RESEARCH
FACT SHEET

Ballance agri-nutrients

POST-DROUGHT NITROGEN USE

Most years, drought affects farmers in some part of New Zealand, causing serious issues with feed supply, productivity and profitability. Urea is commonly applied after the first rains fall, even though this rain may not be sufficient to elevate soil moisture levels in the long term. There is debate over whether this is the best course of action. Conventional wisdom suggests that there will be sufficient soil mineral N to support growth at this time, thus the benefit of adding fertiliser nitrogen will be negated. Furthermore, it is thought that adding additional nitrogen could increase the risk of nitrate poisoning. To examine these matters, Ballance commissioned research into the subject, and two experiments were undertaken in drought-affected land in the Bay of Plenty and Hawke's Bay regions.

Experimental Approach

Randomised small-plot trials were set up on one farm in the Bay of Plenty (with a Taupo sandy silt soil) and another in the Hawke's Bay (with a Pallic soil). When the trial sites were established, both farms had experienced drought conditions and soil moisture levels had been low for some time. Within each trial there were five treatments:

A. Control plots, which received no fertiliser nitrogen
B. Test plots that received 25 kg N/ha immediately after the first rain fell
C. Test plots that received 50 kg N/ha immediately after the first rain fell
D. Test plots that received 25 kg N/ha after subsequent rainfall or irrigation
E. Test plots that received 50 kg N/ha after subsequent rainfall or irrigation

In the Bay of Plenty trial, the land was not irrigated and relied on rainfall for moisture supply. This meant that it dried out again after the first rainfall. In the Hawke's Bay trial, the land was irrigated after the first rain fell so that soil moisture was maintained at around 33% in the top 0-8 cm. In this instance, treatments D and E were applied four weeks after the initial rainfall.

Effect of fertiliser nitrogen on dry matter production

A pasture dry matter response to nitrogen was noted at both trial sites when urea was applied after the first rainfall. This response varied from 3.7:1 (treatment B, Bay of Plenty) to 9.3:1 (treatment B, Hawke's Bay). Nitrogen responses persisted over the following four weeks, with pasture responses still noted at the second harvest at both sites. Nitrogen fertiliser applied after subsequent rainfall or irrigation (treatments D and E) also produced a dry matter response at both sites, ranging from 9.8:1 (Hawke's Bay) to 10.8:1 (Bay of Plenty). Importantly, the total dry matter response recorded at the end of the trial was similar in all treatments and at both sites (around 12:1), regardless of whether the nitrogen had been applied after the first or subsequent rainfall.

Soil nitrate and ammonium

Soil nitrate and ammonium levels were measured at intervals throughout the experiment. Figures 3 and 4 show soil nitrate levels for the control, treatment B and treatment C plots, at 0-75 mm depth. In the Bay of Plenty trial, there was a flush of soil nitrate after the first rain (1 March), then levels gradually declined throughout the trial. In Hawke's Bay, soil nitrate levels were initially high, then declined rapidly following rain on 3 March. There was a slight flush following irrigation and nitrogen application on 7 March.

Soil ammonium levels were generally low at both sites during drought conditions. At the Bay of Plenty site, ammonium levels rose after the first rain and application of nitrogen, but declined within a matter of weeks. This effect was also seen at the Hawke's Bay site, along with a smaller increase after the later application of nitrogen.

Herbage quality

One major risk during a post-drought period is nitrate poisoning, especially on cloudy days. Analysis of herbage samples taken during this trial showed that nitrate-N levels remained below the critical level of 0.21% for the duration of the trial. In the Bay of Plenty trial, the highest nitrate level recorded was 0.12%, while in the Hawke's Bay trial the highest level recorded was 0.19%.

Plant total nitrogen levels tended to be slightly on the low side of normal (4.5-5.5%) at both sites. At the Bay of Plenty site, herbage total nitrogen content ranged from 3.54% to 5.41%, while at the Hawke's Bay site the range was 3.02% to 5.20%.

Conclusion and recommendations

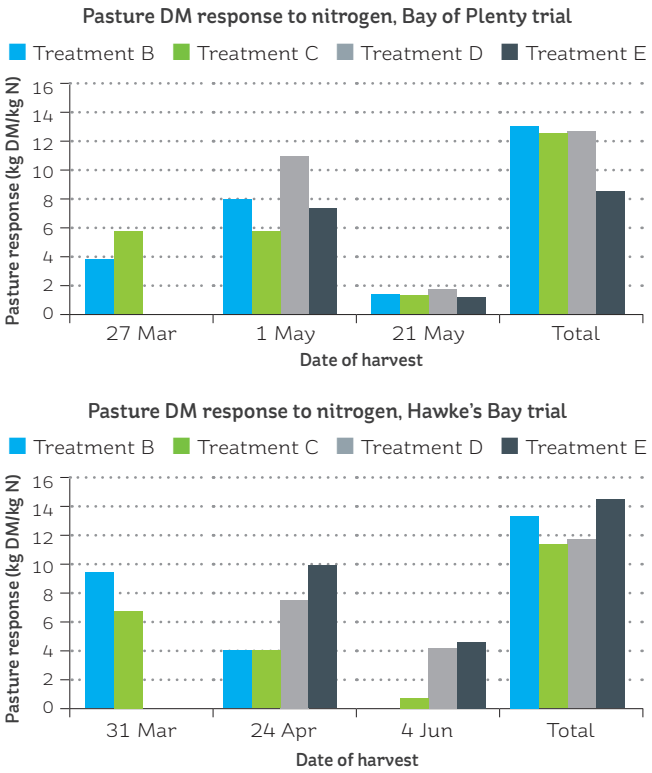
While farmers have traditionally been advised to wait until pasture begins to recover from a drought before applying fertiliser nitrogen, this research indicates that nitrogen can safely be applied to pasture after the first significant rains have fallen.

The key findings from this work are:

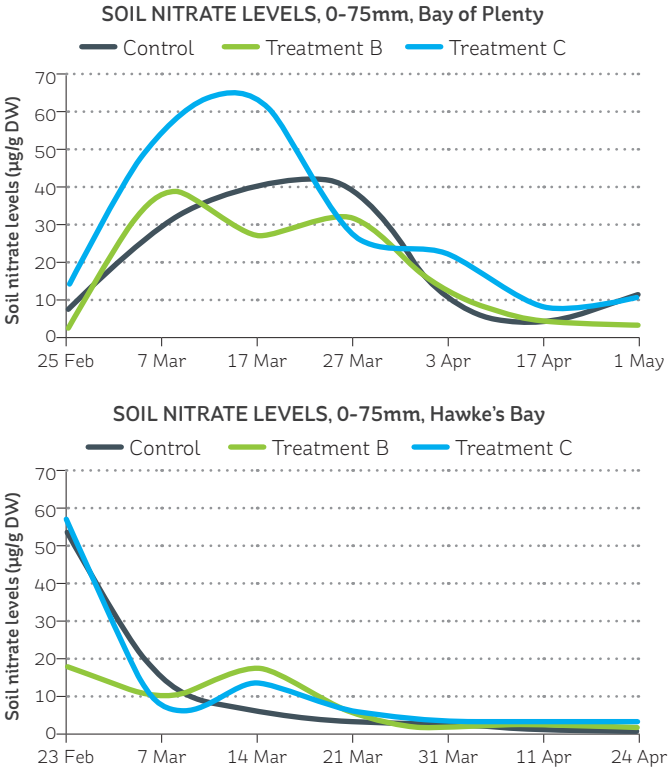
- Nitrogen applied after the first drought-breaking rain will produce a pasture response
- The initial pasture responses will be greater if soil moisture levels do not decrease after the first rain falls
- Any nitrogen not used immediately by the pasture is not lost from the system; once more rain arrives, a carry-over pasture response to residual fertiliser nitrogen will occur

Although the pattern of response to nitrogen fertiliser is affected by soil moisture levels, the overall pasture response will be similar regardless of whether nitrogen is applied after the first rainfall or whether it is deferred until further rain has fallen.

It is recommended that farmers apply nitrogen fertiliser as soon as the first drought-breaking rains fall. They should also take measures to reduce the risk of nitrate poisoning, e.g. by having other feed on hand so that pasture is not the sole dietary intake.



FIGURES 1 AND 2
Pasture dry matter response to urea applied to drought-affected land. Fertiliser nitrogen was applied after the first rainfall (treatments B (25 kg N/ha) and C (50 kg N/ha)) or following subsequent rainfall or irrigation (treatments D (25 kg N/ha) and E (50 kg N/ha)).



FIGURES 3 AND 4
Soil nitrate levels (0-75 mm depth) at test sites in Bay of Plenty and Hawke's Bay. In Bay of Plenty, treatments B (25 kg N/ha) and C (50 kg N/ha) were applied 5 March. In Hawke's Bay, treatments B (25 kg N/ha) and C (50 kg N/ha) were applied 7 March.

Updated 13 February 2015
ONYX 15971