

The genetic basis of phenotypic plasticity in sorghum: Dissection with an environmental profiling

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Identifying the environmental and genetic drivers that occur in phenotype's expression can help to dissect complex traits. This study aims to identify the critical sorghum growth period sensitive to environmental stimuli and to assess genetic loci's effects along the environmental gradient. We evaluated a mapping population of 253 recombinant inbred lines (RIL) in five natural environments focusing on two photoperiod sensitivity traits: flag leaf ligulation and plant height as proxies for assessing grain mold resistance. Grain mold severity scores have been rated and yield components (panicle and grain weight per plant) have been measured. From initial results, variance component analysis attributed 21.50% of the flag leaf ligulation to the environment, and 41.22% of the variation to the genotype. For the plant height, environmental effects accounted for 51.16 % of the phenotypic variance, followed by the genotype effect (24.96%). Using environmental means, we applied the joint regression analysis to unravel the pattern underneath the trait variation. Further, we will implement the CERIS (Critical Environmental Regressor through Informed Search) framework to replace environmental means with an environmental index biologically informing. The combination of environmental parameters: photoperiod (daylength), growing degree day (GDD, °C), diurnal temperature range (DTR, °C), photothermal time (PTT, °C), precipitation (PR, mm); and growth windows with the strongest correlation will be chosen as the environmental index. By regressing again the phenotypes of each RIL on the environment index, two reaction-norm parameters (intercept and slope) will be obtained. The genetic map will then be built using reaction-norm values (as phenotypes) with 952 SNP markers from 3495 SNPs generated by DArTag technology, to identify the genetic loci underlying phenotypic plasticity along environment gradient.

References:

1. Li, Xin, et al. «Genomic and environmental determinants and their interplay underlying phenotypic plasticity.» PNAS 115.26 (2018): 6679-6684.