LSP Soil Builders' Network Fact Sheet

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No-till Fertilizer Considerations

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This fact sheet is written by Myron Sylling, a no-till farmer for 20+ years. He farms 1,300 acres near Spring Grove in southeastern Minnesota with his father and brother. When transitioning to no-till, Sylling originally saw no yield difference when compared to his neighbors' conventional tillage programs, but now is seeing up to a 20-bushel yield advantage as a result of his no-till (and cover cropping) system. Statements made in this fact sheet are from Sylling's personal experience. You may read more about Sylling's experiences in blog posts on the Land Stewardship Project's Soil Builders' Network web page: www.landstewardshipproject.org/lspsoilbuilders.

Covered in this fact sheet are some fertility based issues to keep in mind if you decide to convert to a no-till system. Your soil is accustomed to your prior tillage method—do not expect it to act the same during your transition to no-till. You will find or have heard talk of yield reductions (mainly corn) with no-till. This can happen. It is why some people give up on no-till and go back to conventional tillage methods after their first year or two in transition. But remember, this is a process and your soil needs time to heal itself after years of tillage-caused damage.

Things that happen:

1) As a no-tiller, you will always have livestock doing positive things for you. Once tillage stops, earthworms will return. This does not happen overnight. It may take three years to visually see many more worm holes in your soil. They have to reproduce and that takes time. Once the populations are growing, they grow faster each year since there are more living worms to reproduce. In tillage systems, the worm channels are destroyed with each tillage pass and the worms that live at that depth are killed. There are always some worms in your field—they can and do live further underground where the tillage passes cannot touch them.

In a no-till system, worms become the heavy tillers. However, they do not move the soil in the same way tillage equipment does. They move the soil to create their channels/burrows in the soil. These channels become pore space in the soil that allow more air exchange, as well as water infiltration.

Worms incorporate the above ground crop residue into the soil profile and feed on that residue. They also pull the residue down into their burrows to feed on it later. One estimate is that in healthy soil approximately 8 tons of worm manure is generated annually per acre.

2) Soil microbiology has to change. Tillage is very hard on the fungal community in the soil, leaving that environment more dominated by bacteria. Fungicide applications to your growing crops also slow the rate of fungal re-population.

Fungi are beneficial in helping plants gather nutrients from the soil to grow. They are also important in the decomposition of crop residue. It can take many years for fungal populations to rebound once tillage stops.

3) The change has to be fed. We do not get something for nothing. Once tillage stops, soil life builds. This building must be fed until the system can achieve a balance. This balance comes about when the beneficial and predatory soil life is in sync. Once this is a achieved, the biological life (both positive and negative) that dies, is eaten and is expelled from the system will provide the nutrition to sustain the ecosystem.

All this life requires nutrients and some of that is what your growing crops need too. Nitrogen is a big key to this. Nitrogen is also needed to activate additional residue decomposition. In the first years of no-till, expect to apply more nitrogen per acre than you have in the past—probably 10 percent more. Only soil and tissue testing will tell you the exact amount you need to add. We all know rainfall makes a difference in the available nitrogen as well, making it difficult to give an exact amount of additional nitrogen required.

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How do you accomplish this?

◆ **N-P-K**

It is important that your corn crop receives some nitrogen early to boost growth. In-furrow application of nutrients is very important in the early years of adopting a no-till system for corn. The nutrients a corn plant senses are available early influence the size of the ear a corn plant creates. In the transition years, the soil biology is building and not running at full capacity to provide these nutrients in the quantity needed. In general, the in-furrow application of nutrients contains nitrogen, phosphorus and potassium (N-P-K). All three of these are important to the young corn plant. Phosphorus is the most important, followed by nitrogen and potassium.

In a no-till system, the soil has not been worked and so it is generally not as warm as tilled ground. Soil life does not become very active until above 50 degrees Fahrenheit. In the cooler environment, the nutrients naturally in the soil are slower to release since the microbes are not as active. The cooler and wetter the spring is, the more important a pop-up fertilizer starter is. This places needed nutrients in very close proximity to the plant root so less biological work is needed to get those nutrients into the young plant. Some nutrients can be taken up directly by the plant as well. Be careful placing pop-up fertilizer in-furrow as too much or the wrong kind can damage the plant roots. Salt content is the issue—in most soil types 3-5 gallons of a low salt product is fine. In transitional years, 5 gallons may be the preferred rate—3 gallons in later years. Check with your local agronomist for seed-safe types and rates of fertilizer for your soil types.

The other issue with no-till is there is little choice but to apply a majority of the phosphorus and potassium using surface broadcast-spreading. Broadcast-spreading leaves the fertilizer on top of the ground and not mixed in the soil profile as it would be with a tillage system. Plant roots are not going to get at this nutrient when it's on the soil's surface, at least in early development. Rain can and will move nitrogen and sulfur into the soil. Potassium will move down some as well, but it is not nearly as mobile as nitrogen. Phosphorus, once in the soil, will move no more than a quarter-inch in the soil. Worm holes will help phosphorus get a little deeper in the soil profile before it is tied up. But remember, when converting from a tillage-intensive system, there will be very few of these holes to help with infiltration the first few years.

Broadcasting fertilizer and no-till bring concerns of nutrient stratification in the top few inches of the soil profile. As was mentioned earlier, after several years into no-till the worm holes will become very abundant and allow those nutrients deeper into the soil.

Cover crops, which add extensive root systems to the top few inches of soil, can also help alleviate the problem of nutrient stratification. These roots can soak up the higher levels of nutrients and move them deeper into the soil profile as they grow deeper. Cover crops also release the nutrients in a more available and "movable" form when they decompose. The nutrients are temporarily more mobile due to the fact that while in a decomposing state, they are not bound to the soil.

◆ **Nitrogen**

This element is very important to corn plants and their productivity and its application is a major consideration when changing to no-till. Soil transitioning into a no-till system will need more nitrogen to feed the soil biology. This biology also slowly helps to build organic matter in the soil. Organic matter itself is composed of a certain level of nitrogen. As your soil organic matter increases, so does the amount of nitrogen stored in the soil.

Initially, that slow build up of nitrogen must be provided by the farmer, and if this is not done, you may experience a yield drag compared to your previous tillage system. One of the reasons access to nitrogen fertility can be an issue is that there will be more residue on top of the soil when you no-till, and this residue will quickly tie-up surface applied nitrogen to speed its decomposition.

Surface applied nitrogen can work, but be aware of the tie-up issue and increase the rates accordingly. Tie-up of nitrogen will be less of an issue if the fertilizer is injected, since less residue will come into contact with it. However, the need is still there to increase the applied nitrogen when it is injected. In either method of application, a subsequent side dress application is suggested for being the most environmentally friendly. A split application also allows an adjustment to the total amount of nitrogen applied. Depending on early season weather conditions, more or less nitrogen may be required to maximize the corn crop.

Higher nitrogen rates are useful the first couple years to feed the soil biology. After 3 years and quite possibly during the third year, it is fine to back the rate down to where you had been (if that wasn't already too high).

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◆ **Soybeans & Fertilizer**

Soybeans are not as fussy about nutrient placement since their root system is much closer to the soil surface than corn. Usually, nitrogen is not a consideration in soybeans (unless exceptional yields are expected). Many farmers apply nutrients for the corn crop and let the soybeans gather up what is left the next year. However, some farmers are seeing higher soybean yields due to fertilizer applications. There is no clear evidence that this practice would help increase yields more in a no-till system.

◆ **Soybeans & No-till**

In general, no-till soybeans will start slower, stay pale green longer, and be shorter than conventionally tilled soybeans. The soybean starts slower due to it being planted into a soil that's cooler as a result of lack of disturbance. It stays light green longer due to the soil microbes not being as active; thus, it takes longer to start nodulation and begin fixing nitrogen from the atmosphere. Once nodulation starts, the extra nitrogen greens the plant up.

The shortness of the plant is due to the slower start it gets in the spring. In most cases, the shorter soybean plant has its pods closer together. The eventual yield is very similar to conventionally raised soybeans. In fact, during a dry year, the yield for the no-till soybeans will most likely be higher due to the presence of increased soil moisture levels as a result of the ground not being worked. The ability of the soil to store soil moisture increases over time as the water infiltration rate rises.

Planter Set-up Video

Check out this 12-minute no-till planter preparation video: **http://bit.ly/2ETOuzv**.

LSP's Soil Builders' Network

The Land Stewardship Project invites crop and livestock farmers to join the southeastern Minnesota-based Soil Builders' Network to get regular updates on workshops, field days and on-farm demonstrations, as well as soil health and cover crop research. To sign-up and for more information, see **www.landstewardshipproject.org/lspsoilbuilders**.

On that page, you will also find links to fact sheets, blogs, podcasts and videos. More information is also available by contacting these LSP staffers:

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