

Enhanced utilization of Sorghum – Exploring Domestic and International markets

Sorghum

Sorghum is one of the most important cereal crops of India, cultivated in about 8 million hectares annually. Sorghum provides highly nutritious food, feed and fodder and has great potential for industrial use as bio-ethanol for fuel. As principal crop of dryland, it is popular with farmers due to assured grains and fodder yields for low-input cultivation, under harsh weather, especially in drought.

In Tamil Nadu it is annually grown in 2.2 lakh hectares with an average productivity of 850 kg/ha. Crop improvement research at TNAU has resulted in release of five hybrids and 44 varieties in sorghum. Most farmers prefer sorghum as a fodder crop as both green fodder and stover are largely used as cattle feed. Among the hybrids K tall from Kovilpatti was very popular among the farmers of southern districts. Red sorghum is also grown in an area of 5000ha under irrigated conditions around usilampatti area of Madurai district and the produce is exclusively used for biscuit making.

Now-a-days, sorghum is becoming more popular as a health food, especially in urban areas. Sorghum grain has high fibre content, moderate digestibility and rich mineral content compared to other cereals such as rice and wheat. Hence, sorghum foods are recommended for diabetic and obese persons. Being free from gluten, sorghum is the ideal food for celiac patients. To create greater demand for millets, especially sorghum for foods, we are working through the INSIMP involving public-private partnership by creating value chains.

Alcohol yield from sorghum grain

Although maize is the most commonly used grain for alcohol production especially in USA, sorghum has several advantages over maize. Firstly, it has higher starch compared to maize (Lorenz and Kulp, 1991). Secondly, sorghum is grown in both *kharif* and *rabi* seasons and the *kharif* crop is mostly F₁ hybrids, which have good

fodder and grain yield. Lastly, out of 10-11 million tonnes of sorghum produced annually in India, about 2-3 million tones is wasted due to grain blackening following unseasonal rains. This grain is not suitable for human or animal consumption. Hence it is sold at a low price and thus gives low returns to the farmer. Thousands of marginal farmers will be benefited if such grains are used for alcohol production. A comparison between maize and sorghum grain qualities are provided below

Component	Content (%)	
	Sorghum	Maize
Starch	63 – 68	60 – 64
Moisture	9 – 13	8 – 11
Proteins	9 – 11	9 – 11
Fats and oils	1 - 1.5	3 – 5
Crude fiber	1.5 – 2	1.5 – 2
Ash	1 – 2	1 – 2
Other organics	8 – 12	7 – 9

Although there are few distilleries in India already using sorghum, their alcohol yields are low. Sorghum can potentially give good yield of alcohol of about 380 to 390 L absolute alcohol t⁻¹ of grain provided the process is optimized.

Seagram has been producing international quality alcoholic beverages for the Indian market since 1994. All the products are made from grain alcohol. The capacity of grain alcohol manufacture in the country is very low as many companies, although licensed to produce grain alcohol, are not actually producing it. This is primarily due to low yield of alcohol production. Seagram has established the R&D center in Pune with the primary objective of improving the yield of alcohol production using indigenous raw materials such as grain, enzymes, and yeast.

Major Exporting Countries of Grain sorghum

Country	Quantity in MT	Value in 000'US\$
USA	1103863	3,64,492
Argentina	268531	71,001
Areas, nes	18742	18,912
India	57883	15,124
Ukraine	47359	14,348
France	9798	8,429
Sudan	12007	5,192
Russian Federation	17471	4,109
Italy	6121	3,008
Romania	4553	1,785
Other countries	23938	6566
Total	1570266	512966

Exports From India - Grain Sorghum other than seed

Country	Quantity (in tonnes)	Value (Rs in crores)
Israel	52534	80.02
Kenya	30000	43.76
Italy	26250	39.45
Eritrea	24000	39.09
Taiwan	22743	35.44
Cameroon	15872	23.15
Togo	12500	19.88
Tanzania Rep	10002	15.84
Saudi Arab	5956	12.85
Senegal	6648	10.16
Other countries	37284	69.28
Total	243789	388.92

Source : <http://agriexchange.apeda.gov.in/>

Sweet sorghum

Sweet sorghum holds a great potential as a field crop for ethanol production throughout the world because it is adaptable to a wide range of growing conditions, unlike sugarcane which can only be grown in tropical and subtropical climates. Sweet sorghum is also called as sugarcane of temperate zone and its production capacity is equal or superior to sugarcane in the tropics when considered on a monthly basis. Unlike sugarcane, sweet sorghum has a wide range of growing conditions and requires low unit costs due to less consumption of water and fertilizer (Singh, 1994). Since sweet sorghum is a short duration crop with less water requirement compared to sugarcane with higher sugar related quality characters, there is a scope for the introduction of sweet sorghum in Tamil Nadu. Sweet sorghum produces a very high yield in terms of grains, sugar, lignocellulosic biomass.

Work done at TNAU

Research work on sweet sorghum was initiated in Tamil Nadu Agricultural University during 1983 and the available sorghum germplasm were screened for brix value and also for ethanol purity. Among the 100 genotypes screened, cultures MS 7789, IS 18530 and MS 8301 were found to have high brix (19.1) and high juice extractability (56.21%). Later on, Department of Millets, Coimbatore and Agricultural Research Station, Virinjipuram served as AICSIP centres for evaluating the sweet sorghum genotypes developed by different AICSIP centres for their yield potential and quality parameters. The Agricultural Research Station at Virinjipuram has become successful in identifying two TNAU high yielding short duration sweet sorghum cultures VMS 98002 and VMS 98003 with green cane yield of 35-40 tons/ha and grain of 25 to 30 quintal/ha and were found to be suitable for *kharif* and *summer* seasons and promoted to ART.

In addition a total of 132 sweet sorghum hybrids was synthesized and evaluated during 2005 and through preliminary evaluation, five promising high yielding hybrids

viz., BJ 3A x RSSV 9, AKMS 22A x SSV 84, AKMS 14A x RSSV 9, AKMS 14A x VMS 98003 and AKMS 22A x VMS 98002 were identified.

Sweet sorghum demonstration cum seed production plots have been organized in TNAU at twelve research stations and seven sugar mills (Sakthi Sugar, Bannari amman, Dharani Sugar, Rajashree sugar, Amaravathi coop.sugar mills, Kotari sugar mills and EID parry) with variety SSV 84. TNAU had produced a quantity of 7400 kg of SSV 84 truthful seeds during *Rabi* 2004. However as there was no indent from the sugar factories and distilleries, no supply was made during 2005.

Field experiment was undertaken at Tamil Nadu Agricultural University, Coimbatore from June to November, 2005 in sweet sorghum crop to identify optimum sowing time under different dates of sowing. There are 4 dates of sowings at fortnightly interval from June to July 2005. date viz., June 8th, 2005, June 23rd, 2005, July 8th, 2005, July 23rd, 2005. The dates of sowing had significant influence on millable cane yield, extractable juice percentage and juice yield of sweet sorghum. The highest millable cane yield of 37.17 t ha⁻¹ was recorded under June 8th sowing and it was superior to all the other dates of sowing. Similarly, June 8th sowing gave the highest percentage of extractable juice (41.2) and it was at par with June 23rd sowing treatment. The lowest value of 30.6 per cent was observed in July 23rd sowing treatment. Among the four dates of sowing June 8th sowing recorded significantly higher juice yield of 15.37 l ha⁻¹ when compared to the rest of the treatments.

Value addition: Alternative uses of sweet sorghum

Productivity and profitability are essential issues for keeping sweet sorghum crop competitive. Alternate use may create market demand for raw material and make sweet sorghum production remunerative.

One can utilize sweet stalk sorghum (SSV 84) and number of other high yielding strains, varieties and hybrids under advance testing for making jaggery, syrup and even ethanol from three roller crusher and management practices for sweet sorghum can be formulated under rainfed condition where growing of sugarcane is not economical.

Character	Sweet stalk varieties		
	SSV 84	RSSV 16	NSS 104
Green cane yield (t/ha)	36.0	38.0	41.0
Grain yield (q/ha)	23	23	20
Juice brix	8	19	20
Jaggery yield (q/ha)	30	31	33
Ethanol yield	1851	1948	2101

Ethanol

The desirable characteristics of sweet sorghum varieties for ethanol production are; (1) production of a high biomass yield (2) high percentage of fermentable sugars along with combustible organics (3) comparatively short growth period (4) tolerance to drought stress (5) relatively low fertilizer requirements (6) production of grain for food or feed use and (7) the possibility of complete mechanization.