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What are the Effects of No-till Farming on Soil Moisture and Soil Temperature Compared to Conventional Tillage in Rice County Kansas?

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ABSTRACT

This research was done to find how the method of no-till farming affects soil temperature and soil moisture in the sandy-loam soils of Rice County Kansas. The temperature, moisture level, and organic matter were measured in eight samples of conventionally-tilled soil and no-tilled soil on a weekly basis for three consecutive weeks. The primary literature used to support the hypothesis was *Building Soils For Better Crops* by Magdoff. The literature was based on samples in darker, heavier soils.

Keywords: *Conventional, No-till, Residue*

INTRODUCTION

No-tillage farming is a method of farming in which the farmer performs no means of tillage to the soil, such as plowing, disking, or cultivating. In a no-tillage system the farmer uses chemicals and other means to rid his soil of weeds. The plant roots remain in the soil and the plant's residue lies on top of the soil. With the plant's residues left on top of the soil and the dead root systems left within the soil it has been found in many cases that the soil will hold moisture better (Magdoff 1992). The undisturbed plant roots and the increase in organic matter in the soil have been found to create larger pores in the soil causing it to hold moisture better when saturated with water in darker, heavier soils. "No-till soils tend to have more moisture then conventionally tilled soils because of better water infiltration and less evaporation"(Magdoff 1992).

Soil temperatures can range from -40 to 60 degrees Celsius. The greatest temperature extremes tend to occur at the surface, thus temperatures are greatly affected by the amount of surface cover or residue (Livingston 1993). In no-till farming the residue of old crops left on the surface and within the soil helps to protect the soil from the sun in addition to soil erosion causing agents like wind and water.

My null hypothesis is that tilled soil and no-tilled soil will hold the same amount of moisture and organic matter, and that there would be no difference in their temperatures. My alternative hypothesis is that no-till will hold more of both organic matter and moisture, and the temperatures between the two will differ. I believe that the practice of no-till farming versus conventional farming in the sandy soils of Rice County Kansas will improve soil moisture and stabilize soil temperature. There has been little study done on the effects of the no-till farming system in Rice County. My research comparing the effects of no-till and conventional farming in sandy loam soil types may give farmers in this area of Kansas answers to the questions they have about no-till and its value. My objectives are to find how the sandy soils react to a no-till system. I plan to try and find if no-till will hold more moisture, and organic matter, and how no-till affects the soil temperature.

MATERIALS AND METHODS

To start my research I plotted out the test area in both the conventional and no-till fields. The location of my plot was the inside 80 acres of the southwest quarter of section 23-19-10. The 80 acres is divided into two 40 acre fields; the north 40 conventional till and the south 40 no-till since 1997. I placed eight flags, roughly 100 feet apart, down the middle of the field, which separates the conventional from the no-till field. I pulled samples ten feet north and ten feet south of each of the eight flags, resulting in eight samples from the no-till and eight samples from the conventional-till fields. From September 15, 2002 to October 7, 2002 I pulled samples and measured soil temperature at each site on a weekly basis. To determine the soil temperature a standard soil thermometer was used that tested the temperature five inches deep. To determine the amount of rainfall during the three weeks a rain gauge was used. A soil probe was used to extract soil samples from approximately 0" to 7" deep. The samples were then double bagged in air tight bags and frozen until April 4, 2003. The samples were taken to the lab. In the lab I washed the soil containers and put them in the oven for one hour to get the moisture out of them. After that I put them in the disicater for twenty minutes to get the rest of the moisture out of them. Then I weighed the containers and recorded the container weights. After that I loaded the containers about two thirds full and weighed them again to get a wet weight. Then I put the samples into the oven at 105 degrees Celsius and dried to a constant weight. This takes less then nine hours. Once dried, they were weighed again to find the amount of moisture within the soil sample. After I had a dry weight for the samples I cooked the organic matter out of them in the muffle furnace at 1000 degrees Celsius for three and half hours and weighed them again. Listed below are the calculations and tests that were run to analyze the data.

Wetweight-containerweight=wetmass
wetmass-drymass=waterloss
waterloss/wetmass*100=%water
dryweight-organicweight/drymass*100=%organic
mean
Standard deviation
t-Test: Two Sample Assuming Unequal Variances

RESULTS

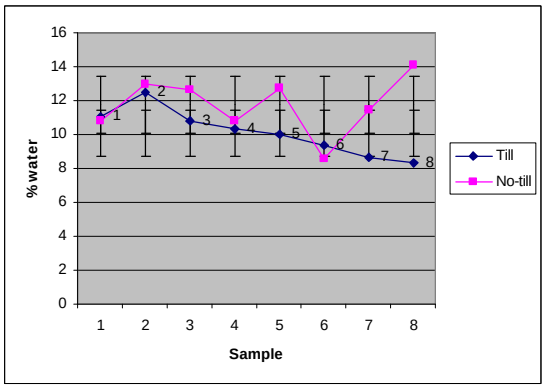


Figure 1.1. This shows the percent of moisture of no-till vs. conventional till in the first week. Standard deviation of both no-till and conventional till is also show.

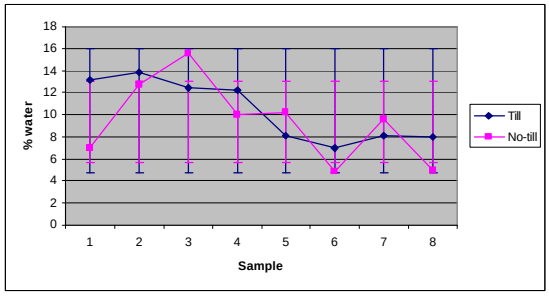


Figure 1.2. This shows the percent moisture in week the second week. Standard deviation is also shown.

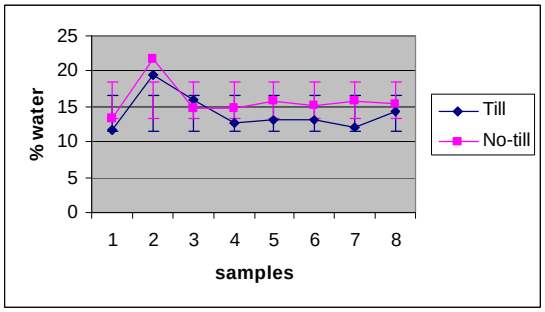


Figure 1.3. This shows the percent moisture in the third week. Standard deviation is also shown.

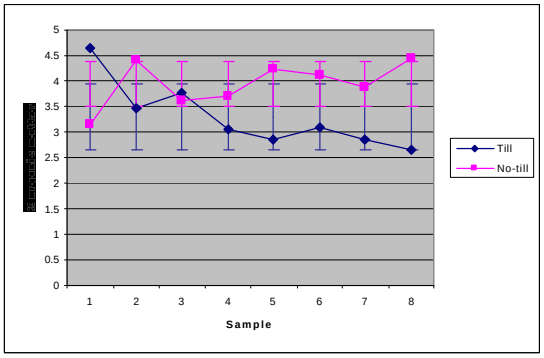
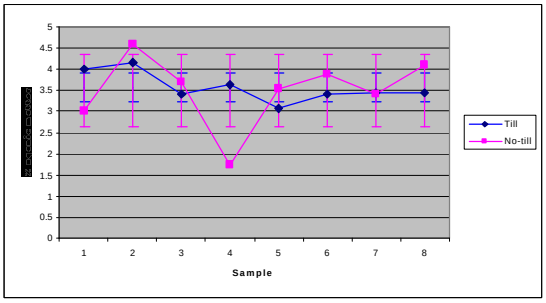


Figure 2.1. This shows the percent of organic matter that was found in the first week. Standard deviation is also shown.



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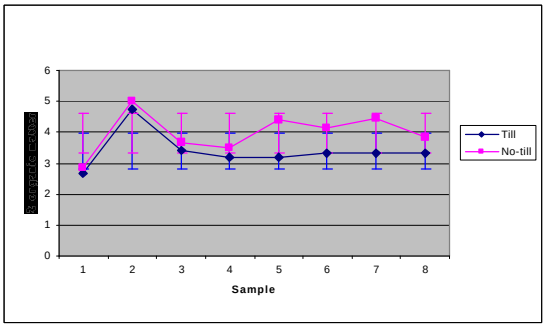

Figure 2.3. This figure shows the percent organic matter found in the third week.

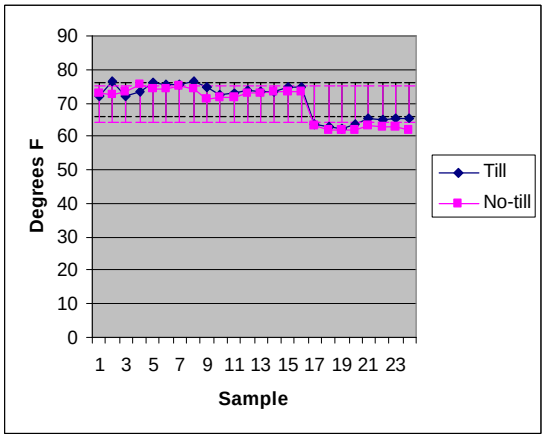

Figure 4.1. This shows the temperatures that were recorded of the three weeks. As you can see there was not much variation between the no-till and conventional till temperatures.

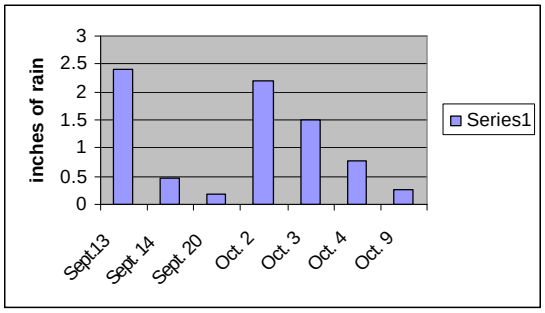

Figure 5.1. This shows the rain fall during the period of when the samples were taken. The high amount of rain may have affected the data taken.

DISCUSSION

Each set of data for all for the different test was combined to have a t-Test ran to find a p-value. These test would show the confidence level tell whether the results of the study were statistically significant. The confidence level for the total temperatures was 79.47 percent. The confidence level for the total moisture was 79.67 percent. The confidence level for the organic matter was 98.25 percent. This means that the tests done over temperature and moisture didn't show any statistical difference. The temperature test lacked other variables that affect the soil temperature such as air temperature, level of sunlight, weather, and so on. The moisture test was not statistically significant either. This could have been explained by the amount of rainfall that was received over the period of the test. Organic matter on the other did show a statistical difference between the no-till and the conventional till and could possibly prove the alternative hypothesis correct.

LITERATURE CITED

Livingston, N. J. 1993. Soil Temperature. *In Soil Sampling and Methods of Analysis* by M.R. Carter, Lewis Publishers, London.

Magdoff, 1992. *Building Soils for Better Crops.* University of Nebraska Press, Lincoln.