# Assessing the Use of Enhanced Efficiency Fertilizers on Sugarbeet Yield and Quality

Christopher A. Bauer* and K. Steinke
Department of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI

## Introduction

- Nitrogen (N) inversely affects sugarbeet root yield and percentage sugar and therefore must be balanced for optimal return.
- Sugarbeet is often the first crop planted in spring and subject to longer periods of weather variability and fertilizer uncertainty including N leaching, denitrification, and volatilization.
- Achieving early canopy development and row closure through increased light interception and plant biomass is critical for maximizing sugar content in the beet root.

## Objective

- To study the effects of enhanced efficiency fertilizers in comparison to standard N management programs on sugarbeet yield and quality.

## Materials and Methods

- Field study was initiated in Richville, MI on a Tappan-Londo loam complex in 2014.
- Eight treatment randomized complete block design with four replications
- Individual six row plots were 4.5 m wide by 10.7 m long with 76.2 cm row spacing.
- All treatments received 45 kg N $ha^{-1}$ as 28% UAN applied as a 5x5 (cm) at planting with total N applications at 179 kg N $ha^{-1}$.

- Treatments consisted of the following:
  - Urea sidedressed with light cultivation
  - Urea applied pre-emergence with a urease and nitrification inhibitor
  - Urea applied pre-emergence with and without a urease inhibitor
  - UAN banded sidedress with and without a urease inhibitor without cultivation
  - Ammonium polyphosphate (10-34-0) applied in-furrow with remaining N as urea sidedressed with light cultivation
  - A 75:25 ratio of polymer-coated urea:urea applied pre-emergence

- Data measureables:
  - Plants 16.3 $m^{-2}$ were counted at 15 and 25 days after planting.
  - Weekly digital images were taken from the 2-4 leaf stage until canopy closure to determine percent canopy coverage.
  - Tissue samples were collected in June and July 2014 and analyzed for total N.
  - Chlorophyll readings were collected to determine sugarbeet leaf greenness.
  - At harvest the center two rows were harvested to determine yield and sugar components.

- Data were analyzed using PROC GLIMMIX in SAS and means were separated using Fisher's protected $LSD_{(0.05)}$.

## Results and Discussion

**Table 1.** Sugarbeet stand count at 15 and 25 days after planting, Richville, MI, 2014.

| Treatment | Plants 16.3 $m^{-2}$ | |
|---|---|---|
| | 15 DAP | 25 DAP |
| Urea sidedressed w/cultivation | 174 a* | 168 a |
| Urea w/urease & nitrification inhibitor pre-emergence | 168 ab | 160 ab |
| Urea w/urease inhibitor pre-emergence | 152 c | 145 b |
| UAN sidedressed no cultivation | 167 ab | 160 ab |
| UAN sidedressed w/urease inhibitor | 174 a | 164 a |
| Urea pre-emergence | 127 d | 127 c |
| In-furrow followed by urea sidedressed | 159 bc | 157 ab |
| PCU:urea pre-emergence (75:25 ratio) | 165 abc | 159 ab |
| Significance P>F | <0.001 | 0.004 |

* Values with the same lower case letter are not significantly different (α=0.05).

**Table 2.** Percent canopy coverage on 3 of 7 rating dates, Richville, MI, 2014.

| Treatment | May 29 | June 12 | June 26 |
|---|---|---|---|
| | % | % | % |
| Urea sidedressed w/cultivation | 3.0 b* | 23.6 ab | 78.1 ab |
| Urea w/urease & nitrification inhibitor pre-emergence | 1.4 d | 19.4 c | 67.1 c |
| Urea w/urease inhibitor pre-emergence | 1.6 cd | 21.4 bc | 72.3 bc |
| UAN sidedressed no cultivation | 1.6 cd | 19.3 c | 66.4 c |
| UAN sidedressed w/urease inhibitor | 1.8 c | 20.6 bc | 68.6 c |
| Urea pre-emergence | 1.5 cd | 20.5 bc | 73.1 abc |
| In-furrow followed by urea sidedressed | 3.8 a | 26.0 a | 79.9 a |
| PCU:urea pre-emergence (75:25 ratio) | 1.8 c | 20.3 c | 76.4 ab |
| Significance P>F | <0.001 | 0.028 | 0.027 |

* Values with the same lower case letter are not significantly different (α=0.05).

- A significant decrease in plant population was observed where N was applied pre-emergence without a urease inhibitor (Table 1).

- Below average precipitation limited N loss conditions early in the growing season of 2014 (Fig. 1) as 14.7 cm of rainfall was received in the months of May and June.

- Digital images were taken and ran through Sigma Scan Pro 5 to measure canopy coverage (Fig. 2). Sugarbeets receiving in-furrow fertilizer resulted in significantly greater canopy coverage on 3 of the 7 rating dates throughout the growing season (Table 2).

- With minimal N loss conditions throughout the growing season, root yield and sugar quality were not statistically different among the eight treatments (Table 3).


**Figure 2.** Digital image taken on 12 June 2014 (a) and the same digital image ran through Sigma Scan Pro 5 (b) to measure percent canopy coverage. The resultant canopy coverage in this photo was 26.6 %.

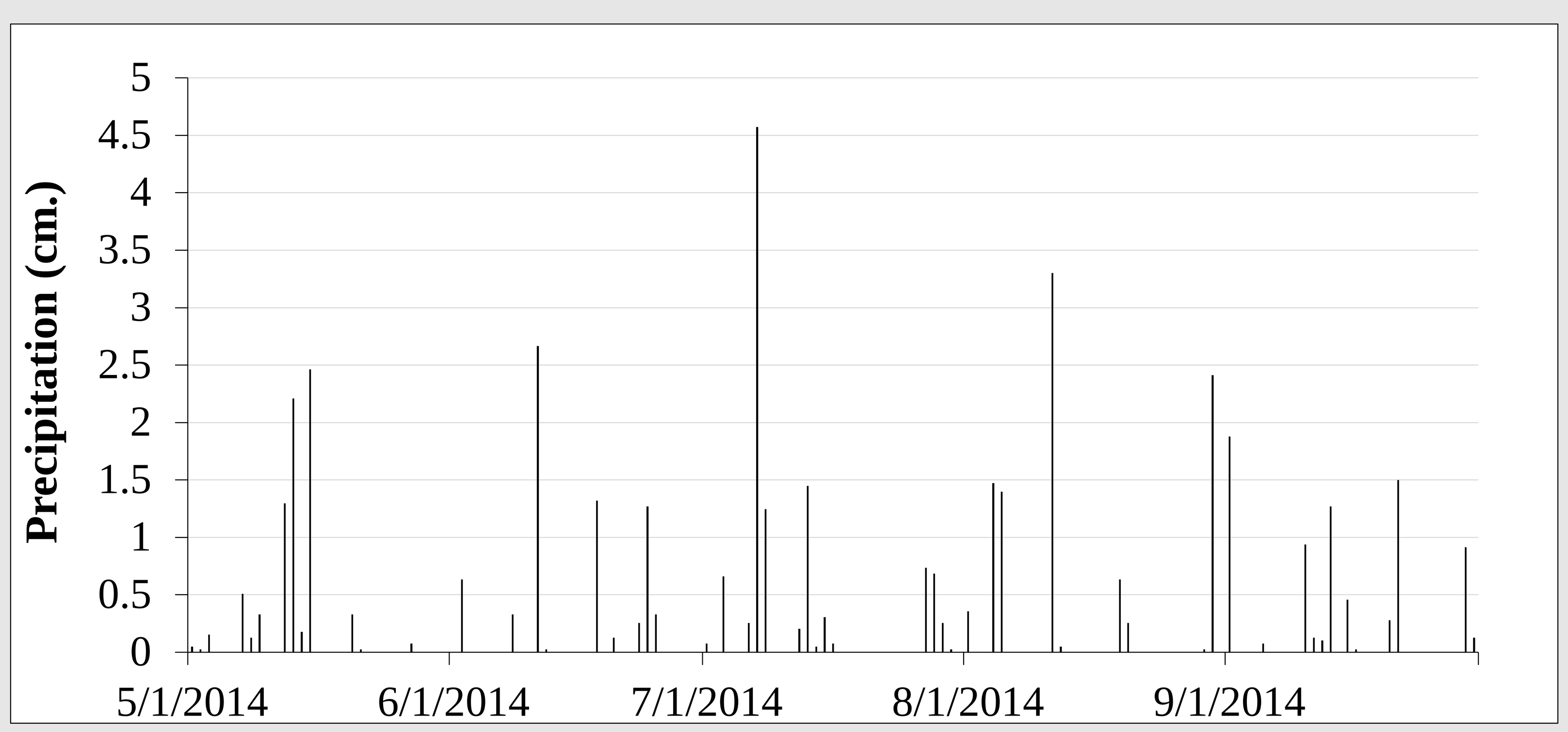


**Figure 1.** Daily precipitation in Richville, MI from May-Sept. of the 2014 growing season.

**Table 3.** Sugarbeet root yield (Mg $ha^{-1}$) and sugar quality (g $kg^{-1}$), Richville, MI, 2014.

| Treatment | Yield | Sugar |
|---|---|---|
| | Mg $ha^{-1}$ | g $kg^{-1}$ |
| Urea sidedressed w/cultivation | 86.2 a* | 183 a |
| Urea w/urease & nitrification inhibitor pre-emergence | 77.9 a | 184 a |
| Urea w/urease inhibitor pre-emergence | 82.7 a | 188 a |
| UAN sidedressed no cultivation | 84.2 a | 189 a |
| UAN sidedressed w/urease inhibitor | 82.2 a | 187 a |
| Urea pre-emergence | 78.8 a | 187 a |
| In-furrow followed by urea sidedressed | 82.7 a | 185 a |
| PCU:urea pre-emergence (75:25 ratio) | 77.3 a | 188 a |
| Significance P>F | 0.764 | 0.749 |

* Values with the same lower case letter are not significantly different (α=0.05).

## Conclusions

- First year preliminary data suggest that using enhanced efficiency fertilizers in comparison to standard N programs did not result in significant differences in final root yield or sugar percentage where N loss conditions were not a factor.

- When applying N pre-emergence, urea alone resulted in a significantly reduced stand whereas N applied with a urease inhibitor and or a nitrification inhibitor did not reduce beet population.

- Although enhanced efficiency fertilizers did not affect root yield or sugar percentage in 2014, this technology did allow for greater pre-plant N application rates without stand loss. With this option growers may be able to 1) more frequently utilize a stale seed bed, and 2) reduce the application risk of greater rates of N in a 5x5 cm application when trying to achieve the overall N rate of 179 kg $ha^{-1}$ which has resulted in the most economical rate of N for several years running.

## Acknowledgements

Thank you to Andrew Chomas, Paul Horny, and Dennis Fleischmann for their technical assistance and the Michigan Sugar Company and MSU AgBioResearch for funding.

Michigan State University AgBioResearch

Pioneer · Big Chief Michigan Sugar