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Impact of tree cutting on water-soluble organic compounds in podzolic soils of the European North-East

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Water-soluble organic compounds (WOCs) and their single components, i.e. low-molecular organic acids, alcohols, and carbohydrates, attain a great deal of attention among soil scientists. WOCs are an important component of soil organic matter (SOM) and form as a results of different biological and chemical processes in soils. These processes are mainly responsible for formation and development of soils in aboveground ecosystems.
The purpose of the work was identifying qualitative and quantitative composition of low-molecular organic substances which form in podzolic loamy soils against natural reforestation after spruce forest cutting.
The studies were conducted on the territory of the European North-East of Russia, in the middle taiga subzone (Komi Republic, Ust-Kulom region). The study materials were soil of undisturbed bilberry spruce forest (Sample Plot 1 (SP1)) and soils of different-aged tree stands where cutting activities took place in winter 2001/2002 (SP2) and 1969/1970 (SP3). Description of soils and vegetation cover on the plots is given in [1]. Low-molecular organic compounds in soil water extracts were identified by the method of gas chromatography mass-spectrometry [2, 3].
Finally, reforestationafterspruceforestcutting was found to be accompanied by different changes in soil chemical composition. In contrast with soils under undisturbed spruce forest, organic soil horizons under different-aged cuts decreased in organic carbon reserves and production of low-molecular organic compounds, changed in soil acidity. Within the soil series of SP1→SP2→SP3, the highest content of WOCs was identified for undisturbed spruce forest (738 mg kg-1 soil). In soils of coniferous-deciduous forests on SP1 and SP3, WOC content was 294 and 441 mg kg-1 soil, correspondingly. Soils at cuts decreased in concentration of any water-soluble low-molecular SOM components as low-molecular acids, alcohols, and carbohydrates.
Structure of low-molecular WOCs in the study podzolic soils was dominated by carbohydrates with ratio from 49% (SP1) to 63-66% (SP2, SP3) of total content of all identified compounds. The increase in relative content in carbohydrates observed for soils under cuts was possibly affected by vegetation cover change after clear-cutting and presence of birch and aspen leaves in plant waste composition (due to tree species change). At SP2 and SP3 cuts, content of alcohols and low-molecular carboxylic acids fell by almost twice as compared with SP1.
Tree cuts changed not only in total content of water-soluble compounds but also in ratio of individual low-molecular compounds in water extracts composition. Totally, we identified 26 various compounds, including 12 low-molecular organic (carboxylic) acids, 10 carbohydrates, and 4 alcohols. Composition of carboxylic acids was dominated by aliphatic substituted acids (mainly 2-oxyacetic acid, 2-oxypropane, and 2,3-dioxypropane acids). Total number of aliphatic substituted acids, as well as aliphatic non-substituted and aromatic carboxylic acids, decreased in soils under cuts at initial reforestation stages (SP2). Content of all mentioned acids gradually rose with time (SP3).
Soils under cut forests were observed for a decrease of erythrite ratio in composition of water-soluble alcohols (from 52 to 40% of total alcohols) and an increase of glycerin ratio (from 46 to 72%).
10 of identified mono- and disaccharides were dominated by mannose, galactopyranose, and D-ribose. Disturbed soils were identified for increased ratio of galactopyranose and D-ribose and for by almost twice as decreased ratio of mannose.

References

1. Dymov, A. A. Changes in the organic matter of taiga soils during the natural reaforestation after cutting in the middle taigaof the Komi Republic / A. A. Dymov, E. Yu. Milanovskii // Eurasian Soil Science, 2013. Vol. 46. № 12. P. 1164-1171.
2. Shamrikova E.V., Punegov V.V., Gruzdev I.V., Vanchikova E.V., Vetoshkina A.A. Individual organic compounds in water extracts from podzolic soils of the Komi Republic // Eurasian Soil Science, 2012. . 45. № 10. . 939-946.
3. Shamrikova E.V., Gruzdev I.V., Punegov V.V., Khabibullina F.M., Kubik O.S. Water-soluble low-molecular-weight organic acids in automorphic loamy soils of the tundra and taiga zones // Eurasian Soil Science, 2013. . 46.№ 6. . 654-659.