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Plant root exerted a stronger positive effect on aggregate stability than soil during plant secondary succession on the Loess Plateau, China

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The stability of soil aggregates is an indicator of restoration of soil in degraded ecosystems. A multitude of factors such as properties of plant roots and soil have been suggested to contribute to aggregate stability, but little information is available on the relative importance of these factors in temperate grass zones. We examined how root and soil properties modified aggregate stability along a gradient of secondary succession grassland on the Loess Plateau in China. We selected three cropland abandoned for 3, 10, and 16-year and measured the distribution of aggregates, mean weight diameter (MWD), bulk and aggregate-associated soil organic carbon (SOC) and glomalin-related soil protein (GRSP) contents, root biomass density, root length density, and specific root length (SRL). Compared with 3-year site, the amount of large macroaggregates (>2 mm) and aggregate stability (indicated by MWD) at 16-year site increased by 25.6% and 8.5%. The higher MWD contributed the most to the accumulation of SOC in large and small macroaggregates and to the accumulation of GRSPs in microaggregates (<0.25 mm). SRL was significantly positively correlated with MWD. Redundancy analysis (RDA) showed that soil and plant variables together explained 89.1% of the aggregate distribution variation. Partial RDA further revealed that soil variables solely explained 6.4% of the variation, plant root variables explained 47.9% of the variation, and interaction of soil and plant variables accounted for 34.8% of the variation. Our study indicated that increased soil aggregate stability during plant secondary succession depended on both plant roots and aggregate-associated SOC and GRSPs, and plant root exerted a stronger influence on soil aggregate stability than soil. Allowing secondary succession may be a promising strategy for restoring degraded ecosystems on the plateau.