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Estimates of genetic parameters of fruit quality traits in teasle gourd (*Momordica subangulata* Blume. subsp. *renigera*)

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The present investigation was carried out to assess genetic variability, heritability and genetic advance in five genotypes of teasle gourd. The experiment was laid out in a randomized block design with four replications. High phenotypic coefficients of variation were observed for all characters except ascorbic acid in excoarp, ascorbic acid in mesocarp, total soluble solids (TSS) in exocarp, b-carotene in exocarp, acidity in mesocarp, b-carotene in mesocarp, TSS in mesocarp, acidity in exocarp which showed high heritability coupled with high genetic advance indicating that these traits were gene control and simple phenotypic selection can be used for further improvement of these traits. Fruit weight, which showed the highest positive direct effect on fruit yield also showed positive correlation with β-carotene in exocarp. The most important fruit quality influencing traits from the study includes TSS content of exocarp and mesocarp since these traits character showed positive correlations with most important fruit quality characters.

Key words: Teasle gourd, clones, variability, heritability, genetic advance, correlation coefficient.

INTRODUCTION

The teasle gourd (Momordica subangulata Blume ssp. renigera) belongs to the family Cucurbitaceae. It is probably native to India. It is dioecious in nature and a perennial climber with tuberous roots mainly cultivated in Assam, West Bengal, Bihar, Orissa, North-eastern States, Maharashtra, Gujarat and Andaman Islands. The fruits are highly nutritious and the unripe fruits are very astrinegent and can be used as an appetizer. Estimates of various parameters for assessment of genetic variability including mean range of variation, heritability, genetic advance and coefficients of variation help plant breeders in designing suitable plant types through improvement in quantitatively inherited traits. Correlations provide an estimate of the degree and direction of association among various components of yield. It is therefore, essential to determine the contribution of various variables to the observed association and partition the correlation coefficient into components with direct and indirect effects. Hence, the present investigation was undertaken.

MATERIALS AND METHODS

The experimental materials consisted of five female clones

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Table 1. Mean fruit and fruit quality characters in five female clones of teasle gourd.

Female clone	Fruit weight at marketable stage (g)	Ovary diameter (mm)	Fruit length at marketable stage (cm)	Fruit breadth at marketable stage (cm)	Pericarp thickness at marketable stage (mm)	TSS in exocarp (°Brix)	TSS in mesocarp (°Brix)	Acidity in exocarp (%)	Acidity in mesocarp (%)
Purulia Local-1	58.75	8.55	6.54	4.90	3.39	2.21	6.41	0.19	0.20
Purulia Local-2	61.22	8.98	6.21	6.21	4.25	4.35	5.35	0.15	0.15
Purulia Local-3	64.86	7.49	6.66	4.85	4.50	4.08	5.23	0.26	0.18
Assam Local	56.78	7.41	6.82	4.32	4.13	5.08	8.16	0.19	0.33
Mondouri Local	46.30	5.55	5.55	4.49	3.97	4.35	8.16	0.18	0.17
S.E.D	1.27	0.38	0.14	0.85	0.46	0.10	0.09	0.02	0.03
C.D.	2.93	0.88	0.31	1.97	1.07	0.24	0.20	0.04	0.08

Female clone	Ascorbic acid in exocarp (mg/100 g)	Ascorbic acid in mesocarp (mg/100 g)	Total sugar in exocarp (%)	Total sugar in mesocarp (%)	Reducing sugar in exocarp (%)	Reducing sugar in mesocarp (%)	β-carotene in exocarp (mg/100 g fresh)	β-carotene in mesocarp (mg/100 g)
Purulia Local-1	278.77	21.67	0.97	1.09	0.86	0.96	2.64	1.18
Purulia Local-2	179.20	12.41	1.38	1.49	1.06	1.11	2.37	0.51
Purulia Local-3	205.46	19.56	1.12	1.48	0.94	0.77	2.61	0.88
Assam Local	103.02	20.21	2.33	5.01	1.27	1.68	1.11	0.84
Mondouri Local	186.49	30.02	2.01	3.03	1.54	1.79	1.33	0.74
S.E.D	5.07	0.39	0.08	0.15	0.04	0.08	0.20	0.12
C.D.	11.71	0.89	0.18	0.35	0.08	0.18	0.47	0.27

of teasle gourd grown in two consecutive years (2007 to 2008 and 2008 to 2009) at the research field of All India Coordinated Project on Vegetable Crops situated at C Block farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia. The tuberous roots of the five female clones were planted in February in a randomized block design with four replications including 6 plants per replication at spacing of 1.5 × 1.5 m between plants. When vining started 30 days after planting, the vines were trained on a low trellis made of bamboo strips and nylon wire net. A general fertilizer dose at 150 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare were applied. One-third of the dose of nitrogen along with the phosphate and potash fertilizers was applied given as a basal application while the rest of the N was top dressed in two split doses, at 80 days after planting and the remainder, one month later. Five plants of each genotype were selected randomly in each replication for recording observations on exocarp, acidity in mesocarp, b-carotene in exocarp, reducing sugar in mesocarp, ascorbic acid in excoarp, b-carotene in mesocarp, ascorbic acid in mesocarp, TSS in exocarp, reducing sugar in excoarp, acidity in exocarp, fruit breadth at marketable stage, TSS in mesocarp, ovary diameter, pericarp thickness at marketable stage, fruit weight at marketable stage.

The mean data were subjected to analysis of variance (Panse and Sukhatme, 1984), coefficient of variation and heritability (Burton and de Vane, 1953) and genetic advance in percent of the mean (Johnson et al., 1955) and the correlation coefficient analysis was done according to A1-Jibouri et al. (1958).

RESULTS AND DISCUSSION

Genetic variability for fruit quality characters based on mean performance

The mean of the 17 fruit characters recorded in the female clones is presented in Table 1. The data for different characters namely, fruit weight at marketable stage (g), ovary diameter (mm), fruit length at marketable stage (cm), fruit breadth at marketable stage (cm), pericarp thickness at marketable stage (mm), TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%),

Table 2. Analysis of variance for different fruit quality characters.

Character	Mean sum of squares		
	Genotype	Replication	Error
Fruit weight at marketable stage (g)	146.52**	16.07	2.41
Ovary diameter (mm)	5.31**	0.31	0.22
Fruit length at marketable stage (cm)	0.76**	0.04	0.03
Fruit breadth at marketable stage (cm)	1.66**	0.99	1.09
Pericarp thickness at marketable stage (mm)	0.51	0.13	0.32
TSS in exocarp (°Brix)	3.56	0.03	1.59
TSS in mesocarp (°Brix)	6.22**	0.07	0.01
Acidity in exocarp (%)	0.01	0.0001	0.0003
Acidity in mesocarp (%)	0.015	0.0006	0.002
Ascorbic acid in exocarp (mg/100 g)	11858.48**	130.59	38.56
Ascorbic acid in mesocarp (mg/100 g)	118.48**	0.12	0.22
Total sugar in exocarp (%)	1.03	0.0015	0.01
Total sugar in mesocarp (%)	7.94**	0.005	0.04
Reducing sugar in exocarp (%)	0.22**	0.002	0.002
Reducing sugar in mesocarp (%)	0.61**	0.015	0.01
β-carotene in exocarp (mg/100 g)	1.61**	0.20	0.06
β-carotene in mesocarp (mg/100 g)	0.18**	0.001	0.02

**Significant at 1% level of significance.

acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g), ascorbic acid in mesocarp (mg/100 g), total sugar in exocarp (%), total sugar in mesocarp (%), reducing sugar in exocarp (%), reducing sugar in mesocarp (%), β-carotene in exocarp (mg/100 g fresh) and β-carotene in mesocarp (mg/100 g) showed variation among the female clones and ascorbic acid content was very high between 103.02 mg/100 g fresh weight in Assam Local and 278.77 mg/100 g fresh weight in Purulia Local-1 suggesting ample scope for enhancing ascorbic acid content in the fruits through selection.

Contents of TSS, acidity and sugar were much higher in the mesocarp of the fruit while, ascorbic acid and β-carotene contents were much higher in the exocarp of the fruits (Table 1). These findings abnegate peeling of the fruits during preparation of dishes. Dubey and Gaur (1990), Awasthi et al. (1988), Naik et al. (2012) and Bharathi et al. (2013) also estimated different proximate.

Analyes of variance

Analyses of variance for the 17 characters were computed separately for two years along with the pooled data. Mean sums of squares presented for 17 characters, (Table 2) clearly show significant differences among the female clones for all the characters except some fruit quality characters including pericarp thickness at marketable stage, TSS in exocarp, acidity in exocarp and acidity in exocarp at 1% level of significance.

Coefficient of variation (CV)

The coefficient of variation (Table 3) was very low for most of the characters except fruit breadth at marketable stage (21.09%), pericarp thickness at marketable stage (14.04%), acidity in mesocarp (19.89%), β-carotene content in exocarp (12.42%) and mesocarp (17.40%). In these characters, a comparatively higher effect of the environment for the expression of the characters was evident.

Genetic component of variation

Genotypic coefficient of variation (GCV)

In this investigation, the highest genotypic coefficient of variation was recorded for total sugar content in mesocarp (66.98%) followed by total sugar content in the exocarp (37.32%), reducing sugar content in mesocarp (35.39%) and β-carotene contents in exocarp (35.67%). Moderate GCV ranging between 21.13 to 32.93% was recorded for the characters such as TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g), ascorbic acid in mesocarp (mg/100 g), reducing sugar in exocarp (%) and β-carotene in mesocarp (Table 3).

Broad sense heritability

Broad sense heritability estimates were high ranging from

Table 3. Genetic parameter estimates for different fruit quality characters.

Character	Components of variation						
	Mean	Coefficient of variation (C.V.)	Phenotypic coefficient of variation (PCV)	Genotypic coefficient of variation (GCV)	Heritability %(H)	Genetic advance (GA)	Genetic advance (GA)% of mean
Fruit weight at marketable stage (g)	57.58	2.70	12.33	12.04	95.2	13.93	24.19
Ovary diameter (mm)	7.60	6.12	18.21	17.15	88.7	2.53	33.29
Fruit length at marketable stage (cm)	6.36	2.60	8.18	7.76	89.9	0.96	15.09
Fruit breadth at marketable stage (cm)	4.96	21.09	22.83	8.74	14.6	0.34	6.86
Pericarp thickness at marketable stage (mm)	4.05	14.04	15.35	6.21	16.4	0.21	5.19
TSS in exocarp (°Brix)	4.02	3.14	26.86	26.68	98.6	2.19	54.48
TSS in mesocarp (°Brix)	6.66	1.58	21.65	21.59	99.0	2.96	44.44
Acidity in exocarp (%)	0.19	9.40	23.13	21.13	83.5	0.08	42.11
Acidity in mesocarp (%)	0.21	19.89	37.79	32.13	72.3	0.12	57.14
Ascorbic acid in exocarp (mg/100 g)	190.59	3.26	33.10	32.93	99.0	128.68	67.52
Character	**Mean**	**Coefficient of variation (C.V.)**	**Phenotypic coefficient of variation (PCV)**	**Genotypic coefficient of variation (GCV)**	**Heritability %(H)**	**Genetic advance (GA)**	**Genetic advance (GA)% of mean**
Ascorbic acid in mesocarp (mg/100 g)	20.77	2.28	30.31	30.22	99.4	12.90	62.11
Total sugar in exocarp (%)	1.56	6.31	37.85	37.32	97.2	1.18	75.64
Total sugar in mesocarp (%)	2.42	7.70	67.43	66.98	98.7	3.32	137.19
Reducing sugar in exocarp (%)	1.13	3.91	24.31	23.99	97.4	0.55	48.67
Reducing sugar in mesocarp (%)	1.26	7.54	36.18	35.39	95.7	0.90	71.43
β-carotene in exocarp (mg/100 g)	2.01	12.42	37.77	35.67	89.2	1.40	69.65
β-carotene in mesocarp (mg/100 g)	0.83	17.40	32.64	27.61	71.6	0.40	48.19

83.50 to 99.4% for most of the characters, moderate ranging from 71.6 to 72.3% for acidity in mesocarp and β-carotene in mesocarp whereas it was very low for fruit breadth at marketable maturity and pericarp thickness at marketable stage (Table 3).

However, the broad sense heritability values are likely to be overestimated since in this calculation, it was not possible to exclude variation due to different genetic components and their interrelations.

Genetic advance (GA)

In the present investigation, genetic advance as a percentage of the mean indicated few significant traits. Genetic advance was high ranging from 42.11 to 137.19% for most of the fruit quality characters including TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g), ascorbic acid in mesocarp (mg/100 g), total sugar in exocarp (%), total sugar in mesocarp (%), reducing sugar in exocarp (%), reducing sugar in mesocarp (%), β-carotene in exocarp (mg/100 g fresh) and β-carotene in mesocarp (mg/100 g). This estimate was moderate (24.19 and 33.29%) for fruit weight at marketable maturity and ovary diameter.

The effect of GCV, heritability and GA combined

In the present investigation, high GCV coupled with high broad sense heritability and high genetic advance were observed in four fruit quality characters namely, ascorbic acid content in mesocarp, total sugar content in exocarp, total sugar content in mesocarp and β-carotene in exocarp (Table 3). According to Panse (1957), such situations may arise due to additive gene action controlling the characters. So, these characters can well be included in the improvement programme through selection. It is predicted that early generation selection would be helpful for improving these characters. A high to moderate heritability coupled with moderate genetic advance was recorded for TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g) and β-carotene in mesocarp indicating that these characters could also be improved by selection in early generation. However, selection could also be applied following repeated evaluation over the years. A moderate to high heritability accompanied with low genetic advance was recorded (Table 3) for fruit weight at marketable stage (g), ovary diameter (mm), fruit length at marketable stage (cm), fruit breadth at marketable stage (cm) and pericarp thickness at marketable stage (mm). Improvement of these characters needs long term evaluation to ascertain the efficacy of selection for these characters because such association of genetic parameters may be attributed to non-additive gene action.

Correlations among the fruit quality characters

In the present study, the magnitude of genotypic correlation coefficient was higher than phenotypic correlation coefficient in most of the pairs of character under study (Table 4). In general though, the genotypic and phenotypic correlation coefficients agreed closely which indicated less influence of environment on the correlated response of pairs of characters involved. In the situation of environmental influence on the joint expression of the characters, there is always a possibility of over estimation of genotypic correlation coefficient. Hence, phenotypic correlation coefficients between pairs of traits have been utilized to study trait associations. In the present investigation, most of the characters did not show significant phenotypic correlations. However, 28 pairs of traits showed significant positive correlations including:

1) Fruit weight at marketable stage and ovary diameter.
2) Fruit weight at marketable stage and fruit length at marketable stage.
3) Fruit weight at marketable stage and β-carotene in exocarp.
4) Ovary diameter and fruit length at marketable stage.
5) Ovary diameter and β-carotene in exocarp.
6) Fruit length at marketable stage and acidity in mesocarp.
7) Pericarp thickness at marketable stage and TSS in exocarp.
8) TSS in exocarp and total sugar in exocarp.
9) TSS in exocarp and total sugar in mesocarp.
10) TSS in exocarp and reducing sugar in exocarp.
11) TSS in exocarp and reducing sugar in mesocarp.
12) TSS in mesocarp and acidity in mesocarp.
13) TSS in mesocarp and ascorbic acid in exocarp.
14) TSS in mesocarp and ascorbic acid in mesocarp.
15) TSS in mesocarp and total sugar in exocarp.
16) TSS in mesocarp and total sugar in mesocarp.
17) TSS in mesocarp and reducing sugar in exocarp.
18) TSS in mesocarp and β-carotene in exocarp.
19) Acidity in mesocarp and total sugar in exocarp.
20) Acidity in mesocarp and total sugar in mesocarp.
21) Ascorbic acid in exocarp and β-carotene in exocarp.
22) Ascorbic acid in exocarp and β-carotene in mesocarp.
23) Ascorbic acid in mesocarp and reducing sugar in exocarp.
24) Ascorbic acid in mesocarp and reducing sugar in exocarp.
25) Total sugar in exocarp and total sugar in mesocarp.
26) Total sugar in exocarp and reducing sugar in exocarp.
27) Total sugar in exocarp and reducing sugar in mesocarp.
28) Reducing sugar in exocarp and reducing sugar in mesocarp.

Fruit weight, which showed the highest direct positive effect on fruit yield also showed positive correlation with β-carotene in exocarp which strongly suggests the possibility of simultaneous enhancement of fruit yield and β-carotene in exocarp of the fruit through selection of fruit weight in the positive direction.

The phenotypic corre-lation coefficients revealed associations among most of the fruit quality traits. However, the most important fruit quality influencing trait including TSS content of exocarp and mesocarp showed positive correlations with most of the important fruit quality characters.

Selection indices for fruit yield and quality

Important selection indices have been determined from the studies of genetic variability and character associations. Fruit weight emerged as the most important character influencing both fruit yield and fruit quality particularly β-carotene content. Number of fruits per plant also justified its importance as another prime fruit yield component. It is encouraging to note that the prime quality traits such as ascorbic acid and β-carotene did not exert negative effects on each other. However, TSS content of the fruit emerged as the most influential fruit quality determining character. Hence, selection in teasle

Table 4. Genotypic (G), phenotypic (P) and environmental (E) correlation coefficients among pairs of characters.

Character		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	P	1.000	0.734	0.719	0.201	0.218	-0.164	-0.819	0.309	-0.010	0.165	-0.793	-0.611	-0.453	-0.849	-0.844	0.697	0.084
1	G	1.000	0.791	0.774	0.916	0.597	-0.167	-0.841	0.411	-0.014	0.161	-0.816	-0.635	-0.457	-0.887	-0.860	0.733	0.096
	E	1.000	0.102	0.032	-0.696	-0.089	-0.064	-0.038	-0.650	0.011	0.404	0.096	-0.006	-0.380	0.148	-0.505	0.309	0.045
	P		1.000	0.517	0.500	-0.117	-0.350	-0.665	-0.236	-0.066	0.263	-0.849	-0.565	-0.455	-0.777	-0.645	0.589	0.112
2	G		1.000	0.587	1.147	-0.126	-0.384	-0.695	-0.269	-0.043	0.276	-0.899	-0.598	-0.498	-0.841	-0.681	0.708	0.017
	E		1.000	-0.069	0.279	-0.225	0.236	-0.500	-0.039	-0.178	0.124	-0.204	-0.182	0.295	0.084	-0.253	-0.369	0.550
	P			1.000	-0.070	0.031	-0.054	-0.261	0.360	0.624	-0.107	-0.501	-0.184	0.077	-0.615	-0.437	0.239	0.357
3	G			1.000	0.162	0.216	–0.070	-0.286	0.441	0.626	-0.120	-0.542	-0.198	0.103	-0.679	-0.469	0.264	0.453
	E			1.000	-0.037	-0.178	0.316	0.399	-0.168	0.711	0.183	0.473	0.017	-0.560	0.400	-0.040	0.021	-0.038
	P				1.000	0.219	-0.047	-0.486	-0.177	-0.363	0.124	-0.513	-0.340	-0.370	-0.276	-0.243	0.311	-0.325
4	G				1.000	0.079	-0.191	-1.244	-1.029	-1.091	0.345	-1.307	-0.795	-1.071	-0.689	-0.898	1.067	-0.966
	E				1.000	0.245	0.236	-0.158	0.487	-0.017	-0.088	-0.208	-0.262	0.350	-0.105	0.486	-0.246	-0.026
	P					1.000	0.506	-0.211	0.205	0.090	-0.369	-0.236	0.147	0.087	0.136-	0.085	-0.017	-0.390
5	G					1.000	1.231	-0.508	0.706	-0.293	-0.966	-0.559	0.274	0.275	0.121	-0.097	-0.163	-1.161
	E					1.000	0.104	-0.083	-0.150	0.397	0.216	-0.153	0.247	-0.223	0.592	-0.242	0.150	0.015
	P						1.000	0.321	-0.010	0.302	-0.939*	-0.072	0.773	0.706	0.619	0.548	-0.658	-0.651
6	G						1.000	0.325	-0.016	0.349	-0.955	-0.078	0.775	0.716	0.622	0.568	-0.699	-0.780
	E						1.000	-0.047	0.111	0.115	0.389	0.560	0.695	-0.045	0.493	-0.139	-0.062	0.065
	P							1.000	0.192	0.520	0.457	0.701	0.832	0.810	0.789	0.913*	0.862	0.092
7	G							1.000	-0.2|6	0.590	-0.456	0.705	0.845	0.824	0.800	0.927	-0.936	0.099
	E							1.000	0.486	0.510	-0.632	-0.061	0.101	-0.763	0.090	0.563	0.818	0.219
	P								1.000	0.092	0.069	0.178	-0.215	-0.065	-0.264	-0.327	0.228	0.398
8	G								1.000	0.139	0.111	0.203	-0.246	-0.074	-0.275	-0.445	0.215	0.418
	E								1.000	-0.072	-0.782	-0.213	0.101	0.044	-0.238	0.837	0.313	0.343
	P									1.000	-0.528	0.036	0.530	0.685	0.158	0.349	-0.460	0.298
9	G									1.000	-0.621	0.035	0.621	0.8692	0.113	0.428	-0.638	0.29
	E									1.000	-0.036	0.172	0.114	-0.820	0.746	-0.067	0.302	0.312
	P										1.000	0.108	-0.843	-0.847	-0.566	-0.628	0.727	0.500
10	G										1.000	0.105	-0.862	-0.859	-0.580	-0.631	0.791	0.624
	E										1.000	0.554	0.152	0.187	0.284	-0.674	-0.497	-0.492
	P											1.000	0.355	0.289	0.617	0.538	-0.472	0.298
11	G											1.000	0.354	0.293	0.623	0.555	-0.494	0.370
	E											1.000	0.526	-0.049	0.293	-0.197	-0.306	-0.343
	P												1.000	0.938*	0.850	0.905	-0.939*	-0.320
12	G												1.000	0.961	0.858	0.948	-1.015	-0.400
	E												1.000	-0.161	0.574	-0.281	0.119	0.149
	P													1.000	0.666	0.808	-0.918*	-0.159
13	G													1.000	0.690	0.832	-0.949	-0.164
	E													1.000	-0.571	-0.014	-0.737	-0.346

Table 4. Contd.

	P	1.000	0.901*	-0.843	-0.368
14	G	1.000	0.951	-0.911	-0.485
	E	1.000	-0.509	0.113	0.424
	P		1.000	-0.899*	-0.261
15	G		1.000	-1.000	-0.312
	E		1.000	0.368	-0.023
	P			1.000	0.266
16	G			1.000	0.269
	E			1.000	0.288
	P				1.000
17	G				1.000
	E				1.000

*= Significant at 5% level of significance. 1, Fruit weight at marketable stage; 2, ovary diameter; 3, fruit length at marketable stage; 4, fruit breadth at marketable stage; 5, pericarp thickness at marketable stage; 6,TSS in exocarp; 7, TSS in mesocarp; 8, acidity in exocarp; 9, acidity in mesocarp; 10, ascorbic acid in exocarp; 11, ascorbic acid in mesocarp; 12, total sugar in exocarp; 13, total sugar in mesocarp; 14, reducing sugar in exocarp; 15, reducing sugar in mesocarp; 16, β-carotene in exocarp; 17, β-carotene in mesocarp.

gourd must be applied on fruit weight, number of fruits per plant, fruit yield per plant and TSS content of the fruit for simultaneous improvement of both fruit yield and quality.

Conclusion

Genetic variability for fruit quality characters

Genotypic coefficient of variation: In this investigation, the highest genotypic coefficient of variation was recorded for total sugar content in mesocarp (66.98) followed by total sugar content in the exocarp (37.32), reducing sugar content in mesocarp (35.39) and β-carotene contents in exocarp (35.67). Moderate GCV ranging between 21.13 to 32.93 was recorded for TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g), ascorbic acid in mesocarp (mg/100 g), reducing sugar in exocarp (%) and β-carotene in mesocarp.

Broad sense heritability: Broad sense heritability estimates were high ranging from 83.50 to 99.4% for most of the characters and moderate ranging from 71.6 to 72.3% for acidity in mesocarp and β-carotene in mesocarp.

Genetic advance (GA): Genetic advance was high ranging from 42.11 to 137.19% for most of the fruit quality characters such as TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g), ascorbic acid in mesocarp (mg/100 g), total sugar in exocarp (%), total sugar in mesocarp (%), reducing sugar in exocarp (%), reducing sugar in mesocarp (%), β-carotene in exocarp (mg/100 g fresh) and β-carotene in mesocarp (mg/100 g). This estimate was moderate ranging between 24.19 and 33.29% for fruit weight at marketable maturity and ovary diameter.

GCV, heritability and GA combined: High to moderate heritability coupled with moderate genetic advance was recorded for TSS in exocarp (°Brix), TSS in mesocarp (°Brix), acidity in exocarp (%), acidity in mesocarp (%), ascorbic acid in exocarp (mg/100 g) and β-carotene in mesocarp indicating that these characters could also be improved by rigid selection in early generation. However, selection could also be applied following repeated evaluation over years.

Correlations among fruit quality characters

In the present investigation, most of the characters did not show significant phenotypic correlations. However, 28 pairs of characters showed significant positive correlations. Fruit weight, which registered the highest positive direct effect on fruit yield also showed positive correlation with β-carotene in exocarp. The most important fruit quality influencing trait study include TSS content of exocarp and mesocarp since this character showed positive correlations with most of the important fruit quality characters.

Important selection indices for fruit yield and quality

Fruit weight emerged as the most important character influencing both fruit yield and fruit quality particularly β-carotene content. Number of fruits per plant was as the other prime fruit yield component. It is encouraging to note that the prime quality traits namely, ascorbic acid and β-carotene did not exert any negative effect on each other. TSS content of the fruit emerged as the most influential fruit quality determining character. Hence, selection in teasle gourd must be performed on fruit weight, fruits per plant, fruit yield per plant and TSS content of the fruit for simultaneous improvement of both fruit yield and quality.

REFERENCES

Al Jibouri HA, Miller PA, Robinson (1958). Genotypic and environment variances and co-variances in an upland cotton cross of interspecific origin. Agron. J. 50:633-636.

Awasthi GP, Singh IS, Singh Ajoy, Singh A (1988) Biochemical composition of promising Karonda (*Momordica dioica*) cultivars. Prog. Hortic. 20(3-4):190-196.

Bharati LK, Behra TK, Singh R, Singh A (2013). Carotenoid contents in sweet gourd (*Momordica cochinsinensis* Spreng.) accessions of india. Indian J. Hortic. 70(2):165-169.

Burton GW, Devane EN (1953). Estimating heritability in fall fescus from replicated clonal material. Agron. J. 45:478-481.

Dubey AK, Gour GS (1990). Biochemical studies of four strains of Kakrol *Momordica dioica* Roxb.). Veg. Sci. 17(1):31-37.

Johnson HW, Robinson HW Comstock RE (1955) Estimates of genetic and environmental variability in soyabean. Agron. J. 47:314-318.

Naik A, Akhtar S, Chattopadhyay A, Hazra P (2012). Study of genetic variability, heritability and genetic advance for fruit quality characters in Teasle gourd (*Momordica subangulata* blume. subsp. *renigera*) AJAR 7(49):6550-6552.

Panse VG (1957). Genetics of quantitative characters in relation to plant breeding. Indian J. Genet. 28:225-229.

Panse VG, Shukhatmi PV (1984). Statistical Methods for ICAR Agricultural Workers.ICAR, New Delhi.