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Soil Water Content Changes with Cover Crops between No-till Wheat and Grain Sorghum

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Introduction

The addition of double-crops and cover crops into no-till systems has become popular in recent years as a means of increasing cropping system intensity and diversity. A primary concern of producers in areas where water often limits yield is the possibility that fallow replacements may reduce the amount of soil water available for the next grain crop, potentially reducing yields.

Objectives

1. Evaluate the effect of cover crops and double-crop soybean on soil-profile water content in a winter wheat-grain sorghum-soybean no-till cropping system.
2. Evaluate the effect of cover crops and double-crop soybean on sorghum yield in a winter wheat-grain sorghum-soybean no-till cropping system.

Materials and Methods

- Data collected from 2014 to 2016 from no-till experiment established in 2007 at Manhattan
  - Well drained Wymore silty clay loam (fine, smectitic, mesic Aquertic Argiudoll), with 0 to 1% slopes
  - 30-yr mean annual precipitation = 905 mm
  - 30-yr mean annual air temperature = 13° C
- RCBD, 4 replicates, 6 treatments imposed between wheat harvest and grain sorghum planting:
  - Chemical fallow (CF)
  - Double-crop soybean [DSB; *Glycine max* (L.) Merr]
  - Summer legume cover crop, late-maturing soybean (LMS)
  - Summer non-legume cover crop, sorghum-sudangrass (SS; *Sorghum bicolor* × *Sorghum bicolor* var. sudanese)
  - Winter legume cover crop, crimson clover (CL; *Trifolium incarnatum* L.)
  - Winter non-legume cover crop, daikon radish (DR; *Raphanus sativus* L.)
- Summer cover crops were terminated with a roller/crimper in September each year.
- Winter cover crops were terminated by freezing temperatures over winter or herbicide application in the spring if needed.
- Grain sorghum was planted without tillage on 1 June 2015 and 12 May 2016 with a White 6200 planter (AGCO Corp., Duluth, GA) equipped with residue managers and was harvested on 15 October 2015 and 20 October 2016 with a modified Gleaner EIII (AGCO Corp., Duluth, GA) combine.
- Soil volumetric water content was measured to a depth of 1.5 m in 2014 and 2.74 m in 2015 via neutron thermalization.
  - Neutron probe was calibrated against volumetric soil water content samples from the site.
  - Access tubes were installed soon after cover crop emergence and removed just before sorghum planting.
- Near-surface soil water content was estimated using a Field Scout TDR 300 Soil Moisture Meter (rod length 12 cm, Spectrum Technologies, Inc., Plainfield, IL) calibrated to soil obtained from the site.
- Analysis of variance was conducted using GLIMMIX procedure of SAS (SAS Institute, Cary, NC) to test for significant treatment effects (α = 0.05).

Results

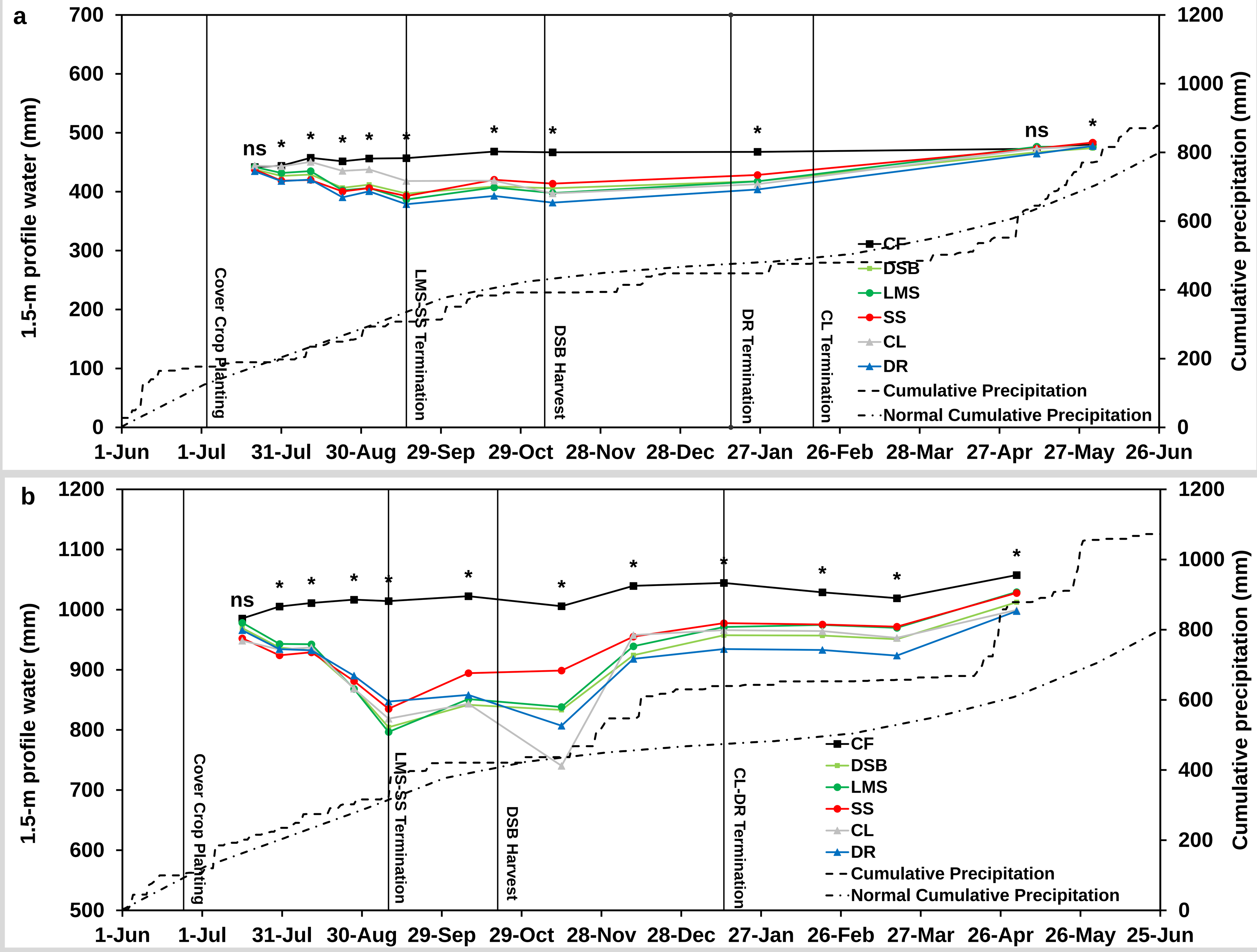

Figure 1. Profile soil water content for cover-crop treatments imposed between wheat harvest and sorghum planting and cumulative precipitation at Manhattan, KS, 2014-15 (a) and 2015-16 (b).

- Precipitation in both years was near or greater than Normal (Figures 1 a and b).
- All treatments reduced soil water content from the second sampling date through January in 2014-15 (Figure 1a) and April in 2015-16 (Figure 1b).
- At the last sampling date before sorghum harvest:
  - volumetric water content differed between treatments at the 0.15 and 1.07 m depths (Figure 2a), but total soil profile water content was not different from the chemical fallow for any treatment in 2015 (Figure 2b).
  - volumetric water content differed between treatments at depths below 1.4 m (Figure 2c), and total soil profile water content was less in the double-crop soybeans (DSB), crimson clover (CL), and daikon radish (DR) than in the chemical fallow treatment in 2016 (Figure 2d).

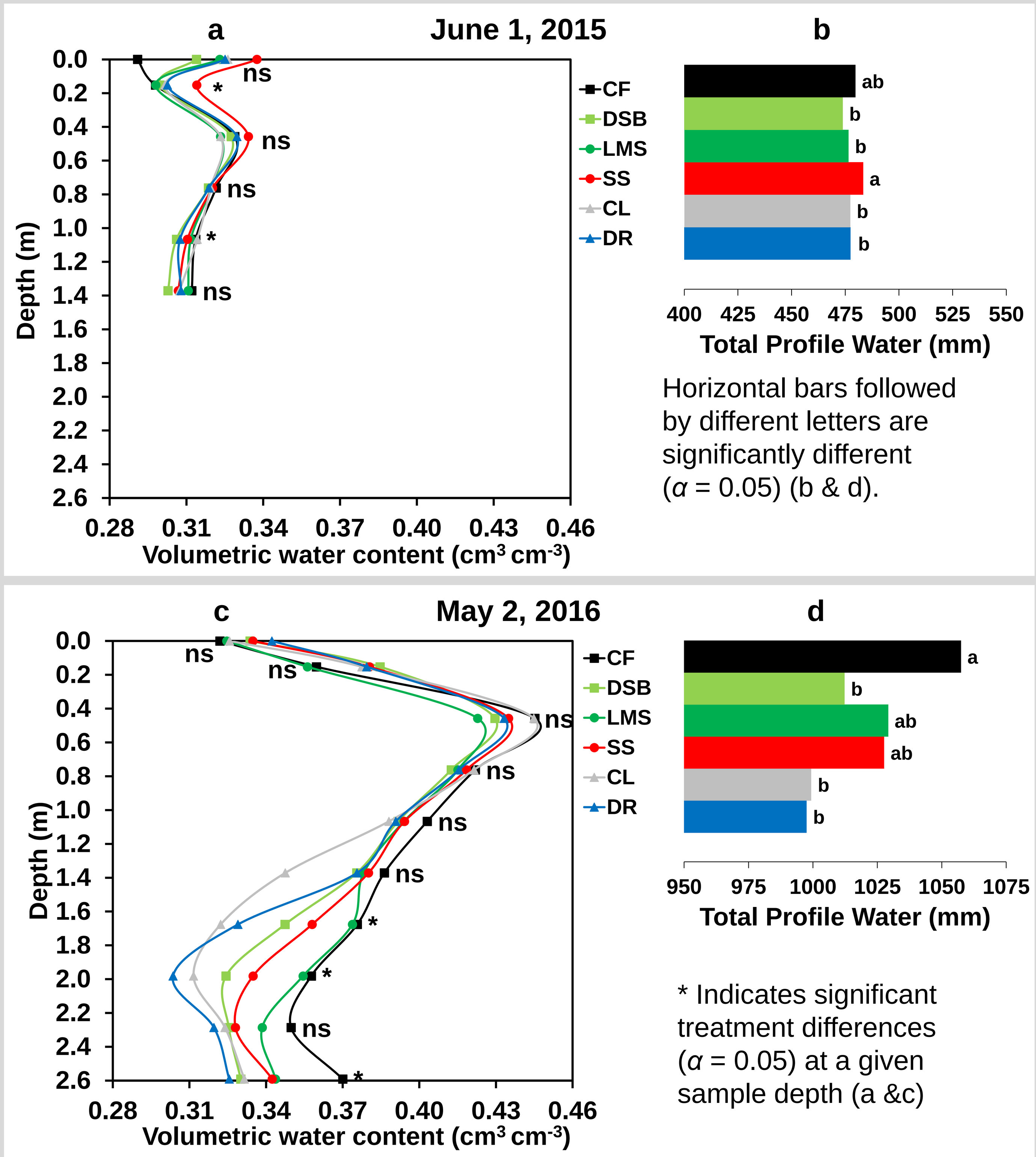

Figure 2. Profile soil water content, by depth (a & c) and total (b & d) before sorghum planting in spring of 2015 (a & b) and 2016 (c & d) at Manhattan, KS.

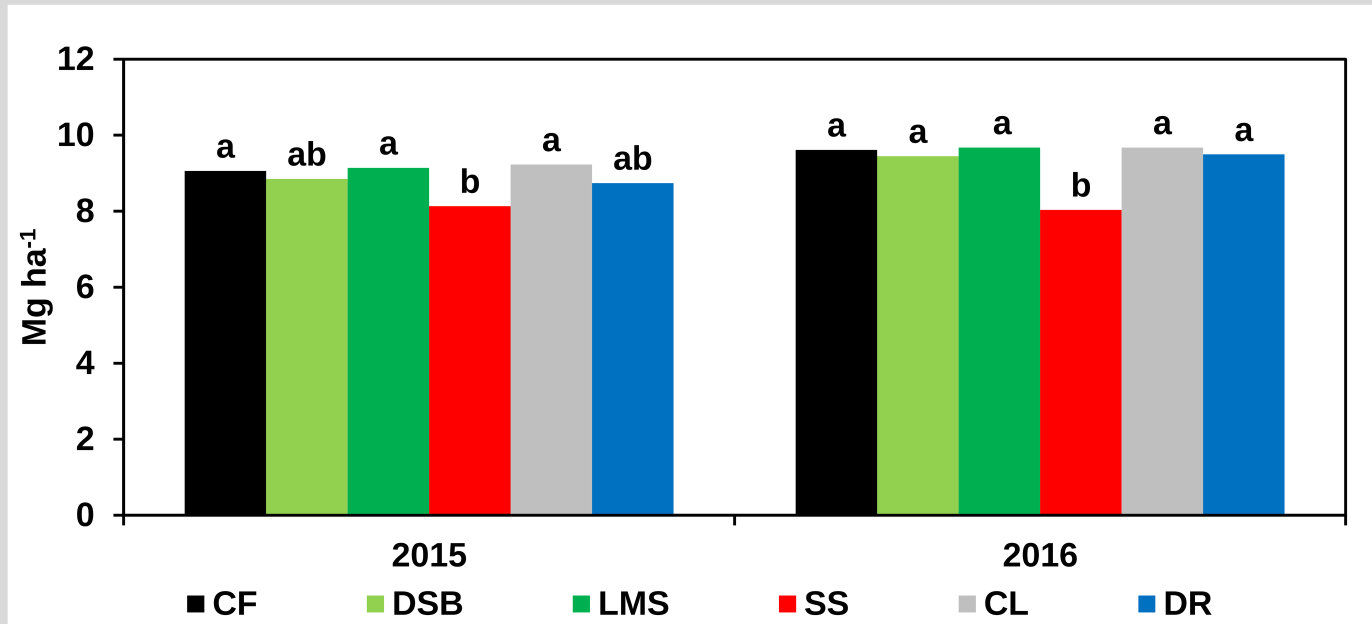

Figure 3. Sorghum grain yield after cover crops at Manhattan, KS, 2015 and 2016.

- The only treatment to result in grain sorghum yielding less than the chemical fallow in either year was the sorghum-sudangrass (SS, Figure 3), which had a significantly greater C:N ratio than all other treatments (data not shown).

Conclusions

- Cover crops and double-crop soybeans reduced soil water content while they were growing.
- Differences in soil water content persisted at some depths and for some treatments until just before planting of the next sorghum crop.
- Cover crop water use did not influence sorghum yield at this location in years with near or greater than normal precipitation, rather sorghum yield reductions were more closely associated with cover crop residue characteristics (C:N).