2011-2014 Strawberry irrigation trials

Evaluation of irrigation regimes in Oxnard strawberry fields

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2011-2014 Strawberry irrigation trials

yields, water use and leaching

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Evaluation of irrigation regimes in Oxnard strawberry fields

- Background
- Effect on yields
- Water and energy savings
- Leaching control and reduction
- Next steps

How water moves from the soil to the plant

- Water moves according to laws of physics from low tension (wet spot) to high tension (dry spot)
- Tension measures the amount of energy that a plant has to exert to pull the water from the soil
  - Initiate irrigation based on plant needs
  - Tool to detect leaching (tension reaches 0 at lower depths)

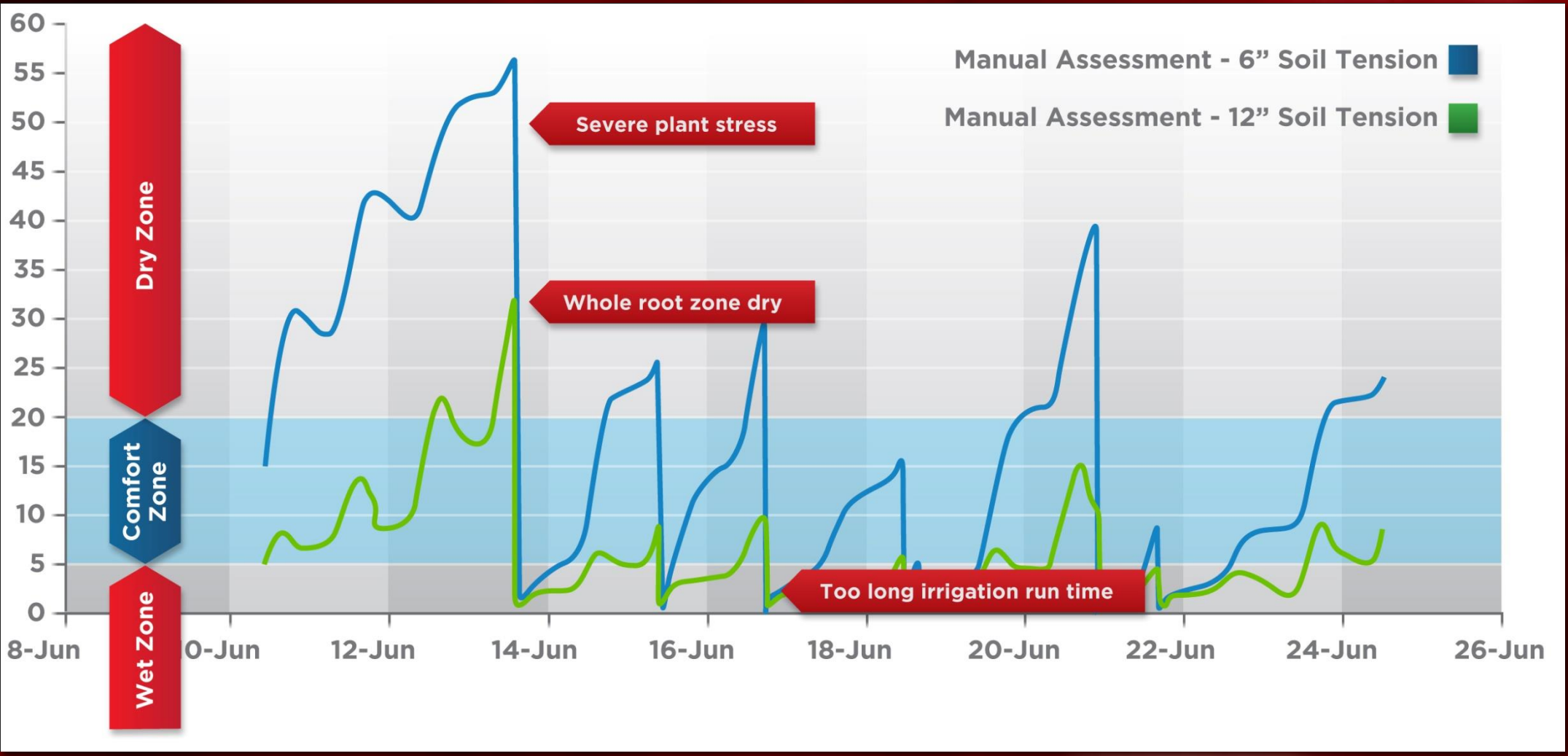
Using tension or suction forces to drive irrigation decisions

Ajdusting irrigation time

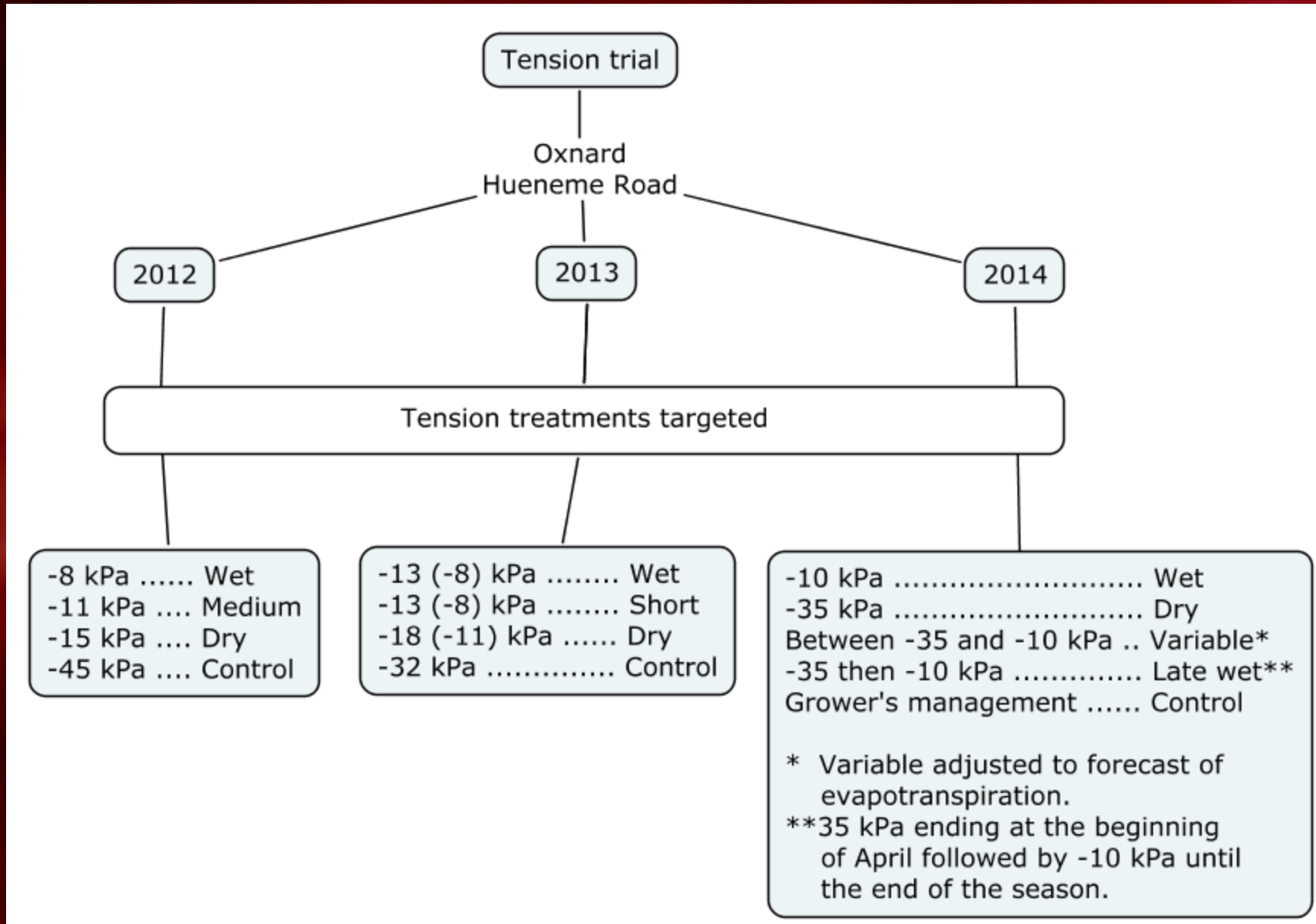
(Avoid leaching : drop at -5 kPa)

Initiating irrigation: threshold reached

Observed tension fluctuations at two depths with precision tensiometers



All Oxnard thresholds tested between 2012-2014



Effects of real time irrigation management on strawberry production:

Parameters Measured

Soil sampling and soil analysis

Initial properties

- Texture
- Saturated Hydraulic Conductivity (Ksat)
- Soil Water Retention Curves
- Salinity : Electrical Conductivity (EC)

Weekly determination

- Amount of water/ac using flowmeters
- Soil salinity (EC) using suction lysimeter
- Leaching water
- Soil salinity using SSE method 1: 1 suspension (initial, mid and end of season)

Effects of real time irrigation management on strawberry production:

Parameters Measured

Plant performance and hydric stress measurements (Weekly measurements)

- Yield in sub-sampling sites
- Size of the fruits (caliber)
- Fruit quality using Brix index
- Plant size (canopy area, collar circumference, roots weight and roots observation through soil profile)

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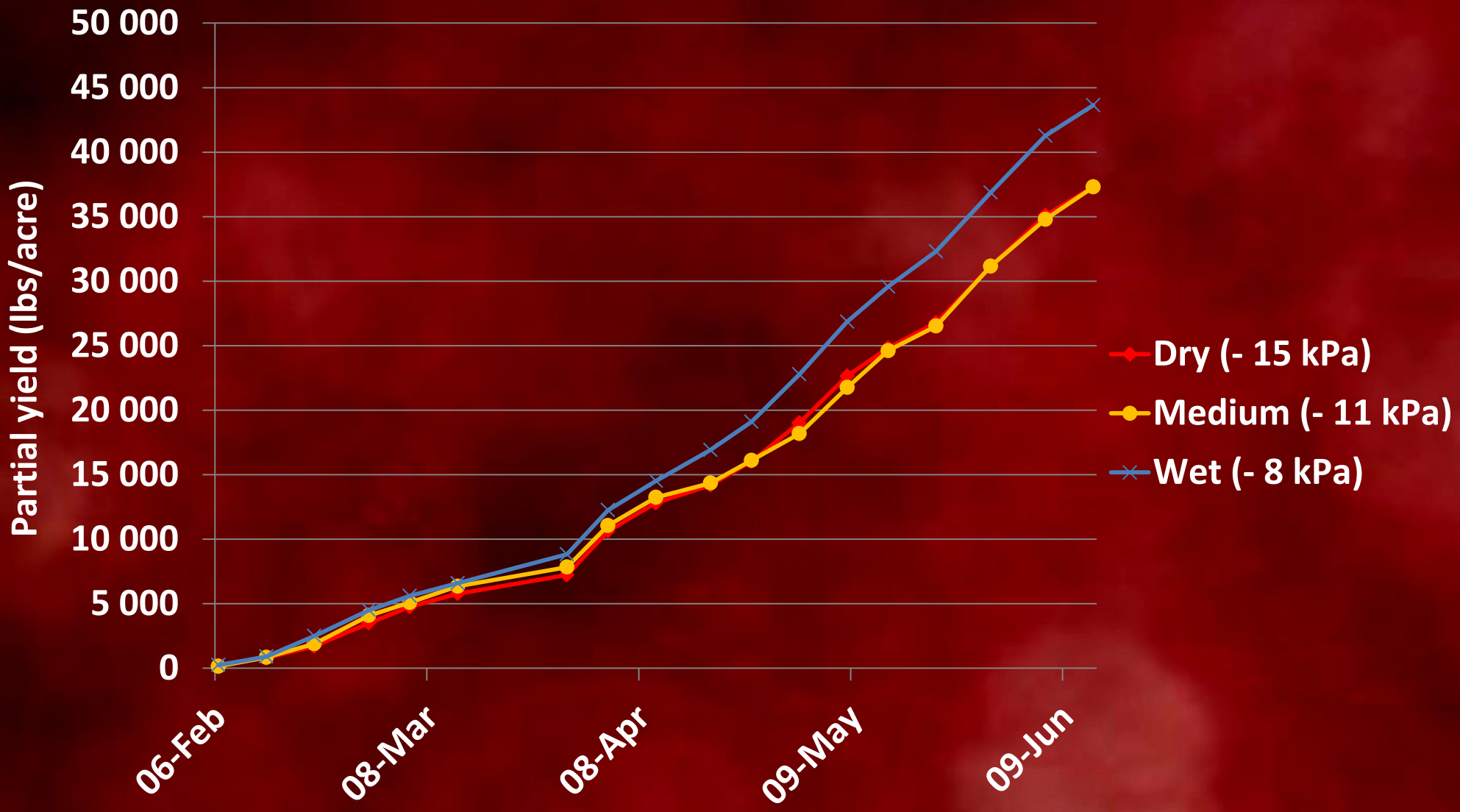
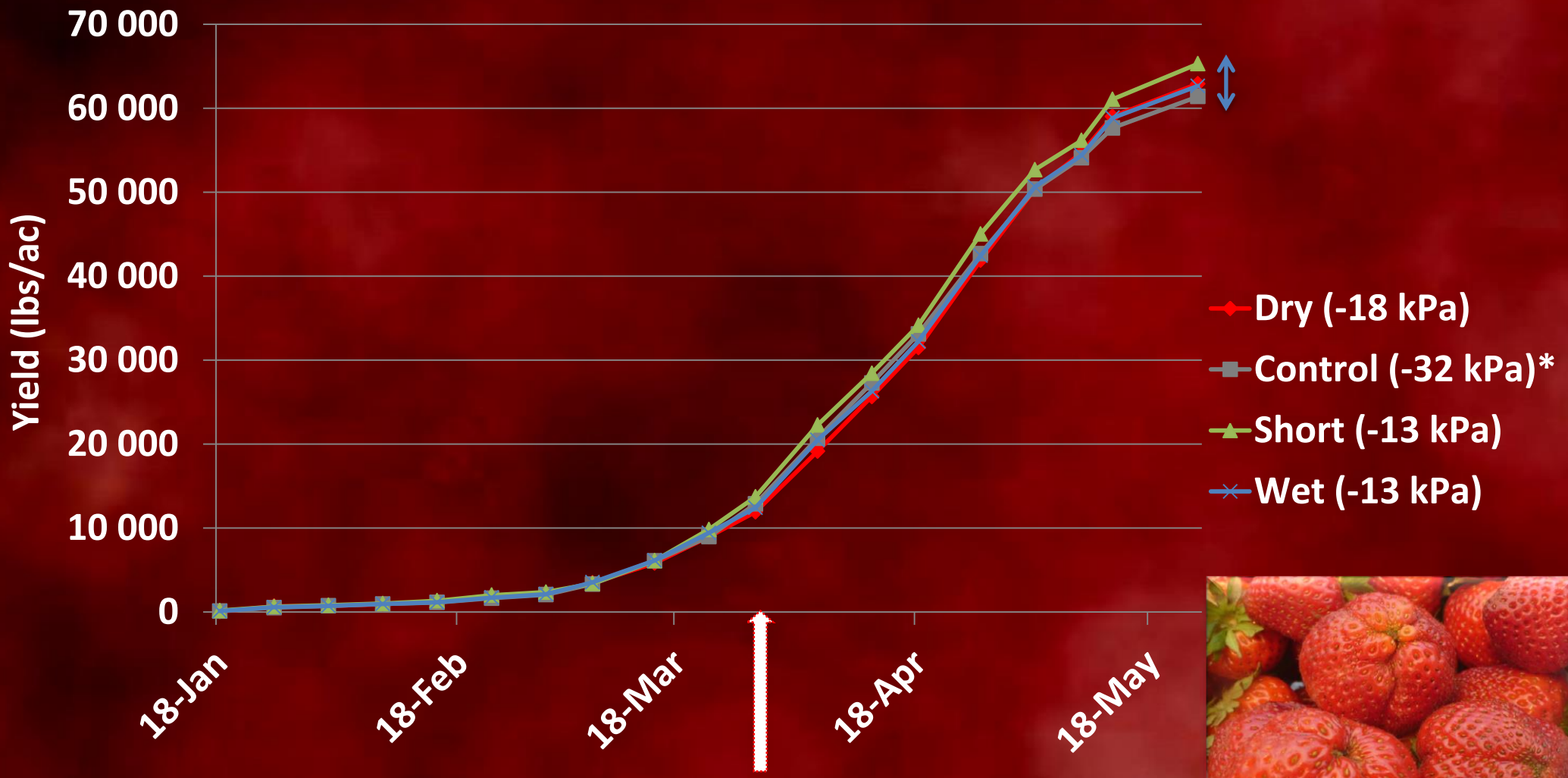
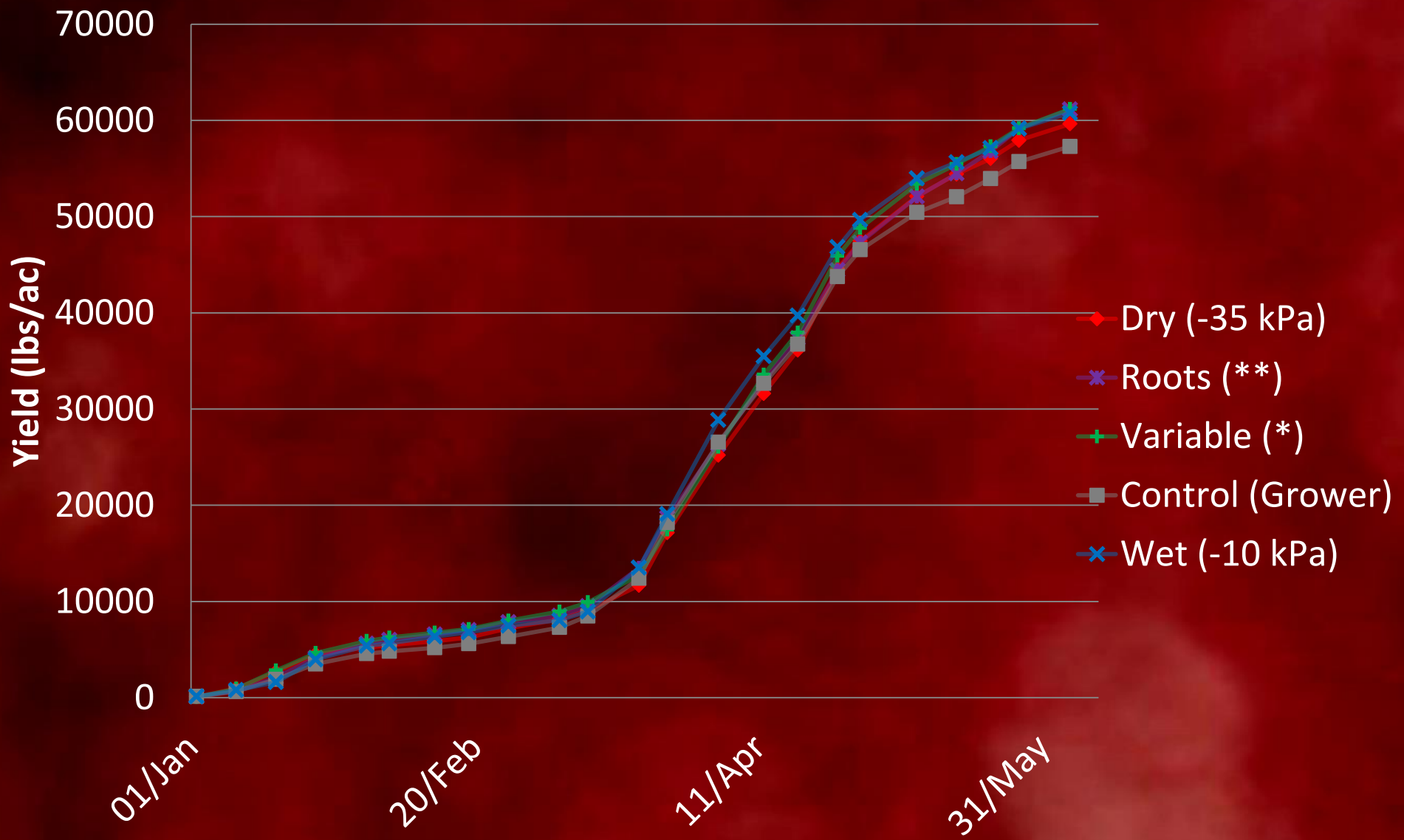
Partial cumulative yield (Oxnard 2012)



Partial cumulative yield (Oxnard 2013) - no differences



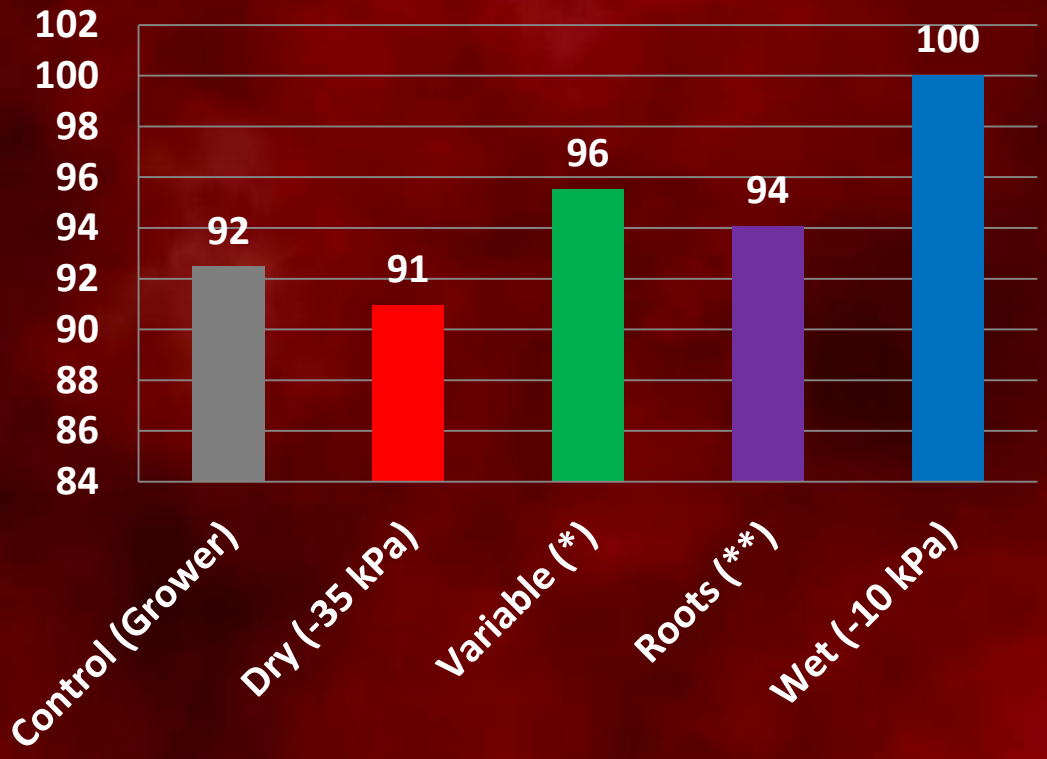
Partial cumulative yield (Oxnard 2014)



Partial cumulative yield (Oxnard 2014)

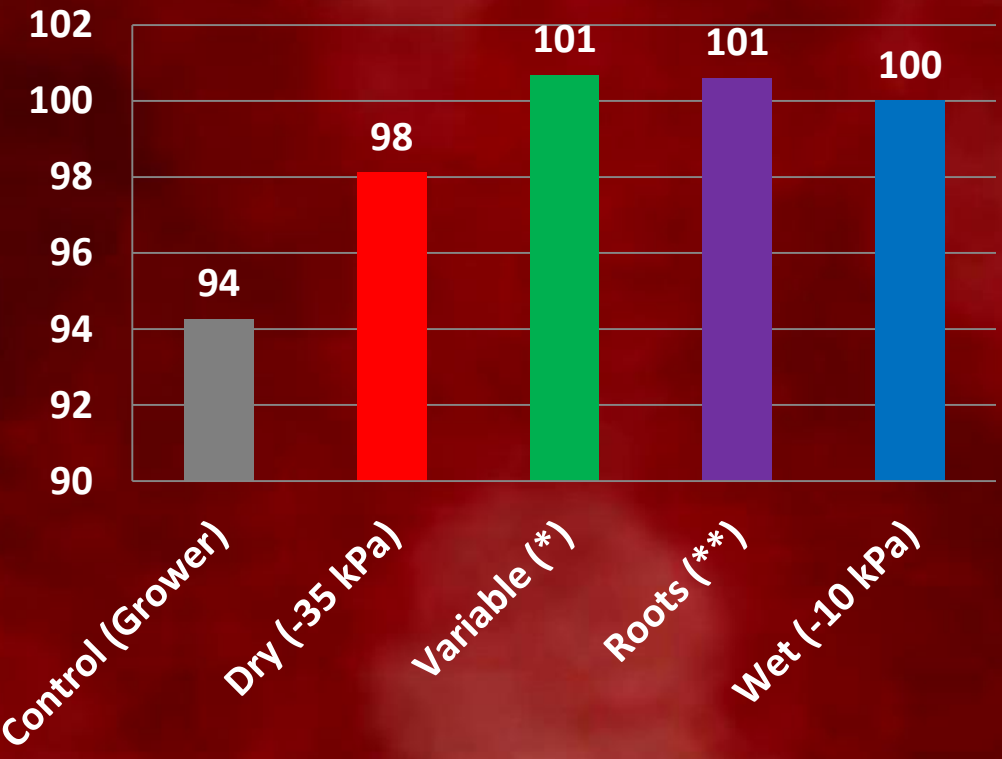
Fresh Market only

From Januray 2th to April 18th 2014
(% 10 kPa treatment)

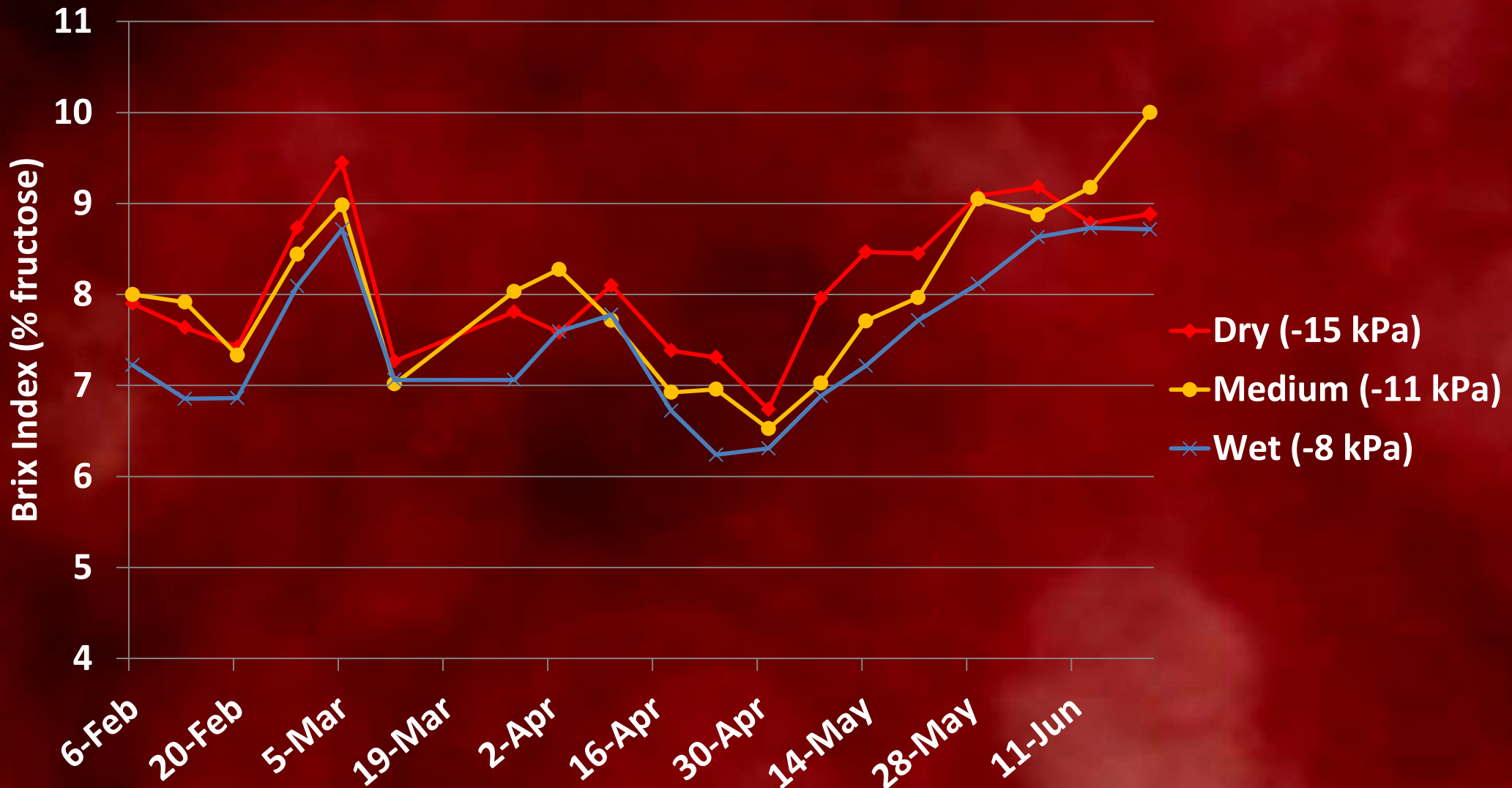


Whole season

From Januray 2th May 5th 2014
(% of 10 kPa treatment)



Fruit quality (Brix index) at the Oxnard site (2012)



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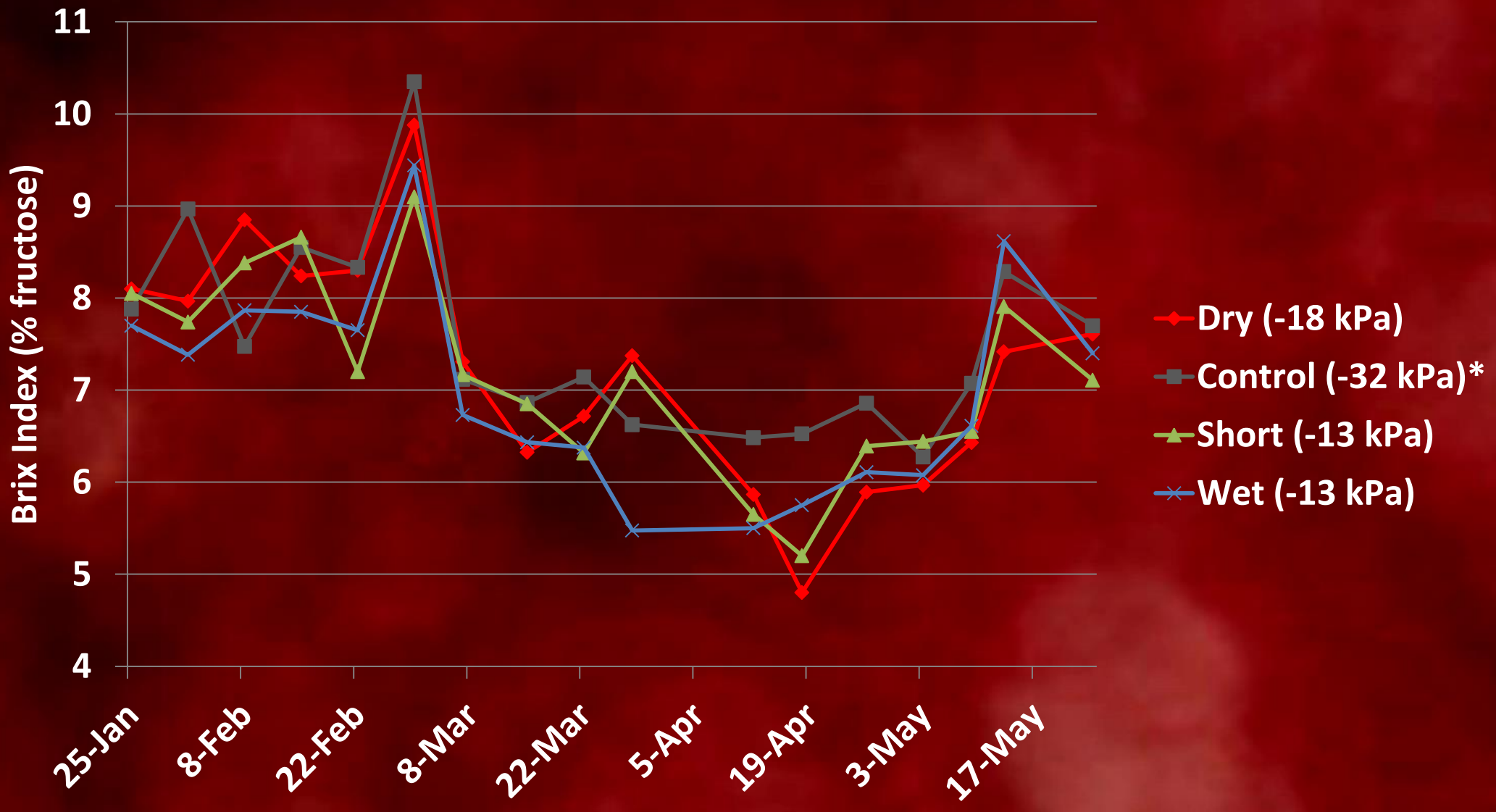
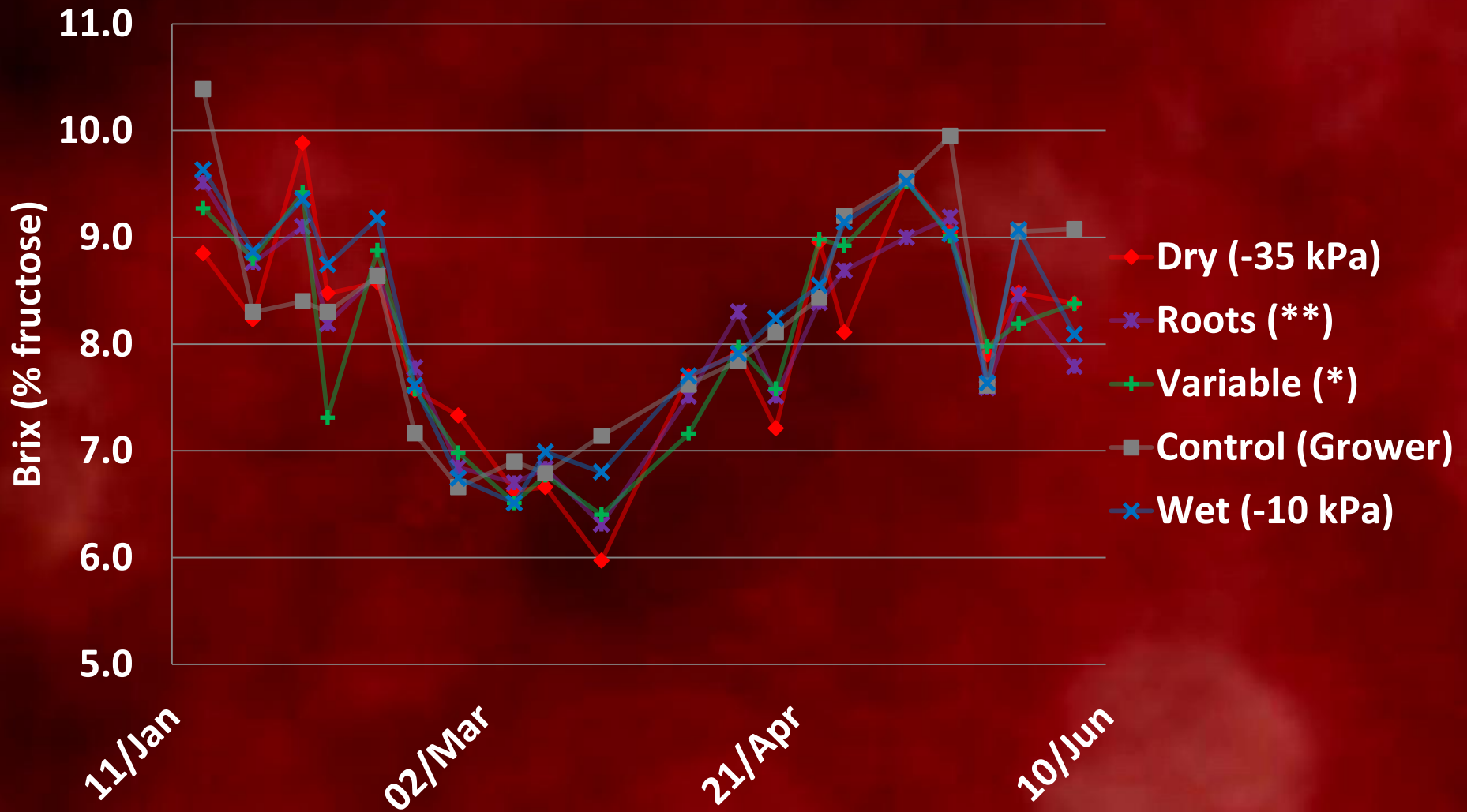


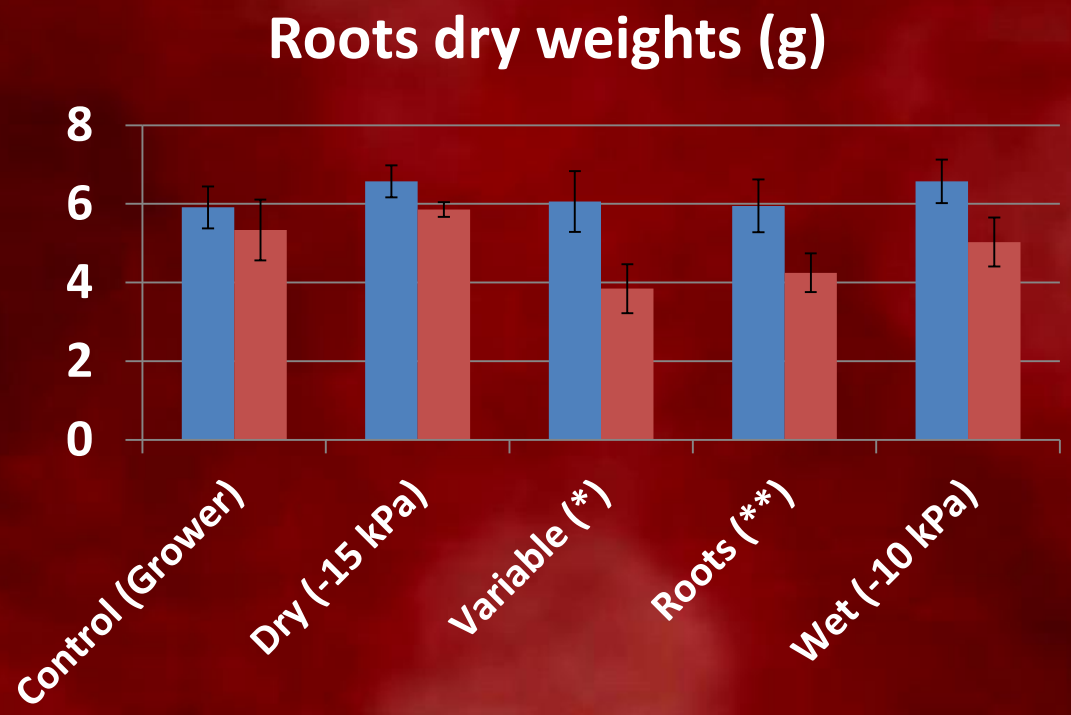
Fruit quality (Brix index) at the Oxnard site (2014)



Results on roots measurements

Protocol : Roots sampled with 20 cm height and 30 cm diameter bucket, washed, separated from collar, dried, and weighted.

March 12th 2014 : Roots treatment switched from dry (-35 kPa) to wet (-10 kPa)
June 12th 2014 : End of the season



•Error bars using SEM

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yields, water use and leaching

Evaluation of irrigation regimes in Oxnard and Watsonville strawberry fields

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- Leaching control and salt buildup
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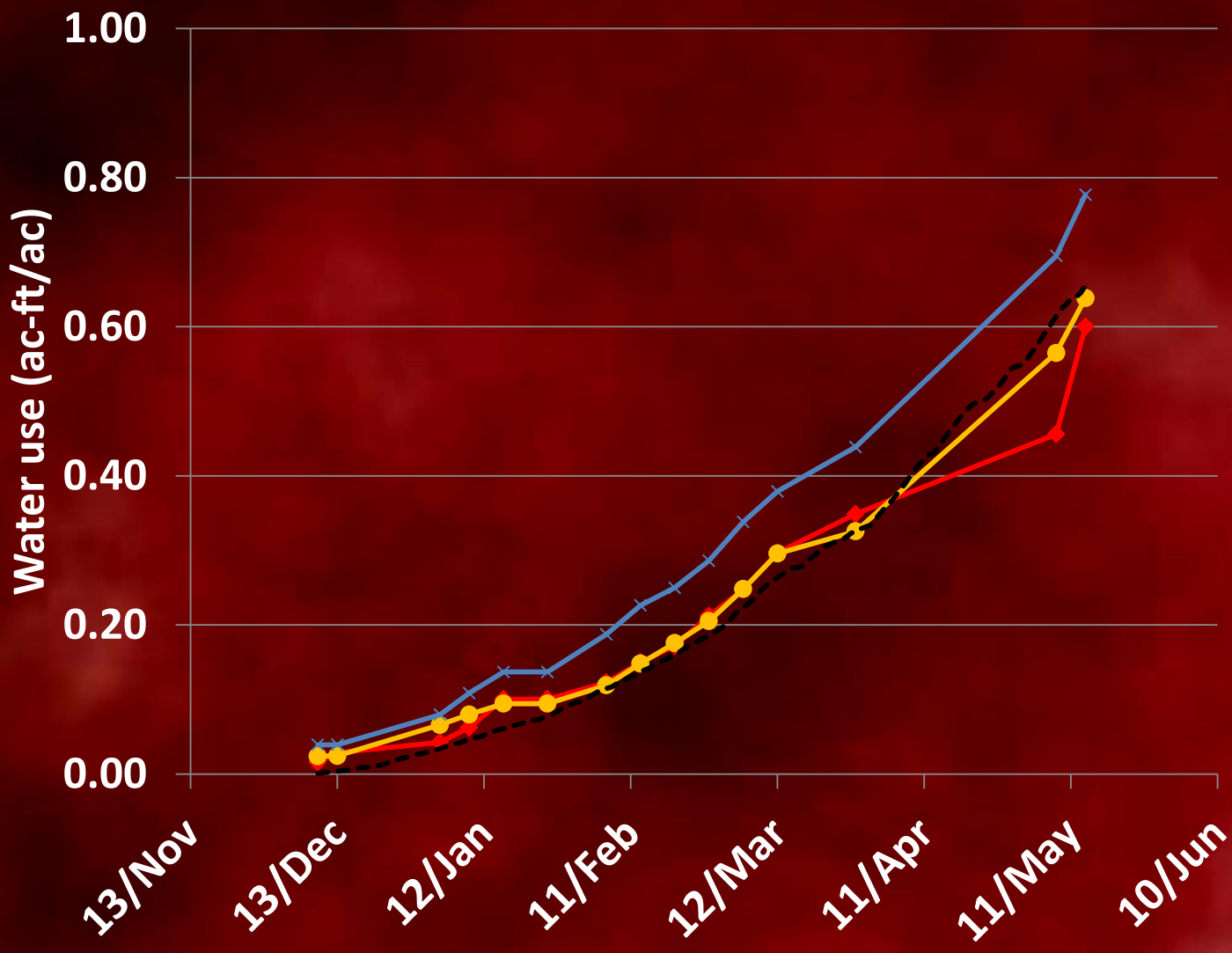
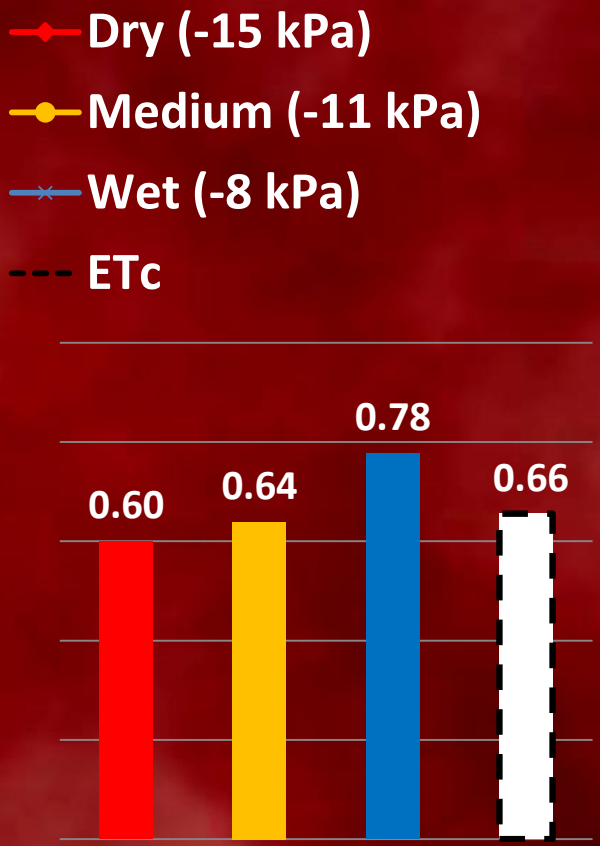
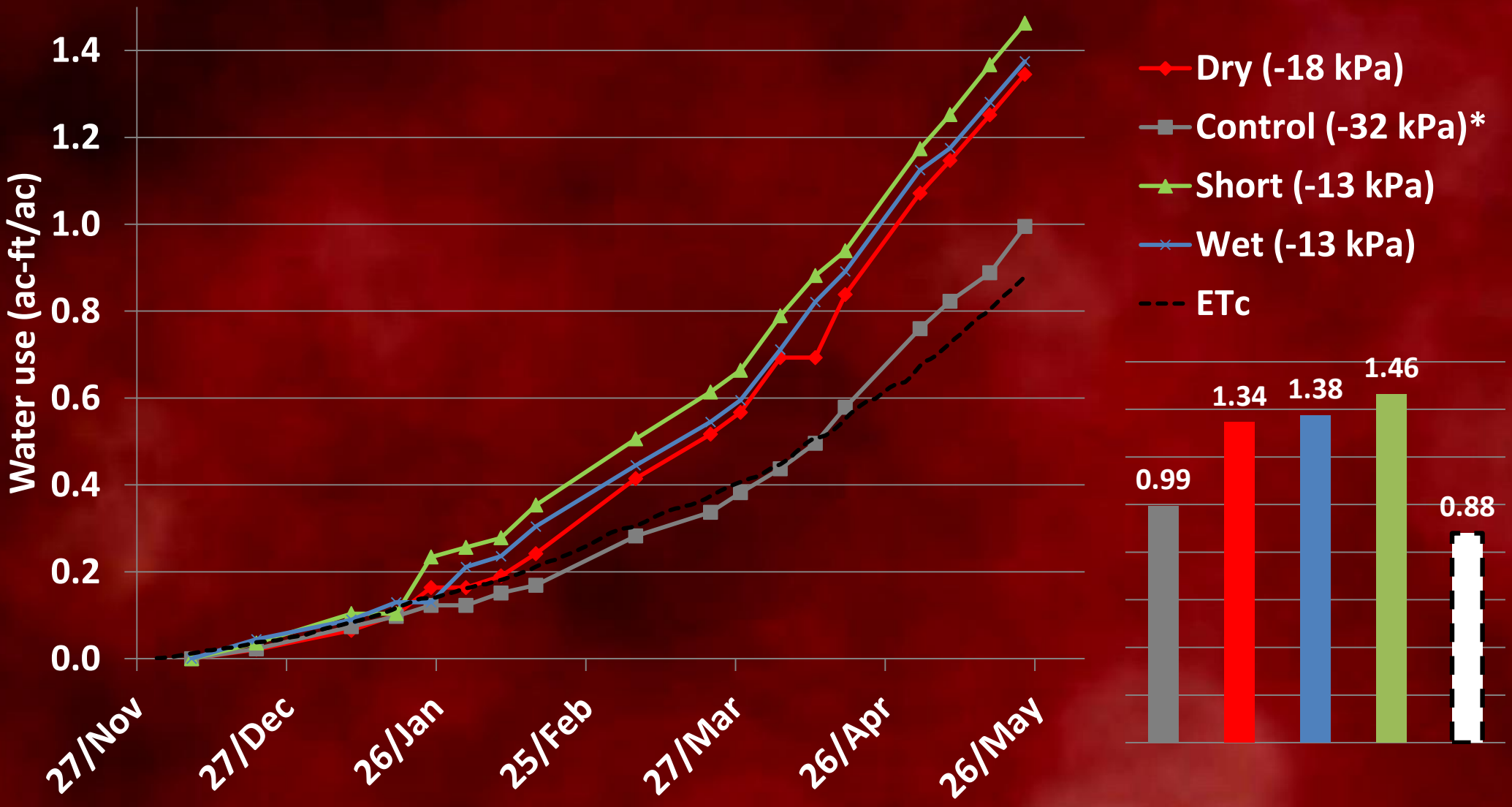
Water applied in 2012 in Oxnard (yield increase with extra water)





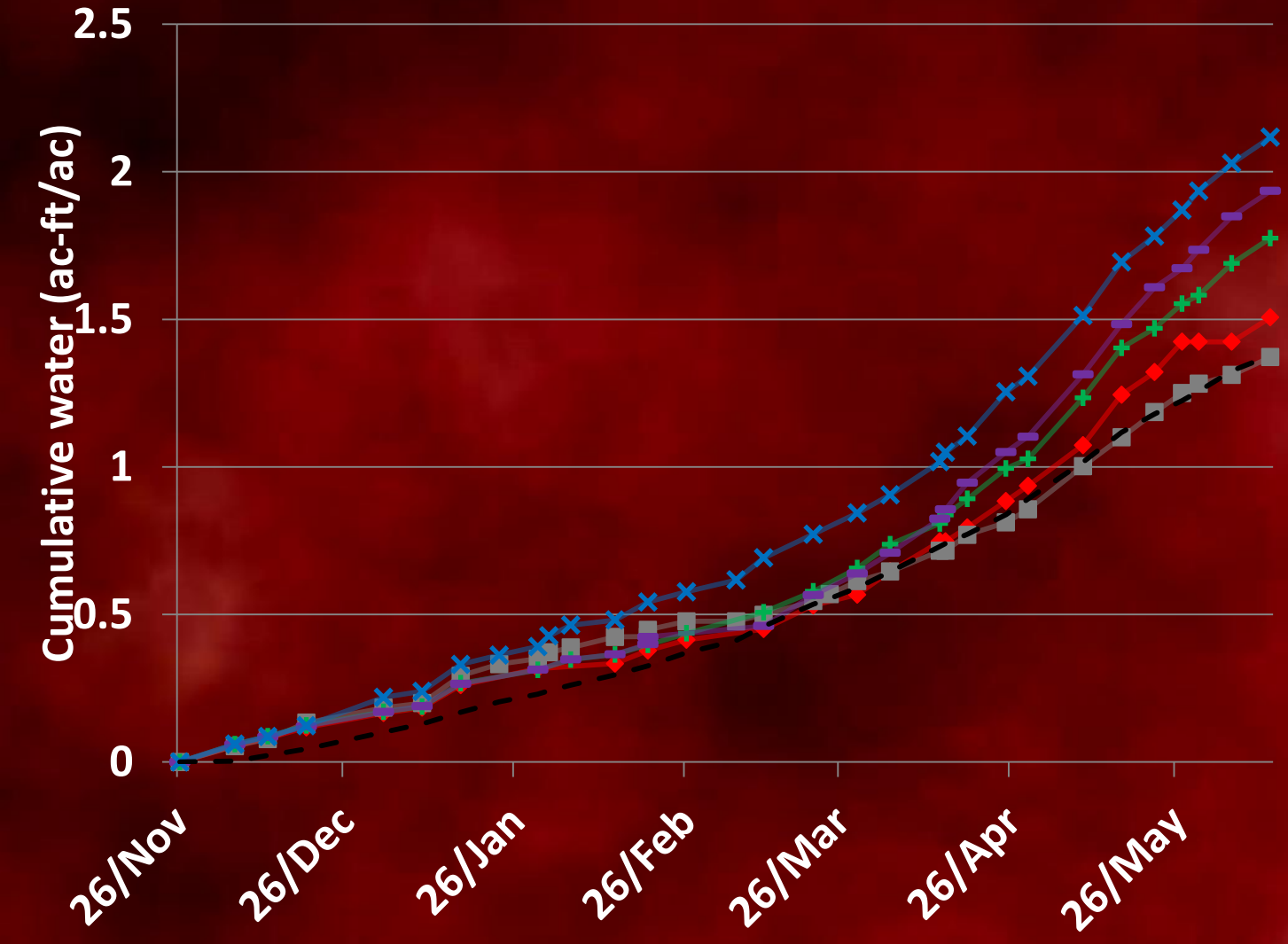
Amount of water (acre-foot per acre) applied in the Oxnard Study from December 9th to May 14th 2012

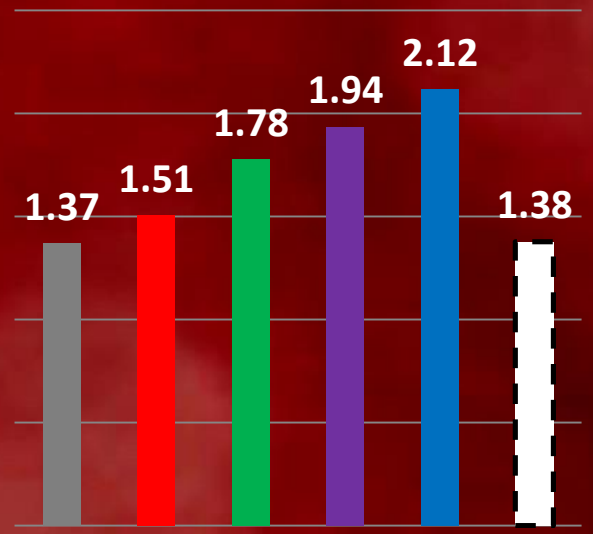
Water applied in 2013 Oxnard (poorly efficient)



Amount of water (acre-foot per acre) applied in the Oxnard Study from December 8th to May 24th 2013

Water applied in 2014 Oxnard – Poorly efficient?

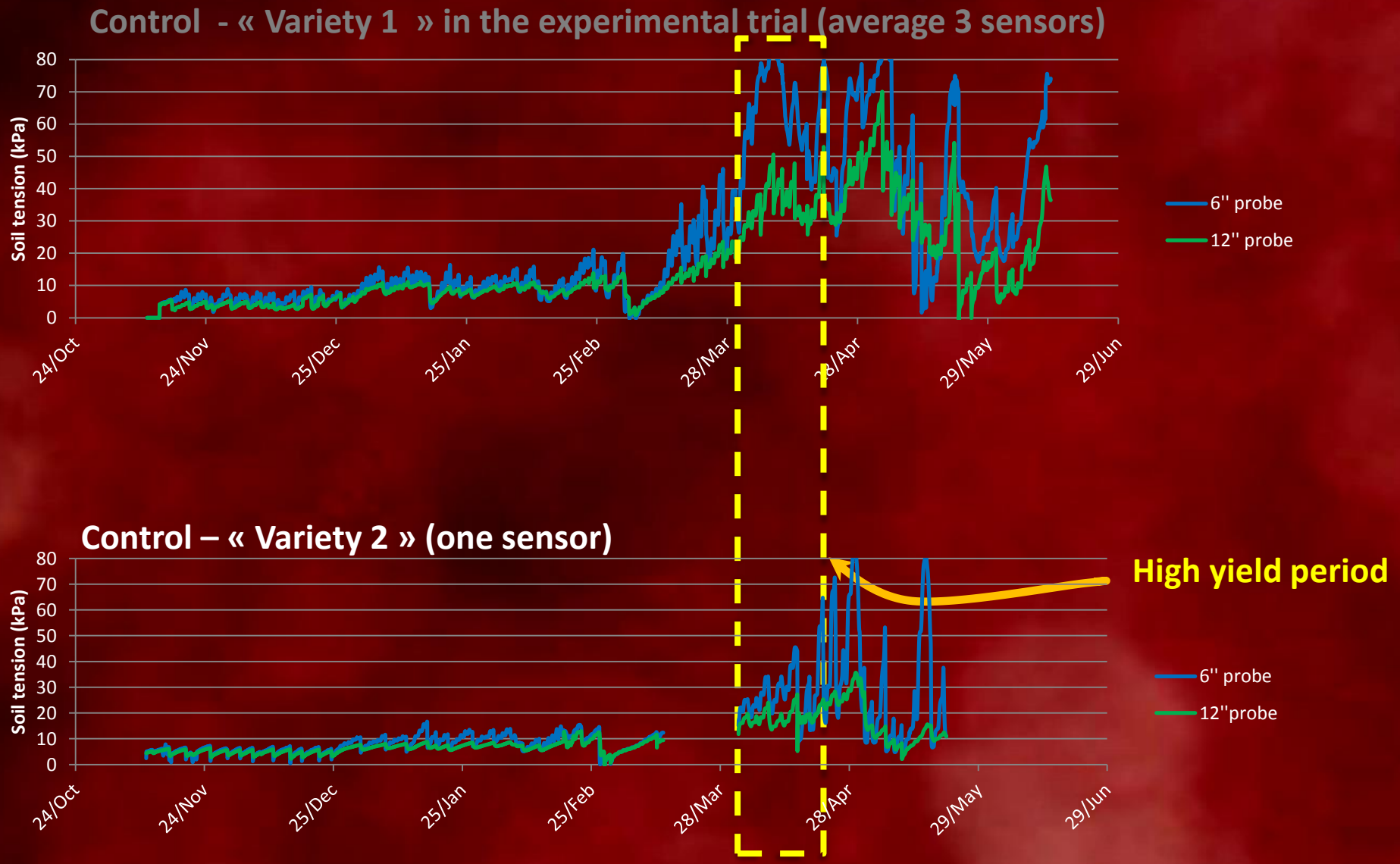




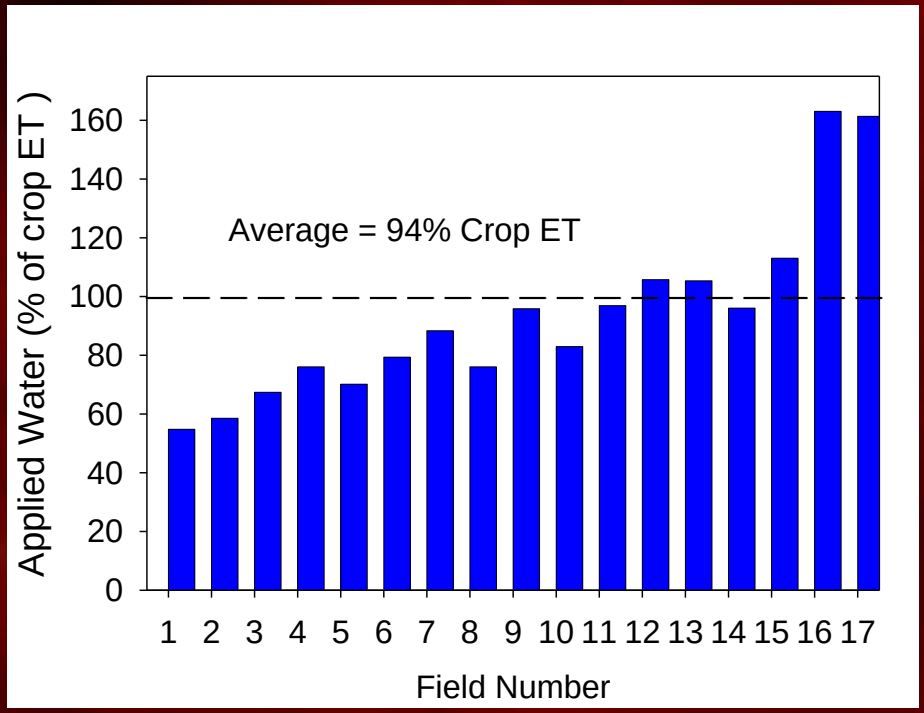
Amount of water (acre-foot per acre) applied in the Oxnard Study from December 6th to June 12th 2014

Only observed on low Ksat (hydraulic conductivity) trials on very fine sandy loam or after prolonged drying.

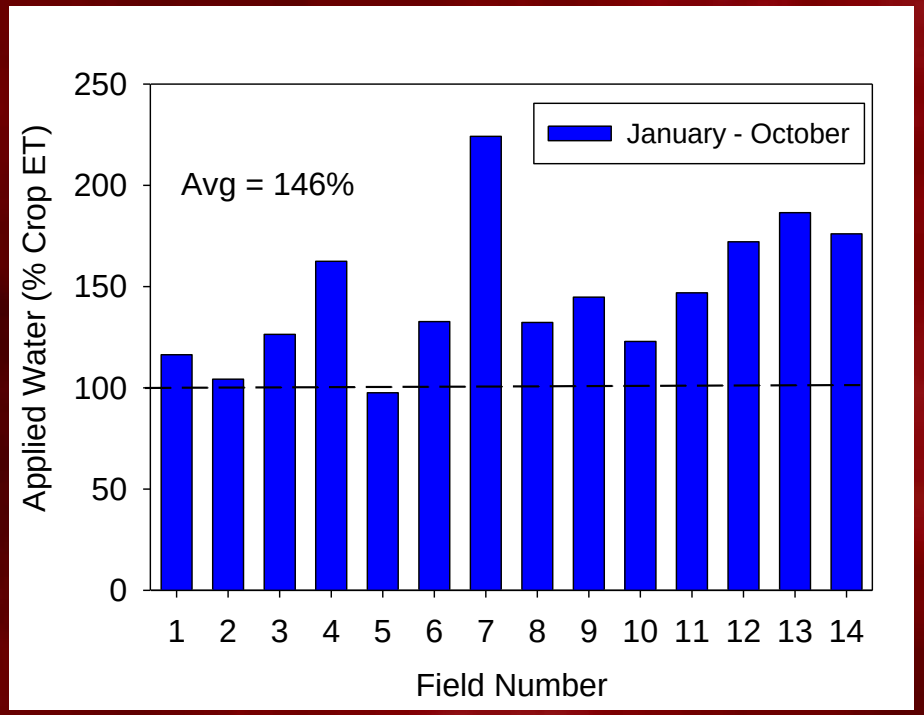
Evolution of tensions with Control management(2014) for two varieties



2010



2011



Percentage of crop ET applied by growers in 2010 and 2011 in the Watsonville area (drawn from Cahn, 2012)

Overuse of water relative to ET?

- Varietal effects
- Compacted beds with surface water runoff
- ET estimate accuracy?

Effects of real time irrigation management on strawberry production (2012-2014):

	2012	2013	2014
Soil series	Hueneme sandy loam	Hueneme sandy loam	Hueneme sandy loam
Yield difference between tension treatments	17%	6%	9%
Optimum tension cbars	8	(8)11.7	10
Acre foot/Acre water difference between treatments	0.15	0.50	0.75
Percentage of crop ET from top yield	126%	165%	154%

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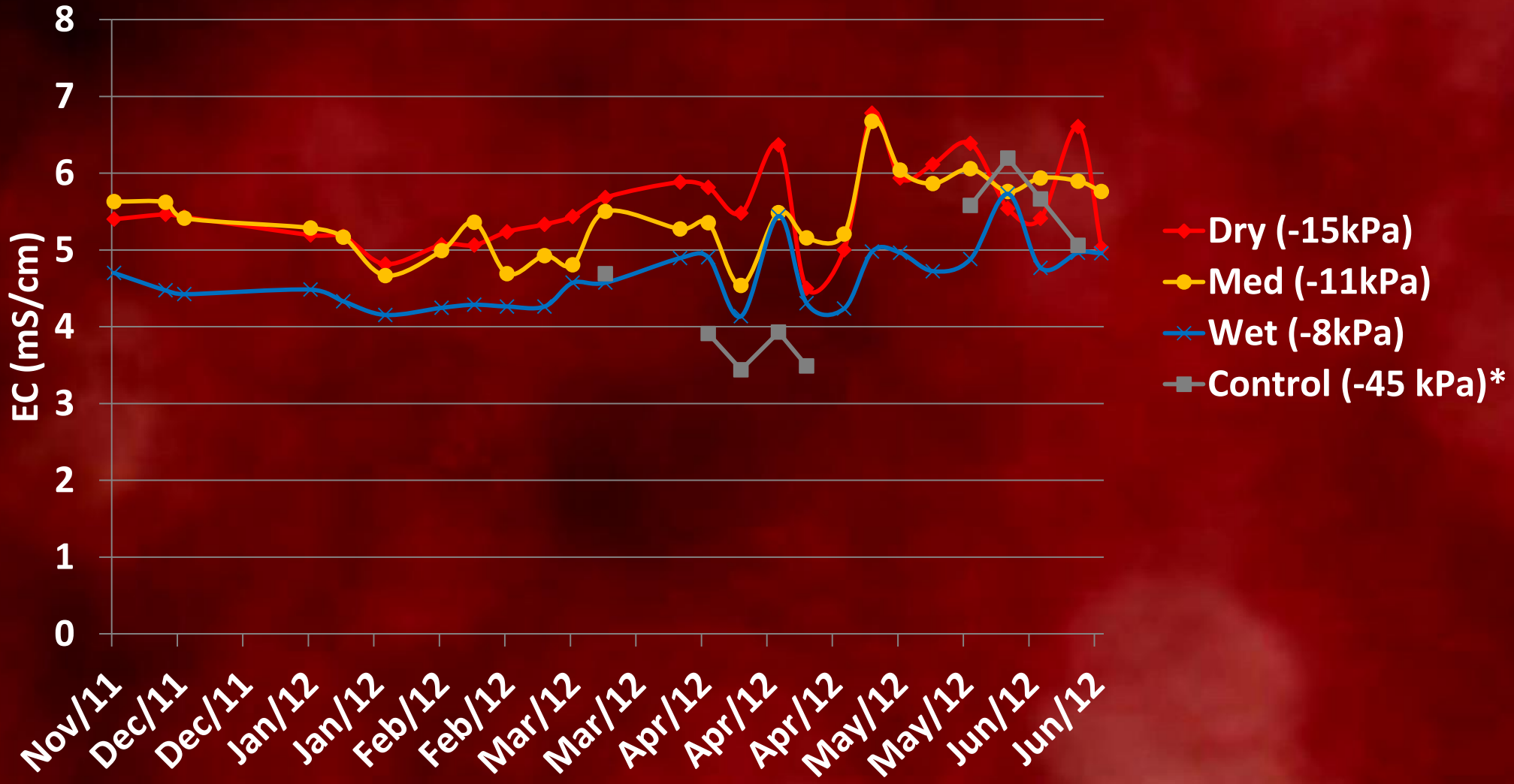
Evolution of electrical conductivity in Oxnard in 2012



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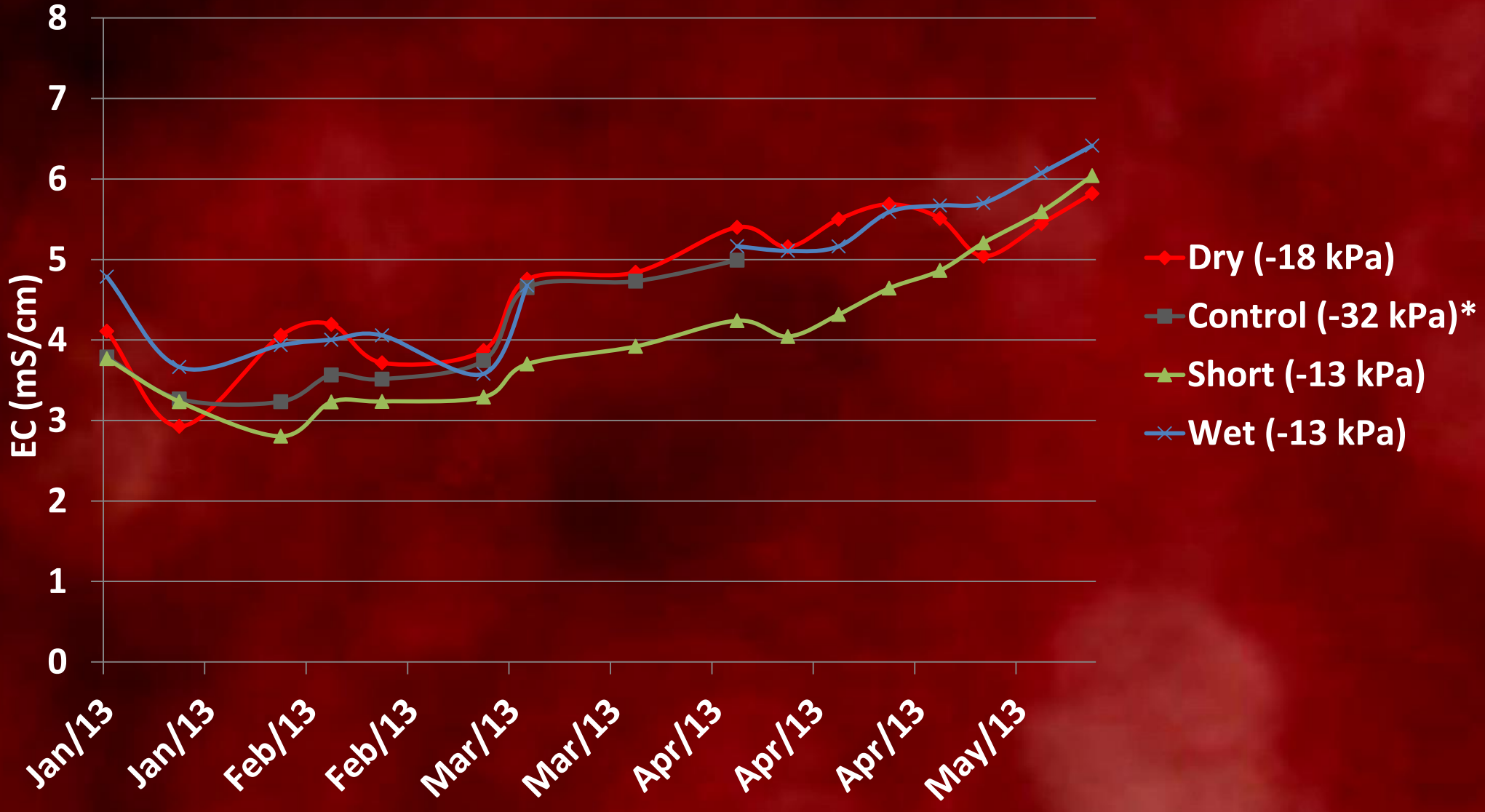
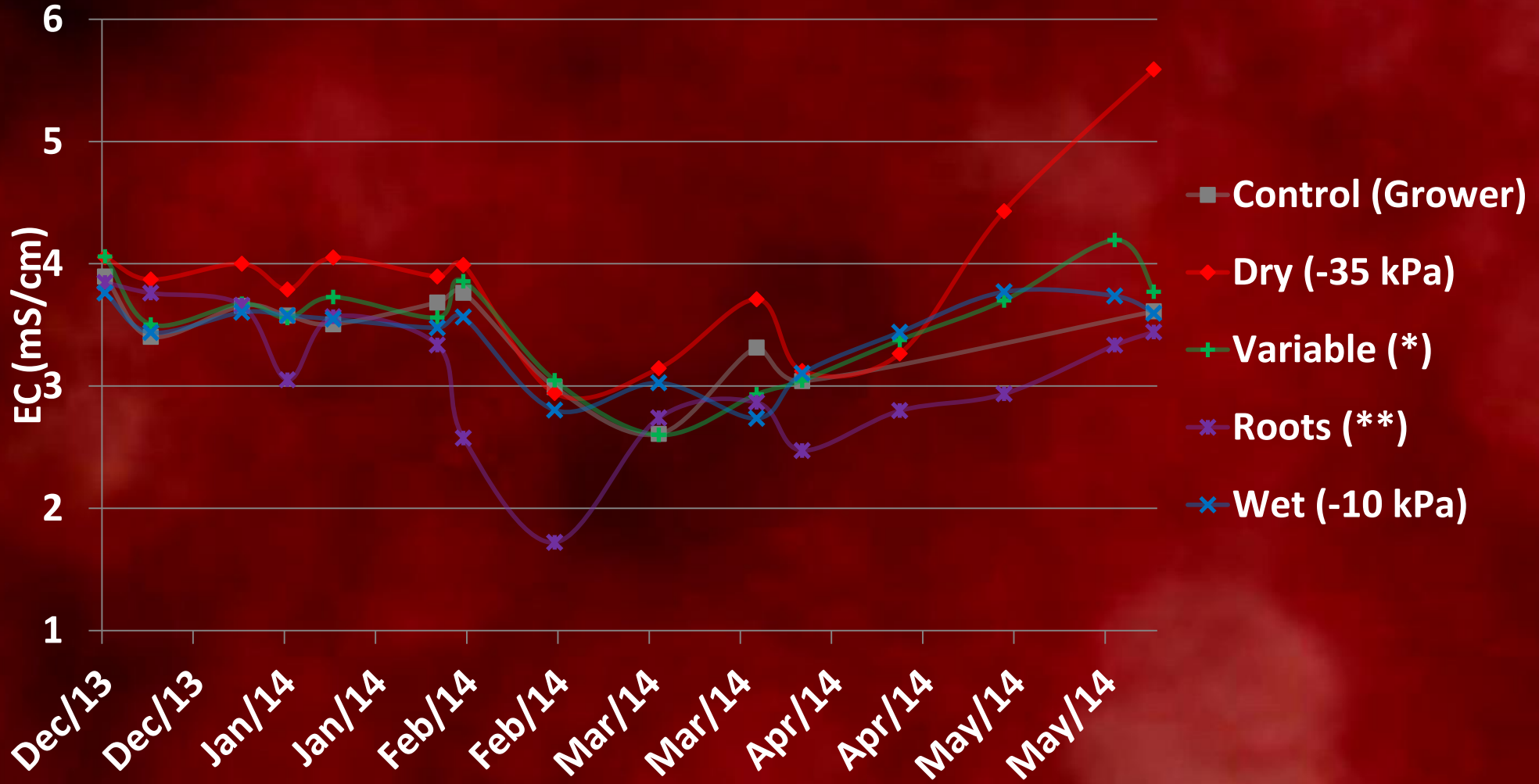
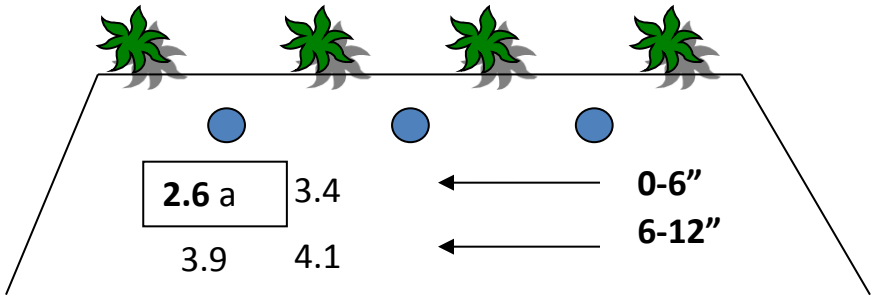


Evolution of electrical conductivity in Oxnard in 2014

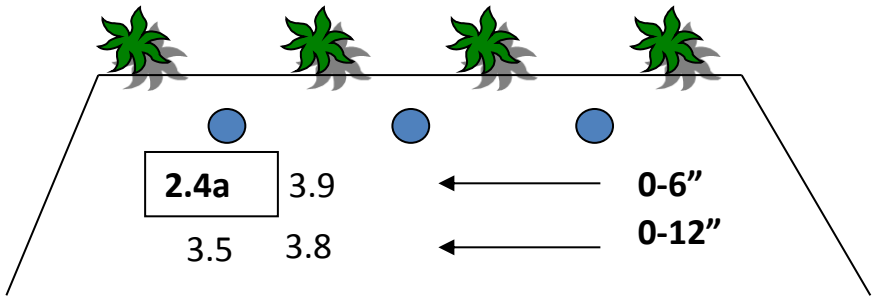


2014 EC = electrical conductivity, dS/m

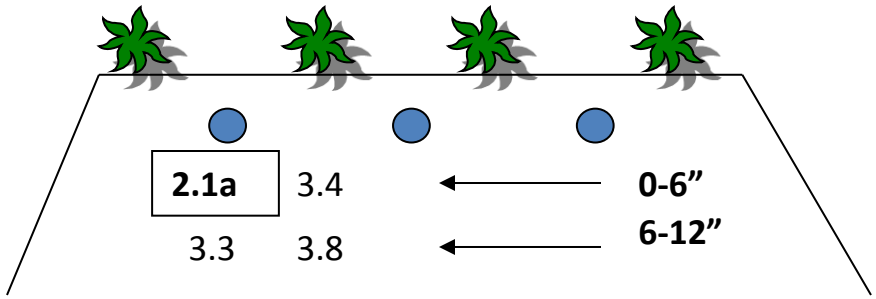
Grower



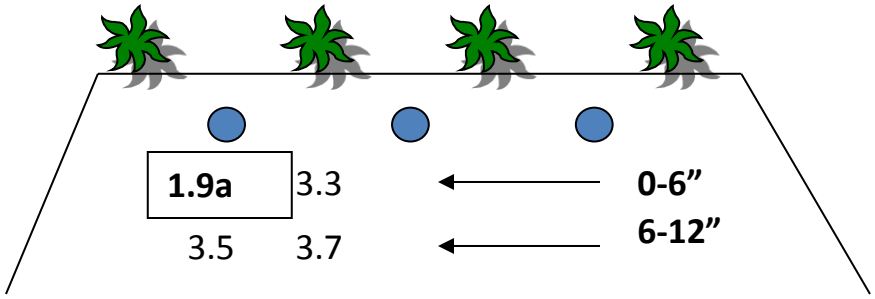
Roots



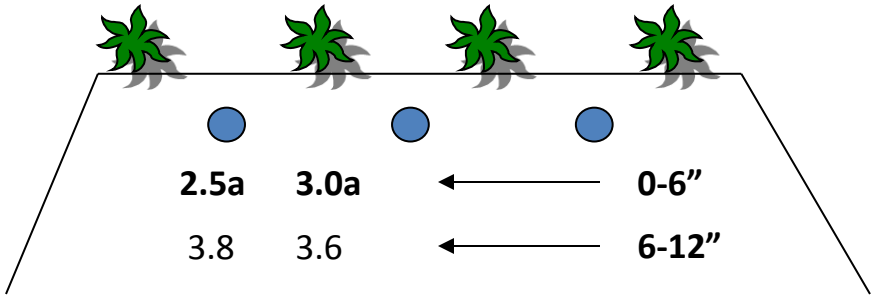
Wet



Variable



Dry



2014 Chloride (Cl), meq/l

NO interactions

Depth:

0-6” = 2.6b

6-12”= 3.7a

Irrigation Treatment:

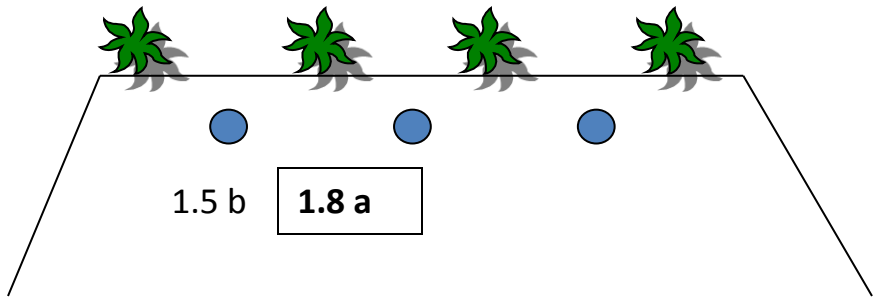
Grower	3.8 a
Dry	3.3 ab
Roots	3.1 b
Variable	2.6 b
Wet	2.8 b

2012 Potassium (K), meq/l

IRRIGATION TREATMENT

Grower=wet=medium=dry

LOCATION WAS IMPORTANT FOR ALL TREATMENTS



DEPTH: WAS IMPORTANT FOR ALL TREATMENTS

6-12” = 1.9 a
0- 6”=1.4 b

2013 Potassium (K), meq/l

ONLY DEPTH: WAS IMPORTANT FOR ALL TREATMENTS

6-12” = 1.76 a
0- 6”=1.11 b

2014 Potassium (K), meq/l: depth and location only signf.

6-12” = 2.0 a
0- 6”=1.1 b

Under drip = 1.2 a
Under plant row =1.9 b

Leaching

- Very little observed in 2013-2014
- Runoff observed because of bed compaction
- Small salinity increasing in all treatments
- No observed treatment effects, position effects
- Minor effects on different salts

Further work (2014-2015)

- Repeat the experiment of a partial drying and a root treatment (one year only).
- Leaching measurement and solute distribution analysis.
- Calculation of economical returns associated with treatment differences

2011-2014 Strawberry irrigation trials

Conclusions (2013-14)

In Oxnard, differences in tension can result in yield differences (6% to 17% depending on season and thresholds)

Approach calibrated: optimum tension threshold for maximum yield in clay soils was about 10 cbars (Watsonville-Salinas) and in a sandy loam (Oxnard)

Water requirements consistently higher than calculated ET in Oxnard and lower in Watsonville.

2011-2014 Strawberry irrigation trials

yields, water use and leaching

Thank you for attending

Acknowledge financial contribution of the National Sciences and Engineering Research Council of Canada, Laval University, UCalifornia and Hortau

Technical support from UC, Hortau and Henry Ito