



The impact of soil fertilization experiment on soil water chemistry in forest stands on drained organic soil, in Latvia

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- The forest soil fertilization can compensate the nutrient deficiency in forest stand, thus improving growth conditions of trees.
- Wood ash can be used as fertilizer, because of high content of K, Ca, Mg, P. Wood ash in combination with N containing fertilizer may also be used in soil improvement.

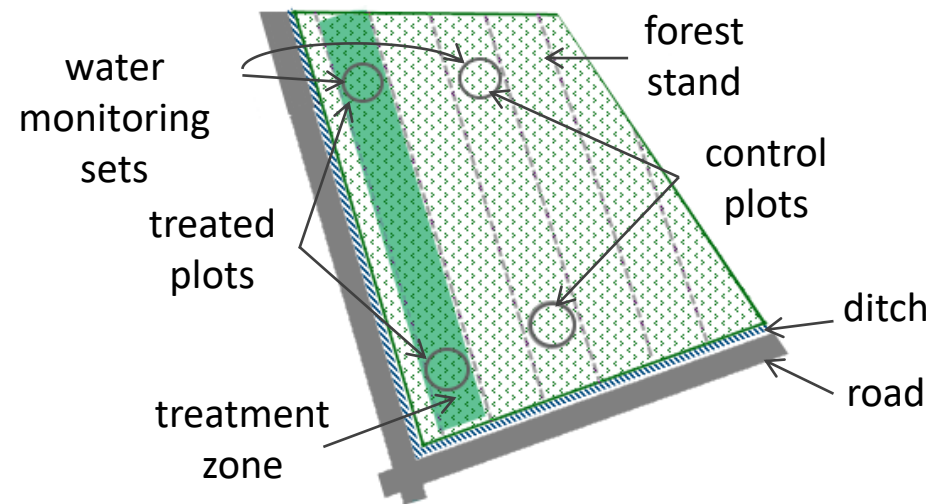
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The aim of the research was to estimate impact of organic forest soil fertilization on chemical properties of soil water.

Research objects

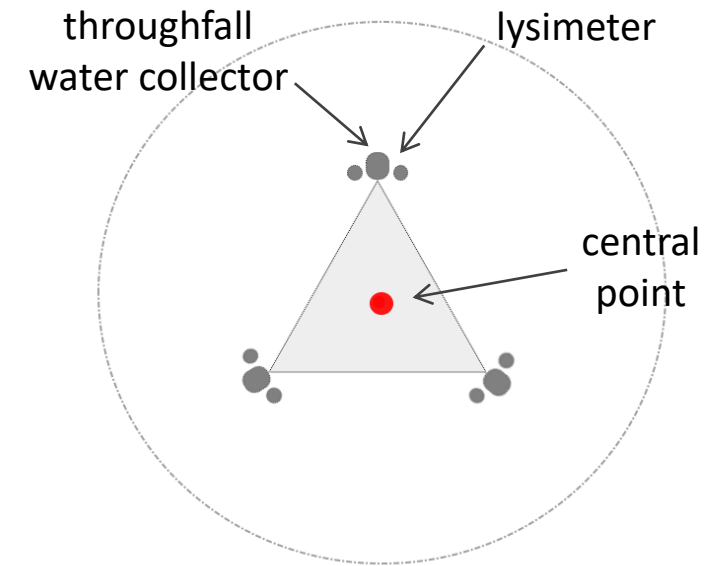
Object	Tree species	Stand age	Plots	Date of treatment	Fertilizer	Dose of WA: t ha ⁻¹ / NH ₄ NO ₃ : t ha ⁻¹	Spreading of fertilizer
NS54	Norway spruce	54	4	11.2014	wood ash	2	manually
NS49	Norway spruce	49	4	11.2014	wood ash	2	manually
NS54	Norway spruce	54	2	10.2016+ 07.2017	wood ash + ammonium nitrate	3/0.44	mechanically

Scheme of trial object



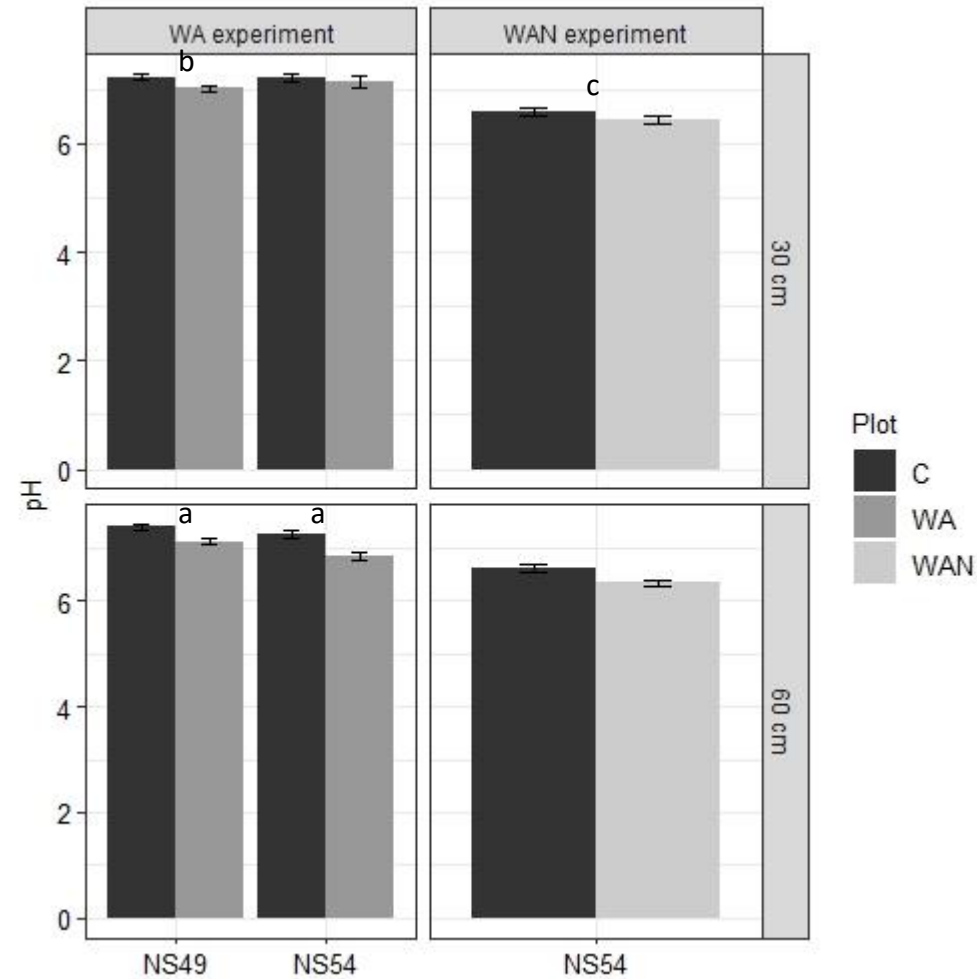
Sample collection

- Soil water and throughfall monitoring in 3 experimental objects
- Established monitoring set in one treated plot and in one control plot
- Throughfall water collector and a pair of lysimeters (30 cm and 60 cm) – 3 replicates per plot
- Data range: 2017-2019
- Soil samples collected at four fixed depths (0-10 cm, 10-20 cm, 20-40 cm, 40-80 cm), ensuring 2 replicates per plot. The samples were collected in 2019.



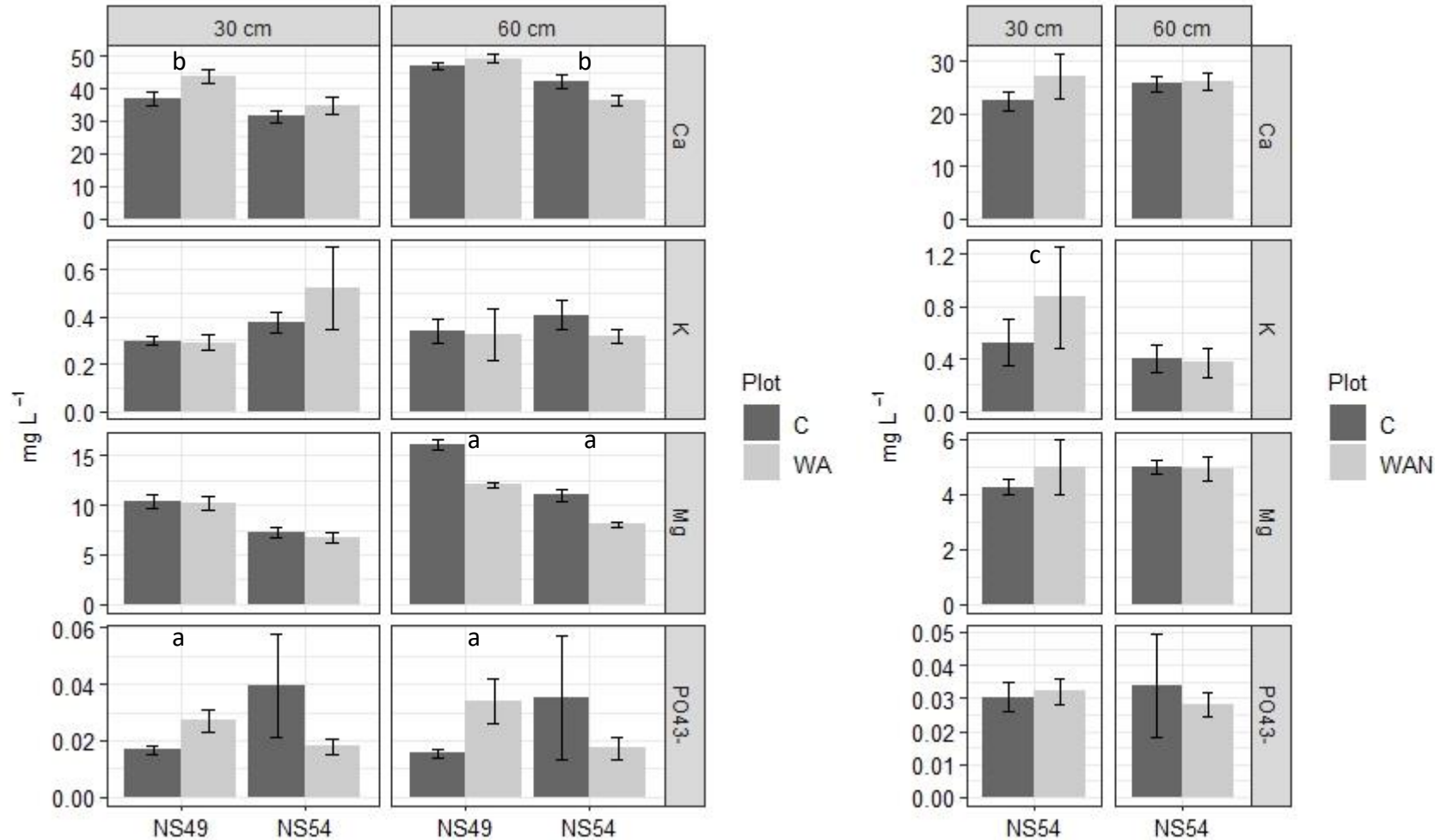
Scheme of a trial plot

The average pH of soil water collected in control and treated plots



C – control plot; WA – plot fertilized with wood ash; WAN – plot fertilized with wood ash and ammonium nitrate;
^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.1$

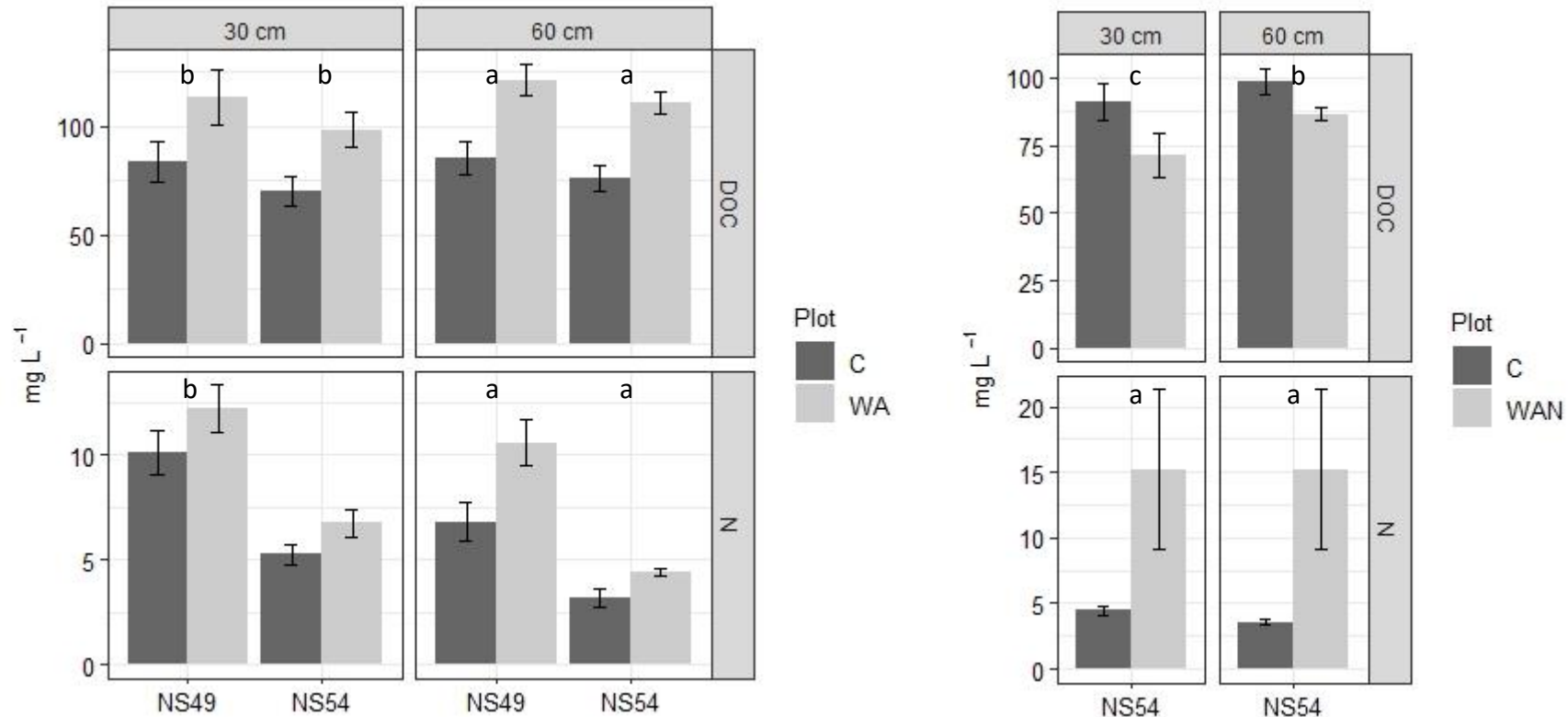
The average concentrations of Ca, K, Mg and PO_4^{3-} of soil water collected in control and treated plots



C – control plot; WA – plot fertilized with wood ash; WAN – plot fertilized with wood ash and ammonium nitrate;

^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.1$

The average concentrations of DOC and N_{TOT} of soil water collected in control and treated plots



C – control plot; WA – plot fertilized with wood ash; WAN – plot fertilized with wood ash and ammonium nitrate; ^a p<0.01; ^b p<0.05; ^c p<0.1

Correlation between chemical parameters of soil water and throughfall water

Parameter	Depth	WA experiment		WAN experiment	
		NS49	NS54	NS54	
		C	WA	C	WAN
pH	30 cm		0.57		0.63
	60 cm		0.58		0.53
K	30 cm			-0.56	
Mg	30 cm	0.56			
PO ₄ ³⁻	30 cm	0.70			

C – control plot; WA – plot fertilized with wood ash; WAN – plot fertilized with wood ash and ammonium nitrate

The diapasons of 5-month sums of atmospheric input:

N_{TOT}: 1.10 – 2.78 kg ha⁻¹

K: 1.43 – 7.18 kg ha⁻¹

Ca: 2.40 – 5.95 kg ha⁻¹

Mg: 0.70 – 1.66 kg ha⁻¹

PO₄³⁻: 0.04 – 1.28 kg ha⁻¹

Threshold values of N atmospheric input in Europe:

- 12 kg N ha⁻¹ yr⁻¹ (Pitman, 2006)
- 10 kg N ha⁻¹ yr⁻¹ (Dise, Wright, 1995; Kristensen et al., 2004)

Correlation between chemical parameters of soil water and soil of control and fertilized plots

Parameter	Depth	WA experiment	WAN experiment	
		NS54	NS54	
		WA	C	WAN
pH	30 cm		-0.63	
K	30 cm		0.64	
PO ₄ ³⁻	30 cm	-0.79		-0.81
	60 cm		-0.67	
Ca	30 cm	0.71		

Conclusions

- Forest soil improvement with wood ash or combined wood ash and N containing mineral fertilizer resulted in significantly elevated total N concentrations and decreased pH in the soil water samples from treated plots.
- Contrary to expectations, we did not observe a tendency of elevated pH of soil water in wood ash treated plots. There were significant increase in concentrations of Ca and PO_4^{3-} 3 – 5 years after the soil improvement with wood ash.
- Significant correlations between parameters of canopy throughfall water and soil water were found, but the effect of forest soil fertilization on soil water was more distinct.

Thank you for your attention!

Research program on forest fertilization 2015-2021

The study is implemented within the scope of the memorandum between LSFRI
“Silava” and Joint Stock Company “Latvia’s State Forests” from 11.10.2011