Nitrogen Management in U.S. Sugar Beet Production

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4R Nutrient Stewardship

Goal:

- Optimize crop yields
- Maximize producer profits
- Maximize N use efficiency
- Minimize NO₃ leaching, N gas losses

Research and Management Collaboration
• Improved in N use efficiencies
• Improved in N rate recommendations
• An important knowledge gap: Mineralization
• Further refinement of N rate recommendations
Yield vs N Rate – American Crystal Area
Yield vs N Recs – Amalgamated

Recoverable Sucrose Yield (lbs/acre)

Year


University of Idaho Amalgamated Recs

Amalgamated Rec Low Range

Amalgamated Rec High Range

192 lbs/acre/year

Nr (lbs N/ton beets)

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Yield vs N Recs – Amalgamated
N Rate Study with various rates including a 0 N fertilizer check.

23 site years

1984-1987

North Dakota

Spring Soil NO3-N, 0-2

Maximum Sugar Yield (statistically)
  – If no difference in yield, site labeled as non-responsive

Determined the recommended N needed from published 1976 and 1988 recommendations (Univ. MN and NDSU).

N Recommended – N that yielded the greatest sugar yield

(+ ) amount of excess N from fertilizer

( - ) amount of N deficient to meet need.

Moraghan
Moraghan, ND 1984-1987

Non-N Responsive

Ave  141

Ave  68

Ave  -3

N Responsive

1976
1988

Used 0-2 ft soil NO3-N
Nitrogen Cycle
• N Rate Study with various rates including a 0 N fertilizer check.
• Dave Elison, Greg Dean, Paul Foote, Stacey Camp, David Tarkalson.
• 24 site years (year, site, variety).
• 2005-2010.
• Replicated 4 to 8 times.
• Spring Soil N, 0-3ft.
• Located across the sugarbeet growing area.
• Various soil types, sand – clay loam.

Idaho Research (Amalgamated and ARS)
• Compared available N to achieve maximum sugar yield with N requirements of 4 lbs N/ton, 5 lbs N/ton, 6 lbs N/ton, 7 lbs N/ton and 8 lbs N/ton (UoFl rec).

• Determined the maximum sugar yield (statistically).
  – Maximum sugar yield was obtained at a rate greater than the check on 8 of the sites, responsive sites.
  – 16 of the sites were non-responsive. Maximum yield was assigned to the check yield.
Available N at Maximum Sucrose Yield (lbs N/acre)

N Recommendation (lbs N/acre) [Nr lbs N/ton X Root Yield tons/acre]

Nr = 4 lbs N/ton
Ave Diff = - 36 lbs N/acre

Idaho – 24 Site Years 2005-10
Available N at Maximum Sucrose Yield (lbs N/acre)

N Recommendation (lbs N/acre) [Nr lbs N/ton X Root Yield tons/acre]

Nr = 5 lbs N/ton
Ave Diff = 28 lbs N/acre

Idaho – 24 Site Years 2005-10
Available N at Maximum Sucrose Yield (lbs N/acre)

N Recommendation (lbs N/acre) [Nr lbs N/ton X Root Yield tons/acre]

50 100 150 200 250 300 350 400

Nr = 6 lbs N/ton
Ave Diff = 66 lbs N/acre

Idaho – 24 Site Years 2005-10
Available N at Maximum Sucrose Yield (lbs N/acre)

N Recommendation (lbs N/acre) = Nr lbs N/ton X Root Yield tons/acre

Nr = 7 lbs N/ton

Ave Diff = 103 lbs N/acre

Idaho – 24 Site Years 2005-10
Available N at Maximum Sucrose Yield (lbs N/acre)

N Recommendation (lbs N/acre)

Nr = 8 lbs N/ton
Ave Diff = 141 lbs N/acre

Idaho – 24 Site Years 2005-10
Idaho – 24 Site Years 2005-10

Study Root Yield/Available Soil N (lbs N/ton, Nr)

Brei Nitrate (ppm)
Idaho – 24 Site Years 2005-10

Study Root Yield/Available Soil N (lbs N/ton, Nr)

Brei Nitrate (ppm)

149
5-6=202
6-7=179
7-8=257
>8=281
Effect of Past Manure on N Mineralization

NO$_3^-$-N + NH$_4^+$-N in 0-2 ft (lbs N/acre)

Conv. Fert.  Manure Every Other Year  Manure Every Year

0  100  200  300  400  500
• N use efficiencies have improved
• N rate recommendations have improved
• We need to better understand the process of mineralization in our systems
• Research data supports growers in Idaho reducing Nr to around 6 lbs/ton