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Short Communication

Postagrogenic Transformation of Soils and Vegetation in the Mountain Forest-Steppe of Western Transbaikalia

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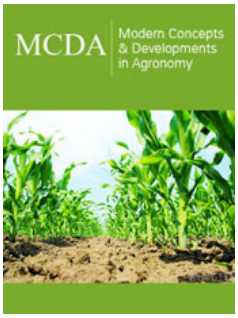

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Abstract

Agrogenically transformed soils in the mountain forest-steppe of Western Transbaikalia have been investigated. The morphological, chemical and physical properties of the Ap horizons of 10-15-year old fallow lands have been studied. The main stages of restoration of the fallow lands vegetation are revealed.

Keywords: Western Transbaikalia; Fallow land; Agrogenically transformed soils; Physicochemical properties; Restoration of vegetation

Introduction

Intermountain valleys in Western Transbaikalia are confined to the gentle slopes of the foothill ridges. These landforms are covered by a layer of sand and loess-like deposit. The climate is sharply continental, the average annual precipitation does not exceed 250mm. The most amounts (50-55%) fall in summer. The absence of a stable snow cover contributes to deep soil freezing. The exposure differences of the northern and southern slopes in terms of heat and moisture supply are so great that they lead to the coexistence of mountain steppes and mountain taiga without intermediate zonal subdivisions of vegetation.

The landscapes of the mountain forest-steppe in Western Transbaikalia are the most developed and are subject to the strongest anthropogenic pressures. Therefore, agrogenically transformed soils prevail in the structure of the soil cover. These soils have high fertility due to the high saturation of the soil-absorbing complex with bases. Soils of arable lands are good agricultural land and intensively used.

Postagrogenic transformation of fallow soils is characterized by changes in morphological, physical and agrochemical properties. As a result of agrogenic transformation, the soils involved in agricultural land use are degraded. Planar and linear erosion develops, the thickness of the humus layer decreases in the soil profile and the content of humus decreases, a plow base is formed, the structure changes, the bulk density increases, and the water resistance of aggregates decreases.

At present, steppe meadows occupy large areas and can be rhizome and shrub [1].

The study of the regularities of the restoration of vegetation cover and changes in the content of morphological, chemical, and physical properties in the Ap horizons of agrogenically transformed soils is scientific interest.

Method

Soil morphology was described according to Guidelines for Soil Description [2]. Soil types were determined according to [3]. Soil color was determined in the dry state using Munsell color charts. Physicochemical properties were carried out by conventional methods [4]. Particle-size distribution was analyzed by the pipette method according to Kachinsky [5]. Structural and aggregate composition of soils was analyzed by the method of dry and wet sieving according to N.I. Savvinov.

Result and Discussion

Pit 1M-13 was examined on the upper part of the hollow 4-5km to southwest of the settlement of Maly Kunaley on the middle part of deluvial fan on of the north-facing 7º-8º steep slope at 850m a.s.l. under the shrub-grass-forb communities. The projective cover was 30-40%. The soil was identified as Eutric Cambisol (Protocalcic, Siltic) on loesslike sediments. The Ap horizon is brownish-dark (10YR 3/2) dense; silt loam with crumb structure.

Pit 2K-13 was excavated 2km to northeast of the settlement of Kuitun on the middle part of deluvial fan on of the north-facing 6º-7º steep slope at 814m a.s.l. under the grass-herb communities. The projective cover was 20%. The soil was classified as Eutric Cambisol (Protocalcic, Siltic) on loesslike sediments. The Ap horizon is brownish-dark (10YR 4/2) dense; silt loam with lumpy-crumb structure.

The percentage of agricultural land is one tenth of the total value of the land fund of the Republic of Buryatia. According to the All-Russian Agricultural Census [6], in the Tarbagatai and Bichurskiy municipal districts, the total area of agricultural land is 26018.5 hectares and 52396.4 hectares. Of these, arable land accounts for 49% and 48%, fallow lands -23% and 11%. A high percentage of fallow lands in the Tarbagatai region are associated with a high density of ravines.

Agrogenically transformed soils of Western Transbaikalia are formed on arable lands and fallow lands of deluvial fans. The soils are characterized by a brownish-dark gray humus horizon, gradually giving way to little-altered parent rock, lumpy-crumb and crumb structure, dense constitution, low humus content, which is associated with dehumification due to long-term use in agricultural production. All horizons are characterized by a neutral and slightly alkaline of soil reaction. Calcium predominates among the exchangeable cations [7].

The vegetation of 10-15-year-old fallow lands is represented by steppe meadows, which reflect the initial stages of regenerative successions with a high participation of weeds and xeromesophytes. The rhizome stage of the steppe meadow of Pit 2K-13 is represented by *Elytrigia repens* (L.) Nevski. The grass cover: *Poa botryoides* (Trin. Ex Griseb.) Roshev., *Carex pediformis* C.A. Meyer, *Bromopsis inermis* (Leysser) Holub., *Artemisia scoparia* Waldst. et Kit., *Potentilla tanacetifolia* Willd. Ex Schlecht., *Antennaria dioica* (L.) Gaertn., *Galium boreale* L., *Veronica incana* L. The shrub stage of the steppe meadow of Pit 1M-13 is represented by a shrub-grass-forbs community. Shrubs occupy up to 10% and are represented *Rosa acicularis* Lindley, *Cotoneaster melanocarpus* Fischer ex Blytt, *Spiraea salicifolia* L., *Caragana pygmaea* (L.) DC. The grass cover: *Carex pediformis* C.A. Meyer, *Bromopsis inermis* (Leysser) Holub., *Poa botryoides* (Trin. Ex Griseb.) Roshev, *Artemisia scoparia* Waldst. et Kit., Potentilla tanacetifolia Willd. Ex Schlecht., *Antennaria dioica* (L.) Gaertn., Aconitum barbatum Pers., *Galium boreale* L., *Urtica dioica* L.

The shrub stage of the steppe meadow reflects the next stage of demutation of steppe vegetation and further reforestation of the territory.

Along with the succession of phytocenoses, there is an increase in the content of organic carbon and exchangeable cations in the Ap horizons. pH of the medium decreases towards acidification. In the granulometric composition is observed an increase in the content of the silt fraction (Table 1).

Table 1: Physicochemical properties of the Ap horizon of agrogenically transformed soils.

Horizon, Depth, cm	pH_{H2O}	Humus, %	C/N	$Ca^{2+}+Mg^{2+}$ cmol/kg	BS, %*	Particle size (mm)	
						<0.001	<0.01
Pit 2K-07							
Ap (0-20)	7.2	0.82	-	17.2	-	7	19
Pit 2K-13							
Ap (0-20)	6.9	2.57	8	20.8	99	10	17
Pit 1M-13							
Ap (0-20)	7.3	3.47	9	25.3	95	8	17

*BS is base saturation

The soil structure of the Ap horizons of Pit 2K-13 and Pit 1M-13 is generally favorable due to the predominance of agronomically valuable fractions 0.25-10mm. Structural coefficient is 2.56 and 1.75. The content of water-resistant aggregates is 52% and 24%. It indicates a good water-resistant structure of the Ap horizon of Pit 1M-13 and soil unsatisfactory of Pit 2K-13 (Table 2).

Table 2: Structural and aggregate composition of the Ap horizon of agrogenically transformed soils (dry and wet sieving).

Horizon, Depth, cm	Fraction Content, %; Aggregate Size, mm							
	>10	10-May	05-Mar	03-Feb	02-Jan	1-0.5	0.5-0.25	<0.25
Pit 2K-13								
Ap (0-20)	18	22	8/20	8/8	12/12	4/6	7/6	21/48
Pit 1M-13								
Ap (0-20)	45	23	5/0	5/0	5/2	2/4	3/18	12/76

The bulk density of the Ap horizon of Pit 1M-13 is favorable for the growth and development of plants. The compaction of the Ap horizon of Pit 2K-13 is much higher, as indicated by the lumpy-crumb structure (Table 3).

Table 3: Physical parameters of the Ap horizon of agrogenically transformed soils.

Horizon, Depth, cm	Wet, % (W)	Bulk Density, g/cm^{-3}	Total Porosity, %
Pit 2K-13			
Ap (0-20)	11.1	1.43	47
Pit 1M-13			
Ap (0-20)	19.8	1.18	54

Conclusion

We first established the restoration of vegetation of 10-15-year-old fallow lands of steppe meadows on the key sites 2K-13 and 1M-13 is represented by the rhizome and shrub stages. Self-restoration of agrogenically transformed soils is characterized by an increase in the content of organic matter and exchangeable cations. pH of the medium changes towards acidification. The proportion of the silty fraction increases, the structural condition improves, and the bulk density decreases.

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