Funded by Sustainable Farming Fund

Ministry for Primary Industries
Manatū Ahu Matua

Systems fodder beet

Managing the inputs

The second season of trial work on fodder beet agronomic solutions has shown little or no effect of potassium fertiliser on plant yield at final harvest and the same for nitrogen fertiliser where soil fertility levels are already high. That could mean fertiliser savings and therefore improved profitability of the crop by up to three cents per kilogram of drymatter (DM), or $750/ha for a crop of 25 tonne DM/ha.

Plant & Food Research scientist, John de Ruiter, reported on the results of the Ministry for Primary Industries (MPI) Sustainable Farming Fund (SFF) project at a Hamilton seminar in early July. The study is investigating some key challenges with fodder beet production as well as demonstrating good management practices. While these primarily relate to yield of fodder beet, they also take into account profitability and suitability of the crop for feeding.

The first season of trials in 2016/17 involved crops planted at seven sites around the country, two each in Southland and Canterbury and a trial on farms in Whanganui, Taranaki and the Waikato.

Soil properties were measured in the paddocks before establishment of nitrogen (N), potassium (K) and boron (B) plot trials looking at the timing and rate of fertiliser application.

Soil pH levels ranged from 5.7 to 6.3, and Olsen P levels from 11.3 to 27. Calcium Quick Test (QT) values ranged from 6 to 11.5, magnesium from 16.5 to 25.5, potassium from 2.8 to 13.5 and sodium from 7.8 to 12. Boron ranged from 1 to 2.7 parts per million (ppm).

Crop performance was also assessed with three harvests for biomass during the season, as well as monitoring for plant health and insect and weed presence. While there were some differences between sites in the yield response to nitrogen, most crops peaked at less than 100 kg N/ ha applied.

Differences between treatments were more apparent in N concentration and N uptake, de Ruiter said. However, there is a need to manage the nitrogen inputs given information about the soil N supply characteristics of individual paddocks and locations.

"In year one, the range of starting mineral nitrogen was 35kg N/ha in Southland through to 355 kg N/ha in the Waikato," he said.

Questions arose after the first year's results and there was a need to confirm the nitrogen responses over a lower range of application rates, and to determine how consistent the responses were over a wider range of sites and soil types.

In the second year, nitrogen and potassium fertiliser treatments were modified, and again soil properties were measured before and during the 2017/18 trial. Three of the same farms were used for trials in South Canterbury, Whanganui and the Waikato, and new trial sites were set up on farms in Mossburn (N trial) and Gore (K trial) in Southland.

Available mineralisable nitrogen (AMN) levels were 82kg N/ha on the South Canterbury farm, 138kg/ha on the Whanganui farm, 175kg/ha at Mossburn and 271kg N/ha in the Waikato. There was less variation in the soil pH levels, varying from 5.7 to 5.9, and Olsen P readings of between 13 and 25. Calcium ranged from QT 7 to 12.3, magnesium from QT 14.3 to 27, potassium from QT 3 to 21.7 and sodium from QT 6.7 to 13.3.

Pre-season mineral N was high at the Waikato and Southland sites, de Ruiter said. Even though the soil in Mossburn was shallow and stony it still had a high readily available N level of 180 kg/ha measured in the top 30cm.

At the South Canterbury and Whanganui sites, this base level was around 50kg N/ha. These soils were deeper and there was a supply of readily available nitrogen down to 90cm. The Waikato site was generally very fertile with high base levels of potassium and nitrogen and adequate minerals. There was 140kg N/ha available in the top 30cm, 110kg from 30–60cm and 45kg from 60–90cm.

"If we were to expect a nitrogen fertiliser response it would have been at the South Canterbury and Whanganui sites," he said.

On Peter Risi's Waitoa dairy farm where the Waikato trial was carried out Bangor was sown on September 25 at a rate of 100,000 plants per hectare, which produced an established plant population of 87,400 plants/ha. The whole trial area received pre-sowing basal fertiliser of 250kg/ha of triple super (50kg P/ha), 150kg/ha of AgSalt and 30kg/ha Borate 46 (4.5kg of Boron/ha).

In the second season, there were three replications of five different levels of nitrogen application at 0, 50, 100, 200 and 300kg N/ha all applied in two equal dressings on October 18 and at canopy closure on December 14. Two applications of the full rate of 350ml/ha of Escolta fungicide went on as normal on January 12 and February 16.

"The Waikato farm had more nitrogen available at sowing and more left at the end of the season," de Ruiter said.

There was no response for rate of nitrogen application on yield when the fodder beet was harvested on May 23 with the control treatment producing 23.1 tonnes DM/ha compared with 16.4t/ha where two applications of 25kg N/ha went on. At two applications of 50kg the yield was 16.9t/ha, at the double 100kg rate 16.3t/ha and at two times 150kg applications 18.4t/ha.

While the Whanganui trial yield figures were 22t/ha for the control, they rose to more than 25t/ha in the trial where two applications of 100kg of nitrogen went on. There was a strong linear effect of the rate of fertiliser N application on the whole plant nitrogen concentration in the Waikato trial which tailed off at higher levels. This increased from 1.5% N in the control up to 2% N when three applications totalled 100kg N/ha. The Whanganui trial showed a lift from 1% N in the control to 1.88% N when two applications of 150kg N/ha were made.

There was also a strong linear effect of rate on nitrogen uptake. While the control wasn't significantly different to all the other treatments combined, there were significant differences between the low and high nitrogen rates.

No yield increase was seen with the increased nitrogen application rate with the average yield 18.2t DM/ha. Total nitrogen uptake increased from 215kg/ha for the control to 419kg/ha for the 300kg N/ha treatment.

Yield was lower in the second season primarily because of high disease presence which was not controlled by fungicide, de Ruiter said. The current season's crop averaged 18.2t/ ha compared with 25.8 in the previous season. The N concentrations and N uptake results were consistent between years with higher N rates resulting in more N uptake and higher N concentrations.

"The maximum economic nitrogen rate was between nil and 50–IOOkg N/ha depending on the site fertility. At Waikato the maximum yield was attained with no N applied. This result needs to be considered in the context of a quite fertile site," he said.

"Fodder beet response to N was indicative of luxury feeding. It will take up much of the nitrogen applied up to 300kg N/ha but there's no effect on the final yield, just on the N concentration in the plant.

"If nitrogen was applied late in the growing season it could increase whole plant protein levels if there is continued active leaf growth," he said.

"But the net effect would likely be minimal in terms of promoting increased N concentrations because the continuing bulb growth will dilute the whole crop N".

When it came to potassium trials with fodder beet crops seven sites were used in the first year and three in the second. Treatments in the current season were single applications of 150kg K/ha or 300kg K/ha which showed average biomass production of 21.8t DM/ha and 22.3t compared with the control at 21.5t/ha. There were also three applications of IOOkg/ha and the same of 150kg/ha resulting in crops of 21t DM/ha and 21.4t/ha.

The second season potassium trial sites were located at Gore, South Canterbury and Whanganui on sites with moderate to low K levels. With lower soil potassium levels at the Gore and Whanganui sites in particular, a response to K could have been expected, de Ruiter said.

Only one site in either season showed a response for yield, and only when comparing a control treatment (OK) with 150kg/ha of potassium. All other sites showed no effect of rate of potassium application or whether it was applied in single or multiple split applications.

But there were small differences in the potassium concentration in the whole plant when increased levels of potassium were applied. These averaged 1.72% for the control and 1.98% when 150kg K/ha went on. There was no significant change in potassium uptake with the rate applied although de Ruiter said a trend was suggested with an average uptake of 361kg of potassium per hectare for the control lifting to 464kg/ha where 150kg/ha was applied.

These findings should make farmers question whether it was worthwhile applying high rates of potassium on fodder beet. The crop accumulates large amounts of K if it is available for uptake. The trials had shown that the yield response over a range of sites and soils was consistent, with the sites used in the second year of the trial performing the same as in the first. The crops did differ in the concentration K in the whole plant and the amount of K taken up.

"The existing potassium levels and mineralisation of reserve K may be enough to keep the crop growing up to the level required," he said.

"We also have to work out what is happening to the potassium which is being taken up," he said.

"If it's being fed in the paddock some of it will be returned. If the crop is lifted and fed elsewhere, we need to account for the paddock K loss, and apply K to restore the soil to base levels."

End of season soil tests after last year's trial had shown quite a lot of potassium left over at some of the sites.

de Ruiter showed gross margin analysis figures showing a potential $200/ha saving on nitrogen fertiliser if application rates were dropped from 300 to 100 kg N/ ha. And there could be a $300/ha saving on potassium if this came back from 350 to IOOkg/ha. The aim for economic production should be to grow at least 20t/ha of fodder beet with input costs of less than 15 cents/kg DM, he said.

Fertiliser savings alone would adjust profitability by up to 3c/kg DM (assuming a 20t/ha crop). More work needs to be done to verify the longer-term implications for productivity and sustainability if reducing fertiliser inputs, he said. There are also strong reasons to maintain a moderate level of fertiliser inputs to ensure healthy crops.

A fungicide and canopy health demonstration was run at five sites, two in Southland and one each in Canterbury, Whanganui and the Waikato. But with no replications de Ruiter said it wasn't possible to form any conclusions.

There were no differences in the final yield of the crops when comparing control (no fungicide) with single or double fungicide treatments. But there was a difference between the sites in the amount of leaf remaining on the plants at harvest which reflected the amount of disease present.

All plants showed some sign of leaf disease in mid-February on both the Waikato and Whanganui farms. In December the crops had less than 25% infection rate. But the severity of damage was less in Whanganui at up to 20% severity level in May compared with up to 50% in the Waikato in February and May. There was some recovery after the initial leaf necrosis in the Waikato but bacterial leaf spot was a major influence on the final yield.

"By February there was pretty much plant shut down, with little bulk DM added in the final 10 weeks," he said.

In the coming season, the project's last, the concentration will be on on-farm demonstrations of good establishment and management options. The production of good crop management guides for farmers is also planned with de Ruiter saying while generalised management tools would be included it would be stressed that these would need to be varied according to where the fodder beet was grown.

Industry partners for the project are Foundation for Arable Research, DairyNZ, South Island Dairy Development Centre (SIDDC) Beef + Lamb, Ravensdown, Ballance Agri-Nutrients, Agricom, Agriseeds, Bayer CropScience, DLF, SeedForce and Cropmark.

Reprinted from *NZ Dairy Exporter,* www.nzfarmlife.co.nz August 2018. Words by Glenys Christian.