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Influence of conservation soil tillage on field water capacity and packing density under climate change

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Introduction

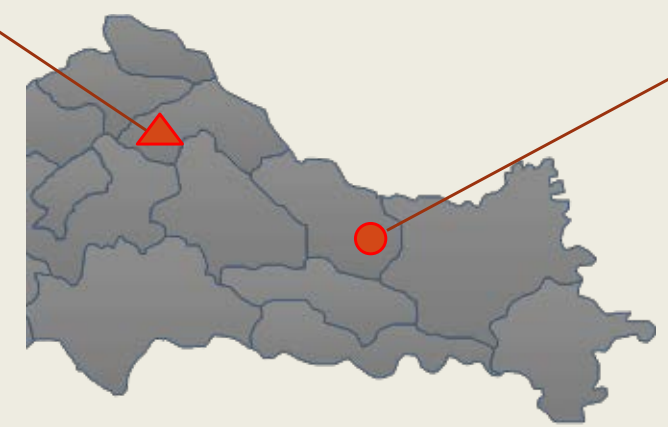
Soil compaction:

- anthropogenic and/or natural basis
- serious degrading process
- directly impacted physical and indirectly chemical and biological soil properties
- negative influence on soil porosity
- climate changes aggravate negative influence

The aim of these studies was to determine the extent to which soil type, tillage system and soil depth affect the water capacity of the field and packing density as one of the indicators of soil compaction

Material and methods

Experimental site B (Križevci)



Experimental site A (Čačinci)

Treatment A (Soil tillage)	Treatment B (Liming)	Treatment C (Fertilization)
A1-ST	B1-CY	C1-FR
A2-CTD	B2-CN	C2-FD
A3-CTS		C3-GFR
		C4-GFD

Gleysol

Stagnosol

Material and methods

Soil tillage treatments

ST standard (conventional) tillage

- Ploughing
- Up to 30 cm deep
- Soil surface covered with crop remains at maximum 15%

CTD Conservation tillage - Deep

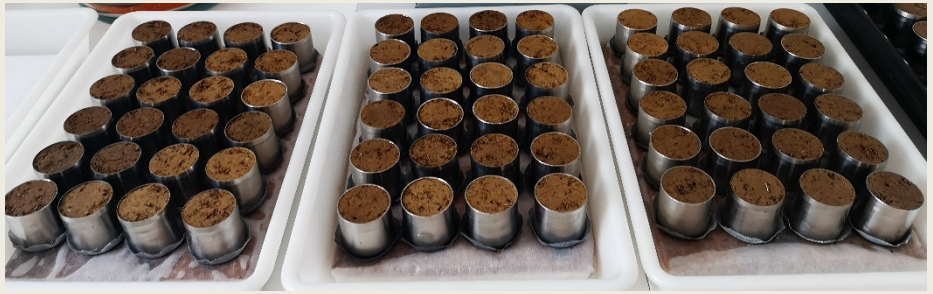
- Chiseling
- Up to 30 cm deep
- Soil surface covered with crop remains at minimum 30%

CTD Conservation tillage - Shallow

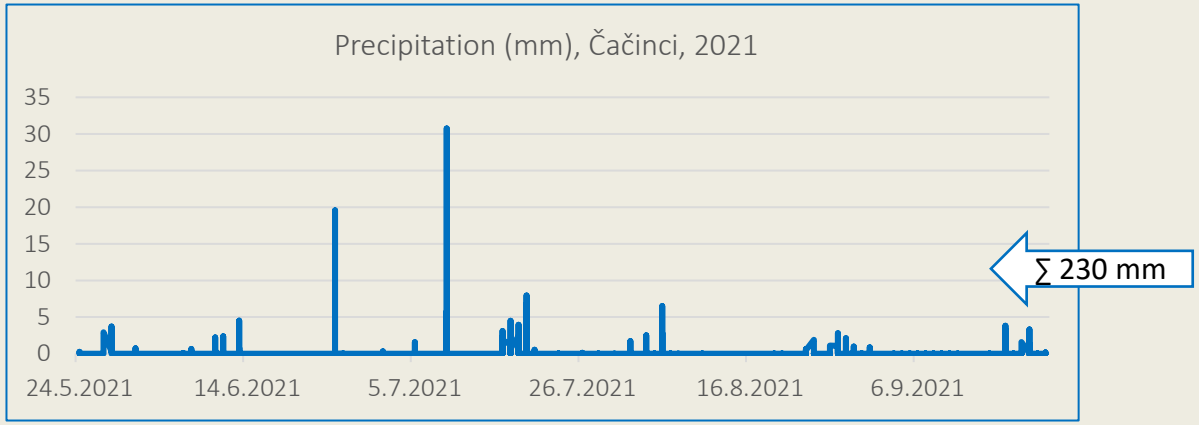
- Chiseling
- Up to 10 cm deep
- Soil surface covered with crop remains at minimum 50%

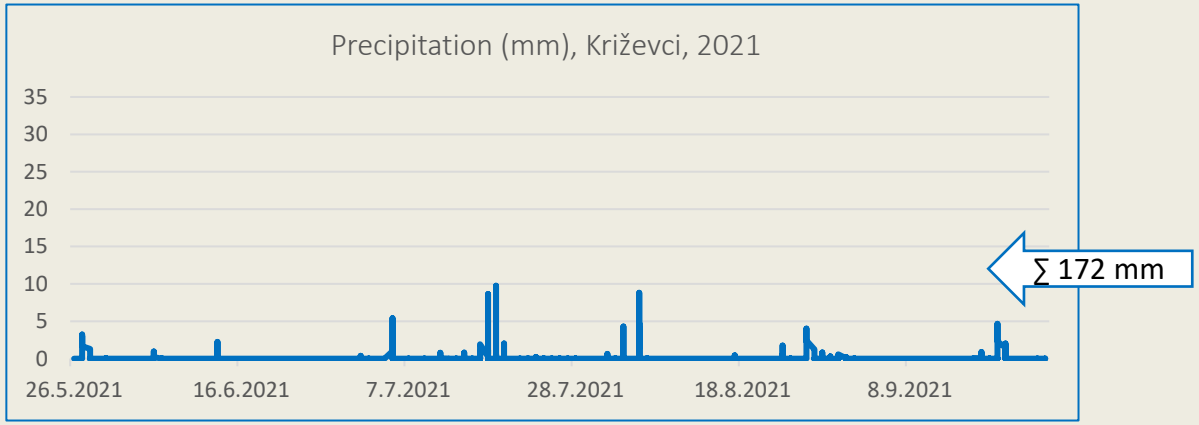
Material and methods

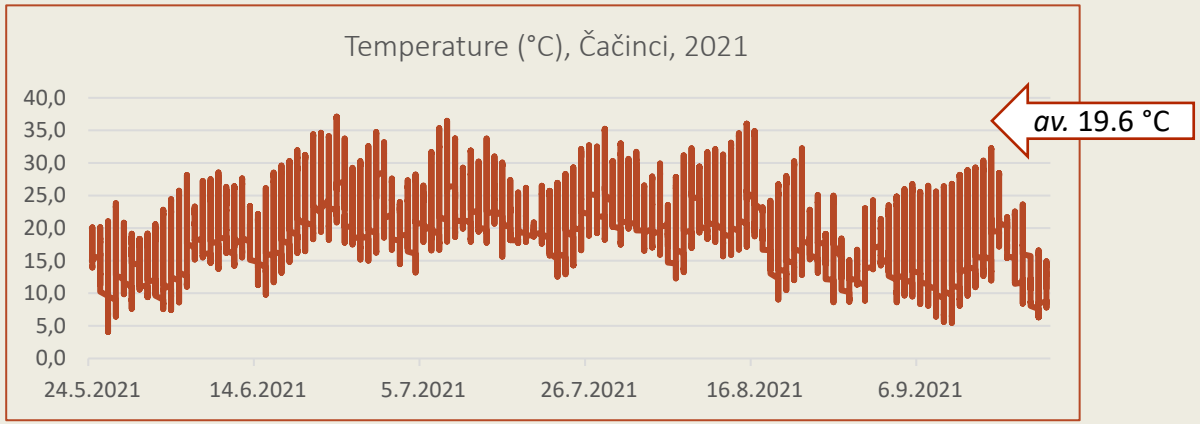
- Experiment started: autumn 2020
- Experimented crop: maize (and will follow: soybean-w. wheat-maize)
- Sampling dates (coordinated with phenophases):
  a) early growth (3-5 leaves): June
  b) silking: July
  c) harvest: September
- Soil sampling locations: 2 locations (Čačinci and Križevci)
- Soil sampling method: undisturbed - Kopecky rings (100 cm^{-3})
- Soil samples depth: 0 - 20 cm and 20 - 40 cm
- Determining:
  a) Field Water Capacity (FWC) [HRN ISO 11272:2004]
  b) Packing density (PD) [PD = ρ_v + (0,009 x clay, %)]

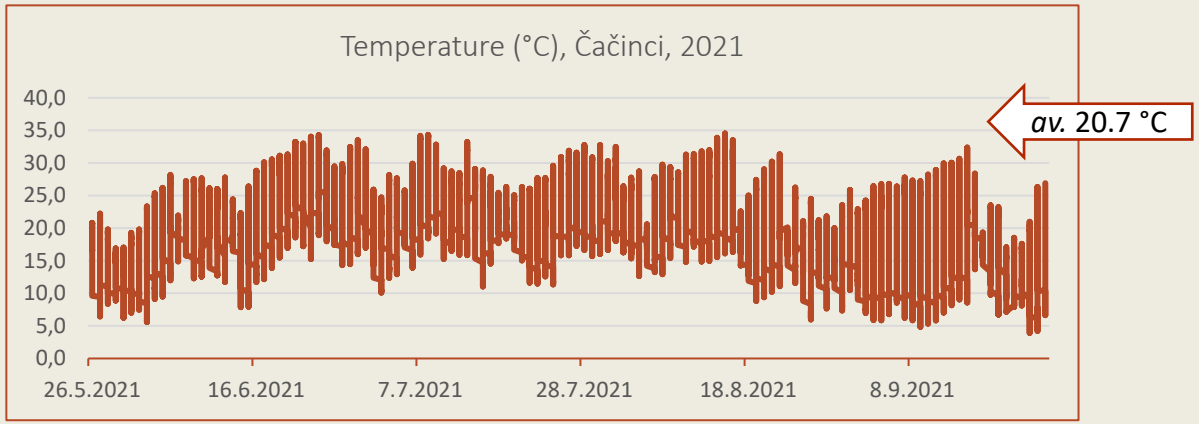


Results


Precipitation (mm), Čačinci, 2021
35
30
25
20
15
10
5
0
24.5.2021
14.6.2021
5.7.2021
26.7.2021
16.8.2021
6.9.2021
∑ 230 mm


Precipitation (mm), Križevci, 2021
35
30
25
20
15
10
5
0
26.5.2021
16.6.2021
7.7.2021
28.7.2021
18.8.2021
8.9.2021
∑ 172 mm


Temperature (°C), Čačinci, 2021
40,0
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
24.5.2021
14.6.2021
5.7.2021
26.7.2021
16.8.2021
6.9.2021
av. 19.6 °C


Temperature (°C), Čačinci, 2021
40,0
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
26.5.2021
16.6.2021
7.7.2021
28.7.2021
18.8.2021
8.9.2021
av. 20.7 °C

- The texture in Stagnosol (Čačinci) is silty clay loam:
  - 0 – 20 cm = 31.82 – 34.05% clay (average 33.23%)
  - 20 – 40 cm = 33.54 – 35.23% clay (average 34.23%)

- The texture in Gleysol (Križevci) is a silty:
  - 0 – 20 cm = 8,84 - 9,97 % clay (average 9,51 %)
  - 20 – 40 cm = 9,87 -10,37 % clay (average 10,10 %)

Stagnosol			
Tillage	0 -20 cm	20-40 cm	average
	Field water capacity (%)		
ST	37.18	35.70	36.44
CTD	29.96	30.73	30.34
CTS	33.94	33.42	33.68
average	33.69	33.28	33.48 B
	Packing density (g cm^{-3})		
ST	1.82	1.94	1.88
CTD	2.01	2.03	2.02
CTS	1.91	1.96	1.93
average	1.91	1.98	1.94 A

Gleysol			
Tillage	0-20 cm	20-40 cm	average
	Field water capacity (%)		
ST	41.41	44.31	42.86
CTD	43.73	47.04	45.38
CTS	44.87	47.41	46.14
average	43.33	46.25	44.79 A
	Packing density (g cm^{-3})		
ST	1.53	1.46	1.50
CTD	1.42	1.42	1.42
CTS	1.47	1.43	1.45
average	1.47	1.44	1.46 B

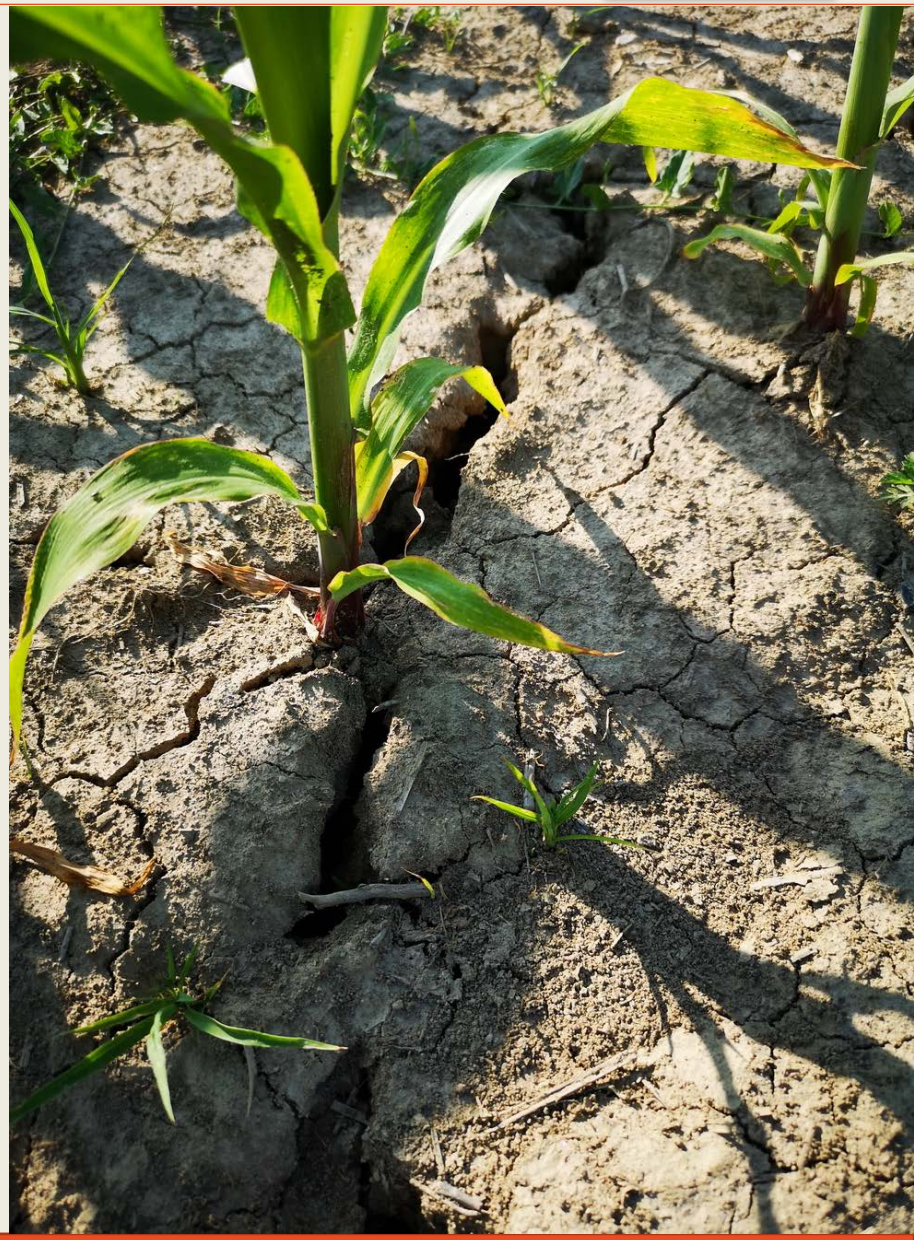
FWC	A	B	C	AxB	AxC	BxC	AxBxC
$LSD_{0,05}$	0.958	1.277	-	1.964	2.022	-	-
F test	593.561	6.845	n.s.	26.986	6.446	n.s.	n.s.

PD	A	B	C	AxB	AxC	BxC	AxBxC
$LSD_{0,05}$	0.034	-	-	0.090	0.039	-	-
F test	852.236	n.s.	n.s.	7.725	15.249	n.s.	n.s.

Legend: A – soil type, B – soil tillage, C – soil depth

Final remarks

- Packing density was significantly influenced by soil type
- Significant interactions between soil type with tillage and soil type with depth, were determined
- The lowest packing density was measured on Glaysol on CTD (1.42 g cm^{-3}) and on depth 20 - 40 cm (1.44 g cm^{-3})
- The highest packing density was measured on Stagnosol on CTD (2.02 g cm^{-3}) and on depth 20 - 40 cm (1.93 g cm^{-3})
- The lowest field water capacity was measured on Stagnosol on CTD (30.34 %) and on depth 20 - 40 cm (33.28 %)
- The highest field water capacity was measured on Glaysol on CTS (46.14 %) and on depth 20 - 40 cm (46.25 %)
- Advantages of conservation soil tillage was found and research is ongoing



Thank you for your kind attention!!!

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