

Supplementary Material

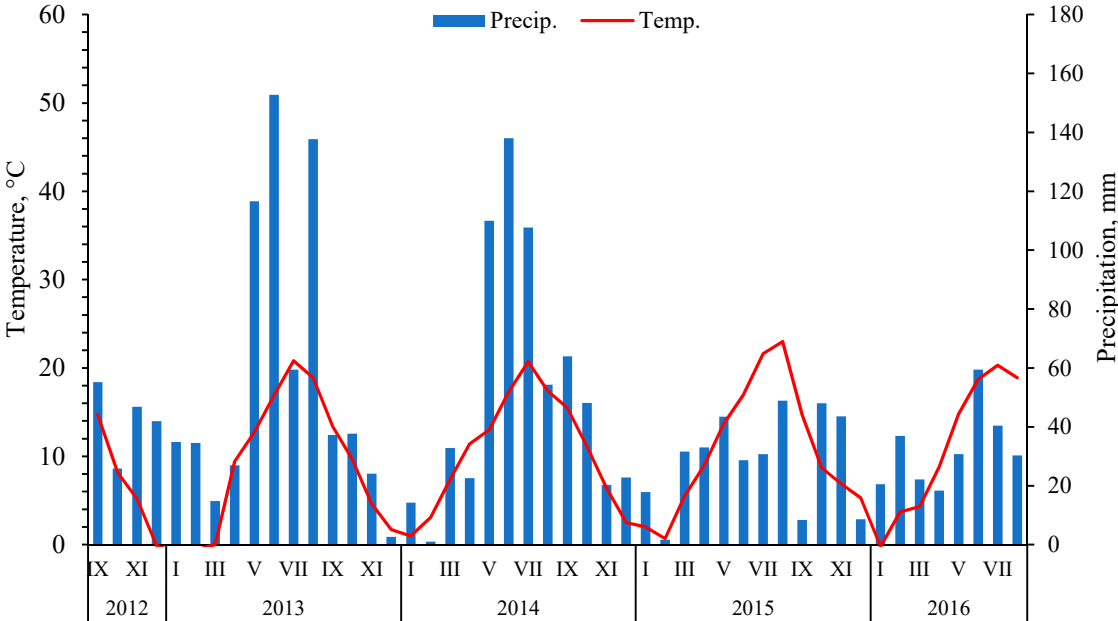


Figure 1. Mean monthly air temperature and sum of precipitation during 2012–2016 growing seasons of winter wheat and spring barley. Prague-Ruzyně Meteorological Station.

The monthly rainfall and average air temperature during the 5-year experiment are presented in Figure S1. It is worth noting, that the growing seasons in 2013 and 2014 were characterized by higher precipitation compared to the growing seasons in 2015 and 2016. The sum of precipitation from 2013 to 2016 amounted to 679, 636, 345, and 382 mm, respectively. The mean air temperature ranged from 8.9 (2013) to 10.7 °C (2015).

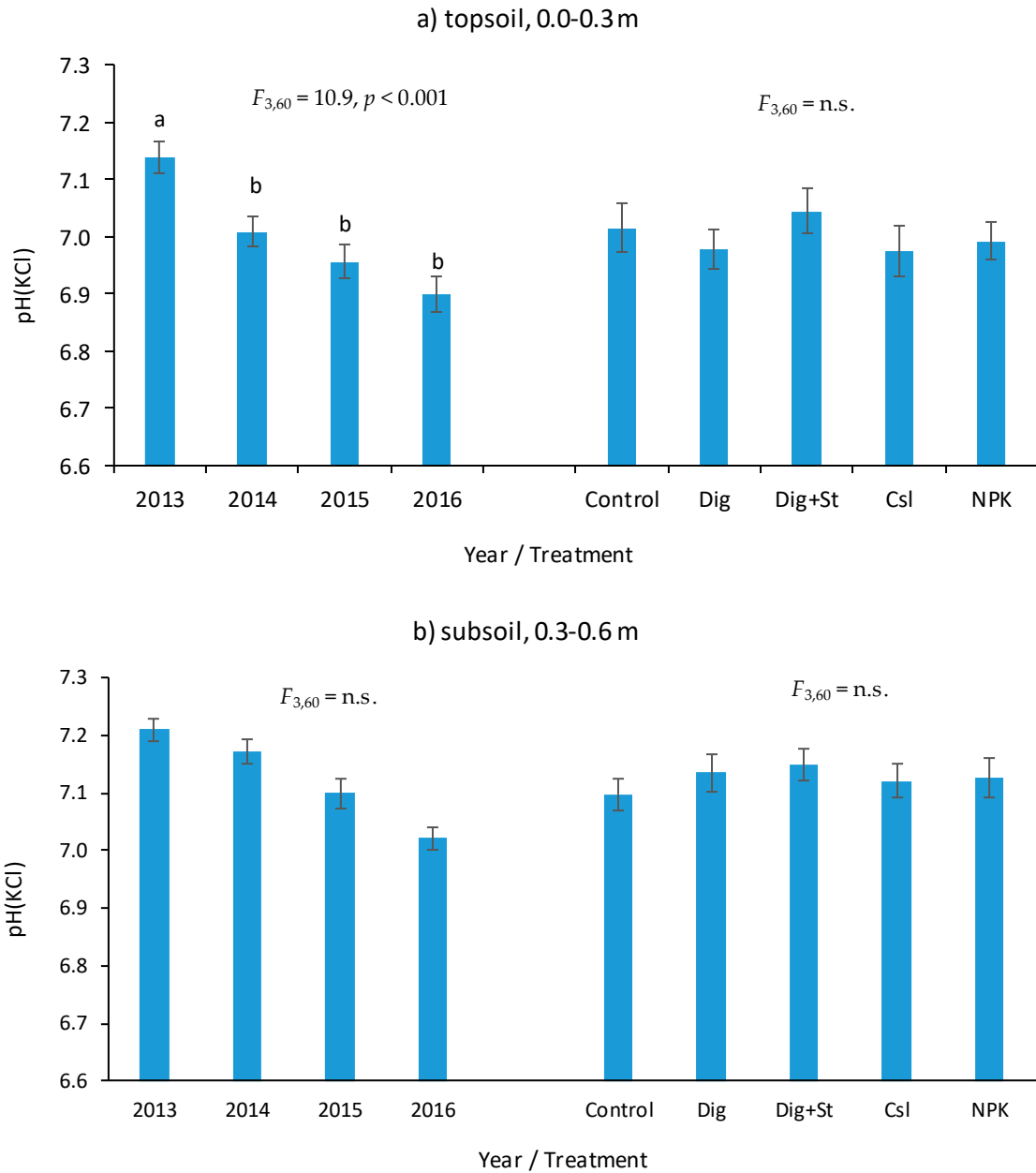


Figure 2. Soil reaction (pH) depending on the year and fertilization treatment. Different letters indicate statistically significant differences between treatments at $p < 0.05$ (HSD test). Hatched bars represent $2 \times \text{SEM}$ ranges. Key: Dig-digestate, Dig + St-digestate and straw incorporation, Csl-cattle slurry, NPK-mineral fertilizers.

Table S1. Total content of phosphorus, sulfur, copper, manganese and zinc in soil samples as a result of application of digestate (Dig), digestate + straw (Dig + St), cattle slurry (Csl) and mineral fertilizers (NPK). Mean for 4 years \pm standard error of the mean.

Soil depth	Treatment	Elements				
		P g kg ⁻¹	S g kg ⁻¹	Cu mg kg ⁻¹	Mn mg kg ⁻¹	Zn mg kg ⁻¹
0.0–0.3 m	Control	545.1 \pm 9.5	289.6 \pm 2.9	24.5 \pm 0.4	549.8 \pm 6.7	70.1 \pm 0.5
	Dig	547.9 \pm 8.4	307.9 \pm 8.4	25.4 \pm 0.5	547.9 \pm 9.0	70.3 \pm 0.4
	Dig + St ¹	541.0 \pm 7.0	296.9 \pm 3.9	24.9 \pm 0.5	546.5 \pm 8.3	70.5 \pm 0.5
	Csl	554.7 \pm 10.0	292.9 \pm 2.3	24.6 \pm 0.5	547.0 \pm 8.4	69.6 \pm 0.6
	NPK	544.6 \pm 7.3	288.7 \pm 4.0	24.6 \pm 0.5	550.1 \pm 11.0	69.9 \pm 0.6
0.3–0.6 m	Control	397.9 \pm 20.6	205.0 \pm 16.0	18.8 \pm 1.1	534.9 \pm 16.3	65.7 \pm 0.7
	Dig	409.9 \pm 19.8	200.8 \pm 9.8	19.2 \pm 0.8	506.5 \pm 8.2	65.4 \pm 0.7
	Dig + St	392.0 \pm 20.3	197.6 \pm 12.8	18.6 \pm 1.0	522.3 \pm 8.4	65.3 \pm 0.9
	Csl	418.4 \pm 20.1	215.0 \pm 11.3	19.5 \pm 1.1	532.5 \pm 10.9	66.3 \pm 0.8
	NPK	377.7 \pm 23.2	193.6 \pm 13.5	18.9 \pm 1.0	517.5 \pm 12.9	64.8 \pm 0.8

Total sulfur (S) were determined by using Vario Max analyser. The (pseudo)total nutrient content in soil (P, Cu, Mn, Zn) was determined in 1 g of subsamples after decomposition in digestion vessels mixed with aqua regia (1:3 mixture of nitric acid and hydrochloric acid). For digestion MLS-1200 mega microwave system (Milestone Inc., Sorisole, Italy) was used. The concentration of elements in the soil digests and extracts was determined by optical emission spectroscopy with inductively coupled plasma (ICP-OES Thermo Jarrell Ash, Trace Scan, Franklin, USA).

Table S2. Correlation matrix loadings and variance of the significant principal components (PCs) for soil quality properties depending on soil depth

Independent variable	Soil depth: 0.0-0.3 m			Soil depth: 0.3-0.6 m		
	PC ₁	PC ₂	PC ₃	PC ₁	PC ₂	PC ₃
SOC	0,38	-0,61	0,30	0,97	0,05	-0,14
TN	-0,38	-0,37	-0,77	0,91	0,38	-0,10
SOC/TN	0,92¹	0,08	0,31	-0,02	-0,95	0,03
pH	0,81	-0,26	-0,26	0,82	-0,18	0,35
Ca ²	-0,42	0,61	0,09	-0,87	-0,04	0,00
Mg	-0,04	0,57	0,72	-0,90	-0,37	0,16
P	0,03	-0,53	0,76	0,94	0,20	-0,09
K	-0,45	-0,48	0,09	-0,29	0,08	0,89
NH ₄ -N/A ³	0,81	-0,41	-0,05	0,89	-0,35	0,03
NO ₃ -N/A	-0,39	-0,63	0,34	0,88	0,03	0,42
NH ₄ -N/S	-0,88	-0,28	0,26	-0,55	0,68	0,36
NO ₃ -N/S	-0,16	-0,93	-0,05	0,54	-0,27	0,39
Eigenvalue	3,8	3,3	2,1	7,1	1,9	1,5
Variance, %	31,5	27,5	17,7	59,4	16,1	12,1
Cumulative, %	31,5	59,1	76,8	59,4	75,5	87,7

¹ boldfaced loadings are >0.70; ² boldfaced loadings are >0.70, ³ soil sampling dates: S–spring, A–autumn,