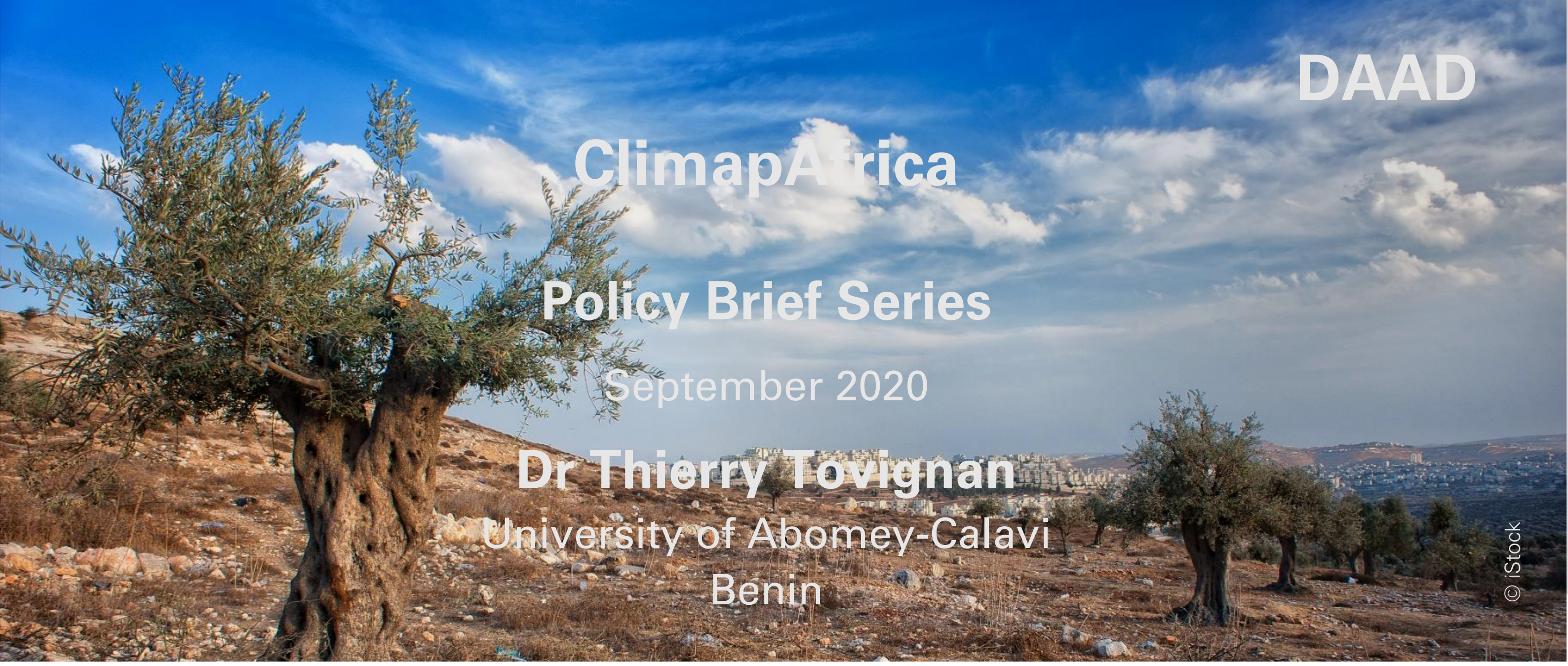

Drought resilience of sweet sorghum: importance of photoperiod-sensitivity and leaf stay green

Sweet sorghum: multipurpose uses and drought stress damages

Sweet sorghum has multiple advantages: it produces grains for human consumption, provides a high leaf and stem biomass for animal feed and thermal energy production, while accumulating in stem a sweet juice that can be transformed into bioethanol. Its limited water needs also make it a cereal perfectly suited to rain-fed agriculture in semi-arid conditions. It is therefore ideal for responding to the challenges facing Sahelian countries: ensuring food security for the population and diversifying the energy sources. Although sorghum is known to be drought tolerant, its grain yield can be dramatically affected by post-flowering drought depending on the severity and duration, due to the reduction of green leaf area, photosynthetic capacity and thus carbohydrates availability. Drought persistence was shown to weaken sorghum plants and favour diseases like fungal infestation leading to grain yield loss up to 60%. Occurrence of drought before flowering was shown to reduce stem biomass production by 42%. In some instances, drought causes a total failure of the crop. Therefore, it is crucial to find out strategies to reduce post-flowering drought effects on sweet sorghum growth in order to achieve multipurpose production in West Africa.

How do photoperiod-sensitivity and stay green contribute to buffer drought effects on sweet sorghum?

Improving the multipurpose ability of sorghum dedicated to both grain (for food mainly) and forage or energy (methane, bioethanol) production for West Africa, requires concomitant association between i) an efficient acquisition of carbon resource during the crop cycle through leaf area expansion and leaf photosynthetic efficiency, ii) an efficient activity and sizing of both the vegetative (stem structural biomass and sugar accumulation) and reproductive (panicle grain number and filling) sinks. Most of the sorghum cultivars used in West Africa are photoperiod-sensitive. This trait allows them to synchronize their flowering time with the end of the rainy season, irrespective of the sowing date. When photoperiod-sensitive variety of sorghum is sown early, its vegetative phase duration is increased and allows accumulation of high biomass and potentially high stem sugar before flowering. This was shown through the field experiments conducted in 2013 and 2014 in Senegal where twelve sorghum varieties with similar phenology were assessed through two sowing dates (July & August) and two post-flowering water treatments (irrigated, non-irrigated). Late sowing date led to the reduction of sugar and grain production more than post-flowering drought, whereas early sowing enhanced both types of production. No post-flowering competition was found between grain filling and stem sugar accumulation. However, under drought conditions, the maintenance of combined production was better for the most leaf stay-green varieties.

In short, to achieve dual production (sugar, grain) with photoperiodic sweet sorghum, it is important to adopt an early sowing date to lengthen the vegetative phase and allow the plant to produce more vegetative biomass and particularly more stem sugar before flowering. Even if a drought stress occurs during the grain filling, less sugar is remobilized from the stem to panicle filling. In addition, if the variety has ability to maintain large green leaf area after flowering, this allows the plant to keep performing photosynthesis and fill directly the panicle using the carbon assimilates from the photosynthesis instead of remobilizing the carbohydrates from the stem.

Strengthening the sorghum value chains in Western Africa

To strengthen the sorghum value chains, policymakers should foster capacity building of farmers regarding the choice of used varieties, the technical itinerary and knowledge packages that can harness the increase of sorghum productivity and good quality product in drought prone contexts.

In some West African countries, like Senegal and Burkina Faso, there is growing experience with the incorporation of sorghum floor in local bread making. There is a need to further train local food processing actors how to use sorghum-based products in bakery and patisserie. Encouraging results have been achieved and need to be strengthened and enlarged to other countries.

Private sector initiatives need to be involved in developing sorghum seed systems to provide quality seeds to the farmers and a market for sorghum products exportation (e.g. seeds for beer production and livestock feeding). This will increase the local demand and provide more opportunities to the sector. Moreover, initiatives aiming at processing the sorghum stem sweet juice into sugar or ethanol could play an important role in the future.

Based on Journal Article: "Terminal drought effect on sugar partitioning and metabolism is modulated by leaf stay-green and panicle size in the stem of sweet sorghum (Sorghum bicolor L. Moench)"

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