Evaluation of genotypes of French marigold (*Tagetes patula* L) under Nauni, Solan, Himachal Pradesh conditions

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ABSTRACT

The present investigations were conducted at the experimental farm of Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh to evaluate the genotypes of French marigold (*Tagetes patula* L). The experiment was laid out in a randomization block design with three replications. Twenty five genotypes of French marigold were evaluated for various growth and yield parameters. Analysis of variance showed significant differences among all the genotypes for all the characters under study. Maximum plant height (68.80 cm) and flower weight (3.89 g) were obtained in genotype ms_7 x Bonita Bolero. Genotype ms_{10} x Spray Boy recorded maximum plant spread (52.34 cm), number of flowers per plant (100.23), flower weight per plant (380.37 g) and flower yield per square meter (6.08 kg). The genotype ms_6 x Spray Boy recorded maximum flower size (6.37 cm), minimum days taken to bud formation (28.91) and minimum days taken to flowering (36.94). Maximum duration of flowering was recorded for the genotype ms_6 x FM-786 (62.00 days). Weight of flowers per picking, flower yield per square meter and flower weight exhibited high coefficient of variation, heritability and genetic gain. Flower yield per square meter had significant positive association with plant height, plant spread, duration of flowering, flower size, flower weight, number of flowers per plant and weight of flowers per picking. The genotypes ms_{10} x Spray Boy and ms_s x Spray Boy proved promising as they had many desirable traits.

Keywords: Marigold; evaluation; genotypes; variability; correlation

INTRODUCTION

Marigold is one of the most important flower crops grown commercially in different parts of India especially in the plains. It is a short duration, free blooming crop belonging to family Asteraceae. It has gained popularity because of its adaptability to various soil and climatic conditions and longer blooming period. The flower is endowed with a wide spectrum of attractive colours, shape and size having good keeping quality. It is highly suitable as a bedding plant in a herbaceous border. French marigold is ideal for rockeries, edging, hanging baskets and window boxes.

Marigold is not only being grown as an ornamental plant but also serves as a source of nutritional supplement for poultry feed due to presence of an antioxidant, carotenoid pigment known as lutein. Since yellow and orange colour in marigold is due to presence of this pigment hence lutein is added in the poultry diet to intensify the yellow colour of eggs yolk and broiler skin (Sreekala et al 2002). Carotenoids are having therapeutic values (Gau et al 1983). Dietary carotenoids can be used to treat cancer and photosensitive diseases. Marigold flower meal that remains after removal of lutein is chosen as a potential source of gum Arabic as it is believed to contain a polysaccharide component that has got the ability to protect the hydrophobic substances from oxidation.

The essential oil present in different species of *Tagetes* are being used in perfume industry. All parts of *Tagetes patula* contain essential oil which can

readily be extracted by steam distillation (Dhingra and Dhingra 1956). The oil has a pronounced odour and acts as a repellent to flies.

Tagetes patula commonly known as French marigold is being grown commercially as loose flower in India and Central America. It has an added advantage that it is not season bound like other annual flower crops. Marigold plant needs a plenty of sunshine and is grown in open sunny situation. French marigold has different strains varying in plant height, growth habit, flower size and shape. It has got yellow and orange colours in various shades like light yellow, canary yellow, golden yellow, bright yellow, cadmium yellow, deep orange, bright orange, white and bicoloured. Also crimson and mahogany red colours are very attractive.

The available congenial conditions at Nauni, Solan in mid-hill zone (sub-temperate to sub-tropical with mild summer to cool winter) of Himachal Pradesh are suitable for successful cultivation of marigold in terms of yield and quality of flowers. The present investigations were therefore undertaken to evaluate various genotypes of French marigold here.

MATERIAL and METHODS

The experiment was carried out at the experimental farm of the Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. The experimental site is located at a latitude of 30°52' 02" N and at a longitude of 77°11'30" E with an elevation of 1,276 m amsl. The healthy, pure and disease-free seeds of twenty five genotypes of French marigold were harvested from the farm from the experiment on production of F_1 hybrids in marigold. It included 10 inbred lines and 15 crosses.

The seeds of genotypes were sown 1-2 cm deep in lines/furrows and covered with sieved well-rotten FYM. After seed sowing the beds were covered with hessian cloth/gunny bags and irrigated lightly with watering can. Seed germination started after 5-6 days of sowing and at this stage covering material was removed. Vigorous and uniform seedlings were selected and transplanted. Full dose of phosphorus (20 g/m^2) and potassium (20 g/m^2) and half of nitrogen (7.5 g/m^2) was incorporated as basal dose. The remaining half dose of nitrogen (7.5 g/m^2) was applied after 30 days of transplanting. Nitrogen, phosphorus and potassium were applied through urea, single super phosphate and muriate of potash respectively. Irrigation was applied immediately after transplanting. Plants were irrigated daily for one week after transplanting until the they established themselves. Various intercultural operations like irrigation, weeding, hoeing, pinching etc were performed.

The experiment was laid out in a randomized block design with three replications. The genotypes were planted in a plot of size 1 x 1 m at a spacing of 25 x 25 cm accommodating 16 plants per plot. Data on various vegetative and reproductive attributes were recorded time to time and later on were subjected to statistical analysis.

RESULTS and DISCUSSION

Significant variations among different germplasms for all the vegetative and floral characters were observed as shown in Table 1. Plant height varied among different genotypes from 68.80 to 32.95 cm wherein genotype ms_7 x Bonita Bolero recorded maximum plant height and minimum value was recorded in French Bonita. Maximum (52.34 cm) spread was observed in ms_{10} x Spray Boy whereas minimum (27.82 cm) was registered in genotype Bonita Bolero. Number of days taken to first flower bud appearance and flowering signifies the earliness or late flowering habit of a genotype.

Among genotypes, ms_6 x Spray Boy was the earliest in bud formation and flowering (28.91 and 36.94 days respectively). Maximum duration of flowering was observed in ms_6 x FM-786 (62.00 days) while it was minimum in Harmony Boy (40.96 days). A wide variation in days to flowering in different genotypes of chrysanthemum has also been reported by Kanamadi and Patil (1993).

Genotype ms_{10} x Spray Boy was floriferous in nature and produced maximum number of flowers per plant (100.23) as compared to others. The results are in close conformity with the findings of Sharga et al (1975). Flower size was found maximum in ms_6 x Spray Boy (6.37 cm) and maximum single flower weight was recorded in ms_7 x Bonita Bolero (3.89 g). In contrast minimum flower size (3.09 cm) and flower weight (1.20 g) were recorded in genotypes Double Dwarf Lemon and Single Petal Red respectively. This variation may be attributed to the inherent genetic and environmental factors. The results are in confirmation with the findings of Dilta et al (2005) in chrysanthemum.

Table 1. Performance of different genotypes of French marigold under Nauni, Solan, Himachal Pradesh conditions

Genotype	Plant height (cm)	Plant spread (cm)	Days taken to bud formation	Days taken to flowering	Duration of flowering (days)	Flower size (cm)	Flower weight (g)	Number of flowers /plant	Weight of flowers /plant	Total flower yield/m^2 (kg)
Safari Queen	40.30	30.50	33.14	46.01	50.28	5.03	1.57	73.05	114.51	1.83
Spray Boy	35.58	28.90	36.01	50.21	47.99	4.80	2.02	51.03	103.43	1.65
Single Petal Red	33.38	33.52	35.04	41.83	49.67	5.12	1.20	73.54	88.26	1.41
Spray max	41.28	32.07	40.94	49.37	42.66	5.01	1.54	78.30	120.82	1.93
Harmony Boy	50.76	38.67	44.76	52.30	40.96	4.63	1.28	63.79	81.68	1.30
Bonita Bolero	39.16	27.82	42.02	49.49	41.61	4.07	1.49	69.14	103.25	1.65
Sunkist	36.09	30.20	41.92	48.78	45.17	4.39	1.85	69.98	129.73	2.07
French Bonita	32.95	30.30	39.23	47.37	46.76	4.43	1.33	66.45	88.54	1.42
Double Dwarf Lemon	35.87	34.49	46.30	56.76	43.53	3.09	1.72	65.73	112.97	1.80
FM-786	41.15	35.85	36.15	45.50	43.63	3.80	2.01	71.97	144.29	2.31
ms_4 x Harmony Boy	52.70	43.51	30.04	37.47	53.88	5.38	3.76	90.20	335.84	5.37
ms_4 x French Bonita	46.27	38.49	30.79	39.84	59.03	6.17	3.60	88.03	317.30	5.08
ms_4 x FM- 786	42.03	40.92	36.24	44.02	55.19	6.04	3.73	95.10	354.80	5.53
ms_5 x FM- 786	43.43	38.20	41.53	48.67	53.73	6.13	3.85	90.47	348.88	5.58
ms_6 x Sunkist	40.30	42.45	34.56	43.67	53.93	5.24	3.77	92.82	350.03	5.61
ms_6 x Spray Boy	47.86	44.32	28.91	36.94	55.78	6.37	3.49	84.80	295.73	4.73
ms_6 x FM-786	51.03	45.45	33.84	41.28	62.00	4.89	3.38	88.90	300.51	4.92
ms_6 x French Bonita	52.09	46.11	35.99	44.25	60.39	5.34	2.98	86.77	258.97	4.14
ms_7 x Sunkist	50.97	46.87	38.78	46.81	58.00	5.02	3.18	87.07	277.41	4.44
ms_7 x Bonita Bolero	68.80	51.04	42.40	50.23	59.68	5.25	3.89	90.15	350.35	5.60
ms_7 x Spray Max	59.78	45.37	43.12	51.45	58.42	6.03	3.77	87.59	330.39	5.29
ms_7 x Safari Queen	51.94	43.32	37.98	47.13	51.89	4.60	3.59	92.60	333.18	5.33
ms_{10} x Spray Boy	62.63	52.34	46.89	50.67	52.72	5.44	3.79	100.23	380.37	6.08
ms_{10} x French Bonita	44.53	44.22	38.17	47.67	58.09	6.12	3.57	91.54	326.53	5.22
ms_{10} x Bonita Bolero	67.66	47.88	38.69	47.60	58.98	6.26	3.45	95.17	328.96	5.23
Mean	46.74	39.71	38.14	46.61	52.16	4.80	2.79	84.83	300.23	3.82
$CD_{0.05}$	5.50	4.89	2.01	2.45	3.76	0.47	0.31	5.39	29.51	0.49

Differences were significant among the French marigold genotypes for weight of flowers per picking and flower yield per square meter. These were found to be maximum in genotype ms_{10} x Spray Boy (380.37 g and 6.08 kg/m^2 respectively). The varietal differences might be attributed to the genotypic variation. These results are in accordance with the findings of Dhiman (2003) in chrysanthemum and Poornima et al (2006) in China aster.

The estimates of phenotypic and genotypic coefficients of variability gave a clear picture of amount of variations present in the available germplasm as shown in Table 2. Phenotypic coefficients of variability were higher in magnitude than the genotypic coefficients of variability for all the characters studied though difference was very less. The PCV and GCV were found to be highest for the weight of flowers per picking, flower yield per square meter and flower weight. This reflects greater genetic variability among the genotypes for these characters for making further improvement by selection. Moderate PCV and GCV were recorded for plant height followed by plant spread and number of flowers per plant. This shows that coefficients of variation were moderate to high for all the flowering attributes. These results get the support from the findings of Barigidad et al (1992) in chrysanthemum and Patnaik and Mohanty (2002) in African marigold.

Estimates of broad sense heritability for the characters under study ranged from 84 (plant spread) to 97 (weight of flowers per picking) per cent. The single flower weight and weight of flowers per picking showed significantly high heritability of 96 and 97 per cent respectively. High heritability estimates are helpful in making selection of superior genotypes on the basis of quantitative characters.

Table 2. Estimates of phenotypic and genotypic coefficients of variability, heritability, genetic advance and genetic gain for different traits

Character	Mean	Range	Coefficient of variation (%)		Heritability (%)	Genetic advance	Genetic gain (%)
			PCV	GCV			
Flower yield/m2 (kg)	3.84	1.41-6.08	46.98	46.29	92.00	3.61	93.97
Plant height (cm)	46.74	32.95-68.80	22.41	21.24	89.00	19.39	41.48
Plant spread (cm)	39.71	27.82-52.34	19.20	17.69	84.00	13.33	33.57
Days taken to bud formation	38.14	28.91-46.89	12.63	12.23	93.00	9.39	24.39
Days taken to flowering	46.61	36.94-56.76	10.37	9.87	93.00	9.01	19.34
Duration of flowering (days)	52.16	40.96-62.00	13.08	12.32	88.00	12.48	23.93
Flower size (cm)	4.80	3.09-6.37	17.46	16.82	92.00	1.71	33.39
Single flower weight (g)	2.79	1.20-3.89	37.21	36.61	96.00	2.07	74.22
Number of flowers/plant	84.83	53.70-100.89	16.10	15.60	93.00	25.58	31.16
Weight of flowers /picking (g)	300.23	90.65-383.98	47.02	46.37	97.00	226.61	94.19

Table 3. Simple correlation between different morphological and floral characters in French marigold

Parameter	FY/m^2	PH	PS	DTBF	DTFF	DOF	FS	FW	NFPP
PH	0.555*								
PS	0.823*	0.800*							
DTBF	-0.013	0.330	0.205						
DTFF	-0.278	0.274	-0.128	0.830*					
DOF	0.747*	0.171	0.545*	-0.386	-0.551*				
FS	0.688*	0.242	0.430*	0.007	-0.467*	0.559*			
FW	0.984*	0.732*	0.919*	0.252	-0.251	0.845*	0.601*		
NFPP	0.922*	0.537*	0.815*	0.004	-0.349	0.709*	0.666*	0.778*	
WFPP	1.000*	0.551*	0.821*	-0.015	-0.280	0.746*	0.689*	0.984*	0.922*

FY: Flower yield, PH: Plant height, PS: Plant spread; DTBF: Days taken to bud formation, DTFF: Days taken to first flowering, DOF: Duration of flowering, FS: Flower size, FW: Flower weight, NFPP: Number of flowers per plant, WFPP: Weight of flowers per picking; *Significant positive relationship

Flower yield per sqm was positively and significantly associated with plant height, plant spread, duration of flowering, flowers size, flower weight and number of flowers per plant (Table 3). Significant association of yield with different characters has also been reported by Raghava et al (1992) and Behera et al (2002) in chrysanthemum, Bhat (1995) in gerbera over one season and Sreenivasulu et al (2007) in China aster. Number of flowers per plant was positively and significantly associated with plant height, plant spread, duration of flowering, flower size and flower weight.

CONCLUSION

It was observed that genotype ms_{10} x Spray Boy was found to be the best amongst all the twenty five genotypes with respect to flower yield per square meter. Other genotypes which showed a flower yield of more than 5 kg/m^2 include ms_4 x Harmony Boy, ms_4 x French Bonita, ms_4 x FM-786, ms_5 x FM-786, ms_6 x Sunkist, ms_7 x Bonita Bolero, ms_7 x Spray Max, ms_7 x Safari Queen, ms_{10} x French Bonita and ms_{10} x Bonita Bolero.

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