

Managing Salinity in Walnuts



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Higher Salinity in 2014?

- **Surface waters**
 - Reduced runoff -> higher salt load
 - Reduced supply -> use well water
- **Well water**
 - Often higher in salts



Where do they come from?

- Salts are found in all irrigation waters
 - Mineralization of soils
 - Fertilizers
 - Manures and composts
- Salts can accumulate in root zone and damage crops

What salts are in the water?

- Sodium (Na^+)
 - Calcium (Ca^{2+})
 - Magnesium (Mg^{2+})
 - Chloride (Cl^-)
 - Sulfate (SO_4^{2-})
 - Bicarbonate (HCO_3^-)
- Cations
- Anions

Boron (B), Carbonate (CO_3^{2-}), Nitrate (NO_3^-), Potassium (K^+)

How is salinity measured?



Electrical Conductivity (EC)

- EC_w = salinity of the water
- EC_e = salinity of the soil
- The units:

- dS/m = mmhos/cm
- $\mu\text{S/cm} = 1000 \times \text{dS/m}$

• Total Dissolved Solids (TDS)

- mg/L = ppm



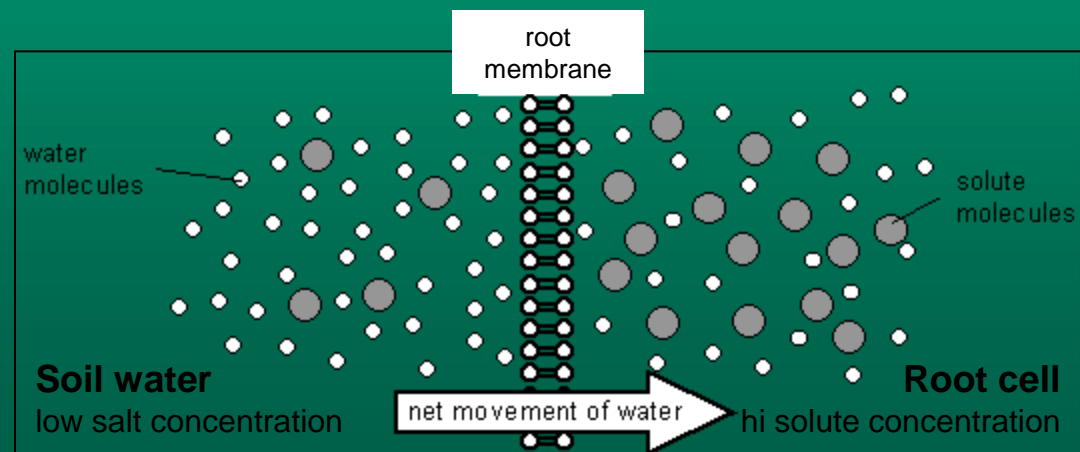
How does salt effect walnuts?

1. Overall salinity
 - EC (dS/m)
2. Specific ion toxicity
 - Sodium (Na)
 - Chloride (Cl)
 - Boron (B)



How does salt effect walnuts?

- Overall salinity
 - High salt restricts osmotic flow
 - uses more energy to exclude salt in the root zone and take in water
 - Water stress symptoms
 - Less growth
 - Lower yields



The overall osmotic effect is stunting of plant growth

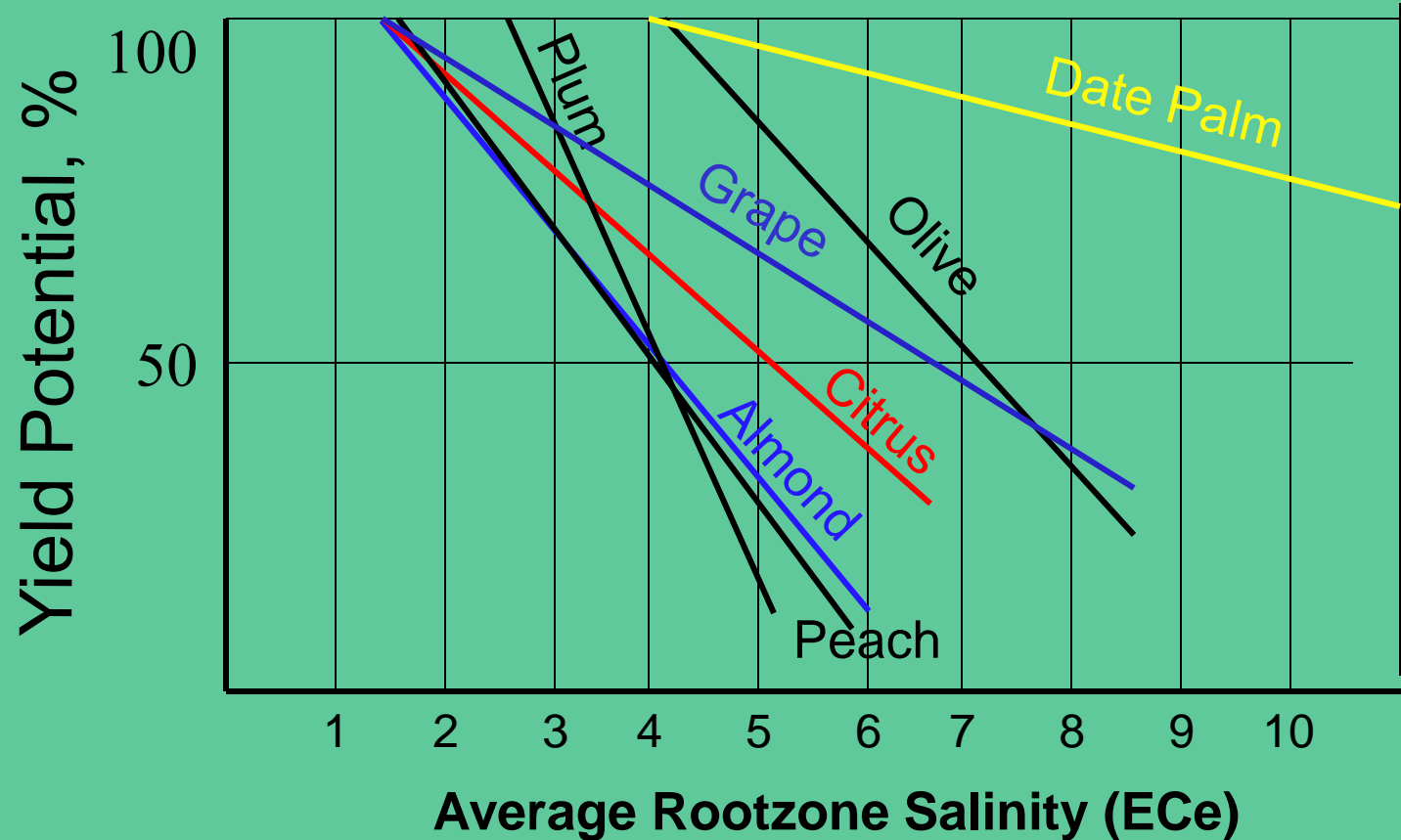


Non-stressed crop



Salt-stressed crop

Tree Salt Tolerance

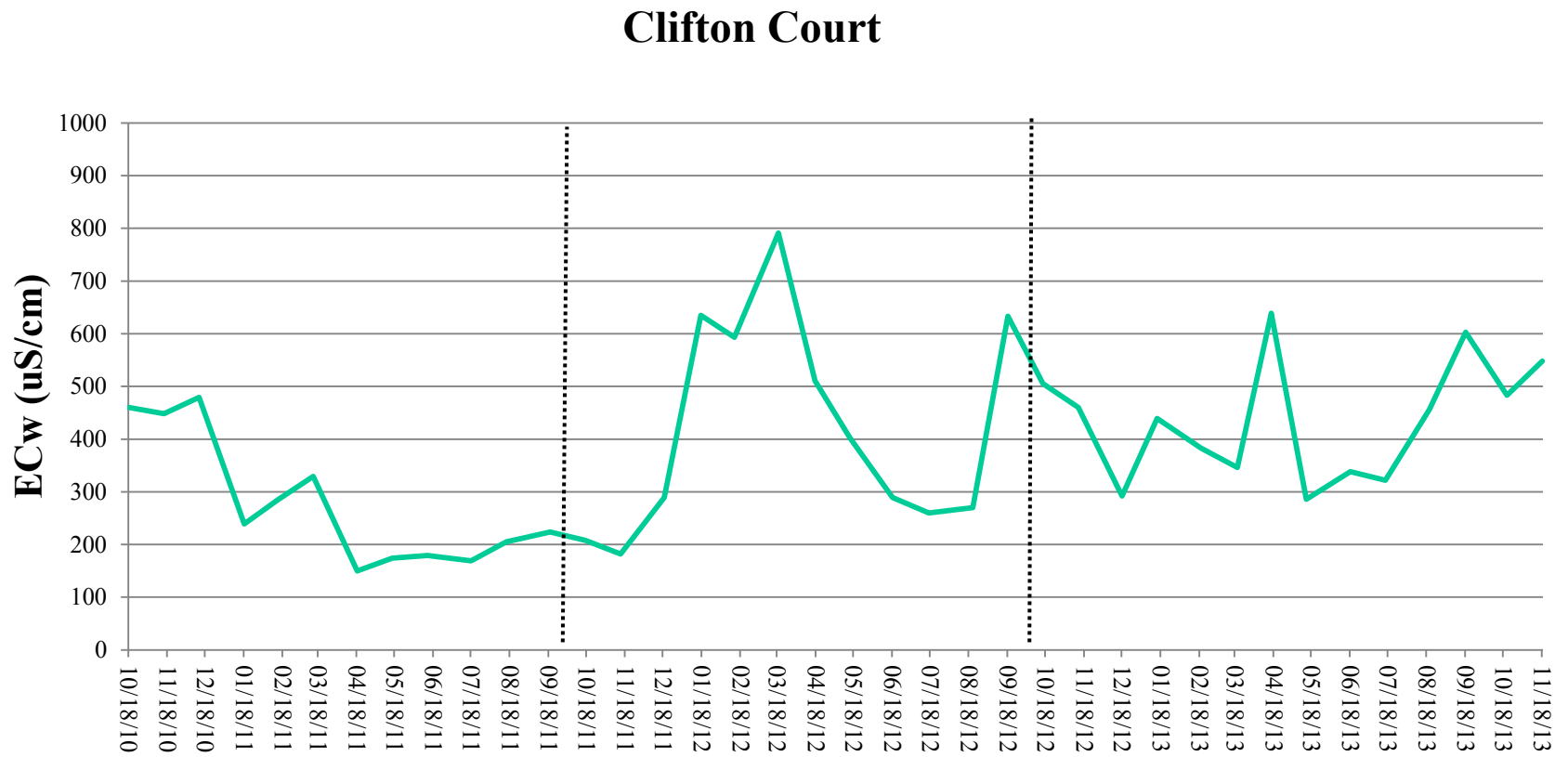


How much salt is too much ?

Source of Salinity	Salt Effects on Yield EC (dS/m)		
	None	Increasing	Severe
Soil/Rootzone (EC _e)	<1.5	1.5-4.8	>4.8
Irrigation Water (EC _w)	<1.1	1.1-3.2	>3.2

- What does “Increasing Effect” mean
 - Water: (assumes full ET_c + 15% LF)
 - 1.5 ~ 10% yield reduction
 - 1.9 ~ 25 % yield reduction
 - 2.8 ~ 50% reduction

ECw varies over the season



Specific Ion toxicity



Boron (B), Chloride (Cl) and sodium (Na)

Specific Ion Toxicity (Na, Cl, B)



- Normal plant nutrients
- Accumulate in the wood & leaves
 - Interfere with normal cellular processes
 - Reduced photosynthesis
- Roots can regulate uptake
- Rootstocks vary in regulation ability

Salt Tolerance of Walnut Rootstocks

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PARADOX



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Salt Tolerance of Walnut Rootstocks

Leaf Analysis

ROOTSTOCK	Boron (ppm)	Chloride (%)	Sodium (ppm)
Black	480 b	0.7 c	56 b
Paradox	667 a	1.8 b	87 b
English	704 a	2.1 a	125 a
Excess Level	300	0.3	100

Salt Tolerance of Walnut Rootstocks



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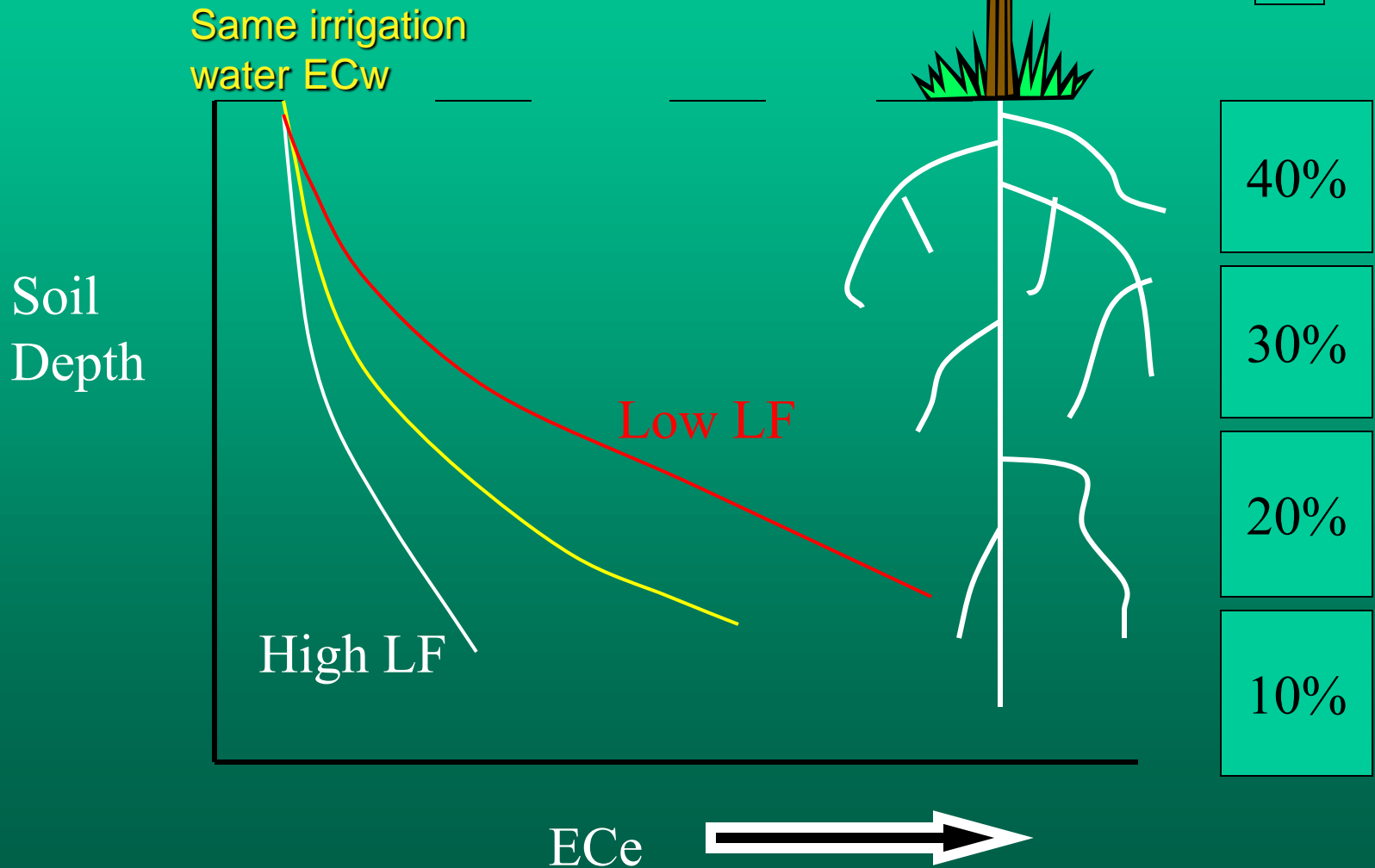
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PARADOX

Salinity Management

- Apply more water!
 - Leach salts below root zone
 - Apply the full crop water use (ET_c)
 - Apply an additional 15-20% “leaching fraction”
 - Many years the rainfall provides the leaching fraction!
- More frequent in-season irrigations
 - Keep the upper root zone wetter - it will be easier for the tree to extract water and exclude the salt
- Apply fertilizer modestly (they are salts!)

Salinity distribution in relation to various leaching fractions



Resources

UC Drought Management website

<http://ucmanagedrought.ucdavis.edu/>

UC ANR publications

<http://anrcatalog.ucdavis.edu/>

- Agriculture Salinity & Drainage (\$25)
- Irrigation Water Salinity & Crop Production (free)