Utilization of Introduced CIMMYT Inbred Lines for Hybrid Maize Breeding in India

S Venkatesh, JC Sekhar, Iqbal Singh and NN Singh
Maize Winter Nursery, Directorate of Maize Research, Amberpet, Hyderabad-500 013, Andhra Pradesh

Key Words: Maize, Introductions, Inbred Lines, Combining Ability

Successful hybrid breeding in cross-pollinated crops like maize, primarily involves continued upgrading of genetic divergence among component inbred lines. This is to maximize heterotic potential for grain yield and related traits. One way of bringing this, is through introduction and utilization of exotic germplasm in hybrid maize breeding. The current investigation is an effort in this direction.

Indian Maize breeding programme in the public sector under the aegis of Directorate of Maize Research (DMR), has a very active collaboration with the Maize Programme of International Maize and Wheat Improvement Centre, CIMMYT, Mexico. In the late 1990's materials generated by CIMMYT for hybrid maize development started to be introduced into India. Initially self bulks and later on early and advanced inbred lines from the tropical and sub tropical maize programme of CIMMYT were introduced. At the Maize Winter Nursery, DMR, Hyderabad over 250 maize inbred lines/ S3 bulks from CIMMYT were introduced in 1997 and 1998 Winter (*rabi*) season (Maize Winter Nursery Monitoring Book,1997-98). These introductions were acclimatised at this neutral environment for four seasons. Finally based on agronomic desirability and grain type 15 inbred lines (Table 1) were selected for use in winter nursery breeding programme. The inbred lines were first selected for potential use as male or female inbred parents for generating hybrids. For male parent suitability, the criteria was based on the tassel characteristics like length of main spike and number of secondary branches, size of tassel and spatial orientation of branches, apart from ease of pollen dehiscence. For female parent selection, the criteria was ease of silk emergence, full husk cover, ear size, kernel boldness, and kernel color. The combining ability of these inbred lines vis-à-vis the adapted lines used in the indian maize programme was assessed. 15 of the best acclimatised inbreds from CIMMYT were crossed to two widely used inbred tester lines CM111 (flint grain type) and CM 202 (yellow dent grain type). The 30 test cross hybrids and parents there of were evaluated in a completely Randomised Block Design with two replications across two *kharif* seasons at ARS Amberpet, Hyderabad. Each plot comprised 2 rows of 5M length each with a spacing

Table 1. List of the 15 promising Introduced CIMMYT Maize Inbred lines and their important characteristics

S No	Inbred Line Introduction	Pedigree	Grain Type and characteristics*	Overall GCA Status+	Overall SCA status+ Cross with CM111 (T1)	CM202 (T2)
1	L1	AMATCOHS129-1-1-1-2-1-1-1-BB-XXX	Of, Tall, M/ F	H	L	H
2	L2	MBR-HC96-1-#-1-1-1-6-3# B-3b-B#BB-XXX	Oysd, Med, M	H	H	L
3	L3	P590BC4F220-1-1-B-B-B#BB-B-XXX	Of, Tall, M/ F	M	M	M
4	L4	P33C2 (STE)-102-2-B-2-B-1-3-B-B-XXX	Of, Short, M	H	H	L
5	L5	CML228-B-XXX	Of, Tall, M/ F	L	M	M
6	L6	CML336-89(TL864)/ (P47S3/ MP78/ 51B)B-24-1	Oysd, Med, M	L	L	H
7	L7	CML371-X	Of, Tall, M/ F	L	H	M
8	L8	89(TL8645)/ (P47S3/ MP78:518)B-24-1-1-4-1-3	Oysd, Med, M/ F	L	M	M
9	L9	89(TL8645)/ (P47S3/ MP78:518)B-266-2-3-12-1	Yf, Tall, M	M	M	M
10	L10	P33C2(STE)102-2-B-2B-1-3-B-B-5B	Dof, Med, M/ F	M	M	M
11	L11	P33C2(STE)-137-1-B-1-B-2-1-B-B-5B	Of, Tall, M/ F	L	L	H
	12	L12	CML324-B-6B	Of, short, F	L	L
H						
13	L13	CML373-6B	Of, Tall, M/ F	L	H	L
14	L14	Int 5174 (ACC: HYD1998R)	Dof, Med, M	L	L	H
15	L15	CML300	Dof, Tall, M/ F	H	L	H

* Grain type: O=orange kernel color, Y=yellow kernel color f=flint, sd=semi-dent, d=deep color; Plant height= Tall(> 1M), Medium (0.7M- 0.9 M), Short (< 0.7M); M=Male parent suitable;
F= Female parent suitable; + = based on overall combining ability status

Table 2. Pooled ANOVA for various traits studied across the seasons

Source	df	Mean squares			
		Days to 50 percent silking	Plant height (cm)	Test Weight (g)	Grain yield per plot (kg)
Replications	1	36.3**	580.8*	2.3	0.01
Seasons	1	90.1**	691.2**	76.6**	0.84**
Rep*seasons	1	0.033	132.3	1.2	0.1
Crosses	29	13.3**	291.9**	28.6**	0.3**
Line effect	14	17.6**	244.9*	37.6*	0.2*
Tester effect	1	83.3**	896.5*	7.8	0.02*
Line*Tester effect	14	4.1**	295.6**	21.1*	0.4**
Seas*crosses	29	1.1**	260.8**	0.9	0.3**
Seas* Line effect	14	0.9	284.8	0.8	0.3
Seas*Tester effect	1	0.01	472.1	1.3	0.24
Seas*Line*Tester effect	14	1.3**	221.6*	0.9	0.35**
Error	58	0.15	93.7	10.1	0.04
Total	119	4.65	192.1	12.8	0.172
CV		7.40	7.73	13.50	14.69

of 0.75 Mx 0.25 M. Data was recorded on days to 50 percent silking per plot (for maturity assessment), plant height in cm (for morphological assessment), test weight (100 kernel weight in g) an important grain yield related character) and grain yield per plot (adjusted to 15 % moisture) the most economical character. Pooled analysis of data was carried out after undertaking F variance test for homogeneity of error variances following Gomez and Gomez (1984) and Kempthorne (1957).

The test cross hybrids exhibited variation for all the characters studied as seen from the ANOVA presented in Table 2. Among crosses the line x tester interaction accounted for the most significant differences for all traits thus hinting at heterosis manifestation. The parents especially the lines showed significant differences for all the traits studied while the testers showed significant differences for all the traits except test weight. The season x treatment interaction was significant for days to 50 percent silking, plant height and grain yield.

The pooled estimates for status of overall general combining ability (GCA) effects (Arunachalam and Bandyopadhyay, 1979) across all the characters studied are given in Table 1. The inbred lines L1, L2, L14 and L15 had high overall GCA status. These lines can be utilized extensively in hybrid breeding programme. Overall SCA status (Table 1) computed based on Arunachalam and Bandyopadhyay (1979) showed the crosses of T1 with L2, L4, L13 and the crosses of T2 with L1, L6, L11, L12, L14, L15 as having high SCA status.

The heterosis computed over the mid- parent value indicated that for days to silking the crosses L15 x T2 (50 days) was the earliest followed by L14 x T2 (50.5 days) as also L1 x T2, L10 x T2, L11 x T2 and L12 x T2. For plant height the crosses L14 x T2 (153.5 cm) and L1 x T1 (151.5 cm) exhibited maximum mid-parental heterosis. For test weight the crosses L8 x T2 (31.6g) and L2 x T2 (30.68g) showed maximum heterosis. For grain yield per plot the crosses L7 x T1 (1.56 kg) and L2 x T2 (1.44kg) exhibited maximum heterosis over the mid parental value. The best crosses for grain yield are being tested extensively at multiple locations. Based on the overall heterosis and combining ability the 15 inbred lines were grouped into two groups as those belonging to Tester 1 (CM 111) or Tester 2 (CM202). Within each of these groups the lines will be crossed for further enhancement of per se performance through line recycling procedure.

References

Kempthorne O (1957) An Introduction to Genetic Statistics. John Wiley, New York.

Maize Winter Nursery Monitoring Book (1997-98) DMR, Pusa, New Delhi.

Arunachalam V and Bandyopadhyay A (1979) Are multiple cross multiple pollen hybrids an answer for productive populations in *Brassica* campestris var brown sarson? Methods for studying macromorphs. *Theor. Appl. Genet.* **54:** 203-207

Gomez KA and Gomez AA (1984) Statistical Procedures for Agricultural Research. John Wiley and Sons, New York. p 316-356