Winter Water Management in Almond Orchards

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PROJECT SUMMARY

Objectives:

- Conduct field studies to test the effectiveness of winter/late spring irrigation as a sustainable groundwater recharge strategy.
- Document any negative or positive effects of winter irrigation on almond yield, water status, or root development.
- Determine the threshold level of dormant tree water stress (SWP) indicating the need for pre-bloom irrigation in dry winters.

Background and Discussion:

A number of factors have led to a reduction in groundwater recharge in California, and in some parts of the state groundwater levels have exceeded historic lows. In order to sustain water security and agricultural production in California a new technology is explored where farmland (e.g. almond orchards) is flooded during the winter using surface water to recharge the underlying groundwater. Applying excess surface water, when and where available, to almond orchards during dormancy, could potentially provide a groundwater reserve to respond to critical needs such as droughts or enhanced environmental streamflow. A key assumption of this approach, however, is that almond trees can tolerate saturated or near-saturated soil conditions during dormancy. An equally important question is whether winter irrigation is necessary during dry years and whether dormant almond trees are negatively impacted by drought during dormancy.

Three field sites (Delhi, Modesto, Orland) were instrumented to document the movement of applied water beyond the root system, and to document root health and tree productivity during and after the recharge period. Water for recharge was applied at these sites in late December 2016 and early January 2017. In addition to winter rainfall, 24 and 25.8 inches of water were applied at the Modesto and Delhi sites, respectively. Due to heavy winter rainfall only 4.7 additional inches of water were applied at the Orland site. At the Modesto site soils remained saturated between 48-72 hours after each water application, while the soil water content at the much sandier Delhi site returned to pre-flooded conditions within 12 hours after each water application. At the Orland site, the soil profile quickly filled up in December due to several rain events and stayed at a minimum water content of 0.3 throughout January-March. Subsequent rain and recharge events caused a spike in the volumetric water content to field capacity followed by a slow and long recession. Deep percolation efficiency of recharge water ranged from 77% at Orland to 96% and 99% at Modesto and Delhi, respectively. Reduced conditions did not occur in the root zones at Modesto or Delhi at any time. Midday stem water potential (SWP) for the flood treatment was not different from the control at any site. Trees in the recharge plot produced more roots than in the control plot at the well-drained Delhi site. Lifespan for these roots was increased, leading to significantly greater standing root length for the trees in the recharge plot.

Potted almond trees were used to study the effects on flowering of no (-2 bar) moderate (-15 bar) and severe (-25 bar) stress during dormancy. Treatments began around December 1 and lasted for 20, 40, or 60 days. Bloom was delayed by the combination of both stress level as well as stress duration, with the highest level of stress over the longest time resulting in almost 1 month of bloom delay, although even flowers with this delay appeared normal and set fruit. Dormant trees and flower buds appear to be relatively tolerant of water stress in almond, but bud development is delayed by stress.

Lack of replication of treatments at the Delhi and Modesto sites limits data interpretation, however there is no obvious warning sign that adding additional winter irrigation at these sites harmed tree water relations, root production, or yield. At least 77 % of water applied percolated below the root zone, suggesting that applying water for winter recharge is a feasible option in dormant almond orchards. Tests with potted almonds suggest that bud development is delayed by stress, resulting in delayed bloom, and that winter irrigation may alleviate this stress.

Project Cooperators and Personnel: Roger Duncan, David Doll, Alan Fulton, Dani Lightle UCCE-Stanislaus, Merced, Tehama, Glenn Counties respectively

For More Details, Visit

- Poster location 35 Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/ResearchDatabase
- 2016 - 2017 Annual Reports (16-PREC9-Volder-Shackel-Dalhke) on the web at Almonds.com/ResearchDatabase
- Related Projects: 17-WATER10-Nico; 17-WATER7-Horwarth/Dahlke; Poster 38 - Mountjoy