PROFITABILITY OF NO-TILL WHEAT: ON-FARM RESEARCH

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In 1997, the Kentucky Small Grain Growers Association (KySGGA) established the goal of having 75% of the state's wheat acreage managed using no-till methods by the year 2005. At that time, about 28% of the state's wheat acreage was planted without tillage. In order for such a dramatic change to occur, producers must be convinced that they will not have to sacrifice short-term economic viability in order to gain the long-term benefits of topsoil conservation attainable using no-till methods. Hence, this project's goal was to compare some tillage (ST) and no-tillage (NT) wheat production systems for profitability, both under intensive management.

MATERIALS AND METHODS:

Eleven separate tests were conducted over the 1997-98, 1998-99, and 1999-00 winter wheat growing seasons (**Table 1**). In addition to the University of Kentucky, two private wheat consulting firms were also involved in this series of experiments. It would be fair to say that the University has shown long-term interest in promoting no-tillage practices; on the other hand, both consulting firms have generally been advocates of fairly extensive tillage. It was indeed remarkable that these three groups were able to work together; that is a real credit to the KySGGA for its strong encouragement of such cooperative projects.

Eight of the 11 tests were planted in well-drained soils; some drainage limitations were present on all three of the Opti-Crop test sites. Tillage practices, as shown for each test in Table 1, varied with season and cooperator, but were representative of tillage practices employed by Kentucky wheat growers.

Each test was replicated two times with two different wheat varieties and two tillage systems (denoted below as no-till or some till); thus eight strip plots of a minimum size of 3000 ft^2 were established at each test location. Variety selections were made by each cooperator at a particular site, so varieties were not held in common across tests or years. Likewise, other management practices were at the discretion of a given test's manager (from UK, Opti-Crop, or Wheat Tech), and thus varied substantially across tests and years. Data reported below include residue cover (as %) estimated by the use of overhead slide shots taken about 3 weeks after planting, stand establishment (counted at that same time), and grain yield was recorded at harvest. Economic data used in our analyses were based on actual costs where possible; that is, all inputs except tillage. For tillage, we used agricultural economists estimates from UK, and applied the same cost to a given tillage operation at each test site.

Additional assumptions made in working through the economic assessments were as follows: Expenses which were in common were not considered in this analysis, as the goal of the project was to compare economic advantages of the two tillage systems. No economic credit was given for the long-term economic advantage likely to result from use of no-tillage methods (through the conservation of topsoil). No economic credit was given for the potential benefits of no-tillage methods to rotated corn and soybean crops. We assumed that neither test weight nor harvest moisture were influenced by tillage system. Both ST and NT were managed to optimize their profitability rather than to obtain the highest possible yields. Each location included two varieties and two replications. Calculated yield differences between tillage systems are assumed to represent real differences. Rather than picking the better variety from each location to paint this economic collage, we averaged across the two (to make our conclusions more supportable). This data should be interpreted with some caution, as environmental conditions in coming seasons could clearly affect the outcomes of the two tillage systems. In 1998, we used a market price of $2.90/bushel. The loan deficiency payment for 1999 tests brought the value of the 1999 crop to $2.80/bushel. In 2000, used adjusted price of $2.70 (including the loan deficiency payment). No adjustments were made for differing speed of operations; for example, ST was not penalized for slightly slower combining, nor was NT penalized for slower speeds while drilling the crop.

RESULTS:

Table 2 shows yield differentials between the two tillage systems. In 10 of the 11 tests, some tillage resulted in higher yields. The average yields for some tillage were 4.3 bu/A higher than for no-tillage. We chose to set up Table 2 with comparisons showing “advantage for some tillage.” Yield differentials were multiplied by a reasonable market price for a given year, resulting in an average advantage in gross income of $11.80 /A for some tillage. Total additional costs for both some tillage and no-tillage systems are shown in columns on Table 2, and are described in detail on tables 3 and 4. The last column on Table 2 shows the economic advantage for some tillage over no-tillage wheat production, once the gross income and additional costs for both tillage systems are taken into account. 6 of 11 tests showed an advantage for some tillage; on the average, these 11 tests showed, by this partial budget analysis, an advantage of $2.20/A for some tillage. **Table 5** provides a more detailed perspective on residue cover, stand establishment, and grain yield for each of the 11 tests.

Most of the additional costs for some tillage (**Table 3**) were for tillage operations *per se*, along with stalk chopping (listed only when that operation was done for some tillage strips but not for no-tillage strips). Additional costs incurred for no-till (**Table 4**) were for heavier seeding rates, additional burndown or post-emergence herbicides, and extra nitrogen fertility applied. It should be noted that we used actual costs of fresh seed, rather than the costs for producer-saved seed; had we chosen to utilize costs for producer-saved seed, Table 4 would have looked a bit different.

CONCLUSIONS:

We have now repeated this study at 11 locations over the 1997-2000 growing seasons, so our results should be credible. Our results appear to provide modest incentive for growers to consider moving toward a no-till system, particularly if they factor in some value for topsoil conservation. However, we do note this caution: The on-farm tillage comparisons in the 1996-97 growing season resulted in an average of 65 bushels/A for ST and 58 bushels/A for NT. Those grower-managed tests produced 12% less grain under NT management, while our 1997-00 consultant (or researcher) managed tests only produced 5% less grain under NT management. It appears that no-till may respond to more careful management than some growers have been willing to implement.

It is our opinion that most farmers will not be highly motivated to switch to a no-tillage system when the economics indicate little or no advantage to make such a complex management change. Pressures which could move more to consider such a switch could include continued high fuel prices or increasingly higher labor costs (both related to the operation of tillage equipment).

PLANS FOR FUTURE RESEARCH:
Starting with this fall season (2000), a newly funded (by the KySGGA), cooperative study (with the same three participating cooperators) has been initiated on three Kentucky farms. That research is based on studies done by Lloyd Murdock and colleagues at the University of Kentucky. He has shown a 9% yield advantage for corn following no-till wheat (in our common winter wheat, double crop soybean, corn rotation) compared with corn following wheat established using some tillage. That benefit appears to be greater in seasons with limited late summer rainfall, and may be related to a change in the pore size distribution in no-tilled plots. Murdock's work has also shown a 3% yield benefit for soybean following no-till wheat in the above rotation, as compared with soybean following tilled wheat.

If this new project can document similar yield advantages in producer fields, it may turn out to be the key to moving toward a more complete utilization of no-tillage in our state's grain cropping systems.

Table 1. Soil Series, Drainage Classes, Some Tillage Practices.

Year and County	Cooperator	Soil Series	Drainage Class	Tillage Practices
1998 Daviess	Opti-Crop	Henshaw silt loam	somewhat poorly drained	rip, disk, roll, field cultivate
1998 Fayette	Univ. of KY	Maury silt loam	well drained	Chisel plow, disk 2 times
1998 Logan	Wheat Tech	Pembroke silt loam	well drained	disk rip, disk & roll 2 times
1999 Caldwell	Univ. of KY	Pembroke silt loam	well drained	chisel plow, disk 3 times
1999 Daviess	Opti-Crop	Uniontown silt loam	moderately well drained	disk, rip, disk & roll 2 times
1999 Fayette	Univ. of KY	Armour silt loam	well drained	Chisel plow, disk, soil finisher
1999 Logan	Wheat Tech	Pembroke silt loam	well drained	disk, disk rip, disk & roll
2000 Caldwell	Univ. of KY	Pembroke silt loam	well drained	chisel plow, disk 4 times
2000 Daviess	Opti-Crop	Henshaw silt loam	somewhat poorly drained	disk 2 times, rip, disk & roll
2000 Fayette	Univ. of KY	Maury silt loam	well drained	Chisel plow, disk, soil finisher
2000 Logan	Wheat Tech	Pembroke silt loam	well drained	disk, mulch till, disk 2 times

Table 2. Economic Summary of Some Tillage Advantage over No-Tillage.

Year and County	Yield bu/A	Yield Value $/A	NT Costs $/A	ST Costs $/A	**Net Value $/A**
1998 Daviess	+ 0.2	+ 0.6	15.9	28.0	**- 11.5**
1998 Fayette	+ 4.9	+ 14.2	14.7	22.0	**+ 6.9**
1998 Logan	+ 6.1	+ 17.7	10.7	22.0	**+ 6.4**
1999 Caldwell	+ 5.6	+ 15.7	7.6	31.0	**- 7.7**
1999 Daviess	- 3.7	- 10.4	20.8	28.0	**- 17.6**
1999 Fayette	+ 1.5	+ 4.2	13.5	22.0	**- 4.3**
1999 Logan	+ 6.4	+ 17.9	20.3	22.0	**+ 16.2**
2000 Caldwell	+ 9.6	+ 25.9	22.2	34.0	**+ 14.1**
2000 Daviess	+ 3.9	+ 10.5	4.5	22.0	**- 7.0**
2000 Fayette	+ 0.4	+ 1.1	26.4	20.0	**+ 7.5**
2000 Logan	+ 12.2	+ 32.9	14.0	26.0	**+ 20.9**
MEANS	**+ 4.3**	**+ 11.8**	**15.5**	**25.1**	**+ 2.2**

Table 3. Additional Costs of Some Tillage in $/A.

Year and County	Residue Mgmt.	Tillage	**Total**
1998 Daviess	6.0	22.0	**28.0**
1998 Fayette	0.0	22.0	**22.0**
1998 Logan	0.0	22.0	**22.0**
1999 Caldwell	6.0	25.0	**31.0**
1999 Daviess	6.0	22.0	**28.0**
1999 Fayette	0.0	22.0	**22.0**
1999 Logan	0.0	22.0	**22.0**
2000 Caldwell	0.0	34.0	**34.0**
2000 Daviess	0.0	22.0	**22.0**
2000 Fayette	0.0	20.0	**20.0**
2000 Logan	0.0	26.0	**26.0**
MEANS	**1.6**	**23.5**	**25.1**

Table 4. Additional Costs of No-Tilllage in $/A.

Year and County	Seed	Herbicide	N Fertility	**Total**
1998 Daviess	0.9	15.0	0.0	**15.9**
1998 Fayette	9.1	0.0	5.6	**14.7**
1998 Logan	10.7	0.0	0.0	**10.7**
1999 Caldwell	4.4	0.0	3.2	**7.6**
1999 Daviess	5.8	15.0	0.0	**20.8**
1999 Fayette	7.1	2.2	4.2	**13.5**
1999 Logan	12.4	7.9	0.0	**20.3**
2000 Caldwell	10.0	6.6	5.6	**22.2**
2000 Daviess	4.5	0.0	0.0	**4.5**
2000 Fayette	8.0	12.8	5.6	**26.4**
2000 Logan	14.0	0.0	0.0	**14.0**
MEANS	**7.9**	**5.4**	**2.2**	**15.5**

Table 5. Comparison of No-Tillage and Some Tillage for Several Measurements.

Year and County	Corn Residue Cover %		Established Stand plants/ft^2		Grain Yield bushels/A	
	No-Till.	Some Till.	No-Till.	Some Till.	No-Till.	Some Till.
1998 Daviess	99	33	26	27	48.4	48.6
1998 Fayette	95	65	22	25	63.9	68.8
1998 Logan	98	34	30	26	71.4	77.5
1999 Caldwell	93	11	31	26	88.8	94.4
1999 Daviess	95	0	22	29	86.1	82.4
1999 Fayette	85	4	29	29	69.6	71.1
1999 Logan	87	0	24	29	115.9	122.3
2000 Caldwell	75	16	32	31	63.4	73.0
2000 Daviess	93	26	36	36	97.6	101.5
2000 Fayette	65	9	23	28	83.8	84.2
2000 Logan	95	6	33	31	67.6	79.8
MEANS	**89**	**19**	**28**	**29**	**77.9**	**82.1**