Double Cropping in Wheat: The Relative Impacts of Roots and Tillage on Soil Health

Lauren E. Tomlin[1], Haly L. Neely[1], Clark B. Neely[2], Jamie L. Foster[3], Katie L. Lewis[4], Ronnie W. Schnell[2], Paul B. DeLaune[5]

[1]Texas A&M AgriLife Research, College Station, TX [2]Texas A&M AgriLife Extension, College Station, TX, [3]Texas A&M AgriLife Research, Beeville, TX, [4]Texas A&M AgriLife Research, Lubbock, TX, [5]Texas A&M AgriLife Research, Vernon, TX

Introduction

- Wheat is one of the top four major commodity crops consumed in the United States as well as around the world. For wheat-based cropping systems in Texas, few summer crops have been identified as potential rotational crops for winter wheat.
- Cover crops have been shown to slow soil erosion, increase soil infiltration, suppress weeds, and increase soil organic matter. Double cropping has similar benefits, but with the addition of potential crop profit.
- Research has lead us to believe that by reducing tillage, soil porosity can be increased, as well as aggregation, and organic matter.

The Objectives

1. Evaluate the impact of increasing cropping system diversity and reduced tillage on wheat yields, soil moisture, and total system profitability.

2. Monitor the impact of increasing cropping system diversity on soil health including soil C, nutrient cycling of systems, soil respiration, wet aggregate stability, infiltration rate, and bulk density.

3. Identify a best fit summer crop for winter wheat in the Texas Blackland Prairie Region.

Materials and Methods

Research Site
- Location: Stiles Farm Foundation, Thrall, TX
- Ecoregion: Blackland Prairie

  - Soil Type: Burleson clay
  - Annual High: 79°F
  - Annual Low: 54.8°F
  - Rainfall: ~35" per year
  - Irrigation: none

Current Soil Methods
- Neutron Moisture Meter
- Soil Respiration
- Soil Fertility Panel
- Bulk Density

Additional Measurements
- Wheat Yields (kg ha^{-1})
- All Species Biomass for C:N Ratio

- Neutron Moisture readings taken every other week. Start Date: July 19th, 2016.

Experimental Design

Split-Plot RCBD (3 reps.)
Tillage Treatments:
- Conventional Tillage
- Strip Tillage
- No-Tillage

Cover Crop Treatments:
- Fallow (control)
- Grain Sorghum (DKS 37-07)
- Cowpea (TX Pink Eye)
- Sesame (S32)
- Mixed Cover: Buckwheat (Mancan), Cowpea (TX Pinkeye), German Foxtail Millet, Guar (Kinman), LabLab (Rio Verde), Pearl Millet, Short Stature Sunflower (8H668S), Sunnhemp (*Crotalaria juncea*)

Figure 1. Dr. Haly Neely measuring out a deep soil fertility core.

Conventional Tillage (Cowpea) | Strip Tillage (Sesame) | No Tillage (Cover Crop, Peanut)

Results

Tillage Effects

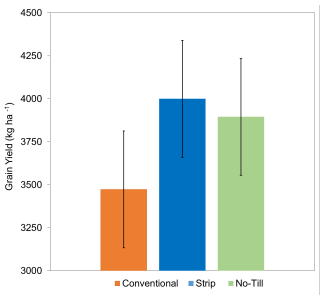

Figure 2. Average winter wheat yield (kg ha^{-1}) as affected by tillage treatments.

Double Crop Effects

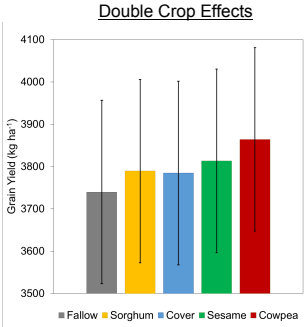

Figure 3. Average winter wheat yield (kg ha^{-1}) as affected by 2015's double crop plots.

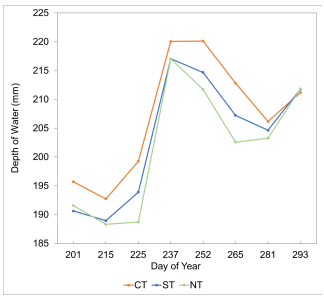

Figure 4. Soil moisture (mm) from soil's surface (60 cm) in all tillage treatments.

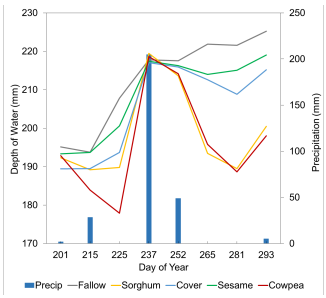

Figure 5. Soil moisture (mm) for soil's surface (60 cm) in 2016's double crops. Bar graph displayed in mm of precipitation.

- Higher yields were observed in minimally tilled plots, as compared to conventional tillage (Fig. 2).
- Greater wheat yields observed in plots with previous year's summer crops (Fig. 3).
- The amount of water in upper soil profile is greater in plots: fallow > sesame > cover. Sorghum and cowpea plots require more water during growing season (Fig. 5).
- The neutron moisture meter detected more plant available water in conventionally tilled plots (Fig. 4).

Figure 6. Some visually observed differences in crop robustness (cowpea). Conventional till (left) and no-till (right).

Figure 7. Neutron Moisture Meter takes readings in a conventional till rep with cowpeas as the double crop (Day 215).

Discussion

Tillage
- From the previous years' tillage (Fig. 2), wheat yields appear to be greater in areas with reduced tillage (p-value < 0.01).
- Alternatively, conventionally tilled plots held more soil moisture than strip or no-till (Fig. 4). This could be explained by the lack of plants during the growing season.
- Stand counts were very low for all conventionally tilled plots due to low soil moisture at planting.

Figure 8. Aluminum access tube (180 cm) for gathering neutron moisture meter data.

Soil Water
- Soil water greater in less conservatively tilled plots.
- Cowpea and sorghum have greater water demands than sesame and cover crop.
- Sesame has lowest water use of any crop (Fig. 5).

Figure 9. Brittany Garza with large sesame plant.

Double Cropping
- Wheat yields higher in double cropped plots (Fig. 3). Statistical significance not yet observed.
- Sesame could be a summer contender for winter wheat rotation.

\+ Insect and disease tolerant
\+ Drought tolerant

– Long growing season (120-150 day crop)
– Fall harvest could result in a lower wheat stands due to cooler soil temperatures during germination.

Future Research

- The entire project consists of three locations, Lubbock, Beeville, and Thrall, Texas. Thrall's research site has been active for a full cropping cycle longer than the other locations; Beeville and Lubbock were added last fall.
- Next year, data from all locations will be presented.

Anticipated Data Analysis
- All Location Soil Data
- All Location Double Crop Yields
- All Location C:N Biomass

Spring 2017 Measurements
- Infiltration Rate
- Wet Aggregate Stability
- Soil Penetrometer

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Thanks, and Gig 'em!