Future Dairy Farm Systems for Northland Project

Summary
Farmers are being given a clear message from government and society to lower their greenhouse gas emissions. This project will demonstrate strategies that may help farmers adapt their farm systems to mitigate the effects of climate change and comply with changing regulations. It will test the effectiveness of three dairy farm systems: one currently common to Northland dairy farms, one using pasture species better adapted to a warmer climate, and another designed to achieve future greenhouse gas emission targets.

Background
Recent farm systems trials at the Northland Agricultural Research Farm (NARF - Dargaville) have indicated that a pasture-based system with relatively small quantities of imported feed to fill deficits is a profitable and resilient farm system. However, there are questions over the ongoing productivity of ryegrass-based pastures in a warming climate. In addition, constraints on GHG emissions will demand changes to farm systems.

Northland farm systems are at the forefront of the effects of a warming climate and demonstrate the challenges that the rest of New Zealand will experience over time. In Northland, ryegrass persistence is relatively poor, rust and pest damage are increasing and regression to kikuyu often occurs within 3 years. Kikuyu is productive during summer/autumn, however it is difficult to manage and has very poor winter/spring growth. The performance of alternate pasture species such as tall fescue, cocksfoot, legumes and herbs seem to be better and the reinvasion of kikuyu considerably slower.

We are also being given a message from government to lower GHG emissions on dairy farms. There is plenty of modelling information, however farmers are uncertain as to whether the strategies are physically or financially sustainable, particularly the lowering of stocking rate on pastures containing kikuyu.

This project will conduct a farm systems trial at NARF to test and compare three farm systems which may be used in the future to mitigate and alleviate the effects of a warming climate.

Trial Design
This project will compare three farm systems being:

1. **Current farm** (Red) – existing ryegrass/kikuyu pasture farm system with imported feed (likely PKE) to fill feed deficits. Stocking rate 3.0 cows/ha and up to 190 kg applied N/ha
2. **Alternative Pastures farm** (Blue) – at least 75% of pastures in fescue, cocksfoot, legumes & herbs with imported feed (PKE) to fill feed deficits. Stocking rate 3.0 cows/ha and up to 190 kg applied N/ha
3. **Low Emissions farm** (Green) – existing ryegrass/kikuyu pasture farm system that targets a 25% reduction in methane emissions and 50% reduction in nitrous oxide emissions (compared to the

Current farm). Stocking rate 2.1 cows/ha, no nitrogen application. Imported supplement and little or no imported feed

This farm systems trial commences on 1st June 2021 and runs for four years to test these systems under a range of climatic conditions. Pastures on the Alternative Pastures farm will have a mix of 15 month old and 3 month old pastures at the time of the trial commencement. Pasture sowing will continue in future seasons at 10% of the farm/annum to maintain over 75% of the farm in these pastures.

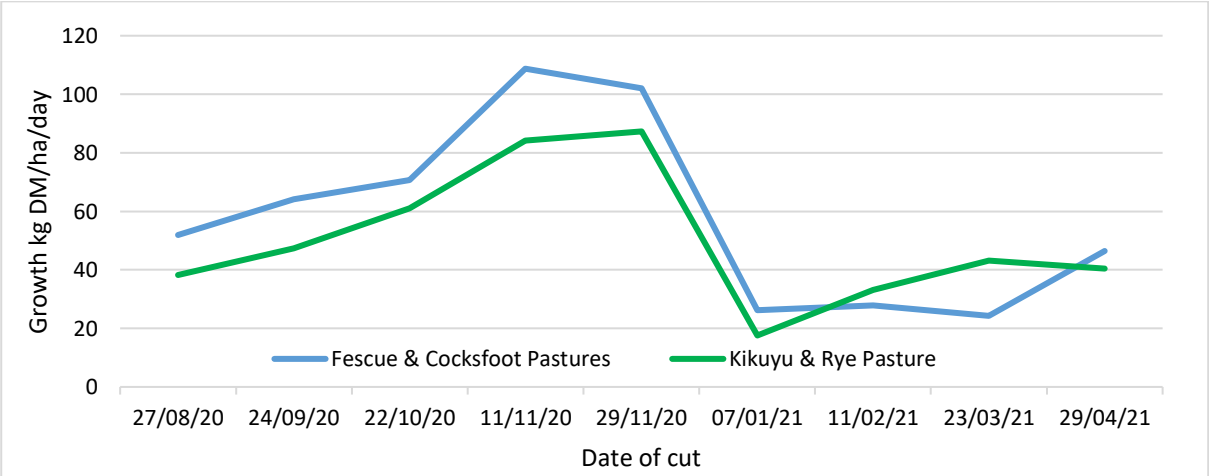
Trial measures will capture pasture and milk production, milk composition, profit and people (labour input and management difficulty) data on the three systems.

Pasture Introduction and Monitoring – so far

To set up the Alternative Pastures farm, 9 ha of new pastures were sown in May 2020. Grass species sown was fescue or fescue and cocksfoot, with white clover, red clover and Persian clover. Another 11 ha was sown in March 2021 either fescue or fescue and cocksfoot or cocksfoot with white clover, red clover and chicory (only 1 kg/ha).

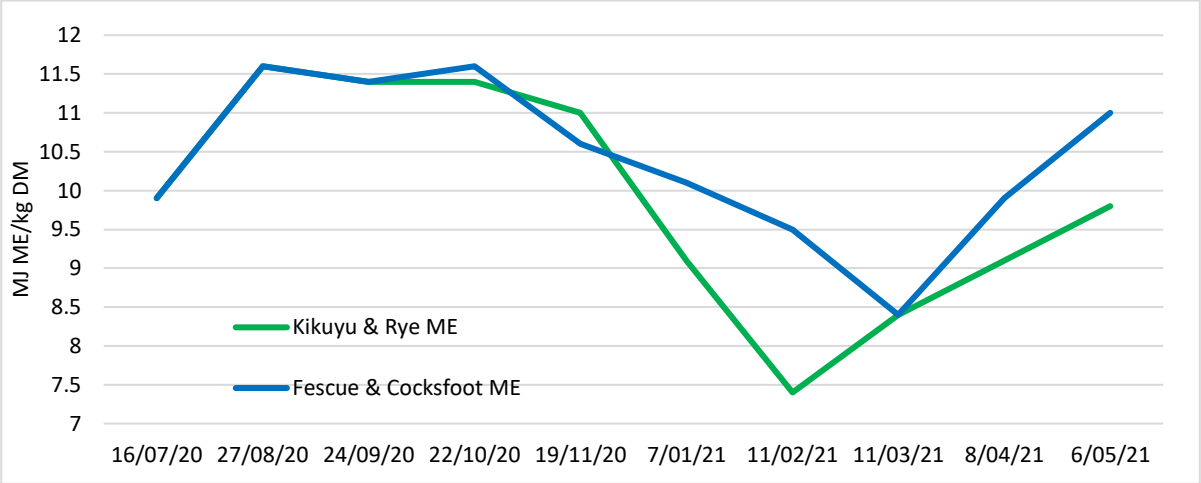
Pasture growth, composition and quality has been compared between the resident kikuyu/Italian ryegrass pastures and the Fescue/Cocksfoot based pastures since July 2020. Figure 1 shows the pasture growth differences between these pastures as measured by cutting cages. The newly sown fescue/cocksfoot pastures showed higher pasture growth rates during late winter through to early summer, while the kikuyu-based pastures showed higher growth rates through late summer/early autumn. This monitoring indicates that the fescue/cocksfoot based pastures have produced 1281 kg DM/ha more than the resident pastures.

Figure 1. *Pasture growth rates as measured by cage cuts.*



Pasture quality monitoring, as indicated by lab analysis of pasture ME (see figure 2), has shown that the two pasture types had similar pasture quality through late winter and spring, however the fescue/cocksfoot pastures showed higher pasture quality through most of summer and autumn.

Figure 2. *Pasture metabolisable energy content (MJ ME/kg DM).*



Modelling of Farm Trial Systems

Farmax and Overseer computer modelling was used to establish stocking rates and management strategies, and to determine production, financial and environmental outputs. Farm systems were tested under three different climatic conditions, being an average season, a wet winter and a dry summer. Changes in milk price and feed costs were also examined.

Modelling shows that if no nitrogen is applied to the Low Emissions farm, little or no imported supplements are used and stocking rate is reduced by 26% then this farm will show a reduction of 24% in methane emissions, 47% in nitrous oxide emissions and 54% in nitrogen leaching, compared to the Current farm system.

Pasture growth rates used in the modelling are shown in figure 3. Anticipated response rates to nitrogen range from 10:1 to 15:1 depending on the season.

Figure 3. *Anticipated pasture growth rates used in modelling.*

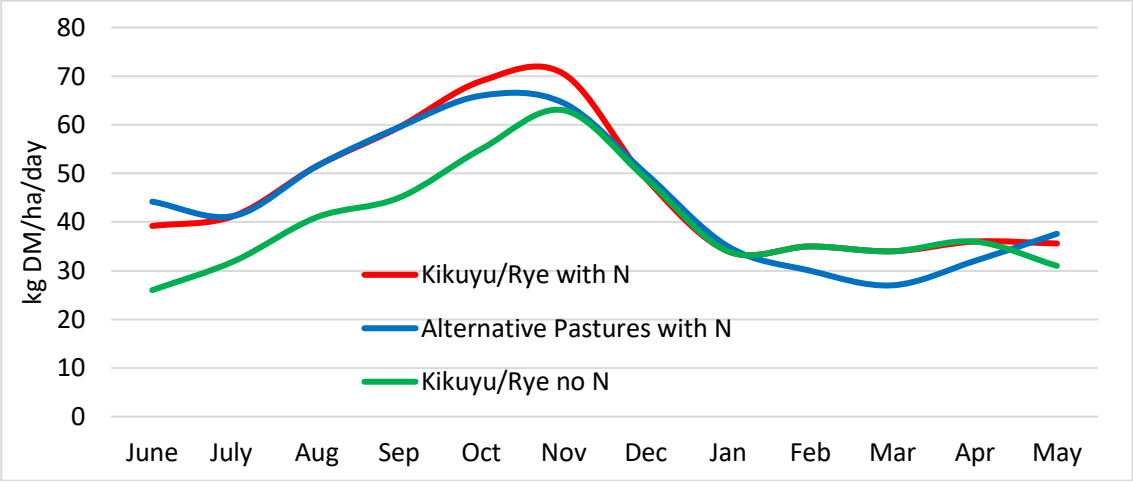


Table 1 shows the predicted milk production under three different climatic conditions: an average season, a dry summer/autumn and a wet winter/early spring. The Low Emissions farm is predicted to have significantly lower production than the other farms under all climatic conditions.

Table 1. *Predicted Milk Production (kg MS/ha) under variable climatic conditions.*

	Total Milk Production/ha		
	Average Season	Dry Summer	Wet Winter
Current Farm	**1,144**	976	1,122
Alternative Pastures Farm	**1,163**	997	1,128
Low Emissions Farm	**833**	659	744

Table 2 shows the predicted GHG emissions for the three farm systems. The Current Farm and Alternative Pastures farm are predicted to have similar emissions while the Low Emissions farm has lower emissions.

Table 2. *Predicted GHG Emissions* – kg CO_2 equivalent/ha and CO_2/kg milk solids for an average climatic season.

	Methane	Nitrous Oxide	CO_2/kg MS
Current Farm	8,848	3,196	10.4
Alternative Pastures Farm	8,623	3,126	10.0
Low Emissions Farm	6,706 (24% reduction)	1,696 (47% reduction)	9.9 (5% reduction)

Project Management and Funding

This project is initiated and managed by the Northland Dairy Development Trust (NDDT) with support from the Northland Agricultural Research Farm (NARF).

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