Effect of Controlled Release Nitrogen Fertilizer on Vine Desiccation and Potato Tuber Yield

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Introduction

Nitrogen management is essential for maximizing potato tuber yield. Vine biomass, quality of tubers, specific gravity, and grade are all influenced by N application rate. Nitrogen application timing is also important. Early-season N is essential for canopy development; however, in excess, hollow heart occurrence may increase. Excessive late-season N may result in low specific gravity and reduced skin set (Stark and Westermann 2008). Controlled-released N (CRN) products may be used in potato production to reduce nitrate leaching (Ruark et al. 2010). There are conflicting results on the effect of CRN products on tuber yield. Polymer-coated urea, a CRN product, may increase tuber yields over conventional fertilizers (Wilson et al. 2009). However, this may be more likely under reduced N application rates. At optimum N rates, tuber yield may be the same for CRN and conventional fertilizer (Ruark et al. 2010).

Vine desiccation is essential to hasten tuber maturity and skin set. Vine desiccation occurs naturally, but products are often used to control tuber size and facilitate harvesting. Rate of vine desiccation may be influenced by elevated N levels due to increased vine production and delayed natural desiccation.

Little research has been conducted to investigate the effect of CRN applications at planting, first cultivation, or hilling on vine vigor, efficacy of vine desiccation products, and tuber yield.

Objectives

- To examine the effect controlled-release (CRN) and conventional 28% urea-ammonium nitrate (UAN) on vine vigor and desiccation, and potato tuber yield.
- To determine the correlation between visual ratings and normalized difference vegetation index (NDVI) measurements used to evaluate vine desiccation.

Methods

- A study was conducted in 2010 at the Montcalm Research Farm near Entrican, MI, in irrigated 'Snowden' variety potatoes.
- A factorial design was used where four liquid N programs (Table 1) and three vine desiccation treatments were evaluated. Vine desiccation treatments included:
  - diquat (0.28 kg ai ha^{-1}) + NIS (0.25% v/v ha^{-1}) followed by (fb) diquat (0.28 kg ai ha^{-1}) + NIS (0.25% v/v ha^{-1})
  - glufosinate (0.43 kg ai ha^{-1})
  - no vine desiccation product (control)
- Prior to applying the vine desiccation products, a Greenseeker™ (NTech Industries) optical sensor was used to measure NDVI to evaluate vine vigor.
- Vine desiccation was evaluated using visual ratings and NDVI measurements at 14, 21, and 28 days after treatment (DAT).
- At harvest, potato tubers were graded and yield determined.
- PROCMIXED procedures were used in SAS to determine if treatments influenced potato tuber yield, vine vigor, and vine desiccation. Least significant difference ($\alpha \leq 0.05$) was used to separate means. The correlation between visual ratings and NDVI was evaluated using Pearson's correlation coefficient.

Table 1. Nitrogen rate, product, and time of application.

	Nitrogen Rate and Product (kg N ha^{-1})			
Program	Planting (May 17)	1st Cultivation (June 15)	Hilling (June 25)	Late July
1	67 CRN	67 UAN	67 UAN	112 urea
2	67 UAN	67 CRN	67 UAN	112 urea
3	67 UAN	67 UAN	67 CRN	112 urea
4	67 UAN	67 UAN	67 UAN	112 urea

Figure 1. Visual control ratings of vine desiccation for three vine desiccation treatments.

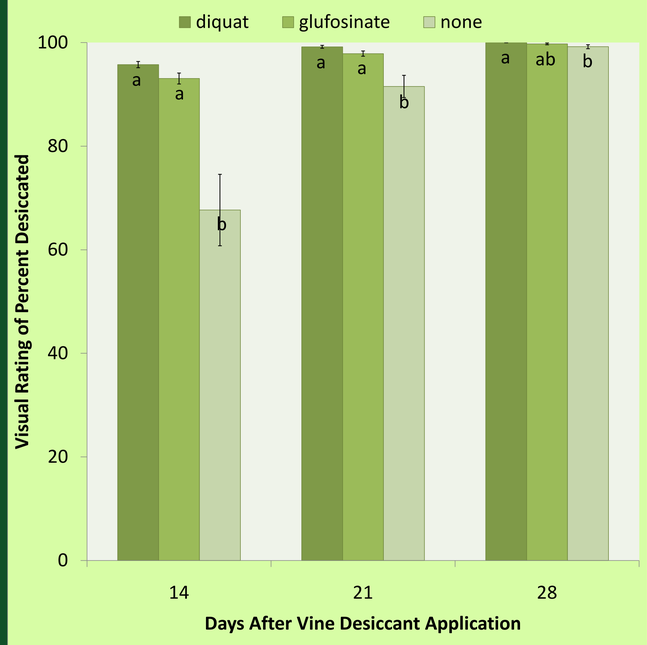


Figure 2. Correlation between visual rating and NDVI measurements of vine desiccation.

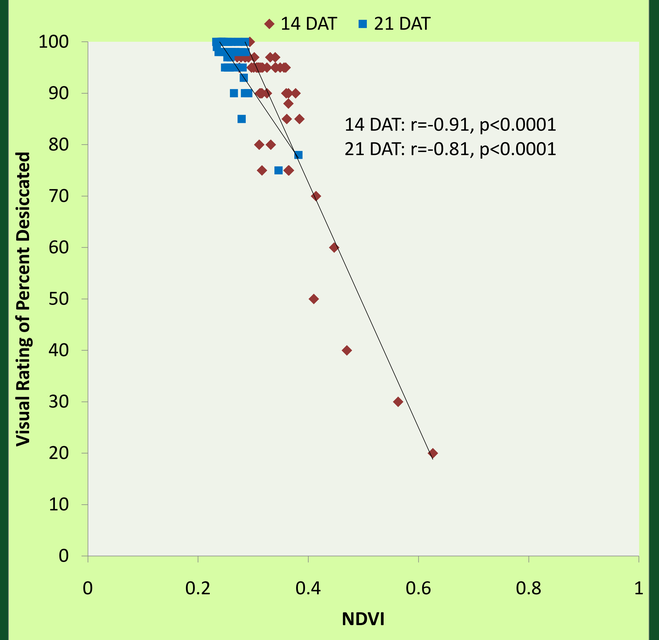


Figure 3. Total potato tuber yield by herbicide and fertility program.

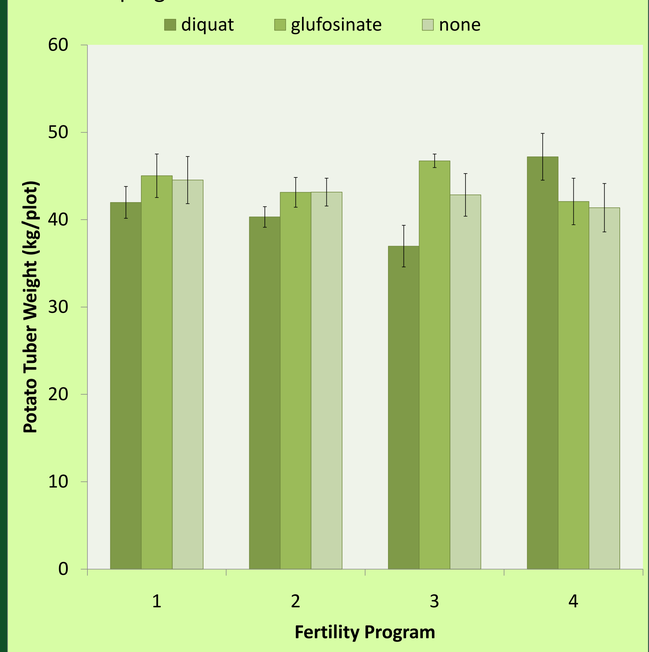
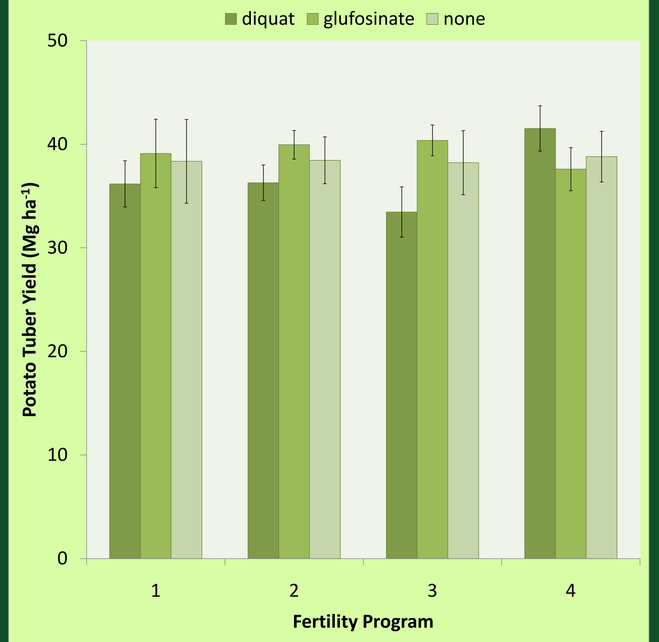


Figure 4. Total marketable potato tuber yield by vine desiccant and fertility program.



Results and Discussion

- There were no differences in vine vigor among the four fertility programs (data not shown).
- Vine desiccation was not influenced by fertility program. There were no differences in desiccation between diquat fb diquat and glufosinate at the 14 and 21 DAT visual ratings. At the 28 DAT visual rating, vine desiccation was between 99-100% for all desiccation treatments (Fig. 1).
- There was a strong, negative correlation between visual ratings and NDVI measurements of vine desiccation at 14 and 21 DAT (Fig. 2).
- Total potato tuber weight was influenced by both fertility program and vine desiccation treatment. When diquat was used in fertility programs 2 and 3, tuber yield was significantly less than the highest yielding treatment (Fig. 3).
- There was no difference in marketable tuber yield for fertility program or desiccation treatment (Fig. 4).

Conclusion

- Timing of CRN application had no effect on vine vigor.
- Vine desiccation was the same for all CRN applications and desiccation products.
- Marketable tuber yield was not influenced by CRN timing or desiccation product.
- There was a strong correlation between visual rating and NDVI measurements of vine desiccation. This indicates that visual ratings may provide accurate estimates of vine desiccation.

References

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