Benefits of Using Liquid Sources of Potassium Fertilizer in Blueberry

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Blueberry Production Systems

Past

- Ideal soils
- 4-5 ft. spacing
- Flat ground
- Sawdust mulch
- Sprinklers
- Granular fertilizers (1 application/yr)
Blueberry Production Systems

- Less-than-ideal soils
- Raised beds
- Weed mat
- 2.5-3 ft. spacing
- Trellising
- Drip irrigation
- Fertigation

Photo by B. Strik, OSU
Fertigation
Application of fertilizers through the irrigation system

Advantages

- Reduced application costs
- Greater control
- Targeted application
- Reduced fertilizer usage
Fertigation vs. granular nitrogen applications

Vargas & Bryla (2015)

12-40% more yield with N fertigation than with granular N fertilizer
Nitrogen Fertigation is the Way to Go

N fertigation produces:
- Larger plants
- Higher yields

Fertigation (irrigation water + fertilizer)
- Continuous, weekly, or bi-weekly injections (April – July)

What about other nutrients?

*K+ High amounts in the fruit

*About 150 lb/acre N is needed per year in mature plants
K Deficiency

- Drought
- Poor drainage
- Very low soil pH
- Heavy crop loads
- Sandy soil / low organic matter
Current K Guidelines

75-100 lb/acre $\text{K}_2\text{O}$
- Soil K < 100 ppm
- Leaf K < 0.2%

0-75 lb/acre $\text{K}_2\text{O}$
- Soil K = 100-150 ppm
- Leaf K = 0.2-0.4%

Fertilizer: potassium sulfate (0-0-52)
K Toxicity
Preliminary greenhouse study

- **Two liquid K sources**
  [potassium sulfate (K₂SO₄) and potassium thiosulfate (KTS)]

- **Five liquid N sources**
  [ammonium sulfate, urea, ammonium thiosulfate (ATS), urea ammonium nitrate (UN32), urea-triazole (slow release)]

- **Five K rates** (0-0.2 g/L)

- **Two soil types** (excellent & marginal)
Why potassium thiosulfate (KTS)?

- Highly soluble in water and compatible with many other fluid fertilizers

- Acidifying agent

\[
S_2O_3^{2-} + 2 H_2O \rightarrow 2 H_2SO_4
\]

thiosulfate  water  sulfuric acid

Blueberry is adapted to acidic soils (pH 4.5 to 5.5)
## Soil Types

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

Measurements:
• Dry weights
• Leaf nutrients
• Soil nutrient availability
Concentration of K

Willamette silt loam

- Ammonium sulfate
  - No K
  - K₂SO₄
  - KTS

- Urea

Malabon silty clay loam

- Ammonium sulfate
  - No K
  - K₂SO₄
  - KTS

- Urea

Soil solution K (mg/L)

Days after transplanting

0 7 14 21 28 35 42 49 56
Preliminary Conclusions
(based on greenhouse study)

KTS appears promising

- Use with ammonium sulfate on high pH soils
- Use with urea on soil with optimum pH
Weak planting

Soil conditions (Apr. 2016)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>pH</td>
<td>5.7</td>
<td>Fair</td>
</tr>
<tr>
<td>SOM (%)</td>
<td>3.1</td>
<td>Fair</td>
</tr>
<tr>
<td>K (ppm)</td>
<td>124</td>
<td>Low*</td>
</tr>
<tr>
<td>Ca (ppm)</td>
<td>1880</td>
<td>Med. high</td>
</tr>
<tr>
<td>Mg (ppm)</td>
<td>680</td>
<td>High</td>
</tr>
</tbody>
</table>

‘Duke’
(12 years)
Weak planting

Treatments

- No K
- $\text{K}_2\text{SO}_4$ (granular)*
- $\text{K}_2\text{SO}_4$ (liquid)*
- KTS (liquid)*

*75 lb/acre $\text{K}_2\text{O}$

N source: ammonium sulfate
Drip irrigation (covered w/mulch)

$K_2SO_4$ (banded)

Drip emitter

$K_2SO_4$ or KTS (fertigation)
Soil solution

Under drip emitter

2016
May  Jun  Jul  Aug  Sep  Oct  Nov

K concentration (ppm)

0  20  40  60  80  100  120  140  160  180

No K
SOP (granular)
SOP (fertigation)
KTS (fertigation)

6 inches from drip emitter

2016
May  Jun  Jul  Aug  Sep  Oct  Nov

Soil solution

K+  K+  K+  K+  K+  K+  K+  K+  K+  K+

Wetting front

Drip line

Drip line

Fertigation

Granular fertilizer

SO_4^{2-}
distribution was similar to K+
## Soil solution

<table>
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<tr>
<th>K treatment</th>
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<td>Under emitter</td>
<td>6” from emitter</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>No K</td>
<td>5.7 ab</td>
<td>5.0 a</td>
</tr>
<tr>
<td></td>
<td>62 b</td>
<td>87</td>
</tr>
<tr>
<td>(K_2SO_4) (granular)</td>
<td>6.0 a</td>
<td>4.5 b</td>
</tr>
<tr>
<td></td>
<td>62 b</td>
<td>119</td>
</tr>
<tr>
<td>(K_2SO_4) (fertigation)</td>
<td>5.0 c</td>
<td>4.2 c</td>
</tr>
<tr>
<td></td>
<td>93 a</td>
<td>129</td>
</tr>
<tr>
<td>KTS (fertigation)</td>
<td>5.1 bc</td>
<td>4.4 bc</td>
</tr>
<tr>
<td></td>
<td>85 a</td>
<td>139</td>
</tr>
<tr>
<td>Significance**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
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- **Significance**: 
  - **: Significant at \(p < 0.01\)
  - *: Significant at \(p < 0.05\)
  - NS: Not significant

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**Fertigation**

- Wetting front
- Drip line

**Granular fertilizer**

- Wetting front
- Drip line

\(SO_4^{2-}\) distribution was similar to K⁺
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Add K+ to the soil solution to replace K⁺ with Na⁺ and Ca⁺₂⁺ with Mg⁺²⁺ to maintain neutrality.
## Leaf nutrients

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<thead>
<tr>
<th>K treatment</th>
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<th>Ca (%)</th>
<th>Mg (%)</th>
<th>S (%)</th>
<th>Mn (ppm)</th>
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<tr>
<td>No K</td>
<td>0.37</td>
<td>0.47 b</td>
<td>0.17 b</td>
<td>0.141 c</td>
<td>99 b</td>
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<td>K$_2$SO$_4$ (granular)</td>
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Significance: NS $†$ * **

The treatments had no effect on other leaf nutrients.
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The treatments had no effect on other leaf nutrients

K fertilizer had no effect on yield or fruit quality.
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Significance

- NS
- †
- *
- **

*The treatments had no effect on other leaf nutrients*

# Berry nutrients

<table>
<thead>
<tr>
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<th>K (%)</th>
<th>Mg (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No K</td>
<td>0.54 a</td>
<td>0.043 b</td>
</tr>
<tr>
<td>K$_2$SO$_4$ (granular)</td>
<td>0.52 ab</td>
<td>0.048 ab</td>
</tr>
<tr>
<td>K$_2$SO$_4$ (fertigation)</td>
<td>0.50 c</td>
<td>0.050 a</td>
</tr>
<tr>
<td>KTS (fertigation)</td>
<td>0.51 bc</td>
<td>0.049 a</td>
</tr>
</tbody>
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Significance

- **
- †

*The treatments had no effect on other berry nutrients*

K fertilizer had no effect on yield or fruit quality
Conclusions

- Fertigation with K had more effect on soil & plant nutrition than granular K
  - Reduced soil pH & increased K, Ca, and S in the soil solution
  - Increased leaf Ca, Mg, S, and Mn (but not K)
  - Reduced berry K (but increased Mg)
  - Improved leaf color (SPAD)

- K fertilizer had no effect on yield (or fruit quality)
Thank you

**Technical Support**
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- OSU undergraduates

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- Oregon Blueberry Commission
- Fall Creek Farm & Nursery
- Fluid Fertilizer Foundation
- Tessenderlo Kerley Inc.