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Sub-Surface Flow Processes at a Juniper Covered Plot in a Karst Region of the Edwards Plateau

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The impact of juniper trees on the water cycle at the Edwards plateau with karst geology has been the focus of active research for several years. The objective of this study was to gain insight into the subsurface flow processes occurring within a 7m X 14 m plot at the Edwards plateau (Honey Creek) containing juniper trees. A 2.3 m deep trench was excavated at the downslope end of the plot and time domain reflectometry (TDR) probes were installed at various locations within the trench to measure water contents. A rainfall simulator consisting of 6 individual (15 m high) telescopic masts was set up to provide artificial rainfall on the plot. Eight rainfall simulations with different intensities and durations and two dye-tracer tests were conducted on the plot during a 7-month period. Subsurface interflow was visually inspected at various locations on the trench face and monitored by TDR probes. The total volume of sub-surface flow was also recorded. The results demonstrated that subsurface flow occurred in a tri-modal manner, consisting of flow in karst conduits, planar fractures in the limestone, and soil matrix. Conduit and fracture flow response time decreased exponentially with increasing rainfall intensity and comparable responses for similar boundary conditions were observed. Matrix flow response time decreased linearly with increasing rainfall intensity and total amount of rainfall. The increase in matrix water content was inversely proportional to the antecedent moisture content. During large rainfall events, water exchange was observed between the fractures and matrix which was absent during smaller rainfall events. The dye studies indicated that fractures and juniper roots are primary pathways for preferential flow within the plot.