Morphological traits for sorghum ideotype development to cope with climate variability in Africa

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Climate change is forecast to adversely affect agriculture in the tropical arid and semi-arid areas. The contribution of grain sorghum production systems to the economy and food security of the populace of these regions could be affected if climate changes. Adapting these systems to climate change in the arid to semi-arid tropics (ASAT) would require ideotype traits that can enhance among others, plasticity of crop cyles, tolerance to drought, delayed start of senescence and maintenance of green leaf area (staygreen) and/or reserve mobilization during grain development. A pool of diverse traits and well established breeding methodologies exist, but the magnitude and specificity of response to changed climates, of these genotypes need to be determined via field research. Field experiments involving split plot arrangements of date of sowing (mainplot factor) and genotypes (subplotfactor), were tested in a RCBD with 3 replications at 3 locations (Farako, Sotuba and Cinzana) along a latitudinal gradient in Mali during 2008 and 2009. The aim was to determine the grain yield response and relationships between yield and key morphological traits of the ten diverse grain sorghum genotypes. Data were recorded on morphological traits such as features of the largest leaf area, length and width, total leaf number, time from sowing to ligulation of the flag-leaf (in days and GDD)], plant height, maximum leaf area index, leaf area duration, harvest index and grain yield (GY). Relationships between GY and each of the other traits were tested by Pearson correlation.
Grain yield response to variation in sowing date ranged from 0 to 475 g m^{-2}, 0 to 319 g m^{-2} and 0 to 431 g m^{-2} at Farako, Sotuba and Cinzana respectively. All main effects represented significant sources of variation in GY at all the sites. First order interactions, except year and variety at Sotuba significantly affected GY. Second order interactions were also significant sources of yield variation at Farako and Sotuba but not Cinzana. Across factors, a weak positive correlation was observed between HI and GY while there was no relationship between GY and the rest of the traits. The significant interaction between genotype and location and genotype and sowing date for GY 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 are highlighted and discussed.

Keywords: sorghum genotypes, latitudinal gradient, G*E interaction, yield