Impact of Warm-Season Cover Crops on Dual-Purpose Wheat Systems

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Introduction

Continuous wheat production for grain and grazing is a common practice in the southern Great Plains. Monoculture practices are detrimental to soil quality and depletion of nutrients. Adoption of conservation systems has been hampered by perceived soil compaction in no-till under dual purpose production systems. Cover crops and conservation tillage practices can improve soil health. However, cover crops and soil moisture use is a top concern in semi-arid environments.

Objectives

This study was established to evaluate and quantify the impact of cover crops in dual-purpose no-till wheat on soil chemical, physical, soil moisture and crop growth in Texas Rolling Plains. Specifically this presentation evaluates the impact of cover crops on soil water dynamics in dual purpose wheat systems.

Methods

Location: Smith Walker farm, Vernon, Texas
Soil type: Abilene clay loam soil, non irrigated
Precipitation: semi-arid, average annual precipitation of 711mm.
Experimental Design: Randomized complete block design with 4 replicates
Treatments:
1) conventional tillage, ConvTill
2) No-tillage, NoTill
3) No tillage with Cover crops and Grazing, NT Cover/Graze
4) No tillage with Cover crops and No Grazing, NT Cover/No Graze

Plot sizes: 55m long by 37m wide with 6m borders.
Cover crops: Cover crops were seeded in summer and grazed prior to termination. Cover crops mix included, cowpea, guar, mungbean, forage sorghum, buck wheat and pearl and foxtail millet. Seeded at 30 lb/ac in 2013 and 25 lb/ac in 2014.
Winter wheat: Seeded in the fall after terminating cover crops. Grazed prior to hollow stem.
Cover Crop Grazing: Flash grazing each year.
Soil moisture: Access tubes were placed in each treatment to a depth of 150 cm. A neutron probe was used to measure soil water storage once every two weeks at 20cm depth increments from 0 to 140 cm. The neutron probe readings were converted to volumetric soil water content with three calibration equations determined for the soil type under investigation at one of the experimental sites for the neutron probe that was used (Model 503DR, CPN International Inc, Martinez, CA, Serial No. H350607921).

Table 1: Calibration Equations:

Depth (cm)	Equations
10	$\theta v = -0.0696 + 0.2698 C_R$
30-50	$\theta v = 0.1046 + 0.0730 C_R$
70-130	$\theta v = -0.0395 + 0.1766 C_R$

θ_V is volumetric water content in ($m^3\ m^{-3}$)
C_R is count ratio that is, count in the Measured material to standard count

Figure 1. Neutron probe taking readings in one of the study plots.

Figure 2. Cover crop mix seeded ·6/13/2014

Figure 3. Cows being moved into the plots for their palatable cover crops treat this summer

Data Analysis

Data collected were analyzed by ANOVA using general linear procedure (SAS Institute, 2008). Mean separation was Fisher's protected least significant difference (LSD) and all analyses were declared significant at 0.05 probability level. Descriptive statistics was also used in analyzing soil moisture data spanning from July 2013 to October 2014.

Results

Stored Soil Water: 0-140cm Depth

Figure 4. Stored soil water in 0-140cm depth in millimeters (mm) for period July 2013 to October 2014

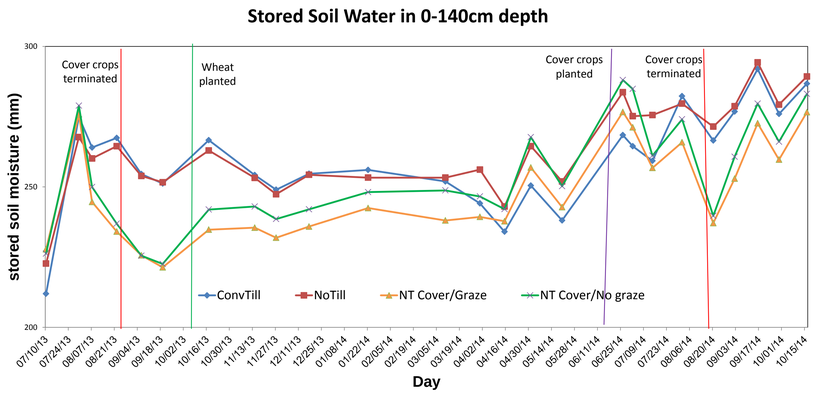
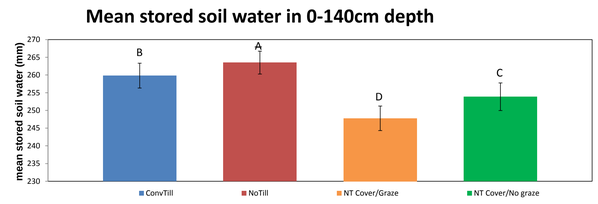


Figure 5. Mean Stored soil water in 0-140cm depth in millimeters (mm) for period July 2013 to October 2014



Stored Soil Water: 0-30cm Depth

Figure 6. Stored soil water in 0-30cm depth in millimeters (mm) for period July 2013 to October 2014

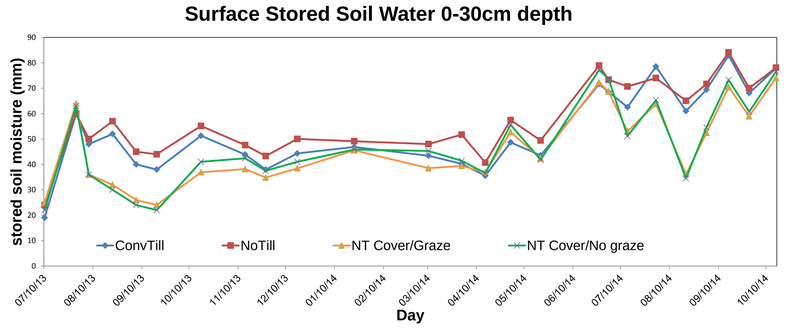
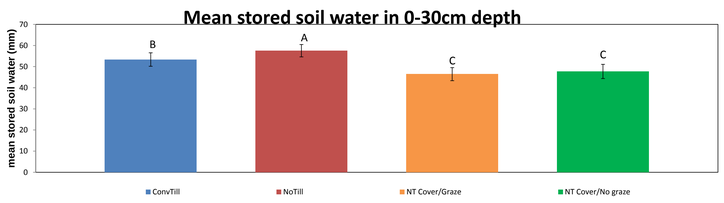
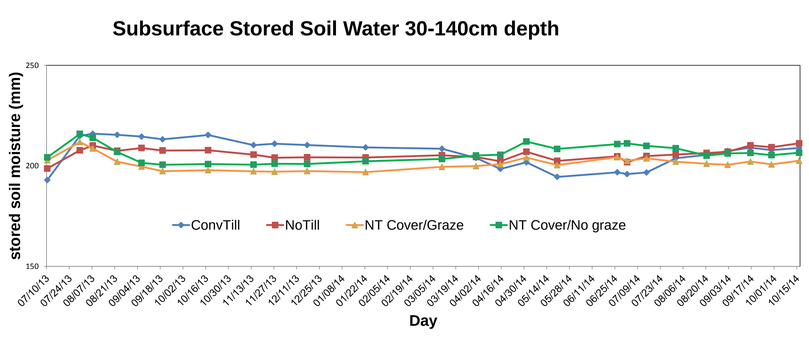


Figure 7. Mean Stored soil water in 0-30cm depth in millimeters (mm) for period July 2013 to October 2014



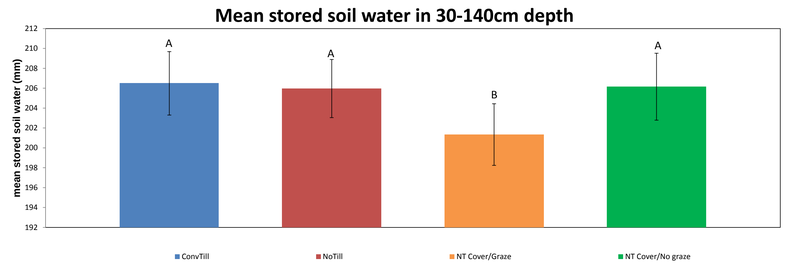
Subsurface Stored Soil Water: 30-140cm

Figure 8. Stored soil water in 30-140cm in millimeters (mm) for period July 2013 to October 2014



Subsurface Stored Soil Water: 30-140cm

Figure 9. Mean Stored soil water in 30-140cm depth in millimeters (mm) for period July 2013 to October 2014



Yields and Cover Crops Biomass Production

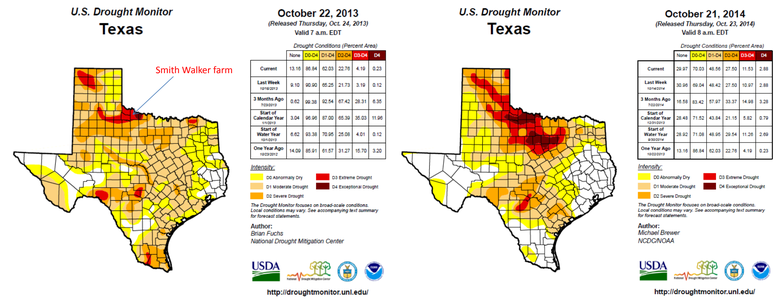
	Mean stored soil water (mm)			Wheat Yield	summer cover crops Biomass Production (Kg/ha)	
Treatment	0-140cm	0-30cm	30-140cm	Kg/ha	2013	2014
ConvTill	260b	53b	206a	151a	no cover	no cover
NoTill	264a	58a	206a	75b	no cover	no cover
NT Cover/Graze	248c	46c	201b	18c	2169	3133b
NT Cover/No graze	254d	48c	206a	27d	2129	3629a

Columns: Numbers with same letter are not significantly different Fisher's protected LSD (P<0.05)
Numbers without letters are not significantly different Fisher's protected LSD (P<0.05)

Table 2. Summary table for period July 2013 to October 2014

Texas Drought Monitor

Figure 10. Texas Drought Monitor Maps for 2013 and 2014



Summary

- ❑ This investigation is being conducted under extreme drought conditions (Figure 10).
- ❑Cover crops treatments showing significantly less soil water storage at time of termination each year (Figures 4 & 5).
- ❑ Difference in stored soil moisture between cover crops and no cover treatments decreased by half from 26mm in August to 12mm in September.
- ❑ Cover crops may be improving soil infiltration and water holding capacity
- ❑ A partitioning of soil moisture storage by depth, showed that significant moisture depletion by cover crops occurred in 0-30cm depth (Figures 6 & 7).
- ❑ Cover crop treatments stored less water in the 0-30 cm depth compared to ConvTill and NoTill treatments.
- ❑ Subsurface (30-140cm) stored soil water was fairly uniform, notably ConvTill recorded lowest in summer months and NT cover/No graze highest (Figure 8).
- ❑ No significant differences in subsurface mean stored soil water among NT cover/No graze, NoTill and ConvTill treatments. However NT cover/Graze recorded the least amount of stored water for this period (Figure 9).
- ❑Cover crops treatments produced biomass over 2000 and 3000 Kg/ha for 2013 and 2014 respectively (Table 2).
- ❑ Cover crops use moisture and need more time to recharge in semi-arid regions where precipitation is limiting compared to sub-humid areas.
- ❑ Consideration of deep rooted crops may be beneficial in offsetting soil moisture deficit experienced in the early days of cover crops adoption.
- ❑ Cover crops produce biomass that will be beneficial in the long term.
- ❑Cover crops termination timing is a critical management decision in semi-arid environments.
- ❑ Gradual and systematic adoption of cover crops in semi-arid environments may spread risk associated with inevitable soil moisture depletion.
- ❑Economic analysis are also being conducted. In 2013, cover crop mix at 30 lb/ac costs $32.95 per acre.