

In Australian dairy systems N use has steadily increased over the past 20 years as the industry has intensified. Both N surpluses and high N excretion rates have been calculated for many of these grazing systems. Ruminants excrete most of their N intake, with the majority excreted in urine. As a result, urine is the greatest contributor of N losses to the environment in dairy systems worldwide.

Quantifying N excretion will assist in the development of improved N management practices, but is difficult in grazing dairy systems. A urine sensor, developed by AgResearch, New Zealand, which allows the determination of N concentration (%) and volume of each individual excretion event performed by grazing cows, was tested in Australian conditions.

Methods

- Twenty Friesian-cross lactating dairy cows were fitted with urine sensors for up to 72 hours in spring 2014 and winter 2015 (Figure 1).
 - The cows grazed as part of small herds, returning to the dairymen twice a day to be milked.
- The sensors were evaluated on animals fed and milked in metabolism stalls with individual collection and immediate storage (-20°C) of urine.
 - Sub-samples of collected urine was analysed for N concentration (TruMac N analyzer, Leco Corp.)
- Volume calibration of the sensors was done in the laboratory using known volumes of water, while N concentration calibration was based on urine samples collected in the metabolism stalls (Figure 2).



Figure 1. Attachment of urine sensors

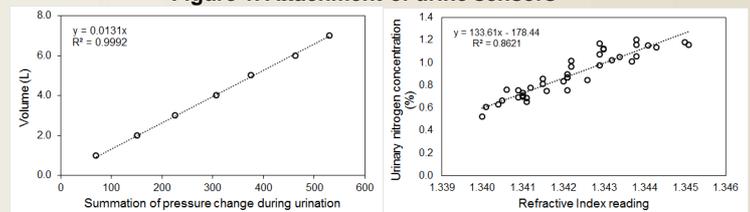


Figure 2. Volume and N concentration calibrations

Results

- Over the two monitoring periods 420 urination events were recorded with an average (minimum-maximum) of 24 events (12-38) in spring 2014 and 21 events (4-37) in winter 2015 (Figure 3a).
- Urination frequencies averaged 0.52 events / hour / cow, and ranged between 4 and 18 events per day.
- The fewest number of events occurred before daybreak and the most between 4 and 6 pm.
- Average urine volume per event was 2.0 L (0.24 to 8.23 L).
- Average urinary N concentration was 7.1 g N / L (Figure 3b)
- Average urinary N load was 12.8 g (Figure 3c).

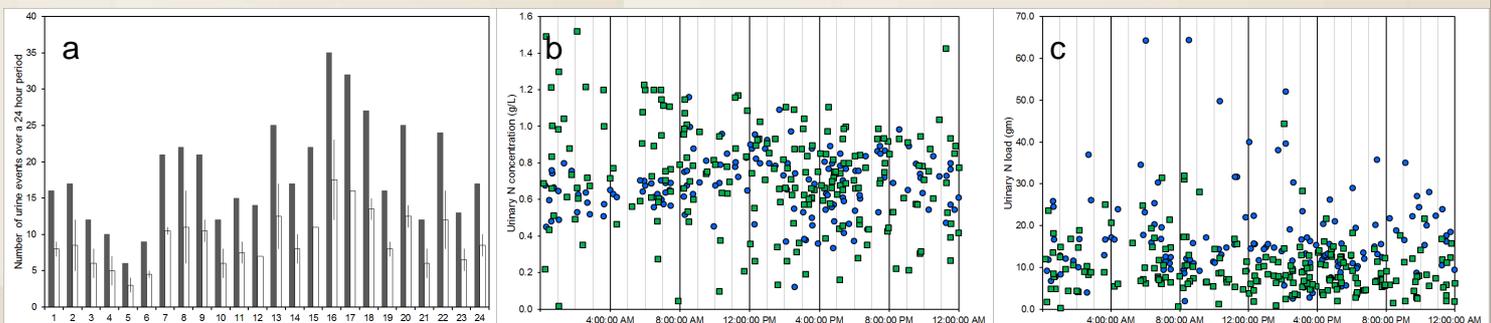


Figure 3. Total (shaded bars) and mean (with standard error; white bars) number of urination events for each hour over 24 hours (a), urinary N concentrations (b) and urinary N loads (c) for cows grazing in spring 2014 (blue circles) and in winter 2015 (green squares).

Conclusions

Urine volume, frequency and N concentration of individual events are reported here for the first time for lactating cows grazing Australian pastures.

The urine sensors enabled non-invasive assessment of urinary N excretion, and provided data that can be used to model N losses in these grazing systems.