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Morphological diversity analysis among watermelon (*Citrullus lanatus* (Thunb) Mansf.) genotypes

B.R. Choudhary, Sudhakar Pandey and P.K Singh
Indian Institute of Vegetable Research-Seed Production Centre, Kushinagar (UP) 274 406
Email : *sudhakariivr@yahoo.com*

ABSTRACT

A study was carried out during summer season of 2009 and 2010 to determine variability, heritability, genetic advance, correlation, path analysis and genetic divergence in watermelon for eleven quantitative characters. The TSS (89.5%) had maximum heritability followed by rind thickness (81.7%), days to first fruit harvest (81.2%), number of primary branches per plant (80.7%), fruit yield per plant (79.7%), node at which first female flower appeared (79.3%) and main vine length (79.0%) which provides ample scope for varietal improvement through selection. Significant positive correlation was found between fruit yield per plant and node at which first female flower appeared (0.440), number of primary branches per plant (0.342), fruit weight (0.339) and number of fruits per plant (0.077). The maximum direct effect on fruit yield per plant was exerted by fruit weight had maximum positive direct effect (1.023) at phenotypic level followed by number of fruits per plant (0.862). Therefore, selection should be practices on these characters these characters in breeding programme of watermelon.

KEY WORDS : Watermelon , Morphological, diversity, genotypes

INTRODUCTION

Watermelon (*Citrullus lanatus* (Thunb) Mansf.) belongs to the family Cucurbitaceae and it's the only cultivated species of genus *Citrullus* (Bisnonin, 2002). It is a popular dessert crop throughout the tropics and the Mediterranean regions of the world (Tindall, 1983). It is vital for plant breeding programmes to have sufficient diversity to produce new varieties that are aimed towards high productivity, quality, appearance traits such as shape and colour and able to withstand damage from biotic and abiotic factors (Wehner *et al.*, 2001). High genetic variation exists in watermelon due to high degree of cross pollination. Some genotypes may be superior in certain traits but lacking in other aspects. Their morphological characteristics may also be different. Therefore, morphological characterization can be an effective means to determine genetic relatedness among cultivars and among selections used in watermelon breeding programmes. The evaluation of available variability and its characterization is necessary for planning a vital breeding programme. The objective of this study was to determine the genetic variation, heritability and character association among yield components in watermelon cultivars and genotypes to select desirable genotypes.

MATERIALS AND METHODS

The experimental material consisted of twenty six diverse genotypes selected from land races on the basis of yield performance and quality parameters and four commercial cultivars of watermelon. Twenty six land races of watermelon have been collected from different parts of Uttar Pradesh (Varanasi, Shahjahpur, Bareilly) and Rajasthan (Jaipur, Tonk) during 2006. The collected material was selfed for three consecutive seasons to make each line homogenous. Four commercial cultivars viz., Sugar Baby from IARI, New Delhi, Arka Manik from IIHR, Bangalore, Durgapura Lal and Durgapura Meetha from ARS, Durgapura were also included in the study. The experiment was laid out in a Randomized Block Design (RBD) with three replications at Experimental Farm of IIVR Seed Production Centre, Kushinagar (UP). Experiments were conducted between February and June in the years 2009 and 2010 and evaluated for eleven quantitative and five qualitative traits of watermelon. The seeds were directly sown in the field at a spacing of 2.50m between rows and 0.75cm within rows. All standard agronomic practices including fertilization, irrigation, weeding, top dressing and plant protection measures were followed uniformly to maintain proper plant stand and healthy crop. Data was collected on morphological (both qualitative and quantitative) characters of watermelon which include vine, leaf, flower, fruit and seed characteristics. The observations on quantitative traits were recorded on five randomly tagged plants per accession from every replication on main vine length (cm), number of primary branches/ plant, node at which Ist female flower appeared, days to appearance of Ist female flower, days to first fruit harvest, fruit weight (kg), number of fruits per plant, rind thickness (cm), number of seeds per fruit, TSS and fruit yield per plant (kg). Data on quantitative traits of both the years were averaged and statistically analyzed for genotypic and phenotypic coefficient of variation (Burton, 1952), heritability (Hanson *et al.*, 1956) and genetic advance (Johnson *et al.*, 1955). Phenotypic and genotypic correlation coefficient was calculated following A1-Jibouri *et al.* (1958) and path analysis following the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among 30 genotypes for all the characters (Table 1). Variation in quantitative characters (Table 2) was found significant among the genotypes. Qualitative characters that were evaluated include leaf shape, ovary colour, fruit shape, rind colour and flesh colour summarized in Table 3. The leaf shape was found to be pentalobate in all the genotypes except Durgapura Lal which was found to be non-lobed (Yadav and Luthra, 2005). VRW-3 is a unique watermelon line having yellow

Table 1: Analysis of variance

Source of variation	d.f.	Main vine length (cm)	Primary branches /plant	Node at which Ist female flower appeared	Days to appea-rance of Ist female flower	Days to first fruit harvest	Fruit weight (kg)	Fruits/ plant	TSS (%)	Seed/ fruit	Rind thickness (mm)	Yield/ plant (kg)
Replication	2	0.11	0.25	0.46	9.92	26.41	0.15	0.35	0.43	1095.00	0.98	5.73
Treatment	29	1.49*	2.91**	70.93**	56.80**	159.28**	6.14**	1.38*	19.76**	97908.82**	43.01**	57.34**
Error	58	0.12	0.21	5.69	8.09	11.39	0.94	0.53	1.37	3037.25	1.62	4.50

*P=0.005 and **P=0.001

Table 2: Mean performance of 30 genotypes

Genotypes	Main vine length (cm)	Primary branches / plant	Node at which Ist female flower appeared	Days to appearance of Ist female flower	Days to first fruit harvest	Fruit weight (kg)	Fruits/ plant	TSS (%)	Seed/ fruit (mm)	Rind thickness	Yield/ plant (kg)
VRW-1	3.30	4.00	17.07	52.07	84.93	3.90	1.87	12.27	365.60	12.27	7.20
VRW-2	4.03	4.20	18.47	53.80	85.53	4.47	2.27	8.40	500.40	12.27	9.88
VRW-3	2.50	4.67	16.27	56.87	82.40	3.04	4.33	10.67	267.40	15.00	13.16
VRW-4	4.07	5.67	25.60	56.73	90.93	5.66	3.00	9.67	675.33	18.27	16.95
VRW-5	3.70	5.13	23.60	59.87	94.40	4.45	3.27	15.00	823.40	10.60	14.14
VRW-6	3.70	5.60	21.67	57.87	89.60	4.67	3.87	13.40	676.73	10.13	17.81
VRW-7	3.37	6.40	27.40	56.53	85.93	4.89	3.93	7.80	893.40	18.13	19.11
VRW-8	3.30	4.93	20.33	53.87	86.73	6.66	3.47	12.60	601.53	18.20	22.55
VRW-9	5.00	6.60	29.80	60.87	93.67	3.81	3.00	17.20	644.00	10.33	11.67
VRW-10	3.37	5.53	25.07	59.53	92.13	5.23	3.20	14.33	507.20	9.07	15.87
VRW-11	4.37	6.80	16.87	60.53	91.33	4.74	4.20	15.07	717.13	10.53	19.07
VRW-12	4.87	7.33	18.53	56.53	92.93	7.22	2.93	15.40	155.67	12.67	21.21
VRW-13	3.60	4.87	23.47	55.53	82.00	6.07	2.93	15.07	433.53	12.73	17.54
VRW-14	5.17	6.27	22.53	50.07	79.67	4.38	3.20	8.67	251.53	9.47	13.51
VRW-15	4.57	6.93	24.93	50.07	82.60	2.97	4.20	8.60	700.00	10.27	11.93
VRW-16	3.63	6.00	20.80	49.33	78.33	3.86	3.47	11.67	500.60	17.80	12.74
VRW-17	3.33	7.67	18.93	54.20	87.00	3.13	4.40	13.73	712.60	9.40	13.41
VRW-18	3.27	6.13	23.40	53.40	92.73	5.34	3.47	14.47	642.40	13.67	18.08
VRW-19	4.73	4.67	30.20	60.67	100.33	7.46	2.53	12.40	432.33	11.67	18.46
VRW-20	4.57	7.27	17.93	46.27	77.13	6.13	3.73	10.87	500.47	19.47	21.71
VRW-21	5.00	6.73	23.80	52.73	89.53	6.60	3.47	10.20	419.33	20.27	21.79
VRW-22	4.40	5.60	32.80	60.93	95.53	7.63	2.53	16.20	362.13	18.53	18.43
VRW-23	4.40	6.60	26.13	50.33	74.67	3.50	3.27	13.60	552.53	10.73	10.93
VRW-24	3.73	5.80	24.87	48.20	69.53	3.76	3.07	9.27	752.27	21.67	10.94
VRW-25	4.33	5.87	17.40	47.13	75.20	7.03	2.60	15.53	632.80	13.13	17.71
VRW-26	4.83	7.27	35.07	58.00	87.07	6.32	3.67	10.47	582.20	19.93	22.75
Sugar Baby	2.97	6.07	17.20	50.53	83.20	2.87	2.73	10.33	286.13	13.13	7.77
Arka Manik	3.20	7.47	20.33	57.67	91.93	5.95	2.40	12.40	296.07	14.40	14.25
Durgapura Lal	3.37	6.67	22.20	54.07	91.27	5.01	2.33	12.20	498.60	12.53	11.43
Durgapura Meetha	3.43	6.33	19.60	58.33	96.80	6.35	2.13	12.40	472.87	12.47	13.44
CD (P=0.05)	0.58	0.77	3.95	4.71	5.59	1.61	1.21	1.94	91.35	2.11	3.51

Table 3: Qualitative traits of watermelon genotypes

Genotype /variety	Leaf shape	Ovary colour	Fruit shape	Rind colour	Flesh colour
VRW-1	Pentalobate	Green	Round	Uniform dark green	Bright red
VRW-2	Pentalobate	Light green	Oblond	Light green with deep green wide stripes	Yellow
VRW-3	Pentalobate	Yellow	Round	Yellow with light yellow lines	Red purple
VRW-4	Pentalobate	Dark green	Round	Uniform blackish	Red
VRW-5	Pentalobate	Green	Round	Whitish green devoid of stripes	Yellow
VRW-6	Pentalobate	Green	Oval	Green with dull green stripes	Red
VRW-7	Pentalobate	Light green	Oblong	Light green with deep green wide stripes	Bright red
VRW-8	Pentalobate	Dark green	Round	Uniform deep blue	Red
VRW-9	Pentalobate	Green	Oblong	Uniform dark green	Crimson red
VRW-10	Pentalobate	Dark green	Round	Uniform bluish black	Red
VRW-11	Pentalobate	Light green	Oblong	Whitish green with green narrow stripes	Bright red
VRW-12	Pentalobate	Dark green	Oblong	Uniform dark green	Light yellow
VRW-13	Pentalobate	Green	Round	Whitish green with dark green narrow stripes	Red
VRW-14	Pentalobate	Light green	Round	Light green with dark green lines	Bright yellow
VRW-15	Pentalobate	Green	Round	Uniform dark green	Red
VRW-16	Pentalobate	Green	Round	Light green dark green with lines	Red
VRW-17	Pentalobate	Green	Round	Uniform whitish green	Red
VRW-18	Pentalobate	Dark green	Round	Green with dark green stripes	Yellow
VRW-19	Pentalobate	Dark green	Oblong	Deep green	Red
VRW-20	Pentalobate	Green	Round	Green with narrow stripes	Red
VRW-21	Pentalobate	Green	Oblong	Light green with dark green stripes	Crimson red
VRW-22	Pentalobate	Green	Round	Uniform bluish black	Red
VRW-23	Pentalobate	Light green	Round	Light green with wide stripes	Light red
VRW-24	Pentalobate	Light green	Oval	Whitish green	Red
VRW-25	Pentalobate	Dark green	Round	Bluish black	Bright red
VRW-26	Pentalobate	Dark green	Round	Dark green with stripes	Red
Sugar Baby	Pentalobate	Dark green	Round	Uniform bluish black	Red
Arka Manik	Pentalobate	Dark green	Oval	Green with dark green stripes	Deep crimson
Durgapura Lal	Non-lobed	Dark green	Round	Dark green with dark lining	Dark red
Durgapura Meetha	Pentalobate	Light green	Round	Light green with dark lining	Red

Table 4. Range, mean, variability, heritability and genetic advance

Characters	Range	Mean	Variability		Heritability (h^2)	Genetic advance
			PCV	GCV		
Main vine length (cm)	3.20-5.17	3.94	19.32	17.17	79.0	1.24
Primary branches /plant	4.00-7.67	6.03	17.48	15.71	80.7	1.75
Node at which Ist female flower appeared	16.27-35.07	22.74	23.03	20.51	79.3	8.55
Days to appearance of Ist female flower	46.27-60.93	54.75	9.01	7.36	66.7	6.78
Days to first fruit harvest	69.53-100.33	86.83	8.97	8.09	81.2	13.04
Fruit weight (kg)	2.87-7.63	5.10	32.06	25.80	64.7	2.18
Fruits/plant	1.87-4.40	3.18	28.41	16.73	34.7	0.65
TSS (%)	7.80-17.20	12.33	22.21	20.08	81.7	4.61
Seed/fruit	155.67-893.40	528.54	35.22	33.65	91.2	349.91
Rind thickness (mm)	9.07-21.67	13.96	28.13	26.61	89.5	7.24
Yield/plant (kg)	7.20-22.75	15.51	30.31	27.05	79.7	7.72

Table 5: Estimates of genotypic (rg) and phenotypic (rp) correlation coefficients

Traits	Main vine length (cm)	Primary branches / plant	Node at which Ist female flower appeared	Days to appearance of Ist female flower	Days to first fruit harvest	Fruit weight (kg)	Fruits/ plant	TSS (%)	Seed/ fruit	Rind thickness (mm)	Yield/ plant (kg)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	rg	0.342**	0.440**	-0.048	0.014	0.339**	0.077**	0.068	-0.035	0.027	0.386**
	rp	0.286*	0.411**	0.016	0.046	0.344**	-0.060	0.032	-0.054	0.013	0.294*
(2)		rg	0.079	-0.144	-0.016	0.017	0.481**	0.006	0.078	0.070	0.278*
		rp	0.097	-0.060	-0.018	0.008	0.232	0.070	0.069	0.035	0.197
(3)			rg	0.375**	0.258*	0.257*	0.080	0.055	0.262*	0.249	0.294*
			rp	0.419**	0.276*	0.269*	-0.085	0.015	0.209	0.208	0.204
(4)				rg	0.863**	0.289*	0.034	0.475**	0.055	-0.252*	0.279*
				rp	0.809**	0.254*	-0.111	0.334**	0.020	-0.207	0.159
(5)					rg	0.425**	-0.196	0.417**	-0.079	-0.263*	0.277*
					rp	0.403**	-0.231	0.298*	-0.064	-0.240	0.209
(6)						rg	-0.193	0.341**	-0.226	0.370**	0.856**
						rp	-0.498**	0.215	-0.191	0.273*	0.586**
(7)							rg	-0.197	0.527**	0.033	0.336**
							rp	-0.072	0.316*	0.060	0.359**
(8)								rg	-0.031	-0.382**	0.182
								rp	-0.012	-0.352**	0.137
(9)									rg	0.053	0.421**
									rp	0.038	0.103
(10)										rg	0.421**
										rp	0.379**

*P=0.005 and **P=0.001

Table 6: Direct (diagonal) and indirect effect of different traits on yield at genotypic (G) and phenotypic (P) level

Traits		Main vine length (cm)	Primary branches /plant	Node at which Ist female flower appeared	Days to appearance of Ist female flower	Days to first fruit harvest	Fruit weight (kg)	Fruits/ plant	Rind thickness (mm)	Seed/ fruit	Correlation with yield/ plant (kg)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	G	**0.057**	0.067	-0.064	-0.024	-0.006	0.357	0.017	-0.012	-0.006	0.386**
	P	**0.000**	-0.003	-0.001	0.000	0.000	0.352	-0.051	-0.001	-0.001	0.294*
(2)	G	0.020	**0.197**	-0.012	-0.072	0.007	0.018	0.108	-0.001	0.013	0.278*
	P	0.000	**-0.011**	0.000	0.000	0.000	0.008	0.200	-0.001	0.002	0.197
(3)	G	0.025	0.016	**-0.146**	0.187	-0.110	0.270	0.018	-0.010	0.044	0.294*
	P	0.000	-0.001	**-0.002**	-0.003	0.003	0.275	-0.073	0.000	0.006	0.204
(4)	G	-0.003	-0.028	-0.055	**0.498**	-0.368	0.304	0.008	-0.087	0.009	0.279*
	P	0.000	0.001	-0.001	**-0.007**	0.007	0.260	-0.096	-0.007	0.001	0.159
(5)	G	0.001	-0.003	-0.038	0.430	**-0.426**	0.447	-0.044	-0.076	-0.013	0.277*
	P	0.000	0.000	0.000	-0.006	**0.009**	0.412	-0.199	-0.006	-0.002	0.209
(6)	G	0.019	0.003	-0.037	0.144	-0.181	**1.052**	-0.044	-0.062	-0.038	0.856**
	P	0.000	0.000	0.000	-0.002	0.004	**1.023**	-0.429	-0.004	-0.005	0.586**
(7)	G	0.004	0.095	-0.012	0.017	0.083	-0.203	**0.226**	0.036	0.089	0.336**
	P	0.000	-0.003	0.000	0.001	-0.002	-0.509	**0.862**	0.001	0.009	0.359**
(8)	G	0.004	0.001	-0.008	0.236	-0.178	0.358	-0.044	**-0.182**	-0.005	0.182
	P	0.000	-0.001	0.000	-0.002	0.003	0.220	-0.062	**-0.020**	0.000	0.137
(9)	G	-0.002	0.015	-0.038	0.027	0.034	-0.238	0.119	0.006	**0.169**	0.092
	P	0.000	-0.001	0.000	0.000	-0.001	-0.195	0.273	0.000	**0.027**	0.103

*P=0.05 and **P=0.01. Residual effect at genotypic level = -0.013 and phenotypic level = 0.092

coloured ovary and rind with red purple flesh. It could be a useful parent for developing yellow rinded cultivars and hybrids of watermelon. Earlier Levi and Thomas, 2001; Wehner *et al.,* 2001; Yadav and Asathi, 2005; Gichimu *et al.,* 2009 also characterized the watermelon genotypes for different morphological traits. The extent of variability in watermelon genotypes was measured in terms of mean, range, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability and genetic advance (Table 4). The range of variation was higher for number of seeds per fruit (155.67-893.40) followed by fruit yield per plant (7.20-22.75 kg). The narrowest range was observed in main vine length (3.20-5.17). High magnitude of GCV was recorded in number of seed per fruit (33.65%) and fruit yield per plant (27.05). In most of the characters, the magnitude of difference between PCV and GCV were observed to be narrow except fruit weight and number of fruit per plant indicating less influence of environment on expression of these traits. The narrow difference between PCV and GCV was also reported by Thakur and Nandpuri, 1974; Prasad *et al.,* 1988; Krishna Prasad *et al.,* 2002 in muskmelon genotypes.

Heritability (in broad sense) was high (>70%) in number of seed per fruit (91.2%), TSS (89.5%), rind thickness (81.7%), days to first fruit harvest (81.2%), number of primary branches per plant (80.7%), fruit yield per plant (79.7%), node at which first female flower appeared (79.3%) and main vine length (79.0%). The characters like node at which first female flower appeared, days to first fruit harvest, rind thickness, fruit yield per plant and TSS having high GCA, heritability and genetic advance could be effectively used in selection on the basis of phenotypic performance (Johnson *et al.*, 1955). Thakur and Nandpuri (1974) observed quite high heritability (in broad sense) for fruit weight, number of fruits per plant, vine length, sex ratio, TSS, number of seeds per kg of fruit weight and 100-seed weight. Similarly, Krishna Prasad *et al.* (2002) also reported high heritability and genetic advance for yield per plot, number of nodes, days to appearance of female flower and number of fruits per plot.

Yield of watermelon is a result of interactions of a number of interrelated characters. Therefore, selection should be based on such component characters after assessing their correlation with yield. The correlation coefficients (Table 5) revealed that yield per plant had positive and highly significant correlation at phenotypic level with node at which first female flower appeared (0.440), number of primary branches per plant (0.342), fruit weight (0.339) and number of fruits per plant ((0.077). Thus, these characters should be kept in mind while making selection for yield improvement in watermelon. Positive correlation of fruit yield with main shoot length, number of primary branches per plant, number of fruits per plant, number of nodes per plant, number of female flowers per plant has also been reported by Sidhu and Brar, 1981; Singh and Singh, 1988; Prasad *et al.,* 1988; Gopal *et al.,* 1996; Rolania *et al.,* 2003.

The contribution of these characters was further analyzed by computing their direct and indirect effect on yield (Table 6). Among yield attributes, fruit weight had maximum positive direct effect (1.023) at phenotypic level followed by number of fruits per plant (0.862) and significant positive correlation with yield per plant. However, the days to first fruit harvest (-0.426) and node at which first female flower appeared (-0.146) has negative direct effect at genotypic level but significant positive association with yield per plant. These results are in confirmation with Singh and Brar, 1981; Singh and Singh, 1988; Gopal *et al.,* 1996; Rolania *et al.,* 2003.

In the light of above findings it may be concluded that improvement characters like number of fruits per plant and fruit weight will help in improving the yield of watermelon both directly and indirectly. Since these characters have high level of heritability and genetic advance, they can be considered dependable for improving the yield through selection. Few genotypes VRW-12, VRW-22, VRW-11, VRW-18 and VRW-25 were found promising in order as far as yield and other important yield contributing traits are concerned. Thus by exploiting the above listed genotypes selection against economic traits may be exercised for the improvement of watermelon.

REFERENCES

Al-Jibouri, H. A., Miller, P.A. and Robinson, H.F. 1958. Genotypic and environmental variances and co-variances in an upland cotton cross of interspecific origin. *Agron. J.* **50**: 633-636.

Bisognin, D.A. 2002. Origin and Evolution of Cultivated Cucurbits. *Ciencia Rural, Santa Maria.* **32**(5); 715-723.

Burton, G.W. 1952. Quantitative inheritance in grasses. In: *Proc. of 6th Int. Grassland Cong. J.* **1**: 277-283.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of yield component of the crested wheat grass seed production. *Agron. J.* **51**: 515-518.

Gichimu, B.M., Owuor, B.O., Mwai, N.G. and Dida, M. M. 2009. Morphological characterization of some wild and cultivated watermelon (*Citrullus sp.*) accessions in Kenya. *ARPN J. Agric. & Biol. Sci.* **4**(2): 10-18.

Gopal, Y.H., Shankar, C.R. and Reddy, K.B. 1996. Correlation and path analysis in watermelon. *New Botanist*, **23**(1-4): 97-101.

Hanson, G.H., Robinson, H.F. and Comstock, R.E. 1956. Biometrical studies of yield in segregating population of Korean Lispedeza. *Agron. J.* **48**: 268-271.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in Soybean. *Agron. J.* **47**: 314-318.

Krishna Prasad, V.S.R., Pichaimuthu, M. and Dutta, O.P. 2002. Adaptive response and diversity pattern in watermelon. *Indian J. Hort.* **59**(3): 298-306.

Levi, A. and Thomas, C.E. 2001. Low genetic diversity indicates the need to broaden the genetic base of cultivated watermelon. *Hort. Sci.* **36**(6): 1096-1101.

Prasad, L. Gautam, N.C. and Singh, S.P. 1988. Studies on genetic variability and character association in watermelon. *Veg. Sci.* **15**(1): 86-94.

Rolania, S., Fageria, M.S., Dhaka, R.S. and Jat, R.G. 2003. Correlation and path coefficient analysis in watermelon (*Citrullus lanatus* (Thunb) Mansf.). *Haryana J. Hort. Sci.* **32**(1-2): 113-116.

Sidhu, A.S. and Brar, J.S. 1981. Correlation and path coefficient analysis for yield, quality and earliness in watermelon (*Citrullus lanatus* Thunb). *Indian J. Agric. Sci.* **81**: 33-37.

Singh, N.K. and Singh, R.K. 1988. Correlation and path coefficient analysis in watermelon (*Citrullus lanatus* (Thunb) Mansf.). *Veg. Sci.* **15**(1): 95-100.

Thakur, J.C. and Nandpuri, K.S. 1974. Studies on variability and heritability of some important quantitative characters in watermelon (*Citrullus lanatus* (Thunb) Mansf.). *Veg. Sci.* **1**: 1-8.

Tindall, H.D. 1983. Vegetables in the tropics. The Macmillan Press Limited, London, pp. 150-152.

Wehner, T.C., Shetty, N.V. and Elmstrom, G.W. 2001. Breeding and seed production. In: D.N. Maynard (ed.). Watermelons: Characterization, production and marketing. ASHS Press, Alexandria, Va. pp. 27-73.

Yadav, R.K. and Asati, B.S. 2005. Correlation among fruit characters in indigenous germplasm lines of watermelon. *Haryana J. Hort. Sci.* **34**(1-2): 135-136.

Yadav, V.S. and Luthra, J.P. 2005. A promising simple non-lobed leaf marker watermelon genotype: RW-177-3. *Haryana J. Hort. Sci.* **34**(1-2): 137.

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