

Nitrogen Cycling Through the Seasons and Management Considerations

Spring – Summer: Active Growing Season

Rising soil temperatures and longer days in spring kick microbial activity into high gear. With adequate moisture:

- **mineralization** speeds up as organic matter breaks down to ammonium;
- which then converts to nitrate through **nitrification** which is the form your crops can readily use.

Spring and early summer are when your crops are most nitrogen hungry. Rapid vegetative growth often pulls more nitrogen than the soil can naturally supply, making this your critical window for nitrogen management.

Management Considerations

The 4R Nutrient Stewardship practices – Right Source, Right Rate, Right Time and Right Place are a good framework to make nutrient management decisions that optimize your crop needs and minimize nutrient loss.

Right Time:

- Time your applications to match peak crop demand; you want nitrogen available.
- Watch the weather closely; heavy rains can leach nitrates where roots can't reach it, and waterlogged fields create the perfect conditions for **denitrification**, when nitrogen converted to nitrous oxide is lost into the atmosphere as a greenhouse gas.
- Split your applications: putting all your nitrogen down at once leaves more nitrogen vulnerable to loss. Apply what the crop needs at the start, coming back with more nitrogen when the crop hits peak demand.

Right Rate:

- Base your rates on actual soil test numbers to provide the right amount of nitrogen, reducing excess nutrients.

Right Source:

- Nitrification inhibitors and urease inhibitors slow down nitrogen conversion processes, reducing **nitrification** (ammonium converted to nitrates), **volatilization** (ammonium converting to nitrogen gas) and denitrification (nitrate converting to nitrogen gas).

Right Place:

Banding, injecting or getting nitrogen below the soil surface or under the canopy puts it where roots can access it and cuts down on surface losses.

Mid-season management: Hot, dry stretches of the summer season slow mineralization as microbes need moisture to function. Tissue tests during mid-season tell you what the plant actually has available for nitrogen and lets you know if you need to make adjustments rather than guessing.

Fall: Post-Harvest

Management Considerations

Fall can be spent building nitrogen back into the system by:

- Applying manure, compost or other organic amendments that will break down slowly over winter, mineralizing nutrients so they're plant-available by spring.
  - If you're applying nitrogen in the fall: Hold off until soil temps drop below 10°C, when it is cold enough that nitrification slows down.
- Establishing cover crops after harvest
  - Legume covers (clover, vetch, field peas) fix atmospheric nitrogen, adding nitrogen into the soil.
  - Grass and brassica covers scavenge residual nitrogen left in the soil, holding it in their biomass through winter instead of letting it leach away.

Winter: Dormant Season…?

Cold winters with steady frozen ground can preserve your soil nitrogen, minimizing both leaching and gas losses, but nitrogen cycling can still occur during what is considered the dormant season:

- Freeze-thaw cycles break up soil structure and release nutrients from dead roots and residue, creating short bursts of microbial activity. This can provide brief windows where **mineralization** and **denitrification** pick back up.
- Warmer winters with lots of freeze-thaw events may mean more N_2O gas losses to the atmosphere, losing nitrogen in the soil and contributing to greenhouse gas emissions.
- In the early spring, increased temperatures and snow melt lead to soil thawing, increased soil water content, microbial activity and loss of extra soil nitrogen through **leaching** (common in coarse textured soils) or **denitrification** (common in fine textured soils).

Management Considerations

- Cover crops with active root systems or good biomass through winter hold nitrogen in place and absorb precipitation, minimizing nitrogen leaching from rain or snowmelt.
- Plan for your next season: use the downtime to run your nitrogen budget based on last year's yields, current soil test results and what you're expecting to grow.
  - Factor in nitrogen removal rates for your specific crops, and credit any legume residual, manure applications, or mineralization.

Nitrogen management is not just a growing season issue and should be considered through each season.

READY TO TRY A NEW BENEFICIAL MANAGEMENT PRACTICE (BMP) FOR NITROGEN MANAGEMENT?

The On-Farm Climate Action Fund (OFCAF) program provides cost-share funding oppurutnities to implement Nitrogen Management BMPs. For more information, consult the program guide.

Funded under Agricultural Climate Solutions (ACS) – On-Farm Climate Action Fund (OFCAF) by Agriculture and Agri-Food Canada.