Drought Management Strategies for Grapes

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2014 Drought Challenges

1. **Not enough water**
   - **Are we going to have cutbacks?**
2. **Salty water**
   - **Less runoff -> more salt in surface water**
   - **More use of groundwater**

Not Enough Water

Make every drop count!

1. Control weeds
2. Improve irrigation efficiency
   - System maintenance
   - Irrigation management

Not Enough Water

1. Control weeds
2. Control the cover crop

They increase water use by 20-30%

- Winter annuals:

  terminate early

- Permanent:
  - eliminate & renew in fall

Not Enough Water

2. Improve irrigation efficiency

System evaluation & maintenance

- Know the application rate
- Maximize the uniformity
- Maintain the system

Improving Efficiency:

- Know your application rate
  - Measure emitter flow rates
  - Install flow meter
- How uniform is it?
  - Maximize uniformity!

Improving Efficiency:

Causes of non-uniformity

- Poor design

Improving Efficiency:

Causes of non-uniformity

- Leaks & Breaks

Improving Efficiency:

- Causes of non-uniformity
  - Emitters with variable flows

Variable flow rate: clogging

Improving Efficiency:

- Causes of non-uniformity
  - To prevent clogging
    - Clean & flush lines
    - Clean & flush filters
    - Chemical – acid for HCO3
    - Biological –acid, chlorine, Cu

http://micromaintain.ucanr.edu

Not Enough Water

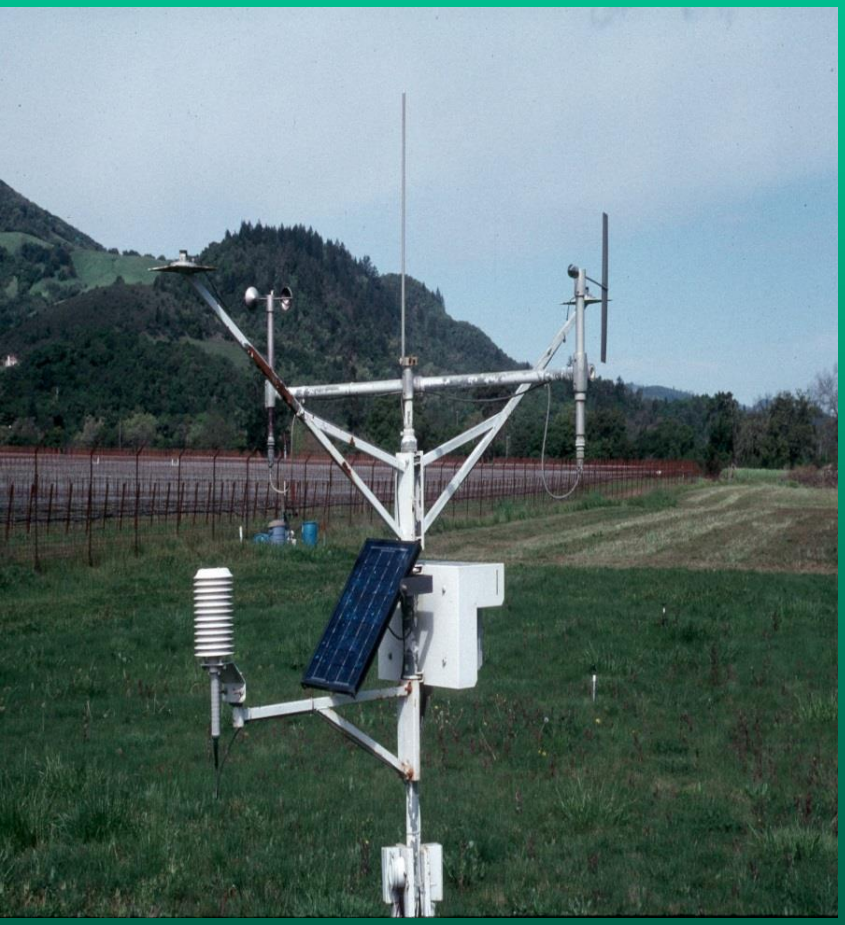
Make every drop count!

- ✓Control weeds
- ✓Improve irrigation efficiency
  - ✓System maintenance
  - – Irrigation management
    - How much to put on?
    - When to do it?

Evapotranspiration

CIMIS

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
DEPARTMENT OF WATER RESOURCES
OFFICE OF WATER USE EFFICIENCY



ETo is available from local CIMIS weather stations:

- Pleasanton (CIMIS # 191)
- Tracy (CIMIS # 167)
- Brentwood (CIMIS # 47)
- Moraga (CIMIS # 178)
- Union City (CIMIS # 171)

www.cimis.water.ca.gov

Calculating Crop ET (ETc)

To convert Reference ET (ETo) to Crop ET (ETc):

1. Calculate the crop coefficient (Kc) for your own vineyard

   Kc = % shaded area midday x .017

2. Calculate Crop ET

   ETo x Kc = ETc

3. Add a deficit amount

   ETc x RDI = Irrigation

Regulated Deficit Irrigation (RDI)

- Reduce the ETc by a certain amount to:
  - Increase quality
  - Reduce excessive vine growth
  - Save water
- Impose a set RDI throughout the season
  - Moderate stress ~ 50-60% ETc
- Irrigation amount => ETc x RDI

Weekly Irrigation Spreadsheet

DATE	ETo (in/wk)	Kc	ETc (in/wk)	RDI	Irrigation Amount	
					(in/wk)	(gal/vine/wk) *
Jul 8-14	1.5	0.51	.78	.5	.39	12
Jul 15-21	1.4	0.51	.72	.5	.36	11
Jul 22-28	1.4	0.51	.70	.5	.35	11
Jul 29-Aug 4	1.4	0.51	.72	.5	.36	11
Aug 5-11	1.3	0.51	.68	.5	.34	11
Aug 12-18	1.4	0.51	.70	.5	.35	11
Aug 19-25	1.3	0.51	.66	.5	.33	10
Aug 26-Sept 1	1.2	0.51	.62	.5	.31	10
Sept 2-8	1.2	0.51	.62	.5	.31	10

* Gal/vine/wk = inches/wk x .622 x vine spacing (ft^2)

When do you begin?

- Let the vines dry down until they show moderate stress:
  - The vines have stopped growing
  - 50% of available water in the root zone is used
  - Leaf water potential hits target (10-16 bars)
- Once you begin irrigating
  - Apply the calculated ETc x RDI amount for the week
  - The vines should NOT start growing again

Plant Stress Monitoring

- Visual Stress cues

Plant Stress Monitoring

- Pressure Chamber thresholds
  - White Varieties ~ 10-13 bars
  - Red varieties ~13-16 bars
- Stress tolerance varies among varieties:
  - Merlot < Cab Sav < Zinfindel

Soil Moisture Monitoring

There are numerous techniques, devices, and monitoring services available

Not Enough Water

Make every drop count!

- ✓ Control weeds
- ✓ Improve irrigation efficiency
  - ✓ System maintenance
  - ✓ Irrigation management

Not Enough Water

What if you need to reduce more?

Plan for more stress than usual

- Apply an even deficit all season
- Minimize leaf pulling
- Minimize tucking in divided canopies
- Prune out extra canes, spurs
- Drop excess crop ASAP
- Drop sunburn late to protect remaining

2014 Drought Challenges

1. **Not enough water**
   - ✓ Control weeds/cover crop
   - ✓ Improve irrigation efficiency
   - ✓ Use deficit irrigation
2. **Salty water**
   - Will it be too salty to use?

Where do salts come from?

- Irrigation water is the primary source of salts in agricultural systems
- Also from fertilizers, manures, composts

Salts can accumulate in root zone and damage crops

What salts are in the water?

- Sodium (Na^{+})
- Calcium (Ca^{2+})
- Magnesium (Mg^{2+})

} Cations

- Chloride (Cl^{-})
- Sulfate (SO_4^{2-})
- Bicarbonate (HCO_3^{-})

} Anions

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

How is salinity measured?

Electrical Conductivity (EC)

- ECw = salinity of the water
- ECe = salinity of the soil
- The units:
  - dS/m = mmhos/cm
  - uS/cm = 1000 x dS/m

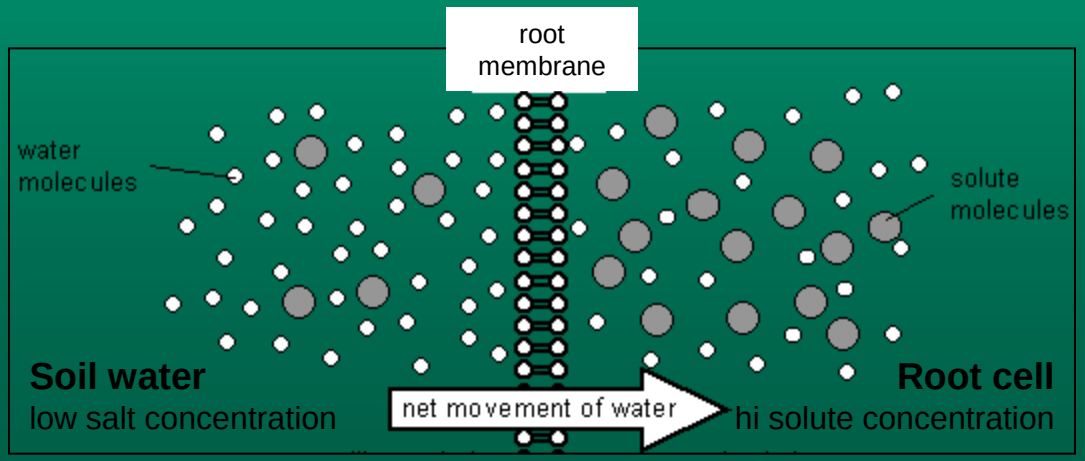
- **Total Dissolved Solids (TDS)**
  - mg/L = ppm

How does salt effect plants?

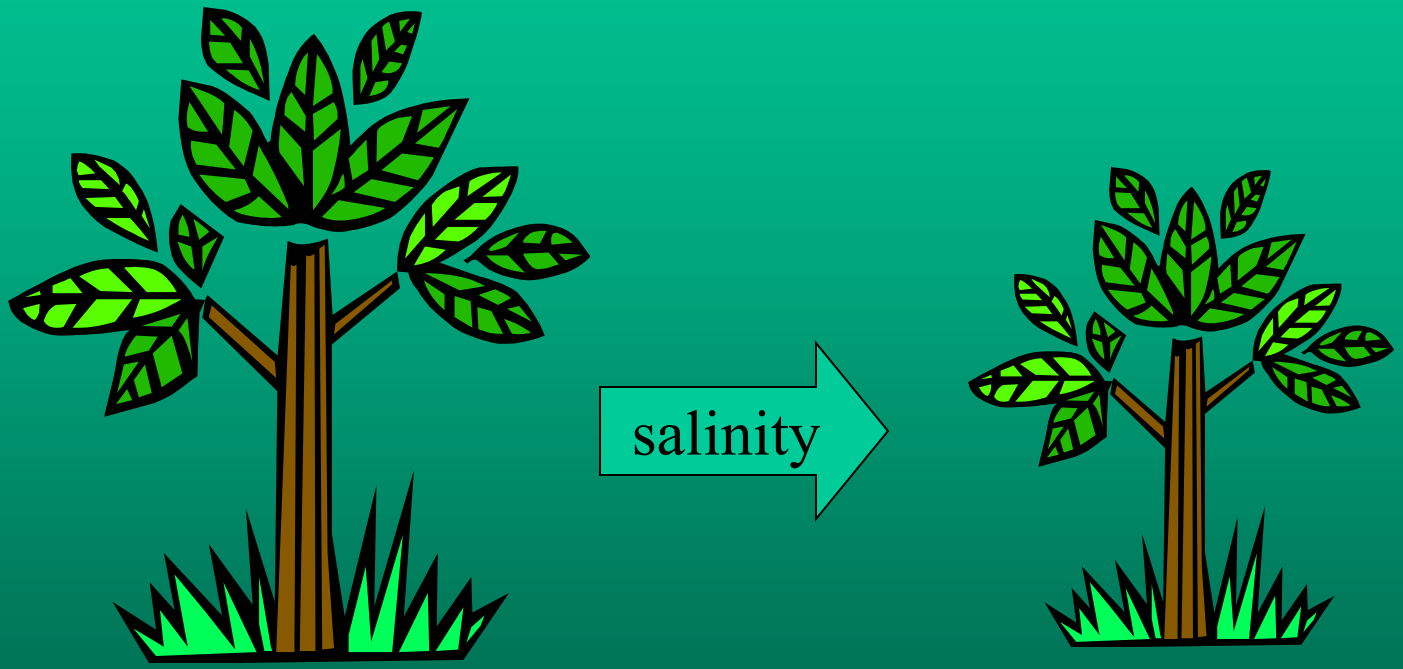
1. Overall salinity
   - EC (dS/m)
2. Specific ions
   - Toxicity (Na, Cl, B)
3. Water Infiltration

How does salt effect plants?

- 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

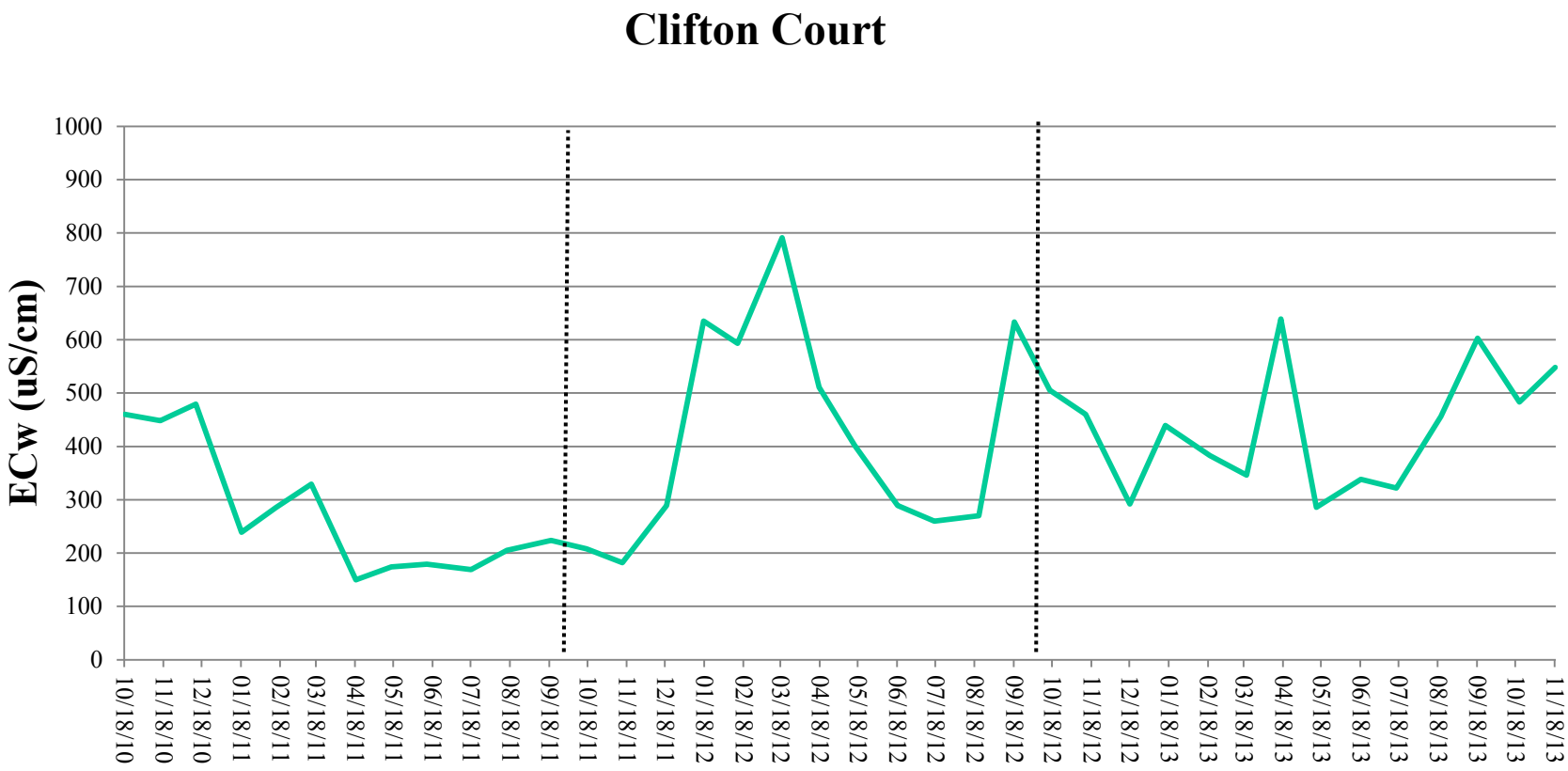
Salt-stressed crop

How much salt is too much ?

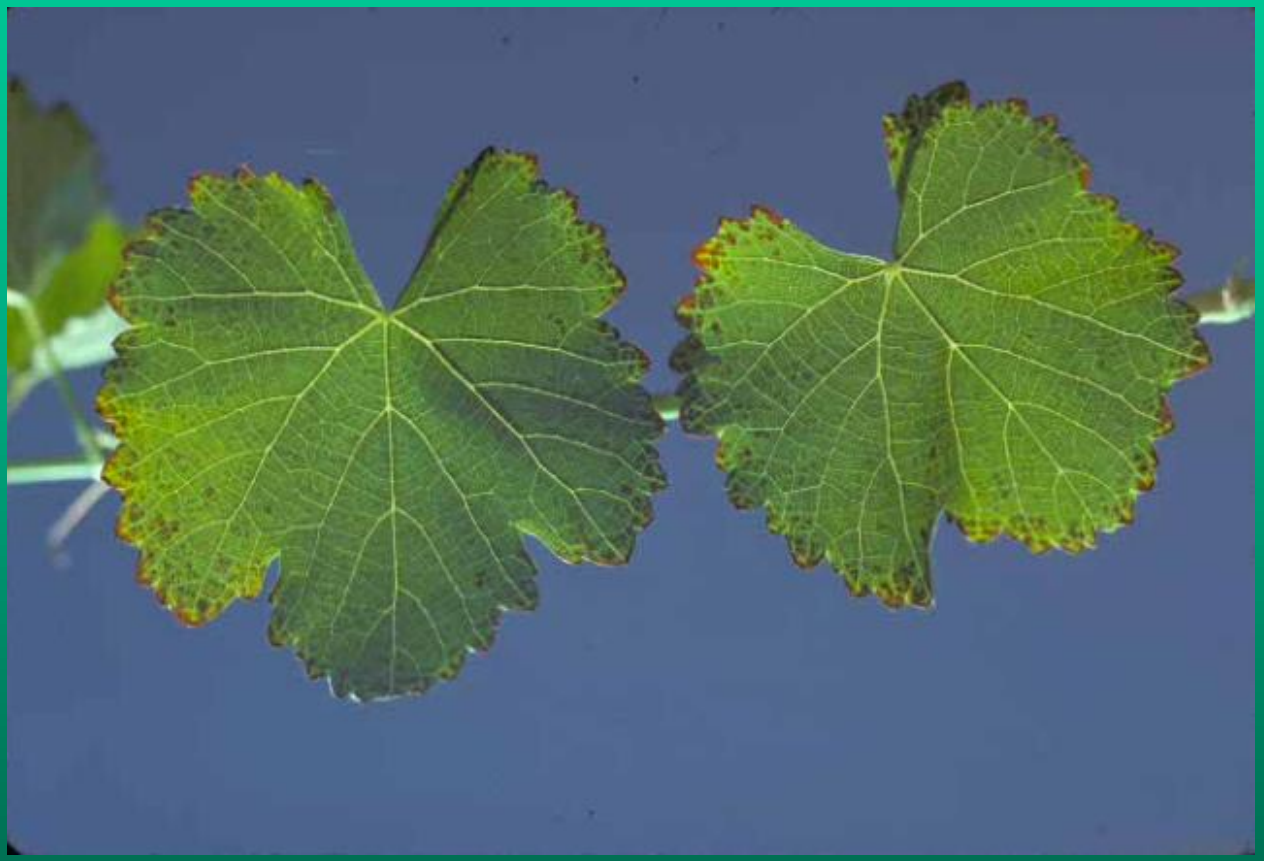
Source of Salinity	Salt Effects on Yield EC (dS/m)		
	None	Increasing	Severe
Soil/Rootzone (ECe)	<1.5	1.5-4.1	>4.1
Irrigation Water (ECw)	<1.0	1.1-2.7	>2.7

- What does “Increasing Effect” mean
  - Water: (assumes full ETc + 15% LF)
    - 1.7 ~ 10% yield reduction
    - 2.7 ~ 25 % yield reduction
    - 4.5 ~ 50% reduction

ECw varies over the season



Specific Ion toxicity



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

Specific Ion Toxicity
(Na, Cl, B)

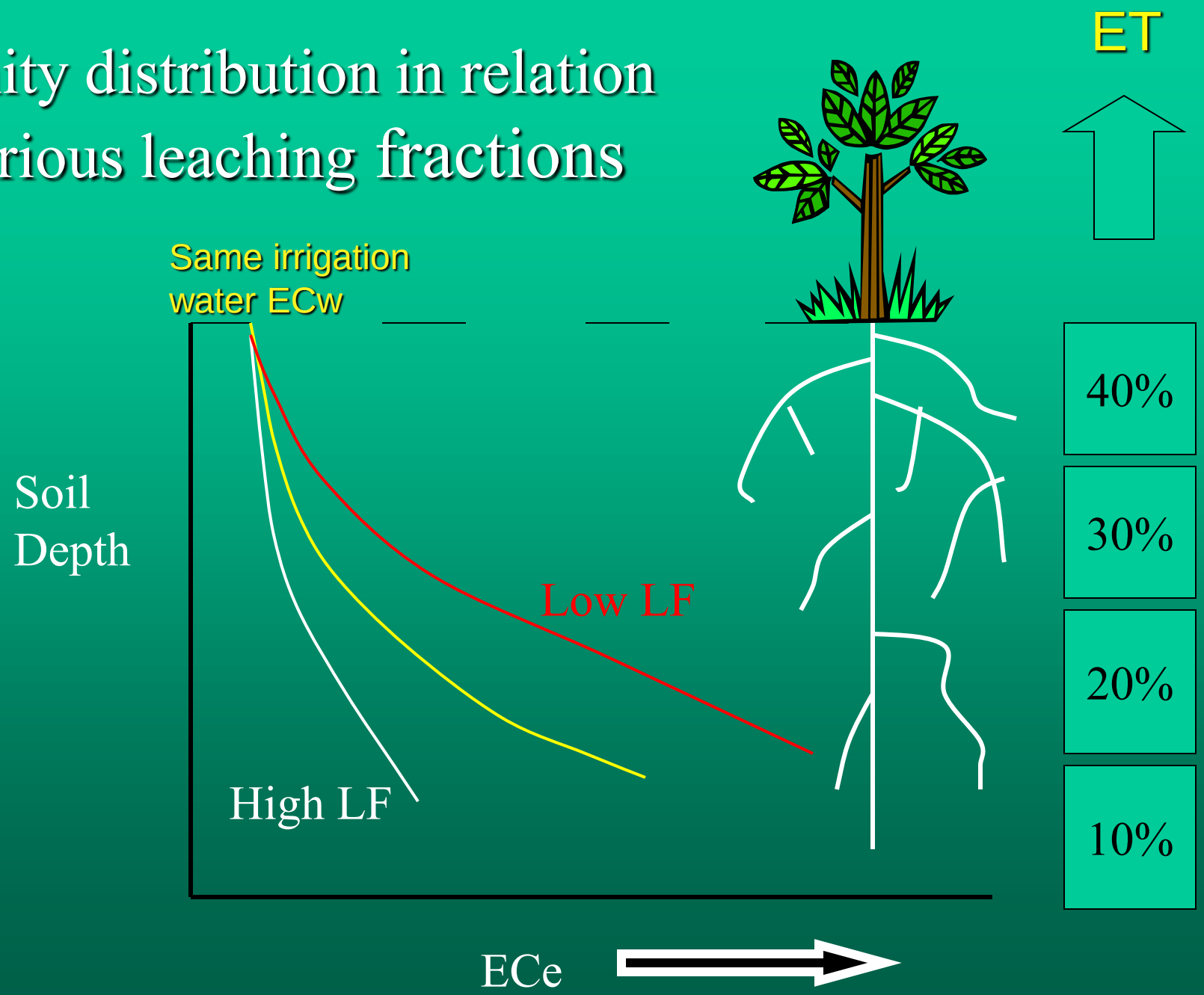
How much is too much ?

Source of Toxicity	**Ion Effects on Yield** EC (dS/m)		
	None	Increasing	Severe
Sodium (ppm)	< 460		
Chloride (ppm)	< 140	4-15	> 15
Boron (ppm)	< 1	1-3	> 3

Salinity Management

- Apply more water!
  - Leach salts below root zone
    - Apply full crop water use (ETc) after harvest, if possible
    - Let the rainfall leaching salts below the root zone
- 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



Web Resources

UC Drought Management website

http://ucmanagedrought.ucdavis.edu/

Best Practices for Vineyard Water Management

UCDavis Workshop – 2/20/14:

http://wineserver.ucdavis.edu/content.php?category=VENSource&id=1012

Integrated Viticulture website:

http://iv.ucdavis.edu/Viticultural_Information/

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