Late Nitrogen Applications and Potato Storage Quality

Sastry S. Jayanty, Ph.D.
Associate Professor and Extension Specialist
Purpose of our Late Nitrogen Research Program

Our postharvest research program was interested in determining if reducing fertilizer inputs to potatoes, which may improve sustainability, also improved returns to growers.

- Late season applications of N have been demonstrated to have potential to increase yield

- Late season N applications may also result in poorly matured tubers at harvest that may be more likely to be damaged at harvest or may not be stored successfully
<table>
<thead>
<tr>
<th>Late Nitrogen Application</th>
<th>Storage Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extending Bulking Time</td>
<td>Shrink</td>
</tr>
<tr>
<td>Increased Yield Potential</td>
<td>Poor Skin Set</td>
</tr>
<tr>
<td>Persistent Green Vines</td>
<td>Lower Specific Gravity</td>
</tr>
<tr>
<td>Delayed Foliar Blight</td>
<td>Susceptibility to Pressure Bruise</td>
</tr>
</tbody>
</table>

Are we making money?
<table>
<thead>
<tr>
<th>Physiological Factors Affecting Bulking Rate</th>
<th>Environmental Factors Affecting Bulking Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivar</td>
<td>Planting Date</td>
</tr>
<tr>
<td>Day Length</td>
<td>Early Season Temperature</td>
</tr>
<tr>
<td>Number of Tubers/ft²</td>
<td>Nutrition and Water Management</td>
</tr>
<tr>
<td>Seed Piece Size</td>
<td>Mid season Temperature &gt;95 °F</td>
</tr>
<tr>
<td>Stem Numbers / Hill</td>
<td>Frost / Hail</td>
</tr>
</tbody>
</table>
Growth Stage

I. Vegetative
II. Tuberization
III. Tuber Growth
IV. Maturing

Dry matter, %

Days after planting
Growth Stage

I  VEGETATIVE  II  TUBERIZATION  III  TUBER GROWTH  IV  MATURING

Nitrogen

Total N accumulation, lb/A

N accumulation rate

Total N accumulation

Days after planting

N accumulation rate, lb/A/day
The number of harvested tubers will depend on the stem population as well as the environmental conditions during this initiation phase of growth. Initiated tubers not carried to harvest will be re-adsorbed by the plant.
Tuber growth rate as affected by the number of tubers per unit area
Leaf Area Index and Tuber Yield curves of Russet Burbank

Leaf Area Index and Tuber Yield curves of Russet Norkotah

Maximum bulking rates for any individual cultivar and field will be determined by the physiology of the seed and the environmental conditions during tuber initiation.
Nitrogen Application

- Approximately two-thirds of the total plant N is accumulated in the first few months following planting.

- Therefore, an adequate availability of N must be maintained in the root zone to support rapid uptake.

- Excessive early season N can increase the susceptibility to brown center, hollow heart, and delays in maturation.

- Petiole testing is frequently useful for monitoring N availability and determining the need or supplemental fertilization.
Late Nitrogen Applied

Is the project reflecting the practices and experiences of Colorado Potato Growers?
The plot trials at the SLVRC were laid out as randomized complete block design, with each treatment replicated four times.

The plots were fertilized at a rate of 110-120 lbs/acre with half applied up front and the rest applied in 2-3 applications in June and July depending on the growth of the crop.

Treatments included the application of N from two sources [organic (org) and inorganic (inorg) source of N].

Depending on treatment, 0, 20, or 40 lbs of additional 34-0-0 nitrogen were applied late in the growing season, about 3 to 4 weeks after the recommended N rates had all been applied to the crop. Mostly during the first week of August.

Thus, there were a total of five treatments; (i) control, (ii) 20 lb. ‘org’ N, (iii) 40 lb. ‘org’ N, (iv) 20 lb. ‘inorg’ N, (v) 40 lb. ‘inorg’ N.

After harvest, potatoes were evaluated for skinning and cuts, skin set, yield, storage shrink and pressure bruising.
- Tuber yield increased by 9 and 8% for >4 and >6 oz. tubers respectively, when additional 40 lb. organic N was applied late in the growing season.
- Additional late application of 20 lb. organic N increased the yield of >6 oz. tubers by 7%.
Additional late application of 20 lb./ac of inorganic N increased the yield of > 4 and > 6 oz. size tubers by 7 and 12%, respectively. Additional late application of 20 lb./ac organic N increased the yield of > 6 oz. tubers by 11%.
The crop did utilize N more efficiently for the production of >4 and >6 oz. tubers when additional 20 lb. inorganic N was applied late in the growing season.

For every unit of 20 lb. late N applied, 115 and 125 lb. more tubers were produced for the >4 and >6 oz. tubers, respectively.

Also, for every additional unit of 20 lb. organic N applied late in the growing season, 120 lb. more tubers in the > 6 oz. size was produced.
Canela Russet responded positively to additional late organic N application, but responded negatively to additional late inorganic N application.

For every unit of 20 or 40 lb. organic N applied, 50 or 75 lb. more potatoes were produced in the >4 oz. size respectively.

For every unit of additional 20 or 40 lb. organic N applied late in the growing season, 85 or 53 lbs more tubers were produced in the >6 oz. size respectively.
### Effect of Additional Late Nitrogen on Rio Grande and Canela Russet

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rio Grande Russet</th>
<th>Canela Russet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>External Defects 1</td>
<td>Internal Defects 2</td>
</tr>
<tr>
<td>Control</td>
<td>5.0</td>
<td>0.6</td>
</tr>
<tr>
<td>20 lb. inorganic</td>
<td>3.1</td>
<td>0.5</td>
</tr>
<tr>
<td>40 lb. inorganic</td>
<td>4.3</td>
<td>0</td>
</tr>
<tr>
<td>20 lb. organic</td>
<td>2.4</td>
<td>0</td>
</tr>
<tr>
<td>40 lb. organic</td>
<td>1.3</td>
<td>0</td>
</tr>
</tbody>
</table>

No internal defects were observed in any of the two cultivars when additional 40 lb. inorganic N fertilizer or organic N fertilizer were applied late in the growing season.

1 Includes growth cracks, knobs, and misshapes
2 Includes hollow heart and brown center
Pressure Bruise Area
(After 6 months in storage 2012-13)

- Canela
- Rio Grande

control  20 Org  20 INOR  40 Org  40INOR
Bruise count
(After 6 months in storage 2012-13)
Shrink (%)  
(After 6 months in storage 2012-13)
Potato Long Term Storage Losses

Shrink and disease
Loss (%) Fall
Production in Colorado

Losses due to Shrink
and Disease in Millions ($)

National Agricultural Statistics Service
Shrinkage loss

Medium size potato storage bin holding 180,000 cwt, for every 1% shrinkage loss is equivalent to $13,140 (calculated based on 2012 price $7.30 @cwt)

Late nitrogen applied 5 to 10 pounds ($12/Acre) = $120.00
yield per Acre 450 cwt (2012)
180000/450 = 400 Acres to fill the bin
Total cost to for Late N for medium size bin = 400 acres*120 = $48,000

National Agricultural Statistics Service
SUMMARY

The response of Russet potato to additional late N fertilizer application is varietal dependent.

Additional late application of 20 lb./ac inorganic N fertilizer can increase marketable (>4 oz.) and large marketable (>6 oz.) size tuber yield of Rio Grande Russet.

Canela Russet did not respond to additional late inorganic N fertilizer application.

Pressure bruise incidence, bruise count and percentage of shrink increased with increase in late nitrogen application.
Acknowledgements

- CPAC Area II & III
- Western SARE
- NRCS
- CSU SLV Research Center – Dr. Henry Castleberry, Dr. Diganta Kalita, Michael Gray, Elita Castleberry, and Colter Carroll.
- CSU Farm Staff - Stanley and Ron Price
Thank you