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ASSOCIATION OF FRUIT SHAPE INDEX AND QUALITY CHARACTERS IN TOMATO

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ABSTRACT

Sixty four tomato lines were evaluated for analysis of fruit shape index, total solids, total soluble solids, insoluble solids, juice yield, acidity, pH, reducing sugar, consistency, lycopene, locules/fruit, and pericarp thickness. Positive correlation was observed between fruit shape index and consistency, pericarp thickness, insoluble solids, lycopene, total solids, pH, and TSS. The analysis confirmed that fruits with high shape index have fewer locules, thick pericarp, high total solids, insoluble solids, consistency, lycopene and pH but low acidity and reducing sugar.

Key words: Fruit shape, quality traits, tomato

In the selection of processing tomatoes special emphasis is often laid on preference of elongated fruits with shape index >1. Since fruit shape index is easy to judge visually, its relationships of quality components, if established, can make selection more effective. The available information on fruit characters of tomato mainly deals with the association among yield and yield contributing characters [1–3]. The present study has been undertaken to understand the extent and nature of direct and indirect effects of eleven quality characteristics on fruit shape index in tomato.

MATERIALS AND METHODS

The experimental materials comprised 64 tomato lines which includes major processing lines from abroad and a few popular strains of Indian origin (Table 1). These lines were raised in pots, maintaining twelve pots in each line. Fruit shape index and quality characteristics were recorded on the fruits collected from five randomly selected plants. Fruit shape index was considered as the effect factor in a closed system of cause-and- effect variables, the casual variables being total solids, total soluble solids, insoluble solids, juice yield, acidity, pH, reducing sugar, consistency, lycopene, locules/fruit and pericarp

thickness. The estimates of direct and indirect effects in such a closed system of variables were calculated by path coefficient analysis as suggested by Dewey and Lu [4].

RESULTS AND DISCUSSION

The maximum correlations at genotypic and phenotypic levels (Table 2) were observed between consistency and fruit shape index (rg = 0.64, rp = 0.56). The fruit shape index had positive correlations with pericarp thickness (r = 0.62), insoluble solids (r = 0.50), lycopene (r = 0.35), total solids (r = 0.33), pH (r = 0.26) and TSS (r = 0.09). Strong negative correlation was observed between fruit shape index and locules/fruit (r = –0.53). Reducing sugar, juice yield and acidity also showed a negative correlation with fruit shape index (i.e. fruit length in relation to its width).

Insoluble solids had maximum positive direct effect (0.77) on fruit shape index, followed by pericarp thickness (0.55) (Table 3). Acidity, consistency and TSS also had direct positive effect on fruit shape index (0.44, 0.43 and 0.36 respectively). Negative direct effect on fruit shape index was observed for total solids (–0.65), locules/fruit (–0.33), reducing sugar (–0.26), lycopene (–0.24) and pH (–0.07). Insoluble solids, besides their strong direct effect (0.77), influenced fruit shape index through indirect effect on total solids, consistency, lycopene,

Table 1. Fruit shape index of tomato genotypes

Genotype	Fruit shape index	Genotype	Fruit shape index
Ohio 832	1.31	Pant T2	1.52
Ohio 7814	1.27	Fire Ball	0.92
Ohio 8129	1.20	Fresh Market 9	1.02
St 61	1.39	DMM (EC 108759)	1.67
St 64	1.03	EC 129968	0.72
St 87	1.27	EC 104162/P2-1	1.19
ONt 828	1.14	EC 54645	1.01
ONt 8210	1.16	EC 50366-1-1	0.96
H 722	1.37	EC 129599/P1	1.00
H 2653	1.41	EC 129599	1.24
H 7038	1.22	EC 128965	0.75
FM 6203	1.18	EC 129355	1.21
HW 208F	1.04	EC 101652	0.89
TH 318	1.11	Kt 1	0.87
Veepick	2.02	Kt 2	0.87
Veepro	1.29	Kt 3	0.97
Veeking	1 02	Kt 4	0.94
Veemore	0.82	HS 101	0.91
Veeroma	0.47	HS 102	0.90
Rubyvee	1.25	AC 142	0.83
UC 28	1.20	AC 238	0.73
UC 82	1.29	AC 2301	0.71
E 6203	1.36	S 12	0.88
Processor 40	1.40	Sweet 72	0.75
Roma	1.42	Punjab Kesari	1.04
San Marzano	1.42	Pusa Early Dwarf	0.71
Heinz 1350	0.99	Money Maker	0.80
Sioux	0.91	Marutham	0.91
Punjab Chhuhara	1.40	Pusa Ruby	0.74
Labonita	1.04	LE 206	0.88
IHR 674	1.25	LE 214	0.89
Sel. 11	1.51	Sakthi	0.90

pericarp thickness and pH. Insoluble solids had maximum indirect effect on consistency and total solids (0.62). Increase in consistency with higher level of insoluble solids were reported earlier [5, 6]. Insoluble solids also made a major contribution (0.38) to the high direct effect of pericarp thickness (0.55) on fruit shape index. Increased pericarp thickness of the fruits with shape index >1 was reported by [7, 8]. Pericarp thickness is said to increase due to greater partitioning of dry matter into insoluble cell wall components [9]. This is further substantiated by the observed indirect influence of pericarp thickness (0.27) and consistency (0.34) on soluble solids.

Table 2. Genotypic (r_g) and phenotypic (r_p) correlations between fruit shape index and fruit quality parameters in tomato

Quality parameter	Correlation with fruit shape index	
	r_g	r_p
Consistency	0.64	0.56**
Pericarp thickness	0.62	0.53**
Insoluble solids	0.50	0.46**
Lycopene	0.35	0.31*
Total solids	0.33	0.30*
pH	0.26	0.23
T.S.S.	0.09	0.05
Reducing sugar	–0.10	–0.07
Juice yield	–0.22	–0.16
Acidity	–0.34	–0.29*
Locules/fruit	–0.53	–0.42**

*,**Significant at P = 0.05 and P = 0.01, respectively.

The negative direct effect of total solids (–0.65) and lycopene (–0.24) but its positive correlation (0.33 and 0.35, respectively) with fruit shape index was mainly due to the indirect positive influence of insoluble solids on total solids (0.62) and lycopene (0.59).

Direct effect of pH on fruit shape index was negative (–0.07). But the high indirect influence of insoluble solids on pH (0.41) made the correlation between pH and shape index positive (0.26). This association is understandable in the light of the reported evidence of low acidity in firm fruits with more insoluble solids having shape index >1 due to reduced locular area [9, 10].

Acidity (low pH) had positive direct effect (0.44) on fruit shape index but the correlation was negative (–0.34). This can be attributed to the fairly high negative indirect influence of pericarp thickness (–0.41), insoluble solids (–0.38) and consistency (–0.24) on acidity. With increased fruit shape index there is chance for increased acidity but due to strong influence of factors such as pericarp thickness, insoluble solids and consistency, the acidity will be lowered. Reduced acidity with increase in fruit shape index was reported in association with reduced locular area [9, 10].

The locule number was reduced with increase in fruit shape index (i.e., length) as indicated by the negative correlation (–0.53) and direct effect (–0.33). Negative relationship of locule number with fruit shape index is well established [7, 8]. Reducing sugar and juice yield also showed negative relationship with fruit shape index. The fruit firmness increases pericarp thickness and reduce the locular area and since the locules contain more reducing

Table 3. Direct and indirect genotypic effect of quality parameters on fruit shape index in tomato

Quality parameter	r_g	Direct effect	Indirect effects via										
			insoluble solids	pericarp thickness	acidity	consistency	T.S.S.	pH	juice yield	lycopene	reducing sugar	locule number	total solids
Insoluble solids	0.50	0.77	—	0.27	–0.22	0.34	0.001	–0.04	–0.03	–0.18	0.03	0.08	–0.52
Pericarp thickness	0.62	0.55	0.38	—	–0.33	0.28	–0.09	–0.02	0.02	–0.11	0.06	0.09	–0.19
Acidity	–0.34	0.44	–0.38	–0.41	—	–0.24	0.19	0.03	–0.01	0.10	–0.13	–0.03	0.10
Consistency	0.64	0.43	0.62	0.35	–0.25	—	–0.03	–0.04	–0.01	–0.16	0.05	0.12	–0.43
T.S.S.	0.09	0.36	0.003	–0.14	0.24	–0.03	—	0.03	–0.01	0.01	–0.13	0.07	–0.30
pH	0.26	–0.07	0.41	0.18	–0.21	0.27	–0.14	—	0.001	–0.09	0.05	0.07	–0.22
Juice yield	–0.22	–0.13	0.18	–0.09	0.05	0.04	0.04	0.001	—	–0.09	–0.006	0.01	–0.21
Lycopene	0.35	–0.24	0.59	0.26	–0.19	0.29	–0.01	–0.03	–0.05	—	0.04	0.10	–0.42
Reducing sugar	–0.10	–0.26	–0.08	–0.13	0.22	–0.08	0.18	0.01	–0.003	–0.04	—	0.09	–0.08
Locule number	–0.53	–0.33	–0.18	–0.15	0.04	–0.15	–0.07	0.01	0.003	0.07	0.07	—	0.16
Total solids	0.33	–0.65	0.62	0.16	–0.07	0.28	0.16	–0.02	–0.04	–0.15	–0.03	0.08	—

sugar than pericarp, the reducing sugar content of the fruit gets lowered [10]. Also, the increased pericarp thickness is associated with rise in insoluble solids which results in lowering the proportion of sugars [9]. Total soluble solids do not make a significant relation with fruit shape index (0.09), but its fairly good direct effect was mainly through the indirect influence of acidity (0.24). This can be explained by the major contribution of organic acids to soluble solids in tomato [11].

Based on these results, it can be inferred that selection in tomato based on fruit shape index has a direct positive effect on insoluble solids. With increased insoluble solids, other fruit qualities such as total solids, consistency, lycopene, pH and pericarp thickness were enhanced but the levels of acidity, reducing sugar, and number of locules/fruit decrease.

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