Assessing soil crack dynamics during dryings from reduced tillage and conventional tillage fields

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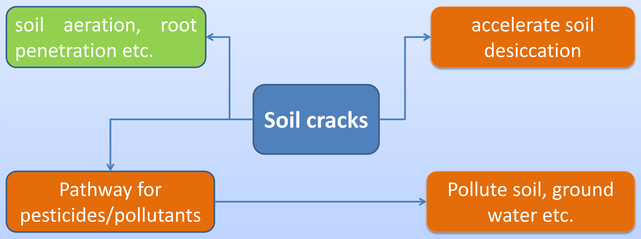
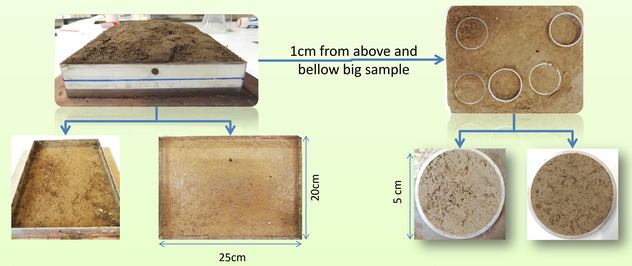
BACKGROUND



Cracks were mostly studied in: high clayed soil (Vertisol). This study used agricultural soil found in Gembloux-Belgium (Silt-loam). **Aims**: Insight on crack dynamics during dryings and re-drying of conventional and reduced tillage soil.

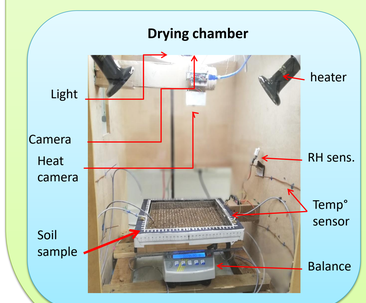
MATERIALS AND METHODS

➢ **Samples**



a)- Big sample : 1.6cm thick (from 4-6cm depth)

b)- Small sample : 1 cm thick



➢ **Drying chamber** :
- Surface temp°= 25°C
- Temp° & humidity : PT1000 & DHT22

➢ **Image collection and analysis**:
-Digital camera: 12 Mpixel
- Image analysis : Matlab + ImageJ
- Cracks properties : size, shape, etc.

➢ **Soil hydraulic properties**:
-Evaporation rate

➢ **Consecutive drying**

➢ **Tillage based treatments**
- Reduced Tillage
- Convetional Tillage
- Disturbed soil

REFERENCES

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I- BIG SAMPLES

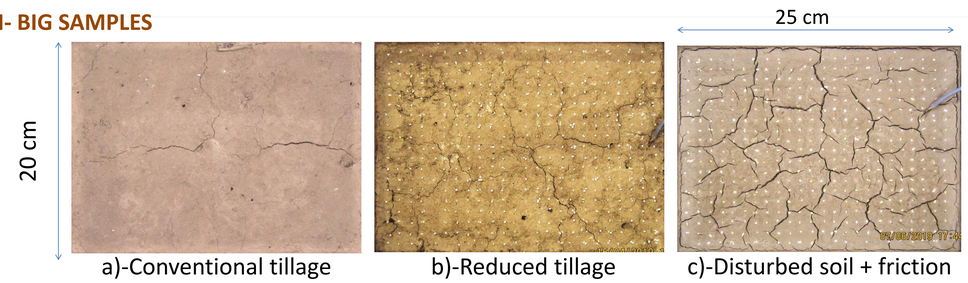

Figure 1: Cracks from Conventional tillage (a), Reduced tillage (b), and Disturbed soil (c)

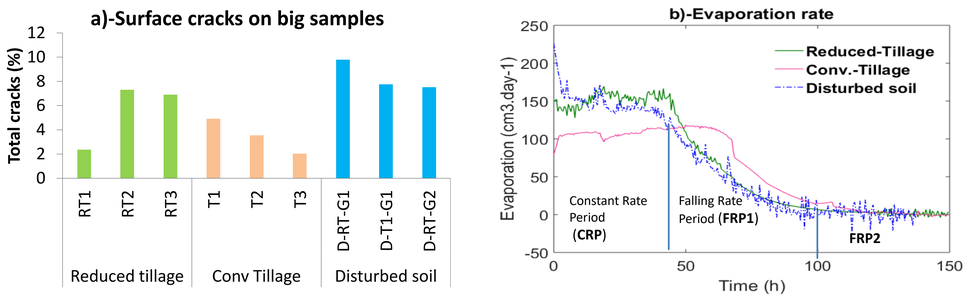

Figure 2: Cracks percentage (a), and soil evaporation rate (b) of big samples

II- SMALL SAMPLES

Figure 3: Cracks formation from wet (a), to first (b) and second (c) dryings of small samples

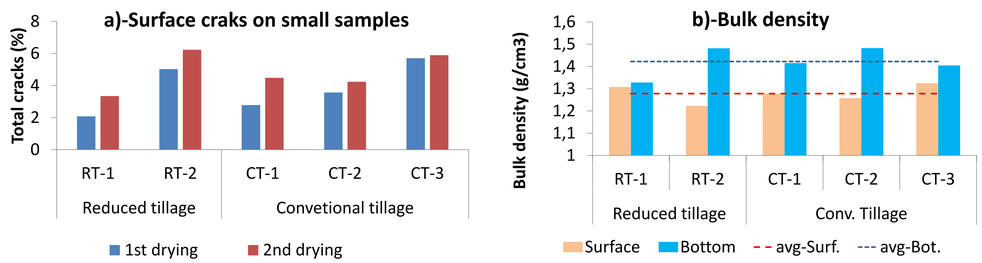

Figure 4: Percentage of cracks (a) and soil bulk density (b) of small samples

RESULTS FROM BIG SAMPLES

Cracks percentage :
Disturbed soil > **Reduced**-tillage > **Conventional** tillage

- **Disturbed** soil: less soil cohesion, high shrinkage .
- **Reduced tillage**: high bio activities (worm, micro.) + more soil aggregates.
  ✓ *Bioturbation*: made heterogeneous soil. Soil heterogeneity created big differences in heat/water absorption, and shrinkage direction.
  ✓ *Space between aggregates*: weak area during drying. Cracks started from the area where the ratio, soil stress over soil weakness, was the highest.
- **Conv. Tillage**: has fresh organic matter (roots, stems and leaves), destroyed soil structures and soil aggregate, reduced porosity, increased bulk density. All that circumvented crack formation and development.

Water evaporation :
Disturbed soil ≈ **Reduced**-tillage > **Conventional** tillage

- Cracks increased the surface of evaporation(Figure 2).
- Cracks exposed water to atmosphere (without passing the soil matrix).
- The soil temperature was stabilised at 25°C for all experiments.

RESULTS FROM SMALL SAMPLES

➢ **Re-drying process**: increased cracks length and width for the deeper dense small samples (Figure 3). Some pre-existing cracks could be present in the soil and they widened with repetitive wetting-drying.

➢ Very **few cracks** for the porous upper soils (Figure 4). The increase in soil shrinkage (tensile stress) could be absorbed by homogenous pores, while it burst to cracks for heterogeneous soil .

CONCLUSIONS

-Cracks in disturbed soil > reduced-tillage > conventional tillage. Due to no soil cohesion, soil OC, soil aggregation, biological activities, and soil porosity.

- The opening increased the soil desiccation rate in disturbed soil ≈ reduced-tillage > conventional tillage.

-Re-drying process increased the size of the previous cracks. X-ray scan is necessary to observe the presence of pre- (micro) cracks in soil.

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