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Enhancing water infiltration and water-holding in soils by macropore system

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Artificial macropore was introduced into degraded soil profile to enhance infiltration and water holding capacity. Degraded soils sometimes suffer from heavy rain and the impact of rain drops causes soil crust at the surface. This impermeable layer shows poor infiltration, resulting surface flow and erosion of fertile surface soils. Agriculture practice usually employs tillage, however, this traditional technique would break soil aggregates and cause another particle losses. Therefore, the key issue is enhancing infiltration without tillage. The objective of this research was that enhancing water infiltration into soils and control water distribution in soil profiles using artificial macropores.

Masa soils, one of the degraded soils in western Japan, were packed into columns (diameter:16cm, height:60cm) to 55cm with a bulk density of 1.45gcm-3. Rainfall was applied with a shower device once every three days to greenhouse experiment and continuously applied to growth chamber experiment. The amount of rainfall was maintained 400mm which is typical in semi-arid regions. The rainfall intensities were 2 and 20mmh-1, respectively. Water content was monitored at 10,30 and 50cm by soil water sensors. Moreover, overflow surface water was collected by plastic bottles.

As results at greenhouse experiments, columns with artificial macropores reduced surface water while control columns showed high surface water at 20mmh-1 rainfall. Artificial macropore columns induced rainfall water much deeper than control columns did. Rainfall intensity affected surface soil condition, making surface crust at 20mmh-1 intensity rainfall. At growth chamber experiments, temperature was controlled at 25 oC to observe water holding ability of artificial macropore columns. Because induced rainfall was kept in deeper profile in the columns, more water was held in artificial macropore columns than controlled columns. In all, artificial macropore systems enables control of infiltration water distribution and hold rainfall water much effectively than natural soil profile. It would make possible for degraded soil to keep water and nutrients in soil profiles.

Keywords: soil environment, macropore, infiltration, carbon storage