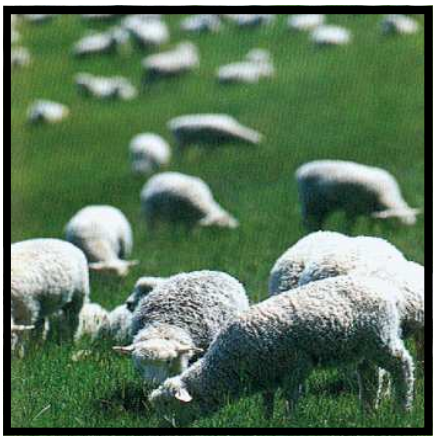
Wise Use of N-Fertiliser on Hill Country

What is the Relationship Between Nitrogen Fertiliser Use and Stock Health/Performance?

Frequently Asked Questions

Dr Annette Litherland of AgResearch Grasslands has reviewed the published evidence for effects of nitrogen fertiliser on stock health and performance. These are the results.



- Urea is sometimes used to boost N concentration of supplementary feeds. The recommended rate is <1% of the diet and it is improbable that NZ sheep and beef animals would ingest this level in the field, even if grazing pastures immediately after fertiliser urea application.

- Nitrogen application may influence concentration of calcium (Ca) and magnesium (Mg) in herbage, and these can influence incidence of grass tetany (low Mg) or milk fever (low Ca). However the reported effects of N fertiliser on concentrations of these minerals in herbage are variable (ranging from small increases through no effect to small decreases) and are difficult to predict. Overall the effects of fertiliser N are small relative to those of high pasture potassium levels, and underfeeding is probably of more significance in causing staggers and milk fever.

- Following fertiliser N application herbage crude protein concentration (i.e. both protein-N and non protein-N) rises to a peak 2-3 weeks after application, then decreases to normal levels as enhanced pasture growth dilutes the luxury uptake. Increases recorded overseas are of the order of 0.05-0.09 % crude protein/ kg N applied. High concentrations of non protein-N in the nitrate form (or as its more potent derivative nitrite) may lead to animal toxicity. Nitrate poisoning is influenced by a range of environmental factors and is normally only an issue with new or annual pastures or crops.

- When faced with high nitrate uptake plants preferentially divert energy into converting ni-

trates into amino acids rather than accumulate that energy as sugars. Hence herbage soluble sugar concentration can be depressed (e.g. a rise in crude protein content of 1% immediately after fertiliser application will reduce soluble sugars concentration by 1%), the effect being greatest with annual ryegrasses. However herbage soluble sugar concentrations vary several-fold throughout the day, and between days depending on how sunny it is. Reduction in soluble sugar concentration as a consequence of N application does have the potential to slightly reduce pasture quality; but pastures are often of high quality in the winter-early spring period when they are gazed, anyway. Effects of decreases in soluble sugar concentrations of this magnitude are likely to be minor.

- The increase in herbage crude protein over several weeks following N application will in most instances have no direct beneficial effect on animal production because NZ pastures normally provide more than adequate levels of crude protein to sheep and beef cattle, and especially in the cooler times of the year. The excess crude protein has to be metabolised by the animal in an energy-requiring process, and a small production penalty may occur e.g. it may increase maintenance requirements of the animal by up to 4%.
- Nitrogen fertiliser has little direct effect on digestibility of pasture because it does not directly influence the content and structure of the main energy constituent of herbage i.e. the plant cell walls or fibre. Recorded differences have been minor, sometimes positive sometimes negative, and in the range of ±0.3 MJ/kg DM. Various indirect effects may also occur e.g. if N-boosted grass is not well-utilised its quality will subsequently drop as it ages and older leaf, dead material and stem accumulate; and if N-boosted grass 'dilutes' older low-quality grass it will overall increase pasture quality. Nitrogen boosted pasture will be of similar quality to non-boosted pasture at the same mass or cover - if compared at the same time of regrowth the N-boosted grass, which has been growing faster, will be more mature at the same age and so may be of lower quality, especially under warmer conditions when maturation occurs more rapidly.

- Dung tends to have a constant N concentration and excess N in the animal's diet is excreted as urea in urine. Urine-N is deposited at concentrations of about 400 kg N/ha by sheep and at about 800 kg N/ha by cattle. These N concentrations decline over time as the urea is converted to ammonium-N and nitrate-N and is taken up by pasture or lost to the atmosphere

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as N-containing gases (including nitrous oxide, a greenhouse gas) or as leached N lost to waterways or ground water. Although only a relatively small area of pasture (say up to 15%) is influenced by urine at a single grazing, the urine patch effect persists for some time and the pasture in the patch responds strongly I terms of growth. This pasture can comprise a significant proportion of an animal's diet in the cooler time of the year, so animals routinely consume urea-boosted pasture (from urine) completely independently of fertiliser N application.

- The vast majority of experiments with pen-fed or grazing animals in NZ have found that consuming N-boosted pasture has relatively minor direct effects (both positive and negative) on animal performance. The economic implications of these minor effects are insignificant compared to the implications of under-feeding at key times of the year, or reducing stocking rate to lower the risk of running out of feed in winter-early spring.
- From an animal perspective, what is of greater concern is that the surplus crude protein in both N-boosted and non-boosted pasture is excreted in urine which leads to issues around environmental impacts of grazing systems through increased greenhouse gas evolution and N leaching.