Soil Basics Products on Processing Tomatoes in California

Research Summary for

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Background

Processing tomatoes are peeled, sliced, or sauced for canning preservation. Nearly half of the world's processing tomatoes – and 90% of the nation's supply – are grown in California. Over 240,000 acres were planted to processing tomatoes in 2018[1]. With average production near 52 ton/ac, processing tomatoes contribute almost $1 billion to California's economy[1].

Nearly all processing tomato acreage is transplanted, with seedlings placed into pre-prepared beds. Irrigation is generally supplied by drip tape, which reduces disease pressure compared to overhead watering. Pesticides are used as needed in-season to control weeds, diseases, and insects. Blossom end rot, linked to low calcium levels, is a physiological problem in some cases. Potassium is another nutrient important to plant health and tomato quality. Season uptake can be as high as 450 lb/ac of KO[2].

Unlike fresh market tomatoes, which are often picked green, processing tomatoes are allowed to ripen in the field. Mechanical harvesters pick and sort the tomatoes, which are often processed within 10 hours. Most tomatoes are marketable since they will be processed, with rots the main criteria for culling. Processing tomatoes have thicker skin, firmer consistency, and meatier taste than fresh market varieties.

The objective of this trial was to evaluate several Soil Basics programs applied soil and foliar to processing tomatoes. Tissue nutrition, yield, coloration, and culls were the measured variables.

[1]National Agricultural Statistics Service. 2018. State Agricultural Overview: California. United States Department of Agriculture.

Materials and Methods

The trial was established in Kettleman City, California, in a conventional processing tomato field. The soil series is Panoche loam, a fertile soil with a parent material of alluvium from sedimentary rock. Variety Heinz 2401 was transplanted April 12 into 5' raised beds with drip irrigation. All pest management additions were made by the collaborating grower in accordance with standard practices. Throughout the season, 225 lb/ac N, 25 lb/ac P, 5 lb/ac K, and 45 lb/ac Ca were fertilized.

Treatments included: Kappa, Oasis Calcium + Brilliance, Kappa + Oasis Calcium + Brilliance, and untreated (table 1). Plots consisted of 30' of one bed, with one bed buffers. Treatments were replicated four times and arranged in a randomized complete block design.

Product and Application Details			
Product	*Rate*	*Application*	*Dates*
Kappa	5 gal/ac	Soil	5/20 (bloom), 6/7, 6/21, 7/5
Oasis Calcium	1 qt/ac	Foliar	5/20, 6/21
Brilliance	1 gal/ac	Soil	6/7, 7/5

Table 1. Rate and applications for each product included in the trial.

Soil applications were made in high water volume, poured along the drip tape. Foliar applications were made with a CO_2 powered backpack sprayer with a 5' hand-held boom. PSI, flat fan TeeJet nozzles, and walking speed by metronome were calibrated to deliver 15 gal/ac spray volume.

A composite tissue sample was taken in each treatment and sent to a commercial laboratory for nutrient analysis on August 1. On August 11, a 5' section in each plot was hand harvested. Marketable, cull (rot), and green (>75% of surface) tomatoes were weighed separately. Statistical analyses were performed in RStudio under ANOVA with Tukey-Kramer modification and an alpha of 0.10.

Results and Discussion

The trial site was a mid-season field, being transplanted April 12. Several significant rain showers fell during May (figure 1). Temperatures were moderate and began climbing June to August. Overall, the climate was adequate for tomato production.

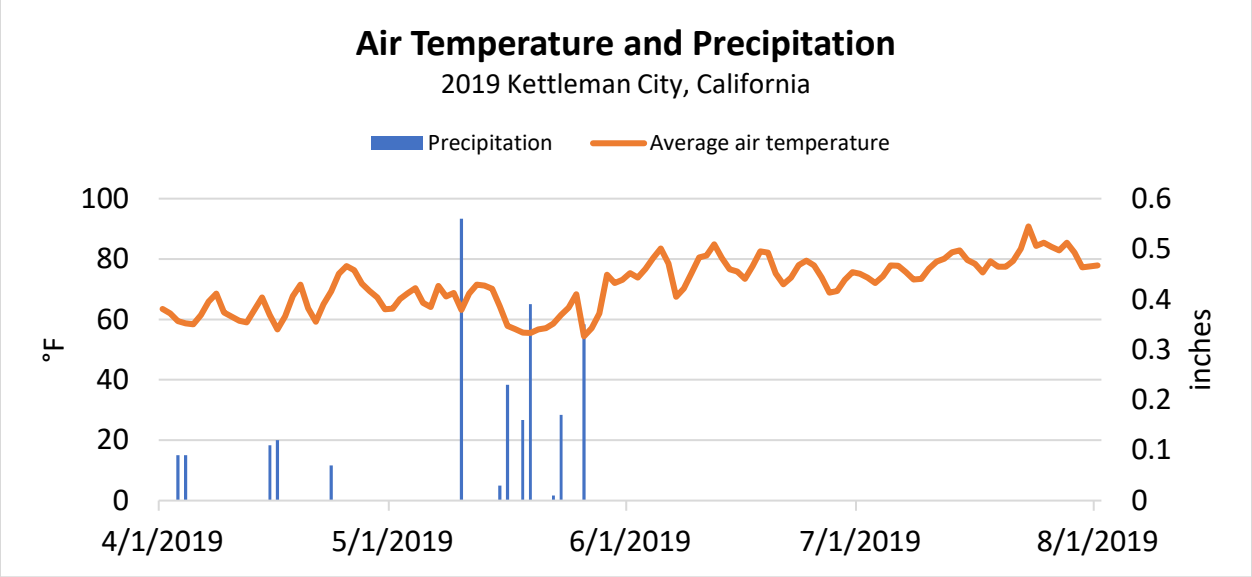

Figure 1. Average daily air temperature from March to August at the trial site is shown in orange and referenced on the left axis. Corresponding to the right axis is total daily precipitation for the same time period. Data from Cimis.

When measured late season, nutrition was similar between treatments (table 2). Calcium was improved in both Oasis Calcium/Brilliance programs, 12% over untreated. Phosphorus and potassium, however, were highest in untreated foliage. Boron levels were extremely high, but most other nutrients fell within recommended ranges.

August 1 Tissue Sample					
Nutrient	*Unit*	*Kappa*	*Oasis Calcium + Brilliance*	*Kappa + Oasis Calcium + Brilliance*	*Untreated*
Total N	%	3.34	3.17	3.19	3.32
P	%	0.23	0.26	0.29	0.3
K	%	1.14	1.63	1.76	1.76
Ca	%	3.85	4.84	4.83	4.31
Mg	%	0.7	0.87	0.79	0.77
Cl	%	2.05	2.13	1.97	2.11
Zn	ppm	23	24	25	32
Mn	ppm	83	100	98	94
Fe	ppm	289	320	307	355
Cu	ppm	19	20	19	24
B	ppm	179	194	194	209

Table 2. Tissue sample nutrient results from each treatment taken on August 1.

Yield was high, with replicate three producing the most tonnage. The greatest total biomass (over 90 ton/ac) was observed in the untreated plots, and they also had the most marketable weight (table 3, figure 2). Green tomato weight was statistically highest under Oasis Calcium + Brilliance, while the addition of Kappa may have aided in color development. Rotted weight was again highest in Oasis Calcium + Brilliance plots and lowest in untreated. Kappa was intermediate in all categories. However, the rot differences were not statistically significant.

Yield and Quality				
Treatment	*Marketable*	*Green*	*Rot*	*End Rot*
	ton/acre			
Kappa	70.9a	8.57a	1.99a	1.70a
Oasis Calcium + Brilliance	72.4a	12.7b	3.32a	2.12a
Kappa + Oasis Calcium + Brilliance	65.6a	7.74a	2.17a	2.31a
Untreated	78.7a	9.64ab	1.62a	1.56a

Table 3. For each treatment, marketable, green, and rot weights. Values followed by the same letter indicate no significant differences (α=0.10).

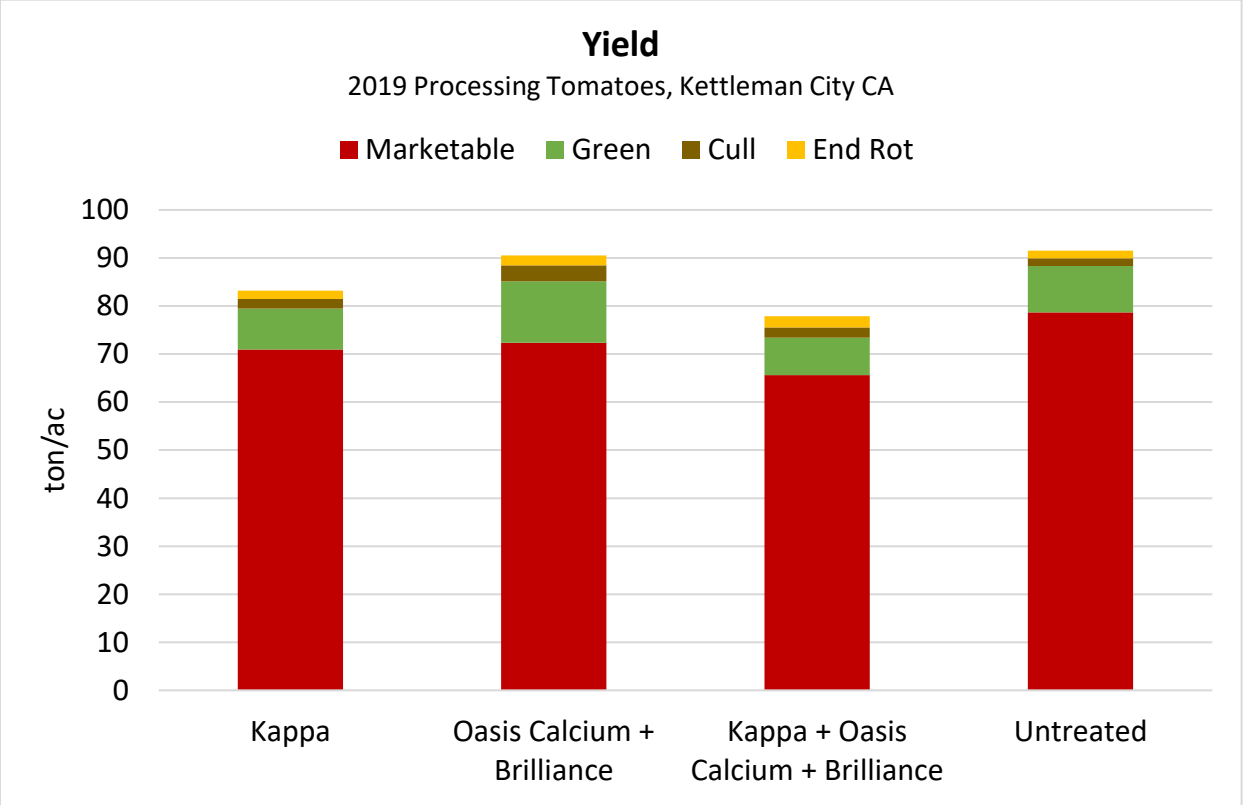

Figure 2. Tons per acre for each treatment, broken into marketable, green, and rot categories.

Similar trends remained percentage-wise (table 4, figure 3). Untreated retained the highest percentage of marketable tomatoes (statistically more than Oasis Calcium + Brilliance), followed closely by Kappa. Green tomato proportion was highest under Oasis Calcium + Brilliance but dropped nearly 5% with the addition of Kappa. Both treatments containing Oasis Calcium + Brilliance resulted in the highest rot percentages.

Yield and Quality				
Treatment	*Marketable*	*Green*	*Rot*	*End Rot*
	percent			
Kappa	85.3ab	10.3a	2.39a	2.04a
Oasis Calcium + Brilliance	80.1a	14.0b	3.59a	2.34a
Kappa + Oasis Calcium + Brilliance	84.9ab	9.40ab	2.58a	3.10a
Untreated	86.2b	10.4ab	1.69a	1.73a

Table 4. For each treatment, marketable, green, and rot percentages. Values followed by the same letter indicate no significant differences (α=0.10).

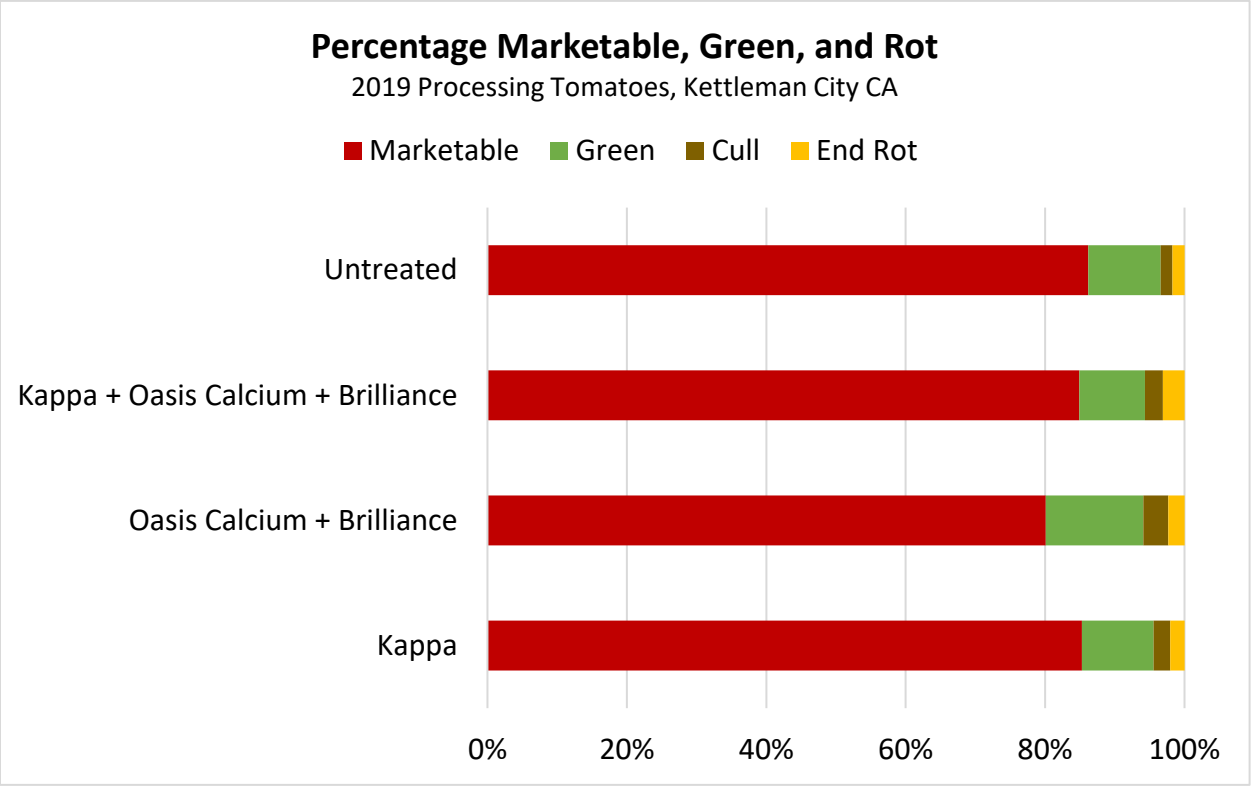

Figure 3. Percentage marketable, green, and rot for each treatment.

Based on an average price of $79 per ton for 2018 processing tomatoes, gross return was high (figure 4). Untreated areas produced the highest return, a 9% increase over Oasis Calcium + Brilliance, the second-highest treatment.

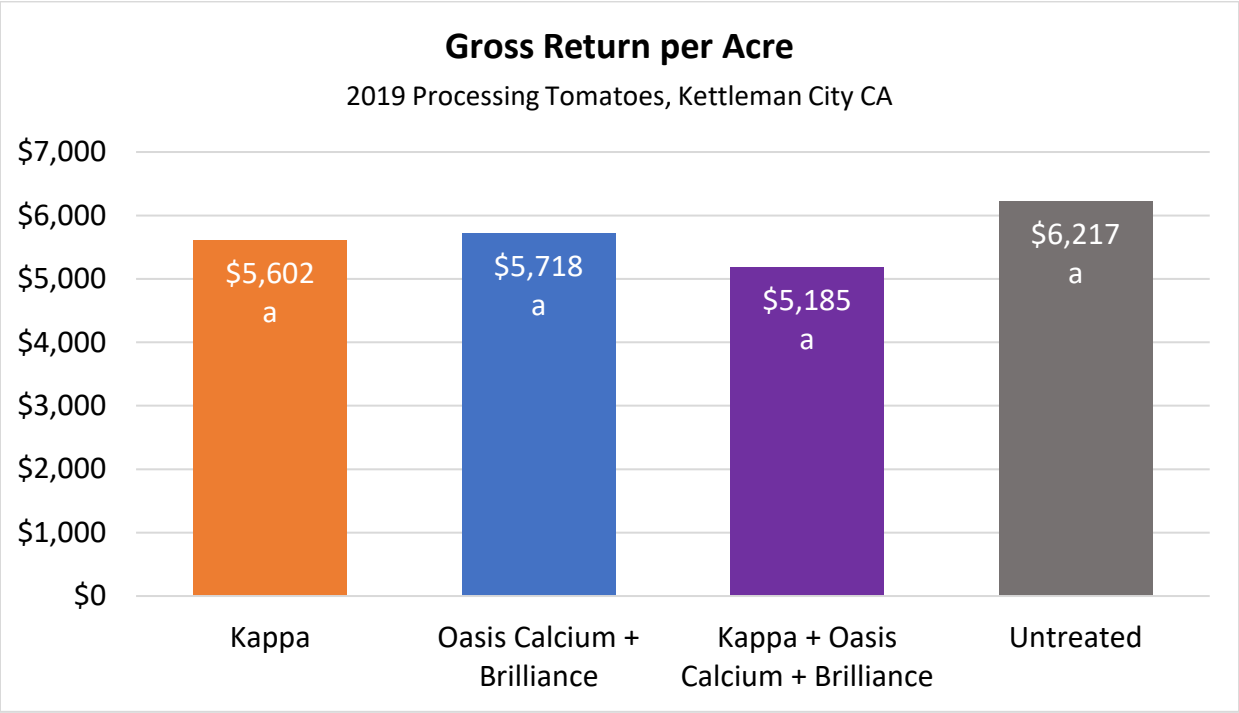

Figure 4. Average gross return per acre for each treatment. Values followed by the same letter indicate no significant difference (ANOVA, $\alpha = 0.10$).

Conclusions

While tissue calcium content was slightly improved in the Oasis Calcium + Brilliance plots, any potassium or phosphorous increase from the Kappa applications was not evident in leaves by the time of nutrient analysis.

At harvest, total and marketable tomato biomass was highest in untreated plots. Percent green and cull tomatoes was highest in Oasis Calcium + Brilliance, while end rot was most prominent in Kappa + Oasis Calcium + Brilliance. These results are unexpected. No yield differences were statistically verified, so field variability may have produced the observed differences, rather than the fertility additions causing a yield drag.

Photographs

Kappa

Oasis Calcium + Brilliance

Kappa + Oasis Calcium + Brilliance

Untreated

Raw Data

Treatment	*Replicate*	*Marketable*	*Green*	*Cull*	*End Rot*
		pounds			
Kappa	1	79.80	8.40	1.30	4.65
	2	78.70	9.65	6.00	1.00
	3	77.95	9.50	0.60	0.65
	4	89.15	11.80	1.25	1.50
Oasis Calcium + Brilliance	1	76.80	15.80	4.95	7.20
	2	89.40	18.85	4.45	0.85
	3	74.20	10.60	1.70	0.75
	4	91.90	13.25	4.15	0.95
Kappa + Oasis Calcium + Brilliance	1	72.40	6.50	0.75	4.25
	2	78.60	13.80	7.40	1.60
	3	64.05	2.90	0.85	2.50
	4	86.30	12.35	0.95	2.25
Untreated	1	88.50	9.30	0.90	2.15
	2	95.35	16.25	4.50	1.05
	3	90.10	5.90	1.35	1.70
	4	87.35	12.80	0.70	2.25