INDIRECT BENEFIT OF NO-TILL WHEAT: ENHANCED YIELD OF ROTATIONAL CORN AND SOYBEANS

University of Kentucky - Lloyd Murdock and John Grove
OptiCrop - John Hagen and Phillip Needham
Wheat Tech - Scott Van Sickle

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 3% yield benefit for soybeans and an 8% 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.

OBJECTIVES:
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 and 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. 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. All 6 fields had a history of tilled wheat plantings followed by no-tilled double-cropped soybeans and no-till corn the next year.

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. This work has been completed on the 2000 fields and is being done on the 2001 fields.

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 have no-till corn at this point and the fields established in 2001 have double-cropped soybeans. These fields were scouted for differences according to tillage treatments.

The fields are:

Fall 2000 Establishment

1) Gary Lester Farm (Christian County)
   Pembroke and Nolin soil types

2) Larry Thompson (Todd County)
   Pembroke, Crider and Huntington soil types

3) Halcomb Farm (Logan County)
   Pembroke and Nolin soil types

Fall 2001 Establishment

1) Chester Farm (Todd Co.)
   Pembroke, Nolin and Lindside soil types

2) Robertson Farm (Logan Co.)
   Pembroke soil type

3) Thompson Farm (Logan Co.)
   Pembroke, Crider and Huntington soil types

RESULTS AND DISCUSSION:

SOIL BACKGROUND DATA

Soil measurements (texture, density, aggregate size, pore size and distribution and waterhold capacity) were taken at the beginning of the trials to establish a boreline for later comparison. Samples were taken on different landscape positions after tillage had been done and wheat planted.

2001 Farms

There is little difference by farm in the soil physical measurements of texture, soil density, aggregate size and water holding capacity. This is to be expected since the soil types are similar as well as the past history. There was also little difference in the same soil physical measurements when compared by landscape position. The exception is the back slope position. This position has the highest slope percentage which has resulted in the most erosion over the years. So it is not surprising that the clay is higher and the aggregate size is slightly higher. When the soil data is compared by tillage treatment, there are differences. The amount of clay is very similar, but the tillage in the fall has resulted in a lower soil density, a smaller aggregate size and a reduced water holding capacity. These measurements of the tilled area should move closer to the no-till measurements as the soybean and corn will both be no-tilled prior to the next tillage for wheat.

2002 Farms

There were larger aggregates with the no-till areas and in zones that had wheel traffic (due to clod formation). The differences in aggregate sizing are due to organic matter and clay content differences, which vary from field to field. Bulk density was greater on the Chester farm, probably due to a previous long term history of heavy cultivation and erosion. Bulk density is also higher in wheel traffic areas (as expected). The fraction of pore space occupied by air declines as bulk density increases, especially in wheel traffic areas. The pore size occupied by water is the rest of the pore space. Plant available water holding capacity shows little difference at this point in time. The water holding capacity of the shoulder and backslope portions of the landscape were higher than expected.

2001 WHEAT YIELDS

The yields on all farms were high. The data on the Thompson farm is not complete due to a computer crash which resulted in the loss of most of the yields in the field. A small area was retrieved and allowed a side by side tillage comparison. When the data was compared by landscape position, the summit and foot slope positions were similar. The back slope position, where previous erosion had existed, resulted in lower yields. This will probably not always be true over the years. When the yields are compared by tillage treatment, they are almost identical. The stands on all 3 fields were good for both tillage treatments and the visual appearances throughout the growing season was also good for both treatments.

2001 WHEAT YIELDS	
Farm	**Yield (bu/ac) @ 13.5% H_2O**
Halcomb	83.8
Lester	109.1
Thompson*	86.0
*Data lost on most of field due to a computer crash.	
Tillage	
No-Tillage	96.4
Tilled	96.3

2002 WHEAT YIELDS

The yields on all the farms were good and were excellent compared to average yields for this year. The head scab problem was probably one of the contributing factors to the lower yields. When the data is compared by tillage treatment, there is an average of 3.1 bu/ac difference in favor of the till across all 3 farms. The largest difference was 5.3 bu/ac on the Chester farm. The difference was only 2 bu/ac on the other 2 farms. If the difference is 4 bu/ac or less in favor of tilled, no-till should be as profitable as tilled. The stands on all 3 fields were good. In fact, no-till stands were slightly higher in all 3 cases. When data is compared by landscape position, the differences are all in favor of the tilled treatment. The differences are small and insignificant except for the shoulder position (more eroded) which was significantly different.

2002 WHEAT YIELDS			
Grower	**Tillage System**	**Wheat Yield (bu/ac)**	**Grower Avg Wheat Yield (bu/ac)**
Chester	No-Till	73.8 **	76.4 a
	Till	79.1 **	
Robertson	No-Till	65.0	66.0 b
	Till	67.0	
Thompson	No-Till	69.5	70.5 ab
	Till	71.5	
Average	No-Till	69.4	71.0
	Till	72.5	
** Yield difference due to tillage significant at the 95% level of confidence.			

TWO YEAR WHEAT YIELD SUMMARY

When the yields of the six fields are averaged over the two years, the yields are very similar. The tilled yields are 1.4 bu/ac higher than the no-till yields.

Effect of Tillage on Wheat for Six Fields over 2 years (3 per year)	
Tillage	Yield
No-Till	82.4
Till	83.8

2001 SOYBEAN YIELDS

The yields on all of the farms were quite good for double-cropped Soybean yields. Some of the farms had outstanding yields. When the results are compared by landscape position, the summit and foot slope positions were very similar. These two positions do not have much slope and had not experienced much erosion. There was a good topsoil depth. The backslope position has the highest slopes and soil analysis indicates past erosion on these positions. Yields were significantly reduced on this position. The yields of the soybeans planted after no-till wheat were almost the same as those planted after tilled wheat. This was expected since it will take at least 2 years for the soil to begin to change significantly and hold more plant available water. When the results were examined further, landscape position did not effect the differences in yield when compared by tillage. In other words, the soybean yields on the tilled and no-tilled wheat areas were almost equal regardless of being on a summit, backslope or footslope. One field (Lester field) had a paraplowed strip between the tilled and no-tilled areas. The paraplowing was done in the fall before planting no-till wheat in it. The paraplowing had no effect on the yield of wheat or soybeans.

Halcomb	34.8
Lester	53.1
Thompson	47.2
Tillage*	
No-Till Wheat	44.9
Tilled Wheat	45.2
*Average of 3 Farms	N.S.

The project is just getting started. The yields for both wheat and soybeans show no difference between the tilled and no-tilled wheat areas. Since the soil changes which take place as one begins a total no-till program are slow, the yields between the two tillage areas would not be expected this soon.

The six fields will continue to be studied and the same type of information will continue to be gathered on all three crops (wheat, soybeans and corn).

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2001 DOUBLE-CROPPED SOYBEAN YIELDS	
Farm	**Yield (bu/ac) @ 13% H_2O**