Research on Maize Testers in CIMMYT-Asian Regional Maize Program

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Introduction

Hybrid growth is occurring in several maize producing countries in the Asian region. An increase in area under maize hybrids is continuing and as a consequence, NARs and private institutions in the region have expanded their maize research activities on hybrid research and development. Research on maize testers is one aspect of hybrid maize research which receives little or no emphasis. Conscious research efforts are generally lacking. Since the beginning of hybrid maize research at CIMMYT, concerted efforts have been made to identify new and better testers on a continuous basis. A sequence of studies has been conducted at CIMMYT on this important aspect of hybrid maize research (1,2,3,4,5,6). Unfortunately, an effective and efficient use of maize testers identified in CIMMYT, Mexico is not always possible, because of lack of resistance to specific stresses especially downy mildew in Asia. Alternative options of using Kasetsart University testers were thus exploited in the beginning of hybrid research activities. Because of some restriction in freely exchanging these lines with NARs, their use had to be abandoned. Emphasis was thus given on developing our own testers in CIMMYT-ARMP. Conscious efforts have been underway since 1997 to identify maize inbreds which could be referred to and used as tester lines. A number of early and later maturing inbreds were identified as testers to meet program needs. Efforts are continuing in tester research and the present study provides information on late maturity maize inbred lines.

Materials and Methods

In the present study 81 maize inbreds generally past S4 inbreeding stage, and having their origin from different source populations, were crossed to three inbred testers derived from Asian Mildew Acid Tolerant late (AMATL) maturity maize population. Inbred codes and source populations of 81 tropical late yellow lines and three testers used in this study are given in table 1. The lines were divided into three groups: L1 to L24 (group 1), L25 to L49 (group 2) and L50 to L81 (group 3). Lines from each group were crossed to three testers to produce 72 crosses in group 1, 75 in group 2 and 96 in group 3. Additional entries were included as checks to increase the number of entries to 81 in groups 1 and 2, and to 100 in group 3. Therefore, two trials were constituted with 81 entries each and the third with 100 entries. All three trials were conducted in simple lattice design with two replications in each location. The trials were conducted at two or more locations in different countries of Asia (Table 1). Data were recorded on most important traits but for the most part, results and discussion will be limited to grain yield only.

Results and Discussion

Mean yields from the three groups of trials evaluated at different locations are presented in table 2. In general, coefficient of variation in most locations was quite low except for two locations. Suwan Farm yields in all these trials were quite high compared to other locations as can be seen in table 2. The yield level at this location was almost twice in contrast to other locations where such hybrids were tested. The results from combined data will be presented and discussed.
Five of the top yielding crosses in three groups of hybrids tested had yields ranging from 7.93 to 8.96 t/ha (table 3). Also three of the hybrids performed better than the best local check. It is also

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evident that four of the five top yielding hybrids involved T3 as a tester parent. The two highest yielding crosses in three groups of trials were L39 x T3 and L9 x T2 with yield levels of 8.96 t/ha and 8.74 t/ha, respectively. The plant height in most of the hybrids was below two meters.

Table 4 presents information on GCA, SCA, and mean grain yield (t/ha) for the best line x tester combinations. Seven inbred lines (L6, L9, L21, L30, L39, L40 and L63) indicated in table 4, had positive and significant GCA effects ranging from 0.5 to 1.03 t/ha. The top four lines having high GCA effects were L6 (0.96 t/ha), L9 (1.00 t/ha), L21 (1.00 t/ha) and L63 (1.03 t/ha). Also it may be interesting to note that SCA effects in most superior performing crosses were not important and had values either negative or almost zero. Only a few hybrid combinations gave high positive significant SCA effects. These were L6 x T1 (0.30 t/ha), L9 x T2 (0.77 t/ha), L21 x T3 (0.39 t/ha) and L39 x T3 (0.72 t/ha). Among the three testers, tester 2 and tester 3 had positive GCA effects while tester 1 had negative GCA effects (figure 1). Considering hybrid performance data as well as SCA and GCA effects, tester 3 appears to be the best. A graphic representation of lines in crosses with three testers in group 1, 2 and 3 is given in figures 2, 3 and 4 respectively. In figure 1, L9 appeared to be a good line with tester 2 while L9 and L21 with tester 3. L39 was clearly an outstanding line with tester 3 (figure 3) and L63 with tester 2 (figure 4).

Among the three testers used, tester 3 appeared to be superior compared to other two with respect to high GCA effects. Tester 2 was next in performance but tester 1 was poor as it gave negative GCA effects in all three studies. The SCA effects did not appear important in most crosses as judged by their negative or near zero values. Only a few crosses appeared to have positive and significant SCA effects. L39 with T3 exhibited highest SCA value and was also the best performing cross in three different studies. A few lines such as L9, L21 and L39 appeared to be new good lines worth considering as testers in future studies and in hybrid development.

Conclusions

1) A few superior hybrid combinations were identified with yield levels slightly better than the best local check hybrid.
2) Tester 3 appeared to be the best among the three testers used in this study.
3) Several lines such as L6, L9, L21, L30, L39, L40 and L63 exhibited high positive and significant GCA effects.
4) SCA effects appeared unimportant except for a few superior crosses.
5) A few lines were identified as potential testers for future hybrid research.

References

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Table 1. Codes and Source Populations of 81 Tropical Late Yellow Lines and Three Testers Used in the Study

Line Code and Source Populations (Group 1)		Line Code and Source Populations (Group 2)		Line Code and Source Populations (Group 3)	
L1	(24STE-5*24STE-17)-S11-1	L25	AMATLCOHS92-S9-1	L50	P345C4S2B-46-S8-3
L2	(24STE-5*24STE-17)-S11-2	L26	AMATLCOHS92-S9-2	L51	P345C4S2B-46-S8-4
L3	[AC8328BNC6/Ki21//LYDMR]-S4	L27	AMATLCOHS92-S7	L52	P345C5HS249-S5
L4	[AMATLCOHS167-1-1-1-2F/R]-S3	L28	AMATLCOHS92-S9-3	L53	P345C5HS306-S5
L5	[AMATLCOHS71-1-1-2-2F/R]-S3	L29	CML52	L54	P345C5HS400-S7
L6	[AMATLCOHS133-1-F/R]-S6	L30	KC3001/KC3002-22-S11	L55	PHY11-S8-1
L7	[AMATLCOHS184-2-F/R]-S6	L31	KSX3601F2-S6-2	L56	PHY11-S8-2
L8	[CGHG2S2-19-1-1F/R]-S3	L32	KSX3601F2-S6-3	L57	AMATLCOHS71-S9
L9	KSX3601F2-S6	L33	KSX3601F2-S6-4	L58	PIO.3011F2-S6-2
L10	[G5470-2P-1-1F/R]-S3	L34	KSX3601F2-S6-5	L59	PIO.3011F2-S6-3
L11	[P345C3S3B-32-F/R]-S6	L35	KSX3601F2-S6-6	L60	PIO.3011F2-S4
L12	[P345C4S2B-46-2-3F/R]-S3	L36	KSX3601F2-S4	L61	PIO.3011F2-S6-4
L13	AMATLCOHS115-S10-1	L37	KSX3601F2-S6-7	L62	PIO.3011F2-S4
L14	AMATLCOHS115-S10-2	L38	KSX3601F2-S6-8	L63	PIO.3011F2-S6-5
L15	AMATLCOHS169-S9	L39	KSX3601F2-S6-9	L64	PIO.3011F2-S6-6
L16	AMATLCOHS170-S8	L40	KSX3601F2-S6-10	L65	PIO.3274-S7-1
L17	AMATLCOHS23-S7	L41	KTX3752F2-S6-1	L66	PIO.3274-S7-2
L18	P28C7S5B-S10	L42	KTX3752F2-S6-2	L67	PIO.3274-S7-3
L19	AMATLCOHS233-S9	L43	KTX3753F2-S6	L68	POB28F107-S4
L20	AMATLCOHS63-S7	L44	NS1-52-S6	L69	POP24C5HC227-S15
L21	PIO.3011F2-S6-1	L45	P28C7S5B-13-S10-1	L70	POP28C7-S4-S11
L22	AMATLCOHS71-S9	L46	P28C7S5B-13-S10-2	L71	POP28C9HC113-S10
L23	AMATLCOHS92-S9	L47	P28C7S5B-13-S10-3	L72	POP28F41-S13
L24	AMATLCOHS92-S9	L48	P345C4S2B-46-S8-1	L73	POP345-C5-HS-2-S6
		L49	P345C4S2B-46-S8-2	L74	POP36C5HC144-S14
				L75	AMATLCOHS92-S9
				L76	SIN.AM.TSR23-S16
				L77	SW1 (S) C11-42-S7
				L78	SW1(S)C11-68-S6
				L79	SW1(S)C11-81-S6
				L80	AMATLCOHS233-S9
				L81	KSX3601F2-S4

Tester No.

T1	AMATLCOHS63-S8
T2	AMATLCOHS170-S8
T3	AMATLCOHS169-S8

Table 2. Mean grain yield (t/ha) and CV of locations where the three groups of line x tester crosses were evaluated in 1999.

Group No.	Location	Mean Yield	C.V.
1	Suwan Farm, Thailand	9.63	8
	Tak Fa, Thailand	4.18	21
2	Suwan Farm, Thailand	10.22	7
	Tak Fa, Thailand	5.24	13
	Phraputtabat, Thailand	6.03	12
	Dan Phuong, Vietnam	5.95	13
3	Suwan Farm, Thailand	9.77	8
	Tak Fa, Thailand	4.89	13
	Muneng, Indonesia	4.86	15
	Nanning, China	4.00	18

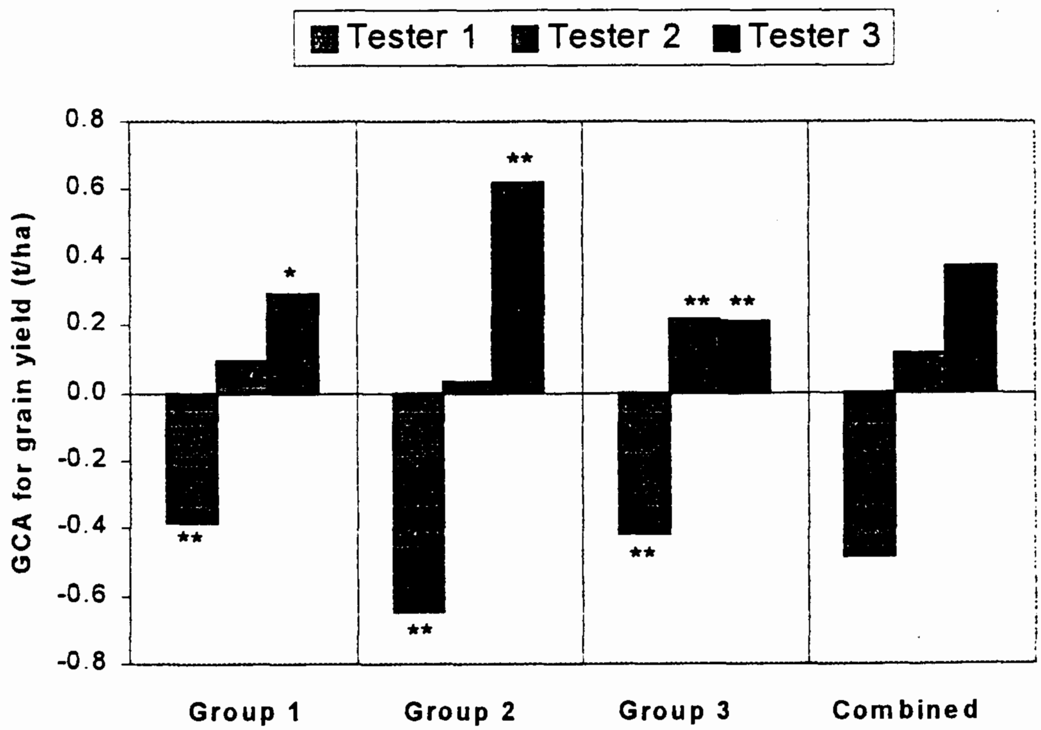
Table 3. Grain yield, days to silk, plant height and grain moisture content of best line x tester crosses from the three groups evaluated at 2-4 locations in Asia during 1999.

Hybrid Code	Grain Yield (t/ha)	% of Best Local Check	Days to Silk	Plant height (cm)	Grain moisture (%)
L9 x T2	8.74	98.0	54	181	28.2
L30 x T3	8.10	101.8	54	195	26.3
L38 x T3	8.04	101.1	56	185	28.7
L39 x T3	8.96	112.6	56	191	28.4
L40 x T3	7.93	99.7	57	194	30.1

Table 4. GCA, SCA and mean grain yield (t/ha) for the best line x tester combinations included in the study.

Lines	GCA	Tester 1		Tester 2		Tester 3	
		Yield	SCA	Yield	SCA	Yield	SCA
L6	0.96**	7.44	-0.02	7.90	-0.03	8.18	0.05
L9	1.00**	6.83	-0.66	8.74	0.77	8.06	-0.10
L21	1.00**	7.24	-0.25	7.83	-0.14	8.56	0.39
L30	0.75**	7.21	0.30	7.35	-0.23	8.10	-0.07
L39	0.82**	6.49	-0.48	7.42	-0.24	8.96	0.72*
L40	0.50**	6.72	0.06	7.27	-0.07	7.93	0.01
L63	1.03**	6.32	-0.10	6.98	-0.08	7.24	0.18

*,** Significant at 0.05 and 0.01 levels of probability, respectively.



*, ** Significant at 0.05 and 0.01 probability levels respectively

Figure 1. GCA Effects for grain yield (t/ ha) of the three testers used in this study. GCA values given for each group separately, and for three groups combined.

Figure 2. Grain yield (t/ ha) of three testers crossed to 24 lines included in group 1

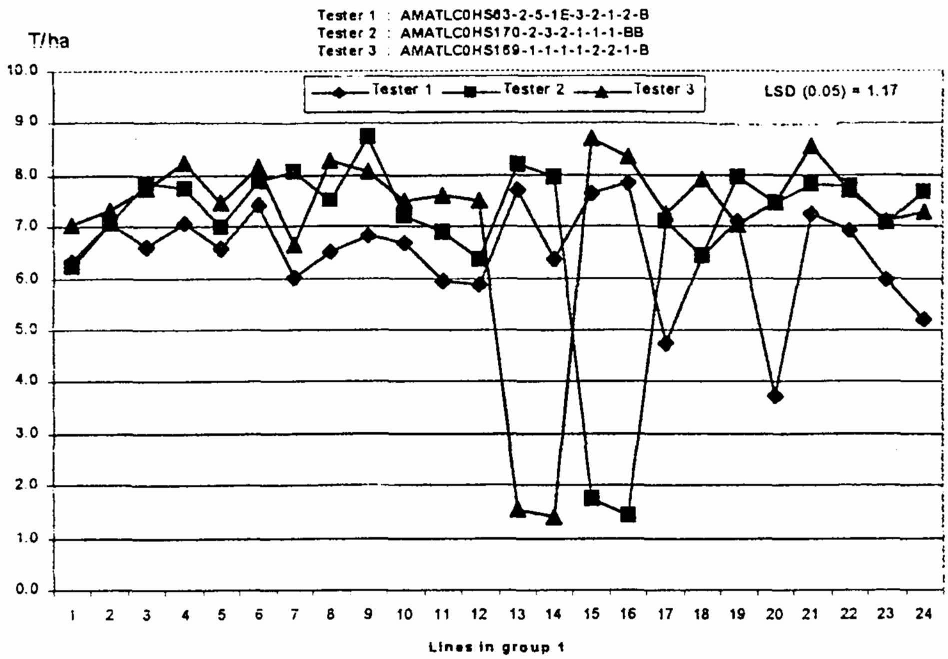


Figure 3. Grain yield (t/ ha) of three testers crossed to 25 lines included in group 2

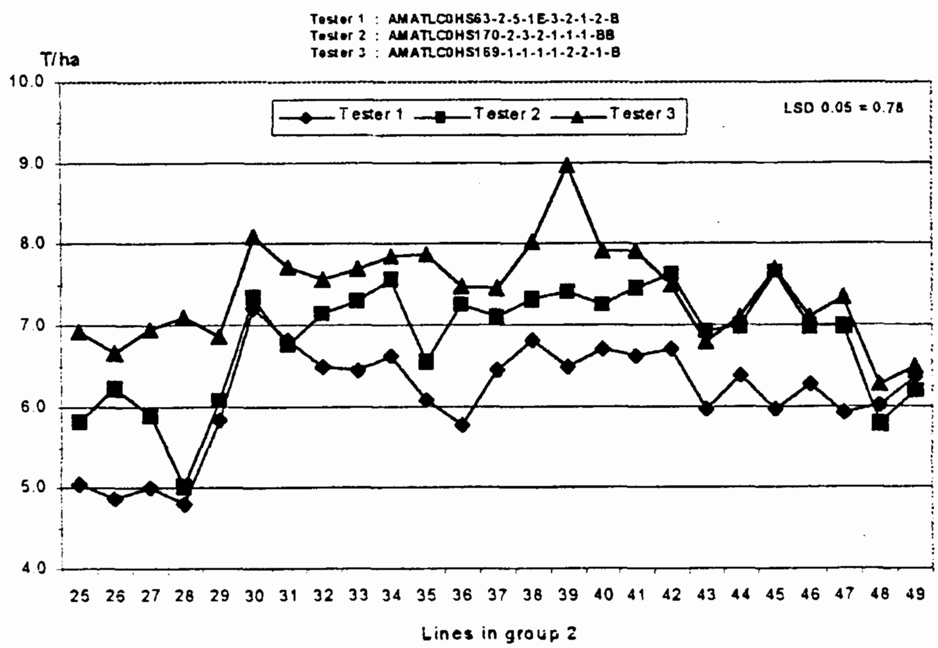


Figure 4. Grain yield (t/ ha) of three testers crossed to 32 lines included in group 3