

## **Pre-anthesis morpho-physiological response of tropical sorghum to combined drought and heat stress**

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### **Abstract**

Combinatory stress of soil water deficit and extreme temperatures has become a major limiting abiotic factor in rain-fed areas of semi-arid tropics. Vast genetic resources in gene banks have not been evaluated for the aforementioned stressors in context of their adaptation to climate change. The present study assessed 48 sorghum genotypes and two check varieties under combined pre-flowering drought and heat stress which has received insufficient attention compared to post-flowering stress despite its significant negative effects on the development of yield components. A potted experiment was set up in a split-plot arrangement of treatments in a randomized complete block design with three replicates in two consecutive seasons 2021/22 and 2022/23. Basal diameter, plant height, canopy temperature depression, relative leaf water content, cell membrane stability, leaf area, panicle length and grain weight were measured at flowering after stress inductions except for grain weight that was assessed at physiological maturity. The F-test revealed significant main effects of stress, genotype and their interactions on some traits in both seasons. The dual stresses negatively affected all the traits except basal stem diameter and showed no significant effect on relative leaf water content. Stress treatments had notable yield reductions of 7.2 % and 5 % in the seasons 2021/22 and 2022/23 respectively. Significant effect of the interaction between genotype and stress was observed in canopy temperature depression, basal stem diameter, panicle length and yield. Genotypes IS24426, IS12391 and NPGRC3093 were identified as the most stable and tolerant in terms of grain weight. Principal component analysis revealed that plant stem height, panicle length, canopy temperature depression and grain weight were contributors of most variation in assessed genotypes under combined stresses. Canopy temperature was found to have a weak positive ( $r^2 = 0.29$ ) and significant correlation with GW as well as a highly significant weak negative ( $-0.37$ ) correlation with LA. A weak positive correlation ( $r^2 = 0.30$ ) was also observed between LA and BSD. The highest direct effect on GW was noted in CTD, while PL had notable indirect effects through CTD and SPH. The genotypes were grouped into eight distinct clusters using the hierarchical clustering technique with one cluster with two genotypes namely IS24272 and IS29925 identified for dual purposes (grain and forage) characterized by

moderate plant stem height, largest leaves and highest grain yield. The study formed the basis for breeding for pre-anthesis combined drought and heat stresses in sorghum using proxies such as CTD and panicle length.