LANDESAMT FÜR UMWELT,
LANDWIRTSCHAFT
UND GEOLOGIE

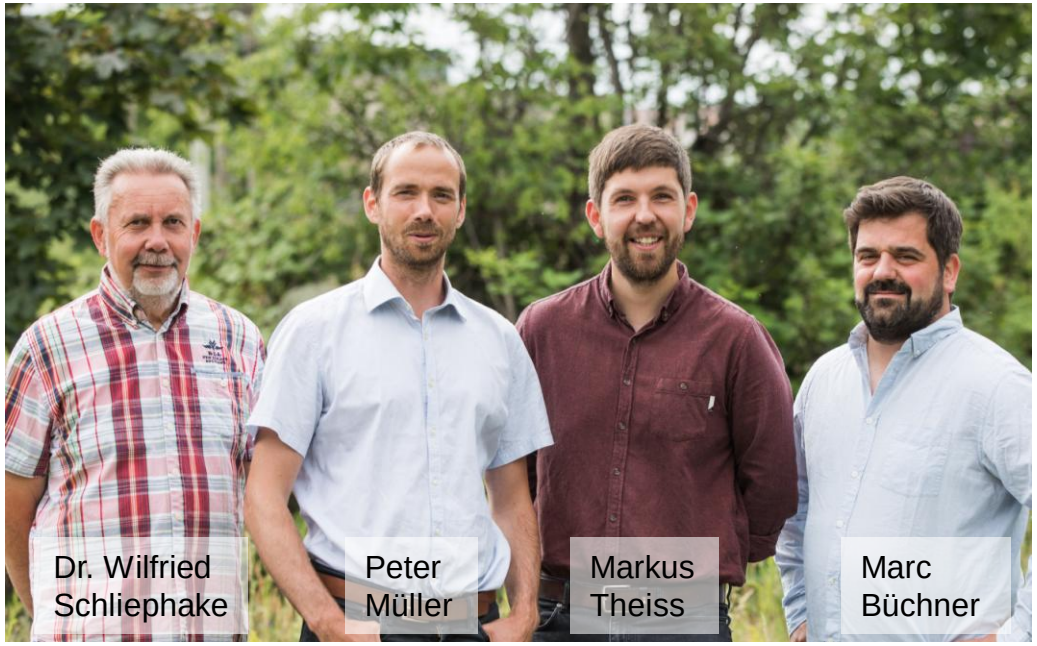
Freistaat
SACHSEN

AgUmenda

Opportunities for Good Utilisation - Nitrogen Utilisation of Organic Fertilisers

Peter Müller – AgUmenda GmbH

AgUmenda GmbH

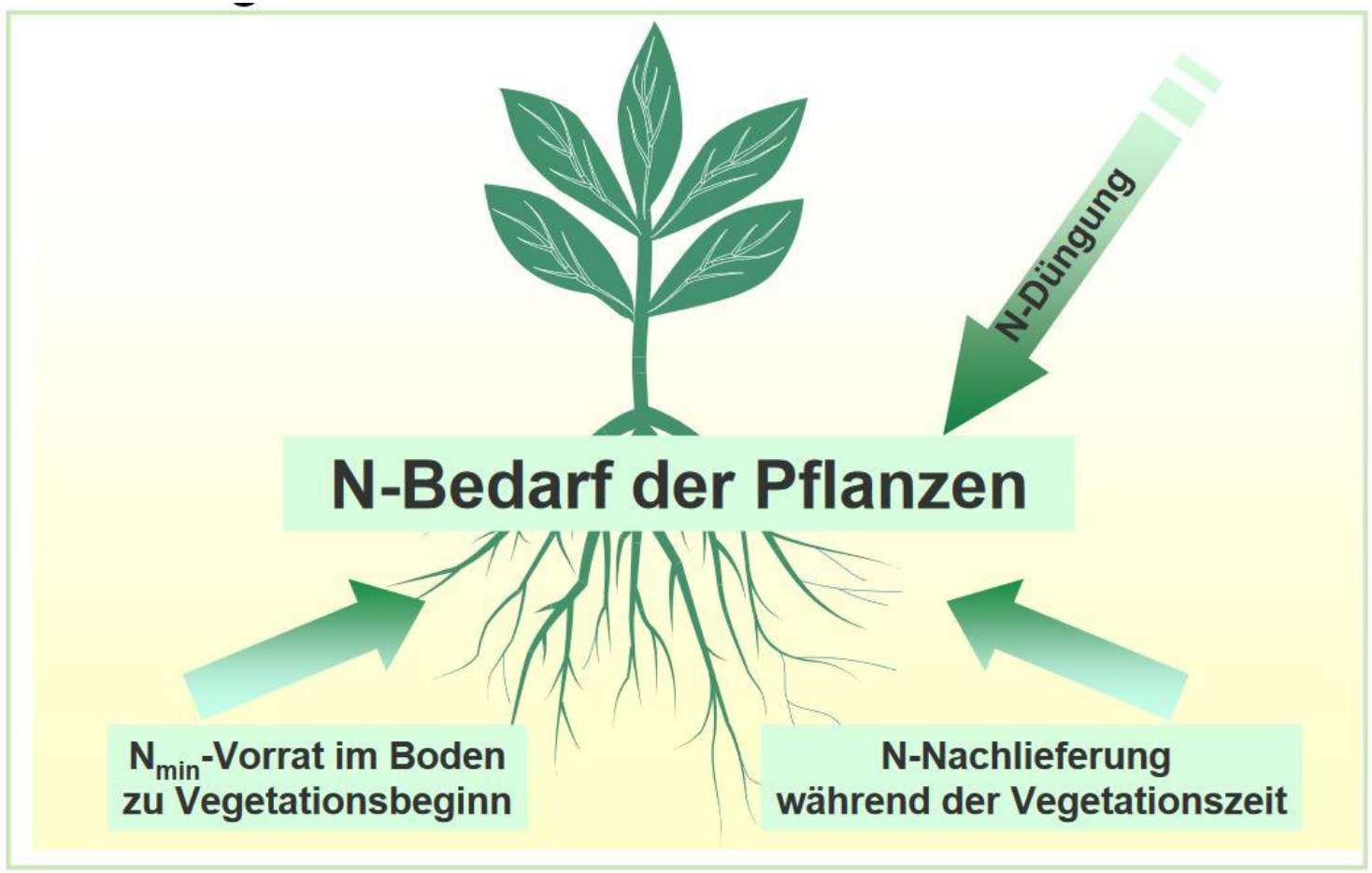


Focal areas:

- Support for agricultural consulting for water protection in Saxony on behalf of the LfULG
- Cooperation with research institutions
- Agricultural consulting
- Support for project-related orders with the industry

Further information under
www.agumenda.de

Calculation of the legally and optimal compliant N-requirement quantity



- Legally Quantification of N replenishment:
  - Determination of the minerally available N before the first fertilisation in February/March
  - N-requirement is legally stipulated in Germany for each crop and their yield
  - Calculation depends on previous crop, organic fertilisation in the year before and the mineralisation

Possibilities for optimising N-fertilisation

Winter grains

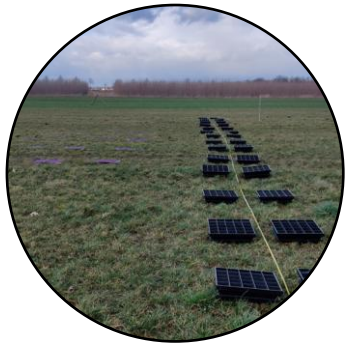
- N_{min}-sampling
- up to 90 cm deep
- Nitrate quick test + fertilisation window
- Org. fertilisation in crop
- Urease inhibitors

Rapeseed

- N-uptake before winter

Maize, sugar beet

- Site-specific N-replenishment
- N-supply catch crop
- Higher N-utilisation org. fertiliser
- Nifis slurry/UI AHL
- Strip processing



General

- Fertiliser spreader optimisation
- Catch crop cultivation
- pH/basic nutrients
- Cultivation of extensive crops

Partial area

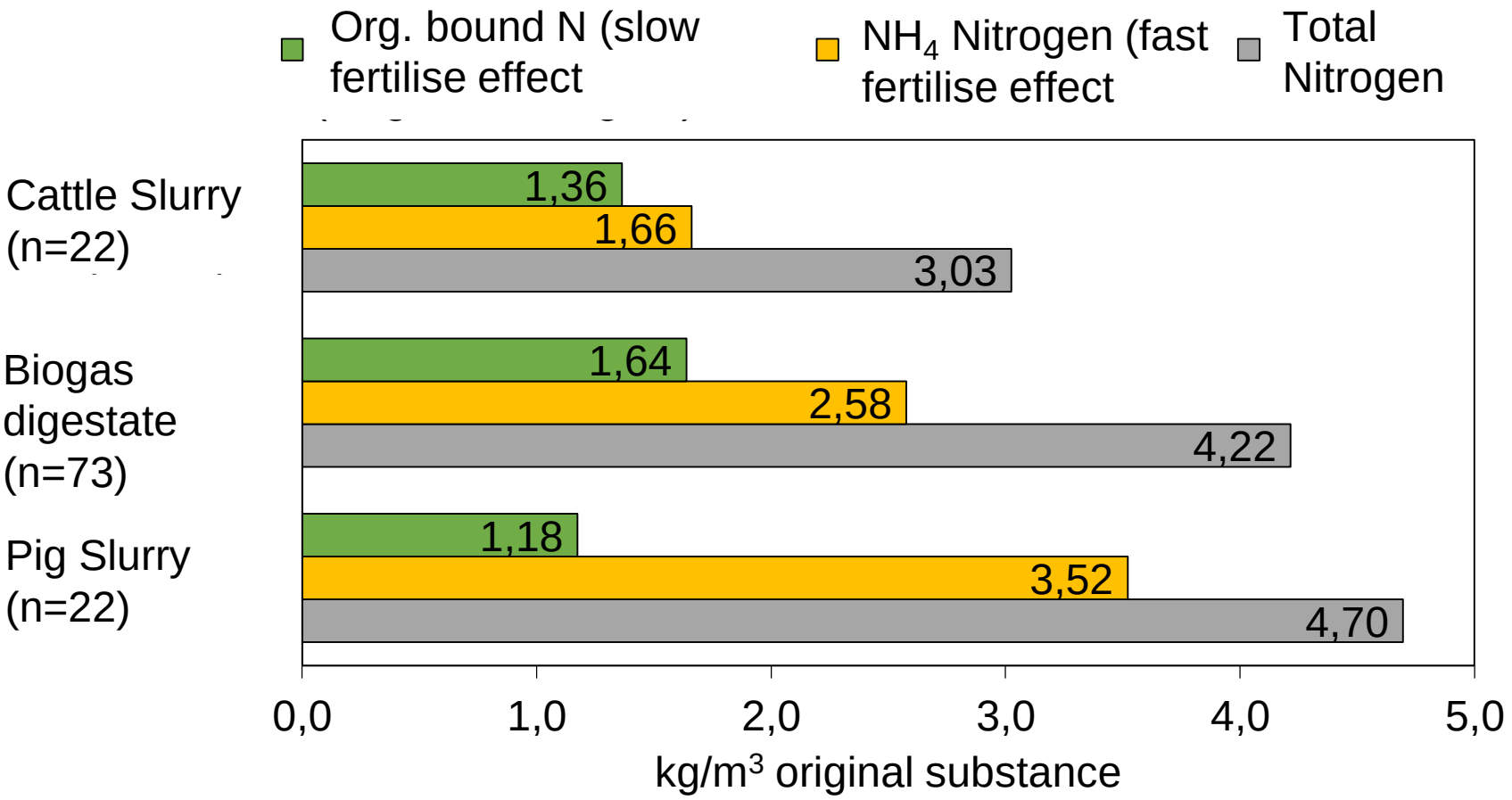
- Rapeseed fertilisation according to satellite maps
- Var. basic fertilisation
- N_{min}-sampling according to zones
- Stable yield zones

Organic fertilisation

Ingredients / Nutrient availability

N-characteristics of organic fertilisers

Multi-year manure analyses from consulting operations



NH_4-N

- In the liquid phase
- Almost 100 % effective with low-loss application

Org. bound N

- Firmly bound in the org. substance
- Must first be mineralised
- Convertibility depending on C/N ratio

Simplified representation for N-utilisation of cattle slurry/digestate by crop and application date

Month	Rapeseed	W-grain	Maize	Turnip, potato	Field grass, grassland
February	60 %	60 %			Better**
March	60 %	60 %	Better*	Better*	Better**
April	Rather lower	Rather lower	Better*	Better*	60 %
May		Certainly lower	60 % (or lower)	60 % (or lower)	Rather lower

* For direct incorporation ** For slurry with low TS

Classification according to DüV

- Crop efficiency = 60

Professional classification

- NH_4-N fully available in rapeseed and winter grains
- Summer crops also use organic N in fertiliser

Organic fertilisation in gains and rapeseed crops

Grains / Winter rapeseed

Results for N-utilisation of organic fertilisers in wheat on a heavy loess site (Dornburg)

Source: Zorn TLL

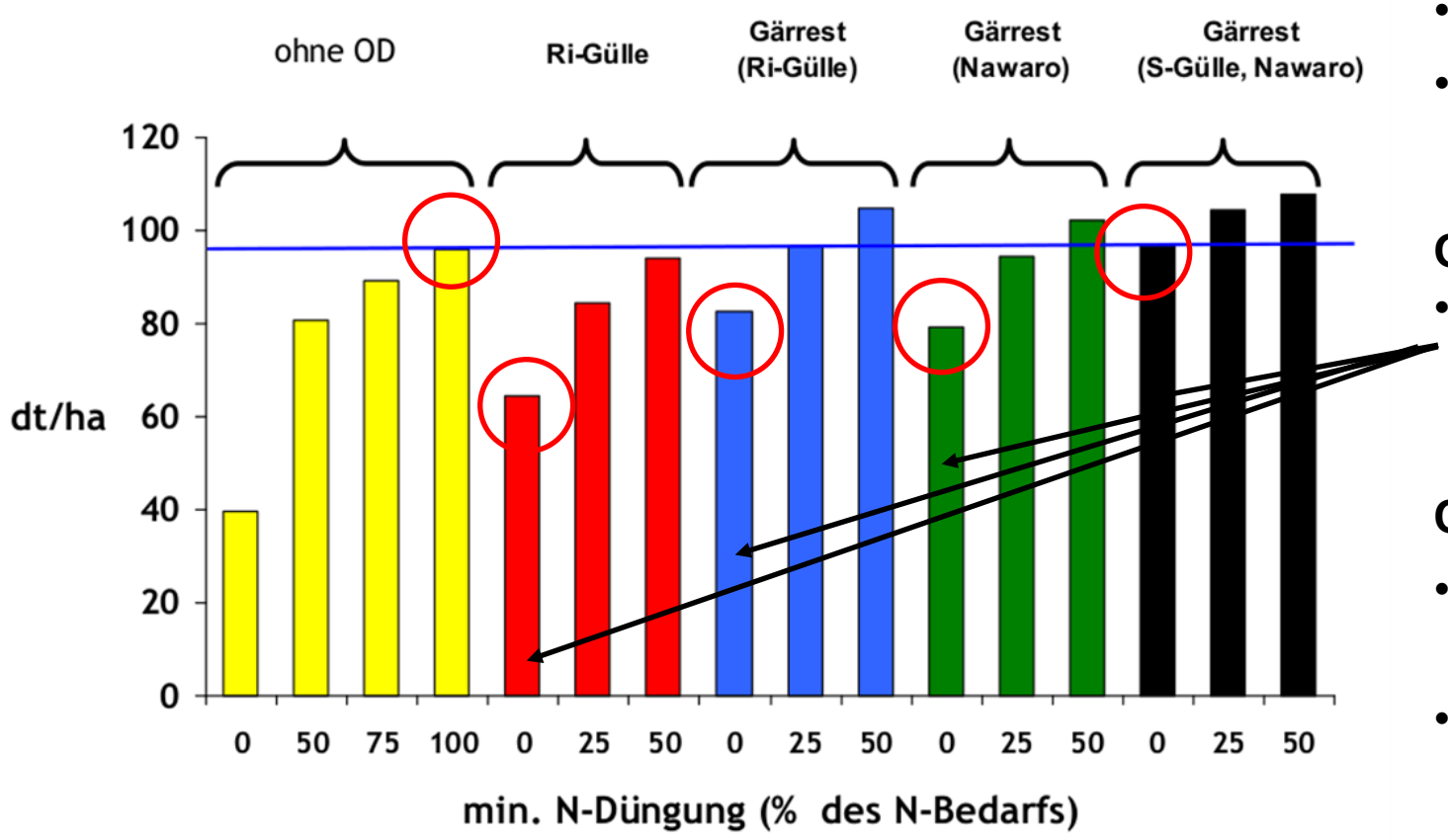
Parameter	Schwerer Standort[1)]			
	Rinder-gülle	Gärprodukt aus		
		Rinder-gülle	NawaRo/ Mist	Schweine-gülle
TS %	10,1	5,8	12,0	2,5
Nt %	0,42	0,30	0,79	0,45
NH_4-N %	0,21	0,19	0,51	0,40
NH_4-N % von Nt	50	63	65	89

Foto: Schröter

Output to VB

Results for N-utilisation of organic fertilisers in wheat on a heavy loess site (Dornburg)

Source: Zorn TLL



Location

- Dornburg - loess brown soil
- Start of vegetation at the beginning of March

Organic fertilisation

- Same amount of total N in each case, very different amounts of NH_4-N depending on the fertiliser

Conclusion from the trials

- N-MDÄ strongly dependent on the organics used. Fertiliser
- Taking into account the NH_4N content, same yields as with purely mineral fertilisation

Operational advice on the influence of driving over with slurry technology on grain yield in the field (2020)

Organic use often as second application in mid/late March

Tabelle 2: Auswirkung der Überfahrung der Getreidebestände im Frühjahr auf das Ertragsgeschehen in den untersuchten Betrieben

Parameter	Ort 1	Ort 2a	Ort 2b	Ort 3	Ort 4	Ort 5	Ort 6	Ort 7
Ertrag im nicht befahrenen Bereich (dt/ha)	120	89	106	74	72	93	68	66
Ertrag im Bereich der Fahrspur (dt/ha)	114	78	82	63	70	90	71	57
Spurbreite (m)	4	4	4	4	1,8	4	4	1,8
Arbeitsbreite (m)	8	18	18	8	12	6	8	18
Spuranteil (%)	50	22,2	22,2	50	15	67	50	10
berechnete Ertragsreduktion auf der Gesamtfläche in (%)	2,5	2,7	5,1	6,8	0,5	2	0	1,3

Bei trockenem Boden kaum Ertragsrückgang

Welche Auswirkungen hat im Frühjahr die Überfahrung von Getreidebeständen mit schwerer Gülletechnik auf den Getreideertrag? Dieser Frage wurde in Sachsen nachgegangen. Die Befahrbarkeit sollte gegeben sein, ansonsten leiden die überfahrenen Pflanzen.

Article published in the farmers' magazine "Technik für den Pflanzenbau 2020" (43rd week)

Location 1/3/5/6: SD + trench
Location 2: SD + dribble bar
Location 4: Tractor + trench
Location 7: Tractor + dribble bar

SD: Self-driving

Damage from driving over on winter rapeseed crops – sandy loam site

Spreading date - end of September 2017 shortly before the blocking period
Technology: Fendt 828 with Annaburg tandem axle barrel and 16 m dribble bar system

Conclusion: The lane had only marginal effects on yield due to the compensatory capacity of the winter rapeseed

Solution - Fixed lanes through wide trailing shoe or dribble bar systems

Creation of fixed lanes - these are used again every year

Andreas Schmidt, ExAgt GbR (Agrarmanager 05/2017)

Annual application in fixed lanes - soil structure changes without impact

Närmann-Peitzmeier GbR

Conclusion:

- Large working widths enable spreading in the crop
- Lanes can be loosened in a targeted manner if required
- Permanent lanes do not require deep loosening

Solution approach - Self-driving with crab steering

Prerequisite - Conservation tillage; late sowing, passable soils

Advantages - Independent process, avoidance of compaction due to crab steering

Visually visible growth depressions have no influence on yield: “strength lies in rest”

<u>Conclusion:</u>

- Low-loss application of liquid organic fertilisers
- Spreading before growing

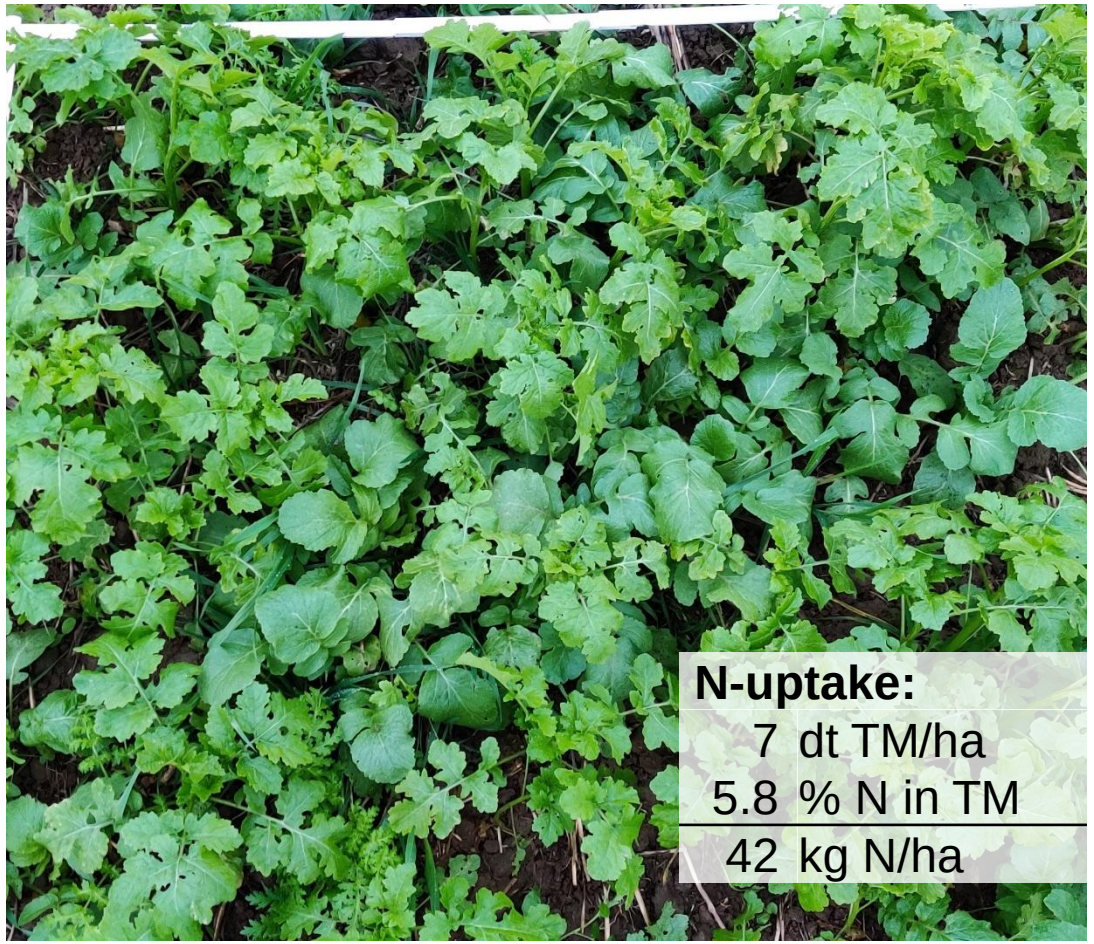
Assessment of the N-quantity for sugar beet and maize under consideration of the N-supply through regular organic fertilisation

Maize / sugar beet

Mustard crop (intercropping) in the Torgau area, 26/11/2020

N-uptake:

46	dt TM/ha
2.8	% N in TM
127	kg N/ha

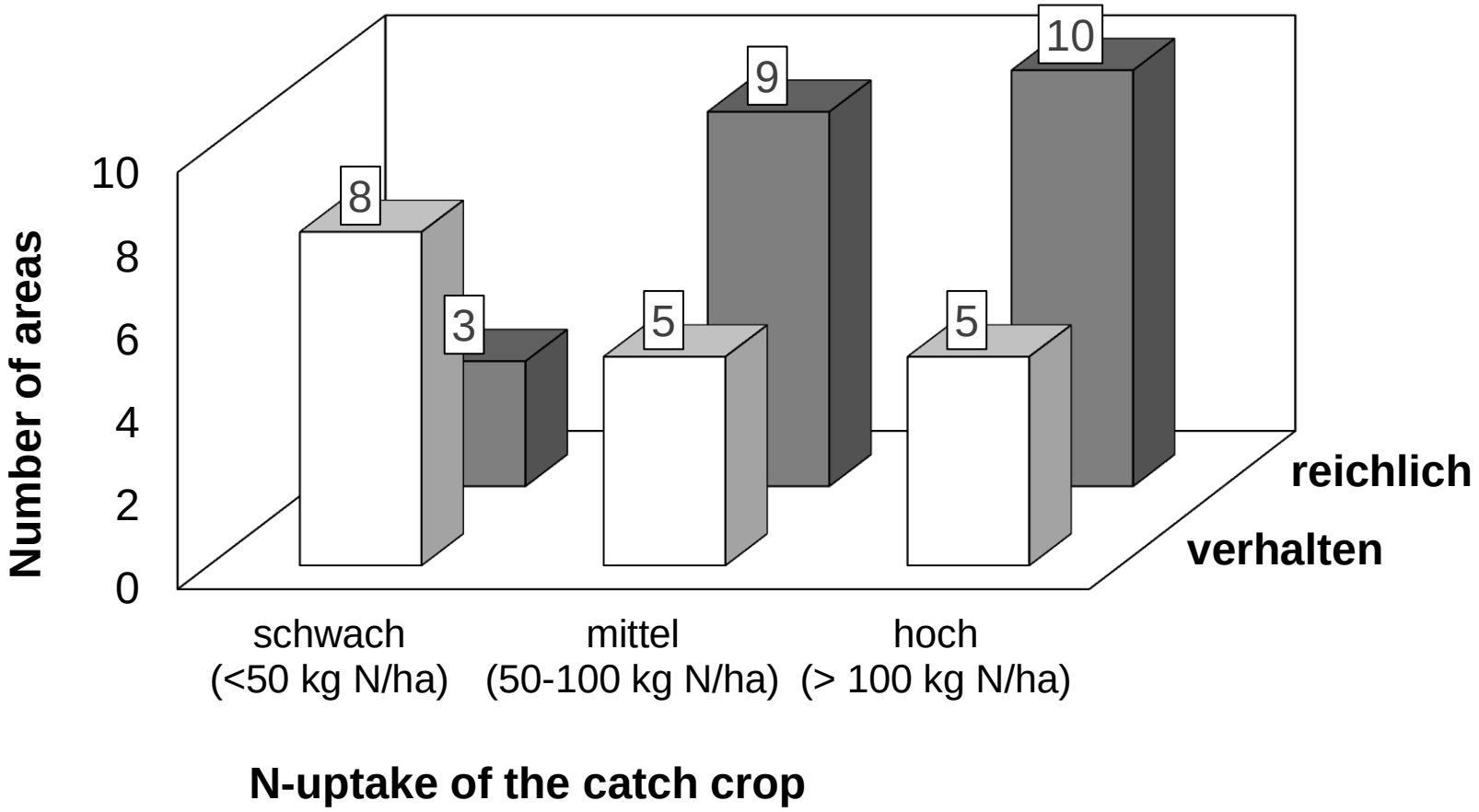


N-uptake:

7	dt TM/ha
5.8	% N in TM
42	kg N/ha

N-uptake of catch crop with different N-supply

(40 practice plots in the period 2018-2020)



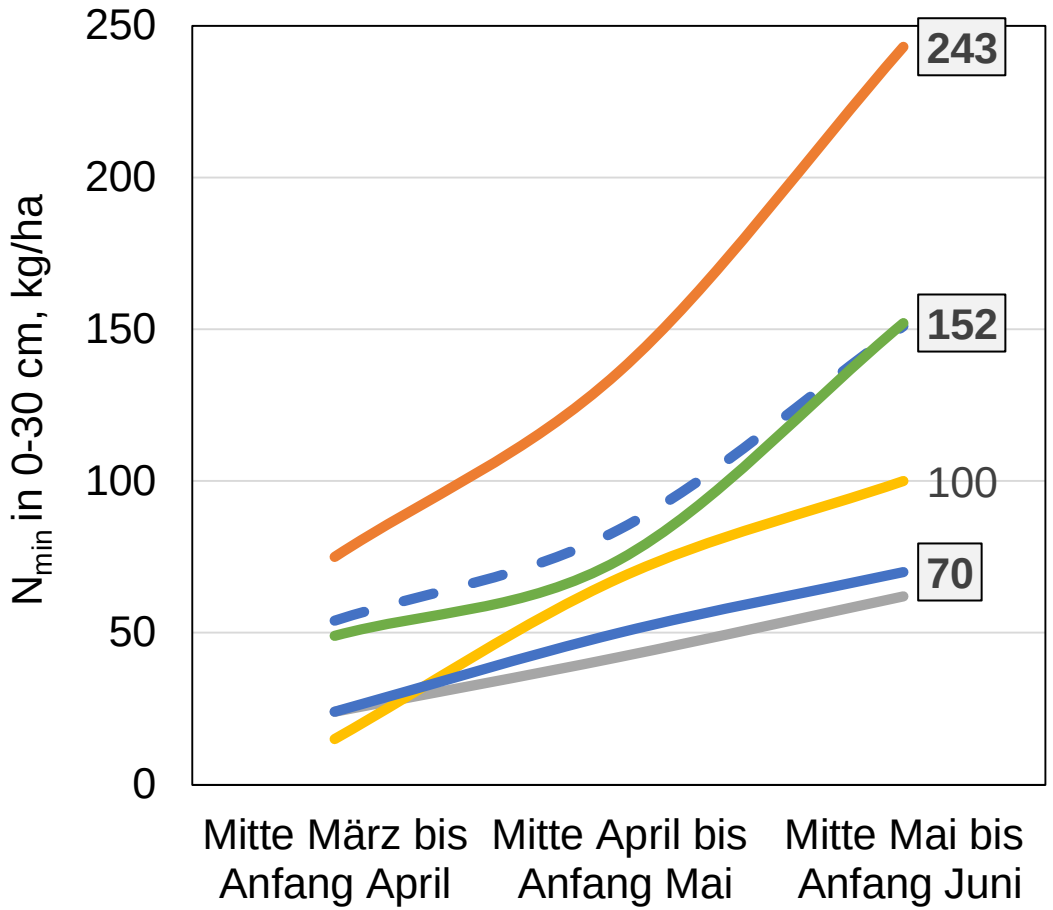
- Nutrient supply is an essential factor for N-uptake
- In the case of vigorously developed, well-nourished catch crop, **at least 15 %** of the N-uptake can be credited (to maize, sugar beets)
- Rough guide value to determine independently:
  1 kg fresh matter/m2 = 35 to 40 kg N/ha

Operational consulting on fertiliser windows in maize (and sugar beet)

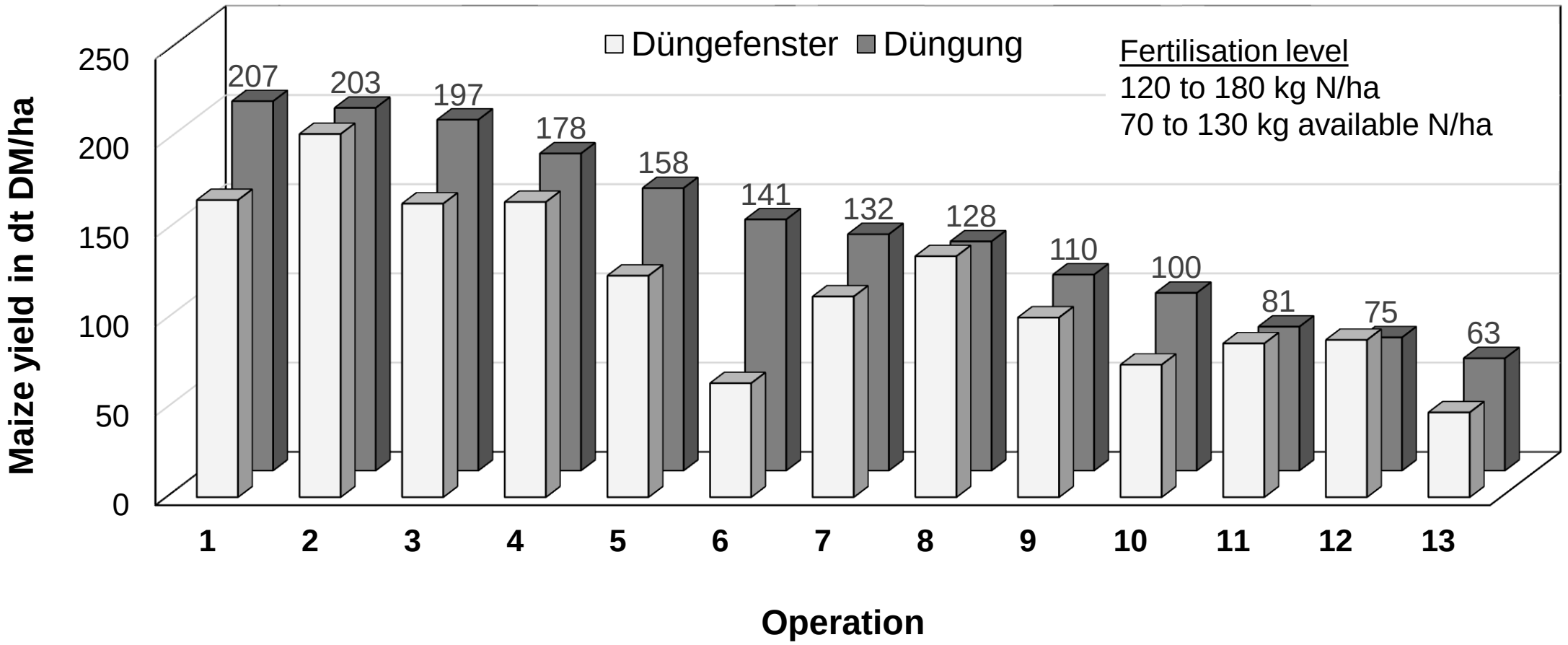
- **Fertilisation window** = without org. fertilisation (UFD, possibly MD re-spread)
- Regular N_{min}-sampling until the beginning of June

- Determination of TM yield and N-removal in the fertilisation window and with operational fertilisation
- N_{min}-sampling after harvest

Development of N_{min}(0-30 cm) under maize and sugar beet in the fertilisation windows



Realised TM yield of maize in the fertilisation windows compared to maize fertilised as usual



Subsequent N-quantities supplied in the maize fertilisation windows

(Operations 1 to 8, better soils and/or more precipitation)

Location	N-removal, kg/ha	N-replenishment, kg/ha	Change in N_{min} at harvest, kg/ha
Operation 1	180	**157**	-5
Operation 2	252	**242**	-10
Operation 3	187	**179**	-8
Operation 4*	162	**162**	0
Operation 5*	121	**98**	+26
Operation 6	**53**	**2**	**-33**
Operation 7	123	**128**	+3
Operation 8	161	**117**	15
Operation 9	95	**112**	**+62**
Operation 10	92	-	**-**
Operation 11	99	**161**	**+80**
Operation 12	96	**147**	**+51**
Operation 13*	55	81	**+44**

* Second-crop maize after forage rye or ryegrass

- Considerable amounts of N were added at almost all locations (with the exception of Operation 6)
- In operations 1 to 8, the subsequently supplied N was also well utilised → high N withdrawals, hardly any increase in N_{min} for harvesting
- In operations 9 to 13, N-utilisation was worse due to the drought → low N-removals, significant increase in Nmin at harvest

Hardly any fertilisation effects in maize on two sites with predominantly secure water supply (exact trials)

→ Cause: Nutrient replenishment

No = Nossen (clayey silt)
Fo = Forchheim (sandy loam)

5. Versuchsergebnisse: Mittel der Jahre 2015 – 2019

PG	N-Düngung in kg N/ha				FM-Ertrag dt/ha		Stärke %		ELOS %	
	1. Gabe zur Aussaat	2. Gabe bei 40 bis 60 cm Bestandeshöhe	gesamt No	gesamt Fo	No	Fo	No	Fo	No	Fo
1	0	0	*0*	*0*	453,1	446,4	32,1	29,1	69,9	69,9
2	nach BESyD - 50 %	nach BESyD - 50 %	*70*	*54*	513,3	502,5	34,9	28,2	70,2	68,8
3	nach BESyD - 25 %	nach BESyD - 25 %	*105*	*80*	499,4	507,6	34,4	28,9	69,8	69,6
4	nach BESyD	nach BESyD	*140*	*107*	500,2	527,5	33,6	28,4	69,4	69,6
5	nach BESyD + 25 %	nach BESyD + 25 %	*175*	*134*	514,6	517,7	33,5	28,6	69,7	69,0
6	DüV, Aufteilung wie nach BESyD (%)		*171*	*130*	511,6	540,2	33,6	28,5	70,0	69,1
7	nach BESyD Gesamt - 30 kg	30 kg	*140*	*107*	503,9	519,4	33,9	29,1	69,6	69,4
8	nach BESyD Gesamt - 60 kg	60 kg	*140*	*107*	509,4	520,3	34,3	29,0	70,1	68,8
		GD(A) 5% gepoolt			*8,2*	*13,5*	*1,1*	*0,8*	*0,8*	*0,7*

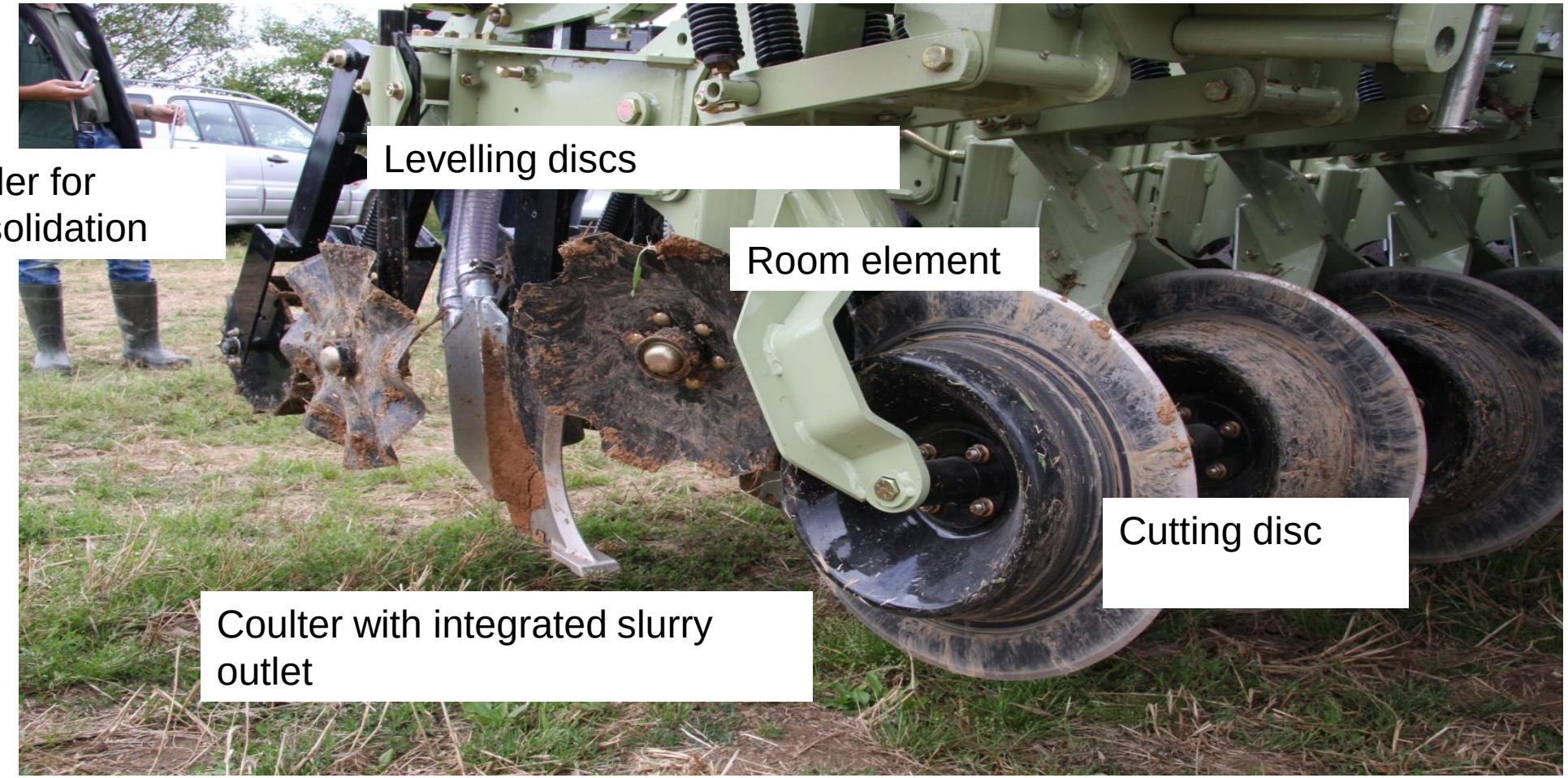
Source: LfULG

Strip tillage to maize

Maize

Strip tillage to maize

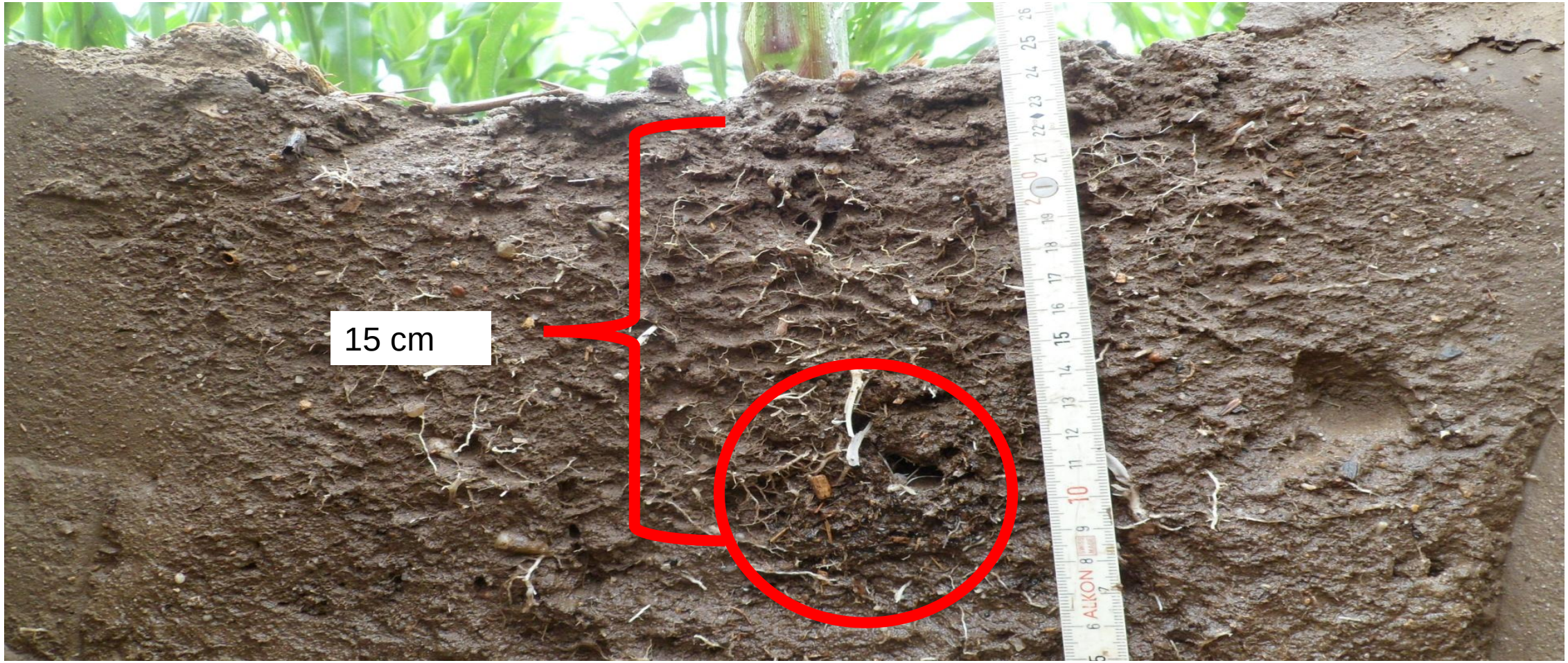
Typical structure of a strip processing unit



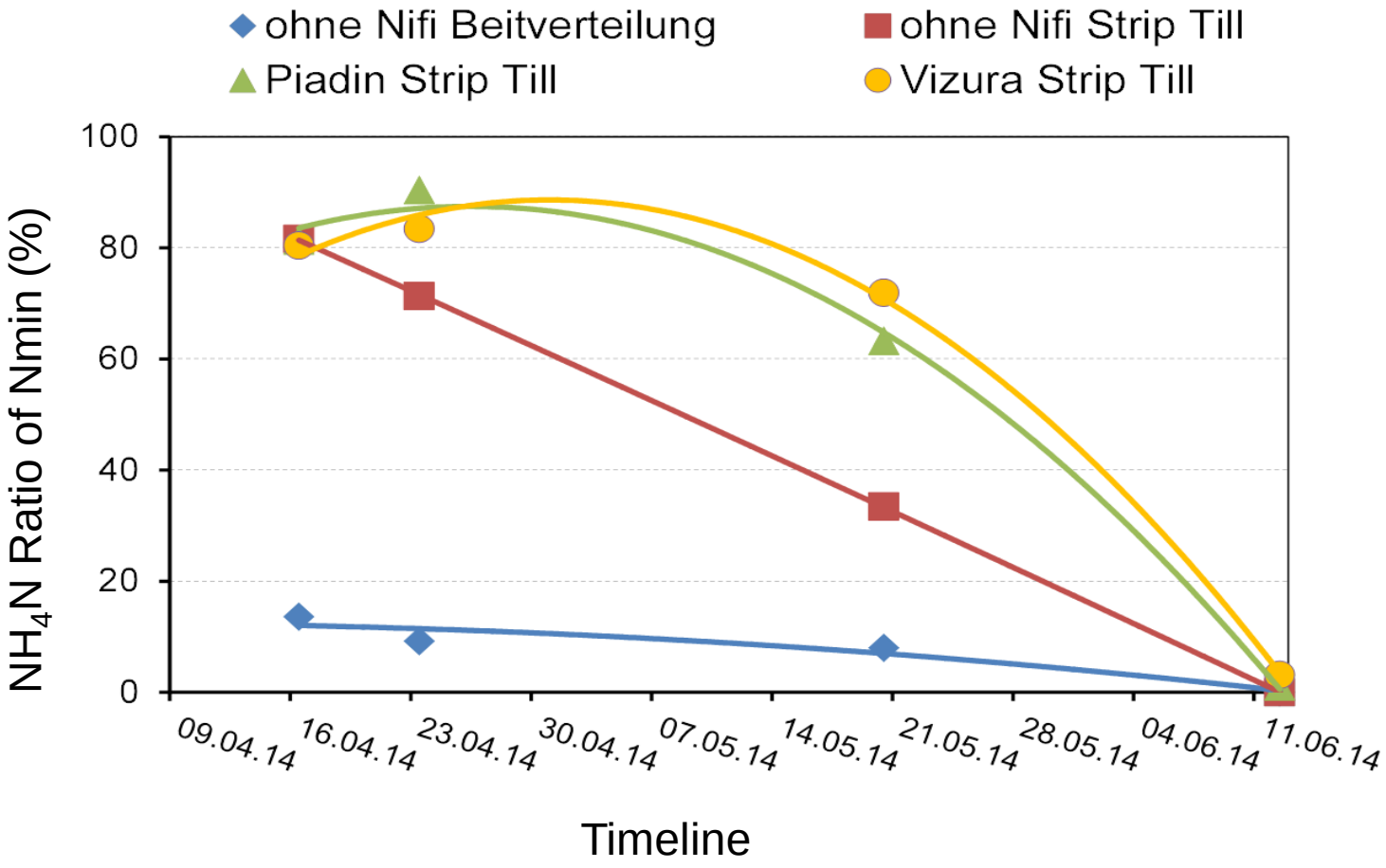
Depth of the slurry or digestate depot depending on the tillage depth

- Ø Processing depth in the trials - 20 cm;
- Ø Placement depth (depot) - 16 cm (top or bottom edge of depot 14 or 18 cm);
- Slurry outlet near the coulter tip;
- A minimum placement depth of 12 cm at the top of the deposit is recommended to avoid burns - so-called 7 cm (distance between grain and deposit) + 5 cm (placement depth) rule [Laurenz LWK, NRW];

Higher root density near the slurry depot



Ammonium content of N_{min} with slurry application for strip tillage in 0-30cm (alluvial loam) in combination with a Ammonium stabilizer



Trial facts:

- Cattle Slurry + mineral N -> 20m³/ha = 113kgN/ha; 62kg NH_4N/ha
- Application 9.04.2014
- Seeddate 15.04.2014
- Working depth -> 15cm

Conclusion

(1) Summer crops benefit enormously from N-replenishment at the site
→ Significant savings potential in fertiliser application

(2) Summer tillage makes particularly good use of N from organic matter
→ Significant fertiliser savings potential

(3) Consider organically fertilised catch crops as an additional N-source before winter

(4) Livestock operations need to think about how to use and credit their organic matter more optimally
→ Organic fertilisation for grains and rapeseed

AgUmenda

Contact:
Peter Müller
AgUmenda GmbH

Tel: 0152 54249344
http://www.agumenda.de
p.mueller@agumenda.de