Solution:

Adoption of Sweet Sorghum cultivars for sustainable commercial and household energy (bioethanol)

Submitter: (ICRISAT)

Solution Overview

ICRISAT in partnership with NARS and private partners has developed sweet sorghum cultivars CSV 52 SS and CSV 58 SS , for the sustainable production of bioethanol biofuel. Denatured bioethanol is an efficient, renewable alternative to fossil fuels for cooking and transport, reducing indoor air pollution, greenhouse gas emissions, and deforestation. The grain starch and stem sugars in sweet sorghums ensure high yield in the bioethanol bioconversion process, 19-30% cheaper than the use of molasses, outperforming sugarcane and maize, and avoiding competition with food value chains. The proposed technology mitigates climate change impacts, empowers women, drives economic growth in a scalable way, and is backed by the growing global market demand projected to reach over USD 120 billion by 2032.

Key Features & Benefits

- Bioethanol based cooking has several advantages like:
- Health: Reduces indoor air pollution, improving health outcomes.
- Climate: Reduces greenhouse gas emissions compared to biomass burning.
- Environment: Uses renewable resources, reducing reliance on fossil fuels and deforestation.
- o Social: Can empower women and reduce the time spent gathering firewood.
- o Economic: May offer increased employment opportunities in the bioethanol production and distribution chain
- • The bioethanol bioconversion involves pretreatment (hydrolysis/liquification-saccharification), fermentation, distillation, and dehydration. FirstGen (1G) bioethanol is already in the market, while 2G bioethanol though still in its infancy, promises further 20-30% reduction in production cost.
- A few companies like EcoLinks aim to replace traditional cookstoves with improved, cleaner options, often using bioethanol. They collaborate with local communities to enhance market access and productivity, improving living standards.
- ICRISAT, over the years, has developed several hybrids and open pollinated varieties of sweet sorghum with high Brix and high biomass.
- Recently released high ethanol yielding sweet sorghum varieties such as CSV 52 SS (Ethanol yield: 1729 L ha-1, Juice yield: 15000-16000 L ha-1, Brix content: 16-17%) and CSV 58 SS (Ethanol yield: 2000-2500 L ha-1, Juice yield: 15000-16000 L ha-1, Brix content: 16-17%) developed using ICRISAT bred material offer suitability for scaling.

Where It Works and Where It Can Work:

- Using sweet sorghum as renewable feedstock, bioethanol can be produced across the globe where sorghum is grown, including the dryland areas. In US ~ one-third of the grain sorghum crop is used for ethanol production. Being naturally drought tolerant, sorghum gives ethanol producers in water-stressed areas a smart choice to help farmers preserve regional resources.
- In India 10% of the bioethanol is blended with diesel and petrol for vehicular use. Depending upon the region, sweet sorghum hybrids/OPVs could be used for dual purpose – grain and stover for ethanol production.
- The high ethanol yielding sweet sorghum cultivars, CSV 52SS and CSV 58SS, have been released and notified in the year 2023 and 2024 respectively for cultivation in India and recommended for the states including Maharashtra, Telangana, Tamil Nadu, Punjab and Uttar Pradesh.
- ICRISAT's contribution would be making available seeds of high biomass producing and dual-purpose sweet sorghum.

- Evidence & Impact
- Bioethanol is a clean energy and hence contributes to climate change mitigation. The use of bioethanol as a household cooking fuel will greatly improve the livelihood and resilience of the targeted communities and will drastically reverse deforestation with significant environmental and biodiversity benefits. In addition, bioethanol offers the opportunity to build business models for household and commercial clean energy solutions. There are several bioethanol plants in the US and in Latin America.

According to Fortune Business Insights, the global bioethanol market size was valued at USD 75.96 billion in 2023. The market is projected to grow from USD 80.47 billion in 2024 to USD 121.93 billion by 2032, growing at a CAGR of 5.33% during the forecast period. North America dominated the global market with a share of 41.35% in 2023. https://www.fortunebusinessinsights.com/industry-reports/bioethanol-market-101076

Scalability & Adoption Support

By integrating environmental restoration with economic empowerment, bioethanol advances inclusive, sustainable development pathways that deliver climate, biodiversity, and resilient livelihood co-benefits at scale. In addition to public institutions, international institutions, and non-governmental entities, it is important to get private business onboard in order to scale out this initiative.

Partners & Contact Info

Key Contact:
Ephrem Habyarimana
Email: Ephrem.Habyarimana@icrisat.org