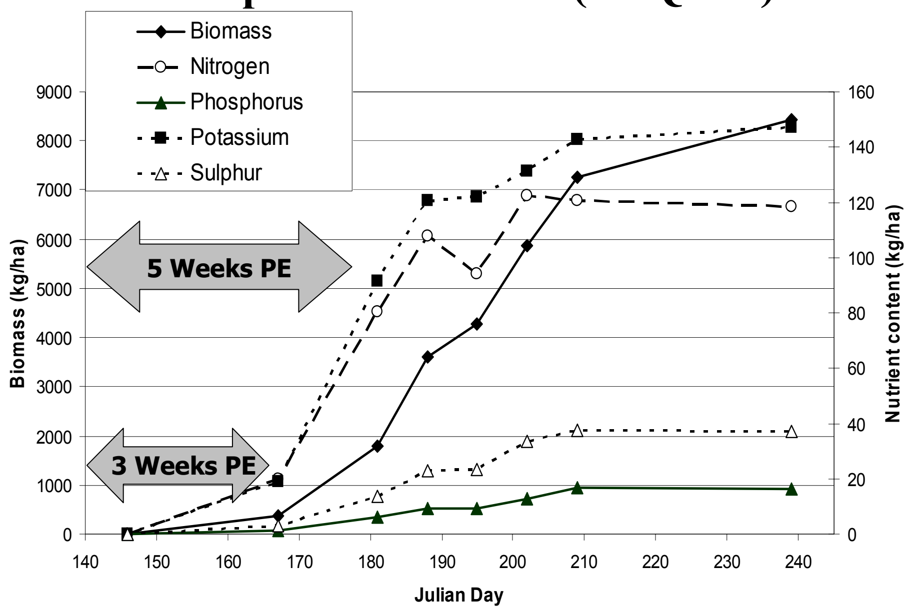
Nitrogen – Split Application

Split applying crop nitrogen needs is a tool that is gaining widespread popularity among Canadian producers. Many producers view the technique as a risk management tool for dry land cropping, while other growers consider this practice as a way to manage plant nitrogen uptake more efficiently. The gain in popularity has been brought on by many factors. These include increased scientific research into split application and post emergent fertility; the advent of new technology capable of applying nitrogen post emergent; poorer soil moisture reserves at seeding; and increased producer awareness of nitrogen use efficiencies, especially in an era of escalating nitrogen prices.

Figure 1 - Biomass Accumulation and Nutrient Uptake for Canola (cv. Quest)



Adrian Johnston - AAFC, Melfort

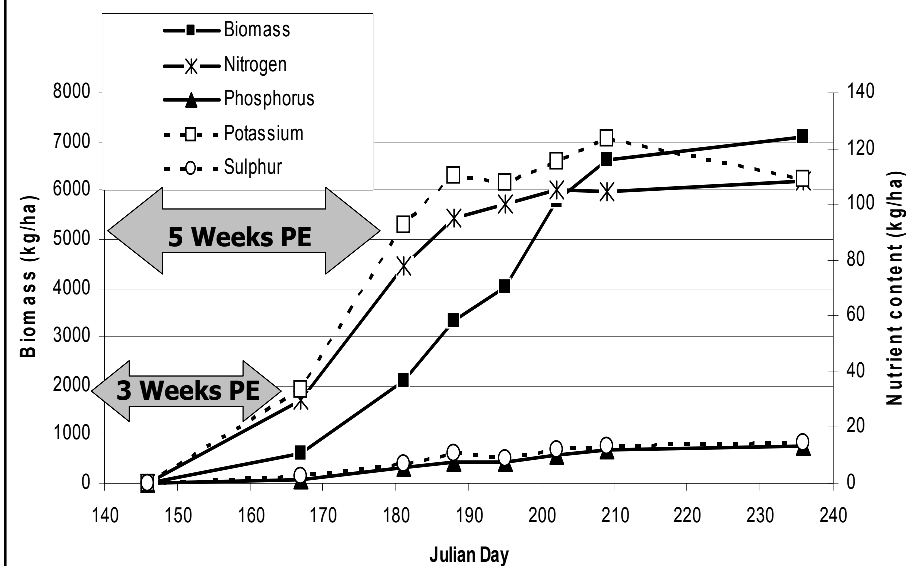
In most cases, nitrogen fertilizer is the most costly major nutrient in any fertilizer program. By placing all the nitrogen requirements at seeding, a producer must rely on adequate rainfall during the growing season so the crop can efficiently utilize the nitrogen. Split application is the process of matching nitrogen supply for a preestablished target yield and a given level of soil moisture, and then supplying the remaining nitrogen as moisture conditions improve.

Split applications of nitrogen give producers greater flexibility in their fertilizer program. This practice minimizes the risk of placing all the nitrogen at the time of seeding. By providing nitrogen to meet the changing demands of a growing crop, producers can potentially increase nitrogen use efficiency. Split application reduces the exposure of nitrogen in saturated soils where the potential for losses such as leaching and denitrification are increased. It also reduces the amount of product a producer must handle during the busy seeding period. Finally, proper timing and placement of nitrogen may help reduce nitrous oxide emissions, a very potent greenhouse gas.

Figures (1 & 2) show the biomass accumulation and nutrient uptake for both canola and wheat. Both graphs are consistent in showing a slower rate of biomass accumulation and nitrogen uptake in the initial three-week period following emergence. At the three to five week period after emergence, the plant enters the vegetative phase of its life cycle where the rate of biomass accumulation and nitrogen uptake increases rapidly. Past the five-week period after emergence, we see a reduction in both biomass accumulation and nitrogen uptake as the plant begins the next phase in its life cycle.

The figures also indicate 75 to 80 percent of the crops' nitrogen requirements are taken up in the period within five weeks after emergence. This nitrogen plays a key role in determining crop yield. Nitrogen split applications, therefore, require timely management decisions. With the scenario of poor soil moisture reserves, a producer may decide to split apply nitrogen. Enough nitrogen must be placed at seeding to ensure early season growth. If moisture conditions improve shortly after seeding, the second nitrogen application must be made within the three to four week period after emergence. The amount of nitrogen applied and the timing of the second application will depend on the amount of nitrogen fertilizer placed at time of seeding, the producer's yield goals, and the spring soil moisture conditions**.** In essence, placing the second application at an earlier stage, rather than a later stage, will have a greater impact on yield. The degree of impact will depend on the amount of nitrogen placed at seeding and the amount and timing of rainfall received after application. As the timing of application increases past the five week period, additional nitrogen may increase grain protein concentration but not necessarily grain yield.

Figure 2 - Biomass Accumulation and Nutrient Uptake for Wheat (cv. AC Barrie)



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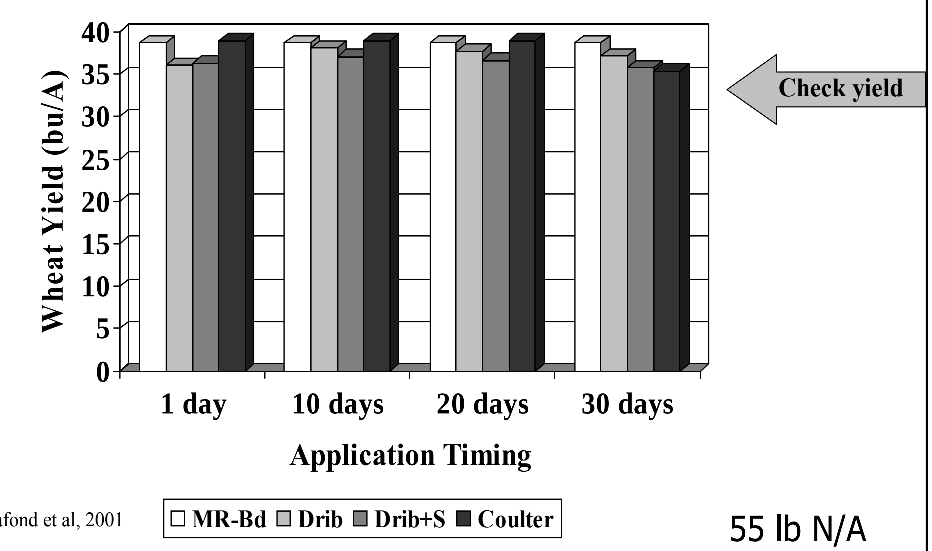
Research on wheat and canola conducted at Indian Head, Saskatchewan also showed favorable yield and protein results when split applying nitrogen (Figures 3, 4, and 5). In this project, the nitrogen application was conducted at intervals of 1, 10, 20, and 30 days after seeding. Starter fertilizer was applied at seeding. Both crops received actual 25 lbs nitrogen, 35 lbs phosphorous, 18 lbs potassium and 18 lbs sulfur. The nitrogen fertilizer forms used included urea placed mid-row at time of seeding followed up by sequential applications of urea ammonium nitrate and UAN + ammonium thio sulphate (5% v/v). ATS was added in the UAN band to determine if its presence would help improve nitrogen efficiency by reducing nitrification, the process that converts ammonium to nitrate. The rate of nitrogen applied to wheat was 55 kg/ha and 90 kg/ha to canola. The liquid fertilizer was applied with an applicator capable of applying the liquid fertilizer either as a surface dribble band or injected into the soil with a coulter. Both methods were at 30 cm (12 in) spacing.

Figure 3 - Wheat Response to Time of Fluid N Application – Indian Head, SK 2001



Lafond et al, 2001

55 lb N/A

The results indicate that all application methods and application timings for both crops showed comparable yield. All treatments also showed superior yield results when compared to the check yields. The addition of 5% ammonium thio sulphate to the UAN band did not show a significant yield improvement over UAN alone. The research suggests that post emergent applications can sustain yields providing the fertilizer applications can be made at an early stage of crop development rather than later stages.

A producer who undertakes post emergent fertilizer application may access the necessary equipment from a local Ag retailer, or choose to retrofit existing equipment. There are many methods that can be used to apply post emergent nitrogen, including surface banding, broadcasting, coulter injection, and spoke wheel injection.

Surface dribble banding involves the placement of a concentrated band or stream of liquid nitrogen on the soil surface. High clearance sprayers, pull type sprayers, floaters, or specially designed pull type applicators can be utilized to dribble 28-0-0 (UAN) onto the soil surface. When retrofitting a sprayer to apply liquid, producers require dribble band nozzles. The nozzles have one to three orifices to create the desired stream on the 20-inch centres common to most field sprayers. European nozzles have also entered the market, and include up to eight orifices. Producers can also purchase dribble bars that space liquid streams at four inches apart on the soil surface.

Surface broadcasting of nitrogen fertilizer applied post emergent can be accomplished with both liquid and dry fertilizer. UAN needs to be sprayed at low rates on the plant surface, as crop injury will result with increasing rates. Spraying UAN over the entire surface increases the potential for ammonia volatilization. Ammonium nitrate (34-0-0) or urea (46-0-0) can be broadcast on the soil surface. Although ammonium nitrate is preferred over urea due to its lower volatility, many ag retailers do not handle it or are unable to acquire it. When broadcasting surface granules post emergent, risk of ammonia losses through volatilization is always a concern so timing

Figure 4 - Wheat Protein Response to Time of Fluid N Application – Indian Head, SK 2001

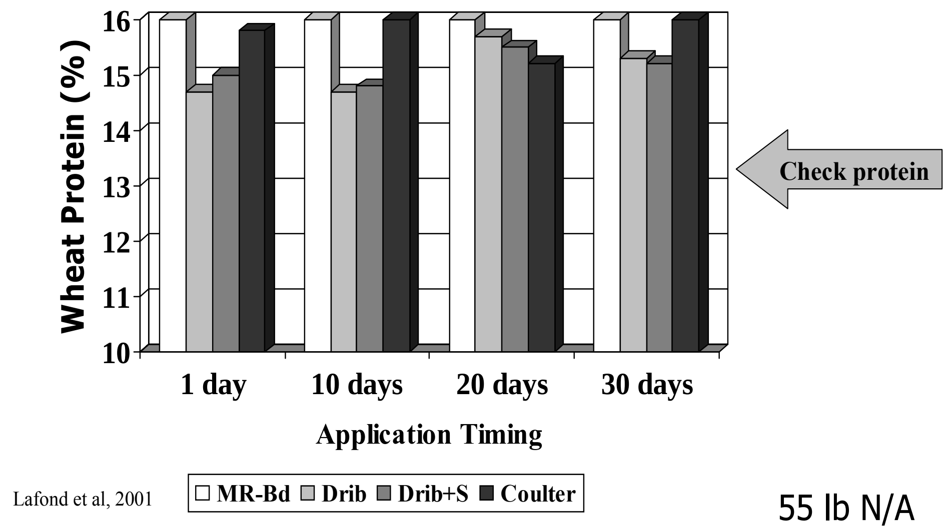
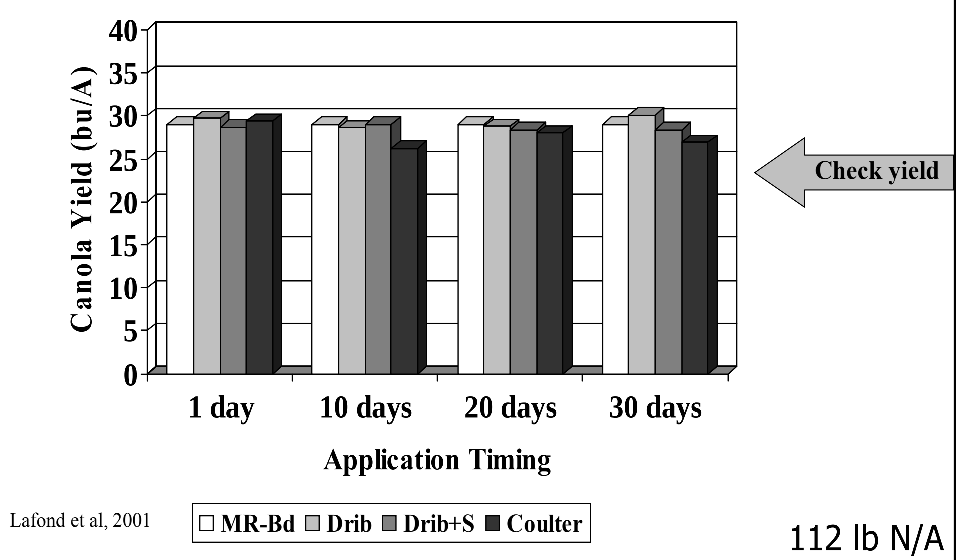


Figure 5 - Canola Response to Time of Fluid N Application – Indian Head, SK 2001



this event with precipitation to carry the nutrients into the rooting zone is required. If conditions are favorable for volatilization, producers can also utilize a urease inhibitor impregnated on the fertilizer granule. The inhibitor helps reduce the volatility of ammonia losses to the atmosphere (see Fact Sheet on Nitrogen Management Options in Direct Seeding).

Surface banding provides many agronomic advantages over broadcast application. First, the concentrated liquid fertilizer band will penetrate crop canopy more effectively than a broadcast application resulting in more fertilizer reaching the soil surface. Second, the application in a liquid band will decrease contact between the fertilizer and surface residues, thereby reducing the amount of nutrient tie-up or immobilization of nitrogen in the surface trash. Third, the application in a concentrated band reduces the risk of nitrogen loss through volatilization. Finally, surface banding reduces the risk of crop injury as the liquid is being dribbled onto the soil surface instead of being applied onto the crop foliage.

Disc or coulter machine applications place nitrogen fertilizer into the soil once the crop has emerged, and provide minimal disturbance to the soil and emerging crop, improving root access to the nitrogen. This method also improves the efficiency of nitrogen use, as volatilization losses and nutrient tie-ups with surface residue are reduced.

A spoke injector places fertilizer into regularly spaced pockets or nests below the surface. Fertilizer nesting results in very low disturbance, and provides similar agronomic advantages to coulter banding.

Although split application is a good risk management tool when soil moisture at seeding is low, producers should be aware of potential problems. In most cases, the second nitrogen application is made at the time of post emergent spraying. This creates time constraints for producers, unless adequate help and equipment are available. In many situations, producers undertake post emergent spraying for weeds in the morning or evening when the wind is down, and place the second nitrogen application during the day when the wind tends to be stronger.

Second, June tends to be the wettest month of the year, so a period of downtime may occur causing producers to miss the window of opportunity for that second nitrogen application. To avoid problems with delayed application, producers must ensure that adequate starter nitrogen is applied at seeding. This avoids nitrogen limitations between seeding and the second nitrogen application.

If the soil is full of water at seeding, there is likely little advantage to split applying nitrogen due to the increased risk that the N may not get to the crop in time to optimize yield potential. The keys to success when using split nitrogen application are timely rainfall, and adequate nitrogen application rates at seeding time. This helps carry the crop without hampering yield, until the second nitrogen application can be made. From an economic perspective, the additional costs of split applying nitrogen must be justified by increased yields or protein content.

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Greenhouse Gas Mitigation Program for Canadian Agriculture

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Agriculture et Agroalimentaire Canada — Agriculture and Agri-Food Canada

Canadian Cattlemen's Association

Canadian Pork Council — Conseil canadien du porc

Dairy Farmers of Canada — Les Producteurs laitiers du Canada

The Soil Conservation Council of Canada