Electronic Supplementary Material (ESI) for RSC Applied Polymers.

Supporting information:

Macroporous Hydrogels for Soil Water Retention in Arid and Semi-Arid Regions

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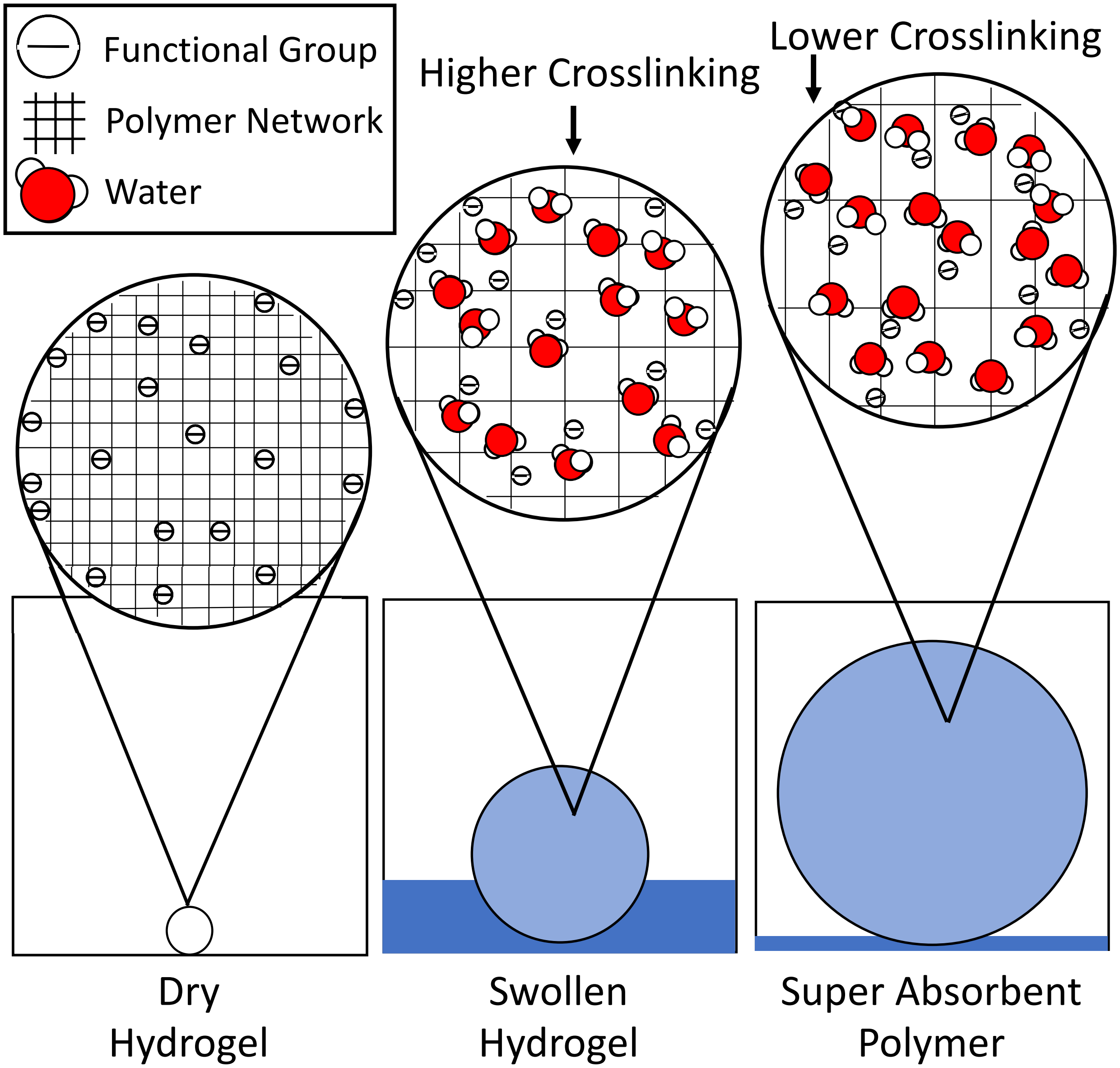

Figure S1: Simple schematic of hydrogel sorption process. Dry hydrogels have a tightly compact polymer network. The water interacts with polymer chain functional groups causing the chains to expand and allow more water to enter the hydrogel. The comparison of swollen hydrogels shows a higher water absorbency with a lower degree of crosslinked chains.

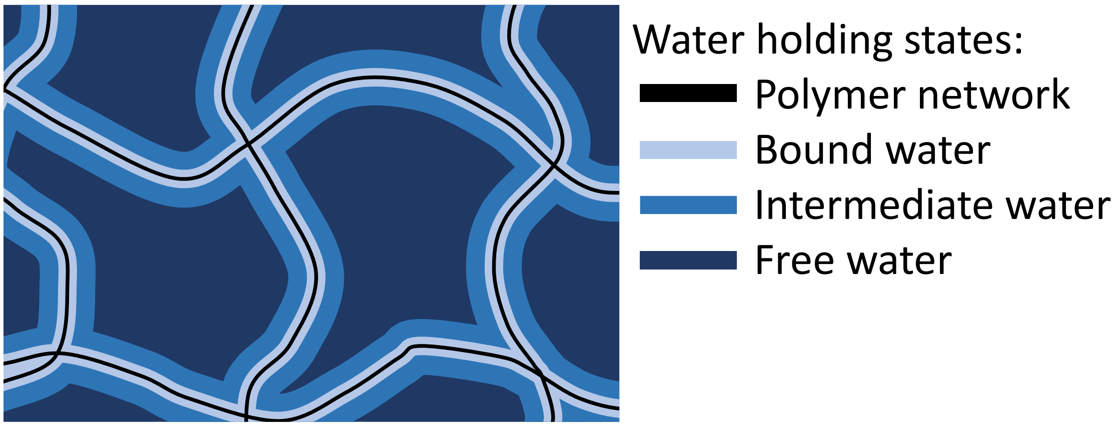

Figure S2. A simple schematic of where water resides in the hydrogel polymer network. The bound water is tightly interacting with functional groups through hydrogen bonding. The intermediate water is the water interacting with bound water and free water. Free water is non-bound water easily removed by external stimuli (pressure, heat, etc.).

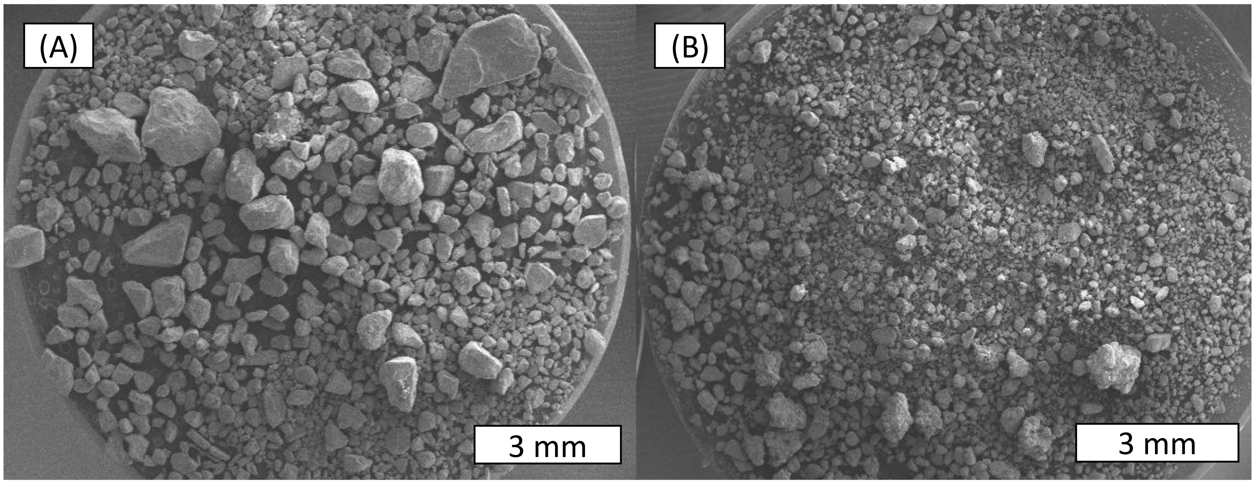

Figure S3. Scanning electron microscope images of the sandy soil (A) and sandy loam (B) at x10 magnification.

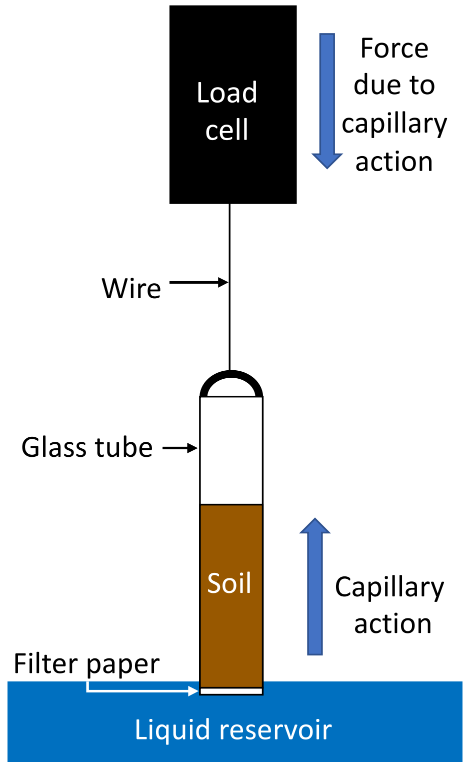

Figure S4. A simple schematic of the capillary rise experiment setup using a 50 N load cell equipped with a tensile testing device.

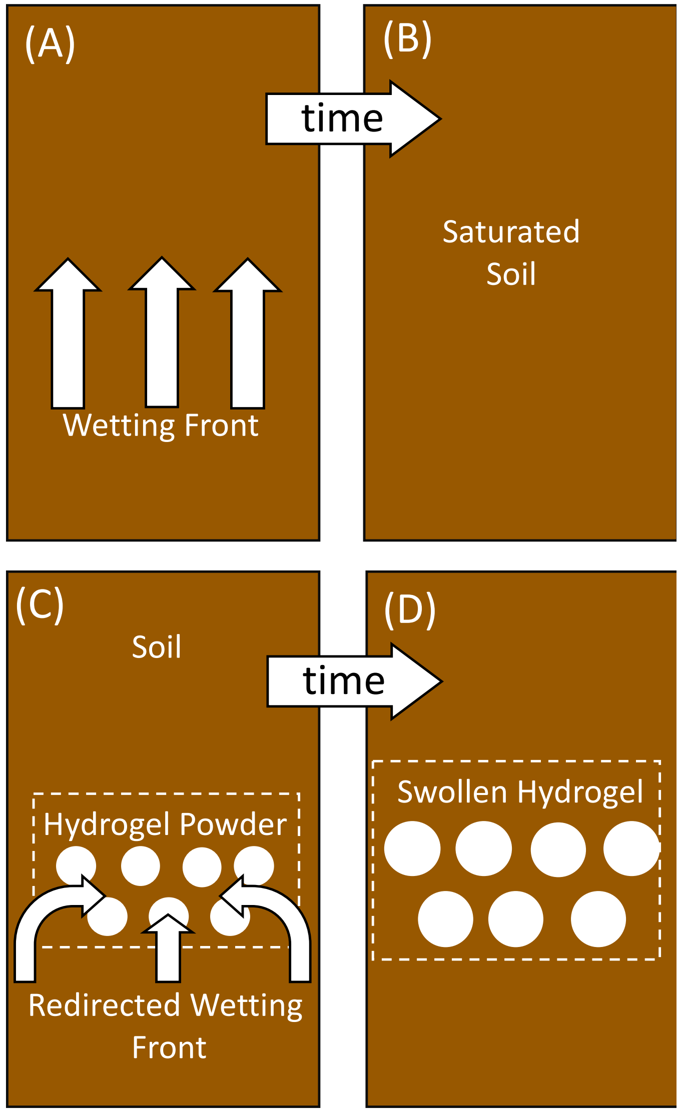

Figure S5. A simple schematic of the hydrogel having higher osmotic and capillary potential preference than control soil reducing wetting front. (A) Soil has a wetting front increase in height over time. (B) Water eventually saturates the soil. (C) Hydrogel powders redirect the wetting front slowing it down due to having higher capillary and osmotic potential. (D) The wetting front or mass of water will be less at the same time as the control. The reduced rate of water uptake is what exhibits less hydrophilic behavior.

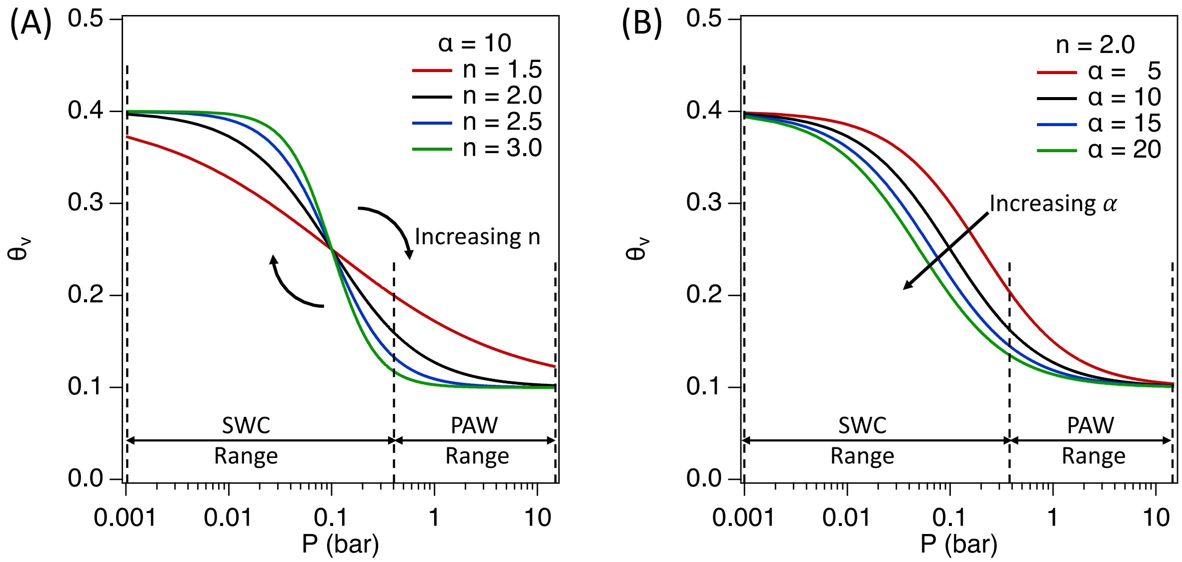

Figure S6. Example of variation in soil water characteristic curve (SWCC) shape by changing parameters α and n when $\theta_r = 0.1$, $\theta_s = 0.4$, the saturated water content (SWC) pressure range is <0.3 bar, and the plant available water (PAW) content pressure range is 0.3 – 15 bar. (A) The n value increases while $\alpha = 10$, resulting in a steeper curve. (B) The α value increases while $n = 2$, resulting in lower water content at every pressure reading.

Table S1. Calculated soil parameters from Lucas-Washburn equation where A_{Hex} and A_{Wat} are Lucas Washburn fitting parameters for water and hexane fluid capillary rise respectively, c is capillary constant, and θ_{Wat} is the soil-water contact angle.

	A_{Hex} ($g \cdot s^{-2}$)	A_{Wat} ($g \cdot s^{-2}$)	c (m^4 $x10^9$)	θ_{Wat}
SL_0	0.26 ± 0.03	0.30 ± 0.03	2.68 ± 0.61	66.2 ± 4.5
SL_B(1.0)	0.30 ± 0.01	0.40 ± 0.03	3.45 ± 0.19	55.2 ± 5.3
SL_B(2.0)	0.33 ± 0.02	0.33 ± 0.03	4.24 ± 0.40	71.6 ± 3.4
SL_H(1.0)	0.29 ± 0.02	0.32 ± 0.00	3.23 ± 0.51	67.3 ± 0.7
SL_H(2.0)	0.30 ± 0.06	0.28 ± 0.01	3.61 ± 1.30	74.5 ± 1.5
SS_0	0.33 ± 0.02	0.29 ± 0.01	4.18 ± 0.49	75.8 ± 1.1
SS_B(1.0)	0.31 ± 0.01	0.29 ± 0.01	3.63 ± 0.31	73.0 ± 1.4
SS_B(2.0)	0.32 ± 0.01	0.26 ± 0.02	4.03 ± 0.23	78.1 ± 1.4
SS_H(1.0)	0.32 ± 0.01	0.28 ± 0.01	4.04 ± 0.18	76.1 ± 1.1
SS_H(2.0)	0.31 ± 0.01	0.24 ± 0.02	3.69 ± 0.31	79.0 ± 2.0