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Plant and Soil Science

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REDUCED TILLAGE AND CONVENTIONAL CROPPING SYSTEMS OF SEVERAL FIELD CROPS EVALUATED FROM 1980 THROUGH 1982.

Charles R. Graves, Tom McCutchen and Lawson Safley*

Summary

Fifteen soybean-wheat cropping systems were evaluated at Milan from 1980 through 1982. At Springfield in 1982 six cropping systems of barley, wheat and soybeans were evaluated on a Dickson soil.

Several planters were evaluated for seeding soybeans in green wheat at Milan from 1980 through 1982.

Six soybean varieties were grown no-till in wheat stubble for three years at Milan. Grain sorghum was grown no-till in wheat stubble, no-till in green wheat and single crop at Milan in 1981 and 1982.

In 1981 wheat was evaluated in 7, 10 and 14 inches between rows. In 1982 a spacing of 7, 14, and 20 inches between wheat rows and one treatment with wheat spaced 7 inches between rows with 14 inch space for the tractor wheels to run was evaluated for seeding soybeans in green wheat with the minimum of wheat yield reduction.

Corn, soybeans and cotton were grown no-till in killed wheat and rye for two years. Several wheat tillage methods were evaluated following soybeans. Also several soybean varieties were grown no-till following wheat varieties in 1980.

Conclusion

Using a three year average, the single cropped soybeans out-yielded the no-till soybeans planted in wheat stubble and soybeans planted in a conventional seedbed after wheat harvest by 23 and 19 percent, respectively. When soybeans were interseeded in green wheat on May 1, May 15 and June 1 with chemical weed control, the June 1 planting date produced the highest soybean yield and the lowest wheat yield while the May 1 planting produced the lowest soybean yield and the highest wheat yield.

The yields of barley and wheat grown on a Dickson soil were severely reduced when soybeans were interseeded at heading. Also weeds were a greater problem on a Dickson soil at Springfield than had been experienced on a Memphis or Loring silt loam soil at Milan.

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No differences were found in soybean yields among planters used to interseed soybeans in green wheat. Large differences in wheat yields, however, occurred from using various equipment. Of seeders investigated, the Oliver grain drill reduced the wheat yields the most and the Tye drill, using 20 inch row spacing, reduced yields the least.

Corn, soybeans and cotton planted no-till in killed rye or wheat produced high yields which were similar following either smallgrain.

Wheat broadcast with fertilizer and disced into the soil, and wheat drilled no-till in soybean stubble produced the highest yields in a wheat tillage experiment at Milan. The lowest yield was obtained by aerial seeding wheat in soybeans on September 25.

When three soybean varieties were grown no-till following fourteen wheat varieties, no abnormal growth or yield reduction was observed of any soybean variety following any wheat variety.

DOUBLE CROPPING SYSTEMS USING SOYBEANS AND WHEAT AT MILAN FROM 1980 THROUGH 1982

Introduction

In a wheat-soybean double cropping system, soybeans are usually seeded the second or third week of June in wheat stubble. Date of planting studies in Tennessee have shown that yields may be reduced when soybeans are planted after June 1. Therefore, any practice that would permit earlier planting of soybeans in a double-cropping system should generally result in higher yields. Also, any method of seeding soybeans in a double-cropping system that would reduce production costs and at the same time increase soybean yields is needed.

In 1980 at Milan the killed wheat cover crop treatments were seeded in killed wheat on May 1, May 15 and June 1. Also starting in 1980, the wheat was removed as forage and soybeans planted no-till on May 1, May 15 and June 1. The interseeded soybeans in green wheat treatments were split and one half of the wheat plots received a herbicide and the other half received no herbicide. This section is an update on soybean-wheat cropping systems from 1980 through 1982.

Fertilization

The test was conducted at Milan on Memphis silt loam from 1980 through 1982. All soils had a pH of about 6.5 with P and K testing high. All fertilizer was applied to the wheat with none added to the soybean crop. The wheat was fertilized in the fall of each year with 300 pounds of 10-20-20 ($N-P_2O_5-K_2O$) per acre each year and was topdressed with 58 to 67 pounds of N from urea in February.

Chemical Weed Control

The no-till soybeans planted in wheat stubble, killed wheat treatments and wheat removed for forage in 1980 and 1981 received Paraquat + Dual + Lorox + surfactant. Lasso was substituted for Dual in 1982.

The soybeans planted as a single crop received Dual + Dyanap in 1980, Treflan + Sencor in 1981, and Lasso + Lorox in 1982. Conventionally planted soybeans after wheat harvest were treated with Dual + Lorox in 1980, Treflan + Sencor in 1981, and Lasso + Lorox in 1982.

The soybeans interseeded in green wheat plots were divided equally with one-half of each plot receiving Surflan in 1980 and 1981 and Prowl in 1982. In 1980, Basagran + BAS 9052 was applied overtop to these same split plots. No chemical weed control was applied to the other half of the interseeded in green wheat plots. In 1982 Poast + Agridex was applied on June 10 and Basagran applied on June 14 to the treatments where the soybeans had been planted no-till after the wheat had been removed as forage (May 1) and where the soybeans had been seeded no-till in killed wheat (May 1).

Results and Discussion

Using a three year average (1980-82), the single cropped soybean treatment produced the highest yields followed by seeding after wheat forage harvest (May 1), and seeding in killed wheat (May 1, May 15, and June 1). Soybeans planted in a conventional seedbed after wheat harvest (June 18-20), interseeded in green wheat with the use of a herbicide to control weeds in the wheat, or seeded no-till after wheat harvest, produced similar yields (Table 1). The no-till double crop treatment produced 23 percent less beans than the single crop. The no-till and conventional double crop system, however, produced 57 bushels of wheat per acre. The wheat yield was reduced when soybeans were interseeded in green wheat (May 1). This reduction varied depending upon the equipment used to seed the soybeans. For most of the studies the wheat yield was reduced about 5 bushels per acre when soybeans were interseeded (May 1). Little or no difference was observed between the no-till soybeans following wheat and soybeans grown in a conventional seedbed after wheat harvest. These two treatments were planted at the same time each year.

Summary and Conclusion

Soybeans and wheat were evaluated in a double cropping system at Milan from 1980 through 1982. In 1980-82 the single cropped soybeans (planted May 1-4) outyielded the no-till soybeans in wheat stubble (planted June 18-20) and soybeans in a conventional seedbed prepared after wheat harvest (planted June 18-20) by 23 and 19 percent, respectively. Little difference in yield was found among the three treatments of no-till in wheat stubble, conventional seedbed after wheat harvest and interseeding in green wheat on June 1 with chemical weed control. Interseeding soybeans in green wheat on May 1 (at heading) without a herbicide produced the lowest soybean yields because of a weed problem. When soybeans were interseeded in green wheat on May 1, May 15, and June 1 with chemical weed control, the June 1 planting date produced the highest soybean yield while the May 1 planting date produced the lowest soybean yield and the highest wheat yield. Row spacing of wheat and a wheel track planting system study is under way at Milan to investigate methods of reducing wheat injury when interseeding soybeans in green wheat.

Soybeans seeded in killed wheat on May 1, May 15, and June 1 produced similar yields at all three planting dates. Soybeans planted in killed wheat significantly out-yielded the soybeans planted conventionally after wheat harvest and soybeans seeded no-till in wheat stubble two out of three years.

Table 1. Soybean yields from several cropping systems of wheat and soybeans evaluated at Milan from 1980 through 1982.

Cropping Systems Soybeans	Date planted	3 yr. avg. 1980-82	1982	1981	1980
		Bushels per acre			
Grown single crop, conventional tillage	May 1-4	48	53	70	22
Seeded after forage harvest	May 1	46	51	67	19
Seeded in killed wheat	May 1	46	53	62	22
Seeded in killed wheat	May 15	45	52	61	22
Seeded in killed wheat	June 1	44	49	57	26
Seeded after forage harvest	May 15	43	44	66	19
Seeded after forage harvest	June 1	43	47	59	23
Planted conventionally after wheat harvest	June 18-20	39	46	49	23
Drilled in green wheat-herbicide	June 1	37	40	49	23
Seeded no-till in wheat stubble	June 18-20	37	40	46	25
Drilled in green wheat-herbicide	May 15	31	36	43	16
Drilled in green wheat-no herbicide	June 1	29	32	41	13
Drilled in green wheat-herbicide	May 1	23	33	18	18
Drilled in green wheat-no herbicide	May 15	22	28	26	12
Drilled in green wheat-no herbicide	May 1	19	29	13	15
L.S.D. (.05)		3.9	7.1	7.9	3.8
C.V. %		16.3	14.6	14.1	16.6
Avg.		36.8	42.2	48.4	19.8

CROPPING SYSTEMS OF BARLEY, WHEAT AND SOYBEANS ON DICKSON SOIL AT SPRINGFIELD

In 1982, an experiment was conducted at Springfield where soybeans were seeded: (1) no-till in killed wheat or barley, (2) seeded in a conventional seedbed after barley or wheat harvest, (3) seeded no-till in wheat or barley stubble, (4) seeded no-till after barley or wheat removed for forage after heading, (5) seeded no-till in green wheat or barley at heading and (6) seeded single crop in a conventional seedbed.

Barsoy barley and Southern Belle wheat were seeded October 8, 1981 on a Dickson silt loam. The small grain was fertilized with 30-60-60 lbs. per acre on October 8 and topdressed with 46 pounds of nitrogen per acre on March 24, 1982. The forage treatment for barley and wheat was harvested after heading April 29, 1982. Treatments where soybeans were single cropped and either seeded no-till in killed small grain, no-till after forage harvest, or no-till in green wheat, were all planted May 6, 1982. The killed small grain no-till treatment and the forage removed no-till treatments received Dual + Lorox + Paraquat + surfactant preemerge. The single cropped soybeans received Dual + Lorox preemerge. The soybeans drilled in green small grain at heading received no preemerge herbicide and had Blazer applied over-top on June 6, 1982.

Essex soybeans seeded no-till in stubble after wheat (June 17) and barley harvest (June 9) received Dual + Lorox + Paraquat + surfactant preemerged. The soybeans planted in a conventional seedbed after small grain harvest were treated with Dual + Lorox preemerge.

Results and Discussion

Soybeans seeded in killed wheat or barley produced the highest yields (Table 2). The lowest yields were obtained when soybeans were drilled in green wheat or barley on May 6. These yields were reduced due to a severe weed problem. No preemerge herbicide was used on these treatments.

Table 2. Yields of soybeans from various cropping systems with barley and wheat evaluated at Springfield in 1982. 1/

Soybeans	Soybean yield following: Barley	Wheat
	Bushels per acre	
Seeded no-till in killed barley or wheat (May 6)	38	44
Seeded in conventional seedbed after barley or wheat harvest 2/	37	38
Seeded no-till after wheat or barley harvest 2/	35	35
Seeded no-till after barley or wheat harvested for forage (May 6)	34	36
Seeded single crop conventional tillage (May 6)	28	28
Seeded no-till in green barley or wheat (May 6)	18	20
L.S.D. (.05)	7.8	5.2
C.V. %	18.7	10.4

1/ Dickson silt loam (2% to 5% slopes).
2/ Soybeans seeded after barley on June 9 and soybeans seeded after wheat on June 17, 1982.

Basagran applied over-top gave some weed control. Effective weed control must be obtained when seeding soybeans in green wheat or barley on a Dickson soil if this procedure is to be economically feasible. Soybeans seeded single crop produced low yields due to stand reduction from soil crusting which was caused by a heavy rain after planting.

The wheat and barley yields were reduced severely by seeding soybeans in the small grain at heading time (Table 3). This small grain yield reduction on Dickson soil was much higher than had been obtained at Milan on a Memphis silt loam soil. Further work needs to be done on Dickson type soils with these cropping systems.

Table 3. Barley and wheat yields obtained from various cropping systems with soybeans at Springfield in 1982.[1/]

Soybeans	Yields of Barley	Yields of Wheat
	Bushels per acre	
Seeded in conventional seedbed after barley or wheat harvest	54	31
Seeded no-till in barley or wheat stubble	65	30
Seeded no-till in green barley or wheat	15	15
Seeded no-till after barley or wheat removed for forage	1.91[2/]	1.88[2/]

[1/] Dickson silt loam (2% to 5% slopes).
[2/] Yield in tons of oven dry forage per acre.

PLANTER EVALUATION FOR INTERSEEDING SOYBEANS IN GREEN WHEAT

The Allis Chalmers (AC) No-Till planter and Tye drills have been used to interseed soybeans in green wheat at Milan. The primary objective of the experiment was to determine which planter would injure the green wheat the least and still produce good soybean yields. A Tye drill was evaluated at both 20 and 6 2/3 inch row spacing. The A.C. no-till planter was set on 20 inch rows and the Oliver grain drill on 7 inch rows. The Tye Pasture Pleaser was evaluated in 10 inch rows in 1980. This machine was dropped from the test because of the severe reduction in wheat yield each year and replaced by a Tye stubble drill. The John Deere Max-Emerge planter was evaluated in an adjacent area to the test in 1982 and was included as one of the treatments in 1983.

In 1980 Essex soybeans were interseeded in Arthur wheat on May 5 on a Calloway silt loam and wheat harvested on June 16. In 1981 and 1982 Forrest soybeans were interseeded in McNair 1003 wheat April 27 and April 30, respectively, on a Loring silt loam. Wheat was harvested on June 15 in 1981 and June 14 in 1982. The wheat was fertilized with 30-60-60 pounds per acre in the fall of 1980 and 1982. In 1981, 0-80-80 pounds of fertilizer per acre was used in the fall. Wheat was topdressed February 22 to 24 with 60 to 70 lbs. of N per acre. The seeding rate for wheat and soybeans each year was 1½ bu. per acre. Wheat had been drilled in 7 inch rows. No chemical weed control was used.

Results and Discussion

Planter Evaluation

No significant difference was observed in soybean yields among planters used to interseed soybeans in green wheat in 1980 or 1982. In 1981 use of the AC no-till planter and Tye stubble drill produced the highest soybean yields (Table 4). The regular Tye drill produced the lowest soybean yield each year.

Table 4. Soybean yields when planters were evaluated for interseeding soybeans in green wheat at Milan from 1980 through 1982.

Planter	Row spacing	Avg. 1980-82	Soybean yields 1982	1981	1980
	in.		Bushels per acre		
AC No-Till planter*	20	32	40	45	12
Tye Pasture Pleaser*	10	32	37	44	14
Oliver grain drill	7	29	31	42	15
Tye Drill	6 2/3	26	31	34	14
Tye Drill	20	26	29	37	11
L.S.D. (.05)			N.S.	9.7	N.S.
C.V. %			30.0	15.6	34.1

*Equipped with fluted coulters. Tye Stubble Drill replaced Pasture Pleaser in 1981-82.

Using a three year average, the Oliver grain drill reduced the wheat yield the most and the Tye drill using 20 inch rows the least (Table 5). The AC no-till planter reduced the wheat yield more in 1981 than it had in previous years.

Table 5. Wheat yields when planters were evaluated for interseeding soybeans in green wheat at Milan from 1980 through 1982.

Planter	Row spacing	Avg. 1980-82	Wheat yields 1982	1981	1980
	in.		Bushels per acre		
Check		54	53	53	56
Tye drill	20	49	52	43	52
Tye drill	6 2/3	46	45	45	49
AC No-Till drill*	20	44	45	33	55
Oliver grain drill	7	43	47	40	43
Tye Pasture Pleaser*	10	-	-	34	39
L.S.D. (.05)			7.0	6.0	7.5
C.V. %			10.3	9.7	10.2

*Equipped with fluted coulters. Tye Stubble Drill replaced Pasture Pleaser in 1981-82.

SOYBEAN VARIETIES GROWN NO-TILL IN WHEAT STUBBLE

Most soybean variety tests are planted at the optimum time in conventional seedbeds. For many years in Tennessee the statement " if planting soybeans late, plant a late maturing variety" has been accepted as a fact by many farmers and agricultural workers. The validity of this statement was investigated when five medium maturing varieties (maturity group V) were grown no-till in wheat stubble and compared with Centennial, a late maturing variety (maturity group VI) from 1980 through 1982. The five medium maturing varieties evaluated each year were Essex, Bay, Nathan, Forrest and Bedford. Asgrow A5474 (maturity group V) and Duocrop (maturity group VII) were added to the study in 1982. All tests were planted after wheat harvest from June 17 to June 21.

In 1980 and 1981 the study was conducted on a Memphis silt loam and in 1982 on a Loring silt loam. The wheat was fertilized with 30-60-60 lbs. per acre in the fall and topdressed with 70 lbs. of N per acre in the spring. The varieties were planted no-till in wheat stubble on June 21 in 1980 and June 17 in 1981 and 1982. A recommended herbicide was applied with good weed control.

Results and Discussion

Using a three year average, Essex produced the highest yield and was followed very closely by Bay, Nathan, Forrest and Bedford (Table 6). Medium maturing varieties performed better than Centennial, a late maturing variety, each year. Asgrow A5474, a medium maturing variety, performed well in 1982, the only year it was evaluated no-till in wheat stubble. Duocrop also performed well in 1982 but was very late maturing. These results are similar to results obtained at Milan and other locations in Tennessee for many years. Medium maturing varieties have consistently out-yielded late maturing varieties when planted early or late in Tennessee.

Table 6. Yields of soybean varieties planted no-till in wheat stubble at Milan from 1980 through 1982.

Variety	3 yr. Avg.	1982	1981	1980	Date mature	Lodging	Plant height
	Bushels per acre					%	in.
Essex	38	42	49	23	10-15	5	26
Bay	37	43	45	24	10-17	10	29
Nathan	36	43	46	20	10-21	55	31
Forrest	35	37	46	22	10-19	55	31
Bedford	34	36	44	20	10-24	55	34
Centennial	25	25	38	11	10-28	58	30
Asgrow A5474 1/	--	43	--	--	10-18	0	30
Duocrop 1/	--	38	--	--	11-1	10	35
L.S.D. (.05)		4.1	3.2	2.9			
C.V. %		7.2	4.2	9.8			

1/ 1982 data only.
Test seeded June 17, 1982.
Wheat fertilized Nov. 4, 1981 with 30-60-60 lbs./acre.
Wheat topdressed with 70 lbs. of N as 32% liquid N on Feb. 23, 1982.
Soil type was Loring silt loam (2% to 5% slopes).
Test harvested October 23 except for Centennial and Duocrop which was harvested Nov. 5, 1982.

WHEAT ROW SPACING EVALUATED 1981 AND 1982

In 1981 row spacing of single cropped wheat was evaluated and in 1982 wheat row spacing was evaluated for interseeding soybeans in green wheat. The objective of the 1982 study was to find a wheat row spacing system that would allow interseeding soybeans in green wheat with a minimum of wheat yield reduction. The spacing of wheat was 7, 14, and 20 inches between rows and one treatment with wheat spaced 7 inches between rows with a 14 inch space for the tractor wheels to run. (This will be referred to as the wheel track system).

A Tye stubble drill was used with a 1 inch fluted coulter to interseed soybeans in 10 inch rows in the various row spacings of wheat. Essex soybeans were interseeded May 4 on a Memphis silt loam soil. Prowl herbicide was applied April 15 at the 2nd joint stage of wheat. On July 14, 1982 Basagran and Blazer were applied overtop for weed control in soybeans.

Results and Discussion

In 1981 there was no significant difference in wheat yield among row spacings when no soybeans were seeded in the wheat (Table 7).

Table 7. Wheat yields as affected by wheat row spacings evaluated at Milan in 1981. 1/

Spacing between rows	Wheat yield	Date headed	Date mature
in.	Bu/A		
7	51	4-27	6-8
10	49	4-27	6-8
14	48	4-27	6-8
L.S.D. (.05)	N.S.		
C.V. %	13.7		

1/ Seeded at the rate of 1½ bushels per acre on a Memphis silt loam (2% to 5% slopes).

In 1982 when soybeans were seeded in the wheat, the wheel track treatment (7 inch spacing between wheat rows with 14 inches for tractor wheels) produced only a slight wheat yield reduction. The 20 and 14 inch spacings produced the greatest reduction in wheat yield when compared to the check treatment (Table 8).

There was no significant difference in soybean yields in the wheel track experiment in 1982.

Table 8. Soybean and wheat yields as affected by wheat row spacing evaluated for seeding soybeans in green wheat at Milan in 1982.

Wheat spacing between rows	Soybean yields	Wheat yields	Wheat yields reduced by treatments compared with check	
in.	Bushels per acre		Bu/A	%
7	33	43	7	14
14	36	35	15	30
20	35	33	17	34
7 (14" for wheel track)	32	47	3	6
Check (7" between rows)	-	50 1/	-	-
L.S.D. (.05)	N.S.	4.1		
C.V. %	10.1	6.5		

1/ An adjacent area used as a check for wheat yields.

GRAIN SORGHUM CROPPING SYSTEMS

Grain sorghum was evaluated as a single crop, interseeded in green wheat and no-till planted in wheat stubble at Milan in 1981 and 1982. In 1981 Funk G-522DR grain sorghum was seeded April 30 single crop, April 27 in green wheat, and planted no-till after wheat harvest on June 24. In 1982 the planting dates were May 5, May 4 and June 15, respectively for the above treatments. An AC No-till planter was used to plant grain sorghum in 20 inch rows on Collins silt loam soil each year.

In the Fall of 1980 the wheat was fertilized with 0-80-80 lbs. per acre. On Feb. 24, 1981 the wheat was topdressed with 70 lbs. of nitrogen as urea. All grain sorghum was topdressed with 60 lbs. of N as ammonium nitrate on June 26. On November 1, 1981 the wheat was fertilized with 30-60-60 lbs. per acre and topdressed February 23, 1982 with 70 lbs. of N as liquid uran (urea-ammonium nitrate). All grain sorghum treatments were topdressed with 90 lbs. of N per acre on no-till (June 17) and single crop and interseeded in green wheat (June 19).

In 1981 the no-till grain sorghum in wheat stubble showed nitrogen deficiency. This could not be explained because all treatments received the same amount of nitrogen. The grain sorghum seeded in green wheat showed no N deficiency symptoms. In 1982 the topdressing of grain sorghum with nitrogen was increased from 60 to 90 lbs. per acre and no deficiency was noted in the no-till after wheat harvest treatments.

Results and Discussion

The grain sorghum grown single cropped in a conventional seedbed produced the highest yields (Table 9). The lowest yields were obtained when grown no-till in wheat stubble.

Table 9. Grain sorghum yields from three cropping systems in green wheat at Milan in 1981 and 1982.

	Grain Sorghum			
Grain Sorghum grown:	1982	Date seeded	1981	Date seeded
	Bu/A		Bu/A[1/]	
Single crop	115	May 5	96[2/]	April 30
Interseeded in green wheat	81	May 4	67[2/]	April 27
No-till in wheat stubble	73	June 15	42[3/]	June 24
L.S.D. (.05)	14.6			
C.V. %	12.7			

1/ Data not analyzed due to bird damage.
2/ Ten percent bird damage.
3/ Forty percent bird damage.

CORN, SOYBEANS AND COTTON PLANTED NO-TILL IN KILLED WHEAT OR RYE COVER CROP

Interest has developed in growing various crops in killed wheat for erosion control. This study was designed to determine differences in growing corn, soybeans or cotton no-till in killed wheat or rye.

In 1981 and 1982, corn (Pioneer brand 3147), soybeans (Essex) and cotton (Stoneville 825) were planted in killed wheat (Hart in 1981 and Arthur in 1982) and rye (Balbo type).

The wheat or rye was killed with an appropriate herbicide combination for each crop.

Fertilization

The wheat and rye was fertilized with 0-80-80 per acre on October 22, 1981. Corn received 160 lbs. of N on April 14 and cotton 60 lbs. of N on May 4. In 1982 wheat and rye was fertilized with 30-60-60 lbs. per acre on Nov. 12, 1981 and topdressed with 70 lbs. of N on February 22, 1982. The corn plots received 160 lbs. of N/acre on May 19 and cotton 60 lbs. of N/acre the same day.

The wheat was seeded at 1½ bushels per acre and rye 2 bushels per acre each year.

Table 10. Yield of corn, soybeans and cotton seeded no-till in killed wheat or rye at Milan in 1981 and 1982.

Crop planted no-till in killed	Corn		Soybeans		Cotton	
	1982	1981	1982	1981	1982	1981
	Bushels per acre				Seed cotton lbs/acre	
Wheat	157	138	61	61	2,169	2,150
Rye	152	135	60	61	1,920	1,928
L.S.D. (.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
C.V. %	8.7		6.7		3.2	

Results and Discussion

Corn, soybeans and cotton were evaluated when grown no-till in killed wheat and rye for two years (1981-82). No significant difference was found in yields of each crop grown in killed wheat or rye each year (Table 10).