beef+lamb new zealand

RESEARCH AND DEVELOPMENT

JANUARY 2007

R&D BRIEF 126: USING CLOVER AND NITROGEN TO IMPROVE COCKSFOOT DRYLAND PASTURES

This R&D Brief presents some interim findings from the Max Clover project. It outlines how nitrogen (either bag fertiliser or through legumes) can improve the quality of dryland grasses such as cocksfoot. Including subterranean clover is a cost-effective way of making cocksfoot-based pastures more palatable and productive in spring. This is key to generating high annual stock performance in dryland systems.

WHY INCLUDE LEGUMES IN DRYLAND PASTURES?

IMPROVED STOCK GROWTH RATES

Stock growth rate increases as legume content increases in the pasture. Monitoring at Lincoln University farm Ashley Dene shows that good-condition lactating ewes on pasture with a high level of sub-clover in the diet (30-40% of sward) can grow lambs at 400 grams/head/day from birth to weaning. Clover contains 12 megajoules of metabolisable energy (MJ ME/kg DM).

FIX NITROGEN

All legumes fix nitrogen into their root systems. As shown in the Max Clover study on cocksfoot, nitrogen can double cocksfoot growth rate and its annual energy (ME) production. The grass becomes more worthwhile as a feed source.

AIMS OF THE STUDY

This Beef + Lamb New Zealand-funded project was carried out by Lincoln University. It aims to answer the questions:

a. What are the nitrogen (N) and water barriers to getting cocksfoot to perform at its best (quality and quantity)?

b. How does including legumes in the pasture impact on grass performance (namely cocksfoot, ryegrass)?

c. Which legumes make the best match with different grass species?

THE GROWTH AND QUALITY POTENTIAL OF COCKSFOOT MEASURED

Farmer's tend to have a love/hate relationship with cocksfoot. It can be unpalatable and a slow starter in spring but it can produce valuable feed during summer dry conditions.

Research by a PhD student at Lincoln University aimed to fi nd the true potential of cocksfoot. This was done by providing high nitrogen applications and adequate water (through irrigation). Production from the Wana cocksfoot single-sward pasture was measured, given different soil temperatures, moisture and nitrogen levels.

Cocksfoot is a necessary part of a dryland farm system. It is the second most common pasture grass sown in New Zealand.

TOP COCKSFOOT YIELD TWENTY-TWO TONNES

Results showed the environmental maximum yield (with irrigation and nitrogen) was 22 tonnes dry matter (ha/year).

The fastest growth recorded was 7kg DM (ha/day) for every degree above 3°C. It was found that nitrogen is key to spring production of cocksfoot and sward quality as summer advances.

At this time nitrogen was more important than soil moisture content for cocksfoot growth.

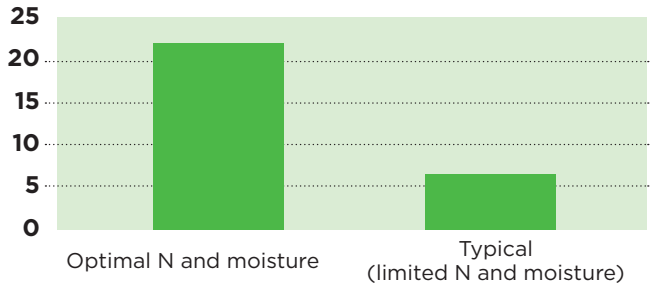

Figure 1: Cocksfoot production (tonnes DM/ year) in optimal and typical dryland conditions, Beef + Lamb New Zealand.

Farmers' experience big ranges in DM production from cocksfoot (usually 5-12t/ha/year) and improving legume content will help overall yield. If both nitrogen and moisture are limiting, which is the case on most dryland farms, cocksfoot will only grow at about 25% of its potential. In this study it produced only ~6.5t DM/ha in the year.

COCKSFOOT QUICK TO 'SWITCH ON/OFF' WITH MOISTURE

The effect of moisture levels on cocksfoot was also studied. Results show that cocksfoot growth will switch off quite quickly when soil moisture is sub-optimal. However, it quickly reaches fast growth rates again when moisture becomes adequate.

NITROGEN THE LIMITING FACTOR IN SPRING?

Applying 50 to 100kg/ha of nitrogen in spring to cocksfoot would provide enough nitrogen to grow at about 80% of the maximum expected 7kg DM/day for every degree day over 3ºC.

SPRING EXAMPLE 1.4T VERSUS 0.6T:

If N and water are suffi cient, a 30-day rotation in September (mean day/night temperature of 9.2ºC) would produce 1.4t/ha.

In contrast, the normal nitrogen defi cient pastures produce only 0.6 t/ha. The spring application is important because this is the only time when soil moisture levels are reliable for dryland farmers.

LOWER NITROGEN MEANS SLOWER GROWTH

Without ample nitrogen, cocksfoot grew at 3.2kg DM/ha for every degree (°C) day over three degrees. For example, if the mean daily temperature was 5°C then it grew at 6kg DM/ha. This is a typical rate for most farms.

WHAT IS A DEGREE DAY?

Degree days are calculated from the daily minimum plus maximum temperature, divided by two to get a daily mean. Then the base temperature is subtracted (in this case 3°C).

When plenty of nitrogen is available, at levels equivalent to a sheep urine patch, cocksfoot grew at over twice the rate. The study showed a rate of 7kg DM/ha for every degree (°C) day over three degrees. This is the ultimate level, when moisture is adequate.

On an annual basis, this is the difference between 10t/ha and an impressive 22t/ha (even if both areas are irrigated). Nitrogen generates these high results by boosting the photosynthesis ability of leaves.

LESS NITROGEN MEANS LESS CRUDE PROTEIN AND ENERGY

As well as impacting on growth, nitrogen defi ciency means the grass is less palatable. Annual crude protein yield of cocksfoot with nitrogen was 3.7t/ha but only 1t/ha without nitrogen.

Total annual metabolisable energy was higher from the extra nitrogen pastures. It was 183 and 172 GJ ME/kg DM compared to only 69 GJ ME/ha from pastures with low nitrogen.

Only at one point were the low nitrogen and high nitrogen pasture growing at a similar rate. This was during summer when moisture was limited.

> As bag nitrogen is not always cost/effective in dryland farming situations, legumes may be a more sustainable long-term option. In September dryland cocksfoot pasture produced 10kg DM/kg N applied. If the nitrogen was applied as urea at $1.34/kg N, each kg of additional DM costs 13.4c (based on 2006 prices).

LEGUMES MOST COST-EFFECTIVE WAY TO 'ADD' NITROGEN AND IMPROVE COCKSFOOT QUALITY AND QUANTITY

Research suggests that sub-clover is the most practical non-fertiliser way for fi xing nitrogen into dryland soils and improving overall pasture quality and quantity.

> **HOW MUCH N DO LEGUMES FIX?**
> Legumes fix about 25kg N per tonne of DM grown. For example, 3000kg DM of sub-clover grown over a year would fix 75kg N.

BETTER LAMB LWG ON COCKSFOOT/SUB CLOVER THAN RYEGRASS/WHITE CLOVER

Research showed that cocksfoot together with sub clover produced more liveweight gain in lambs in spring than cocksfoot on its own and ryegrass/white clover pastures.

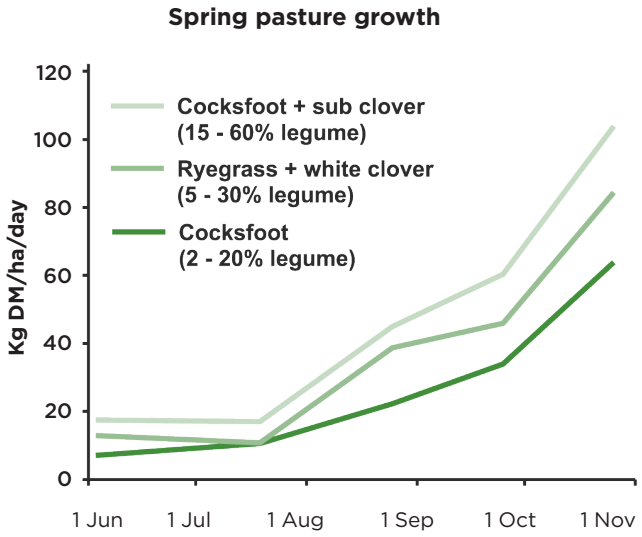

Figure 2: Cocksfoot and sub clover grew more herbage than ryegrass/white clover over spring, MAX Clover project, beef + Lamb New Zealand.

Cocksfoot/sub clover pasture grew at a slightly faster rate in July and maintained this lead over ryegrass/white clover into spring.

In early September, cocksfoot daily pasture production leapt ahead to 50kg DM/day while ryegrass levelled off at 40kg. Legume content ranged from 15% to 60%—double that of the white clover in with the ryegrass.

Most importantly, the extra production translated into more lamb liveweight.

Ryegrass/white clover only managed around 75% of cocksfoot/sub clover performance.

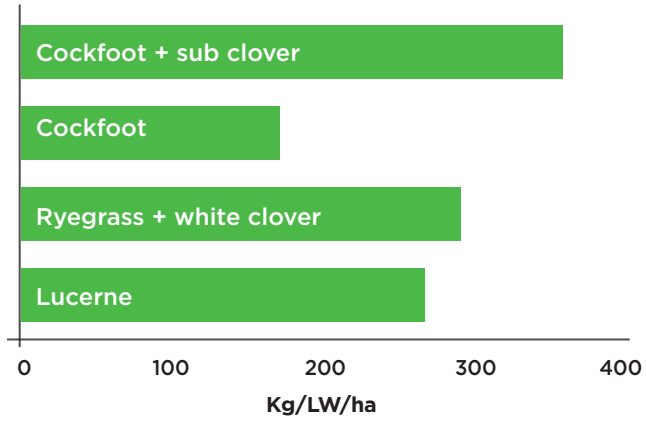

Figure 3: Spring live weight production (9 September - 17 October 2005)

From mid-December to mid-February in the trial, ryegrass/white clover pastures dried off to the point where they could not be grazed. On the other hand, Vision cocksfoot produced 56kg of LW gain/ha (hoggets stocked at 14/ha). At this time the Denmark sub clover had flowered set seed and died.

WHICH LEGUME TO USE?

SUB CLOVER (ANNUAL) THE BEST

Sub clover and cocksfoot can be a productive pairing. The biology of sub clover suits cocksfoot as it has early growth in spring, before cocksfoot gets going. This means the clover it is not dominated and shaded out which can happen when paired with ryegrass.

Most sub clover seed is set by late December. The plant then dies, releasing a fl ush of nitrogen from its roots. By this time cocksfoot is growing strongly, producing persistent grass even in dry conditions. The pasture can be hard grazed in late summer, allowing ample light and space for germination of sub clover. Having a higher nitrogen content in autumn (3% N versus 2.2% for pure cocksfoot sward) means the cocksfoot is more palatable. It can be 'cleaned up' more readily by stock.

WHITE CLOVER (PERENNIAL) NOT IDEAL

White clover is not the most persistent or productive legume on dry sites. It is not a good match with cocksfoot because they are both summer growers and the cocksfoot becomes too dominant by grabbing any available summer rainfall. This reduces the amount and persistence of perennial clovers.

LUCERNE

Lucerne showed superior growth rates in lambs over summer but it can not be grazed as early as sub clover/grass pastures. However, its strengths are providing high quality feed in summer so it should be an important part of the matrix of feed for a dryland farm.

MORE INFORMATION

Related Beef + lamb New Zealand resources:

R&D Brief 64 Grass species and fertiliser options for finishing beef on hill country.

R&D Brief 82 Pasture persistence for profits.

R&D Brief 98 Improved forage systems.

R&D Brief 125 Annual legumes enhance animal production from summer dry pastures.

R&D Brief 127 Using subterranean clover.

R&D Brief 128 Using Caucasian clover.

MAX Clover project leader:
Derrick Moot Moot@lincoln.ac.nz

For further information freephone Beef + Lamb New Zealand on 0800 BEEFLAMB (0800 233 352) or email enquiries@beeflambnz.com or visit www.beeflambnz.com

REDESIGNED AUGUST 2014.