



Changes of the “Birch effect” in a course of post-agrogenic successions in abandoned fellows along the N-S transect from south taiga Podzols to dry steppe Calcisol–Solonetz soil complexes (European Russia)

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This chronosequential longitudinal (58 – 48oN) study in European Russia includes measurements of the dynamics of soil respiration and changes of the so called “Birch effect” during different stages of self-restoration in post-agrogenic south taiga Pogzols (1, 7, 23, 55, 100, 170 yr after abandonment); Haplic Luvisols in the temperate broadleaf forest zone (1, 3, 7, 20, 60, 110 yr); forest-steppe Chernozems (1, 2, 8, 38, 66 yr), and Calcisol–Solonetz complexes in the dry steppe zone (1, 7, 12, 17 and 42 yr). This effect is well known in soil ecology studies (Birch, 1954) and results in intensive rise of surface CO₂ emission and nitrogen release due to soil moistening after drought events. Measurements of the “Birch effect” in the agro-ecosystems were made in 2012 - 2015 during the vegetative periods (April- September). We measured CO₂ emissions monthly at every succession stage, using a closed chamber technique before and after 200 ml of distilled water addition per base (equivalent of 2 mm rain). The maximum rates of observed CO₂ soil emission fluxes due to “Birch effect” per initial respiration values were than compared between different zonal ecosystems and stages of agro-successions. Our results show that the fellows stages in dry steppe zone demonstrate the lowest seasonal rate of basic soil respiration at average: 3.5 times lower, if compared to the fellows chronosequence in Podzols, 4.6 times lower, if compared to Agro-chernozems, and the maximum difference was found with the Haplic Livisols in the zone of broadleaf forests – 7.8 times lower. The “Birch effect” for soil respiration of the zonal fellow chronosequences in study was shown to increase from 1.1 ± 0.6 for broadleaf Haplic Vertisols (no effect), to 7.1 ± 1.5 in the zone of forest steppe, and to 15.2 ± 3.5 in dry steppe, which is due to zonal deterioration of hydro-thermal conditions and aridization. In south taiga zone it is weakly expressed and changes within the limits of 1.0 - 2.5. In Chernozems and dry steppe soil complexes the effect is significantly greater at the late stages of successions.