



## Nitrogen management options for Saskatchewan soybeans

CATEGORY [soils and fertility](#) | May 15, 2019

On land without a history of soybeans, dual inoculant provided a 24% yield benefit with an overall yield increase of 7 bu./acre (500 kg/ha). Starter N provided little yield benefit when good N-fixation was achieved. In-season N application could be used to rescue a poorly nodulated crop.

A three-year trial led by the Indian Head Agricultural Research Foundation investigated nitrogen management and inoculant strategies for soybeans grown in Saskatchewan. Because soybeans are a relatively new crop in Saskatchewan, the researchers investigated the benefits of dual inoculation, N fertilizer strategies, and the interaction between inoculants and N fertilizer.

The locations included Indian Head, Melfort and Outlook, Saskatchewan in 2015 through 2017 for a total of 9 site-years. All trial sites had no history of soybean production, except one site at Outlook in 2016 where soybeans were previously grown in 2010 and 2013. This site was analyzed separately.

The four N fertilizer treatments were 0 or 49 lbs. N/acre (55 kg N/ha) as side-banded urea, side-banded ESN or post-emergent surface dribble-banded urea ammonium-nitrate (UAN). Four granular inoculant rates of 0, 1x, 2x and 4x the recommended label rate of 4 lbs./acre (4.5 kg/ha) were applied. All treatments received seed-applied liquid inoculant and the surface-dribbled banded (SBD) UAN was targeted for early pod fill (R2-R3). In addition to the N applied as part of the

treatments, all plots received a blanket application of 51 lbs./acre (58 kg/ha) of monoammonium phosphate (11-52-0).

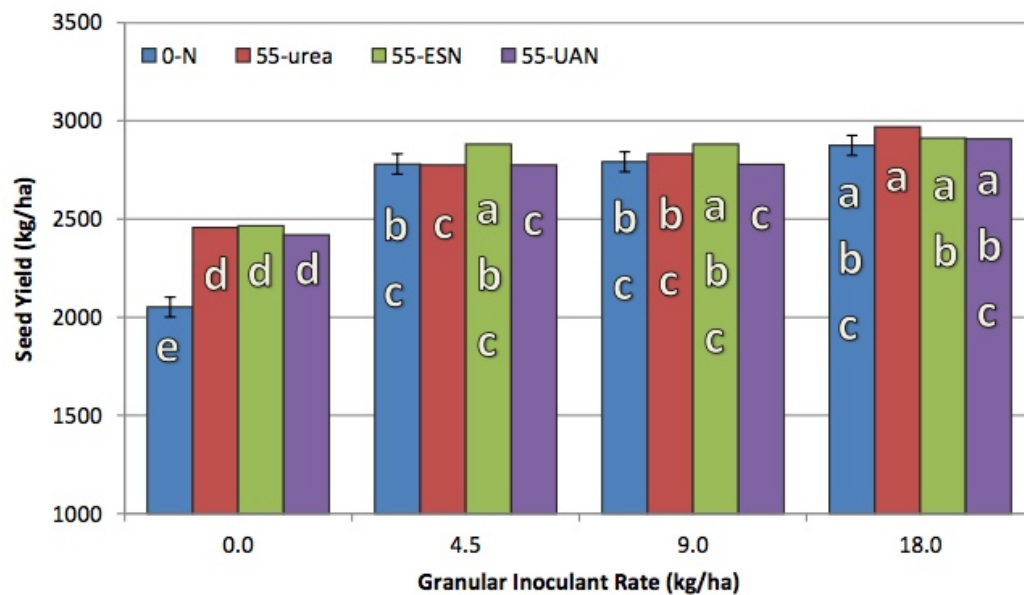
### Large N uptake and removal

A total of 72 to 215 lbs. N/acre (81-242 kg N/ha) was removed in the harvested seed, depending on yield at the individual site years with an overall average of 140 lbs. N/acre (158 kg N/ha). Based on uptake and removal studies by Heard (2006) where 88% of N uptake is removed in the harvested seed, the researchers estimated that total N uptake peaked at around to 82 to 245 lbs. N/acre (92-275 kg N/ha) with a mean of 160 lbs. N/acre (180 kg N/ha). The observed N removal and estimated peak uptake of soybeans in this study clearly illustrated the need for strong nodulation and subsequent N fixation to produce high soybean yields.

### Yield response to dual inoculation

Soybean seed yield averaged 40 bu./acre (2722 kg/ha) across all sites and treatments ranging from 23 to 60 bu./ac (1534 to 4030 kg/ha) with lowest production at Indian Head in 2017 where drought was a major limiting factor.

### Average soybean yield response to contrasting N management strategies and dual inoculation across 8 site-years in Saskatchewan.



Source: Holzapfel et al. 2017.

At the 8 sites with no previous soybean history, dual inoculation provided a 24% yield benefit with a mean overall yield increase of 7 bu./acre (500 kg/ha). At 5 out of 8 sites there was no benefit to increasing rates beyond the 1x label rate. At 3 sites (all in 2017) the highest yields were achieved with the 4x rate, presumably because of the dry spring and higher inoculant mortality. Given the added expense of applying higher than recommended granular inoculant rates, a labeled rate of inoculant should usually be sufficient for optimum yield.

At the one site, Outlook 2016, with a history of soybeans in rotation there was no practical benefit to dual inoculation. This is consistent with findings from the Manitoba Pulse and Soybean Growers Association that found single inoculation is likely sufficient when all the following conditions are met:

- 1) field has had at least two previous soybean crops;
- 2) previous soybeans have nodulated well;
- 3) most recent soybean crop was within the past four years; and
- 4) no significant flooding or drought.

<https://www.manitobapulse.ca/2016/05/soybean-fertility-fact-sheet>

### **Starter N not necessary with good inoculation and nodulation**

With poor inoculation, starter N rates of 49 lbs./acre (55 kg/ha) applied as side-band urea or ESN frequently, but not always, led to increased yields. However, these yields almost never reached the yields on plots with good nodulation and N fixation.

Starter N on the double inoculated treatments also had a negative impact on tissue and seed N concentrations in some instances. Because of the importance of biological N fixation, the added cost of starter N, and the lack of benefit with well-inoculated soybeans, the researchers do not recommend starter N applications with soybeans, even with low levels of residual NO<sub>3</sub>-N. They believe that the small amounts of N provided with P and S fertilizer products are likely to be sufficient to prevent yield limiting N deficiencies before biological N fixation can take over in the vast majority of cases.

### **In-crop applications as rescue treatments**

In the research, in-crop N applications were found to have a fit for mitigating yield loss when poor nodulation is suspected. Surface dribble-banded UAN at R2-R3 (early pod fill) increased yields by 5.5 bu./ac (368 kg/ha) when no granular inoculant was applied. However, the yields achieved with in-crop applications were still lower than on treatments where good inoculation was achieved.

Averaged across 8 sites, in-crop N applications recovered yield to approximately 88% of the yields achieved with dual inoculation while, for comparison, yields with no rescue application were 75%.

Liquid UAN also caused frequent and significant leaf burn. Granular urea may be more appropriate for in-season rescue N applications in soybeans.

---

Financial support specific to this project was provided by the Saskatchewan Pulse Growers. The organizations that completed the work also receive unrestricted funding from the Saskatchewan Ministry of Agriculture Agri-ARM applied research program and have strong working relationships with Agriculture and Agri-Food Canada, which must be acknowledged.

Holzapfel, C., Hnatowich, G., Pratchler, J. Developing Nitrogen Management Recommendations for Soybeans in Saskatchewan. Final Report 2017.

<https://iharf.ca/wp-content/uploads/2018/04/N-recommendations-for-Soybean-in-Saskatchewan-Final-Report.pdf>