Identifying genetic variation in photosynthetic performance of cowpea genotypes under drought stress conditions

Olakunle O. Sansa[123], *Michael T. Abberton*[1] , Omolayo. J. Ariyo[3] , Jonne Rodenburg[2], Oyatomi A. Olaniyi[1], Ibnou Dieng[1]

[1]*International Institute of Tropical Agriculture, (IITA), Ibadan, Nigeria*

[2]*Natural Resources Institute, University of Greenwich, United Kingdom.*

[3]*Federal University of Agriculture, Abeokuta (FUNAAB), Ogun, Nigeria*

ORCiD: https://orcid.org/0000-0002-6391-1907.

Keywords: High-throughput phenotyping, PhotosynQ, Photosynthesis, drought stress, Chlorophyll content, Leaf Temperature, Cowpea, Germplasm utilization.

High-throughput phenotyping (HTP) are cost effective platforms that provide efficient evaluation of genetic resources, promote germplasm utilization, and inform breeding efforts for development of climate-resilient crops. MultispeQ device, a rapid, cost effective, and reliable HTP tool was employed to screen 112 cowpea genotypes for photosynthetic performance under drought stress conditions in a 8× 14 alpha-lattice design during the 2020/2021 and 2021/2022 dry seasons in three agro-ecological zones in Nigeria.

Drought stress was imposed at 35 DAP and relative chlorophyll content (RCC), leaf temperature differential (LTD), leaf angle, linear electron flow (LEF), Phi2 (Quantum yield of Photosystem II) before and during drought stress imposition, were measured. Data was subjected to ANOVA using a mixed model for individual and combined environment analysis. Each stress condition by year was considered as an environment, giving a total of twelve environments. Best Linear Unbiased Predictions and broad-sense heritability (H^2) were computed.

Significant genotypic effects for RCC, LEF, LTD, Phi2 before and during stress conditions were recorded while genotype × environment effects were observed for all measured traits. LEF had lowest H^2 (27%) while LTD had highest H^2 (63%). High RCC and lower LTD under drought stress suggested drought tolerance and stomatal closure, reported to be associated with plant biomass under limited water conditions.

Genetic variation in photosynthetic performance exists among the cowpea genotypes under drought stress. RCC, LTD and Phi2 were identified as useful traits in selection for drought resistant lines aimed at boosting crop production in a changing climate and extreme weather conditions.