Short Course

Trickle Irrigation Installation for Horticulture Crops

by

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Princeton - March 26, 1987
9 a.m. to 3 p.m. - CST
Course Outline

1. Trickle Irrigation Overview
   a. Mean monthly precipitation
   b. Mean monthly pan evaporation
   c. Monthly irrigation requirement

2. Design Planning
   a. What is needed to design a system
   b. Design planning map information
   c. Example planning map

3. Water Supply
   a. City water
   b. Other water supplies pumps, motors, and engines

4. Basic Trickle Irrigation System
   a. Control station
      (1) pump or city water connection
      (2) backflow preventor
      (3) fertilizer tank
      (4) fertilizer injector
      (5) water meter
      (6) filter(s)
      (7) pressure gauges
      (8) pressure regulators
      (9) main shutoff valve
      (10) controllers
      (11) pressure relief valves
   b. Main, submains/manifolds
   c. Laterals
      (1) strip tubing
      (2) hose with emitters
         (a) laminar flow emitter
         (b) turbulent flow emitter
         (c) vortex
         (d) pressure compensating emitter
   d. Fittings
      (1) an example for city water connection
      (2) schematic of various fittings

5. Design Drawing

6. Installation
   a. Tools required
   b. Procedure

7. Emitter Clogging Problems
   a. Needed water quality
   b. Physical, chemical, and biological clogging problems

8. Irrigation Scheduling
   a. Tensiometers
   b. Resistance blocks
1. Trickle Irrigation Overview

Climatic Conditions

Bluegrass Region

<table>
<thead>
<tr>
<th>Precip.</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.11</td>
<td>4.19</td>
<td>4.66</td>
<td>3.43</td>
<td>2.95</td>
</tr>
</tbody>
</table>

Evapo.¹

<table>
<thead>
<tr>
<th>Evap.</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.96</td>
<td>6.46</td>
<td>6.72</td>
<td>6.25</td>
<td>4.57</td>
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</tbody>
</table>

Western Region

<table>
<thead>
<tr>
<th>Precip.</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.43</td>
<td>3.95</td>
<td>3.79</td>
<td>3.33</td>
<td>3.19</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evap.</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.40</td>
<td>7.15</td>
<td>7.47</td>
<td>6.31</td>
<td>4.66</td>
<td></td>
</tr>
</tbody>
</table>

Irrigation Needs² (Hort. crops)

Soil type  | condition  | May | Jun | Jul | Aug | Sep |
-----------|------------|-----|-----|-----|-----|-----|
loamy      | normal³    | 0.00| 0.36| 3.23| 1.81| 0.00|
           | dry⁴       | 0.00| 0.50| 3.57| 2.14| 0.00|
           | very dry⁵  | 0.14| 1.07| 4.56| 3.55| 0.00|
sandy      | normal     | 0.00| 0.44| 3.44| 2.32| 0.00|
           | dry        | 0.00| 0.57| 3.74| 2.61| 0.00|
           | very dry   | 0.00| 0.62| 3.85| 2.73| 0.00|

¹ Pan evaporation
² Irrigation required to increase the water holding capacity (WHC) to field capacity whenever WHC decreases to 50%
³ Normal 1 year out of 2
⁴ Dry 1 year out of 5
⁵ Very dry 1 year out of 10

Ponds and Wells

Pond Volume

<table>
<thead>
<tr>
<th>ft³</th>
<th>40% x Width x Length x Depth</th>
<th>7.48 x ft³</th>
</tr>
</thead>
<tbody>
<tr>
<td>gal</td>
<td>40% x Width x Length x Depth</td>
<td>7.48 x ft³</td>
</tr>
<tr>
<td>ac-ft</td>
<td>40% x Width x Length x Depth</td>
<td>7.48 x ft³</td>
</tr>
<tr>
<td></td>
<td>ft³/43,560</td>
<td>ft³/43,560</td>
</tr>
</tbody>
</table>
Advantages and Disadvantages of Trickle Irrigation

Advantages:
* reduces water volume needed
* reduces water waste (minimizes water runoff)
* water placement to roots
* reduces weed growth
* prevents soil crusting
* improves crop quality and yield, may hasten maturity
* reduces disease problems
* promotes even soil moisture (reduces tomato cracking)
* reduces root zone temperature
* No wind interference with distribution pattern
* Runs on low pressure, uses smaller equipment and less energy
* Easily automated, zoned
* Can be permanent system for perennial crops
* Can inject chemicals
* Can work while watering
* Between rows remains hard and dry for equipment
* Seeds and transplants not washed, damaged or dislodged
* Low labor requirement once installed
* Variable spacing design

Disadvantages:
* Clean water needed to prevent clogging
* Roots may seek emitters/holes
* Initial assembly labor
* Above ground line damage by equipment
* Rodent damage
* Dislodging supply tubes
* Frequent irrigation required
2. Design Planning

a. What is needed to design a system

Area
  1) area to be irrigated
  2) Topography of area

Crop
  1) Crops to be raised__________
  2) Field location of crops
  3) Row spacing

Water Supply
  1) Location of water supply
  2) Type of water supply__________
  3) Pressure
  4) Flowrate

Soil
  1) Soil Series or Soil Type

b. Design Planning Map Information

1. Map scale 1'' = _________ ft

2. Sketch boundary of farm.

3. Locate the water source

4. Locate field(s)

5. Provide elevations on the map or at least
   a. locate highest point in the field
      and elevation difference between
      the water supply and highest point
   b. provide estimate of field slope(s)

6. Location of rows and preferred direction

7. Spacing between rows

8. Plant spacing along rows

Refer to enclosed example
2. Design Planning

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Refer to enclosed example
3. Water Supply

a. City Water

1. Size of service line _______ in
2. Water meter size _______ in
   - normally 5/8, 3/4, or 1 in
3. Static water pressure _______ psi
   - connect a pressure gauge to a hose bib
   and turn water on
4. Flow rate in gallons per minute _______ GPM
   obtain from the table below:

<table>
<thead>
<tr>
<th>Service Line (in)</th>
<th>Water Meter (in)</th>
<th>Gallons Per Minute for Static Pressure of (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5/8</td>
<td>30, 40, 50, 60</td>
</tr>
<tr>
<td>3/4</td>
<td>5/8</td>
<td>2.0, 5.0, 6.5, 7.5</td>
</tr>
<tr>
<td>3/4</td>
<td>3/4</td>
<td>3.5, 7.0, 9.5, 11.0</td>
</tr>
<tr>
<td>1</td>
<td>3/4</td>
<td>6.0, 9.0, 12.0, 14.0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>7.5, 11.5, 15.0, 17.5</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1</td>
<td>10.0, 13.5, 19.5, 23.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.0, 17.0, 23.5, 28.5</td>
</tr>
</tbody>
</table>


b. Other Water Supplies
   - Pump
     Pressure and flow rate depend on irrigation system requirements. A pump should be selected that achieves:
     a. _______ ft of head (H)
     b. _______ gpm
   - Drive system
     To determine horse power needs:
     - determine water horse power from
     \[ WHP = H \times 8.3 \times GPM \]
     \[ \frac{33,000}{ } \]
     - determine break horse power which accounts for pump efficiency being less than 100%
     - obtain pump efficiency from a manufacturing pump curve
     \[ BHP = \frac{WHP}{pump\, efficiency} \]
     - select drive system to be used and corresponding efficiency from the table below

<table>
<thead>
<tr>
<th>Drive System</th>
<th>Efficiency (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric motor</td>
<td>90%</td>
</tr>
<tr>
<td>Gas engine</td>
<td>25%</td>
</tr>
<tr>
<td>Diesel engine</td>
<td>25%</td>
</tr>
</tbody>
</table>
- required motor or engine horse power

  Required H.P. = HP/efficiency

- this may be further increased depending upon the connection
  between the drive system and pump, i.e., direct drive, belt
  drive, etc.