Effects of Pattern, Rate, and Forms of Nitrogen Application

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Introduction:

The use of nitrogen fertilizer in snap bean production varies greatly between growers of snap beans in the state of Wisconsin. Processing company field persons and, state agricultural extension persons recommend nitrogen rates which do not seem consistent with one another. Published fertilizer trials in the literature often seem to conflict with one another, and little attention is given to the nitrogen fixation capabilities or crucial components of nitrogen fixation in fertility studies. It is our intention to improve, or add some clarity to information on the structure underlying the debate on nitrogenfertilizer use in snap beans.

Materials and Methods:

Experimental design was a RCB factorial done over 2 years. The factors considered were:

1. Form of nitrogen fertilizer (Urea vs. Ammonium nitrate)
2. Rates of nitrogen (standard sidedress vs. reduced rates)
3. Pattern of application (uniform, wave, and declining)
4. Cultivar (True Blue vs. Evergreen)

Two snap bean cultivars True Blue and Evergreen were selected as typical of standard processing types. True Blue is quite vigorous and has responded to rhizobia inoculant. Evergreen is a more compact type and nodulates under field conditions, but has been an average in nitrogen fixation evaluations.

The forms of nitrogen side dressed were ammonium nitrate and urea. Appropriate amounts of each fertilizer were weighed each week and applied to their respective plots as a liquid solution incorporated after application.

Rates of nitrogen side dressed consisted of 67.2 kg/ha (60 lb/ac) or 33.6 kg/ha (30 lb/ac) of actual N total. Ammonium nitrate, 33.6 kg/ha (30 lb/ac) of N was applied to all plots as a preplant broadcast application.

The patterns of nitrogen application were labeled as uniform, wave, and declining. The uniform pattern consisted of proportional sidedressed amounts of nitrogen on a weekly basis starting at 10DAP and ending at 45 DAP, just prior to harvest. The wave pattern consisted of 2 side dress applications at 17 DAP and 38 DAP which reelects a typical commercial and university side dress recommendation. The declining pattern utilized 2 applications at 10 DAP and 17 DAP.

The experimental unit consisted of single row 1.67 meters long (6'). Rows were spaced 91 cm apart (36"). Seeds treated with Chloroneb and Metalaxyl were hand planted at a rate of 100 per length of row. Rhizobia inoculant was applied in furrow as granular implant. A post emergence application of frozen concentrate rhizobia inoculant was done 17 DAP. This was done to help ensure that the absence of rhizobia bacteria was not a limiting factor. The plots were mechanically harvested with a single row Pixall. The research site was the Hancock Agricultural Research station in Hancock, Wisconsin. The soil at this station is classified as a Plainfield loamy sand with 0.82% organic matter.

Results and Discussion:

No direct or indirect measures of nitrogen fixation were made in this initial study. All plots however, were noted to be moderately to well nodulated in both years of the study.

The condensed ANOVA presented (Table 1.) shows significant yield effects for cultivar, rates of nitrogen, and year. Significant second order interactions of (cultivar X pattern of N application) and (pattern X rate of N applied) are also observed. Implications of this research are that simply reducing nitrogen inputs to select lines with enhanced performance under lower input conditions with out consideration of the pattern of application may not achieve the desired results of high yield and reduced nitrogen inputs.

Table 1. Summary of Anova for yield 94/95 BNF2 experiment. Wisconsin. 1994-95.

Source	df	Seq. SS	Adj MS	F	P
Cultivar	1	27441084	27610324	432.97	0.000
Pattern of N applic.	2	198428	12618	1.99	0.139
Form of N	1	101977	92791	1.46	0.229
Rate of N	1	386986	371365	5.82	0.016
Year	1	5622956	5687501	89.19	0.000
Cultiv. X Pattern	2	1022757	537693	8.43	0.000
Pattern X Rate	2	386521	196219	3.08	0.048
Error	263	16771362	63769		

The ability of True Blue to maintain high yield under reduced nitrogen conditions (Table 2.) occurs only when the nitrogen was applied in the *declining* pattern. The cultivar Evergreen fails to maintain yields equal to the standard practice (high nitrogen applied in a *wave* pattern) in any of the reduced nitrogen side dress treatments.

Additionally these results indirectly suggest that further study is necessary to clarify complex interactions of cultivars, nitrogen fertilizer, and biological nitrogen fixation.

Table 2. Yield summary for side dress nitrogen applications in experiment BNF2. Hancock. WI. 194-95.

	Uniform N Application		Wave Pattern of N Applic		Declining Pattern N Applic	
Cultivar	60 lb N	30 lb N	60 lb N	30 lb N	60 lb N	30 lb N
	----------(tons/acre)----------					
True Blue	3.99 a	3.65 ab	3.77 a	3.51 b	3.84 a	3.96 a
Evergreen	2.39 c	2.13 d	2.56 c	2.10 d	1.78 e	1.82 e

* Numbers followed by the same letter are not significantly different at the .05 level of significance

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