

Millets should be used as food and not for fuel

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Introduction

Recently, the United Nations has declared 2023 as the [“International year of millets”](#). This was done on the recommendations from the Indian government in the year 2019. Shri. Modi ji, our Prime Minister has been instrumental in raising awareness regarding this important category of crops.

[Millets](#) are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for human food and as fodder for animals. The main cereals classified as millets are *jowar, bajra, ragi, sanwa, cheena, kodo, kutki and kuttu*. They are relatively easy to grow, are resistant to climatic stress, pests and diseases and do not require a lot of resources like water and fertile land. Their main health benefit is that they are gluten-free. Millets can be a long-term source of income for farmers due to the low investment required to grow them. They are also highly tolerant to drought and other extreme weather conditions and have a nutrient content similar to that of other cereals.

India is the largest producer of millets in the world accounting for about [40% of world production](#). In India, bajra (pearl millet) accounts for 60% of total production followed by jowar (Sorghum) which is about 27%.

Before green revolution, millets made up around 40% of all cultivated grains in India. However, since then the production of rice has doubled, and wheat production has tripled. Consequently, the use of millets has reduced

substantially. The production of millets in India [have stagnated in the last 60 years showing the trend of reducing consumption](#). Hopefully with the new push by the Government of India (GOI) this trend can be reversed, and we should be able to see more people consuming millets as food.

However, with the recent policy by GOI to also allow production of ethanol from grain, it is imperative that these important crops should not be used for producing ethanol for vehicles.

NARI's work on sweet sorghum (SS)

Nimbkar Agricultural Research Institute ([NARI](#)) has been working on [sweet sorghum \(one type of millet\) for the last 50 years](#). This article gives in a nutshell our contribution in this field.

Sweet sorghum (SS) is a class of sorghum which is characterized by high sugars in its stem-just like sugarcane. It produces grain from the earhead, sweet juice from its stem and bagasse is an excellent fodder. Bagasse can also be converted to paper. SS is an arid region crop, uses much less water than sugarcane and can be harvested in 4 months so two crops/yr. can be grown on the same piece of land.

[Sweet sorghum \(SS\) crop was introduced into India in late 1968](#) when Mr. B. V. Nimbkar, the then president of the NARI, visited the experiment station of the University of Georgia, USA. He got from there the seeds of sweet sorghum cultivars Brawley, Collier, Rex, Rio, and Tracey. These were all high sugar containing varieties. In the early 1970s trials were conducted at NARI farms regarding their performance and 'Rio' performed best with stalk yield of 32.4 T ha⁻¹ and sucrose percentage of 10.6. However the American varieties produced low yields of poor-quality grain for human consumption.

So, in the early 1970s the scientists at NARI crossed the American lines like 'Rio' with local Indian fodder/grain varieties like 'Maldandi' to produce new sweet sorghum varieties which had a juicy stalk and good quality grain. This resulted in the development of our pioneering variety [Madhura sweet sorghum \(SS\)](#).

Our initial work on sweet sorghum was mainly focused on using this as a complimentary raw material for sugar production during sugarcane off-season. However, the efforts for producing sugar were not successful because of high starch and aconitic acid content in SS juice which did not allow the crystallization of sugars. So, we started looking for alternative uses of this high sugar containing crop.

Ethanol from sweet sorghum

Thus, in the early 1980s NARI started working on producing ethanol from sweet sorghum. The impetus for this development came from the desire to use ethanol (a renewable fuel) to replace kerosene as a cooking and lighting fuel for rural households. Kerosene was imported from Russia in 1970s and 80s and was used in very inefficient stoves and lanterns in rural areas. Thus, the desire to use [clean burning fuel for household purposes](#) led to our work on ethanol from sweet sorghum.

Around 80% of total energy consumption in producing ethanol is in distillation. This energy is mostly supplied by fossil fuels. To make ethanol production as sustainable as possible, we set up [world's first pilot plant for solar distillation of ethanol from sweet sorghum](#). This pioneering effort was highlighted in 1990s by being mentioned in [Rolex Award book](#) and [US National Academy of Sciences publication \(chapter 11\)](#).

Besides this, a major program of fermentation was also set up. Thus, by the early 1990s NARI had set up the largest, sweet sorghum R&D program in the world which included breeding of sweet sorghum; its fermentation and distillation; and development of devices running on ethanol for cooking and lighting. These developments in early 1990s resulted in NARI becoming the only Indian Institute to be invited to become a part of European Economic Commission's consortium on sweet sorghum and allowed our Madhura hybrid to be planted and tested in about half a dozen countries around the world.

We were also the first organization in the world to [promote the use of ethanol as cooking and lighting fuel in rural households](#). This effort spawned similar efforts world over. However due to the draconian excise laws which exist in India (they do not allow household use of ethanol for cooking and lighting) this program could not take off. Finally, it was decided to opt for syrup production from sweet sorghum. Nevertheless our ethanol based cooking and lighting development got us a [major International award in Stockholm in 2009](#).

Nevertheless, NARI in the early 1990s also helped start India's first distillery (10,000 liters/day capacity) in Mysore area of Karnataka for producing ethanol from sweet sorghum. The basic legwork was done, and large-scale Madhura sweet sorghum was planted in the area, but the cost of ethanol did not justify its setting up, so the plans were dropped. In the early 1990s there was no national program of ethanol and so its price was very low. We were about 30 years ahead in time!

Similarly in late 1990s we also helped Tata Chemicals and other sugar factories to set up sweet sorghum ethanol plants, but the costing of ethanol made it economically unfeasible.

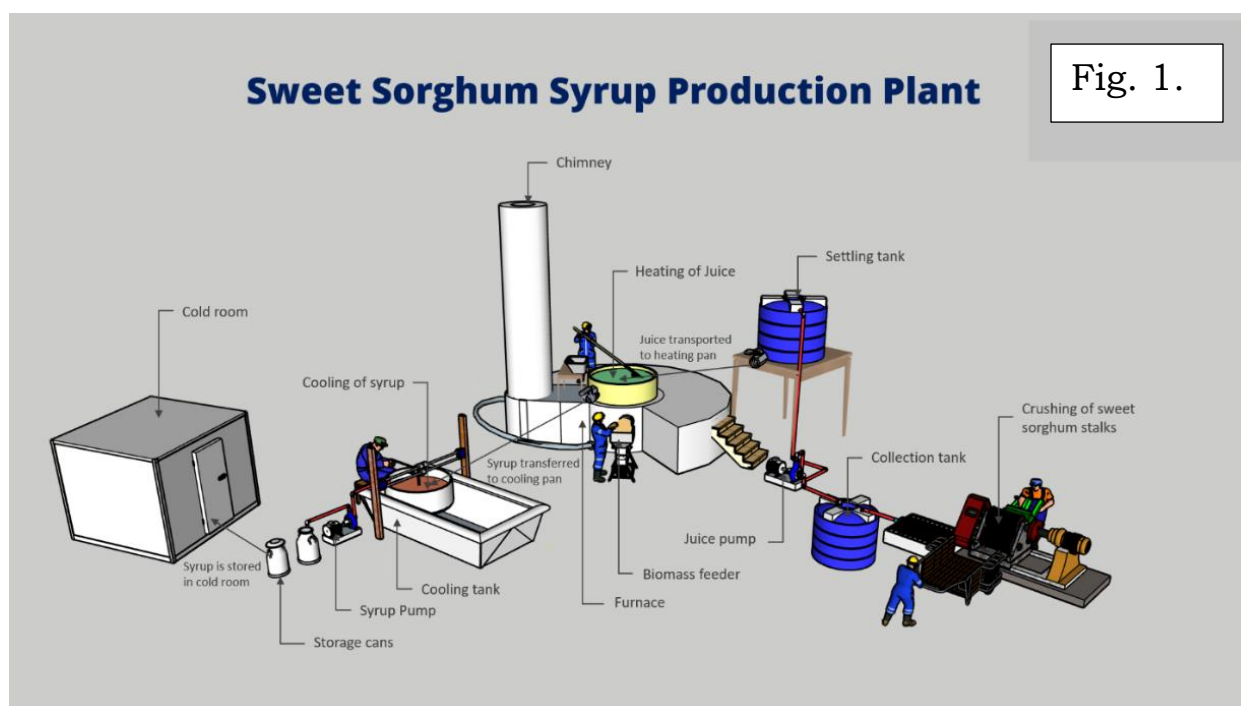
Simultaneously we continued the work on developing the technology of producing jaggery and syrup from sweet sorghum. For both these things

stripping green leaves from the stalk was essential. This tedious and labor-intensive process of stripping leaves was identified as the major bottleneck to commercialization of sweet sorghum jaggery and syrup. Even today this is one of the costliest part of SS syrup processing.

We also developed a completely automated multifuel [gasification system producing thermal output between 120-500 kW for](#) producing jaggery and syrup. The fuel used was sweet sorghum bagasse, sugarcane leaves and other loose leafy biomass residues. The aim was to increase the income of the farmers by a total utilization of all components of the sorghum plant.

Syrup from sweet sorghum

Since our Madhura sweet sorghum varieties have very high [brix](#) in the juice (16-21 - similar to that in sugarcane) it was felt that it can produce [excellent syrup](#). Thus, a semi-automatic syrup making plant was set up at our Institute (Fig. 1). This plant produces 50-70 kg of table variety syrup per batch (8-hour duration) of 74-76 brix (pictured).





NARI has sold about 7 tons of this syrup in the last 5 years to nutraceutical and food industries. We are presently the only organization in India producing this syrup and hope the demand will increase in the coming years.

The syrup has excellent keeping quality and [food properties like high antioxidant and pigment levels](#). It also contains protein, vitamins like B1, B2 and B9 and essential minerals like calcium, iron, potassium, and zinc and compares very favorably with honey. Presently the food industry is using it to replace sugar and honey.

Being a multipurpose crop even if sweet sorghum is grown for producing ethanol or syrup, farmers will still get grain for food purposes and the leaves and bagasse as a fodder for their cattle or as a soil amendment. Therefore, the food vs. fuel dilemma could be minimized.

Sweet sorghum for food and not for fuel

Government of India has embarked on a very aggressive and a major program of ethanol blending with petrol for reducing the petrol import bill and pollution associated with vehicles. India imports around [85-90 percent of its petroleum products which costs ~ 1 lakh crore rupees/yr.](#) Most of it is for the transportation sector which accounts for approximately 20% of total energy needs of India.

[Ethanol has about 60% of the energy of petrol](#) so its blending with petrol reduces the energy and performance of the engine. This also reduces the mileage of automobiles. Besides it is being used in the existing engines which

are not made for [flexi fuels](#). This reduces the life of the engine and ruins it, besides creating problems with the fuel supply piping of the automobile.

Also 20% blend of ethanol will not make a dent in the pollution since maximum air pollution is caused from diesel vehicles and other sources like stubble burning and construction industry.

So, on both counts of reducing the oil import bill and reducing pollution the choice of [ethanol blending is a wrong choice](#). It is dictated more by crony capitalism and helping the sugar lobby rather than helping the country. Besides the use of water intensive crops like sugarcane will further increase, thereby creating more water woes. This is also forcing millets, which should go into the food chain, to be diverted for fuel production.

For the growing population of the country, we should use our lands judiciously for producing food rather than fuel for cars. Besides, large amounts of arable land will be required to produce bio-crops leading to problems such as soil erosion, deforestation, fertilizer run-off and salinity.

[Automobile is a 2% efficient machine](#) in terms of energy for transporting a body through a certain distance with a certain speed. To use an extremely important chemical like ethanol for this inefficient machine is very unproductive. For mobility a better answer is [electric vehicles running on renewable electricity](#). That will reduce pollution and will also help the import bill.

However, ethanol should be used in chemical industries. It is already used for cosmetics and beauty products; in pharmaceutical preparations; as food additive; in alcoholic drinks, etc. Besides it could replace fossil fuels for all our plastics and other chemical industries.

Conclusions

Both history and dietary patterns reveal that millets are the oldest food crops known to humans and have been cultivated for thousands of years. Different millet varieties play a significant role in traditional diet of many states of India. Worldwide sorghum is the fifth highest produced grain crop and fourth in India. Nutritionally it is better than rice as it contains β -carotene, folic acid, fiber, thiamine, and riboflavin. Sorghum grain is also rich in condensed tannins, flavonoids, and phenolic acids.

Therefore, sweet sorghum which will provide such nutritious grain and highly nutritious syrup should be the crop of the future for human food and not for fuel.

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