



Diagnostics of soil compaction in steppe zone

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Abstract:

Land degradation and desertification are among the major challenges in steppe zone, and leads the risks of food security in affected areas. Soil compaction is one of the basic reasons of degradation of arable land. The processes of soil compaction have different genesis. Knowledge of soil compaction mechanisms and their early diagnostics permit to accurately forecast velocity and degree of degradation processes as well as to undertake effective preventive measures and land reclamation activities. Manifestations of soil compaction and degradation of soil structure due to vertic, alkaline and and mechanical (agro-) compaction, as well as caused by combination of these processes in irrigated and rainfed conditions were studied in four model plots in Krasnodar and Saratov regions of Russia. Typic chernozems, solonetz and kashtanozem solonetz, south chernozem and dark-kashtanozem soils were under investigation.

Morphological (mesomorphological, micromorphological and microtomographic) features, as well as number of physical (particle size analyses, water-peptizable clays content (WPC), swelling and shrinking, bulk density and moisture), chemical (humus, pH, CAC, EC), and mineralogical (clay fraction) properties were investigated.

Method for grouping soil compaction types by morphological features was proposed.

It was shown that:

- overcompacted chernozems with vertic features has porosity close to natural chernozems (about 40%), but they had the least pore diameter (7-12 micron) among studied soils. Solonetzic soils had the least amount of “pore-opening” (9%).
- irrigation did not lead to the degradation of soil structure on micro-level.
- “mechanically” (agro-) compacted soils retained an intra-aggregate porosity.
- studied soils are characterized by medium and heavy particle size content (silt [$<0.1\text{mm}$] of 30-60%). Subsoil horizons of chernozems with vertic and alkaline features were the heaviest by particle size content.
- the share of WPC to clay ratio was 40% in average, this ratio in vertic and alkaline soils was up to more than 70%.
- overcompacted chernozems with vertic features has the swelling degree of 17-25%, all studied soils have the maximum value of swelling degree in subsoil compacted horizon.
- humus content varied from 2 to 4%, pH – from 6.9 to 8.2. Studied soils were saturated with basics, Ca of 30 $\text{mg}\cdot\text{eq}/100\text{g}$ and more, Na was more relevant to compacted solonetz and solonetz-like soils (up to 4.3 $\text{mg}\cdot\text{eq}/100\text{g}$)