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Ecological impacts of apple orchards on China's Loess Plateau

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Due to their great economic benefits, there are many apple orchards on the Loess Plateau and aggressive expansion is planned. However, little is known about their ecological impact in relation to the deep soil water, soil organic carbon and soil particle aggregation. An accurate evaluation of the ecological impact of apple orchards is crucial to ensure the establishment of sustainable ecosystems on the Loess Plateau. We, therefore, measured the soil water content variation in deep layers (WCAD) (200-800 cm), soil organic carbon (SOC) content and density (0-800 cm) and, soil aggregate stability (0-40 cm) in apple (Malus pumila) orchards and ecological plantations of black locust (Robinia pesudoacacia) and korshinsk peashrub (Caragana korshinskii). The results suggested that (1) the soil water in deep soil was generally lower under apple orchards (13.29%), black locust (12.4%) and korshinsk peashrub (13.46%) than under arable land (18.35%), both in the semiarid and semihumid regions. This finding implied that apple orchard, black locust and korshinsk peashrub plantations caused intense reductions in soil moisture compared with the arable land, leading to severe soil desiccation. (2) Apple orchards (1.85 to 5.49 g kg^{-1}) had significantly ($p < 0.05$) lower SOC density than ecological plantations (2.15 to 8.95 g kg^{-1}), especially in 0-100 cm soil layer, in both semiarid and semihumid regions. This result suggests that apple orchards have no profitless for SOC sequestration over the long-term because their clean cultivation management increase the risk of SOC loss by soil erosion. (3) In semiarid and semihumid regions, soil aggregate stability (the mean weight diameter, MWD) in apple orchards (0.26-0.63 mm) was significantly ($p < 0.05$) lower than under black locust (0.63-2.97 mm) and korshinsk peashrub (0.72-2.13 mm) plantations in 0-40 cm layers, and even lower than in arable land in the 0-20 cm layer in most regions, which means that apple orchards have low anti-erodibility. Our results suggest that continued expansion of apple orchards and ecological plantations both consumed much deep soil water, but the ecological effect (e.g., SOC sequestration, soil and water conservation) brought by apple orchard is much lower than that of ecological plantations. In the interest of sustainable development in the region, apple cultivation should be undertaken with caution, especially in semiarid regions.