Get the Edge on Fertilization Management

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Fall Strip Tillage and Fertilization for Corn

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Strip tillage is gaining in popularity in many corn producing regions.

CORN producers can often increase profit by minimizing or eliminating tillage. However, in some situations, this can reduce corn yield. The yield reduction results largely from cool, moist soil conditions for the seedling, especially on fine-textured or poorly-drained soils. Fall strip tillage (also called zone tillage or strip-till) is one way of overcoming some of the problems with no-till while retaining many of its benefits.

Strip-till opens up new fertilizer placement options. During the tillage operation, plant nutrients can be placed several inches deep, directly below the seedbed. This can be an economical and agronomically efficient way of supplying some of the crop's nutrient requirements, particularly for nutrients with limited mobility like phosphorus (P) and potassium (K). Furthermore, getting some of the nutrient application job done in the fall helps streamline spring field operations, resulting in a better chance of timely planting.

The concept of tilling narrow strips in the fall is attractive for several reasons:

- It requires one-third to one-half the time and fuel of a fall moldboard plow/spring secondary tillage system.
- It provides a zone of bare soil that warms and dries more quickly in the spring.
- It retains residue cover on the untilled land, protecting against wind and water erosion and maintaining infiltration.

One drawback of strip-till is that it may disturb the network of mycorrhizal fungi that can help the corn seedling take up nutrients. Pure no-till may take better advantage of these biological partners of the corn plant, but the drawbacks of colder soils and later planting often outweigh the benefits.

A Kansas State University (KSU) tillage research project was initiated in the fall of 2002 where fall strip-till is being compared to no-till. Timing (spring vs. fall) of nutrient applications within strip-till treatments is being evaluated, as is nitrogen (N) rate (0, 40, 80, and 120 lb/A) across all treatments. Phosphorus, K, and sulfur (S) are not variables in the experiment, and are being applied at rates considered adequate. In the fall application timing treatment, all fertilizer is placed approximately 5 to 6 in. deep during the strip-till operation. Fertilizer in the spring treatments is placed in a 2x2 configuration. The average effects of tillage and fertilizer timing across three locations are shown in **Table 1**.

Fall strip-till significantly increased corn grain yields over no-till in 2003. Application of nutrients during the fall strip-till operation resulted in yields similar to the spring applied fertilizer, indicating that fall application of nutrients with strip-till is an effective management practice. Additionally, early season soil temperatures were higher in strip-till (**Figure 1**), thus providing an advantage in emergence, early season growth, and stand uniformity over no-till.

In Ontario, previous research on corn following wheat found that fall strip-till produced yields equal to or slightly better than those with no-till. However, in the past 2 years, at two sites where corn followed soybeans,

Table 1. Impact of tillage and nutrient application timing treatments on corn grain yield in three locations in Kansas in 2003. Yields are averaged across three N treatments (40, 80, and 120 lb N/A). All plots received 30 lb P_2O_5/A and 5 lb/A each of K_2O and S.

Tillage	Fertilizer timing	Location			Average of locations
		Manhattan	Bellville	Ottawa	
		Grain yield, bu/A			
Strip-till	fall	193	60	91	115
Strip-till	spring	186	61	85	111
No-Till	spring	164	48	85	99

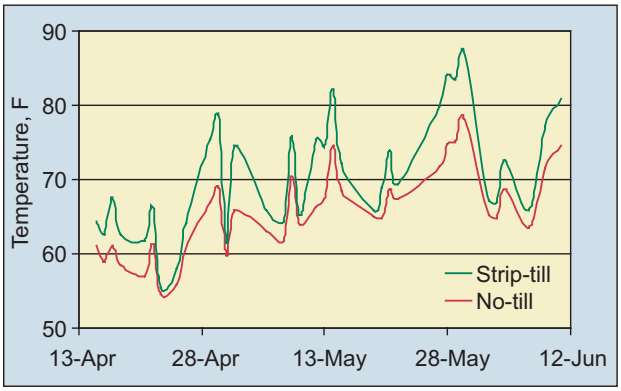

Figure 1. Effect of tillage treatment on soil temperature at seeding depth at the Kansas research site near Manhattan (2003). Temperatures were measured directly in the seed row, 1.5 in. deep.

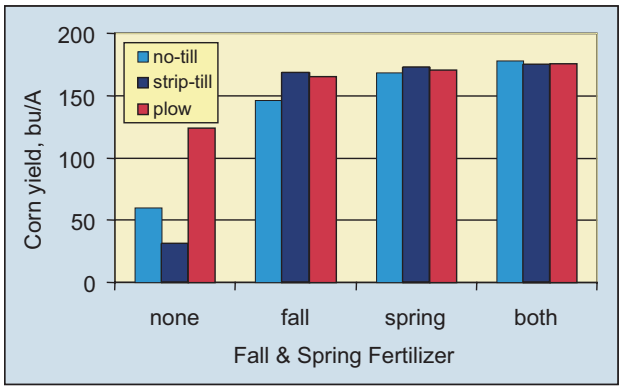

Figure 2. Corn response to fall and spring P and K fertilizer and tillage at a single site in Ontario, 2003. Soil test P and K were 16 and 58 ppm, respectively.

strip-till produced yields intermediate between no-till and full tillage with a fall moldboard plow (**Table 2**). These yield data do not fully reflect the advantages of strip-till, because all plots were planted the same day. The strip-till plots were often ready for planting a few days earlier than the no-till plots. Across seven sites in 2002, strip-tilled soils contained 20% moisture in the seed zone to 6 in. deep, compared to 30% in no-tilled soils. The drier soil facilitates earlier planting which potentially can provide an additional yield boost.

Table 2. Corn yield in three tillage systems, averaged across two sites in Ontario and 2 years (2002 and 2003).

Tillage	Corn yield, bu/A
No-till	153
Fall strip-till	156
Moldboard plow	160

In field trials carried out from 2000 to 2002, corn responded to P and K fertilizers applied in either fall or spring. Fall-applied P and K boosted yields by an average of 4% (12 site-years). Spring-applied, the same two nutrients boosted yields by 8% (13 site-years). There appeared to be little interaction…the response to spring application occurred whether fall fertilizer had been applied or not. Responses to fertilizer were similar for each tillage system. Soil test levels ranged from medium to high for both P and K.

In the 2003 growing season, a low fertility field in Ontario demonstrated how responses to fall and spring fertilizer can depend on tillage (**Figure 2**). The soil test was medium for P (16 parts per million [ppm] Olsen) and low-medium for K (58 ppm). Seedlings showed visual symptoms of P and K deficiencies in the check plots. The trial conducted in this field comprised tillage treatments subdivided to receive combinations of fall and spring applied P and K, with a constant level of N (27 lb/A as starter, plus 134 lb/A as sidedress).

Responses to either fall or spring-applied P and K were larger in no-till and fall strip-till than in moldboard plowed soil (**Figure 2**). Application in the fall was more effective in strip-till than in no tillage. However, in general, the spring-applied fertilizers were more effective than those applied in the fall, even though the rate applied in the spring was only half that applied in the fall (125 lb/A of each of P_2O_5 and K_2O). Applying both fall and spring fertilizer produced yields that were not significantly higher than spring fertilizer alone. Overall, the results illustrate the importance of adequate P and K fertility for successful performance of reduced tillage systems.

Summary

We need to learn more about optimum placement and timing of nutrients in modified tillage systems. **The Ontario research indicates that P and K produce larger yield responses applied in the spring than in the fall, but also that there appears to be an independent yield boost from fall-applied fertilizer. On the other hand, in Kansas there was no significant difference between fall and spring application of fertilizer in a strip-till system.** We encourage continued on-farm testing of fertilizer placement and timing in combination with conservation tillage.

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