PROJECT TITLE

Roles of root traits on leaf mineral composition for improved drought tolerance in pearl millet – a combined ionomics and root phenotyping approach

CONSORTIUM

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SUMMARY OF THE REPORT

Pearl millet is the sixth cereal crop in terms of production in the world and is consumed by more than 90 million people. It is adapted to the arid and semi-arid regions of Africa and India but its yield remains low. The main limitations for pearl millet production are drought and poor soil fertility since it is mainly grown in rainfed agrosystems with low nutrient inputs. These constraints are forecast to worsen in the future due to climate change while population is concomitantly increasing, especially in the Sahelian area. To increase food security, it is therefore important to improve the tolerance of pearl millet to drought and nutrient deficiency. The root system that is responsible for water and nutrient acquisition represent an obvious target, especially because it has been poorly considered in breeding programs in the past.

In the IonoMil project, our objective was to find a relationship between root traits and plant nutrition. For this, a panel of 160 lines representing the genomic diversity of pearl millet was grown in field conditions in Senegal under irrigated and drought stress conditions. After three weeks of vegetative drought stress, leaves were sampled to measure ion content by ICP-MS at the Ionomics Phenotyping platform of the University of Nottingham. The same plants were phenotyped for root architectural and anatomical traits using high-throughput imaging technologies. Ion content in different soil horizons sampled at different locations of the field was also performed. In the soil, the results show that some ions such as Phosphorus, Calcium or Strontium are more present in shallow soil horizons while other as Arsenic, Lithium or Selenium accumulate more in deeper soil horizons. In the leaves, we observed a 4-fold variation in Phosphorus content in the panel with a heritability above 0.7. Furthermore, the chemical analogues Calcium and Strontium, as well as Potassium and Rubidium are highly positively correlated elements as expected.

Overall, the generated data will allow the identification of roots traits that are associated with nutrition. Furthermore, this dataset will be useful to identify genomic loci controlling nutrient content in leaves using association genetics. Ultimately, it will help identify markers for improved root functions for nutrient and water acquisition under low-inputs conditions which can be used by breeders.