Tracking nutrient applications with soil water extractors

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Inefficient fertigation programs are expensive:

Leaching nutrients beyond the rootzone immediately impacts orchard economics, particularly during periods of high fertiliser costs.

Excess soil nitrogen (especially towards the end of the fruit growth phase) has been linked to Carpophilus Beetle and Hull Rot. Both significantly downgrade kernel quality.

Rootzone nutrient monitoring network:

In 2021, a grower operated rootzone nutrient monitoring network was established across six almond irrigation districts (Figure 1a).

The network comprised +70 Soil Water Extractors (SWE) hosted by 12 commercial irrigators. Participating irrigators received equipment and training to monitor soil water nitrates at rootzone depths of 30, 60 and 90 cm, at a sampling frequency that suited their own operations.

In-field measurements of soil water nitrate concentrations were estimated using Quantofix® Nitrate/Nitrite colorimetric test strips. A subset of samples were lab validated using spectrophotometry.

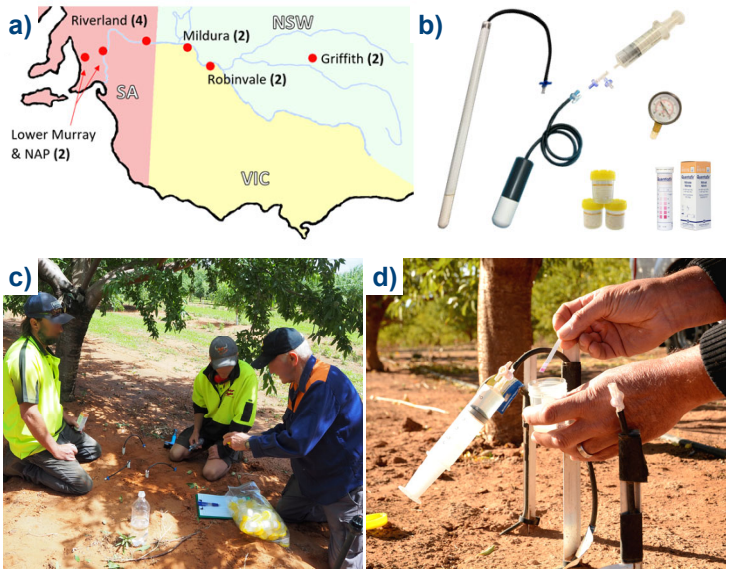

FIGURE 1. Distribution of collaborating almond irrigators participating in network (a). SWE tools and consumables (b). Collaborating irrigators using SWE's (c & d).

Irrigators tracking their fertigation events:

Over 350 soil water samples were collected from across the network in its first season (2022). Soil water nitrate concentrations ranged from <1 mg/L through to >500 mg/L (Table 1).

Early results showed that most of the deeper (90 cm) profile samples had nitrate below 10 mg/L. However, some sites reported in excess of 15 mg/L nitrate in their deeper soil water samples, suggesting nutrients were being lost from the system.

TABLE 1. A subset soil water nitrates from three SWE depths across the network

	Depth (cm)	Count (n)	Soil water nitrate concentration (mg/L)		
			Avg	Max	Min
Pre-harvest	30	53	36.0	**538**	0.08
	60	52	19.5	229	0.10
	90	51	3.9	18	0.07
Post-harvest	30	19	0.9	10	0.08
	60	23	0.7	8	0.07
	90	21	2.4	7	0.10

Early observations from South Australian orchard:

At an example monitoring site, a significant portion of the nitrogen budget was applied between the spring flush and nut fill (Figure 2a).

The SWE's captured a rootzone nutrient spike through September and October with nitrate concentrations of 12, 6 and 3 mg/L measured at soil depths of 30, 60 and 90 cm (Figure 2b).

A second spike of 28 mg/L of rootzone nitrate was captured by the shallow SWE's and coincided with postharvest fertigation (Figure 2b).

Despite fertigation continuing into November (at rates exceeding 12 kg/ha/week), nitrates in the deeper rootzone remained low. The crop was efficient in its consumption of rootzone nitrogen or there may have been migration of nitrogen away from the sampling zone (possibly prompted by rain events and/or deeper irrigation cycles).

At all times, the 90 cm SWE's reported nitrate less than 4 mg/L, which is well below recommended thresholds for Australian drinking water.

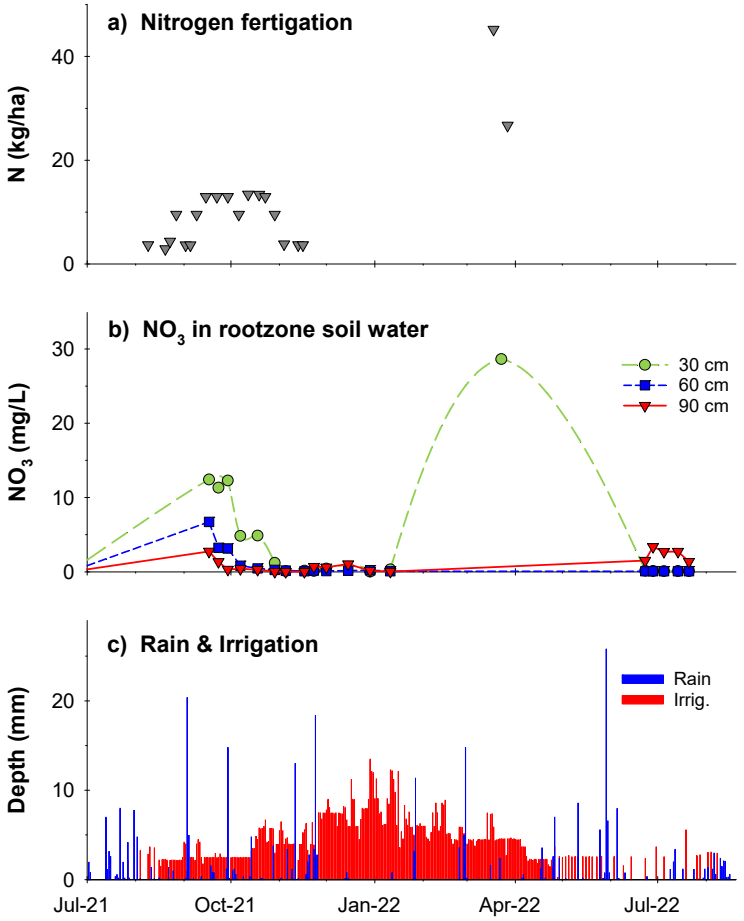

FIGURE 2. Example dataset collected from SA almond orchard through 2022. Incudes timing and extent of nitrogen fertiliser (a), concentrations of soil water nitrates at multiple depths (b) and seasonal rainfall and irrigation (c).

Where to next?

SWE datasets are being integrated into numerical modelling scenarios to investigate nutrient leaching risks and the potential for migration back towards the rootzone at undesirable growth stages.

Modelling outputs will be finalised in late 2023 and reported alongside two seasons of field-measured rootzone nutrient trends and irrigator surveys on the value of SWE's for tracking fertigation events in almonds.

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