Keynote Speech

Secondary Succession and Wildfires Change the Soil Properties of Abandoned Fields

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Abstract

In 1989, Europe experienced a significant social transformation as the Iron Curtain fell and many Eastern European nations saw the demise of communism, ultimately bringing an end to the Cold War. This period also saw the emergence of democratic movements and the establishment of new political systems in these countries. In the 1990s, Slovakia underwent significant economic and social changes, including the transition from a centrally planned economy to a market-oriented one. As a result of this transition, there was a decline in the importance of the agricultural sector in Slovakia. As sandy soils are less fertile, their cultivation is often abandoned.

Abandonment can cause ecosystem recovery by replacing crop species with vegetation that disperses from the surrounding habitats and subsequently establishes itself (secondary succession). Vegetation and its changes during succession can induce soil water repellency. Hydrophobic layers on or near the surface of the soil can result in reduced infiltration occurring in irregular patterns, enhanced runoff and increased erosion rates. Although the burning of grass and crop residues is prohibited in many countries, farmers perceive it as a quick and inexpensive way to get rid of unwanted biomass, often in abandoned fields. Wildfires affect different physical, chemical and hydraulic properties of the soil, and the extent of their effects varies depending on the soil's intrinsic properties and the wildfire's characteristics.

The first objective of our research was to find the impact of secondary succession during more than 30 years of abandonment of agricultural fields on soil parameters, infiltration and surface runoff. The second objective was to estimate the impact of heating temperature on some properties (pH, soil organic carbon content (SOC), and water drop penetration time (WDPT)) of acidic sandy soil and its dependence on the duration of field abandonment. The sites are located in western Slovakia in the central part of the Borská lowland. The method of space-for-time substitution was used so that the fields abandoned at different times were treated as a homogeneous chrono sequence.

The changes in SOC, pH, water and ethanol sorptivity, hydraulic conductivity, WDPT, repellency index, time to runoff, and surface runoff coefficient characterized the impact of abandonment. Our findings indicate that abandoned soils, previously used for agriculture, exhibit a reduction in soil water content and pH, as well as a notable increase in soil water repellency and a decrease in infiltration. These changes can potentially lead to severe issues concerning surface runoff and soil erosion. The pH(H_2O) and pH(KCl) decreased monotonously, and ethanol sorptivity did not change significantly during abandonment. The time to runoff did not change between 10 and 30 years of abandonment significantly and could not be measured in arable field, where no runoff occurred. The dependence of the other characteristics on the duration of field abandonment was not unambiguous. Water sorptivity and hydraulic conductivity showed a decrease between 1 and 10 years, followed by a slight increase between 10 and 30 years of abandonment. On the other hand, soil organic carbon content, water drop penetration time, repellency index, and surface runoff coefficient showed an increase between 1 and 10 years, followed by a slight decrease between 10 and 30 years of abandonment.

Different heating temperatures significantly affect soil parameters from abandoned agricultural areas with different durations of secondary succession. We found that soil samples exposed to higher

heating temperatures (up to 400 °C) showed higher persistence of the soil water repellency characterized by WDPT. The pH values increased with the heating temperature. The SOC content showed the opposite trend and decreased with the heating temperature. The arable field had the lowest initial SOC content, while the 10-year abandoned field had the highest. Furthermore, the WDPT increased with temperature and ceased at 400°C in samples from all plots.

Abandoned fields with sandy soil underwent secondary succession and wildfires, resulting in a notable rise in water repellency that could contribute to the development of soil drought, heightened surface runoff, and soil erosion. To mitigate soil water repellency and its associated consequences in sandy soils, it is essential to maintain adequate soil water content, and mixed forest afforestation should be prioritized over pine afforestation.

Keywords: Abandoned fields, Heating temperature, Sandy soil, Soil parameters, Soil water repellency