



Split Applications of Nitrogen in Canola and Wheat

This document was produced by SaskCanola, Sask Wheat and the Western Applied Research Corporation (WARC), to support growers who are currently participating in, or considering future participation in the Commissions' on-farm trial programs.

Split application of nitrogen is a practice that involves applying a portion of total applied nitrogen (N) at seeding but also withholding a portion to apply in-season based on yield and/or quality goals. Producers might consider this practice for several agronomic and economic reasons. Going into the growing season, weather conditions can be difficult to predict, and many producers might consider "holding back" on nitrogen rates at seeding to save costs. Instead of going "all-in" at the start of the season if the conditions are unknown, producers can wait until after the crop is up and growing to have a better idea of yield potential and crop conditions. If adequate and timely moisture is received throughout the season, producers might top up with post-emergent nitrogen to support potential higher yield and quality. Remember that any fertility program needs to consider the 4R's: right rate, right timing, right place and right source.

There are potential benefits to split nitrogen applications. This practice can be a way to help manage risk by

decreasing leaching and denitrification losses by only applying what the crop needs, when it needs it. Adding additional nitrogen to the crop in-season can potentially increase quality and yield. However, there are mixed results from across the prairies on yield and protein advantages in wheat mainly due to in-crop precipitation received and timing of the application. Applications made earlier in the season are more beneficial to yield while later applications contribute less to yield and more to protein increase. Signs of nitrogen deficiency show up in older leaves as they start to pale or turn yellow. Tissue testing is a great method to help identify N deficiency in-crop. Also, split applications have the potential benefit of supplying higher nitrogen levels without the increased risk of lodging that comes with applying all nitrogen at seeding. Splitting applications may help logistically - less nitrogen required at seeding results in longer intervals between fills, resulting in more efficient seeding. Some research has shown that split applications, under the right circumstances, reduce emissions compared to shallow or deep urea applied during seeding.



Volatilization: loss of nitrogen applied to the atmosphere as ammonia gas.

Leaching: nitrogen loss when soil becomes excessively wet and can no longer hold any more water. Water then moves through the soil profile and nitrogen is carried with it or runs off the surface.

Denitrification: nitrogen loss through the conversion of nitrate to gaseous form such as nitrous oxide and dinitrogen gas when soils are saturated.

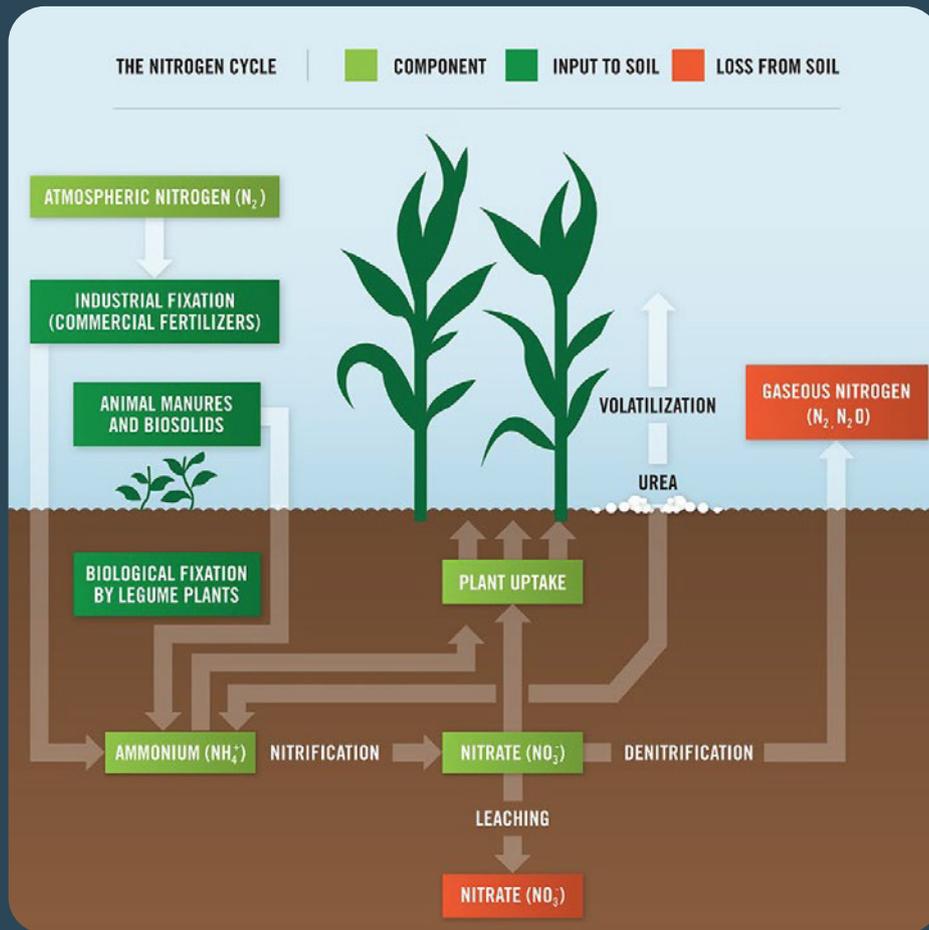


Figure 1: Koch Agronomic Services - The Nitrogen Cycle showing nitrogen losses of volatilization, denitrification and leaching. Knowledge Center - Koch Agronomic Services

What is the ideal timing for a split application of nitrogen in canola and wheat?

Nitrogen contributes to plant yield, biomass and protein. For most annual crops grown in Saskatchewan, most nitrogen uptake that contributes to yield occurs in the first few weeks following germination, as seen in Figures 2 and 3. Further nitrogen uptake, especially later in the season contributes to additional protein requirements.

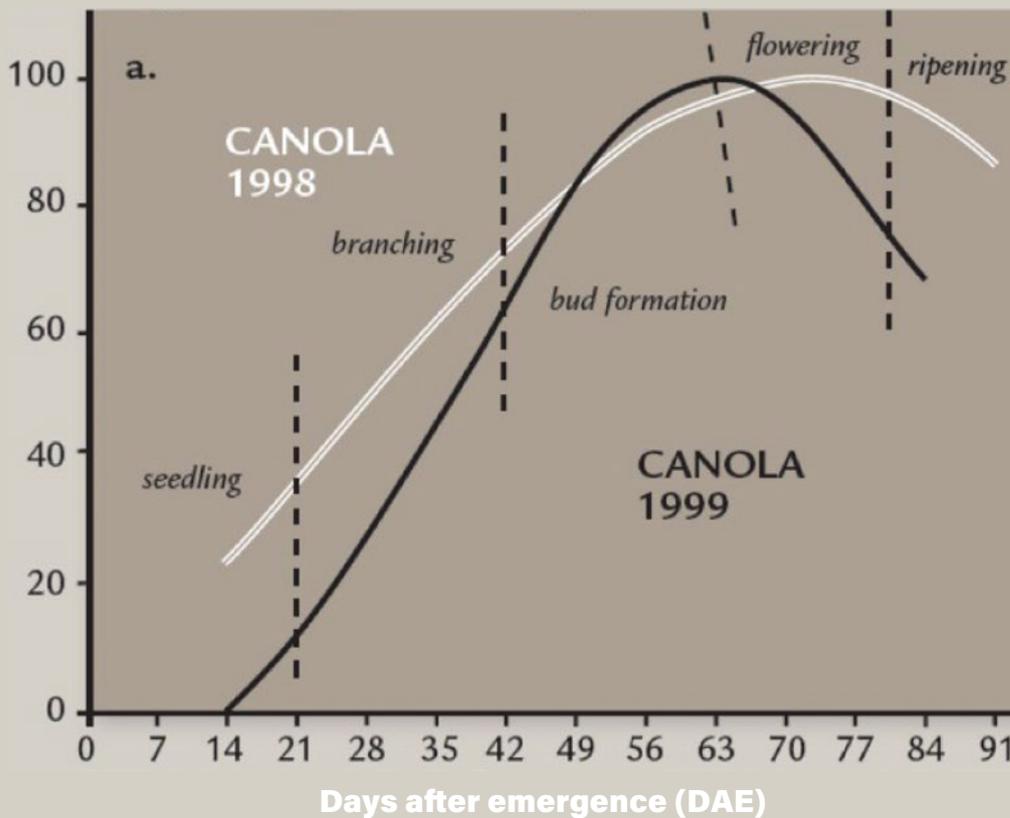


Figure 2: Adapted from Mahli et al; Nutrient Uptake and Timing in Canola, MSU.

In canola, the maximum rates of nitrogen uptake occur from the 5-leaf stage to full bloom. When top dressing, the ideal stage to apply the top up nitrogen is the 4-6- leaf stage, but there has been research shown that an application at early flowering can still be beneficial, though likely not as economical as applying earlier. When applying a liquid nitrogen source containing dissolved urea to plant foliage, some burn may be observed and allowing the crop a few days to recover before an herbicide application is the best practice to reduce overall plant stress. Nitrogen will extend the vegetative period and extend maturity. Watch the calendar date and consider the risk of a fall frost before making a nitrogen application.⁵

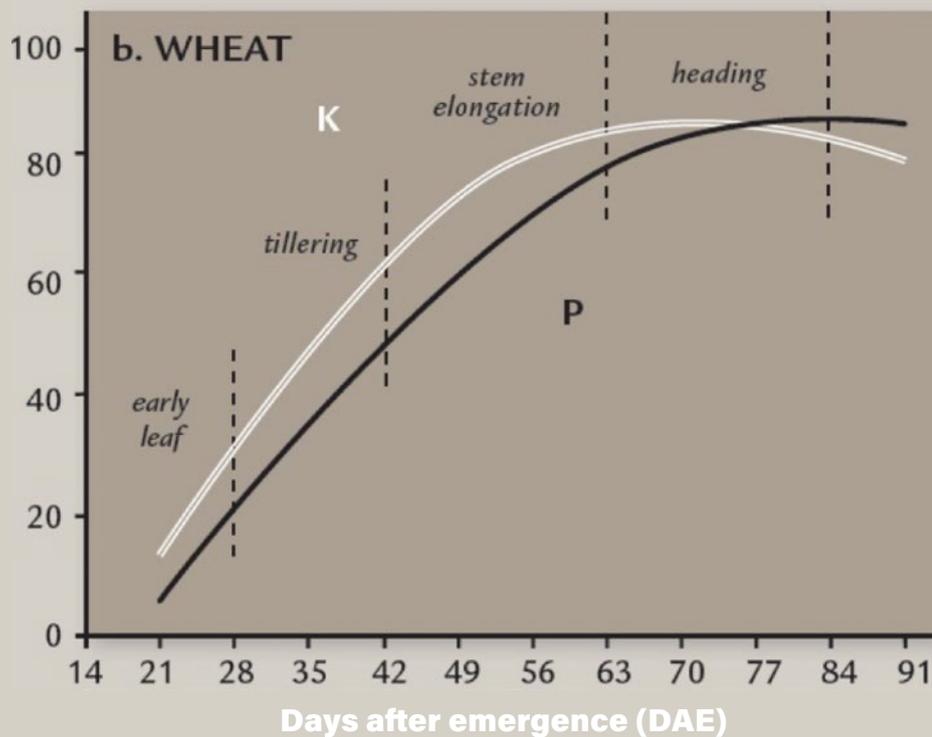


Figure 3: Adapted from Mahli et al; Nutrient Uptake and Timing in Wheat, MSU

As seen in Figure 3, the rate of nitrogen uptake is greatest during early growth stages. During the season, nitrogen is translocated in the plant to where it is needed with significant translocation to the seed as the crop matures.

In-season nitrogen application in wheat can be applied at different stages with varying results. Many studies across the Prairies have looked at timing from early 3-5 leaf, stem elongation/flag leaf stage and up until post anthesis. In 2022, trials were conducted to demonstrate the efficacy of various rates and timings of split applied N relative to applying all the N at seeding across Saskatchewan. While the efficacy of split applications varied between locations based on environmental conditions, economic returns were usually increased when UAN was dribble banded early at the 3-5 leaf stage compared to a late application at early flag₂. Early applications usually yielded more, and late applications usually resulted in higher grain protein. However, the value of increased grain protein from late applications in this study was not enough to compensate economically for the yield loss.

Nitrogen applications made in later stages in the season will impact protein. Once wheat has surpassed anthesis stage (heading), nitrogen applications are not recommended as chlorosis can occur.

What products are available for in season applications?

There are a range of products that are recommended for use with split applications. Which product is best will depend on the crop you're applying it to, your operation, equipment and goals.

Product	Form	Application	Note
46-0-0 (Granular urea)	Granular	Broadcast	High losses from volatilization are possible if urea on surface is not moved into soil with moisture.
46-0-0 (Dissolved urea*)	Liquid	Dribble banded	Urea diluted with water (50:50) to lessen risk of crop damage. High potential losses from volatilization if urea remains on soil surface.
28-0-0 (UAN: dissolved urea and ammonium nitrate)	Liquid	Dribble banded, jet nozzle	Volatilization losses from urea component of UAN are enhanced when solution is surface applied without incorporation under warm, windy conditions on alkaline, calcareous or drying soils. ⁶

* Caution is needed when dissolving urea as it is endothermic and can freeze lines. Dissolve slowly into warm water.³

Do I need to use a nitrogen stabilizer or inhibitor?

With split applications it is often recommended to use a nitrogen stabilizer or inhibitor product to help protect from losses. Of particular concern are volatilization losses of ammonia from granular or dissolved urea that is surface applied and then remains on the soil surface due to dry conditions. A urease inhibitor product can help protect against losses for around 2 weeks until a rainfall event can move the product into the soil. Consult your agronomist or agricultural retailer for the most up-to-date and complete list of compatible products.

Form	Chemical	Notes
Urease inhibitors*	NBPT	Slow the transformation of urea to ammonium, which can convert to ammonia gas and be lost by volatilization
Nitrification inhibitors	DCD, DMPP	Delay the conversion of ammonium to nitrate, which is the form of nitrogen vulnerable to loss by denitrification (conversion to dinitrogen and nitrous oxide gas) or leaching
Dual inhibitor products (Urease + Nitrification)	NBPT+DCD, DMPP	Reduce losses of both ammonia and nitrous oxide. The benefits of a dual inhibitor can be more significant than a single inhibitor.
Polymer coated urea	ESN	Provides controlled release - not recommended for use in split applications because it may not release the N in time to produce an economic yield response. ⁵

*In UAN the addition of urease inhibitor only protects the urea fraction from volatilization losses for a period of time (up to 15 days for Agrotain). If you apply UAN when there is no rain in the forecast to move it into the soil use a urease inhibitor.



What rate should I use?

The rates for a split application used will vary from farm to farm, depending on practices, yield and quality goals. Past research conducted has focused on applying 75% at seeding, and 25% as a top up application, while some farms may apply 50% of their nitrogen at seeding and add the remaining 50% as a top up application. In canola, at least 20% of the targeted nitrogen rate (in actual lbs.) is recommended as a "top up".⁵ Work done at the AgriARM sites in Saskatchewan on wheat and canola has found it is best not to withhold anything more than about 30lb N/ac at seeding.²

How should I apply my in-crop application?

Accurate and uniform application of in-crop nitrogen applications is the key to success. How the in-season nitrogen is applied will depend on what equipment is available and what form of nitrogen is being applied. Broadcasting urea or dribble banding UAN are the most common and fastest application methods. Dribble banding is effective to minimize leaf burning and volatilization compared to a foliar application with a fan nozzle, as most of it is taken up by the roots instead of foliage. Top dressing a granular product with a floater before a rain or irrigation water application is also a common practice in Saskatchewan.

Note that foliar broadcast spray can cause significant leaf burning – if using this method, consider diluting UAN with water. To minimize burn from a foliar spray, keep nitrogen rate below about 20lb N/acre.

What are the recommended nozzle types?⁴

Nozzle Type	Notes
Flat Fan	Not recommended for liquid UAN as it can increase crop injury (leaf burn).
Flood	Not recommended for liquid UAN as it can increase crop injury (leaf burn).
Streamer	Excellent option if boom height can be managed. If boom is too low, gaps in spray coverage can occur and if too high, could cause overlap and cause crop injury. Significantly reduced crop injury when applying UAN.
Streamer Bars	Uniform coverage no matter boom height, topography or wind. Possibly the best choice. Delivers nitrogen to the crop vertically and allows for even distribution at various boom heights, unlike streamer nozzles.

Additional information on nozzles can be found here: [Equipment for top-dressing fertilizer | Canola Council of Canada](#)



What are the best conditions for a split nitrogen application?

Sufficient moisture is vital for a successful split application. Significant rainfall after application (15 mm or more) is needed to move nitrogen into the soil, otherwise nitrogen stranding at the surface with risk to loss from volatilization and/or temporary N tie-up from immobilization can occur.⁵ Note that most research conducted on split application of nitrogen where a positive outcome occurred was due to moisture events in season.

If using a granular product, make sure leaves are dry during application so fertilizer prills roll off onto the ground and don't cause leaf burn. If using a liquid product, apply when leaves are moist from early dew or light rain, so it runs off quickly. Evaporative losses are also reduced during this time. Application when conditions are hot, enhance leaf burn. Do not apply 28-0-0 under extreme heat.

What are the disadvantages to split applications of nitrogen?

As with any practice, there are risks associated with split nitrogen applications, and so, knowledge and setting expectations beforehand is important.

Disadvantages to keep in mind begin with an additional cost associated with another field application including fuel, time and labour to be considered. This additional field operation is often happening at the same time as in-crop herbicide and insecticide applications, which can stretch resources.

It is important to keep in mind potential crop injury can occur through leaf burn. This is especially true if the product is applied in less-than-ideal conditions or significant moisture is not received after application. To reduce leaf burn, avoid applications when the crop is stressed or during hot and dry conditions, and increase water volumes and reduce direct contact with the leaves.

There is also the potential for having a nitrogen deficiency early in the season at the time of high crop N demand in high yielding wheat or canola if there is not enough nitrogen supplied at the start of the season. By the time the in-crop application is made it may be more of a rescue treatment instead of trying to improve yield or quality. This is another reason why it's important to follow the 4R's with any fertility program.

Finally, as we have seen in previous research there is the risk that split application might not result in expected yield or protein goals. It is important to keep expectations realistic based on timing, product, application method and weather conditions.



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6. **Manitoba Agriculture. 2007. Manitoba Soil Fertility Guide.** [Province of Manitoba | agriculture - Soil Fertility Guide \(gov.mb.ca\)](https://www.gov.mb.ca/agriculture/soil-fertility-guide/)

For more information on split nitrogen applications:

1. [In-crop N application to wheat - Canadian Agronomist](#)
2. [MCA - Wheat-Factsheet - Spring-Wheat-v5.pdf \(mbcropalliance.ca\)](#)
3. [Optimal source, placement and application timing for yield and reduction of greenhouse gas footprint for canola production on light texture soils — SaskCanola](#)
4. [Canola AgriScience Cluster Theme 4: Sustainability and Climate Change - Improving Nutrient and Water Use Efficiency —SaskCanola](#)
5. [In-crop nitrogen fertilizer application - Top Crop ManagerTop Crop Manager](#)
6. [Tips to apply nitrogen and sulphur in season | Canola Council of Canada](#)
7. [Microsoft Word - Top-dressing Durum with Nitrogen to Manage Protein.doc \(iharf.ca\)](#)
8. [nitrogen-splits-for-wheat.pdf \(manitoba.ca\)](#)

