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Reduced Tillage Cropping Systems for Southwest Kansas

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Reduced tillage studies at the Garden City Experiment Station were initiated in 1971. Those studies were designed to compare conventional (tillage only) systems with reduced tillage systems substituting herbicides for tillage. Weed control, retention of crop residue, moisture conservation, and yield are being studied. The study reported here was begun in 1978 and is a comparison of the wheat fallow (WF), sorghum fallow (SF), continuous sorghum (SS), and wheat-sorghum-fallow (WSF) systems.

Procedure

The WF system consists of three treatments. The first is a tillage only treatment where no herbicides are applied; only blades or rodweeders are used for weed control. The second consists of 1 lb of atrazine applied after wheat harvest, followed by tillage as required when the herbicide no longer controls weeds. The third treatment consists of the application of 1 lb of atrazine following wheat harvest, 2.4 lbs of Bladex in April of the following year, and tillage when the herbicides degrade. The WSF system consists of three simi-

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Table 1. Effect of herbicides on the number of tillage operations during fallow in the wheat-fallow and wheat-sorghum-fallow systems.

Herbicides	1979	1980	1981	1982	Avg.
Wheat-fallow			No. of Operations		
Tillage only	7	5	7	9	7.00
1.0 lb Atrazine	5	3	5	7	5.00
1.0 lb Atrazine + 2.4 lbs Bladex (Sequential)	4	2	3	4	3.25
Wheat-sorghum -fallow					
Tillage only	4	3	3	4	3.50
2.0 lbs Atrazine	2	1	1	2	1.50
2.0 lbs Atrazine + 1.6 lbs Bladex (Sequential)	0	0	0	0	0

lar treatments except that 2 lbs of atrazine are applied in the second and third treatments, and 1.6 lbs Bladex is applied in the third treatment. There is no tillage for weed control in the third treatment of the WSF system. Conventional tillage practices usually are followed for sorghum in the SF and SS systems, and prior to wheat in the WSF system.

Results: Tillage Reduction

Table 1 shows the number of tillage operations for each treatment in the WF system, and prior to sorghum in the WSF system. In the WF system one or two operations per year were saved by applying atrazine. The addition of Bladex in the spring saved an additional one to three operations. Therefore, application of atrazine followed by the sequential application of Bladex reduced the average number of tillage operations by about one-half. In the WSF system, atrazine followed by sequential Bladex eliminated all tillage and allowed no-till sorghum to be planted. Two pounds of atrazine alone allowed the elimination of two tillage operations in each year.

Results: Yield

Table 2 lists sorghum yields in the WSF, SF, and SS systems. In the WSF system, a significant increase in yield due to a reduction in tillage occurred only in 1981, however, there was a trend toward increased

Table 2. Yield of sorghum as affected by cropping system and herbicides.

Tillage System	Year	Wheat-sorghum -fallow	Sorghum-fallow	Continuous sorghum
			-Bu/A-	
Tillage Only		49 a[1]	64	
Min Till [2]	1979	51 a		
No Till[3]		57 a		
Tillage Only		56 a	59	
Min Till	1980	54 a		
No Till		57 a		
Tillage Only		60 a	84	44
Min Till	1981	56 a		
No Till		70 b		
Tillage Only		72 a	79	71
Min Till	1982	73 a		
No Till		76 a		
Tillage Only		59	71	—
Min Till	Avg	58		
No Till		65		

[1] Yields within a column in the same year followed by a different letter are significantly different at the 10% level. Yields in the WSF, SF, and SS Systems differ significantly in 1981 at the 10% level.

[2, 3] Min Till is 2 lbs Atrazine after wheat harvest. No Till is 2 lbs Atrazine after wheat harvest + 1.6 lbs Bladex the next spring.

yields in 3 of the 4 years. The trend indicates that a yield increase may be more likely with no tillage at all, rather than a reduction in tillage. This may be because of the effect of the stubble in reducing evaporation from the soil surface after the sorghum is planted. Unlike the research in other areas, the results of this study indicate that essentially no additional soil moisture was stored in the soil profile during fallow in the reduced and no-till treatments. This explains why larger yield increases generally did not occur.

The yield in the SF system, while appearing to be somewhat larger than WSF sorghum yields, was significantly larger only in 1981. This was due in part to an additional 1.7 inches of water being stored during the fallow period. 1981 was the only year in which more water was stored by planting time in the SF as opposed to the WSF system. Usually the shorter fallow periods in the WSF system have proven to be more effective in storing moisture than the longer WF and SF periods.

Continuous sorghum yields are somewhat inconclusive. The continuous sorghum plots were fallowed in 1979 to correct a sandbur problem so only 2 years' data are available. The 1981 yield was affected by average rainfall in April and May prior to planting followed by adequate growing season rainfall. The 1982 yield was affected by average winter and spring precipitation plus abnormally high growing season rainfall.

Wheat yields from the WF and WSF systems are presented in Table 3. Wheat yields were unaffected by treatment. Over one inch of moisture was saved by reduced tillage prior to planting the 1981 crop, although no increase in yield occurred. A late freeze during heading may have reduced the yield of the 1981

Table 3. Yield of wheat as affected by cropping system and herbicides.

Herbicides	1980	1981	1982	Avg.
		Bu/A Wheat-fallow[1]		
Tillage only	45 a[2]	32 a	54 a	44
1.0 lb Atrazine	41 a	31 a	50 a	41
1.0 lb Atrazine +2.4 lbs Bladex	44 a	32 a	54 a	43
		Bu/A Wheat-sorghum-fallow		
Tillage only	40 a	20 b	51 a	37
2.4 lbs Bladex	39 a	24 b	51 a	38

[1] Wheat-fallow yields correspond to 1979, 1980, and 1981 tillage operations in Table 1.

[2] Yields within a column followed by a different letter are significantly different at the 5% level.

wheat, possibly eliminating any response to moisture. Above average rainfall in May could have reduced any response also. WSF wheat yields were lower than WF yields only in 1981. The reason is unknown, but it may be related to the late freeze or perhaps a slight difference in stage of growth between the two systems. Soil moisture at wheat planting did not differ between the WF and WSF systems in any year.

Summary

The proper selection and use of herbicides has allowed a reduction of one-half of the tillage operations in the WF system and the elimination of all tillage prior to sorghum in the WSF system. When cropping systems were compared, sorghum yields from the WSF system were less than SF yields in only 1 of 4 years, while wheat yields from the WSF system were less than WF yields in 1 of 3 years. Even if WSF yields were reduced more often, obtaining two crops in three years with the WSF system would tend to compensate for any increased yield of the SF and WF systems.

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