**PROGRESS REPORT TO CTRI, September 2019**

**Project Title:** Optimizing Potassium Fertilizer Uptake Efficiency while Minimizing Costs in Processing Tomato

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**Key Takeaways at this date:** Application of potassium fertilizer early in the season, whether it was fall-incorporated or applied via fertigation at 30 days after transplanting, increased tomato yields at the Russell Ranch site by 3 to 5 tons/acre in a tomato crop following winter fallow or cover crops. Application of K fertilizer in fall-incorporated and spring fertigation treatments significantly increased soil exchangeable K at tomato planting and in June during the rapid K uptake period.

**Goal and Objectives:**

*Goal:*  Identify the method and timing of K fertilization that results in the greatest uptake of K in tomato while minimizing costs; i.e., getting the most K uptake per dollar investment, when comparing fall broadcast to in-season fertigation.

*Treatments:*

1. No-K control
2. Fall shank K fertilizer (100 lb K/acre) – only at Russell Ranch
3. “Full” Fertigation at 30 DAT (100 lb K/acre at Russell Ranch, 180 lb K/acre at commercial field)
4. “Split” Fertigation at 30 and 60 DAT (50 or 90 lb K/acre per application time, depending on trial)

*Objectives:*

* Measure exchangeable K in soils at tomato transplanting and early flower
* Measure tomato tissue-K levels at full bloom
* Evaluate fertilizer and application costs
* Compare yields

**Progress and Preliminary Findings**

*Russell Ranch Location*

In mid-October 2018, potassium sulfate was shanked into the tops of the beds at a rate of 100 lb K/acre, in a conventional, winter-fallowed tomato system (“Conv”) and a winter cover cropped tomato system (“Conv+WCC”). The rate was determined following baseline soil testing, which found soils to contain 170-210 ppm exchangeable K, which is below recommended levels for tomato production. The potassium sulfate application increased soil exchangeable K levels at the time of tomato planting, compared to a no-K control (Table 1). Tomatoes were transplanted around 5/1/2019, and the Full fertigation application and the first half of the Split application was injected the week of June 3, around 30 DAT. Soil and leaf samples were collected at the end of June, around the full flower stage of the tomato crop.

**Table 1.** Soil exchangeable K levels just prior to tomato transplanting; soil sampled 4/26/2019 at Russell Ranch location.

|  |  |  |
| --- | --- | --- |
| **Treatment** | Conv | Conv+WCC |
|  | *Soil Exchangeable K (ppm)* |
| **Fall Shank** | 252 | 195 |
| **Control** | 197 | 144 |

All three K fertilizer treatments increased soil exchangeable K levels at the end of June, around 50 DAT. Soil K levels were greatest in the Fall Shank treatment, followed by the Full and Split fertigation treatments, which were similar (Figure 1). These results indicate that 50 lb K/acre in the early-season period is likely sufficient for increasing soil K levels, as the extra 50 lb K/acre in the Full fertigation treatment did not affect soil K levels relative to the Split fertigation treatment. Soil K levels were greater overall in the Conv system, implying the winter cover crops before tomato tend to reduce soil K levels over time; however, the K fertilizer treatments had similar effects in each system. While differences in K levels among treatments were detected in the soil, no differences were observed in the leaf samples (Figure 2).

 Figure 1. Soil exchangeable K levels on 6/21/2019, around the full flower stage of tomato growth, at the Russell Ranch site.

Tomato leaf samples were also collected at July 19, around the pink fruit stage, and we are waiting to get the tissue test results back from the UCD Analytical Lab. Tomato yields were collected via machine harvesting entire rows of tomatoes in the plots, within treatments. Despite differences in soil K levels in June among the Conv and Conv+WCC, tomato fruit yields were similar among the systems. All three K fertilizer treatments benefited tomato fruit yields similarly, by 3-5 tons/acre compared to the no-K control. Tomato fruit yields trended slightly higher in the Split fertigation treatment, though the difference was not significant (Figure 3).

*Commercial field near Tracy, San Joaquin County*

A trial was established in a commercial field which had been transplanted on June 14, 2019. Soil samples were taken after transplanting but before potassium applications began. At five weeks after transplanting, the first potassium application was made (180 lb K per acre in the full rate treatment, 90 lb K per acre in the split rate treatment). The second application in the split treatment was made at 10 weeks after transplanting, on August 12. At 12 weeks, whole leaf samples were taken from each plot for tissue nutrient testing.

*Work Remaining:* From the Russell Ranch site, we are still waiting on the July leaf K results from the lab and the results of the PTAB fruit quality analysis; both these sets of samples have been submitted for testing. While preliminary results suggest the fall shank treatment was more costly than the fertigation K applications, a full accounting of costs is still underway and will be conducted after tomato harvest concludes, in cooperation with the collaborating growers. At the grower site, we are awaiting soil and tissue results. Harvest will be in mid-October.

Figure 2. Leaf total K levels on 6/29/2019, around the Figure 3. Tomato fruit yields, measured via

full flower stage of tomato growth, at RR. machine harvest on 9/4/2019, at RR.

**What’s Next for the Project:** One year of data and investigation is rarely sufficient to answer agronomic management questions, as results are subject to a variety of sources of variability within one year (e.g., weather, tomato variety, etc.). We would like to repeat this experiment next year to obtain a second year of data and at least four site\*years of data to support clear management recommendations for K fertilizer application and economic outcomes.

**This project as leverage for other dollars:** We are articulating the benefits of understanding how to maintain good soil K fertility, whether through synthetic fertilizer application and/or organic amendments like compost which have high K levels, as a subject of study in other grants. We are examining soil K fertility effects on tomato yields and quality in two Healthy Soils Initiative grants from the California Dept. of Food and Agriculture; one began in 2018-19 funded at $125,000. Another HSP grant was obtained in 2019, where we received $85,000, and anticipate a total of $210,000 received in 2020, and $85,000 in 2021.