Field Validation of Near Isogenic Lines and Hybrids Contrasting for Tolerance to Aluminum Toxicity and Comparison of Parameters Derived From Nutrient Solution and Field Evaluation at Various Levels of Aluminum

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ABSTRACT

Two experiments were conducted where near isogenic genotypes were evaluated as seedlings in nutrient solution and at an aluminum phenotyping site with three levels of aluminum saturation in the topsoil. The first experiment consisted of two pairs of cytoplasmic male sterile female near isogenic lines (NILs) and four tester restorer R-lines, three susceptible to aluminum toxicity and one tolerant to aluminum toxicity. The seven lines and sixteen hybrids were evaluated as seedlings in nutrient solution with five levels of aluminum toxicity (0. 11, 20, 27 and 39 μM active aluminum). All sources of Al tolerance were from the sorghum line SC283 with the Alt_{SB} gene. Root growth was recorded at zero, three, five and seven days in the nutrient solution with Al. The same genotypes were evaluated in replicated field trials with three levels of Aluminum saturation in the top 20 cm of the soil, 0, 40%, and 60%. Significant differences were observed between the NILs and near isogenic hybrids (NIHs) for the seedling root parameters and grain yield. Yield advantages of more than one ton per hectare were observed for the NILs and NIHs indicating the impact of the gene Alt_{SB}. The second experiment consisted of 100 recombinant F_7 lines (RILs) derived from the cross of an Al susceptible parent BR007B and Al tolerant parent SC283. Each RIL was genotyped for the presence of Alt_{SB} and phenotyped for seedling root growth in nutrient solution with 27 μM Al and in the field equivalent to the first experiment. The RILs with the Al tolerant Alt_{SB} allele had an average yield advantage of approximately 1 t · ha^{-1}. A significant positive correlation was observed between seedling root growth in nutrient solution and yield in the field with Al saturation of 60%.