

Sorghum^{ID}

SORGHUM THE SAFE BET FOR THE FUTURE

*Grain sorghum,
From growing
to selling.*



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SORGHUM GRAIN MARKETS

Sorghum is the fifth most widely-grown crop in the world with over 40 million hectares.

It can be found on all continents and in both tropical and temperate zones. Just over 40% of this production is intended for human consumption, primarily in Africa and Asia, where it is eaten as a whole grain, like rice, in semolina and flour (gluten free), or after transformation, in the form of sugar, or malted and fermented, as alcohol (beer, spirits, etc.).

FOR
ANIMAL FEED

**40 to
45%**

OF PRODUCTION



1 top
exporting
countries

UNITED STATES
ARGENTINA
AUSTRALIA



1 top
importing
countries

CHINA
JAPAN
MEXICO

MAIN
PRODUCING
COUNTRIES
IN EUROPE

RUSSIA
225,000 ha

UKRAINE
70,000 ha

FRANCE
53,000 ha

ITALY
46,000 ha

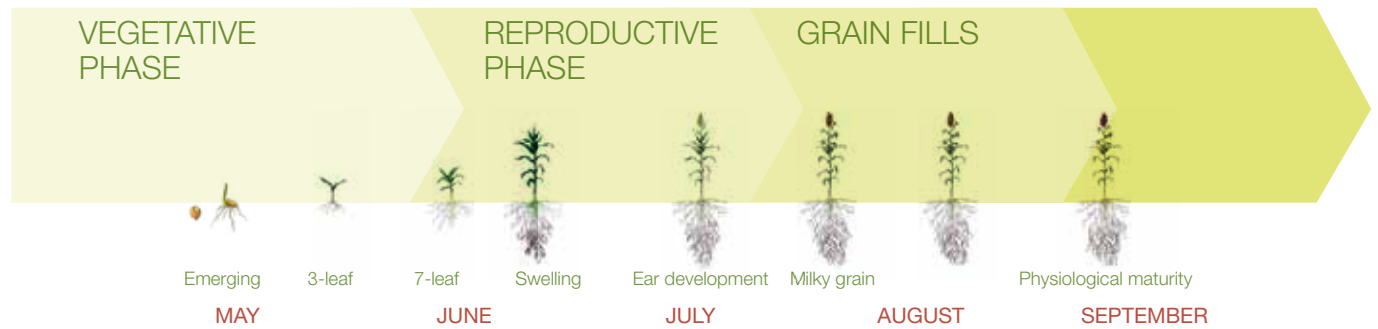
Sorghum is also found in Austria, Spain, Romania, Bulgaria and Hungary.



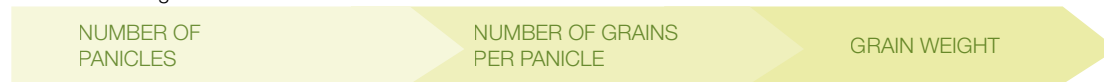
TECHNICAL ITINERARY

Sorghum cycle

Sorghum grain is an annual self-pollinating plant using C4 carbon fixation, which enables the plant to enjoy good photosynthetic yield and thus greater efficiency under warm and dry conditions.



Yield-determining factors:



Sensitivity to hydric stress:

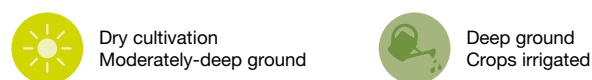


Implantation

The challenge here consists in fostering a good soil structure and carefully preparing the seedbed. Successful crop growth will be based in large part on emergence quality. Inter-row spacing can vary from 30 to 80 cm, the optimum level being 40 to 60 cm, to enable better plant distribution. Smaller inter-row spacing is better suited to early varieties. The use of an airplanter is recommended.

Recommended sowing density in number of seeds per hectare

Recommended sowing density (1,000k). Assumes 20% loss upon emergence



Regions	Very early		Early Semi-early		Semi-late	
Western Europe: FR, ES, IT, DE, AT, etc.	330-370	350-430	270-330	320-380	270-300	300-350
Central Europe: RO/HU/BG, etc.	290-320	350-370	270-300	320-350	250-280	300-330
Eastern Europe: Ukraine Russia*	250-275	200-240	200-240	250-280	190-220	230-260

* sowing density adjusted to enable 80 cm spacing usually applied in these countries.



Variety selection

The earlier a variety, the lower the number of grains on the panicle. Consequently, the earliest varieties require higher sowing density than the later varieties in order to achieve optimal yield.

- You will need to factor in a loss rate upon emergence of 20%.
- You will need to sow in well-heated soil, as sorghum's initial vigour is highly-dependent on soil temperature. It is advised that you sow as soon as the soil temperature reaches 12°C minimum, with one week of fair weather to follow (ideally between mid-April and mid-May). This will enable swift and even emergence, facilitating weeding.
- Sorghum seeds are relatively small and need to be positioned between 2 and 4 cm into the ground, in cool conditions. The seedbed needs to be fine, in order to ensure good soil/grain contact; maintain small plugs at the surface should there be a risk of soil sealing. Stay away from overly cloddy soil and excessively deep sowing.

Weeding



Sorghum is a crop sensitive to early competition from weeds. Successful weeding is one of the key points on this itinerary. It is particularly important to take aim at grass weeds in emergence not exceeding the 2-3 leaf stage. This application can be chosen as well to fight broadleaf weeds. There too, the soil's surface humidity at the time of treatment and in the following days is essential for successful weeding.

Depending on the existing flora, it may be possible to apply anti-grassweed during the post-sowing/pre-raising (root product), or anti-grassweed and anti-broadleaf weeding during sorghum's 3-4-leaf stage (root- and leaf-penetrating herbicides). The sowing done using an airplanter can be weeded mechanically more than once, if necessary.

Fertilisation

Though sorghum is a species with low phosphorus- and potassium-requirements, it is recommended that a supplement be added during the sowing process when planting in P/K-poor soils. Below is a chart summarising the N, P

and K requirements. While other mineral elements are needed to ensure good plant development (Ca, Mg, oligo-elements), in most cases, the soil provides for them in adequate quantities.

 Target yield	< 7 t/ha	35-50	Recommended phosphorus supplement P2O5/ha units or kg
	>7 t/ha	50-70	
 Residues from prior crop	Exported	50-100	Recommended potassium supplement K2O/ha units or kg
	Imported	0-60	

Amount of nitrogen absorbed by sorghum to produce one production unit

PRODUCTION TYPE	PRODUCTION POTENTIAL	UNITARY REQUIREMENT
kg N/hundredweight of grain	< 50 q/ha	2.9
	50 – 80 q/ha	2.5
	80 – 100 q/ha	2.3
	> 100 q/ha	2.1

Parasite pressure

Sorghum is little-exposed to diseases and ravaging parasites. Parasite attacks may occur, but more often than not, the pressure they cause remains low and does not require action.

The main diseases potentially affecting sorghum during vegetation are connected with fungus, e.g. *Fusarium* or *Macrophomina*. The risk can be curbed through lower sowing density. As for fusariosis, it is highly recom-

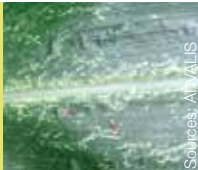
mended that you choose the appropriate varieties. Maize-boring insects (both corn-borers and stem-borers) can also attack sorghum. However, the damage is less significant and, to date, the impact on yield is limited. Symptoms include leaf perforations visible during stem elongation, then through galleries in the lower part of the stems. The use of an approved insecticide is possible in the event of high infestation.



Irrigation

The phase most sensitive to hydric stress occurs between the end of stem elongation (swelling) and the start of grain formation. When irrigating, it is thus during this period that water input is to be determined.


LEAF-HOPPERS



Sources: ARVALIS

Leaf-hopper bites show up as small white dots on the leaves. The symptoms can be seen frequently, but the degree of harm to the yield is limited.

APHIDS



Sources: ARVALIS

Aphids are frequently found on sorghum in June, but in most cases, remain for only a short period. However, in the event of strong colony growth and persisting presence, a special product may be used.

TECHNICAL ITINERARY

Harvesting and storage

Sorghum harvesting does not require any special equipment to supplement the combine harvester equipped to harvest straw cereals.

Sorghum has reached its point of physiological maturity when the grain's water concentration is around 35%. It can be harvested from 30% humidity, but generally, grain desiccation proceeds quickly and harvesting is done while humidity levels are between 18 and 25%.

Sorghum harvesting does not require any special equipment.

GOOD TO KNOW When the grains are ripe, the plant's leaf cover is still green. Consequently, it is important not to wait until the plant dries out to harvest it. However, major drought in the autumn and/or early frost can

cause the plant to desiccate quickly and sometimes coincide with lodging if the harvest does not quickly follow.

ADVICE

- Harvest as early as September if humidity is below 20%.
- After September, do not delay the harvest date in the hopes of enjoying very low-humidity grains, as the risk of re-humidification increases and, what's more, the quality of the grain can be affected by high atmospheric humidity (fog). Delaying the harvest date also increases the risk of lodging and can impact grain quality.
- Avoid picking too many stems and leaves (this would slow down the speed of harvest and increase the grain humidity level).

CONSERVATION Sorghum grains need to be stored below 15% humidity.

Tip:

Harvest humidity will determine the recommended conduct: if you harvest when humidity levels are below 16%, ventilate the grains as soon as the ventilation ducts are covered. Cooling ventilation, which will take place in two to three stages depending on the temperature at the time of harvesting, will make it possible to adequately lower humidity. As for grains harvested at humidity levels higher than 18%, the use of a dryer will be essential. The dryer will need to be cleaned regularly, following manufacturer recommendations. Hot air temperature should not exceed 90°C. Grains will be cooled as soon as they come out of the dryer.

- The drying technique known as deferred slow cooling can be used, in which case, to ensure effectiveness, hot air temperature should be raised to the maximum possible level (90°C).



Double-cropping

Sorghum and double-cropping: an attractive opportunity

ADVICE

- Select a prior crop such as protein peas, spring barley or rapeseed,
- Choose a very early sorghum variety
- Plant as quickly as possible after the prior crop harvest, if possible by end-June. A crop's success is conditional upon the irrigation capacity which enables emergence and satisfies water needs during the period of high sensitivity to hydric stress that occurs around ear emergence.

OPPORTUNITIES AND USES

Animal feed

Sorghum offers chemical composition similar to that of maize, though with a slightly higher protein level and energy value. It can thus be woven into the rations of most livestock sectors.

The majority of varieties in the European catalogue stand out for being tannin-free, thus enabling good energy use and proteins for animals.

Nutritional value of sorghum grain

IN POULTRY

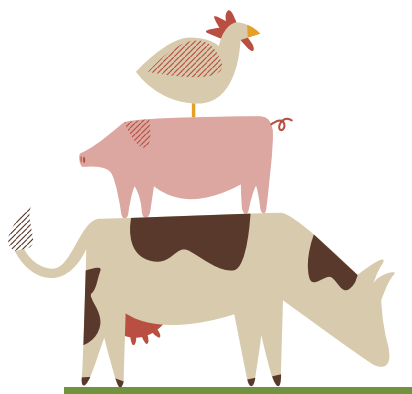
Sorghum has the highest energy content of any grain. The energy value for chickens is similar to that of maize.

IN PIGS

The absence of tannins enables good energy and protein value. The digestible energy is relatively high, similar in level to that of maize in growing pigs and slightly lower in sows.

IN GRAZING ANIMALS

Sorghum grains can be used to produce the energy concentrates that supplement fodder and nitrogen-enriched sources. In contrast to wheat, they must be finely-crushed in order to be well digested.



The use of sorghum could be optimised by taking into consideration its technological behaviour during the production process:

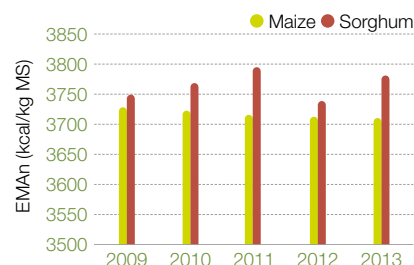
- crushing should be adapted to its small size, to prevent whole grains from remaining, or even to improve pellet quality;
- sorghum's clumping power, slightly better than that of maize, but significantly better than that of wheat, should be taken into account during granulation;
- as a food, it can be adapted for use in soup, to prevent faster decanting due to less absorption of liquids than other cereals.

Human nutrition, new opportunities

New to Europe but traditional in Africa and Asia, sorghum is a grain that can be cooked like rice, quinoa or others. It can be incorporated into beer and other alcohols. Today, Europe is just discovering its taste and dietary properties. Highly nutritious, it is rich in proteins, iron, vitamin B6 and more... High-energy, rich in anti-oxidants, gluten-free and thus entirely suited to people with allergies, it is also a source of dietary fibre and potassium.



Energy value of sorghum for poultry compared to maize



Sorghum 2009 to 2013 (1) = 3770 kcal/kg MS
Maize 2009 to 2013 (2) = 3725 kcal/kg MS

Compared energetic value of maize and sorghum

ENERGETIC VALUE	GROWING PIG		SOW	
	Sorghum	Maize	Sorghum	Maize
ED	3,931	3,924	4,002	4,081

Source: INRA-AFZ, 2004

Compared average composition of maize and sorghum

COMPOSITION % MS	SORGHUM	MAIZE
Starch*	75.1	75.8
Proteins*	10.6	8.7
Fat*	4.1	4.5
Cell walls*	8.3	9.3
Total sugars*	0.8	1.9
Calcium	0.04	0.05
Phosphorus	0.32	0.30
Lysine	0.25	0.28
Methionine	0.36	0.35
Met+Cys	0.38	0.43
Tryptophane	0.12	0.06

(*) Source: ARVALIS/FranceAgriMer surveys on French maize and sorghum (2009-2013). The other values are derived from the INRA-AFZ 2004 tables.