OKLAHOMA TILLAGE UPDATE REPORT

BY

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A series of tillage studies were initiated in Oklahoma in 1981-82 as the result of renewed interest by farmers and the Oklahoma Wheat Commission. Historically reduced tillage for wheat production in Oklahoma had been associated with reduced yields. Weed control, stand establishment, dieseases, insects and fertilization each had been suggested as potential causes of the reduced yields. New equipment, herbicides, emphasis on energy conservation, and renewed emphasis on erosion control resulted in a necessity to investigate the advantages and disadvantages of reduced tillage systems.

Plots were set up with different tillage systems designed to evaluate the impact of different levels of prior wheat crop residue remaining on the soil surface after planting. In Oklahoma the majority of wheat acreage is planted where wheat is grown every year for decades. Thus, these plots were designed as a monoculture yearly wheat production system with the same tillage practice remaining on each plot for the duration of the study.

Table 1 lists the treatments, ground cover and yield data from the residue management studies. These studies are in the fourth year at three locations. We have been encouraged since yields in the minimum tillage plots have been equivalent to clean tillage except for two locations in the third year. At one location the wheat was planted under damp conditions and many of the seed were deposited in straw rather in firm soil. This has been our only planting or stand establishment problem. We have not determined the reason(s) for the low yields in the minimum tillage plots at the second location in 1984-85. Overall, yields of no-till and subsurface tillage have been competitive.

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Table 1. Ground Cover And Grain Yield For Different Tillage Systems.

Tillage System	Residue Level	Ground Cover* (%)	3 Yr. Ave. Yld.** (Bu/A)
Moldboard Plow, disc.	minimal	8	38
Disc	low	25	39
Subsurface	intermediate	80	37
No-Till	maximum	95	36

*Ground cover average of three locations after planting the fourth crop of wheat.

**Grain yield average of three locations across three years. Subsurface tillage was accomplished with a 6-8 foot v-blade followed by a single treader.

Wheat tillage plots at four Oklahoma locations have consistently shown significant reductions in greenbug numbers where residues were left on the surface. The southwest Oklahoma location showed the greatest difference between tillage practices. At this location the moldboard plow plots had a mean number of greenbugs of 250 per row foot and the no-till plots had only 10. At another location, adding straw to existing conventionally tilled plots substantially prevented greenbug increases. No-tilled plots with residues removed by burning or raking had a reduced number of greenbugs when compared to conventionally tilled plots, indicating that more than just residues are responsible.

Sorghum plots have also shown that greenhugs are reduced under a reduced tillage situation. Continuous sorghum and wheat-fallow-sorghum-fallow plots both showed a reduction in greenhug numbers from 900 per plant when these treatments were conventionally tilled to less than 300 per plant under a no-till situation. In another study a significant reduction in greenhug damage occurred even though one-half of the residue had been removed.

Apparently, surface residues act as a reflective mulch. This reflective situation either repels the immigrating migratory greenbugs or masks the attractiveness of the soil surface. Soil condition and canopy, perhaps acting as a reflecting background, also have an influence on the number of greenhugs. We are continuing to observe the responses on large fields, however, plot or field size will probably not be a factor since this is a behavioral response of to the greenbug. At this point, residue management and other reduced tillage practices appear to be effective tools for managing greenbugs.

Diseases and nematodes have been monitored in these tillage studies. Initially some people predicted gloom because diseases and insects might be much more problem in minimum tillage monoculture wheat. However, as noted above, we have already seen that greenbugs responded exactly in reverse. It is a general opinion among wheat workers that reduced tillage practices increase the incidence and severity of the foliar diseases septoria tritici blotch and pyrenophora tan spot. Initial infection of wheat in Oklahoma by the blotch pathogen, Mycosphaerella graminicola (anamorph, Septoria tritici), occurs during fall rains. Since only the Septoria state of the pathogen has been observed in Oklahoma, asexual spores released from fruiting structures in old leaf lesions are the presumed primary source of inoculum. The tan spot-inciting fungus, Pyrenophora tritici-repentis (anamorph, Dreschlera tritici-repentis), produces both sexual fruiting bodies and asexual spores on infected straw and stubble. Since some level of these diseases develops in the crop each year, tillage practices that leave infected leaf and straw tissue above ground expectedly would increase their incidence in the following wheat crop. To determine effects of tillage modes on septoria tritici blotch and tan spot, we counted septoria lesions per gram of flag-2, and penultimate leaves; and tan spot lesions per gram of flag-2 and flag leaves. The leaves were randomly collected from plants grown in the same tillage plots described earlier.

Results indicated that tillage method had little or no effect on development and severity of septoria tritici blotch. Among eight data sets, only two (collections made in April and May 1983 at Stillwater) indicated that plowing under plant refuse significantly reduced the number of lesions that developed in flag-2 and penultimate leaves.

The number of tan spot lesions which developed in leaves of plants grown in plowed and disked plots were similar in all but one instance (collection made in May 1983 at Altus) (Table 2). The data strongly support the hypothesis that covering infected straw with soil will significantly reduce the incidence of tan spot. We believe that the lack of discretely different levels of infection between plants grown in clean and near-clean tillage plots (plowed and disked) and those grown in subsurface and no-tillage plots resulted in part from contamination by spores carried by wind from one plot to another.

Table 2. Effect of tillage systems on tan spot levels in winter wheat.

Tillage System	Lesion/Gram of Leaf Tissue					
	Flag -2 Leaf		Flag Leaf			
	Altus		Altus		Stillwater	
	4-11-83	4-9-85	5-23-83	5-10-85	5-24-84	5-17-85
Moldboard	2a*	85a	70a	175a	115a	735a
Disc	6ab	114ab	92b	227ab	118a	881ab
Subsurface	9bc	194c	110bc	276ab	117a	1364b
No-till	11c	123ab	16c	347c	142a	898ab
C.V.(%)	78	24	14	29	39	39

*Lesion numbers followed by the same letter indicate that the treatments are not significantly different according to either an LSD test or Duncan's multiple range test.

On these same plots the effects of surface straw residue on microbial populations are being studied. Soil fungi, actinomycetes, bacteria, and total microbial population were determined in 1984-85 crop season as part of the pre-, post-plant and at harvest soil sampling. At Stillwater, subsurface tillage resulted in significantly greater post-plant and harvest total soil fungal populations (includes pathogenic and nonpathogenic fungi) than in the plow treatment. Similarly at Altus, total soil fungal populations were significantly higher at harvest for the subsurface tillage compared to plow tillage, and the soil fungal populations were higher, but not significantly at post-plant sampling.

Soil actinomycetes, bacteria, fungi and total microbial populations at both locations were directly affected by soil moisture. At Altus, microbial counts increased from post-plant to harvest sampling periods reflecting the post-plant (12%) to harvest (22%) increase in soil moisture (gravimetric *0-4* cm depth). No fluctuations in populations were seen over this period at Stillwater because soil moisture (14%) was the same at both sampling periods.

At both locations, soil bacterial populations decreased as surface residue levels increased, as contrasted with the general tendency for increased soil fungal populations. At harvest, populations of soil bacteria were higher regardless of treatment at Altus than at Stillwater as a result of the wetter soil conditions at this location. We will be looking at these effects with regard to the rhizosphere populations and root populations in the next season.

Populations of pin, <u>Paratylenchus projectus</u>, stunt, <u>Merlinius brevidens</u> and root lesion, <u>Pratylenchus</u> spp. nematodes are also being monitored. To date neither biologically nor statistically significant differences have been measured in the tillage studies.

No pest discussed thus far has developed as a distinct problem in minimum tillage contrasted with clean tillage. However, the first problem which became apparent was the higher population of cheat, <u>Bromus</u> spp., in the subsurface and no-till plots. In these plots the cheat levels have been held to a noncompetitive level with careful variety selection and herbicide applications. For a farmer to do this he can use only two herbicides and four wheat varieties and then only if the soil pH is not too high and the soil texture not too coarse. Thus, cheat control remains as a limitation to widespread use of minimum tillage for wheat production in Oklahoma.

Another attempt to control cheat has been with triazine herbicides. These herbicides, such as atrazine and cyanazine (Bladex), can effectively control cheat and are relatively inexpensive. However, wheat has little relative selectively to these herbicides. A research program was initiated to develop a no-till drill to improve crop safety by providing placement selectively at planting.

To provide placement selectivity, triazine herbicides are applied as a broadcast spray prior to planting wheat with an experimental no-till hoe drill. This drill consists of an air seeder metering unit mounted on a frame attached to the three point hitch of a tractor. A coulter with depth bands for gauging, hoe opener, and Vee press wheel are mounted on a box beam which is attached to the drill with a 4-bar linkage. The specially design hoe opener moves the triazine treated soil, along with cheat seed, out of the drill rows and into the middles. The Vee press wheel firms the furrow walls, preventing the cheat seed and the herbicide treated soil from falling back into the furrow. The triazine herbicide and cheat are concentrated between the rows, leaving the rows free of cheat, and providing a herbicide free zone in which wheat can germinate and emerge.

First year's research showed that placement selectively could be obtained for atrazine with modified hoes or with concave discs to move atrazine treated soil from the row. The second year's research will refine the drill design, investigate use of cyanizine as well as atrazine to control cheat, and evaluate effect of application rates and soil type on cheat control and wheat injury. Yield data from the first year and crop injury and weed control ratings from current experiments indicate that this system will provide good cheat control without yield reduction under no-till conditions.

We have also been particularly interested in any changes in fertilization requirements as we change tillage systems. Currently, we suggested that when much of the straw is left on the soil surface that farmers apply 30-40 pounds of additional nitrogen. Phosphorus studies have also been conducted and placement seems to have little affect as long as it is placed in the soil rather than on the surface. The exception to this occurs in situations where phosphorus soil test is quite low. Under these conditions placement close to the germinating seed has been beneficial. Effects of tillage on ammonia volitization is also being studied but these studies have not been concluded.

Soil moisture has also been monitored on these residue management studies. Differences have been apparent in the top two to three inches where higher levels of soil moisture have frequently been observed in the mulched plots, allowing us to establish a wheat stand at earlier dates on no-till plots than on clean tilled plots. This has been important in Oklahoma where wheat is grazed in the fall, winter and early spring if enough growth is obtained. It was hoped the earlier establishment would result in greater forage yields. However, forage yields have not consistently been better even when establishment occurred one month earlier on no-till than moldboard plow plots. Wheat grain yields have not been improved by water conservation as a result of leaving mulch on the soil surface. This has surprised us and we are not sure of all the reasons yet. One reason is that the mulch has not given us the large differences in soil moisture which has been reported by others.

Economics is a very important factor in farmer acceptance of management changes. Because yields have been equal between the tillage systems, profit potential has been controlled by input costs. No-till costs more than moldboard or discing and therefore profits have not been as good. Some of the one and two tillage systems have been economically competitive, but because of cheat control limitations are not widely used in Oklahoma.

Farmers are aware of erosion in Oklahoma and see the benefits of minimum tillage for erosion control and a small acreage is managed in this manner because of erosion, but much more would be if there were more economic benefits and cheat could be controlled more reliably.