Anticipate Salinity Problems In Strawberry Fields

***By Jose Luis Aguiar**, UCCE Riverside County & Khaled M. Bali, UCCE Imperial County*

Strawberry acreage in the Coachella Valley has been increasing over the past four years. During the last 10-year period, acreage has fluctuated from 351 acres to 580 acres with the highest acreage in 2013. The gross crop value has also increased dramatically (**Table 1**). Compared to other strawberry production areas in California, the desert production season is shorter due to warming temperatures that begin to rise and then stay over 100°F beginning around March. Fruit quality declines at these temperatures while other production areas with cooler climates and higher quality fruit enter the market. Strawberries are usually grown in fields that were previously in vegetable crop production where salinity may not have been a problem for the previous crops. Salinity can be a problem for strawberry production.

Typically, buried drip irrigation is used on strawberries. Each drip line supplies water to two plant lines and typically there are four plant lines per bed. Drip lines serve many purposes; they provide water and needed nutrients

Strawberry plants with fringe burn due to chloride toxicity.

Salinity

(continued from page 9)

calcium, potassium and magnesium. Sodium can also affect the rate of water infiltration in heavier soils resulting in poor root aeration. Sodium is not an essential micronutrient; however, chloride is an essential micronutrient and it moves readily with soil water. It is taken up by the roots, translocated and accumulated in the leaves. Chloride injury begins with a yellowing in the leaf tip and margins and progresses to leaf burn or drying of the tissue. The whole plant follows the same pattern if salinity is not addressed.

When one suspects salinity damage, soil sampling can provide the information that will help in diagnosing this type of problem. Examples of soil samples results from a strawberry field with a salinity problem are presented in **Table 3**. Soil sample 1 was taken from area where plants were normal, soil sample 2 and 3 were taken from an area where plants displayed salinity-like damage symptoms. YW

Table 2. Salinity Tolerance of Selected Crops (from South Dakota fact sheet 904)

CROP	ROOTING DEPTH@	RATING[b]	Yield decrease to be expected for certain crops due to soil salinity[a]. 0% EC_E[1]	10% EC_E	25% EC_E	50% EC_E	MAXIMUM EC_E
Asparagus	D	T	4100	9100	16600	29100	54100
Bean	M	S	1000	1525	2300	3650	6300
Beet, red	M	MT	4000	5100	6800	9600	15100
Broccoli	S	MS	2800	3900	5500	8300	13700
Brussels Sprouts	S	MS*	----	----	----	----	----
Cabbage	S	MS	1800	2850	4400	7000	12100
Carrot	S	S	1000	1700	2800	4600	
Cauliflower	S	MS*	----	----	----	----	----
Celery	S	MS	1800	3400	5850	9900	17900
Corn, sweet	D	MS	1700	2550	3800	5900	10000
Cucumber	S-M	MS	2500	3300	4400	6400	10200
Eggplant	M	MS*	----	----	----	----	----
Lettuce	D	MS	1300	2100	3200	5200	9000
Muskmelon	S-M	MS	----	----	----	----	----
Onion	S	S	1200	1800	2800	4300	7500
Parsnip	D	S*	----	----	----	----	----
Pea	M	S*	----	----	----	----	----
Pepper	M	MS	1500	2250	3300	5100	8700
Potato	S-M	MS	1700	2550	3800	5900	10000
Pumpkin	D	MS*	----	----	----	----	----
Radish	S	MS	1200	2000	3150	5100	8900
Spinach	S-M	MS	2000	3300	5300	8600	15200
Squash, scallop	D	MT	3200	3800	4800	6300	9500
Squash, zucchini	M	MT	4700	5800	7400	10000	15300
Strawberry	S	S	1000	1300	1775	2525	4050
Sweet Potato	D	MS	1500	2400	3800	6000	10600
Tomato	D	MS	2500	3500	5000	7500	12600
Turnip	M	MS	900	2000	3700	6500	12000
Watermelon	D	MS*	----	----	----	----	----

[a] These data serve only as a guideline to relative tolerances among crops. Absolute tolerances vary, depending upon climate, soil conditions, and cultural practices.
[b] Ratings are S=sensitive; MS=moderately sensitive; MT=moderately tolerant; T=tolerant to salts.
* Ratings with an * are estimates.
@ Rooting depths are shallow (S) = 12-18", medium (M) = 18-24", and deep (D) = greater than 24" (after Sanders, 1993).
[1] EC_E = Electrical Conductivity of the saturation extract of the average root zone (micromhos/cm).
(The above EC_e values are in micromhos per cm, to convert from micromhos/cm to milliohms/cm, divide the stated value by 1000).

Modified from South Dakota Extension Fact Sheet 904. Salt/Salinity Tolerance of common horticultural crops in South Dakota

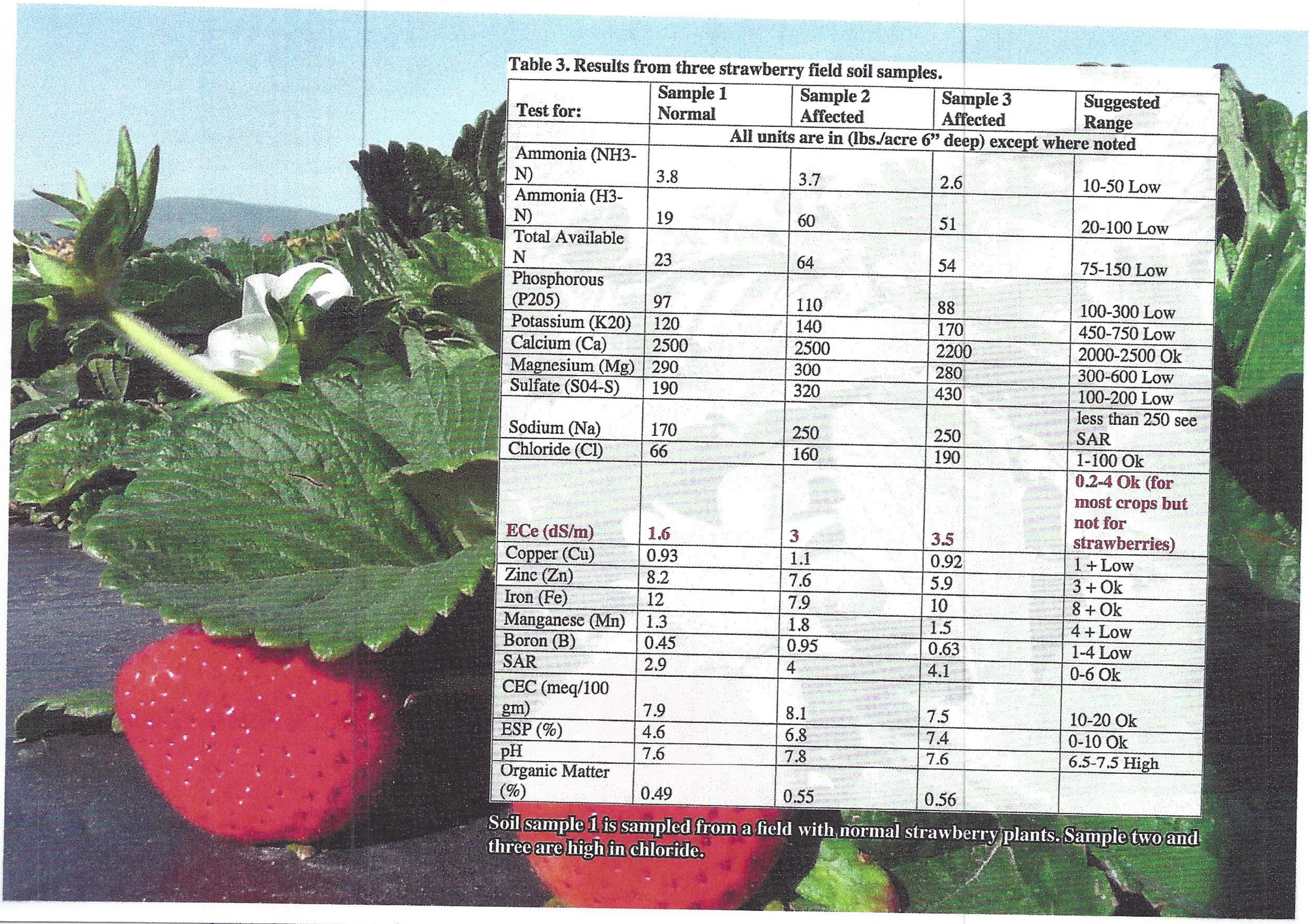
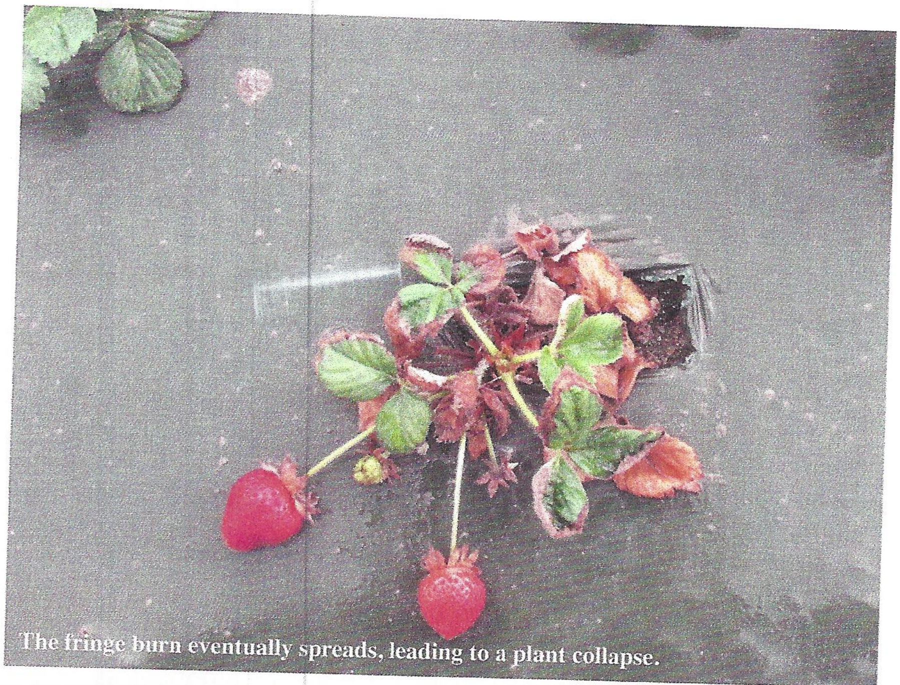


Table 3. Results from three strawberry field soil samples.

Test for:	Sample 1 Normal	Sample 2 Affected	Sample 3 Affected	Suggested Range
	All units are in (lbs./acre 6" deep) except where noted			
Ammonia (NH3-N)	3.8	3.7	2.6	10-50 Low
Ammonia (H3-N)	19	60	51	20-100 Low
Total Available N	23	64	54	75-150 Low
Phosphorous (P205)	97	110	88	100-300 Low
Potassium (K20)	120	140	170	450-750 Low
Calcium (Ca)	2500	2500	2200	2000-2500 Ok
Magnesium (Mg)	290	300	280	300-600 Low
Sulfate (S04-S)	190	320	430	100-200 Low
Sodium (Na)	170	250	250	less than 250 see SAR
Chloride (Cl)	66	160	190	1-100 Ok
ECe (dS/m)	1.6	3	3.5	0.2-4 Ok (for most crops but not for strawberries)
Copper (Cu)	0.93	1.1	0.92	1 + Low
Zinc (Zn)	8.2	7.6	5.9	3 + Ok
Iron (Fe)	12	7.9	10	8 + Ok
Manganese (Mn)	1.3	1.8	1.5	4 + Low
Boron (B)	0.45	0.95	0.63	1-4 Low
SAR	2.9	4	4.1	0-6 Ok
CEC (meq/100 gm)	7.9	8.1	7.5	10-20 Ok
ESP (%)	4.6	6.8	7.4	0-10 Ok
pH	7.6	7.8	7.6	6.5-7.5 High
Organic Matter (%)	0.49	0.55	0.56	

Soil sample 1 is sampled from a field with normal strawberry plants. Sample two and three are high in chloride.



The fringe burn eventually spreads, leading to a plant collapse.

Table 1. Coachella Valley Strawberry Gross Value and Acreage (2013 Riverside Agricultural Commissioner's Report)

YEAR	US Dollars Gross Value	Acreage
2004	6.327,500	351
2005	5,901,500	319
2006	4,307,000	353
2007	2,329,000	274
2008	1,894.20	246
2009	3,314,303	236
2010	3,832,539	318
2011	11,344,614	363
2012	16,126,662	430
2013	27,528,540	580

Data from Riverside County Agricultural Commissioners' Crop Reports

Strawberry plants are very sensitive to excesses of sodium and chloride.

and are also used to move the salinity away from the root zone to the bed shoulder. Strawberry plants have a shallow root system and if not enough water is applied, the salinity can accumulate in the root zone. Plastic mulch is used for weed control and for conserving moisture. The color of the mulch used can vary and some growers prefer black while others prefer green colored mulch.

The main two sources for irrigation water in the region are ground water and Colorado River water delivered by the Coachella Valley Water District. The Colorado River has a salinity range varying from 550-780 ppm (Electrical Conductivity of up to 1.2 dS/m). The salinity of ground water can vary depending on where the wells are located (from 130 to 2000 ppm). Soils also vary in the amount of salinity they contain and this is usually related to irrigation water quality, soil type, leaching practices and type of drainage system.

Salinity is typically expressed as Electrical Conductivity (EC_e) in decisiemens per meter (dS/m which is equivalent to millimhos per cm). It is the measurement of the salt concentration in irrigation water or soil solution. Higher EC_e readings indicate high amounts of salts. A reading of one dS/m equals approximately 640 parts per million (ppm) total salts. As the salinity in the soil root zone increases, the osmotic potential increases and plant roots have a difficult time extracting moisture from the root zone even if the soil has plenty of water. The impact of soil salinity (ECe) in the root zone on yield is presented in **Table 2 on page 10**. At 0% EC_e the crop yields are normal. The EC_e's are presented for a 10%, 25% and 50% yield loss. Note that for strawberry, soil salinity must be at or below 1 dS/m for optimum yield.

Sodium and chloride usually cause damage to strawberries when they accumulate in the leaves, roots and stems. Salinity damage on strawberries begins with leaf tip burn on the outer edge of the leaves. As the salinity increases, the affected area extends toward the stem and the leaves eventually become brown and papery. High sodium levels can cause nutritional imbalances and result in deficiencies of

(continued on page 10)