We have 1001 reasons to invest in sorghum

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FEEDING THE FUTURE:
A SMART CHOICE FOR A CHANGING CLIMATE

1001 reasons: The diverse one…

Why is sorghum so diverse?

More than 25 species in the genus

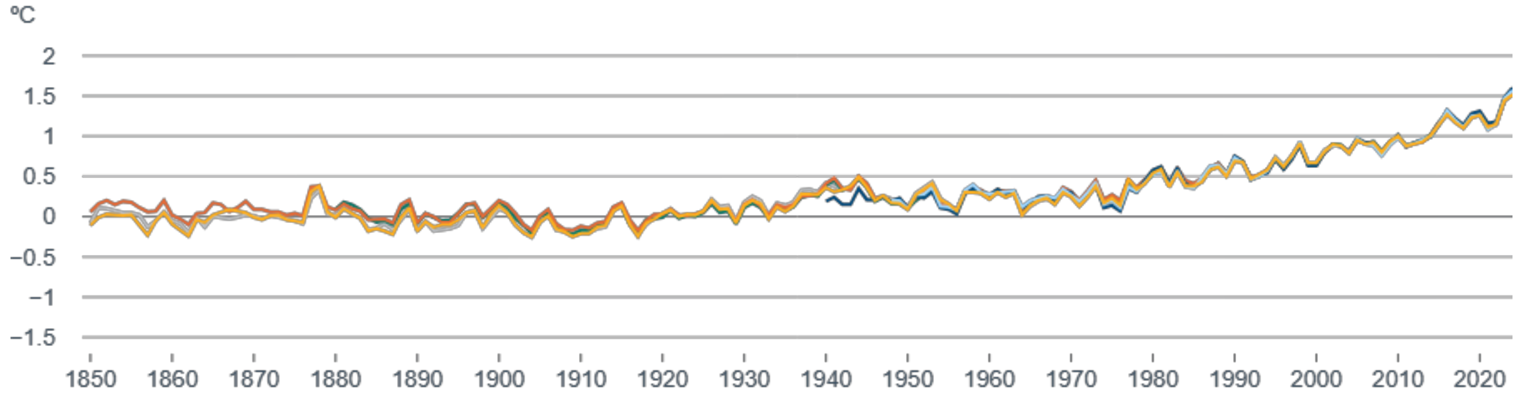
4 cultivated species

- Sorghum bicolor
- Sorghum sudanense
- Sorghum drummondii
- Sorghum arundinaceum

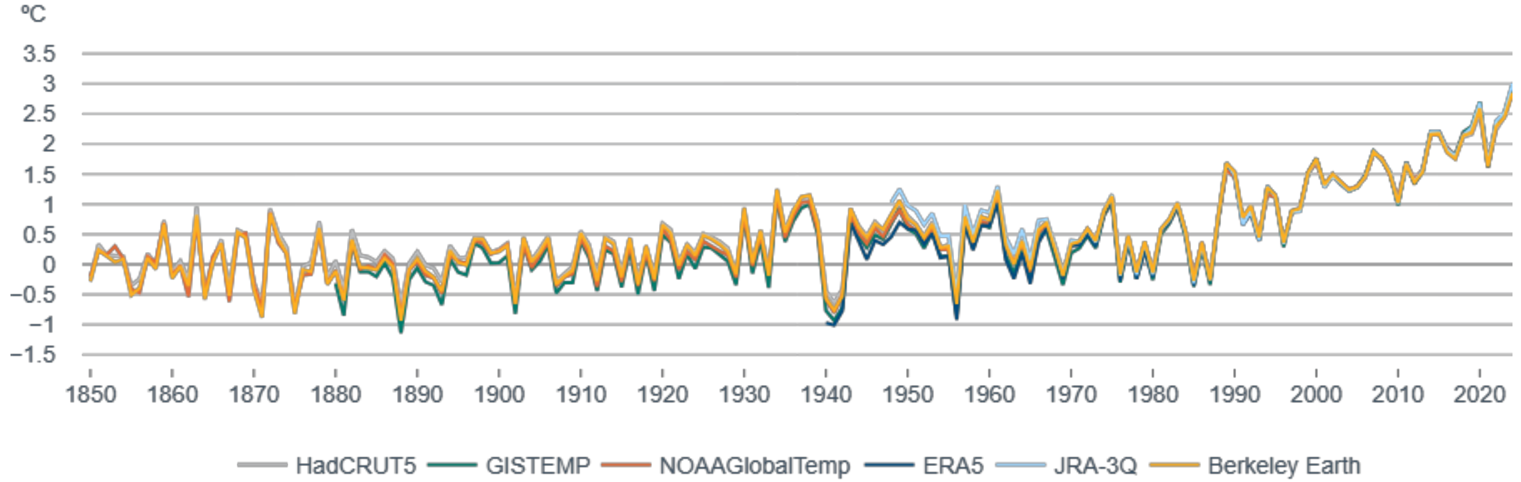
A real flex-crop, with many types and races

Climate issues
What do we feel and what do we know?

Global annual average near-surface temperature anomalies relative to the pre-industrial period 1850-1900



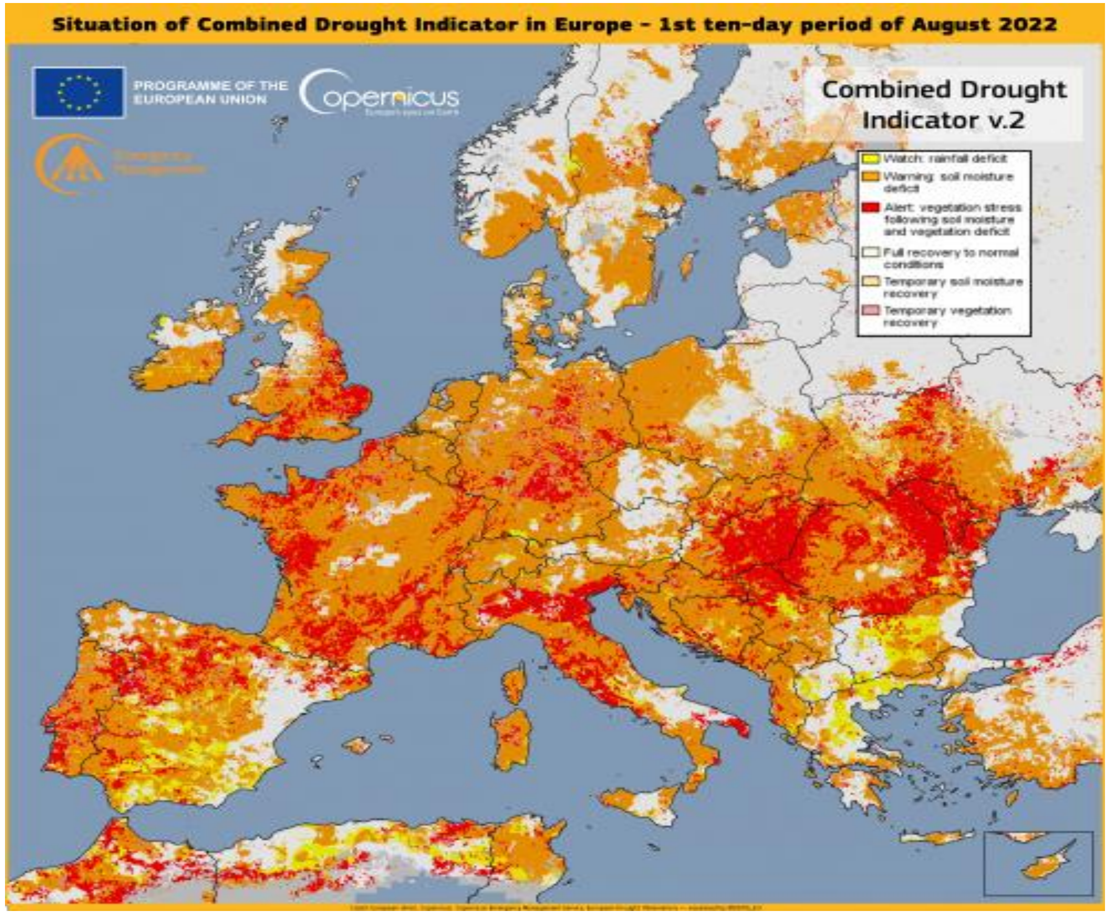
European annual average near-surface temperature anomalies relative to the 1850-1900 average



Tendencies in climate change

- **Heatwaves:** 3 times more frequent,
- **Heavy precipitation** events: ~20% more frequent globally since 1970
- **Agricultural zones shifting**: 10–20 km northward per year in temperate regions

Climate issues
What do we feel and what do we know?



Source: European Drought Observatory

Drought affected areas in the EU

– Droughts have become **twice as frequent** since 1970

– Most affected regions: **Southern Europe**

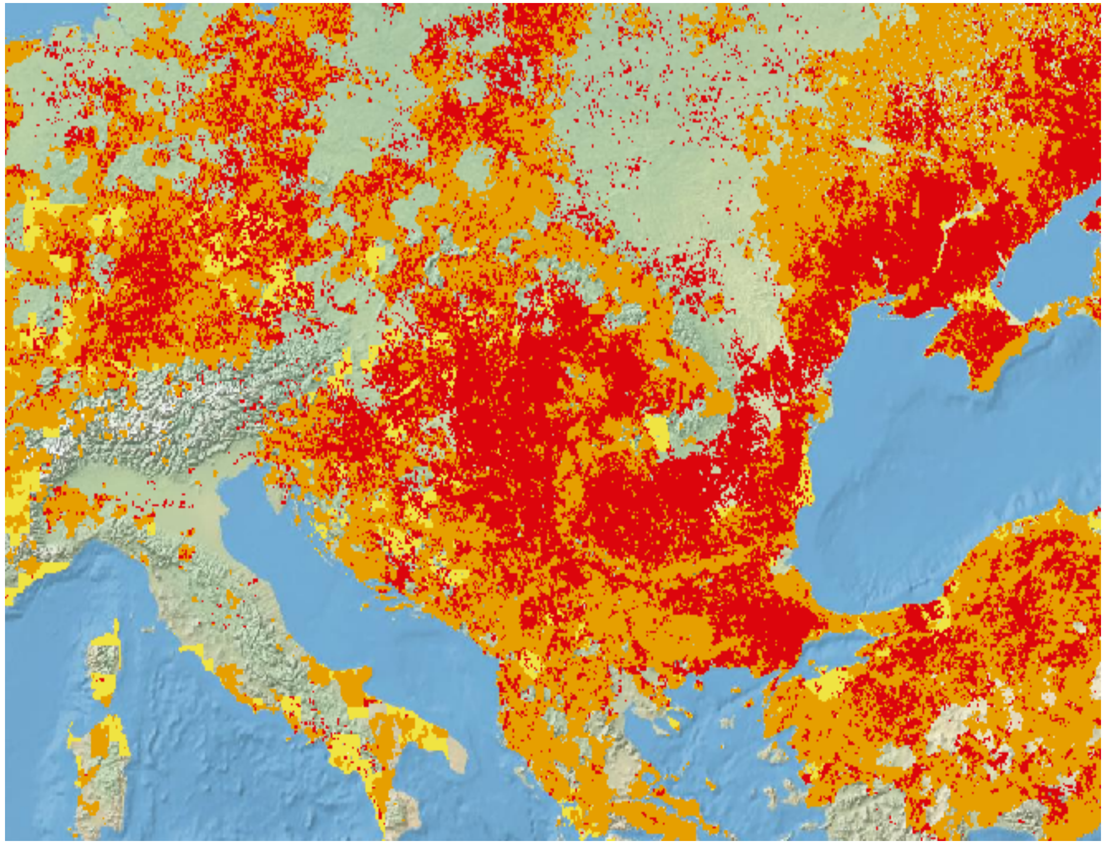
– Also recurring in **Central Europe**

– 2022: Europe faced its **worst drought in 500 years**

– In Hungary 2022, agricultural drought damage was **~2 billion €**

Climate issues
What do we feel and what do we know?

Drought MAP of Central Europe in 2025 July



Source: European Drought Observatory

Recent experiences in the EU

Yield loss:
- **30–50%** in maize
- **15–20%** in case of barley and wheat
- **20–25%** in case of sunflower

– Groundwater levels significantly decreased

– Irrigation demand **increased by 30–40%**

– Frequent **soil moisture deficits** → reduced soil fertility

– Increased feed costs → livestock sector under pressure

Drought resilience, the key feature

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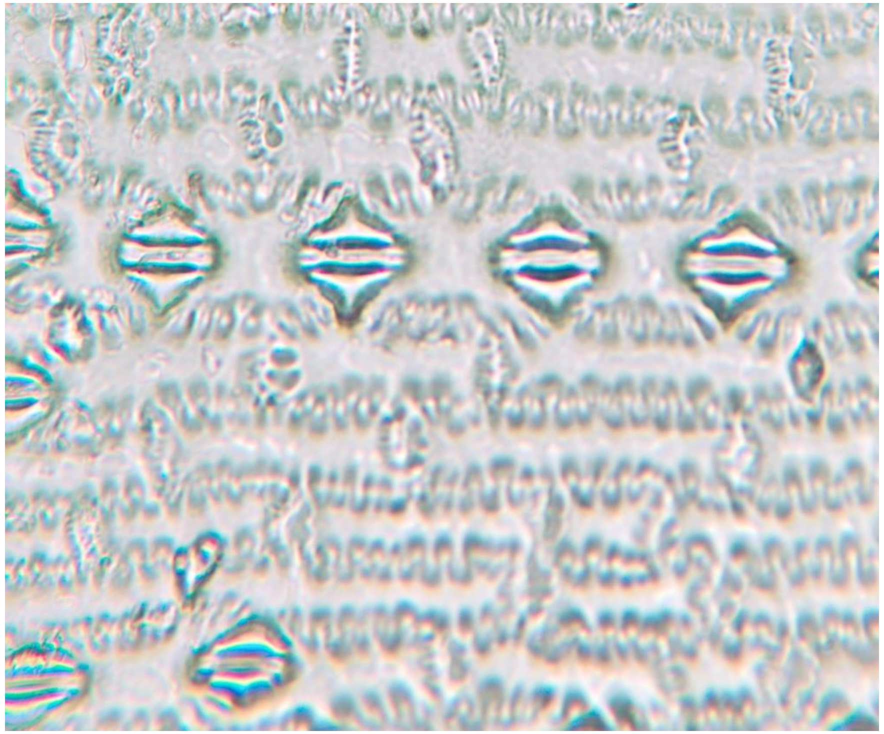
Corn and sorghum fields on the Great Hungarian Plain in 2025 August

CAMPAIN FINANCED WITH AID FROM THE EUROPEAN UNION

THE EUROPEAN UNION SUPPORTS CAMPAIGNS THAT PROMOTE HIGH QUALITY AGRICULTURAL PRODUCTS.

Drought resilience and facts behind the scenes



Why is sorghum drought tolerant?

- **C4 photosynthesis**
- **Deep, aggressively growing root system**
- **“Stay-green” trait**
- **Efficient stomatal regulation**
- **Leaf architecture**
- **Thick cuticle + epicuticular wax (“bloom”)** on leaves/stems
- **Osmotic adjustment** (proline, soluble sugars, K^+, etc.)
- **Antioxidant & heat-stress defenses** (SOD, CAT, heat-shock proteins)
- **Mobilization of stem non-structural carbohydrates (NSC)**
- **Reproductive stability**
- **Root anatomical/hydraulic adaptations**
- **Developmental/phenological plasticity**
- **Genetic basis/QTLs**
- **Role of symbionts** (e.g., arbuscular mycorrhizae)

Sorghum types

Grain types

fodder grain, flour, bioethanol, baiju, garnish, popsorgh, beer etc.

Silage types

Silage, syrup, biogas, bioethanol etc.

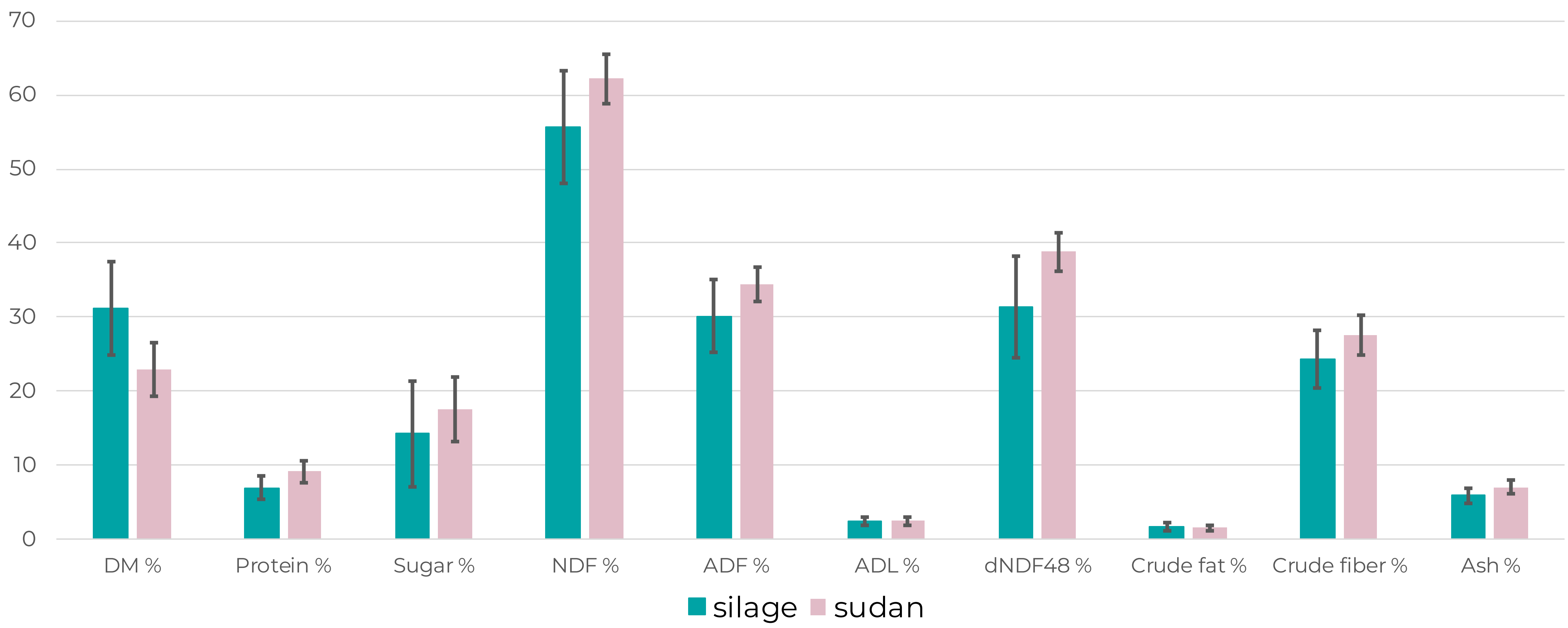
Sudan types

Silage, hay, green manure etc.

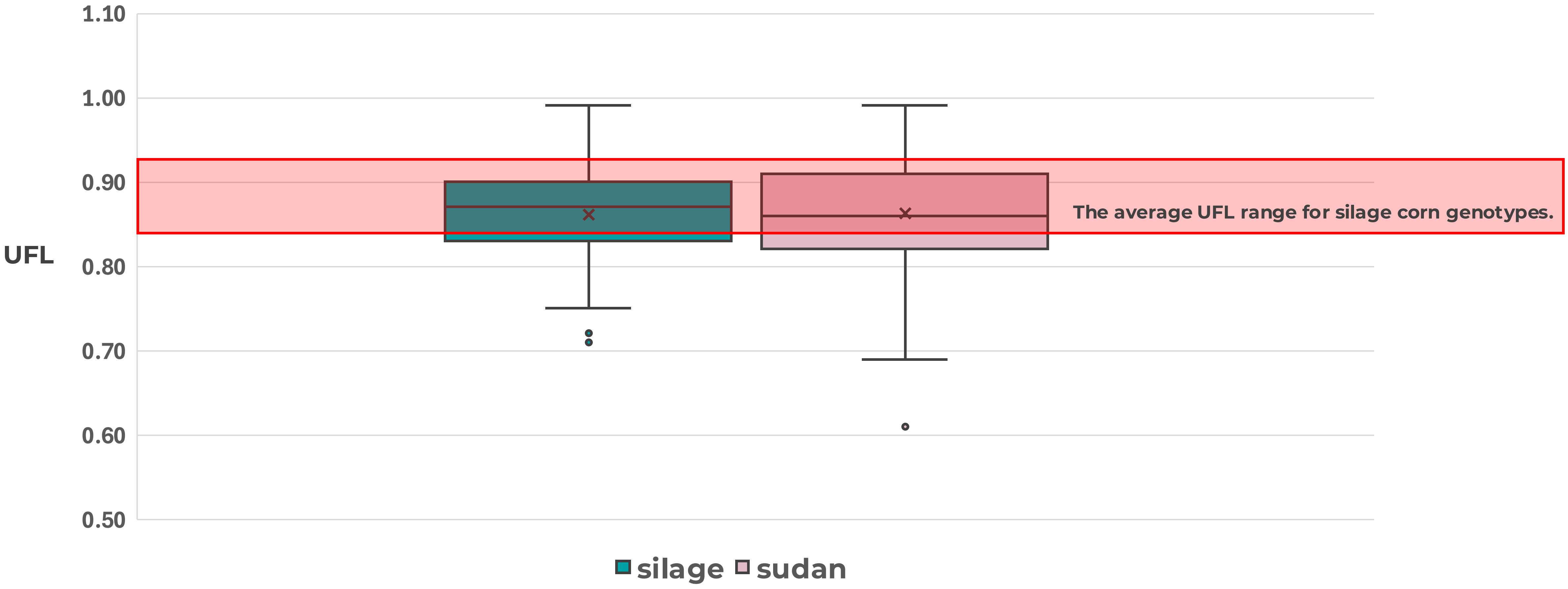
What can we get out of a forage sorghum field?

	Green yield (t/ha)	Dry material (t/ha)	Dry material (%)
Silage corn	45-60	13,5-22,8	30 - 38
Silage sorghum	40-65	12,4-20,15	31
Sudan grass (2 cuts)	35-55	8,05-12,65	23
Sudan grass (3 cuts)	40-65	9,2-14,95	23

Characteristics of forage sorghums



Sorghum or Corn?



Sorghum or Corn?

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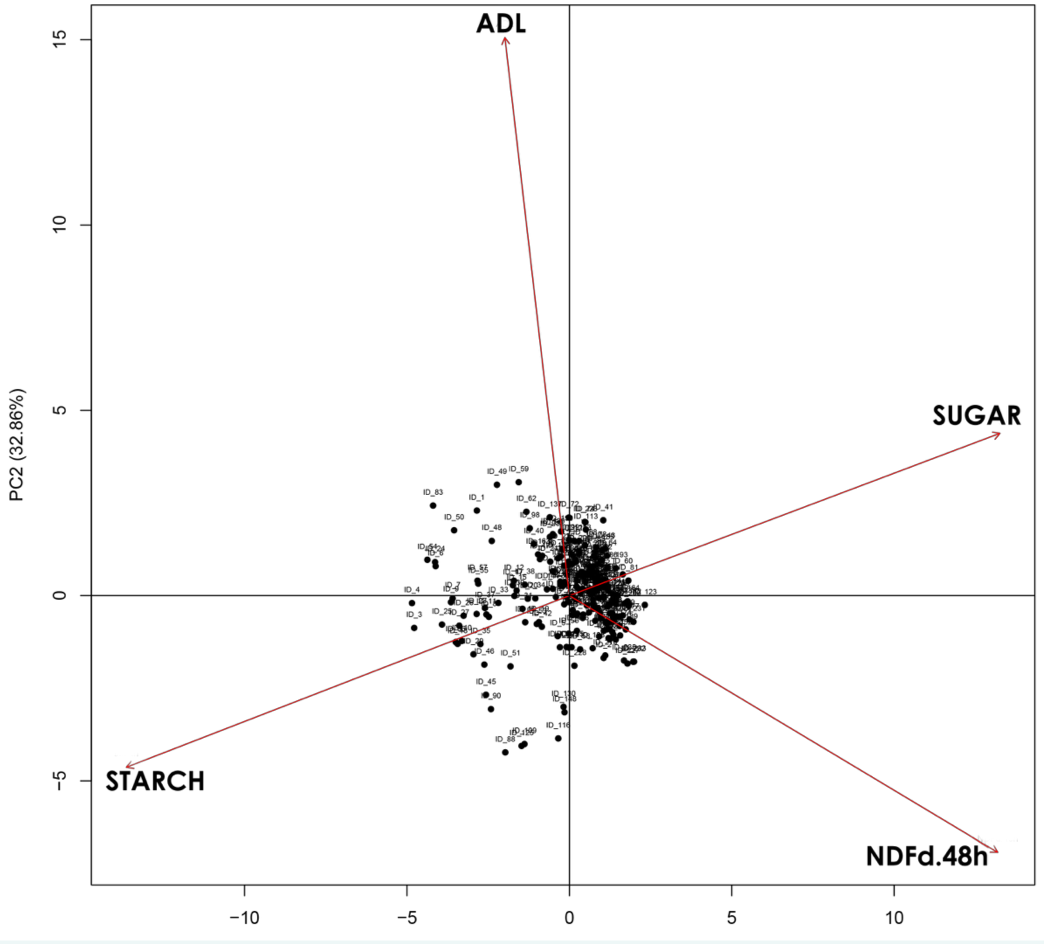
	Silage type sorghum	Sudan type sorghum	Silage corn
Dry Material (%)	31	23	30 - 38
ADL (% of DM)	2,5	2,4	4 - 5
ADF (% of DM)	30	35	26 - 30
NDF (% of DM)	56	62	46 - 53
NDFd48 (% of NDF)	~ 31	~ 39	~ 58
Starch (% of DM)	~ 14-25	> 10	22 - 26
Protein (% of DM)	6,9	9,1	8,4 – 8,6
Sugar (% of DM)	18	16	N/A

Source: Structured by data from www.corn.agronomy.wisc.edu and www.fyi.extension.wisc.edu

What are the most determinative factors?

The relation of NDFd48 with other parameters in in case of sorghum genotypes

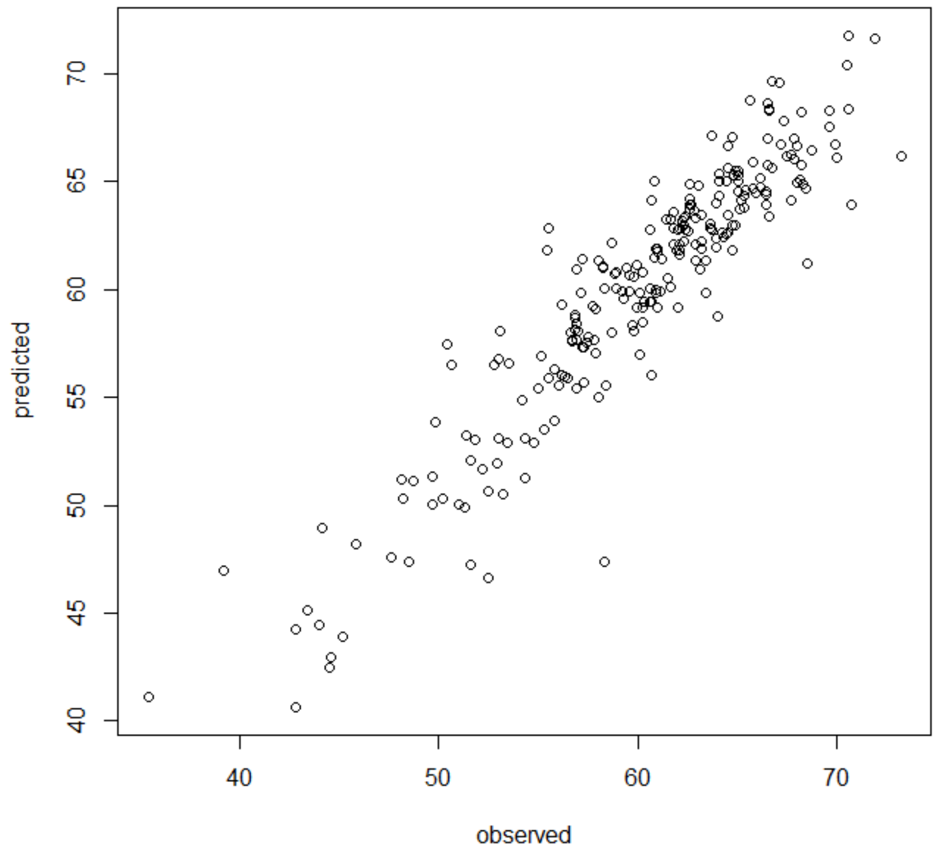


The main parameters to estimate the NDFd48

- Sugar and starch is in negative correlation
- Sugar and and NDFd48 is in positive correlation
- NDFd48 is negatively correlated to starch, meaning that high starch level has a negative effect on NDFd48.
- **ADL has a highly negative effect on NDFd48h.**
- Genotypes with a higher NDFd.48h and higher sugar is located in the right bottom square.

The linear model of NDFd48

A linear regression model for NDFd48



The main parameters to estimate the NDFd48

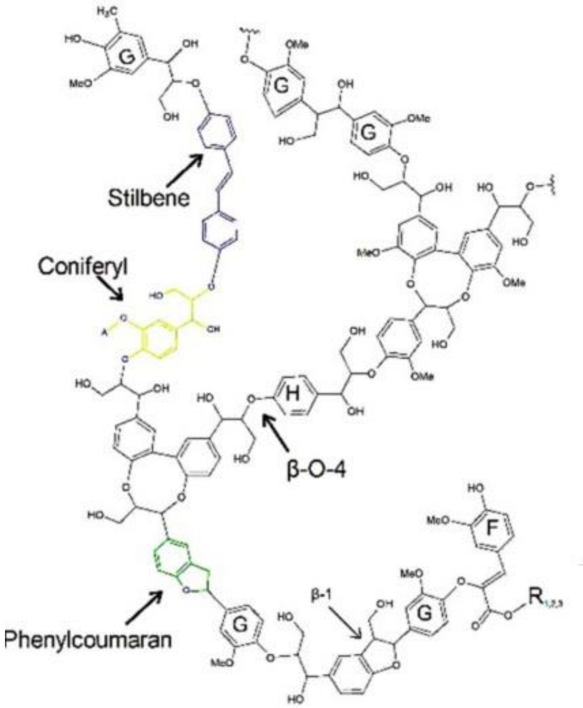
NDFd.48h = -0.02508a+ 0.09965b- 0.11966c- 0.06870d+ 0.01744e- **0.40539f**
R^2= 0,85

a) Dry material content
b) Crude fat content
c) Crude fiber content
d) Starch content
e) NDF content
f) ADL content

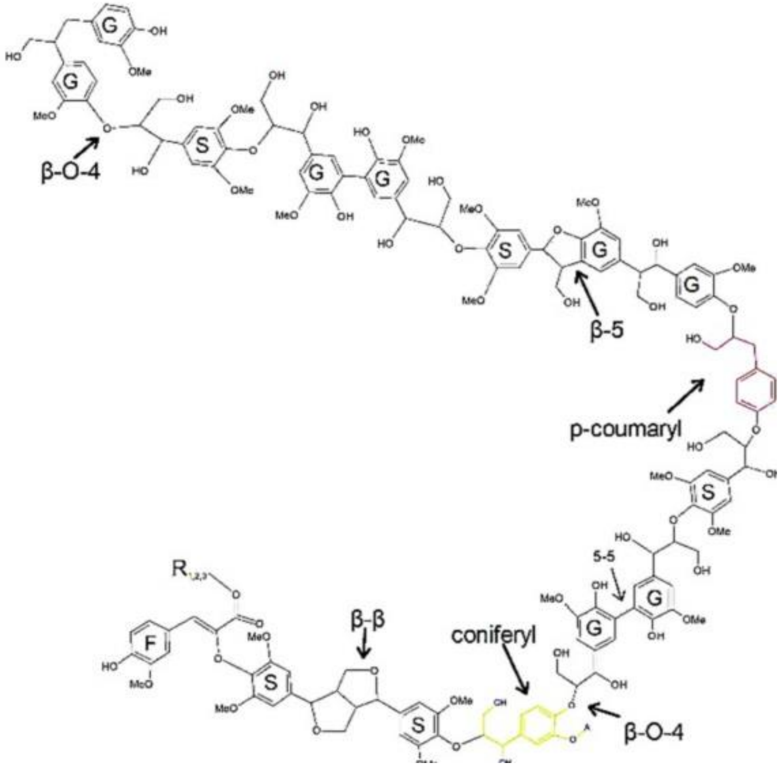
These factors explaining 85% of the digestibility.

What is lignin?

G-lignin



S-lignin



Source: Maceda and Terrazas, 2022

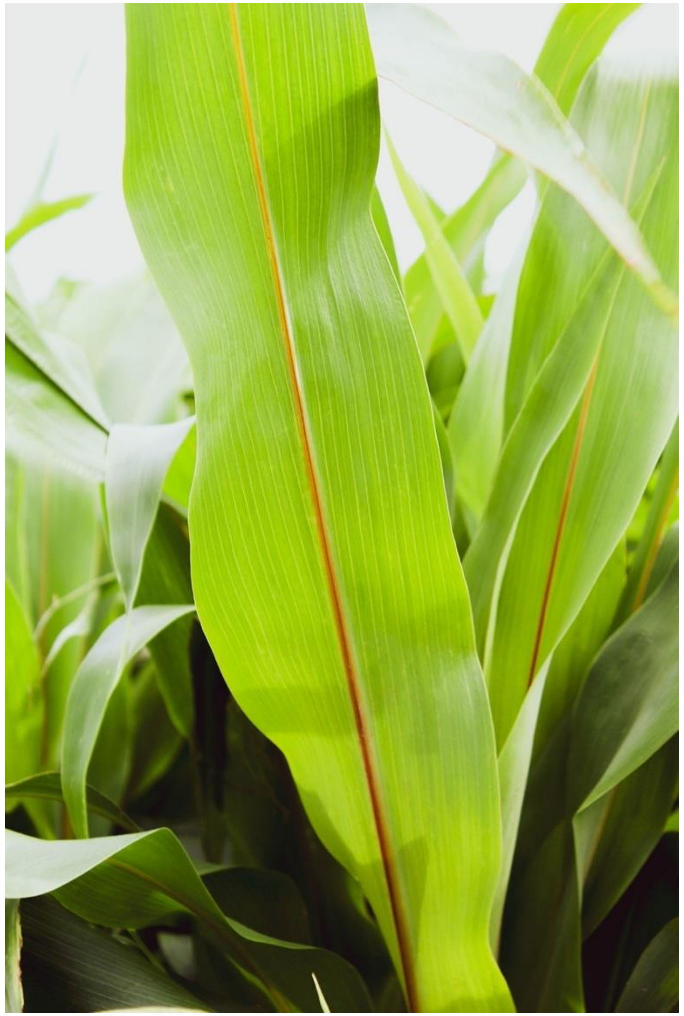
Structural compounds in the stem

The main structural compounds are the in the cellulose – hemicellulose – lignin matrix.

Lignin is a major aromatic polymer of the plant cell wall. Provides mechanical strength/rigidity.

It reinforces and waterproofs xylem vessels/tracheids and acts as a physical/chemical barrier against pathogens, UV, and herbivores.

BMR sorghums for a lower lignin content!



Effects of BMR6 and BMR12

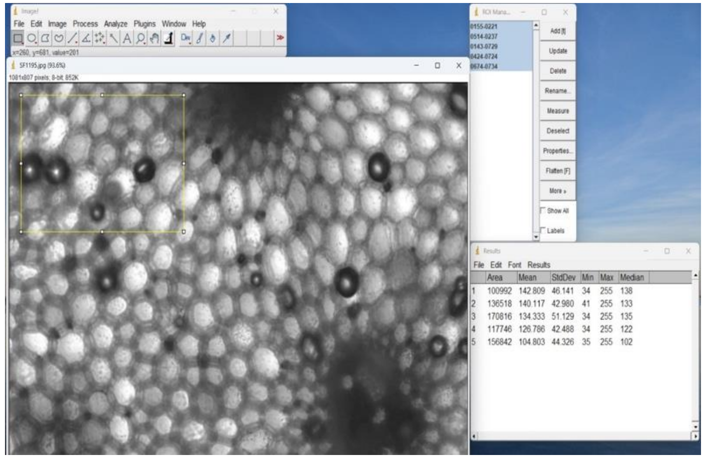
BMR6 ⇒ CAD (cinnamyl alcohol dehydrogenase)

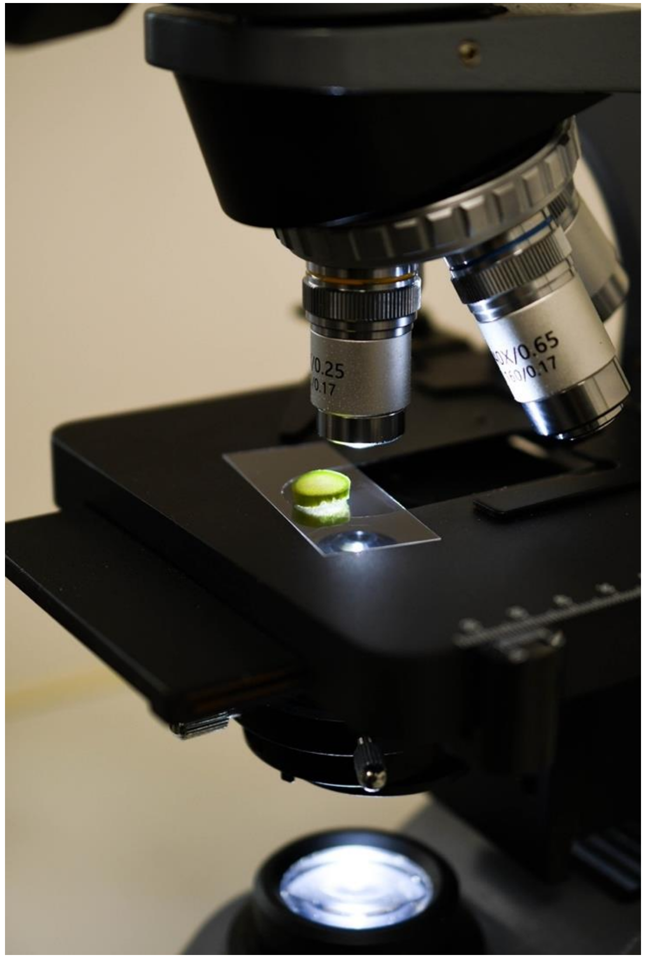
The result: less total lignin, modified S/G and bond type ratios → easier delignification/digestibility as S- and G-lignin content is lower.

BMR12 ⇒ COMT (caffeic acid O-methyltransferase)

BMR12 usually results in a **greater ADL decline** and a **stronger S-proportion decline** (lower S/G)

Where can we find the lignin?



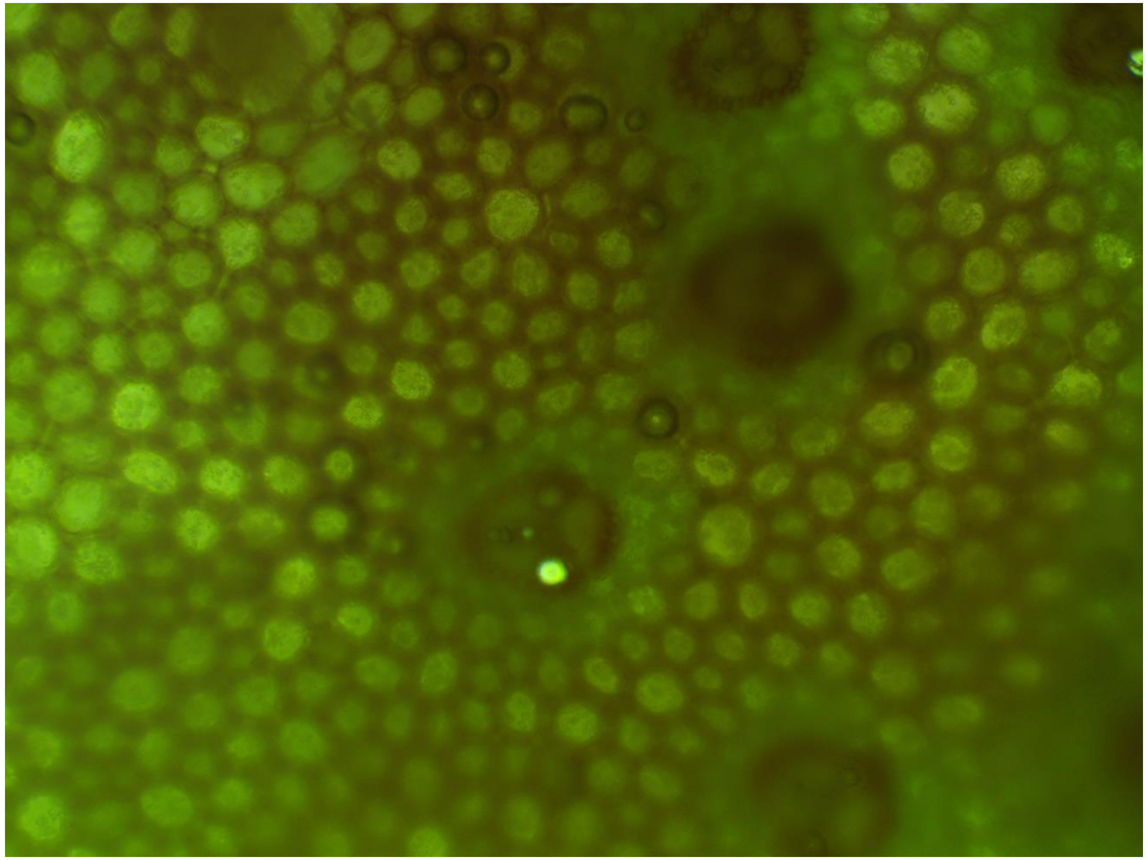


Identification of lignin

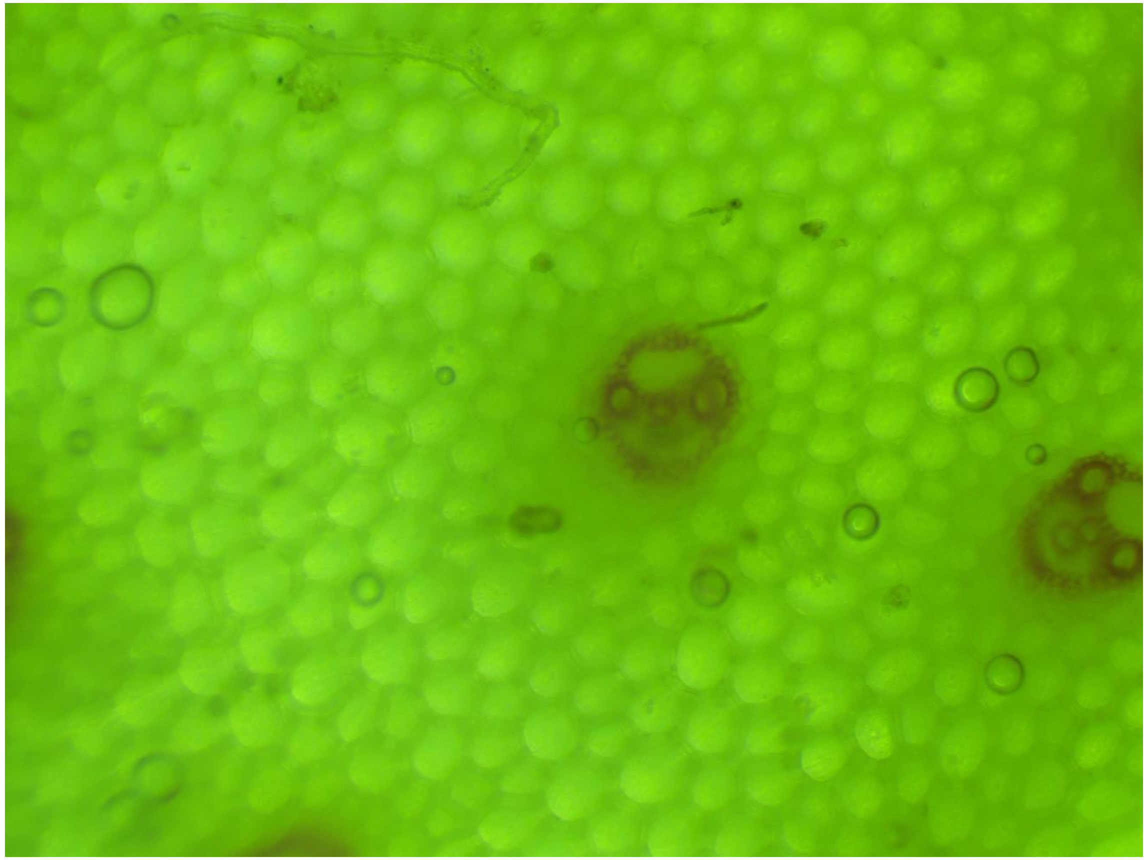
- Lignin can be painted by chemicals in a slice of a stem
- The coloured regions can be processed and analysed by specific software
- Lignin content can be determined as a quantitative trait, what makes the opportunity to select ideal genotypes.

Where can we find the lignin?

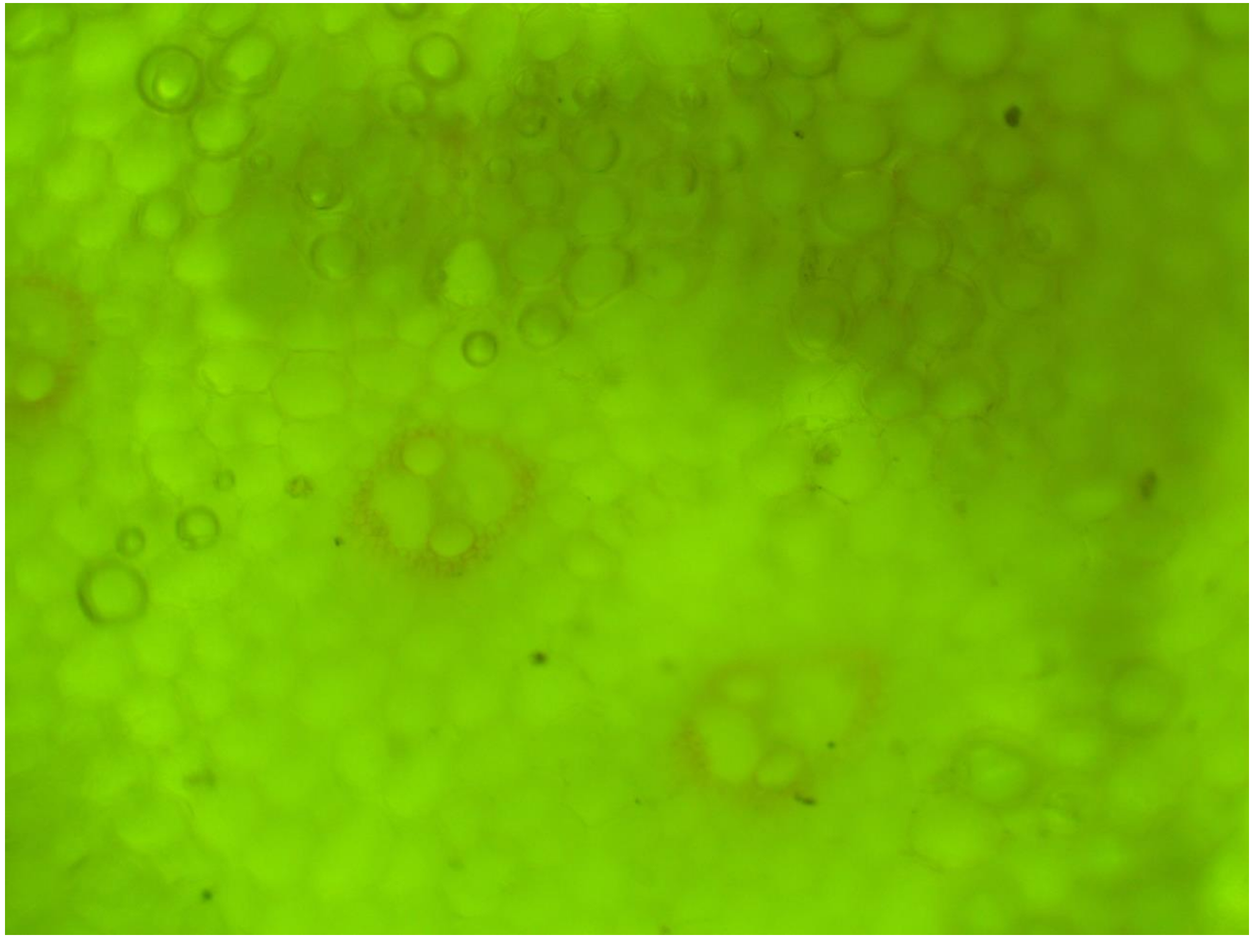
Cross section of a non-BMR sorghum



Cross section of a BMR sorghum



The exceptions what breeders are looking for!



Non-BMR genotypes with low lignin content

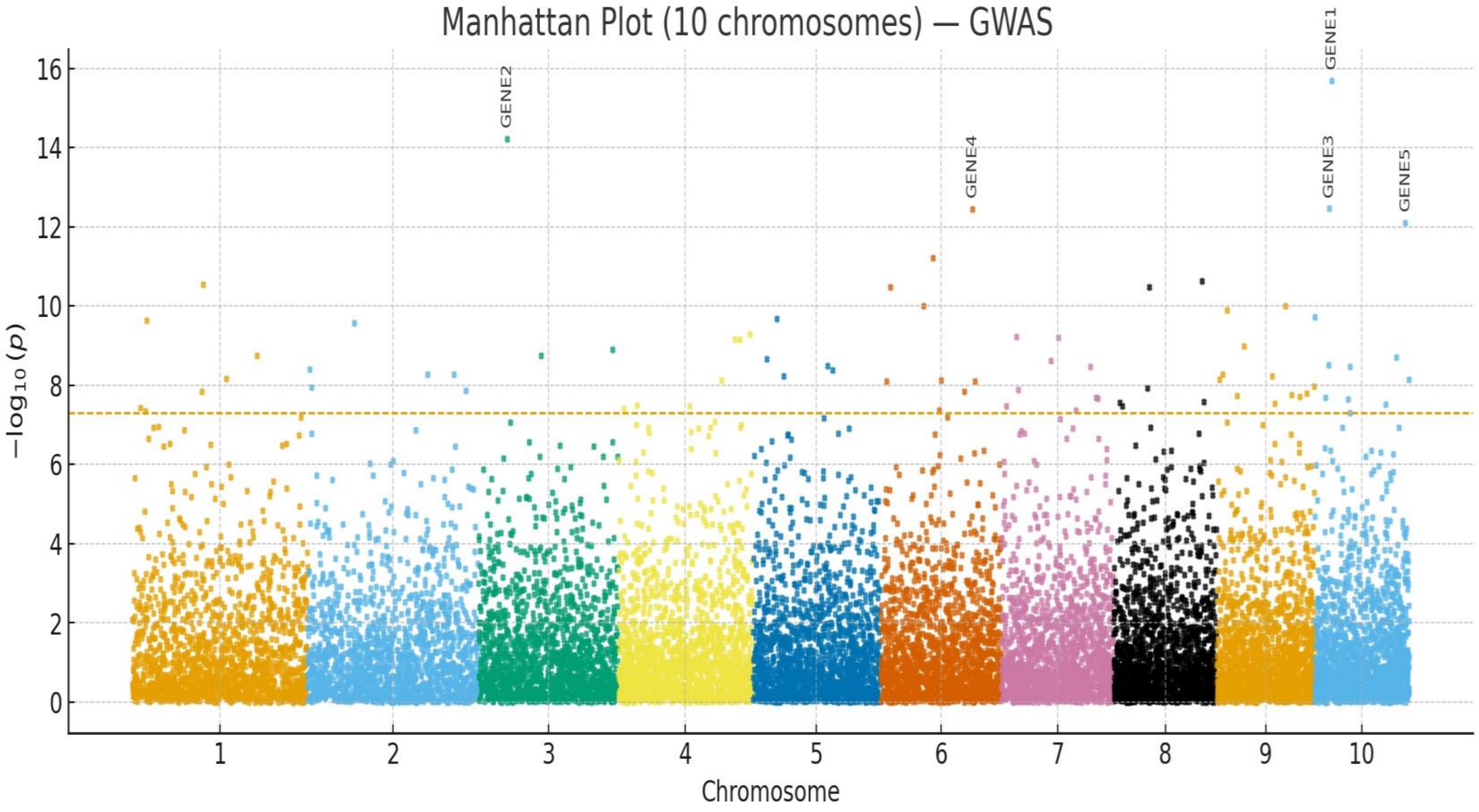
Recently a few genotypes were identified with low lignin content and white or orange midrib.

Lignin content is probably determined by multiple genes having major or minor effects on trait.

Theoretically, hybrids with even higher digestibility can be created than what we experience with current BMR hybrids.

Further research work is needed indeed!

Where to head towards?



The next steps

- Trait association
- Marker development
- Marker validation
- MAS breeding
- Hybrid development

Next generation hybrids on pipeline!

The future hybrids

Value added hybrids have a key importance in future agriculture.

Resistance traits, higher quality or improved yield can contribute to the success of future agriculture.

Modern plant breeding can provide the relevant answers what our changing world is looking for.

We keep our hopes high to have solutions for you!

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Thank you!

Stay tuned – visit us at: www.alfaseed.hu