Soil Physical Properties Affecting Canola Growth and Yield in Central Oklahoma

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Introduction

- An increase in winter canola (*Brassica napus* L.) production in Oklahoma has raised some issues in no-till cropping systems. Several factors have limited the success of no-till canola. Perhaps the two biggest issues are thought to be residue and soil physical properties.
- The increase in no-till cropping systems in Oklahoma makes it important to understand the influence of soil physical properties on canola growth. This should allow us to develop recommendations for seeding winter canola in no-till cropping systems.
- The objective of the present work was to evaluate the influence of soil physical properties on winter canola growth.

Material and Methods

Two studies conducted

- ***Field Study***: Cimarron Valley Research Station, Perkins, OK
  - RCBD with 4 replications
  - Soil Texture: Sandy Loam (69 % sand, 19 % silt, 12 % clay)
  - Canola variety: DKW 13-69
  - Four tillage treatments (Moldboard, Harrow, No-Till, Chisel) following winter wheat.
  - Soil physical properties measured: 1) Soil resistance was determined using a hydraulic cone penetrometer, 2) bulk density with volumetric ring method, and 3) pore size distribution also was determined using the volumetric rings.
- ***Green House Study***:
  - Randomized complete design
  - 10 cm diameter pots with 2 seedlings grown for 6 wk
  - Two soil textures: 1) Sandy Loam (69 % sand, 19 % silt, 12 % clay) 2) Clay (15 % sand, 38 % silt 47 % clay)
  - Bulk Densities (g cm^{-3}): 1.30, 1.50, 1.65, 1.70 and 1.80
  - Biomass of plant and root system were determined through washing the soil and separating plant from root.

Field Study

- Winter canola seed yields increased as tillage intensity increased (Figure 1).

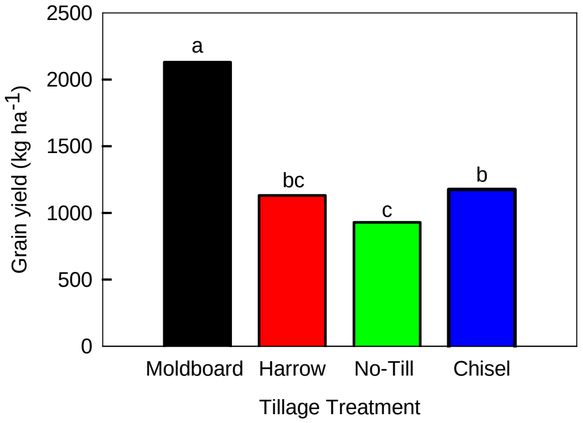

Figure 1. Winter canola seed yields in 2008 at Perkins, OK.

- Soil resistance was less for the moldboard and chisel treatments compared to NT and harrow treatments in the surface 20 cm (Figure 2). Below a depth of 10 cm soil resistance quickly went above 2000 kPa for the NT and harrow treatments. Canola roots would have a difficult time penetrating a resistance > 2000 kPa.

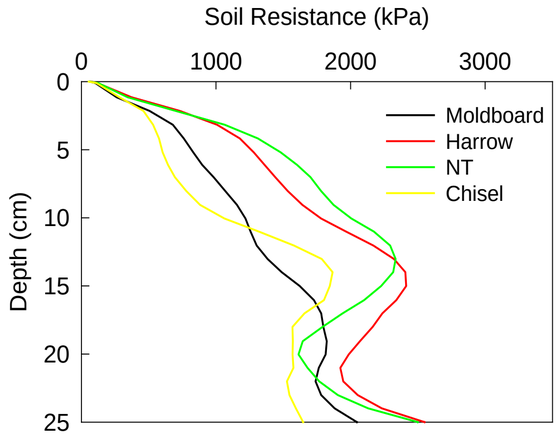

Figure 2. Soil resistance under different tillage practices. Perkins, OK, 2009. Photo on right is the penetrometer mounted on the back of a tractor.

- Bulk density followed similar trend as soil resistance. However, soil under chisel plow had higher bulk density at 10-20 cm depth compared to the other treatments (Figure 3).

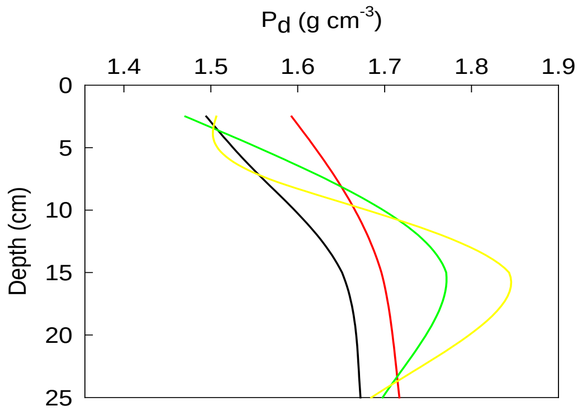

Figure 3. Bulk density at different depths under different tillage practices. Perkins, OK, 2009. Photo on left is bulk density sample collection.

Green House Study

- Root biomass decreased linearly with increasing bulk density for both the sandy and clay soil (Figure 4). This means that higher bulk densities could reduce winter canola root mass, which may reduce winter survival. Canola plants rely on carbohydrates stored in the root mass to survive the winter months.

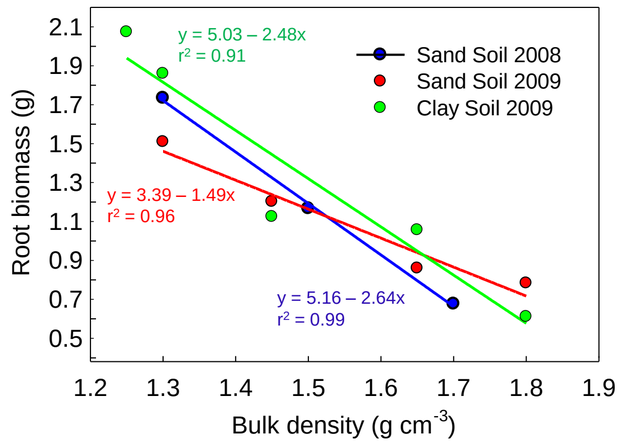

Figure 4. Root mass from a sandy soil (2008 and 2009) and clay soil (2009). Plants were grown in the greenhouse.

Figure 5. Canola plants in the greenhouse. Top photo is shows increasing bulk density from left to right. Bottom left photo is showing root growth at 1.3 g cm^{-3}, middle photo is 1.5 g cm^{-3}, and the right photo is root growth at 1.7 g cm^{-3}.

Conclusion

- No-till winter canola production presents challenges in managing residue and can be influenced from soil physical properties.
- Winter canola root growth can be reduced from high bulk density (> 1.5 g cm^{-3}) soils, which may reduce the plants ability to survive winter dormancy.
- Early no-till systems may not be a good fit for winter canola due to higher bulk densities.