Improving Pearl Millet Drought Tolerance

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Quantitative trait loci (QTL) have been identified for drought tolerance of grain yield in pearl millet (Yadav et al. 1999 and 2002). Marker-assisted selection (MAS) is being used to develop improved parental lines by introgression of QTLs into a homozygous inbred line background for the subsequent production of improved hybrids (marker-assisted back crossing), and by transforming them into topcross pollinator populations that are more heterogeneous than inbred lines. Until – and unless – it is clearly demonstrated that the incorporation of these QTLs into elite breeding lines will significantly enhance the performance of cultivars based on those lines, the benefits of these QTLs are unlikely to ever reach farmers' fields.

Three topcross pollinator populations (TCPs) were developed by selecting and inter-mating individual genotypes from within the $F_{2:4}$ mapping families of a pearl millet population used for mapping QTLs for drought tolerance (Fig. 1). The three TCPs produced were selected according to the following methods and criteria:

- Marker-assisted selection: genetic composition at the drought tolerance QTL (to constitute a MAS-based TCP);

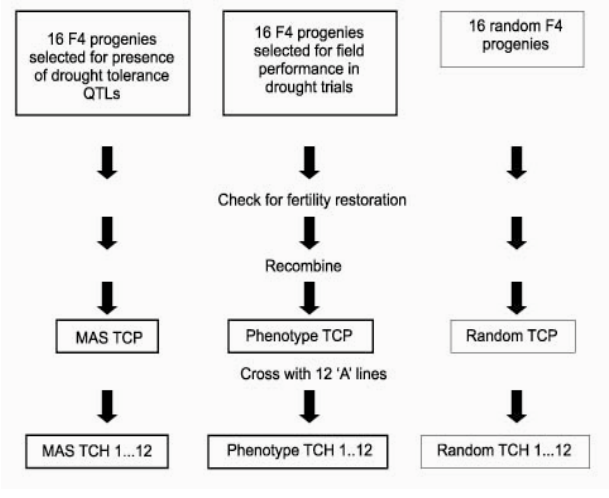

Figure 1. The scheme used to test marker-assisted selection for pearl millet QTLs controlling drought tolerance using topcross pollinators. Topcross pollinators based on phenotypic and random selections are controls for the pollinator based on marker-assisted selection.

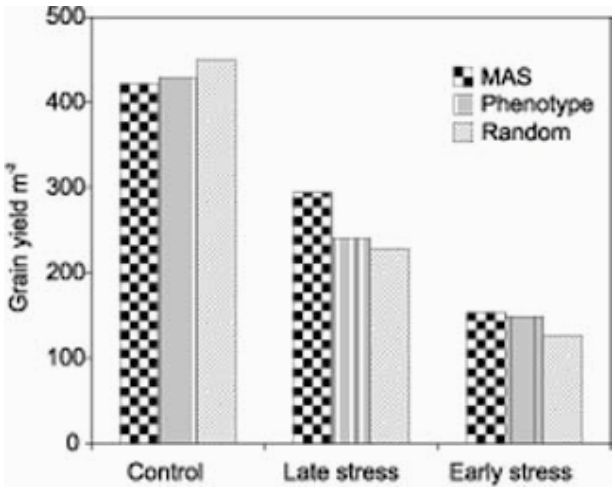

Figure 2. Grain yield performance of pearl millet hybrids made between three topcross pollinators and male-sterile line ICMA 92777 in a range of summer season drought nursery moisture environments, ICRISAT 2001.

- Phenotypic selection: field performance (best 16) in the drought trials used to identify QTLs (to constitute a phenotype-based TCP); and
- A random control: a random sample from within the mapping population (to constitute a random TCP).

The three TCPs were subsequently used as pollinators on 12 A-lines (male-sterile lines) to produce topcross hybrids, as shown in Figure 1. Compared to hybrids of the phenotype and random TCPs, the MAS TCP hybrids had better drought tolerance indices and grain yields (Fig. 2) in the drought-stress environments, although they had a lower yields in the irrigated control environment. Selecting simply on the basis of field performance under drought was ineffective, but MAS was able to produce improvement in this character, which is notoriously difficult to breed for using conventional methods.

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