

High yielding and hardy, those in the ethanol industry are taking note of sweet sorghum's significance as a potential biofuel. With hybrid varieties further increasing yield, is sorghum 'an important piece' in the sustainable energy puzzle? Charlotte Niemiec writes

Sweet sorghum – a variety of grain sorghum, a large plant that grows over six metres in height – has been grown primarily for its syrup since the 1850s. It contains a larger amount of sugar than grain sorghum and, while its food use is limited, it can be used as a syrup for pancakes or to provide a sweet flavouring in cough medicines.

These uses are slowly being displaced by artificial sweeteners or sugar itself, leaving little space on the market for sorghum. Currently, less than one million gallons/year are produced in the USA. While Africa is the world leader in grain sorghum production, both varieties can be grown in southern Asia and the USA. The USA's syrup-producing sweet sorghum crop is grown mainly in Colorado, Kansas, Oklahoma, South Dakota and Texas, as the plant is drought resistant and therefore thrives in hot, dry conditions. Its stalks are crushed in a similar way to sugarcane, unlike grain sorghum, where it is the seeds that are harvested.

These advantages make the plant a valuable one in the food versus fuel debate. The high sugar content of the stalks is of particular interest to the ethanol industry, as they yield the same amount of ethanol/bushel as corn. With increasing advances in genomics (see *OFI, January 2013, p29*), which could further improve sorghum's yield, sweet sorghum may replace jatropha as the biofuel of the future.

Biofuel is produced by squeezing the juice of the plant and then fermenting it into ethanol. Dr Bellmer of Oklahoma State University explains that sweet sorghum yields 3,888 litres/ha of liquid sugar and 3,516 litres/ha of biomass (see *Table 1, below*). The plant also has relatively low input requirements and a very positive energy balance. Not only can sorghum be used as a low cost seasonal feedstock in existing ethanol plants, but it can also be used as a complementary feedstock during sugarcane processing for the four to five months when harvestable cane is not available, using various processing options (see *Table 2, opposite page*). It provides high carbohydrate production in diverse climates (including temperate regions) and can compete in both the sugar and cellulose arenas. "The question", Bellmer says of



Sweet sorghum's biofuels potential

sweet sorghum's potential, "is not 'if?' but 'how?'"

In the midst of European concerns over indirect land use change (ILUC) and global doubts on whether biofuels are sustainable, attention is turning to feedstocks that do not have an edible use, such as jatropha. With a limited food use, sweet sorghum may begin to play a larger part in biofuel production than it has to date. New EU proposals call for biofuels to be produced from waste rather than food crops and the drought last summer in the USA sparked calls for the renewable fuels standard (RFS) mandate to be waived. In the unpredictable climates of weather and science – and with a growing world population – it is more important than ever to source renewable energy from renewable sources that does not impact on food rations.

Dr Bellmer emphasises the potential of genetically improving sorghum, and it is this that may be the key to success with sorghum. Yield increases from genetic improvement have been well documented in other crops, with corn yields rising from 1,200kg/ha to more than 10,000kg/ha from 1935-2009. If sweet sorghum yields follow a similar trajectory, significant increases are expected.

Ukraine profits from sorghum

In the Ukraine, interest in both grain and sweet sorghum has been steadily growing. A poll conducted by APK-Inform Agency shows the cost of sorghum production in the country last year varied between 1,500 UAH/ha (US\$187) and 3,200 UAH/ha (US\$395), with the average cost esti-

mated at 2,320 UAH/ha (US\$286).

The profitability index was also high; the poll demonstrated that 50% of Ukrainian producers gained 10-30% profit. In the last five years, the average sorghum yield in the country totalled 2.1 tonnes/ha which, according to APK-Inform, exceeds the indices of other domestic niche grains such as buckwheat, millet, peas, oats and rye.

Exploiting sorghum's potential

Sweet sorghum is quickly gathering media interest. News report on sweet and grain sorghum appear more and more frequently, suggesting that players in the biofuel industry are awakening to its full potential.

One step forward came in December last year, when the US Environmental Protection Agency (EPA) announced its approval of grain sorghum ethanol as a renewable fuel under the RFS. The EPA concluded that ethanol produced from sorghum achieved enough greenhouse gas (GHG) emissions savings to count toward federal biofuel mandates.

The National Farmers Union (NFU) applauded the decision. NFU president, Roger Johnson, stated: "NFU is very pleased with EPA's decision to count grain sorghum as an eligible feedstock, which opens the possibility of it being counted as an advanced biofuel. This revision was based on sound science subject to public review and we fully support efforts to increase our nation's energy independence through the increased production of renewable fuels."

He added: "The RFS mandates the production

TABLE 1: COMPOSITION OF SWEET SORGHUM

Parameter	Quantity
Fermentable sugars	13.0%
Fibre	15.0%
Water	68.0%
Dissolved non-sugars	3.5%
Ash	0.5%
pH	6.8%

Source: www.ethanolproducer.com



SWEET SORGHUM IS A VARIETY OF GRAIN SORGHUM AND THRIVES IN HOT, DRY CLIMATES, MAKING IT A VALUABLE POTENTIAL FEEDSTOCK FOR BIOFUELS PRODUCTION

up to 60 days. The hybrid varieties can be grown on fallow sugarcane land and processed using the same equipment, and they require less water than sugarcane. In its agricultural plan for 2012 to 2013, Brazil has announced it considers sweet sorghum a strategic crop.

The *BiofuelsDigest* report explains that last season, Brazilian mills planted Ceres sweet sorghum on more than 3,000ha (7,400 acres) of land and the company completed the registration process in Brazil for its new generation of sweet sorghum hybrids. The results were successful: the trials demonstrated large increases in biomass, extractable juice volume and total harvestable sugar compared to commercial products introduced just last year. These hybrids averaged 80+tonnes/ha.

But all is not sunny, as the roll-out of Ceres' new hybrids is slower than expected. Michael Cox at Piper Jaffray – a leading investment bank and asset management firm – explains: “Due to the drought conditions in Brazil during the last growing season, field trial yields for Ceres sweet sorghum hybrids were down, resulting in a slower adoption of the seed technology in the upcoming FY13 planting season...we are shifting our model out by a year and lowering our price target. Despite the expectation of lower planted hectares in FY13, we believe the likely increase in ethanol blending in Brazil next year will increase demand for sweet sorghum and ramp product adoption.”

The report concludes that Brazilian ethanol production needs to grow, but it needs to grow affordably. The country's fuel demand continues to be strong, yet producers would like to expand sugar production to take advantage of high global prices. Sweet sorghum remains at the epicentre of the Brazilian ethanol expansion story – even if its timeline of adoption looks slower in the mid-term as Brazil recovers from drought.

For the biofuels industry, sweet sorghum offers compelling options – if the hybrids work economically and the adoption is there. ●

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of 36bn gallons of renewable fuels by 2022 from conventional as well as advanced biofuels. Thanks to EPA's announcement, grain sorghum now has the potential to serve as an even more important piece in the nation's energy security puzzle.”

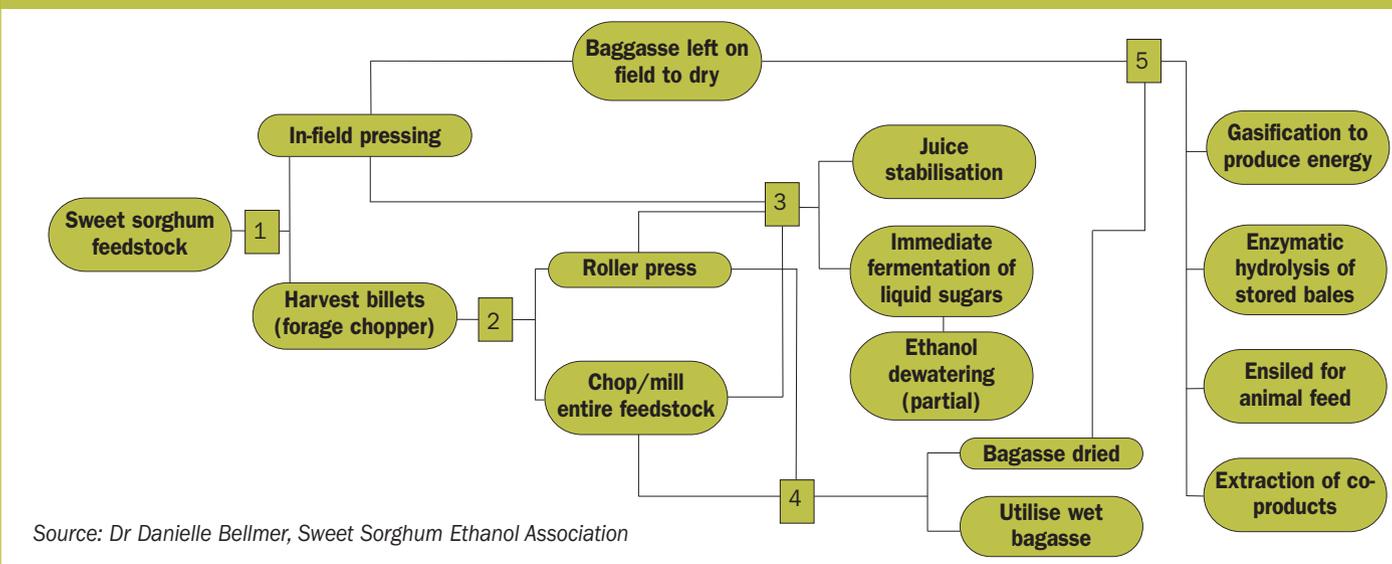
Supporting hybrid sorghum varieties

A recent deal between energy crop company Ceres Inc and Syngenta will stimulate sorghum adoption, *BiofuelsDigest* reported in November.

The companies intend to work together to support the introduction of sweet sorghum as a source of fermentable sugars at Brazil's 400 or more ethanol mills. Syngenta will contribute its agronomy resources to evaluate its portfolio of crop protection products alongside Ceres hybrids, while Ceres will provide both seed and research support.

There are also high hopes for planting sweet sorghum in Brazil. It is hoped that, once the hybrids have proven themselves in local trials, the crop will extend the ethanol production season by

TABLE 2: SWEET SORGHUM PROCESSING OPTIONS



Source: Dr Danielle Bellmer, Sweet Sorghum Ethanol Association