SUMMARY

Quality Protein Maize (QPM) has elevated levels amino acids lysine and tryptophan, thus important in addressing protein nutritional challenges. Unfortunately, these are largely lacking in Uganda. Desirable QPM varieties should combine high yield, disease resistance and stability across environments. This study was carried out to 1) estimate genetic variances and gain for resistance to turcicum leaf blight (TLB), grain yield and agronomic traits during 2 cycles of S_1 selection; 2) assess stability for agronomic traits and response to TLB and other foliar diseases among QPM single and 3-way hybrids in Uganda; 3) estimate general and specific combining abilities for resistance to TLB, grain and agronomic traits in QPM maize inbred lines and t3-way hybrids in Uganda; and 4) estimate heterosis for TLB resistance, grain yield and agronomic traits QPM maize inbred lines, and 3-way hybrids. The study was conducted at National Crops Resources Research Institute, Namulonge with an open pollinated QPM variety (Longe 5) as the source for S_1 families and cycles C_1 and C_2. Evaluation of the cycles C_0, C_1 and C_2 was done in 2012B. The study showed lower AUDPC values in C_2 reflecting genetic improvement of the population against TLB as well as efficacy of the recurrent selection method (AUDPC significantly reduced from 35.09 to 25.8). The negative value of selection differential indicated that additive genes control the disease. The second study involved 53 new single and 28 new 3-way QPM hybrids and was done across 3 locations: Namulonge, Masaka and Bulindi in 2016A. Fourteen parental inbred lines were crossed in 2015 at Namulonge in a diallel to give 91 single crosses. The parental inbred lines were simultaneously crossed to two QPM tester single cross hybrids (CML181/CML182 and CML144/CML159) to generate 48 3-way test hybrids. The resulting hybrids and 3-way crosses were evaluated alongside two popular commercial checks. Ten genotypes performed better than the check for grain yield across locations with average grain yield of 6.5t/ha across all sites. The average TLB, GLS and MSV scores for the best performing single crosses across sites were lower than the overall mean scores. AMMI analysis of variance showed significant effects for genotypes, environments, and genotype by environment interaction (GEI) for most traits indicating wide phenotypic variability. The highly significant variance of the environment indicates its major contribution in influencing yield in maize. Two mega environments are suggested for each trait evaluated. Based on stability coefficients for genotype by environment, the most superior and stable single cross QPM hybrids across environments for grain yield were identified as QPMSC-18(6.2t/ha) and QPMSC-29 (6.19t/ha). Based on GCA analysis, QPML6, QPML11, QPML4 and QPML21 were the top general combiners for grain yield and therefore could be utilized in maize grain improvement programs. The final study estimated the extent of heterosis for grain yield, agronomic traits**,** and foliar diseases, among QPM single cross and three-way cross hybrids. ANOVA indicated significant ($P < 0.05$) genotype effects for grain yield, other agronomic traits and foliar diseases. Single crosses, QPMSC-29 (7.07t/ha), QPMSC-10 (6.72t/ha) and QPMSC-18 (6.59t/ha) resulted into significantly high yields. The three-way crosses, QPM-TC1-11, QPM-TC1-6 and QPM-TC1-4 had significantly high yields compared to checks. Four single crosses and nine 3-way hybrids were identified for high grain yield, resistance to GLS and TLB, ear and plant aspect, desirable flowering date and anthesis-silking interval (ASI), and grain texture. The significant genetic variation and high heterosis among the new QPM hybrids offers a valuable opportunity for release of improved QPM varieties and forward breeding activities.