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Nitrogen Response Patterns of Potato Varieties as Affected by Rate, Source, and Timing of Application

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Introduction

Potatoes grown in Minnesota are primarily used for processing with Russet Burbank as the main cultivar. While productive, this cultivar is susceptible to tuber uniformity and defect problems and requires high rates of N to optimize yields. New cultivars have recently been released from potato breeding programs with better tuber uniformity and less defects, but have not been tested extensively under Midwest conditions. Potatoes in the upper Midwest are often grown on irrigated, coarse-textured soils. Therefore, how these varieties respond to nitrogen (N) is important from both a production and environmental standpoint. Cost effective polymer coated fertilizers such as ESN (Environmentally Smart Nitrogen, Agrium, Inc.) may reduce the risk of N losses and have been documented to be an effective N source for Russet Burbank potato (Wilson et al., 2009a). Because the release characteristics of ESN can affect tuber set and bulking of potatoes, evaluation of this new technology is essential for adoption. The use of newer cultivars in combination with cost effective coated urea fertilizer technology has the potential to improve N use efficiency in potato.

Objectives

The overall goal of this research is to optimize N fertilizer management for new potato cultivars (Umatilla Russet, Premier Russet, and Bannock Russet) under Midwest growing conditions. Specific objectives include:

a)Determine the effect of N rate, timing, and source on tuber yield and quality of new potato cultivars, and
b)Evaluate the effectiveness of a cost-effective coated urea product on tuber yield and quality of the potato cultivars.

Methods and Materials

A two year study was conducted over the 2008 and 2009 growing seasons:

❖ Location: Sand Plain Research Farm, Becker , Minn.
- o Cultivars- Russet Burbank, Umatilla, Premier, Bannock (2009 only)
- o Soil – Hubbard loamy sand
- o 10 treatments each year in a RCBD, 4 replications (Table 1) with a split plot treatment arrangement. N treatment was the main plot and cultivar the subplot
- o Spacing was 91cm between rows and 30 cm within rows
- o Planted the 4th week of April ; vines killed the 3rd or 4th week of September
- oTubers were harvested and graded into size and quality categories
- oTubers greater than 112 grams considered “Grade A”
- o Means within each cultivar and year followed by the same letter are not significantly different at P=0.10 by LSD test.

❖ Nitrogen release from ESN was determined using a buried bag technique (Wilson et al., 2009b)
- o 3.00 grams fertilizer was placed in 5 cm x 5 cm plastic mesh bags and buried:
  - ▪ In the fertilizer band at planting (~ 20 cm below the top of the hill)
  - ▪ In the hill at emergence (~ 8 cm below the top of the hill
- o Bags were retrieved every 10-14 days and then air-dried.
- o Prills were separated from soil and then weighed. Weight loss was assumed to be due to N release.
- o Results reported only for 2008 since data are still being collected for 2009.

Table 1. Nitrogen fertilizer treatments – 2008 and 2009.

Treatment	Preplant	Planting	Emergence	Post-hilling**	Total
	---------- N sources* and rates (kg ha^{-1} N) ----------				
1	0	34 MAP	0	0	0
2	0	34 MAP	56 Urea	12 UAN x 4	136
3	0	34 MAP	78 Urea	23 UAN x 4	204
4	0	34 MAP	101 Urea	34 UAN x 4	272
5	0	34 MAP	56 Urea	46 UAN x 4	272
6	0	34 MAP	101 Urea	51 UAN x 4	340
7	169 ESN	34 MAP	0	0	204
8	237 ESN	34 MAP	0	0	272
9	0	34 MAP	169 ESN	0	204
10	0	34 MAP	237 ESN	0	272

*ESN = Environmentally Smart Nitrogen (44-0-0), MAP = monoammonium phosphate urea = 46-0-0, UAN = a combination of granular urea and ammonium nitrate.
**Post-hilling N was applied 4 times at 10-14 day intervals.

Figure 1. Irrigation and precipitation in 2008.

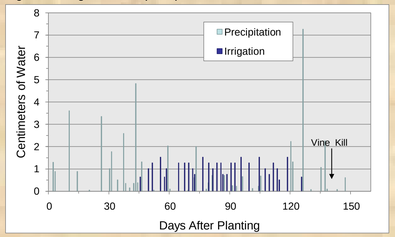
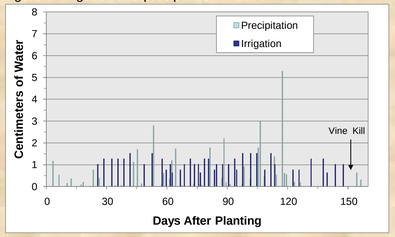


Figure 2. Irrigation and precipitation in 2009.



Acknowledgements

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Results

Figure 3. Russet Burbank grade A tuber yields - 2008.

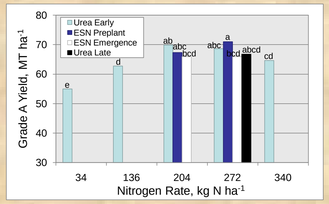

Figure 4. Umatilla grade A tuber yields - 2008.

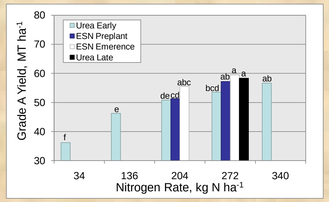

Figure 5. Premier grade A tuber yields - 2008.

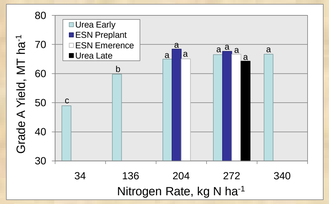

Figure 6. Release of N from ESN applied at preplant or emergence - 2008.

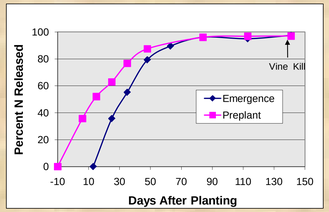

Figure 7. Russet Burbank grade A tuber yields – 2009.

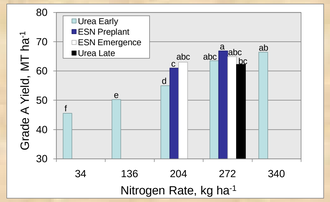

Figure 8. Umatilla grade A tuber yields - 2009.

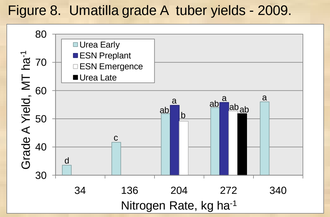

Figure 9. Premier grade A tuber yields - 2009.

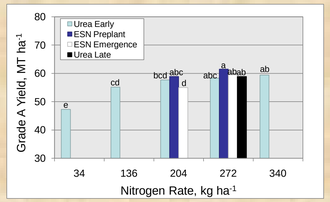

Figure 10. Bannock grade A tuber yields - 2009.

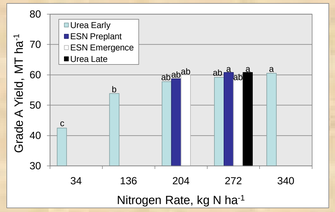

Figure 11. Russet Burbank tubers.

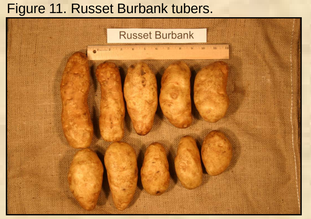

Figure 12. Umatilla Russet tubers.

Figure 13. Premier Russet tubers.

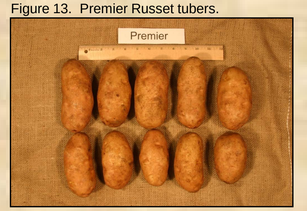

Figure 14. Bannock Russet tubers

Discussion & General Conclusions

❖Both growing seasons were relatively dry from 40 to 100 days after planting. 2008 had more potential leaching events than 2009 (Figures 1 and 2). Yields were higher in 2008 than in 2009.

❖ Most of the N was released from ESN by 80 days after planting (Figure 6).

❖ Response to N rate, source, and timing depended on cultivar and year:
- o **Russet Burbank**: maximum yield was at 204 kg N ha^{-1} in 2008, but yields were still increasing at 340 kg ha^{-1} in 2009, ESN preplant tended to result in higher yields than ESN at emergence (Figures 3 & 7), but this was only significant in 2008.
- o **Umatilla Russet**: Yield increased with increasing N rate both years. Higher rates of late season applied urea and emergence applied ESN were beneficial in 2008, but not 2009 (Figures 4 & 8).
- o **Premier Russet**: Yield was maximized at about 204 kg N ha^{-1}. At equivalent N rates, N Source and timing did not affect yields; although preplant ESN tended to result in higher yields than ESN at emergence (Figures 5 & 9).
- o **Bannock Russet**: Yield was maximized at about 204 kg N ha^{-1}. At equivalent N rates, N source and timing did not affect yields (Figure 10).

❖ Misshapen tubers: Russet Burbank (37%) > Umatilla (8.3%) > Bannock (5.8%) > Premier (3.4%).

❖ Overall yields: Russet Burbank > Premier = Bannock > Umatilla.

References

Wilson, M.L., C.J. Rosen, and J.F. Moncrief. 2009a. Potato response to a polymer-coated urea on an irrigated , coarse-textured soil. Agron. J. 101: 897-905.

Wilson, M.L., C.J. Rosen, and J.F. Moncrief. 2009b. A comparison of techniques for determining nitrogen release from polymer-coated urea in the field. HortScience 44:492-494.