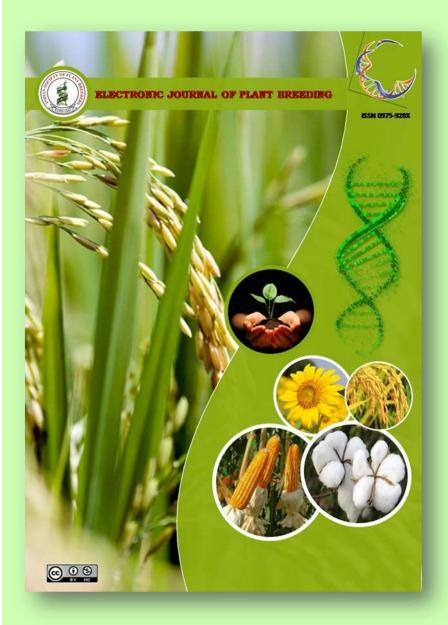# Combining ability and association studies on different yield contributing traits for enhanced green cob yield in sweet corn (*Zea mays* con var *saccharata*)

A. Chinthiya, K. N. Ganesan, R. Ravikesavan and N. Senthil

Research Article

Combining ability and association studies on different yield contributing traits for enhanced green cob yield in sweet corn (*Zea mays* con var *saccharata*)

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Abstract
The present study was carried out to determine the combining ability of six sweet corn inbred lines and their hybrids and to ascertain the association between different biometrical and quality traits for increased green cob yield in sweet corn (*Zea mays* con var *saccharata*). Six sweet corn inbred lines were used as parental lines and they were crossed in full diallel fashion. The resultant sweet corn hybrids and their parents along with check hybrid were evaluated in randomized complete block design. The SCA variance was found to be greater than GCA variance indicating the predominance of non additive gene action for all the characters studied. Highly positive *sca* effects were noticed in the hybrid 45683x45508 for cob placement height, plant height, cob length, cob breadth, number of kernels per row. The cross 45684x45508 expressed highly significant and positive *sca* effect for the most important trait, green cob weight and quality traits *viz.,* total sugar and non reducing sugar and possibility of commercial exploitation of this hybrid to be assessed based on its stability. The traits *viz.,* cob length, cob breadth, number of kernels per row and plant height had positive association with green cob weight which indicates the possibility of green cob yield improvement through selection in favour of these correlated traits.

Introduction

Sweet corn (*Zea mays* con var. *saccharata*) is a cereal with high sugar content. Also known as sugar corn and pole corn. Unlike field corn, which is harvested at dent stage(kernels are dry and mature), sweet corn is picked at milky stage(immature). The kernels are eaten as vegetable rather than a grain. Sweet corn must be eaten fresh, canned or frozen, before the kernels become tough and starchy. Sweetness of sweet corn is conferred by few recessive genes that affect the conversion of sugar into starch in kernels. Sweet corn seed has reduced food reserve because of less starch and high sugar content. The four most useful mutants (Lertrat and Pulam, 2007)that are used to enhance sugar are sugary (su), sugary enhanced (se), super sweet or shrunken (sh2) and brittle (bt). These genes affect carbohydrate metabolism of kernels resulting in higher sugar content.

Ability of the parents to combine well with each other during hybridization programme is known as combining ability (Fasahat *et al.,* 2016) . Average performance of the inbred is termed as General Combining Ability (GCA) and hybrid combination which performs better or poorer is explained by Specific Combining Ability (SCA) (Sprague and Tatum, 1942). With the help of combining ability

analysis, type of gene action controlling the trait can be determined, which inturnis useful for selecting breeding procedure to be followed.

Selection is the basic method used in plant breeding for crop improvement. Association of characters mainly influences the response to selection. Plant breeders always work with yield, which is a complex character, contributed by many other characters (Ilker, 2011). Hence, correlation studies are being carried out to assess the relationship among yield and yield components to enhance the usefulness of selection (Sadaiah *et al.,* 2013).The present study was carried out to determine the genetic nature of different biometrical and quality traits of sweet corn hybrids and to determine the relationship between different traits in sweet corn hybrids to design a selection index for improving green cob yield in sweet corn.

Materials and Methods

Six sweet corn inbred lines obtained from Winter Nursery Centre, Indian Institute of Maize Research, Hyderabad were used as parental materials for the present study. These six parental inbreds were crossed in full diallel fashion to obtain 36 cross combinations. The hybrids and their parents were

evaluated along with one check hybrid *viz.,* Sugar75 for their yield and quality traits. Statistical design adopted for hybrid evaluation was randomized complete block design(RBD) with two replications. All the 30 hybrids, 6 parents and one check(Sugar75) were raised and evaluated during *kharif* 2018. Each entry was sown in two rows of 4m length with the spacing of 60 x 25cm. All the recommended practices were followed to maintain healthy crop standin all the entries.

Sixteen biometrical and quality traits were observed during hybrid evaluation programme. Five plants per replication from each hybrid was taken for recording the observations, which was used to arrive replication mean. The mean values were used for statistical analysis. The characters *viz.,* days to first flowering, days to 50% tasseling, days to 50% silking, anthesis silking interval, days to maturity, green cob weight(g), cob length(cm), cob breadth(cm), plant height(cm), cob placement height(cm), total soluble solids(% brix) (Olsen *et al.,* 1990), total sugar(%) by anthrone method (Yemm and Willis, 1954), reducing sugar(%) by Nelson and Somogyi method (Somogyi, 1952) and non reducing sugar(%) were recorded for both parents and sweet corn hybrids. The mean values of each character were first analyzed for testing their significance through analysis of variance. And then, combining ability and correlation studies were carried out.
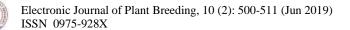
Results and Discussion
The analysis of variance showed significance of the treatments for all the characters studied (Table1). Combining ability analysis facilitates the partitioning of genotypic variation of the hybrids into variation due to general combining ability (main effects) and specific combining ability (interaction effects). GCA variance and SCA variance provides a measure of variance due to additive and non-additive gene action respectively. In the present study, SCA variance was found to be greater than GCA variance for all the traits studied, indicating that non additive gene action was higher than additive gene action in the genotypes under study. Similar results were reported in sweet corn by Dickert and Tracy (2002); Kumara, (2011);Elayaraja *et al.,* (2014); Suhashini, (2016); Niji, (2018). For the most important trait, green cob weight, the inbred, 45684 showed significantly positive and high *gca* when compared with other parents. It also exhibited positive and high *gca* for total soluble solids too (Table6). Out of sixteen characters studied, the parent,45684 was identified as good general combiner for five characters. None of the parents were identified as a good general combiner for all the characters studied (Table3 and Table4). Considering earliness in flowering traits,

low anthesis silking interval, early maturity along with higher green cob weight, the parent,45684 was found to be promising which could be further utilized in breeding programme to develop hybrids with enhanced green cob yield.

Specific combining ability effect is considered as the most important criterion for the evaluation of hybrids. The hybrid, 45683x45508 registered significant and negative *sca* for days to first flowering and days to 50% tasseling (Table5). For days to 50% silking, significant and positive *sca* effect was noticed in 45678x45679. Significant negative *sca* effect for anthesis silking interval was noticed in the hybrid 45679x45678. The cross, 45508x45683 have shown negatively significant *sca* effect for days to maturity. For most of the traits studied such as cob placement height, plant height, cob length, cob breadth, number of kernels per row, the hybrid 45683x45508 exhibited significant and positive *sca* effects (Table6 and Table7). The cross 45684x45508 expressed significant and positive *sca* effect for most important trait, green cob weight and quality traits *viz.,* total sugar and non reducing sugar. Similar results were already reported for green cob weight and quality traits by kumara (2011); Elayaraja *et al.,* 2014; Suhashini (2016); Niji (2018).

Green cob weight had positive and significant relationship with cob length(r=0.784), followed by number of kernels per row(r=0.757), cob breadth(r=0.739) and plant height(r=0.486). In accordance with the present results, kumara (2011) reported significant positive correlation of plant height (r=0.80), green cob length (r=0.94), green cob girth (r=0.90) and number of kernels per row (r=0.89) with green cob weight. Negative and significant association of green cob weight was observed with anthesis silking interval(r=-0.330).Ilker (2011) reported similar result of significant positive correlation of fresh ear weight with plant height (r=0.595) and ear length (r=0.470). The traits *viz.,* days to first flowering (r=-0.264), days to 50% tasseling (r=-0.150), days to 50% silking (r=-0.318) and days to maturity (r=-0.228) exhibited non significant and negative association with green cob weight while cob placement height (r=0.255) and number of kernel rows per cob (r=0.151) registered non significant and positive correlation with green cob weight. (Table9)

Green cob weight had significant and negative correlation with reducing sugar(r=-0.327), while total soluble solids(r=-0.143) exhibited non significant negative association with green cob weight. Other quality traits *viz.,* total sugar(r=0.205) and non reducing sugar(r=0.236)

were positively and significantly associated with green cob weight. In contrary to these results, Niji (2018) reported positive association between green cob weight and reducing sugar.

The predominance of non additive gene action in inheritance of all the characters studied, suggesting that heterosis breeding with postponement of selection to later generation will be ideal for genetic improvement of the studied traits. Considering earliness in flowering traits, low anthesis silking interval, early maturity along with higher green cob weight, the inbred *viz.,*45684was found promising. Highly positive *sca* effects were noticed in the hybrid 45683x45508 for cob placement height, plant height, cob length, cob breadth, number of kernels per row. The cross 45684x45508 expressed highly significant and positive *sca* effect for the most important trait, green cob weight and quality traits *viz.,* total sugar and non reducing sugar. Hence, this sweet corn hybrid 45684x45508 may be exploited after assessing its stable performance over locations. The traits *viz.,* cob length, cob breadth, number of kernels per row and plant height had positive correlation with green cob weight which indicates the possibility of green cob yield improvement through the selection in favour of these correlated traits. Quality traits *viz.,* total sugar and non reducing sugar expressed positive association with green cob weight which indicates that the selection for these quality traits also contributes for improvement of yield and quality simultaneously. Therefore, selection index may be designed for the above mentioned correlated biometrical and quality traits in order to improve the green cob yield in sweet corn hybrids besides improving the quality traits.

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Table 1. Analysis of variance of parents and sweet corn hybrids for various biometrical and quality characters

Source of variance	Df	DFF	D50%T	D50%S	ASI	DM	CPH	PH	CL
Replication	1	0.1184	0.1184	0.18	1.0658	0.0202	313.229	11.9688	2.9962
Treatment	36	8.5366**	5.7799**	3.42**	2.6447**	19.7650**	356.25**	707.5577**	12.0902**
Error	36	1.9563	0.4911	0.6657	0.4712	7.9232	130.4861	206.7662	1.5691
Source of variance	Df	CB	NKRPC	NKPR	GCW	TSS	TS	RS	NRS
Replication	1	0.0004	0.0526	17.0526	330.9314	0.0883	0.1724	0.0047	0.0047
Treatment	36	6.6212**	2.4765**	61.3556**	13729.79**	2.0234**	4.7147**	0.0874**	0.0874**
Error	36	0.8095	0.7013	4.3926	823.483	0.3002	0.3024	0.0058	0.0058

. Significant at 0.01 level. *. Significant at 0.05 level. **DFF- days to first flowering, **D50%T**- days to 50% tasseling, **D50%S**- days to 50% silking, **ASI**- AnthesisSilking Interval, **DM**- days to maturity, **CPH**- cob placement height, **PH**- plant height, **CL**-cob length, **CB**- cob breadth, **NKRPC**- number of kernel rows per cob, **NKPR**- number of kernels per row, **GCW**- green cob weight, **TSS**- total soluble solids, **TS**- total sugar, **RS**- reducing sugar, **NRS**- non reducing sugar.

Table 2. Analysis of variance for combining ability of parents and sweet corn hybrids for various biometrical and quality traits

Source of variance	Df	DFF	D50%T	D50%S	ASI	DM	CPH	PH	CL
gca	5	2.99*	2.31	6.7**	1.92**	15.07**	567.08**	897.39**	2.68**
sca	15	3.31**	2.36	4.43**	1.73**	11.77**	122.77**	302.12**	10.86**
reci	15	5.14**	3.6*	3.12*	0.375	4.60	105.00**	262.28**	2.84**
Error	35	1.00	1.63	1.36	0.248	2.88	67.187	13.862	0.896
Source of variance	df	CB	NKRPC	NKPR	GCW	TSS	TS	RS	NRS
gca	5	2.28**	0.65	8.04*	4305.056**	0.7361**	0.8184**	0.0605**	0.8394**
sca	15	3.20**	1.29**	53.68**	8089.286**	1.0772**	2.1804**	0.0419**	2.1241*
reci	15	3.23**	1.4**	13.51**	5226.685**	1.1383**	1.778**	0.0392**	1.8755
Error	35	0.68	0.37	2.296	435.026	0.15	0.154	0.002	0.157

- significant at 0.01 level.*- significant at 0.05 level.DFF**- days to first flowering, **D50%T-** days to 50% tasseling, **D50%S-** days to 50% silking, **ASI**- AnthesisSilking Interval, **DM**- days to maturity, **CPH**- cob placement height, **PH**- plant height, **CL**-cob length, **CB**- cob breadth, **NKRPC**- number of kernel rows per cob, **NKPR**- number of kernels per row, **GCW**- green cob weight, **TSS**- total soluble solids, **TS**- total sugar, **RS**- reducing sugar, **NRS**- non reducing sugar.

Table 3. Combining ability effects of parents(gca)

PARENTS	DFF	D50%T	D50%S	ASI	DM	CPH	PH	CL
45530 (P1)	0.0694 ns	0.0417 ns	-0.2917 ns	-0.3194 *	-1.1819 *	-2.1650 ns	-3.8456 **	0.6932 **
45684 (P2)	-0.7222 **	-0.2500 ns	-0.7083 *	-0.4028 **	0.4952 ns	6.8687 **	7.2774 **	-0.6576 *
45679 (P3)	-0.3056 ns	-0.0000 ns	-0.0833 ns	-0.0278 ns	-0.6415 ns	-3.6888 ns	-5.3535 **	0.1465 ns
45508 (P4)	-0.1389 ns	-0.3750 ns	-0.1667 ns	0.0972 ns	1.2510 **	-8.1471 **	-6.6047 **	-0.0601 ns
45678 (P5)	0.4861 ns	0.8333 *	1.4583 **	0.7222 **	1.1889 *	9.8512 **	14.2015 **	-0.3518 ns
45683 (P6)	0.6111 *	-0.2500 ns	-0.2083 ns	-0.0694 ns	-1.1115 *	-2.7192 ns	-5.6751 **	0.2299 ns

	DFF	D50%T	D50%S	ASI	DM	CPH	PH	CL
SE	0.2638	0.3362	0.3082	0.1313	0.4478	2.1600	0.9812	0.2496
CD (5%)	0.82	1.05	0.96	0.41	1.41	6.79	3.08	0.78
CD (1%)	1.11	1.41	1.29	0.55	1.88	9.10	4.13	1.05

- significant at 0.01 level. *- significant at 0.05 level.DFT**- days to firstflowering, **D50%T-** days to 50% tasseling, **D50%S-** days to 50% silking, **ASI**- AnthesisSilking Interval, **DM**- days to maturity, **CPH**- cob placement height, **PH**- plant height, **CL**-cob length.

Table 4. Combining ability effects of parents(gca)

PARENTS	CB	NKRPC	NKPR	GCW	TSS	TS	RS	NRS
45530 (P1)	0.0346 ns	0.2778 ns	0.9583 *	10.5247 ns	-0.2071 *	-0.0854 ns	-0.0208 ns	-0.0593 ns
45684 (P2)	0.3333 **	-0.2222 ns	-0.0000 ns	18.3110 **	0.3879 **	0.2050 ns	0.0542 **	0.1544 ns
45679 (P3)	-0.4071 **	0.2778 ns	-0.5000 ns	12.0064 *	0.0679 ns	-0.1158 ns	-0.0583 **	-0.0647 ns
45508 (P4)	0.5012 **	-0.1389 ns	0.5417 ns	6.2735 ns	-0.3229 **	-0.4317 **	0.0292 *	-0.4622 **
45678 (P5)	-0.6287 **	0.0278 ns	-1.3333 **	-18.3494 **	0.0638 ns	0.1979 ns	-0.0958 **	0.2919 **
45683 (P6)	0.1667 *	-0.2222 ns	0.3333 ns	-28.7661 **	0.0104 ns	0.2300 *	0.0917 **	0.1399 ns

	CB	NKRPC	NKPR	GCW	TSS	TS	RS	NRS
SE	0.0679	0.1604	0.3994	5.4964	0.1023	0.1034	0.0138	0.1045
CD (5%)	0.21	0.50	1.26	17.29	0.32	0.33	0.04	0.33
CD (1%)	0.28	0.68	1.68	23.16	0.43	0.43	0.06	0.44

- significant at 0.01 level.*- significant at 0.05 level.CB**- cob breadth, **NKRPC**- number of kernel rows per cob, **NKPR**- number of kernels per row, **GCW**- green cob weight, **TSS**- total soluble solids, **TS**- total sugar, **RS**- reducing sugar, **NRS**- non reducing sugar.

Table 5. Combining ability effects of sweet corn hybrids (*sca* and *rca*) for Days to first flowering (DFF), Days to 50% tasseling (D50%T), Days to 50% silking (D50%S), Anthesis silking interval (ASI)

Crosses	DFF		D50%T		D50%S		ASI	
	sca	rca	sca	rca	Sca	rca	Sca	rca
P1XP2	-0.1111 ns	-1.0000 ns	-0.5417 ns	-0.2500 ns	-0.9167 ns	0.0000 ns	-0.0139 ns	-0.2500 ns
P1XP3	-0.7778 ns	-1.7500 *	0.2083 ns	-2.2500 *	-0.0417 ns	-1.5000 ns	-0.1389 ns	0.5000 ns
P1XP4	-0.4444 ns	-1.2500 ns	-0.6667 ns	-0.5000 ns	-0.9583 ns	-1.0000 ns	-0.5139 ns	0.2500 ns
P1XP5	0.9306 ns	0.2500 ns	0.1250 ns	-0.5000 ns	1.1667 ns	-0.2500 ns	1.1111 **	0.5000 ns
P1XP6	-0.1944 ns	-2.2500 **	-0.5417 ns	-0.7500 ns	-0.4167 ns	-0.5000 ns	-0.0972 ns	0.0000 ns
P2XP3	0.2639 ns	0.5000 ns	0.0000 ns	-0.2500 ns	0.1250 ns	-0.2500 ns	0.1944 ns	0.2500 ns
P2XP4	-0.1528 ns	0.7500 ns	0.1250 ns	1.0000 ns	-0.0417 ns	0.5000 ns	-0.4306 ns	-0.2500 ns
P2XP5	0.4722 ns	-2.0000 **	-0.0833 ns	0.0000 ns	0.3333 ns	-1.5000 ns	0.9444 **	-0.7500 *
P2XP6	-1.1528 ns	0.5000 ns	0.5000 ns	0.5000 ns	0.5000 ns	1.0000 ns	-0.5139 ns	0.0000 ns
P3XP4	-1.3194 *	0.5000 ns	-0.8750 ns	0.7500 ns	-1.9167 **	-0.2500 ns	-0.5556 ns	-0.5000 ns
P3XP5	0.8056 ns	1.2500 ns	-0.0833 ns	2.7500 **	-1.5417 *	2.2500 **	-1.4306 **	-0.2500 ns
P3XP6	-0.3194 ns	-0.2500 ns	-0.7500 ns	-0.5000 ns	-0.8750 ns	-0.2500 ns	-0.1389 ns	0.7500 *
P4XP5	-1.3611 *	0.7500 ns	-1.2083 ns	-0.7500 ns	-0.7083 ns	-1.0000 ns	-0.0556 ns	-0.7500 *
P4XP6	1.7639 **	-4.5000 **	2.8750 **	-3.2500 **	1.7083 *	-3.2500 **	-0.2639 ns	-0.2500 ns
P5XP6	-2.6111 **	0.2500 ns	-0.5833 ns	0.0000 ns	-1.9167 **	0.2500 ns	-1.1389 **	0.0000 ns

	DFF	D50%T	D50%S	ASI		DFF		D50%T		D50%S		ASI	
						CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)
SE (*sca*(ij))	0.6061	0.7667	0.7029	0.2994	(*sca*(ij))	2.34	3.14	2.99	4.00	2.74	3.67	1.17	1.56
SE(*reci*(ij))	0.7079	0.9022	0.8271	0.3523	(*reci*(ij))	2.03	2.72	2.58	3.47	2.37	3.18	1.01	1.36

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Table 6. Combining ability effects of sweet corn hybrids (*sca* and *rca*) for Days to maturity(DM), Cob placement height(CPH), Plant height(PH), Cob length(CL)

Crosses	DM		CPH		PH		CL	
	sca	rca	sca	rca	Sca	rca	Sca	rca
P1XP2	-0.8464 ns	-2.1400 ns	-4.7325 ns	-6.4400 ns	-18.2786 **	2.4475 ns	-0.5157 ns	0.2100 ns
P1XP3	0.9003 ns	-0.6350 ns	3.8300 ns	-3.8050 ns	10.8272 **	-2.4875 ns	1.3451 *	-0.5950 ns
P1XP4	0.8053 ns	-0.2075 ns	-3.5867 ns	7.7100 ns	-2.4865 ns	9.1075 **	1.2218 *	-0.3250 ns
P1XP5	0.7323 ns	1.6775 ns	9.1200 ns	12.9950 *	16.5373 **	23.1275 **	2.2285 **	-0.2400 ns
P1XP6	-2.5622 *	-1.2875 ns	4.8079 ns	6.6175 ns	6.1939 **	7.7475 **	0.2368 ns	-0.2100 ns
P2XP3	-0.2443 ns	-0.6825 ns	-0.0437 ns	2.1050 ns	9.7043 **	13.0475 **	0.0410 ns	0.6700 ns
P2XP4	-0.5343 ns	0.4350 ns	10.6496 *	1.4600 ns	15.4356 **	8.5875 **	0.7826 ns	-0.7650 ns
P2XP5	0.7228 ns	-2.3350 ns	-2.4487 ns	-0.1400 ns	-4.6257 *	7.9725 **	0.3743 ns	1.5650 *
P2XP6	-2.5793 *	-1.8725 ns	7.9117 ns	2.0600 ns	11.6835 **	5.1850 ns	1.9226 **	0.0150 ns
P3XP4	-1.9227 ns	1.5900 ns	-4.4229 ns	-3.8900 ns	-5.3336 *	-4.5525 ns	1.9735 **	0.1700 ns
P3XP5	-2.2231 *	0.0275 ns	5.6537 ns	-12.7150 *	-4.9873 *	-17.9300 **	1.1451 *	-1.4300 *
P3XP6	-2.0801 *	0.6000 ns	6.6642 ns	0.6150 ns	11.4518 **	3.8125 ns	1.0185 ns	1.1250 ns
P4XP5	-0.9131 ns	-0.4550 ns	-1.0179 ns	8.6050 ns	1.7364 ns	5.5625 *	0.5468 ns	0.5750 ns
P4XP6	0.9398 ns	-3.2525 **	-12.3975 *	13.9450 *	-16.8569 **	23.4675 **	-0.8199 ns	3.6800 **
P5XP6	-1.1931 ns	1.3275 ns	0.4442 ns	-1.7150 ns	-1.1832 ns	-2.0575 ns	1.4218 *	-0.0500 ns

	DM	CPH	PH	CL		DM		CPH		PH		CL	
						CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)
SE (*sca*(ij))	1.0212	4.9256	2.2374	0.5691	(*sca*(ij))	3.98	5.34	19.21	25.76	8.72	11.69	2.22	2.97
SE (*reci*(ij))	1.2016	5.7960	2.6328	0.6697	(*reci*(ij))	3.44	4.62	16.64	22.29	7.55	10.12	1.92	2.58

Table 7. Combining ability effects of sweet corn hybrids (*sca* and *rca*) for Cob breadth (CB), Number of kernel rows per cob (NKRPC), Number of kernels per row (NKPR), Green cob weight (GCW)

Crosses	CB		NKRPC		NKPR		GCW	
	sca	rca	sca	rca	Sca	rca	Sca	rca
P1XP2	-0.0713 ns	-0.9475 **	-0.8611 *	-0.5000 ns	-2.4583 **	-0.7500 ns	-59.7710 **	25.7500 ns
P1XP3	0.0317 ns	-1.1700 **	-0.3611 ns	0.5000 ns	3.0417 **	0.7500 ns	73.6986 **	-84.4050 **
P1XP4	-0.5867 **	-0.5750 **	1.0556 **	0.5000 ns	1.2500 ns	2.0000 ns	-2.6735 ns	5.7500 ns
P1XP5	1.5458 **	-1.0425 **	-0.1111 ns	1.5000 **	4.8750 **	-1.7500 ns	44.2644 **	16.0250 ns
P1XP6	1.4554 **	1.6225 **	0.1389 ns	0.5000 ns	-0.5417 ns	-0.5000 ns	23.1761 ns	15.5600 ns
P2XP3	0.9129 **	2.2050 **	1.1389 **	0.5000 ns	2.2500 *	4.0000 **	42.8373 **	127.9400 **
P2XP4	1.4546 **	1.0500 **	-0.9444 *	0.0000 ns	4.2083 **	0.0000 ns	102.3228 **	73.4925 **
P2XP5	0.3971 *	1.2225 **	0.8889 *	-2.0000 **	1.0833 ns	3.0000 **	-19.9018 ns	33.2050 *
P2XP6	-0.3808 *	-0.5300 **	-0.3611 ns	-0.5000 ns	4.1667 **	1.2500 ns	16.6449 ns	2.0750 ns
P3XP4	0.4975 **	0.7975 **	1.0556 **	0.5000 ns	4.2083 **	-2.0000 ns	11.8949 ns	-6.8600 ns
P3XP5	-0.1925 ns	-0.8775 **	-0.1111 ns	-0.5000 ns	1.8333 *	-1.2500 ns	16.4228 ns	-48.3050 **
P3XP6	-0.1279 ns	0.5925 **	-0.8611 *	0.5000 ns	1.9167 *	3.0000 **	15.0994 ns	24.8750 ns
P4XP5	1.0042 **	0.8175 **	-0.1944 ns	1.0000 *	1.5417 ns	2.5000 *	23.2307 ns	-12.3900 ns
P4XP6	-0.7213 **	2.7775 **	0.0556 ns	1.0000 *	-3.8750 **	6.7500 **	-33.2177 *	68.4750 **
P5XP6	0.6487 **	-0.2225 ns	0.8889 *	0.0000 ns	3.2500 **	0.0000 ns	42.2753 **	-12.7550 ns

	CB	NKRPC	NKPR	GCW		CB		NKRPC		NKPR		GCW	
						CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)
SE (*sca*(ij))	0.1549	0.3658	0.9107	12.533	(*sca*(ij))	0.60	0.81	1.43	1.91	3.55	4.76	48.89	65.51
SE (*reci*(ij))	0.1823	0.4305	1.0716	14.748	(*reci*(ij))	0.52	0.70	1.24	1.66	3.08	4.12	42.34	56.73

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Table 8. Combining ability effects of sweet corn hybrids (*sca* and *rca*) for Total soluble solids(TSS), Total sugar(TS), Reducing sugar(RS), Non reducing sugar(NRS)

Crosses	TSS		TS		RS		NRS	
	sca	rca	sca	rca	Sca	rca	Sca	rca
P1XP2	0.2529 ns	-0.1125 ns	1.0275 **	-0.5625 *	0.0500 ns	0.1500 **	0.9689 **	-0.6975 *
P1XP3	-0.4996 *	1.0700 **	-0.9392 **	0.6850 *	-0.0125 ns	0.2250 **	-0.9344 **	0.4650 ns
P1XP4	-0.3413 ns	-0.5975 *	-0.3233 ns	0.0350 ns	-0.0750 *	-0.1000 **	-0.2394 ns	0.1325 ns
P1XP5	-0.9879 **	-0.9975 **	-1.3679 **	-1.3950 **	-0.0000 ns	0.0500 ns	-1.3736 **	-1.4375 **
P1XP6	0.5754 *	-0.2675 ns	-0.2575 ns	-0.5125 ns	-0.0375 ns	0.2000 **	-0.2115 ns	-0.7125 *
P2XP3	0.8204 **	0.6150 *	1.5463 **	-1.0025 **	-0.0875 **	-0.1250 **	1.8625 **	-0.8625 **
P2XP4	0.5237 *	1.2975 **	1.7250 **	-0.4775 ns	-0.2000 **	-0.1500 **	1.6339 **	-0.3250 ns
P2XP5	-0.0479 ns	-0.5975 *	-1.1783 **	-1.9650 **	-0.0250 ns	0.0000 ns	-1.1399 **	-1.9650 **
P2XP6	-0.3896 ns	-0.0125 ns	-0.5304 *	-0.3600 ns	-0.0625 ns	0.2500 **	-0.4703 ns	-0.5975 *
P3XP4	-0.8438 **	0.2850 ns	-0.7254 **	0.5125 ns	0.0625 ns	0.1000 **	-0.7940 **	0.3925 ns
P3XP5	0.2021 ns	0.6925 *	0.1750 ns	0.7625 **	-0.0625 ns	-0.0500 ns	0.2393 ns	0.7900 **
P3XP6	-0.5996 *	-0.4175 ns	-0.8396 **	0.1400 ns	-0.0500 ns	0.1500 **	-0.7861 **	0.0075 ns
P4XP5	-0.3046 ns	-0.7850 **	0.2458 ns	-0.6625 *	-0.0750 *	-0.0250 ns	0.3143 ns	-0.6375 *
P4XP6	1.1138 **	-1.4450 **	0.4029 ns	-0.9150 **	-0.0875 **	0.1000 **	0.4943 ns	-1.0250 **
P5XP6	0.5096 *	0.3125 ns	1.3167 **	0.1388 ns	0.2875 **	-0.1500 **	1.0322 **	0.3243 ns

	TSS	TS	RS	NRS		TSS		TS		RS		NRS	
						CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)	CD(5%)	CD(1%)
SE (*sca*(ij))	0.2332	0.2358	0.0314	0.2383	(*sca*(ij))	0.91	1.21	0.92	1.23	0.12	0.16	0.93	1.25
SE (*reci*(ij))	0.2744	0.2774	0.0369	0.2804	(*reci*(ij))	0.79	1.06	0.80	1.07	0.11	0.14	0.81	1.08

Table 9. Correlation coefficient values for different biometrical and quality characters studied for sweet corn genotypes

	DFF	D50%T	D50%S	ASI	DM	CPH	PH	CL	CB	NKRPC	NKPR	GCW	TSS	TS	RS	NRS
DFF	1	0.657**	0.713**	0.374*	0.573**	-0.312	-0.330*	-0.408*	-0.274	-0.089	-0.415**	-0.264	0.246	0.238	-0.332*	0.268
D50%T		1	0.819**	0.085	0.442**	-0.242	-0.226	-0.351*	-0.315	-0.349*	-0.388*	-0.150	0.463**	0.434**	-0.341*	0.457**
D50%S			1	0.636**	0.612**	-0.162	-0.104	-0.527**	-0.373*	-0.242	-0.531**	-0.318	0.293	0.249	-0.322*	0.277
ASI				1	0.520**	0.036	0.123	-0.430**	-0.197	0.032	-0.382*	-0.330*	-0.115	-0.120	-0.098	-0.105
DM					1	-0.235	-0.160	-0.519**	-0.224	-0.025	-0.458**	-0.228	0.123	0.290	-0.113	0.292
CPH						1	0.884**	0.250	0.159	0.112	0.269	0.255	-0.190	-0.136	-0.080	-0.121
PH							1	0.362*	0.304	0.113	0.385*	0.486**	-0.230	-0.050	-0.167	-0.028
CL								1	0.710**	0.218	0.937**	0.784**	-0.341*	-0.070	-0.155	-0.049
CB									1	0.102	0.722**	0.739**	-0.189	0.183	-0.081	0.186
NKRPC										1	0.201	0.151	-0.228	-0.174	-0.067	-0.159
NKPR											1	0.757**	-0.329*	-0.003	-0.126	0.012
GCW												1	-0.143	0.205	-0.327*	0.236
TSS													1	0.779**	-0.111	0.763**
TS														1	-0.265	0.994**
RS															1	-0.371*
NRS																1

. Correlation is significant at 0.01 level. *. Correlation is significant at 0.05 level. **DFF- days to first flowering, **D50%F-** days to 50% tasseling, **D50%S-** days to 50% silking, **ASI**-AnthesisSilking Interval, **DM**- days to maturity, **CPH**- cob placement height, **PH**- plant height,**CL**-cob length, **CB**- cob breadth, **NKRPC**- number of kernel rows per cob, **NKPR**- number of kernels per row, **GCW**- green cob weight, **TSS**- total soluble solids, **TS**- total sugar, **RS**- reducing sugar, **NRS**- non reducing sugar.