

Fall Strip Tillage and Fertilizer Placement

Purpose:

To evaluate the effectiveness of Fall Strip Tillage Systems and Fertilizer Placement on corn production in comparison to conventional and No-Tillage production systems.

Methods:

Corn yield response to timing and placement of P and K fertilizer were conducted on nine field sites located in West-Central Ontario during 2001 to 2003. The growing season is rated at 85 to 95 Relative Maturity Days.

Prior to application of fall fertilizer and tillage, soil-test P and K levels in the surface 6" were determined using Ontario Ministry of Agriculture and Food (OMAF) accredited procedures (OMAF Staff, 2002). Ontario accredited soil test for plant available P is based on extraction using Sodium Bicarbonate and soil-test K is based on extraction using Ammonium Acetate.

At each site, corn yield response to placement and timing of P and K fertilizer was evaluated for three tillage systems with the placement of fall applied fertilizer differing among tillage systems. The tillage systems, and associated placement of fall fertilizer, are described as follows:

- 1) Conventional tillage (Fall Plow): Fall moldboard plowing to a depth of 6 - inches with two passes of spring secondary tillage. Fall fertilizer was broadcast on the soil surface shortly before plowing.
- 2) Fall Strip-tillage (Fall Strip): Fall tillage was confined to strips approximately 8 inches wide on 30 inch centres. A modified Trans-till (Row-tech, Snover MI) was operated at a depth of 6-8 inches. The Trans-till applied fall fertilizer at a depth of 6 inches in the centre of the tilled strip.
- 3) No tillage (No-till): No tillage occurred. Fall fertilizer was broadcast on the soil surface.

Tillage system plots were split in order to evaluate two fall fertilizer treatments, which were 1) fall fertilizer not applied and 2) fall fertilizer applied. The same rates of fall P and K were applied to all tillage systems within a site. However, actual rates did vary across sites and are described in greater detail in Table 1.

The fall fertilizer plots were also split in order to evaluate two planter-banded treatments which were 1) N only applied as U.A.N and 2) a combination of N applied as U.A.N plus a band of dry fertilizer containing P and K. The rate of starter N was 30 lbs/ac for both starter treatments at all sites. The rate of starter P and K was the same for all tillage and fall fertility treatments within a site, but actual rates of P and K did vary across sites and are described in Table 1.

Corn at all sites was planted in 30" rows at a seeding rate of 30,000 seeds/ac. The planter was equipped with unit-mounted tine row cleaners and a single disk fertilizer opener positioned to deliver starter dry fertilizer 2 inches below and 2 inches beside the seed. This same opener was also designed to apply the U.A.N. in the same band as the dry fertilizer.

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Appropriate weed control measures were used at each site which ensured that yields were not affected by the presence of weeds. Supplemental N was sidedressed applied as U.A.N., when corn was at the 7 to 9 leaf stage, to ensure that the total rate of applied N at each site was at least 150 lbs/ac. Grain corn yields were calculated to 15.5% moisture.

Table 1: Experimental Site Details

Field Group	Number of site/years	Fall Fertilizer	Planter Fertilizer	P Soil Test (ppm)	K Soil Test (ppm)	Soil texture
		P @ lbs/ac (P ₂ O ₅) K @ lbs/ac (K ₂ O)				
Heartland	3	P: 42	P: 30	15 - 21	127 – 145	Loam
		K:100	K: 30			
Ancaster	3	P: 43	P: 30	15 - 18	75 – 111	Silt loam
		K: 100	K: 30			
Alma A	2	P: 43	P: 31	20 - 25	75 – 86	Silt loam
		K: 100	K: 31			
Alma B	1	P:62	P: 31	16	58	Silt loam
		K:62	K: 31			

Results:

Yield response to tillage and P and K fertilizer at the various experimental sites fall into three groups which are related to their soil test values. The groupings and their associated soil test values for P and K are presented in Table 1.

Sites with Minimal Yield Response

Yields at the Heartland sites were not affected by tillage or by the addition of P and K fertilizers (Table 2). Deep placing P and K within the zone tillage system did not result in higher corn yields than more traditional timing or placement methods. At each of the Heartland sites corn was planted following winter wheat and soil test values (Table 1) recommend application rates of 20 lbs-P₂O₅/ac and 0 lbs-K₂O/ac (OMAF Staff, 2002). The results of this study were consistent with the results of an earlier Ontario study where tillage and K fertilization did not affect yield of corn planted following winter wheat when soil-test K levels were high (Vyn and Janovicek, 2001).

Sites with Moderate Yield Response

Yields at the Ancaster and Alma A sites were affected by tillage and application of P and K fertilizer (Table 3 and 4). At each of these sites corn was planted following soybeans and soil test values (Table 1) recommended application rates, on average, which were 20 lbs-P₂O₅/ac and 50 lbs-K₂O/ac.

Table 2. Impact of placement and timing of P and K fertilizer on grain corn yields for 3 tillage systems on loam soils following winter wheat. Average of three experiments. Heartland, 2001-2002.

Tillage		Fall Fertilizer		Planter Fertilizer	
Treatment	Yield	Treatment	Yield	Treatment	Yield
Fall Strip	134	None	132	N only	131
				N,P,K	133
		P and K	135	N only	137
				N,P,K	133
Fall Plow	144	None	146	N only	147
				N,P,K	145
		P and K	142	N only	139
				N,P,K	145
No-till	143	None	141	N only	139
				N,P,K	142
		P and K	145	N only	143
				N,P,K	147
LSD (.10)	Ns	Ns		Ns	
Averages	140	None	140	None	139
		P and K	141	N,P,K	141
LSD (.10)	-	Ns		Ns	

Note: Standard Error of Tillage by Fall Fertilizer by Spring Fertilizer yields is 3.4.

The Ancaster sites took a “systems” approach and compared only two of the possible four fertilizer options which were 1) P and K applied only in the fall (no starter P and K) and 2) P and K applied only in the starter band (no fall applied P and K) (Table 3). Yields were generally higher in the Fall Plow system, regardless of the timing of P and K fertilizer application. In the Fall Strip system, fall applied P and K fertilizer produced yields similar to those obtained when P and K were applied in the starter-band. Also, No-till corn yields were lower where P and K was fall broadcast applied compared to where P and K fertilizer was starter-banded.

The Alma A sites also demonstrated that fall application of P and K fertilizer could provide yield increases similar to those obtained with P and K applied through the planter (Table 4). In general, P and K applied through the planter increased yields in all three tillage systems, but the size of yield response was significant only within Fall Strip and No-till systems. Fall application of P and K fertilizer in the Fall Strip system (no starter P and K) produced yields similar to those obtained in the No-till system with P and K applied as part of the starter fertilizer (no fall applied P and K).

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Table 3. Impact of placement and timing of P and K fertilizer on grain corn yields for 3 tillage systems on a silt loam soil following soybeans. Average of three experiments. Ancaster, 2001-2003.

Tillage	Fertilizer Strategy	Yield
Fall Strip	Fall - P and K; Planter – N only	120
	Fall – none; Planter – N,P,K	120
Fall Plow	Fall - P and K; Planter – N only	126
	Fall – none; Planter – N,P,K	133
No-till	Fall - P and K; Planter – N only	109
	Fall – none; Planter – N,P,K	117
LSD (.10)		7.1

Table 4. Impact of placement and timing of P and K fertilizer on grain corn yields for 3 tillage systems on a silt loam soil following soybeans. Average of two experiments. Alma A, 2001-2002.

Tillage		Fall Fertilizer		Planter Fertilizer	
Treatment	Yield	Treatment	Yield	Treatment	Yield
Fall Strip	143	None	138	N only	133
				N,P,K	142
		P and K	147	N only	143
				N,P,K	150
Fall Plow	145	None	146	N only	144
				N,P,K	147
		P and K	143	N only	140
				N,P,K	145
No-till	141	None	142	N only	136
				N,P,K	147
		P and K	141	N only	137
				N,P,K	144
LSD (.10)	Ns	5.7		6.5	
Averages	142	None	142	N only	138
		P and K	144	N,P,K	145
LSD (.10)	-	Ns		3.8	

Sites with Large Yield Response

The Alma B site had dramatic yield responses to tillage and application of P and K fertilizer (Table 5). Corn on this site was planted following soybeans and the soil test P and K levels recommend application rates of 20 lbs-P₂O₅/ac and 100 lbs-K₂O/ac (OMAF Staff, 2002). In general, yields in the Fall Plow were higher than in either the Fall Strip or No-till systems. Yield differences among tillage systems were particularly large when P and K was not applied. Both fall and starter application of P and K fertilizer significantly increased yields in all tillage systems. Yields in the Fall Strip system where P and K was applied only in the fall did not produce yields as high as those obtained in the No-till system where P and K was applied only in the starter-band.

Table 5. Impact of placement and timing of P and K fertilizer on grain corn yields for 3 tillage systems on a silt loam soil following soybeans. Alma B, 2003.

Tillage		Fall Fertilizer		Planter Fertilizer	
Treatment	Yield	Treatment	Yield	Treatment	Yield
Fall Strip	87	None	66	N only	16
				N,P,K	116
		P and K	108	N only	91
				N,P,K	125
Fall Plow	121	None	106	N only	80
				N,P,K	132
		P and K	135	N only	125
				N,P,K	144
No-till	88	None	73	N only	33
				N,P,K	113
		P and K	102	N only	72
				N,P,K	131
LSD (.10)	19.8	15.9		16.8	
Averages	99	None	82	N only	43
				N,P,K	120
		P and K	115	N only	96
				N,P,K	133
LSD (.10)	-	9.2		9.7	

Summary:

The major observations and associated conclusions of this study are summarized as follows:

1. Corn yields were not affected by tillage or by application of P and K fertilizer on sites with soil test K levels sufficiently high such that application of K fertilizer is not recommended. This implies that on soils where planter applied P and K result in no additional corn yield that deep placement of P and K within a strip tillage also may not increase corn yield.
2. On sites where soil test recommended about 50 lbs/ac of K, fall application of P and K fertilizers produced yields similar to those obtained with no-till where P and K was starter-banded. This implies that on sites with a moderate requirement for P and K application that P and K requirements of conservation-till corn may be effectively met by fall banding P and K fertilizers in a fall strip-till system.
3. When the requirement for K fertilizer was high, applying P and K fertilizers only in the fall did not maximize corn yields. The requirement for P and K applications through the planter was not removed by placing the fall P and K in a band within the strip tillage system. On soils with a relatively large requirement for K (or P) fertilizer optimizing corn yields may require the application of P and K fertilizers in the fall as well as in the planter band, particularly in reduced tillage systems.

Next Steps:

New studies have been initiated to look at various other aspects of the strip tillage production system. These include adaptation in clay soils, use in spring shortly before planting with and without N application as part of the strip tilling operation.

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