Southern Cross University

Integrated Orchard Management: Retaining soil and nutrients for the benefit of the grower and the environment

Supplementary Data

Report to NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)

Report prepared by
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1. Overview

This report presents metals and chemical residue data collected as part of the comparative study that assessed event-based pollutant loads in surface water run-off from an IOM plot and a plot that did not utilise IOM practices (Non-IOM plot).

Detailed descriptions of the project, including methodology, are provided in *Integrated Orchard Management: Retaining soil and nutrients for the benefit of the grower and the environment - Final Report August 2024.*

2. Metals

Water samples were analysed for the presence of metals that commonly occur in soils as well as rarer metals. Metal loads were considerably lower form the IOM plot compared to the Non-IOM plot (Table 1 and Table 2).

Table 1 Areal weighted surface water run-off loads (mg/m^2) of metals per event when detected.

Event	Aluminium			Copper			Iron			Manganese			Zinc		
	Non-IOM	IOM	*Diff (%)*	Non-IOM	IOM	*Diff (%)*	Non-IOM	IOM	*Diff (%)*	Non-IOM	IOM	*Diff (%)*	Non-IOM	IOM	*Diff (%)*
1	0.10	0.003	*-97%*	0.004	0.001	*-74%*	0.08	0.01	*-82%*	0.010	0.014	*45%*	0.029	0.007	*-75%*
2	0.32	0.01	*-98%*	0.004	0.001	*-79%*	0.27	0.01	*-96%*	0.023	0.005	*-79%*	0.052	0.015	*-71%*
3[a]															
4	0.20	0.01	*-95%*	0.002	0.001	*-53%*	0.15	0.02	*-90%*	0.046	0.033	*-30%*	0.013	0.008	*-39%*
5[a]															
6	0.21	0.01	*-95%*	0.001	0.0004	*-68%*	0.15	0.02	*-88%*	0.028	0.008	*-71%*	0.012	0.007	*-41%*
7	0.23	0.01	*-96%*	0.001	0.0002	*-69%*	0.16	0.01	*-91%*	0.027	0.003	*-89%*	0.014	0.006	*-59%*
8	4.21	0.64	*-85%*	0.011	0.001	*-88%*	1.52	0.48	*-68%*	1.00	0.029	*-97%*	0.072	0.033	*-54%*
9	22.7	0.35	*-98%*	0.076	0.020	*-74%*	17.8	0.49	*-97%*	2.24	0.12	*-95%*	0.557	0.372	*-33%*
10	0.91	0.01	*-99%*	0.005	0.001	*-85%*	0.71	0.01	*-98%*	0.122	0.002	*-98%*	0.049	0.013	*-73%*
11	0.059	0.005	*-92%*	0.001	0.0003	*-59%*	0.04	0.01	*-76%*	0.01	0.001	*-88%*	0.005	0.004	*-10%*
12	23.6	0.21	*-99%*	0.025	0.001	*-96%*	16.7	0.18	*-99%*	2.69	0.019	*-99%*	0.13	0.01	*-91%*
13	569	20.2	*-96%*	0.746	0.040	*-95%*	285	15.7	*-95%*	104.3	1.65	*-98%*	4.29	0.43	*-90%*
14	6.00	0.02	*-99%*	0.016	0.0003	*-98%*	2.91	0.02	*-99%*	1.35	0.002	*-100%*	0.15	0.005	*-97%*
15	2.60	0.04	*-98%*	0.006	0.0003	*-95%*	0.89	0.03	*-97%*	0.77	0.007	*-99%*	0.051	0.008	*-84%*

[a]No screening for metals at these events

Table 2 Areal weighted surface water run-off loads (mg/m^2) for rarer metals per event when detected.

Event	Nickel		Arsenic		Chromium		Lead		Selenium	
	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM
1	0.0004	0.0001	0.0001		0.0001		0.0001		0.0001	0.00003
2	0.0088	0.0001								
3[a]										
4	0.0003	0.0001	0.0001		0.0001		0.0001		0.0001	0.00003
5[a]										
6	0.0003	0.0002								
7	0.0001	0.0001								
8										
9	0.0098	0.0047						0.003		
10	0.0007	0.0001								
12	0.0029		0.002	0.0002	0.002					
13			0.052	0.010	0.048				0.073	0.056
14							0.002			
15	0.0005						0.001			

[a]No screening for metals at these events

3. Chemical Residue

Water samples were analysed for the presence of commonly used agricultural chemicals.

Chemical residue was detected in run-off from both plots at concentrations well below guideline values for the protection of aquatic ecosystems provided by the International Union of Pure and Applied Chemistry (IUPAC) Pesticides Properties Database (Table 3).

The incidences of detection and residue loads were considerably lower from the IOM plot compared to the Non-IOM plot (Table 4). The results show that when chemical residue is present in the soil, IOM substantially reduces the amount mobilised in surface water run-off and exported to the receiving environments

It is noted that low concentrations of Imazalil and Pyrimethanil were detected in two sampling events (Event 6 & 7) but there are no recorded of their use on either plot in recent history (i.e. the last few years) and the origin of these chemicals is unknown. To rule out potential contamination of samples from the sampling methodology utilised (i.e. infrastructure, autosamplers, pre-event flushing process), sample blanks were collected and submitted to the laboratory for analysis on the 30th January 2024. The infrastructure was flushed and setup as per each event. On-site tap water, which is sourced from the farm dam and used to flush the system prior to each event, was run through the sampling infrastructure (including the autosamplers) to mimic the sampling of a run-off event. No chemical residue was detected in any of the sample blanks, providing confidence that the results observed were not related to any contamination issues from sampling methodology.

Table 3 Minimum guideline value for aquatic ecosystems (and the applicable organism) and the maximum concentration measured during the study for each pesticide detected. All values mg/L.

Pesticide		Max concentration during study		Minimum Guideline Value and Applicable Organism	
		Non-IOM	IOM		
Azoxystrobin	Fungicide	0.002	0.001	0.04	Temperate Freshwater Aquatic invertebrates
Tebuconazole	Fungicide	0.002	0.002	0.01	Temperate Freshwater Aquatic invertebrates
Pyrimethanil	Fungicide	0.001	0.0003	0.9	Temperate Freshwater Aquatic invertebrates
Imazalil	Fungicide	0.007	0.004	0.04	Temperate Freshwater Fish
Acetamiprid	Insecticide	0.001	0.001	0.005	Sediment dwelling organisms

Table 4 Results of chemical residue analysis for the events when residue has been detected. Average areal weighted surface water run-off load are in brackets (µg/m^2).

	Tebuconazole		Azoxystrobin		Acetamiprid		Imazalil		Pyrimethanil	
Event	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM	Non-IOM	IOM
1[a]										
2[a]										
3[ab]										
4	0.114	0.009	0.08							
5[b]										
6	0.071	0.010	0.026				0.799		0.059	
7	0.050	0.010	0.019				0.449	0.230	0.049	0.018
8	0.576		0.291							
9	13.689	2.820	12.166	1.451	7.019	1.266				
10	0.309	0.042	0.093		0.062					
11	0.064	0.033								
12	0.637	0.055	0.479		0.393					
13	5.654									
14		0.008								
15										

[a] A different analysis used to screen for chemical residues. A more comprehensive analysis was utilised from Event 4 onwards.
[b] No screening for chemical residue at these events