One Situation of Yellow Strawberry Plants in Salinas:
Genesis and Solution

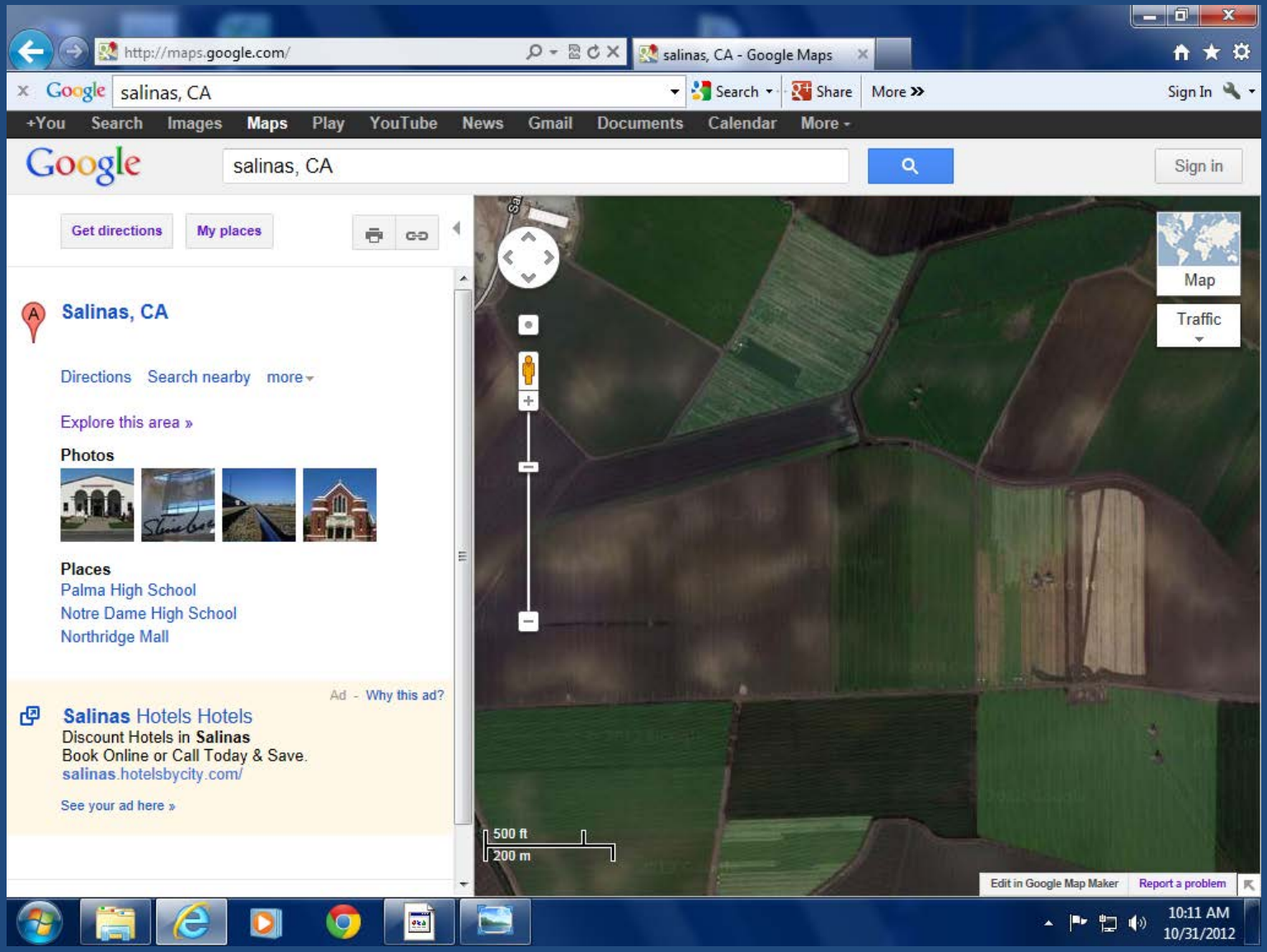
Mark Bolda

UC Cooperative Extension

Chlorosis in Strawberry Leaves.

Yellow spots visible from the side of the road

And visible from space...



Low nitrogen

Magnesium deficiency?

Iron Deficiency?

Maybe it’s too much water?

N (Total) [SOP 525] %	P (Total) [SOP 590] %	K [SOP 550] %	S (Total) [SOP 590] ppm	B (Total) [SOP 590] ppm	Ca (Total) [SOP 590] %	Mg (Total) [SOP 590] %	Zn (Total) [SOP 590] ppm	Mn (Total) [SOP 590] ppm	Fe (Total) [SOP 590] ppm	Cu (Total) [SOP 590] ppm
2.85	0.50	2.12	2190.00	54.00	1.88	0.49	17.00	243.00	206.00	5.10
2.50	0.46	1.97	2020.00	54.00	2.02	0.46	17.00	222.00	251.00	5.30
3.01	0.48	2.07	2470.00	54.00	1.70	0.42	19.00	169.00	202.00	5.70
2.79	0.48	2.05	2226.67	54.00	1.87	0.46	17.67	211.33	219.67	5.37
2.39	0.36	1.47	1690.00	45.00	1.41	0.51	16.00	232.00	200.00	4.00
2.39	0.36	1.27	1700.00	47.00	1.51	0.53	17.00	252.00	203.00	3.50
2.42	0.30	1.41	1780.00	42.00	1.75	0.54	19.00	287.00	909.00	4.30
2.39	0.31	1.24	1860.00	42.00	1.52	0.42	13.00	166.00	158.00	2.80
2.52	0.37	1.40	1990.00	43.00	1.52	0.47	15.00	191.00	152.00	2.80
2.47	0.35	1.23	1880.00	44.00	1.63	0.46	13.00	199.00	168.00	3.00
2.43	0.34	1.34	1816.67	43.83	1.56	0.49	15.50	221.17	298.33	3.40
2.69	0.33	1.53	2050.00	55.00	1.95	0.69	13.00	578.00	250.00	4.70
2.37	0.29	1.19	2000.00	49.00	1.82	0.63	18.00	407.00	211.00	3.90
2.47	0.29	1.39	1990.00	51.00	1.97	0.64	17.00	486.00	276.00	4.00
2.51	0.30	1.37	2013.33	51.67	1.91	0.65	16.00	490.33	245.67	4.20
2.62	0.29	1.26	1880.00	48.00	1.85	0.44	15.00	155.00	202.00	2.70
2.56	0.32	1.31	1820.00	48.00	1.78	0.44	14.00	125.00	167.00	2.80
2.58	0.35	1.42	1840.00	47.00	1.76	0.49	13.00	159.00	171.00	2.70
2.59	0.32	1.33	1846.67	47.67	1.80	0.46	14.00	146.33	180.00	2.73

Yellow N: 2.65 %
Yellow P: 0.39 %
Yellow K: 1.71 %
Yellow S: 2120 ppm
Yellow Zn: 17 ppm
Yellow Fe: 233 ppm

Green N: 2.51 %
Green P: 0.33 %
Green K: 1.71 %
Green S: 1831 ppm
Green Zn: 14 ppm
Green Fe: 239 ppm

Leaves

B (SP)	NO3-N	Olsen-P	X-K	X-Na	X-Na	X-Ca	X-Mg	Zn (DTPA)	Mn (DTPA)	Cu (DTPA)	Fe (DTPA)
0.1	96.3	48.6	0.92	283	1.23	39.8	8.26	2.0	20.4	1.0	19.8
0.1	17.6	49.6	0.98	249	1.08	39.4	8.27	1.9	20.0	1.1	23.2
0.1	17.4	56.1	0.99	248	1.08	39.6	8.42	14.5	18.8	1.0	22.5
0.1	14.2	34.2	0.99	358	1.56	41.9	13.78	1.2	13.0	1.2	16.8
0.1	21.4	37.3	0.98	338	1.47	42.5	11.55	1.6	11.5	1.1	14.6
0.1	12.8	35.8	0.96	311	1.35	42.3	13.00	1.6	10.1	1.1	13.9
0.1	30.0	43.6	1.0	297.8	1.3	40.9	10.5	3.8	15.6	1.1	18.5
0.1	9.5	79.3	1.48	310	1.35	43.5	10.44	2.5	25.1	1.5	39.7
0.1	9.3	80.8	1.48	308	1.34	42.2	10.12	2.5	24.6	1.5	37.3
0.1	3.4	78.9	1.47	272	1.18	42.5	10.15	2.7	28.9	1.4	40.5
0.1	22.4	90.3	1.33	344	1.49	45.9	9.15	2.5	23.3	1.8	30.5
0.1	49.9	78.6	1.41	354	1.54	44.9	9.39	4.4	21.0	1.6	25.8
0.1	36.8	75.2	1.34	390	1.70	45.3	9.17	2.5	24.2	1.6	28.0
0.1	21.9	80.5	1.4	329.7	1.4	44.1	9.7	2.9	24.5	1.6	33.6

Soil

Break apart an entire bed to sample separate sections.

Frank Shields, Soil Control Lab, Watsonville

4	10	5.7	5.7	4.1	2.7	3.3	3.6	0.9	1.5
8	47	27	27	20	12	15	16	4.0	6.3
9	34	39	42	42	52	41	38	94	107
7	52	45	60	73	154	92	75	234	538
0	42	34	30	40	80	50	50	125	254
4	2.1	1.9	2.3	2.3	2.3	3.2	2.4	2.4	2.3
2	129	114	140	286	694	295	199	644	1900
0	234	167	165	215	264	302	287	455	596
9	96	87	99	100	99	183	180	432	460
0	0	0	0	0	0	0	0	0	0

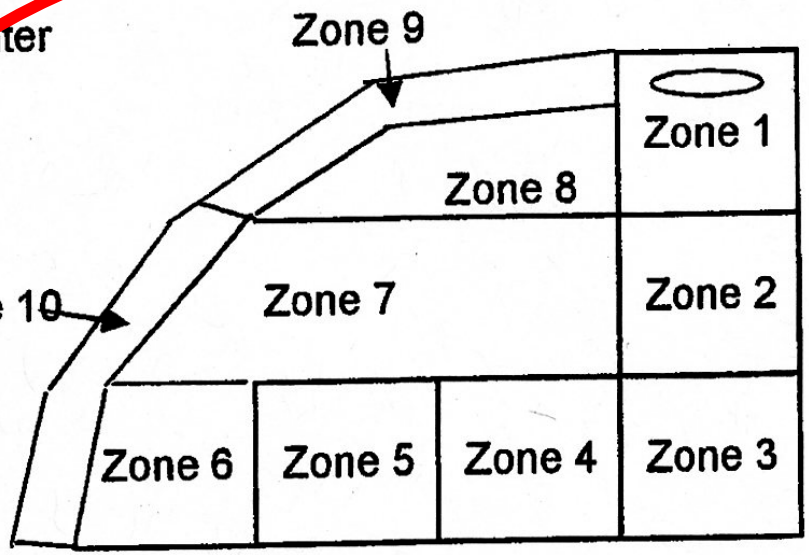
a one to five water extract.

e movement and accumulation of water

zones from the accumulation of salts

nistry or nutrient placement. If

ms can be predicted and corrective



n #10)	0.2
to #10)	1.7
#40)	10.5
an #200)	87.7
cc dry wt.)	1.8
.) % water	21

nformation:

per Bed	2	Mulch	plastic	Weeds	none
per Acre	13939	Color	black/silv	Cracks	none
		Cover	full	Fungus	none

Plant Problems

yellow extreme / turning brown and dying. In sections of the field

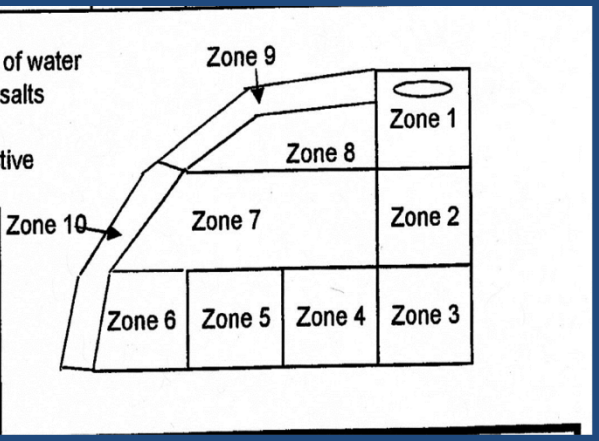
Irrigation water.

- Recycled water blended with well or river water.
- EC = 1.3 dS/m
- Sodium 118 ppm,
- Chloride 160 ppm
- Adjusted SAR of 3.4 (sodium adsorption ratio, an index of sodium hazard adjusted for the amount of calcium in the irrigation water).

Table 1: Leaf Tissue for Green and Yellow Plants

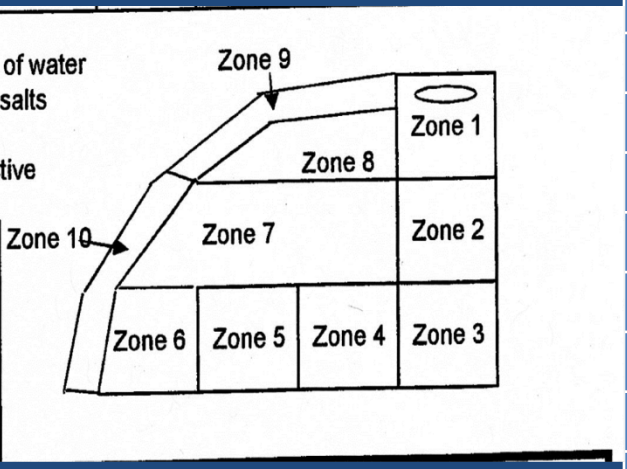
Mineral	Yellow Plant	Green Plant
Total Nitrogen	2.4%	2.2%
Total Phosphorous	0.38%	0.44%
Potassium	1.1%	1.2%
Calcium	1.5%	1.3%
Magnesium	0.55%	0.38%
Total Sulfur	0.21%	0.18%
Copper	4.5 ppm	3.7 ppm
Zinc	23 ppm	18 ppm
Iron	515 ppm	365 ppm
Manganese	185 ppm	108 ppm
Boron	73 ppm	78 ppm
Molybdenum	1.1 ppm	1.9 ppm
Sodium	350 ppm	79 ppm
Chloride	4150 ppm	3000 ppm

Table 2: Evaluation of Zones 1- 6 of Bed in Yellow and Healthy Areas



Data (mg/Kg dw)	Zones 1,2 and 3		Zones 4,5 and 6	
	Yellow	Healthy	Yellow	Healthy
Moisture (%)	33.7	33.6	29.8	31.8
pH (units)	8.5	8.1	8.5	8.1
EC5 (umhos/cm)	269	267	381	355
Ammonia (NH3-N)	24	32	60	16
Nitrate (NO3)	204	49	443	94
Phosphate (PO4)	126	86	66	68
Potassium (K)	157	184	157	92
Calcium (Ca)	419	417	398	201
Magnesium (Mg)	169	375	174	130
Carbonate (CaCO3) %	2.3	1.8	2.7	1.7
Sulfate (SO4)	219	195	694	412
Sodium (Na)	454	417	578	426
Chloride (Cl)	175	184	181	242
Nitrite (NO2)	0	0	0	0

Table 3: Evaluation of Zones 7-10 of Bed in Yellow and Healthy Areas



Data (mg/Kg dw)	Zone 7- Root Zone		Zone 8- Plant Zone		Zones 9 and 10	
	Yellow	Healthy	Yellow	Healthy	Yellow	Healthy
Moisture (%)	30.6	32.1	33	33.1	22.8	26.3
pH (units)	8.7	8.2	8.7	8.3	8.3	8.2
EC5 (umhos/cm)	305	389	258	374	938	546
Ammonia (NH3-N)	34	14	54	16	48	44
Nitrate (NO3)	314	30	199	25	968	452
Phosphate (PO4)	6.5	57	85	55	111	45
Potassium (K)	144	74	185	89	206	89
Calcium (Ca)	341	156	713	194	512	195
Magnesium (Mg)	140	83	383	127	384	104
Carbonate (CaCO3) %	2	1.3	2.0	1.9	2.0	1.9
Sulfate (SO4)	434	492	239	437	1216	622
Sodium (Na)	500	446	492	496	872	520
Chloride (Cl)	160	309	165	330	433	310
Nitrite (NO2)	0	0	0	0	0	0

Analysis

- pH of the soil in all zones high- lime
- High accumulations of N, P and K around yellow plants related to compromised plant uptake.
- Irrigation water not great, but OK.

Analysis

- Accumulated amounts of Na and Cl : (crops perform best when Na<250ppm and Cl<100ppm)
- These two ions are very high at crust, 40% higher chlorides in yellow tissue than green.

- Lime ($CaCO_3$) in soil samples is high; meaning calcium is precipitating out and not limiting soil exchangeable Na. Relationship to calcium is explaining why some spots are yellow and others not.

What do we do about it?

- Get rid of the salt: leach the soil.
- Reduce precipitation of calcium by acidifying the irrigation water.
- Avoid adding fertilizers containing sodium or chloride, such as sodium nitrate or potassium chloride.