Response of tropical maize S_0 and S_3 progenies to phosphorus in field experiments

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Approximately 20% of Brazil, an area corresponding to more than two million square kilometers, has an acid savanna ecosystem. Crops grown in these savanna soils are generally subjected to stresses especially those caused by limitations in phosphorus and nitrogen availability. The use of P fertilizers alone is not likely to be a viable solution to this production constrains for the small-scale farmer. New technology, such as plants adapted to this stress, must be developed for sustainable agricultural production. The identification, development and use o maize germplasm more efficient in phosphorus acquisition and utilization will result in increased sustainable production across those tropics where low P availability is a primary constraint.

This study was conducted to evaluate difference between the use of two types of progenies, S_0 and S_3, for ear yield and agronomic traits under P stress for selecting superior progenies in a breeding program. Two groups, one composed of 120 half-sib S_0 progenies and the other composed of 120 self-pollinated S_3 progenies from two tropical maize synthetics. The first group of S_3 progenies was extracted from a synthetic previously characterized for water stress in field conditions using anthesis silk interval (ASI) as the key parameter. The second group of S_0 progenies originated from two synthetics undergoing improvement for abiotic stresses. The experiments were conducted on a red yellow latosol, sandy clay loam, in Janaúba, MG, Brazil, with drip irrigation. A lattice design 11 x 11 with 2 replications was used. The P deficient soil had 3 mg of P/dm^3 (Mehlich1), and the control was fertilized with simple super phosphate to reach 30 ppm P. N and K were applied in accordance with soil analysis. Data were collected for days to female flowering (DF), plant height (PH), ear height (EH), prolificacy (PROL), stalk and root lodging (SRL) and grain yield (GY). Analysis of variance was computed for each trait. A "response index" (RI) was calculated by using the index proposed by Fageria & Kluthcouski, (1980) to classify the progenies for efficiency and response to P. (RI = (Yield high P – Yield low P)/ (kg ha^{-1}of P_2O_5 high P - kg ha^{-1}of P_2O_5 low P).

The phosphorus treatment had a significant effect on DF, PH, EH, PROL and GY. The mean squares values were significant (P<0,01) for progenies and for progeny by environment interaction in the experiment with S_3 progenies. The means of the characteristics DF, PH, EH and PROL were 3 days latter, and 10 %, 18 % and 8 % smaller in the P stressed environment, respectively. The GY mean of the S_3 progenies was 3.221 kg ha^{-1} in the stressed environment and 4.829 kg ha^{-1} in the non-stressed environment, a grain yield reduction of 33 %.

The mean squares values were significant (P<0,01) for progenies and for the progeny by environment interaction in the experiment with S_0 progenies. The means of the characteristics in the stressed environment for DF, PH, EH and PROL were 6 days latter, and 20%, 27%, and 7% smaller than the non-stressed environment, respectively. The GY mean of the S_0 progenies was 5.865 kg ha^{-1} in the stressed environment and 8.711 kg ha^{-1} in the non-stressed environment, a yield reduction of 33 %. The S_0 and S_3 progenies with RI values above the average RI and yield above the average EY in the stresses environment were considered efficient and responsive to P, quadrant one in Fig. 1.

Seventeen S_3 and 15 S_0, classified as P efficient and P responsive, in quadrant one were selected for continued breeding enhancement.

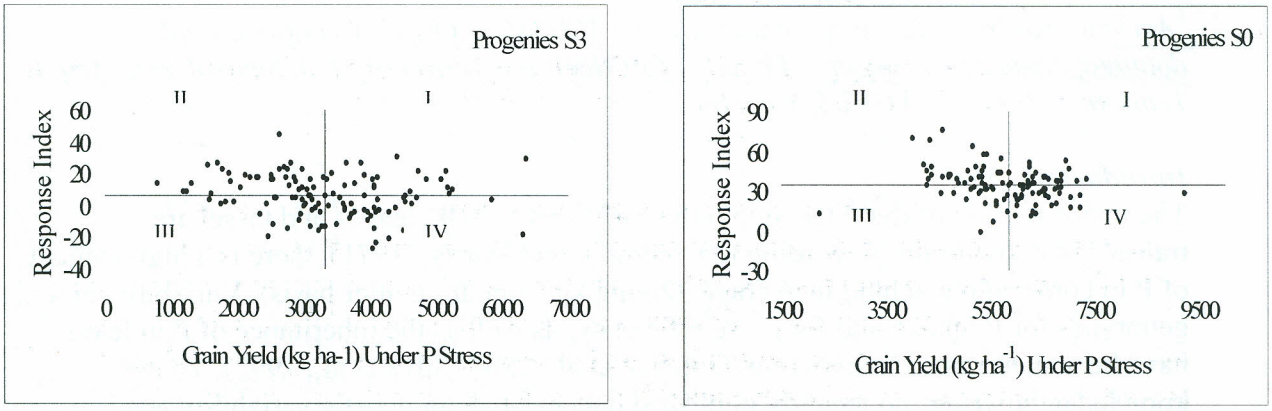

Fig 1. Grain yield as a function of the response index (RI) for 244 S_0 and S_3 progenies grown under two P levels. Sete Lagoas (MG), 2003.

The test to determine whether the frequency of P efficiency S_0 and S_3 progenies was different by selecting sibed (S_0) or selfed (S_3) progenies from drought stress tolerant synthetic versus conventional synthetics, showed them to be almost similar. Desirable alleles are normally fixed through inbreeding in maize, thus there is a greater chance of obtaining better lines from selfing S_0 progenies and selecting for P efficiency, rather than starting with S_3 progenies. A greater gain from selecting for P efficiency and drought tolerance is expected by recombining the selected S_3 into a new synthetic, to be used as a breeding source for new inbred line development or as an open pollinated variety for small scale farmers.

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