Irrigating Blueberries

ed browning,
natural resource engineering specialist
My Thanks

- I’d like to thank Bob Schultheis, regional agricultural engineering specialist, Webster County, for providing several of the slides in the this presentation.
Soil & Climate Properties

- Soils store 1.5”-3” of water per foot of depth (check county NRCS Soil Survey)
- Intake rate = 0.3”-2.0” per hour, rest is runoff
- Available water = 75% of total water in soil
- Summer E.T. rate is 0.25” per day (as high as 0.33”)
- A 12 in. deep soil holds 6 - 12 day supply of moisture
- SW Missouri historical weather:
  - Rainfall = 41”-42” per year
  - Evaporation = 40” per year
Average annual rainfall
1961 to 1990
20 % - Point of crop stress
80 % - Irrigate to this point
100 % - Runoff
Infiltration Rates

• Topsoil
  – Depends on soil type
  – $\frac{1}{2}$” to $\frac{3}{4}$” per hour

• Subsoil (clay, etc.)
  – $\frac{1}{7}$” (0.14”) per hour
Factors affecting Evapotranspiration

- Net Radiation
  - Day Length
  - Temperature
  - Cloud Cover

- Relative Humidity
- Mulch

- Type and size of plants
- Plant Density
Maximum Crop Use Per Day

- May 0.21” (5.3 mm)
- June 0.23” (5.8 mm)
- July 0.37” (9.4 mm)
- August 0.34” (8.6 mm)
- September 0.19” (4.8 mm)
- October 0.14” (3.6 mm)
Plant Use By Month

- May  5”  (12.7 cm)
- June  6”  (15.2 cm)
- July  6.9”  (17.5 cm)
- August  6.7”  (17.0 cm)
- September  4.3”  (10.9 cm)
- October  3.5”  (8.9 cm)
Irrigation Basics

- 1” water on 1 acre = 1A-In. = 27,154 gallons
- 1” water per 1000 ft$^2$ with sprinkler = 625 gal
- 1” water per 1000 ft$^2$ with trickle = 300 gal
- Friction loss expressed as psi or ft of head
  - 1 psi = 2.31 ft of head
- Water flow rates expressed as:
  - gallons per minute (gpm)
  - gallons per hour (gph)
Trickle Irrigation

• First used in Afghanistan in 1866
• Australia instrumental with use of plastic for water distribution
• Israel developed plastic emitters
• Introduction of drip tape in U.S. in early 1960s
• Also called low-flow, drip
Trickle Irrigation System

- Less water
- Reasonable cost
- Less evaporation loss
- More maintenance?
- Shorter life of parts?
- Easy to assemble
Benefits of Trickle Irrigation

- Water conservation
- Energy conservation
- May be able to use existing water system
- Reduces foliar diseases
- Insecticides/fungicides not washed off
- Less need for weed control
- Low evaporation/no drift
Benefits continued

• Can inject fertilizer
• One lateral may serve two rows
• Can direct to crop needing water
  – seed germination
  – transplants
  – sweet corn (silking, tasseling
  – vine crops (flowering, early fruit devel.)
    • muskmelons develop sugar when dry
    • onions cure & store if dry after max. bulb
Drawbacks to Trickle Irrigation

- Higher supply cost
- High labor requirement for initial installation
- More frequent watering
- Higher degree of management
- Rodent/equipment damage
- Water quality a MUST
- Must have backflow prevention
- Can’t use for frost prevention
Maintenance

• Flush/clean screens (once per week?)
• Flush laterals
• Blow air through clogged emitters
• For winter
  – Drain main/submain lines, valves, screens
  – Drain buried laterals
  – Pick up & store surface laterals
Drip Irrigation

• 0.5-2.0 GPH flow rate per emitter
• 2-5 GPM/acre for water supply
• Point use gives less runoff, less evaporation, easier weed control, saves 30%-50% water
• Low pressure of 6-20 psi means smaller pumps & pipes
• Can fertilize through system
• Do field work while irrigating
Drip Irrigation

- Can automatically control
- Susceptible to clogging
- Must design system to carefully match equipment to elevation
  - 2.3 feet of head = 1 psi pressure
- Requires diligent management
- Cost = $900 - $1200 for 1st acre;
  $600 - $800/acre for rest
Wetting Patterns (Drip)
Filters

- Stainless or plastic
- Reusable
- Periodic cleaning
Filters

• Series of thin plastic disks w/grooves of precise dimensions cut into them
• Reusable
• Periodic cleaning
Filters

- Graded layers of fine sand
- Backflush to clean
Dewline
Adjustable flow

Foggers
Screw-in
Punch-in

Emitters
Non-compensating
Compensating

T-Tape

In-Line Drip
In-Line Drip

- 0.5 to 2 gph
- 12″, 18″, 24″, 36″, 48″ spacings
Micro Spray
Microspray Irrigation

• More water than drip
• Less water than sprinkler
• Covers wider area than drip (1.5’ to 6’)
• Bryla @ OSU researching microspray
  – Wet more soil volume
  – 2004 study in Chile showed increase in production & water use efficiency than with drip
  – Downside—cane interference could be an issue
  – Leaf or cane diseases???????
Table 1. Total irrigation water applied to ‘Elliott’ blueberry during the first (2004) and second (2005) year after planting in Corvallis, OR.

<table>
<thead>
<tr>
<th>Irrigation level</th>
<th>2004</th>
<th></th>
<th>2005</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sprinkler</td>
<td>Microspray</td>
<td>Drip</td>
<td>Sprinkler</td>
<td>Microspray</td>
</tr>
<tr>
<td>50% ET&lt;sub&gt;c&lt;/sub&gt;</td>
<td>184</td>
<td>115</td>
<td>103</td>
<td>450</td>
<td>212</td>
</tr>
<tr>
<td>100% ET&lt;sub&gt;c&lt;/sub&gt;</td>
<td>365</td>
<td>228</td>
<td>203</td>
<td>927</td>
<td>436</td>
</tr>
<tr>
<td>150% ET&lt;sub&gt;c&lt;/sub&gt;</td>
<td>547</td>
<td>339</td>
<td>295</td>
<td>1397</td>
<td>642</td>
</tr>
</tbody>
</table>

*Irrigation was applied 9 July to 10 Sept. 2004 and 23 May to 22 Sept. 2005. Values do not include precipitation (which from April to September contributed an additional 216 mm of water to each treatment in 2004 and 244 mm in 2005) or the six handheld sprinkler applications (∼8 mm each) applied before 9 July 2004 (see Fig. 2). Each millimeter of water was equivalent to 2.32 L/plant. ET<sub>c</sub> = estimated crop evapotranspiration.*

OSU Study 2004, 2005

- Determine the effects of sprinklers, microsprays, and drip on vegetative growth in blueberry
- Few roots were found deeper than 0.3m which is typical for blueberry
- Plant growth was similar among treatments the first year after planting
- By year 2, drip irrigation produced the largest plants among the irrigation methods and had the highest number of new canes and cane dry weight when plants were irrigated at 100% $E_{tc}$
- Root dry weight also differed among irrigation methods and averaged 0.20, 0.21, and 0.23 kg per plant with sprinklers, microsprays, and drip, respectively
- Bottom line -- In terms of both growth and water use, drip irrigation was the best and most efficient method to establish the plants.
OSU Study con’t

• Drip irrigation was not beneficial at the site in ‘Duke’ (Bryla and Linderman, 2007). In this case, plants irrigated by drip were only approximately half the size as those irrigated by sprinklers or microsprays. Root sampling revealed that ‘Duke’ was infected by Phytophthora cinnamomi, the causal organism primarily associated with root rot in blueberry, and drip maintained conditions more favorable to the disease.


The Two Major Factors in Irrigation System Planning

1. How much water do you need?

2. How much time do you have?
## Plant Water Requirements

<table>
<thead>
<tr>
<th>Fruit Crop</th>
<th>Plant x Row Spacing, Ft.</th>
<th>Sq.Ft./Plant</th>
<th>Plants/Acre</th>
<th>Gal/Plant/Day</th>
<th>Gal/Acre/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueberries</td>
<td>4 x 12</td>
<td>48</td>
<td>908</td>
<td>4</td>
<td>3632</td>
</tr>
<tr>
<td></td>
<td>3 x 12</td>
<td>36</td>
<td>1210</td>
<td>4</td>
<td>4840</td>
</tr>
<tr>
<td></td>
<td>5 x 10</td>
<td>50</td>
<td>871</td>
<td>4</td>
<td>3484</td>
</tr>
</tbody>
</table>

### Plant age in years

<table>
<thead>
<tr>
<th>Spacing</th>
<th>1-2</th>
<th>3-4</th>
<th>5-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 x 10</td>
<td>18</td>
<td>27</td>
<td>35</td>
</tr>
</tbody>
</table>

Gallons per acre per day per 100’ of row:

- 5 x 10: 784, 1176, 1524
Water Source Quality

**Good**
- Well = check pH & hardness
- Municipal = may be expensive
- Spring or stream
- Pond water = sand filters
- Pump to tank on hill
  - Elevation dictates pressure
    (2.3 feet of head = 1 psi pressure)
  - Watch for tank corrosion

**Poor**
Pump Cycling Rate, Max.

<table>
<thead>
<tr>
<th>Horsepower Rating</th>
<th>Cycles/ Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 to 2.0</td>
<td>20</td>
</tr>
<tr>
<td>3 to 5</td>
<td>15</td>
</tr>
<tr>
<td>7.5, 10, 15</td>
<td>10</td>
</tr>
</tbody>
</table>
## Pressure Tank Selection

<table>
<thead>
<tr>
<th>Tank Size, gallons</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping Capacity, GPM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>82</td>
<td>11</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>144</td>
<td>19</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>220</td>
<td>29</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>315</td>
<td>42</td>
<td>30</td>
<td>22</td>
</tr>
</tbody>
</table>

* Cut-in pressure + 10 psi = Avg. Pressure = Cut-out pressure - 10 psi
Pressure Tanks

Larger tank

OR

variable pump speed controller

Multiple tanks
Using Ponds for Irrigation

• Pond 8' deep, 100' dia. holds 280,000 gallons of water.
• One-half of water volume is usable for irrigation. Rest is seepage & evaporation.
• 20 GPM demand for 20 hrs/day uses 24,000 gal/day.
• Pond holds about 6-day water supply.
• Water is least available when most needed!!
Pond Water Quality

- Grass filters sediment & nutrients

Copper sulfate controls algae & slime
Use Backflow Prevention
Questions

Comments

Arguments

Downright disagreements