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Research Note

Influence of quality traits on green cob yield in hybrids of sweet corn (*Zea mays* L. *saccharata*)

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Abstract
Seventy two sweet corn hybrids developed from eighteen sweet corn lines were studied for association between green cob yield and quality traits. The genotypic correlations revealed that the green cob yield had highest positive and significant correlation with green cob length followed by green cob girth, number of kernels per row, plant height, leaf length, leaf breadth, number of kernel rows per cob, number of leaves, non reducing sugar and total sugar. Days to 50 per cent tasseling, days to 50% silking and days to green cob harvest recorded significant and negative association with green cob yield. The inter association among quality traits showed that total soluble solids recorded positive relationship with total sugar and total sugar had negative association with starch.

Key words
Genetic correlation, green cob yield, total soluble solids, total sugar- and starch

Sweet corn (*Zea mays* L. *saccharata*) is gaining momentum during recent days as immature cob used as vegetable or eaten after boiling in many countries throughout the world including India. It is an important source of fibre, minerals and certain vitamins. In India, it is mainly grown in periurban areas of southern states. It is the resultant of a naturally-occurring recessive mutation in the genes which increase sugar content and decrease the starch content (Tracy, 1997). There are two classes of mutants that govern starch synthesis (Boyer and Shannon, 1983). Class 1 mutants include sh_2, bt_1 and bt_2 which result in reduced starch synthesis and increased sugar content in the endosperm. Class 2 mutants used in commercial sweet corn are su_1 (used singly) and *ae*, *du* and *ae*, *du and wx* (used in combination). The sugar levels of su_1 are two to three times higher than those of field corn, but due to a high level of water soluble polysaccharides, phytoglycogen, su_1 results in a creamy texture. The *shrunken-2* mutant produces more sugar content and less phytoglycogen compared to sugary mutant. Another important sweet corn mutant gene in new sweet corn hybrids is sugary enhancer, se_1 (Kumari *et al.,* 2008), which improves the flavour of su_1su_1 sweet corn.

In India, sweet corn breeding programme was started early and several composites like Madhuri, Priya, Win-Orange and Almora sweet corn were developed and released for general cultivation of farmers. Although the composites are popular among the farming community in some of the Northern states, yet they have the inherent problem of low yielding potential compared to hybrids. As the trend of maize breeding turned towards developing single cross hybrids to enhance the yield and quality, so, it is necessary to bred single cross hybrids of sweet corn for commercial cultivation. Improvement of sweet corn yield, while retaining quality is one of the major challenges faced by sweet corn breeders (Hunsperger, and Davis, 1987). Quality of sweet corn is measured in terms of high sugar content, water soluble polysaccharides, texture, flavour, cob size, cob length, shelf life *etc.*

A better picture of the contribution of each component trait in building up the total genetic architecture of a complex character such as yield and quality may be obtained through correlation estimates which provide information on the relative importance of component traits. Selection for one trait invariably affects a number of other associated traits. So, a knowledge of inter-relationship of characters may prove useful in improving the yield and quality traits. Therefore, an attempt was made to find out the inter - relationship of various sweet corn components including quality parameters, among themselves and with green cob yield in sweet corn hybrids.

A total of 22 sweet corn lines were involved in the study with 18 genotypes as lines (female) and four as testers (male). Details of germplasm lines used are given in table 1.Sweet corn lines were raised during *Kharif*' 2010 and crossing was effected in a Line x Tester design as suggested by Kempthorne, 1957. The resultant 72 hybrids along with their parents and a standard check, (Madhuri) were evaluated in randomized complete block design with two replications, during *Rabi* 2010-11. Each genotype was raised in two rows of five meters length with the spacing of 60 x 25 cm.

The biometrical observations were recorded on five selected plants per replication and mean of each replication was arrived. Biometrical data

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recorded are plant height (cm), number of leaves per plant, leaf length (cm), leaf breadth (cm), days to 50% tasseling, days to 50% silking, days to green cob harvest, green cob length (cm), green cob girth (cm), number of kernel rows per cob, number of kernels per row and green cob yield (g).

The quality traits *viz*. total soluble solids (% brix), total sugar (%), reducing sugar (%), non reducing sugar (%), starch (%) and total carbohydrate (%) were estimated in all 72 hybrids and 22 parents. The cobs collected at milky stage (20-25 days after pollination) from parents and hybrids were dried in hot air oven then kernels were ground in to fine powder and this formed the sample for quality analysis. Total soluble solids was measured using hand refractometer (Olsen *et al.,* 1990) by taking juice directly by squeezing a grain at milky stage, total sugars was estimated using Anthrone method (Yemm and Willis, 1954), reducing sugar by Nelson Somogyi method (Somogyi, 1952), non-reducing sugar by subtracting reducing sugar from total sugar, starch by Anthrone method (Clegg, 1956) and total carbohydrate by phenol-sulphuric acid method (Dubois *et al.,* 1956).

Genotypic correlation co-efficient were worked out as per the method suggested by Johnson *et al.* (1955) to find out the association of traits with green cob yield and association among quality traits.

Green cob yield in sweet corn is a complex character controlled by many factors. Selection for desirable genotypes should be made based on green cob yield and other yield contributing traits. The correlation analysis is usually performed to measure the relative influence of each of independent variable on a dependent variable like yield. In an attempt to achieve higher yield, one has to examine various yield components and concentrate on those having dominating influence on green cob yield. The knowledge on the degree of relationship between yield and yield component characters will aid the breeders to launch successful crop improvement programme. In the present investigation, the genotypic correlation between pairs of characters have been analysed to identify the component traits which are closely related to green cob yield.

Among the various traits studied, the most important trait green cob yield had highest positive and significant correlation with green cob length (Om prakash *et al.,* 2006), followed by green cob girth (Kashiani and Saleh, 2010), number of kernels per row (Om prakash *et al.,* 2006; Kashiani and Saleh, 2010), plant height (Kashiani and Saleh, 2010), leaf length, leaf breadth, number of kernel rows per cob (Kashiani and Saleh, 2010), number of leaves, non reducing sugar and total sugar.

Green cob yield also showed significant negative correlation with Days to 50 per cent tasseling (Kashiani and Saleh, 2010), days to 50 per cent silking (Kashiani and Saleh, 2010) and days to green cob harvest. Plant height exhibited significant and positive relationship with number of leaves per plant, leaf length, leaf breadth, green cob length, green cob girth (Kashiani and Saleh, 2010), number of kernel rows per cob, number of kernels per row (Yosuf and Saleem, 2001), total sugar and reducing sugar. However, it recorded a significant negative association with days to 50% tasseling (Kashiani and Saleh, 2010) and days to 50% silking.

Number of leaves per plant showed positive and significant association with leaf length, leaf breadth, green cob length, green cob girth, number of kernel rows per cob, number of kernels per row. Whereas, it showed positive and significant correlation with total sugar and reducing sugar. Leaf length recorded positive and significant relationship with leaf breadth, green cob length, green cob girth, number of kernel rows per cob, number of kernels per row. It also had significant positive correlation with quality traits like total sugars and reducing sugar. Leaf breadth had a positive and significant association with green cob length, green cob girth, number of kernel rows per cob, number of kernels per row, total sugar and non reducing sugar. However, significant and negative association of this trait with days to 50% tasseling and days to 50% silking was also noticed.

The trait, days to 50% tasseling had exhibited significant positive association with days to 50% silking (Stojsin and Kannenberg, 1994) and days to green cob harvest. However, it showed significant and negative correlation with green cob length, green cob girth, number of kernel rows per cob and number of kernels per row. Days to 50 per cent silking showed positive significant association with days to green cob harvest and negative significant association with green cob length, green cob girth number of kernel rows per cob and number of kernels per row. Similar kind of relationship was reported by Kashiani and Saleh (2010).

Days to green cob harvest had recorded negative and significant association with green cob length, green cob girth, number of kernel rows per cob and number of kernels per row. Cob length recorded significant positive relationship with green cob girth, number of rows per cob and number of kernels per row, total sugar and reducing sugar. While, green cob girth showed positive and significant association with number of kernel rows per cob, number of kernels per row, total sugar and reducing sugar.

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Number of kernel rows per cob was positively and significantly correlated with number of kernels per row, total sugar and reducing sugar. Number of kernels per row was significant and positively related with total sugar and reducing sugar. The important quality trait, total soluble solids was positively correlated with total sugar but association was non-significant. It is in confirmation with the earlier findings of Kumari *et al. (*2006). Total soluble solids had a positive but non-significant association with non reducing sugar and total carbohydrate.

Total sugar showed a significant and positive correlation with both reducing and non reducing sugar. It also recorded negative but non significant relation with starch. This relation was in coincidence with Nelson and Rines (1962); Creech (1965); Azanza *et al.* (1995); Voichipa (1999) and Dickert and Tracy (2001). Reducing sugar had significant negative association with non reducing sugar. Non reducing sugar registered negative but non-significant relation with starch and non significant positive relationship with total carbohydrate.

The trait green cob yield had highest positive and significant correlation with green cob length, followed by green cob girth, number of kernels per row, plant height, leaf length, leaf breadth, number of kernel rows per cob. Therefore, indirect selection for these traits simultaneously would contribute for the improvement of green cob yield in sweet corn.

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Table 1. Details of parents utilized in the study

S.No.	Inbreds	Kernel shape	Kernel colour
Lines			
1	72173-2-1-2	Shrunken	Orange
2	SC 11-1	Shrunken	Orange
3	SC 11-2	Shrunken	Yellow
4	SC 8324-3	Shrunken	Orange
5	B.NO. 1386	Shrunken	Orange
6	B.NO. 1457-6	Shrunken	Yellow
7	B.NO. 1413-6-2	Shrunken	Orange
8	B.NO. 1421-5-1	Shrunken	Orange
9	USC 10-3-1-1	Shrunken	Yellow
10	USC 10-3-2-1	Shrunken	Orange
11	B.NO.1378-5-1	Shrunken	Orange
12	72173-3-1	Shrunken	Orange
13	B.NO.1396-4-1	Shrunken	Orange
14	USC 1-1-1	Shrunken	Orange
15	USC 10-2-2	Shrunken	Orange
16	USC 10-3-2-3	Shrunken	Yellow
17	SC 7855-3-1	Shrunken	Orange
18	USC 1-1-2	Shrunken	Yellow
Testers			
1	USC 4	Shrunken	Orange
2	USC 3-1-2-2	Shrunken	Yellow
3	B.NO. 1394-6	Shrunken	Yellow
4	USC 1053-6	Shrunken	Orange
Check			
1	Madhuri	Shrunken	Orange

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Table 2. Genotypic correlation coefficient among yield, yield attributing characters and quality traits

	PH	NL	LL	LB	DFT	DFS	DGH	GCL	GCG	R/C	K/R	TSS	TS	RS	NRS	STA	TC	GCY
PH	1.000	0.573**	0.787**	0.613**	-0.229*	-0.256*	-0.181	0.804**	0.746**	0.529**	0.748**	0.056	0.292**	0.332**	0.051	-0.138	-0.047	0.797**
NL		1.000	0.564**	0.399**	-0.006	-0.086	-0.014	0.519**	0.477**	0.378**	0.519**	-0.171	0.377**	0.303**	0.170	-0.129	-0.077	0.494**
LL			1.000	0.563**	-0.135	-0.157	-0.070	0.734**	0.653**	0.404**	0.730**	0.02	0.302**	0.294**	0.088	-0.059	-0.050	0.730**
LB				1.000	-0.21*	-0.267**	-0.193	0.649**	0.639**	0.384**	0.638**	-0.026	0.236*	0.030	0.215*	-0.169	-0.128	0.633**
DFT					1.000	0.940**	0.891**	-0.326**	-0.408**	-0.268**	-0.249*	0.125	0.030	-0.047	0.069	0.134	0.104	-0.380**
DFS						1.000	0.948**	-0.370**	-0.465**	-0.283**	-0.273**	0.107	0.010	-0.034	0.039	0.108	0.104	-0.416**
DGH							1.000	-0.249*	-.359**	-0.224*	-0.136	0.082	0.010	0.000	0.012	0.103	0.091	-0.309**
GCL								1.000	0.921**	0.595**	0.889**	0.006	0.296**	0.241*	0.120	-0.120	-0.089	0.938**
GCG									1.000	0.678**	0.833**	-0.014	0.301**	0.229*	0.132	-0.160	-0.129	0.902**
R/C										1.000	0.551**	-0.144	0.274**	0.268**	0.090	-0.078	-0.010	0.578**
K/R											1.000	0.007	0.367**	0.298**	0.160	-0.123	-0.107	0.892**
TSS												1.000	0.038	-0.175	0.171	-0.127	0.079	-0.004
TS													1.000	0.424**	0.734**	-0.036	0.184	0.266*
RS														1.000	-.297**	0.069	0.107	0.286**
NRS															1.000	-0.097	0.103	0.055
STA																1.000	0.754**	-0.147
TC																	1.000	-0.119

** Significant at 1% * Significant at 5% **PH**-Plant height, **NL**-No. of leaves, **LL**-Leaf length, **DFT**-Days to 50% teasseling**, DFS**- Days to 50% silking ,**DGH**- Days to green cob harvest, **GCL**-Green cob length, **GCG**-Green cob girth, **R/C**-No. of kernels rows per cob, **K/R**-No.of kernels per row, **TSS**-Total soluble salts, **TS**-Total sugar, **RS**-Reducing sugar, **NRS**- Non-reducing sugar ,**STA**-Starch, **TC**-Total carbohydrate, **GCY**- green cob yield