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Studies on genetic variability and scope of improvement in round melon under hot arid conditions

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ABSTRACT

Genetic variability, heritability, genetic advance and correlation coefficients components in round melon using eighteen land races/genotypes under hot arid environment were studied in order to identify desirable genotypes for crop improvement programme. On the basis of fruit quality characters along with more number of fruits and early yield per plant, the genotype AHRM-1 (1.91 kg), KPT-3, Arka Tinda and KCM/BKP 01 were observed to be most potential. The estimates of GCV were high for fruit yield and number of fruits/ plant and moderate for node to female flower appearance, fruit weight, number of seeds/fruit, plant height and number of branches/plant indicated better scope of improvement through selection. The genetic advance as percentage of mean ranged from 10.62 to 91.17. High estimates of heritability values accompanied with high genetic gain were observed for fruit yield/plant, number of fruits/plant, node to first female flower appearance, and number of seeds per fruit. A very strong positive and significant correlation was recorded between fruit yield per plant with number of fruits per plant (0.921) and vine length (0.808) indicating that effective improvement through these characters could be achieved in round melon. Negative and significant association of days to appearance of female flower and days to first harvest with number of fruits per plant which indicated that early genotypes bear more number of fruits per plant.

Key words: Round melon, genetic variability, correlations, arid environment.

INTRODUCTION

Some cucurbitaceous vegetables have local importance in their areas of occurrence. Round melon (*Praecitrullus fistulosus* Pang.), commonly called as *tinda* is a summer vegetable extensively grown in northwestern India. Its immature fruits are used in *rayata* or curry preparations. This short duration crop is becoming very popular in north India due to its high nutritional value, good taste and keeping quality, and high remunerative price. It may be an excellent export cucurbit vegetable from arid regions. With slight modification in production technology, its fruits could be made available for as long as eight months, *i.e.* from March to October. At present, the yield potential of round melon is very low compared to the other cucurbits grown in the arid region. This is due to non-availability of seeds of standard genotypes producing better quality fruits under the climatic conditions of north-western India (Samadia, 8).

Very little efforts has been made to the genetic studies in round melon. Hence, present investigation was undertaken to assess the nature and magnitude of available variability and association of yield with its contributing traits in round melon based on twenty important quantitative and qualitative characters, and to identify the desirable genotypes based on *per se* performance and to select promising donors for various characters which could be used in a hybridization programme to obtain useful recombinants and to create additional genetic variability.

MATERIALS AND METHODS

The study was conducted at Central Institute for Arid Horticulture (CIAH), Bikaner (28° N latitude and 73° 18 E longitude and an altitude of 235 m above mean sea level). The agro-climate is characterized by extremes of temperature (-4° C in winter to 48° C in summer), low rainfall (150-350 mm in short duration during July-September), high vapour pressure deficit (30 mb in May-June), high solar radiation, high wind speed (12-16 km/h) with dusty days, beside poor soil fertility and water holding capacity. Eighteen round melon genotypes of which 14 landraces collected from arid and semi-arid areas of Rajasthan and four potential genotypes were employed. The experiment was laid down during spring-summer season 2002 in a randomized block design with three replications. The seeds were sown at 0.50 m distance in row on one side of the channels of 10 m length for each genotype and channels were 2.5 m apart. Out of 15-18 plants maintained, the observations were recorded on five selected plants per replication for each entry on thirteen quantitative traits *viz.*, days to first male flower appearance (DFMF), days to first female flower appearance (DFFF) and days to first harvest (DFH) after sowing (DAS); node to male flower (NMF), node to female flower (NFF), fruit weight (FW, g), fruit length

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(FL, cm), fruit girth (FG, cm), number of fruits per plant (NF/P), fruit yield per plant (FY/P, kg), vine length (PH), number of branches/plant (NB/P) and number of seeds/ fruit (NS/F). To characterize and categorize the germplasm, important fruit quality and seed characters under extremes of climatic conditions were also recorded. Fruit characters were assessed at marketable stage to ensure better judgment on quality of fruits. The data were analyzed adopting standard statistical procedures using computer based INDOSTAT and IRRISTAT packages.

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant genotypic difference for all the quantitative thirteen characters depicting greater diversity in the experimental material (landraces/genotypes) under study (Table 1 and 3). The data on growth, maturity and fruit yield components are presented in Table 1 and on the fruit quality of the genotypes in Table 2. The period of appearances of first male and female flower ranged from 30.8 to 41.1 and 38.2 to 48.1 days after sowing (DAS) respectively. The range of days to first marketable harvest varied from 47.8 to 64.8 days from sowing. Among the genotypes, the earliest first fruit harvest (<55 days) was obtained in AHRM-1 (47.84 DAS) followed by Arka Tinda, KPT-3 and DPY 158. The number of fruits per plant ranged from 5.23 to 19.6. The genotype AHRM-1, KPT-3 Arka Tinda, PDVR-48, DPY-158 and KCM/BKP-01 recorded better number of fruits (>10) per plant. A wide range of variations for fruit quality characters at marketable stage *viz.*, fruit weight (71.4-137.5 g), fruit length (4.18-6.14 cm), fruit girth (14.45-21.47 cm) were recorded. Keeping the consumers preferences and marketable fruit quality indexing the genotype KCM/BKP-01, KCM/BKP-11, AHRM-1, PDVR-48, KPT-3 and Arka Tinda were found to be excellent in quality parameter. Among the tested genotypes, total marketable fruit yield/plant ranged from 0.48 to 1.91 kg with a population mean of 0.89 kg. The maximum fruit yield/plant was obtained in AHRM-1 (1.91 kg) followed by KPT-3, Arka Tinda, Bikaneri Green and PDVR-48 while minimum in DPY-128. On the basis of fruit quality characters along with higher number of fruits and early yield per plant, the genotypes AHRM-1, KPT-3, Arka Tinda and KCM/BKP 01 were found to be most potential. It is noteworthy that the landraces/ genotypes under evaluation were diverse and had great potential for further improvement in quality fruit yields under arid conditions.

The traits such as days to first female flower, node to first female flower and fruit set are the useful parameters indicating the earliness and also associated with the earliest higher yield in a genotype. Under arid

Table 1. Growth, flowering and fruit yield component characters of round melon germplasm under hot arid conditions.

Genotype	DFMF	NMF	DFFF	NFF	DFH	FW	FL	FG	NF/P	FY/P	PH	NB/P	NS/F
KCM/BKP 01	37.06	2.72	44.20	12.56	61.13	76.59	5.06	20.56	10.81	0.78	2.11	7.40	86.38
KCM/BKP 05	42.36	2.84	46.15	10.87	60.90	128.70	4.36	17.67	6.16	0.79	1.62	4.25	73.30
KCM/BKP 06	35.35	3.17	45.60	10.58	64.81	137.55	6.07	21.47	5.75	0.75	1.37	4.73	62.84
KCM/BKP 08	41.14	2.88	47.44	8.22	55.68	108.02	4.61	16.47	7.16	0.76	1.46	6.23	58.69
KCM/BKP 11	37.99	3.26	44.89	10.73	57.86	82.48	6.12	17.53	7.23	0.57	1.52	6.15	52.42
KCM/BKP 12	35.00	3.19	45.87	8.10	56.06	73.22	5.19	15.57	8.22	0.58	1.41	7.50	42.50
KCM/BKP 16	35.00	2.83	45.49	10.91	56.06	105.26	5.46	14.58	5.23	0.52	1.53	5.50	44.37
KCM/BKP 20	35.53	2.54	45.53	9.05	55.61	82.29	4.18	14.45	8.19	0.65	1.39	6.09	37.44
DPY 125	36.77	2.24	45.52	5.45	55.41	75.52	5.11	15.26	7.56	0.55	1.59	8.15	77.25
DPY 128	37.16	3.26	44.23	5.58	55.24	78.14	4.24	15.87	6.370	0.48	1.53	7.37	58.78
DPY 136	37.24	3.50	48.11	8.30	55.94	71.42	4.90	15.97	7.46	0.51	1.58	7.67	43.33
DPY 152	40.54	3.19	47.16	6.23	58.49	115.64	4.41	18.28	9.61	1.07	1.47	5.19	58.15
DPY 158	36.87	2.53	46.11	8.23	54.68	106.23	4.50	19.22	7.75	0.85	1.72	7.23	73.54
Bikaneri Green	38.76	3.15	47.01	13.27	58.20	112.49	5.25	17.84	11.37	1.28	1.54	7.51	64.64
AHRM 1	30.84	3.16	38.22	5.24	47.84	99.03	6.14	17.54	19.61	1.91	2.19	6.51	54.61
PDVR 48	40.54	4.08	46.15	7.40	55.72	106.24	5.88	16.41	11.67	1.24	1.93	4.46	41.93
KPT 3	35.87	4.08	45.70	7.35	54.97	97.50	5.81	17.17	14.41	1.36	2.33	6.51	46.46
Arka Tinda	35.26	3.16	40.55	8.33	51.48	95.32	5.56	16.45	14.41	1.35	2.36	5.58	52.55
Mean	37.18	3.10	45.22	8.68	56.45	97.31	5.16	17.13	9.38	0.89	1.70	6.33	57.17
CV (%)	1.61	2.29	1.36	3.89	1.16	2.43	1.54	2.75	2.62	2.00	4.85	1.10	1.34
CD at 5%	0.99	0.11	1.02	0.56	1.08	3.92	0.13	0.78	0.40	0.02	0.13	0.11	1.27

Table 2. Important fruit and seed characteristics of round melon germplasm.

Genotype	Fruit quality grade	Fruit shape	Fruit skin colour	Seed test weight (g)
KCM/BKP 01	Excellent	Round	Light green	9.69
KCM/BKP 05	Moderate	Round-spherical	Light green	7.96
KCM/BKP 06	Moderate	Spherical-round	Green	8.34
KCM/BKP 08	Moderate	Spherical	Light green	6.60
KCM/BKP 11	Excellent	Round	Greenish white	7.61
KCM/BKP 12	Moderate	Round-spherical	Light green	7.73
KCM/BKP 16	Moderate	Spherical-round	Green	10.31
KCM/BKP 20	Poor	Round	Green	8.02
DPY 125	Moderate	Round	Light green	7.91
DPY 128	Moderate	Oval	Light green	8.43
DPY 136	Moderate	Spherical	Light green	8.11
DPY 152	Moderate	Spherical	Greenish white	8.62
DPY 158	Poor	Round	Green	8.81
Bikaneri Green	Poor	Flat-round	Dark green	6.82
AHRM 1	Excellent	Round	Green	7.52
PDVR 48	Excellent	Round	Light green	7.68
KPT 3	Excellent	Round-flat	Greenish white	8.26
Arka Tinda	Excellent	Round	Light green	7.32

environment short duration genotypes with early flowering and fruit setting are desirable. This results in higher productivity because the crop is able to give the maximum pickings before the temperature rises (>40° C) in extremes of hot summer. The continuous high temperatures, *i.e.* more than 40° C in May-June and 38-40° in C July-October resulting in poor fruit set and drying of ovaries and desiccation of tender fruits (Samadia, 9). The genotypes with more number of fruits at lower nodes along with earliest fruit settings and harvesting should result in higher early yields and such genotypes must tolerate higher temperature and aridity in late stages of crop growth for high quality fruit (on secondary and tertiary branching) yield.

However, the absolute variability in different characters cannot be the criteria for deciding as to which character is showing the highest degree of variability. In the present study, the estimates of genotypic and phenotypic coefficient of variation (GCV and PCV) indicated that there is an ample scope for the improvement of this crop (Table 3). In general, the estimates of PCV were higher than GCV for all the characters. The GCV which gives a picture of the extent of genetic variability in the population ranged from 5.21% (days to appearance of first female flower) to 44.27 percent (fruit yield/plant). The GCV estimates were considerably high (>30%) for characters such as fruit yield/plant and number of fruits/ plant whereas it was moderate for node to female flower appearance, fruit weight number of seeds/fruit, plant height and number of branches/plants, indicating better scope of improvement through selection. A close correspondence between PCV and GCV values in respect of all the character indicate that environment has very little influence on the expression of the characters. In such a situation, selection can be effective on the basis of the phenotypic alone with equal probability of success.

With the help of GCV alone, it is not possible to determine the amount of variation that is heritable. Heritable variation can be found out with greater degree of accuracy when heritability (h, broad sense) is taken into consideration alongwith genetic advance (GA). Hence, both heritability and genetic advance were determined to get a clear picture of the scope of improvement in various characters through selection. Very high heritability estimate values were recorded for all the characters. The genetic advance in the present study ranged from 10.62 to 91.17% of mean (genetic gain). The investigation revealed that the economic character fruit yield per plant could be improved by 0.81 units under 5% selection intensity (SI), which would be 91.17% higher to the mean. High heritability value accompanied with high genetic gain for fruit yield/plant, number of fruits/plant, node to first female flower appearance and number of seeds/fruit

Table 3. Components of genetic variability in round melon germplasm.

Character	Range	Mean	GCV (%)	PCV (%)	h^2 (Broad sense)	Genetic advance	Genetic gain (%) of SI
DFMF	30.84-41.14	37.18	7.36	7.42	98.4	5.59	15.05
NMF	2.24-4.08	3.10	15.32	15.38	99.3	0.97	31.45
DFFF	38.22-48.11	45.22	5.21	5.27	97.8	4.80	10.62
NFF	5.24-13.23	8.68	27.23	27.32	99.3	4.85	55.91
DFH	47.84-64.81	56.45	6.47	6.51	98.9	7.49	13.27
FW	71.42-137.55	97.31	20.01	20.06	99.5	40.03	41.13
FL	4.18-6.14	5.16	13.02	13.05	99.5	1.38	26.77
FG	14.45-21.47	17.13	10.98	11.09	98.0	3.83	22.39
NF/P	5.23-19.61	9.38	39.84	39.86	99.9	7.70	82.01
FY/P	0.48-1.91	0.89	44.27	44.29	99.9	0.81	91.17
PH	1.37-2.33	1.70	19.08	19.29	97.9	0.66	38.90
NB	4.25-8.15	6.33	18.72	18.73	99.9	2.44	38.55
NSF	37.44-86.38	57.17	24.11	24.12	99.9	28.39	49.65

and moderate for fruit weight, vine length and number of branches per plant indicated additive type gene action. Simple selection therefore could be effective for the improvement of these traits. High heritability estimates alongwith low genetic gain in respect of days to appearance of first male and female flowers, days to first harvest and fruit size was probably due to non-additive type of gene action and direct selection for these characters will be less effective, Panse and Sukhatme (6). The present results on genetic variability components are in agreement with the results of Abusaleha and Dutta (1) and Rao *et al.* (7) in cucumber. It is clear from the Table 3 that traits like fruit yield/plant, number of fruits/plant and node number to first female flower possessing high GCV, heritability and genetic gain could be effectively used in selection, as it has been suggested that characters with high heritability coupled with high genetic gain would respond to selection better than those with high heritability and low genetic gain (Johnson *et al.*, 4). The high variability and heritability alongwith high genetic advance as percentage of mean expressed by the above mentioned traits indicated that the potential genotypes could be tested in multi-locational trials and selected as donors for these characters or used as parent in hybridization programme.

In general, the magnitude of genotypic correlation coefficients were slightly higher than their corresponding phenotypic correlation coefficients for all the characters (Table 4) indicating thereby a strong inherent association between various traits under study. These results are in agreement with those of Dahiya *et al.* (3) in round melon and Abusaleha and Dutta (2) in ridge gourd. Yield is an dependent character and highly influenced by environment, so for the improvement of this trait, information of its association with its main components is beneficial in formulating the breeding programme. A very strong positive and significant correlation was recorded between fruit yield/plant with number of fruits/plant (0.921) and vine length (0.808) indicated that effective improvement through these characters could be achieved in round melon. Fruit weight, length and girth had shown non-significant positive correlations with fruit yield/plant. Days to first female flower appearance and days to first harvest had shown negative and significant correlation with fruit yield/plant. Dahiya *et al.* (3) in round melon and Krishna Prasad and Singh (5) in ridge gourd reported similar findings for these characters. Days taken to first harvesting which is a character of earliness or late had positive and significant association with days to first male and female flower appearance and nodal position of female flower which is clearly an indication of mutual association of these traits for their expression. Fruit girth showed positive and significant correlations with fruit weight and number of seeds/fruit. Negative and significant association of days to appearance of female flower and days to first harvest with number of fruits/plant which clearly indicated that early genotypes bear more number of fruits/plant. It is suggested that for effective selection for higher yield in round melon number of fruits/plant is an important character. However, it may slightly affect on fruit weight and size, a moderate balance has to be made for medium number of fruits, fruit weight and size to achieve better results in round melon under arid environment.

Table 4. Genotypic (G) and phenotypic (P) correlation coefficients among various characters in round melon.

Character		DFMF	NMF	DFFF	NFF	DFH	FW	FL	FG	NF/P	FY/P	PH	NB	NS/F
DFMF	G	-	0.074	0.684	0.215	0.489	0.326	-0.440	0.080	-0.432	-0.249	-0.321	-0.272	0.237
	P		0.071	0.671**	0.210	0.478*	0.321	-0.436	0.075	-0.429	-0.246	-0.318	-0.323	0.235
NMF	G		-	0.031	-0.144	-0.088	0.082	0.472	0.024	0.372	0.396	0.358	-0.272	-0.538
	P			0.031	-0.142	-0.087	0.082	0.471*	0.021	0.372	0.395	0.353	-0.271	-0.536*
DFFF	G			-	0.267	0.588	0.112	-0.428	-0.047	-0.689	-0.571	-0.641	0.030	-0.021
	P				0.262	0.581*	0.113	-0.421	-0.041	-0.681**	-0.565*	-0.627**	0.028	-0.022
NFF	G				-	0.623	0.251	0.093	0.365	-0.280	-0.191	-0.153	-0.134	0.226
	P					0.615**	0.251	0.092	0.360	-0.279	-0.191	-0.151	-0.133	0.225
DFH	G					-	0.383	-0.114	0.546	-0.625	-0.479	-0.482	-0.273	0.370
	P						0.380	-0.112	0.537*	-0.620**	-0.476*	-0.476*	-0.271	0.368
FW	G						-	0.109	0.490	-0.047	0.329	-0.093	-0.726	0.174
	P							0.110	0.484*	-0.048	0.328	-0.090	-0.724**	0.174
FL	G							-	0.221	0.456	0.443	0.428	-0.175	-0.209
	P								0.218	0.455	0.442	0.421	-0.175	-0.209
FG	G									0.088	0.231	0.148	-0.169	0.014
	P									0.087	0.227	0.152	-0.166	0.610
NF/P	G										0.922	0.817	0.043	0.602**
	P										0.921**	0.808**	0.043	-0.107
FY/P	G											0.709	-0.208	-0.108
	P											0.701**	-0.208	-0.054
PH	G												-0.014	-0.054
	P												-	0.071
NB	G													0.071
	P													0.212
NS/F	G													0.212
	P													-

**, * Significant at 1 and 5 per cent levels.

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