Russell Ranch Field Day 2019
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Decision support tools for deficit irrigation management to optimize processing tomato quality and yield

1. Background

- Deficit irrigation: irrigation input is lower than the full crop evapotranspiration (ET). If implemented in the second half of the growing season, it can save water while increasing the soluble solids concentration (Brix) of processing tomatoes.
- Our goal is to develop guidelines for processing tomato growers on how to implement late-season deficit irrigation that increase the fruit Brix without significant yield penalty.

2. Questions to answer

- When and what tools can be used to assist decision making on the onset of late-season deficit irrigation for processing tomatoes?
- How much irrigation water to apply to optimize Brix without sacrificing yields?

3. Our study

- Proposed tool: Normalized Difference Vegetation Index (NDVI) indicates plant vigor based on how plants reflect light at specific frequencies. NDVI is highly correlated with crop ET.
    - We propose that deficit irrigation can be imposed when NDVI reaches the plateau (Figure 1).

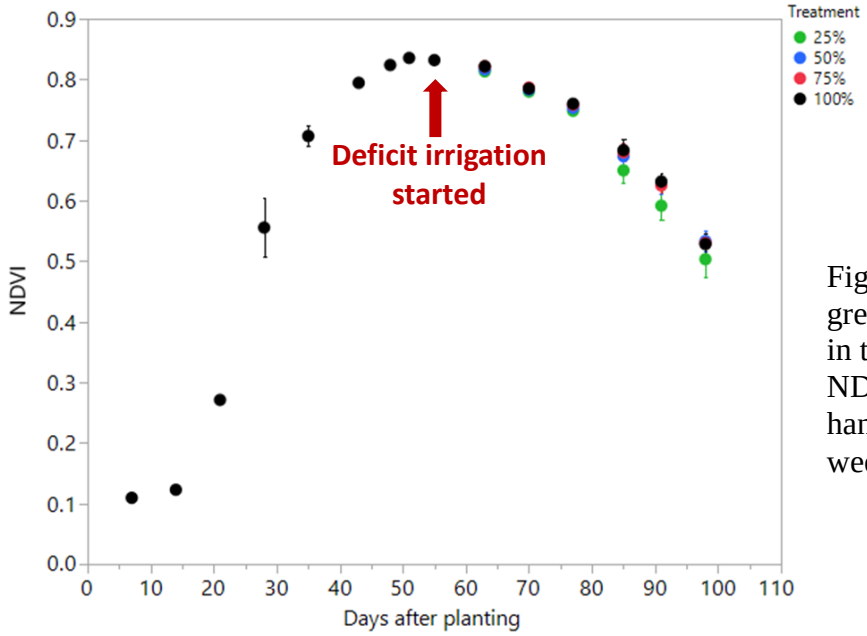

Figure 1: Changes of canopy greenness indicated by NDVI in the 2018 growing season. NDVI was measured using a handheld crop sensor on a weekly basis.

- Deficit irrigation levels: 100%, 75%, 50%, 25% ET (The weekly irrigation schedule was derived from the irrigation recommendation of Tule (Tule Technologies, USA)).
    - Deficit irrigation treatments were imposed 74 days (2017) and 56 days (2018) after the transplanting of processing tomatoes.

- Soil and plant water potential were measured to monitor deficit irrigation effects on soils and crops during the second half of the growing season.
    - Soils became dry 7-10 days after deficit irrigation. (Soil type: Yolo silt loam and Rincon silty clay loam. Method: soil water potential.)
    - Plants started to show stress 2-3 weeks after deficit irrigation was imposed in our experiment. (Method: mid-day stem water potential and canopy temperature.)

4. Results

- Tomato yield decreases but Brix increases as water is reduced in the second half of the growing season in both years (Table 1).
- Processing tomato **Brix yields are maximized by decreasing irrigation to ~80% of ETa** (Tule) or 65~70% ETo (reference ET) in the second half of the growing season (Figure 2).
- Deficit irrigation could be initiated when NDVI reaches the plateau.

Table 1: Effect of deficit irrigation on processing tomato yield and fruit quality.

Treatment	Irrigation (inches)	Yield (tons/acre)	Soluble solids concentration (°Brix)
----------2017----------			
25% ET	14.4	39.1 ab	5.50 a
50% ET	16.2	38.7 b	5.33 b
75% ET	17.6	42.7 a	5.23 b
100% ET	19.1	39.4 ab	5.27 b
----------2018----------			
25% ET	9.5	37.8 b	5.39 a
50% ET	12.3	48.0 a	4.93 ab
75% ET	14.8	51.0 a	4.79 b
100% ET	17.8	52.7 a	4.78 b

Note: Letters represent significant differences at P<0.05.

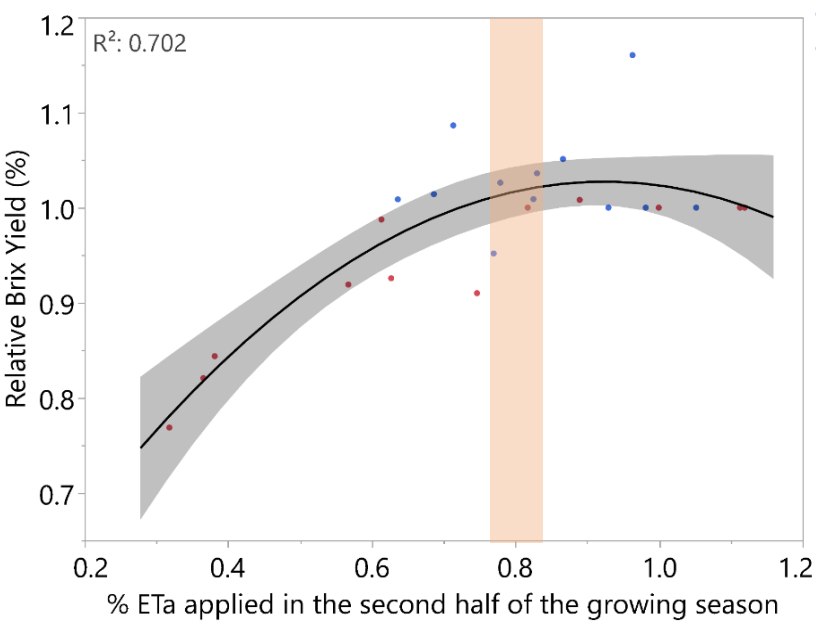

Figure 2: The relationship between relative brix yield and percentage of actual ET (ETa) applied in the second half of the 2017 and 2018 growing season. Relative brix yields was calculated as the ratio of the target treatment relative to the fully irrigated treatment, allowing for data integration from two years. Orange shade indicates the optimum range of deficit irrigation.