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Land preparation techniques and vegetation type commonly determine soil conditions in a typical hilly watershed, Loess Plateau of China.

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Soil is a key component of the earth, it plays important role in regulating the chemical, hydrological and biological cycles. Land preparation techniques (e.g., leveled ditches, leveled benches, adversely graded tableland and fish-scale pits) is one of the most effective ecological engineering practices to reduce water erosion. Land preparation greatly affects soil physicochemical properties, soil moisture variation, runoff and sediment prevention. This study investigated the influence of different land preparation techniques on soil conditions, runoff and erosion during vegetation restoration, which remained poorly understand to date. Soil samples were collected from depths of 0–10 cm, 10–20 cm, 20–40 cm, 40–60 cm, 60–80 cm and 80–100 cm, in the typical hilly watershed of Dingxi City, Loess Plateau. Soil bulk density (BD), soil organic matter (SOM) and total nitrogen (TN) were determined for different land preparations and vegetation type (*Caragana korshinskii*, *Platycladus orientalis*, *Pinus tabulaeformis* and *Prunus armeniaca*) combinations. Fractal theory was used to analyze the soil particle size distribution (PSD). Redundancy analyses were conducted to distinguish the relationships between soil conditions and the factors influencing them (land preparation and vegetation). The analysis of runoff coefficient and erosion rates were calculated considering the monitoring time. The results indicated that: 1) the effect of land preparation on soil properties and PSD varies with soil depth. For each land preparation category, SOM and TN values showed a significant difference between the top soil layer and the underlying soil depth. 2) The 20 cm soil layer was a boundary that distinguished the explanatory factors, with land preparation and vegetation type as the controlling factors in the 0-20 cm and 20-100 cm soil layers, respectively. Land preparation and vegetation significantly affected soil properties in the surface soil layer, while land preparation (41.6%) was the more important driver for this layer compared with vegetation (37.2%). Land preparation affected the soil properties by abiotic factors (e.g., surface runoff and sediment transport), while vegetation influenced soil physical and chemical properties via biotic factors (e.g., canopy and root). 3) Fish-scale pits-*Pinus tabulaeformis* had the highest runoff coefficient (3.91%) and adverse grade tableland-*Platycladus orientalis* had the lowest (1.10%). The runoff coefficient of level bench-*Caragana korshinskii*, fish-scale pits-*Platycladus orientalis*, level ditch-*Prunus armeniaca* and adverse grade tableland-*Pinus tabulaeformis* were 3.02%, 2.59%, 2.42% and 1.58%, respectively. Level bench-*Caragana korshinskii* had the highest erosion modulus (0.036 t/ha) and adverse grade tableland-*Pinus tabulaeformis* showed the lowest (0.006 t/ha). Erosion modulus of fish-scale pits-*Platycladus orientalis*, level ditch-*Prunus armeniaca* and adverse grade tableland-*Platycladus orientalis* were 0.026 t/ha, 0.019 t/ha and 0.015 t/ha, respectively. Compared with control, the runoff coefficient could be reduced 37.7%, 31.9%, 44.3%, 60.5%, 18.2% and 63%, respectively. Erosion modulus could be reduced 77.8%, 62.9%, 82.6%, 84.7%, 53.9% and 76.3%, respectively. Our study demonstrated that land preparation techniques and vegetation type commonly determine soil conditions and that land preparation is a recommended method to improve and rehabilitate degraded ecosystems. Applications of land preparation to vegetation restoration in the fragile ecosystems were an effective way for preventing water loss and soil erosion. Considering site-specific land preparation-plant species combinations could be critical to ensure long-term land stabilization.