Deficit irrigation for processing tomatoes

Why deficit irrigate a high value crop like tomatoes?

- Save water (up to 10-15% of seasonal irrigation)
- Save energy
- Increase fruit soluble solids concentration ('brix')
- Dry soil in preparation for harvest machinery, to minimize soil compaction

What constitutes full irrigation?

- Seasonal crop evapotranspiration (ET_c, the amount of water transpired by the crop or evaporated from the soil) of drip-irrigated processing tomatoes typically runs between 24-28 inches.
- ET_c is driven by environmental factors, which can be estimated by reference evapotranspiration (ET_o, available from CIMIS weather stations), and the degree of ground cover by crop foliage (heating by sunlight interception is a primary driving force for plant transpiration).
- Fig. 1 shows the typical pattern of ET_c for a drip-irrigated processing tomato crop on which no water stress is imposed. By midseason ET_c can be slightly higher than ET_o, but later the ET_c declines as the crop senesces. The degree of decline varies among fields.

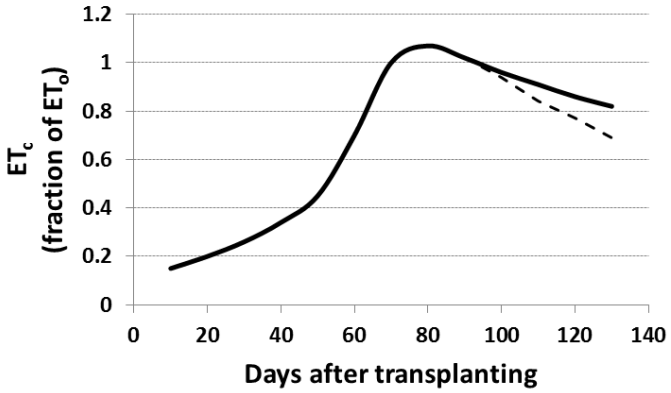

Fig. 1. Crop evapotranspiration (ET_c) in a drip-irrigated tomato field as a fraction of reference evapotranspiration (ET_o).

How can deficit irrigation be managed?

- Water stress reduces fruit set; therefore, full irrigation is typically applied until fruit set ends, which corresponds to approximately the time of early fruit ripening. Deficit irrigation should be limited to the last 4-6 weeks of the season.
- While a moderate level of water stress can affect fruit water content, it takes a higher level of stress to substantially reduce photosynthesis; this provides an irrigation management 'window' in which fruit brix can be increased without reducing brix yield (the total amount of fruit solids per acre). However, increasing fruit brix by deficit irrigation always comes at the cost of reduced fruit

yield. To make deficit irrigation worthwhile, energy and water savings, and/or a price premium for higher brix fruit, must exceed the value of lost tonnage.

- In the last 4-6 weeks before harvest water stress is induced by applying less irrigation than the potential ET_c; this can be done either by irrigation cutoff, or by irrigation cutback. The strategy matters, due to the way tomato fruit respond to water stress. Stress limits the amount of water in green fruit; red fruit are unaffected by water stress that occurs after they ripened.
- Irrigation cutoff (commonly employed 10-20 days before harvest) comes too late to have maximum influence on the overall fruit brix level because the brix of fruit that are already red at the time of water stress imposition will not be affected.
- Irrigation cutback started 30+ days before harvest can impose stress early enough to affect most fruit, and therefore have a significant impact on the composite fruit brix concentration at harvest (Fig. 2).

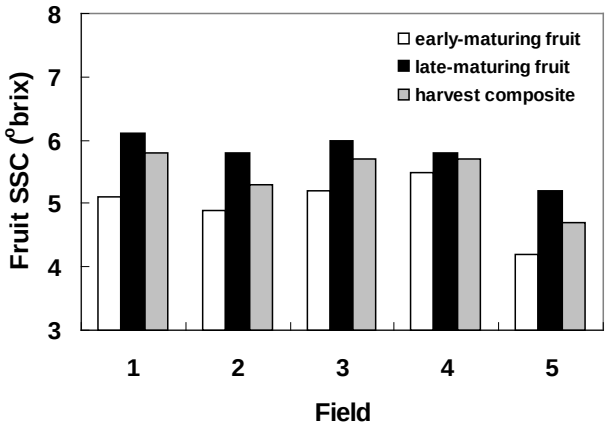

Fig. 2. Effect of drip irrigation cutback on fruit brix level.

- In general, applying only 40-60% of reference evapotranspiration (ET_o) over the last 4-6 weeks before harvest is appropriate; however, field-specific factors have significant influence (amount of ET_o, soil water holding capacity, etc.).

What is the Russell Ranch experiment?

Although general drip irrigation management guidelines (including for end-of-season deficit irrigation) have been developed, field-specific factors (weather, soil and plant vigor) introduce uncertainty. In this field Tule™ sensors will be installed to provide an estimate of ET_c, and varying late-season deficit irrigation strategies will be imposed on individual rows to provide a continuum of water stress. Economic analysis will compare changes in fruit yield and brix level with water and energy savings.

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