Sweet sorghum

Establishing the case for a potential biofuel feedstock

The rising cost of fossil fuels and the associated increase in greenhouse gas emissions has of late resulted in an increase in the adoption of biofuel crops as alternative renewable and sustainable energy sources. Some countries have not only made the blending of petrol with bio-ethanol mandatory but provide subsidies for using biofuels. Biofuels are not new to South Africa, which used bio-ethanol derived from sugarcane in petrol between the 1920s and 1960s before the policy was dropped due to low international crude oil prices. However, of late, there has been worldwide growth in the bio-energy industry due to calls for environmentally-friendly energy sources to reduce global warming.

In this regard, in 2007 the South African government drew up the Biofuels Industry Strategy, which sought to focus initially on a short-term five-year pilot programme to achieve a 2% penetration of biofuels into the national liquid fuel supply. The strategy targeted production of biofuel feedstocks in the former homelands where 14% of arable land is under-utilized. Recently, the Department of Science and Technology's (DST) Bio-Economy Strategy identified agriculture as the industry which currently has the highest economic impact of the three sectors identified as crucial elements of the bio-economy. This strategy document emphasized that the emerging biofuels industry will rely heavily on the agricultural sector for low-cost, low-maintenance energy crops such as sweet-stem sorghum, sugar beet, triticale and some species of grass, cultivated exclusively for biofuel production. Use of these non-food feedstocks, particularly sweet sorghum, is of paramount importance as it prevents a potential food-biofuel conflict.

Sorghum characteristics

Sweet sorghum (Sorghum bicolor (L.) Moench) has become a very important crop due to its high potential for use as a biofuel feedstock. Sweet sorghum is a fast growing, tropical C4 crop with juicy stalks rich in sugars from which ethanol can be produced more cheaply than from starchy crops like maize. It has become a leading candidate crop for bioenergy purposes due to its versatility, yield potential and growth characteristics. The crop has lower agronomic requirements than other sugar crops such as cane or beet. For instance, it is well adapted for dryland production, has a short growing period, high water use efficiency and high biomass production. As a biofuel feedstock its advantages include superior quality of ethanol with less sulphur and high octane and lack of competition between biofuel and food purposes.

Sustainable production

The anticipated increase in production, particularly in the former homelands, may present several challenges. For instance, apart from small-scale farmers being sceptical about venturing into biofuel crop production, the possible effects of intensive biofuel crop production on soil resources are still poorly understood. This is particularly important since many soils in the former homelands are highly susceptible to soil degradation. Incidentally, gains made in terms of carbon sequestration may be offset by the negative impacts on the soil due to intensification of production and land use change. Uncertainty on possible effects of intensification of production also arises from lack of knowledge on sweet sorghum management and recent breeding history. This is primarily because its development is still far behind that of maize, sugarcane or sugar beet.

It is generally agreed that annual biofuel crops may deplete soil organic matter and nutrients, causing soil erosion and soil pollution through associated direct and indirect land use change. Intensifying biofuel crop production on marginal or idle soils will also intensify demands for sustainable production systems. Appropriate agronomic management practices that enhance crop productivity must therefore be established. To achieve this, the ARC is conducting research aimed at developing sweet sorghum cropping systems that improve soil quality, C sequestration and N cycling through enhanced nutrient management, crop rotation, tillage and residue management. Funded by the National Research Foundation, the project is being implemented at the University of Fort Hare research farm and at Cala near Queenstown in the Eastern Cape.

Opportunities for smallholder farmers

According to the DST, the emerging biofuels industry will rely profoundly on the agricultural sector for low-cost, low-maintenance energy crops such as sweet sorghum, cultivated exclusively for biofuel production. Targeting production in the former homelands presents smallholder farmers in these areas with an excellent opportunity to enter into the bio-economy. This will not only introduce them to new income streams (i.e. biofuel crop production) but improve their soils, since appropriate cropping systems that are environmentally and economically sustainable will be established for them.

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