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# PERFORMANCE OF ADVANCED GENERATION MAIZE-TEOSINTE HYBRID SEED FOR COMMERCIAL USE

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In view of the better performance of the hybrid forage, studies on the utilization of advanced generation hybrid seed were undertaken as the production of $F_1$ seed on a large scale presented difficulties. It was revealed that in the advanced generations the cob and seed components retain considerable hybrid vigor and therefore $F_2$ or $F_3$ seed may be used for commercial utilization of heterosis in maize-teosinte hybrid forage.

## INTRODUCTION

Maize has been hybridized with teosinte to increase its fodder yielding capacity by combining good qualities of teosinte such as profuse tillering and multiple cob bearing. The hybrid gives high yield of fodder and matures earlier than teosinte. The results on the hybrid vigour exhibited in forage yield components in $F_1$ and its reduction in advanced generations were published in a previous paper (Gilani and Hussain, 1972). The increased yield of $F_1$ hybrids indicated the desirability of considering commercial production of hybrid seed. There are two difficulties: Firstly, the time of flowering of these two crops did not coincide, which could be taken care of by sowing them at suitable intervals. Secondly the cost of $F_1$ hybrid seed production was high. Therefore, it was envisaged to utilize the advanced generation hybrid seed for commercial use.

The rate at which hybrid vigour diminishes in a population is related to the proportion of outcrossing. With complete selfing the amount of hybrid vigour falls by one-half in the $F_2$ generation and then remains constant. With a mixture of selfing and out-crossing intermediate results are to be expected, which can be calculated from the formulae offered by Stephens, (1950).

$$h = \tfrac{1}{2}\ (1-k)\ \ h+k)$$

where 'h' represents the proportion of $F_1$ vigour retained in the preceding generations and 'K' is the proportion of the out crossing. This formula is based on the assumption that gene action on average is additive.

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Kiesselback (1930) compared $F_1$, $F_2$ and $F_3$ generations of 21 single crosses with parental inbred lines in maize. The theoretical yield of $F_2$ (40.5 bushels) did not differ significantly from the actual yield (38.0 bushels).

Bredemann and Heuser (1931) studied a number of intervarietal Rye hybrids and observed that the grain yield of $F_2$ was in general lesser than the original parents, however, in some cases they observed that the $F_2$ yield exceeded than that of the $F_1$.

Salamov (1949) pointed out that the yielding capacity of the $F_1$ maize hybrid can be maintained in the $F_3$ or later generations provided adequate selection methods are practised. Josephson (1953) observed that the $F_1$ and $F_2$ maize hybride gave an increased yield of 49.2 and 15.0 per cent, respectively, over the average of the parents.

Thus, the hybrid vigour in the $F_2$ generation falls approximately midway between the $F_1$ and the parental average and may be taken advantage of heterosis by utilizing the $F_2$ or the later generation hybrid seed for commercial culture of crops where the production of $F_1$ seed is not easy. This consideration has led to the present studies on hybrid vigour for seed components, in the advanced generations of the maize-teosinte hybrids.

## MATERIALS AND METHODS

The experimental material comprised yellow maize, annual teosinte, reciprocal $F_1$ hybrids, maize-teosinte $F_2$, $F_3$ and $F_4$ generation both open and self-pollinated. The observations were made at maturity on the following characters; data on cob characters in case of teosinte was taken at the milk stage because teosinte cob at maturity disarticulate and the grains scatter. The data were analysed by the statistical methods given by Fisher (1939).

Hundred grains per plant randomly sampled were weighed in grams on Mettler Balance. The number of rows in a cob were determined by direct counting, in hybrids and parents. In the case of hybrids five cobs per plant were taken while only one cob each in maize and teosinte was taken to represent a plant. The length of cob excluding the stock was measured in centimeters. In the case of teosinte and hybrids ten cobs per plant were measured at random while in the case of maize data were recorded on one cob per plant. The maximum breadth of cob was measured in centimeters with the help of Vernier's caliper. The material utilized for measuring the length of cob was used for the measurement of the breadth as well.

## RESULTS AND DISCUSSION

The F values for various characters are summarized in Table 1. The

$F_1$ hybrids were highly significant for the characters studied. However, the results on 100-grain weight were not significant.

TABLE 1. *F. Values of the Characters of Parents and Hybrids.*

| Source of variation | D.F. | Cob length | Cob breadth | *F. Values* Number of cobs | 100-grain weight | Number of grains per row |
|---|---|---|---|---|---|---|
| Blocks | 3 | | | | | |
| Varieties | 9 | 58.81++ | 25.82++ | | 0.78$^{NS}$ | 56.66++ |
| Error | 27 | | | | | |
| Total | 39 | | | | | |

The average performance of the hybrids and the parents for various characters are summarized in Table 2. It is apparent that the hybrid cobs were better than the teosinte but were much smaller than the maize cobs. The advanced generation hybrids did not exhibit a decrease in cob length as compared to maize-teosinte $F_1$ hybrids.

Maize produced cobs with maximum breedth, which differed significantly from the various generation hybrids and teosinte. The hybrids had more breadth than teosinte. The advanced generation hybrids did not show a marked decrease from the maize-trosinte $F_1$ hybrids or its reciprocal. The maize teosinte $F_2$ hybrid produce the maximum breadth of cob among the hybrids.

Teosinte produced the maximum number of cobs. However, it is evident from Table 2 that even the advanced generation hybrids had significantly more cobs than the maize parent. Among the hybrids $F_3$ (open pollinated) produced the maximum number of cobs, while the $F_2$ hybrids fell short of the $F_1$.

The differences in the grain weight between parents and hybrids were nonsignificant. $F_2$ hybrids (self pollinated) out weighed all other hybrids and parents in seed weight. The $F_4$ hybrids showed a decrease in seed weight compared to the earlier generations. The teosinte-maize hybrid showed an increase of 3.65 gms. over its reciprocal.

The results shown in Table 2 indicated that the average number of grain rows per cob in the case of maize was 14.86 as against one row of grains in teosinte. Teosinte maize hybrids produced fewer grain rows than its reciprocal, showing a tendency towards teosinte. The $F_2$ hybrids produced the maximum number of grains rows as compared to the $F_1$, $F_3$ and $F_4$ generation hybrids.

These investigations envisaged commercial exploitation of heterosis in seed components through the use of the advanced generations hybrids did not exhibit a significant decrease in various seed and cob characters studied.

The maize-teosinte $F_2$ hybrid produced cobs with maximum length and breadth as compared to $F_1$ and the advanced generation hybrids, while the number of cobs were produced the highest in the case of $F_3$. Similarly, the $F_2$ hybrid cobs contained the maximum number of grain row per cob as compared to the $F_1$ and other hybrid generations.

This evidently shows that the $F_2$ and $F_3$ generations seed retained sufficient heterosis to utilize it for a commercial use.

TABLE 2. *Comparative performance of the parents, $F_1$, $F_2$, $F_3$ and $F_4$ generation hybrids for the different characters.*

| | Cob length | Cob breadth | Number of cobs | 100-grain weight | No. of grain per row |
|---|---|---|---|---|---|
| Maize | 16.03 | 4.061 | 2.25 | 14.62 | 14.86 |
| Teosinte | 3.90 | 0.462 | 395.91 | 9.58 | 1.00 |
| Maize and Teosnite $F_1$ | 5.41 | 0.942 | 100.66 | 14.90 | 4.00 |
| Teosinte and Maize $F_1$ | 5.66 | 0.849 | 95.83 | 11.35 | 2.43 |
| Maize and Teosinse $F_2$ (self) | 6.43 | 1.274 | 57.58 | 17.33 | 5.38 |
| Maize and Teosinte $F_2$ (open) | 6.86 | 0.954 | 90.33 | 10.42 | 4.38 |
| Maize and Teosinte $F_3$ (self) | 6.65 | 0.829 | 117.16 | 9.52 | 2.91 |
| Maize and Teosinte $F_3$ (open) | 6.43 | 1.173 | 130.49 | 11.09 | 3.29 |
| Maize and Teosinte $F_4$ (self) | 5.68 | 0.948 | 120.33 | 9.12 | 3.40 |
| Maize and Teosinte $F_4$ (open) | 6.32 | 0.806 | 124.75 | 9.27 | 4.35 |

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