# Sorghum – a crop with various agronomic possibilities

**AgriSem GmbH**

**Energy from the power of the sun**

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## Introduction

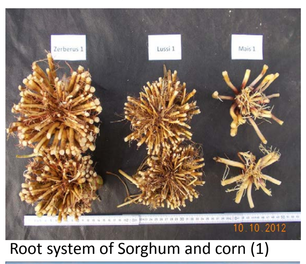
Sorghum belongs to the family of the true grasses and is the basic food ressource for many humans especially in arid climate zones. Through years of selection, genotypes have been generated that are well adapted to extreme conditions.

Experiences in Sorghum cultivation under our temperate climate show that Sorghum can act as the perfect supplement to corn, e.g. for biogas production (→ Sorghum cultivation for biogas production). Sorghum cultivation increases the biodiversity of energy crops. Since Sorghum belongs to the C4-plants, it has an improved photosynthesis activity and a remarkable water and nutrient efficiency. Its resistance to many corn pests and diseases maintains a positive influence particularly in corn based crop rotations.

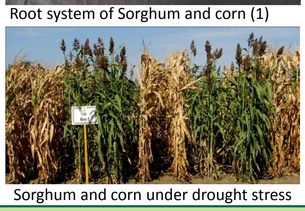
*Sorghum bicolor* and crossings of *S. sudanense* x *S. bicolor* are used not only in scientific projects but also for practical use.
Many different food products are processed out of the Sorghum grains, but furthermore the whole plant can generalyl be used as feed (→ Sorghum cultivation for fodder silage production). In addition, Sorghum cultivation for grain production can be successfull in favorable regions (→ Sorghum cultivation for grain production).

In 2012 a milestone was reached when the Federal Plant Variety Office in Germany established a variety list for Sorghum. A grain-based *S. bicolor* hybrid is also tested in the nationwide experiences for its cultivation ability.

*S. Sudanense, S. bicolor, Z. mays*



Root system of Sorghum and corn (1)



Sorghum and corn under drought stress

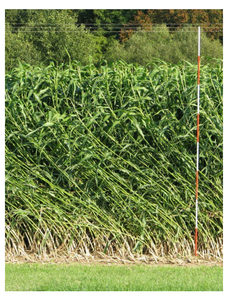
## Sorghum cultivation for biogas production

**Sorghum as a supplement to corn for biogas production**

- Increase of biodiversity
- Local limitations in corn cultivation
- Reorganization of corn-based crop rotations
- Suboptimal growth conditions for corn

### Characteristics of biomass-based Sorghum varieties

- bias to lodging
- low dry matter content at harvest
- growth is predominantly vegetative
- high contents of lignin
- low energy concentration and gas yield



**Influence of different Sorghum varieties (CV) referring to protein content (XP), ADF, NDF, ADL, ash (XA) and the specific gas yield in batch trials at Groß Gerau (Athar, M., 2012) (2)**

| sorghum variety | CV | XP % DM | XZ % DM | ADF % DM | NDF % DM | ADL % DM | XA % DM | gas N/kg DM | methan N/kg DM |
|---|---|---|---|---|---|---|---|---|---|
| **silage based** | Rona-1 | 7.50 | 10.70 | 28.40 | 50.3 | 3.10 | 6.20 | 721 | 387 |
| **biomass based** | Goliath | 6.30 | 11.20 | 38.7 | 58.0 | 5.30 | 7.90 | 519 | 280 |
| **Sudan gras** | Akklimat | 8.00 | 6.00 | 36.4 | 59.6 | 5.50 | 8.10 | 415 | 232 |

### Characteristics of corn-based Sorghum varieties

- resistance to lodging – good stability
- grain is the main part of the yield
- ideal DM-content even of green stover
- biogas and methane production is equal to corn

**Comparison of grain-based and biomass-based Sorghum varieties (TFZ Straubing, 2012) (3)**

| | lodging | DM-content | | DM-yield | | theor. methane yield/ha* |
|---|---|---|---|---|---|---|
| **grain-based** | rating 1-9 | % | rel. | dt/ha | rel. | in m³ 330 nL/kg o TS |
| Sweet Susana | 1.0 | 28.7 | 123 | 214.1 | 171 | 7064 |
| Sweet Caroline | 1.0 | 26.7 | 114 | 194.2 | 155 | 6409 |
| Alföldi | 1.0 | 30.4 | 130 | 193.1 | 154 | 6374 |
| Emese | 1.0 | 29.6 | 126 | 181.9 | 145 | 6002 |
| Stamm-1 | 1.0 | 28.4 | 121 | 180.9 | 144 | 5970 |
| Express | 1.0 | 28.0 | 120 | 164.2 | 131 | 5417 |
| DSM B7B-2C7 | 1.0 | 21.7 | 93 | 127.3 | 102 | 4201 |
| 50 | 2.0 | 23.4 | 100 | 125.2 | 100 | 4132 |
| **average** | **1.1** | **27.1** | **115.8** | **172.6** | **137.8** | **5696** |
| **biomass-based** | | | | | | 230 nL/kg o TS |
| **average** | **1.9** | **27.5** | **100** | **292.5** | **121** | **5548** |

* benchmark from analyses of Blgg (4)

- the biomass-yield of grain-rich Sorghum varieties does not reach the level of biomass-based varieties but their methane production capability is much higher!

## Sorghum cultivation for fodder silage production

- Sorghum can easily be harvested with the forage harvester
- a DM-content of min. 26 % at harvest reduces soakage
- grain-based hybrids can achieve a grain content of 50%

**Ingredients of grain-based Sorghum and corn silage in g/kg DM grown in 2012 (Blgg 2012) (4)**

| ingredients | GK-Emese | Sweet Susana | corn silage |
|---|---|---|---|
| **DM %** | 31.4 | 37.3 | 32-38 |
| **ash** | 45 | 38 | 35-45 |
| **protein** | 95 | 93 | 70-90 |
| **fibre** | 193 | 174 | 170-190 |
| **starch** | 345.4 | 360 | > 300 |

- biomass-based sorghum varieties tend to lodge. Yield (ha) as well as energy content comparable to corn silage was not achievd (LfL 2009-2010) **(5)**

## Sorghum cultivation for grain production

- ingredient composition is optimal for fodder production
- gluten- and tanninfree varieties are beneficial for human diet

**Ingredients of different cereals (g/kg DM)**

| cereal | protein | fat | fibre | NfE | starch |
|---|---|---|---|---|---|
| **wheat** | 138 | 20 | 29 | 794 | 675 |
| **barley** | 125 | 27 | 27 | 764 | 600 |
| **oat** | 123 | 52 | 113 | 679 | 447 |
| **corn** | 106 | 46 | 26 | 805 | 646 |
| **GK-Emese** | 128 | 33 | 27 | 790 | 659 |

- grain yield of 8.11–11.03 t/ha was harvested in field trials at five places and years at 86 % DM-content
- reduction of tillers with a delay in maturation because of sorghums‘ tolerance to a high population density (> 30 plant/m²)

**Quality- and yield parameters of *Sorghum bicolor* hybrids at side Bingen 2012 (6)**

| variety | Besatz % | Hight cm | panicle/m² | plant/m² | panicle/plant |
|---|---|---|---|---|---|
| **Fuego** | 5,8 | 119,8 | 36,3 | **34.3** | 1.1 |
| **ASM 7-018** | 5.4 | 104.2 | 27.3 | **33.3** | 0.8 |
| **Leggoo** | 18.4 | 113.1 | 36.0 | **31.8** | 1.1 |
| **Iggloo** | 9.6 | 113.8 | 38.7 | **25.5** | 1.5 |
| **Balto** | 5.7 | 98.0 | 47.7 | **24.8** | 1.9 |
| **SC 25-05-5** | 6.5 | 131.4 | 34.0 | **22.0** | 1.5 |

## References

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2. Athar, M., Performance of Sorghum (*Sorghum bicolor* L. Moench) as an Energy Crop for Biogas Production, Justus Liebig Universität Gießen, 2011
3. Technologie- und Förderzentrum, TFZ, Straubing
4. Blgg Deutschland GmbH, Parchim
5. Ettle, T. et al., Ertragsleistung und Verdaulichkeit von Hirsesorten zur Fütterung, Landesanstalt für Landwirtschaft, 2013
6. Petersen, J., Körnersorghum als Alternative zu Körnermais, MAIS 03/2013

## Outlook

- Breeding of varieties with cold tolerance, early maturation, resistances
- Establishment of a test system to detect the utilization specific characteristics
- Optimization of cultivation techniques: plant protection, fertilization management, crop rotation