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. 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 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 with a combine that had a calibrated GPS yield monitor or a weigh wagon. 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.

The fields established in 2000 had the second crop of wheat and no-till soybeans

in 2003 and no-till corn in 2004. The fields established in 2001 had no-till corn in 2003 and wheat (tilled and no-tilled) and no-till soybeans in 2004. These fields were scouted for differences according to tillage treatments.

Research and Discussion:

Wheat Yields

The average wheat yields for the fields over the five wheat crops grown since the beginning of the project are found in Table 1. The yields for only twelve 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 on one year. The wheat yields with the two different practices are the same and are not significantly different. Based on previous research one would have expected the tilled wheat to yield 3 to 5 bu/ac more than the no-tilled.

Soybean Yields

When the yields of the six fields are averaged over the four 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 soil structural change has not taken place when these crops were grown.

Corn Yields

The average yields for the fields over the three 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. See Soil Measurement Section.

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

Tillage	Yield (bu/ac)
No-Till	78.8
Till	79.2

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

Tillage	Yield (bu/ac)
No-Till	42.8
Till	43.4

Table 3. Effect of Wheat Tillage on the Succeeding Corn Yields for Nine Fields for Three Years

Tillage	Yield (bu/ac)
No-Till	176
Till	177

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. This was expected since changes of a greater magnitude take several years. The measurements shown in Table 4 are for the 4 fields that had wheat/soybeans in 2004 and have been in the program 3 years. There are significant soil changes taking place. The aggregate size and bulk density are significantly greater in the 4 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 this 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.

The measurements shown in Table 5 are for the 2 fields that had corn in 2004 and have been in the program 4 years. The aggregate size, bulk density and plant available water holding capacity was much greater in no-till treatment on the Halcomb farm. The soil structure change that occurred in this field appears to be great enough to result in a yield difference. Based on past research, the yields should be greater in the no-till treatment 1/3 to ½ of the time when the soil structure has changed significantly. The aggregate size, bulk density and plant available water holding capacity was only marginally different in the Lester field.

It appears that the 4 year trial was long enough to change soil properties sufficiently on the Halcomb field, but only marginally on the Lester field. Either more time is required to make soil structure changes on soil at Lester's or it was further behind in the beginning which would require more time.

Summary and Conclusions:

To this point, the yields of all three crops are similar when the tilled and no-tilled treatments are compared with the exception of the Halcomb field with 4 years of no-till. The soil measurements that are being taken on the fields have been similar when compared between the two tillage treatments although it now appears that the soil changes are beginning to be different in the two treatments on many of the fields. The soil structure changes should allow more water storage in the soil to increase yields of the corn and soybean crops about 1/3 to ½ of the time of the fields with significant soil changes.

Table 4. Effect of Tillage on Soil Properties from Fields in the Program for 3 Years and Grew Wheat and Double-Cropped Soybeans in 2004			
Tillage	**Aggregate Size-Geometric Mean Diameter (mm)**	**Soil Bulk Density (g/cm^3)**	**Plant Available Water Holding Capacity (In. H_2O/in soil)**
No-till	20.1 a	1.31 a	0.189
Till	12.1 b	1.20 b	0.160
	**	**	NS

NS - No statistical significant difference
** - Treatments different at 95% level of confidence

Table 5. Effect of Tillage on Soil Properties and Yield from Fields in the Program for 4 Years and Grew Corn in 2004				
Tillage	**Aggregate Size Geometmric Mean Diameter (mm)**	**Soil Bulk Density (g/cm3)**	**Plant Available Water Holding Capacity in./in. Soil**	**Yields (bu/ac)**
HALCOMB				
No-Till	23.9 a	1.36 a	0.208 a	230.7
Till	17.0 b	1.14 b	0.139 b	204.1
LESTER				
No-Till	13.4	1.28	0.189	219.8
Till	11.5	1.24	0.146	230.5