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Performance of dahlia (*Dahlia variabilis*) cultivars for vegetative, floral and relative economic parameters under sub-humid southern plains and Aravalli hills of Udaipur*

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Dahlia (*Dahlia variabilis* L.) belongs to family Asteraceae and native from Mexico. Genus dahlia contains basic chromosome number n = x = 8 and *D. variabilis* is octaploid in nature, ie 2n = 64. Tubers of dahlia contain significant amount of inulin, and fructose and small quantities of medicinally active compounds, such as phytin and benzoic acid. Cut flowers of pompon and miniature types stay fresh in flower vases for many days and also makes moderately good garlands. Its free flowering habit, wide spectrum attractive colour, shape, size and good keeping quality and easy transportation attract flower growers. It has a great potential for export market, especially during winter for European countries, which fetch better market price. There was no comprehensive report on evaluation of dahlia cultivars for vegetative, floral and relative economic parameter under Zone IV A- sub-humid southern plains and Aravalli hills of Rajasthan, hence the present study was undertaken.

The experiment was conducted at Horticulture Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during October 2006–April 2008, situated at 24º 35′ N latitude and 24º 42′ E longitude at an altitude of 579.5 m above msl. The region falls under agro-climatic zone IV A- sub-humid southern plains and Aravalli hills of Rajasthan. The experiment was conducted on clayey loam soil with *p*H 8.4 and EC 0.54 dS/m under irrigated condition. The cultivars used namely 'Black Out' (T_1), 'DRS' (T_2), 'Jyotsna' (T_3), 'Korean Bicolour' (T_4), 'Korean Blue' (T_5), 'Korean Orange' (T_6), 'Korean White' (T_7), 'Korean Yellow' (T_8), and 'NT Pompon' (T_9). The terminal rooted cutting was planted at 90 cm in row-to-row and 75 cm from plant-to-plant on well prepared bed on 28 October 2006 and 2007 with bed size 4 m^2 × 2 m^2 on drip irrigation system in 3 replication and 9 varieties used as a treatment in randomized block design. The observations were recorded on various parameters, viz plant height, number of leaves, number of lateral shoots, plant spread, number of spray, number of tubers, number of days required for bud initiation, first flower bud break, complete flower opening, flowering duration, freshness of the flower on the plant under field, flower diameter, flowers/plant, average weight of flower, flower weight/plant, flower colour, cost of production, flower yield, number of tubers, gross returns, net returns/ha and B:C ratio. The data were recorded on 5 plants and all the mean value of the recorded data were statistically analyzed as per the method suggested by Gomez and Gomez (1984) at 5% level of significance and tabulated.

Out of the 9 cultivars evaluated for their vegetative parameter (Table 1), the maximum plant height was recorded in cv. 'Black Out' (8.61 cm), followed by 'DRS' (6.77 cm) at 30 days after transplanting while at 60 days after transplanting as it was maximum in cv. 'DRS' (27.71 cm), followed by 'Jyotsna' (18.81 cm). At 90 days after transplanting maximum plant height was found in cv. 'DRS' (52.86 cm), followed by 'Jyotsna' (45.89 cm). This variation in plant height among various cultivars may be due to the hereditary traits and may be due to the effect of prevailing environmental condition which resulted in varied growth rate. The result revealed that there was a significant difference in number of leaves/plant was recorded among all the cultivars at 30, 60 and 90 days after transplanting. The maximum number of leaves/plant were recorded in cultivar 'NT Pompon' (10.1), followed by 'DRS' (8.0) at 30 days after transplanting. Maximum number of leaves/plant were recorded in 'NT Pompon' (22.87), followed by 'Korean Blue' (22.13) at 60 days after transplanting, while minimum in

*Short note

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Table 1 Vegetative growth of dahlia cultivars under sub-humid southern plains and Aravalli hills of Rajasthan (based on pooled mean of 2 years)

Cultivar	Plant height (cm)			Number of leaves			Lateral shoots/ plant	Plant spread		No. of spray/ plant	No. of tubers/ plant
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT		(N–S)	(E–W)		
'Black Out'	8.61	16.09	31.29	6.8	19.07	39.20	5.07	34.00	35.85	8.87	3.27
'DRS'	6.77	27.71	52.86	8.0	21.00	48.67	5.73	37.49	40.66	10.13	3.13
'Jyotsna'	6.10	18.81	45.89	5.5	16.73	58.13	4.80	55.10	52.23	10.53	4.60
'Korean Bicolour'	4.53	10.53	24.79	4.7	15.60	30.53	3.73	32.10	34.30	6.87	2.73
'Korean Blue'	5.12	15.45	34.13	5.0	22.13	51.67	5.13	48.55	47.98	10.27	2.80
'Korean Orange'	4.07	9.89	24.84	5.4	14.53	28.20	3.60	27.43	29.51	6.40	2.27
'Korean Yellow'	4.61	12.28	23.76	6.4	14.93	28.87	4.47	24.94	25.15	8.13	2.87
'Korean White'	5.71	14.13	23.67	6.2	16.80	27.80	5.07	26.48	27.53	6.47	2.80
'NT Pompon'	6.45	17.25	43.97	10.1	22.87	52.13	6.07	48.77	50.87	11.67	6.73
SEm±	0.62	1.80	3.14	0.95	1.92	2.70	0.44	1.80	2.36	0.65	0.44
CD (*P*=0.05)	1.86	5.39	9.41	2.85	5.77	8.09	1.32	5.39	7.07	1.94	1.33

Table 2 Floral and yield parameters of dahlia cultivars under sub-humid southern plains and Aravalli hills of Rajasthan (based on pooled mean of 2 years)

Cultivar	Bud initiation (days)	Bud break (days)	Complete flower opening (days)	Flowering duration (days)	Freshness (days)	No of flowers/ plant	Flower diameter (cm)	Weight of flower (g)	Flower weight/ plant (g)	Flower colour
'Black Out'	95.60	29.73	8.87	89.00	6.13	16.07	16.56	62.69	1008.78	Blackish-red
'DRS'	91.67	30.27	7.47	86.47	5.93	16.73	16.05	54.63	929.13	Purple-white tip
'Jyotsna'	81.60	22.40	9.57	77.13	5.00	16.40	17.79	56.05	936.26	Purple
'Korean Bicolour'	91.53	30.53	8.47	77.93	5.60	15.07	11.96	31.59	476.38	Red-white
'Korean Blue'	101.47	27.60	7.00	77.07	4.73	26.80	12.46	25.93	694.46	Sky blue
'Korean Orange'	95.60	30.53	6.77	59.13	6.57	16.13	17.61	44.01	716.71	Orange
'Korean White'	96.87	31.33	6.80	85.87	5.40	8.13	14.65	48.85	395.55	White
'Korean Yellow'	95.80	29.33	6.30	76.47	4.80	8.80	19.66	48.18	421.79	Yellow
'NT Pompon'	88.33	27.90	8.73	90.73	7.73	60.40	11.20	17.77	1 072.56	Red
SEm±	3.51	1.21	0.49	1.70	0.52	1.16	0.49	1.58	65.38	
CD (*P*=0.05)	10.52	3.63	1.49	5.10	1.55	3.48	1.47	4.75	196.00	

Table 3 Relative economics of dahlia cultivars used under study

Cultivar	Yield/ha		Gross returns (Rs/ha)	Net returns (Rs/ha)	B : C ratio
	Flowers yield (tonnes)	Number of tubers			
Black Out	14.944	48 441.78	2 94 766.0	176 209.0	1.49
DRS	13.764	46 367.82	2 76 744.8	158 187.8	1.33
Jyotsna	13.870	68 144.40	3 43 130.8	224 573.8	1.89
Korean Bicolour	7.057	40 442.22	1 91 897.6	73 340.59	0.62
Korean Blue	10.288	41 479.20	2 27 314.9	108 757.9	0.92
Korean Orange	10.617	33 627.78	2 07 056.8	88 499.76	0.75
Korean Yellow	6.248	42 516.18	1 90 032.5	71 475.51	0.60
Korean White	5.860	41 479.20	1 83 034.4	64 477.38	0.54
NT Pompon	15.889	99 698.22	4 57 983.7	339 426.7	2.86

Selling price of flower, Rs 10 000/tonnes; tuber, Rs 3/tuber

'Korean Orange' (14.53). Whereas at 90 days after transplanting maximum number of leaves/plant was recorded in 'Jyotsna' (58.13), followed by 'NT Pompon' (52.13), while minimum value in cv 'Korean White' (27.80). The variation in number of leaves among different cultivars at different stage might be due to the distinguished varietal genetic make up of a particular cultivar as a result, variations in phenotypic expression are expected to occur under prevailing environmental condition. Hence, wide variations for vegetative characters are observed. Similar results were found by Ram *et al*.(2005) in gladiolus.

The highest number of lateral shoots/plant was recorded in cultivar 'NT Pompon' (6.07), while lowest value was recorded in cultivar 'Korean Orange' (3.60). The results indicated that a significant difference among different cultivar with respect to the number of lateral shoots produced after pinching. Being genetically controlled factor variation occurred due to the hereditary traits of different cultivars, hence after pinching apical dominance was removed which resulted in maximum number of lateral shoots in different varieties. Similar findings were noted by Kulkarni and Reddy (2007) in chrysanthemum.

Plant spread character for north-south ranges from 'Korean Yellow' (24.94 cm) to 'Jyotsna' (55.10 cm), while east-west value ranges from 'Korean Yellow' (25.15 cm) to 'Jyotsna' (52.23 cm). This plant spread was increased mainly due to production of increased number of branches with leaves and wider angles with point of origin which results in maximum photosynthesis. Greater plant spread shows better vegetative growth of the plant. Similar results were reported by Poonam and Kumar (2007) in Chrysanthemum.

The maximum number of spray/plant was recorded in cultivar 'NT Pompon' (11.67) which was at par with cv 'Jyotsna' (10.53), while minimum number of spray/plant was noted in cultivar 'Korean Orange' (6.40). In Crossandra similar findings were recorded by Aswath *et al.* (2007).

The maximum value for number of tubers/plant was recorded in cultivar 'NT Pompon' (6.73), while minimum value for number of tubers/plant was observed in cultivar 'Korean Orange' (2.27). This variation in number of tubers/plant may be due to the distinguished genetic make-up, plant morphological characters like size, number of leaves, number of flowers and prevailing environmental conditions which affects the growth and yield of tubers. Similar findings were recorded by Baweja and Brahma (2003), Ram *et al*. (2005) in gladiolus and Jhon and Khan (2002) in tulip.

Out of the 9 cultivars evaluated for their floral parameter (Table 2), among the varieties bud initiation was earlier in case of 'Jyotsna' (81.60 days) which was at par with cultivar 'NT Pompon' (88.33 days), where as it was very late in 'Korean Blue' (101.47 days). Cultivars, viz 'Jyotsna' and 'NT Pompon' were earliest in flower bud initiation. The variation in number of days required for first bud initiation was primarily due to the different genetic constitution of various cultivar and prevailing environmental conditions during the period of crop growth.

The number of days required for first flower bud break (petals start unfurling) ranged from a minimum in 'Jyotsna' (22.40 days) to a maximum in 'Korean White' (31.33 days). This variation in number of days required for opening of first flower bud in various cultivars of dahlia may be due to different genetic make-up and prevailing environmental conditions.

The minimum days required for complete flower opening after bud break was in cultivar 'Korean Yellow' (6.30 days), followed by 'Korean Orange' (6.77 days), while maximum value in the cultivar 'Jyotsna' (9.57 days), followed by cultivar 'NT Pompon' (8.73 days). This variation may be attributed because of varied genetic make-up of different cultivars along with prevailing environmental conditions. Similar findings were also noted by Mohanty *et al.* (2002) in marigold; Kumar and Yadav (2005) in gerbera.

The flowering duration showed significant variation ranging from a minimum in 'Korean Orange' (59.13 days) to a maximum in 'NT Pompom' (90.73 days), while cultivar 'Korean Bicolour', 'Jyotsna', 'Korean Blue' and 'Korean Yellow' were at par with each other. Similar results were found by Mishra *et al*. (2001) in dahlia. This variation in duration of flowering among various cultivars of dahlia may be due to different genetic make-up, which might be further modified by the prevailing environmental conditions during the field trial.

The freshness of flower on the plant under field condition ranges from a minimum in cv 'Korean Blue' (4.73 days) to a maximum in cv 'NT Pompon' (7.73days), while cultivar 'Korean Orange', 'Black Out' and 'DRS' were statistically at par with each other. This variation in dahlia cultivars may be due to different genetic make up of cultivar, combinely affected by the prevailing environmental condition which, affects physiological processes of the plant like cell turgidity, water loss through evapotranspiration and breakdown of the reserve food which reduces the freshness of the flower under field condition.

The maximum number of flowers/plant was recorded in cv 'NT Pompon' (60.40), while the minimum value was observed in 'Korean White' (8.13), while cultivar 'Korean White' and 'Korean Yellow' were statistically at par with each other. The variation in number of flowers/plant may be due to genetic variability among the different cultivars of dahlia, which were tested under this trial. Another probable reason for this variation in number of flowers/plant may be due to the effect of environmental condition prevailing during field trial. Similar results were noted by Mishra *et al*. (2001).

The maximum flower diameter was recorded in cv 'Korean Yellow' (19.66 cm), while minimum value for flower diameter was recorded in cv. 'NT Pompon' (11.20 cm), while cultivar 'Korean Orange' and 'NT Pompon' were statistically significant with each other. Similar findings were obtained

by Mishra *et al*. (2001). Variation in diameter of flower is mainly due to the genetic make-up, which might have been further modified by the environmental condition prevailing during the time of experiment.

The maximum weight/flower was recorded in cultivar 'Black Out' (62.69 g), while a minimum value in cultivar 'NT Pompon' (17.77 g) while, 'Korean White' and 'Korean Yellow' were statistically at par with each other. Variation in flower weight might be due to different genetic make-up of the different cultivars. Similar results were obtained by Sarkar and Ghimiraj (2004), Kumar and Yadav (2005) in gerbera and Aswath *et al*. (2007) in crossandra.

The flower weight/plant was ranged from a minimum value in cv. 'Korean White' (395.55 g) to a maximum in cv 'NT Pompon' (1072.56 g), while the cultivar 'NT Pompon', 'Black Out' and 'Jyotsna' were at par with each other. The results showed significant differences among different dahlia cultivars for the parameter flower weight/plant. The different genetic make-up of the cultivar contributed different growth and yield-attributing character for flower weight/plant in cultivars of dahlia. Thus, cultivar 'NT Pompon', 'Black Out' and 'Jyotsna' were found heavy yielder. Similar finding was noted by Aswath *et al.* (2007) in *Crossandra undulaefolia*.

The variation in flower colour among distinct cultivars used for study showed different colours according to genetic makeup and colouring pigment present in a particular variety. Red colour of flower is due to presence of *anthocyanin* pigment in 'NT Pompon' and 'Black Out', orange colour is due to presence of anthocyanin on yellow background in 'Korean Orange', yellow colour of flower is due to *chalcones* and *aurones* colouring matter in 'Korean Yellow'. It has also reported that white colour of flower is due to flavonols and carotenoid pigment in 'Korean White', while purplish in 'Jyotsna' and 'DRS' and bluish colour in 'Korean Blue' is due to presence of cyanidin pigment. The bicolour of flower is due to mixing of two different monochrome coloured pigments in cultivar 'Korean Bicolour' as reported by Bhattacharjee (2006) in dahlia.

Relative economics were calculated for different cultivars under study (Table 3) revealed that cultivar 'NT Pompon' was found best with a gross income of Rs 457 983.7 on the basis of flower yield 15.889 tonnes and number of tubers 99 698.22/ ha. The selling price for 1 tonne of flower and/tuber was Rs 10 000 and 3, respectively. So the maximum net income of Rs 339 426.7/ha was obtained from cultivar 'NT Pompon', while the cost of cultivation was Rs 118 557/ha. Among various cultivars the net returns/Re investment (B:C ratio) was maximum, i e Rs 2.86 in cultivar 'NT Pompon', while it was minimum in 'Korean White', ie Rs 0.54.

SUMMARY

An investigation was carried out with 9 cultivars of *Dahlia variabilis* L. at Horticulture Farm, Department of Horticulture, RCA Campus, MPUAT, Udaipur during winter season 2006–08 to evaluate the cultivars for vegetative, floral and relative economics parameter. The experiment was laid out in randomized block design with 3 replications by planting 12 plants/replication and data were recorded on 5 plants for various parameters. The data were analyzed by analysis of variance technique. The maximum value for plant height at 30, 60, and 90 days after transplanting were recorded in. 'Black Out' (8.61 cm), 'DRS' (27.71, 52.86 cm), respectively. The maximum number of leaves at 30, 60 and 90 days after transplanting were obtained in cv. 'NT Pompon' (10.1, 22.87) and 'Jyotsna' (58.13). While, maximum plant spread were recorded in 'Jyotsana' for north-south (55.10 cm) and east-west (52.23 cm), similarly, number of lateral shoots (6.07), number of spray (11.67), and number of tubers/ plant (6.73) in 'NT Pompon'. Minimum days required for flower bud initiation (81.60 DAT) and bud break (22.40 DAI) were recorded in cultivar 'Jyotsna' and complete flower opening (6.30 DAB) was recorded in cultivar 'Korean Yellow'. The maximum flowering duration (90.73 days) was recorded in cultivar NT Pompon. The maximum freshness of flower (7.73 days) on plant under open field condition was recorded in cultivar 'NT Pompon'. The maximum number of flowers/plant (60.40), flower diameter (19.66 cm) and average weight of flower, (62.69 g) were recorded in cultivar 'NT Pompon', 'Korean Yellow' and 'Black Out' respectively. In cultivar 'NT Pompon' minimum flower diameter (11.20 cm) and flower weight (17.77 g/flower) were recorded. The maximum flower weight/plant (1072.56 g) was recorded in cultivar 'NT Pompon'. On the basis of data recorded for vegetative, floral and relative economics parameters cv. 'NT Pompon' for cut flowers and 'Jyotsna' were found best for exhibition/standard purposes under Udaipur condition.

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CORRECTION

In volume 79, issue 5 on page 395 the Table 1 may please be read as:

Table 1 Estimates of general combining ability effects for 07 yield and drought tolerance related traits under normal (E_1) and moisture-stress (E_2) environmental conditions for the years 2003–04 and 2004–05 (Y_1, Y_2)

Parents	Tillers/plant						Grain yield/plant						Flag leaf area					
	E_1			E_2			E_1			E_2			E_1			E_2		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
'PWB 175'	0.81	1.05	0.93*	0.41	0.41	0.45*	3.39	3.27	3.33*	2.49	2.39	2.44*	2.14	2.80	2.47*	1.11	1.41	1.21*
'RSP 81'	1.59	1.17	1.38*	1.29	1.01	1.15*	1.29	1.13	1.21*	1.73	1.57	1.65*	3.45	4.17	3.81*	2.81	3.25	3.03*
'PWB 500'	3.31	4.21	3.76*	0.17	0.21	0.19	2.93	2.85	2.89*	0.30	0.26	0.28	0.53	0.47	0.50	0.49	0.44	0.46
'K 9943'	3.19	3.67	3.43*	0.16	0.19	0.18	3.23	3.11	3.17*	0.27	0.30	0.29	0.56	0.53	0.54	0.50	0.44	0.47
'HUW 576'	2.91	2.65	2.78*	0.20	0.17	0.19	1.29	1.21	1.25*	2.65	2.53	2.59*	0.51	0.49	0.50	0.46	0.43	0.44
'RSP 303'	1.39	1.31	1.35*	–0.61	–0.37	–0.49*	2.99	2.87	2.93*	–1.99	–1.85	–1.92*	–1.31	–1.45	–1.38*	2.69	3.19	2.94*
'WH 542'	1.93	2.13	2.03*	–0.31	–0.23	–0.27*	2.05	1.89	1.97*	–2.24	–2.02	–2.13*	–2.57	–2.89	–2.73*	3.11	3.55	3.33*
'RSP 312'	2.11	2.49	2.30*	–0.79	–0.65	–0.72*	2.39	2.23	2.31*	–2.23	–2.09	–2.16*	–3.00	–3.06	–3.03*	1.23	1.51	1.37*
S.E. ($\hat{g}i$)	0.28	0.30	0.28	0.09	0.11	0.10	0.14	0.18	0.16	0.16	0.14	0.15	0.29	0.29	0.29	0.28	0.23	0.25
S.E. ($\hat{g}i$–$\hat{g}i$)	0.43	0.45	0.44	0.14	0.18	0.16	0.21	0.27	0.24	0.25	0.21	0.23	0.44	0.44	0.44	0.43	0.35	0.39

	Harvest index						Relative water content (%)			DSI			Proline content					
	E_1			E_2			E_2						E_1			E_2		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
'PWB 175'	0.97	0.91	0.94	0.71	0.65	0.68	4.11	3.61	3.86*	0.02	0.02	0.02	0.15	0.07	0.11*	0.17	0.11	0.14*
'RSP 81'	1.01	0.83	0.92	0.65	0.61	0.63	3.61	3.15	3.38*	0.14	0.06	0.10*	–0.12	–0.06	–0.09*	0.09	0.05	0.07
'PWB 500'	1.03	1.00	1.01	0.72	0.65	0.68	0.47	0.48	0.47	–0.09	–0.05	–0.07*	–0.19	–0.13	–0.16*	0.06	0.12	0.09*
'K 9943'	3.19	3.71	3.45*	2.75	2.43	2.59*	0.42	0.46	0.44	–0.013	–0.05	–0.09*	–0.07	–0.05	–0.06	0.08	0.06	0.07
'HUW 576'	2.01	2.37	2.19*	4.00	4.18	4.09*	3.41	3.69	3.55*	0.34	0.20	0.27*	–0.17	–0.09	–0.13*	0.19	0.12	0.15*
'RSP 303'	5.87	6.21	6.04*	–2.44	–3.00	–2.72*	0.51	0.43	0.47	0.01	0.01	0.01	0.07	0.05	0.06	0.06	0.04	0.05
'WH 542'	3.19	3.93	3.56*	0.72	0.68	0.70	6.14	5.28	5.71*	–0.17	–0.09	–0.13*	0.05	0.05	0.05	0.19	0.13	0.16*
'RSP 312'	3.47	3.87	3.67*	–3.83	–4.21	–4.02*	5.19	4.49	4.84*	–0.14	–0.06	–0.10*	0.06	0.07	0.07	0.25	0.17	0.21*
S.E. ($\hat{g}i$)	0.53	0.51	0.52	0.37	0.35	0.36	0.26	0.24	0.25	0.02	0.02	0.02	0.04	0.06	0.05	0.05	0.05	0.05
S.E. ($\hat{g}i$–$\hat{g}i$)	0.20	0.79	0.79	0.55	0.55	0.55	0.39	0.39	0.38	0.04	0.04	0.04	0.06	0.12	0.09	0.08	0.10	0.09

*Significant at P=0.05 level of significance

In volume 79, issue 7 on page 527 the authors of the article, 'Validation and popularization of integrated pest management technology in cotton (*Gossypium hirsutum*), may please be read as O P Ameta[1], G K Bunker[2] and O M Bambawale[3] in place of O P Ameta[1] and G K Bunker[2]