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# Aggregate stability: underlying physical, chemical and biological (de)stabilising mechanisms due to temperature and moisture effects

Emily Dowdeswell-Downey, Jane Rickson, and Robert Grabowski
Cranfield University, Cranfield, United Kingdom (e.dowdeswell@cranfield.ac.uk)

Soil structure is often described by the degree of aggregation and aggregate stability. Aggregate characteristics influence many soil properties, including the architecture and stability of soil pores, the flow of gases and water, and the storage of organic matter and nutrients, which in turn affects soil functions and ecosystem services. Aggregate stability has been observed to vary seasonally and interannually, with a strong influence of weather patterns likely. There are multiple mechanisms of aggregate stabilisation which operate simultaneously. However, studies which fully incorporate physical, chemical and biological mechanisms in mediating aggregate stability dynamics remain rare.

Soil physical characteristics such as soil texture exert considerable influence over aggregation; the amount of organic matter and clay content strongly affects the nature of particle interaction forces. Additionally, fluctuations in soil moisture content and temperature can influence aggregation through the reorientation of soil particles and the shrinking and swelling nature of clays. Soil aggregation is also mediated by the chemical interaction of soil particles, minerals and organic matter with the formation of polycationic and organo-mineral bridges between particles. Such particle interactions and surface charges are also influenced by changes in soil pH. Furthermore, fungi release sticky exudates that bind soil particles together and may encourage soil hydrophobicity. Soil bacteria also produce sticky extracellular polymeric substances (EPS) which bind soil particles together to form aggregates. Soil aggregation is also promoted by the enmeshment of particles by fungal hyphae. Certainly, at the aggregate scale, soil microarchitecture, chemistry and soil organisms interact. The interpretation of the simultaneous physical, chemical and biological (de)stabilising processes is a major challenge for developing a better understanding of aggregate stability dynamics.

This study investigates the effects of temperature and moisture content on soil aggregate stability at the microcosm scale. Changes in temperature and soil moisture influence aggregate stability directly through physical and chemical processes, but may also affect biological stabilisation by stimulating or limiting the size and activity of the microbial community. The study seeks to investigate the effects of temperature and moisture content on the potential underlying physical, chemical and biological aggregate (de)stabilising processes. Overall, the research investigates how changing weather patterns, and future climate change scenarios, alter soil aggregate stabilisation processes and the implications for aggregate stability, soil structure and erodibility.