ENVIRONMENT PROTECTIVE VALUE OF SOIL COVER IN BOREAL PEDOCLIMATIC CONDITIONS

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Introduction

The environmental status of separately located territory depends to a great extent on soil cover composition and functioning. This is the main reason for rising interest in evaluation and monitoring soils from the environmental aspect (Doran & Jones, 1996). The environment protection ability of different soil types varies very much depending on soil physical and chemical properties and its biological activity. In connection with this the main goal of the present work is to analyze and to evaluate environment protection ability of Estonian postlithogenic (or normally developed) mineral soils depending on their composition, properties and productivity.

Material and Methods

The analysis embraces a total of 20 Estonian soil groups, whereas the quantitative characteristics for each group are presented separately, according to land use (arable and forest soils) as well as according to their different layers (humus cover, soil cover and metric layer). Soil group names are given according to the WRB classification system (FAO et al 1998). In order to classify soils according to their environment protective ability, the following features were taken into account: thickness of humus cover (or epipedon) and soil cover (or solum), type (determined by fabric and biological activity) of epipedon, textural properties, indices of the specific surface area, cation exchange capacity, calcareousness and annual phytoproductivity. In the analysis of environment protective ability of different soils, the active and passive aspects of this ability were considered.

Our research was carried out in *frigid-udic* and *frigid-aquic* pedoclimatic conditions, where the annual average air temperature is +4.7^{O}C and the annual precipitation rate 500 - 700 mm.

Results and Discussion

The parameters characterizing environmental value of some Estonian soils are presented in Table 1. For pedoclimatic conditions of the area relatively thin humus- and soil covers are characteristic, which is also accompanied by the soil's low capability to retain substances cycled between plant and soil, to accumulate water available by plant and to create good conditions for soil organisms. As a result of classifying Estonian postlithogenic mineral soils (Fridland, 1982) the soils studied were divided into five groups by their environment protective ability (Table 2). The passive aspect of this ability was characterized complexly by using parameters presented in Table 1 and a three-stage scale. In the evaluation of the active aspect of environment protective ability the annual phytoproductivity level (Kõlli, 2002) of soil, as shown in the table, were taken into account. The third component in estimation of the rating level was subsoil quality, mainly from the passive environment protective aspect.

Besides that, erosion hazardous areas are problematic. If these areas are used as arable lands, they may be classified as synlithogenic mineral soils (Fridland, 1982), the erosion degree of which have been fixed for all the Estonian territory in the course of soil survey. But their possible influence to environment may be

Table 1. Characterization of environment protective parameters by different layers (E - epipedon, S - solum, M - metric layer) of some Estonian soil types

Land-use	n	Thickness cm		Index of specific surface area 10^5 ha ha^{-1}			Cation exchange capacity kmol			Base saturation%		
		E	S	E	S	M	E	S	M	E	S	M
Skeletic Regosols												
Forests	3	16	37	186	334	497	418	909	1776	93	94	96
Fields	4	19	21	176	180	399	705	735	2776	97	97	98
Mollic Cambisols												
Forests	12	17	46	116	332	572	368	1350	2932	86	92	96
Fields	20	27	53	267	491	643	801	1545	2538	92	93	95
Stagnic Albeluvisols												
Forests	18	18	93	98	472	522	363	1666	1886	29	67	70
Fields	12	26	93	192	554	570	551	1875	2120	81	85	85
Haplic Podzols												
Forests	21	4	67	20	114	231	43	518	736	23	46	51
Dystric Gleysols												
Forests	5	28	63	190	343	607	664	2418	4928	69	89	92
Fields	4	26	54	211	315	454	694	1892	3333	71	85	89
Histic Podzols												
Forests	13	15	75	41	226	292	134	1658	1974	19	36	40

Table 2. Environment protective value of studied postlithogenic mineral soils

Group	Characterization of environment protective value	APP[1)] Mg ha^{-1}	Rating[2)] of environment protection ability from different aspects			
			active	passive	subsoil	totally
I	Good	13-15	A3	P3	S3	9
II	Relatively good	10-12	A2	P3	S3	8
III	Satisfactory	12-14	A3	P1	S1	5
IV	Relatively feeble	6-8	A1	P2	S2	5
V	Feeble	6-8	A1	P1	S1	3

1) APP - annual phytoproductivity (Kõlli, 2002); 2) Environment protective value: A - active protection ability, P - passive protection ability, S - subsoil influence; Degree of value: 3 - good. 2 - satisfactory, 1 - feeble.

evaluated more profoundly on each specific area separately, depending on the local situation. In case of using these soils for forest growing, very effective environment protection ability may be acquired by the soil cover as a result of the formation of the forest floor, which avoids erosion features completely. At the same time, more intensive acidification of thin superficial layer of mineral soil part on these soils may take place.

In the first group are soils with good active and passive protective value, thick soil covers, where the texture is loam or loamy sand on loam, epipedons are rich in humus and soil parent material contains only low quantity of coarse (*skeletic*) material. These soils (*Haplic&Gleyic Luvisols, Stagnic&Gleyic Albeluvisols* as well as with thick loamy or clayey subsoil *Calcaric&Mollic&Gleyic Cambisols)* have good water purifying and pollution eliminating activity.

To the second group (having relatively good environment protective ability) belong unified soil covers formed on wet sediment areas, which have organo-mineral or raw-humous epipedons and from medium-textured to fine-textured or clayey particle size composition. To this group belong different *Gleysols (Hypocalcic&Luvic&Mollic&Haplic).*

Soils selected to group III have good environment protective rating from the active aspect, as these soils have well structured *mollic* type epipedons and they are highly productive and biologically active. The main constraints of these soils are subsoils rich in coarse material or the presence of thin and rich in coarse material soil cover. To this group (IV) belong *Calcaric&Skeletic Cambisols* as well as *Calcari&Abruptic&Endoskeletic Gleysols.*

Group IV soil covers with relatively feeble environment protective value are formed on thick sandy materials. Their epipedons are very acid, the profiles of these soils are degraded to varying extent due to podzolisation and forming of compacted B (*placic*, *carbic, densic*) horizons. The soils of this group are different kinds of *Podzols,* beginning from drought timid (*Haplic&Entic*) to wet *(Fibrihistic&Epigleyic) Podzols.*

To group V belong soils very sensitive to pollution and with unstable water conditions. These soils (*Rendzic Leptosols, Skeletic Regosols)* are thin and drought timid soils.

Conclusions

The environment protective value of epipedon is determined first of all by the content and quality of soil organic matter and depending on the cation exchange capacity as well as index of specific surface area. The environment protective value of metric soil layer is determined mainly by soil particle size composition (among this with presence of coarse soil material). In formation of environment protective value of any soil cover both the soil organic matter and texture are important, but besides that the thickness of soil cover is of utmost importance.

In environment protective value of various soil types very great differences exist, which must be taken into account in soil management. One part of these properties is determined by stable soil components and these are not easily controllable by management of soils. Soil environmental protection value determined by more dynamic properties may be enhanced by environmentally proper land use.

In the soil cover of Estonia there are sufficiently soils with high environment protective rating, which provides the possibility to develop intensively managed agricultural crop rotations.

References

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