Title: Analyzing and modelling biomass accumulation in sorghum stem and its drought regulation at tissue and organ level – genotypic variability and implications for ideotype conception

Delphine Luquet, Lisa Perrier, Anne Clément Vidal, Sylvie Jaffuel, Jean Luc Verdeil, David Pot, Florian Larue, Armelle Soutiras, Sandrine Roques, Christelle Baptiste, Frédéric Gatineau, Grégory Beurier, Lauriane Rouan

Presenting Author: Delphine Luquet

UMR AGAP, Cirad, F-34398 Montpellier, France

Sorghum can significantly contribute to growing needs in ligno-cellulosic biomass for bio-sourced product diversification, particularly in water-limited conditions. However, the genotypic and environmental variability of stem biomass production and quality is still poorly understood, limiting its genetic improvement. This study aimed to identify the morphogenetic, biochemical and histological traits underlying at internode level the genotypic and environmental variability of stem biomass accumulation by sorghum. Three field experiments were organized to compare 8 genotypes under irrigated and drought (applied during stem elongation). The eco-physiological model *Ecomeristem* was used to explore trait impact for different cropping situations and production targets.

Both stem biomass production and quality were affected by water deficit due to the reduction of the number, length and ligno-cellulosic content of expanded internodes, whereas their soluble sugar content was increased and diameter unaffected. Internodes developed after re-watering observed a remarkable recovery whereas those developed under stress did not recover. Genotypic variability for drought sensitivity and recovery was highlighted but no correlation was found between them. The drought response of growth, biochemical and histological traits was slightly correlated, suggesting only partial trade-offs between stem biomass production and quality response to drought, obviously under complex physiological and genetic controls.

Once validated on available data, the crop growth model *Ecomeristem* was used to *in silico* explore trait impact on biomass production depending on the variation in key cropping criteria for biomass sorghum worldwide: targeted production (structural, nonstructural carbohydrates), planting density and water availability. Different ideotypes were suggested for each simulated situation, mainly defined by the *trade-off* between tillering propensity and internode sink capacity (related either to size or biomass density). It is suggested that not only internode biomass accumulation but also tillering capacity should be further considered for phenotyping and ideotyping biomass sorghum in its targeted cropping environments.

Presenter Biography

I'm Delphine Luquet, I'm a crop physiologist and modeler at CIRAD (France). I'm working on sorghum since 2005 and more particularly on sweet and biomass sorghum since 2008. I'm currently leading PAM (Plasticity and Adaptation of Monocots), a team aimed at identifying, modeling and phenotyping the traits underlying plant performance variability depending on the genotype and the environment (climate, resource availability), toward the genetic study of these traits and ideotype exploration. Focus is on rice, sorghum and palm tree. I'm currently leading 2 work-packages in companion projects aimed to better understand the genetic determinism of sorghum biomass quality, optimize available breeding tools and support the development of biomass value chains. These projects focus on both temperate and semi-arid cropping environments in partnership with colleagues from West Africa. Also, unraveling the impact of drought on biomass production and quality is crucial. This presentation focuses on the physiological understanding and modelling of the traits underlying the drought regulation of biomass accumulation in the sorghum stem and its implication for ideotype conception.