Inter-trait Association and Genetic Variability Assessment in Snapmelon (*Cucumis melo* var. *momordica*)

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Genetic variability, heritability (h^2), genetic advance, character association and path analysis were carried out in 74 accessions of snapmelon (*Cucumis melo* var. *momordica*) for 12 quantitative characters. High phenotypic (PCV) and genotypic (GCV) coefficient of variation was observed for fruit weight and yield per plant. High heritability along with high expected genetic advance was recorded for polar and equatorial circumference of fruit. Yield had positive and significant correlation with fruit weight, polar and equatorial circumference of fruit at both phenotypic and genotypic level and with days to first female flower anthesis at genotypic level. Fruit weight, polar and equatorial circumference of fruit had positive correlation coefficient among themselves. Higher and positive direct effect on yield was exerted by number of fruits per plant followed by fruit weight, polar and equatorial circumference of fruit, days to first male flower anthesis and node at which first female flower appears. Besides, direct selection for fruit weight, indirect selection through polar and equatorial circumference of fruit could be considered for further improvement of yield.

Key Words: Snapmelon, Variability, Heritability, Genetic advance, Correlation, Path analysis

Introduction

Snapmelon (*Cucumis melo* var. *momordica*), belongs to family Cucurbitaceae, is used as vegetable in a variety of ways. Snapmelon is rich in quality and its juice is gaining popularity as squash. Evaluation of the variability is prerequisite for a quality improvement programme. Germplasm from heterogeneous environment are genetically diverse and could provide scope for screening better genotypes with specific traits. Knowledge about the nature and magnitude of variation provide a rational choice of character (s) on which selection can be exercised. The observed variability is a combined estimate of genetic and environmental factors, of which only former one is heritable. However, the estimate of heritability alone does not provide an idea about the expected gain in next generation, therefore it is generally considered in conjunction with genetic advance. Correlation and path analysis establish the extent of association between yield and its components and also bring out relative importance of their direct and indirect effects. This gives a clear understanding of their association with yield. In the present study, an assessment was made about the performance of various economic traits and the extent of variability, heritability, expected genetic advance and interrelationship of yield components in snapmelon was measured.

Materials and Methods

Seventy-four accessions of snapmelon were grown in a completely randomized block design (CRBD) with three replications with row-to-row distance of 3 m and plant-to-plant distance of 60 cm during rainy season of 2007. Eight plants were maintained in each plot. Standard cultural practices were followed and recommended dose of fertilizers were given to raise a good crop. The observations were recorded on five random plants for each treatment in each replication for days to first male flower anthesis, days to first female flower anthesis, node at which first male flower appears, node at which first female flower appears, primary branches per plant, vine length (cm), polar and equatorial circumference of fruit (cm), fruit weight (kg), number of fruits per plant, total soluble solids (TSS) and yield per plant (kg). The data thus obtained was subjected to various statistical analysis for estimating the genotypic and phenotypic coefficient of variation (Burton, 1952), heritability (Hanson *et al.*, 1956), and genetic advance (Johnson *et al.*, 1955). Phenotypic and genotypic correlation coefficients were calculated following the procedure of A1-Jibouri *et al.* (1958) and path analysis was carried out according to the method of Dewey and Lu (1959).

Results and Discussion

Significant differences were observed among the genotypes for different characters under study (Table 1). A wide range of variability was recorded for fruit weight (0.1-3.9), yield per plant (0.4-9.4), polar circumference of fruit (12.8-96.4), equatorial circumference of fruit (10.2-54.4) and node at which first female flower appears (3.0-17.0). The higher phenotypic coefficient of variation (PCV) than those of genotypic coefficient of variation

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Table 1. Range, mean, variability, heritability, genetic advance and genetic advance in per cent of mean

Characters	Range	Mean	Variability		Heritability (h^2) advance	Genetic	Genetic advance in per cent of mean
			PCV	GCV			
Days to 1st male flower anthesis	42.0-52.0	46.5	8.3	3.5	17.4	1.4	3.0
Days to 1st female flower anthesis	43.3-57.0	51.7	9.0	0.79	0.8	0.07	0.1
Node at which 1st male flower appears	2.3-4.3	3.3	13.1	10.4	62.7	0.6	16.9
Node at which 1st female flower appears	3.0-17.0	8.4	32.5	31.5	94.0	5.3	62.9
Primary branches/ plant	4.0-12.0	6.2	22.0	20.3	85.6	2.4	38.7
Vine length (m)	2.2-5.9	3.6	19.9	17.0	77.7	1.1	30.8
Polar circumference of fruit (cm)	12.8-96.4	44.0	37.9	36.8	94.1	32.3	73.5
Equatorial circumference of fruit (cm)	10.2-54.4	27.5	29.5	28.0	90.3	15.1	54.7
Fruit weight (kg)	0.1-3.9	0.9	76.4	75.5	97.7	1.3	144.1
Number of fruit/plant	2.0-13.4	4.9	56.8	55.7	95.9	5.5	112.3
TSS (%)	2.2-5.0	3.8	19.4	17.7	83.0	1.3	33.2
Yield/plant (kg)	0.4-9.4	3.2	58.9	57.3	94.6	3.7	114.7

(GCV) indicated the predominant role of environment on the expression of the traits. The maximum phenotypic and genotypic coefficient of variation was observed for fruit weight followed by yield per plant, number of fruits per plant and polar circumference of fruit, while the lowest PCV was observed for days to first male flower anthesis, followed by days to first female flower anthesis and node at which first male flower appears. The lowest value of genotypic coefficient of variation was observed for days to first female flower anthesis, followed by days to first male flower anthesis. These results are in agreement to the findings of Sahni *et al.*, (1987) in ridge gourd, Dahiya *et al.*, (1989) in roundmelon, Singh *et al.*, (1989) in muskmelon, Prasad and Singh (1992) in cucumber and Pandey *et al.*, (2003) in snapmelon. The variation was also observed for plant growth characteristics *viz.*, ridges on fruit surface, fruit cracking pattern and skin peeling, fruit shape, fruit skin texture, predominant primary and secondary color of fruits, design produced by secondary skin colour and flesh colour (Table 2).

High estimate of heritability in broad sense was obtained for all the characters except days to first female and first male flower anthesis. According to Panse (1957), the magnitude of heritable value is the most important aspect of genetic constitution of breeding material, which has close bearing on the response to selection. The high value for heritability was obtained for fruit weight (97.7), number of fruits per plant (95.9), yield per plant (94.6), polar circumference of fruit (94.1), node at which first female flower appears (94.0) and equatorial circumference of fruit (90.3). These findings indicate that there is a scope for improvement in these characters through direct selection. In the present study, fruit weight showed the maximum genetic gain (144.1) followed by yield per plant (114.7) and number of fruits per plant (112.3). Earlier, in snapmelon, Pandey *et al.*, (2003) reported high genetic advance for yield per plant.

Heritability along with genetic gain is more useful criteria in predicting the resultant effect for selecting the best individual (Johnson *et al.*, 1955). Burton (1952) suggested that characters with high heritability coupled with high genetic advance would show better response to selection than those with high heritability and low genetic advance. In present study, high heritability along with high genetic gain was recorded for polar and equatorial circumference of fruit. These results are in accordance with the findings of Pandey *et al.*, (2002) in pumpkin.

Table 2. Frequency of descriptor states for qualitative descriptors in snapmelon

Trait	Descriptor state (number of genotype)
Ridges on fruit surface	Present (20), Absent (54)
Fruit cracking pattern and skin peeling	No cracking (30), Random cracking (6), Longitudinal cracking (25), Random skin peeling (9), Blossom end cracking (4)
Fruit shape	Cylindrical (12), Oval (29), Elongate (18), Globular (4), Round (5), Pyriform (3), Curved (1), Oblong (2)
Fruit skin texture	Plain (73), Netted (1)
Fruit skin predominant primary colour	Green (40), Dark green (20), Light green (14)
Fruit skin predominant secondary colour	Yellow (35), Orange (7), Brown red (8), Brown cream (1), Light green (9), White (6), Cream (6), Brown (2)
Design produced by secondary skin colour	No design (42), Stripped (19), Streaked (4), Spotted (7), Speckled (2)
Flesh colour	Orange (20), White (12), Cream (42)

The present results indicate that phenotypic selection could bring about improvement in these characters. It is suggested that variation observed for different characters in snapmelon genotypes may be due to the high additive gene effect. High heritability and low genetic gain were observed for node at which first male flower appears and TSS. This reflects that high heritability is not always associated with genetic advance (Swarup and Chaugale, 1962). Hence, selection on the basis of these characters will be less effective since they are controlled by non-additive genes.

Genotypic correlation coefficient was higher than their corresponding phenotypic correlation coefficient for most of the characters except node at which first male flower appears, number of primary branches per plant and TSS (Table 3). It was observed that yield has positive and significant correlation with fruit weight, polar and equatorial circumference of fruit at both genotypic and phenotypic level and with days to first female flower anthesis at genotypic level. It has been reported that fruit weight, polar and equatorial circumference of fruit had positive association among themselves (Vijay, 1987 and Pandey *et al.*, 2003). Higher and positive direct effect (at the genotypic level) on yield was exerted by number of fruits per plant followed by fruit weight, polar and equatorial circumference of fruit, days to male flower anthesis and node at which first female flower appears (Table 4). All the above mentioned characters also showed positive correlation with yield. This indicates that direct selection based on number of fruits per plant, fruit weight and polar and equatorial circumference of fruit could result in an appreciable improvement of total yield. However, vine length, number of primary branches, TSS, node at which first male flower appears and days to first female flower anthesis exerted negative direct effect on yield. Similar results have also been reported in snapmelon (Pandey *et al.*, 2003) and muskmelon (Pandey *et al.*, 2005). From the results of this investigation, it is concluded

Table 3. Estimates of genotypic and phenotypic correlation coefficients of yield and its contributing traits

Traits		Days to 1^{st} female flower anthesis appears	Node at which 1^{st} male flower appears	Node at which 1^{st} female flower /plant	Number of primary branches	Vine length (m)	Polar circum-ference of fruit (cm)	Equatorial circum-ference of fruit (cm)	Fruit weight (kg)	Number of fruits/ plant	TSS (%)	Yield/ plant (kg)
		2	3	4	5	6	7	8	9	10	11	12
1	rg	0.824**	-0.099	0.025	0.281*	0.003	-0.001	0.134	-0.069	0.232*	-0.025	0.206
	rp	0.784**	0.032	0.023	0.072	0.038	-0.060	0.041	-0.053	0.098	-0.099	0.057
2	rg		-0.482	0.631**	0.543**	0.015	0.962**	1.291**	0.509**	0.295**	-0.440	1.318**
	rp		-0.011	0.051	-0.001	0.004	0.006	0.066	0.008	0.012	-0.110	0.058
3	rg			0.094	-0.182	0.045	0.013	0.122	0.154	-0.187	0.012	-0.005
	rp			0.040	-0.133	0.061	0.004	0.071	0.117	-0.139	-0.006	0.012
4	rg				-0.131	-0.021	-0.116	-0.170	-0.119	0.021	-0.008	-0.100
	rp				-0.136	-0.012	-0.113	-0.153	-0.110	0.021	-0.011	-0.100
5	rg					-0.046	-0.196	-0.170	-0.033	0.370**	0.000	0.017
	rp					-0.044	-0.177	-0.151	-0.032	0.346**	-0.013	0.031
6	rg						0.404**	0.414**	0.311**	-0.290	-0.204	0.195
	rp						0.301**	0.320**	0.253*	-0.241	-0.131	0.157
7	rg							0.663**	0.817**	-0.535	-0.277	0.708**
	rp							0.644**	0.810**	-0.510	-0.246	0.692**
8	rg								0.804**	-0.576	-0.191	0.651**
	rp								0.778**	-0.538	-0.201	0.627**
9	rg									-0.508	-0.129	0.784**
	rp									-0.491	-0.122	0.776**
10	rg										0.265*	-0.064
	rp										0.232*	-0.042
11	rg											-0.122
	rp											-0.128

***** Significant at 5% probability, ****** Significant at 1% probability level

Table 4. Direct (diagonal) and indirect effect of different traits on yield (genotypic)

Traits	Days to 1st male flower anthesis	Days to 1st female flower anthesis	Node at which 1st male flower appears	Node at which 1st female flower /plant	Number of primary branches	Vine length (m)	Polar circum-ference of fruit (cm)	Equatorial circum-ference of fruit (cm)	Fruit weight (kg)	Number of fruits/ plant	TSS (%)	Yield/ plant (kg)
	1	2	3	4	5	6	7	8	9	10	11	12
1	**0.090**	-0.006	0.003	0.001	-0.024	0.000	0.000	0.042	-0.040	0.139	0.002	0.206
2	0.074	**-0.007**	0.016	0.027	-0.047	-0.002	0.354	0.401	0.294	0.177	0.029	1.318**
3	-0.009	0.003	**-0.034**	0.004	0.016	-0.005	0.005	0.038	0.089	-0.112	-0.001	-0.005
4	0.002	-0.005	-0.003	**0.043**	0.011	0.002	-0.043	-0.053	-0.069	0.013	0.001	-0.100
5	0.025	-0.004	0.006	-0.006	**-0.087**	0.005	-0.072	-0.053	-0.019	0.222	0.000	0.017
6	0.000	0.000	-0.002	-0.001	0.004	**-0.103**	0.149	0.129	0.180	-0.174	0.014	0.195
7	0.000	-0.007	0.000	-0.005	0.017	-0.042	**0.368**	0.206	0.473	-0.321	0.018	0.708**
8	0.012	-0.009	-0.004	-0.007	0.015	-0.043	0.244	**0.311**	0.465	-0.345	0.013	0.651**
9	-0.006	-0.004	-0.005	-0.005	0.003	-0.032	0.301	0.250	**0.579**	-0.305	0.009	0.784**
10	0.021	-0.002	0.006	0.001	-0.032	0.030	-0.197	-0.179	-0.294	**0.599**	-0.018	-0.064
11	-0.002	0.003	0.000	0.000	0.000	0.021	-0.102	0.060	-0.074	0.159	**-0.066**	-0.122

****** Significant at 1% probability level, Residual effect-0.131

that besides direct selection for fruit weight, indirect selection through polar and equatorial circumference of fruit should be considered for further improvement of yield in snapmelon.

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