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 5% yield benefit for corn when those crops followed no-till wheat compared with tilled wheat. It appears that enhanced moisture availability is 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.
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 has been identified that has ½ the field in no-till wheat and ½ in tilled wheat. However, we will not get the rotation synchronized until the fall of 2003. 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 will already have a history of tilled vs. no-tilled wheat.

All sites were GPSed in the winter 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. This information will be used as baseline data for future comparisons.

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

individual 3 fields established in 2000 and for wheat on the 3 fields established in 2001.

These fields established in 2000 had the second crop of wheat and no-till soybeans in 2003 and the fields established in 2001 had no-till corn in 2003. These fields were scouted for differences according to tillage treatments.

RESEARCH AND DISCUSSION:

Wheat Yields

The average wheat yields for the fields over the three wheat crops grown since the beginning of the project are found in Table 1. The yields for only seven fields are shown due to the loss of one field from the project after the second year and an improper planting practice on another field the last year. The wheat yields with the two different practices are very similar and are not significantly different. Based on previous research one would have expected the tilled wheat to yield 3 to 5 but/a more than the no-tilled.

Soybean Yields

When the yields of the six fields are averaged over the two 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. Soil measurements taken after these crops were harvested indicate that a structural change has not taken place when these crops were grown.

Corn Yields

The corn yields have only been collected and analyzed for 1 year (2002). Although the yields in the tilled part of the three fields average more, there was no statistical difference in the yields. These fields had only been in the project for two years and were not expected to be different. The soil measurements taken after the corn crop indicate that the soil structure has not changed significantly. The aggregate size, soil density and plant available water holding capacity are not different between the tilled and no-tilled treatments.

Soil Changes

In order to see if a soil change is taking place between the cropping rotation with tillage for wheat and the one with no-tillage, soil measurements are make at least once a year and sometimes after each crop during the double-cropping year.

Tables 4 and 5 show the soil measurements on the fields that had been in the project for 1 ½ and 2 ½ years respectively. These are the latest measurements taken from the set of fields that were entered into the project in the fall of 2000 and the second set in the fall of 2001. The results indicate that the soil properties are quite similar between the two tillage systems in the fields that have been in the project for 1 ½ years. However, there is a significantly larger mean aggregate size and higher bulk density in the fields that have been in the project for 2 ½ years. This is the first measurement that indicates that a change in soil properties may be taking place.

SUMMARY AND CONCLUSION:

Previous research using small plots, has shown that a crop rotation of corn, wheat and double-cropped soybean is different if wheat is tilled and the corn and soybean are no-tilled as opposed to no-tilling all three crops. It was found that a soil structure change took place over several years which resulted in higher yields for the continuous no-till rotation. The objective of this study

was to validate this research on farmer fields sing their equipment and practices.

After about 2 years into the project we have found the tilled and no-tilled wheat yields to be about identical. The yields of the succeeding no-till soybean and corn crops are no difference to this point. Soil properties which are being closely monitored have not changed on the fields which have been in the project for less that two years. Soil properties are changing in the continuous no-tilled treatment on the fields which have been in the project for 2.5 years. It is expected that this will result in higher yields of corn and soybean in the coming years.

Table 1. Effect of Tillage on Wheat for Seven Fields Over Three Years

Tillage	Yield (bu/ac)
No-Till	84.1
Till	85.3

Table 2. Effect of Wheat Tillage on the Succeeding Soybean Yields for Six Fields Over Two Years (3 Per Year)

Tillage	Yield (bu/ac)
No-Till	38.3
Till	37.9

Table 3. Effect of Wheat Tillage on the Succeeding Corn Yields for Three Fields for One Year

Tillage	Yield (bu/ac)
No-Till	131
Till	139

Table 4. Effect of Tillage on Soil Properties of Three Fields (In 2002) One and a Half Years After Trial Initiation

Tillage*	Aggregate Size Mean Diameter mm	Soil Bulk Density g/cm^3	Plant Available Water Holding Capacity in H_2O/in. Soil
No-Till	14.5	1.37	0.15
Till	14.0	1.34	0.17
	NS	NS	NS

NS – No statistical difference
*Tillage performed in fall of 2000 on tilled wheat plots.

Table 5. Effect of Tillage on Soil Properties of Three Fields Two and a Half Years After Trial Initiation

Tillage*	Aggregate Size Mean Diameter mm	Soil Bulk Density g/cm^3	Plant Available Water Holding Capacity in H_2O/in. Soil
No-Till	14.8a	1.25a	0.263a
Till	11.4b	1.16b	0.245a