Sorghum: the safe bet for the future

Potential perspectives and benefits of sorghum silage for starch in the crop rotation of dairy farms in North-Western Europe

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CONTENT

- BRIEF INTRODUCTION ABOUT MAIZE SILAGE ON DAIRY FARMS
- POTENTIAL PERSPECTIVES AND BENEFITS OF SORGHUM SILAGE IN THE CROP ROTATION

DOMINANT LAND USE ON DAIRY FARMS IN NW EUROPE

GRASSLAND

- In the Netherlands mostly minimal 80% of surface of a dairy farm
- In Belgium around 70% and Flanders 55%

MAIZE SILAGE

- In the Netherlands maximum 20% of surface of a dairy farm
- In Belgium around 30% and Flanders 45%
- Maize silage is mostly cultivated without rotation

- Sorghum mainly known as a green manure or energy crop

PROBLEMS WITH PRESENT LAND USE AND CONTINUOUS MAIZE CULTIVATION IN PARTICULAR

POTENTIAL PRODUCTION UNDER PRESSURE

SOIL QUALITY IS DECREASING

- Lower organic matter
- Soil compaction

WATER QUANTITY

- Water holding capacity is decreasing
- Climate change, longer periods of drought

WATER QUALITY

- Nitrate, phosphate and herbicides

DISEASES

CAN SORGHUM BE A SOLUTION FOR THESE PROBLEMS?

- DISEASES
- WATER QUALITY←
- WATER QUANTITY←
- SOIL QUALITY←
- PRODUCTION←

This all from the perspective of sorghum for silage with starch (>250 g kg DM)

DISEASES

Sorghum has other soilborne diseases than maize

- FUNGI
- NEMATODES
- CORN ROOTWORM, EUROPEAN CORN BORER

WATER QUALITY

Nitrogen-use efficiency of sorghum compared to maize

3 CROPS

- Maize
- Sorghum bicolor (C7)
- Sorghum sudanhybrid

3 N-LEVELS

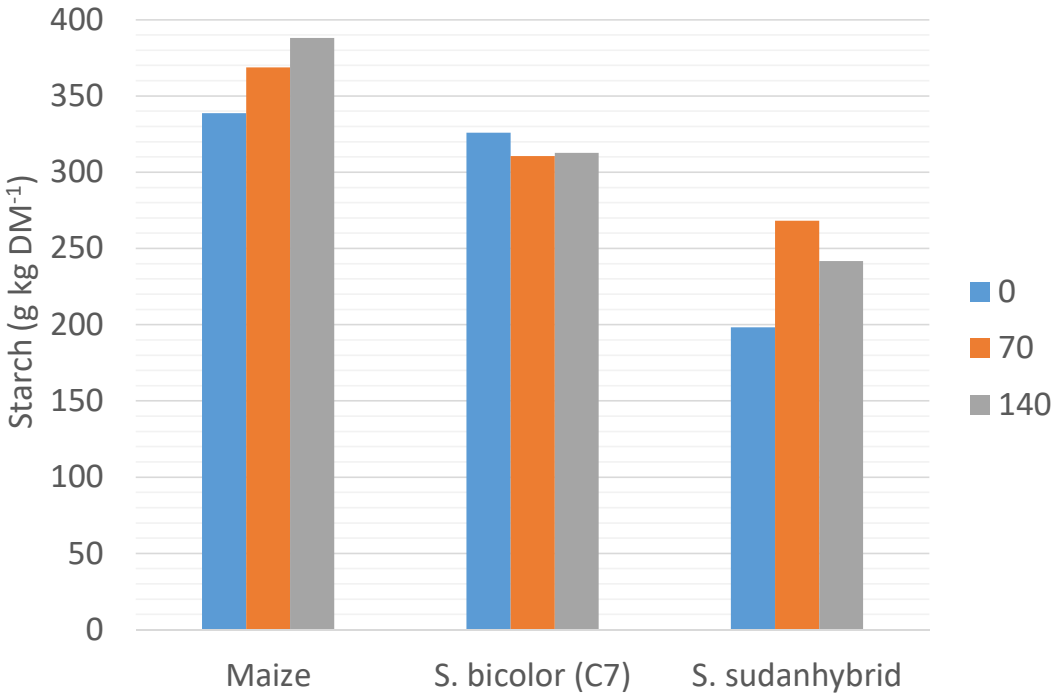
- 0 kg N ha^{-1}
- 70 kg N ha^{-1}
- 140 kg N ha^{-1}

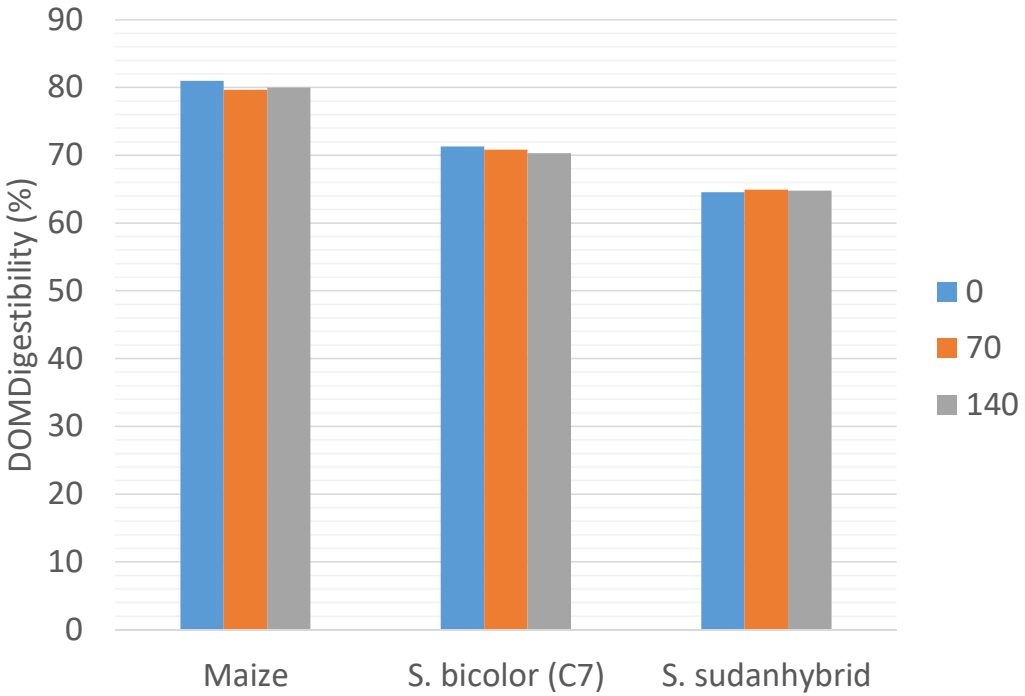
4 REPLICATES

2018 VERY DRY SUMMER, 2 TIMES IRRIGATED

WATER QUALITY, NITROGEN-USE EFFICIENCY OF SORGHUM

Feeding value, starch and Dry Organic Matter Digestibility (Tilley & Terry)

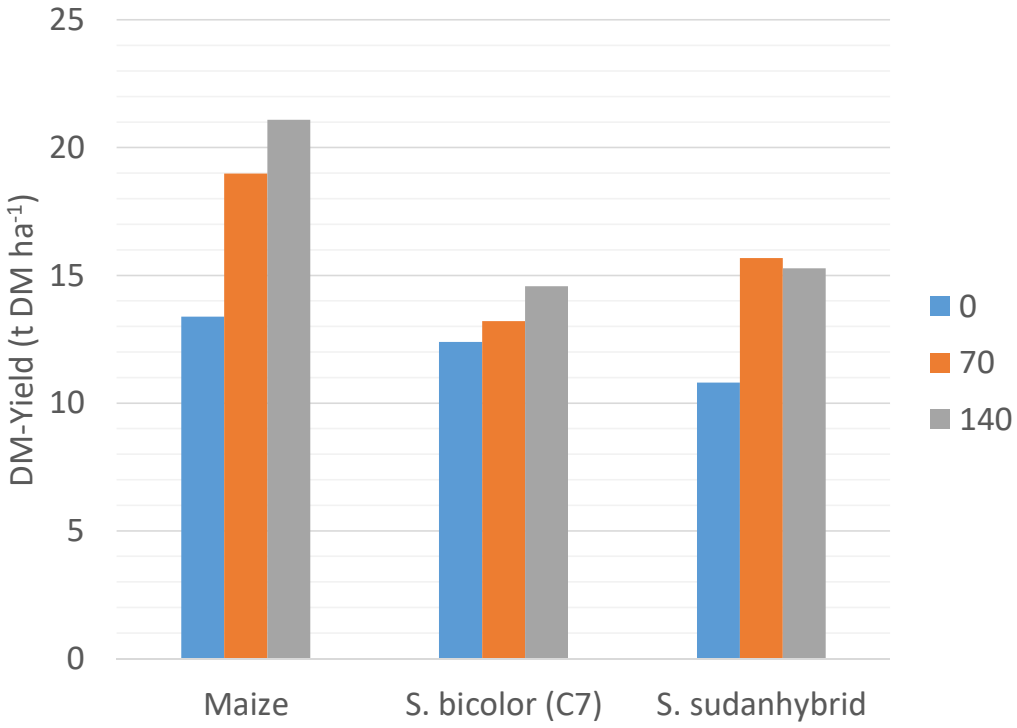


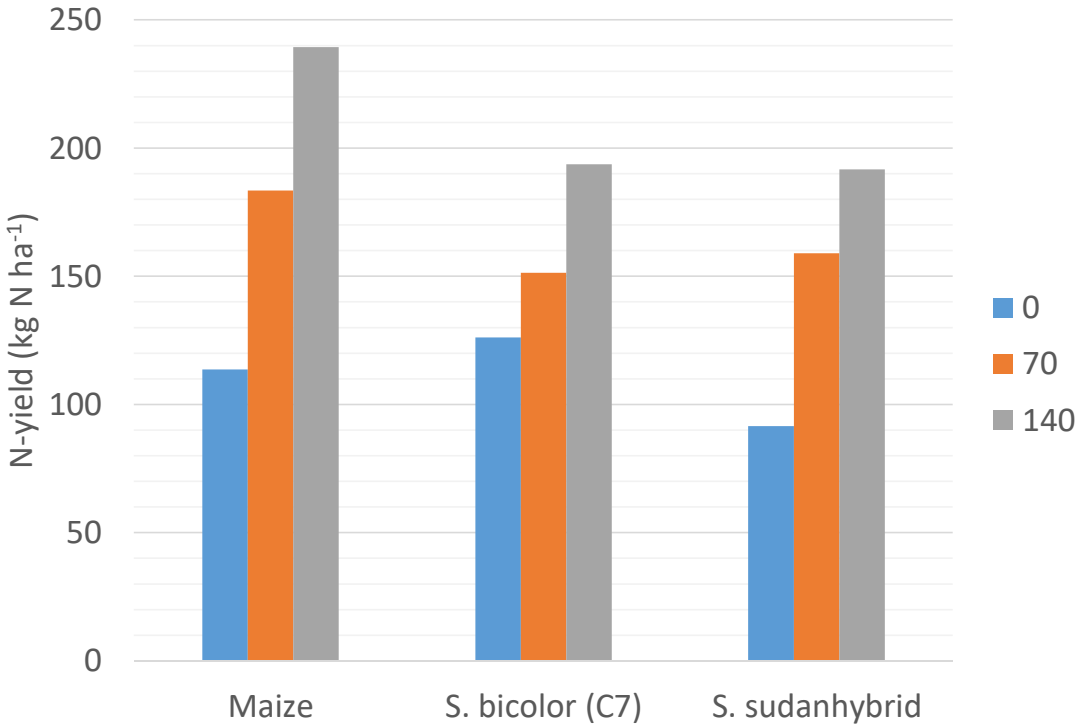


Van Agtmaal et al., in preparation

WATER QUALITY, NITROGEN-USE EFFICIENCY OF SORGHUM

Yield, Dry Matter and Nitrogen

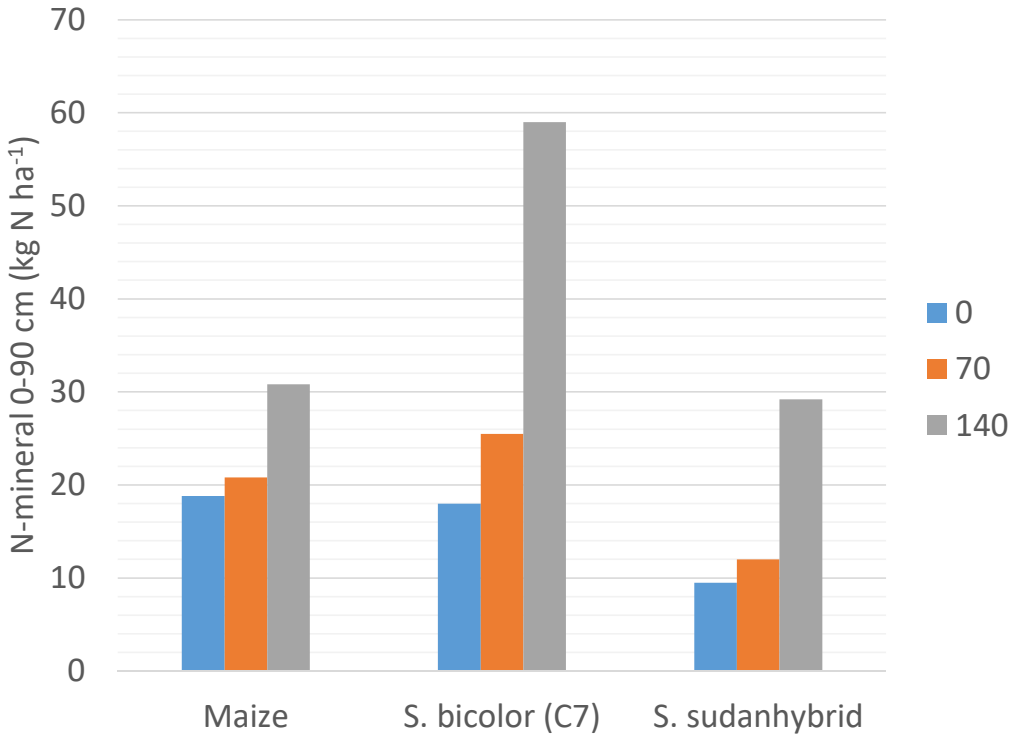




Van Agtmaal et al., in preparation

WATER QUALITY, NITROGEN-USE EFFICIENCY OF SORGHUM

Soil N-mineral residue after harvest in 0-90 cm soil layer



Van Agtmaal et al., in preparation

WATER QUANTITY

- HIGHER WATER USE EFFICIENCY THAN MAIZE
- SORGHUM CAN RESTART FLOWERING AFTER DROUGHT
- DEEPER ROOT SYSTEM WHICH POSSIBLY CAN PENETRATE COMPACTED SOIL

DROUGHT TOLERANCE, ROOT BIOMASS, SOIL QUALITY

Journal of Agronomy and Crop Science

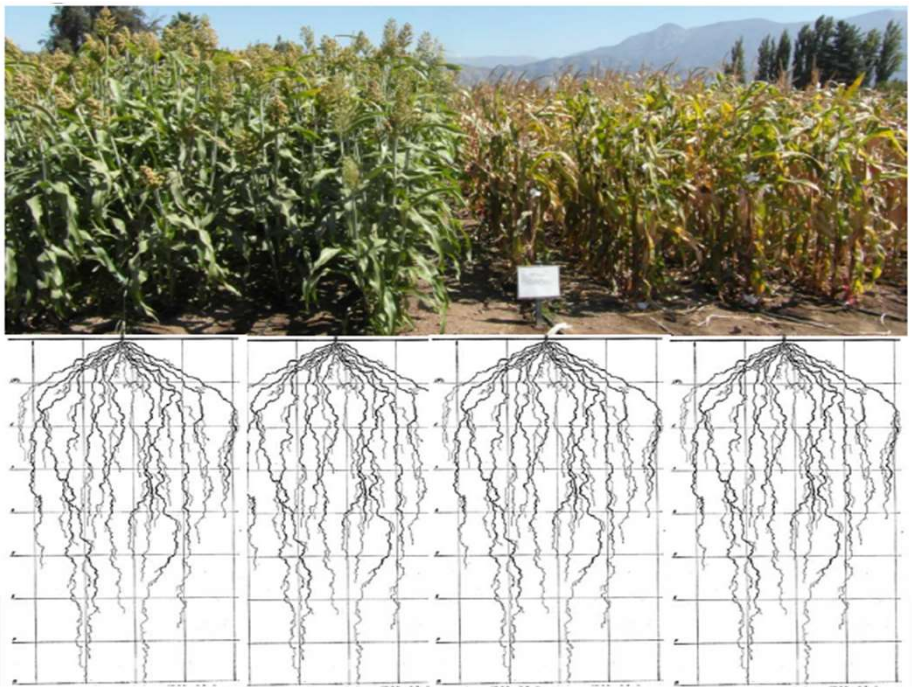
J Agro Crop Sci (2014) ISSN 0931-2250

MISCELLANEOUS

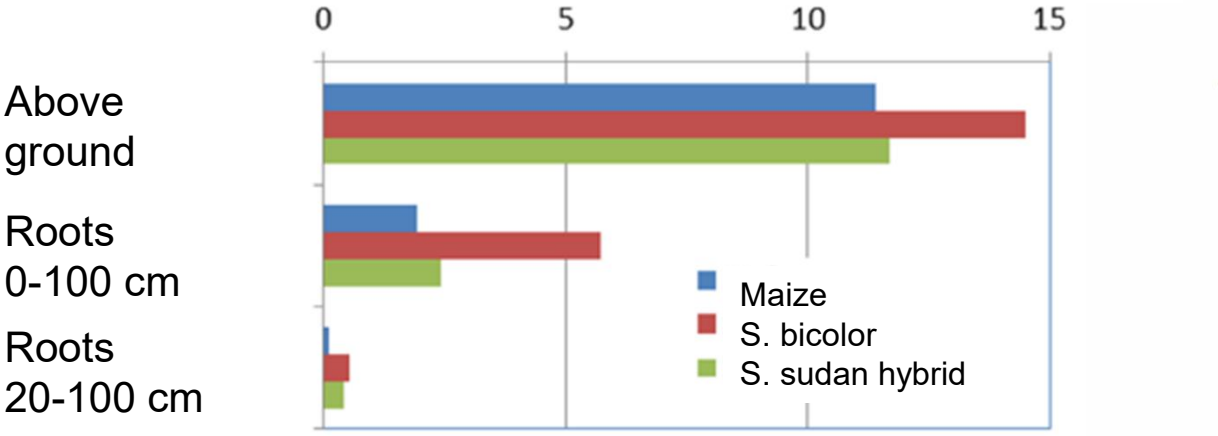
Comparison of Drought Tolerance of Maize, Sweet Sorghum and Sorghum-Sudangrass Hybrids

S. Schittenhelm & S. Schroetter

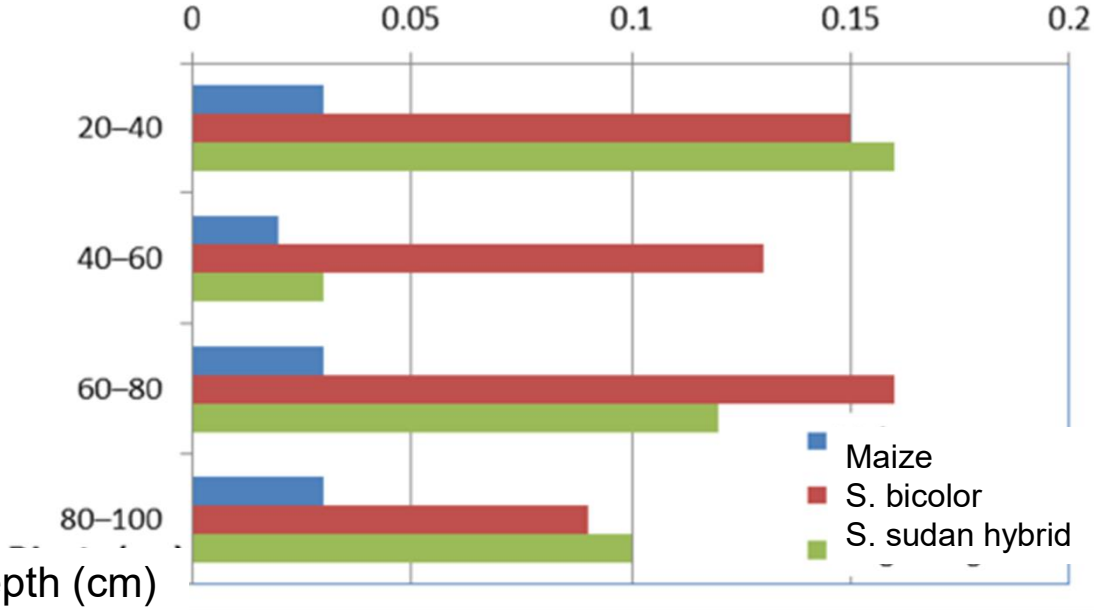
Julius Kühn-Institute (JKI), Institute for Crop and Soil Science, Braunschweig, Germany



DM-yield aboveground and roots (t DM ha^{-1})

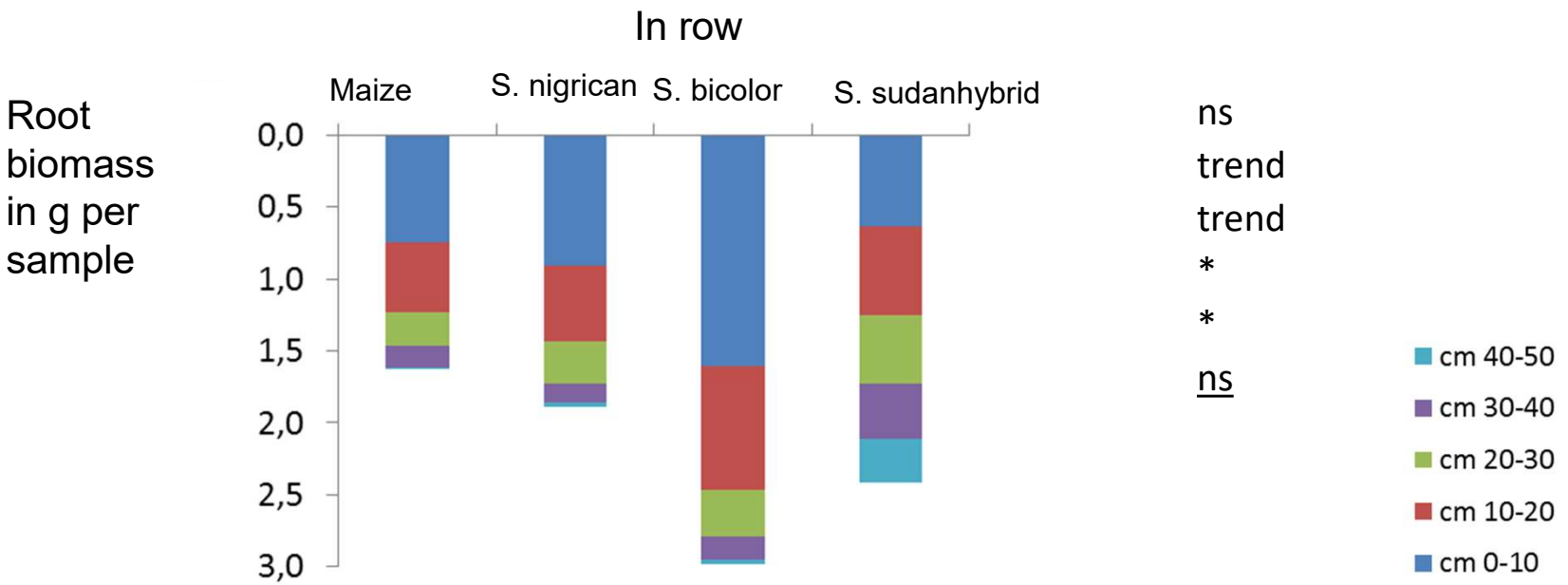


DM-yield roots 20-100 cm (t DM ha^{-1})



Schittenhelm & Schroetter, 2014

ROOT BIOMASS (DROUGHT, SOIL QUALITY, ORGANIC MATTER)

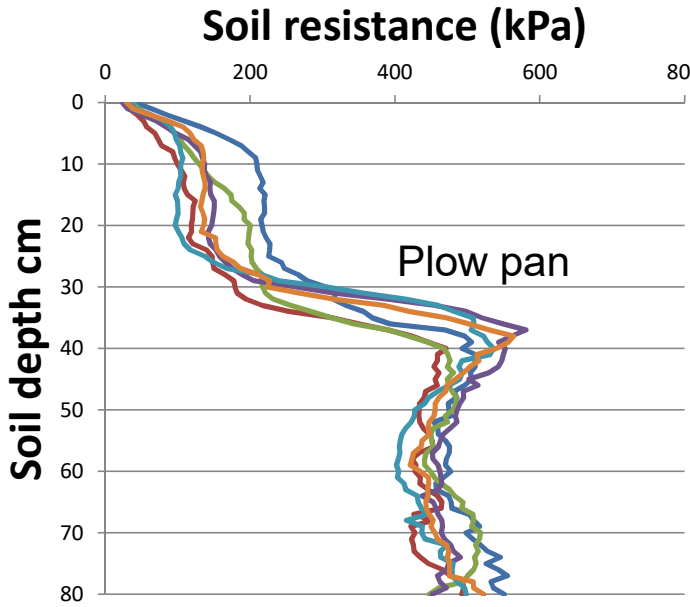


Deru et al, data 2017 in preparation

SOIL QUALITY AND EFFECT IN CROP ROTATION

ENERGY CROPS

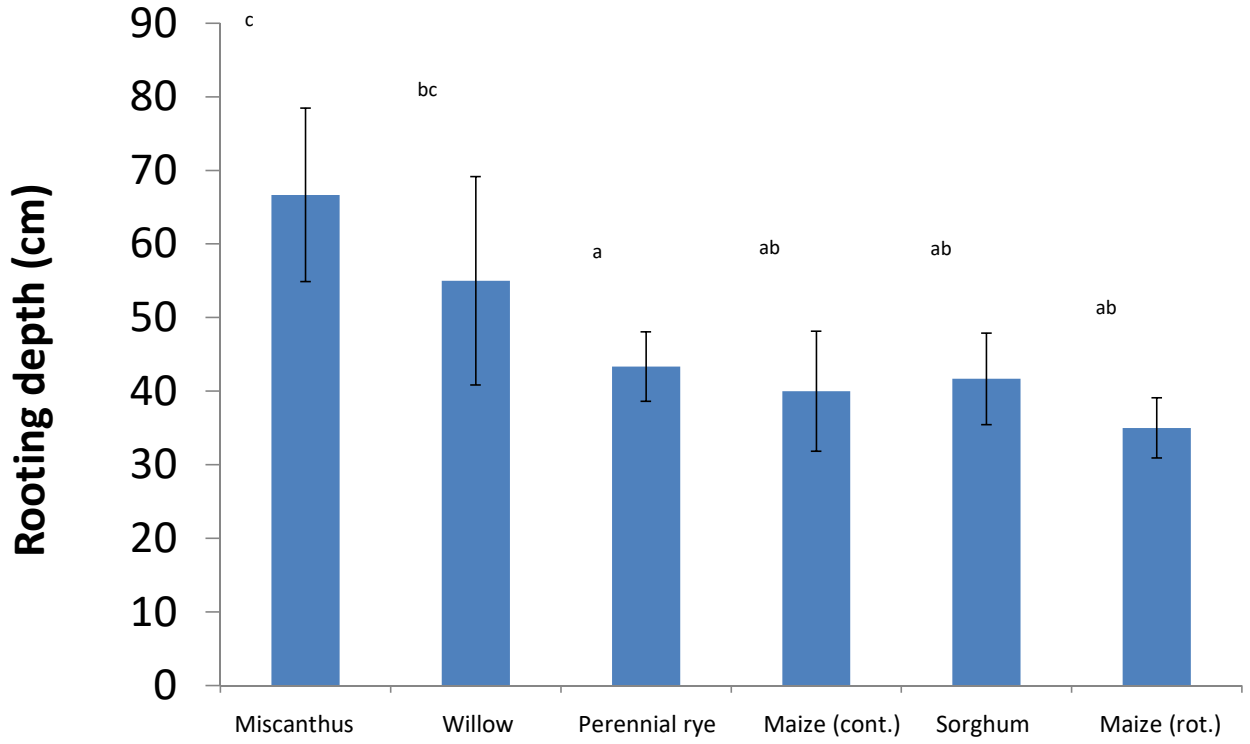
- Miscanthus
- Willow
- Perennial rye grass
- Maize continuous cultivation
- Maize (1st year) in rotation with Italian rye (2nd year) and sorghum (3rd year)



AFTER 8 YEARS MEASUREMENT OF SOIL QUALITY

Muylle et al., 2015
Van de Goor et al., 2017

ROOTING DEPTH



Van de Goor et al., 2017

SOIL QUALITY

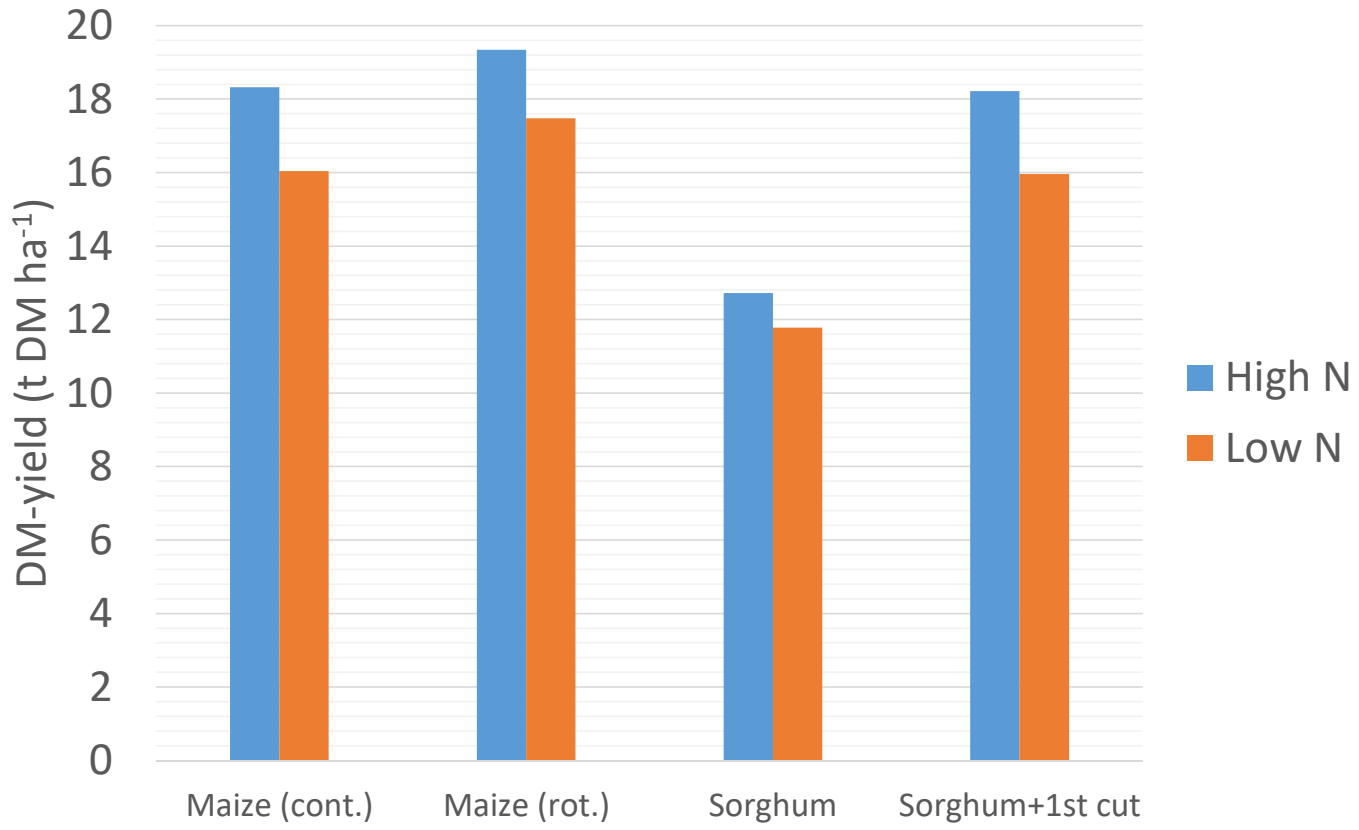
Soil Health Care

			Treatments					
	Variable	P-value	Miscanthus	Willow	Perennial rye	Maize (cont)	Sorghum	Maize (r
Physical	*Available Water Capacity*	0.16	41	34	43	29	34	38
	Aggregate stability	0.012	46a	45a	52a	22b	19b	22b
Biological	*Organic matter score*	0.042	25ab	39a	46a	16b	19b	20b
	Soil protein index score	0.383	28	50	42	20	23	25
	Respiration score	<.001	26b	38a	27b	15c	17c	18c
	Active carbon score	0.197	27	48	44	21	14	23
Chemical	*pH score*	<.001	10b	73a	0b	22b	20b	14b
	K score	0.465	100	100	100	100	99	100
	Micro-elements score	0.058	85	100	56	85	71	56
	Total score		49	62	51	43	41	41

Van de Goor et al., 2017

CROP ROTATION (POSITIVE EFFECT ON MAIZE PRODUCTION)

Increase of 1.44-1.02 t DM ha^{-1}

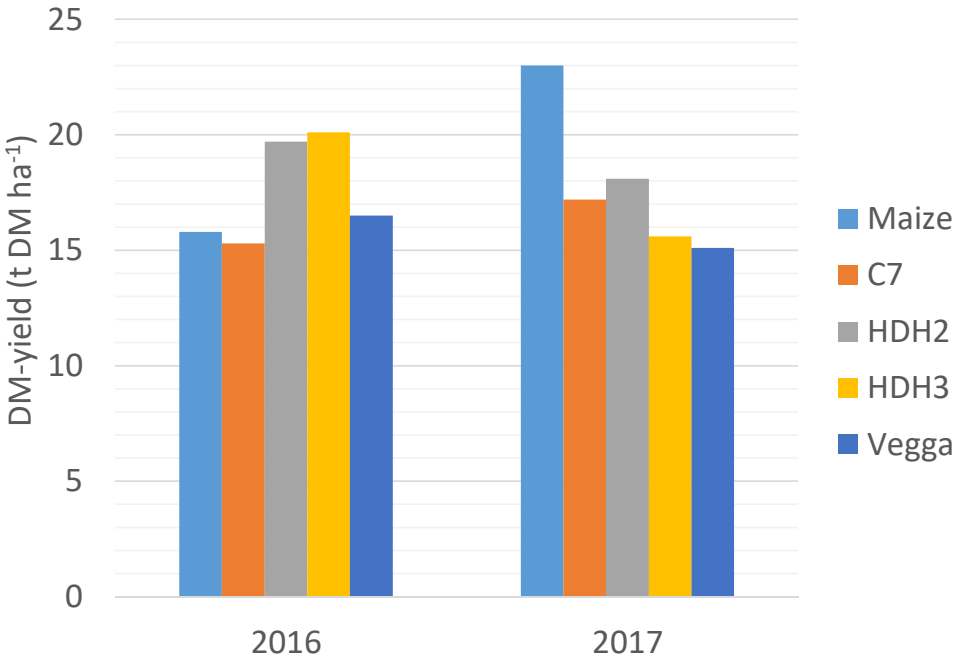


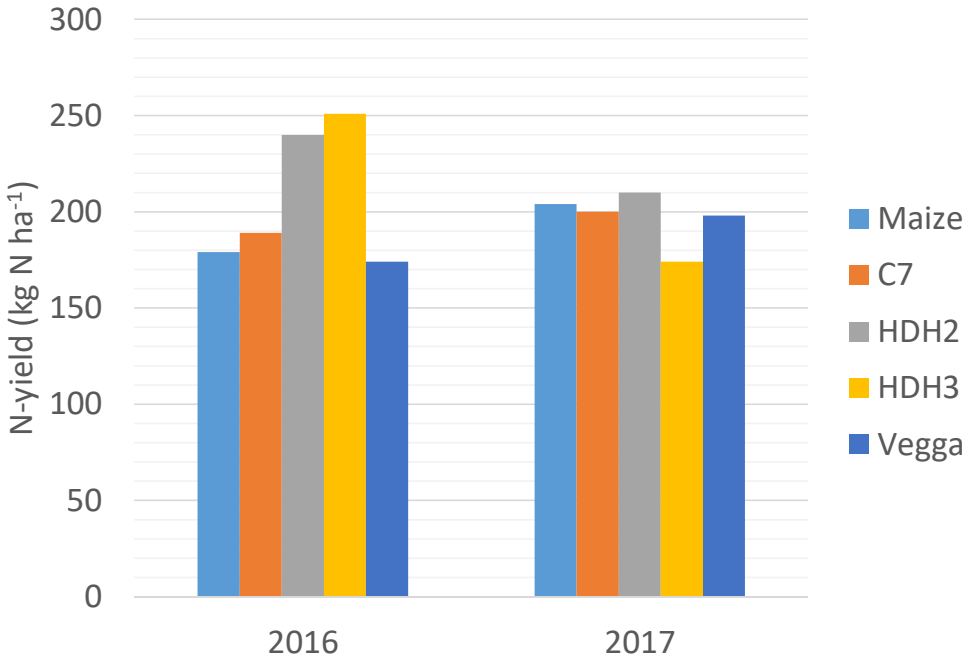
Van de Goor et al., 2017

GENETICS

GENETICS

2016 Wet spring, dry and warm summer, 2017 Dry spring, wet and cold summer





Van Goor et al., 2017

Van Eekeren et al., 2018

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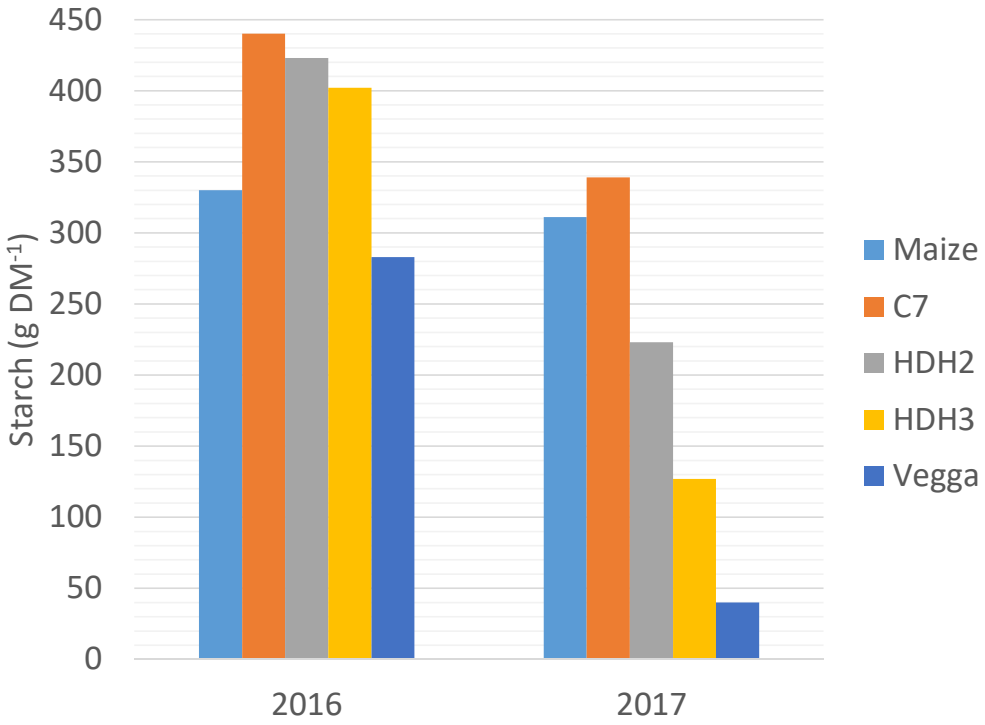

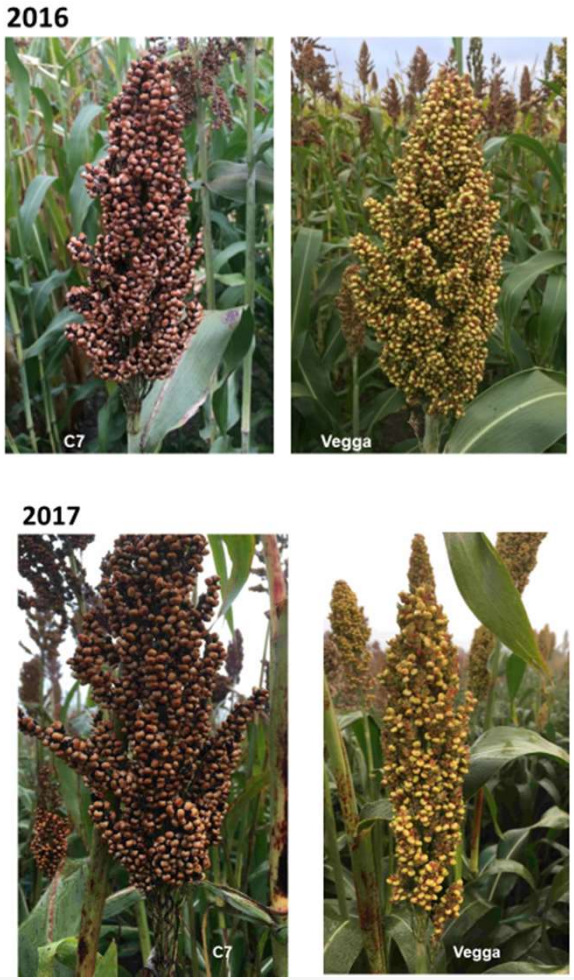

Van Goor et al., 2017
Van Eekeren et al., 2018

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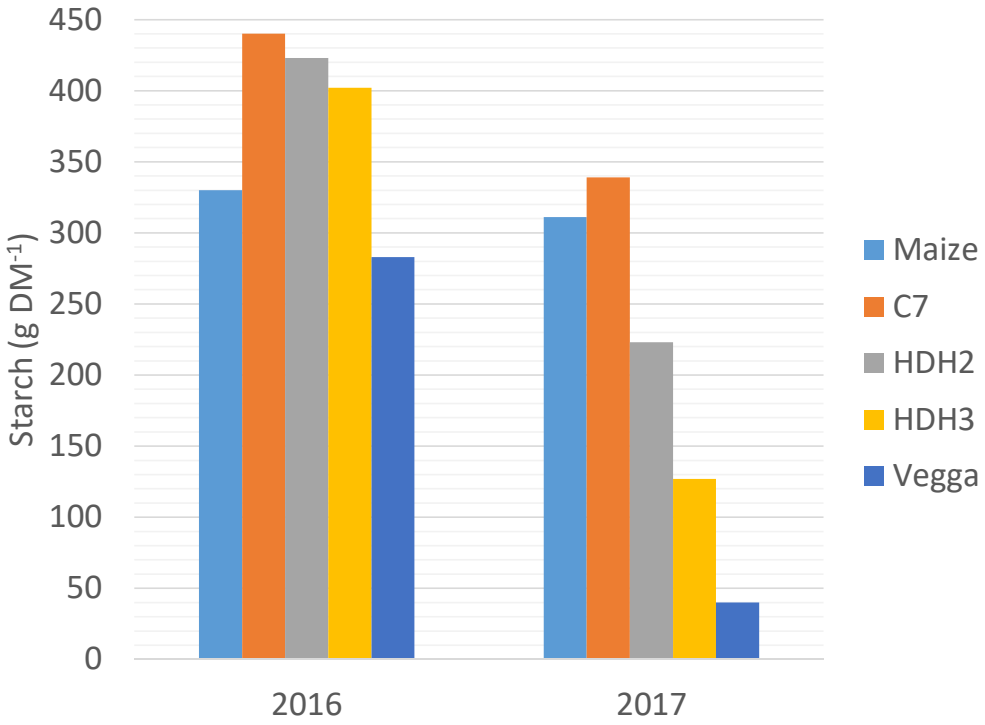

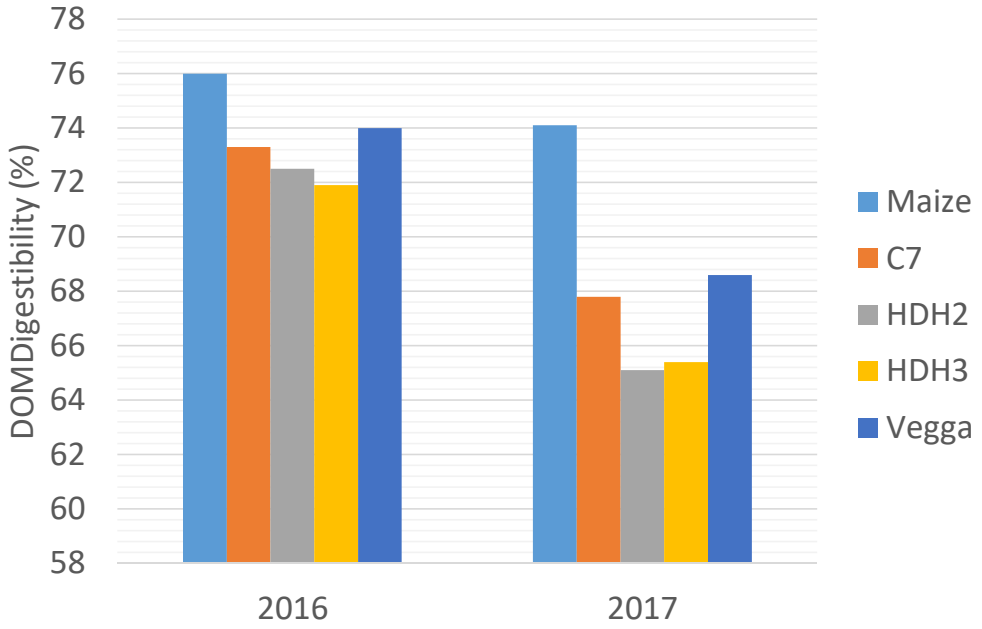

Van Goor et al., 2017
Van Eekeren et al., 2018

CONCLUSIONS

- SORGHUM HAS POTENTIAL PERSPECTIVES AND BENEFITS IN CROP ROTATION ON DAIRY FARMS IN NW-EUROPE
- SORGHUM CAN HELP TO REDUCE DISEASE AND PEST PROBLEMS AND IN CASE OF MAIZE CAN INCREASE YIELD IN CROP ROTATION
- ADVANTAGES FOR DROUGHT TOLERANCE, WATER QUALITY AND IMPROVEMENT OF SOIL QUALITY ARE NOT CLEAR SO FAR
- HUGH BREEDING EFFORTS HAVE BEEN MADE BUT FIRST SELECTIONS ARE NOT WIDELY ADAPTED.
- ON SHORT TERM FURTHER BREEDING NECESSARY BEFORE FULL PERSPECTIVES AND BENEFITS ARE CLEAR

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- ILVO (Alex de Vliegher, Joke Pannecoucque, Johan van Waes)
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- LTO
- Zuivel.nl