Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
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Asian Journal of Plant Sciences 5 (2): 296-299, 2006
ISSN 1682-3974

Suitability of Indigenous Maize Hybrids for Spring Planting in Pakistan

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Abstract: Maize, the leading world cereal, offers the greatest potential for increasing food productivity in countries like Pakistan. The average yield in Pakistan is low compared to the world average. An effective short term strategy to improve maize productivity is to replace the local low yielding varieties and landraces with high yielding hybrids. However, mainly due to very high cost of the imported hybrid seed in Pakistan, the hybrid technology has not been adopted on larger scales. Currently, 25% of the maize area is under hybrids in Pakistan. Therefore, there is a great need to develop, popularize and adopt maize hybrids with indigenous blood. Indigenous hybrids for agro-ecological zones not attended by the private multinational have been developed at National Agricultural Research Centre and tested in the respective ecologies. Six selected indigenous hybrids (NARC-2701, NARC-2702, NARC-2703, NARC-2704, NARC-2705, NARC-2707) were evaluated at two location during spring season. Four leading commercial hybrids (Bemisal-202, 3335, 2303 and 6525 from Engro, Pioneer, Rafhan and Monsanto) were used as checks for comparison. Some of the indigenously developed hybrids (NARC-2702, NARC-2703, NARC-2704, NARC- 2705) performed better than, or as good as their exotic counterparts. These hybrids exhibited desired idiotypes as indicated by plant and ear heights. The indigenous hybrids were earlier in maturity than the commercial checks. These results clearly indicate the superiority and suitability of locally developed (indigenous) maize hybrids for spring planting in Pakistan.

Key words: Maize, *zea mays* L., suitability, indigenous hybrids, performance, spring

INTRODUCTION

Maize has attained the leading position among cereals in the world in terms of production as well as productivity (FAO, 2004). In Pakistan, maize is the third most important cereal after wheat and rice. Currently, maize is planted on 0.896 million ha of land, producing 2775 thousand tones grains, with an average national yield of 3097 kg ha^{-1} (FAO, 2004). This yield level is low compared to the world average (4907 kg ha^{-1}). People in many countries including Pakistan depend to a large extent on maize as a staple food. Maize grain is also a key industrial raw material for diverse purposes. Maize is being increasingly used in animal feed and also grown as a fodder crop.

Pakistan is though not a food insecure country but is still far from ensuring sustained food production (FAO, 2000, 2000a). With shrinking land resources and alarmingly increasing population, Pakistan is left with no option but to strive continuously for progressive yield growth in all crops especially food grains. Maize with the highest yield potential among the cereals and being a traditional crop in Pakistan offers the best option to greatly improve the food and feed availability in the country.

Several factors contribute to the low yields of maize obtained in Pakistan and different strategies have been proposed to improve maize productivity (CIMMYT, 1989; De Leon and Paroda; 1993; Rajaram *et al*., 1998; Chughtai *et al*., 2002; Hussain *et al*., 2003). The commercial hybrids from the multinational enterprises are mostly exotic and adapted to spring season area in Punjab. The seed cost of these hybrids is among the highest in the world and hence beyond the approach of resource poor farmers. Spring maize in Punjab is a very high yielding sector of maize which covers about 0.06 million hectares with an average yield of 7 tones per ha. The development and adoption of maize hybrids, during both spring and kharif seasons in Pakistan, can lead to a breakthrough for increasing maize production and productivity on sustainable basis. Keeping these facts in mind, a number of hybrids have been developed locally at National Agricultural Research Centre, which are largely based on indigenous maize sources. These hybrids are intended for the spring as well as the kharif seasons and for the long and short duration environments especially the rainfed and highland areas which are not attended by the private seed sector. Because the indigenous hybrids are expected to be produced locally, these are going to be much cheaper than the exotic

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commercial hybrids. However, the indigenous hybrids have lower yields than the commercial exotics. They are not generally preferred by the farmers. Thus there is a great need to develop, popularize and locally produce the superior indigenous hybrids to ensure lower prices and wider adoption. This study presents data on the evaluation and suitability of selected indigenous hybrids during the spring season in comparison with exotic imported hybrids currently leading the market.

MATERIALS AND METHODS

Six selected indigenous maize Hybrids were evaluated in comparison with four leading commercial hybrids designated as checks during spring, 2004 at two locations: National Agricultural Research Centre Islamabad and Maize and Millet Research Institute Yousafwala, Sahiwal having different agro-climatic conditions. During spring 2005, the trial was repeated at NARC. The selected indigenous hybrids were NARC-2701, NARC-2702, NARC-2703, NARC-2704, NARC- 2705, NARC-2707 and commercial exotic hybrids were Bemisal-202, P-3335, R-2303 and Dekalb-6525 from Engro Chemical Pakistan Ltd., Pioneer Pakistan Seed Ltd., Rafhan Maize Products Company Ltd. and Monsanto Pakistan Agri. Tech. Pvt. Ltd., respectively. At each location, the experiment was planted under Randomised Complete Block Design (RCBD) with three replications. Each genotype was sown in two row plot (5.0 m long and 0.75 m apart). Both of the rows were used for observations and data recording.

All other inputs and cultural practices were same at all locations. Data regarding agronomic traits were recorded. The observations were recorded on days to 50% silking as maturity indicator, plant and ear heights as idiotype parameter, fresh ear weight, grain moisture, cobs plant^{-1} and damage caused by shoot fly. The grain yield kg ha^{-1} was computed using the following formula at 15% grain moisture. Data were analysed statistically for individual locations separately as well as by using two way Analysis of Variance and Duncan's Multiple range Test (Gomes and Gomes, 1984). Pooled data across locations for grain yield were also subjected to analysis

$$\text{Grain yield (kg ha}^{-1}) = \text{FEW} \times \frac{100 - \text{M\%}}{85} \times 0.8 \times \frac{10,000}{7.5}$$

Where,

FEW = Fresh ear weight in field at harvest
M% = Grain moisture %age at harvest with moisture tester
100 -M/85 = Conversion of grain moisture at 15% level
0.8 = Grain/cob ratio (shelling % age) i.e., for the variety planted, shelling % 80 % is grains.
10,000/7.5 = Conversion of grain yield per plot (7.5 m^2) on hectare basis

RESULTS AND DISCUSSION

Six of the selected indigenous hybrids were evaluated during the spring season in comparison to the four leading commercial hybrids included as checks at NARC, Islamabad (2004, 2005) and MMRI, Yousafwala (2004).

In the trial conducted at NARC during spring 2004 (Table 1), two of the indigenous hybrids, NARC-2704 and NARC-2705, ranked top positions by yielding 7249 and 7013 kg grains ha^{-1}, compared with the best yielding check (P-3335) which yielded 6637 ha^{-1}. These hybrids were at par in maturity with commercial hybrids. The hybrids possessed desired idiotypes for plant and ear heights as those of commercial ones and were good in ear bearing. At Yousafwala (Table 2), the indigenous hybrid NARC-2705 was the best yielder (7317 kg ha^{-1}) followed by Pioneer-3335 (7271 kg ha^{-1}), NARC-2702 (6996 kg ha^{-1}) and NARC-2704 (6823 kg ha^{-1}). Indigenous hybrids were earlier in maturity as compared to all commercial hybrids and were comparatively tolerant to shoot fly attack, which is the main pest of maize crop during spring planting.

Analysis of pooled data across locations (Table 3) showed the consistency of performance of the indigenous hybrids. NARC-2705 and NARC-2704 ranked first and third by assimilating 7109 and 6891 kg of grains ha^{-1}, respectively. These hybrids were earlier in maturity than checks. Both of the formers took 70 days for mid silking against Dekalb-6525 and Pioneer 3335, (72 days) and R-2303 (73 days). During spring 2005 at NARC (Table 4) Bemisal-2514 proved to be the best hybrid by yielding 10791 kg grains ha^{-1}, followed by NARC-2705 and NARC-2704 with grain yield of 10632 kg ha^{-1} and 10198 kg ha^{-1}, respectively. It is very important to note that the differences in yield during spring 2005 at NARC, Islamabad are non-significant. In other words, the indigenous hybrids are as good as the best commercial hybrids included as checks. Indigenous hybrids have temperate blood in their make up and could have the brighter chance to fit in temperate ecologies (Castelberry *et al*., 1983; Ivanovic and Kojic, 1990; Russell, 1991 and Duvick, 1992). Early maturity of indigenous hybrids indicates a higher probability of their adaptability in rainfed ecologies, where short duration genotypes are required to escape the terminal drought. These hybrids are adaptable to the rainfed ecology also, these are tolerant to drought. Studies are consistent with findings that rainfed yield gains are associated with increases in tolerance to prevailing biotic and abiotic stresses as summarized by Castelberry *et al.* (1983) and Duvick (1984b, 1992).

Since exotic temperate types of hybrids lack tolerance to leaf blights, their marketing and planting is restricted to

Table 1: Performance of indigenous maize hybrids at NARC, spring 2004

Enteries	Grain yield (kg ha^{-1})	50% silk (days)	Plant height (cm)	Ear height (cm)	Ear placement (%)	Ears plan^{-1} (No.)
NARC-2704	7249	73	163	77	47	1.05
NARC-2705	7013	72	153	74	49	1.04
Pioneer-3335	6637	72	160	67	42	1.01
R-2303	6611	76	152	74	49	1.03
Bemisal-2514	6526	72	156	68	44	0.99
Dekalb-6525	6476	73	152	69	45	1.06
ICI-G8288	6357	69	160	67	42	1.01
NARC-2703	5858	69	140	61	44	1.00
NARC-2701	5591	72	152	70	46	0.98
NARC-2702	5497	69	146	63	43	1.01
NARC-2707	4647	69	153	66	43	1.01
LSD (0.05)	1322	3	20	12	6	NS
CV %	12	3	8	10	7	3

Table 2: Performance of indigenous hybrids, at MMRI, spring 2004

Enteries	Grain yield (kg ha^{-1})	50% Silk (days)	Plant height (cm)	Ears plant^{-1} (No.)	Shoot fly (1-5)
NARC-2705	7317	67	184	1.04	1.71
Pioneer-3335	7271	72	202	1.05	2.63
NARC-2702	6996	64	173	1.04	0.00
NARC-2704	6823	68	196	1.04	2.66
Dekalb-6525	6565	71	188	1.01	2.56
ICI-G9288	6258	67	196	1.08	1.84
Bemisal-2514	6186	69	173	1.02	0.00
NARC-2703	5984	65	168	1.08	0.98
NARC-2701	5810	67	183	0.99	0.42
NARC-2707	5358	65	161	1.06	1.67
R-2303	5315	71	171	1.03	3.54
LSD (0.05)	NS	4.122	23.39	NS	NS
CV %	15.41	3.57	7.57	5.79	151.64

Table 3: Across location performance of indigenous maize hybrids, spring 2004

Enteries	Grain yield (kg ha^{-1})	50% silk (days)	Plant height (cm)	Ears plant^{-1} (No.)
NARC-2705	7019	70	169	1.04
Pioneer-3335	7019	72	181	1.03
NARC-2704	6891	70	180	1.04
Bemisal-2514	6691	70	165	1.00
ICI-G9288	6437	68	178	1.04
NARC-2702	6334	67	160	1.02
Dekalb-6525	6300	72	170	1.03
R-2303	6056	73	161	1.03
NARC-2703	6049	67	154	1.04
NARC-2701	5875	69	168	0.99
NARC-2707	5401	67	157	1.03
LSD (0.05)	979	2.73	15.26	NS
CV %	13.18	3.36	7.82	4.70

Table 4: Performance of indigenous maize hybrids, NARC, Spring 2005

Enteries	Grain yield (kg ha^{-1})	50% Silk (days)	Plant height (cm)	Ear height (cm)	Ear placement (%)	Ears plant^{-1} (No.)
Bemisal-2514	10791	72	156	68	44	0.99
NARC-2705	10632	72	153	74	49	1.04
NARC-2704	10198	73	163	77	47	1.05
R-2303	10195	76	152	74	49	1.03
P-3335	10153	72	160	67	42	1.05
Garst-8288	9930	69	160	67	42	1.01
NARC-2703	9165	69	140	61	44	1.00
Dekalb-6525	9053	73	152	69	45	1.06
LSD (0.05)	NS	2.62	NS	NS	NS	0.06
CV (%)	10.97	2.08	5.82	9.36	7.44	8.41

spring season where the incidence of the disease is at a low intensity. Also, the multinational hybrids do not fit into the cropping pattern of the rainfed and highland areas mainly because they are late maturing. The indigenous hybrids contain local adaptable temperate type of maize and can be planted in both spring and kharif seasons and due to early maturity, these can fit in cropping system of rainfed and highland areas. Moreover, indigenous hybrids are white in color and semiflint in kernel type, both of these characteristics are preferred by the people of highland areas of AJK, Giligit and NWFP.

The main cause for less coverage of area under hybrid in Pakistan is the socioeconomic condition of the farmer who cannot afford high costs of hybrid seed by the

multinationals, because of huge involvement of foreign exchange in importing exotic hybrids. Indigenous hybrids when locally produced, will not involve heavy investments in seed production. Therefore, the seed of these hybrids will be available to resource poor farmers at relatively cheaper prices. This would lead to hybrid cultivation on a much larger scale like other countries in the region, e.g., China, Vietnam, Thailand. There is a great possibility that bringing more area under hybrid cultivation will ensure a breakthrough in maize production and sustainable food and feed availability in the country.

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