Project Update
P4: Feedbase – Maize for Silage

February 2025

On most Australian dairy farms, the costs associated with feed represent at least half of all expenses associated with producing milk. Feed costs can be even higher for those milking cows in intensive Total Mixed Ration (TMR) systems or housed-cow operations. That's why any refinements to the feed base of a dairy farm can have a huge effect on a business' profit.

Maize silage

Maize is a key component in the feed base of many TMR or partial mix ration (PMR) systems because it is a high yielding and water efficient crop.

Several research studies, including projects through the FutureDairy program, proved the water and nitrogen efficiency of growing maize in Australia. Work with farmers across the country demonstrated that maize silage could consistently yield 25-28 tonnes of dry matter per hectare when good management was combined with good water and nitrogen availability.

In trials where maximum amounts of irrigation water were applied, maize silage yielded 5 tonnes of dry matter per megalitre of water – five-times greater than the average response to perennial pastures in the irrigation region of Northern Victoria.

Unlocking the potential of maize

Dairy UP's P4 project aims to unlock the potential of the dairy feed base, with a focus on growing maize for intensive systems.

P4 is a project which integrates precision agriculture with real-time monitoring of plants and soils as well as advanced modelling to grow better forage crops and increase water and land-use efficiency.

This document provides an update on P4: Feedbase – maize for silage.

With no water limitation, maize for silage also yields an average of 150kg of DM per kg of nitrogen.

The quality challenge

The ingredients that determine profitable maize crop yields are clear but ensuring it is then converted to 'high quality' silage isn't as straight forward – yet.

Maize silage is made from the entire plant. Each element has differing starch, fibre, and energy.

To confuse the matter further, metabolisable energy (ME) – a traditional form of determining feed quality – isn't an accurate indication of the quality of maize silage, as the high ME of the grain (starch) can be diluted by the lower ME of the stem and leaves.

Project aim

Ultimately, Dairy UP researchers want to create a decision support tool to help dairy farmers with their maize silage production. Ideally the tool would enable dairy farmers to accurately predict the quality and yield of maize silage. Through real-time monitoring of a maize crop, this tool would also allow dairy farmers to intervene throughout the life cycle of the maize plant to

improve harvest potential. The tool would be underpinned by a modelling program called Agricultural Production Systems sIMulator (APSIM). Developed for other crops including maize for grain, a key focus of the Dairy UP work is to calibrate and test it for NSW maize crops for silage.

In parallel, the Dairy UP team is exploring other maize varieties, such as the highly digestible Brown midrib (BMR), and the interactions between genetics, the environment and management – exploring options for increased maize efficiency and profitability.

Benefits

Managed well, maize silage is an efficient use of water and nitrogen on-farm, but it's an expensive crop to plant. Tools to improve management can have a big impact on maize yield and quality and therefore the return on investment in the crop.

Understanding the potential yield and quality of the final, harvested silage will also help dairy farmers to plan in advance for their feed requirements and should decrease costs.

This work could also benefit other livestock industries that use maize silage as a feed source.

Progress to date (February 2025)

Yield and quality targets

A literature review together with the research helped establish maize silage yield and quality targets while also identifying knowledge gaps.

Maize silage targets include:

- Dry matter yield: 25t DM/ha.
- Starch: at least 35% to dilute as much fibre as possible.
- Harvest index (ratio of grain to total dry matter): 40-50% can dilute the fibre in maize silage.

Knowledge gaps include:

- Uncertainty about how to accurately measure the dry matter percentage of maize silage and if a maize silage with 35 per cent or more dry matter ensures a lower NDF due to increase in starch content.
- How much does sowing time, plant density, water and nitrogen availability determine crop yield and quality? And how can this be monitored in real time?
- How are indicators of silage 'quality' and yield best monitored?

APISM model calibration

The Dairy UP team has tested and calibrated a modelling tool Agricultural Production Systems sIMulator (APSIM) to predict the yield of a silage maize crop. The initial calibration was done with data from FutureDairy and the results have been published in the Frontiers of Plant Science Vol 14. The subsequent validation used data from maize crops on research (FutureDairy feedbase data) and six commercial dairy farms. The farm data was collected through remote sensing and real-time monitoring.

Overall APSIM predicts biomass of maize crops with reasonable accuracy.

The APSIM calibration has room for improvement in dryland conditions, but it provided reasonable predictions of yield and harvest index for irrigated crops across regions.

Figure 1: Data combined for 6 farms

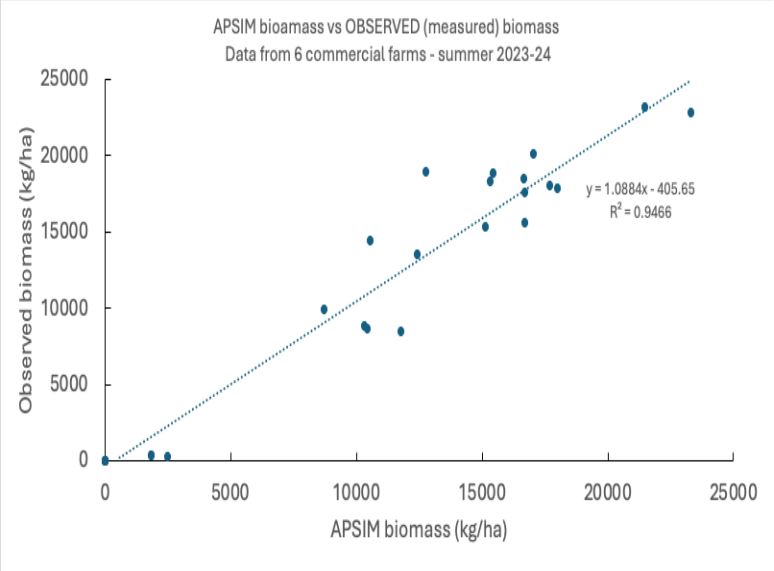
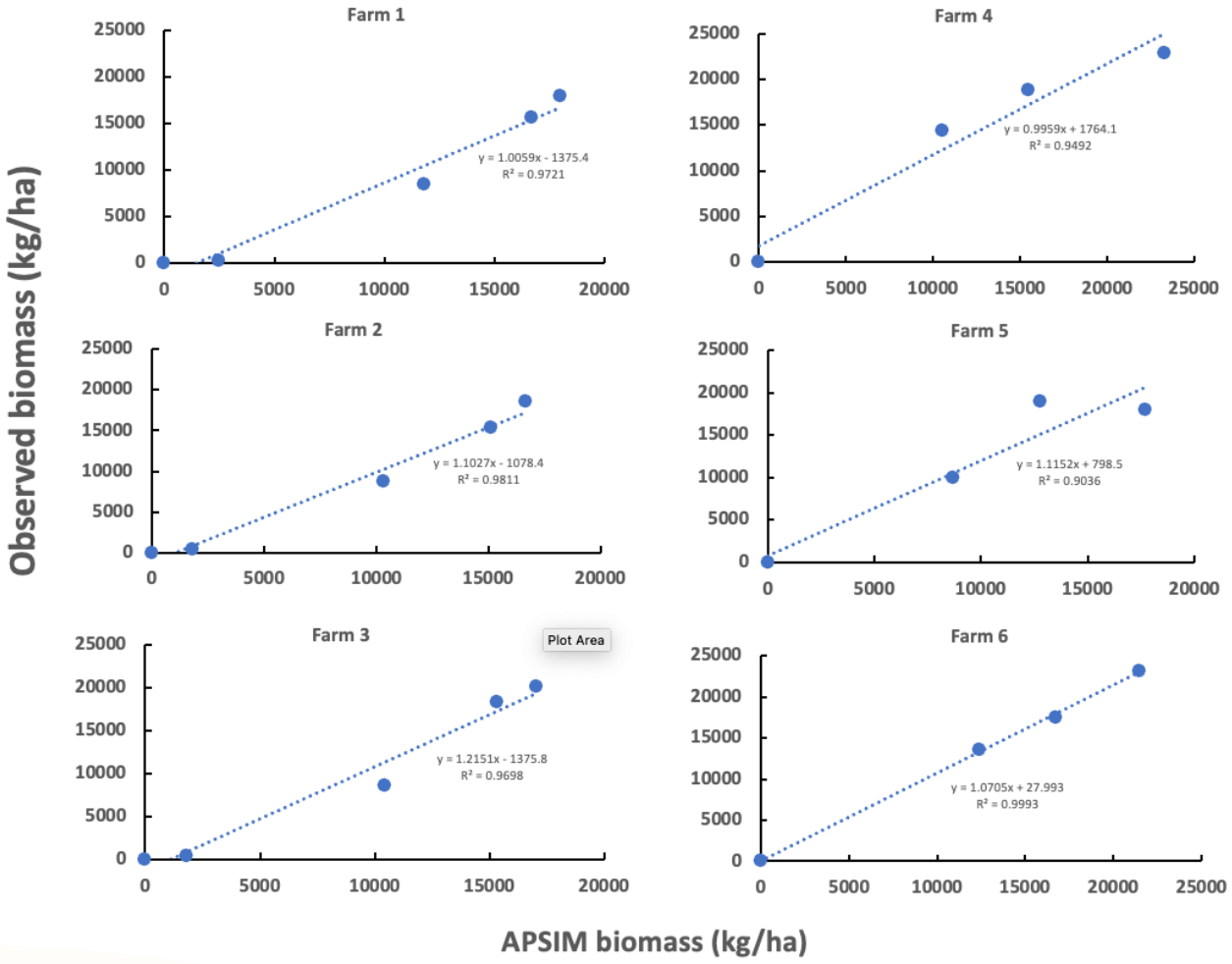


Figure 1 shows the combined data for the six farms.

Figure 2 shows the individual crop/farm data. It demonstrates good performance in all cases.

Figure 2: Individual crop/farm data



The challenge is the lack of gold standard data in terms of actual biomass and grain yield – This was measured through cutting plants but variation with paddock yield was high.

Nutritional value

On farm monitoring

In 2023, Dairy UP researchers evaluated 11 different maize silages across various NSW dairy farms to determine biomass, grain yield and the quality of the crop.

On average, grain in the maize silage was 78% starch and 14 MJ/kg DM, however, there was variation between the different maize cultivars.

Neutral Detergent Fibre (NFD) percentages varied across the rest of the plant. The cob (without the grain) was 70% NDF, while the leaf and stem were at least 60% and the grain was 8%.

Metabolisable energy (ME) of the grain was 14 MJ/kg/DM, while the rest of the plant was 8 MJ/kg DM or less.

Next steps

University of Sydney farm trials

The team is currently collaborating with Pioneer Seeds to evaluate yield and nutritional characteristics of conventional and 'brown mid-rib' (BMR) hybrids grown under full irrigation at the University of Sydney "Lansdowne" farm at Camden. They are also collaborating with the Australian Plant Phenomic Network (APPN), based at the University of Sydney, to monitor how maize performance is influenced by genes and environmental conditions.

DairyUP
Unlocking potential

The project is using drones and advanced technologies.

The findings will provide insight into the extent of nutritional differences of BMR, as well as testing the ability of satellite and APSIM models to predict those differences.

The goal is to integrate APSIM with satellite data to improve yield and quality predictions as well as dairy farmers' ability to monitor, and intervene, in the plants' growth, in real-time.

This should provide the knowledge base to develop a decision support tool.

Read more

Ojeda, JJ et a;. (2023) Field and in-silico analysis of harvest index variability in maize silage. Frontiers in Plant Science Volume 14

More info

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