

Agro-industrial companies **DEMAND** **STAR-RATED SORGHUM**



Sorghum, A CROP FOR OUR TIMES

Sorghum, a rustic, robust cereal whose shoulders are broad enough to enable it to resist predators of all shapes and sizes, economical, with low nutrient requirements and, above all, generous. The ideal crop for our times, which satisfies both agricultural and environmental requirements. For all of these reasons, European selectors have created new, even more resistant, low consumption, generous and economical varieties. These are varieties whose yields have been steadily increasing over the last 30 years, and which fully deserve their star ratings.

SORGHUM HAS ALWAYS BEEN A CEREAL FOR THE FUTURE

Of all the major cereal crops, sorghum is the one with the greatest development potential. A basic foodstuff for centuries in Africa and Asia, sorghum, already acclaimed in the USA, is now winning over European farmers on the lookout for high production, profitable, durable crops. And sorghum also has a valid claim to be an ecologically virtuous plant.

It doesn't need a lot of water.

With its CO₂ absorption mechanism which gives it excellent photosynthesis properties, even in dry conditions, and its deep, dense root system capable of extracting water and the nutrients in the soil in the most efficient manner.

Undemanding in its nutrient requirements, it's capable of effectively extracting natural fertilisers from the soil and therefore needs few additional fertilisers. It's also relatively invulnerable to disease and pests, and therefore needs only limited plant health treatments. And the cherry on the cake is that it can easily be incorporated into existing crop rotations and plays an anti-parasite role by interrupting the cycle of weed, disease and pest attacks.

SORGHUM HAS MORE THAN ONE STRING TO ITS BOW.

For you as agro-industrial operators, sorghum is interesting for a number of reasons. Not only does it offer various market opportunities (as a human and animal foodstuff, a source of bio-energy, biomaterials, etc.), but it can also satisfy different types of demand at the same time. A single crop of sorghum provides grain for use as a human food source, while the soluble sugars extracted from the stem juices can be used in ethanol production, and the stem residues (pulp) and leaves are suitable as an animal feed or for energy production (co-generation or 2nd generation biofuel).



WITH SORGHUM, NOTHING GOES TO WASTE AND EVERYTHING CAN BE TRANSFORMED.

THE GRAIN

Sorghum grain can be used to produce foods for humans and animals, as well as the 1st generation biofuels obtained from the conversion of starch.

THE LEAVES

It can be consumed by livestock as silo or to produce energy from co-generation and 2nd generation biofuels.

THE STEM

Soluble sugars can be extracted from the stem from which 1st generation biofuels can be produced by direct fermentation. The residues from the stem (pulp) can be consumed as forage by livestock, or to produce energy from co-generation (simultaneous heat and electricity production) and 2nd generation biofuels or for transformation into paper or fertilisers.

THE WHOLE PLANT

The whole sorghum plant can be used to manufacture organic fertilisers and generate methane.



Demand star-rated sorghum. Productive, profitable and durable.

Our warmest thanks to the European selectors who have been producing high quality sorghum with steadily increasing yields for thirty years.

Why?

Because this star-rated sorghum has the dual advantage of meeting all the industrial requirements of livestock feed and high productivity. This persuades farmers to grow it and makes for secure supplies.

+1% per year* since 1990. That's the increase in yield generated by the precocious and semi-precocious European genetic hybrid.

*French example
Source: Arvalis 2015



THE AREAS ARE DEVELOPING TO GUARANTEE SUPPLIES.

In 2020, the areas planted with sorghum in European territory increased significantly for the 3rd consecutive year.

In the EU, the average growth by comparison with the previous year was 18% in 2020. The figure for 2019 was +10%. This upward trend can also be observed in East European countries (Russia, Ukraine).

This is proof of the growing interest of growers in this crop, whose resilience in adverse weather conditions is one of its greatest assets. This is confirmed by the sorghum grain yields for 2020, with an average production output of 5.62 tonnes per hectare.

This trend should continue, as sorghum is in receipt of EU funding - among other contributions - for its promotion throughout Europe.

The project is driven by the Sorghum ID joint trade organisation. The success of the 2nd European congress held in Milan in 2018 confirmed the interest of the growers and industrial operators in this cereal.

“ Sorghum accounts for 5% to 10% of the areas planted, depending on the year.

It's an economical and eco-friendly crop which could be extremely successful.

Hervé Clamens, a grower in France.
To find out more, go to www.sorghum-id.com

A CROP WHICH IS GROWING, AND GROWING, AND GROWING...

More and more European farmers are growing sorghum. This is a crop which enables them to diversify and at the same time provide an agricultural response to global warming (we shouldn't forget that 85% of agricultural land receives no irrigation!). Another convincing argument is that, with star-rated genetic sorghum, yields are increasing.

On the way to success!





SORGHUM.

A BIG FAMILY IN WHICH EACH MEMBER HAS A STRONG PERSONALITY.

Different varieties of sorghum are grown, each with its own specific morphological properties and uses. Several of these are of interest to agro-industrial operators.



SORGHUM GRAIN

This is a reduced size sorghum selected for grain production.



The varieties of this type have high potential yields and excellent resistance to the diseases responsible for crop lodging.



They're mainly used as poultry and (monogastric) pig feed, but they're also suitable as a human food source. These varieties are also

exploited in the biofuel industry (ethanol).



SWEET SORGHUM

As the name implies, this is a variety which builds up high sugar concentrations in the stems. The sweet juices extracted from the stems can be used to produce a syrup for food uses, or, after undergoing a fermentation process,



1st generation ethanol. Livestock farmers use it as silage, but its high energy biomass can also be used in methane conversion to produce 2nd generation biofuels.



SORGHUM AS SILAGE

This is a good sized monocropped sorghum variety used as forage.



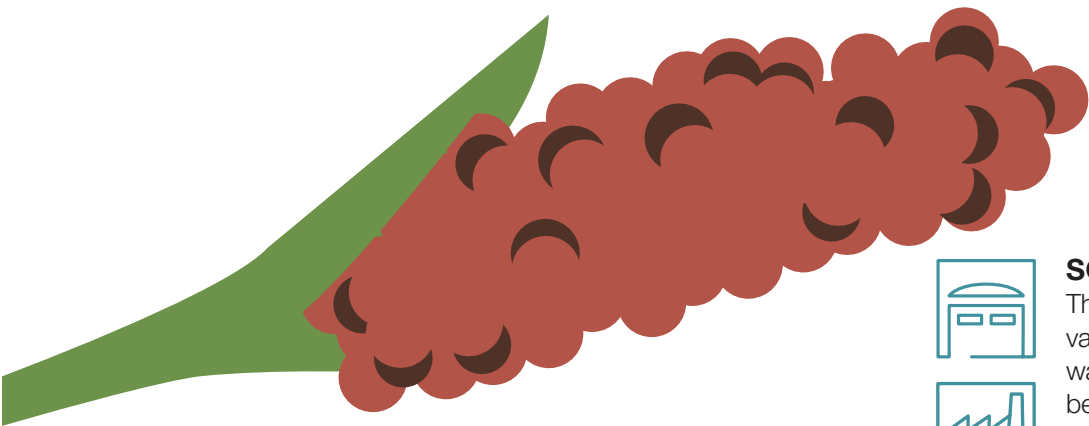
The whole plant is harvested. It's valued for its ability to produce large volumes of biomass. As well as being used for silage, it also has

promising potential in methane production.



SORGHUM BIOMASSE

This is a large sorghum variety which produces large volumes of fibre-rich biomass. It can be used in methane conversion units and as a precious raw material in several industrial biomaterial production processes.



GOOD TO KNOW

Forage varieties of sorghum are also used as silage, pasturage and as a source of green feed.



SORGHUM FOR DYES

This is a dual colour sorghum variety. In Africa, where sorghum was first cultivated, it's always been used to dye leather, objects made from gourds, fabrics, baskets and other articles. The colouring substance is extracted from the leaf



sheaths of the plant. The development potential is huge: cosmetics, textiles, the agri-food industry, and many others.

Sorghum, a raw material **FOR OUR TIMES**

The consumers of today are on the lookout for healthy, perfectly traceable local produce grown in an environmentally friendly way. They're concerned about global warming and prefer green energy and sustainable raw materials.

Sorghum is one of those virtuous cereals in which the bio-industry operators can place full confidence.

“ *Sorghum - high biomass yield.*

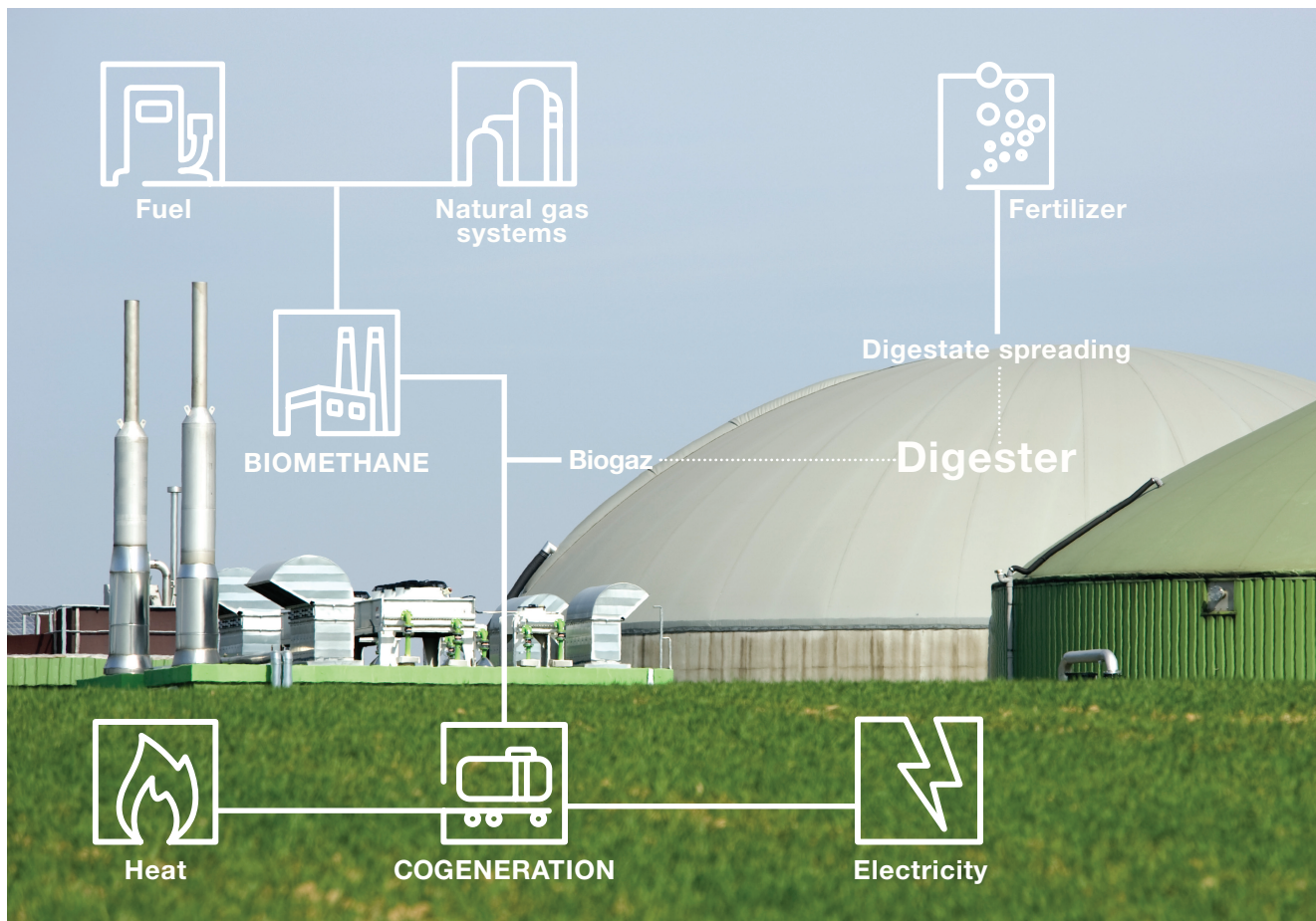
SORGHUM CAN BE SERIOUSLY USEFUL IN METHANE PRODUCTION

With its genetic diversity and careful European selection, there are various high biomass yield varieties of sorghum, including forage, sweet and biomass sorghum. In addition, the growing of sorghum for methane production doesn't compete with its cultivation as a food crop. Biomass sorghum is in fact one of the intermediate biofuel producing crops which can serve a dual purpose when the land so permits.

Other arguments in favour of sorghum-based methane production?

- 1.** In a situation of global warming, renewable energy sources are essential, as they're able to take over a part of the role played by fossil fuels with high greenhouse gas emissions.
- 2.** The European authorities sustain the development of renewable energy, which means guaranteed long term profitability for methane conversion plants already in operation or in the installation process.
- 3.** Apart from its good energy ratio, methanisation has the advantages of short circuit production and offers a response to important social expectations.
- 4.** New perspectives for the exploitation of this renewable energy source are currently being studied, including third generation production and methane for fuel uses.





Methane conversion technology is based on the breakdown of organic matter by microorganisms in controlled anaerobic environments. This breakdown leads to the production of:

Biogas. This is a gaseous mixture saturated in water at the digester outlet, whose composition mainly consists of methane CH₄ (50%-70%) and carbon dioxide (20%-50%). Biogas has a NCV (net calorific value) of 5 to 7 kWh/Nm³. This renewable energy can be exploited in two main forms - as combustion for electricity and heat production, and for fuel production by injection into the gas supply network following purification.

Digestate. This is a humid by-product rich in particularly stable organic matter. It is used most frequently as a fertiliser, as well as in agricultural exploitation and biogas installations.



Demand star-rated sorghum. This is a carefully selected product.

THE 8 PILLARS OF EUROPEAN SELECTION

1
Yield and stability

2
Early ripening, tolerant of low temperatures during early growth and flowering

3
Tolerant of drought conditions

4
Lodging resistant, with stay green properties

5
Resistant to disease

6
Resistant to pests

7
Grain quality: virtually zero tannins, good colour and brilliance, high protein content and healthy properties

8
Forage quality: easy to digest, a useful food source, good basal metabolic rate, high sugar content

SORGHUM CAN BE SERIOUSLY USEFUL FOR BIOFUELS

Green fuel production is continuing to increase throughout the world, driven by growing demand for alternative non-carbon energy sources. This is where biofuels come into their own, due to the many years of experience in their production, dynamic research processes and leading operators based in a number of countries.

Sorghum has very high energy yields.

THE BENEFITS OF SORGHUM

1. With its genetic diversity and following the European selection processes, there are several varieties of sorghum with high biomass potential and/or a composition suitable for a number of bioenergy strategies, such as starch conversion, the use of the soluble sugars from the stem and the use of lignocellulosic biomass.
2. Sorghum has very high energy yields, comparable to those of maize, for example.
3. The sorghum varieties used for 1st generation ethanol production also yield a number of by-products with interesting potential when used in their various forms.
4. Sorghum is probably the crop for which the genetic advantages for bio-energy production can be most rapidly achieved.





TYPE OF SORGHUM CULTIVATED	SORGHUM GRAIN	SWEET SORGHUM	SORGHUM BIOMASS
PLANT ORGANS EXPLOITED FOR BIOFUELS	GRAINS	STEMS	
RAW MATERIAL EXTRACTED	Starch (1)	Soluble sugars (2)	Lignocellulose (3)
TYPES OF FUELS PRODUCTS	1 st generation biofuel (ethanol)		2 nd generation biofuels
BY-PRODUCTS	Pulp (stem residues)		Starch extracted from the grains
OUTLETS FOR BY-PRODUCTS	Livestock feed Cogeneration (heat + electricity) 2 nd generation biofuels (3)		Ethanol



EXTRACT OF RAW MATERIAL
STARCH (1)

Sorghum can be used to produce biofuel from the starch contained in the grains, through a process of conversion. In the USA, where most bio-ethanol production is based on conversion, sorghum is the second source of bio-ethanol. The vegetative growth and residues from ethanol production are used as animal feed or for cogeneration (when electricity and heat are produced at the same time).



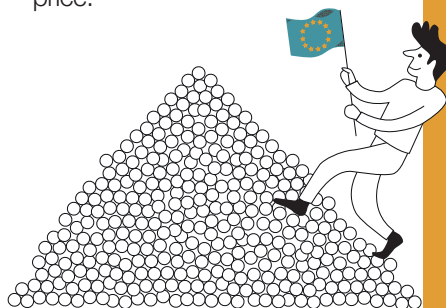
RAW MATERIAL EXTRACTED
SOLUBLE SUGARS (2)

The soluble sugars extracted from sorghum stems are simple sugars (sucrose, glucose and fructose) obtained by pressing using the industrial processes developed for sugar cane. The pulp (residues obtained after the extraction of the sugars from the stem) is then used as animal feed or for cogeneration. The grains which are not used up in this process can be used as a human or animal food source to produce ethanol after the transformation of the starch. It has been estimated that optimised use of the by-products, while bio-ethanol continues to be the first priority, could lead to bio-ethanol production at a very competitive price.



RAW MATERIAL EXTRACTED
LIGNOCELLULOSE (3)

Sorghum is the crop of choice for second generation biofuels based on lignocellulosic biomass. There are various possible scenarios. Firstly, the exploitation of the cellulose residues from sorghum grain or sweet sorghum cultivation, as well as dual cultivation (summer planted intermediate biofuel producing crops), and by exploiting specific high biomass production sorghum varieties, even in difficult soil and climatic conditions, all of which makes this one of the most interesting plants.



Demand star-rated sorghum. The quality of the seeds is unusually high

European seed production meets a number of highly demanding requirements.

Minimum germination capacity: 80%

Maximum humidity: 14% in weight

Minimum specific purity: 98% in weight

These are the regulation standards for the certified commercial seeds.

Demanding, certainly, but not standardised for the bases and pre-bases.

Sorghum ALL WRAPPED UP

SORGHUM THE INTERNATIONAL PACKAGING MATERIAL

It can be used in a very broad range of applications, mainly on the basis of the fibre rich varieties of sorghum and the by-products of the biofuel manufacturing process, or with the use of the sorghum dye varieties.

A FEW EXAMPLES

Paper, obtained from the pulp residues from the biofuel industry.

Biodegradable food packaging, obtained from kafirin, the main storage protein obtained from sorghum grains. This protein can be extracted from the residues from the biofuel industry, starting with the starch in the grains.

A biological plasticising agent for PVC, based on aconitic acid, an organic acid which is present in sorghum in high concentrations. The aconitic acid obtained from sorghum can replace the traditionally used phthalic acid, which has now been banned in Europe and several other countries due to its toxicity.

Dyes. The colouring varieties of sorghum meet the needs of industrial operators wishing to incorporate renewable, fully traceable, environment-friendly raw materials in their products. The potential applications for the dyes (soluble form) and pigments (insoluble form) are huge, covering a wide variety of sectors, including cosmetics, textiles, eco-materials, packaging materials and many others.





“ I've been growing sorghum every year since 2014. It's a crop that doesn't need much water, and its root system helps prevent soil erosion. It's a crop which can be of interest to agriculture and industry.

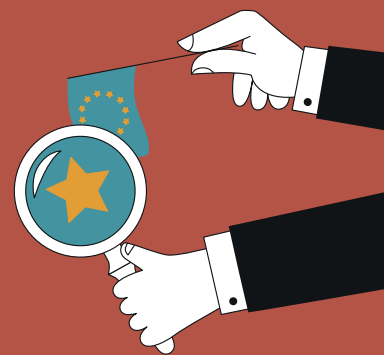
Cristian Spiridon, grower in Romania.
To find out more, go to www.sorghum-id.com

Demand star-rated sorghum It has low sensitivity to mycotoxins and isn't a GMO.

Sorghum isn't attacked by wood boring insects, which create an entry point for fungi such as the fusarium species. In addition, as the panicle and grains are in the open air, the grain dries rapidly, which is another safeguard against fungus infestation.

As a result of these properties, sorghum is protected against mycotoxins*. And it's also GMO-free.

* It's important however to harvest sorghum as soon as the grain is ripe. If you wait too long, there's a serious risk of mycotoxin development.





SORGHUM THE SAFE BET FOR THE FUTURE

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