

# SALINITY MANAGEMENT IN PROCESSING TOMATOES

Brenna Aegerter and  
Michelle Leinfelder-Miles  
UC Cooperative Extension  
San Joaquin County

# WHERE DO SALTS COME FROM?

- Irrigation water is the primary source of salts in agricultural systems
- Also from fertilizers, manures, composts
- Shallow saline water tables
- Salts can accumulate in the root zone and damage crops

# WHAT SALTS ARE IN THE WATER?

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

}

Cations

- Chloride ( $\text{Cl}^-$ )
- Sulfate ( $\text{SO}_4^{2-}$ )
- Bicarbonate ( $\text{HCO}_3^-$ )

}

Anions

Boron (B), Carbonate ( $\text{CO}_3^{2-}$ ), Nitrate ( $\text{NO}_3^-$ ), Potassium ( $\text{K}^+$ )

# HOW IS SALINITY MEASURED?



## Electrical Conductivity (EC)

$EC_w$  = salinity of the water

$EC_e$  = salinity of the soil

## Total Dissolved Solids (TDS)

mg/L = ppm

Exchangeable Sodium Percentage (ESP): % of soil cation exchange sites occupied by sodium

Sodium adsorption ratio (SAR): a ratio of Na, Ca and Mg concentrations

# HOW DOES SALT EFFECT PLANTS?

Overall salinity causes osmotic stress

Specific ion toxicity (Na, Cl, B)

Physical changes to the soil; water infiltration problems

# HOW DOES SALT EFFECT PLANTS?

Overall salinity → Osmotic stress

- High salt restricts osmotic flow
  - more energy used to exclude salt in the root zone and take in water
- Water stress symptoms
  - Stunting
  - Reduced yields

# SALINITY VS SODICITY

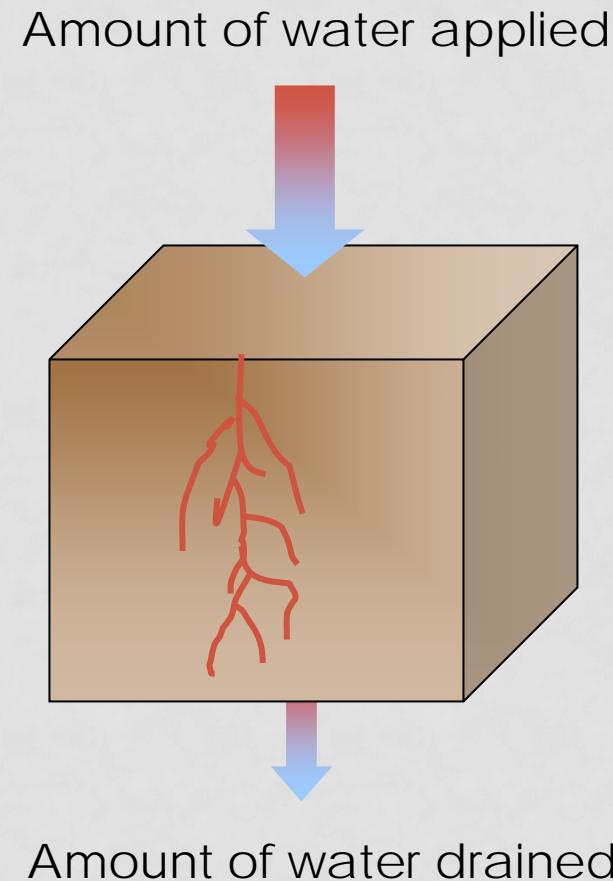
- Salinity is a condition where the salt concentration is sufficiently high to reduce crops yields or quality (Electrical conductivity, EC)
- Sodicity is a condition where the water is dominated by sodium ( $\text{Na}^+$ ); affects soil structure; poor aeration; water infiltration; affects plant health (measured as Sodium Adsorption Ratio, SAR; or Exchangeable Sodium Percentage, ESP)

# SAR & EC<sub>W</sub> TOGETHER AFFECT PERMEABILITY

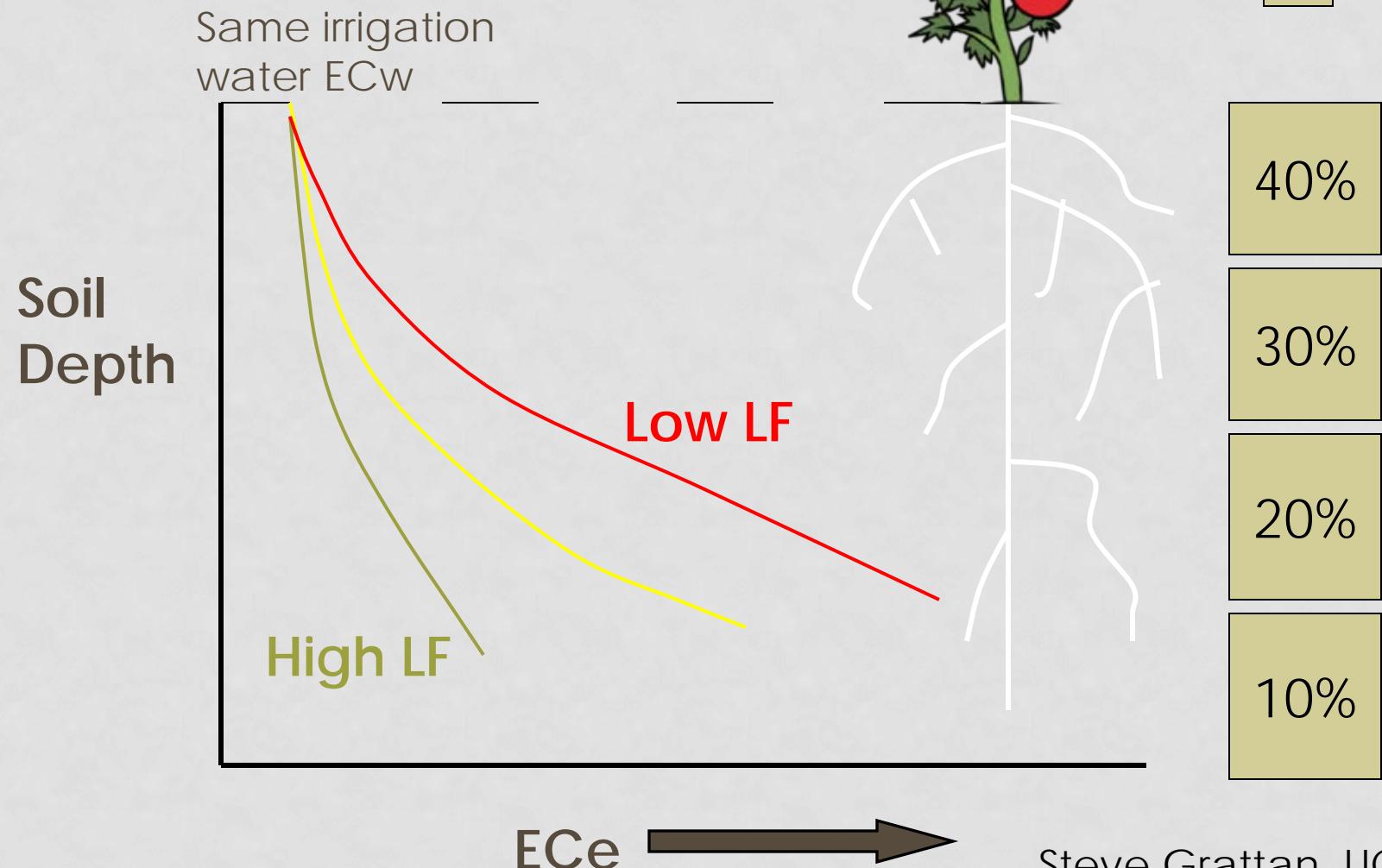
Permeability	No Problem	Increasing Problem	Severe Problem
SAR = 0-3 & ECw =	> 0.7	0.7 – 0.2	< 0.2
SAR = 3-6 & ECw =	> 1.2	1.2 – 0.3	< 0.3
SAR = 6-12 & ECw =	> 1.9	1.9 – 0.5	< 0.5
SAR = 12-20 & ECw =	> 2.9	2.9 – 1.3	< 1.3
SAR = 20-40 & ECw =	> 5.0	5.0 – 2.9	< 2.9

# SALINITY MANAGEMENT

Leaching Fraction  
(LF) = volume of  
water that drains  
below the rootzone  
/ volume of water  
that infiltrates the  
ground



# Salinity distribution in relation to various leaching fractions



# AMENDMENTS

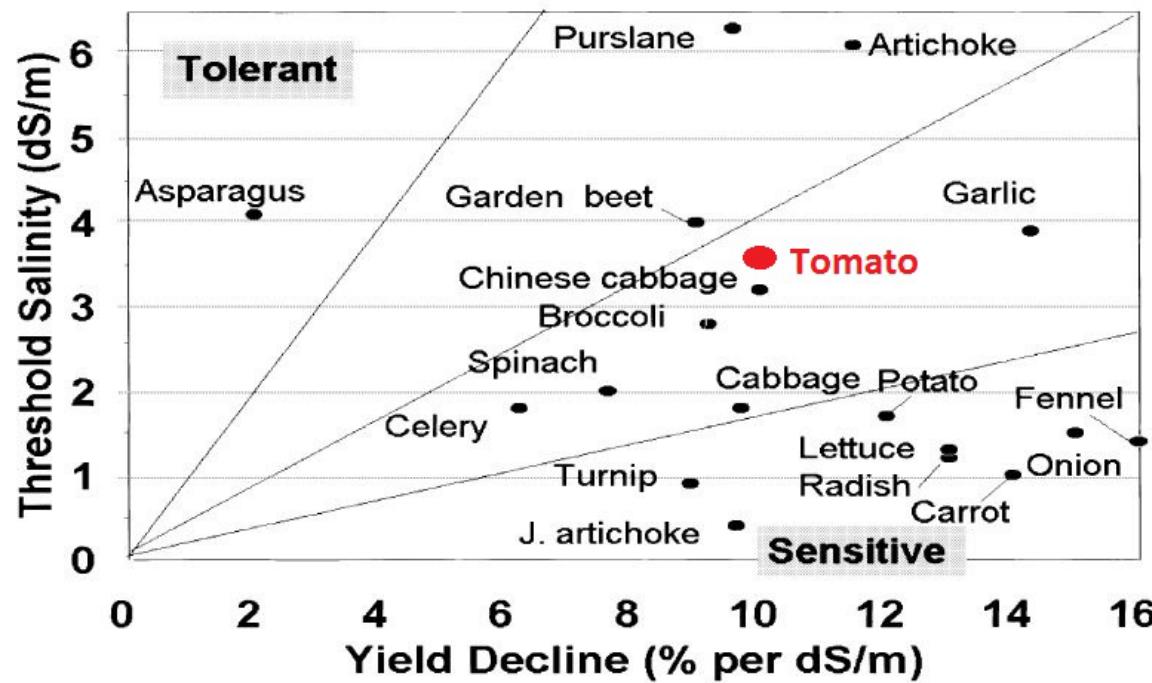
- Gypsum ( $\text{CaSO}_4$ )
- Sulfuric Acid ( $\text{H}_2\text{SO}_4$ )
  - In soils containing lime ( $\text{CaCO}_3$ )

## Calcium

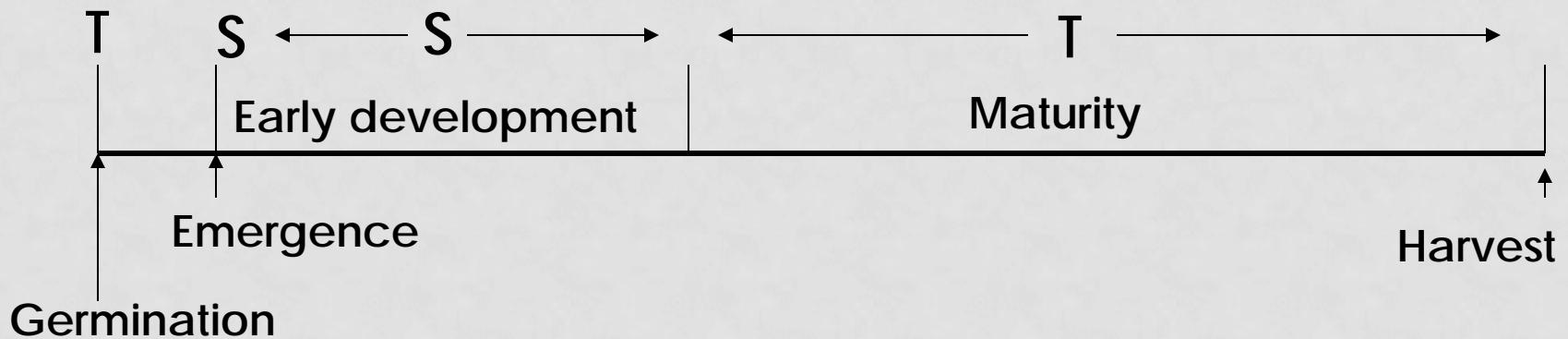
- Improves soil aggregation & structure
- Improves root function & ion transport across membranes
- Plants can tolerate higher ECe (+ 1-3 dS/m) in soils with high levels of gypsum

# TOMATOES ARE MODERATELY SENSITIVE TO SALINITY

M.C. Shannon, C.M. Grieve/*Scientia Horticulturae* 78 (1999) 5–38

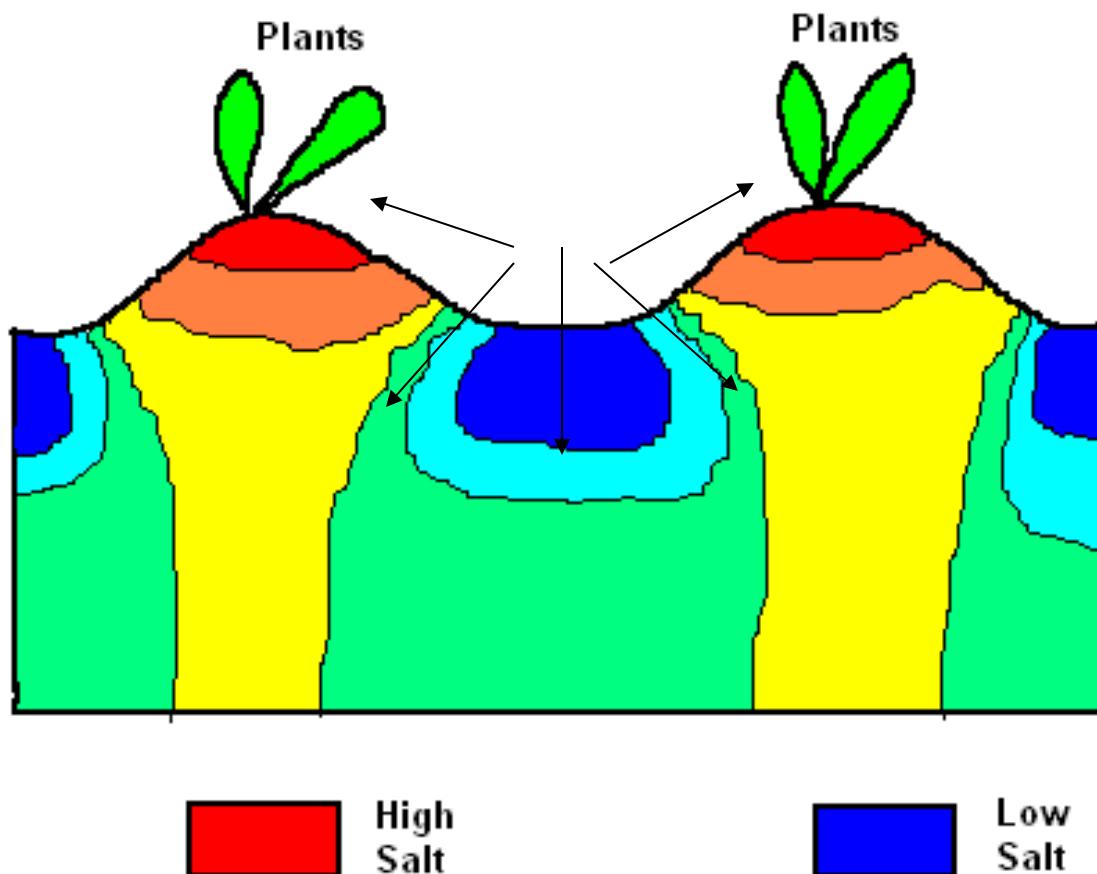


# Crop Sensitivity to Salinity in Relation to Stage of Growth



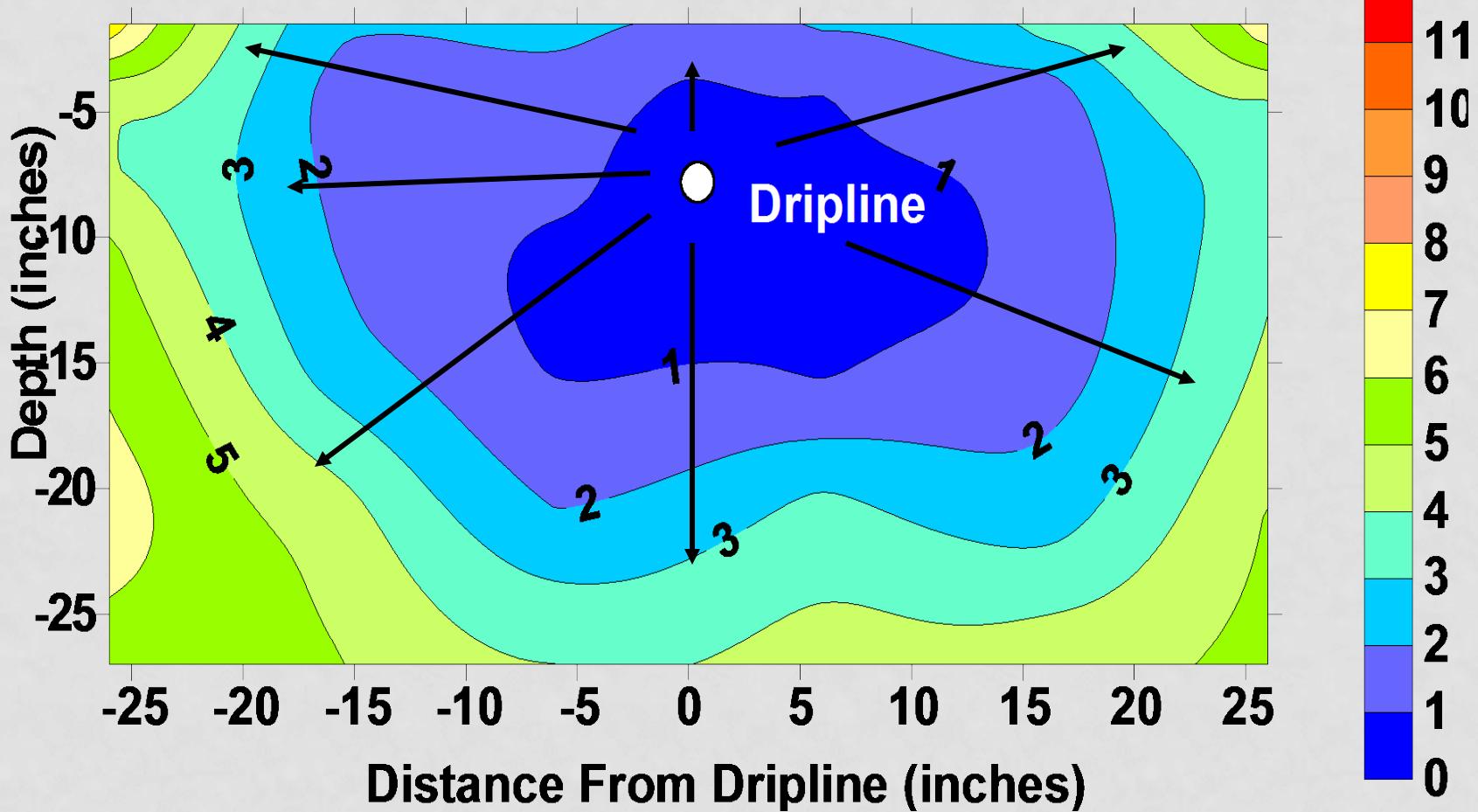
After Maas and Grattan, 1999

# FURROW IRRIGATION



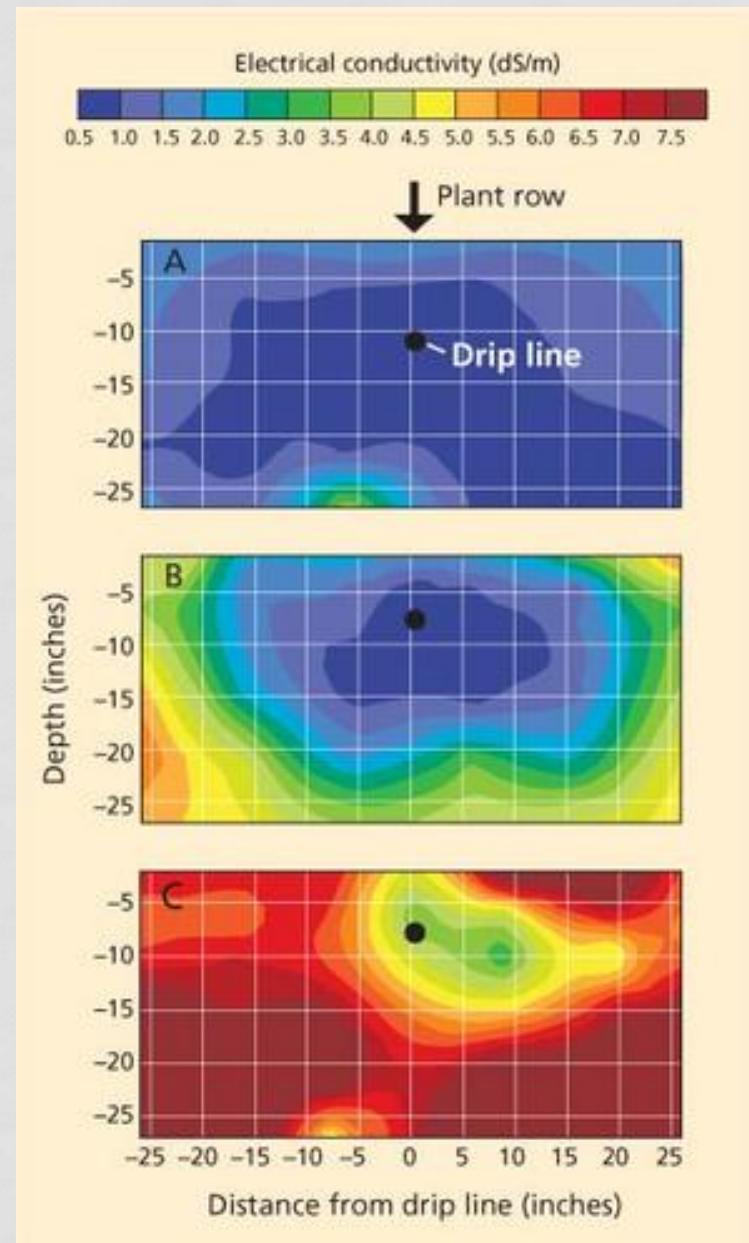
# Salt pattern under drip irrigation (EC<sub>w</sub> = 0.3 dS/m)

Site BR



Soil salinity around the drip line for water depth of about

- (A) 6 feet,  $EC_w = 0.3$  dS/m, EC groundwater = 8 to 11 dS/m;
- (B) 2 to 3 feet,  $EC_w = 0.3$  dS/m, EC groundwater = 5 to 7 dS/m
- (C) 2 to 3 feet,  $EC_w = 1.1$  dS/m, EC groundwater = 9 to 16 dS/m



# PROCEDURES

Two commercial field sites in the Delta region

- Furrow irrigated field
- Drip irrigated field (2014 was second year)
  - Grower's schedule
  - Full irrigation in the early season followed by a deficit irrigation strategy

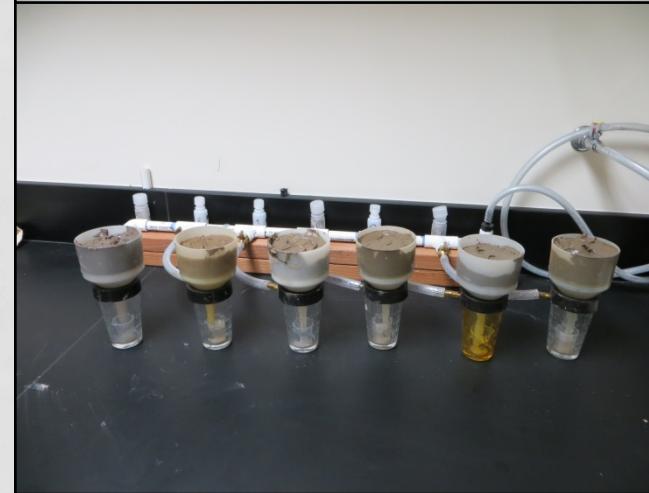
Both sites were transplanted with 60" bed configuration with single plant rows

Both sites sourced water from Middle River near Howard Road bridge, soils of both are categorized as Egbert series

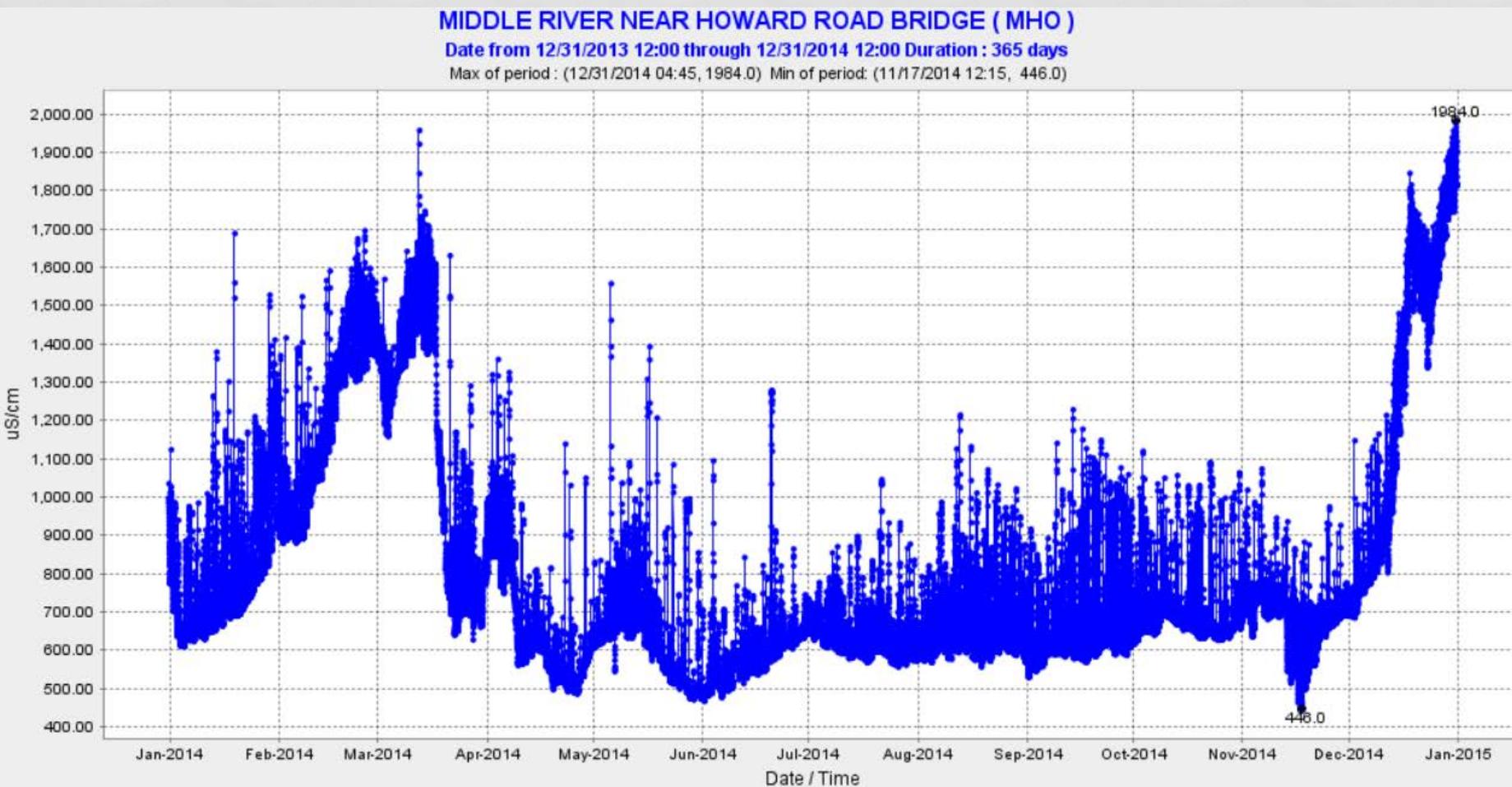
# PROCEDURES

## Measurements:

- Fruit yield and quality
- Applied water volumes (drip field)
- Groundwater salinity
- Depth to water table
- Irrigation water salinity
- Soil salinity



# $EC_W$ VARIES OVER THE SEASON

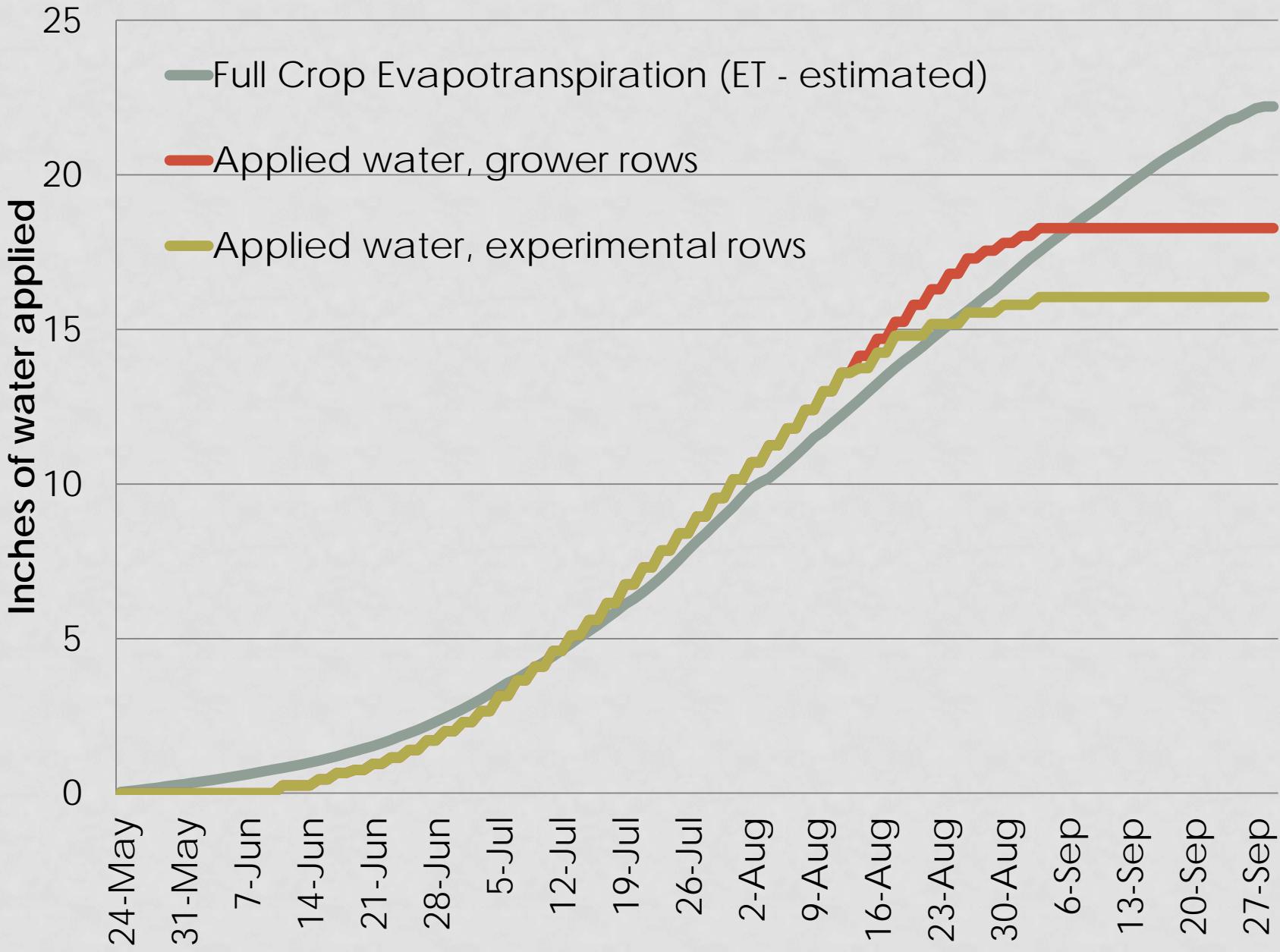






# DRIP-IRRIGATED FIELD

- Soil sampled on May 13 after pre-irrigation
- Transplanted to UG 19406 on May 23
- Irrigation cutbacks initiated on Aug. 14, 7 weeks before harvest
- Soil sampled and harvested on Sept 29-30
- EC of irrigation water averaged 0.6 dS/m



# WATER BALANCE, DRIP FIELD

	Grower irrigation program	Experimental irrigation program
<b>Stored soil moisture (inches in top 3 ft)</b>		
Soil moisture at transplanting	17.6	17.3
Soil moisture at harvest	14.9	13.0
<b>Stored soil moisture used</b>	<b>2.7"</b>	<b>4.3"</b>
<b>Irrigation water applied via drip system*</b>	<b>18.3"</b>	<b>16.0"</b>
<b>Consumptive water use (stored plus applied)</b>	<b>21.0"</b>	<b>20.3"</b>
<b>Estimated full crop ET**</b>	<b>22.2"</b>	<b>22.2"</b>

\* does not include one pre-irrigation, which is captured by the soil moisture measurements.

\*\* Estimate based on 2014 CIMIS data and crop coefficients of Hanson & May (2006).

# YIELD AND FRUIT QUALITY

Irrigation Program	Yield (tons/acre)	Soluble solids (°Brix)	PTAB color	pH
<b>Grower irrigation program</b>	53.7	5.15	22.5	4.23
<b>Experimental irrigation program</b>	58.0	5.30	23.5	4.23

# Drip field - Electrical Conductivity (dS/m)

Pre-transplant May 13, 2014										Harvest Sept 29, 2014										Change in EC from spring to fall 2014										
Deficit irrigation row	BED CENTER					FURROW					BED CENTER					FURROW					BED CENTER					FURROW				
	depth	↓				↓					↓					↓					↓					↓				
0 - 4"	1.75	1.62	1.33	1.60	1.65	1.86					2.80	3.73	2.41	2.24	2.81	5.12					1.05	2.11	1.08	0.65	1.16	3.26				
	1.43	1.16	1.03	1.20	1.57	1.47	1.39	1.07			1.74	1.42	1.39	1.29	1.2	1.54	5.09	3.69			0.31	0.26	0.37	0.09	-0.36	0.07	3.70	2.62		
	1.44	1.12	1.42	1.25	1.20	1.32	1.43	1.05			1.12	0.96	0.94	0.89	1.18	1.06	1.13	1.19			-0.32	-0.16	-0.49	-0.37	-0.02	-0.26	-0.30	0.15		
	1.3	1.32	1.33	0.98	1.00	1.08	0.94	0.96			0.82	0.74	0.79	0.87	1.03	1.06	0.93	0.84			-0.48	-0.59	-0.54	-0.10	0.03	-0.02	-0.01	-0.12		
	1.27	1.14	0.94	0.98	1.19	0.98	1.03	0.96			0.61	0.85	0.73	0.78	0.82	0.89	1.50	0.92			-0.66	-0.29	-0.21	-0.20	-0.37	-0.09	0.47	-0.04		
	1.26	1.08	1.14	1.14	1.01	1.24	1.02	0.93			0.91	0.85	1.14	0.80	0.80	1.03	1.45	0.86			-0.35	-0.23	0.00	-0.34	-0.21	-0.21	0.43	-0.06		
	0.92	1.26	1.29	1.19	1.48	1.05	1.33	0.98			0.72	0.94	0.95	0.90	0.95	1.52	0.92	1.18			-0.20	-0.32	-0.34	-0.30	-0.53	0.47	-0.41	0.20		
	1.55	1.23	1.32	1.35	1.53	1.18	1.39	1.14			0.97	1.13	1.14	1.20	1.33	1.14	1.04	1.03			-0.58	-0.11	-0.19	-0.16	-0.20	-0.05	-0.35	-0.11		
	1.13	1.17	1.13	1.17	1.10	1.05	1.05	1.25			0.94	1.14	1.36	1.75	1.58	1.41	1.41	1.46			-0.19	-0.03	0.24	0.59	0.48	0.37	0.36	0.21		
	1.13	1.27	1.28	1.14	1.16	1.30	1.17	1.14			1.13	1.26	1.70	1.46	1.26	1.22	1.54	1.24			0.00	-0.01	0.41	0.32	0.11	-0.08	0.37	0.10		
Grower irrigation row	BED CENTER					FURROW					BED CENTER					FURROW					BED CENTER					FURROW				
	depth	↓				↓					↓					↓					↓					↓				
	0 - 4"	2.01	1.90	1.77	1.66	1.56	1.55				2.69	2.58	1.58	1.10	1.44	3.95					0.68	0.67	-0.20	-0.56	-0.12	2.40				
	4 - 8"	1.86	1.63	1.64	1.58	1.56	1.41	1.58	1.40		1.35	0.98	0.8	0.74	1.13	1.10	1.66	2.46			-0.51	-0.65	-0.84	-0.84	-0.43	-0.31	0.09	1.06		
	8 - 12"	1.46	1.20	1.45	1.51	1.56	1.30	1.14	1.22		0.98	0.86	1.08	0.85	0.91	0.95	0.87	0.74			-0.48	-0.34	-0.38	-0.66	-0.65	-0.36	-0.28	-0.48		
	12 - 16"	1.31	1.14	1.08	1.53	1.31	1.13	1.07	1.07		0.90	1.09	1.00	0.98	0.80	0.71	0.70	0.61			-0.41	-0.05	-0.08	-0.55	-0.51	-0.42	-0.37	-0.46		
	16 - 20"	1.15	1.01	1.27	1.07	1.12	0.88	0.95	1.07		0.87	0.86	0.87	0.79	0.85	1.10	1.03	0.77			-0.29	-0.14	-0.40	-0.28	-0.27	0.22	0.09	-0.31		
	20 - 24"	1.17	1.01	1.05	1.05	1.22	1.01	1.32	1.39		1.14	1.11	1.14	1.33	1.04	1.08	0.86	0.82			-0.03	0.10	0.09	0.28	-0.17	0.07	-0.46	-0.57		
	24 - 28"	1.12	1.02	1.13	1.33	1.20	1.15	1.00	1.02		1.34	1.41	1.48	1.30	1.55	1.22	1.20	1.44			0.22	0.39	0.36	-0.03	0.35	0.06	0.21	0.41		
	28 - 32"	1.09	1.14	1.05	1.26	1.33	1.17	1.27	1.14		1.19	1.67	1.32	1.41	1.65	1.68	1.65	1.27			0.09	0.53	0.27	0.15	0.32	0.52	0.38	0.12		
	32 - 36"	1.10	1.17	0.95	1.12	1.19	1.12	1.15	1.12		1.05	1.20	1.25	1.18	1.30	1.26	1.03	0.91			-0.05	0.02	0.30	0.06	0.11	0.14	-0.11	-0.21		
	36 - 40"	0.83	0.9	0.81	0.94	1.15	0.92	0.94	0.91		0.89	0.94	1.08	0.95	1.05	0.94	0.92	0.78			0.06	0.04	0.27	0.01	-0.10	0.02	-0.02	-0.13		

# Drip field - Chloride (ppm)

Deficit irrigation row

Pre-transplant May 13, 2014										
	BED CENTER				FURROW					
depth	↓					↓				
0 - 4"		137	133	134	174	182	201			
4 - 8"		141	135	146	135	175	146	117	69.3	
8 - 12"		168	144	191	152	136	147	102	77.4	
12 - 16"		162	191	202	129	117	127	99.1	94.9	
16 - 20"		194	180	151	151	171	130	124	114	
20 - 24"		221	201	201	266	159	182	130	116	
24 - 28"		202	237	242	222	258	173	197	132	
28 - 32"		304	246	232	226	257	179	203	159	
32 - 36"		203	208	202	193	177	161	156	186	
36 - 40"		203	229	225	191	195	208	183	179	

Harvest Sept 29, 2014

	BED CENTER				FURROW					
depth	↓					↓				
0 - 4"		372	544	271	245	304	576			
4 - 8"		243	203	192	162	131	144	340	517	
8 - 12"		147	119	104	103	134	97.7	91.4	92.8	
12 - 16"		120	111	107	111	128	130	109	83	
16 - 20"		102	155	120	133	128	140	215	123	
20 - 24"		177	195	236	155	152	202	260	147	
24 - 28"		152	191	191	180	187	317	179	236	
28 - 32"		222	238	217	220	244	207	193	198	
32 - 36"		208	236	264	329	284	255	258	273	
36 - 40"		249	270	341	279	230	220	292	230	

Change in chloride concentration from spring to fall 2014

	BED CENTER				FURROW					
depth	↓					↓				
0 - 4"		236	411	137	71	123	375			
4 - 8"		102	68	46	27	-43	-3	223	448	
8 - 12"		-21	-25	-87	-49	-2	-50	-11	15	
12 - 16"		-42	-81	-95	-18	12	2	10	-12	
16 - 20"		-92	-25	-30	-18	-43	10	91	9	
20 - 24"		-44	-6	36	-111	-7	20	131	32	
24 - 28"		-50	-46	-50	-42	-71	144	-18	104	
28 - 32"		-83	-7	-15	-6	-13	27	-10	40	
32 - 36"		5	28	62	136	107	94	103	88	
36 - 40"		46	41	116	88	35	12	109	51	

Grower irrigation row

	BED CENTER						FURROW				
depth	↓							↓			
0 - 4"		166.6	151.9	155.4	145.3	130.6	131.6				
4 - 8"		175.7	164.5	175.0	166.6	149.8	131.6	131.3	96.6		
8 - 12"		169.8	136.9	172.9	175.0	159.3	131.6	96.3	87.5		
12 - 16"		161.4	139.3	134.4	186.2	152.3	125.0	107.5	137.2		
16 - 20"		183.8	144.2	142.1	113.1	104.3	155.4	115.2	108.2		
20 - 24"		181.3	152.3	167.7	164.2	188.3	147.0	184.1	181.3		
24 - 28"		178.9	161.7	188.3	241.2	203.0	191.5	149.1	140.7		
28 - 32"		183.8	192.5	186.2	226.5	231.7	195.7	197.8	169.8		
32 - 36"		180.6	202.3	155.8	197.4	204.8	186.6	184.5	161.4		
36 - 40"		133.0	144.2	125.0	147.0	184.1	139.3	143.9	134.8		

	BED CENTER						FURROW				
depth	↓							↓			
0 - 4"		378.4	429.1	209.7	113.8	171.9	468.0				
4 - 8"		173.6	115.9	91.0	90.3	138.6	109.6	146.3	286.3		
8 - 12"		109.2	107.1	129.5	99.4	99.4	87.9	71.1	69.3		
12 - 16"		138.6	180.6	142.8	139.7	112.0	106.8	94.2	84.4		
16 - 20"		183.1	177.5	171.2	155.1	175.0	224.4	202.3	147.7		
20 - 24"		258.7	391.0	246.4	291.6	231.7	244.7	183.1	188.7		
24 - 28"		290.2	298.6	317.8	279.0	353.9	261.5	272.3	326.2		
28 - 32"		240.1	331.8	265.0	295.1	353.5	376.6	361.9	260.8		
32 - 36"		205.8	226.5	253.4	241.5	274.1	273.7	216.7	177.8		
36 - 40"		171.2	177.1	216.3	193.2	218.4	198.5	195.0	155.1		

	BED CENTER						FURROW				
depth	↓							↓			
0 - 4"		212	277	54	-32	41	336				
4 - 8"		-2	-49	-84	-76	-11	-22	15	190		
8 - 12"		-61	-30	-43	-76	-60	-44	-25	-18		
12 - 16"		-23	41	8	-47	-40	-18	-13	-53		
16 - 20"		-1	33	29	42	71	69	87	40		
20 - 24"		77	239	79	127	43	98	-1	7		
24 - 28"		111	137	130	38	151	70	123	186		
28 - 32"		56	139	79	69	122	181	164	91		
32 - 36"		25	24	98	44	69	87	32	16		
36 - 40"		38	33	91	46	34	59	51	20		

# FURROW FIELD

- Transplanted with H5608 on Apr 29
- Soil sampled on May 20
- Irrigated weekly using alternate furrows
- $EC_w$  averaged 0.62
- Last irrigation July 30
- Soil sampled Aug 29
- Harvested Sept 2



# Furrow field - Electrical Conductivity (dS/m)

		3 wks after transplanting						At harvest						Changes in EC from spring to fall 2014											
		BED CENTER			FURROW			BED CENTER			FURROW			BED CENTER			FURROW								
Field bottom	depth	↓							↓							↓									
	0 - 4"	3.87	2.10	0.97	0.73	0.72	0.95	1.10	1.55	3.95	3.50	1.63	1.54	1.53	1.16	0.09	1.41	0.66	0.82	0.81	0.21				
	4 - 8"	1.74	1.31	1.06	0.99	0.89	0.94	0.84	1.11	1.88	1.27	0.85	0.86	0.92	0.70	0.74	1.68	0.14	-0.04	-0.21	-0.13	0.03	-0.24	-0.10	0.57
	8 - 12"	1.28	1.40	1.40	1.11	1.03	1.02	1.18	1.22	1.26	1.13	0.91	0.99	0.99	0.84	0.80	0.80	-0.02	-0.27	-0.49	-0.12	-0.04	-0.19	-0.38	-0.42
	12 - 16"	1.15	1.31	1.35	1.43	1.23	1.22	1.58	1.28	1.74	2.14	1.53	1.24	1.15	0.90	1.32	1.39	0.59	0.83	0.18	-0.20	-0.07	-0.32	-0.26	0.12
	16 - 20"	1.52	1.49	1.48	1.50	1.34	1.48	1.46	1.43	2.30	2.48	1.50	1.59	1.85	1.98	2.17	2.44	0.78	0.99	0.02	0.09	0.51	0.49	0.70	1.01
	20 - 24"	1.62	1.74	1.53	1.54	1.38	1.43	1.54	1.54	1.96	2.63	2.23	2.24	2.29	2.53	2.56	2.85	0.33	0.89	0.70	0.70	0.91	1.10	1.02	1.31
	24 - 28"	1.75	1.67	1.48	1.52	1.43	1.43	1.68	1.72	2.48	2.52	2.47	2.45	2.67	2.66	2.60	2.61	0.72	0.85	0.99	0.94	1.24	1.23	0.92	0.88
	28 - 32"	2.04	1.78	1.77	1.61	1.77	1.68	1.72	1.91	2.60	2.81	2.76	2.54	2.53	2.82	2.65	2.54	0.56	1.03	0.99	0.93	0.76	1.14	0.94	0.63
	32 - 36"	1.93	1.96	1.98	1.72	1.80	1.81	1.80	2.25	2.65	2.79	2.88	2.96	3.11	2.84	2.76	2.14	0.73	0.83	0.90	1.24	1.31	1.03	0.96	-0.11
	36 - 40"	2.26	2.36	2.28	1.90	1.95	1.87	2.11	2.40	1.99	2.2	2.41	2.58	2.82	2.84	2.46	2.57	-0.27	-0.18	0.13	0.69	0.87	0.97	0.35	0.17
Field top	depth	↓							↓							↓									
	0 - 4"	2.94	1.43	0.91	0.90	1.20	1.19			3.41	1.60	1.27	1.59	1.77	1.80		0.46	0.16	0.37	0.69	0.57	0.61			
	4 - 8"	1.12	0.91	0.9	0.83	0.85	0.73	0.72	0.58	0.94	0.91	0.71	0.88	0.50	0.52	1.24	-0.18	0.00	-0.19	0.05	-0.36	-0.21	0.51		
	8 - 12"	0.98	1.09	1.12	0.96	1.05	1.00	0.81	0.88	0.94	0.76	0.71	0.48	0.85	0.65	0.71	0.81	-0.04	-0.33	-0.41	-0.48	-0.20	-0.36	-0.10	-0.07
	12 - 16"	1.11	1.13	0.98	0.90	1.12	1.18	0.93	0.85	0.86	0.82	0.97	0.76	0.68	0.83	0.79	0.97	-0.26	-0.30	-0.01	-0.14	-0.44	-0.36	-0.14	0.13
	16 - 20"	1.35	1.17	0.99	1.01	1.04	1.12	1.04	1.02	0.86	1.02	0.81	0.74	0.84	0.85	0.84	0.80	-0.50	-0.15	-0.18	-0.27	-0.20	-0.28	-0.20	-0.21
	20 - 24"	1.15	1.14	1.06	1.09	1.15	1.11	1.20	1.10	1.01	1.01	1.05	0.82	0.88	0.92	0.98	0.86	-0.14	-0.13	-0.01	-0.27	-0.27	-0.19	-0.22	-0.24
	24 - 28"	1.29	1.15	1.17	1.16	1.22	1.16	1.14	1.47	1.19	1.43	1.54	1.31	1.21	1.06	1.08	1.10	-0.10	0.28	0.37	0.15	-0.01	-0.10	-0.06	-0.37
	28 - 32"	1.24	1.24	1.21	1.20	1.22	1.27	1.17	1.19	1.24	1.49	1.73	1.80	1.40	1.56	1.35	1.22	-0.01	0.25	0.52	0.60	0.18	0.29	0.17	0.03
	32 - 36"	1.27	1.38	1.38	1.33	1.35	1.42	1.39	1.30	1.40	1.59	1.77	1.73	1.28	1.25	1.53	1.36	0.13	0.20	0.39	0.40	-0.07	-0.17	0.15	0.07
	36 - 40"	1.40	1.33	1.32	1.33	1.34	1.23	1.41	1.50	1.28	1.25	1.30	1.44	1.29	1.17	1.38	1.15	-0.13	-0.08	-0.02	0.11	-0.05	-0.06	-0.03	-0.35

# Furrow field - Chloride (ppm)

		3 wks after transplanting								At harvest								Changes in chloride concentration from spring to fall									
Field bottom	depth	BED CENTER				FURROW				BED CENTER				FURROW				BED CENTER				FURROW					
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	0 - 4"	385	168	61	51	57	88	119	164	361	308	135	155	187	137		-24	140	75	104	130	48		-81	-29	-2	
	4 - 8"	166	105	84	78	78	83	78	86	84	75	82	105	124	96	104	297		-29	-2	27	45	13	26	211		
	8 - 12"	132	135	123	93	99	97	118	113	116	155	130	143	141	124	119	130		-15	20	7	50	42	27	1	17	
	12 - 16"	130	142	132	141	126	127	169	127	269	330	249	184	167	139	216	233		139	187	116	42	41	12	47	106	
	16 - 20"	166	162	151	152	141	158	152	154	376	418	246	264	294	317	368	414		210	256	95	112	153	159	216	260	
	20 - 24"	168	182	156	156	142	152	165	165	293	389	352	349	352	387	394	426		125	207	197	193	210	235	229	261	
	24 - 28"	184	171	152	153	150	153	189	203	310	380	383	374	394	388	393	391		126	209	231	221	244	235	204	188	
	28 - 32"	238	202	189	173	207	182	205	242	377	418	414	376	375	414	398	393		139	216	224	203	168	232	193	151	
	32 - 36"	230	233	224	196	201	215	223	306	381	414	426	467	506	462	414	331		151	181	202	271	305	247	191	25	
	36 - 40"	286	281	288	217	237	202	257	347	281	308	350	383	466	463	386	402		-5	27	62	166	229	261	130	55	
Field top	depth	BED CENTER				FURROW				BED CENTER				FURROW				BED CENTER				FURROW					
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	0 - 4"	273	113	64	67	100	131			331	126	143	195	214	249			58	13	78	128	114	118				
	4 - 8"	91	47	55	53	43	48	55	43	93	91	74	76	58	61	209		3	45	18	22	16	13	154	-43		
	8 - 12"	68	68	71	67	53	62	70	73	115	93	88	113	76	90	108	121		48	25	18	46	23	28	37	49	
	12 - 16"	84	85	82	76	84	93	78	72	114	111	138	111	104	125	125	165		30	26	56	35	20	33	47	92	
	16 - 20"	90	109	100	102	99	103	94	97	125	155	113	106	136	130	125	129		35	46	13	4	37	27	31	33	
	20 - 24"	114	112	109	112	113	108	119	110	149	155	164	126	137	131	152	135		34	43	55	13	24	23	34	26	
	24 - 28"	148	133	136	131	139	133	121	124	192	232	251	220	187	153	170	165		44	99	116	89	48	19	49	41	
	28 - 32"	150	161	154	140	152	158	137	138	209	256	299	304	225	246	229	199		60	95	145	163	73	88	92	62	
	32 - 36"	172	187	177	174	184	191	183	188	219	240	275	272	189	193	242	204		47	53	98	99	5	2	58	16	
	36 - 40"	180	199	187	193	206	186	214	232	189	183	198	227	198	170	204	175		9	-16	11	34	-8	-15	-9	-57	

# RESULTS

- Furrow field: Adequate leaching towards top of field, much poorer leaching towards bottom
- Drip field: Even with drip irrigation application volumes lower than estimated crop ET, localized leaching occurred around the drip tape (top 20 to 32 inches depending on soil texture)
- Slightly greater irrigation cutbacks with drip system did affect salinity increases somewhat
- High variability of Delta soils apparent even over short distances within the study area; soil texture and organic matter affect leaching ability

# SALINITY MANAGEMENT

- Leach salts out of root zone
  - Drip tape aligned with plant row
  - Winter rainfall or irrigation
  - In-season irrigation in excess of ET
- More frequent in-season irrigations
  - Easier for plant to extract water
- Apply fertilizer modestly

# RESOURCES

Free publication:

**Drip Irrigation Salinity Management for Row Crops**

University of California Agriculture and Natural  
Resources Publication #8447

<http://anrcatalog.ucdavis.edu>

# ACKNOWLEDGEMENTS

Michelle Leinfelder-Miles, Delta Crops Farm Advisor

Terry Prichard, Emeritus Water Management Specialist

Peter Fahey, Cheryl Gartner

Jacob Loogman, Jeannine Lowrimore

Eric Stockel, Scott Whiteley

Dino Del Carlo

California Tomato Research Institute

