

Cotton Yield and Soil Water as Affected by Annual Applications of FGD Gypsum

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Flue Gas Desulfurized (FGD) gypsum is a by-product of burning coal for energy production. This material is currently being land filled but offers an opportunity as a soil amendment in agricultural practices. The objectives of this experiment were to determine effects of gypsum application on soil water use and cotton yield.

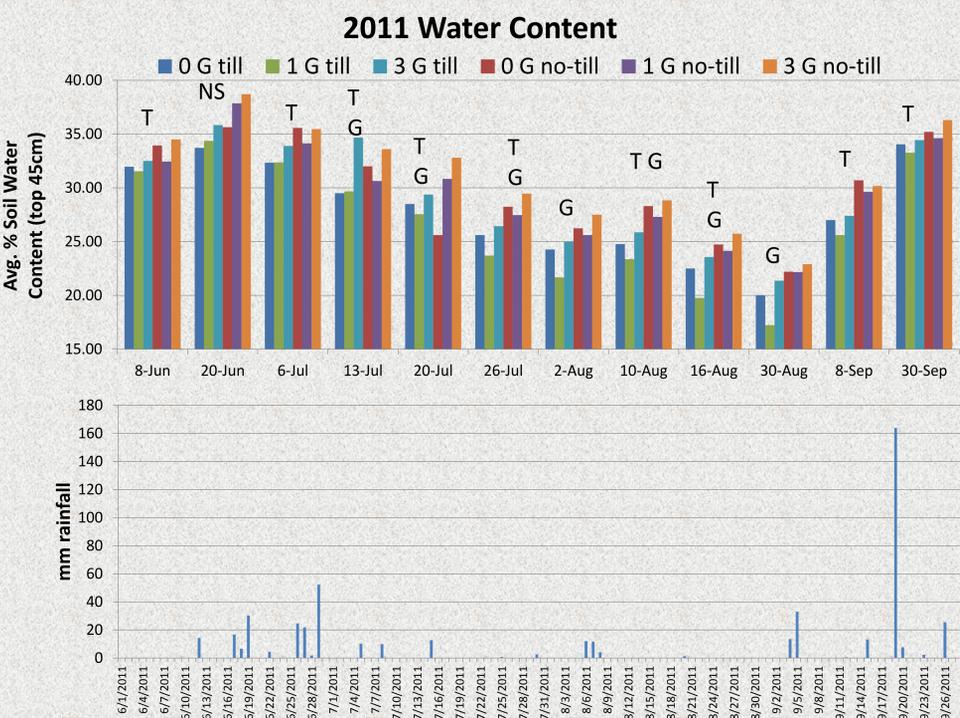
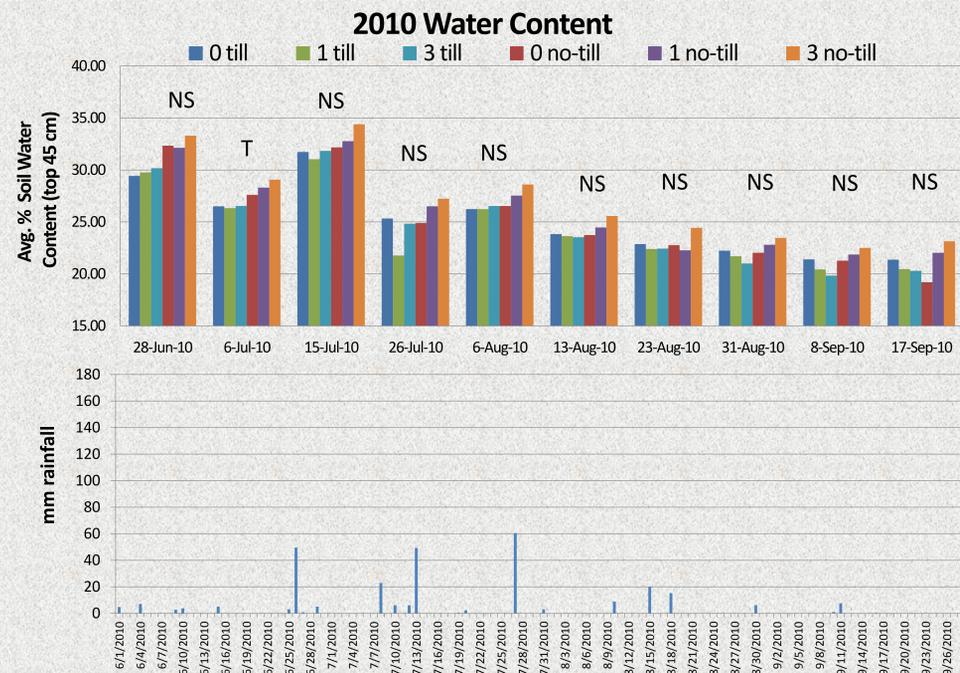


Materials and Methods

Plots were established in 2009 at the University of Tennessee's Milan Research and Education Center located in Milan, TN. The soil series on the site are Memphis (Typic Hapludalfs) and Loring (Oxyaquic Fragiudalfs) silt loams with a slope of 0-2 %. The experimental design is a randomized complete block with split plot design having tillage as the main plot and gypsum rate as the sub-plot with four replications of each treatment. Plots were 4 rows (4meters wide) by 10 meters long. Gypsum was obtained from the Tennessee Valley Authority power plant in New Johnsonville, TN. Prior to application it was air-dried, weighed, and subsequently spread on the plots by hand. From 2009 through 2011, FGD Gypsum was applied annually on a cotton field across both no-till and tilled systems at rates of 0, 2.24, 4.48, 6.72, and 11.2 Mg ha⁻¹. After application, the plots receiving the tilled treatments were disc to incorporate the gypsum. In 2010 and 2011, soil water content in the 0, 2.24, and 6.72 Mg gypsum ha⁻¹ was monitored using time domain reflectometry (TDR) at soil depths of 15, 30, and 45 cm.

Results and Discussion

In 2009, neither tillage nor gypsum rate significantly affected yield. However, in 2010 both tillage and gypsum rate significantly affected yield, with greater yields in the no-till system and 0 Mg gypsum ha⁻¹ with an inconsistent yield decline across other gypsum rates. In 2011, there were no significant differences in yield from tillage or gypsum rate. Yields across years were not significantly different among tillage systems, but yield was significantly affected by gypsum rate with a decreased yield from the addition of any rate of gypsum. There were no significant differences in soil water content across tillage systems or gypsum rates in 2010. In 2011, soil water content significantly varied due to gypsum rate and tillage but differences were inconsistent relative to treatments.



T represents a significant difference from Tillage at $p \geq (0.05)$
G represents a significant difference from Gypsum rate at $p \geq (0.05)$
NS represents no significant difference at $p \geq (0.05)$
0 = 0 Mg Gypsum ha⁻¹, 1 = 2.24 Mg Gypsum ha⁻¹, 3 = 6.72 Mg Gypsum ha⁻¹

Gypsum Rate Mg ha ⁻¹	2009 Yield kg lint ha ⁻¹		
	Till	No-Till	Average
0	1263	1119	1191
2.24	1159	1142	1151
4.48	1176	1152	1164
6.72	1251	1094	1047
11.2	1213	1112	1038

- Tillage N.S. at $p \geq (0.05)$
- Gypsum N.S. at $p \geq (0.05)$
- Interaction N.S. at $p \geq (0.05)$

Gypsum Rate Mg ha ⁻¹	2010 Yield kg lint ha ⁻¹		
	Till	No-Till	Average
0	1659	1554	1607 A
2.24	1322	1553	1438 BC
4.48	1447	1575	1511 AB
6.72	1319	1407	1363 C
11.2	1479	1520	1500 AB
Avg.	1618 a	1705 b	

- Means across tillage followed by different small case letters differ at $p \geq (0.05)$
- Means across gypsum rate followed by different upper case letters differ at $p \geq (0.05)$
- Interaction N.S. at $p \geq (0.05)$

Gypsum Rate Mg ha ⁻¹	2011 Yield kg lint ha ⁻¹		
	Till	No-Till	Average
0	1120	1332	1226
2.24	1174	1235	1205
4.48	1062	1208	1136
6.72	1081	1323	1202
11.2	1148	1111	1130

- Tillage N.S. at $p \geq (0.05)$
- Gypsum N.S. at $p \geq (0.05)$
- Interaction N.S. at $p \geq (0.05)$

Gypsum Rate Mg ha ⁻¹	2009-2011 3 yr. Average Yield kg lint ha ⁻¹		
	Till	No-Till	3 yr. Average
0	1413	1397	1406 A
2.24	1271	1373	1323 B
4.48	1286	1375	1331 B
6.72	1269	1331	1300 B
11.2	1340	1308	1324 B

- Tillage N.S. at $p \geq (0.05)$
- Means across gypsum rate followed by different letters differ at $p \geq (0.05)$
- Interaction N.S. at $p \geq (0.05)$

Conclusions

- Sometimes water content was significantly affected by gypsum rate and/or tillage but differences were inconsistent across treatments.
- Gypsum rate and tillage both significantly affected cotton yield in 2010 with no-till yielding higher than tilled and certain rates of gypsum decreasing yield compared to the control.
- Three year avg. cotton yields were not significantly effected by tillage, but were significantly lower across all gypsum rates compared to no gypsum applied.