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Redistribution of rainfall and soil moisture as influenced by semiarid shrubs at individual plant and patch scales

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Precipitation intercepted by the shrub canopy is partitioned into throughfall and stemflow, as diffuse input and point input, respectively. The proportions of interception, throughfall, and stemflow to incident gross precipitation are highly variable between and within vegetation species and ecoregions. We summarized previous publications concerning rainfall partition by tree, shrub and grass in arid and semiarid zone during the last 60 years, and found that percentage of interception, throughfall and stemflow of the incident gross precipitation averaged 26.9±18.7%, 65.2±15.5% and 11.5±11.9 respectively, under mean annual precipitation from 117 to 570 mm y^{-1}. Grass had a higher mean value of interception (38.4±32.3%) than tree (23.6±14.9%) and shrub (24.8±12.9%), while no significant differences in interception, throughfall and stemflow were found between tree and shrubs. Stemflow showed much greater variability (coefficient of variation is larger than 100%) than throughfall (less than 30%) and interception (less than 60%).

Shrub canopies can affect spatial heterogeneity of the rainwater input process and subsequent soil water dynamics. Stemflow alters the vertical distribution of water by funneling water to the base of plants where it can infiltrate preferentially by root channels. Difference in soil water content and wetting front depths under the shrubs with and without stemflow ascertained that stemflow was conducive to concentrate and store water in deeper layers in the soil profiles. Non-uniform throughfall lead to heterogeneous distribution of soil water within canopy. We measured throughfall and soil water moisture beneath canopy of *Caragana microphylla* stand at 20×20cm grid during rainy seasons of 2009, and found that highly variability in throughfall and soil water within individual shrub stand. The magnitude of spatial variability was stronger for medium size rainfall than small and larger rainfall events. Surface soil moisture measurements by FDR probes at 1m intervals along four 50-m transects revealed that soil water was typically greater beneath *Caragana microphylla* canopies (shrub patch) than beneath interspaces (bare patch) under large rainfall events, but vice verse for small rainfall events. Soil moisture was generally higher on the upper position of the shrub patches and also of the slope. These results suggest that heterogeneous distribution of soil water at individual plant, patch and slope scale is closely associated with rainfall characteristics and terrain positions.