matter accumulation, resulting in the accumulation of maximum photosynthates that may have contributed to the production of bigger size flower (Lohar *et al.* 2018). Similar results have been reported by Patokar *et al.* (2018), Gupta *et al.* (2017), Kumar *et al.* (2019) and Suvija *et al.* (2020) in African marigold.

Significantly maximum flower weight (11.96 g) was recorded in Bidhan Marigold-2 while other varieties were found in significant in respect of flower weight. The minimum flower weight was recorded in genotypes Pusa Narangi Gaiinda (4.04 g) followed by NS-66 (8.25g), NS-104 (7.3 g) Pusa Basanti Gaiinda (5.98 g) and NS-119 (5.23 g). The flower weight may have been depended on the individual flower weight

resulting in the variation in fresh weight of flowers among the genotypes (Kumar *et al.* 2017). The results are in accordance with the finding of Lohar *et al.* (2018) and Manik and Sharma (2016) in marigold.

The variety, Bidhan Marigold-2 recorded longest duration of flowering (85.90 days) while minimum with Pusa Basanti Gaiinda (63.16 days) and Pusa Narangi Gaiinda (63.83 days) Minimum duration of flowering was observed in genotype NS-119 (60.63). The genetic control of the characters and modification in their expression due to environmental conditions might be the possible cause observed for variation in duration of flowering (Choudhary *et al.* 2014).

The minimum shelf life was observed in genotype NS-66 (6.73 days) followed by NS-119 (7.53 days) and maximum shelf life was observed in Pusa Basanti Gaiinda (12.13 days) followed by NS-104 (8.73 days). The different period required days to flowering till decaying of the flower in marigold genotypes might be due to environmental condition and the genetic makeup of the genotypes (Patokar *et al.* 2018). Variation in shelf life is due to genetic differences among the varieties (Samantray 2018). Similar results were observed by Kurukula *et al.* (2018).

The perusal of results in table 2 showed that there were significant differences in length of peduncle among the varieties. The variety NS-104 recorded with significantly highest peduncle length (6.92) which, was at par with Pusa Basanti Gaiinda (6.50), Pusa Narangi Gaiinda (6.48 days), NS-119 (5.81 days) and NS-66 (5.52). The minimum peduncle length was observed in genotype Bidhan Marigold-2

(4.61). The peduncle length of flower may have been dependent on the individual flower resulting in the variation in length of the peduncle of flowers among the genotypes.

Yield parameters

The maximum number of flowers per plant (88.16) was recorded in the genotype Pusa Narangi Gaiinda, which however was at par with genotypes Pusa Basanti Gaiinda (85.03). The minimum number of flowers per plant was recorded in genotype NS-66 (45.06) followed by NS-119 (48.16), NS-104 (70.70) and Bidhan Marigold-2 (79.16). The variation in number of flowers/ plant might be due to hereditary traits of the genotypes. Number of flowers per plant may have increased with the increase of plant height (Kumar *et al.* 2017). The results are in agreement with by Gulia *et al.* (2017) and Kumar *et al.* (2015) in marigold.

The range for flower yield per plant was observed from 252.19 g to 949.33 g. The highest flower yield (949.33 g) was recorded with Bidhan Marigold-2, which was significantly superior to rest of the varieties and was followed by NS-104 (522.80 g) and Pusa Basanti Gaiinda (508.82 g), whereas, it was lowest in NS-119 (252.19 g). The flower yield per plant might be dependent on individual flower weight and number of flowers per plant leading to variation in flower yield per plant among the varieties Kumar *et al.* (2015). Similar variation in flower yield per plant was also observed by Narsude *et al.* (2010) and Manik and Sharma (2016) in marigold.

A close sight of the data revealed that the vari-

Table 2. Mean performance of African marigold genotypes for floral character.

Sl. No.	Genotypes	Days to first bud appearance	Days taken to first flowering	Days to 50% flowering	Flower diameter (cm)	Flower weight (g)	Duration of flowering	Shelf life of flower	Peduncle length of flower (mm)
T ₁	Pusa Basanti Gaiinda	87.46	117.40	134.86	5.89	5.89	63.16	12.13	6.50
T ₂	Pusa Narangi Gaiinda	70.73	96.86	123.86	6.86	4.04	63.83	7.66	6.48
T ₃	Bidhan Marigold	112.93	138.66	170.00	6.62	11.96	85.90	14.93	4.61
T ₄	NS-119	73.66	107.13	133.06	7.89	5.23	60.63	7.53	5.81
T ₅	NS-66	77.40	109.00	133.40	8.59	8.25	69.23	6.73	5.52
T ₆	NS-104	73.33	105.46	132.46	8.65	7.39	79.93	8.73	6.92
	CD at 5%	10.05	10.94	10.51	0.83	1.9	2.81	0.50	0.83

eties demonstrated highly significant differences for flower yield per plot, which ranged from 4.03 Kg to 15.18 Kg. Further, the maximum flower yield per plot (15.18 Kg) was recorded in Bidhan Marigold-2 followed by NS-104 (8.36 Kg) and Pusa Basanti Gaiinda (8.14 Kg). The minimum flower yield per plot (4.03 Kg) was observed in variety NS-119. Data recorded on flower yield per plot might have differed due to inherent capacity of varieties to yield flowers (Narsude *et al.* 2010). Similar results were reported by Raghuvansi and Sharma (2011) in marigold.

The varieties differed significantly for flower yield per hectare with a range of to 12.42 to 46.80 tonnes (Table 3). The maximum flower yield (46.80 t/ha) was recorded in Bidhan Marigold-2 followed by NS-104 (25.77 t/ha) and Pusa Basanti Gaiinda (25.08 t/ha) whereas, the minimum flower yield per hectare (12.42 t/ha) was recorded in variety NS-119 followed by Pusa Narangi Gaiinda (17.56 t/ha) and NS-66 (18.19 t/ha). The increase in flower yield per hectare might be due to increased flower weight and number of flower per plant of specific variety. Similar variation in flower yield of varieties was reported by Samantray *et al.* (2018) in marigold.

Economics of cultivation

The total cost, gross return, net return and benefit cost ratio of marigold varieties grown are presented in Table 4, Variety Bidhan Marigold realized maximum

Table 3. Mean performance of African marigold genotypes for yield characters.

Sl. No.	Genotypes	No. of flowers per plant	Flower yield per plant (g)	Flower yield per plot (Kg)	Flower yield (t/ha)
T ₁	Pusa Basanti Gaiinda	85.03	508.82	8.13	25.08
T ₂	Pusa Narangi Gaiinda	88.16	356.42	5.69	17.56
T ₃	Bidhan Marigold	79.16	949.33	15.18	46.80
T ₄	NS-119	48.16	252.19	4.05	12.42
T ₅	NS-66	45.06	369.04	5.90	18.19
T ₆	NS-104	70.70	522.80	8.36	25.77
	CD at 5%	4.08	123.24	1.96	6.07

Table 4. Economics of cultivation of Marigold varieties.

Varieties	Total expenditure (Rs)	Net yield (Kg/ha)	Net return (Rs)
Pusa Basanti Gaiinda	146880.32	20064	154080.68
Pusa Narangi Gaiinda	137856.32	14048	72863.68
Ns- 66	138612.32	14552	79667.68
NS-104	147708.32	20616	161532.68
NS- 119	131688.32	9936	17352.68

gross return (Rs 5, 61,600 per hectare) and net return (Rs 3, 88,655.68 per hectare) followed by NS-104 and Pusa Basanti Gaiinda (Rs 1, 61,532.68 and Rs 1, 54,080.68 of net return per hectare respectively), minimum net return (Rs 17,352.68) was obtained in NS-119. The benefit to cost ratio (B: C) was highest (3.24) in Bidhan Marigold-2. This variation in ratio might be due to the difference in yield and cost of planting material or seed. Similar results were depicted by Tiwary *et al.* (2014). These findings are in agreement with the report by Haque *et al.* (2012) in marigold.

CONCLUSION

On the basis of the findings of present study, this may be concluded that variety Bidhan Marigold-2 and NS- 104 has performed best for higher loose flower yield, longest shelf life, maximum flower weight, maximum flower diameter and longest duration of flowering whereas variety Pusa Narangi Gaiinda and NS- 104 has performed best for flower earliness and more numbers of flowers per plant. These varieties can be recommended for commercial production in Bundelkhand region for higher yield and other important flower yield attributes.

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