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Post-emergent Nitrogen Applications Have Potential for Increasing N-Use Efficiency in Spring Grains

Provisos are that some starter N is applied at time of seeding, but the amount of starter N is dependent on how much risk the grower is willing to assume by going with more N after crop emergence.

SUMMARY

The results from the Indian Head, SK site showed that a minimum of 33 percent of the total nitrogen (N) fertilizer required for spring grains should be applied at seeding time to ensure that none of the yield potential is lost. We speculate that 50 percent of the total N required should be applied at seeding to further minimize the risks. With spring wheat, applying the N as late as the 5-leaf stage did not appear to reduce grain yields. With canola, applying the N as late as the start of flowering did not affect grain yields. In conclusion, post-emergent N applications have the potential of increasing the flexibility of N management, providing that some starter N is applied at time of seeding. The proportion will be dictated by the agro-ecological zone and by the risk that the producer is willing to assume.

Nitrogen is the most limiting nutrient in crop production. When the increasing need for environmental sustainability is combined with increasing demands for food and fiber and current global trade policies, and then all of that is superimposed on the need of producers to remain economically viable, attention has to be focused on the efficiencies at all levels of the production cycle. Nitrogen use efficiency (NUE) is only about 33 percent and much attention is currently being focused on ways to improve NUE. Nitrogen fertilizer production is very energy intensive and N can easily be lost from the cropping system through

1) leaching, 2) NH_3 volatilization, 3) surface runoff, and 4) denitrification, not to mention the nitrous oxide emissions during the nitrification process. Nitrous oxide is a very potent greenhouse gas and use of N fertilizers has a direct effect on emissions, the extent of which varies with agro-ecological zones. Nitrogen fertilizers also represent a significant proportion of the overall variable cropping costs and account for over 65 percent of all energy requirements needed to grow a crop. The recent increases in oil and natural gas prices, N supply, and demand factors are having a direct impact on the price of N fertilizers. These economic conditions are stimulating many agronomic questions related to management practices needed to attain higher NUE.

A number of studies have been conducted in the last few years to examine the merits of post-emergent N applications using UAN solution and surface dribble applications as a way to apply N closer to the time of crop needs. Studies have shown that this approach was feasible but it was not without risk and never was better than putting all the fertilizer on at the time of seeding as is currently done in a one-pass, no-till seeding and fertilizing system. The studies concluded that the unpredictability of rainfall increases the risks of surface dribble bands because some rainfall is required to move the fertilizer into the soil. In 2003, where no significant rainfall was experienced for the critical part of the growing season, yield losses were experienced with post-emergent N applications due to the inability of the crops to access the N stranded at the surface. The studies also showed that even

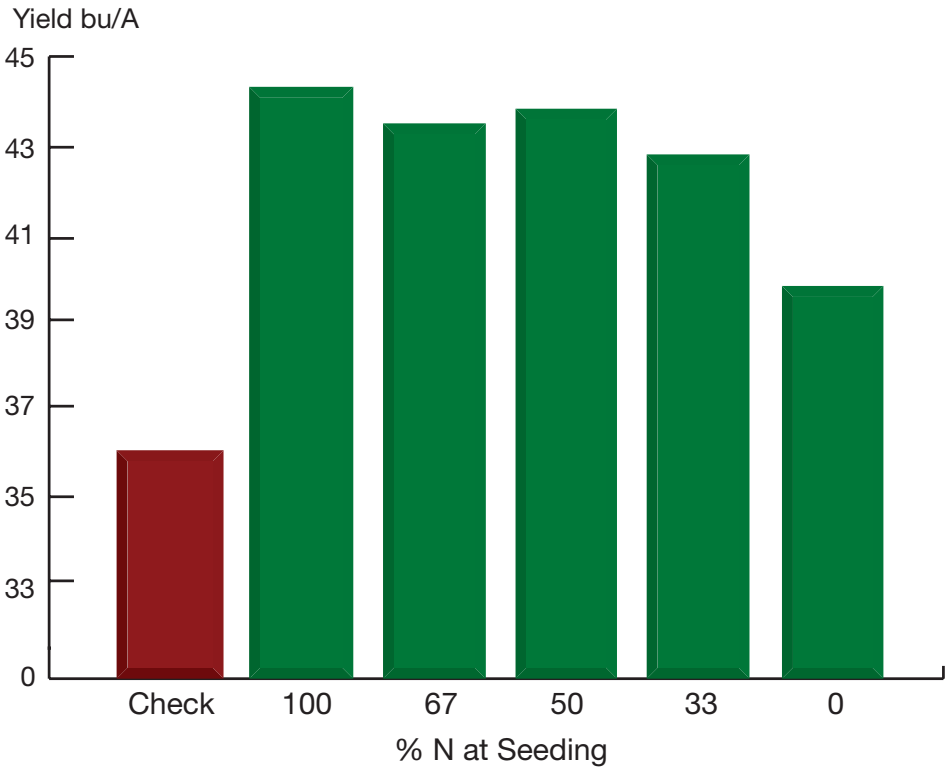

Figure 1. Effect of N starter levels on spring wheat yield via mid-row banding, Indian Head, SK, 2004

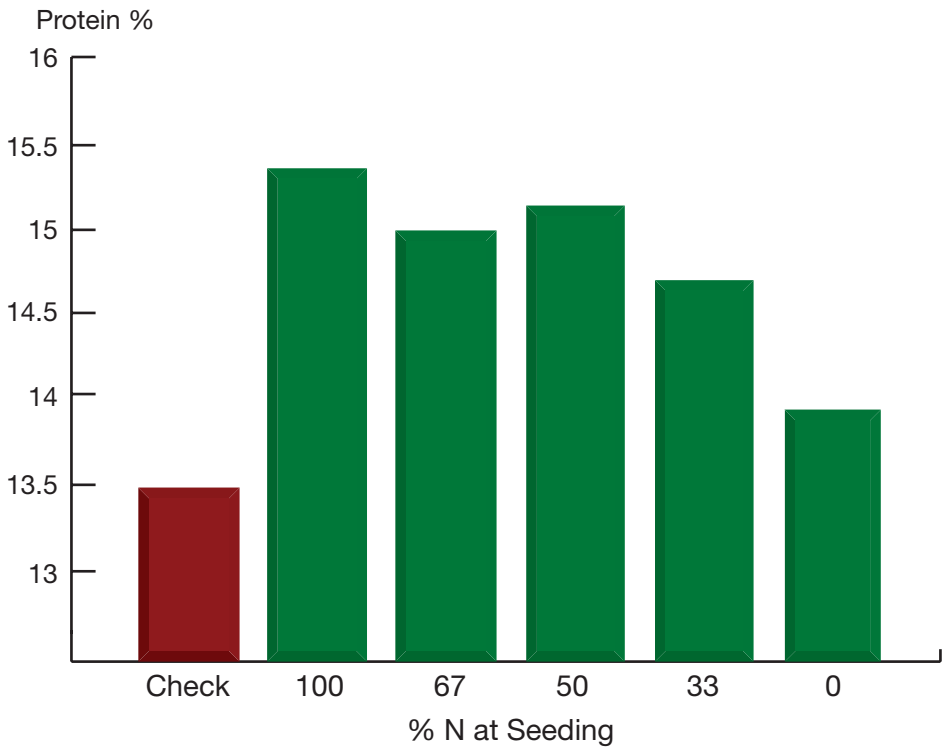

Figure 2. Effect of N starter levels on grain protein of spring wheat via mid-row banding, Scott, SK, 2004.

when a coulter was used to place the fertilizer in the soil in a year like 2003, the yield potential was still not regained. In situations of adequate and timely rainfalls, the coulter provided no advantages over the surface dribble bands. The conclusion was that some N would need to be applied at time of seeding and the proportion would more than likely be greater than 33 percent of the recommended N needs.

There is also an urgent need to determine the latest crop stage feasible for applying the N fertilizer without jeopardizing the crop's yield potential. The other important aspects of this approach deal with risk management of N applications, especially in the drier areas of the Northern Great Plains. Rainfall unpredictability is such that producers are looking at approaches such as post-emergent N applications where all the fertilizer does not have to be put down at time of seeding. Also, with the development of active optical sensors, it is possible to increase NUE based on crop N need and application timing but we need to understand the risks of post-emergent N applications.

The objective of this study was to quantify more accurately the risks associated with post-emergent N and how to reduce them.

Spring wheat

Indian Head site, 2004. Response to N starter levels on yield is shown in Figure 1. Overall, grain yields were higher where some starter N was used at seeding, with the balance applied as a surface dribble band, than when all N was applied as a surface dribble band. Adding just 33 percent of the total N requirements at time of seeding, with the balance applied post-emergently, resulted in yields similar to applying all N at the time of seeding. However, the dry year of 2003 showed us that applying 33 percent of needed N at the time of seeding was not enough. Where no N was applied at seeding and all N was applied post-emergent, the yields were better when applied at the 3-leaf stage than the 1- or 5-leaf stage. This may simply reflect better rainfall immediately after the surface application, again emphasizing the need for rainfall to move N into the soil.

Scott, SK site 2004. There was no significant overall grain yield or grain protein (Figure 2) response to N. An August frost and elevation differences were probable causes.

Indian Head site, 2005. We observed an overall response to N and no differences between treatments where all the N was

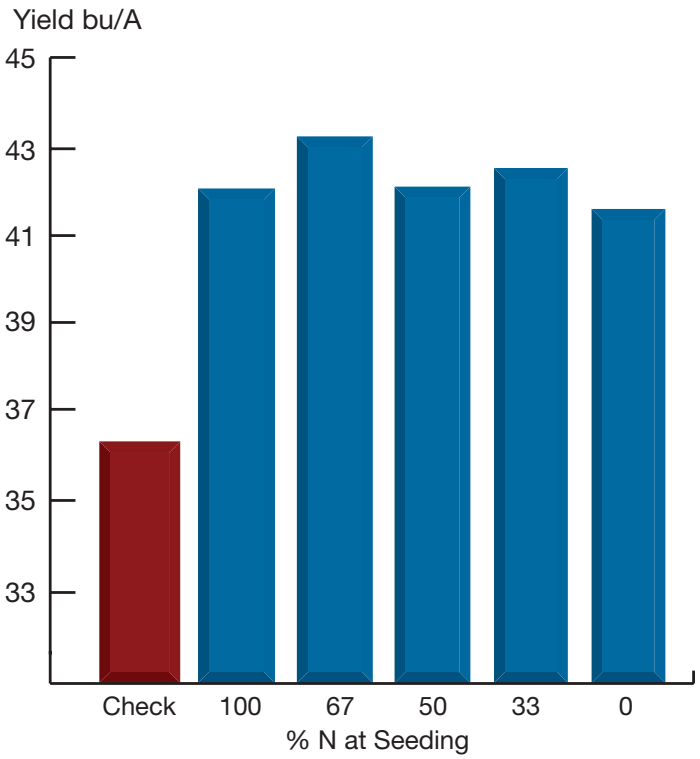

Figure 3. Effect of N starter levels on spring wheat yield via mid-row banding, Indian Head, SK, 2005.

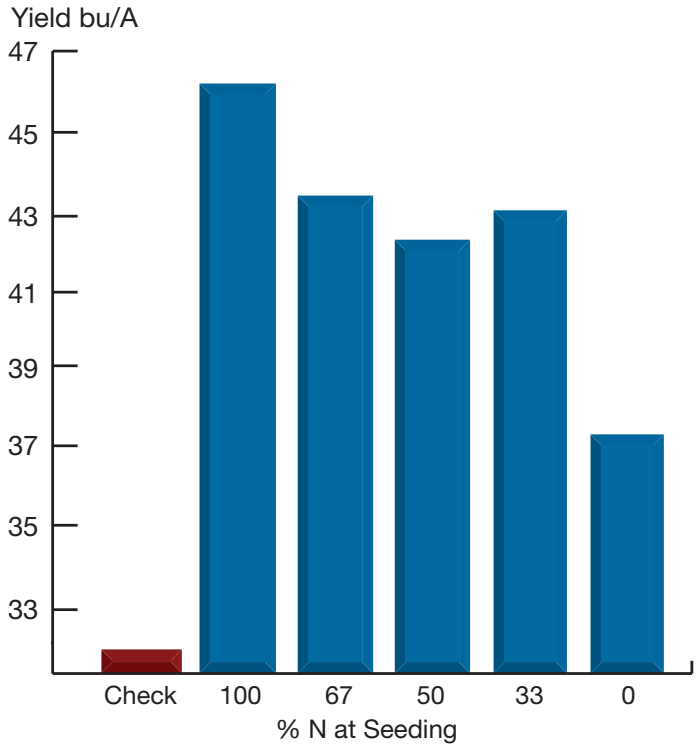

Figure 4. Effect of N starter levels on canola yield via mid-row banding, Indian Head, SK, 2005.

applied at seeding versus all or part after crop emergence (Figure 3). However, yields were higher where some starter N was applied at seeding relative to no fertilizer, even if only 33 percent was applied as a starter N application.

Scott site, 2005. There was no grain yield response to N and no significant treatment differences. However, there was a small effect on grain protein.

Canola

Indian Head site, 2004. There was a grain yield response to N. We also observed wheel traffic effects with all timings of post-emergent N applications, with the largest effect occurring at the last two application dates. Similar to spring wheat, applying some N at time of seeding was better overall than applying all the N post-emergent. Adding 33 to 67 percent or more of the fertilizer N requirements at seeding, combined with the two earliest dates of post-emergent application, was capable of protecting grain yields.

Scott site, 2004. There was no overall N response, hence no conclusions can be made.

Indian Head site, 2005. An overall N response was observed on yield (Figure 4), as well as an effect due to wheel tracks. At all stages of post-emergent N applications, providing that at least 33 percent of the target N was applied, there was no significant reduction in yield. However, if all N was applied after crop emergence, there was a significant drop in grain yield.

Scott site, 2005. Providing that at least 50 percent of target N was applied at time of seeding, the post-emergent N application did not cause a reduction in yield. This is different from the results at Indian Head in 2005. The difference is a reflection of the overall drier growing season conditions at this site.

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