MANAGING WINTER COVER CROPS IN COTTON TO IMPROVE SOIL HEALTH

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Abstract

In Missouri, cotton seedling can be significantly injured due to blowing sand. This injury can often lead to reduced yield, and some fields may require replanting in order to make a viable crop. The use of cover crops has been implemented to protect young cotton seedlings from this injury. However, there are other benefits that can be obtained with the use of cover crops. The Natural Resource Conservation Service has recently been promoting the use of cover crop mixtures in conjunction with many row crops to improve soil health. This experiment was conducted to evaluate the effect of cover crops on soil physical and chemical properties, and to determine the best cover crops and cover crop mixtures to improve cotton growth and yield. Cover crops were seeded in the fall on two locations (sand and silt loam), and terminated shortly before cotton planting. Cover crop treatments included wheat, cereal rye, Austrian winter peas, crimson clover, tillage radish, and rapeseed as well as two cover crop mixtures (Peas/Rye/Radish and Clover/Wheat/Rapeseed). A number of soil health measurements were taken throughout the season, and cotton lint yield was taken at harvest. In 2013, significant differences in cotton lint yield were found on the sand location due to cover crop treatments. The cotton yield in the pea/rye/radish mixture was significantly higher than all individual cover crops as well as the untreated check. On the silt loam field, this mixture also provided the highest numerical cotton yield. Yields were lowest when cotton was grown in conjunction with tillage radishes on both soil types in 2013. On the sandy soil, soil active carbon was increased by 0.6% with the use of a cover crop mixture compared to the untreated check. No significant differences in soil active carbon were found on the silt loam, but this is the first year the study was conducted on that soil. Improvements in active carbon, as well as other soil components, will be monitored on these plots in the following years.

Introduction

Cover crops are often used to protect cotton seedlings from blowing sand to minimize the need for replanting. University of Missouri Delta Center research has shown significant cotton yield increases from planting wheat cover crops in the row middles for wind protection (Stevens, et al, 1996). The Natural Resource Conservation Service is promoting soil quality programs with mixtures of cover crops which would be grown year round. These mixtures can help to diversify the soil ecology in addition to maintaining some type of live root growing in the soil at all times. This will allow for uninterrupted, favorable conditions for soil organisms, including possible fungi parasitic to nematodes (Mankau, 1980). Cover crop residue may also leave concentrated areas of available soil phosphorus (White and Weil, 2011). The polysaccharide mucous secretions from the soil organisms increase soil aggregate stability, promote good aeration, and water infiltration and retention (Clark, 2008).

The objective of this experiment is to evaluate the effect of cover crops on soil physical and chemical properties. This will help us to determine which cover crops and cover crop mixtures improve cotton growth and yields while enhancing soil health.

Methods

Cover crops were seeded in the fall of 2012 just after the cotton harvest on two locations. These locations include a Malden fine sand (Mixed, thermic Typic Udipsamments) at Clarkton, Missouri in 2012-2013 as well as a Tiptonville silt loam (Fine-silty, mixed, superactive, thermic Oxyaquic Argiudolls) at Portageville, MO in 2013. Cover crop treatments included wheat, cereal rye, Austrian winter peas, crimson clover, tillage radish, and rapeseed as well as two cover crop mixtures (Peas/Rye/Radish and Clover/Wheat/Rapeseed). These cover crops were allowed to grow through the winter and were terminated shortly before cotton planting. Plots were seeded with Phytogen 375 WRF at 44,000 seeds per acre. Soil health measurements were taken during the season, including the nutrient analysis, phospholipid fatty acids, and soil active carbon. Cotton lint yield was taken at harvest and adjusted for gin turnout.

Results

At the Clarkton location in 2012, cotton lint yields were not significantly different based on cover crop (Table 1). Yields were numerically lowest when grown behind rapeseed, and highest when grown in a mixture of clover, wheat, and rapeseed. Yields over 1,000 lb lint ac^{-1} were also achieved with wheat, clover, and pea/rye/radish cover crops.

In 2013, the Clarkton location yielded much lower than the previous year. However, significant differences were found among cover crop treatments (α= 0.05). The pea, rye, and radish cover crop mixture yielded 746 lb lint ac^{-1}, which was significantly higher lint than all the individual cover crops and the check (Table 1). Both cover crop mixtures provided statistically similar yield. Similar to 2012, cotton grown in tillage radish residue was numerically the lowest yielding treatment.

At the Portageville location in 2013, significant differences were also found among cover crop treatments (α= 0.05). Similar to the Clarkton location, the pea, rye, and radish mixture provided the highest yield at 500 lb lint ac^{-1} (Table 1). Again, the lowest yielding treatment at this location was grown in tillage radish cover. Soil analysis determined

Table 1. Cotton Lint Yield in lb ac^{-1} from cover crop treatments in Clarkton (2012 and 2013) and Portageville, MO in 2013.

	Lint Yield (lb/ac)		
Cover Crop	**Clarkton 2012**	**Clarkton 2013**	**Portageville, 2013**
Check	964 A	459 B	416 ABC
Wheat	1071 A	518 B	439 AB
Abruzzi Rye	911 A	537 B	335 BC
Austrian Peas	931 A	527 B	384 ABC
Crimson Clover	1010 A	568 B	357 ABC
Tillage Radish	956 A	455 B	284 C
Rapeseed	861 A	554 B	405 ABC
Pea/Rye/Radish	1062 A	746 A	500 A
Clover/Wheat/Rapeseed	1122 A	578 AB	435 AB

differences in active carbon between check, wheat, and clover, wheat, rapeseed mixtures planted on sandy soil. The cover crop mixture increased soil active carbon by 0.6 % compared to untreated checks (Figure 2).

Figure 2. Soil active carbon levels taken from three cover crop treatments at Clarkton and Portageville, MO on June 27, 2013.

On the silt loam soil, no significant increase in active carbon was found due to the addition of cover crops. Active carbon was reduced under the wheat cover, and slightly increased with the cover crop mixture. However, given that 2013 was the first year at this location, no significant increase was expected

Summary

Many differences can be found among cover crop treatments concerning cotton yields. Cover crop mixtures provided the highest numerical yields at each location in both 2012 and 2013. In 2013 specifically, the highest cotton yields were grown with a mixture of peas, rye, and radishes. These yields were significantly higher ($\alpha = 0.05$) on the sandy soil, while numerically higher on the silt loam. In 2013, the lowest cotton yields of both studies were grown with tillage radish as a cover crop. It is not yet understood if some type of antagonistic effect between cotton and tillage radish exists.

Soil health of these treatments is slowly beginning to change. Soil active carbon has increased due to cover crops on the sandy location, which has been maintained in those cover crops for two consecutive years. No increase in active carbon due to cover crops was found on the silt loam, however this is the first year of that study. These plots will be maintained and monitored to see if any changes in soil health can be identified.

References

Clark, Andy, *ed. Managing cover crops profitably.* DIANE Publishing, 2008

Mankau, R. Biocontrol: Fungi as nematode control agents. Journal of Nematology 12.4 (1980)244

Stevens, G., B. Phipps, and J. Mobley. 1996. Managing cotton for reduced wind damage with ridge till systems. p. 1403-1405. In P. Dugger and D.A. Richter *eds.* Proc. Beltwide Cotton Conf., Nashville, TN. 9-12 Jan. 1996. Natl. Cotton Counc. Am., Memphis, TN.

White, C. and R. Weil. 2011. Forage radish cover crops increase soil test phosphorus surrounding radish holes. Soil Sci. Society of America 75:121-130