



TOMATO INFO

General Notes
Potassium Fertilization
Tomato Production Meeting,
Thursday, 8 January 2015

FIELD NOTES

Vine growth and development in local tomato fields this past season were some of the best I've seen in many years. Perhaps the combination of drier soil conditions resulting in less soil compaction from springtime seedbed tillage and the pleasantly warm, mild temperatures greatly contributed to favorable growing conditions.

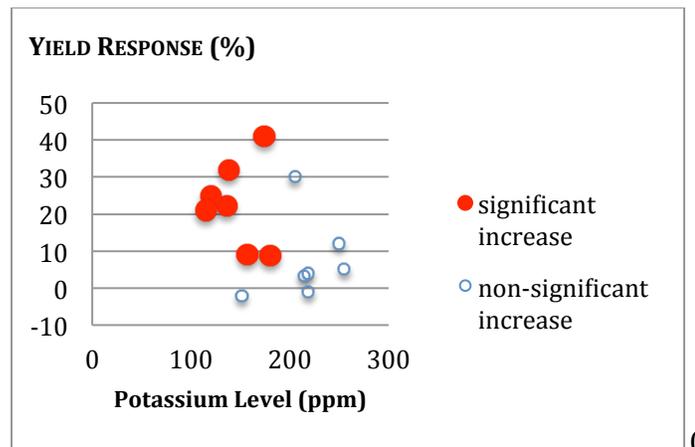
Bacterial speck levels were again low because of the warmer and drier spring weather. Fusarium wilt continues to spread. Root knot nematode populations that overcome the Mi genetics of our current resistant varieties continue to spread, although at a slow rate. Powdery mildew was severe in many fields.

Got Potassium?

Tomatoes may benefit from potassium applications. Plant Pathologist Mike Davis and I measured yield responses up to 40% when soil levels were below 200 ppm K.

Our recent tests explored improving tomato plant health, initially as a soilborne disease control project. In our first season, a supplemental application of composted poultry manure increased yield by 30%. While not demonstrably reducing disease level, we repeatedly observed yield responses to composted manure. Of the 14 tests conducted over a 4-year period, 7 of the tests had statistically significant yield responses to the supplemental compost application. The control was the 'norm' for the grower nutrient management practice in their commercial field where each test was conducted. All tests, except for one, were conducted in buried-drip irrigated fields. Compost increased yields when soil K levels were below 200 ppm (Table A). There were exceptions.

Table A. Influence of soil K level (in ppm) on processing tomato yield response to composted poultry manure, Yolo-Solano, 2011-2014.



Our treatment list was adjusted as we gathered and processed data. Our focus shifted from disease control to nutrient management. We compared the compost input to conventional NPK fertilizer. An estimated compost-equivalent rate to the seasonally available NPK level served as our 'compost mimic' treatment. We also compared a potassium-only input as potassium muriate (KCl). Seven of the 14 tests included the comparative treatments: non-supplemented control, composted poultry manure, NPK compost mimic and KCl.

Composted poultry manure provided the highest yield, while potassium alone also boosted yields, similar to the compost NPK mimic (Table B). The yield response to compost appears to be related to potassium, but there is an added contribution beyond NPK. Compost rates were commonly 10 tons per acre applied in a 12" band centered on the bed top ahead of springtime, seedbed tillage that included a PTO-driven, rotary mulcher. While deeper placement would seem more effective, we were not able to assess the benefit in our few attempts. We plan to continue to evaluate surface vs. deeper placement.

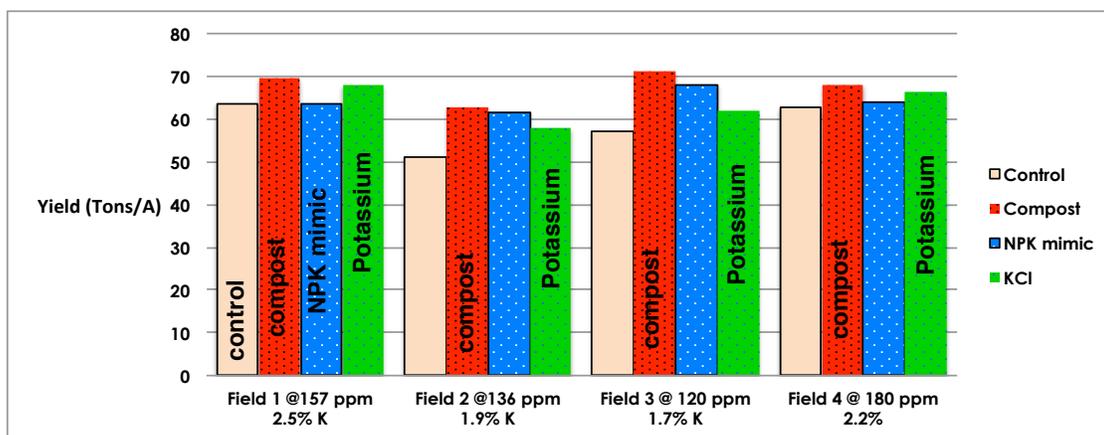
Table B. Yield response in processing tomatoes from 7 field tests, Yolo-Solano county, 2011-2014.

Treatment	Yield (tons/A)	
1 Compost	56.9	a
2 NPK mimic	54.1	b
3 Potassium KCl	53.8	b
4 Control	50.2	c
LSD 1%	2.0	
CV	5	
interaction prob	0.00	

Note: There was a significant influence by individual field sites on the treatment response, as indicated by highly significant statistical interaction.

The interpretation of treatment effects on yield was not straightforward. The graph (Table C) shows that compost (red bars) performed well, while NPK mimic (blue bars) and potassium (green bars) yields varied comparatively when tested in different fields. These select fields ranged from 120 to 180 ppm, which were all below the 200-ppm K threshold.

Table C. Yield response in processing tomatoes from 4 field tests with statistically significant response to composted manure, Yolo-Solano county, 2013-2014



Bottom Line: Composted poultry manure performed well. Potassium improved yield. For ease of application and a more modest cost, manufactured K sources may be more cost effective.

Self-Assessment of Potential Benefit of K: Collect soil samples from top foot. For drip irrigated fields, sample within 6 inches of drip line to measure nutrients from the active root zone. Our limited tests indicate that soils with less than 200 ppm K (from an ammonium acetate extraction lab procedure) are candidates for a potential yield response to K applications. Soil K levels below 150 ppm are more likely to respond. A secondary indicator to the ppm K measurement is percent K on the cation exchange capacity. Fields with K levels below 2% are better candidates for a response. The combination of less than 200 ppm K coupled with less than 2% K help refine the prediction.

As there may well be high variation within a field, the few samples may not accurately reflect the K status. Thus, fertilizing with K across a dozen rows as a test strip may be a practical pilot method of assessing whether a field is K responsive. Harvest those rows separately into empty trailers and record weights relative to harvested row distance and compare to neighboring non-K fertilized rows. Net fruit weight receipts along with trailer identification from the processor and grade station can be tracked.

We've had success with sidedressing K as a preplant application in drip irrigated fields. What rate? One of our test fields had a linear response with rates from 50 to 800 lbs. of K₂O per acre. A rate between 50 to 200 lbs/A seems reasonable given the uncertainty.

Note: If applying K through the drip line, applications should begin ~~around 8 weeks after planting and repeated weekly for 3 to 4 applications~~ **as early as 6 weeks after planting and repeated for 4 to 5 weeks**. Applications should be before 'full-bloom' to be well ahead of fruit-sizing period when K demand is high. Preseason soil sampling appears to be a timelier and better indicator compared to in-season, plant tissue sampling. In my limited experience, by full bloom, tissue sampling may be an indicator of a problem, but is too late for a corrective action.

Thanks to funding support from the California Tomato Research Institute and for fertilizer donations from Agriform. Grower cooperators were: J.H. Meek and Sons, Muller Ranch, Timothy and Viguie, Payne Farms, Don Beeman Farms, Harlan Family Ranch and Joe Yeung Farms.

Further depletion of potassium will continue unless replenished. As yields increase, the crop removal rate of potassium increases. With drip irrigation, the root exploration area is reduced and thus the depletion rate of soil K is higher. It seems logical that in the future, K applications are needed to sustain the system.

The following article contains a well-written summary of the potassium requirement for tomatoes by fellow Vegetable Crops Farm Advisor Brenna Aegerter in San Joaquin County. The information was reported in 2009.

The current local information suggests less than 200-ppm soil K may be a threshold for K applications. At full bloom growth stage, tissue samples to guide potassium management decisions are questionable; and by 1st ripe fruit stage, the samples are ineffective in guiding further K input for the current season.

Reprint: Aug 2009 *Field Notes* newsletter from UC San Joaquin County Farm Advisor Brenna Aegerter.

Potassium requirements for tomatoes

This season and last it seems I've observed more tomato fields exhibiting symptoms of potassium (K) deficiency. This may reflect the current high price of potassium fertilizers, but perhaps also the increasing trend towards continuous tomato cultivation.

Potassium is important for vegetative growth, as well as fruit yield and quality. Although K status can have some impact on soluble solids or blended color, it can have a significant influence on color uniformity, with



deficiencies sometimes resulting in 'yellow shoulder' or 'internal white-tissue'; rendering fruit unsuitable for peeling or dicing. Foliar symptoms of deficiency include necrotic spots on leaves, marginal leaf necrosis, leaf curling, and premature drying and death of the foliage.

Figure 1. Potassium deficiency symptoms in tomato (from Epstein and Bloom 2004)

POTASSIUM UPTAKE

Potassium uptake peaks at a rate of around 50 lbs K₂O per acre per week around 10 to 11 weeks after transplanting. Fertigation via drip irrigation or water-run applications in furrow-irrigated fields can be useful to supply K during periods of peak demand. Over the course of the season, processing tomatoes will take up 300 to 450 lbs of K₂O; depending on yield, 250 to 350 pounds of this is removed with the crop. Higher yields obviously result in higher removal rates. If fertilization levels are below that which is removed in the crop, then you are essentially mining K from the soil. Depending on your soil K levels, fertilizing below crop removal rates may not leave sufficient K to supply future crops.

SOIL SAMPLING

Most soil analytical labs use ammonium acetate extraction to assess soil K content. Using this method, soils with less than 150 ppm extractable K

would be considered low in potassium; a yield response would be expected from K fertilization. Between 150 and 250 ppm, a yield response is considered possible if K is less than 2% of the total cation exchange capacity. Above 250 ppm, no yield response is expected.

Be aware, however, that soil extractable K is a useful but imperfect indicator of K availability to plants. There are more accurate tests for available K, but these are not typically offered. Soil physical characteristics (structure, compaction, aeration, etc), management practices (irrigation method, timing and volume) and the health of the root system all influence root density and function and can also affect K availability to the crop. Soil Mg also has a great influence on crop K uptake. If the K/Mg ratio is too low, color disorders may be difficult to avoid even with K fertilization.

TISSUE SAMPLING

Because K levels in leaf petioles can change rapidly over a few days and be affected by weather conditions, they (ed. petioles) are not a reliable measure of crop K status and certainly should not be used after full bloom. Whole leaf sampling is a better measure of overall crop nutrient status. Nutrient levels in whole leaf samples changes more slowly than petioles, so it projects farther into the future and can provide useful information at any crop stage. Suggested tissue potassium sufficiency levels for tomatoes are shown below (Table 1).

Table 1. Potassium sufficiency level (% K)

Tissue type	early flower	full flower	1st red fruit
whole leaf	2.2	1.6	0.8
petiole	4.5	3.0	- ? -

On a final note, the plant pathologist in me can't help but mention that if the root system or vascular system is damaged by disease (e.g. by corky root, Phytophthora root rot, or Verticillium wilt), then foliar deficiencies may appear even though soil K levels may be adequate.

Brenna Aegerter
Vegetable Crops Advisor
San Joaquin County

SOUTH SACRAMENTO VALLEY PROCESSING TOMATO PRODUCTION MEETING

University of California Cooperative Extension Farm Advisors
Colusa/Sutter/Yuba and Yolo/Solano/Sacramento Counties

Woodland Community Center

2001 East Street, Woodland 95776

(From Highway 113, exit on CR 25A, head west to East Street. Right turn on East St. for ~1 mile)

8 am to noon, Thursday, January 8, 2015

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- | | |
|----------------|---|
| 7:30- | Doors will open — Coffee and refreshments will be ready |
| 8:00 am | <i>Evaluation of supplemental composted manure & potassium on plant health:</i>
Gene Miyao, UC Farm Advisor, Yolo/Solano/Sacramento counties |
| 8:20 | <i>Evaluation of resistant wheat and various grasses on root knot nematode control:</i>
Amelia Harlan, Woodland High School senior's FFA project |
| 8:30 | <i>Update on Fusarium diseases of tomato:</i>
Mike Davis, Plant Pathology Dept, UC Davis |
| 8:50 | <i>Variety Evaluations:</i> Scott Picanso & Luke Slevkoff, T, S & L. |
| 9:10 | <i>Variety Evaluations:</i> Scott Sullivan & Lance Stevens, Ag-Seeds Unlimited |
| 9:30 | <i>Local Pesticide Regulation Update:</i>
Yolo County Ag Commission's office |
| 9:50 | ————— Short Break ————— |
| 10:10 | <i>Chemical control evaluations for stinkbug and for powdery mildew:</i>
Tom Turini, UC Farm Advisor, Fresno County |
| 10:30 | <i>Salinity management in processing tomatoes:</i>
Brenna Aegerter, UC Farm Advisor, San Joaquin County |
| 10:50 | <i>Drought and water management overview in California:</i>
Daniele Zaccaria, Water Management Specialist, UC Davis |
| 11:10 | <i>Irrigation and nutrient management scheduling with CropManage:</i>
Mike Cahn, UC Farm Advisor, Monterey County |
| 11:30 | <i>Surveying the need for an electronic decision support tool:</i>
Daniel Geisseler, Nutrient Management Specialist, UC Davis |
| 11:40- 12:00 | <i>Potential for sensor-based fertigation scheduling in subsurface, drip irrigation:</i>
Mark Lundy, UC Farm Advisor, Colusa, Sutter and Yuba counties |

Hall Rental and Refreshments Courtesy of:

Dow AgroSciences (Jill LeVake)
Syngenta (Derrick Hammonds)
Bayer (Bob Austin)
Valent USA (JR Gallagher)
BASF (Dawn Brunmeier)

DuPont (Tim Gallagher)
FMC (Leanne Becker)
Gowan (James Brazzle)
Farm Credit West (Anna Fricke)
Morningstar Company (Renee Rianda)

Meeting is open to any interested party. Meeting facility is handicap accessible. 

PCA Credit Requested: 0.3 hrs laws & 1.2 hrs 'other'

UPCOMING TOMATO MEETINGS:

- √ 8 January 2015 (Thursday) South Sacramento Valley Processing Tomato Production Meeting, Woodland Community & Senior Center, 2001 East Street, Woodland, 95776
- √ 29 January 2015 (Thursday) N. San Joaquin Valley processing tomato production meeting (AM) follows with CA Tomato Growers Association meeting, DoubleTree Hotel, 1150 9th St, Modesto. Registration required for CTGA luncheon (916) 925-0225 phone ctga@sbcglobal.net
- √ 18-19 Feb 2015 (Wed-Thursday)–EXPO, CA League of Food Processors, Sacramento Convention Center, 1400 J Street, Sacramento. Registration required.
http://s4.goeshow.com/clfp/processing/2015/attendee_information.cfm

Best wishes for a Happy Holiday Season,
(and hope you are enjoying the rain)

Gene Miyao
Farm Advisor, Yolo, Solano & Sacramento counties

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