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NO-TILL FOR KWAZULU-NATAL'S SMALL-SCALE FARMING SYSTEMS

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No-Till is promoted as the best land management practice for soil conservation and rehabilitation. This practice owes its success to its characteristic minimal soil disturbance and at least 30% of crop residue being left on the fields for soil surface coverage. A disregard of these fundamental principles has been assumed to hinder the full benefits of No-Till. Adoption of the practice has been slow in small-scale farming systems. One of the reasons maybe that crop residue is used as livestock feed in winter (Figure 1), thus reducing the quantity of crop residues available on the soil surface. The importance of soil surface coverage by residue, as well as other advantages and disadvantages of No-Till, are discussed by AJ. Arathoon in Agri Update 15/2010.

One of the studies conducted in the Bergville area, KwaZulu-Natal (Mchunu et al., 2011), showed that small-scale farmers could still achieve positive benefits from the No-Till system, even when practiced with grazed crop residue. After six consecutive years of No-Till with grazed residue on the study site, benefits such as: 1) reduced soil erosion, 2) increased aggregate stability, 3) increased microbial biomass and activity were observed.

What caused the observed benefits?

FIGURE 1: *Livestock grazing on No-Till land after the maize-grain crop has been harvested.*

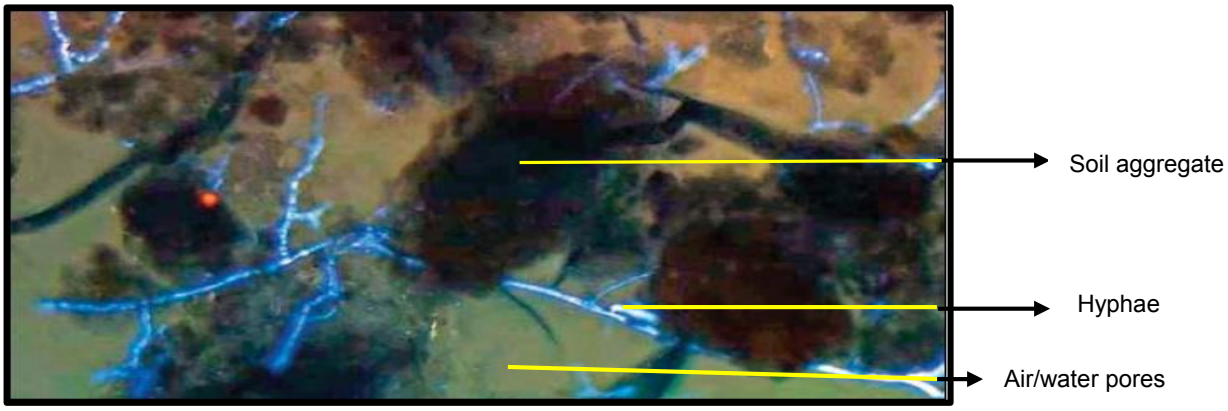

FIGURE 2: *"Fungal hyphae, shown in blue, extending through soil (Image by Karl Ritz)" (Caron, 2011* ww.soilquality.org.au)

Minimal soil disturbance and having some residue on the soil surface was identified to be the main driver in achieving the observed benefits. With minimal soil disturbance, whole aggregates were preserved. Moreover, polysaccharides (adhesive exudates) from microbial activity, together with fungal hyphae (Figure 2), strengthened existing aggregates and promoted the formation of bigger and more stable aggregates; protecting more of the precious organic matter in the soil.

Stability of aggregates and the dominance of structural crusts (as opposed to sedimentary crusts, both sedimentary and structural crusts are illustrated on Figure 3) on the soil surface, were some of the causes of reduced soil erosion in the No-Till systems. Structural crusts form when raindrops hit the soil surface, causing partial disintegration of aggregates, thus forming a layer of fine particles with rough soil clods on the soil surface. These crusts are more resistant to erosion and their porosity promotes higher infiltration rates, compared to sedimentary crusts, which form when the impact of raindrops breaks up unstable aggregates. These aggregates disintegrate into small soil particles, which are then transported by runoff water and are deposited elsewhere, as a thin layer on the soil surface. Upon drying, this layer hardens to form a sedimentary crust (Valentine and Bresson, 1992).

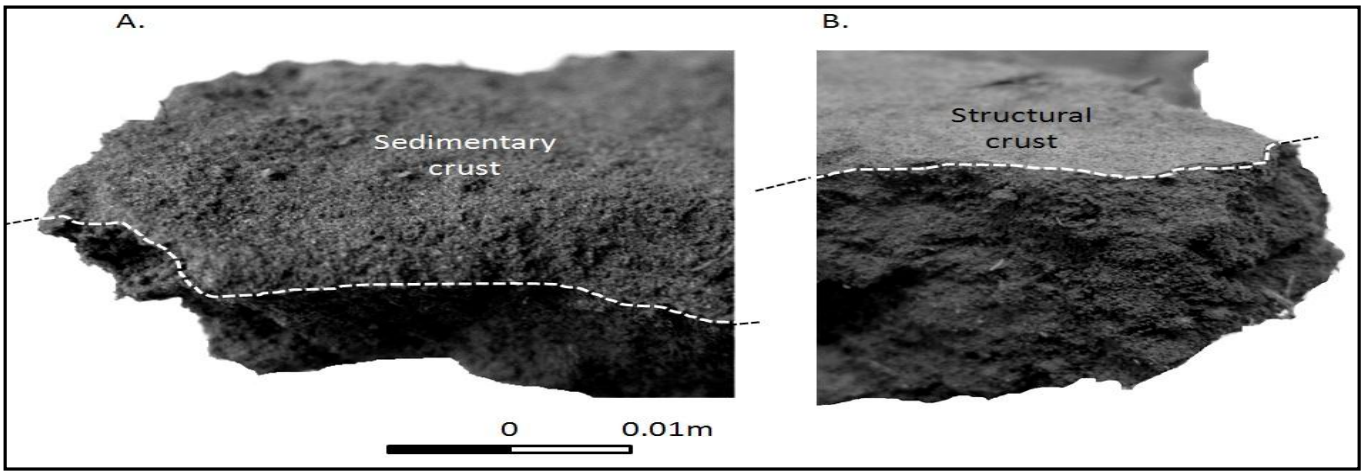

FIGURE 3: *Structural and Sedimentary crusts formed on the soil surface in small-scale farming systems (Mchunu et al., 2011).*

The highest soil losses were observed where No-Till was practiced with no residues on the soil surface. The observed soil losses may have been from the impact of raindrops disintegrating the aggregates and eroding the loose soil particles. With no crop residue (energy source for microorganisms) on the soil surface, biological activity and hyphae essential in aggregate stability was limited, thus weaker aggregates existed in the system. Although crusts may form on the surface of bare soils, these crusts tend to seal the soil surface, thus reducing water permeation rate into the soil below. This may result in

decreased soil moisture, and may hinder crop production.

In spite of the challenges for crop residue being needed for livestock feed in small-scale farming systems, the productive top-soil in these systems still needs to be conserved. This could be achieved by decreasing soil erosion and promoting the protection of organic matter in soils. In evaluating for the Best Land Management Practice, which promotes soil conservation in a small-scale farming system, the following was observed: a No-Till system with bare soils (NT-3 in figure 4) resulted in higher soil and organic matter erosion compared to No-Till with a small amount of residue on the soil surface (NT-1 in Figure 4), as well as the Conventional Tillage system (CT in Figure 4). Moreover, it was in the mulched systems (NT-2 in Figure 4) where aggregates were more stable, protecting organic matter in the soil.

Therefore, in small-scale farming systems, farmers are encouraged to have at least 23% of their soil-surfaces covered by residue (as much residue as shown on CT plots in Figure 4), to assist in reducing erosion, protecting more organic matter in the soil and in promoting a better soil structure.

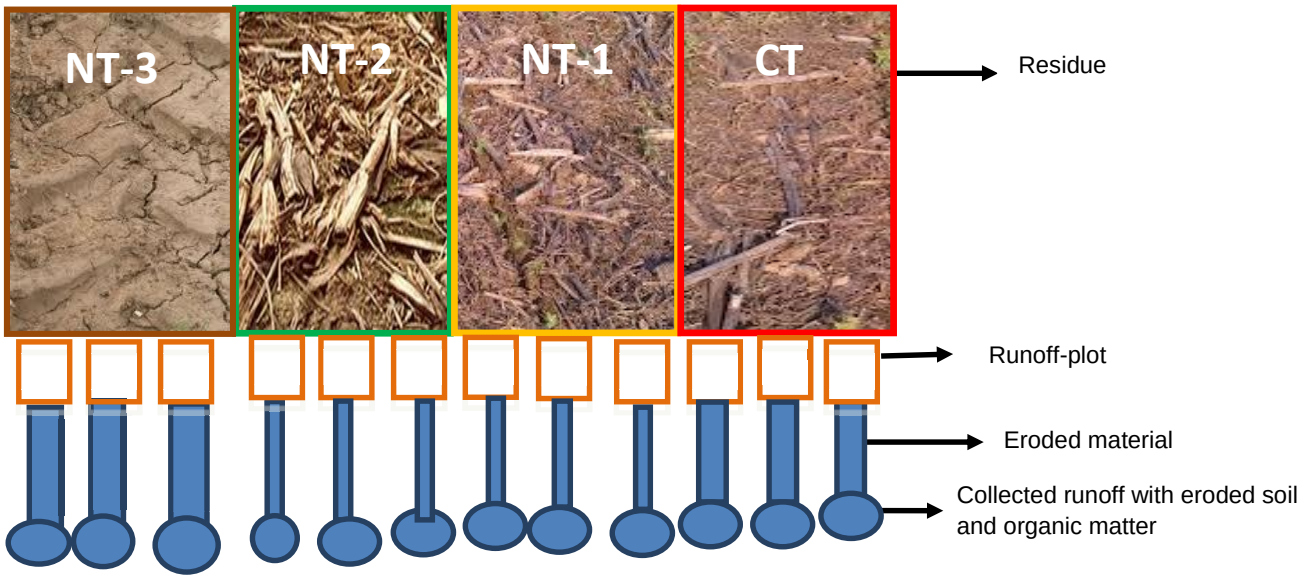

FIGURE 4: *Schematic representation of possible tillage systems and their response to soil erosion by water.*

References and Further readings

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