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Study of Combining Ability in Maize Line x Tester Hybridization

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Abstract
Five maize inbred lines were top crossed to each of the three testers and significant differences were observed among top cross progenies for plant height, ear height, ear length, kernel rows per ear, kernels per row, ear weight and grain yield. Top crosses excelled their respective parents in performance for most of the traits studied. Parents showing high general combining ability (GCA) for a particular trait did not necessity show high specific combining ability for that trait.

Key words: Hybridization, maize, combining ability

Introduction
The top cross (inbred × open pollinated variety method proved to be efficient in testing of inbred lines for combining ability because with its use, it was possible to identify more promising inbred lines by making fewer number of crosses than are required for making all possible single crosses. After the more promising inbred liras have been selected on the basis of good GCA, it is necessary to identify the particular combination that will produce the highest yield through SCA.

The present study was planned to identify maize inbred lines for their GCA and SCA by top crossing with three maize open pollinated varieties, Sultan, Golden and Pak Afgoee, The inbred lines selected will be used in future hybrid breeding programme. The importance of line x tester hybridization technique in maize breeding has been signified by workers like Muthiah *et al.* (1989), Arceo and Galan (1990), Ivakhnenko and Klimov (1991) and Zagnitko (1991).

Materials and Methods
The experimental materials comprised of five inbred lines of maize viz., WF-9, B-73, MO-17, CML-3 and Y-141 and three open-pollinated varieties i.e., Sultan, Golden and Pak Afgoee (used as testers). Each inbred line was crossed to each of the three testers. Top cross progenies of these crosses alongwith their parents were sown in a triplicated randomized complete block design in the experimental area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The plant to plant and row to row distances were maintained as 23 and 76 cms, respectively. The standard of agronomic practices were adopted in order to ensure good crop stand.

At maturity, ten guarded plants of each entry from each replication were selected to record the data on plant height (cm), ear height (cm), ear length (cm) number of kernel rows per ear, number of kernels per row, ear weight (g) and grain yield (g), Line x tester analysis was performed in accordance with Kempthorne (1957).

Results and Discussion
Analysis of variance revealed significant differences among genotypes for all the traits viz., plant height, ear height, ear length, kernel rows per ear, kernels per row, ear weight and grain yield.

Regarding mean performance of parents and their top crosses, in some cases the top cross progenies excelled their respective parents for all the traits (Table 1). However, for plant height and ear height generally short statured plants bearing cobs below the middle are favoured so the crosses CML-3 X PakAfgoee and MO-17 × Pak-Afgoee would be considered as they possessed minimum plant and ear height, respectively.

General and specific combining ability effects for various maize plant traits are presented in Table 2 and 3, respectively. For plant height, male parent Sultan among testers Y-141 and CML-3 among females, showed positive GCA effects while rest of the parents possessed negative effects for the trait. For the development of statured hybrids with low ear height, the crosses showing. negative SCA effects will be preferred for selection (Muthiah *et al.*, 1989). For ear length, maximum GCA effects were possessed' by parents Y-141 and Pak-Afgoee, however, among hybrids maximum SCA effects was evident for cross CML-3 x Sultan. For kernel rows per ear, a relationship existed between GCA and SCA effect of WF-9. WF-9 with Golden gave the maximum SCA effect for the trait (Arceo and Galan, 1990). No relationship was found between GCA ano SCA effects of MO-17 and Pak = Afgoee for kernels per row. Both these parents possessed maximum GCA effects for the trait, but gave a negative SCA effect in hybrid combination.

Maximum SCA effect for ear weight was shown by the cross WF-9 x Golden followed by Y-141 x Pak-Afgoee. The parents in the later cross also possessed prominent GCA effects for the trait in their respective. For grain yield maximum SCA effect was manifested by the cross CML-3 x Sultan which also showed maximum SCA effects for ear length and kernels per row. Prominent GCA and SCA

Table 1: Mean performance of parents and top-crosses for various plant traits

Parents	Plant height (cm)	Ear height (cm)	Ear length (cm)	No. of kernel rows	No. of kernels/rows	Ear weight (g)	Grain yield (g)
Males							
Pak-Afgoee	185.43	74.93	16.30	13.53	36.40	193.83	132.50
Golden	184.56	76.63	14.77	13.73	31.83	181.33	129.83
Sultan	198.60	77.67	17.13	13.60	35.47	194.00	135.61
Females							
Y-141	145.50	49.17	13.66	15.00	26.93	140.83	96.00
WF-9	176.30	71.40	14.73	13.60	31.13	216.00	150.61
CML-3	172.50	50.63	14_03	12.07	34.43	164.83	118.61
Mo-17	166.83	55.10	14.53	13.13	35.07	221.67	151.50
B-73	167.20	56.20	12.33	13.27	28.83	169.67	119.33
Crosses							
Y-141 × Pak-Afgoee	212.00	86.27	18.17	13.533	37.60	227.33	163.33
Y-141 × Golden	187.90	63.23	16.80	14.067	36.20	200.00	148.83
Y-141 × Sultan	181.36	54.90	13.63	12.667	30.03	189.83	136.33
WF-9 × Pak-Afgoee	173.57	58.13	14.20	14.067	34.17	183.17	130.11
WF-9 × Golden	176.50	62.80	13.80	16.133	30.93	199.17	142.50
WF-9 × Sultan	170.93	5.2.13	14.07	14.333	30.93	147.50	102.33
CML-3 × Pak-Afgoee	169.07	57.10	13.40	12.600	31.47	166.83	120.17
CML-3 × Golden	181.00	59.13	14.53	12.867	31.03	169.17	120.33
CML-3 × Sultan	200.50	69.93	17.30	12.867	37.13	223.03	149.17
Mo-17 × Pak-Afgoee	250.63	49.27	15.73	13.067	35.07	207.83	160.50
Mo-17 × Golden	170.17	57.47	13.53	13.933	30.70	192.00	164.83
Mo-] 7 × Sultan	191.23	67.03	17.37	14.067	38.23	198.33	147.17
B-73 × Pak-Afgoee	175.60	67.77	15.77	13.733	38.20	210.00	151.67
B-73 × Golden	171.00	58.60	12.33	13.333	31.70	204.07	138.00
B-73 × Sultan	174.17	61.97	13.07	14.800	30.10	186.67	134.00

Table 2: Estimates of general combining ability effects for various plant traits of maize genotypes

Parents	Plant height (cm)	Ear height (cm)	Ear length (cm)	No. of kernel rows	No. of kernels per row	Ear weight (g)	Grain yield (g)
Males							
Pak-Afgoee	-2.8688	1.9911	0.5400	0.3377	1.7800	5.3711	4.5444
Golden	-1.7288	-1.4688	-0.7133	0.3288	-1.5200	-0.7822	2.2777
Sultan	4.5977	-0.5222	0.1733	0.0088	-0.2600	-4.5888	-6.8222
Females							
Y-141	14.7133	6.4177	1.2866	-0.3155	1.0900	12.0600	8.8777
WF-9	-5.3755	-4.0266	-0.8911	1.1066	-1.6977	-17.0511	-15.622
CML-3	4.4800	0.3400	0.1644	-0.9600	-0.3088	-7.3177	-10.733
Mo-17	-8.3644	-3.7933	0.6311	-0.0488	1.1466	5.7266	16.877
B-73	-5.4533	1.0622	-1.1911	0.2177	-0.23	6.5822	0.6000

Table 3: Estimates of specific combining ability effects for various plant traits of maize genotypes

Parents	Plant height (cm)	Ear height (cm)	Ear length (cm)	No. of kernel rows	No. of kernels per row	Ear weight (g)	Grain yield (g)
Y-141 × Pak-Afgoee	21.11	16.14	1.43	0.45	1.21	16.24	9.29
Y-141 × Golden	-4.13	-3.43	1.31	0.31	3.11	-4.94	-2.94
Y-141 × Sultan	-16.98	-12.71	-2.74	0.76	-4.31	-11.30	-6.34
WF-9 × Pak-Afgoee	2.77	-1.55	-0.36	-0.44	0.56	1.18	0.62
WF-9 × Golden	4.56	6.58	0.49	0.96	0.06	23.33	15.22
WF-9 × Sultan	-7.33	-5.03	-0.12	-0.52	-0.63	-24.52	-15.84
CML-3 × Pak-Afgoee	-11.59	-6.95	-2.22	0.16	-3.52	-24.88	-14.27
CML-3 × Golden	-1.45	0.17	-0.24	-0.66	-16.39	-11.83	
CML-3 × Sultan	12.38	8.40	2.05	0.08	4.18	14.27	26.10
Mo-17 × Pak-Afgoee	-17.16	-10.65	-0.35	-0.28	-1.38	3.07	-1.54
Mo-17 × Golden	1.23	1.01	-1.29	-0.08	-2.44	-6.60	5.05
Mo-] 7 × Sultan	15.95	9.63	1.64	0.36	3.82	3.53	-3.51
B-73 × Pak-Afgoee	4.88	2.99	1.50	0.11	3.13	4.38	5.90
B-73 × Golden	-0.86	-2.71	-0.67	-0.95	-0.07	4.60	-5.50
B-73 × Sultan	-4.02	-0.29	-0.83	0.83	-3.06	-8.99	-0.40

effects for these traits have also been reported by Ivakhnenko and Klimov (1991) and Zagnitko (1991).

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