Irrigation, Salinity and Fertility Management in Substrate production of Berries

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Driscolls Oxnard Test plot Manager

Outline

- Introduction to substrate
- Characteristic of a substrate
- Advantages and disadvantages of growing in substrates
- Irrigation management
- Fertility management
- Salinity management
- Soil borne diseases in substrates

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Introduction

- What is a substrate?
  - Material alternative to soil where the roots grow.
  - Anchor the plant
  - Holds water.
  - Hold nutrient, does not supply nutrient itself.

- Types:
  - Coir
  - Peatmoss
  - Sand
  - Perlite
  - Rockwool
  - Vermiculate
  - Gravel

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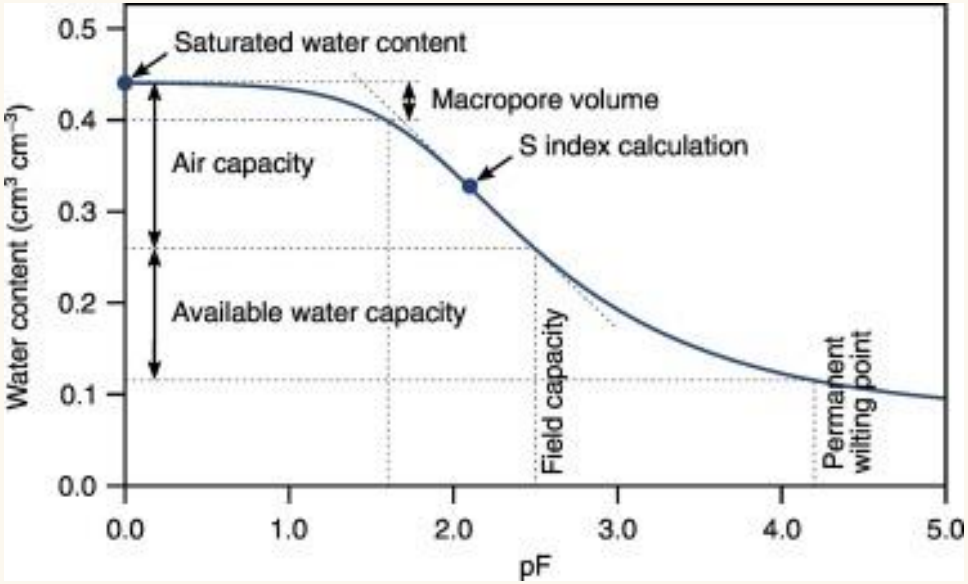
Characteristic of a substrate:

- Easily available water
- High aeration capacity
- Degradation resistance
- Light weight
- Compressible
- Low salinity
- Recyclable
- Cost effective

Water Retention Curve



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Advantages of substrate growing

- Low water tension with high oxygenation capacity
- Easier control of EC and pH
- Soil quality independent:
  - Chemically. Salinity.
  - Physically. Rocky soil or even lack of soil.
  - Biologically. Diseases
- Higher production potencial
- Better fruit quality

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Disadvantages of substrate growing

- High setup cost
- Higher fertilizer cost
- Precise management
- Later production in winter

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Why growing berries in substrate?

- Raspberries and Blackberries: Can grow long canes (Manipulate Chilling hours and production window)
- Strawberries
  - Attract labor
  - Soil diseases
  - Marketing
- Blueberries
  - Early production
  - Higher yield

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Irrigation Management

5 Important Questions:

- How much?(Quantity per irrigation)
- How often? (Frequency)
- When to start in the morning?
- When to finish in the evening?
- How much to drain?

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How much? (Quantity per irrigation)

5% of the available water plus the drain percentage

- Example: 7 liters pot, 3.5L water holding capacity, 35% drain and 4L/h drippers
  - Water consumed by the plant: 5% of 3.5L = 0.175L =175ml
  - Water applied: 175ml x1.35 = 236ml
  - Run time: 236ml/4,000ml/60min =3.5 minutes

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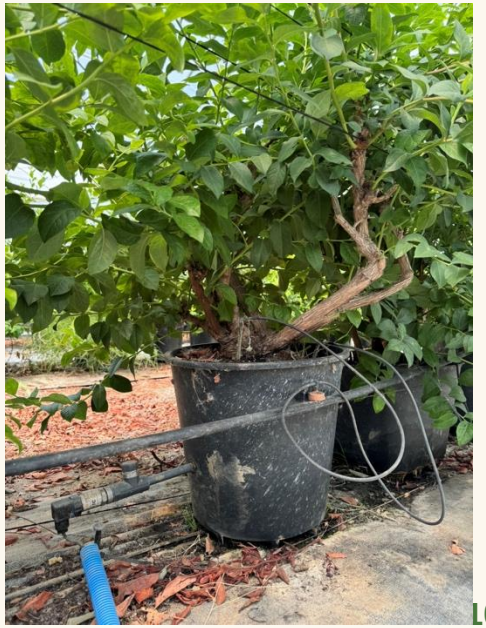
How often?

- Objective:
  - To keep up with transpiration at higher precision
  - Get the targeted drain volume for every irrigation
- Method of programing:
  - Substrate moisture sensors: VWC, microtensiometer or scales.
  - Based on radiation (Jules/cm^2)
  - Drain %.



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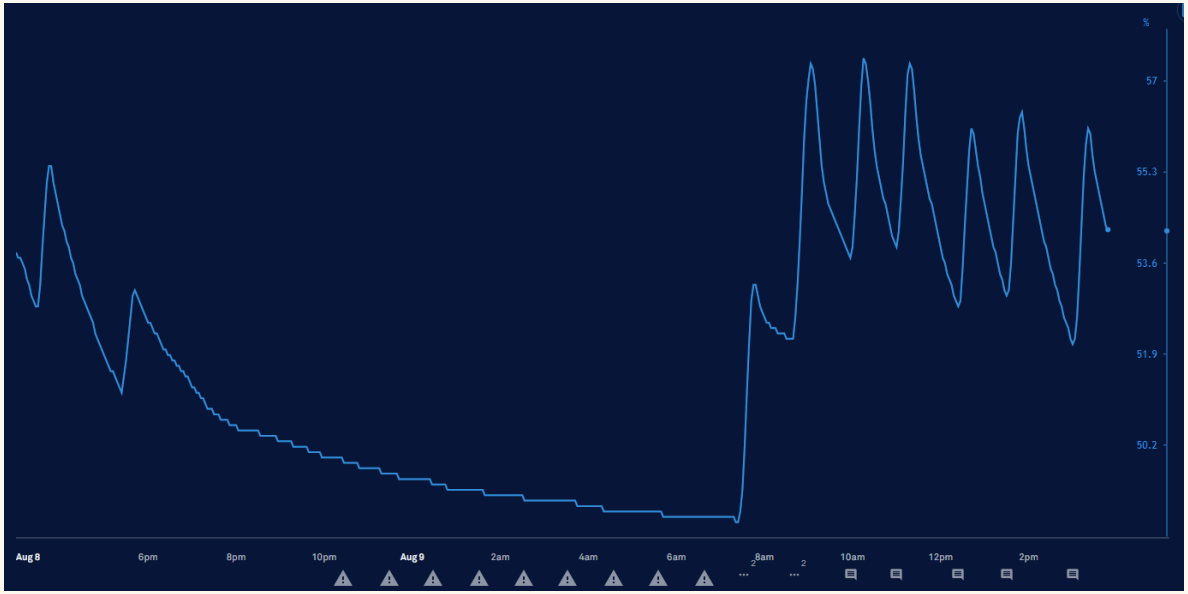
When to start?

- Start with transpiration: sensors or experience
- Rule of thumbs: 2 hours after sunrise
- Sooner in summer
- Later in the winter

Moisture Content

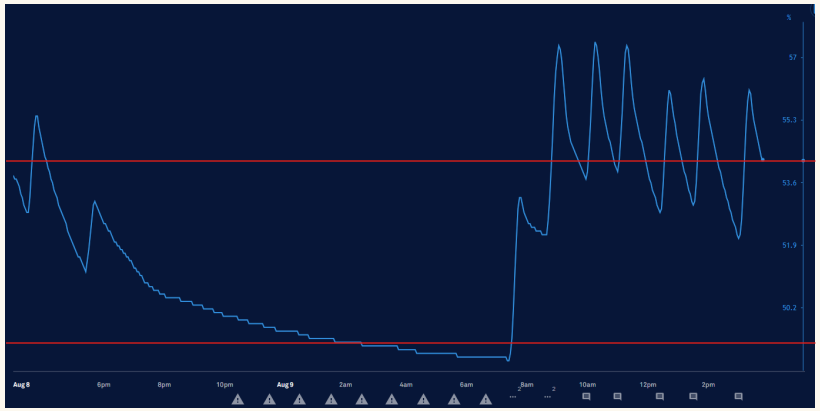


Time

When to finish?

- Dry down: reducing the water content at night for optimal oxygenation.
  - Below daytime ideal moisture content.
  - Reduce the likelihood of phytophthora.
  - Last irrigation must be done before the sunset
  - How early?:
    - Next day drain must be in the second or third irrigation.
    - It is a science and an art.
    - Heavily dependent on evening and night weather.

Moisture Content



Time

How much to drain?

- The purpose of draining in avoiding salt accumulation
- Depends on:
  - Crop tolerance to salinity
  - Salinity of water source
  - Fertilization program
- Rule of thumb: EC (drain) < 3.0 $dS.m^{-1}$

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Special case: Santa Anas

Forget everything I said: Water day and night!

- High temperature
- Low humidity
- High wind speed

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Fertility Management

- Substrates have lower buffer capacity.
- Constant feed is required, every nutrient needs to be applied.
- Source water typically supply some nutrients which need to be considered.
- EC (Drip) = EC (source) + ΔEC
- ΔEC expresses the amount of fertilizer added.
- Nutrients need to be balanced to avoid deficiencies and toxicities.

Example of a raspberry formula

Drip water analysis

mmol.l-1										ppm					
HCO3	NO3	H2PO4	NH4	K	Ca	Mg	SO4	Na	Cl	Fe	Mn	Zn	Mo	Cu	EC
0.5	5.5	0.25	0.2	1.5	3.5	1.7	4	3.9	3.6	1	0.5	0.25	0.04	0.04	1.5

Recipe

Tank A			Tank B		
CN-9	0.0	Ga	Phosphoric acid	7.8	Ga
Pottasium Nitrate 13-0-46	296.0	lbs	Pottasium Nitrate 13-0-46	207.0	lbs
Brandt Sequestar 14% Cu	400.0	gr	AN-20	8.8	Ga
Brandt Sodium Molybdate-Powder	145.0	gr	Magnesium Nitrate	0.0	lbs
Brandt Sequestar 13% Mn	12.0	lbs	Pottasium Sulfate	0.0	lbs
Brandt Sequestar 14% Zn	5.6	lbs	Magnesium Sulfate	0.0	lbs
Brandt Sequestar 13% Fe EDTA	21.1	lbs	Potassium Phosphate	0.0	lbs

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pH control

- Essential in substrate
- Berries are susceptible to both high and low pH
- Ideal pH 5.5-6.5 in drip and drain
- If pH in the drain is over 7.5 high risk of ferrous chlorosis

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Ways to control pH

- Water acidification:
  - Sulfuric acid
  - Nitric acid
  - Phosphoric acid
- Ratio NO3/NH4 in drip
  - 75% NO3/ 25% NH4 helps maintain pH slightly acidic

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Salinity

- It can be problematic in the Oxnard plain
- Salinity affects the plant negatively in two different way:
  - High osmotic pressure
  - Specific ion toxicity: Na, Cl, B
- Source of increased salinity in the substrate
  - Insufficient drainage
  - Excess application of fertilizer
  - Using fertilizers with undesirable salts
  - Salts in the source water

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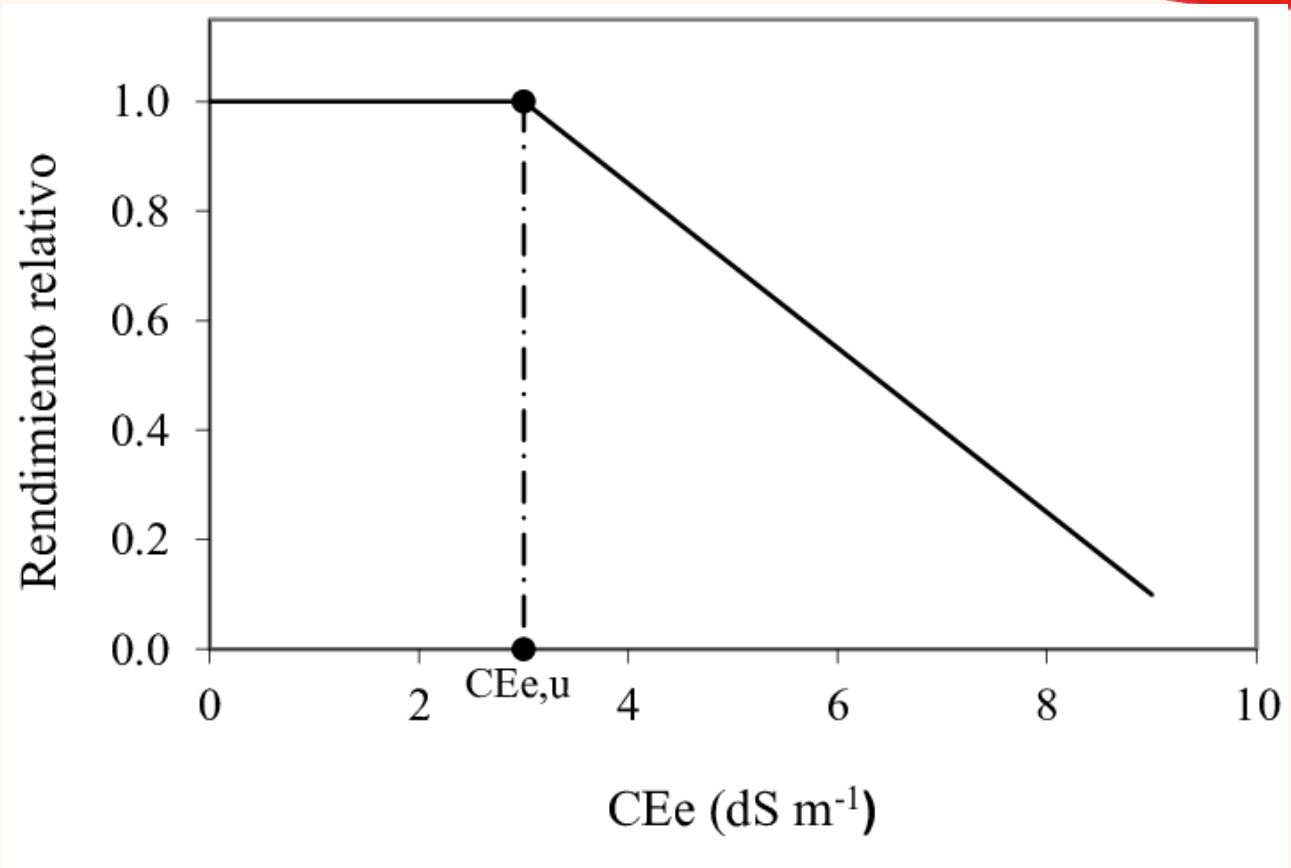
Salinity effect on production



Rule of thumb in berries: EC (drain) <3.0Ds.m-1

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How to minimize salinity damage?

- Drain.
- Avoid over application of fertilizer.
- Choose fertilizer with low undesirable salt content.
- Choose an alternative source of water
- RO water
  - High cost
  - Brine management

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Soil borne diseases in substrate

- Almost nonexistence in substrate:
  - Fusarium oxysporium.
  - Macrophomina.
  - Verticilium dahliae
- Most problematic disease is Phytophthora:
  - Good dry down at night.
  - Avoid overwatering.
  - Choose substrate with good aeration capacity.
  - Biological and chemical pesticides.

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Questions?

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