ABSTRACT

Rice is one of the most important cereal crops in Eastern Africa and it’s often ranked after sorghum, wheat and maize. Unfortunately, rice yield per hectare is low (<3.6 t ha\(^{-1}\)) because smallholder farmers rely on local rice cultivars with low yield potential, poor grain quality, highly susceptible to bacterial leaf blight and rice blast. The deficit of about 75 % is imported from Pakistan, Vietnam and China. Therefore, development of high yielding and locally adapted rice varieties combining high grain quality with other farmer, processor and consumer preferred traits is probably the most effective strategy of increasing rice production in Eastern Africa. The main objective of this study was to contribute to increased rice productivity through the development of improved, locally adapted rice varieties with high yield potential, earliness and high grain quality. The specific objectives were i) to determine the combining ability and heterosis for agronomic and yield traits in indica and japonica rice crosses, and ii) to select for yield potential, earliness and grain quality from existing F2.3 families. For the combining ability trial, 27 F1 progenies were generated from crosses between nine male indica parents and three japonica female using North Carolina Design II mating system. In the second trial, 16 F2 segregating populations and six commercial checks were evaluated in the short rain season between September and December 2016 at Mwea Research Station and Kirogo Experimental Farm in a randomized complete block design with three replications. Seven outstanding F3 families were selected from the segregating populations and advanced for further evaluation during the long rain season between April and September 2017 at two sites. Data was collected on agronomic and yield traits. The physico-chemical characteristics of the F2.3 families were analyzed in the Food Science Laboratory at University of Nairobi.

The results showed that general combining ability (GCA) variances were higher than specific combining ability (SCA) variances implying the predominant role of additive gene action in the expression of days to 50 % flowering, days to maturity, number of tillers plant\(^{-1}\), number of spikelet’s panicle\(^{-1}\), number of panicles plant\(^{-1}\), number of filled grains panicle\(^{-1}\), and grain yield. Specific combining ability was significant (P≤0.05) for plant height, panicle length, flag leaf length and 1000-seed mass. Heterosis for grain yield was observed in the hybrids K2-9 x Basmati 370 (31 %), K2-9 x Komboka (24 %), K2-8 x Basmati 217 (23 %), K2-54 x Basmati 217 (21 %), K2-54 x Dourado precoce (20 %) and K2-8 x Basmati 370 (18 %). Heterosis for number of tillers plant\(^{-1}\), panicle length, number of panicles plant\(^{-1}\) and filled grains panicle\(^{-1}\) was observed in the F1 hybrids. Negative heterosis for earliness was observed in the hybrids K2-54 x Basmati 370 (-8 %) and K2-54 x Dourado precoce (-4 %).

Evaluation of the F2.3 families for agronomic and yield traits showed that the F2.4 families of WAB-56-104 x NERICA 4, NERICA 4 x MWUR 4, NERICA 4 x NERICA 1 and NERICA 10 x KUCHUM were early maturing and consistently maintained higher grain yields in all locations indicating a wider adaptability to varying environments. The grain quality analysis showed that F2.4 families of NERICA 4 x MWUR 4, NERICA 4 x NERICA 1 and NERICA 10 x KUCHUM exhibited slender grain shape while NERICA 4 x NERICA 1 (22.33 minutes) followed by WAB-56-104 x NERICA 4 (22.67 minutes) and MWUR 4 x NERICA 4 (23.33 minutes) cooked fast with soft cooked texture and recorded low gelatinization temperatures. The F2.4 families of WAB-56-104 x NERICA 4, NERICA 4 x MWUR 4, MWUR 4 x NERICA 4 and CG 14 x
NERICA 10 had mild aroma while NERICA 4 x NERICA 1, NERICA 13 x K45 and NERICA 10 x KUCHUM were non-aromatic.

Out of the 12 parents evaluated for general combining ability, only four parents namely Basmati 370, Basmati 217, K2-54 and Komboka were good general combiners for grain yield. From 27 F1 hybrids evaluated for specific combining ability, four F1 hybrids namely K2-9 x Komboka, K2-9 x Basmati 370, K2-54 x Dourado Precoce and K2-54 x Basmati 217 were good specific combiners and expressed better heterotic effects for grain yield. The check Basmati 370 was outstanding for physical grain quality and aroma compared to the non-Basmati rice genotypes suggesting that Basmati 370 has implication for future breeding. From the 16 populations evaluated, three families namely MWUR 4 x NERICA 4, NERICA 4 x NERICA 1 and WAB-56-104 x NERICA 4 exhibited better agronomic, culinary and physico-chemical qualities. However, there is need to advance these F2.4 families for further selection in order to ascertain their agronomic, culinary and physico-chemical qualities and identify potential varieties.

**Key words:** Combining ability, earliness, gene action, grain yield, grain quality, *Oryza sativa*