Case Study: Changes in Soil Salinity over 3 Years in Drip Irrigated Tomatoes

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Fresno County Tomato Production

- Western Fresno County tomato production areas are largely on clay loam soils
- History of erratic water availability
  - years of ample high quality water availability
  - years of insufficient quantities of water necessitating the use of water high in total dissolved salts
- Tomatoes grown with drip irrigation buried to a 10” depth with shallow tillage between seasons for 3 to 5 years.

Tomato

- Tomatoes are considered moderately sensitive to salinity.
  - Threshold electrical conductivity (EC_t) 2.5 dS/m
  - Percentage decrease in yield per unit (dS/m) increase in EC 9.9

Tanji, K.K and N.C. Kielen. 2002. Crop Salt Tolerance Data from Agricultural Drainage Water Management in Arid and Semi-Arid Areas. Food and Agriculture Organization of the United Nations.

Irrigation and Salinity Management Study Initiated in 2010

1. To assess the impact of irrigation regimes on soil salt distribution.
2. Re-evaluate the impact of late season deficit irrigation on yield and quality.
3. To evaluate temporal and spatial distribution of salts in the soil profile.

Trial Site

- Commercial field in Five Points area, Fresno County
- Drip tape installed in 2010 (0.18 gal/hr; 14” between emitters)
- Average EC was 2.2 dS/m prior to trial initiation.
- Except for May 2010, district water was used throughout the trial (0.625 to 0.938 dS/m)

Treatments

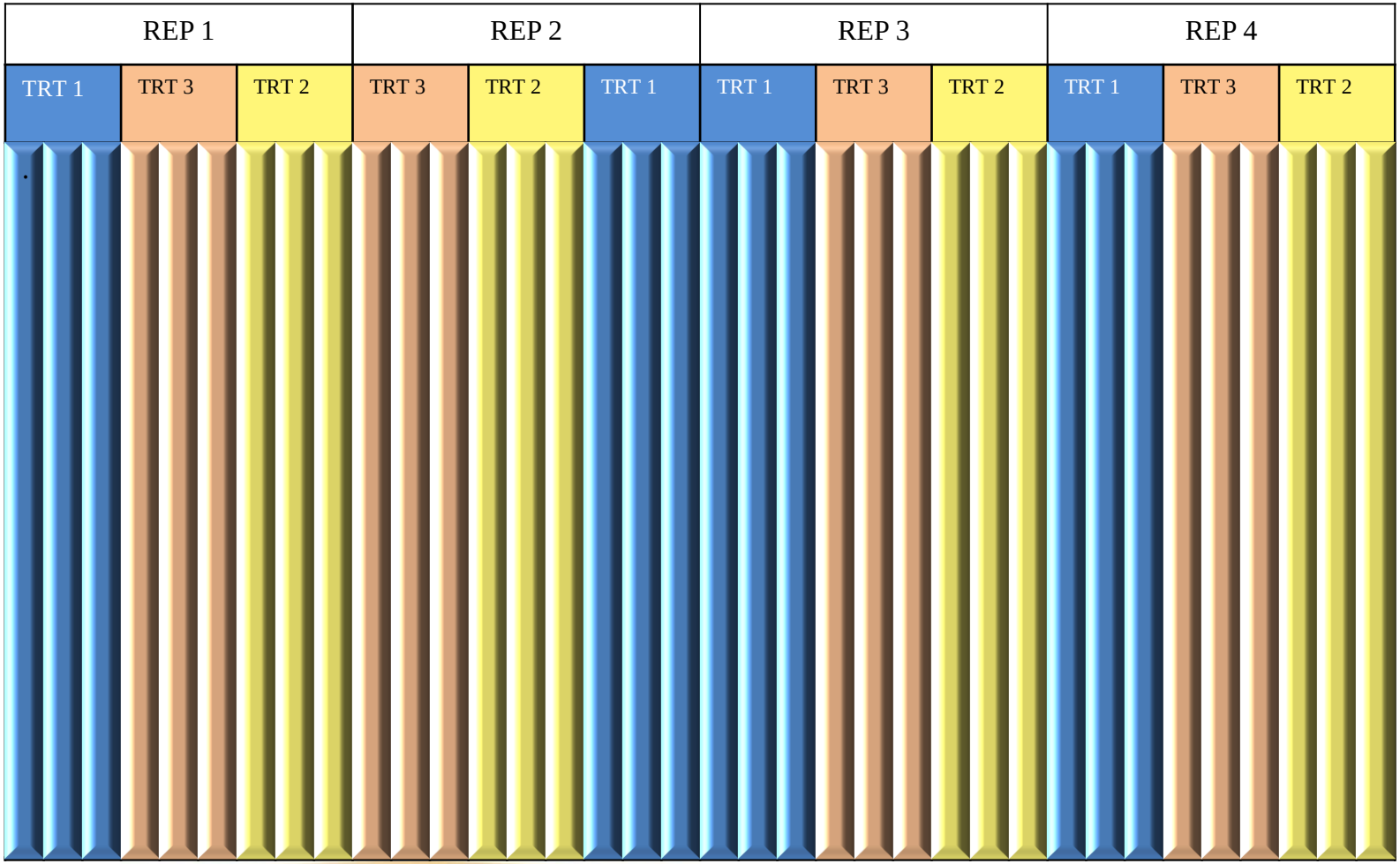
1. Grower treatment or ET greater
2. Grower treatment until 60 days before projected harvest (dbph). Then, 80% ET until 30 dbph. Then, 60% ET.
3. Irrigation reductions similar to *b* early, but at more severe rates of 60% ET from 60 dbph and 40% ET from 30 dbph.

Seasonal Details

Year	Variety	Plant date	1st irrigation reduction	2nd irrigation reduction	Harvest date	Days to harvest
2010	H8502	4 May	14 July	16 Aug	21 Sep	140
2011	H3402	27 Apr	3 July	5 Aug	28 Sep	153
2012	H4707	24 Apr	2 July	1 Aug	31 Aug	128

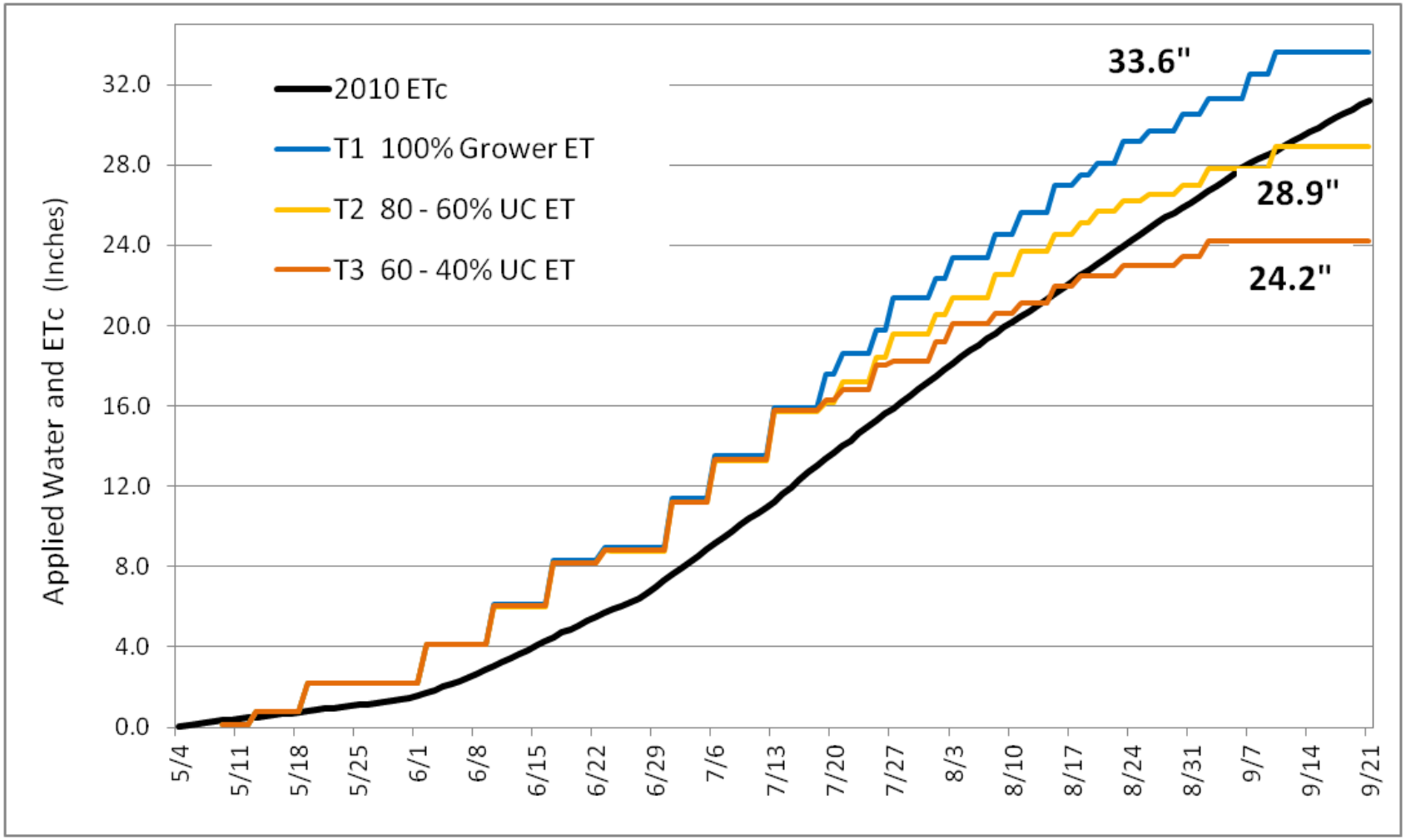
IRRIGATION TREATMENTS WERE APPLIED to THE SAME THREE-BED PLOTS FROM 2010-2012

Each drip treatment plot = 3 beds x 1150 ft

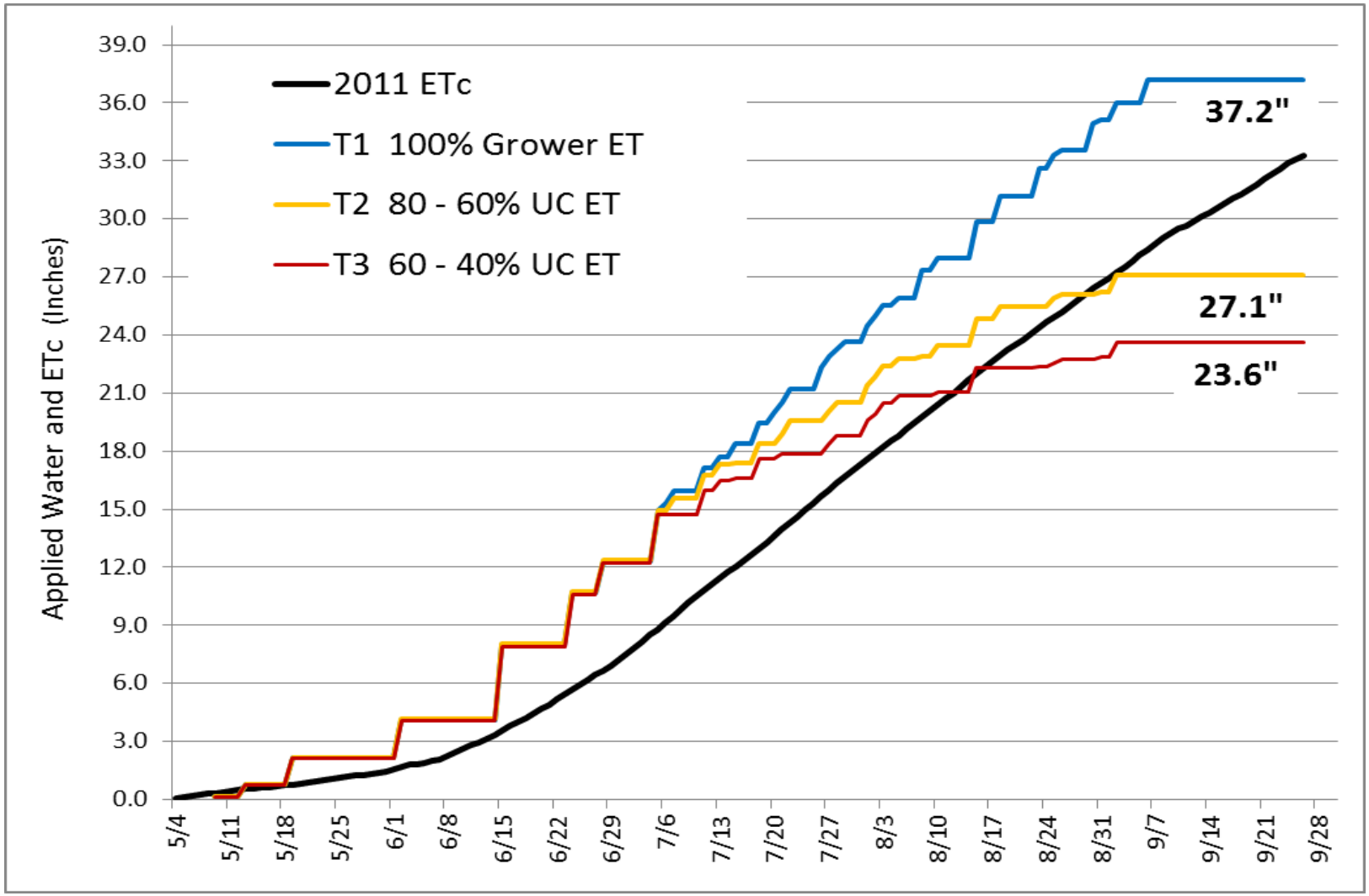


0.18

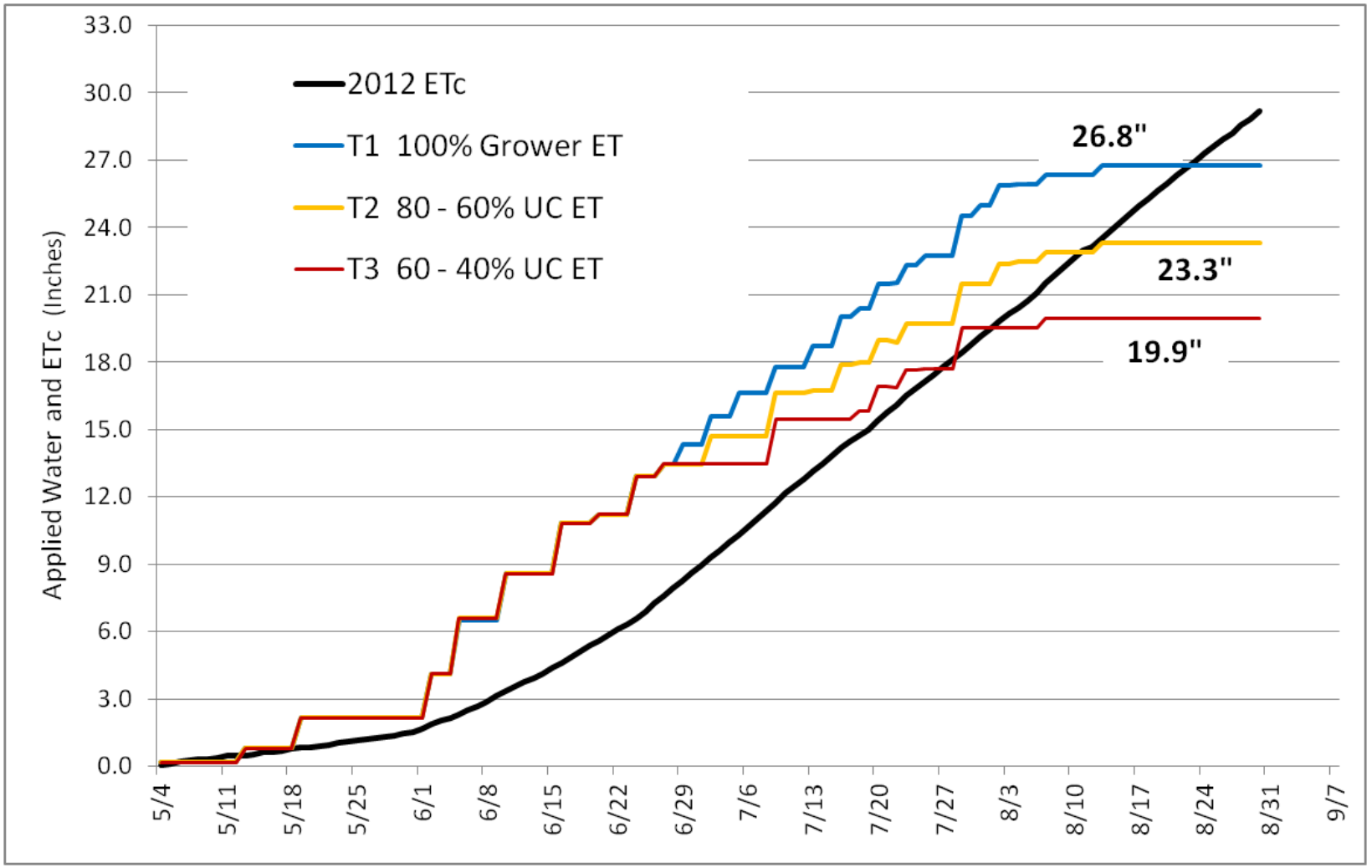
Water Applied in 2010



Water Applied in 2011



Water Applied in 2012



Machine Harvest, Hand Sort, PTAB

Impact on yield and quality were not consistent among years.

Yield and Quality, 2010

irrigation treatment[z]	fruit quality (% by weight)[y]					PTAB[x]			tons/
	red	grn	sun burn	rot	BE rot	color	solids	pH	acre[w]
100% ET minimum (grower program)	67.41	13.76	11.10	6.04	0.00	25.63	4.96	4.457	67.36
80% ET 60 days pre harvest, 60% ET 30 days pre harvest	74.23	9.39	12.32	3.91	0.14	25.00	5.00	4.476	65.93
60% ET 60 days pre harvest, 40% ET 30 days pre harvest (deficit)	77.35	1.52	7.64	2.89	0.60	24.75	5.14	4.450	66.47
Probability[v]	0.049	NS	0.024	0.013	NS	NS	0.072	NS	NS

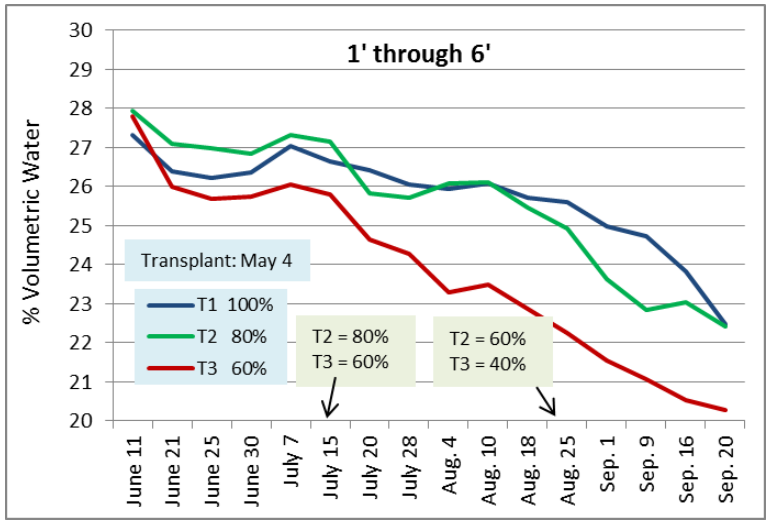
Yield and Quality, 2011

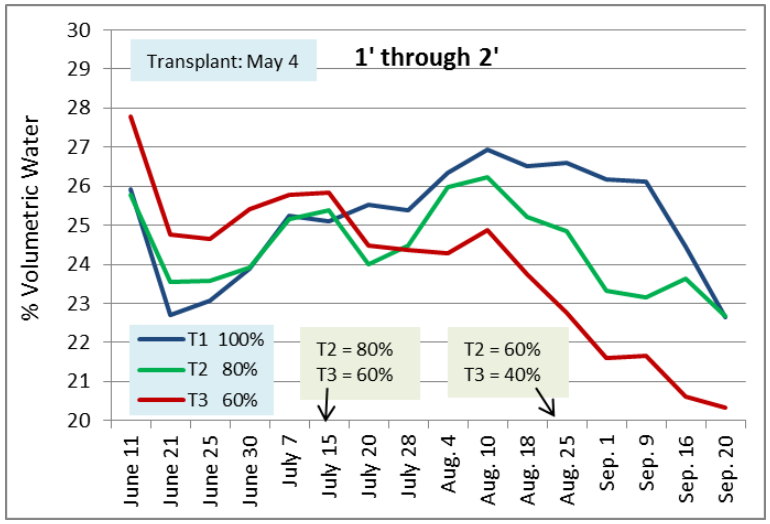
irrigation treatment[z]	fruit quality (% by weight)[y]					PTAB[x]			tons/
	red	grn	sun burn	rot	BE rot	color	solids	pH	acre[w]
100% ET minimum (grower program)	87.9	4.3	1.6	5.9	0.3	22.4	4.84	4.584	67.64
80% ET 60 days pre harvest, 60% ET 30 days pre harvest	89.3	3.1	1.5	5.7	0.4	22.4	4.69	4.596	67.87
60% ET 60 days pre harvest, 40% ET 30 days pre harvest (deficit)	87.5	4.0	2.4	5.5	0.6	22.0	4.90	4.540	63.72
Probability[v]	NS	NS	NS	NS	NS	NS	0.072	0.064	NS

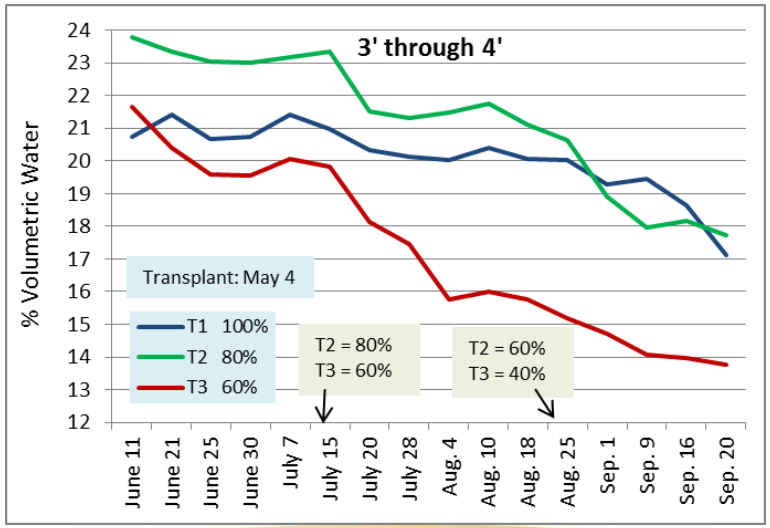
Yield and Quality, 2012

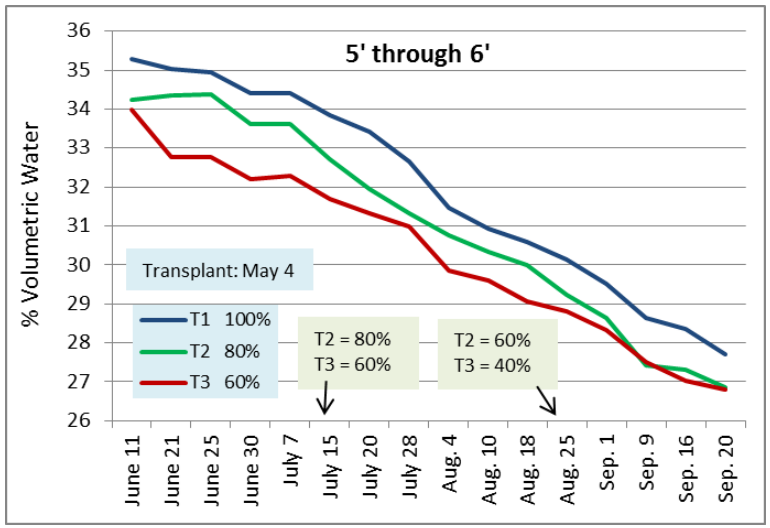
irrigation treatment[z]	fruit quality (% by weight)[y]					PTAB[x]			tons/
	red	grn	sun burn	rot		color	solids	pH	acre[w]
100% ET minimum (grower program)	92.0	4.2	2.4	1.4		23.7	4.54	4.36	65.54
80% ET 60 days pre harvest, 60% ET 30 days pre harvest	88.5	6.7	3.4	1.3		23.9	4.63	4.36	64.51
60% ET 60 days pre harvest, 40% ET 30 days pre harvest (deficit)	88.7	3.8	5.7	1.8		23.3	4.83	4.38	60.28
$LSD_{0.05}$[v]	NS	NS	NS	NS		NS	NS	NS	2.88

2010 Soil Moisture Levels

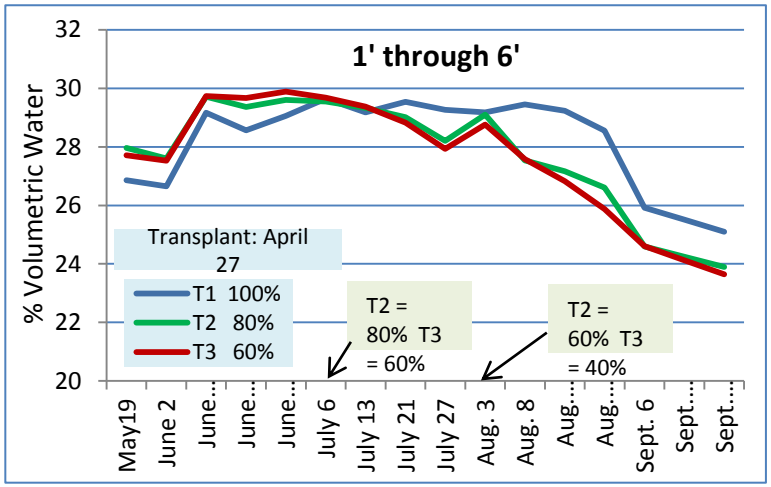


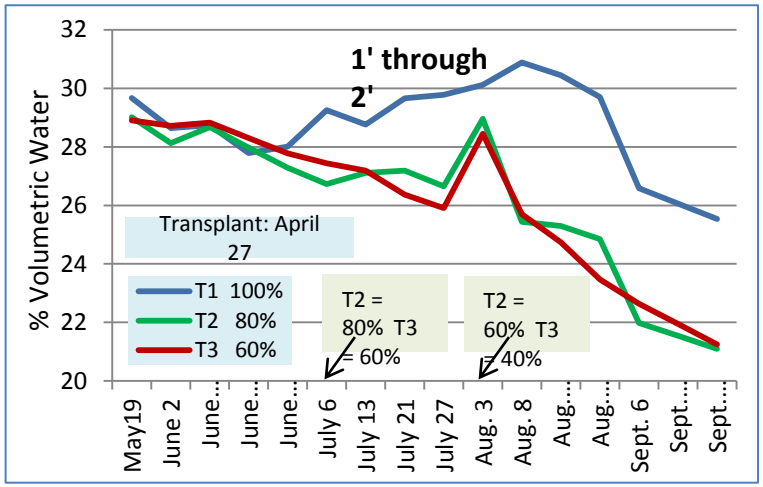


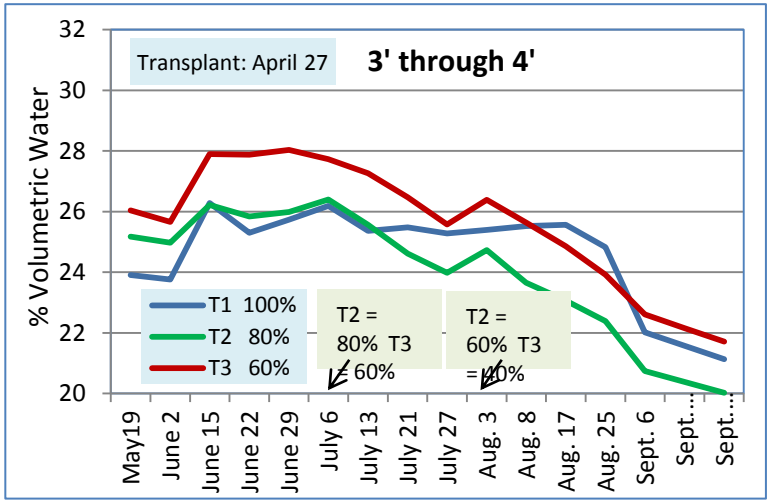


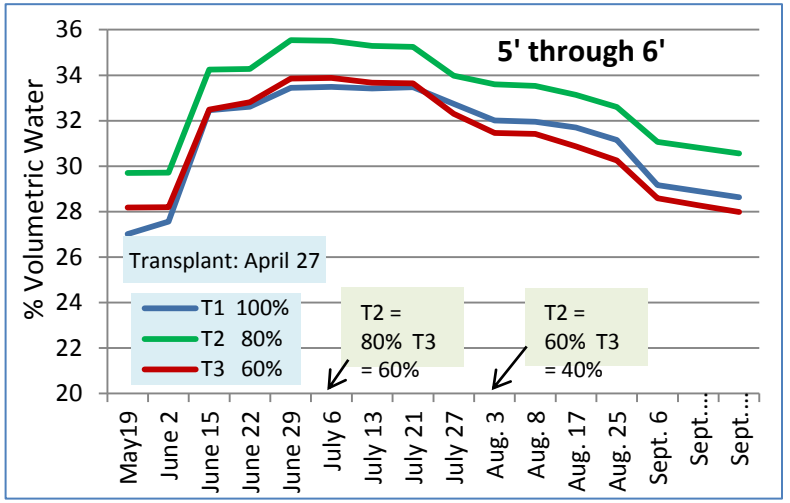


2011 Soil Moisture Levels

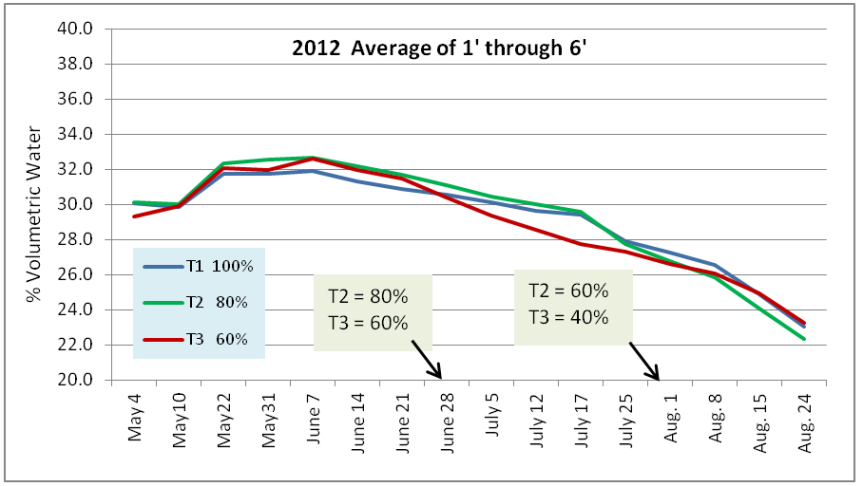


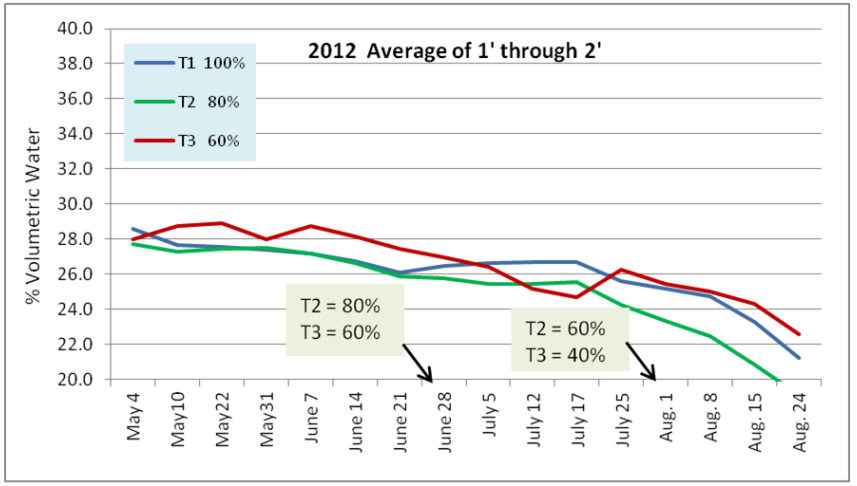


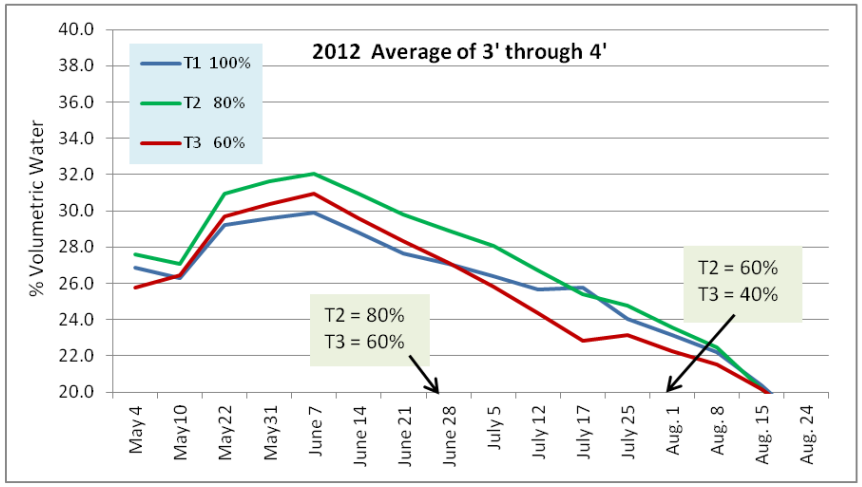


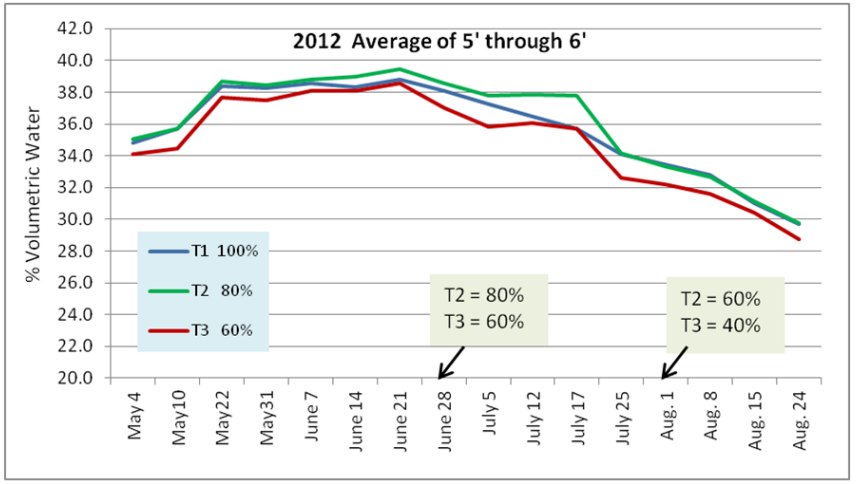


2012 Soil Moisture Levels

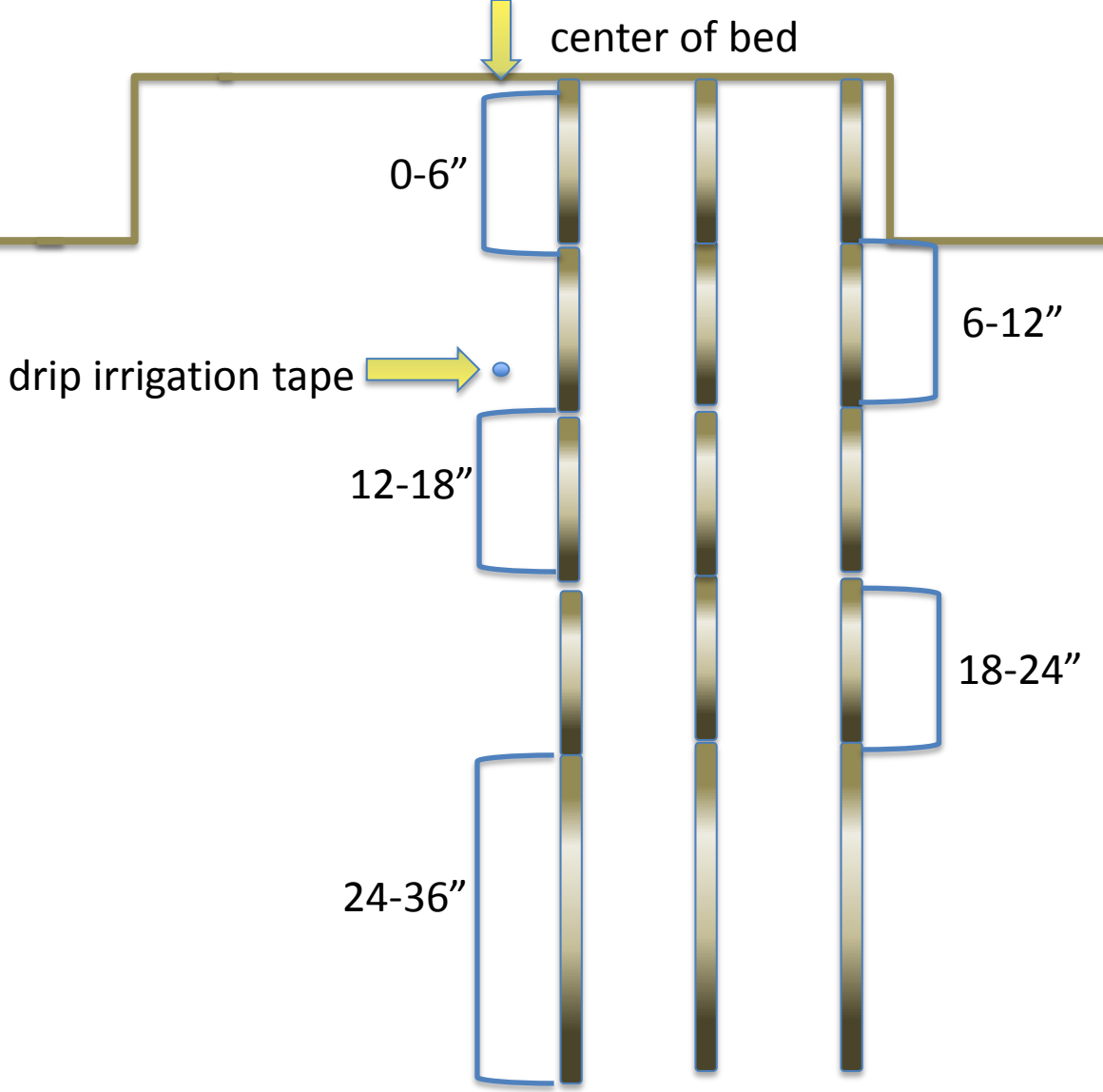






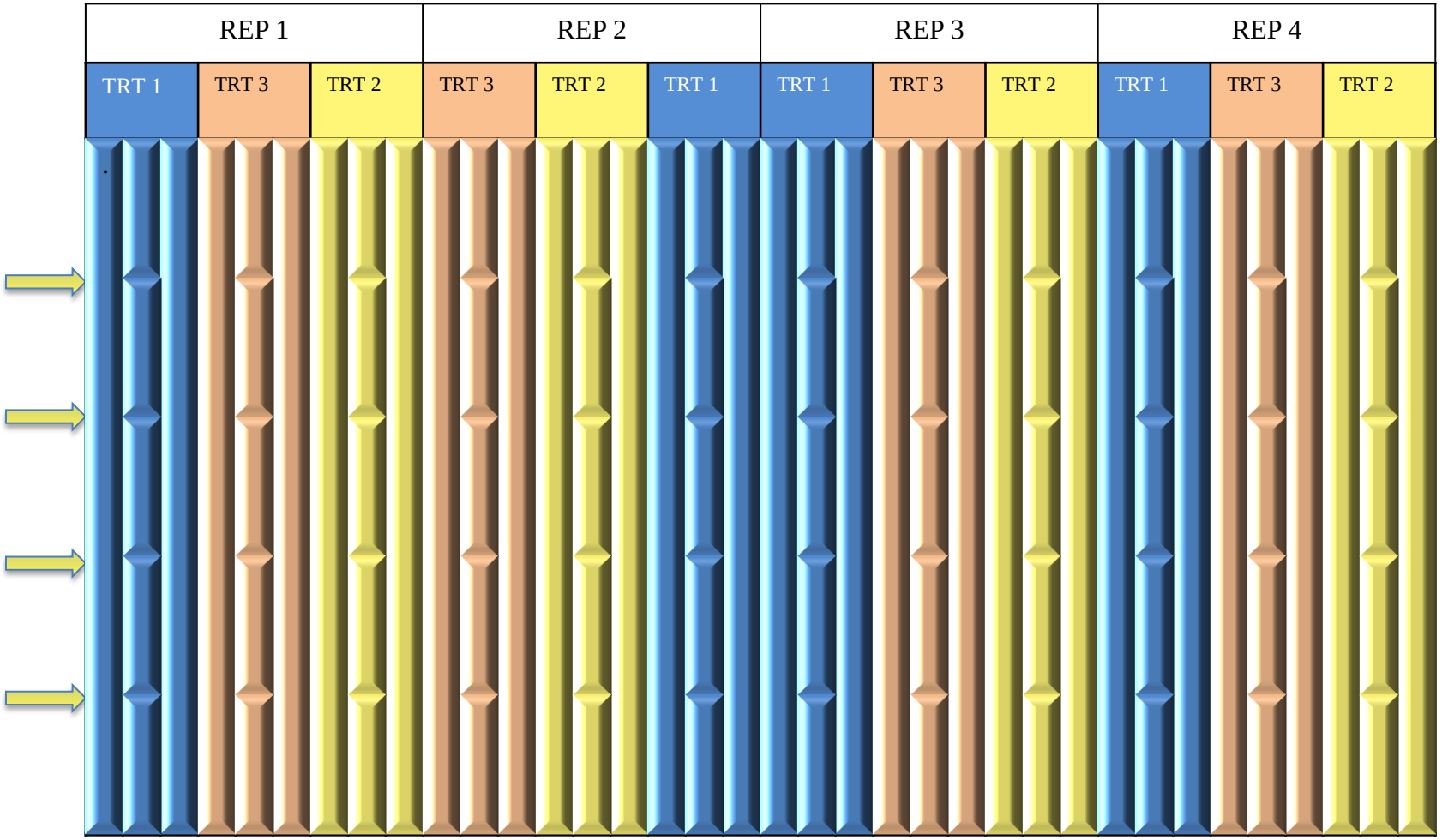


Soil Samples for Salinity Analysis: 5 depths and 3 distances from bed center



Soil samples from center bed of each plot: Composite of 4 sites 200 ft apart

Each drip treatment plot = 3 beds x 1150 ft

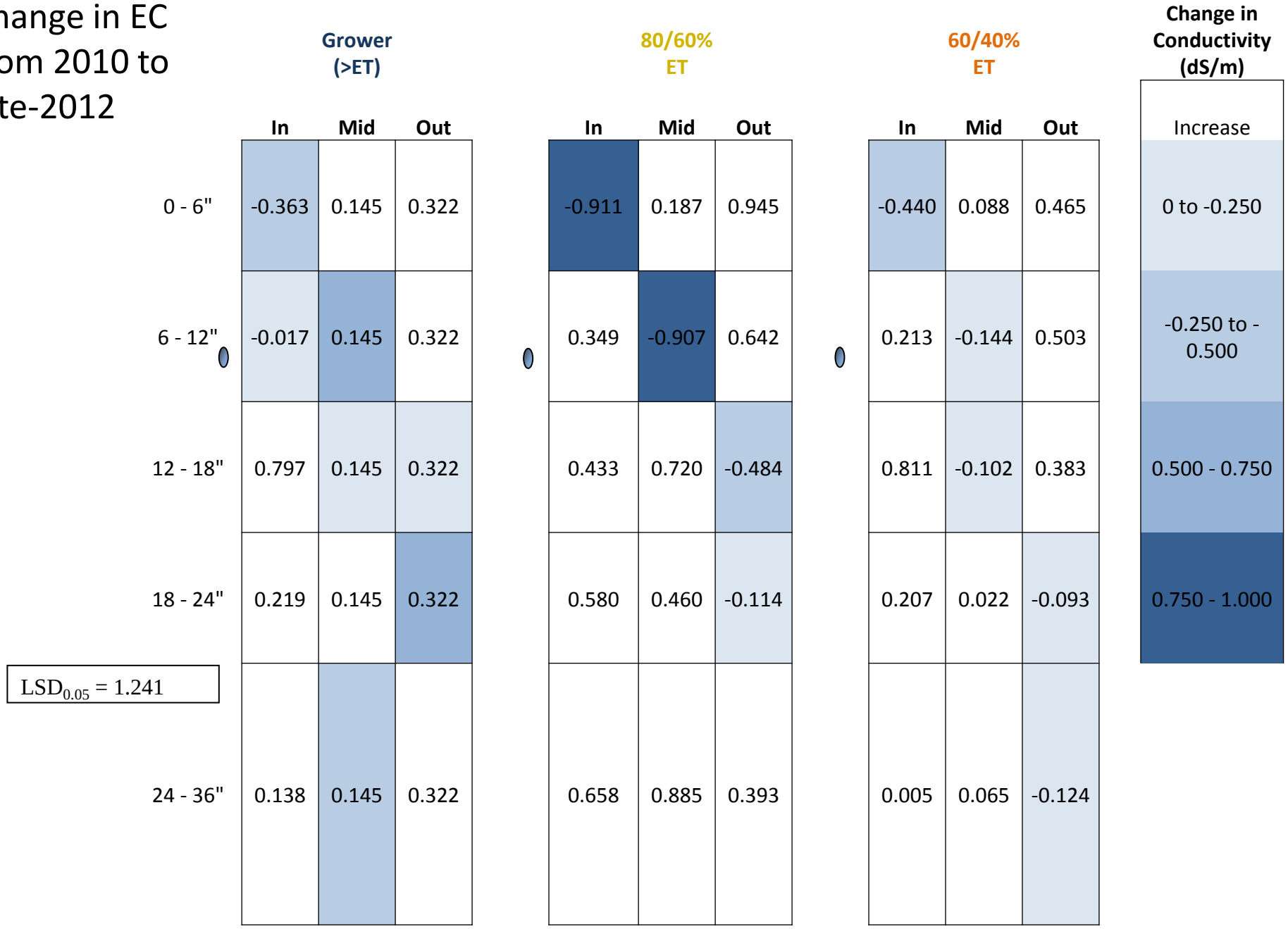


Irrigation Regime Impact 3 years

Irrigation Treatment[z]	Chloride differences (ppm)	EC differences (dS/m)
Grower treatment	-0.532	-0.017
UC reduction (80/60% ET)	-0.035	0.255
Deficit (60/40% ET)	-0.090	0.124
	NS	NS

- Changes in EC and Cl from 2010 pre-tomato season samples and post-season samples in 2012.
- Negative numbers represent a decline.
- Numerical differences exist in means but the impact was inconsistent among replications

Change in EC from 2010 to late-2012



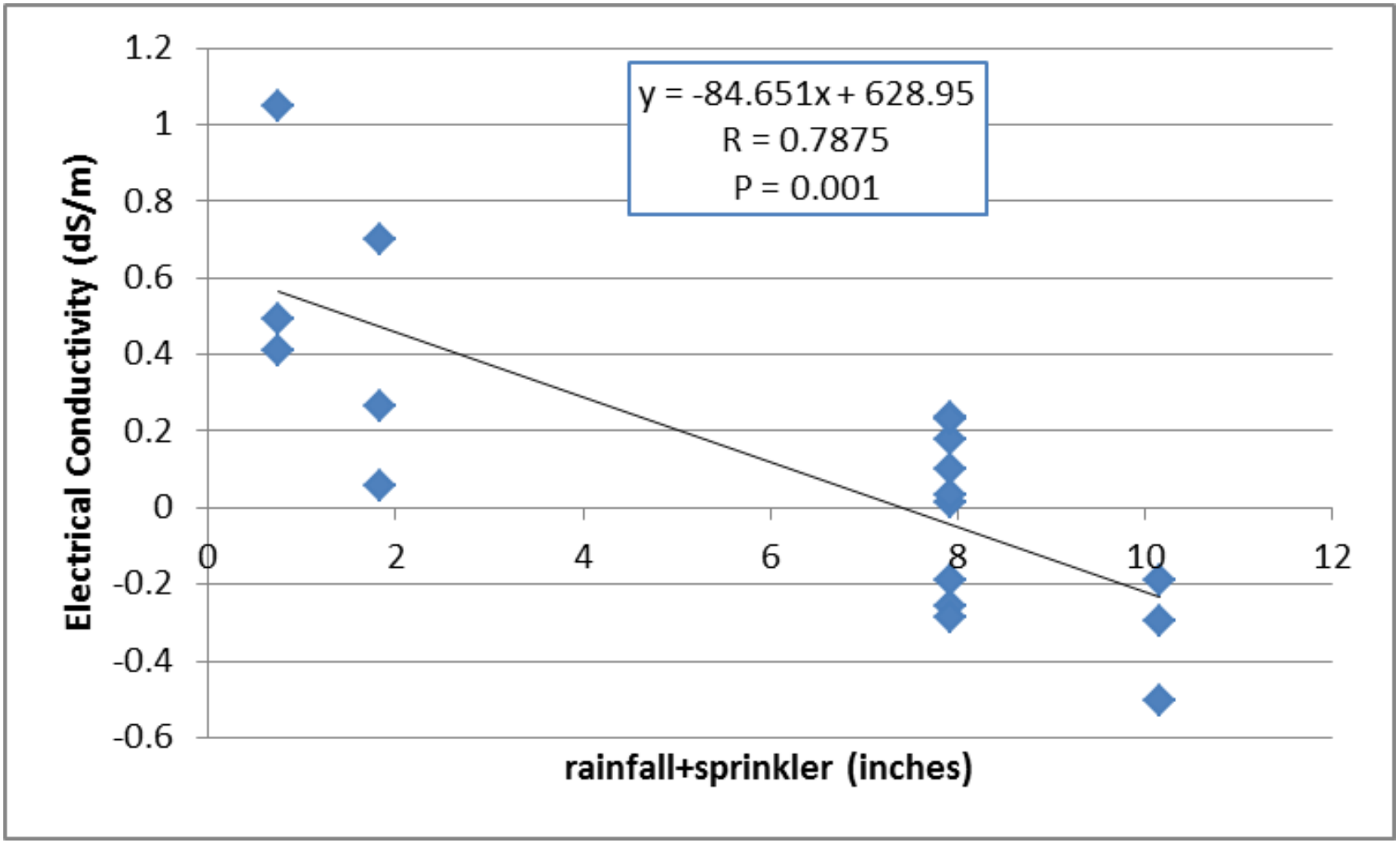
Change in Cl from 2010 to late-2012

	Grower Treatment			80/60% ET			60/40% ET		
	In	Mid	Out	In	Mid	Out	In	Mid	Out
0 - 6"	-189.9	67.5	80.2	-32.3	56.5	57.4	177.5	78.7	29
6 - 12"	-178.5	-178.4	17.1	16.1	-285	-53.9	-1.1	-220.1	38.6
12 - 18"	76.7	-99.5	-104.4	93.1	-34.9	-193.8	88.6	-234	-58.3
18 - 24"	25.6	7.1	-129.1	192.2	-8.7	-212.7	52	11.8	-106.7
24 - 36"	60.9	-197.5	-56.2	244.4	75.2	33.5	16.3	91	-98

$LSD_{0.05} = 305.6$

degree of Cl decrease (ppm)
Increase
0 - 50
50 - 100
100 - 150
150 - 200
200 - 250

Influence of Overhead Water Quantities on Annual EC Changes



Observations

- Yield decrease observed in 2012 with the most severe irrigation reduction. Otherwise yields were not impacted by irrigation reductions.
- No differences among irrigation treatments were documented in terms of EC or Cl levels.
- Annual decreases in EC were greater with greater rainfall/sprinkler irrigation levels.
- Consistent increases in salinity levels were documented just below the drip tape and at the edge of the beds.
- Results will be different under different soil conditions.

Acknowledgements

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- West Side Research and Extension Center

Questions?

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