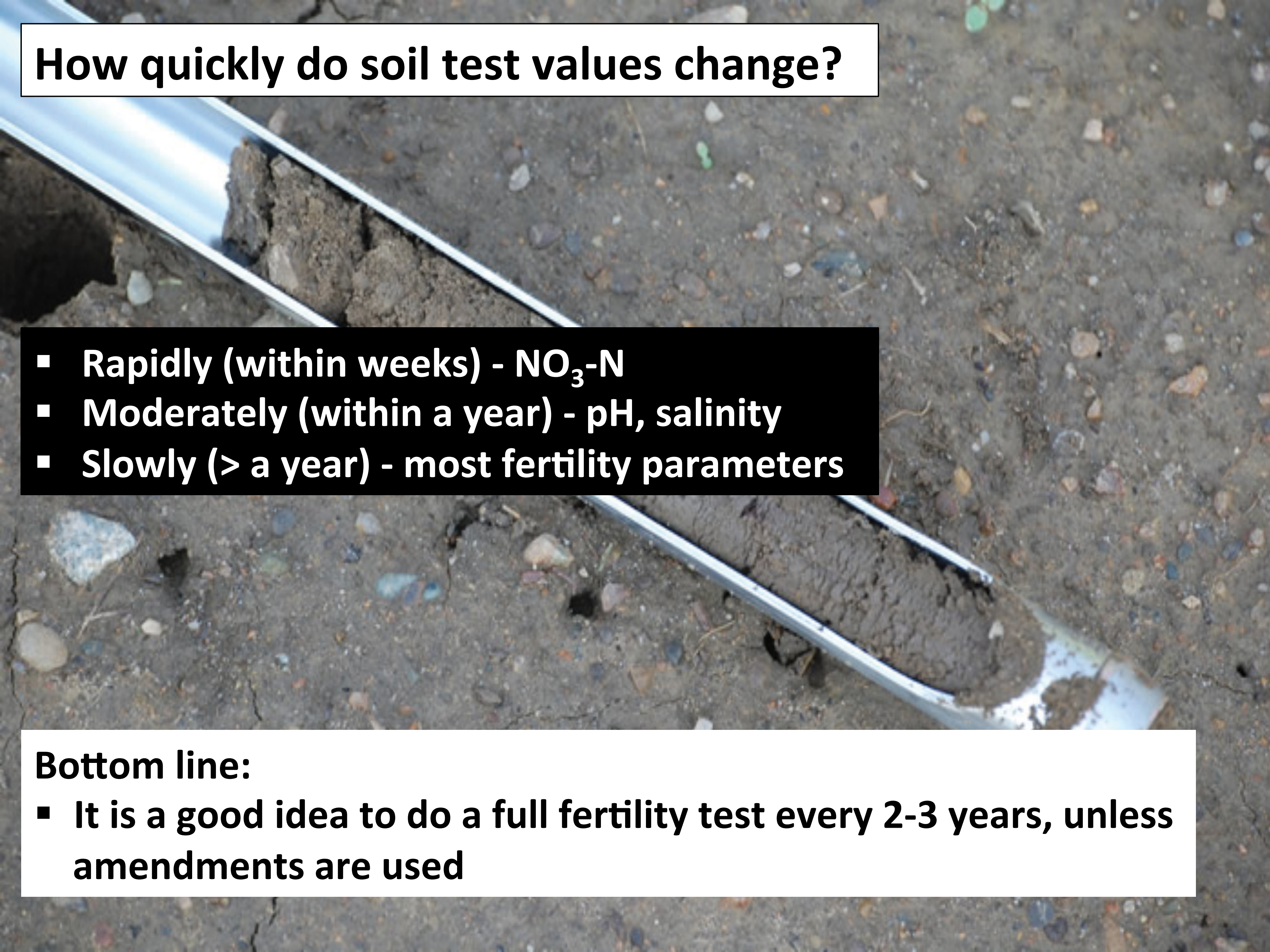
Soil Testing

- **To monitor long-term changes and trends in your soil**
- **To determine if there are deficiencies and/or toxicities in the soil that need to be addressed**
- **Full soil tests done by laboratories**
  - **These are generally complete analyses**
- **Quick soil tests**
  - **These are specific tests to help make decisions on fertilization – the most common being the soil nitrate test**

Soil Testing

- It is important to take a good sample
- Take from multiple locations
- Be aware of differences in soil (texture, etc)
- Take a representative sample from the top foot (shovel slice, soil probe, etc)
- Be careful to not over represent soil from the top few inches as it is higher in organic matter and fertility
- Mix thoroughly



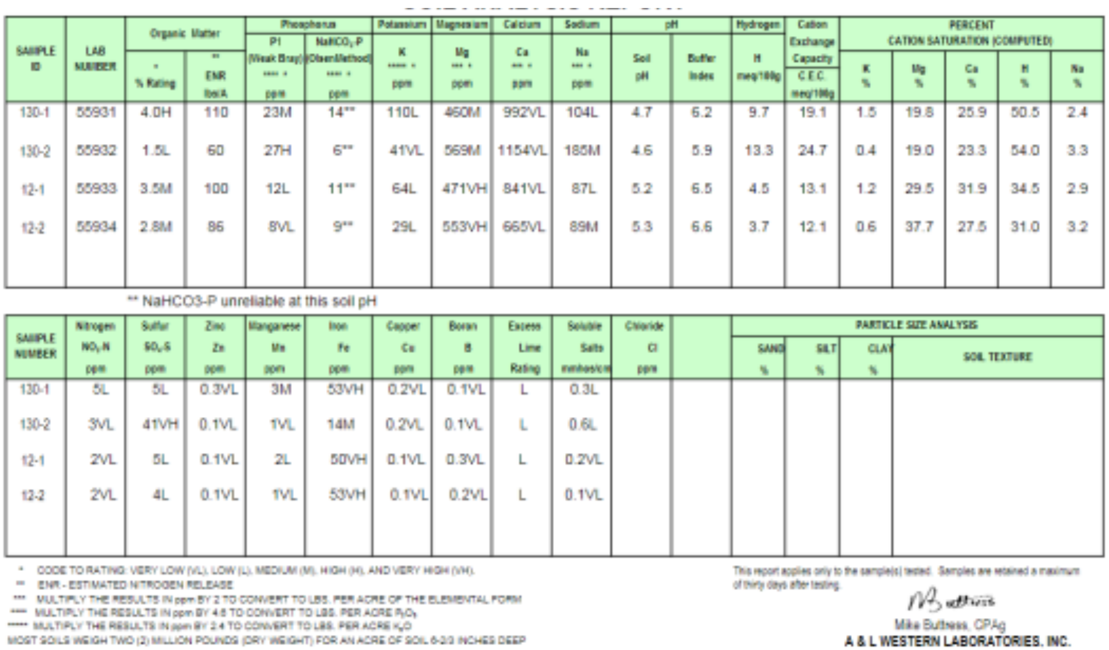
How quickly do soil test values change?

- Rapidly (within weeks) - NO_3-N
- Moderately (within a year) - pH, salinity
- Slowly (> a year) - most fertility parameters

Bottom line:

- It is a good idea to do a full fertility test every 2-3 years, unless amendments are used

Understanding Soil Test Analyses



SAMPLE ID	LAB NUMBER	Organic Matter * % Rating	Organic Matter ** ENR lbs/A	Phosphorus P1 (Weak Bray) **** * ppm	Phosphorus $NaHCO_3$-P (Olsen Method) **** * ppm	Potassium K ***** * ppm	Magnesium Mg *** * ppm	Calcium Ca *** * ppm	Sodium Na *** * ppm	pH Soil pH	pH Buffer Index	Hydrogen H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	PERCENT CATION SATURATION (COMPUTED) K %	Mg %	Ca %	H %	Na %
130-1	55931	4.0H	110	23M	14**	110L	460M	992VL	104L	4.7	6.2	9.7	19.1	1.5	19.8	25.9	50.5	2.4
130-2	55932	1.5L	60	27H	6**	41VL	569M	1154VL	185M	4.6	5.9	13.3	24.7	0.4	19.0	23.3	54.0	3.3
12-1	55933	3.5M	100	12L	11**	64L	471VH	841VL	87L	5.2	6.5	4.5	13.1	1.2	29.5	31.9	34.5	2.9
12-2	55934	2.8M	86	8VL	9**	29L	553VH	665VL	89M	5.3	6.6	3.7	12.1	0.6	37.7	27.5	31.0	3.2

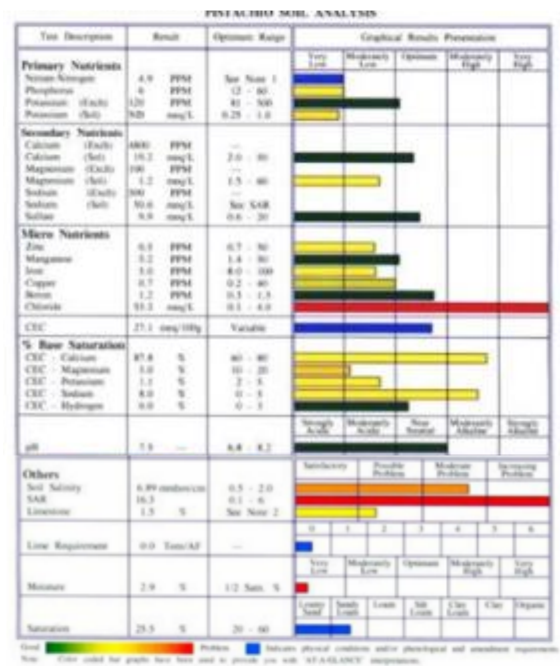
** NaHCO3-P unreliable at this soil pH

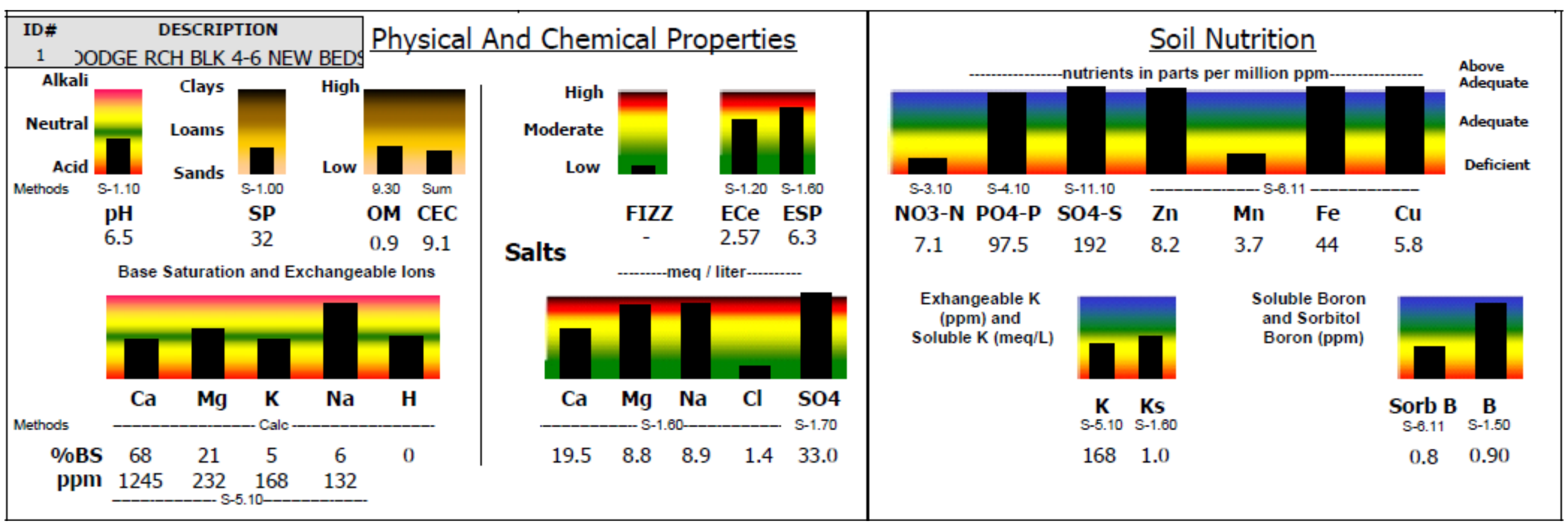
SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
130-1	5L	5L	0.3VL	3M	53VH	0.2VL	0.1VL	L	0.3L						
130-2	3VL	41VH	0.1VL	1VL	14M	0.2VL	0.1VL	L	0.6L						
12-1	2VL	5L	0.1VL	2L	50VH	0.1VL	0.3VL	L	0.2VL						
12-2	2VL	4L	0.1VL	1VL	53VH	0.1VL	0.2VL	L	0.1VL						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.





Characteristics of some California soils:

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM)	
							Bray	Olsen
Smith Block 7	7.1	1.2	0.06	36	2	3	3	8
Jones Block 2-N	7.7	0.7	0.04	21	1	8	31	23
Miller Block 4	6.0	0.8	0.04	24	3	22	54	32
Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

Sacramento Valley

San Joaquin Valley

Santa Maria Valley

Salinas Valley

Sample ID	Soil texture
Smith Block 7	loam
Jones Block 2-N	silty clay loam
Miller Block 4	sandy loam
Ruiz Block 1W	clay loam

Soil pH:

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM) Bray	Phosphorus (PPM) Olsen
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Miller Block 4	6.0	0.8	0.04	24	3	22	54	32
Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

Saturated paste extract

Manganese toxicity

- Many vegetable crops grow well over a range of pH's
- Processing tomatoes for instance, do well from 6.3 to 8.0
- At low pH's (<4.5) too much manganese becomes available and can be toxic

Adjusting Soil pH

- Most crops can handle a wide range in soil pH's
- Nitrogen fertilization tends to reduce soil pH
- Brassica's need soil pH >7.3 to reduce issues with club root
- If you need to increase the pH, lime is used, but other materials such as wood ashes will increase the soil pH
- Also, bicarbonate in irrigation water raises soil pH
- Elemental sulfur is used to lower soil pH

Raising soil pH with lime (calcium carbonate)

Results affected by soil texture and the liming material

Desired pH change	Pounds of $CaCO_3$ equivalent per acre				
in 6" depth	sand	sandy loam	loam	silt loam	clay loam
4.0 to 6.5	2,600	5,000	7,000	8,400	10,000
4.5 to 6.5	2,200	4,200	5,800	7,000	8,400
5.0 to 6.5	1,800	3,400	4,600	5,600	6,600
5.5 to 6.5	1,200	2,600	3,400	4,000	4,600
6.0 to 6.5	600	1,400	1,800	2,200	2,400

Soil organic matter (measured combustion or digestion):

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM)	
							Bray	Olsen
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Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

Selected Salinas Valley Soils

Soil Type	% Organic Matter	Percent Clay
Fine Sandy Loam	0.95	12
Sandy Loam	1.15	18
Loam	1.80	25
Clay loam	2.37	36
Silt loam	2.41	47

Soil organic matter ≈ 58% C; ≈ 7% N; C:N ratio ≈ 10:1 to 12:1

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM)	
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Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

Salinas Valley Soils Comparison

Soil Type	Management	Total Soil N %
Clay Loam	Organic	0.17
Clay Loam	Conventional	0.14
Loam	Organic	0.14
Loam	Conventional	0.11
Fine Sandy Loam	Organic	0.12
Fine Sandy Loam	Conventional	0.06

Soil N mineralization potential:

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM)	
							Bray	Olsen
Smith Block 7	7.1	1.2	0.06	36	2	3	3	8
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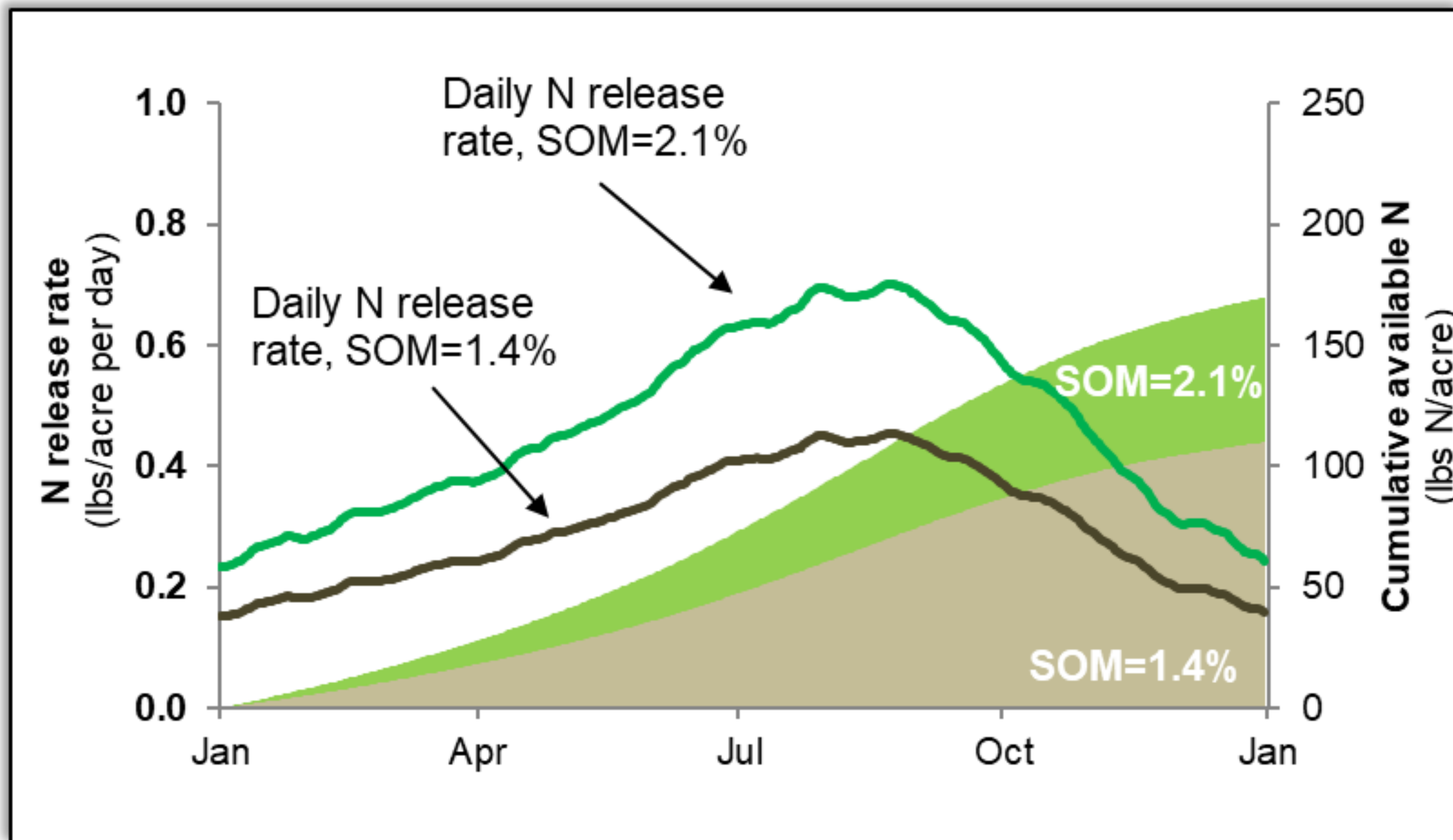
Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

Soil building practices that increase the levels of soil organic matter increase the amount of N available to crops by increasing the total amount of N available for mineralization

Some labs will provide an 'Estimated N release'

- **It is not measured, but calculated from either organic matter or soil total N**
- **Different labs may use different formulas for this calculation**

N Release (lbs N/A/day) in Salinas



From Patricia Lazicki

Soil mineral N (nitrate and ammonium):

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM) Bray	Phosphorus (PPM) Olsen
Smith Block 7	7.1	1.2	0.06	36	2	3	3	8
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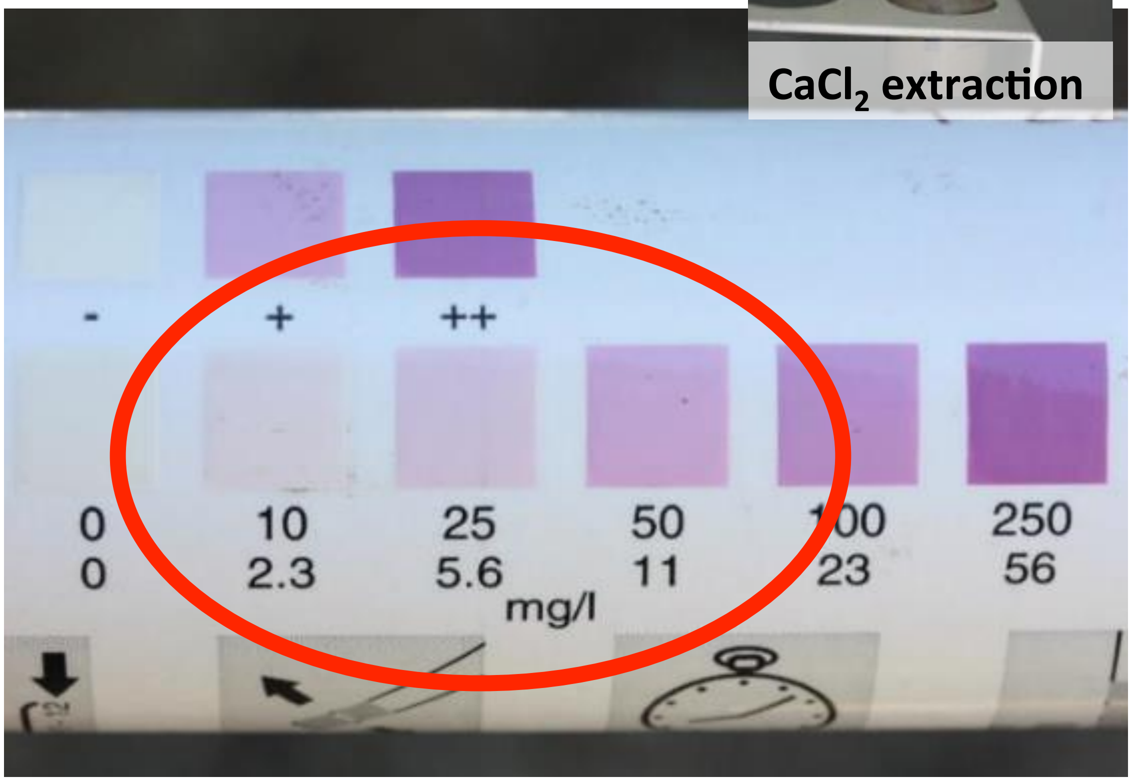
- **NO_3-N is the predominate form of N in soil**
- **NH_4-N levels are low in the summer (1-2 ppm)**
- **NO_3-N can change substantially over time, based on soil temperature, irrigation or rainfall amounts, soil texture**
- **Given that nitrate levels can change quickly it is best to test as close to when you want to fertilize**
- **The nitrate quick test is a good method to get rapidly get a nitrate value from which you can make fertilizer decisions**
- **It is widely used by conventional growers, and is less used by organic growers**

Making a Fertilizer Decision Based on Nitrogen Release from Soil Organic Matter/Prior Crop Residues

- Soil building practices can help the soil to release good amounts of nitrogen for crops
- Long-season crops can benefit from the cumulative amount of N released from the soil
- Short-season, high-nitrogen demanding leafy green vegetables are more difficult, and measuring the pool of residual soil nitrate may be a better indication of available nitrogen for crop growth

Rapid Soil Nitrate Test

$CaCl_2$ extraction



The readings on the test strips are converted (e.g. $\div 2$) to ppm nitrate-N on a dry weight basis depending on the moisture content and texture of the soil

We mostly operate in the 10 to 50 ppm range on the strips.

Spinach Nitrogen Fertility Trial
Clay Loam Soil
4-4-2 Fertilizer

Planting lbs N/A	Topdress lbs N/A	Total lbs N/A	Initial NO_3-N	Fresh wt tons/A
80	80	160	21	6.9
40	80	120	21	6.9
0	0	0	21	6.4

Spinach Nitrogen Fertility Trial
Sandy loam soil

4-4-2 Fertilizer

Planting lbs N/A	Topdress lbs N/A	Total lbs N/A	Initial NO_3-N	Fresh wt tons/A
160	0	160	27	7.7
120	0	120	27	6.8
0	120	120	27	5.7

Nitrogen Content of Various Organic Fertilizers

Fertilizer	Source
Dry	
2.5	Poultry
3 - 4	Seed meals
4	Poultry Manure + Meat and Bone Meals
12 - 13	Feather and blood meals
8	Meat and Bone
9 - 12	Guanos
Liquid	
2 - 5	Fish waste
14	Hydrolyzed soybean

Soil phosphorus:

Sample ID	pH	Organic matter (%)	Total N (%)	Estimated N release (lb/acre)	NH_4-N (PPM)	NO_3-N (PPM)	Phosphorus (PPM)	
							Bray	Olsen
Smith Block 7	7.1	1.2	0.06	36	2	3	3	8
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Miller Block 4	6.0	0.8	0.04	24	3	22	54	32
Ruiz Block 1W	6.8	1.6	0.09	48	1	16	170	114

The soil phosphorus test is good for diagnosing deficiency in the soil; it is also good for monitoring long-term trends in the soil (whether it is increasing, due to manure and compost use or decreasing and becoming a problem)

Common Soil Tests:

Olsen (bicarbonate) extraction:

- **for soil > pH 6.0**

Bray (weak acid) extraction:

- **for soils < pH 6.0**

Phosphorus Soil Test Values and Yield Response to Phosphorus Fertilization

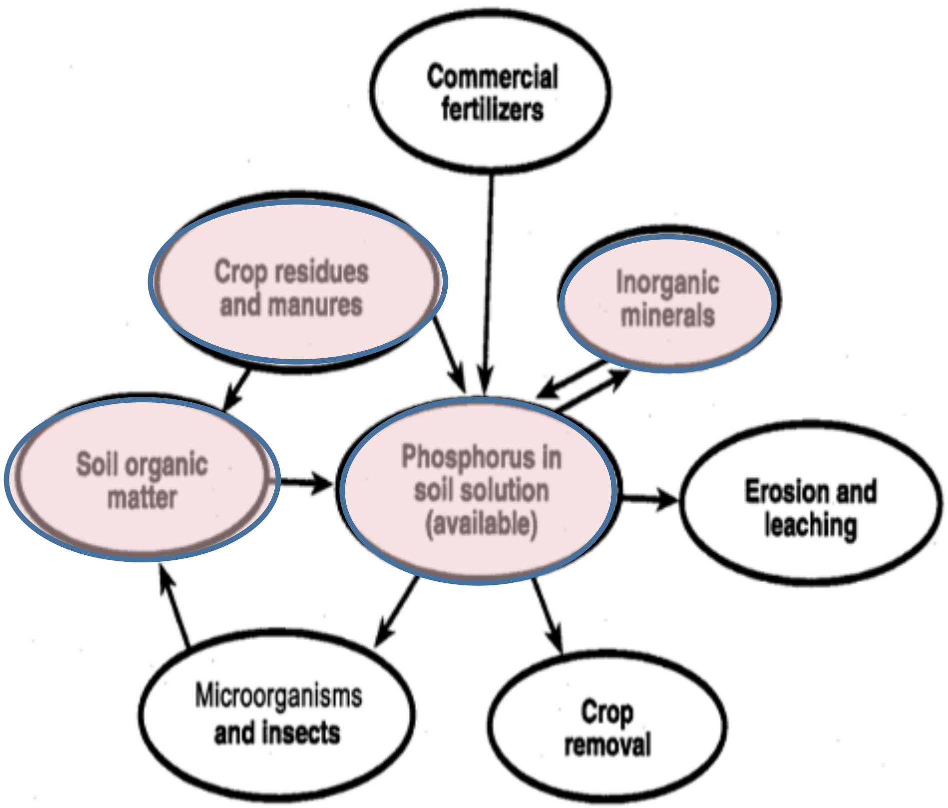
Bicarbonate-extractable soil P*

Crop	Yield improvement likely	Possible yield Improvement**	Yield improvement unlikely
Lettuce/Celery	< 40	40 - 60	> 60
Other Cool Season Vegetables	< 25	25 - 35	> 35
Warm season vegetables	< 15	15 - 25	> 25

*   For Bray extraction method multiply values by 2.5

** Particularly in cold soil temperatures

Soil Tests are an Index of the Availability of Phosphorus



- Available phosphorus is in an equilibrium with insoluble minerals and organic matter
- The Olsen and Bray tests give an indication of plant-available phosphorus
- They do not give a direct measurement of actual pounds per acre of phosphorus that is available

How available is P in animal manures and composts?

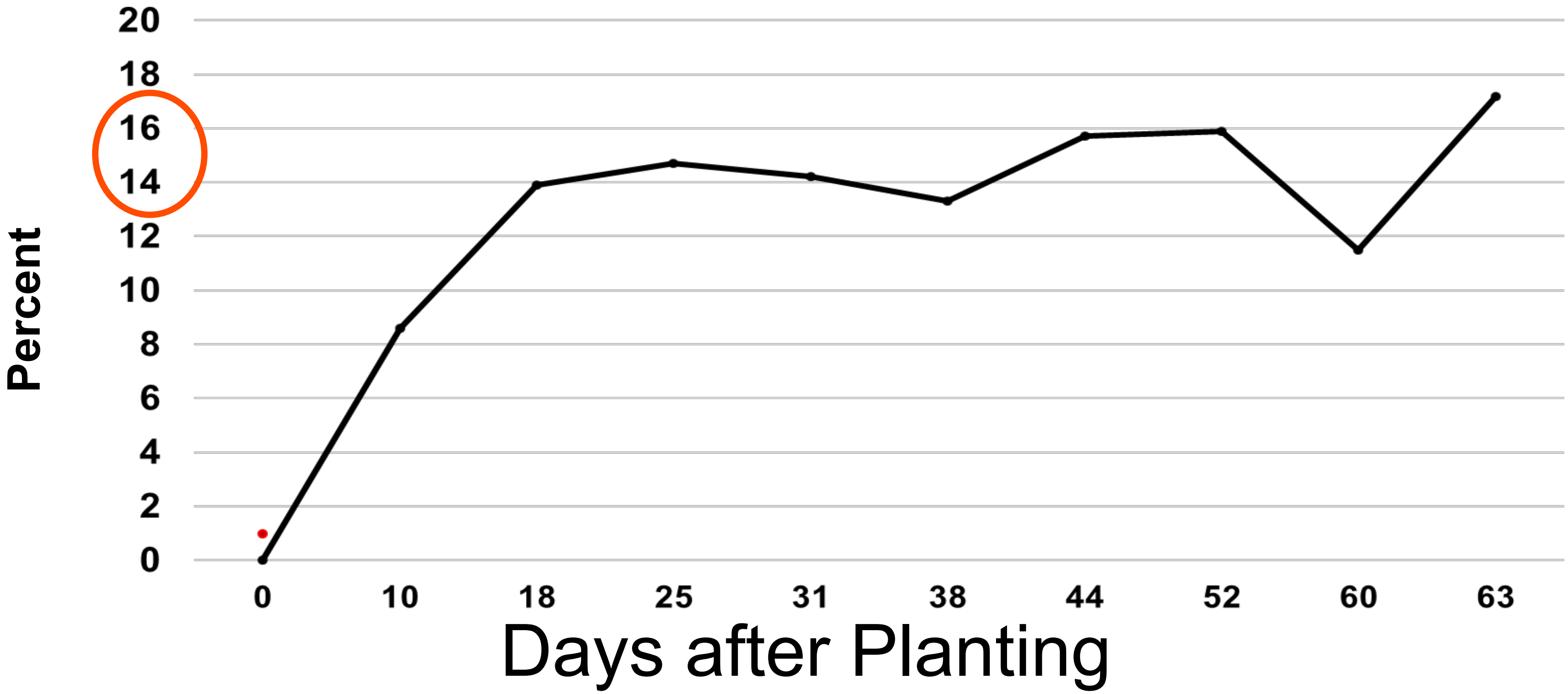
	% P in	
Material	organic form	phosphate form
Feedlot manure	25	75
Composted manure	16	84
Dairy manure	25	75
Poultry litter	10	90
Swine manure	9	91

The Phosphorus in manure (fresh or composted) is equal in availability to synthetic fertilizer

Rock phosphate and bone meal are slowly available in acid soils and are unavailable in alkaline soils

Organic Fertilizer Trials Salinas Valley

Phosphate released from 4-4-2 Fertilizer



Given soil pH's in these evaluations (7.3-8.2), the phosphorus in 4-4-2 that comes from bone meal, is not available to the crop and remains in the soil as an insoluble mineral

Exchangeable soil cations:

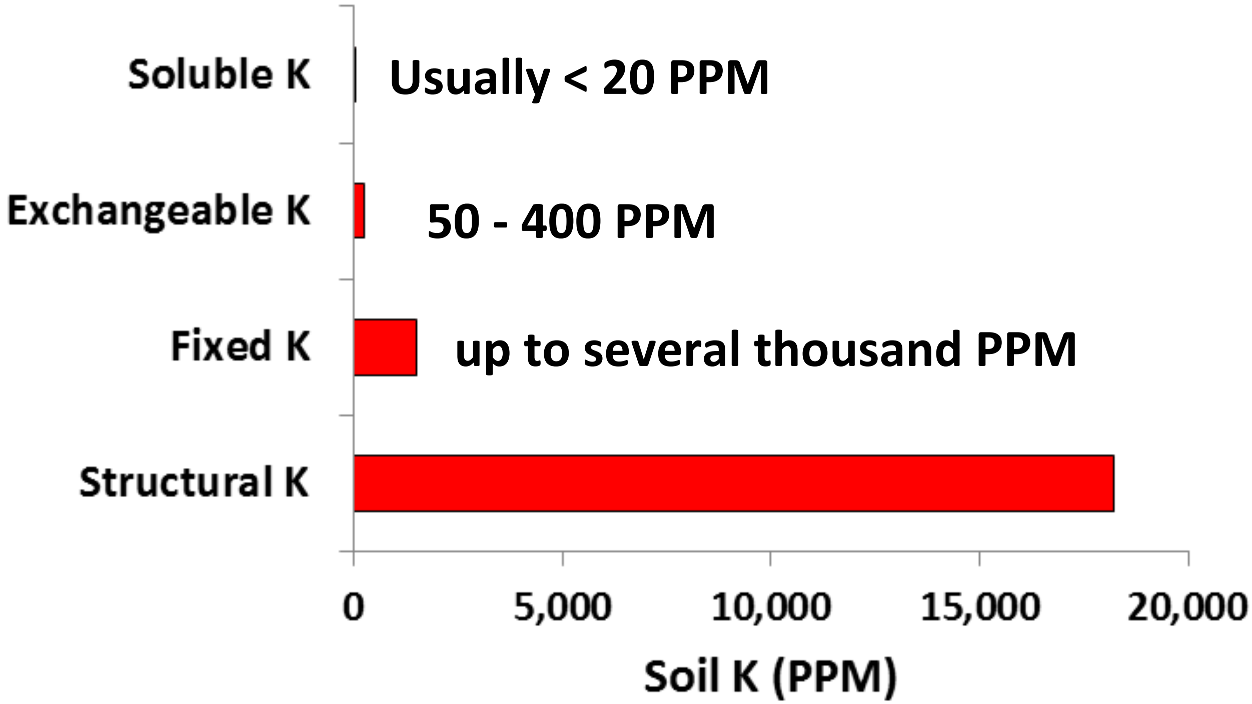
Sample ID	Exchangeable cations (PPM)				Percent cation saturation					Cation exchange capacity (meq/100g)
	K	Ca	Mg	Na	K	Ca	Mg	Na	H	
Smith Block 7	70	1147	992	272	1.2	37.3	53.8	7.7	0.0	15.4
Jones Block 2-N	331	4325	438	638	2.9	74.9	12.6	9.6	0.0	28.9
Miller Block 4	48	878	187	67	1.6	58.6	20.8	3.9	15.0	7.5
Ruiz Block 1W	416	2826	436	60	5.4	71.8	18.5	1.3	3.0	19.7

10:1 ratio of solution to soil

Ammonium acetate (NH_4Oac) extraction:

- **1.0 N NH_4^+ displaces cations from exchange sites**

Soil Potassium Dynamics



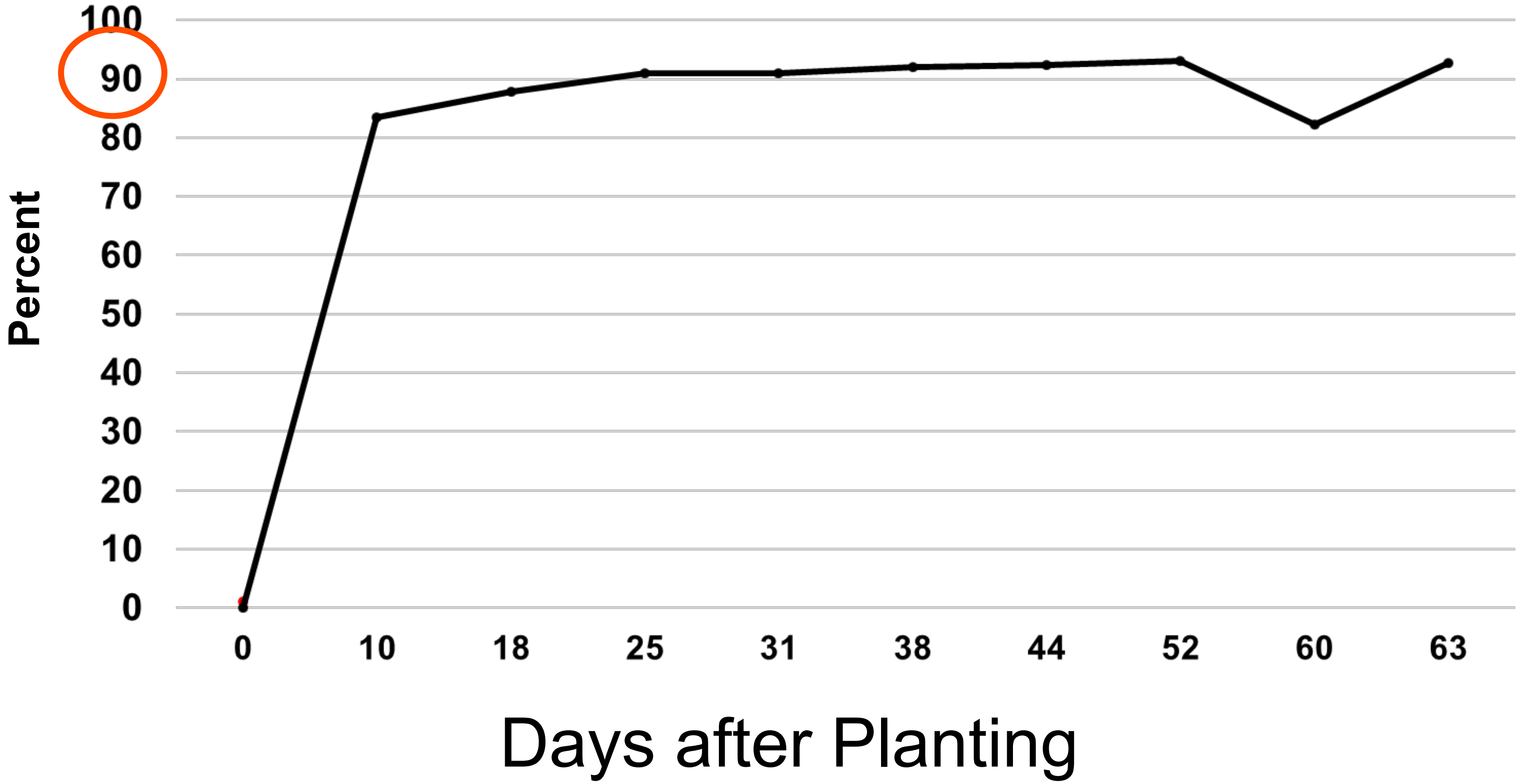
- Potassium is often taken up by many vegetables in greater quantities than nitrogen
- On many farms more potassium is taken off that is added
- Potassium values in fertilizers is reported at K_20 (83% actual potassium)

Sources of Potassium

- Mined minerals:
  - Potassium sulfate (40% actual potassium), potassium chloride (17%)
  - Greensand (1- 5%) – low solubility
- Wood ash (4%)
- Seaweed (up to 2%)
- Compost (depending on feedstock, generally no more than 2%)
- Manures
  - Chicken (2.5%)
  - Cow (15-20%)

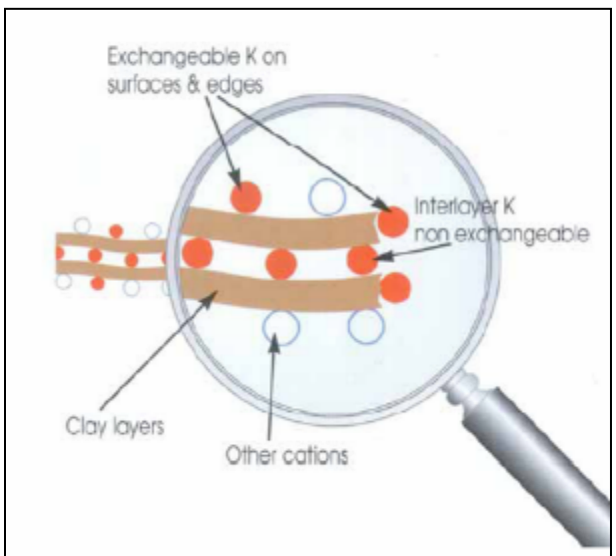
Organic Fertilizer Trials Salinas Valley

Potassium released from 4-4-2 Fertilizer



Potassium Nutrition

- **Issues with potassium result from <u>low levels</u> of potassium in the soil**
- **Also, '<u>fixation</u>' results from vermiculitic (2:1) minerals can trap K ions in interlayer site**



Potassium deficiency on peppers

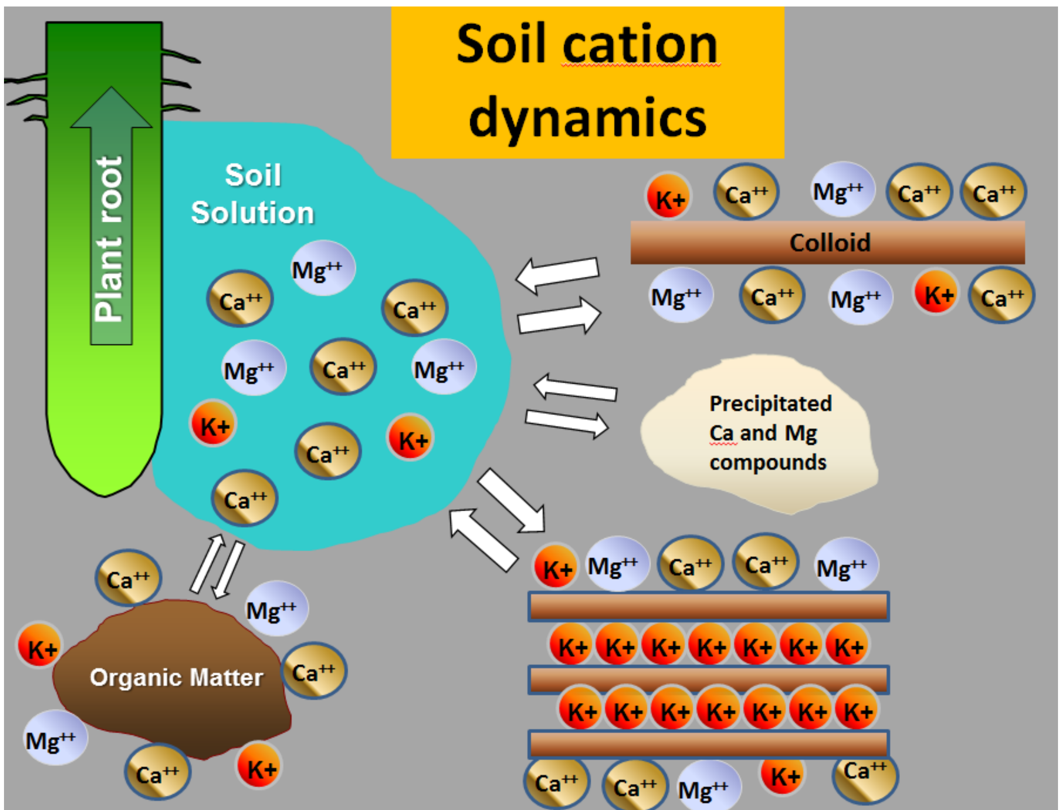
Potassium crop nutrition

- Potassium is taken up by root interception
- Factors that reduce rooting or the amount of soil that the roots explore affect potassium nutrition
- For instance, in the early 1990's when peppers were being transitioned to drip irrigation, potassium deficiency began to show up in the Gilroy area
- Also, nematode issues can result in potassium deficiency symptoms on the plant

	Exchangeable K (ppm)		
Crop	crop response likely	response possible	response unlikely
celery	< 150	150-200	> 200
other cool-season vegetables	<100	100-150	> 150
potato, tomato, pepper	<150	150-200	> 200
cucurbits	< 80	80-120	> 120

Exchangeable soil cations:

Sample ID	Exchangeable cations (PPM)				Percent cation saturation					Cation exchange capacity (meq/100g)
	K	Ca	Mg	Na	K	Ca	Mg	Na	H	
Smith Block 7	70	1147	992	272	1.2	37.3	53.8	7.7	0.0	15.4
Jones Block 2-N	331	4325	438	638	2.9	74.9	12.6	9.6	0.0	28.9
Miller Block 4	48	878	187	67	1.6	58.6	20.8	3.9	15.0	7.5
Ruiz Block 1W	416	2826	436	60	5.4	71.8	18.5	1.3	3.0	19.7



- **The cations are released to the soil solution from the negative charges on clay, organic matter and soil colloids**
- **They are in an equilibrium with these sources**

What about soil cation ratios ?

Many proponents of 'ideal' soil cation ratios:

- **≈ 10% H**
- **60-75% Ca**
- **10-20% Mg**
- **2-5% K**
- **1-5% Na**

In reality:

- **high plant productivity is possible with a wide range of cation ratios (look at parts of the Sacramento Valley – around Davis)**
- **significantly modifying cation ratios in soil is usually prohibitively expensive**

Exchangeable soil cations:

Sample ID	Exchangeable cations (PPM)				Percent cation saturation					Cation exchange capacity (meq/100g)
	K	Ca	Mg	Na	K	Ca	Mg	Na	H	
Smith Block 7	70	1147	992	272	1.2	37.3	53.8	7.7	0.0	15.4
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Ruiz Block 1W	416	2826	436	60	5.4	71.8	18.5	1.3	3.0	19.7

- In California soils, calcium normally dominates the percent of cations
- Calcium deficiency is rare and may only be seen very sandy soils or highly acidic soils

- The Smith, block 7 is from the Sacramento Valley and the magnesium is higher in relation to calcium (soil formed from serpentine rocks)
- This has not affected the yield of crops but has affected quality:
  Tomatoes have more color defects and cantaloupes tend to be softer

Yellow Shoulder

Soil Ca and Mg supply nearly always *much* greater than crop requirement

Sample ID	Exchangeable cations (PPM)			
	K	Ca	Mg	Na
Smith Block 7	70	1147	992	272
Jones Block 2-N	331	4325	438	638
Miller Block 4	48	878	187	67
Ruiz Block 1W	416	2826	436	60

PPM x 4 ≈ lb/acre in top foot of soil

Even assuming only half of exchangeable cations are plant-available, soil Ca and Mg supply is typically high

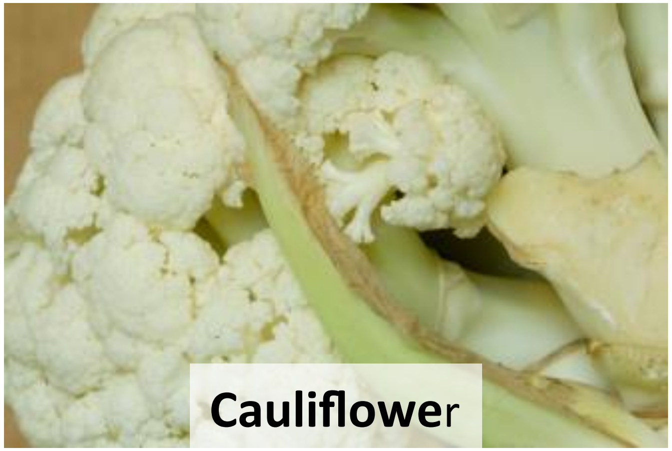
Actual crop requirements seldom exceed 150 lb Ca and 50 lb Mg per acre

There are things to consider regarding soil cation ratios:

- **Low Ca : Mg ratio can cause soil structural problems: hard setting, low water infiltration**

- **Extreme cases of Ca:Mg imbalance result in serpentine soils in wildland where only specific plants are adapted and can grow**

Physiological/Weather Induced Calcium Deficiency



Cabbage

Cation exchange capacity (CEC):

Sample ID	Exchangeable cations (PPM)				Percent cation saturation					Cation exchange capacity (meq/100g)
	K	Ca	Mg	Na	K	Ca	Mg	Na	H	
Smith Block 7	70	1147	992	272	1.2	37.3	53.8	7.7	0.0	15.4
Jones Block 2-N	331	4325	438	638	2.9	74.9	12.6	9.6	0.0	28.9
Miller Block 4	48	878	187	67	1.6	58.6	20.8	3.9	15.0	7.5
Ruiz Block 1W	416	2826	436	60	5.4	71.8	18.5	1.3	3.0	19.7

- **The CEC is a sum of the cations*. It is an indication of the soil texture and the amount of organic matter.**
- **This is an interesting indicator to see if it increases as organic matter increases in your soil building process**

Sample ID	Soil texture
Smith Block 7	loam
Jones Block 2-N	silty clay loam
Miller Block 4	sandy loam
Ruiz Block 1W	clay loam

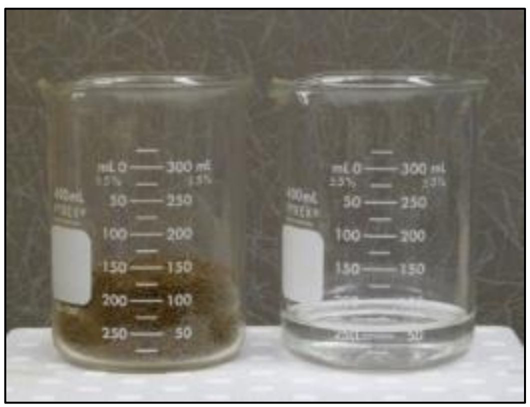
Sulfur

- Sulfur is abundant in California soils
- It comes from mineralization from organic matter, atmospheric deposition, in fertilizers, in gypsum and in irrigation water
- It is important to know how much sulfate (SO_4-S) is in the irrigation water to better understand how much sulfur is available to the crop

Soil salinity:

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
Smith Block 7	0.3	1.0	1.5	5.9	5.3	42	0.2
Jones Block 2-N	1.5	26.7	6.4	17.4	4.3	74	2.5
Miller Block 7	3.5	22.6	13.0	7.8	1.8	67	0.5
Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

'Saturated paste extract'



Filtered extract

Measurement is Electrical Conductivity (EC)

- conductivity is proportional to the concentration of ions

Constituents of salinity

Cations:

Ca^{2+}

Mg^{2+}

Na^{+} (toxic ion)

K^{+}

Anions:

Cl^{-} (toxic ion)

SO_4^{2-}

CO_3^{2-}

HCO_3^{-}

NO_3^{-}

pH

Alkalinity:

$CO_3^{--} + HCO_3^{-}$

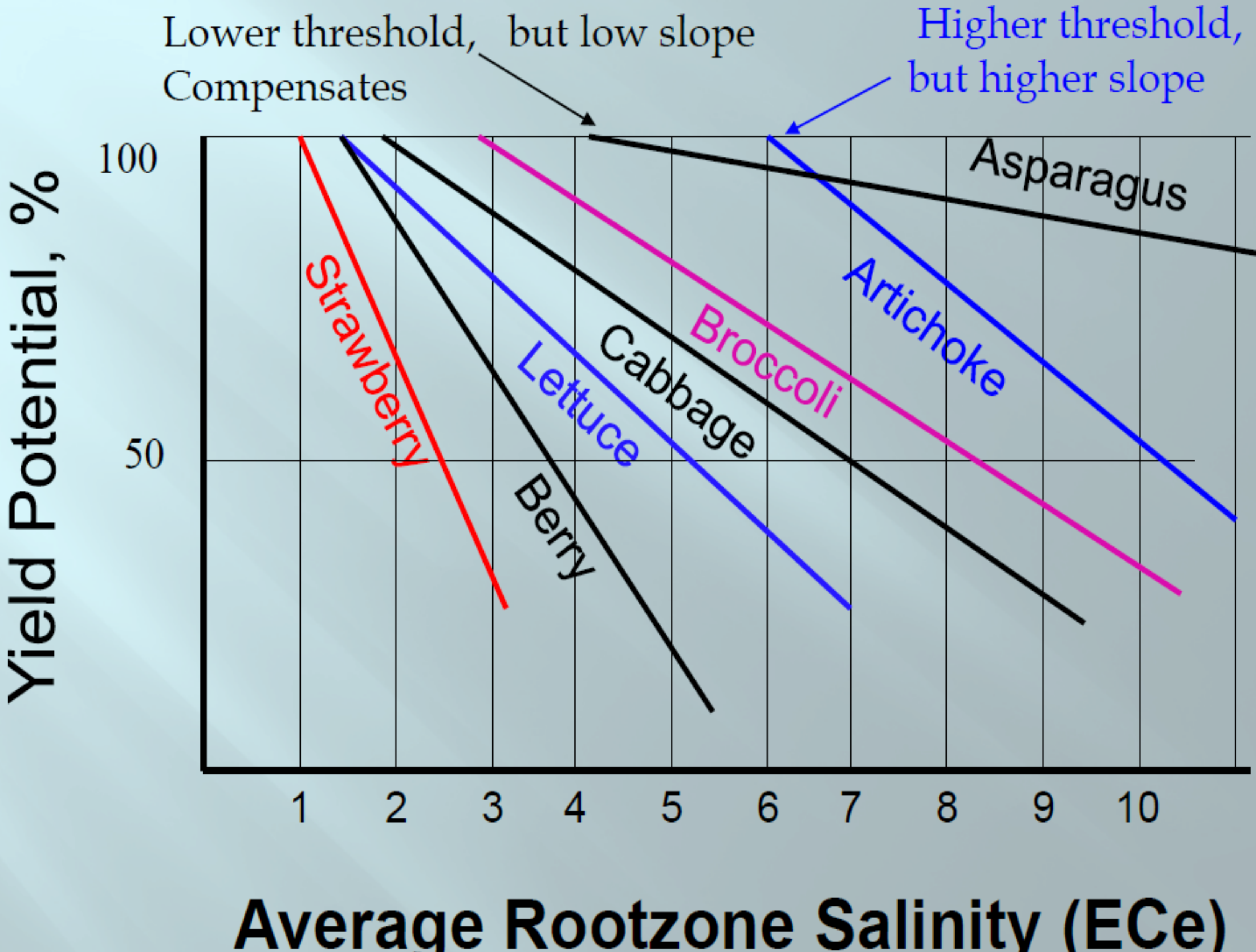
Specific Ion Toxicity:

Na, Cl, Boron

Osmotic Effect of Salts

Stunting is the first symptom of salinity

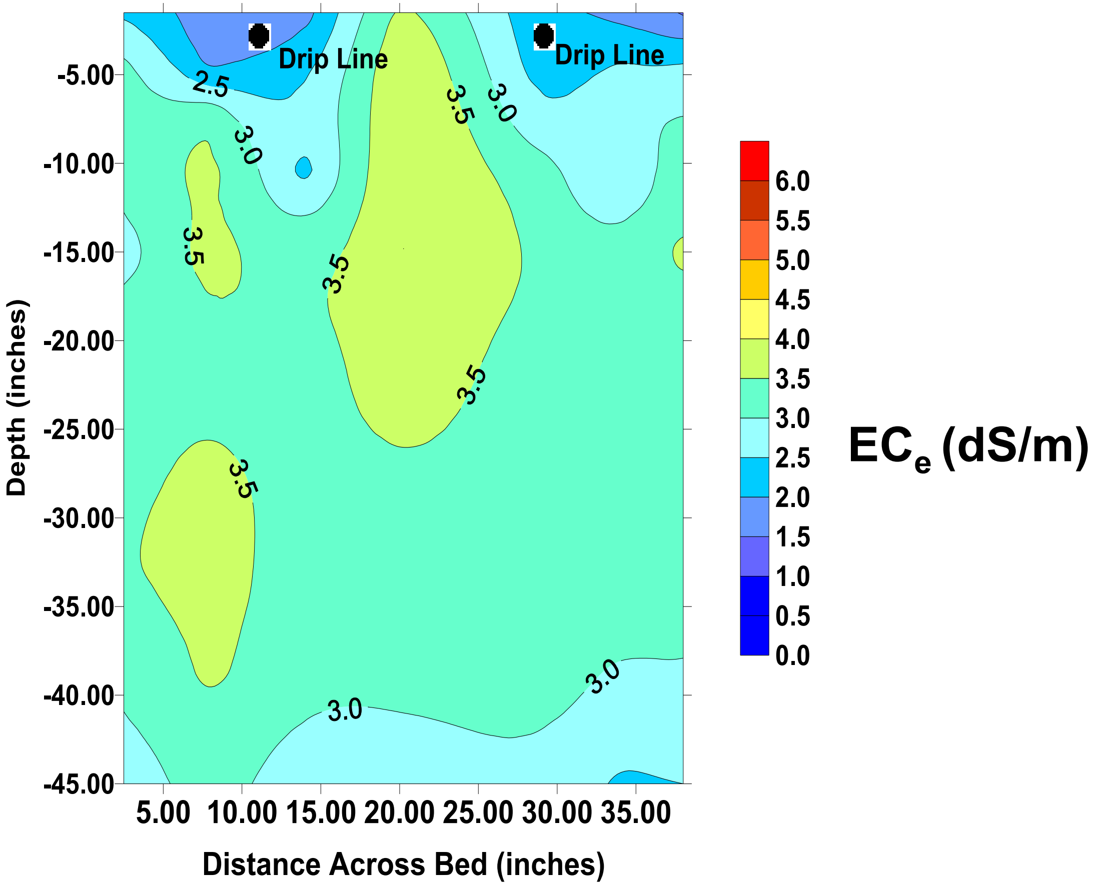
Specific Ion Toxicity



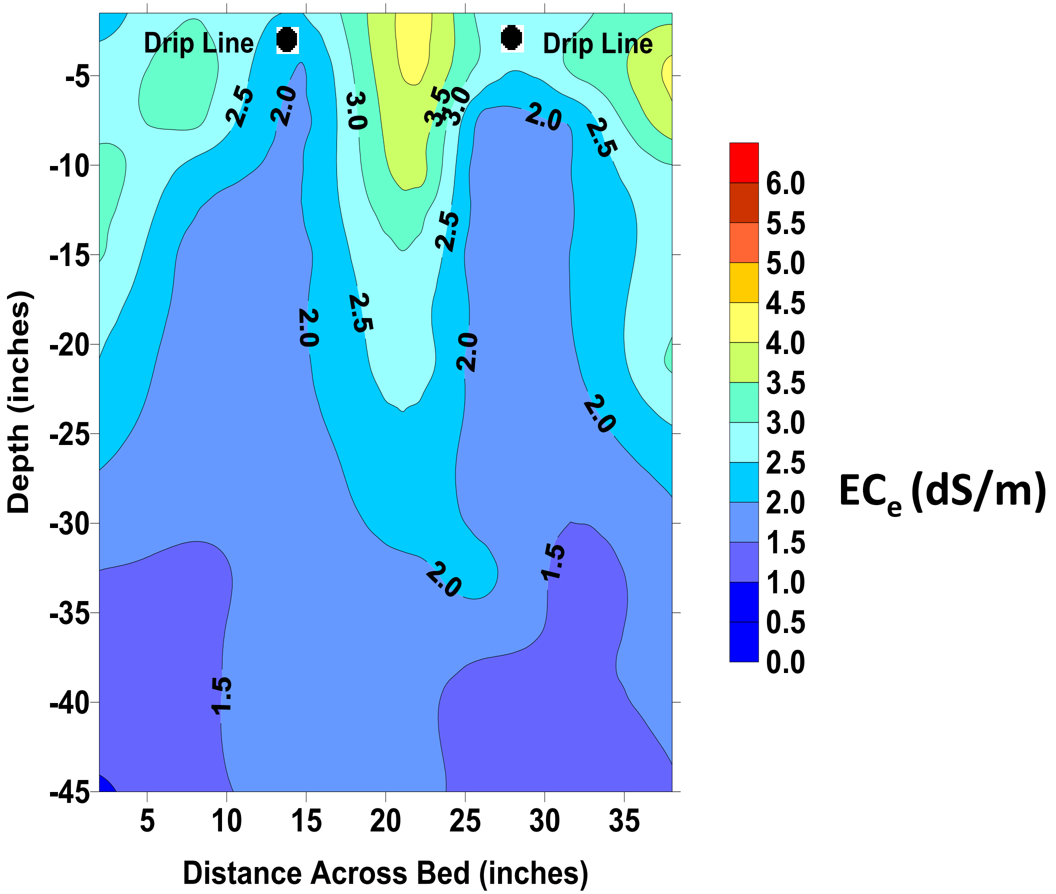
Maas and Grattan, 1999

from Steve Grattan, UC Davis

Low Leaching Fraction under Drip in Strawberry



High Leaching Fraction under Drip in Strawberry



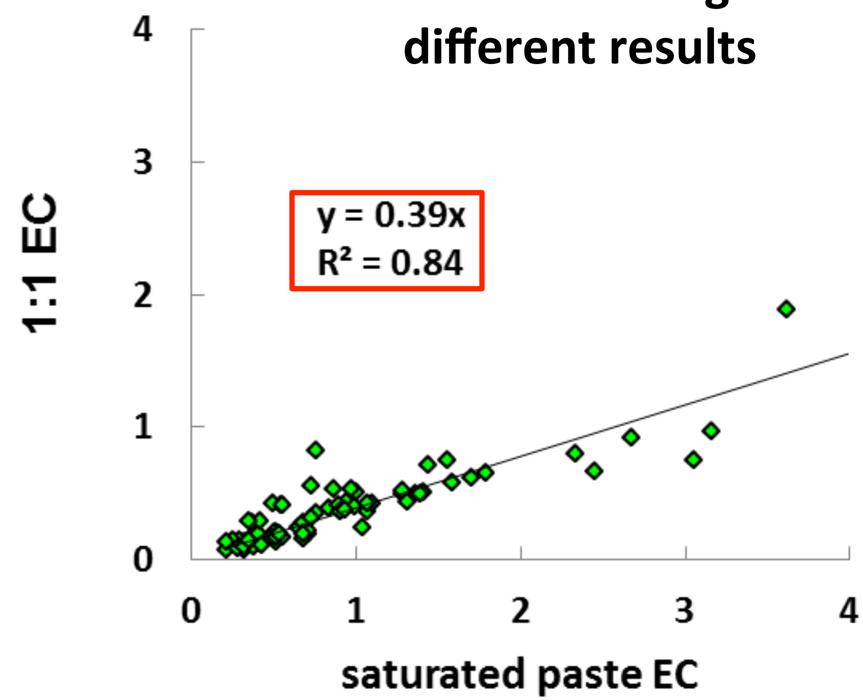
Soil salinity:

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
Smith Block 7	0.3	1.0	1.5	5.9	5.3	42	0.2
Jones Block 2-N	1.5	26.7	6.4	17.4	4.3	74	2.5
Miller Block 7	3.5	22.6	13.0	7.8	1.8	67	0.5
Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

'Saturated paste extract'

Filtered extract

The 1:1 method gives different results



Source: ALP testing program

Soluble cations:

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
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Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

Values differ in both magnitude and ratio from exchangeable cations because

- **extracts are different (deionized water vs. 1 M NH_4Oac)**
- **proportions are different**
- **units are different**

Sodium adsorption ratio (SAR):

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
Smith Block 7	0.3	1.0	1.5	5.9	5.3	42	0.2
Jones Block 2-N	1.5	26.7	6.4	17.4	4.3	74	2.5
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Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

$$SAR = \frac{\text{meq Na}}{\sqrt{(\text{meq Ca} + \text{meq Mg}) / 2}}$$

The sodium absorption ratio measures if the adverse effect of sodium on water infiltration and aeration in the soil are mitigated by the presence of calcium and magnesium in the soil. When the SAR ratio increases to 12 – 15, serious physical properties arise in the soil and plants have trouble absorbing water.

Saturated paste chloride:

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
Smith Block 7	0.3	1.0	1.5	5.9	5.3	42	0.2
Jones Block 2-N	1.5	26.7	6.4	17.4	4.3	74	2.5
Miller Block 7	3.5	22.6	13.0	7.8	1.8	67	0.5
Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

PPM Cl may be reported as meq/liter:
35.5 PPM = 1.0 meq/liter

ppm	meq/liter	Comment
< 70	< 2.0	Generally safe for all plants
70 - 140	2.0 – 3.9	Sensitive plants show injury (beans, onion, lettuce, carrot)
141 - 350	3.9 – 9.8	Moderately tolerant plants show injury (potato, alfalfa, squash)
> 350	> 9.8	Severe problems (sugar beets, barley)

Saturated paste boron:

Sample ID	Soluble salts (dS/m)	Soluble cations (meq/liter)			Sodium adsorption ratio (SAR)	Chloride (PPM)	Boron (PPM)
		Ca	Mg	Na			
Smith Block 7	0.3	1.0	1.5	5.9	5.3	42	0.2
Jones Block 2-N	1.5	26.7	6.4	17.4	4.3	74	2.5
Miller Block 7	3.5	22.6	13.0	7.8	1.8	67	0.5
Ruiz Block 1W	1.4	7.8	3.4	3.6	1.5	28	0.3

- **Boron deficiency in California is unusual**
- **Boron toxicity occurs in certain areas (e.g. some parts of San Benito County)**
- **Boron content of the water needs to be evaluated to see if it is contributing to the issue**
- **saturated paste B is most suited for toxicity evaluation**

DTPA extractable micronutrients:

Sample ID	DTPA micronutrients (PPM)				Soil texture (% by weight)		
	Zinc (Zn)	Iron (Fe)	Manganese (Mn)	Copper (Cu)	sand	silt	clay
Smith Block 7	0.1	9.2	5.4	0.2	48	37	15
Jones Block 2-N	1.8	1.4	1.4	0.6	20	51	29
Miller Block 4	1.8	15.0	5.7	0.6	65	26	9
Ruiz Block 1W	2.0	15.4	13.4	0.9	31	35	34

- **DTPA (diethylenetriaminepentaacetic acid) is a chelating agent**
- **These elements exist in many chemical compounds in soil, of varying solubility**
- **The extractant solution and method are structured to extract micronutrients likely to be plant-available**

Interpreting soil micronutrient levels

Critical ranges for soil DTPA copper, iron, manganese and zinc:

	PPM	Deficiency likely to occur
Copper	0.8-1.2	Organic soils, sands
Iron	5-15	High soil pH, very high Zn and Mn; carbonate in irrigation water
Manganese	2-10	High soil pH
Zinc	0.7-1.5	High soil pH, sandy/low OM (cut areas), very high available P in soil

Why do commercial testing labs sometimes give different results for the same soil sample?

- labs may use different analytical techniques
- labs may report results in different units

Electronic resource:

Converting units on soil analysis reports:

To convert column 1 into column 2, divide column 1 by	Column 1	Column 2	To convert column 2 into column 1, multiply column 2 by
	PPM to/from meq/100g :		
390	PPM K	meq K/100g	390
200	PPM Ca	meq Ca/100g	200
120	PPM Mg	meq Mg/100g	120
230	PPM Na	meq Na/100g	230
	PPM to/from meq/liter :		
39	PPM K	meq K/liter	39
20	PPM Ca	meq Ca/liter	20
12	PPM Mg	meq Mg/liter	12
23	PPM Na	meq Na/liter	23
35.5	PPM Cl	meq Na/liter	35.5
	Concentration to/from lb/acre^x :		
2	lb/acre (6" depth)	PPM (any element)	2
4	lb/acre foot	PPM (any element)	4

Why do commercial testing labs sometimes give different results for the same soil sample?

- there is inherent variability in each test procedure

	Median absolute deviation
pH	2%
E.C.	15%
'soluble' cations	20%
Olsen or Bray P	15%
Exchangeable cations	10%
DTPA micronutrients	15%
NO_3-N	10%
Organic matter	10%

NAPT program

Why do commercial testing labs sometimes give different results for the same soil sample?

- lab accuracy may differ

ALP
Agricultural Laboratory Proficiency Program

NAPT
The North American Proficiency Testing Program

Organic Soil Fertility Short-Course
February 12, 2019

UNIVERISTY OF CALIFORNIA

Organic Soil Fertility for Vegetables and Strawberries

University of California Short Course
Tuesday, February 12, 2019 - 8 AM - 4:30 PM
Agricultural Center Conference Room, Salinas, CA

This short course will focus on the practical aspects of organic soil fertility management for fast-maturing leafy green vegetables and long-season strawberry production .

TOPICS covered include - understanding the contribution of the various sources of nitrogen for crop production including mineralization from soil organic matter, release of inorganic nitrogen from organic fertilizers and composts, and the contribution of prior crop residues, cover crops, and irrigation water.

The focus will be on nutrient management in cool season vegetables grown in multiple rotations, as well as strawberries grown in a year-long production cycle. The content will be geared toward commercial-scale production.

Thank You for Your Attention