Background

- With volatile oil prices, the future of biofuels made from plant materials is of growing interest across the globe.
- Environmental benefits are a key outcome in developing or expanding biofuel (1G/2G bioethanol, biogas) production with its potential to reduce greenhouse gas emissions.
- Biofuels are carbon neutral at large, releasing carbon dioxide (CO₂) recently absorbed from the atmosphere by the crops used to produce them.
- Currently the leading biofuel feedstocks are corn, sugar, and vegetable oils. Notwithstanding, the production of biofuels from these crops and concerns about the impact of rising commodity prices on the global food/feed system, policy makers are keen to explore other biofuel production resources that that does not compete directly with food/feed crops, such as sweet sorghum.

ICRISAT’s Capability

ICRISAT is well poised to significantly contribute to global efforts to increase biofuel production by co-designing, sharing and scaling the technology and know-how with private/public partners and smallholders dryland communities. Some outcomes include:

- Being a low-cost feedstock sweet sorghum is expected to be an important driver for global biofuels. Implementing technologies that increase aboveground biomass yields and optimize lignin concentration, has the potential to significantly increase bioethanol yields per ton of biomass harvested. This is expected to steadily reduce the economic cost and environmental impacts of biofuel production.
ICRISAT has conducted ‘Big Mill Tests’ in sugar mills and has obtained encouraging results i.e., sweet sorghum can complement molasses for meeting the ethanol blending targets of India.

ICRISAT developed superior sorghum multi-purpose cultivars with high potential for aboveground biomass yields, stalk nonstructural and structural carbohydrates, and starch content, all of which are sought after biofuel production metrics.

Available HBM sorghum materials yielded 288 litre ethanol per ton of dry biomass (i.e., 4000-6000 litre/ha), while SS produced up to 3500 vs. 7000 litre/ha per year under single vs. double cycles managements. This highlights sorghum’s competitiveness vis-à-vis paddy straw and other traditional biofuel feedstocks.

Pilot testing of high biomass sorghum in the Numaligarh, Assam, India (where a 2G biofuel plant is being developed), showed that it can supplement Bamboo as ethanol feedstock. Sweet sorghum can also be integrated in the existing sugarcane industry to fill-in the lean period of sugarcane crushing for year-round bio-fuel production.

ICRISAT successfully incubated Rusni Distilleries Pvt. Ltd., a private sector company in India, that used sweet sorghum stalks as its feedstock for bioethanol production in 2005-2012.

The Way Forward

While ICRISAT’s efforts have produced outstanding plant material with high brix, fiber yields and other qualities, more research and development work is needed to:

- continuously improve the adaptability, yields and quality of the products in new developed sorghum varieties and hybrids i.e., biofuel feedstocks
- to streamline and mainstream the bmr gene editing and fine-tune and test pyramided/gene-edited high biofuel-yielding sorghum materials to share with private/public partners
- increase the shelf life of sweet sorghum stalks and juice (currently it has to be crushed and converted into syrup within 24 hours)
- reduce the negative trade-off between higher brix vs higher grain yield in order to develop superior dual purpose biofuel sorghum ideotypes that are competitive for grain, without compromising biofuel yields.
- establish living labs as powerful ‘Learning Technology Transfer Ecosystems’, accounting for the entire biofuel value chains from ‘Farm to Gas Station”, with a particular focus on Asia and in Africa;
- scale up biofuel value chains while empowering stakeholders in drylands production environments and biofuels ecosystems.