NEW SUSTAINABLE PRODUCTS FROM THE SOLID SIDE STREAMS OF THE CHEMICAL PULP MILLS

NSPPulp

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Introduction

Carbon content of agricultural soils is declining in Finland (Heikkinen et al. 2013). Soil organic carbon is an essential input for sustainable food production as it improves plant growth in general by increasing a soil's water holding capacity and cation exchange capacity, and reduces adverse environmental effects of agriculture, e.g. nutrient leaching. Pulp and paper industries produce annually large quantities (420 000 t DM) of agriculturally useable organic side streams.

In NSPPulp-project we investigate the ability of pulp mill side streams to stabilize soil aggregate structure, and consequently reduce erosion and nutrient leaching through a clay soil profile.

Material and methods

Field experiment was established in autumn 2015 on a loamy clay, amended with 1) composted pulp mill sludge (CPMS), 2) lime-stabilized pulp mill sludge (LPMS), both derived from a waste water treatment process of the factory, and 3) fiber sludge (FS). Application rates were 23-26 tn DM ha^{-1} (with about 8 tn org. C ha^{-1}).

Large undisturbed soil columns were taken from the field in spring 2016 and 2017, following rainfall simulation tests (as descibed in Uusitalo et al., 2012).

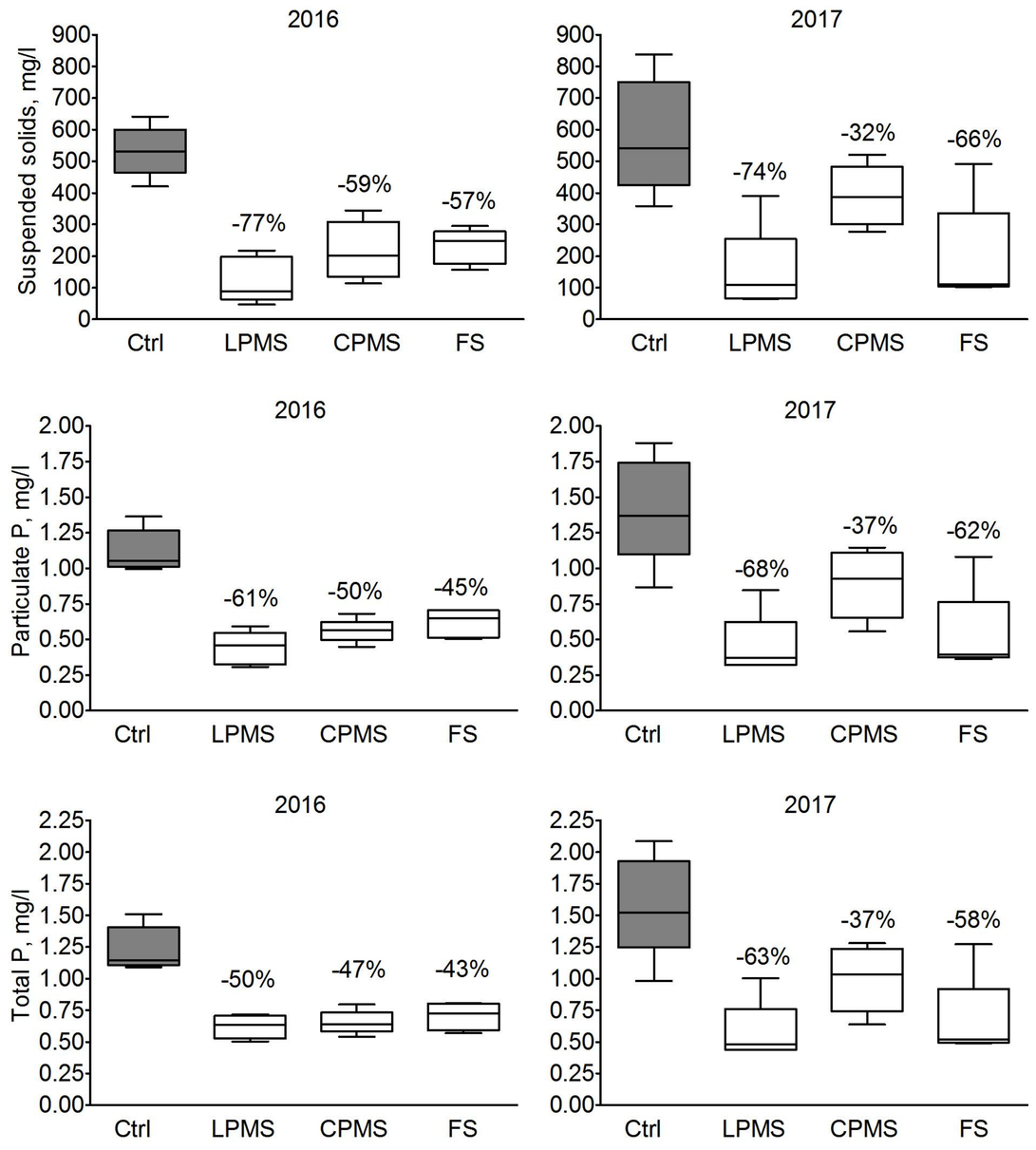

Figure 1. Concentrations of suspended solids, particle-bound phosphorus, and total phosphorus in percolation water after simulated rain in spring 2016 and 2017 (9 and 21 months after amendment applications). Treatment codes are given in Table 1.

Table 1. The amounts of total (Tot-N), soluble organic (Sol-N org) and soluble inorganic (Sol-N inorg) nitrogen, total phosphorus (P), potassium (K), sulphur (S), calcium (Ca) and magnesium (Mg) applied to soil (kg ha^{-1}) in the amendments.

Material	Tot-N	Sol-N org	Sol-N inorg	P	K	S	Ca	Mg
LPMS (Lime-stabilized Sludge)	250	32	1	49	28	121	2010	51
CPMS (Composted Sludge)	214	35	3	42	37	104	900	38
FS (Fibre Sludge)	13	1	0	2	1	7	2206	19

Results

In the first study year, all materials reduced concentration of suspended solids in percolation water more than 57-77% compared to the unamended control soil (Fig. 1). In the second year the reduction was 66-74% for LPMS and FS and 32% for CPMS. Consequently, concentrations in percolation water of particle-bound P and total P were reduced more than 43% in the first and for CPMS and FS more than 58% in the second year.

FS reduced wheat yield in the first year compared to control, but in the second year oat yields were at the same level.

Conclusions

All of the tested pulp mill side-streams clearly decreased mobilization and transport of erosion material and phosphorus through soil monoliths. Eight months after application the effect was equally good for all materials.

In the second year (20 mo after application), the effect seemed to have sustained slightly better when Ca-containing organic amendments (LPMS and FS) were used.

Reduced erosion tendency and P transport through soil monoliths will be tested for two further years in a follow-up project called "Ravinnekuitu".

GOVERNMENT KEY PROJECT

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