Irrigation and Salinity Considerations: some research results on drip irrigation of processing tomatoes

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Research

- Drip line placement
- Crop water use
- Drip irrigation under saline soil conditions
Drip line placement

- **Buried placement**
  - Middle of bed; 8 to 14 inches deep
  - Drip line placement nearly coincides with plant row location
  - Modified tillage
  - Limited crop rotations

- **Alternate furrow placement**
  - Drip line as far as possible from plant row
  - Weeds
  - Drip lines removed before harvest and reused elsewhere
  - Long irrigation times

- **Every furrow placement**
  - Drip line as far as possible from plant row
  - Weeds
  - Vine training considerations
  - Drip lines remove before harvest and reused elsewhere
Soluble Solids (%)
Soil moisture

Distance from drip line (inches)

Wet

Dry

Plant row

Drip line

Buried

Alternate

Every

Soil moisture

Plant row

Drip line

Buried

Alternate

Every

Distance from drip line (inches)
Root distribution

- Drip line
- Buried
- Alternate
- Every

Depth (inches)
Distance from plant row (inches)
Crop water use or evapotranspiration

- Measured in commercial fields
- Drip irrigation and furrow irrigation
- Four-year period – variety of cultural practices (crop season, planting dates, plant rows per bed, irrigation, stand establishment)
$ET = K_c \times \text{reference crop ET}$

Crop coefficient ($K_c$) = actual ET / reference crop ET
Results

- ET ranged from 20.8 to 29.6 inches (significant factors: planting date and crop season)
- No difference between drip and furrow irrigation
- Average ET of study fields = 25.5 inches
- No difference between this average and the historical average (1981)
- Different crop coefficients were found compared to historical coefficients
- Substantial change in water use efficiency of tomatoes (ET/yield) over time
Drip irrigation under saline soil conditions in the San Joaquin Valley

- Saline soils (west side of San Joaquin Valley) – result of upward flow of shallow saline ground water
- 30 years of research – no technically, economically, and environmentally friendly subsurface drainage water disposal method
- Options for growers
  - Land retirement
  - Convert to different irrigation method
  - Reuse drainage water
  - Increase direct crop water use of shallow ground water
Drip Irrigation of Processing Tomatoes Under Saline, Shallow Ground Water Conditions

- Three commercial fields
  - Subsurface drip irrigation vs. sprinkle irrigation
  - Drip line depths – 8 to 12 inches
  - One drip line per bed
  - 2 to 3 irrigations per week
  - EC of irrigation water – 0.3 to 1.1 dS/m
  - Water table depth – 2 to 6 feet deep

- Fourth site
  - Very shallow water table (18 to 24 inches deep)
  - Daily irrigation
  - EC of irrigation water – 0.5 dS/m
Fourth commercial field - water table depth = 18 to 24 inches
Factors Affecting Salt Distribution Around Drip Lines Under Saline, Shallow Ground Water Conditions

- Salinity of irrigation water
- Amount of applied irrigation water
- Salinity of ground water
- Depth to water table
- Soil texture
Soil Salinity

ECi = 0.3 dS/m
ECgw = 8 dSm to 11 dS/m
Average water table depth – 6 feet

ECe

Plant Row

Drip Line
Soil Salinity

ECi = 0.3 dS/m
ECgw = 5 dS/m to 7 dS/m
Water Table Depth – 2 to 3 feet
Is Subsurface Drip Irrigation of Processing Tomatoes Sustainable in these Salt Affected Soils?

- Key – salinity control in root zone
- Little or no field wide leaching based on water balance data (leaching = applied water - ET)
- Soil salinity data – considerable localized leaching around drip lines (responsible for yield increases)
- What is the actual leaching fraction under subsurface drip irrigation?

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Computer simulations (HYDRUS-2D): water balance leaching fraction and actual leaching fraction for drip irrigation

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<th>Applied water (% of potential ET)</th>
<th>Water balance leaching fraction (%)</th>
<th>Actual Leaching fraction (%)</th>
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Notes:
- Myth: applying an amount of water equal to the ET results in an irrigation efficiency = 100% for drip irrigation
- High irrigation efficiency under drip irrigation occurs only for severe deficit irrigation conditions
- This behavior is due to the wetting pattern around drip lines and can not be avoided
Are subsurface drainage systems and drainage water disposal methods needed under subsurface drip irrigation?

- No drainage systems installed in commercial fields
- Little response of water table to drip irrigation except when overirrigation occurred at one site
- Growers continue to use subsurface drip irrigation with no long-term salinity effects

Conclusions:

- Subsurface drip irrigation is sustainable
- Proper management is required
- Drainage water disposal method is not needed for the conditions found in the commercial fields
The End