LINE BY TESTER ANALYSIS OF ELITE TROPICAL-TEMPERATE MAIZE LINES UNDER WATER-STRESS AND NON-STRESS ENVIRONMENTS

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DECLARATION

This thesis is my original work and has not been presented for award of a degree in any other University.

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ABSTRACT

Maize is the second most cultivated cereal crop in the world after wheat. In spite of its importance, the production challenges have continuously led to poor yields in sub-Saharan Africa. This has called for need to improve varieties that are adapted to the tropical ecosystem. The aims of this study were (i) to assess the combining ability of the tropical-temperate maize lines for grain yield, drought tolerance, disease resistance, and heritability of the traits, and (ii) to examine the yield and yield stability of the three-way cross hybrids in eight environments found in different agro-ecological environments and identify the genotypes, of wide or specific adaptation. The maize germplasm used in this study were obtained from various sources. These included seven elite tropical-temperate inbred lines (L), seven single cross testers (T) and six commercial hybrids that were used as checks during evaluation. The results indicated that inbred lines L5 and L3 gave high grain yield across well-watered environments and had a common single cross tester T6, with best linear unbiased estimates values of 8.5 t/ha and 8.4 t/ha, respectively. The two lowest hybrids across locations had a common single cross tester, T7, with two different pollen donors L6 and L7 yielding 6.0 t/ha and 5.5 t/ha, respectively. Forty eight hybrids had statistically better mean grain yield than the best check, Pioneer 3253. Under managed drought stress conditions, the top two performers in grain yield had different testers, namely T6 and T4 but shared the same pollen donor, L5, with values of 4.9 t/ha and 4.8 t/ha, respectively. DK8053 was the best check with value 3.7 t/ha. The results indicated that the inbred lines which produced the top yielding hybrids were related by pedigree and origin. To examine genotype × environment interaction and yield stability, the three-way cross hybrids were planted in eight environments with two replications. Data was analyzed using REML, SAS and GGE biplot tools. The results revealed that Environment (E) contributed 67% of the total sum of squares for grain yield while GEI and genotypes (G) contributed a percentage of 12.5%

and 10.3%, respectively. The first two principal components (PCs) accounted for 67.9% total variation. The biplot figures demonstrated that across environments, entry 10 (L5 × T5), 14 (L5 × T3) and 28 (L3 × T3) were the highest yielding with stable genotypes. The additive or dominance gene action played a greater role in the inheritance of grain yield and the yield related agronomic traits. There were two mega-environments (ME) with ME1 represented by 3 locations and ME2 by 5 locations. The two testers included as checks in this study showed that tester 2 performed better under drought conditions and therefore it is a recommended hybrid for yield increase in water stress environments. Tester 5 should be utilized in Kirinyaga type moisture regimes; as it yielded higher than all experimental hybrids. L1, L3 and L6 could contribute to formation of hybrids with consistent earliness, while L5 contributes to stable high grain yield in both well-watered and water stress conditions. The heritability of most agronomic traits was noted implying that the traits characteristics can be passed to future generations. Tropical maize populations can be improved for these traits using these improved maize germplasm. The promising maize hybrids for yield and agronomic traits could be nominated for national performance trials for commercial release in various Eastern African countries.