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Short communication

Nitrogen and ash elements content in sub-horizons of forest floor

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ABSTRACT

Nitrogen (N) and ash elements contents of forest floor (FF) depend on the fractional and chemical composition of falling litter. The elemental content in FF may be influenced as well by originated from the epipedon mineral particles due to soil fauna mixing activity. In actual work the contents (concentration and stocks) of N and ash elements were analysed in relation to phytogenic FF. In relation to total FF, the FF thickness, acidity, base saturation stage and C:N ratio as general characteristics were studied. The concentrations and amounts of N and ash elements of FF were studied on *Gleyic Albic Fragic Glossic Retisols* (group I), on *Gleyic Albic Podzols* (II) and on *Ortsteinic Histic Podzols* (III). The FF chemical parameters were researched in forest ecosystems with premature and mature (i.e. stabilized) forest stands. The dividing of FF into sub-horizons was possible only on soils with low soil faunal activity. The FF and its sub-horizons (OL, OF, OH) were sampled with a metallic frame (25 × 40 cm). In the field conditions, the FF thickness (cm) and mass superficial density (g m^{-2}) at field moisture content were determined. In the laboratory, the total and phytogenic FF dry mass superficial densities (Mg ha^{-1}) and their elemental contents (concentration – g kg^{-1} and amounts – kg ha^{-1}) were calculated. Content of N in FF samples was determined by Kjeldahl; content of K with flame-photometer; P by colorimetric method; Ca and Mg by complexometric titration with trilon B (using flame-photometer); Fe and Al colorimetrically, whereas in the case of Fe the sulfosalicylic acid and for Al the aluminon was used; the Si and remains were determined with weighing method. The soils of groups' I and II are well drained aeromorphic, but group III hydromorphic. By WRB the soils of group I are *Retisols*, but soils of two rest groups - *Podzols*. The soils of group I have been formed on loamy sand under-layered by loam, but the texture of groups II and III soils is sand. By the humus covers the soils of group I may be classified as *fresh* and *moist moder*, of group II as *fresh* and *moist mor* and of III as *wet* and *peaty mor*. On soils of groups II and III only the pine forest, but on soils of group I as well the spruce forest are presented. In all three soil groups the sequence of chemical elemental concentration in OL horizon (as falling litter) was: N > Ca > Si > Mg > K = Fe = P > Al. In the course of further FF developments, the concentrations Si, Al and N are increased in considerable extent. Practically to the same level persist the concentrations of K, P and Mg. At the end of throughout flow of FF this sequence was: Si > N > Ca > Al > Fe > Mg > K = P. The greatest amounts of all studied elements were observed in the FF of soils' group III on which the humus cover of *wet* and *peaty mor* type has been formed. The formation of this type of humus cover indicates the stagnation of elemental cycling between plant cover and soil cover.

1. Introduction

Nitrogen (N) and ash elements content of forest floor (FF) depends on the fractional and chemical composition of falling litter, which in clearly distinguished way is determined by soil type and its properties (Kõlli, 1977). But the FFs' N and ash elements contents may be influenced as well directly with mineral part of epipedon, due to soil faunal activity, who mix half-decomposed above-ground falling litter with originated from A- or E-horizon's soil. Taking this account, the contents of N and ash elements were analysed: (i) in relation to phytogenic FF (enfolds only originated from falling litter N and ash elements) and (ii) in relation to total FF (enfolds in reality existing mixture of organo-mineral materials on surface of mineral soil).

The dividing FF into sub-horizons (OL, OF and OH) is possible only on soils with low faunal activity, as only in this case the multi-layered FFs are formed. For comparative analysis of N and ash elements contents in sub-horizons of FFs the following three soil groups have formed: I − *Gleyic Albic Fragic Glossic Retisols*, II − *Gleyic Albic Podzols* and III − *Ortsteinic Histic Podzols* (IUSS, 2015). Actual study enfolds totally seven soil types, which are located in premature and mature (i.e. stabilized) forest ecosystems in Estonia (Kõlli, 1980). On soils of groups II and III only the pine forest are presented, but on soils of group I also the spruce

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Table 1
Characterization of soil groups' forest floor properties (presented by range of means belonging into group soils).

Characteristic	Unit	Soil group		
		I	II	III
Number of samples	quantity	27	25	15
Thickness of total forest floor	cm	3.2–4.8	4.3–6.1	8.5–15.9
Amount of phytogenic forest floor	Mg ha^{-1}	15.3–27.7	27.1–36.4	64.4–87.4
Ash content in phytogenic forest floor	%	7.3–8.6	5.1–5.4	3.5–3.7
pH_{KCl} of forest floor or O-horizon	pH	3.9–4.3	3.1–3.2	2.8–3.0
C:N in forest floor	ratio	30–33	38–44	37–39
Specific surface area	10^5 ha ha^{-1}	7.1–9.9	12.7–19.7	21.6–40.7

forest may be find (first of all on *Glossic Retisols)* besides of pine. Predominant forest site type of group I soils is *Oxalis*, group II *Myrtillus, Rhodococcum, Calluna* and *Cladonia*, and of group III *Vaccinium ulginosum, Myrtillus* and *Polytrichum*.

2. Materials and methods

The FF and its sub-horizons (OL, OF, OH) were sampled with a metallic frame (25 × 40 cm). In field conditions, FF thickness (cm) and mass superficial density (g m^{-2}) with field moisture content were determined. In the laboratory, by using the dry mass samples, the total FF dry mass superficial density (Mg ha^{-1}) was calculated. By using parallel analysis, the data of total FF and contaminated it mineral horizons' samples, the phytogenic FF superficial density (Mg ha^{-1}) and its elemental contents (concentration − g kg^{-1} and amounts − kg ha^{-1}) in relation to dry phytogenic FF mass were calculated.

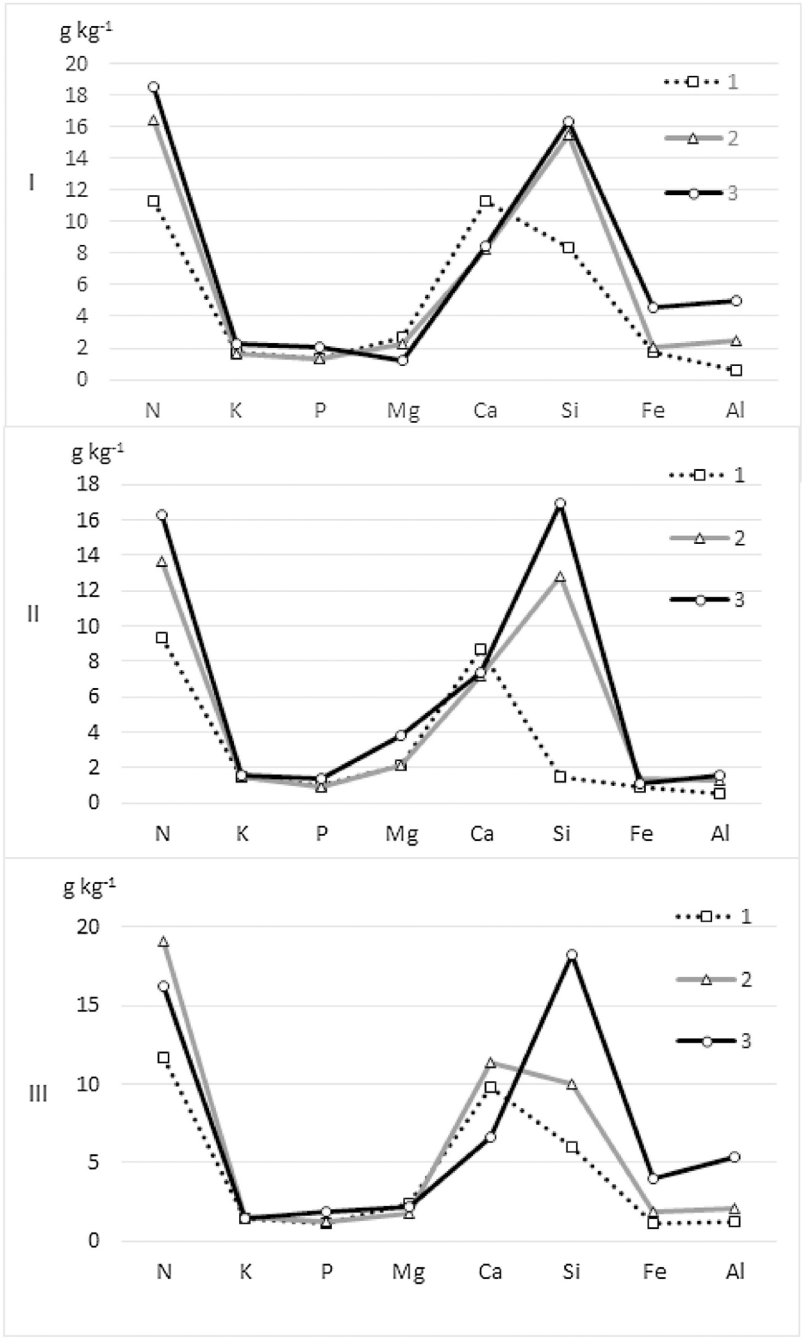

Fig. 1. Concentrations of nitrogen and ash elements in sub-horizons of forest floor by soil groups.
Sub-horizons of forest floor: 1 – OL, 2 – OF and 3 – OH; soil groups: I – *Gleyic Albic Fragic Glossic Retisols*, II – *Gleyic Albic Podzols* and III – *Ortsteinic Histic Podzols*.
Sub-horizons of forest floor (1–3) are according to Humusica of soil group I: 1 – vOL, 2 – nozOF, 3 – nozOH or gOH; of group II: 1 – vOL, 2 – nozOF, 3 – nozOH or gOH, and of group III: 1 – gvOL, 2 – gnozOF or HF, 3 – gnozOH.