

MU Guide

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Fertilizer Management for No-Till Corn and Grain Sorghum in Missouri

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No-till farming will help preserve Missouri's erodible cropland. This publication should answer many of the questions facing crop producers and fertilizer suppliers regarding nutrient management in a continuous no-till production system.

Some assumptions must be made when discussing no-till. The first is that in continuous no-till systems, a buildup of plant residues on the soil surface will occur. These residues provide protection against soil erosion. Whether in a cropping system of soybean, soybean-wheat and corn or sorghum rotation, the assumption is that considerable residue will be covering the soil surface after corn or sorghum planting.

Soil sampling and testing

Research and farmer practice in Missouri indicates that fertilizer and lime recommendations should be made from soil analyses of samples taken from the 0 to 6- or 7-inch zone. Some states now suggest taking a soil sample to a shallower depth for no-till. In Missouri, however, the routine sampling depth is still preferred when interpreting soil sample results and making fertilizer recommendations because of past calibration research.

How many samples should I take on my field?

The best producers are learning the value of taking several soil samples from one field and mapping soil fertility within the field. This information can be extremely valuable. Dramatic adjustments to fertilizer inputs can be made while still improving yields, especially on fields that generally test high in phosphate and potash.

An often recommended technique is to divide the field into 2.5- to 5-acre areas, then grid soil sample the field. One soil sample is composited from each of the grid areas to help identify soil fertility variation within the field.

The standard method for obtaining a composite soil sample is to take at least 12 cores with a soil sample probe from the sample area. These cores are then mixed in a plastic bucket and sub-sampled to get a one-pint composite sample. This is the only sure method for getting good reliable data from field sampling. The technique is the same regardless of tillage systems.

What about sampling fertilizer bands?

Most fertilizer banding is achieved with starter attachments on the planter. Avoid sampling the area where the fertilizer band would be expected. If sampled, the fertilizer band can greatly inflate the soil analyses, resulting in a poor reflection of the field's general fertility.

What about sampling in ridge till?

Experience with ridge till in Iowa and Minnesota suggests that soil samples should be taken from the side of the ridge. The sampling depth should continue to be 6 to 7 inches. Again, if starter has been banded, avoid sampling those bands.

Soil acidity and liming

Obviously, the standard practice of incorporating lime cannot be used in continuous no-till systems. This is not necessarily a problem. Lime will neutralize soil acidity naturally down through the soil from surface applications. However, the process may take several years to have an effect on the subsurface pH.

Sampling the top 2 inches of soil for a pH check is a good practice after continuous no-tilling for five or more years. The soil surface pH should be between 5.5 and 6.3, as measured using Missouri's salt pH test, to ensure good activity of soil-applied herbicides. If using

This publication is a revised edition. The original author is Daryl D. Buchholz, professor of agronomy at Kansas State University and former faculty member at MU.

soil pH measurements in water, the recommended range would be 6.0 to 6.8. To avoid herbicide residual activity for longer periods than stated on the herbicide label, be careful to never allow surface soil pH to rise above approximately 6.3 (6.8 water pH).

What if my soil pH is too high?

Wait for it to come down. In many cases this will be a very slow process. There is no economical way to quickly adjust pH downward. Nitrogen fertilizers will contribute to lowering soil pH. However, they will not significantly change pH in any one growing season. Again, it is best to just wait it out. Select herbicides accordingly.

Phosphate and potash

Surface application of phosphate and potash in no-till has proved to be an effective application method.

Won't phosphate and potash stay at the surface?

In no-till, phosphate and potash will move downward in the soil very gradually. This movement begins only after the surface inch or two of soil becomes high in these nutrients. However, crops will not suffer any deficiency provided a good soil testing program is followed and the nutrients are applied as recommended for broadcast application. Evidence of this comes from a long-term tillage study conducted at MU's Greenley Center in northeast Missouri (Table 1). The heavy crop residues from a no-till system create an excellent crop rooting environment in the soil surface. Thus, the crop is able to take up sufficient nutrients from the surface soil.

Table 1. Phosphorus stratification occurs as tillage practices are decreased, yet does not appear to cause yield reductions.

Tillage system	P soil test lbs. P/A			Corn yield* bu/A
	soil depth (inches)			
	0-1	1-3	3-6	
Plow + 2 diskings	49	45	49	93
Chisel + 2 diskings	121	113	65	90
2 diskings	157	123	34	92
No-till	168	69	19	100

*12-year average corn yields

What about starter fertilizers?

Research work in the Corn Belt has shown that the probability of an early corn growth response to banded starter fertilizer is greater in no-till than in conventional tillage practices. General observations



Figure 1. Broadcast application of phosphate and potash fertilizers remains an excellent practice for no-till crop production.

support these findings. Substantial early corn growth response to starter fertilizer may not always result in increased yields. However, this early growth may be important in avoiding various pest problems. Reduced grain moisture at harvest may also be a benefit of starter fertilizers.

Starter fertilizer should contain both phosphorus and nitrogen. There is no ideal ratio of these two nutrients in a starter, but the amount of phosphorus should be equal to or greater than the amount of nitrogen.

The best place to locate a starter fertilizer band is 2 inches to the side of the seed placement and at least at seeding depth to 2 inches below seeding depth.

Table 2. Anhydrous ammonia injected and ammonium nitrate broadcast tended to be best performers across three locations of a continuous no-till corn-soybean rotation in Missouri.

Nitrogen source	Placement	Corn yield* bu/A
Anhydrous ammonia (82-0-0)	knifed	160
Ammonium nitrate (34-0-0)	broadcast	163
UAN solution (32-0-0)	knifed	156
Urea (46-0-0)	broadcast	149
UAN solution (32-0-0)	1/3 broadcast, 2/3 knifed	134

*1991-1992 average of three Missouri locations with 180 lbs. N/A

Nitrogen

On adequately drained soils, nitrogen requirements for no-till corn are similar to those of a tilled cropping system. On imperfectly to poorly drained soils, nitrogen requirements for no-till will differ from tilled cropping systems. When following soybeans, 10 to 15 percent more fertilizer N is recommended for no-till corn. Continuous no-till corn has similar N requirements to those of a tilled system.

Will I need more nitrogen fertilizer in no-till than when I tilled the ground?

Adequately fertilized no-till corn responds similarly to nitrogen fertilizer as to a tilled cropping system. There is no need to apply extra nitrogen in no-till.

How should I apply the nitrogen fertilizer?

The best recommended application method is to inject the nitrogen fertilizer into the soil to avoid potential N losses. Knife-injected anhydrous ammonia should be the most consistent performer, although ammonium nitrate has performed equal to anhydrous ammonia (Table 2). A very good second choice is knife-injected UAN solution.

While recent Missouri data appears to suggest that knifed UAN results in somewhat lower yields than ammonia or ammonium nitrate, most other data and farmer experience shows injected UAN solution to be an excellent method of nitrogen application in no-till. In general, anhydrous ammonia, UAN solution injected, and ammonium nitrate broadcast all perform equally well in no-till. Cost, availability and personal preference should dictate which of these nitrogen materials to use for no-till production.

What if I want to broadcast my nitrogen fertilizer?

With crop residues on the soil surface, ammonium nitrate is the best nitrogen fertilizer for broadcasting without incorporation. Recent data collected during a three-year period at three northern Missouri locations shows the superiority of ammonium nitrate as a broadcast source in a corn/soybean rotation system (Table 3). Urea usually will be a less desirable second choice for broadcast application. Nitrogen solution should not be used. In heavy crop residues of continuous no-till corn, differences between broadcast N sources tend to be amplified, with ammonium nitrate again being the best choice.

Table 3. Ammonium nitrate is the preferred source of nitrogen in no-till when injection is not possible and the material must be surface broadcast.

Nitrogen source	Corn yield*
Ammonium nitrate (34-0-0)	149
Urea (46-0-0)	142
UAN solution (32-0-0)	132

*Average across eight site years in Missouri

Why don't you recommend UAN solution to be broadcast for no-till?

Corn yields tell most of the story. Crop performance shows erratic results from UAN solution when surface broadcast. Ammonia volatilization and tie-up on the decaying crop residues render part of the applied UAN solution unavailable to the growing crop.



Figure 2. Knife injection of anhydrous ammonia or UAN solution is a best management practice for no-till nitrogen application.

This tie-up appears to be dependent on the amount of decaying crop residues. The UAN solution seems to work as well as urea if residue amounts are low, as with only soybean stubble. However, when residues begin to cover 50 percent or more of the ground, performance of surface-applied UAN solution becomes erratic with often disappointing results.

What about the nitrogen from other fertilizer sources?

The nitrogen in ammonium phosphate and ammonium sulfate fertilizers will be just as effective as that in ammonium nitrate in a broadcast system of no-till fertilization.

Does early spring application help with nitrogen fertilizer choices?

Experience suggests urea will perform more like ammonium nitrate when both are applied in late February or March. However, UAN solution will still be inferior in many cases when broadcast on heavy crop residues. Injected ammonia remains your single best choice for consistent performance. When fertilizer is applied later than March, ammonium nitrate will be difficult to beat if your choice is among broadcast application materials.

What about fall application of nitrogen for no-till?

Fall nitrogen application is not recommended in Missouri for spring planted crops. Averaged over several years, a 10 to 15 percent loss in nitrogen efficiency is expected when comparing fall versus spring pre-plant nitrogen application. Nitrogen losses from fall application generally occur in late spring as gaseous denitrification or nitrate leaching.

Should I broadcast UAN solution on the fall residues?

This practice has been promoted in some areas to the north as a means of getting more residue breakdown through the winter and early spring.

Our observations indicate that broadcasting UAN solution on fall residues is a waste of nitrogen fertilizer in the southern Corn Belt. The crop residues will break down without the added cost and application of nitrogen solution.

Summary

Use a soil fertility map of your field to dictate phosphate and potash needs. Broadcast application will pro-

vide good results. An N-P starter should be used to improve early growth and development of corn or grain sorghum crops. Anhydrous ammonia or nitrogen solution should be injected near planting time or as an early sidedress application. If broadcast is your only means of applying nitrogen, ammonium nitrate is a good choice for a nitrogen source.

Notes
