HORT325:

Water & Irrigation

Read Chapter IV: Cultural Practices and Chapter V: Irrigation

Water Requirements

- Evapotranspiration: amount of water transpired & utilized by the crop + evaporation from the soil
- Some crops require 500 lbs of water to make 1 pound of dry matter
- This water can come from stored water in the soil, supplied by rain, groundwater within reach of the roots, or from irrigation

Critical Periods of Water Use

- Vegetables generally require constant supply of moisture.
  - Water stress early can delay maturity and reduce yield
  - Water stress late can decrease quality even if yield not affected
- Crops grown for foliage
  - Constant supply
- Crops grown for fruits and seeds
  - Largest amounts during fruit set and maturation*
Furrow Irrigation
50-80% Efficient

Sprinkler Irrigation
Moveable Risers
55-75% Efficient

Sprinkler Irrigation
Center Pivot
55-75% Efficient
Drip Irrigation
80-95% Efficient

Determining Irrigation Frequency

- Tensiometer
- Using Crop Coefficients
- “Finger” Method
- Pan Evaporation

Measures pressure as water passes through ceramic tip from the tensiometer into the soil.

This estimates the energy the plant needs to extract water from the soil.

Reading in Centibars

0 Saturation
10 Field Capacity
20-25 Irrigation
30-50 Dry
Crop Evapotranspiration

- Measures the water used by the crop including evaporation and transpiration (ETc)
- Need to know:
  - Reference Evapotranspiration (ETo)
  - Crop Coefficient (Kc)

\[ \text{ETc} = \text{ETo} \times \text{Kc} \]

Irrigation Requirement

- Accounts for Crop Evapotranspiration, Effective Rainfall (ER), Irrigation Efficiency (IE)
  \[ \text{IR} = \frac{(\text{ETo} \times \text{Kc}) - \text{ER}}{\text{IE}} \]

Where:
- ETo = Reference evapotranspiration
- Kc = Crop coefficient
- ER = Effective Rainfall (total – runoff; estimate)
- IE = Irrigation Efficiency

Example of Kc Values on bare soil

<table>
<thead>
<tr>
<th>Crop</th>
<th>Kc Initial</th>
<th>Kc mid</th>
<th>Kc end</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Small Vegetables</td>
<td>0.7</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1.05</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>1.05</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td>1.05</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>1.05</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td>1.00</td>
<td>0.96</td>
<td></td>
</tr>
</tbody>
</table>
For our Field we will use an average:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Kc Initial</th>
<th>Kc mid</th>
<th>Kc end</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Vegetables</td>
<td>0.7</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Solanum Family</td>
<td>0.6</td>
<td>1.15</td>
<td>0.8</td>
</tr>
<tr>
<td>Cucurbit Family</td>
<td>0.5</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Root &amp; Tuber Crops</td>
<td>0.5</td>
<td>1.1</td>
<td>0.55</td>
</tr>
<tr>
<td>Legumes</td>
<td>0.4</td>
<td>1.15</td>
<td>0.55</td>
</tr>
<tr>
<td>Weighted Average</td>
<td>0.6</td>
<td>1.1</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Irrigation Requirement for last Monday

Total Water Requirement = ETo X Kc
Adjusting for Irrigation efficiency and Effective Rainfall:
IR = ((ETo X Kc)/IE)-ER

Where:
ETo = 0.13 (From weather station data for last Monday)
Kc = 0.6 (From our average, initial)
IE = .9 (Using 90% efficient irrigation)
ER = 0 (No effective rainfall for last Monday)*

IR = ((0.13 X 0.6)-0)/.9
= 0.087 inches

So how long do we run the irrigation?

- Our drip delivers 0.45 gpm per 100’
  - Our rows are 200’ long
  - (200'/100) X 0.45 = 0.9 gpm (per row)
- Need to convert inches to gallons:
  - One acre inch = 27,154 gallons
- Each row covers 0.023 acres (5’ wide rows X 200’)
- 0.087 inches X 27,154 gallons X 0.023 acres = 54 gallons
- 54 gallons / 0.9 gpm = 49 minutes
  - This is the time we need to run drip to deliver 0.087 inches of water (amount used last Monday)
Other Types of Monitoring

• “Finger” Method
  – Stick your finger in the soil and see if it’s dry

• Pan Evaporation Method
  – Much simplified ET procedure
  – Fill a pan or bucket in the field; mark a line at the full point and measure water loss from pan or bucket
  – Multiply water loss by 0.8 (since a full vegetative crop usually requires 80% of moisture to be replaced)

Fertigation

• Advantages:
  – Deliver fertilizer to the roots in a form that can be readily taken up by the plants
  – Can deliver precise amounts throughout the growing season
  – Adjustments can be made based on plant tissue analysis

• Disadvantages:
  – Must be able to water the field (can’t have too much rain)
  – Cost per unit of fertilizer is higher

Venturi Injectors

How a Venturi-type Injector Works
When pressurized water enters the injector inlet, it is constricted toward the injection chamber and changes into a high-velocity jet stream. The increase in velocity through the injection chamber results in a decrease in pressure, thereby enabling an additive material to be drawn through the suction port and entrained into the water stream. As the jet stream is diffused toward the injector outlet, its velocity is reduced and it is reconverted into pressure energy (but at a pressure lower than injector inlet pressure).