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Salinity Overview

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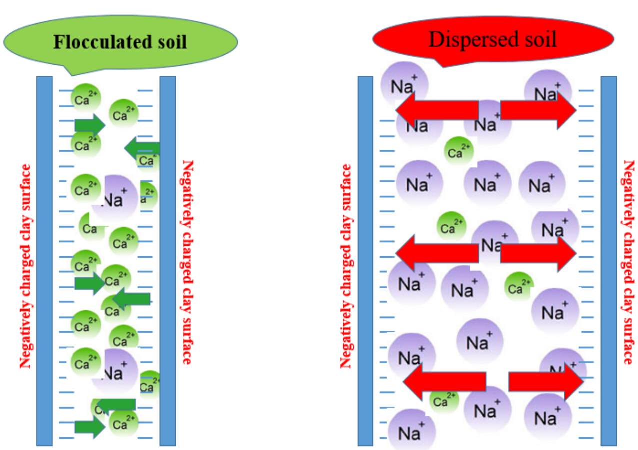
Salts are a major problem in the San Joaquin Valley. Some salts come from the parent material of soil and some can come from soil amendments such as fertilizers. Other times salts are in the irrigation water. Salts are commonly measured in two ways. Total Dissolved Solids (TDS) is the concentration of salts in water. This metric is typically used by commercial labs. The units are milligrams of salt per liter of water, or ppm. Another way to measure salt is with Electrical Conductivity (EC). This metric can be read easily and instantly in the field using an EC meter. You can measure the EC of water or you can measure the EC of the saturated soil extract. Units for EC are decisiemens per meter (dS/m).

One reason that salts in irrigation water are so problematic is they can build up over time. Water with an EC of one dS/m is good quality water for most crops, but one acre-foot of one dS/m water contains nearly one ton of salt. This is especially problematic in arid landscapes with limited drainage. When the water evaporates, the salts are left behind. If the salts are not leached, then they keep building. Over time, even low levels of salt in the water will cause problems in the soil.

> "One reason that salts in irrigation water are so problematic is they can build up over time."

It is important to know the difference between salinity and sodicity. Salinity refers to any type of salts, for example NaCl (sodium chloride, table salt), $CaSO_4$ (calcium sulfate, gypsum), $MgSO_4$ (magnesium sulfate, Epsom salt), and $NaHCO_3$ (sodium bicarbonate, baking soda). Sodicity is measured by the Sodium Adsorption Ratio (SAR), which is the amount of sodium compared to the combined amount of calcium and magnesium. Salinity and sodicity can interact to cause different effects. If sodicity is high but salinity is low, water infiltration problems can happen. However, if sodicity is high and salinity is also high, water infiltration is not as difficult. This is because sodium causes soil aggregates to disperse, reducing large pores. Calcium improves water penetration by building soil structure. This is why adding gypsum ($CaSO_4$) to soils can help. However, if you are having water penetration issues and already have calcium carbonate ($CaCO_3$) in the soil, it is better to add sulfuric acid which will free up the calcium present.

While sodic soils can cause water infiltration issues, saline soils can cause crop stress. Because water moves towards areas of higher concentration, the only way for roots in salty soils to absorb water is to take on more solutes. It takes energy for the plant to try to exclude the salt, and that can reduce growth and yield. Sodium can be toxic to the plants and it competes with other positively charged ions (potassium, calcium, magnesium) for plant uptake, resulting in nutrient deficiencies. For salinity issues, the main remedy is leaching the salts down into the soil with water. This is difficult to do during drought situations and when using drip irrigation, but there are strategies that can be used to help. Check out this ANR publication Managing Salts by Leaching for more information. https://anrcatalog.ucanr.edu/pdf/8550.pdf



Calcium builds structure, sodium breaks it down.
Figure created by Vijay (Nagendra) Chaganti, UC Riverside

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A Note to Our New Subscribers

Joy Hollingsworth, Farm Advisor, Nutrient Management/Soil Quality,
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First, I want to welcome all the new subscribers to our newsletter. Anthony Fulford and I are both UCCE Soil Quality and Nutrient Management Advisors working in the San Joaquin Valley. We send out this quarterly newsletter to share our research, announcements about upcoming events, and other useful information. Previous editions of the newsletter are up on our websites.

http://cestanislaus.ucanr.edu/news_102/On_The_Soil_Horizon/

https://ucanr.edu/sites/Soils_and_Nutrients/Newsletters_710/

Second, I want to thank everyone who recently completed my needs assessment survey. At the end of May I sent out 5,980 surveys to growers in the four counties I work in: Fresno, Madera, Kings and Tulare. As of now I have gotten 550 returned surveys. I am so grateful for all who participated. It is going to take me awhile to go through them all, but there are some clear trends appearing already. Your suggestions of what soil quality and nutrient management issues I should focus on are greatly appreciated and will help me to better serve the grower community.

To receive an electronic newsletter instead of paper please email either Joy or Anthony.

Nitrogen Accumulation in Processing Tomato Fields Following Fall-Applied Compost

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Compost amendments can be used to build soil organic matter and promote efficient cycling of plant nutrients. The emergence of financial incentive programs, along with the relatively low cost of composts, make these amendments an economically attractive way to build soil health and increase plant-available nutrients. Managing compost according to the "4Rs" (right source, right rate, right time, and right placement) becomes difficult when considering the "right time" of compost application. This is because compost amendments require decomposition following soil incorporation to release nutrients and the timing of nutrient release may or may not correspond to the time of greatest crop demand. Applying compost in the fall, following harvest, would be the most convenient application time for processing tomato growers in the Central Valley. However, the value of fall-applied compost as a supplemental nitrogen source is still poorly understood. Therefore, two processing tomato trials were established in Patterson, Calif. on a Capay clay soil to evaluate the accumulation of inorganic nitrogen following fall-applied greenwaste compost. Compost (25% moisture, 2% Total N, and 16:1 (C:N); RecologyOrganics.com) was broadcast-applied on October 30, 2019 at a rate of 5, 10, and 15 tons per acre (T/Ac) in two adjacent fields, Field One-North (F1N) and Field Two-South (F2S), following harvest of processing tomatoes **(Photos 1 and 2)**. Each compost rate and an unamended control (0 T/Ac) were evaluated on individual plots and replicated four times, resulting in 16 plots each in F1N and F2S. Soil samples collected in November 2019 were used to characterize initial soil properties of each field. Beginning in December 2019, an in-field buried bag method was used to monitor inorganic nitrogen accumulation from the amended and unamended plots. Soil was collected from each plot, bagged, and buried back in the plot from which it was removed to a depth of 6 inches. Buried bags were sampled by removing one bag per plot per month and the average inorganic (ammonium + nitrate)-nitrogen availability was measured from December 2019 to March 2020.

> "Compost amendments can be used to build soil organic matter and promote efficient cycling of plant nutrients."

Photo 1. Compost application to Field One-North and Field Two-South on October 30, 2019.

Inorganic nitrogen availability exhibited a similar trend among compost treatments one month after application in

Photo 2. Compost on soil surface prior to tillage incorporation to a 6" depth.

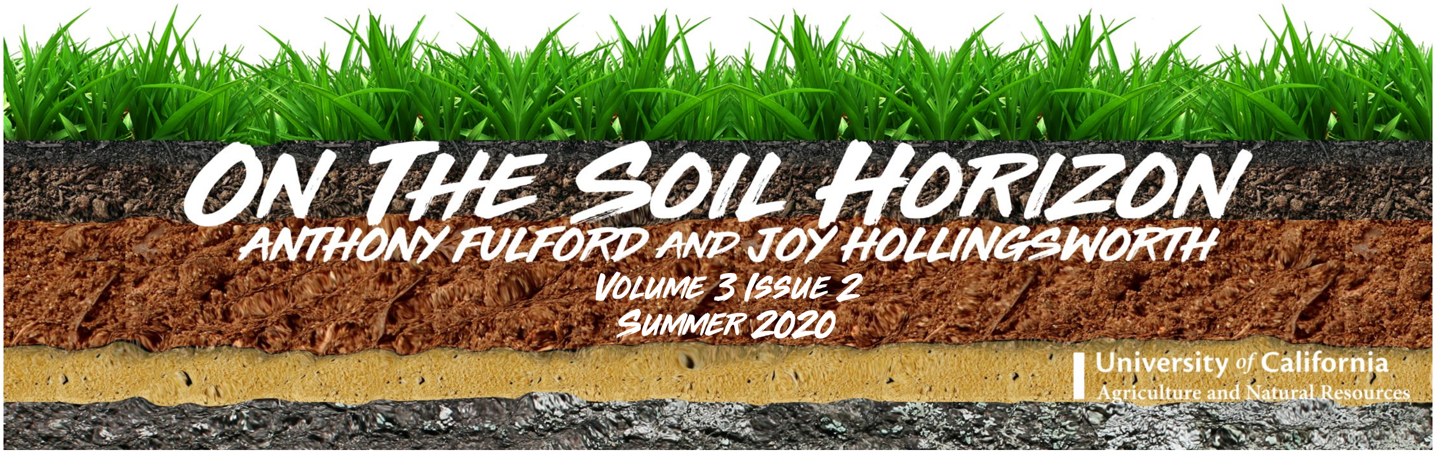
December 2019 in F1N ranging from 19 to 22 lb N/Ac, whereas, in F2S inorganic nitrogen availability of the 15T/Ac compost was noticeably lower (13 lb N/Ac) compared to 5 and 10 T/Ac compost which ranged from 27 to 29 lb N/Ac **(Table 1)**. Over the next three months (January to March), inorganic nitrogen availability remained similar between 5 and 10T/Ac compost for both F1N and F2S with differences of only 2 to 3 lb N/Ac. Whereas, the application of 15T/Ac compost resulted in the lowest inorganic nitrogen availability in January in both F1N and F2S. Despite the lower inorganic nitrogen availability of the 15T/Ac compost in January, there was a relatively large increase in the following two months (February and March). This can be seen most clearly as the percent change between February and March, with inorganic nitrogen availability from 15 T/Ac in March increasing by 74% in F1N and 80% in F2S relative to February. This contrasts with the moderate increase of inorganic nitrogen availability in March from 5T/Ac of 20% (F1N) and 13% (F2S) and from 10T/Ac of 25% (F1N) and 31% (F2S) relative to February. While total inorganic nitrogen was on average 27 lb N/Ac less from 15T/Ac compared to 5T/Ac and 10T/Ac, the large increase of inorganic nitrogen availability from February to March suggest inorganic nitrogen becomes more available from the highest compost application rate as time increased since soil incorporation in the fall.

Overall, applying greenwaste compost in the fall resulted in a cumulative inorganic nitrogen availability in the spring that was similar or less than the unamended soil. There was a trend of initially low inorganic nitrogen availability with 15T/Ac compost application followed by a large increase, a trend that demonstrates the need to appropriately match compost application timing with expected nutrient availability. These preliminary results are a component of ongoing research and planned measurements for the 2020 growing season include leaf nutrient concentration and fruit yield and quality. These additional measurements will tell a more complete story and help better define the "right time" for compost application in processing tomato fields.

This project was supported by funding made available through the California Tomato Research Institute under the project, "Influence of Compost Application Rates and Timing on Nitrogen Management and Processing Tomato Productivity and Quality" and collaboration from Drs. Wang (UCANR) and Zavalloni (CSU-Stanislaus). As results become available they will be distributed in future issues of this newsletter as well as online: http://cestanislaus.ucanr.edu/. No endorsement of named companies or products is intended nor is criticism implied of similar products or companies which are not mentioned.

Compost (Ton/Ac)	Dec19	Jan20	Feb20	Mar20	Total
Field One-North					
0	17 ± 3	29 ± 8	19 ± 6	42 ± 3	107
5	19 ± 6	20 ± 6	30 ± 3	36 ± 3	105
10	22 ± 7	23 ± 6	28 ± 7	35 ± 4	108
15	19 ± 9	7 ± 2	19 ± 7	33 ± 6	78
Field Two-South					
0	23 ± 8	45 ± 8	38 ± 5	62 ± 4	170
5	27 ± 14	24 ± 13	32 ± 7	36 ± 10	120
10	29 ± 9	27 ± 10	29 ± 7	38 ± 2	123
15	13 ± 8	14 ± 7	25 ± 9	45 ± 12	97

Table 1. Average (± standard error) and total inorganic N (lb N/A) accumulation from 5, 10, or 15 tons per acre (T/Ac) of greenwaste compost compared to unamended (0 T/Ac) soil from December 2019 (Dec19) to March 2020 (Mar20) in Field One-North (F1N) and Field Two-South (F2S) processing tomato fields.



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