CORN RESIDUE MANAGEMENT FOR NO-TILL WHEAT

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OBJECTIVE:
A major obstacle of no-till wheat is obtaining an optimum, uniform stand. Most wheat in west Kentucky is planted following corn which results in a large amount of residue that hinders planting. Producers debate the best method for managing corn residue for no-till wheat planting. A corn residue management study (funded by the Kentucky Small Grain Grower's Association) was initiated with the following no-till wheat stand establishment objectives: 1) To determine if mechanical shredding of corn residue is necessary; and 2) Compare different methods of mechanical shredding of corn residue (and corn maturity) to non-shredded and no corn residue for no-till wheat stand establishment.

METHODS:
The experiment was established in 1997 at the UKREC in Princeton, Ky and conducted for three growing seasons (1997-98, 1998-99, 1999-2000). Two corn maturities were utilized; a full season corn (123 GDD) and an early season corn (110-112 GDD). Excellent corn yields each year resulted in a large amount of residue. Corn residue management treatments included: 1) no residue (corn residue removed), 2) residue flail mowed after harvest, 3) residue rotary mowed after harvest, 4) non-shredded residue (plant parallel to corn rows), 5) non-shredded residue (plant at an angle to corn rows), and 6) non-shredded residue (plant parallel to corn rows with 15% increase in wheat seeding rate). Mechanical shredding of corn residue was completed soon after harvest of each corn maturity.

The non-shredded corn residue treatments involved planting directly (either parallel or at an angle to the corn rows) into standing corn residue that existed after corn harvest. Wheat was no-till planted on all corn residue treatments (including the no residue) with a Lilliston 9670 no-till drill in 7 inch rows at a rate of 35 seeds/sq. ft. (except for the increased seeding rate of 40 seeds/sq. ft.). Wheat was planted at an optimum time (Oct. 10-14) each year. Wheat varieties used were: Pioneer 2545 (1997-98); Pioneer 2540 (1998-99); and Pioneer 25R26 (1999-2000). Other wheat management practices each year included: Gramoxone or Roundup at planting; Warrior insecticide in the fall; Harmony Extra in the Spring; a fungicide in early May; fertilizer (P & K) applied in early October according to soil tests; and 120 lbs/acre of nitrogen applied in the Spring in a split application (1/2 in early February and 1/2 in late March). Corn was no-till planted each year at 26,000 seeds/acre in mid-April. Data taken included: corn yields, % soil covered with residue, wheat fall stand counts and wheat yields.

RESULTS:

<u>Corn Yields</u>

Corn yields are reported in Table 1. Excellent corn yields (over 150 bu/acre) were obtained for each corn maturity each year, resulting in a large amount of residue. In two of the three years (1997 and 1999), the early season corn outyielded the full season corn.

% Soil Covered with Residue

The amount of residue cover after wheat planting is shown in Table 2. Less than 10% of the soil had residue cover when the residue was removed. Flail mowed treatments had a higher % of the soil covered with residue than the rotary mowed treatment and can be attributed to a more uniform distribution of residue with a flail mower. With non-shredded residue, the early season corn had less % soil cover than the full-season corn. This may be attributed to less total residue with the early corn and also more decomposition of the early corn residue prior to planting.

Wheat Stands

1) Stands of wheat in the fall are shown in Table 3.
2) Wheat stand establishment was less in the fall of 1997 than 1998 or 1999 and may be attributed to excellent establishment conditions in the fall of 1998 and 1999.
3) As expected, stands were high all years when residue was removed.
4) Flail shredding of corn residue resulted in some of the better stands in 1997, but was not as apparent in 1998 or 1999.
5) Rotary mowed residue achieved generally lower wheat stands than flail mowed residue (particularly in 1997) and may be attributed to a less uniform distribution of residue with a rotary mower.
6) Planting diagonal to the corn rows in non-shredded residue appeared to achieve slightly better wheat stands (1997), but not as apparent in 1998 and 1999, than planting parallel to corn rows in non-shredded residue.
7) Increasing the seeding rate in non-shredded residue resulted in the highest stands in 1998 and 1999.
8) Although the early corn maturity appeared to have less residue and more decomposition prior to planting than the full season corn maturity, wheat stands were not consistently better. In non-shredded corn residue, wheat stands were significantly greater with the early corn maturity than the full season corn maturity in 1997, but was slightly lower (non-significant) in 1998 and 1999.
9) Because of excellent wheat stands obtained in 1998 and 1999, few statistical differences occurred between shredded and non-shredded corn residue as compared to 1997. It may be that under poor establishment conditions, residue shredding is helpful.

Wheat Yields

1) Wheat yield results are shown in Table 3.
2) Wheat yields were low in 1998 due to a spring freeze and high May temperatures. Favorable weather in the 1998-99 and 1999-2000 growing seasons (mild fall/winters and early, warm springs) resulted in high wheat yields in 1999 and 2000 for all corn residue treatments due to excellent tillering and growth.
3) There was little difference in wheat yield (and almost no statistical differences) among the corn residue treatments in any of the three years. None of the corn residue treatments consistently had significantly higher or lower yields than the other residue treatments during the 3-year study.

4) There was little correlation between wheat stands and yield. In fact, some of the treatments with better stands had some of the lower yields and vice-versa. The only exception occurred in 1998 when the non-shredded residue (parallel planted) in full season corn had the lowest yield and also the lowest stand.
5) Planting at an angle in non-shredded residue had some of the highest yields (although not significant) each year.
6) The treatment where all the residue was removed achieved some of the highest stand counts each year but did not result in significantly higher yields than the other residue treatments.
7) Increasing the seeding rate achieved the best stands, but this did not result in significantly higher yields.

CONCLUSIONS:

There were few, small differences in wheat stand counts or yields for any of the corn residue treatments; particularly, in 1998-99 and 1999-00 when good stand establishment occurred and favorable weather (mild fall/winters and early/warm springs) resulted in excellent growth and tillering and high yields. In the unfavorable year of 1997-98 when less than optimum stands were achieved (and also lower yields), the flail mowed residue treatments achieved better stands than non-shredded treatments and also some of the higher yields. It may be that under poor establishment conditions, residue shredding is helpful. Among the shredded corn residue treatments, the flail mower achieved a more uniform distribution of residue than did the rotary mower.

Some of the best wheat stands were achieved in 1998-99 and 1999-00 when all the corn residue was removed or when the seeding rate was increased in non-shredded residue. However, this did not result in achieving significantly higher wheat yields; primarily because all of the other corn residue treatments achieved optimum stands. Increasing the seeding rate for no-till wheat is still a viable recommendation. If stand establishment conditions are unfavorable, the increased seeding rate will have a better likelihood of achieving at or close to needed optimum stands.

It appears that under good stand establishment conditions when excellent wheat stands are achieved (>25 plants/ft^2), irregardless of corn residue management, then shredding vs. not shredding is not an important issue. It also appears that with a favorable growing season (mild fall/winter and early/warm spring), resulting in excellent wheat growth and tillering and no reduction in established stand, then shredding vs. not shredding will also not be an important issue. However, under unfavorable weather (cool fall and/or spring or severe cold winter), corn residue management could influence wheat stands and/or yield. A cool fall and spring would deter wheat growth and development (tillering). Thus, borderline or sub-optimal wheat stands would not compensate as well; resulting in reduced yield potential.

More importantly, a severe cold winter could reduce the established fall stand and the amount of stand reduction could be greatly influenced by corn residue management methods. With no-till wheat planted into substantial corn residue, there is concern about non-uniformity of planting depth; particularly, shallow seed depth placement where seed is placed at or just below the soil surface. Wheat plants developed from the shallow seed placement would be more subject (exposed crown area) to freeze injury and death during periods of extremely cold temperatures. It is logical that greater non-uniformity of planting depth (and thus more shallow seed placement) would occur in non-shredded residue (particularly if planted parallel to corn rows). Non-shredded residue is not uniformly distributed (i.e. greater residue in the corn row than between corn rows) and also has larger pieces of stalk that is more difficult for the no-till drill to cut and place the seed in the soil. Shredded residue would be more uniformly distributed with smaller pieces of residue and allow a more uniform planting depth with less shallow seed placement. However, shredded residue, if not uniformly spread, could also result in shallow seed placement problems similar to non-shredded residue if the residue is distributed in clumps or wind-rows. In this study, visual observations and % soil cover measurements (Table 2) of the shredded corn residue treatments indicated a more uniform distribution of residue and smaller pieces of residue with flail mowing than with rotary mowing.

TABLE 1. EFFECT OF MATURITY ON CORN YIELD

Corn Maturity	Corn Yield (Bu/Acre)		
	1997	1998	1999
Early Season	181	154	182
Full Season	154	162	163

Early Corn = 110-112 GDD (Pioneer 3394, 1997 and Pioneer 33Y18, 1998-99)
Full Corn = 123 GDD (Pioneer 3167, 1997-98-99)

TABLE 2. EFFECT OF CORN RESIDUE MANAGEMENT ON PERCENT OF SOIL COVERED WITH RESIDUE AFTER NO-TILL WHEAT PLANTING

Corn Residue Treatment	Corn Maturity	Soil Cover (%)		
		Fall, 1997	Fall, 1998	Fall, 1999
Removed all corn residue	Full	9 d	7 c	8 c
Flail mowed residue	Full	92 ab	96 a	94 a
Flail mowed residue	Early	90 abc	97 a	93 a
Rotary mowed residue	Full	83 c	93 ab	84 b
Non-shredded residue (parallel planted)	Full	90 abc	96 a	96 a
Non-shredded residue (parallel planted)	Early	85 bc	83 b	84 b
Non-shredded residue (diagonal planted)	Full	93 a	96 a	94 a
Non-shredded residue (15% seed increase)	Full	----	95 a	91 a

Residue shredded: Early Corn = 9-12-97; 9-1-98; 9-15-99
Full Corn = 9-26-97; 9-14-98; 9-15-99

Harvest date: Early Corn = 9-8-97; 8-26-98; 8-30-99
Full Corn = 9-22-97; 9-8-98; 8-30-99

TABLE 3. EFFECT OF CORN RESIDUE MANAGEMENT ON NO-TILL WHEAT STAND AND YIELD							
	Corn	**Wheat Stand (Plants/ft^2)**			**Wheat Yield (Bu/acre)**		
Corn Residue Treatment	**Maturity**	**97-98**	**98-99**	**99-00**	**1998**	**1999**	**2000**
Removed all corn residue	Full	26.8 a	35.2 ab	32.3 b	55.4 ab	104.6 b	108.9 a
Flail mowed residue	Full	24.2 b	32.1 bc	29.8 bc	60.9 ab	112.3 ab	98.9 a
Flail mowed residue	Early	22.4 bc	32.2 bc	31.1 bc	59.4 ab	107.8 ab	99.6 a
Rotary Mowed Residue	Full	21.3 cd	31.9 bc	30.2 bc	57.4 ab	107.9 ab	98.4 a
Non-shredded (parallel planted)	Full	16.8 e	34.1 bc	30.4 bc	53.3 b	106.7 ab	101.0 a
Non-shredded (parallel planted)	Early	20.0 d	31.2 c	29.4 c	62.2 a	101.6 b	99.6 a
Non-shredded (diagonally planted)	Full	21.4 cd	32.9 bc	29.6 bc	59.8 ab	118.6 a	107.4 a
Non-shredded (15% seed increase)	Full	----	37.8 a	35.6 a	----	111.2 ab	105.0 a

Seeding Rate: 1997 = 35 seeds/ft^2
1998 = 39 seeds (35 viable)/ft^2; 15% increase = 45 seeds (40 viable)/ft^2
1999 = 35 seeds/ft^2; 15% increase = 40 seeds/ft^2