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ORIGINAL ARTICLE

Wildfire effects on ash composition and biological properties of soils in forest–steppe ecosystems of Russia

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Abstract Soils affected by forest wildfires in Russia in 2010 were studied in postfire and unburned plots near Togljatty city, Samara region. The microbial biomass, basal respiration of the soil, and the ash composition dynamics were investigated under the effect of forest fires during the 3 years at the site of a surface forest fire, a crown forest fire site, and a site unaffected by fire as a control (unburned). Soil samples were collected at 0–15 cm. The analytic data obtained showed that wildfires led to changes in the chemical composition of soil horizons and increased their ash content. Fires led to the accumulation of nutrients (P and K) in the fine earth of the soil. Thus, when the upper horizons are burned, the ash arriving on the soil surface enriches it with nutrients. The calcium content was also increased, leading to an alkaline pH of the upper soil horizons. The values of nutrients decreased as a result of leaching out with a precipitation during the second year after the fire. The unburned soils were characterized by the greatest values of microbial biomass carbon in the top horizon and the biggest values of basal respiration, whereas both parameters decline in postfire soils. Nevertheless, this influence did not extend to depths >10 cm. Thus, the effects of fire on soils were recognized as a decrease of microbiological activity.

Keywords Soils · Wildfires · Postfire soil development · Biological soil properties · Ash composition

Introduction

Successions of soil–plant cover (demutation changes, anthropogenic chronoseries), caused not only by climate dynamics, but also by the influence of natural factors (windfalls, pest outbreaks), natural and anthropogenic factors (wildfires), and purely anthropogenic factors (logging), are characteristic of forest ecosystems. Forest fires are considered as an important factor that disturbs the forest environment, and their effects and consequences are not predictable (Certini 2005; Guénon et al. 2013; Mataix-Solera et al. 2011). Wildfires are considered as a natural–historical factor of modern forest communities development and soil-formation processes' trends (Certini 2005; Doerr and Cerdà 2005). Wildfires are an active and driving factor of soil formation in most boreal and steppe environments. Catastrophic changes of the plant cover accompany postpyrogenic soil formation in postfire landscapes (Gonzalez-Perez et al. 2004). Simultaneous research studies on postfire successions of vegetation and