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**SUPPLEMENTARY MATERIALS**

## **Effects of soil compaction and reduced tillage on soil properties and maize yield\***

**Krzysztof Orzech<sup>1</sup>, Maria Wanic<sup>1</sup>, Dariusz Załuski<sup>2</sup>**

<sup>1</sup> Department of Agroecosystems and Horticulture

<sup>2</sup> Department of Genetics, Plant Breeding and Bioresource Engineering  
University of Warmia and Mazury in Olsztyn, Poland

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Dariusz Załuski, PhD, DSc. Department of Genetics, Plant Breeding and Bioresource Engineering, University of Warmia and Mazury in Olsztyn, Plac Łódzki 3, 10-719 Olsztyn, Poland, e-mail: [dariusz.zaluski@uwm.edu.pl](mailto:dariusz.zaluski@uwm.edu.pl)

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Table S1

Changes in soil acidity (pH), soil organic carbon (SOC) content, total soil nitrogen content ( $N_{total}$ ) and carbon to nitrogen ratio (C:N) of the soil before starting the experiment (2017) and after completing the study (2020)

Tillage system	Without packing			With packing		
	2017 year	2020 year	<i>p</i> -value	2017 year	2020 year	<i>p</i> -value
soil pH – grassland preceding crop						
TS-1	5.75	5.68	0.2152	5.60	5.71	0.0796
TS-2	5.88	6.12	0.4128	5.80	5.77	0.2610
TS-3	5.93	5.96	0.4982	5.63	5.56	0.0053
TS-4	5.88	5.85	0.7130	5.65	5.64	0.6173
soil pH – winter triticale preceding crop						
TS-1	6.05	6.10	0.4436	5.83	5.92	0.1666
TS-2	5.95	6.26	0.0610	5.88	6.01	0.2478
TS-3	5.93	6.00	0.2954	5.83	5.90	0.3131
TS-4	6.00	6.15	0.0252	5.94	5.95	0.8043
SOC – grassland preceding crop						
	----- g kg <sup>-1</sup> -----			----- g kg <sup>-1</sup> -----		
TS-1	10.60	10.60	0.9482	9.65	9.75	0.0917
TS-2	10.40	10.60	0.3429	9.15	9.25	0.1041
TS-3	10.30	10.70	0.0510	9.50	9.60	0.1817
TS-4	9.50	9.63	0.0496	8.85	8.90	0.7177
SOC – winter triticale preceding crop						
	----- g kg <sup>-1</sup> -----			----- g kg <sup>-1</sup> -----		
TS-1	10.20	10.60	0.0773	9.83	10.00	0.2048
TS-2	9.68	10.00	0.3427	9.90	10.30	0.0094
TS-3	10.10	10.30	0.2596	10.00	10.20	0.3189
TS-4	9.75	10.10	0.2908	10.00	9.90	0.1603
$N_{total}$ – grassland preceding crop						
	----- g kg <sup>-1</sup> -----			----- g kg <sup>-1</sup> -----		
TS-1	8.03 10 <sup>-1</sup>	8.58 10 <sup>-1</sup>	0.4167	0.8.30 10 <sup>-1</sup>	0.843	0.5636
TS-2	8.35 10 <sup>-1</sup>	8.50 10 <sup>-1</sup>	0.6274	0.8.83 10 <sup>-1</sup>	0.898	0.5117
TS-3	7.98 10 <sup>-1</sup>	9.63 10 <sup>-1</sup>	0.0041	0.7.53 10 <sup>-1</sup>	0.880	0.0013
TS-4	8.73 10 <sup>-1</sup>	9.73 10 <sup>-1</sup>	0.0456	0.8.48 10 <sup>-1</sup>	0.853	0.9185
$N_{total}$ – winter triticale preceding crop						
	----- g kg <sup>-1</sup> -----			----- g kg <sup>-1</sup> -----		
TS-1	8.63 10 <sup>-1</sup>	8.55 10 <sup>-1</sup>	0.6084	9.03 10 <sup>-1</sup>	9.35 10 <sup>-1</sup>	0.6080
TS-2	8.28 10 <sup>-1</sup>	8.33 10 <sup>-1</sup>	0.7608	8.40 10 <sup>-1</sup>	9.55 10 <sup>-1</sup>	0.0062
TS-3	8.45 10 <sup>-1</sup>	9.35 10 <sup>-1</sup>	0.0182	7.90 10 <sup>-1</sup>	8.63 10 <sup>-1</sup>	0.1997
TS-4	9.03 10 <sup>-1</sup>	9.23 10 <sup>-1</sup>	0.3371	8.68 10 <sup>-1</sup>	9.28 10 <sup>-1</sup>	0.1612

C:N ratio – grassland preceding crop						
TS-1	13.2	12.3	0.0454	11.6	11.6	0.9313
TS-2	12.4	12.4	0.9424	10.5	10.2	0.3750
TS-3	12.9	11.1	0.0261	12.6	10.9	0.0162
TS-4	10.9	9.9	0.0480	10.4	10.4	0.8011
C:N ratio – winter triticale preceding crop						
TS-1	11.8	12.3	0.1847	10.9	10.7	0.7213
TS-2	11.7	12.0	0.1256	11.8	10.8	0.0416
TS-3	11.9	11.1	0.0420	12.6	11.8	0.0624
TS-4	10.8	10.9	0.8733	11.5	10.7	0.0614

Means and p-values of t-test for two dependent samples, significant at  $p < 0.05$ . Tillage systems: TS-1 (control) skimming to 12 cm + harrowing (after the preceding crop has been harvested), pre-winter ploughing to 28 cm, a tillage and sowing unit; TS-2, (reduced tillage method) grubber 2x, rototiller (after the preceding crop has been harvested), before the sowing: 2 x passive tillage unit; TS-3, (reduced tillage method) disk harrow (after the preceding crop has been harvested), pre-winter medium ploughing to 25 cm, pre-sowing tillage using a passive unit; TS-4, (reduced tillage method) subsoiler to 40 cm (after the preceding crop has been harvested), pre-winter medium ploughing to 20 cm (before winter), a passive tillage unit (harrow + string roller).

Table S2

Changes in the available forms of phosphorus (P), potassium (K), and magnesium (Mg) content in the soil before the start of the study (2017) and after its completion (2020)

Tillage system	Without packing			With packing		
	2017 year	2020 year	p value	2017 year	2020 year	p-value
P content – grassland preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	78.5	78.6	0.4765	76.2	75.8	0.2081
TS-2	75.9	76.1	0.5462	80.6	79.6	0.1246
TS-3	78.5	78.7	0.1656	75.0	74.1	0.0011
TS-4	79.6	79.0	0.2171	83.5	83.0	0.1646
P content – winter triticale preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	106	106	0.9184	99.1	99.7	0.1183
TS-2	98.1	98.5	0.1098	98.2	98.1	0.7888
TS-3	99.2	99.9	0.0140	99.6	99.8	0.4169
TS-4	102	104	0.0017	98.9	99.2	0.0319
K content – grassland preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	121	121	0.6910	141	149	0.0307
TS-2	127	129	0.0925	163	165	0.1305
TS-3	99.2	99.4	0.3339	118	117	0.1360
TS-4	107	109	0.2649	157	158	0.8336

K content – winter triticale preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	128	129	0.0029	155	156	0.0185
TS-2	121	122	0.0236	160	162	0.0354
TS-3	129	130	0.0291	190	198	0.0047
TS-4	147	152	0.0195	200	204	0.0039
Mg content – grassland preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	38.9	38.4	0.1354	38.3	38.3	0.9999
TS-2	36.0	36.4	0.0424	38.8	39.3	0.0947
TS-3	35.8	36.5	0.2111	36.1	36.2	0.8897
TS-4	38.9	39.8	0.0088	38.4	38.5	0.4481
Mg content – winter triticale preceding crop						
----- mg kg <sup>-1</sup> -----			----- mg kg <sup>-1</sup> -----			
TS-1	43.1	44.6	0.0260	45.0	45.0	0.9999
TS-2	44.6	45.0	0.1612	45.6	46.0	0.0596
TS-3	43.9	44.2	0.0032	44.7	45.1	0.0823
TS-4	45.2	45.7	0.1261	44.2	44.4	0.4998

Means and p-values of t-test for two dependent samples, significant at  $p < 0.05$ . Tillage systems: TS-1 (control) skimming to 12 cm + harrowing (after the preceding crop has been harvested), pre-winter ploughing to 28 cm, a tillage and sowing unit; TS-2, (reduced tillage method) grubber 2x, rototiller (after the preceding crop has been harvested), before the sowing: 2 x passive tillage unit; TS-3, (reduced tillage method) disk harrow (after the preceding crop has been harvested), pre-winter medium ploughing to 25 cm, pre-sowing tillage using a passive unit; TS-4, (reduced tillage method) subsoiler to 40 cm (after the preceding crop has been harvested), pre-winter medium ploughing to 20 cm (before winter), a passive tillage unit (harrow + string roller).

Table S3

*F*-statistics for fixed effects in the ANOVA strip-split-plot design model

Source of variation	df	pH	N <sub>total</sub>	P	K	Mg	SOC	C:N	Yield
Preceding crop (A)	1	39**	2.9 ns	5484***	2582***	3788***	6.2 ns	0.86 ns	1839***
Error 1	3								
Soil packing (B)	1	19*	0.60 ns	11*	7274***	0.65 ns	58**	18*	0.01ns
Error 2	3								
A × B	1	0.7 ns	11*	52**	91**	< 0.01 ns	31*	0.12ns	0.37 ns
Error 3	3								
Tillage system (C)	3	5.2**	4.1*	39***	278***	7.1***	9.6***	12****	2.70 ns
A × C	3	0.83 ns	1.7 ns	29***	829***	4.6**	2.6 ns	2.6 ns	0.79 ns
B × C	3	1.6 ns	12***	32***	91***	6.9***	0.42 ns	12****	0.74 ns
A × B × C	3	2.0 ns	1.3 ns	30***	149***	1.7 ns	2.9 ns	3.0 ns	0.68 ns
Error 4	36								

\* significant at the 0.05 probability level; \*\* significant at the 0.01 probability level; \*\*\* significant at the 0.001 probability level; ns, not significant.

Table S4  
Mean chemical properties and maize yield in response to preceding crops, soil packing and tillage systems

Factors	pH <sub>KCl</sub>	N <sub>total</sub> (g kg <sup>-1</sup> )	P (mg kg <sup>-1</sup> )	K (mg kg <sup>-1</sup> )	Mg (mg kg <sup>-1</sup> )	SOC (g kg <sup>-1</sup> )	C:N ratio	Yield (Mg ha <sup>-1</sup> )
Preceding crops								
<i>Grassland</i>	5.8 ±0.04 b	8.9 ±0.11 10 <sup>-1</sup> ns	78±0.5 b	131±4.0 b	38±0.3 b	10 ±0.14 ns	11.1 ±0.20 ns	70 ±0.2 a
<i>Winter triticale</i>	6.0 ±0.03 a	9.3 ±0.11 10 <sup>-1</sup> ns	101±0.5 a	156±5.2 a	45±0.2 a	10 ±0.05 ns	11.3 ±0.14 ns	61 ±0.4 b
Soil packing								
<i>Without packing</i>	6.0 ±0.04 a	9.0 ±0.12 10 <sup>-1</sup> ns	90±2.2 a	124±2.7 b	41±0.7 ns	10 ±0.10 a	11.5 ±0.19 a	65 ±0.8 ns
<i>With packing</i>	5.8 ±0.03 b	8.9 ±0.11 10 <sup>-1</sup> ns	89±2.0 b	164±4.6 a	42±0.7 ns	9.7 ±0.09 b	10.9 ±0.13 b	65 ±0.9 ns
Tillage systems								
<i>TS-1</i>	5.9 ±0.06 b	8.7 ±0.14 10 <sup>-1</sup> b	90±3.4 b	139±3.7 c	42±0.9 a	10 ±0.12 a	11.8 ±0.24 a	66 ±1.1 ns
<i>TS-2</i>	6.0 ±0.06 a	8.8 ±0.15 10 <sup>-1</sup> b	88±2.7 c	145±5.0 b	42±1.0 a	10 ±0.17 a	11.4 ±0.29 a	66 ±1.2 ns
<i>TS-3</i>	5.9 ±0.06 b	9.1 ±0.15 10 <sup>-1</sup> a	88±3.1 c	136±9.7 d	40±1.1 b	10 ±0.12 a	11.3 ±0.15 a	65 ±1.3 ns
<i>TS-4</i>	5.9 ±0.05 b	9.2 ±0.17 10 <sup>-1</sup> a	91±2.7 a	155±8.8 a	42±0.8 a	9.6 ±0.14 b	10.5 ±0.16 b	64 ±1.2 ns

Mean ± standard error; a-c, homogeneous groups of Bonferroni test at the 0.05 probability level (the same letters indicate not significant differences); ns, not significant. Tillage systems: TS-1 (control) skimming to 12 cm + harrowing (after the preceding crop has been harvested), pre-winter ploughing to 28 cm, a tillage and sowing unit; TS-2, (reduced tillage method) grubber 2x, rototiller (after the preceding crop has been harvested), before the sowing: 2 x passive tillage unit; TS-3, (reduced tillage method) disk harrow (after the preceding crop has been harvested), pre-winter medium ploughing to 25 cm, pre-sowing tillage using a passive unit; TS-4, (reduced tillage method) subsoiler to 40 cm (after the preceding crop has been harvested), pre-winter medium ploughing to 20 cm (before winter), a passive tillage unit (harrow + string roller).