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Controlled Traffic Farming “light”- A way to improve soil structure?

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Traffic induced soil compaction



Typical example:

- over 20 years minimum tillage
- working depth < 15 cm
- compacted structure below the tilled layer

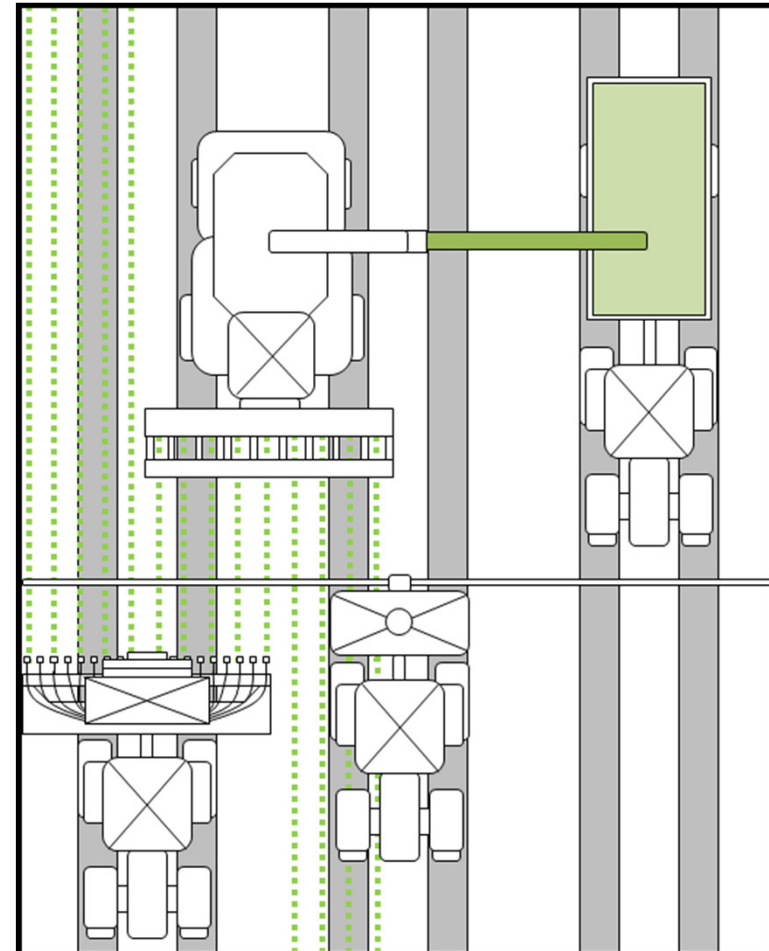
compacted structure
from 15-25 cm

few roots from 25 – 40 cm



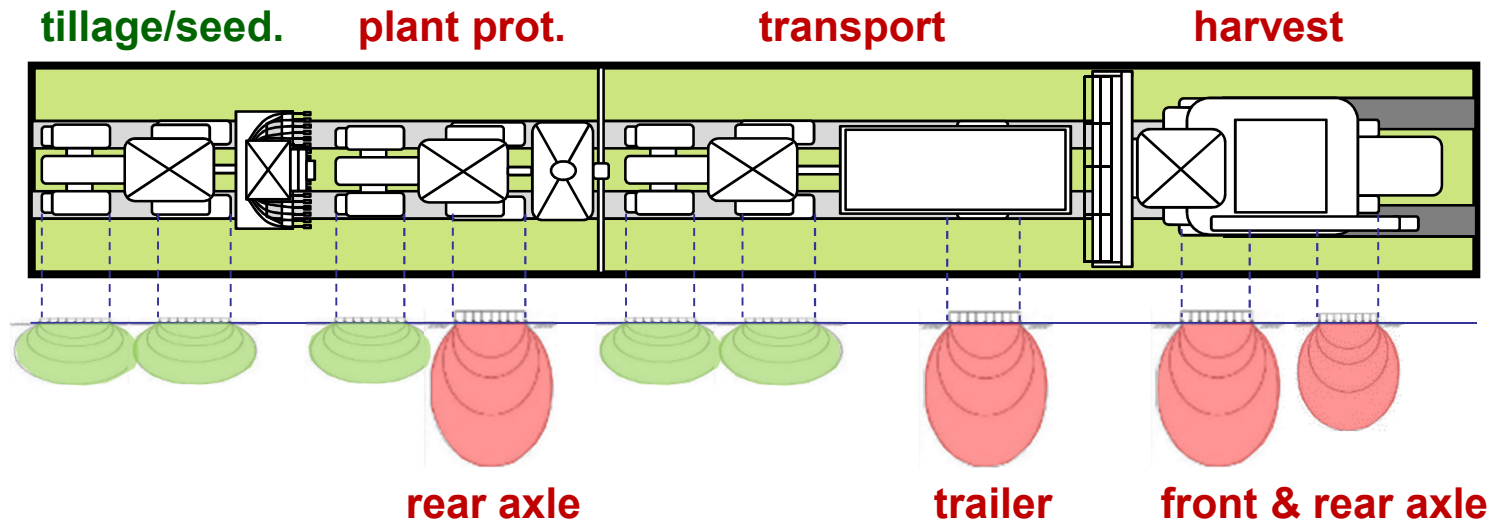
Controlled Traffic Farming (CTF)

- permanent traffic lanes for all field vehicles
- majority of the field area is permanently protected from compaction
- positive effects on soil structure and soil functions
- has to be adapted for small-scaled agriculture in Switzerland





CTF «light» – focus on heavy machines

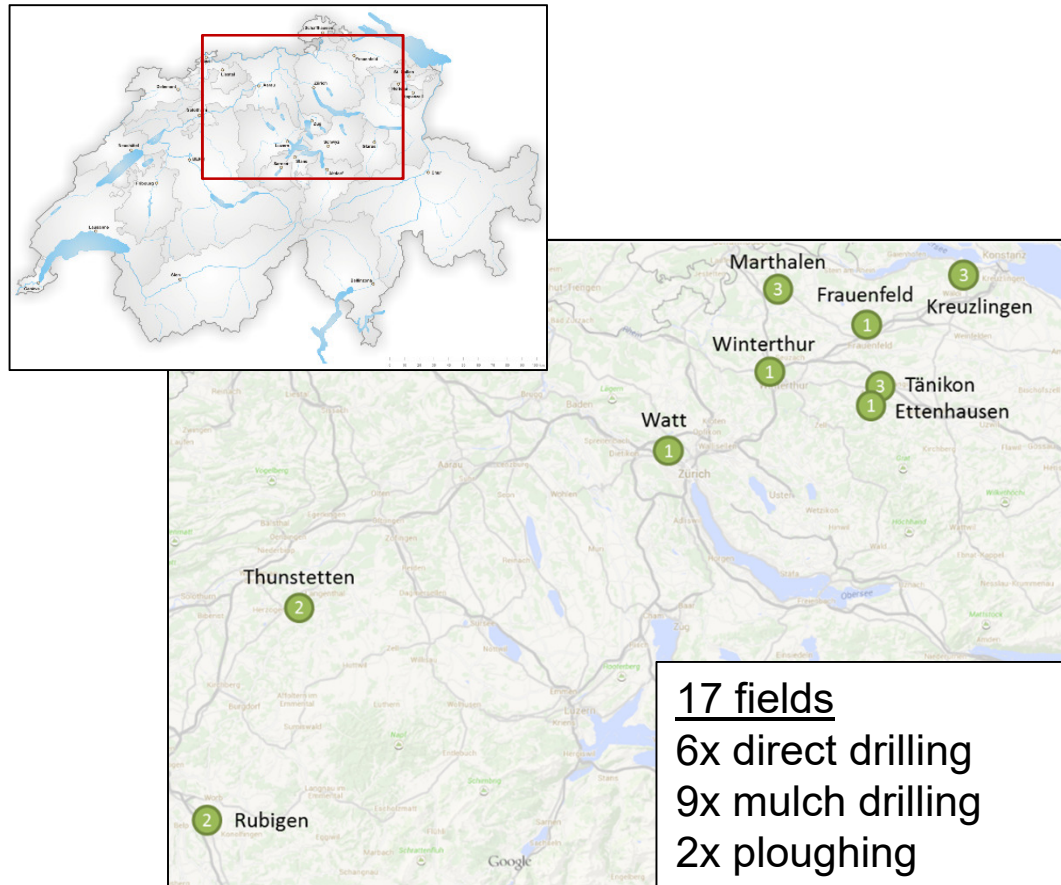


- Practicability with standard machinery?
- Effects on soil physical properties and yields?

➔ field trials in the Swiss Midlands



Experimental sites



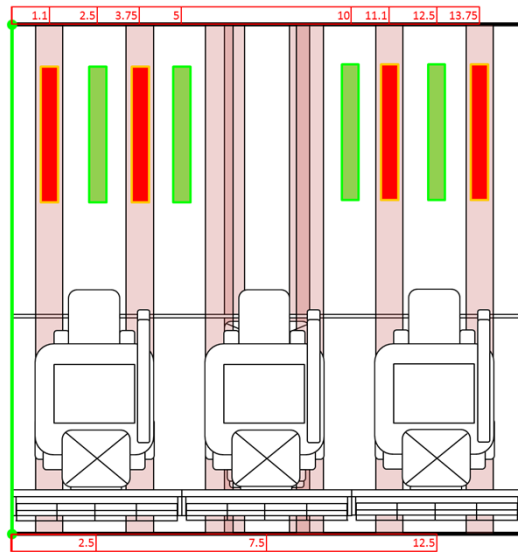
- cantons Bern, Zurich and Thurgau
- 400 - 600 m asl
- 7.5 - 9.5°C
- 900 - 1200 mm
- fertile Cambisols from sandy loam or loam

project duration: 2015-2017



Harmonisation of wheel tracks

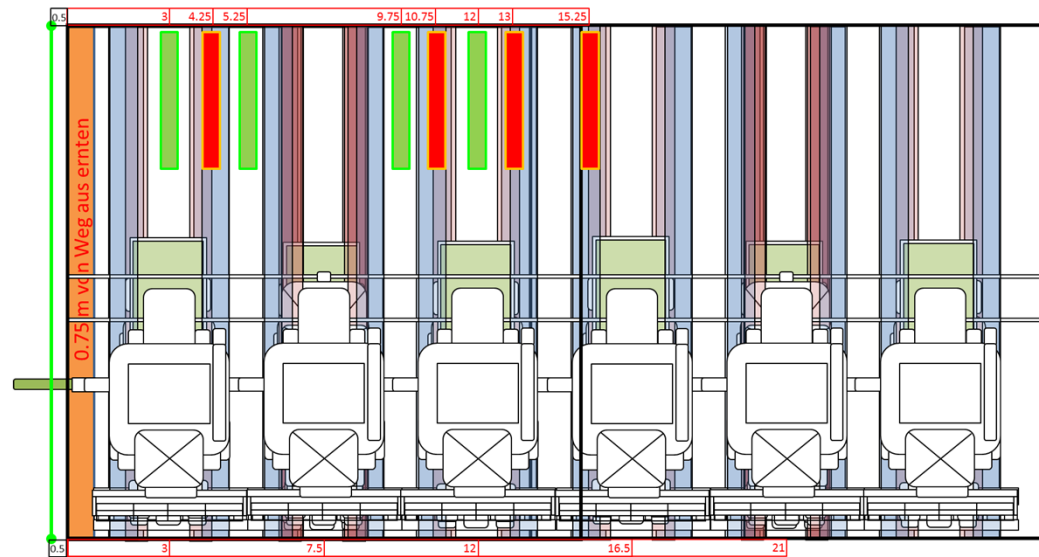
combinable crops



- harvest: 5m
- spray / fertilise: 15m
- trafficked area: 36%

trafficked
not trafficked

combinable crops and silage maize



- harvest: 4.50m (chopper) / 4.80m (combine eff. 4.50m)
- spray / fertilise: 15m with section control
- trafficked area: 49%



Trafficked area depending on crop rotation and machine working widths

	effective working width	trafficked area
combine harvester	5.00 m	36%
	4.50 m	40%
	4.00 m	44%
	3.60 m	54%
combine harvester and maize chopper	4.50 m	49%
	3.00 m	57%
sugar beet and combine harvester	2.70 m	61%

Soil penetration resistance and water infiltration

Penetration:

- spring 2016 /2017
- Eijkelkamp penetrometer
- 4 replications trafficked / untrafficked
- 10 penetrations per replication
- depth max. 80 cm



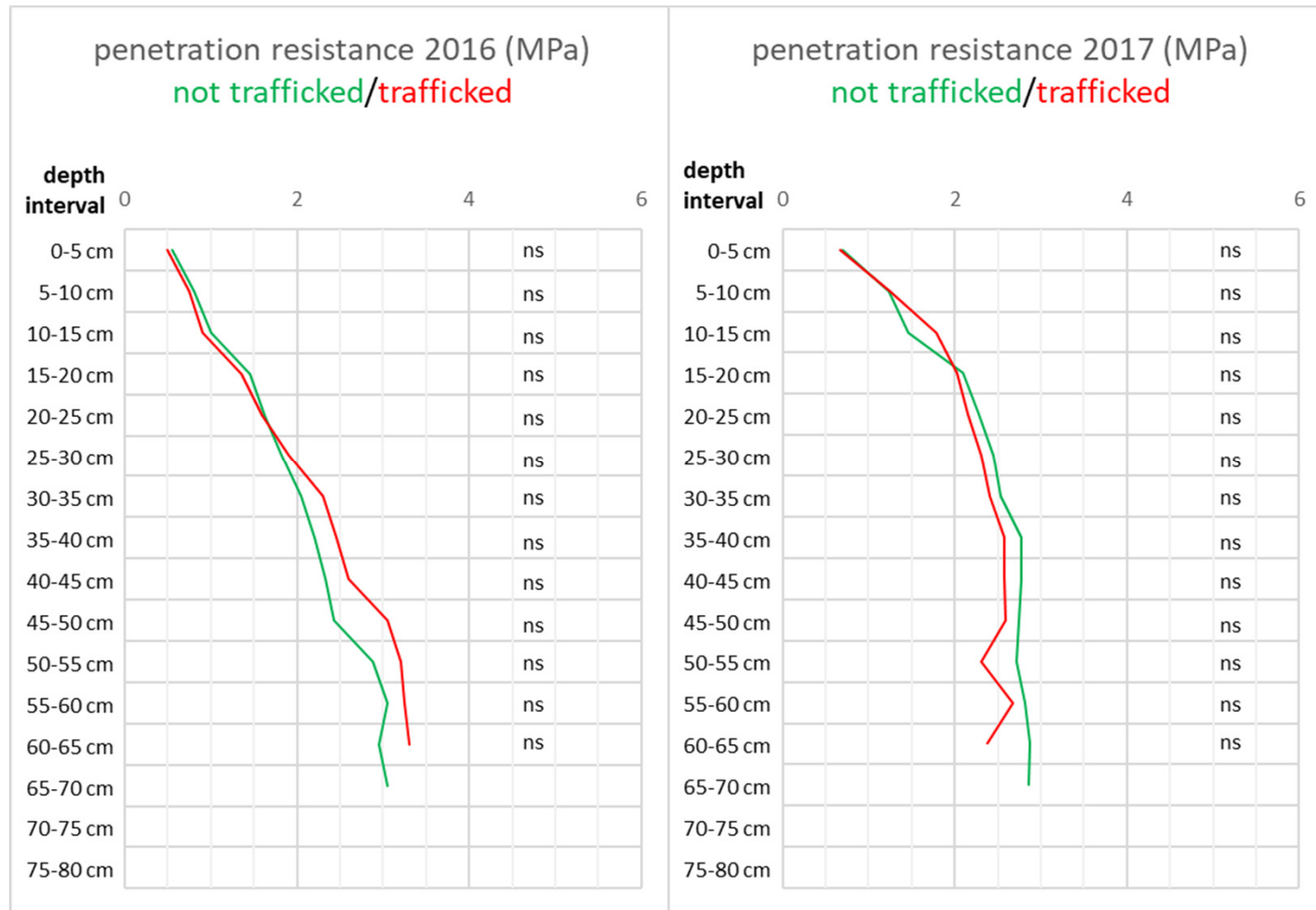
Infiltration:

- spring 2016 /2017
- 28 cm ring infiltrometer
- 4 replications trafficked / untrafficked
- 2 measurements per replication
- time for water lowering by 2 cm





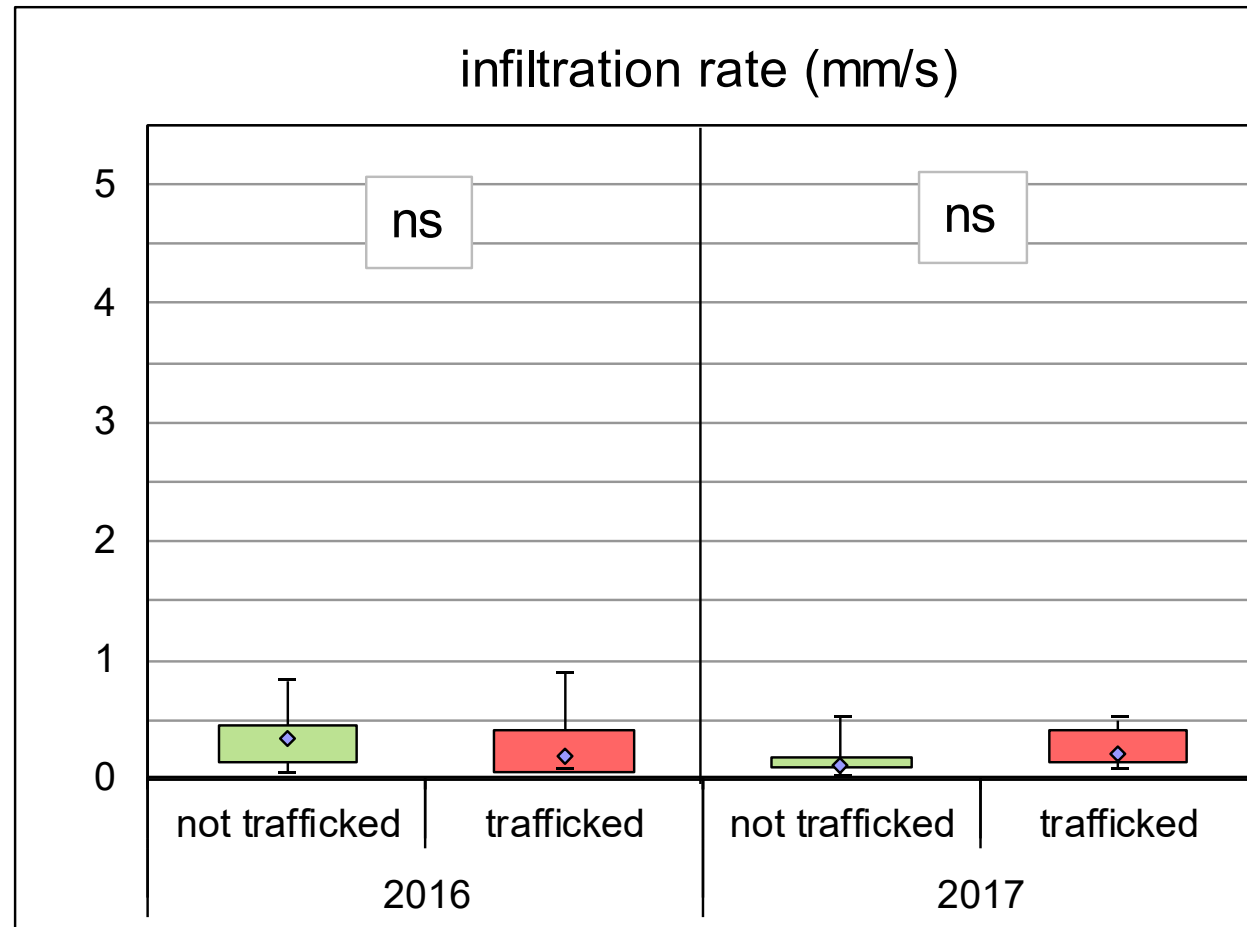
Some plots without traffic induced differentiation



→ no effect of combine wheel!



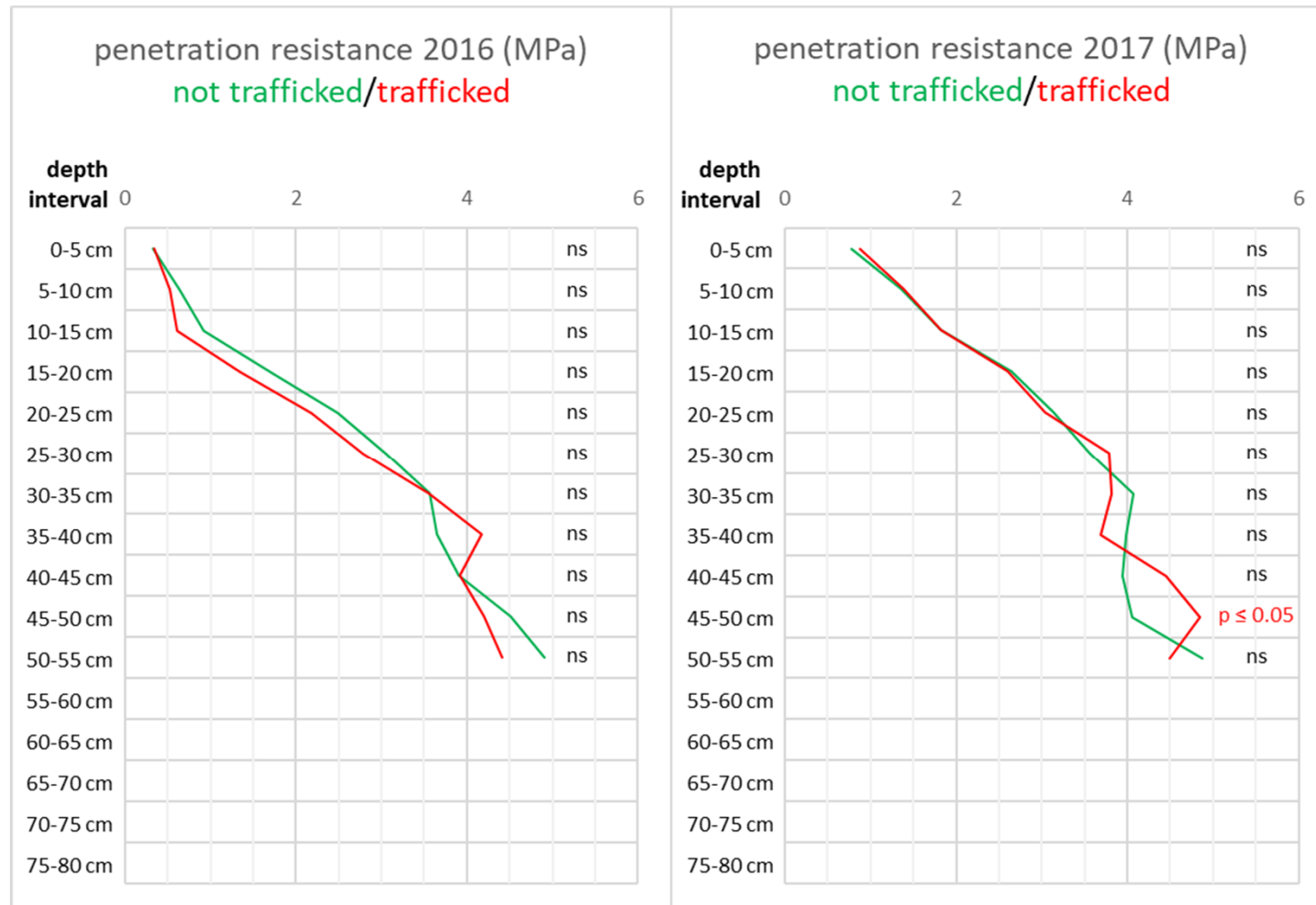
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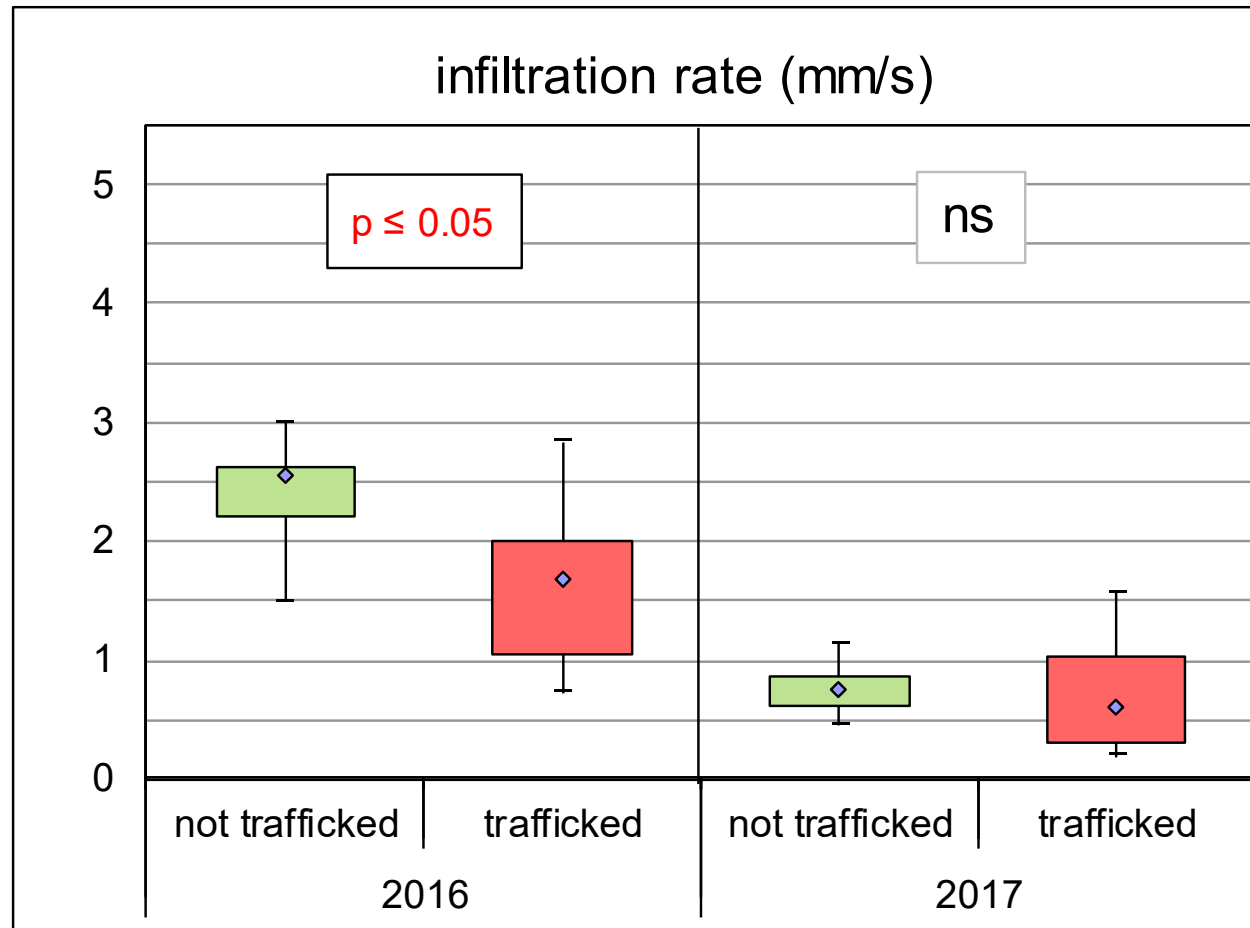


Tänikon: No effects on penetration...





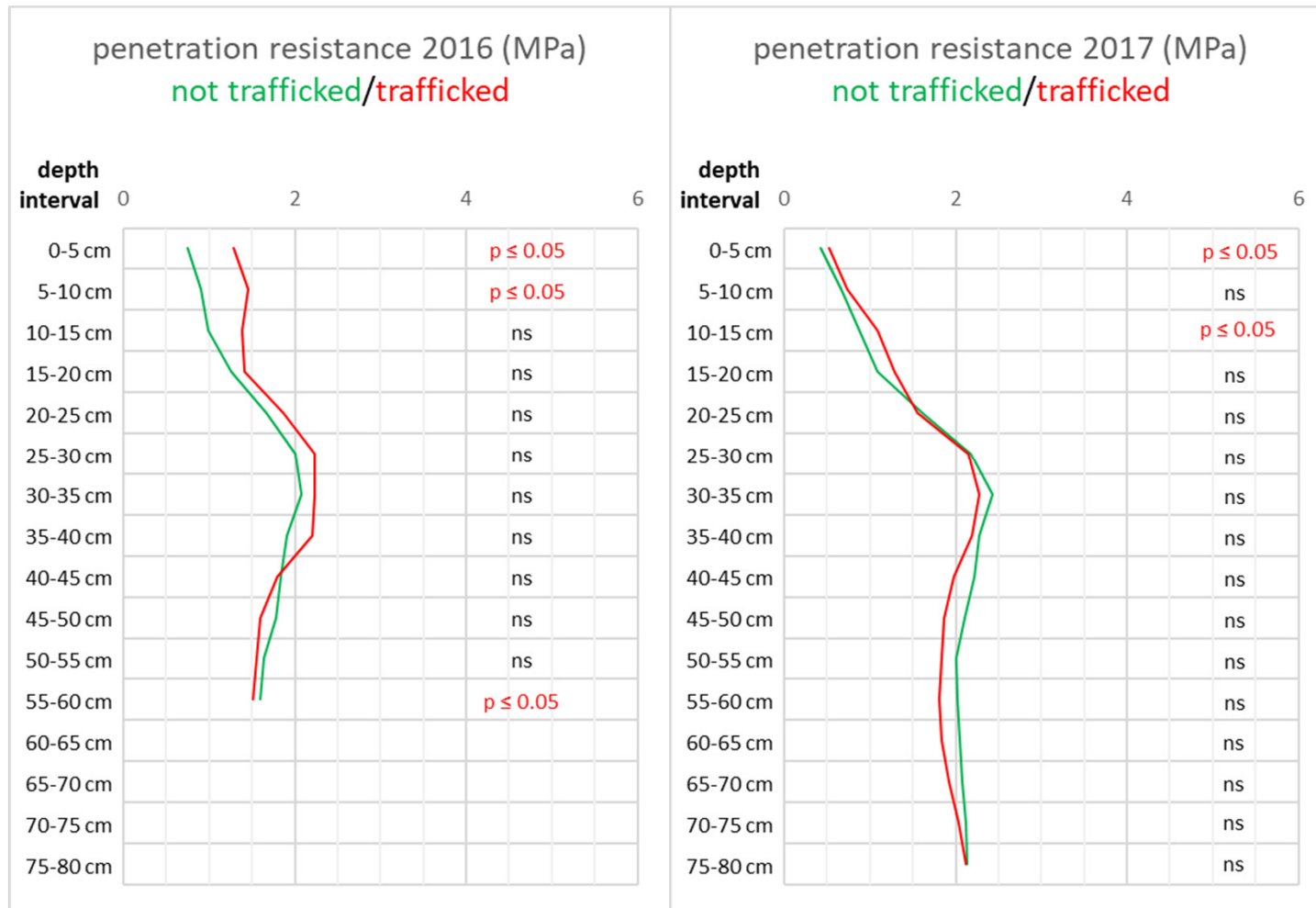
Tänikon: Some significant impact on infiltration



→ reduced infiltration rate within wheel tracks



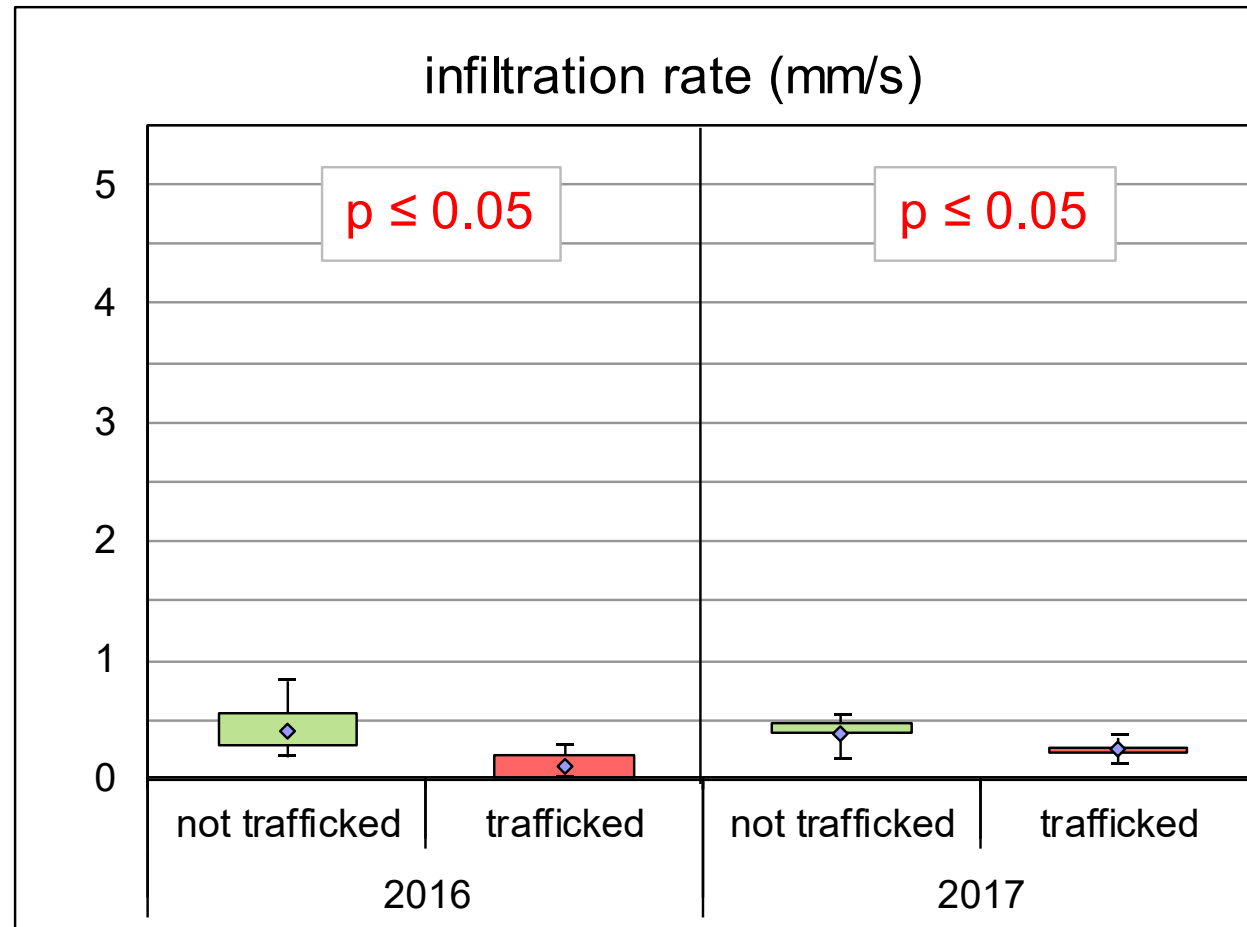
Ettenhausen: Differentiation in both parameters



→ increased penetration resistance within wheel tracks



Ettenhausen: Differentiation in both parameters



→ reduced infiltration rate within wheel tracks



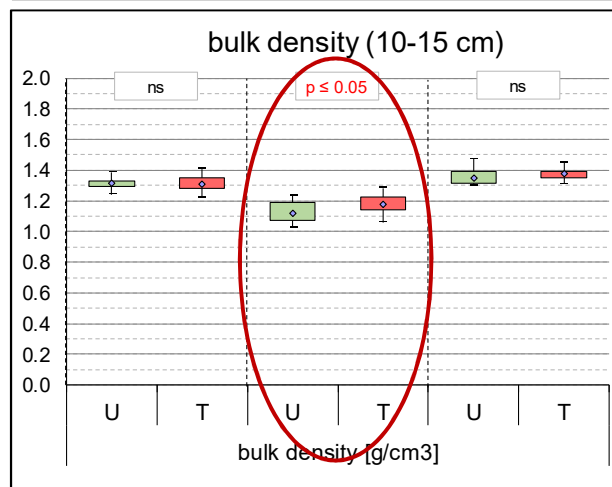
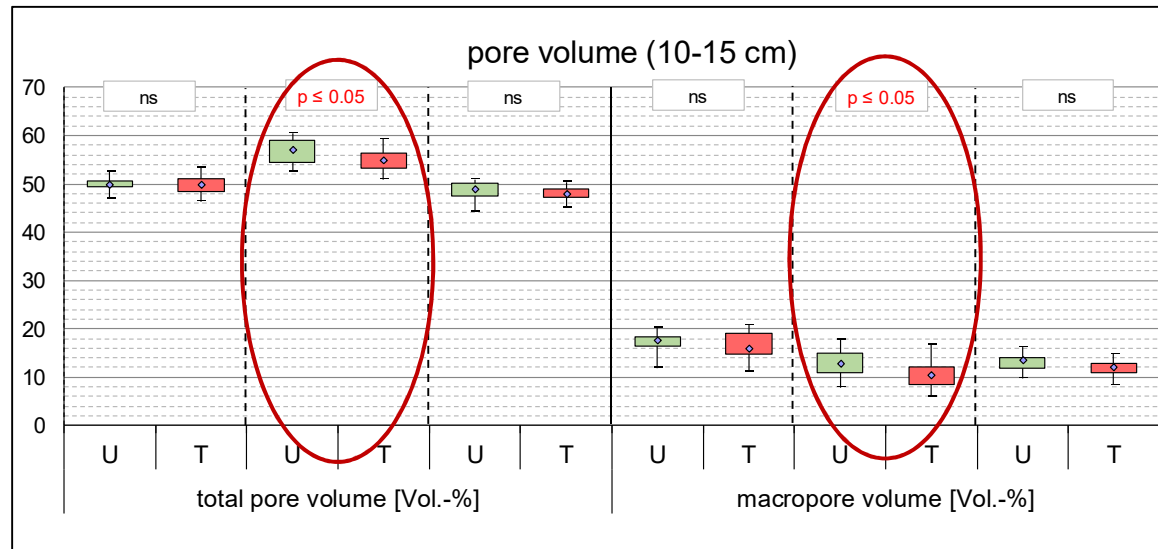
Bulk density and macropore volume



- spring 2017
- 3 selected sites
- 100 cm³, depth 10-15 cm
- 4 replications trafficked / untrafficked
- 3 cores per replication



Laboratory analyses confirmed field measurements



	penetration resistance	infiltration rate
site 1	0	++
site 2	++	++
site 3	0	0

compression...

- increases bulk density and penetration resistance
- decreases macropore volume and infiltration rate



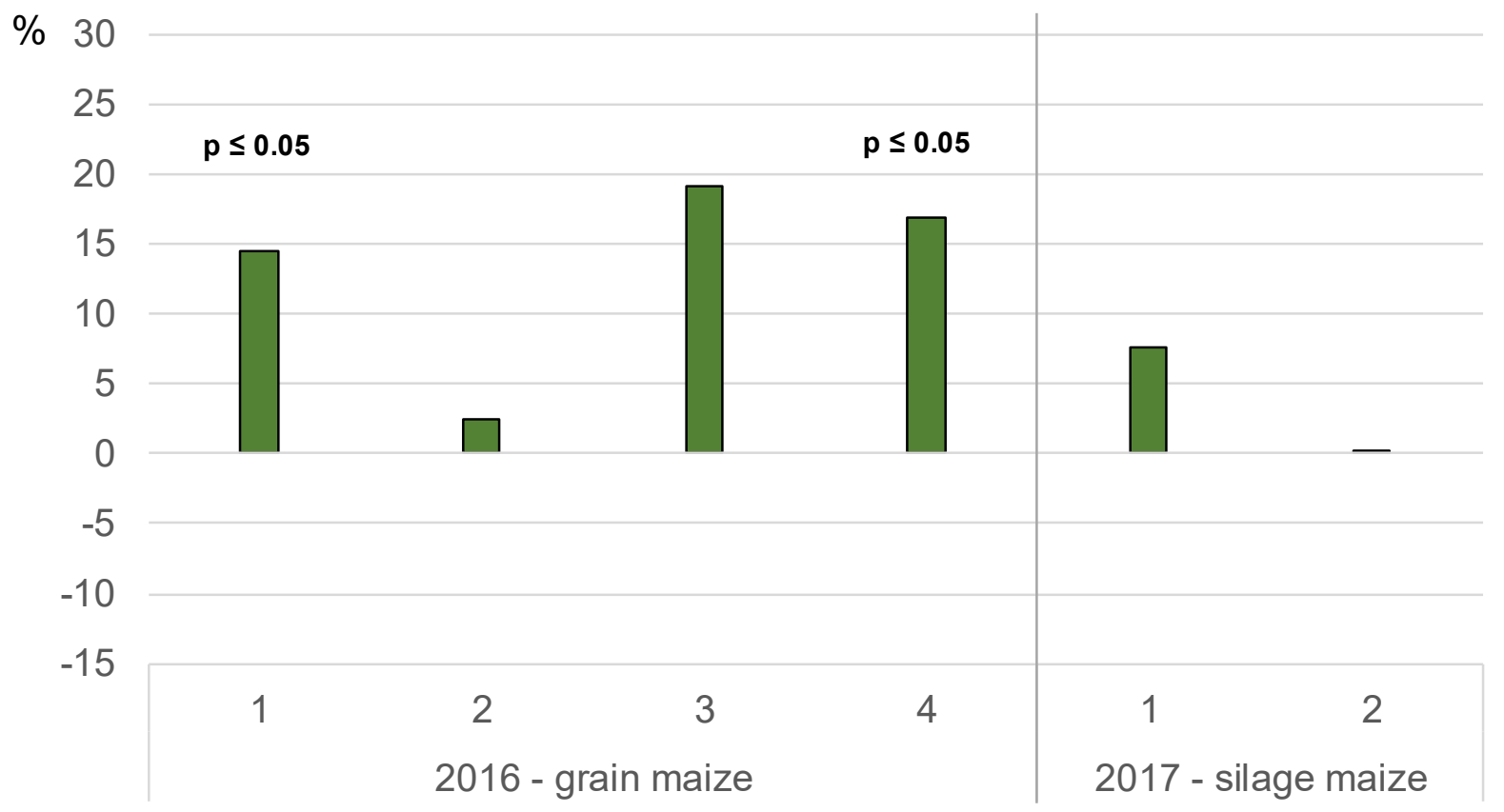
Yield data



- every year just before harvesting
- 4 replications trafficked / untrafficked
- 2 areas of 1 m² (0.5 x 2.0 m) per replication



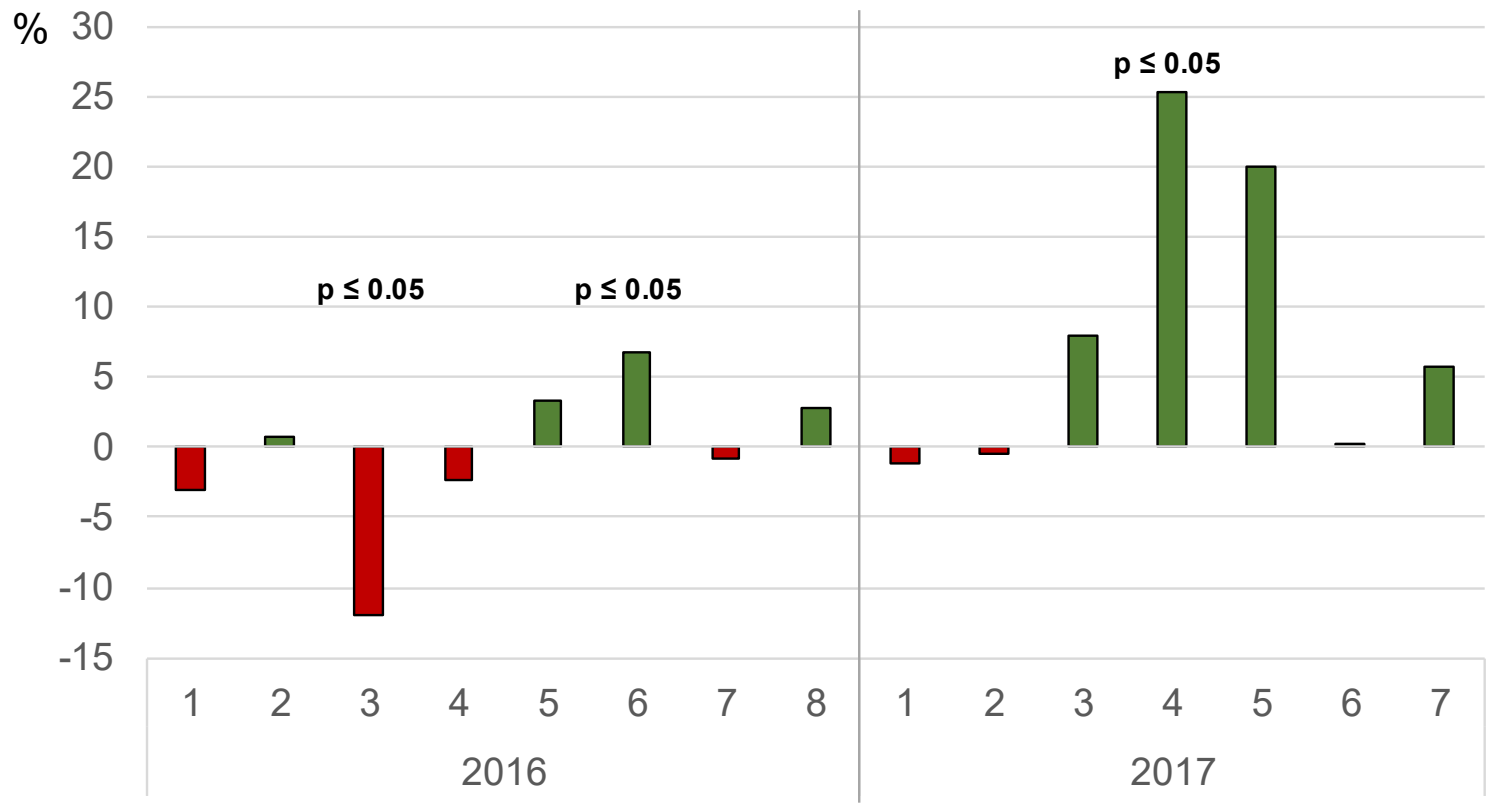
Relative yields of maize (trafficked = 100 %)



→ significant yield increase for maize (mean +13 %)



Relative yields of winter wheat (trafficked = 100 %)



→ other field crops: no consistent yield differences within and between wheel tracks



Overview of the obtained effects

	penetration resistance	infiltration rate	yield	macropore volume	bulk density
direct drilling	0	0	+		
	+	0	0		
	++	0	+		
	0	0	0		
	0	++	0		
	++	++	+		
mulch drilling	0	0	0		
	0	++	++		
	++	++	0		
	0	0	0		
	0	0	0		
	0	0	++		
	0	++	0	0	0
	++	++	0	++	++
	0	0	0	0	0
plough	0	0	0		
	++	++	++		

- half of the fields showed positive effects due to reduced soil compaction
- differences often remained small
- only partial causal relations (3 years project)
- positive effects could increase over time

++: significant improvement, +: trend towards improvement, 0: no improvement



CTF «light» - A way to improve soil structure?

- incipient differentiation of soil physical properties
- clear response of maize to controlled trafficking
- low response of other crops
- increased effects expected over time

→ CTF «light» is not a revolution but a valuable element in combination with reduced tillage

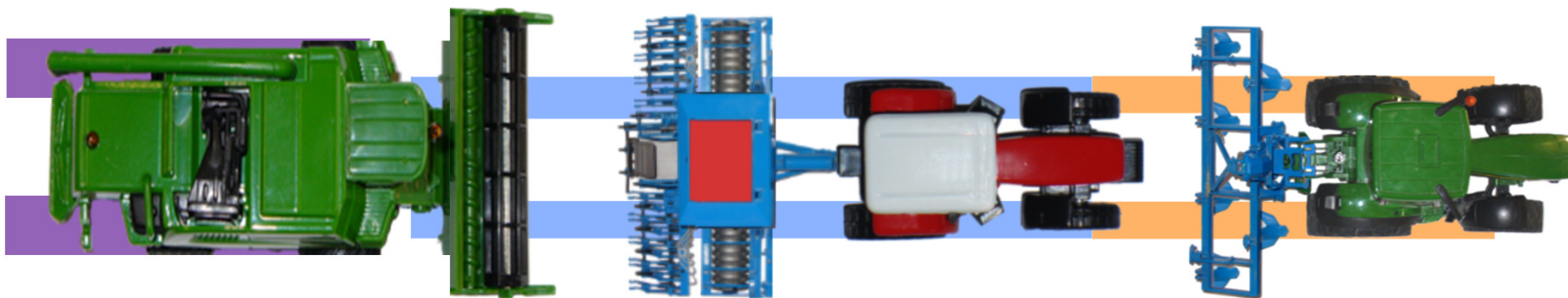


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Thank you for your attention!



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