The influence of conservation agriculture on topsoil stratification in the Western Cape of South Africa

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Introduction

The Western Cape is a very important grain producing area of South Africa. Adoption rate of CA in WC is around 80% resulting in practices that reduces incorporation of crop residue and ameliorates, resulting in higher concentration of soil nutrients and soil organic carbon (SOC) in the soil surface, before decreasing sharply with depth. Minimum soil disturbance will result in chemical stratification and accumulation of, amongst others, C, Ca and P in topsoil. Stratification reduce exposure for nutrient absorption by roots deeper down the profile. The positive effect of higher soil organic C is also restricted to the topsoil. SOM is naturally very low in South Africa, it is estimated that 60% of the soils contain less than 0.5% SOM (Du Preez *et al.*, 2011). Changes in organic matter content are probably the most important long-term effect of CA and an important indicator of soil quality. The aim was to study and quantify nutrient distribution under CA in the Western Cape.

Material and methods

Soil samples were collected in depth increments (0-5, 5-10, 10-15, 15-20 and 20-30 cm) in a long-term trial at the Langgewens Research Farm (33°17'0.78'' S, 18°42'28.09'' E) of the Western Cape Department of Agriculture, South Africa where the effect of degree of soil disturbance on soil health is studied. Tillage treatments were:

- **Zero tillage (ZT)** - soil left undisturbed and planted with a disc planter
- **No-till (NT)** - soil left undisturbed and planted with a no-till tined planter
- **Minimum–till (MT)** - soil scarified to a depth of 100 to 150 mm in March/April and then planted with the no-till planter
- **Conventional-till (CT)** - soil scarified to a depth of 100 to 150 mm in March/ April, then ploughed before planting and planted with the no-till planter. Only the results of ZT and CT will be shown.

The soil was analysed for organic C, pH, exchangeable C, Mg, K, P and extractable Cu, Fe, Mn and Zn and B. Only C, P and Ca will be discussed.




Results

- Decrease of immobile elements like Ca, P and C expected with depth under natural conditions as shown in the layer beyond the tillage depth (20-30cm).
- Figures 1a-c proves that reduced soil disturbance (ZT) resulted in increased stratification.
- Study also shows that Ca is more prone to stratification at Langgewens compared to C and P.
- Due to high P levels, adequate P levels (40 mg kg^{-1} Citric Acid) at 20-30cm depth to satisfy crop demand.
- Build-up of C under ZT took place in the top 10 cm.

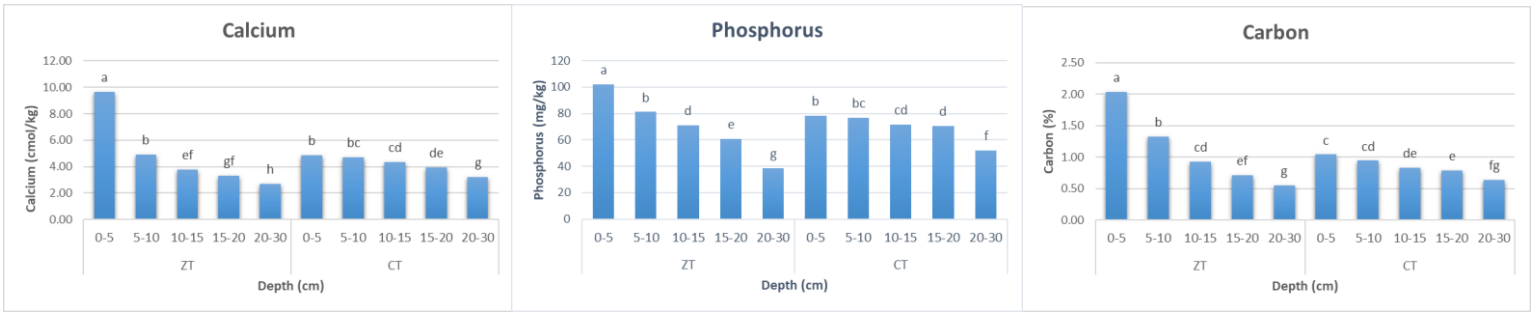

Figure 1 a-c. The effect of degree of soil disturbance on stratification of C, Ca and P at Langgewens Research Farm after 12 years of applying the tillage treatments.

Conclusion

- Stratification of immobile elements, due to CA, is a reality at Langgewens.
- Degree of stratification depends on:
  - Degree of soil disturbance
  - Element under consideration
- Potential negative effects of stratification are determine by quantities of elements in the entire root sone as proved by soil P in this study.
- Degree of stratification will influence the reliability of soil analyses as stratification strongly influence nutrient concentrations at different depths. Depth of sampling is crucial.