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Water-use Efficiency of Sorghum (*Sorghum bicolor* L. Moench) Genotypes in Mali, West Africa, is Affected by Climate Variability

Alhassan Lansah Abdulai[1], Holger Brück[1], Folkard Asch[1], Mamoutou Kourressy[2], Michel Vaksmann[2]

[1] *University of Hohenheim, Department of Crop Production and Agroecology, Germany*
[2] *Institut d'Economie Rurale (IER), Mali*

Abstract

Global climate change, in synergy with rapidly increasing population, reducing proportion of arable land and changing eating habits, poses serious challenges for the already skewed water resource allocation to agriculture. Technological options (genotypes and/or component technologies), for both tactical and strategic adaptation of agriculture, are required for sustainable and/or efficient use of water, especially in the arid and semi-arid regions of the world. One cost effective and feasible option is the introduction and/or development of ideotypes with general or specific adaptation traits that match phenology with water availability.

Diverse sorghum [*Sorghum bicolor* (L. Moench)] genotypes (10) from several races, with differences in morphology and sensitivity to photoperiod, were evaluated in 2008 and 2009 for efficiency with which they used available water for biomass and grain production under rain-fed conditions in Mali. Three sites (along a latitudinal gradient), staggered monthly (to create different climate scenarios) and a split plot arrangement fitted in a randomised complete block design with 3 replications were used in this study. Water use efficiency (WUE) of biomass production and grain yield was calculated from harvest data, seasonal rainfall amount and the change in soil water content monitored by TDR. Additionally, intrinsic water use efficiency (net CO_2 assimilation rate / stomatal conductance) was measured during the vegetative growth periods by infrared gas analyzer.

Mean WUE (pooling varieties, locations, sowing dates and years) in the production of biomass ranged from 0.176g L^{-1} to 3.310 g L^{-1} whiles it was lower for grain yield (0.001 g L^{-1} to 0.5828 g L^{-1}). Years did not significantly affect both measures of WUE while they were differentially influenced by date of sowing, genotype and location. Intrinsic WUE was not differentially affected by any of the treatment factors. The significant interaction between genotypes and locations and genotypes and sowing date for WUE of biomass production and grain yield indicate that genotypic variability can be exploited in order to adapt sorghum production systems to variable climate. The implications for both modelling and development of appropriate ideotypes (photoperiod sensitivity, maturity grouping) are highlighted and discussed.

Keywords: Climate change, grain yield , harvest index, leaf gas exchange

Contact Address: Alhassan Lansah Abdulai, University of Hohenheim, Department of Crop Production and Agroecology, Garbenstr. 13, 70593 Stuttgart, Germany, e-mail: alabdulai@yahoo.co.uk