Using Liquid Sources of Potassium Fertilizer in Highbush Blueberry

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• Health benefits
• Availability year-round
• New global markets
Global blueberry production

From U.S. Highbush Blueberry Council
Fresh Market
Highbush Blueberry

It takes about 6-8 years for a field to mature

Chad Finn (USDA plant breeder) in 20-year-old ‘Bluejay’ field

Photo by B Strik, OSU
Blueberry is a Unique Crop

- **Shallow-rooted**
  [extremely fine (40 – 70 μm) & concentrated in top 12” of soil]

- **“Acid loving”**
  [adapted to low soil pH (4.5–5.5) & high organic matter]

- **Prefers NH₄⁻ over NO₃⁻N**
  [NO₃⁻-N is mobile in soil, whereas NH₄⁻-N is not]

- **Sensitive to salinity**
  [ammonium sulfate has a high salt index]
Blueberry

pH vs. Acidity and Alkalinity of Soil

Acidity:
- Extreme acidity
- Very strong acidity
- Strong acidity

Alkalinity:
- Very strong alkalinity
- Strong alkalinity
- Moderate alkalinity
- Slight alkalinity
- Very slight acidity
- Slight acidity
- Medium acidity

Elements:
- Nitrogen
- Phosphorus
- Potassium
- Sulphur
- Calcium
- Magnesium
- Iron
- Manganese
- Boron
- Copper and Zinc

redrawn by PDA from Troug, E. (1946)
Granular fertilization
Triple-split application (April, May & June)

Soil pH > 5.5: Ammonium sulfate (21-0-0)
Soil pH < 5.0: Urea (46-0-0)
Blueberry Irrigation

Most commercial blueberry fields are irrigated by sprinklers or drip

2003: 90% of fields irrigated by sprinklers
2015: 80% fields irrigated by drip
Nitrogen Fertigation Trial

- **Granular fertilizer**
  - Triple-split application
  - (April, May & June)

- **Fertigation**
  - Weekly application
  - (mid-April to early August)

- **Drip**
  - Two lines per row *(buried under the sawdust mulch)*

- **Sprinklers**
  - Ammonium sulfate
Annual Production

12-40% more yield with fertigation than with granular fertilizer

Vargas & Bryla (2015)
Soil solution sampler
Soil N availability

Fertigation

Granular fertilizer

Fertilizer applications

Soil solution sampler

Bryla & Machado (2011)
Soil salinity

**Fertigation**

**Granular fertilizer**

- 0 lb N/acre
- 45 lb N/acre
- 90 lb N/acre
- 135 lb N/acre

Blueberry salt tolerance

Bryla & Machado (2011)
Nitrogen Fertigation is the Way to Go

Fertigation produces:
- Larger plants
- Higher yields

*About 150 lb/acre N was needed in mature plants

Fertigation (irrigation water + fertilizer)

- Weekly injection
- Triple-split application
Current K Guidelines

75-100 lb/acre K
- Soil K < 100 ppm
- Leaf K < 0.2%

0-75 lb/acre K
- Soil K = 100-150 ppm
- Leaf K = 0.2-0.4%
K Deficiency

- Drought
- Poor drainage
- Very low soil pH
- Heavy crop loads
- Sandy soil / low organic matter
K Toxicity
Using Liquid Sources of K Fertilizer

Treatments:
• Two K sources (K$_2$SO$_4$ and KTS)
• Five N sources (AS, urea, ATS, UAN, urea-triazone)
• Five K rates (0-0.2 g/L)
• Two soil types

Measurements:
• Dry weights
• Leaf nutrients
• Soil nutrient availability
Why KTS?

- Acidifying agent

\[ S_{2}O_{3}^{2-} \rightarrow H_{2}S + SO_{3}^{2-} \]  
Thiosulfate reductase – 2[H]

- Inhibits nitrification & urease activity
## Soil Types

<table>
<thead>
<tr>
<th>Willamette silt loam</th>
<th>Malabon silty clay loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>(excellent)</td>
<td>(marginal)</td>
</tr>
<tr>
<td><strong>Soil pH</strong></td>
<td><strong>Soil pH</strong></td>
</tr>
<tr>
<td>4.9</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>OM (%)</strong></td>
<td><strong>OM (%)</strong></td>
</tr>
<tr>
<td>3.7</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Nutrients (g/kg)</strong></td>
<td><strong>Nutrients (g/kg)</strong></td>
</tr>
<tr>
<td><strong>Total N</strong></td>
<td><strong>Total N</strong></td>
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<tr>
<td>1.0</td>
<td>--</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td><strong>P</strong></td>
</tr>
<tr>
<td>0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>K</strong></td>
<td><strong>K</strong></td>
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<tr>
<td>0.3</td>
<td>0.3</td>
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<tr>
<td><strong>Ca</strong></td>
<td><strong>Ca</strong></td>
</tr>
<tr>
<td>0.5</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Mg</strong></td>
<td><strong>Mg</strong></td>
</tr>
<tr>
<td>0.1</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Soil solution sampler
Soil acidity

Willamette silt loam

- Ammonium sulfate
- Soil solution pH
- Days after transplanting

Malabon silty clay loam

- Ammonium sulfate
- Soil solution pH
- Days after transplanting

Soil acidity over time for Willamette silt loam and Malabon silty clay loam under different conditions.
Concentration of K

**Willamette silt loam**

- Ammonium sulfate
- Ammonium thiosulfate

**Malabon silty clay loam**

- Ammonium sulfate
- Ammonium thiosulfate

Days after transplanting:

- 0
- 7
- 14
- 21
- 28
- 35
- 42
- 49
- 56

Soil solution K (mg/L):

- 10
- 12
- 14
- 16
- 18
- 20
- 22
- 24
- 26

- No K
- K$_2$SO$_4$
- KTS
Preliminary Conclusion

KTS appears promising

- Use with ammonium sulfate on high pH soils
- Use with urea on soil with optimum pH
What’s Next?

- Two fields (good and weak)
- Three K sources
  - KTS
  - $\text{K}_2\text{SO}_4$ (liquid)
  - $\text{K}_2\text{SO}_4$ (granular)
- No K control
- Measurements:
  - Plant and soil nutrients
  - Yield
  - Fruit quality and storage
Thank you

**Technical Support**
- Scott Orr (biological technician)
- Bryan Sales (graduate student)

**Funding**
- Fluid Fertilizer Foundation
- Tessenderlo Kerley Inc. (Tom Fairweather)
- Oregon Blueberry Commission
- U.S. Dept. of Agriculture