5 Things to Consider with Managing Your Nitrogen this Spring

The lack of rainfall last season resulted in diminished yields for many growers in the Red River Valley. As a result, many fields had above average levels of residual nitrogen available for this year's crop.

Figure 1. Above average snowfall and an early melt resulted in water logged soils for extended periods of time this spring

On soil test reports, it wasn't uncommon to see residual nitrate levels ranging between 50 and 100+ lbs in the top two feet. Late season rains created ideal conditions for field work and fall fertilizer applications, and producers were encouraged to apply fall fertilizer by the outlooks predicting price increases into the winter.

Whether it's residual or fertilizer nitrogen, there is usually a risk of some loss over winter and into spring. The percentage of loss will vary from year to year, depending on several factors including soil moisture, texture, temperature and the form nitrogen is in.

What can we expect this spring?

There are 5 factors we need to consider this spring when it comes to nitrogen:

1 Lots of snow and an early melt

This winter, many areas of the Valley received more snow than we have seen in a long time. Coupled with an early melt, there was a lot of water sitting in fields waiting for ditches and culverts to open up. An early melt has been positive in terms of reducing the risk of significant overland flooding and the potential for nitrogen losses and timely planting.

Denitrification is the main form of nitrogen loss in our clay soils where soil microbes in need of oxygen start stripping it off nitrate (NO_3). The result of this is nitrous oxide (N_2O) or dinitrogen (N_2) gasses which are susceptible to atmospheric loss. Therefore, as you can imagine, the warmer and wetter the soils, the higher the losses of nitrogen.

Denitrification rates depend greatly on soil temperature. A general rule of thumb is that denitrification losses can average 2-4 lbs per day at a soil temperature of 5C, but once soils warm up, the potential for loss increases significantly. 20C soil temps could result in potential losses of 8-16 lbs per day.

An early melt usually results in minimal losses given the cold weather and minimal biological activity. If denitrification due to spring flooding was a major problem in most years, there would be no fall applied nitrogen in the Red River Valley. This brings us to factor number 2, late season flooding.

2 Late season flooding

The spring of 2022 is shaping up to be one for the record books with April seeing below normal temperatures and above normal precipitation. Despite the early thaw, cool weather and increased precipitation has dragged out the spring season and resulted in major flooding. The cold weather has slowed the melt and ice breakup in major waterways - including Lake Winnipeg - causing water to back up.

The original crest on the Red River occurred in late March, but it has since been replaced by a 2nd, even higher crest that is not slated to happen before the 2nd week of May.

As you can see in Table 1, this is a full three weeks later than the crest in 2009 and 4-5 days later than it was in 2013, which was the latest crest in recent history.

Year	Crest Date	Crest Level
2009	2009-04-19	782.84
2010	2010-04-05	778.77
2011	2011-04-30	781.27
2013	2013-05-06	774.67
2014	2014-04-20	773.38
2019	2019-04-28	777.55
2022 Forecasted Crest		
2022	May 8-10	782.0-782.5

Table 1. Historical crest levels and dates of previous floods for the Red River at St. Jean Baptiste.

For those who do not remember 2013, it was characterized by two weeks of warm weather with highs between 25 and 30°C as the water receded (Figure 2).

Although I do not have any hard numbers to share, I remember a canola field where the bulk of the nitrogen had been applied as fall NH_3. Due to overly wet conditions in the spring, the producer had elected to float (no pun intended) on his canola along with an additional 40-50 lbs of nitrogen. The yield map showed a rectangular strip along one side of the field that yielded 10-15 bushels better than the rest.

The strip turned out to be where the custom applicator had applied his leftover fertilizer and seed, likely resulting in double the rate of nitrogen….

3 Many fields are still overly wet

Although it has been cold enough to minimize denitrification up to this point, even without flooding, cold weather and additional precipitation has kept things overly wet in many fields.

Last week, I went out to see how things were progressing in the field. The real question is *what will conditions be like once the water recedes, given the late crest?*

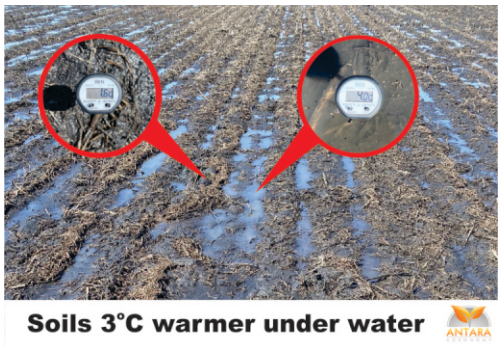

Figure 3. Water is an excellent heat conductor resulting in warmer soils in lower areas where water has pooled.

An interesting thing to note is the difference in soil temperatures due to standing water. Water is a great heat conductor and it can lead to greater N losses during spring thaw. Figure 3 shows the difference in soil temperatures less than a foot apart.

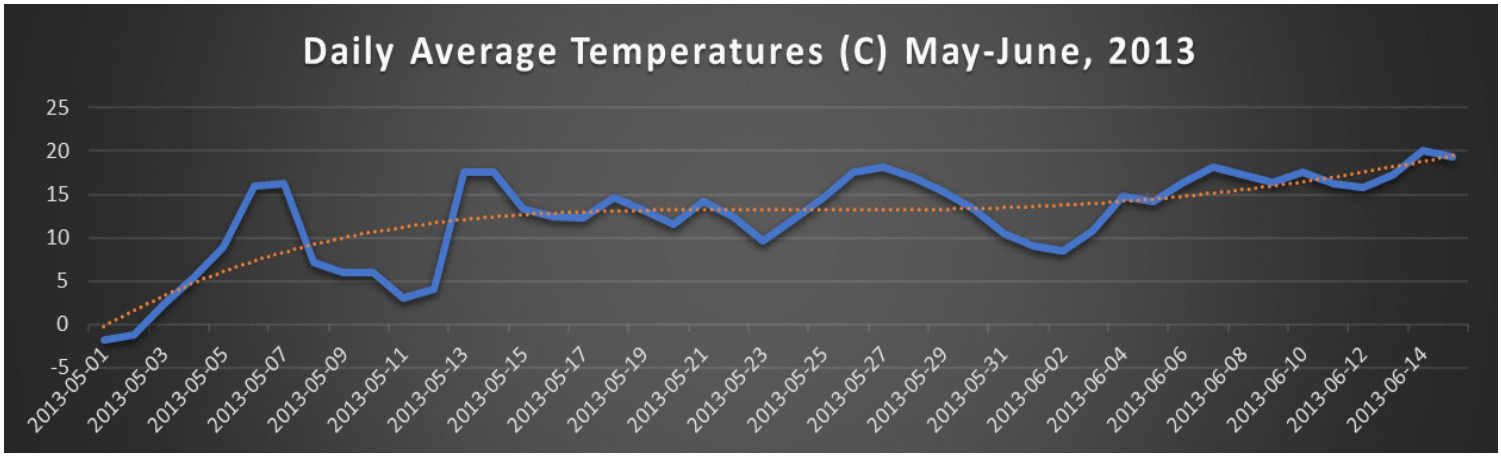

Figure 2. Daily average temperatures in 2013 following the latest flood crest in recent years. Warm weather resulted in denitrification as waters receeded mid-May.

4 Where is the nitrogen?

Dry conditions in 2021 resulted in higher-than-normal levels of residual nitrogen. Composite soil tests revealed levels between 50-100lbs on many fields. Composite soil tests are an average representation of what is in the field. One of the problems is as levels increase, so do the chances that nitrogen levels varying considerably in different areas of a field (Figure 4).

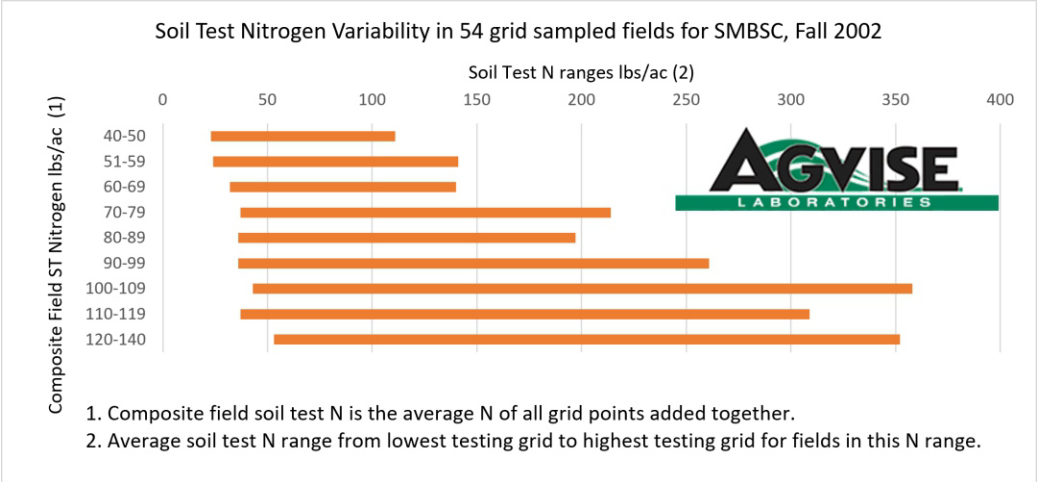

Figure 4. Soil test nitrogen variability in 54 grid sampled fields for SMBSC, information summarized by Agvise Laboratories. Notice that as average soil test nitrogen increases, so does the range between highs and lows.

This variability is due to many factors already discussed, but they all come back to water. Topography, soil textures, and the 10,000 years of history that have passed between Lake Agassiz and today. Hills always shed water, and the low spots always collect it. Plant growth, yields, and nutrient use are higher in areas that collect and hold water. So, an average 50-100 lbs of nitrogen on a soil test may mean there could be 150 on hilltops and only 30-40 in low spots (Figure 4).

Nitrogen losses will be higher in wetter parts of the field. Losses will also be higher if the nitrogen is near the surface vs in the subsoil.

5 What form is the nitrogen in?

Fall applied nitrogen is at an increased risk of denitrification losses, being so close to the surface. The degree of loss will depend on the type of fertilizer and how it was applied. Deep banded nitrogen is safer than shallow placed nitrogen. Deep banding is considered to be placement of 4 inches or deeper. Banded nitrogen is also generally safer because the concentrated bands suppresses microbial activity and conversion to more susceptible forms.

The form of nitrogen and when it was applied are additional factors to consider when assessing loss potential. Fertilizer placed into cold soils (less than 5°C) is slower to convert into susceptible forms. This is why fall application is not recommended before soils cool. Urea is also more readily converted to susceptible forms than NH3, is; this is why experts recommend waiting even longer before applying it in the fall.

If you are looking to learn more about denitrification losses in the Red River Valley, I would invite you to track down a thesis project prepared by Kevin Tiessen entitled “Efficiency of Fall-Banded Urea Fertilizer in Manitoba: Effect of Application Date, Landscape Position and Fertilizer Additives” for the Department of Soil Science at theUniversity of Manitoba.

I will summarize a few of the highlights for the purpose of this report:

- In delaying fall applications, we are trying to keep more nitrogen in the ammonium form that is not susceptible to loss. Conversions are very much driven by soil temperatures as seen in the following table:

Average soil temperature at band depth	Days for 50% conversion to nitrate	Days for 100% conversion to nitrate
1 °C	190	380
5 °C	40	80
10 °C	20	40
15 °C	13	25
20 °C	10	20

Table 2. Nitrification rates of ammonia to nitrate form-N from banded urea at 7.5cm (calculated from Tiessen et al, 2003).

- Nitrogen losses with early application did not always occur. It was only under extremely wet conditions where soils were saturated for an extended period of time in depression areas that significant losses were observed with early fall applications (Figure 5).

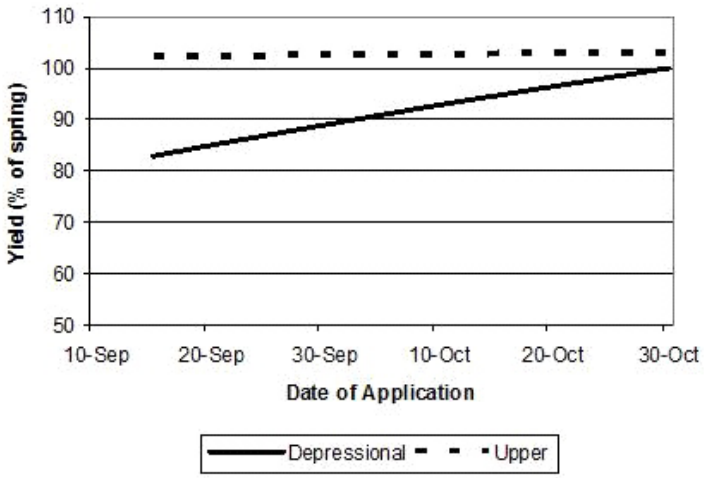

Figure 5. Effect of date of fall N application on spring wheat grain yields from fall-banded urea relative to spring-banded urea at depressional and upper slope positions at three sites near Winnipeg and one site near Brandon (2001-2002) (Tiessen et al, 2003).

IF nitrogen was broadcast applied as urea, early in the season, this would be considered a very high risk of loss in depression areas. So, the big question is how much are we potentially losing and how do we manage it?

Figure 6. Spring 2022 flooding in the Red River Valley of Manitoba.

In conclusion, heading into last fall, we already had nitrogen levels that were already quite variable in fields; add spring conditions that are conducive to increased denitrification, and we potentially have even more nitrogen variability that we will have to contend with.

There is a serious chance that some parts of your fields will have inadequate nitrogen levels to meet the needs of this year's crop.

In our next bulletin (Part 2) we will look at five strategies that can help you get a better understanding of your nitrogen variability and how to measure it. The good news is that nitrogen deficiencies can be fixed using a variety of sources, application methods, and timings.

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