NUTRIENT MANAGEMENT

In no-till, nutrient requirements don't change. But in many cases, the type and timing of application practices do. The differences in the no-till seedbed conditions pose challenges for nutrient retention, fertilizer materials, application methods and timing of operations. There are fewer conventional application methods available – modifications to planting and nutrient application equipment can overcome these.

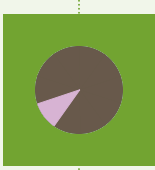
Before beginning a no-till system, soils should be in an acceptable pH range for crops grown.

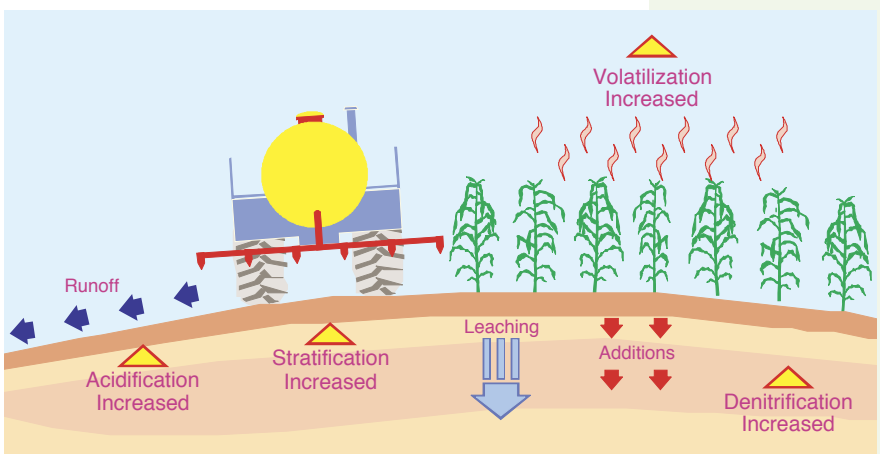
Ideally, nutrient levels (phosphorus, potassium, magnesium, etc.) will be at a medium-high range.

Understanding the fertilizer materials and their activity in no-till conditions is a first step to making nutrient management work in no-till:

- urea or urea-based nitrogen fertilizers should never be broadcast and left on the soil surface, because a portion of the nitrogen could be lost to the air
- surface-applied fertilizers and manures are prone to runoff
- surface-applied manure and nitrogen-based fertilizers could lead to a more acidic soil surface
- soils may become more acidic if lime is not incorporated
- surface-applied or shallow banding of phosphorus and potassium could lead to stratification of these nutrients – this generally is not a problem, except in droughty conditions, as the roots tend to concentrate in this area, and residues preserve moisture, helping uptake
- mycorrhizal activity will increase, in turn increasing phosphorus uptake.

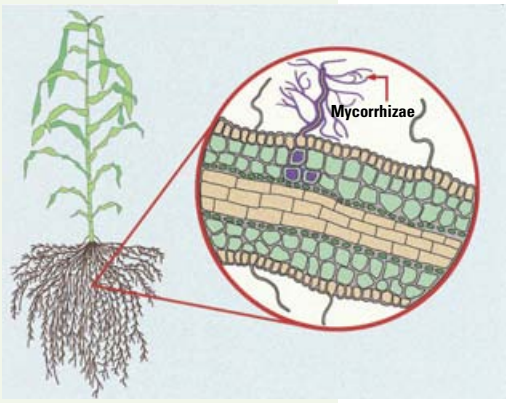
A coulter in front of the knife cuts residue and improves nitrogen placement.





Surface-applied nutrients waste money and increase risk to the environment.

NUTRIENT MANAGEMENT



No-till conditions help the growth of soil mycorrhizae. Soil mycorrhizae assist plant roots in obtaining nutrients (phosphorus) from the soil by increasing the area exploited by the roots.

Phosphorus and Potassium Stratification

Nutrient stratification occurs under long-term no-till conditions. This means that a buildup of phosphorus (P) and potassium (K) occurs on or near the soil surface over time when the soil is managed in a no-till system. This stratification is caused by normal crop demands on the nutrients deeper in the soil profile, and the absence of incorporation.

The nutrient-rich layer with depleted zones below show up after three to five years of no-till management. When fertilizer is applied properly, however, nutrient stratification should not affect yields. To counter stratification, at least some of the phosphorus and potassium requirement should be applied in a band with or near the seed row. Because these two nutrients move very little in soil, plants use phosphorus and potassium applied in a band almost twice as efficiently as they use broadcast fertilizers.

Check the tables in OMAFRA *Publication 296* for safe rates of nitrogen and potassium in starters.

EFFECT OF NITROGEN SOURCE, METHOD AND TIME OF APPLICATION ON NO-TILL CORN GRAIN YIELD, 8 SITE-YEARS, 1990-94

SOURCE	METHOD	TIME	YIELD bu/ac @ 15.5% moisture
No Nitrogen			76.3
Urea	Broadcast	Preplant	130.0
Urea Ammonium Nitrate	Broadcast	Preplant	136.0
Urea Ammonium Nitrate	Coulter injected	Preplant	145.2
Anhydrous Ammonia	Knifed in	Preplant	150.6
Urea Ammonium Nitrate	Spoke wheel injected	Sidedress	147.6
Urea Ammonium Nitrate	Coulter injected	Sidedress	146.3
Anhydrous Ammonia	Knifed in	Sidedress	152.3

Ridgetown College of Agricultural Technology, C.K. Stevenson

The results from eight site-years showed a significant difference among nitrogen source, method and time of application treatments. The anhydrous ammonia and urea ammonium nitrate (UAN) soil-injected treatments gave considerably higher yields than urea ammonium nitrate and urea surface broadcast.

NUTRIENT MANAGEMENT

SOIL SAMPLING IN NO-TILL SYSTEMS

Sample no-till fields the same way you would a conventionally tilled field. When sampling, consider the location of the starter fertilizer band from the previous crop. See OMAFRA *Publication 296, Field Crop Recommendations.*

Sample the top two inches for pH if surface applications of nutrients have been made.

To sample ridge till fields, read page 82 of *Field Crop Production* (Best Management Practices).

For information on nitrate sampling, see OMAFRA *Publication 296.*

Note: the nitrogen soil test will underestimate the amount of nitrogen available to the crop when manure has been applied in the spring, or if cover crops or red clover were killed in the spring. Ask for both the nitrate and ammonia tests when using the nitrogen soil test where manure has been applied. Add the two numbers together to obtain a more accurate indication of soil nitrogen. Sampling for nitrogen at sidedress time will improve the accuracy of the test.

The best way to make manure work in a no-till system is with a full crop rotation.

Chris Brown, Ontario Ministry of Agriculture, Food and Rural Affairs

Manure is not such a big problem in no-till. We can now crop more acres so there's more places and opportunities to spread it. And we don't have to spread it on rough, plowed land.

Kevin Mariott, Lambton County

NUTRIENT MANAGEMENT

BEST MANAGEMENT PRACTICES

NITROGEN

At Planting
- some nitrogen with starter phosphorus and potassium will help emergence and improve phosphorus uptake
- some or all of the nitrogen requirement for corn can be applied at planting behind one of the tillage coulters – at least 4" from the row

We don't need to apply fertilizer to beans. But for corn we put dry starter behind one coulter and 40 lbs. of liquid 28% nitrogen behind the tillage coulter.

Charlie Bolton, Middlesex County

Sidedress
- knifing in and injecting nitrogen are recommended sidedress practices in no-till
- some producers combine sidedress application with cultivation, manure application and herbicide application

We've switched from anhydrous to liquid 28%. It's easier to apply as sidedress.

Murray Lobb, Huron County

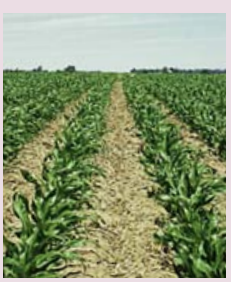
PHOSPHORUS AND POTASSIUM

Broadcast
- phosphorus and potassium where required before starting no-till
- broadcast excess potassium requirements that cannot safely be banded

Band at Planting
- banding with seed or offset by 2" below and 2" beside seed
- over time in no-till, the increased mycorrhizal levels may allow phosphorus application rates to be reduced for corn and possibly beans

When we decided to get into no-till [1986], we tested the soil for phosphorus, potassium and pH levels. We broadcast where there were any problems. Now we test every three years and maintain the levels.

Elwin Vince, Kent County



We do a lot of side-by-side trials in ridge till. We found some inputs weren't paying their way. However, it looks like banding potassium is paying in corn.

Ron McRae, Stormont, Dundas and Glengarry United Counties

NUTRIENT MANAGEMENT

BEST MANAGEMENT PRACTICES, cont'd.

LIME

Broadcast

- get your soil into shape before switching to no-till by broadcasting and incorporating lime – phosphorus, potassium, and manure can be incorporated at the same time (lime mixed with the soil will do a better job at correcting acidity problems)
- once in no-till, incorporate lime if possible
- another option where lime is required is to surface-apply a tonne of lime regularly – coulters will do some incorporation

Lime won't move from where you put it, so surface applications won't help deep problems. Maintenance applications will work, but soil test is best.

Keith Reid, Ontario Ministry of Agriculture, Food and Rural Affairs

BEST MANURE MANAGEMENT PRACTICES

Manure supplies the following:

- ▸ nutrients (nitrogen, phosphorus, potash)
- ▸ organic matter and soil structure improvement
- ▸ food for soil life.

If nitrogen is the most important factor, then a decision will have to be made whether to accept pre-planned tillage or some nitrogen loss.

In a no-till system, there are some options for manure application. Manure in a no-till system works best with full crop rotation. The following are some situations where manure can be utilized:

- ▸ spread on fields that will be planted into corn
- ▸ as a sidedress application in corn (liquid)
- ▸ on alfalfa soon after harvest (rates must be low)
- ▸ **light** application on fields that will be planted to soybeans (choose varieties with shorter heights)
- ▸ applied after cereal crops, especially with a cover crop.

NUTRIENT MANAGEMENT

BEST MANURE MANAGEMENT PRACTICES

LIQUID MANURE

Irrigation

- manure can be applied before, during or after crop using overhead irrigation
  - low rates work best
  - compaction and winter spreading are avoided
- continuous macropores can carry manure to tile drains – applying manure to dry soil or doing light tillage before application will minimize this problem

Caution: measures should be taken to minimize odour and runoff into catchbasins, drains and streams.

Spreaders cause compaction so I irrigate. I apply liquid hog manure from my neighbour at no more than 3-4,000 gal/ac when the crops need it just before planting or as sidedress.

Bruce Shillinglaw, Huron County

Direct Injection

- direct injection before planting or as sidedress (using tractor-mounted injection unit and drag hose) is highly recommended – compaction is minimized and placement is controlled

Injection as sidedress.

Dribble/Broadcast

- liquid manure can be dribbled between rows of growing crops as a sidedress method – incorporation is best, particularly when combined with sidedress nitrogen application and inter-row cultivation

I attached canvas sleeves onto each tube so that the canvas drags along the ground. There's minimal smell and no drift. Within half a day the ground is dry enough to inter-row cultivate.

Randy Molzan, Lambton County

NUTRIENT MANAGEMENT

BEST MANURE MANAGEMENT PRACTICES, cont'd.

SOLID MANURE

Broadcast

- the only way to apply solid manure – try to spread it as evenly as possible
- solid manure is low in ammonium nitrogen so less will be lost to the air (volatilization)
- composted or dry manure has a higher organic matter content – this can be ideal in no-till, especially after wheat

The soil must be dry. I spread dry manure on wheat ground in fall and spring. The ground is chisel plowed in the fall or cultivated once in the spring to incorporate the manure. It is not a "sin" for a no-tiller to work the soil once every three or four years.

Glen Warwick, Huron County

Note: spring manure application that will not be incorporated will lose the majority of the ammonium nitrogen. Regardless of how the manure is applied, one-third of the nitrogen requirement should still be supplied through the planter or as a sidedress application.

OTHER WAYS TO INCLUDE MANURE IN THE SYSTEM

Working in solid or liquid manure at several points in the rotation is still considered part of a no-till system.

After Cereal Harvest

- working in solid or liquid manure along with stubble can perform double duty or even triple duty when cover crops are used the year before corn

After Hay

- as with cereal stubble, solid manure can be worked in after taking the last cut in preparation for next year's corn crop

We are not purists. We will spread manure on wheat stubble in August through the end of September and disc afterwards.

Tom Hayter, Huron County

I spread solid manure on no-till fields as long as they're not near wetlands and water-courses. There is much less runoff on no-till fields. I think solid is easier to manage than liquid manure, even in no-till.

John Miller, Lanark County

NUTRIENT MANAGEMENT

TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
SEEDLING DAMAGE	• burn from too much nitrogen near seedling • salt injury from too much potassium near seedling	• use less nitrogen and potassium in starter • band nitrogen farther from seed • split application to starter plus sidedress
RESIDUE PLUGGING	• heavy corn or cereal residue plugs sidedress injection equipment	• mount coulter in front of knife • sharpen coulters • use more aggressive coulter ahead of knife
ANHYDROUS AMMONIA LOSS	• poor slot closure	• add closing discs • fasten a short piece of chain to the back of the knife just above the injection opening
RILLS FORMED IN MID-SEASON	• knifing in nitrogen on highly erodible fields • poor coverage of knifed trench	• get soils into shape – rotate and use soil-building crops • try no-till cropping across the slope, in strips, or along the contour • use closing discs to fill in trench
LIQUID MANURE IN TILE OUTLETS	• application rates too high • irrigation left unattended • good macropore development • injection too deep	• lower rates over more acres or two applications at half the rate • monitor and calibrate irrigation system • use shallow tillage prior to application to break macropores • close up soil after injection or dribbling
PLANTER PLUGS WITH MANURE	• solid manure applied at heavy rates • manure not distributed evenly • manure not worked in	• reduce application rates and spread evenly • use light tillage or crop-row pre-tillage to incorporate solid manure • adjust coulters on planter – 3-coulter system may work best

Shown here are coulters mounted on an anhydrous ammonia applicator. The chain welded on the knife helps to close the slot.