Improving soil water availability through the use of cover crops in agriculture: Modelling soil moisture on cover crops

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Introduction

- Cover crops have been widely used in sustainable agriculture due multiple benefits associated:

  1) Weed control.
  2) Reduction in soil erosion.
  3) Enhancing C and N content on the soil.
  4) Soil aggregation improvement.

- Nevertheless, the effects of cover crops on soil water availability have not been studied deeply.

Objectives

1. To model soil moisture differences among to soil under cover crops and without cover crops using soil and system factors.

2. To model differences on behavior on soil moisture among cover crops and no cover crops during drought periods.

Experimental design

- A total of 37 farms from North Carolina, Maryland and Georgia were used on present study.
- Two treatments were established:

  1) Soil under cover crop (CC)

  2) Bare soil (BS)

Measurements

- Biomass replicated samples on 1 m^2 were taken to estimate total dry biomass (kg ha^{-1}) in each farm.
- Soil samples were taken in both treatments to determine soil texture, bulk density, C and N content at three depths: 0-30 cm, 30-60 cm and 60-100 cm.
- TDR sensors were installed at three depths: 15, 45 and 80 cm in both treatments to measure volumetric soil water content.
- Present study focused on 15 cm depth measurements

Modelling

- Multiple regression approach was performed to predict :

  1. Differences among soil volumetric moisture content ($\Delta\theta$) among cover crops soil and bare soil under high rainfall events (rainfall > 15 mm).

  2. Differences in soil moisture decay content rate ($\Delta\beta_1$) during drought periods (no rainfall) among cover crops soil and bare soil.

- Total dry biomass, rainfall, silt and sand contents were used as predictors on first model developed.
- Total dry biomass, silt and sand contents were used as predictors on second model developed.

Results

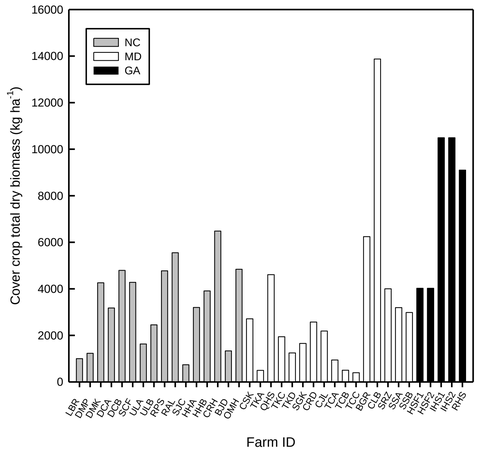


Figure 1. Total dry biomass obtained on each of 37 sites employed on present study.

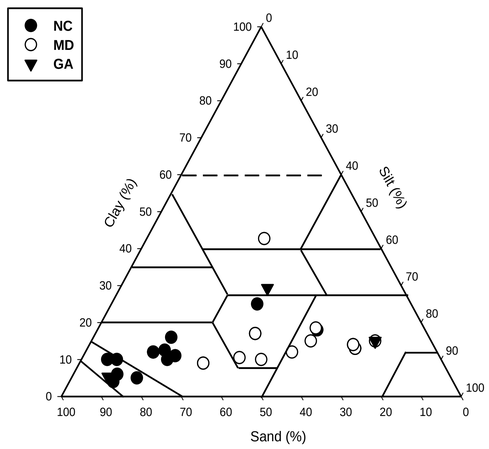
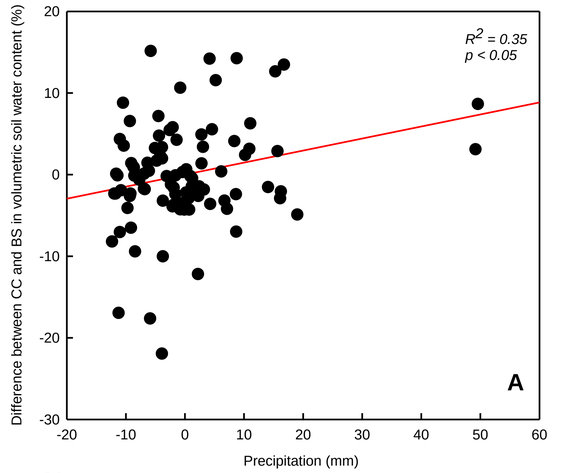


Figure 2. Textural classification of the soils employed on present study.



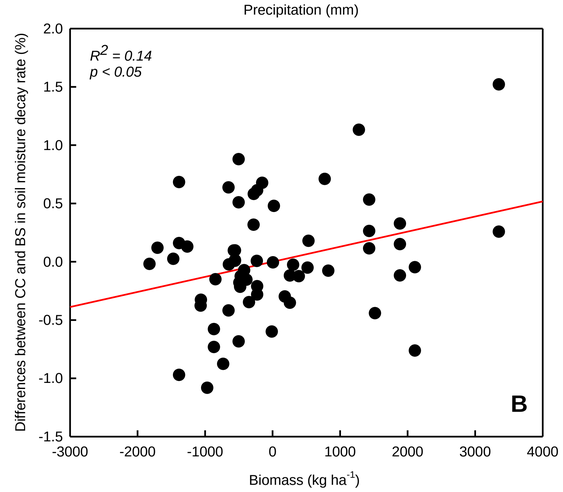


Figure 3. Partial regression plots for A) soil volumetric moisture content differences between CC and BS with predictor precipitation (mm) and B) soil moisture decay content rate differences between CC and BS during drought periods with predictor total dry biomass. Red lines represent the best fit line among variables.

Conclusions

- Combined with other factors cover crops increased soil volumetric water content more after precipitation events compared with bare soil plots. The difference between the treatments is correlated with the magnitude of the rainfall event.
- Higher differences in soil moisture decay content rate values are explained in the model by interaction among drought time and biomass, where soil under cover crops tended to keep similar amounts of water during drought periods, comparing with values from bare soil.

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