ON-FARM NO-TILL WHEAT RESEARCH AND ITS EFFECT ON THE SOIL AND ROTATIONAL CROPS

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Background:

A study at the University of Kentucky has shown benefits for no-till wheat on the production of soybeans and corn in rotation with the wheat. Both soybeans and corn were planted using no-till methods. The research showed a 5% yield benefit for soybeans and a 4% yield benefit for corn when those crops followed no-till wheat compared with tilled wheat. It appears that enhanced moisture availability in such continuous no-tilled systems is involved. Soil research in the different treatments found greater amounts of mid-range pore sizes in the soil, perhaps explained by enhanced microbial activity. This is caused by soil structure changes that occur in the no-till system.

These test results were obtained from small plot research on a specific location. So can farmers obtain similar corn and soybean yield benefit by planting their wheat crop by no-till methods? They will be integrating across more soil types and across more environmental conditions.

Objective:

1. To determine if no-till wheat production enhances yields of rotational corn and soybeans on Kentucky farms and compare tilled and no-tilled wheat yields.
2. To determine if measurable soil characteristics can explain any variation in the response of corn soybeans to no-till wheat production across several Kentucky landscapes.

Research Approach:

The test was established on 3 locations in the fall of 2000 and 3 more in the fall of 2001. One location that was established in the fall of 2000 was lost due to a lease loss. Another location was added that has ½ the field in no-till wheat and ½ in tilled wheat. The soil types are predominantly Pembroke with some Nolin and Huntington soil types also present. The fields are large fields and the fields were split. Tilled wheat was planted on one side of the field and no-till wheat was planted on the other side. The original 6 fields had a history of tilled wheat plantings followed by no-tilled double-cropped soybeans and no-till corn the next year. The new field already had a history of tilled vs. no-tilled wheat.

All sites were GPSed and specific topographic landscape areas in each field were identified (foot slopes, back slopes and summits) and GPSed to allow for proper scientific comparisons. These specific areas were sampled and analyzed for soil texture, bulk densities, aggregate size and water retention curves on an annual basis

Each field was harvested for wheat and double-cropped soybeans and corn with a combine that had a calibrated GPS yield monitor or a weigh wagon was used. Yields of the identified topographical areas were selected for comparison.

Research and Discussion:

Wheat Yields

The average wheat yields for the fields over the six wheat crops grown since the beginning of the project are found in Table 1. The wheat yields with the two different practices are the same and are not significantly different.

Soybean Yields

When the yields of the six fields are averaged over the six years that soybeans have been grown, the yields are very similar and there are no statistical differences (Table 2). Based on previous research we would expect the yields of soybeans in the continuous no-tilled system to increase due to soil structural changes which are expected to take place with time. Table 4 shows the average yield of soybeans for the last two years of the six year project. It was expected that some soil structural changes should have taken place by this time. The yields from the two tillage systems are very similar. However, some of the expected soil structural changes were taking place. So either the weather conditions were not right for the soil changes to cause a difference in yield or the yield differences will not occur on farm conditions.

Corn Yields

The average yields for the fields over the five years corn has been grown with this project are found in Table 3. The yields are almost identical, however, the yields from the portion of the fields with no-till wheat are increasing in some of the fields. Table 5 shows the average yield of corn for the last two years of the six year project. The yields of corn in the no-tillage system was about 5.5 bu/ac higher. This indicates that the soil structural changes were taking place and the weather conditions were favorable for these changes to be expressed with increased yield.

Table 1. Effect of Tillage on Wheat Yields for Twelve Fields Over Six Years

Tillage	Yield (bu/ac)
No-Till	82.6
Till	82.9

Table 2. Effect of Wheat Tillage on the Succeeding Soybean Yields for Six Fields Over Five Years

Tillage	Yield (bu/ac)
No-Till	42.0
Till	42.6

Table 3. Effect of Wheat Tillage on the Succeeding Corn Yields for Six Fields for Four Years

Tillage	Yield (bu/ac)
No-Till	174.1
Till	173.3

Table 4. Effect of Wheat Tillage on the Succeeding Soybean Yields the Last Two Years of the Six Year Trial

Tillage	Yield (bu/ac)
No-Till	36.3
Till	37.0

Table 5. Effect of Wheat Tillage on the Succeeding Corn Yields the Last Two Years of the Six Year Trial

Tillage	Yield (bu/ac)
No-Till	184.5
Till	179.1

Soil Measurements

Soil measurements are taken at least once a year. There were none or small changes between the no-tilled and tilled areas the first 2 years. Soil measurements for the fields that had been in the program 3 years showed significant soil changes taking place. The aggregate size and bulk density are significantly greater in the fields. The plant available water holding capacity in the surface 6 inches is greater but not significantly so. The soil changes are taking place in these fields but did not result in higher yields during the third year due to either 1) the soil changes are not great enough at this time or 2) the rainfall did not favor conditions that would result in an increased yield even with the soil changes.

Soil measurements taken in the fields that had been in the program 4 years showed significantly higher aggregate size and bulk density. The plant available water holding capacity was greater in no-till treatment on some of the fields. The soil structure change that occurred in some of the fields appear to be great enough to result in a yield difference. On some of the fields, aggregate size, bulk density and plant available water holding capacity was only marginally different and the yields on these fields do not favor the no-tillage system.

It appears that 4 years is long enough to change soil properties sufficiently on some of the fields, but only marginally on other fields. Either more time is required to make soil structure changes on soil in some of the fields or they were further behind in the beginning which would require more time.

Summary and Conclusions:

The soil structure was beginning to change when no-till wheat was planted in rotation with no-till corn and soybeans as opposed to the same rotation that included tilled wheat. It took four years for the change to become significantly different in some of the fields and the changes were still not significantly different in others. The structural change resulted in higher yields for corn grown in the complete no-tillage system. The soybean yields were no different and may have been due to rainfall patterns that did not allow the greater water storage capacity to express itself in terms of yield.

The soil structure changes that have occurred should allow a little more water storage in the soil which would result in higher yields on years when the rainfall pattern will allow this to happen.