Better tree performance and water use efficiency through root system resilience

Project update 2019

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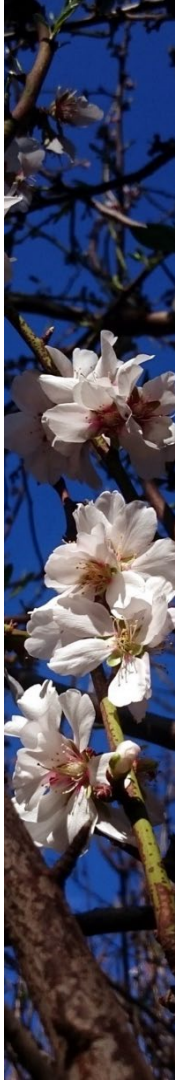
Resilient root systems: project aims

- Comparative assessment of the resilience to abiotic stresses of all *Prunus* rootstocks available for use in almonds.
- Optimised root-system and rootstock management strategies (irrigation and fertigation),
  - based on improved understanding root phenology/function/activity.

What are we trying to achieve?

Root phenology

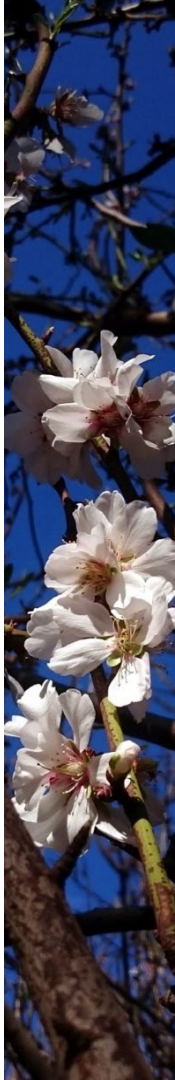
- in the field (commercial orchard),
- volume explored by root system,
- timing of fine root growth and activity,
- duration of activity and lifespan of fine roots.



What are we trying to achieve?

Root function

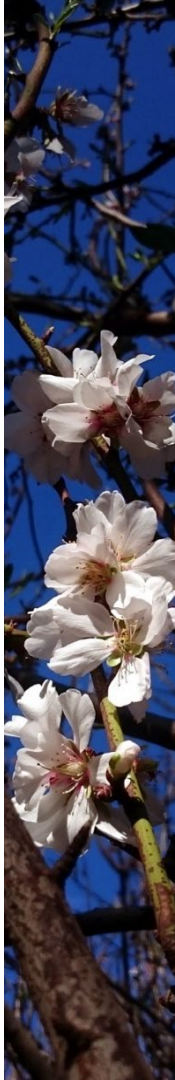
- pot studies (glasshouse & field),
- uptake capacity of fine roots,
- Effect of fine root age and morphology on uptake.



What are we trying to achieve?

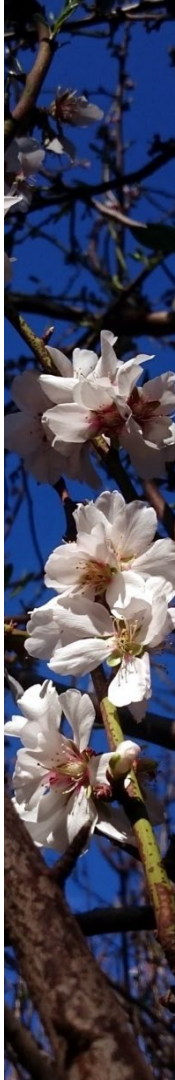
Better understanding

- combine root phenology and function information,
- develop basic model of almond root uptake,
- suggest management strategies to maximise efficiency of uptake.



Where are we at?

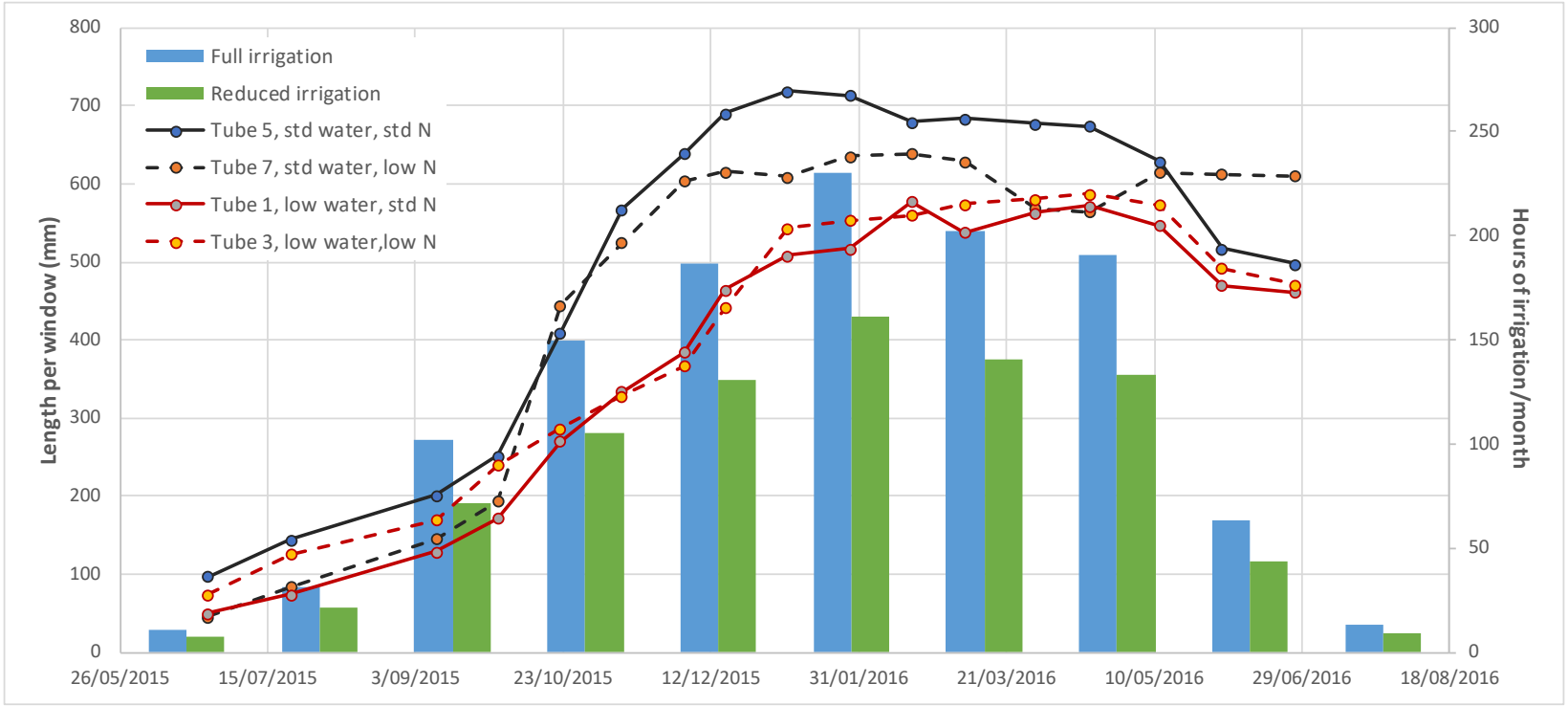
- Root growth in the field:
  - Soil coring during dormancy for five seasons (2015-2019).
  - Root imaging (minirhizotrons) for four seasons (2015/16-2018/19).
- Root function:
  - Using ^{15}N to examine N uptake.
  - Short-term pot studies (glasshouse) with different rootstock:scion combinations.
  - Full season large pot study (field) with application at different phenological stages.
- Data analysis….



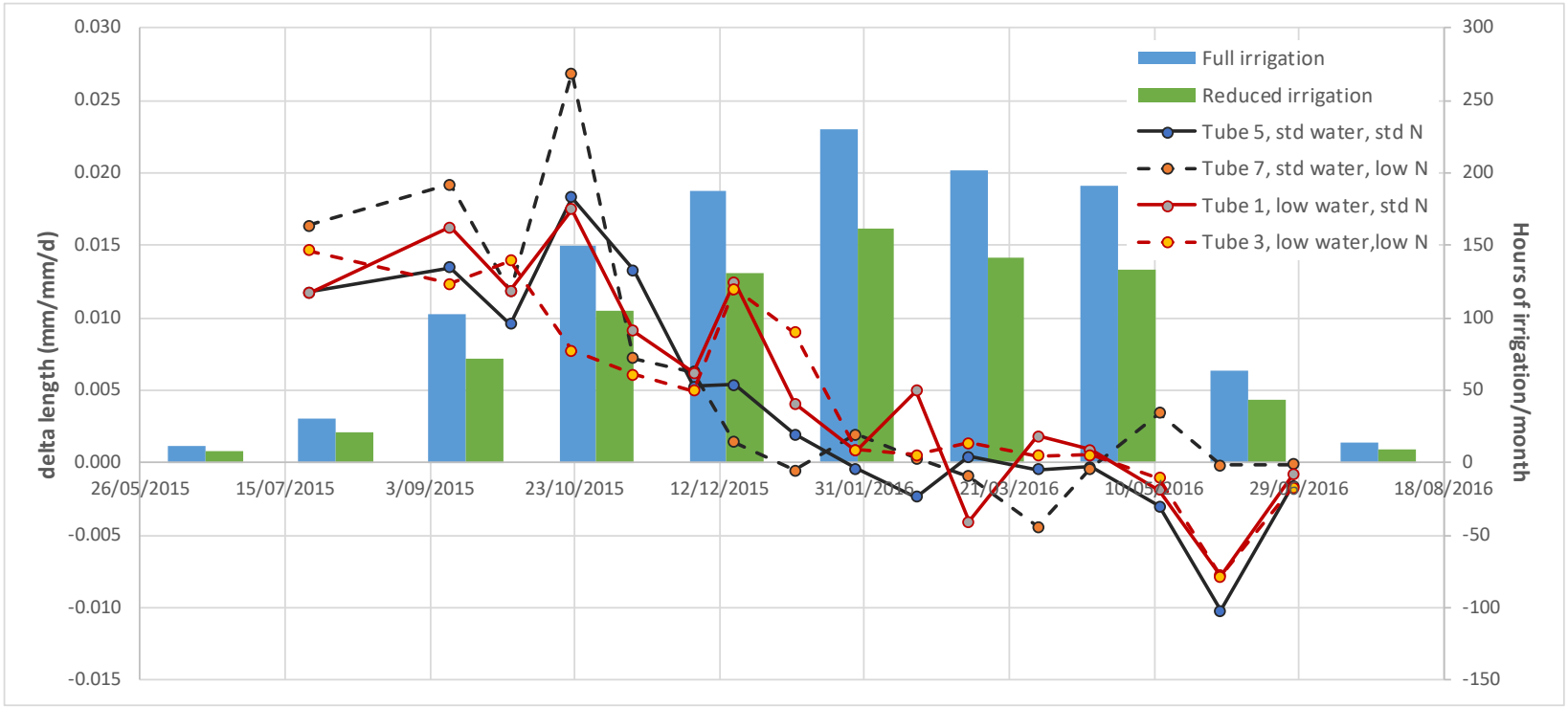
Root phenology: minirhizotrons

- Windows are repeatedly imaged over time.
- Can see development of root growth.

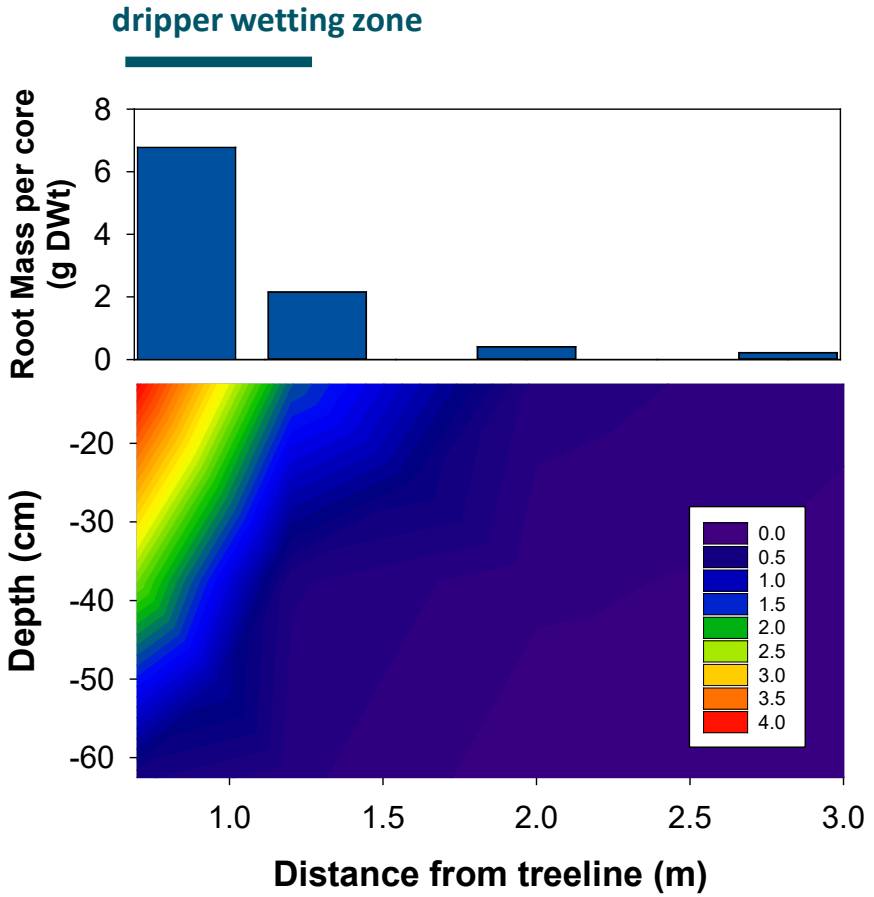
Root phenology update: root length



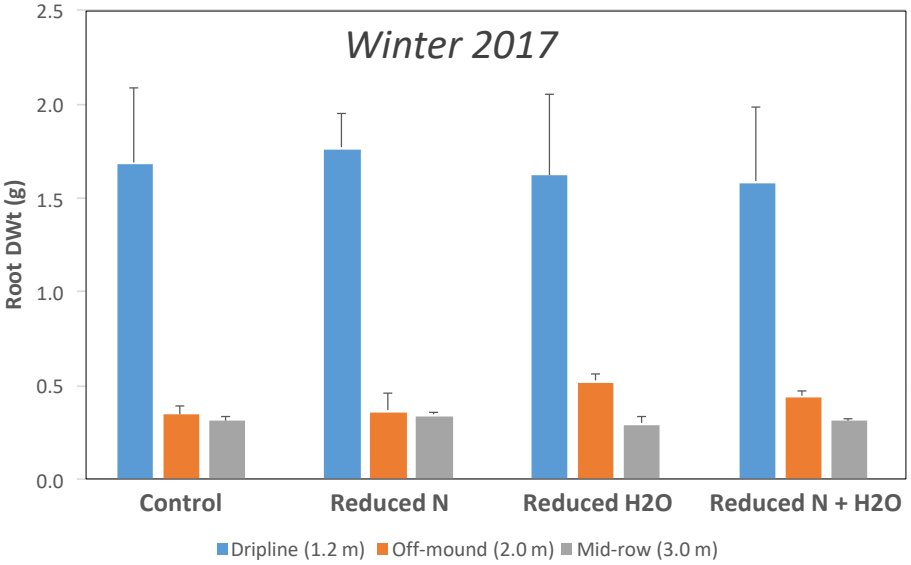
Root phenology update: root growth rate

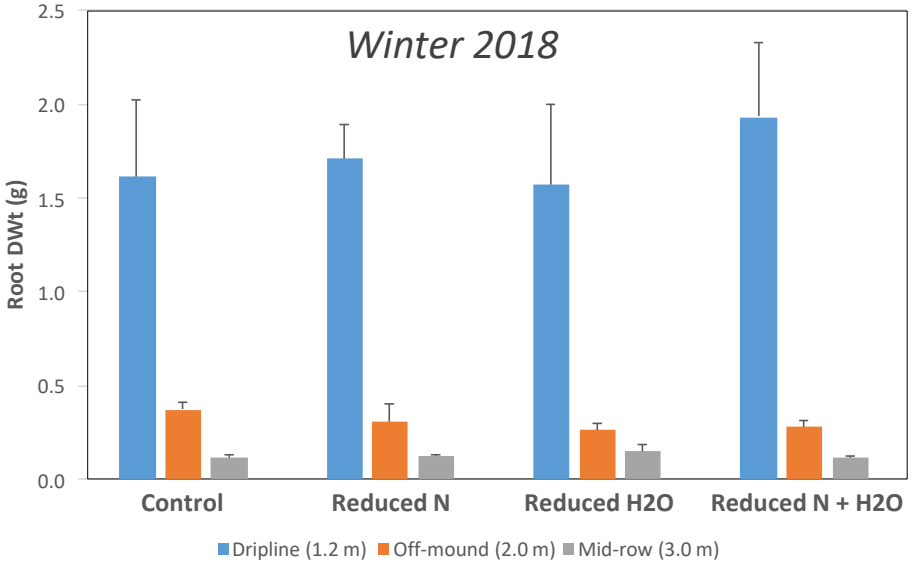


Rooting zone: coring



Fine root biomass: coring





Data available for five seasons + root length/morphology

Root function update: ^{15}N experiments

Short-term glasshouse experiments

Trial experiment using NP:Cornerstone,

- Deficit/well-watered.

Main experiment using:

- NP, Carina & Carmel on Nemaguard,
- Garnem, Barrier 1, Cornerstone, Nemaguard, each grafted to NP.

Experiments run for approx. 9 days, tracking N uptake with ^{15}N ammonium nitrate.

Incorporation into leaf, young fine root (white) and older fine root (brown) measured.

Root function update: ^{15}N experiments

Whole season field experiment

200 L pot experiment using three-year old NP:Nemaguard trees,

Three applications of with ^{15}N ammonium nitrate:

- Budburst,
- Pre-harvest,
- Post-harvest.

Sampling for 10 days per application.

Incorporation into leaves tracked, roots extracted from cores and split into three size classes.

Rootstock screening update

Growth is the ultimate measure of a plant's performance.

Using *Relative Growth Rate* (RGR = increase in biomass per unit of biomass per day).

Screening is defined by a stress index:

$$Stress\ index = \frac{RGR\ stress}{RGR\ control}$$

Wide range of rootstocks already processed.

2019/20 season: final validation experiments.

Tree water use update:

Intention was to measure *actual* tree water use in the field.

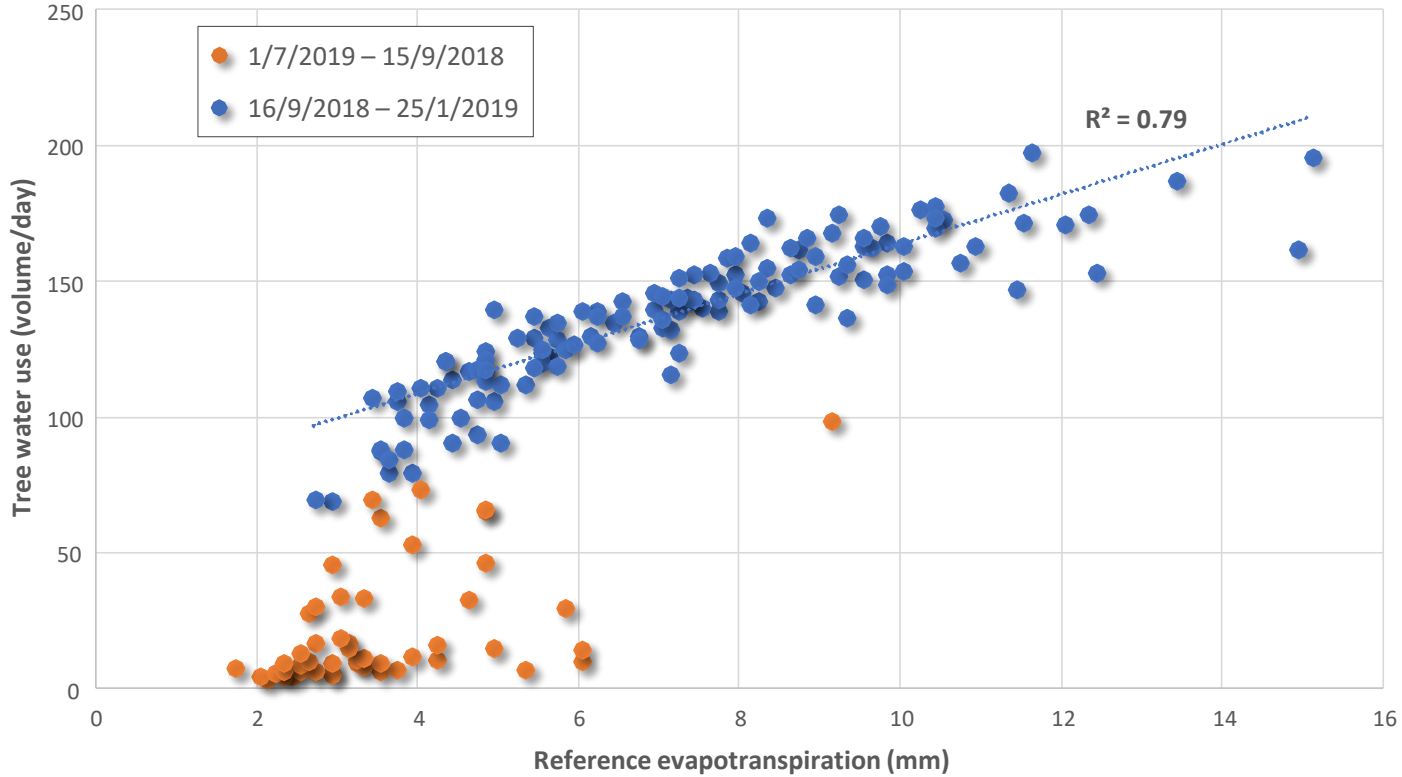
Link to canopy size and root phenology.

Examine the impact of reduced water and nitrogen.

CMV FARMS

CSIRO

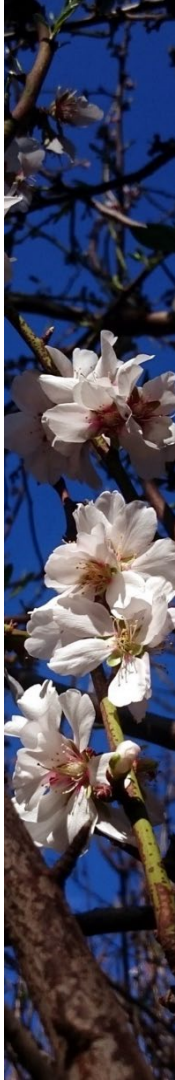
Tree water use update: response to ET_o



Summary

- 12 months left.
- Final validation for rootstock screening, followed by publication.
- Root function studies largely complete, sample analysis underway.
- Root growth & development in the field, experimental work complete, image analysis underway.
- Tree water use in the field, experimental work complete, data analysis underway (will be linked to Ag Vic work).
- Techniques applied with Select harvest trial (see talk tomorrow), data will be combined with final root system modelling work.

SELECT HARVESTS



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