

Winter forage options to increase yield and quality

C4Milk demonstration trial



Mark Bauer

Dairy Feedbase Development Officer,
Queensland Department of Agriculture and Fisheries

Kieran Ison

Dairy Development Officer,
Queensland Department of Agriculture and Fisheries



Photo 1: Dryland cereal rye.

The C4 milk project is focussed on increasing the profitability, productivity and sustainability of sub-tropical dairy farming systems. A key component of the C4 project is reducing feed costs for all classes of stock and optimising feed quality and quantity. The winter forage combination demonstration trial conducted at the Gatton Research Dairy Unit in 2019 evaluated a range of traditional winter cereal forages, winter protein forages and combinations of cereals and protein forages. The trial plots were grown under both irrigated and dryland conditions, with the plots managed to simulate a single or multiple cut harvest or grazing system. Table 1 summarises the species grown within the demonstration.

The following article highlights the major findings from the demonstration and has categorised them into two sections: Part A – Cereal Crops & Part B – High Protein Crops. The results shown include yield, estimated as tonnes dry matter (DM) per hectare (t DM/ha), and quality parameters including crude protein (CP; % DM), metabolisable energy (ME; MJ/kg DM) and neutral detergent fibre (NDF; % DM). Quality values for samples harvested multiple times throughout the season represent the weighted average as a proportion of the yield from each harvest.

Total water applied (irrigation and rainfall) was 363mm (3.63 ML/ha) and 110mm (1.1 ML/ha) for the irrigated and dryland blocks, respectively.

Winter starch forages	Winter protein forages	Winter combinations
Barley	Canola	Barley & Field peas
Cereal Rye	Faba Beans	Barley & Vetch
Forage Wheat	Field Peas	Oats & Brassica
Oats	Lupins (2 varieties)	Oats & Vetch
Triticale	Vetch (2 varieties)	Triticale & Vetch
		Wheat & Faba Beans
		Wheat & Vetch

Table 1 The range of cereal and protein-based forages assessed within the winter forage demonstration.

Part A: Cereal Crops to increase yield.

Winter cereals such as oats and barley are commonly grown as winter fodder sources, either for grazing or conserved fodder. For this demonstration some less commonly grown species were evaluated against the more traditional options. These included cereal rye, triticale and wheat. All of these species were grown under both dryland and irrigated conditions and harvested as both a single and multiple cut system. The dryland multiple cut option was harvested twice and the irrigated multiple cut option was harvested three times.

Dryland Cereals

- Wheat harvested as a single or multiple cut system had the highest crude protein (CP) levels (>30% CP), combined with metabolisable energy (ME) concentrations above 10 MJ and dry matter yield that exceeded 6 t DM/ha (Table 2).
- Cereal rye had the highest yields but this was combined with lower feed quality results for CP and ME (Photo 1 – refer page 1).
- Triticale had above average CP and ME concentrations, however yield was lower than other species in the single cut system.
- The traditional options of oats and barley both performed better when harvested as a single cut system under dryland conditions.
- Oats was consistently lower in NDF compared to the other cereals.

Forage	Yield (t DM/ha)	CP (%DM)	ME (MJ/kg DM)	NDF (% DM)
Single Harvest				
Cereal rye (Southern Green)	7.5	16.9	10.8	44.5
Oats (Austin)	7.3	19.4	11.0	37.6
Wheat (Bennett)	6.4	30.3	10.8	39.7
Barley (Dictator)	6.2	21.1	9.7	41.5
Triticale (Endeavour)	5.2	26.4	11.7	38.1
Average	6.5	22.8	10.8	40.3
Multiple Harvest				
Cereal Rye (Southern Green)	8.3	26.4	10.8	41.2
Triticale (Endeavour)	7.5	30.7	11.2	39.0
Wheat (Bennett)	7.2	33.8	11.5	40.2
Oats (Austin)	5.8	27.9	10.8	36.1
Barley (Dictator)	5.6	29.6	10.5	40.3
Average	6.9	29.7	11.0	39.4

Table 2 Yield, Crude Protein (CP), Metabolisable energy (ME) and Neutral Detergent Fibre (NDF) content of single and multiple harvest dryland cereals. Ranked from highest to lowest yielding.

Irrigated Cereals

- Harvesting all species several times had a positive effect on CP and ME concentration (Table 3).
- Triticale had the highest yield under a single cut situation and had good CP and ME levels under both harvesting systems (Photo 2).
- Shepherd barley was included in the irrigated comparison. It is normally taken as a one-off silage crop, but performed best in terms of yield in a multiple harvest system. However, it had the lowest feed quality across multiple cuts. Its feed quality when harvested as a single cut was comparable to other species.
- Wheat achieved a relatively high yield in the single cut system, with above average CP and ME concentrations (Photo 2).
- Cereal rye displayed good yield potential but was inferior to the other options for feed quality.
- Oats and barley were ranked close to the average on yield and quality, however displayed low NDF under both harvest scenarios.

Forage species (Variety)	Yield (t DM/ha)	CP (%DM)	ME (MJ/kg DM)	NDF (% DM)
Single Harvest				
Triticale (Endeavour)	19.3	13.1	10.1	48.6
Barley (Shepherd)	18.1	15.1	10.1	46.0
Cereal Rye (Southern Green)	16.7	9.5	9.0	54.6
Wheat (Bennett)	15.7	16.2	9.9	48.6
Barley (Dictator)	11.7	15.6	9.9	42.3
Oats (Austin)	8.7	19.7	9.9	47.4
Average	15.0	14.9	9.8	47.9
Multiple Harvest				
Barley (Shepherd)	18.4	21.1	10.1	47.2
Cereal Rye (Southern Green)	16.6	22.7	10.2	47.0
Barley (Dictator)	15.0	24.0	10.8	42.0
Triticale (Endeavour)	15.0	25.0	11.5	44.0
Oats (Austin)	14.6	25.1	11.2	40.5
Wheat (Bennett)	13.0	26.4	11.3	43.5
Average	15.4	24.1	10.9	44.0

Table 3 Yield, Crude Protein (CP), Metabolisable Energy (ME) and Neutral Detergent Fibre (NDF) of single and multiple harvest irrigated cereals. Ranked from highest to lowest yielding.



Key Findings

The trial demonstrated that the use of some alternate winter cereal forages offered the potential to improve yield and quality outcomes in both dryland and irrigated systems over traditional winter cropping options. The use of the alternative crops will depend on individual farm situations as to whether the major driving factor behind species selection is yield, feed quality or a combination of both.

Wheat offered significantly higher feed quality results in both growing systems, allowing potential feed cost savings from less reliance on expensive concentrates used within rations. The wheat variety used in this demonstration also displayed later maturity, offering the potential to maintain feed quality when harvest conditions are delayed. This could also lend itself for use in combination plantings allowing the chance to better match maturity patterns of the crops grown in combination.

Triticale also displayed good yield potential whilst maintaining reasonable feed quality in an irrigated system, whilst cereal rye achieved relatively good yields under dryland conditions. Alternative cereal forage options offer the potential to increase yield, and in some cases, quality parameters as well. Improving yield will decrease feed related cost of the forage and diet, resulting in an improved margin over feed costs and enhanced home grown feed reserves.



Photo 3. Faba beans prior to harvest.



Photo 4. Canola between first and second harvest.

Part B: High Protein Crops to improve forage quality.

Four winter legume forages and canola were selected as potential high protein silage crops, with canola also grown as a grazing and hay option under an irrigated forage production system. Canola was also grown at different rates to assess the impact of planting rate on yield and quality. The species and varieties (in brackets) of each crop are outlined in Table 4.

All legume crops were harvested once at the pod stage of maturity. Multiple cut canola crops were harvested three times, at similar times to cereal crops within the demonstration and left to regrow. The single cut canola crop was harvested at a similar time to the cereal crops just prior to flowering.

Forage	Yield (t DM/ha)	CP (%DM)	ME (MJ/kg DM)	NDF (% DM)
Single Harvest				
Faba Bean (Nasma)	18.4	18.5	10.2	35.3
Faba Bean (Warda)	18.1	18.5	9.6	37.2
Lupins (Bateman)	16.0	14.3	10.1	43.1
Canola (Hyola - 10 kg/ha)	11.6	30.3	10.8	22.2
Canola (Hyola - 5 kg/ha)	10.8	30.9	11.5	22.0
Lupins (Luxor)	7.7	17.6	10.5	32.5
Field Pea (Morgan)	7.1	20.9	10.9	36.3
Vetch (Namoi)	6.1	26.3	10.6	35.9
Vetch (Popany)	5.5	28.9	11.0	33.0
Average	11.3	22.9	10.6	33.1
Multiple Harvest				
Canola (Hyola - 5 kg/ha)	18.9	26.1	11.6	21.1
Canola (Hyola - 10 kg/ha)	17.9	28.9	12.0	18.5
Average	18.4	27.5	11.8	19.8

Table 4 Yield, Crude Protein (CP), Metabolisable energy (ME) and Neutral Detergent Fibre (NDF) of single and multiple harvest irrigated high protein forages. Ranked from highest to lowest yielding.

- Both varieties of faba bean were the highest yielding legumes averaging 18.2 t DM/ha.
- Bateman lupins were the only other high yielding legume variety with 16.0 t DM/ha.
- Both vetch varieties were high in CP, however along with Luxor lupins and field pea were low yielding, all below 8 t DM/ha.
- The single cut canola crops yielded in the mid-range with 11 t DM/ha, with high CP concentrations above 30 %.
- Multiple cut canola yielded an average of 18.4 t DM/ha and were relatively high in CP and ME concentration.
- Planting rate had little effect on yield or quality for all canola crops.
- Canola was low in NDF averaging 21.0 % across all crops, whereas the legume species ranged from 33.0 to 43.1 %.

There are agronomic benefits from a crop rotation viewpoint. Legumes are well known for return of nitrogen to the soil and enhancement to soil structure, whilst offering the option to break disease cycles over monoculture cropping systems.

Key Findings

Overall the canola and faba bean crops were the standout high protein options.

The faba beans yield was exceptional in comparison to the other legume species and indeed other forages grown in the demonstration. Low yields of legume crops have traditionally held back their usage, however the faba beans offered high DM yield and feed quality potential (Photo 3). In addition, there are agronomic benefits from a crop rotation viewpoint. Legumes are well known for return of nitrogen to the soil and enhancement to soil structure, whilst offering the option to break disease cycles over monoculture cropping systems. Some further work needs to be done on how well faba beans will ensile and the palatability of the ensiled product.

The multiple cut Hyola canola (Photo 4) yielded extremely well with high CP and ME. Interestingly, the canola crops were consistently lower in NDF, averaging 21.0 % versus 36.2 % on average across the legume crops. There was no advantage in the higher planting rate of canola for single or multiple cuts.

Identifying and developing high protein forage systems that are high yielding will provide a high quality low cost forage that will potentially offset the use and cost of high cost protein meals and by-products, therefore lowering diet costs and increasing the margin over feed cost of the total diet.

The results from the combination options and economic analysis of all options will be evaluated in the next edition of Northern Horizons. For further information please contact Mark Bauer at mark.bauer@daf.qld.gov.au