EVALUATION OF EARLY GENERATION (S2) TEST CROSSES OF SELFED MAIZE LINES (*Zea Mays* L.)

Bülent SAMANCI[1] Mehmet BAŞBAĞ[2]

1. Dr.,AkdenizÜniversity, Ziraat Fakültesi, Antalya
2. Dr.,Dıcle Üniversıtesi, Ziraat Fakültesi, Diyarbakır

ABSTRACT : The mating of S2 plants to a tester for evaluation of combining ability is a technique widely used in hybrid breeding program. The high yielding S2 test crosses would be expected to have high yield progeny of later generation of selfing. In this study, S2 progeny 10 crossed to B73 tester (an inbred line) and lines 5 and 14 crossed to RD5560 (an inbred line) had the highest yield with a mean of 9.28, 9. 10 and 9.03 Mg/ha, respectively. These lines will be retained for additional inbreeding and progeny with inferior testcross performance will be discarded. It will be expected that in later generations of selfing of these high yielding lines themselves will make high yielding hybrids when crossed to each other.

KENDİLENMİŞ MISIR (Zea Mays L.) HATLARININ ERKEN GENERASYON (S2) YOKLAMA MELEZLERİNİN DEĞERLENDİRİLMESİ

ÖZET: *Genel combinasyon değerlendirilmesi için S2 bitkilerin yoklama melezleri hibrid Islah programında yaygın şekilde kullanılan bir tekniktir. Yüksek verimli S2 yoklama melezlerinin zamanda yüksek verim veren döllere sahip olması beklenebilir. Bu çalışmada, B73'e (saf hat) melezlenen S2 10 hattı ve RD5560'a (saf hat) melezlenen 5 ve 14 hatları sırasıyla 9.28, 9.10 ve 9.03 Mg/ha ortalama verimleri ile en yüksek verimleri vermiştir. Bu hatlar ek kendileme generasyonları için tekrar kullanılacak ve iyi performans gösterilmeyen hatlar ise eleneceklir. Yüksek verimler veren bu hatların daha sonraki kendilenmiş dölleri de kendi aralarında çaprazlandıklarında yüksek verimli hibridler vermesi beklenmektedir.*

INTRODUCTION

Ultimately, the breeder looks for the a pair of inbred lines that gives the superior performance in crosses among inbred lines being developed. The number of the inbred lines used in hybrid combination is very small. However, early generation testing could be used to estimate the genetic potential of an individual line before they becomes completely homozygote; Thus, early generation testing eliminates the lines that doesn't show any potential to be used as an F_1 hybrid and then unnecessary resources and time will not be wasted.

Segregation in the S_0 and later generation allows a new set of inbred lines to be made with gene combinations different from those of lines used to construct the population. One of the important factor that assisted the breeders for use of testers is the heterotic patterns.- i.e. between Reid Yellow Dent and Lancaster Sure Crop, so testers for lines of Reid germplasm are primarily of Sure Crop origin and vice versa (HALLAUER, 1986). But other factors in choice of testers are not resolved. In selection for general combining ability, a broad base heterogeneous population is used as a tester (SYN or OPP). When tester has a narrow genetic base (inbreds or F_1 hybrids), selection among testcrosses is said to be for specific combining ability. In order to find the heterotic patterns, one can identify and measure the genetic distances among inbred lines. Genetic diversity between lines for molecular markers has been considered as a possible avenue for predicting the hybrid performance and heterotic crosses. GODSHALK et al. (1990) found that RFLP analysis could be used to allocate maize inbreds to heterotic groups. However, there was no relationship between RFLP based genetic distance and hybrid performance was apparent. MELCHINGE et al. (1990) evaluated 20 maize inbreds and genetic distances between lines and reported that positive correlations between heterosis and genetic distance. PRICE et al. (1986) related grain yield of 166 and 169 single crosses with heterozygosity of 13 polymorphic isozyme loci. They found that cross performance was not predictably associated with the number of heterozygous isozyme loci. BECK et al. (1991) found highly significant positive general combining ability effects for yield among populations in Mexico.

In Cukurova region of Turkey, maize can be planted as a second crop after wheat and watermelon harvested in June. Several commercial hybrids that could be planted at that time are available in the market. For this reason, It was necessary to develop Fl hybrids to be used in the area. The purpose of this study was to evaluate inbred lines in early generations in testcross combinations.

MATERIALS AND METHODS

The breeding work was started in Ceyhan in 1992. The original population used in this study consisted of open pollinated varieties (F2) grown by the farmers-for number of years in Bolu, Kayseri, Samsun, and Elazığ. 200 seeds from each district were planted in 1992 and 50 healty plants were selfed. They were harvested individually and 20 kernels from each self pollinated ears were planted in 1993 to get F3 generation. F4 progeny of 40 kernels from 15 F3 were planted in 1994 and crossed to common testers of B73 and RD4560 which makes high yielding hybrids when crossed to each other. In 1995, test crosses were planted in two five meter rows replicated for three times in Randomized Complete Block Design in Tarsus and Ceyhan. The planting dates were May 17 and May 23, 1995 for Ceyhan and Tarsus testing locations, respectively. The plant space between rows were 70 cm and 20 cm among the plants in the row. The data for days to anthesis, yield and moisture content was measured with a moisture analyzer and hybrid yields were adjusted to 15 % moisture.

RESULTS

The mean squares from the combined analysis of variance over locations for the days to anthesis, yield and moisture content of 15 hybrids crossed with B73 grown in Tarsus and Ceyhan in 1995 are presented in Table 1. Location effects were not significant for all the traits studied. Highly significant differences (P> 0.01) were observed among test crosses for days to anthesis, yield and moisture content. Location X cross interactions were non- significant for the days to anthesis and moisture contents but highly significant interactions were observed for the yield indicating that the rank of test crosses were not the same for the locations. The ranges were 61 and 73 for the days to anthesis, 5. 65 and 9.28 Mg/ha for the yield, and 20. 15 and 30.25 % for the moisture content, respectively.

Mean squares from analysis of variance for three plant traits of test crosses hybridized with inbred line RD5560 are presented in Table 2. Locations were not significant; however, crosses significantly differed for the traits studied and there were not any location X cross interactions. The ranges were 58 and 74 days for the days to anthesis, 9. 10 and 6.20 Mg/ha for the yield and 21.75 and 27.50 % for the moisture content, respectively.

Table 3 and 4 shows the mean values of the traits for the test crosses combined over locations and replications. The mean values for the test cross hybrids were not the same for each tester. S2 progeny 10 crossed to B73 had the highest yield with a mean of 9.28 Mg/ha and 25 % moisture content whereas, S2 progenies of lines 5 and 14 crossed to RD5560 had the highest yield with a mean 9. 10 and 9.03 Mg/ha, respectively. The S2 lines developed from the different backgrounds had different combining ability which is supposed to be higher when different heterotic backgrounds are used. For this reason, the line 10 crossed to B73 and 5 and 14 crossed to RD5560 will be further selfed to reach homozygosity. This will include 2 generation of further selfing.

Theoretically, S4 lines will reach 98 % homozygosity so that they could be reproduced without changes in their genetic background. In S2 generation, any line that shows potential in testcross performance can also shows good characteristics when selfed up to S4 generation. For example, the line 10 which had high yield can also give high yielding progeny in S4 crosses. In this research, the line numbered as 10 will be crossed to the lines 5 and 14 to get Fl hybrids which will be evaluated for agronomic traits including earliness and yield.

Table 1. Mean squares from analysis of variance for three traits for the hybrids crossed to B73 grown in Ceyhan and Tarsus, Adana in 1995

		Days to anthesis (days)	Yield (Mg/ha)	Moisture (%)
Source	Df		Mean squares	
Location (L)	1	45.06 ns	0.64 ns	5.40 ns
Rep/L	2	27.26	4.94	0.70
Lines (Li)	14	64.00**	3.38**	32.33**
Li X L	14	9.20 ns	0.91**	0.01 ns
Error	28	4.70	0.26	2.29
Total	59			

ns = non-significant
*, ** = significant at 0.05 and 0.01 probability levels, respectively

Table 2. Mean squares from analysis of variance for three traits for the hybrids crossed to RD5560 grown in Ceyhan and Tarsus. Adana in 1995.

		Days to anthesis (days)	Yield (Mg/ha)	Moisture (%)
Source	Df		Mean squares	
Location (L)	1	20.41 ns	1.76 ns	4.64 ns
Rep/L	2	250.88	3.81	2.73
Lines (Li)	14	108.53**	3.30**	10.48*
Li X L	14	16.34 ns	0.26 ns	0.02 ns
Error	28	25.84	0.56	4.28
Total	59			

ns = non-significant
*, ** = significant at 0.05 and 0.01 probability levels, respectively

Table 3. Mean of three measured plant traits combined over locations for test cross hybrids of B73 grown in Ceyhan and Tarsus in 1995.

Test Cross Hybrids	Days to anthesis (days)	Yield (Mg/ha)	Moisture (%)
1	66.50	6.60	24.65
2	63.75	7.10	21.00
3	72.25	6.28	21.20
4	71.50	5.65	25.15
5	63.75	5.83	30.25
6	69.50	6.13	20.15
7	68.00	7.10	22.30
8	62.50	6.53	25.90
9	72.00	6.38	25.50
10	67.25	9.28	25.30
11	61.75	7.83	25.25
12	61.75	7.90	22.30
13	67.75	7.43	21.40
14	63.75	6.00	26.45
15	73.00	7.75	27.75
X	66.23	7.28	24.77
s	4.54	0.88	1.62
LSD (0.05)	8.50	1.25	3.45

Table 4. Mean of three measured plant traits combined over locations for test cross hybrids of RD5560 grown in Ceyhan and Tarsus in 1995.

Test Cross Hybrids	Days to anthesis (days)	Yield (Mg/ha)	Moisture (%)
1	63.50	6.63	25.95
2	63.25	7.18	22.95
3	72.50	6.38	26.00
4	74.50	6.55	22.70
5	68.75	9.10	25.60
6	58.50	6.48	21.75
7	63.50	6.20	23.45
8	66.50	6.93	24.90
9	71.50	7.42	25.05
10	67.50	7.05	25.93
11	63.50	7.58	27.50
12	61.50	7.80	23.70
13	65.50	7.70	24.00
14	62.50	9.03	25.35
15	70.50	7.75	26.80
X	66.23	7.28	24.77
s	4.54	0.88	1.62
LSD (0.05)	8.50	1.25	3.45

CONCLUSION

The association of hybrid yield and heterosis of RFLP (Restriction Fragment Length Polymorphism) loci were reported to be of use as a supplementary tool for predicting the yield performance of crosses between unrelated lines. It seems necessary to employ specific markers for those chromosomal segments that significantly affect the expression of heterosis for grain yield. Another way of finding heterosis maize inbred lines is to cross them to a common tester and check the performance of hybrids in combinations.

Ultimate use of new inbred lines is as parents in the production of hybrids. It is essential therefore to determine if the lines transmit their desirable traits in hybrids. At some stage during inbreeding and acid selection, the stage of inbreeding at which to obtain a measure of combining ability of new lines and the choice of tester should be made. In this research, we used 15 S2 lines which reached 87.5 % homozygosity level. Inbred lines of B73 and RD5560 have been used as testers. They are from two different known heterotic backgrounds. When they are crossed to each other, they give high yielding hybrid progeny. The lines 10 crossed to B73 and 5 and 14 crossed to RD5560 will be used in hybrid combination after reached S4 generation. In conclusion, early generation testing needs to be made in order to find heterotic patterns among inbred lines before the lines reaches completely homozygosity.

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BECK, D. L., S. K. VASAL, and J. CROSSA. 1991. Heterosis and combining ability among subtropical and temperate intermediate-maturity maize germplasm. Crop Sci. 31:618-623. Table 1 . Mean squares from analysis of variance for three traits for the hybrids crossed to B73 grown in Ceyhan and Tarsus, Adana in 1995.