



N-leaching under lucerne: data for July–October 2013



Landcare Research
Manaaki Whenua

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January 2014

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LC1735

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1 Introduction

This is the first report to Taupō Lake Care Inc. (TLC) and the Ministry for Primary Industries under Grant No 13/059 to report N-leaching under cut-and-carry lucerne grown in large diameter lysimeters at Tihoi.

2 Background

Lake Taupō Protection Trust (LTPT) is currently funding a rigorous field trial on N-leaching under cut-and-carry lucerne on a TLC member's Tihoi farm. At this site an underground facility is used to collect leachate from large diameter lysimeters. The leaching data will be used by the Overseer[®] Committee to validate the lucerne module within Overseer[®]. Because of the large volume of the lysimeters (needed because lucerne has such deep roots), further time is required to collect the proportionately large volume of leachate, and the research is now being funded by LTPT and the Sustainable Farming Fund (SFF) through TLC.

3 Objectives

To quantify N-leaching from lysimeters planted with either lucerne, lucerne with topsoil amended with 10 t/ha biochar or ryegrass/clover, for the 4-month period July–October 2013.

4 Methods

An existing lysimeter facility at Tihoi (Figure 1) contained large lysimeters (1 m diameter × 1.5 m high) planted with either (1) lucerne, (2) lucerne with topsoil amended with 10 t/ha biochar, or (3) existing undisturbed ryegrass/clover pasture. There were four replicate lysimeters for each treatment. The lysimeters were collected nearby from established pasture, and the two lucerne treatments were cultivated before lucerne seeds were sown.

Leachate was collected into 200 L barrels and sampled based on volume collected and anticipated weather conditions. Before determining collected leachate volume, a 50-mL aliquot was subsampled for analyses of ammonium-N ($\text{NH}_4\text{-N}$), nitrate-N and nitrite-N ($\text{NO}_x\text{-N}$), total N, total dissolved carbon, dissolved inorganic carbon, dissolved organic carbon, reactive P, and total P. Analyses were undertaken by the International Accreditation New Zealand accredited Landcare Research Environmental Chemistry Laboratory using Test Numbers 310, 314, 316. Details at

<http://www.landcareresearch.co.nz/resources/laboratories/environmental-chemistry-laboratory/services/water-testing/methods-water#310>

Reported concentrations, in milligrams per litre (mg/L), of analyte in the leachate were converted to kg/ha based on the volume of leachate and the area of the lysimeter. Leachate volume was also expressed as pore volumes (PV). A pore volume (648 L) is the amount of air (pores) in the soil, and is about 70% of the total volume of the soil core. Using PV allows comparison of data across different soils.



Figure 1 Lysimeter facility at Tihoi showing lucerne in the foreground and grass in the background. Also visible are webcam, solar panels, cell phone aerial, rain gauges, roof of underground facility and storage shed.

5 Results and discussion

Table 1 below shows N leaching data for the 4-month period July–October 2013. The lysimeters are tagged L for lucerne, B for biochar in the topsoil, and G for ryegrass/clover. On each leachate sampling date, the table shows litres of leachate collected, the cumulative volume (L) since the beginning of the experiment, leachate volume converted to pore volumes, concentration of N in the leachate (mg/L), and the value converted to an amount of N in kg/ha.

Over the 4-month period, each leachate volume collected under lucerne-planted lysimeters ranged from c. 53 to 92 L, while ryegrass/clover-planted lysimeters ranged from c. 28 to 102 L, with only a relatively small volume draining from lysimeter 8G. This brought the total volume collected since the start of the trial to c. 786–1172 L or c. 1.2–1.8 PV. The N concentration in lucerne-planted lysimeters ranged from c. 0.04 to 1.42 mg/L, and from c. 0.03 to 1.75 mg/L in ryegrass/clover lysimeters. The total amount of N in leachate at each collection ranged from c. 0.04 to 2.13 kg/ha in the lysimeters containing lucerne, and c. 0.03 to 2.93 kg/ha in lysimeters containing ryegrass/clover or c. 0.04 to 2.13 kg/ha, while ryegrass/clover-planted lysimeters ranged from c. 0.03 to 1.75 mg/L or c. 0.03 to 2.93 kg/ha.

Figures 2, 3 and 4 show N leached at each sampling, from the start of the trial, in kg/ha. This method of expression has been used while the dataset is not complete to the required 3 PV (suggested by the Overseer® Committee) as it reveals trends in N leaching with increasing PV. The figures show that N peaks likely associated with cultivation before sowing lucerne, have started to decrease. The ryegrass/clover was not cultivated and re-sown so there was no peak of N in the leachate at 1–1.2 PV (Figure 4). Under grass, the higher level of N leached

from lysimeter 6 was likely a result of a cattle urine patch as the lysimeters were collected from a grazed paddock approximately 2 weeks after grazing. Most N within the leachate is nitrate-N or nitrite-N ($\text{NO}_x\text{-N}$) (data not shown).

Table 1 Lysimeter N leaching data for the period July through October 2013

	Date	Lysimeter number											
		3L	4L	7L	10L	1B	2B	5B	9B	6G	8G	11G	12G
Volume of leachate in collection barrel (L)	28/07/2013	69	68	72	71	74	72	53	72	67	28	63	71
	24/09/2013	90.18	80	92	92	89	91	62	89	102	56	91	102
	31/10/2013	83	75	44	83	81	85	48	77	79	50	80	83
Cumulative volume of leachate (L)	28/07/2013	851	860	840	848	842	824	677	899	929	688	972	987
	24/09/2013	941	940	932	940	931	915	738	988	1031	745	1063	1089
	31/10/2013	1024	1015	976	1023	1012	1000	786	1065	1110	795	1143	1172
Cumulative pore volume of leachate	28/07/2013	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.4	1.4	1.1	1.5	1.5
	24/09/2013	1.5	1.5	1.4	1.5	1.4	1.4	1.1	1.5	1.6	1.2	1.6	1.7
	31/10/2013	1.6	1.6	1.5	1.6	1.6	1.5	1.2	1.6	1.7	1.2	1.8	1.8
Total N (mg/L) in leachate	28/07/2013	0.07	0.10	0.07	0.05	0.07	0.07	0.04	0.07	0.52	0.06	0.20	0.03
	24/09/2013	1.38	1.34	1.32	1.34	1.35	1.42	1.32	1.31	1.75	1.34	1.57	1.18
	31/10/2013	0.06	0.04	1.33	1.37	0.06	0.04	0.05	1.38	0.50	0.07	1.89	0.09
Total N (kg/ha) in leachate	28/07/2013	0.08	0.11	0.08	0.06	0.08	0.08	0.04	0.08	0.57	0.03	0.20	0.04
	24/09/2013	2.05	1.76	2.00	2.02	1.97	2.13	1.34	1.93	2.93	1.24	2.36	1.98
	31/10/2013	0.08	0.05	0.96	1.87	0.08	0.06	0.04	1.75	0.65	0.06	2.48	0.13

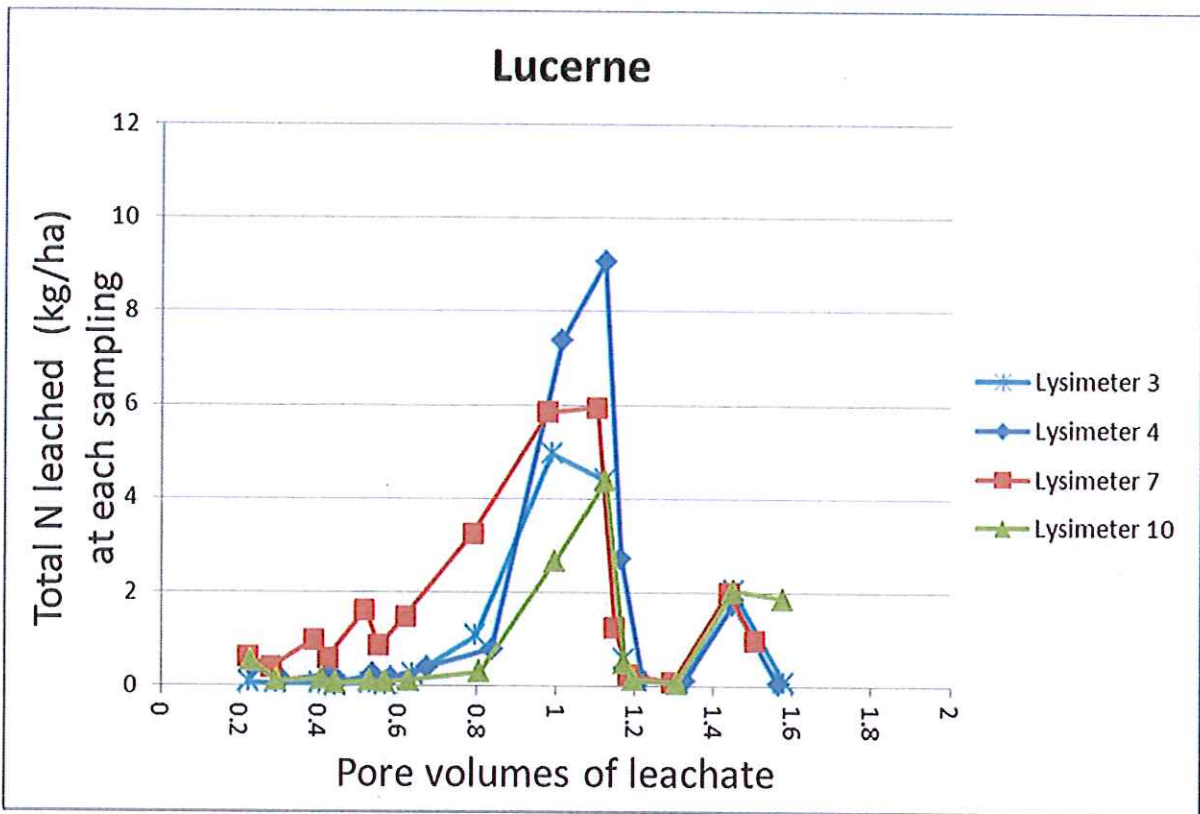


Figure 2 Total N leached at each sampling from four replicated lysimeters sown in lucerne.

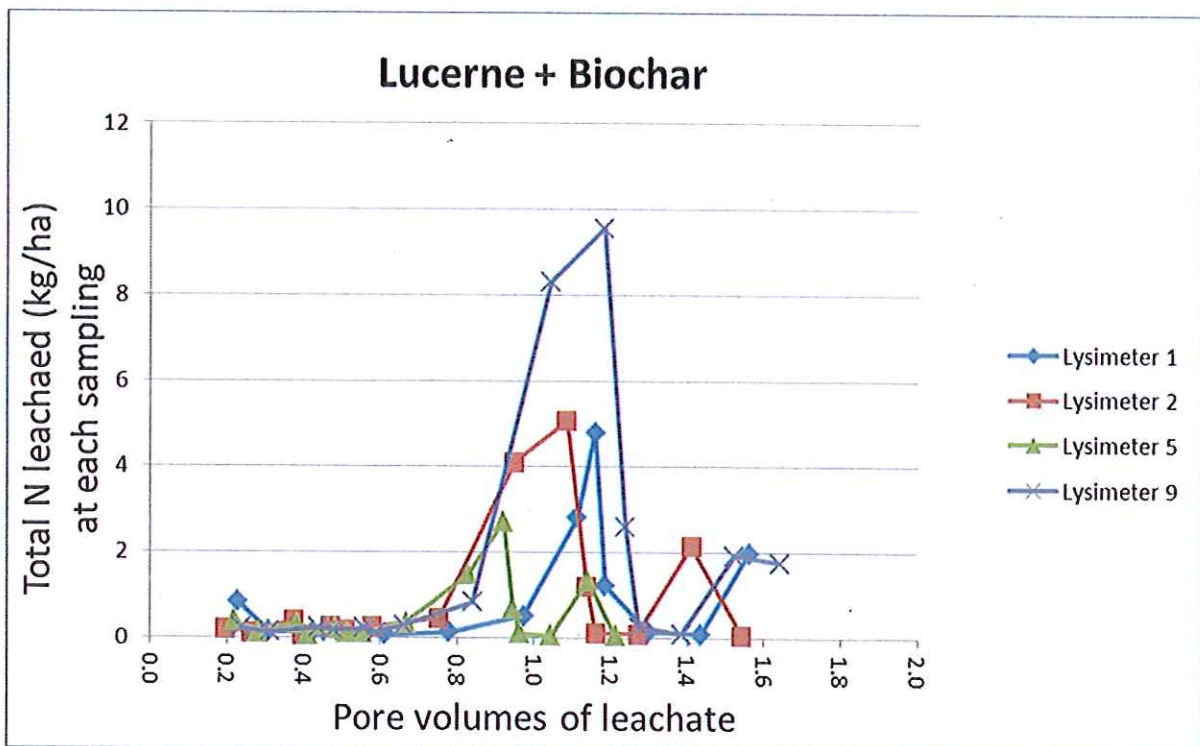


Figure 3 Total N leached at each sampling from four replicated lysimeters sown in lucerne and the topsoil amended with biochar.

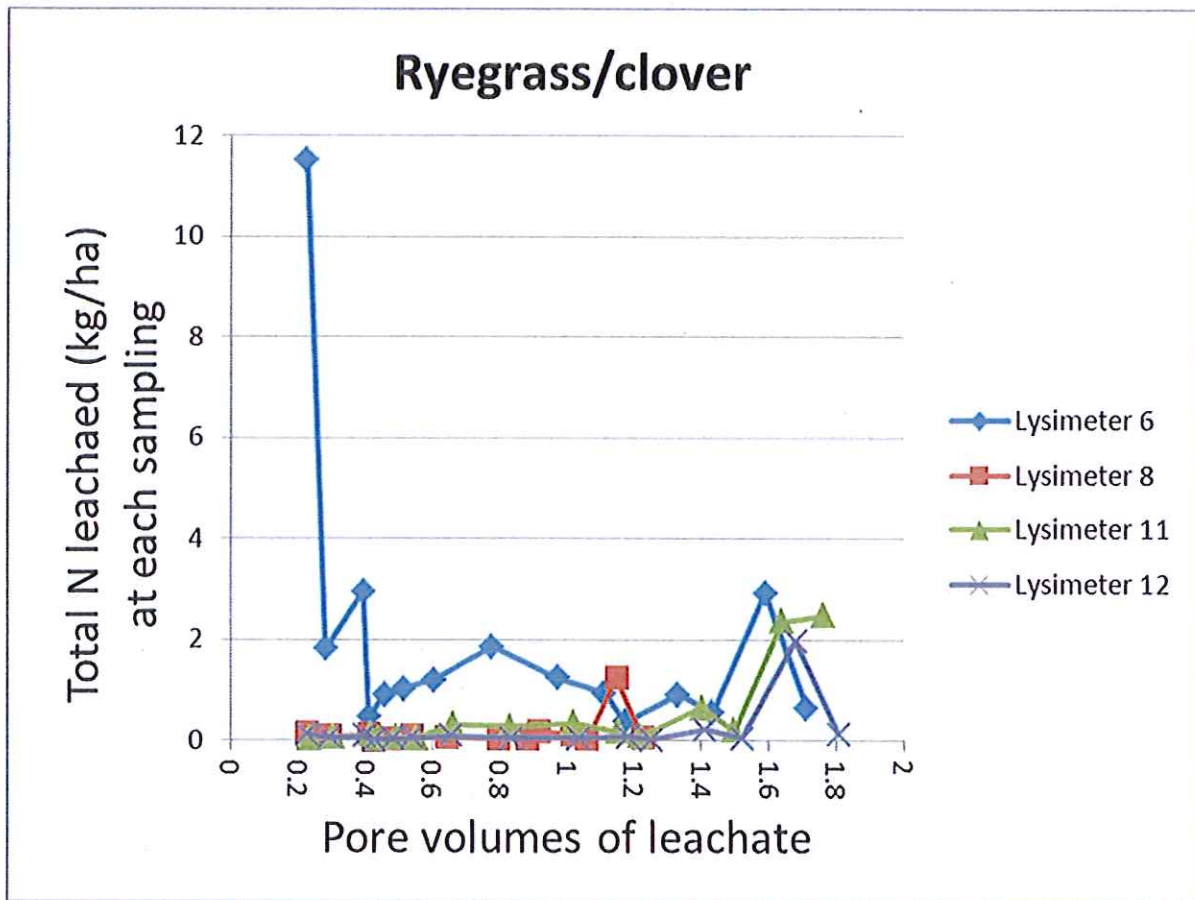


Figure 4 Total N leached at each sampling from four replicated lysimeters containing established ryegrass/clover.

6 Conclusions

- Between 1.2 and 1.8 pore volumes of leachate have been collected from each lysimeter since the start of the experiment. The Overseer[®] Committee recommend the collection of approximately 3 PV.
- For both lucerne treatments, the amount of N (kg/ha) in the leachate at each sampling has decreased from a peak of c. 10 kg/ha at 1–1.2 PV to c. 2 kg/ha at about 1.4–1.6 PV.
- The peak in N-leaching from lysimeters containing lucerne is likely associated with cultivation of the lysimeters before planting lucerne.
- At each sampling the lysimeters planted in ryegrass/clover have leached less than c. 3 kg/N/ha, except for lysimeter 6, which shows N-leaching behaviour consistent with a urine patch within the core before lysimeter collection.
- Lysimeters planted in ryegrass/clover did not show a N-leaching peak at 1–1.2 PV as they were not cultivated.

7 Acknowledgements

This research is supported financially by LTPT and SFF through TLC. Ballance Agri-Nutrients Limited supplies the fertiliser for the trial. Pioneer Seeds supplied the lucerne seed and Genetic Technologies interprets soil and foliage test results for fertiliser recommendations. Farm owners Mike and Sharon Barton continue to provide ongoing enthusiastic support for the project.