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Mathematical model of soil crust tillage interactions.

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Structural units created by tillage practices (mechanical pedoturbation) and exposed at the soil surface can be seen in many instances to breakdown, collapse and be reorganised as a response to rainfall in to what is generally referred to as a soil crust. These crusts vary in thickness (1 to 15mm), and they are different in detail from the original soil aggregates from which they were derived. Specifically, they often show size sorting, micro-parallel bedding fabrics, and are always denser with a most efficient particle packing, and when dry can be hard and brittle.

Subsequent tillage activity will physically disrupt this crust and 'turn' a large proportion of this soil material into the active plough layer. This 'relict' surface crust material will then be part of the subsurface plough layer and as such further disrupted by natural soil mixing processes. But, a proportion will still remain, and will still retain the characteristics of the original soil surface crust. The next tillage event will then simply incorporate the remaining relict crust material into the newly created soil structural units, many of these will themselves be exposed at the surface and the cycle of breakdown, crust formation, and reincorporation will continue.

The implication of the above conceptual model is that through time soils subjected to continuous arable use and multiple tillage cycles will create a soil medium in which more and more soil structural units will be dominated by the properties of relict soil crusts rather than the normal expected 'natural' soil aggregates. It may well be that a positive feedback system is in operation where by soil units containing relict crust material are inherently more unstable, so increasing and intensify the soil crust response.

A mathematical model has been developed to describe this cycle of tillage and crusting, it looks to predict the proportion of relict crust material in the active plough layer

at the end of each growing season. The model is in the form of a mathematical series, estimates of the parameters in the model are obtained from a series of field tillage experiments. These experiments use close range air photography taken at night under UV lighting conditions to trace a series of colour marked crusts.