

Supporting Information

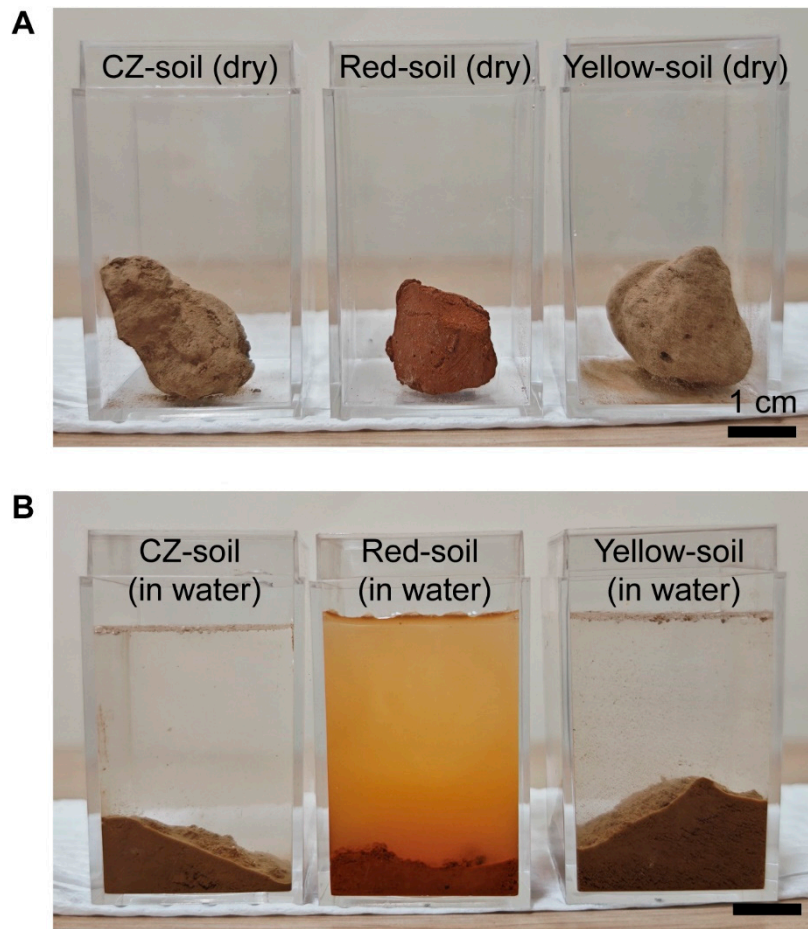
# Improving Water Stability of Soil Aggregates with Polyvinyl Alcohol as a Polymeric Binder

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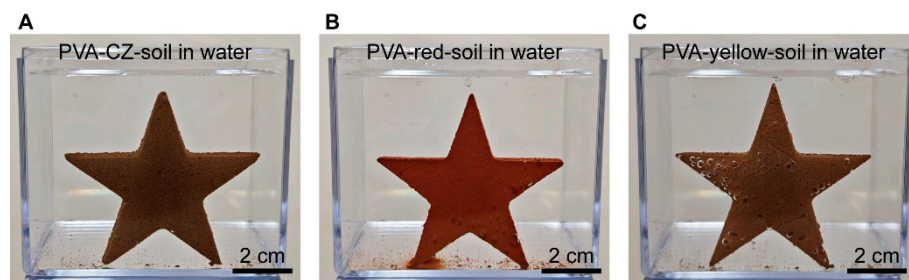
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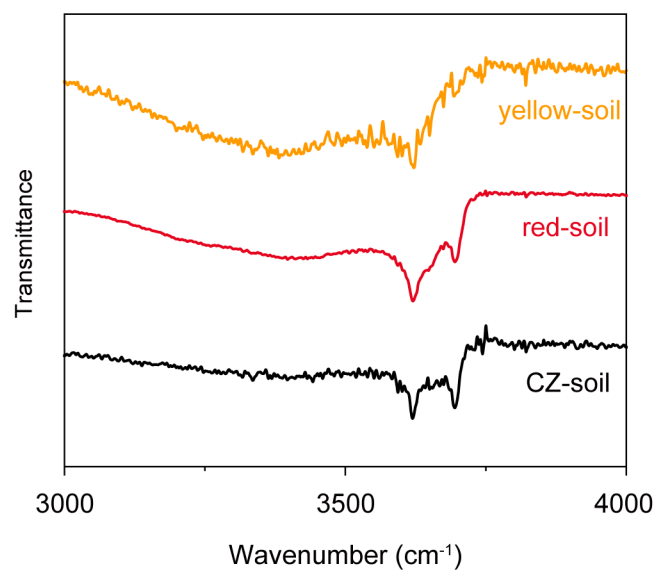
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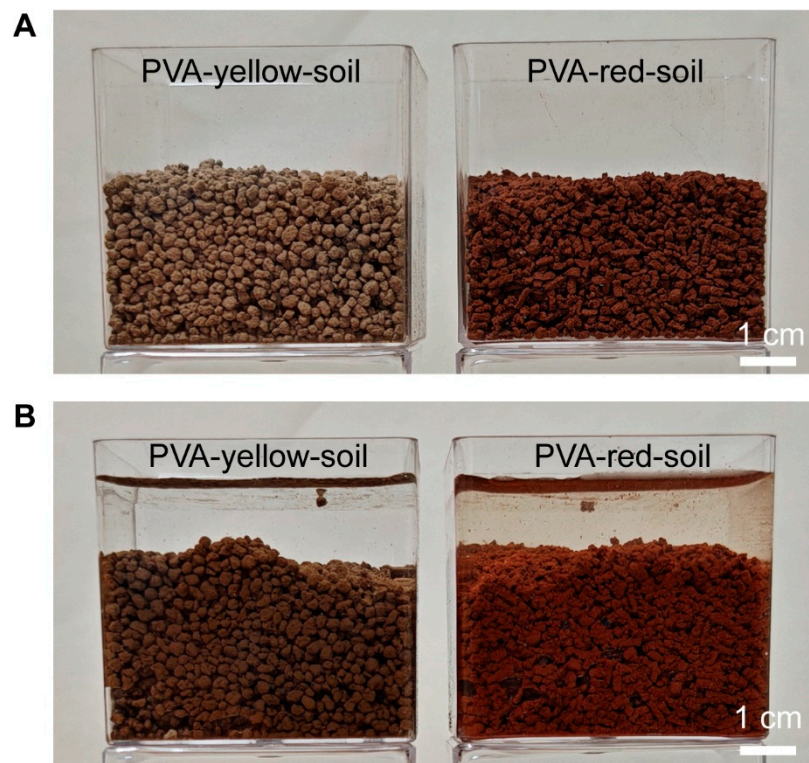
**Figure S1. Soil disintegration in water.** The large grain of soil (A) breaks down into water and loses its initial shape (B).



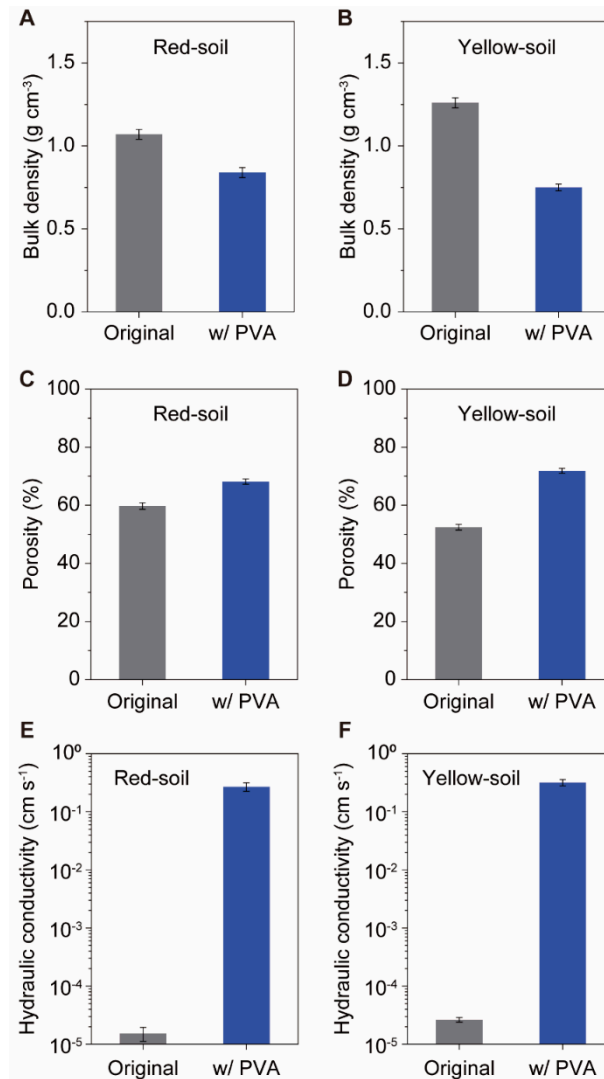
**Figure S2. PVA-soil in water.** The PVA-CZ soil (A), PVA-red-soil (B), and PVA-yellow-soil, with a star shape, show integrity in water, demonstrating their remarkable stability in water.



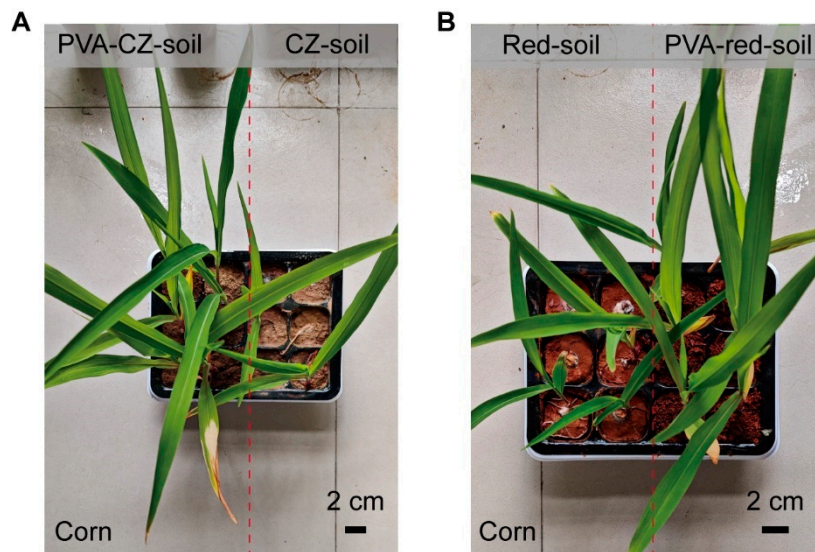
**Figure S3.** TIR-ATR spectra of yellow soil, red soil, and CZ soil reveal the presence of O-H stretching in the range from 3500-3700 cm<sup>-1</sup>.



**Figure S4. PVA-soil in dry state and wet state.** Transferring from a dry environment (A) to an underwater condition does not break down the aggregate of PVA-soil (B).

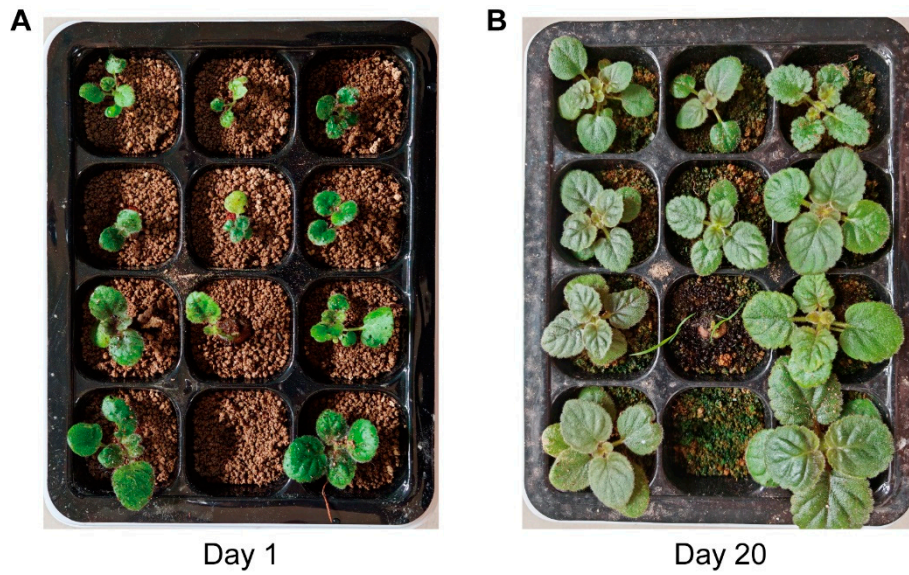


**Figure S5. Comparison of physical properties of soil with and without the addition of PVA.** A) Bulk density of red-soil. B) Bulk density of yellow-soil. C) Porosity of red-soil. D) Porosity of yellow-soil. E) Hydraulic conductivity of red-soil. F) Hydraulic conductivity of yellow-soil.



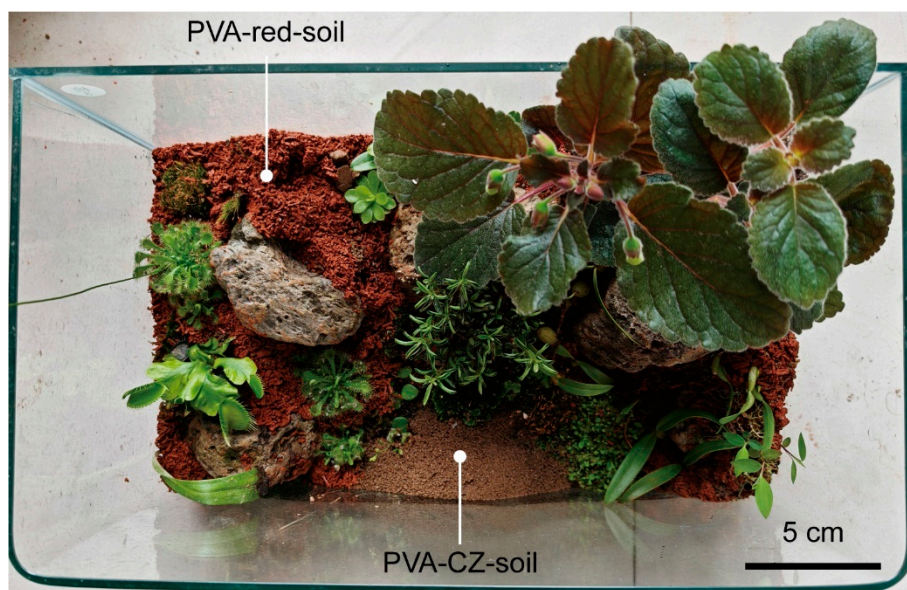
**Figure S6. Using soil containing PVA and soil without PVA for corn cultivation.** A) Corn seedlings grow well and all germinate in PVA-CZ-soil, but only 1/3 of the seedlings germinate and have weaker growth in CZ-soil. B) Corn seedlings grow well and all germinate in PVA-red-soil, but only half of the seedlings germinate in red-soil. Photos are recorded at day 14 after planting.



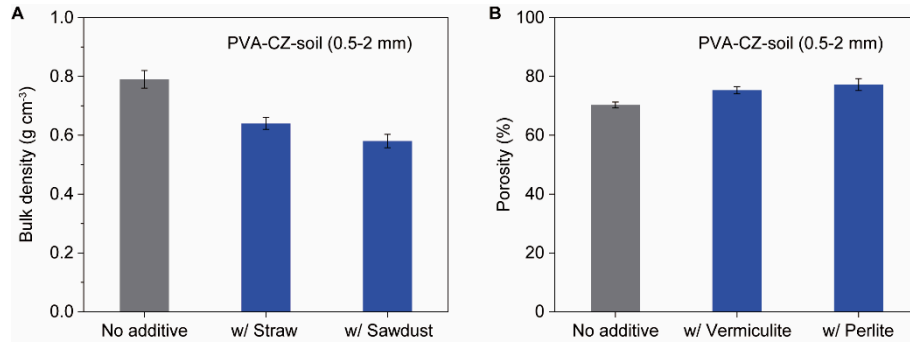


**Figure S7. Growth of mini-cyclamen in PVA-yellow-soil.** A) Mini-Cyclamen just transplanted into PVA-yellow-soil. B) Growth of Mini-Cyclamen after 20 days, with 10 out of 11 plants growing well.

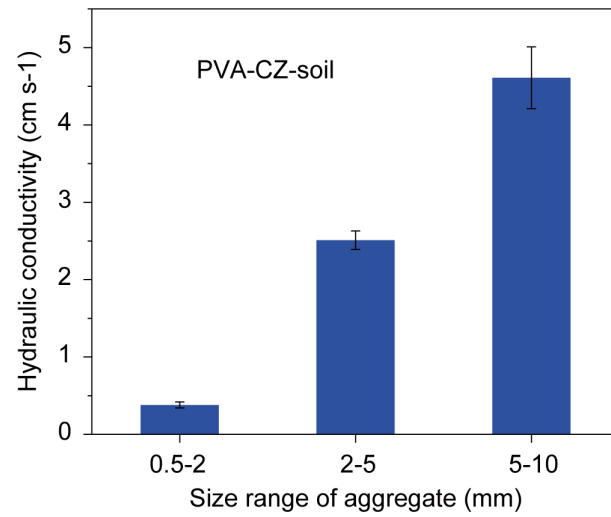




**Figure S8. Plants grow in the PVA-red-soil and PVA-CZ-soil.**



**Figure S9. Comparison of physical properties of PVA-CZ-soil with and without the additive.** A) The addition of 20 wt.% rice straw or sawdust reduces the bulk density of PVA-CZ-soil because rice straw and sawdust are much lighter than soil. In this experiment, straw and sawdust are approximately 2 mm in length. B) The inclusion of 10 vol% vermiculite and perlite increases the porosity of PVA-CZ-soil because these inorganic materials are porous. In this experiment, vermiculite and perlite are roughly 1 mm in size.



**Figure S10. Hydraulic conductivity of PVA-CZ-soil with different aggregate sizes.**