

Does soybean need starter nitrogen fertiliser in Manitoba?

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Introduction

- In Manitoba, harvested soybean area increased by 40% in 2017 from 2016 to 2.29 million acres (Stat Canada, 2017)
- Low soil temperatures that commonly occurs in Manitoba at or after soybean planting has the potential to delay soybean's emergence, nitrogen fixation and plant growth (Zhang and Smith, 1994)
- In addition, average soybean seed yields in Manitoba is low : 2.3-2.6 t /ha. Application of starter N can stimulate early vegetative growth under stressful conditions and eventually increase seed yield (Osborne and Riedell, 2006)

Objective

To investigate the effect of low rates of N fertiliser at planting on growth, N fixation and yield of soybean in Manitoba

Materials and Methods

Field study initiated in 2015 and 2016 at University of Manitoba Research farm, near Carman, Manitoba (49°29'53N 98°01'47W). Site description shown in Table 1.

Experimental Design: RCBD with 4 replicates

Treatments : 0, 17, 34, 50, 67, 84 kg N /ha broadcast and incorporated as urea before planting

Crop Management : Soybean inoculated with *Brady-rhizobium* inoculant (Cell-Tech) seeded with target plant population of 444,600 plants /ha using 38.1 cm (15-inch) row spacing

Sample collection at R1 and R5.5 growth stages

- Biomass for above ground matter & N uptake
- Roots for nodule counts, nodulation index
- NI = Nodule dry weight / shoot dry weight
- Stem and petioles for relative ureide N (RUN) as a measure of N fixation.
- Ureide N (Goos *et al.*, 2015) and nitrate N content (Cataldo *et al.*, 1975) were used to determine RUN
- $RUN (\%) = (4 * Ureide N) / (4 * Ureide N + NO_3^-) * 100$
- Soybean harvested for seed yield.

Statistical analysis ANOVA was performed using Proc Mixed procedures in SAS version 9.4 (SAS Inst., Cary NC). Years were treated as fixed effects in the model due to contrasting precipitation patterns in each year (Table 1),

Results

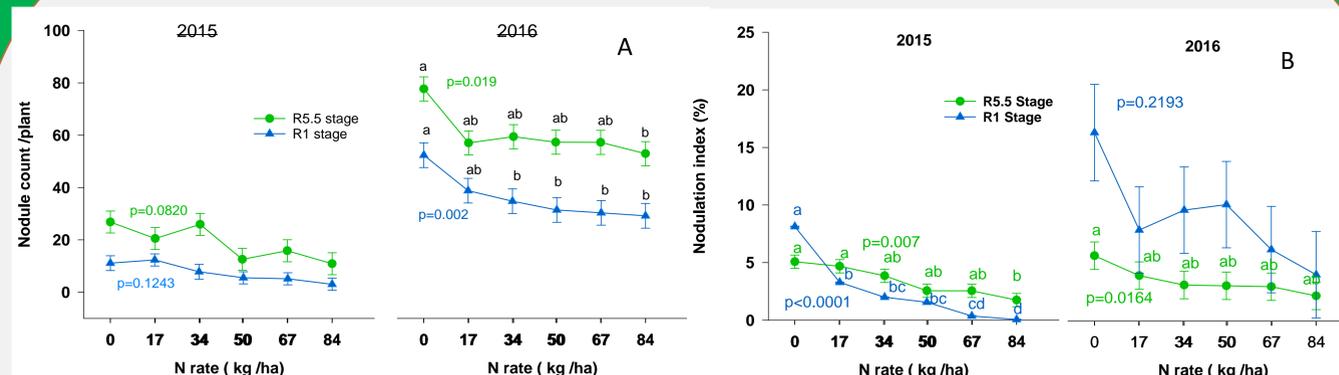


Figure 1: Effect of N fertiliser treatments on (A) nodule count per plant and (B) nodulation index (%) at R1 (blue) and R5.5 (green) stages of soybean at Carman, MB in 2015 and 2016. Means followed by same letters do not differ significantly at $p < 0.05$ by Tukey's test within each growth stage. Bars indicate standard error ($n=4$). P-value is the probability of significant response to treatment at each growth stage

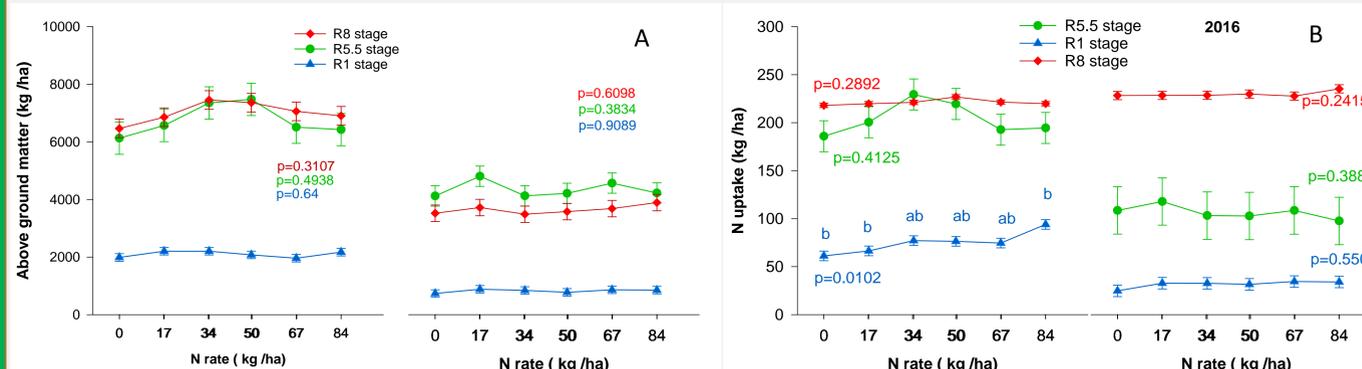


Figure 2: Effect of N fertiliser treatments on (A) above ground dry matter and (B) N uptake at R1 (blue), R5.5 (green) and R8 (red) stages of soybean at Carman, MB in 2015 and 2016. Means followed by same letters do not differ significantly at $p < 0.05$ by Tukey's test within each growth stage. Bars indicate standard error ($n=4$). P-value is the probability of significant response to treatment at each growth stage

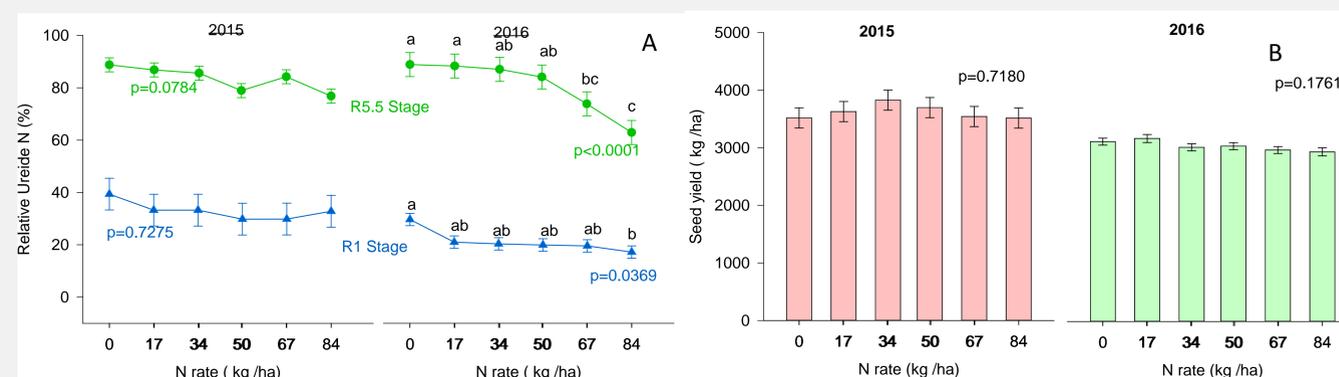


Figure 3: Effect of N fertiliser treatments on (A) relative ureide N (%) at R1 (blue) and R5.5 (green) stages of soybean (B) soybean seed yield at Carman, MB in 2015 and 2016. Means followed by same letters do not differ significantly at $p < 0.05$ by Tukey's test within each growth stage. Bars indicate standard error ($n=4$). P-value is the probability of significant response to treatment at each growth stage

Table 1: Site characteristics, nutrient analysis (spring soil tests) and growing season precipitation at Carman, MB in 2015 and 2016

	2015	2016
Soil name	Gleyed Black Chernozem (Elm Creek Series)	Orthic Black Chernozem (Winkler Series)
Soil drainage	Imperfect	Well
Soil pH	0-15 cm: 5.3 15-60 cm: 8.0	6.2 7.0
Soil nitrate N (kg /ha)	0-15 cm: 27 15-60 cm: 17	17 54
Olsen-P (ppm)	23	20
Potassium (ppm)	223	376
Organic Matter (%)	1.8	4.5
Residue	Spring wheat	Spring wheat
Total precipitation (mm; % of normal)	389 (105 % of normal)	451 (122 % of normal)

Key findings

- N fertiliser treatment >34 N kg /ha reduced nodulation significantly at the R1 stage in 2016 only, but this effect diminished at R5.5 stage except at the 84 kg N/ha treatment (Figure 1a).
- Nodulation index declined with increasing rates of N fertiliser (Figure 1b).
- N fertiliser treatments did not influence soybean above ground dry matter at any stage in both years of the study (Figure 2a).
- N uptake in above ground dry matter was only significantly higher at the highest N fertiliser treatment at the R1 stage in 2015 (Figure 2b).
- Relative Ureide N, as a measure of N fixation, decreased significantly at the highest N fertilizer treatments in 2016 at both the R1 and R5.5 stages (Figure 3a).
- N fertiliser treatments did not increase soybean seed yield in both years of the study (Figure 3b).

References

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Acknowledgements

