SA Drought Hub Technical Report

Mixed Species Pastures in the Mid North

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PROJECT SUMMARY

Selecting and managing pastures effectively can be challenging particularly when aiming to optimise both feed production and livestock performance across variable environments. In response, this project established and monitored two mixed-species pasture trials at Hart and Farrell Flat in the Mid-North of South Australia. This project is a continuation of previous research conducted by the MNHRZ group at Giles Corner and Farrell Flat, with a new site established at the Hart field site to improve pasture selection in that area and improve exposure to the project to a different audience

The trials evaluated a range of cereal, ryegrass, brassica and legume species, assessing both dry matter production and feed quality at two key times during the growing season. In addition, several practical species mixtures were developed and assessed to reflect commercially relevant pasture systems. Broader rotational benefits of the different crop types were also investigated, including soil nitrogen at the end of the season.

During the 2025 season, the trials were used as a demonstration platform for approximately 85 growers, 60 advisers/industry representatives, 50 students and 3 university lecturers with findings communicated through crop walks and trials reports. The results have provided practical insights into the role of different species and mixtures in balancing feed quantity, feed quality and system benefits, supporting improved pasture selection and management decisions across the region.

EXECUTIVE SUMMARY

Project overview and purpose

Selecting and managing pastures to balance feed supply, livestock performance and system benefits is a key challenge for mixed farming systems in the Mid-North of South Australia. Seasonal variability, particularly dry conditions and frost risk, further complicates these decisions.

This project established and monitored two mixed species pasture trials at Hart and Farrell Flat to evaluate a range of cereal, ryegrass, brassica and legume species, grown as both sole crops and mixtures. The aim was to identify pasture options that improve feed quantity and quality across the season, while also delivering rotational benefits such as increased soil nitrogen

What was achieved

The trials successfully demonstrated clear differences between pasture types in terms of dry matter production, feed quality and residual soil nitrogen.

Dry matter production

- Cereals were the most reliable and productive crop type, with barley varieties leading both early and later (post grazing) season dry matter.
- Brassicas offered high dry matter potential but were more variable; tillage radish and forage brassicas performed well early in the season.
- Ryegrass varieties produced moderate early feed but increased later in the season. Pasture legumes were low yielding early and variable later; vetches, medics, clover and trigonella improved with time but generally remained lower than cereals, brassicas and ryegrass in 2025.
- Multi-species mixtures provided consistent dry matter, often matching the best single species crops, highlighting their value for providing feed across the season.

Feed quality

- Legumes and brassicas provided the highest crude protein and maintained feed quality across the season, while cereals produced high biomass but declined in quality as they matured, highlighting the benefit of mixed-species systems.
- Cereals and Brassicas generally maintained the highest metabolisable energy levels across the season
- Ryegrass provided intermediate feed quality across both sampling times.
- These results highlight a clear trade-off between feed quantity (cereals) and feed quality (legumes and brassicas).

Soil nitrogen (system benefits)

- Pasture legumes significantly increased residual soil nitrogen compared to cereals, brassicas and ryegrass, with mixtures providing moderate gains but less than pure legume stands.

Key conclusions

- Cereals are the most reliable option for maximising dry matter production, particularly for early and late season feed supply.
- Legumes and brassicas play a critical role in improving feed quality especially crude protein.
- Mixed-species pastures provide a balanced system, combining the strengths of different species to improve feed supply and resilience.

- Legumes are essential for building soil nitrogen, providing a valuable rotational benefit and reducing reliance on fertiliser nitrogen.
- Seasonal conditions particularly rainfall, strongly influenced both production and quality with Hart showing greater moisture stress impacts than Farrell Flat in 2025.

Who can benefit

The results are directly relevant to:

- Mixed farming growers across the Mid-North and similar environments
- Livestock producers seeking to improve pasture productivity and feed quality
- Agronomists and advisers supporting pasture and crop rotation decisions
- Grower groups and extension programs focused on drought resilience and system performance

Farmers and advisers are already benefiting from the results of this project, along with findings from previous SA Drought hub funded MNHRZ pasture projects (2022–2024). Together, this body of work provides a strong evidence base to support pasture selection and the use of mixtures to balance feed supply, improve feed quality and capture rotational benefits such as increased soil nitrogen in a range of environments in the Mid-North.

The findings can be adopted immediately, particularly when planning pasture programs, selecting species or mixtures to target feed gaps, and incorporating legumes to improve soil nitrogen for following crops. Using cereals (particularly barley) for reliable biomass, combined with legumes and brassicas for improved feed quality, and use of different herbicide technologies to control weeds provides a practical and adoptable system.

Adoption has the potential to improve livestock performance and profitability while reducing reliance on supplementary feeding. Extension has been completed through crop walks, field days and reporting, combined with previous project outputs, have supported uptake and refinement of these practices across the region.

Future actions could include:

- Continue evaluating feed quality and livestock performance outcomes from mixed-species pastures in different regions in the state
- Expand research work to non or semi arable pastures as these are another significant resource livestock farmers use in the Mid North region
- Expand demonstration and extension activities to support adoption across a wider range of farming systems.
- Perennial pastures in the medium rainfall zone

For further information or support with adopting these practices, contact:

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PROJECT BACKGROUND AND OBJECTIVES

This project was undertaken to assess and extend a range of pasture species and mixtures across contrasting environments in the Mid-North of South Australia. In 2025, trial sites were located at Hart and Farrell Flat, representing mixed farming systems with differing seasonal conditions, particularly rainfall and temperatures during the growing season. Farrell Flat, a cold environment received higher growing season rainfall, while Hart is a warmer and shorter season environment with less growing season rainfall. These differences provide a useful comparison of pasture performance across environments.

The project had three key objectives:

1. To assess the performance of a range of pasture species, both as sole crops and in mixtures, based on dry matter production and feed quality.
2. To evaluate the rotational benefits of pasture systems, including residual soil nitrogen
3. To extend the findings to growers and advisers to support improved pasture selection and management decisions.

Pasture species were assessed as sole crops to quantify their production potential and feed quality without the confounding effects of inter-species competition. This approach allows clearer interpretation of species performance and provides confidence in how individual species contribute to pasture systems. Feed quality testing was focused on sole species to avoid uncertainty associated with varying species proportions within mixtures.

In addition to this, pasture mixtures were developed using the sole species as well as commercially available mixtures, with the aim of balancing dry matter production, feed quality and seasonal feed supply. These mixtures were designed to reflect practical, adoptable systems that could be implemented on farm, while also considering factors such as herbicide options and pasture cost.

A key feature of the trial design was the inclusion of two sampling times to reflect different feed demand periods. Early season sampling (pre-grazing) assessed initial biomass production, while a second sampling (post grazing) evaluated regrowth and late season feed supply following a simulated grazing event. This approach provides a more realistic assessment of pasture performance under grazing systems, particularly the ability of species to recover and maintain production later in the season.

The results from 2025 highlight the importance of matching pasture selection to seasonal conditions and feed demand. While dry conditions at Hart reduced overall production compared to Farrell Flat, the relative performance of species and mixtures remained consistent. The findings build on previous years of research, providing a stronger understanding of how different pasture options can be used to optimise feed supply, improve livestock performance and capture rotational benefits within mixed farming systems.

Most aims set out in the project were achieved as planned in 2025. The soil water assessments delivered results that were not realistic and have been omitted from the final report.

METHODOLOGY

	Hart	**Farrell Flat**
Seeding date	20 June 2025	18 June 2025
Grazing date	1 September 2025	2 September 2025
2025 annual rainfall Growing season rainfall	263 mm 223 mm	297 mm 253 mm

Two trials were established at Hart and Farrell Flat, SA to evaluate a range of crop types and species alone or in mixtures. The trials assessed a range of cereal, ryegrass, brassica, legume species and a smaller number of species mixtures (Table 1). Initial soil available nitrogen was 120 kg N/ha at Hart with -2.1 mm plant available water (PAW) and at Farrell Flat there was 146.1 mm of PAW and 132 kg N/ha. During the season, 47 kg N/ha was applied as urea at each trial site in July to create a high nitrogen status and ensure that nitrogen did not limit pasture production.

Pasture species were assessed as sole crops to quantify their production potential and forage quality without the confounding effects of inter-species competition. Pasture mixtures were then developed from the sole species to balance dry matter production, seasonal feed supply, feed quality and herbicide options, with the aim of demonstrating the best pasture options for growers and advisers.

During the season dry matter and feed quality was assessed at two times; early September (pre-grazing and mid-October (post grazing). Grazing was simulated by mowing half of the plot area but, still allowing sufficient leaf area for crop recovery. Other rotational benefits of the different crop species were also assessed at the end of the season including soil nitrogen on selected treatments.

The results were analysed using ASREML and Biometry Assist (Nielsen et al. 2026) Tukey's Honest Significant Difference (HSD) Test which compares all possible pairs of means and identifies any difference between two means that is greater than the expected standard error.

Table 1. Crop type and specific varieties under evaluation in the Hart and Farrell Flat, 2025 trial.

Crop type	Variety	Farrell Flat seeding rates (kg/ha)	Hart seeding rates (kg/ha)
Cereal	Commodus CL barley		70
	Express oats	70	
	Forester oats	70	50
	Magnate barley	70	70
	Mohawk wheat	100	100
	Neo CL barley	70	
	Newton barley	70	70
	Titan AX barley	70	
Ryegrass	Dazzler Ryegrass	20	20
	Prodigy Ryegrass	20	
Brassica	Blue Gorilla brassica	5	
	Captain canola	2	
	Greenland brassica	5	5
	Hybra brassica	5	
	Retained winter canola	5	5
	Tillage radish	5	5
Other	Puna chicory	6	6
Pasture legume	AGF balansa	4	4
	Benetas vetch	40	
	Jester medic		5
	Timok vetch	40	40
	Trigonella	5	5

Table 2. Mixtures under evaluation in the Hart and Farrell Flat, 2025 trials.

Hart	
Mixture and seeding rate (kg/ha)	**Total (kg/ha)**
Timok vetch 40 + Magnate barley 40 + Trigonella 2	82
Retained winter canola 3 + Commodus barley 40	43
Timok vetch 40 + Greenland forage brassica 3	43
AGF Winter Max - Vampire ryecorn 30%, Oats 36%, tillage radish 10%, Crimson clover 8% and tetraploid annual Italian ryegrass 16%	50
Farrell Flat	
Mixture and seeding rate (kg/ha)	**Total (kg/ha)**
Titan barley 40 + Benetas vetch 40 + Retained winter canola 2	82
Retained winter canola 3 + Benetas vetch 40	43
Prodigy ryegrass 40 + AGF balansa 2 + Forester oats 40	82
AGF Winter Max - Vampire ryecorn 30%, Oats 36%, tillage radish 10%, Crimson clover 8% and tetraploid annual Italian ryegrass 16%	50

LOCATION

Site	Latitude (decimal degrees)	Longitude (decimal degrees)	LGA
Hart	33°45'22.80"S	138°24'58.35"E	Wakefield Regional Council
Farrell Flat	33°48'37.73"S	138°50'5.20"E	The Regional Council of Goyder

RESULTS

Early dry matter production – single species

At Hart, early September dry matter production was highest in cereal and brassica species (Table 3). Commodus CL and Magnate barley, along with tillage radish, produced the greatest early biomass. Forester oats, Newton barley, and Mohawk wheat produced moderate dry matter relative to the full range of treatments. Greenland brassica also performed strongly (2107 kg DM/ha), as did retained winter canola. Ryegrass also produced moderate early dry matter, with Dazzler ryegrass yielding 1409 kg DM/ha.

At Farrell Flat, dry matter production at the first sampling was generally lower than at Hart, and differences were observed in the relative performance of species (Table 3). Cereals again provided the most reliable early biomass, with Magnate barley an awnless forage variety, producing 2012 kg DM/ha. Both spring barley varieties Titan and Neo and the winter barley Newton were also high yielding, producing between 1500 and 1700 kg DM/ha. Consistent across both sites, Mohawk wheat and Forester oats produced significantly lower dry matter than the best-performing cereal treatments. Mohawk wheat is a quick-maturing winter variety with a vernalisation requirement, and early season dry matter can be lower compared with spring varieties when all sown in mid to late June. However, this reduced early growth is generally offset by the longer vegetative growth period of winter wheats, which allows more time for dry matter accumulation before stem elongation (GS30). In contrast, a reduction in early dry matter production was not observed for the winter barley variety Newton.

Brassica dry matter production at Farrell Flat was more variable compared to Hart. Forage varieties Hybra, Greenland and Blue Gorilla and tillage radish all performed well, producing approximately 1600 kg DM/ha. In comparison both winter canola treatments (retained seed and Captain) produced lower dry matter. Ryegrass varieties produced dry matter levels comparable to the cereal and brassica treatments at this site.

Pasture legumes produced low early dry matter at both sites (<963 kg DM/ha at Hart and <556 kg DM/ha at Farrell Flat). Chicory also produced very low dry matter at both sites (89–395 kg DM/ha), indicating limited contribution to early feed supply. There were no significant differences in dry matter production among the legume pasture species or chicory at this sampling time. This is consistent with outcomes from previous trials (Nitschke and Smith 2024) at Farrell Flat and Giles Corner which showed pasture legume species produced low early dry matter.

Table 3. Dry matter weights for all treatments in early September at Hart and Farrell Flat, 2025. Results were analysed using Tukey's test, and single-species treatments and mixtures were analysed separately at each site.

Crop type	Variety	Farrell Flat Dry matter Sept 1 (kg/ha)	Hart Dry matter Sept 2 (kg/ha)
Cereal	Commodus barley		2512^{ef}
	Express oats	1308^{def}	
	Forester oats	1351^{def}	1935de
	Magnate barley	2012^{g}	2573^{ef}
	Mohawk wheat	966^{bcd}	1540^{cd}
	Neo barley	1721^{fg}	
	Newton barley	1497^{defg}	1626^{d}
	Titan barley	1504^{defg}	
Ryegrass	Dazzler ryegrass	1352^{def}	1409^{bcd}
	Prodigy ryegrass	1568^{efg}	
Brassica	Blue Gorilla brassica	1584^{efg}	
	Captain canola	1095^{cde}	
	Greenland brassica	1482^{defg}	2107de
	Hybra brassica	1722^{fg}	
	Puna chicory	89^{a}	395^{a}
	Retained winter canola	1167^{def}	1440^{cd}
	Tillage radish	1680^{fg}	3105^{f}
Pasture legume	AGF Balansa	400^{ab}	466^{a}
	Benetas vetch	427^{ab}	
	Jester medic		963^{abc}
	Timok vetch	556^{abc}	818^{abc}
	Trigonella	176^{a}	546^{ab}
Mixtures	Benetas vetch + Forage brassica	825^{a}	
	Prodigy ryegrass + AGF Balansa + Forester oats	1190^{a}	
	Timok vetch + Greenland forage brassica		2851^{a}
	Timok vetch + Magnate barley + Trigonella		2690^{a}
	AGF Winter Max	2149^{b}	2866^{a}
	Retained winter canola + Commodus barley		2625^{a}
	Titan barley + Benetas vetch + Retained winter canola	941^{a}	

Early dry matter production – species mixtures

All species mixtures produced high early dry matter at Hart, averaging 2758 kg/ha (Table 3). There were no significant differences among the mixtures, and dry matter production was comparable to that of the highest yielding cereal treatments. The cereal-based mixtures and non-cereal based mixtures had similar levels of dry matter. At Farrell Flat, Winter Max was the highest yielding mixture at this site, producing 2149 kg DM/ha which was comparable to the best performing cereal and brassica treatments. All remaining mixtures were competitive with the 'mid to lower range' single-species treatments.

Late season (post grazing) dry matter production – single species

By the second sampling time, pastures at Farrell Flat had produced higher dry matter than Hart across all treatments (Table 4). Drought stress had started to impact the Hart trial at this sampling time. This was not observed to the same extent at the Farrell Flat trial, where higher rainfall was received during the growing season. While total dry matter production differed between sites, similar patterns were observed across crop types. Cereals (wheat and barley) consistently provided the most reliable biomass of all crops trialled. Oat varieties were more variable, at times matching the yields of wheat and barley but in other cases producing slightly lower dry matter. Ryegrass varieties also produced comparatively high dry matter at this sampling time, ranging from 2792 to 3976 kg/ha.

At the later sampling time, brassicas generally produced moderate dry matter at both sites, with little variation observed among the varieties trialled. The only exception was Puna chicory which consistently had very low dry matter at around 400 kg DM/ha. Pasture legumes showed a clear improvement at the later sampling at both sites. At Hart a number of pasture legumes were as high yielding as cereal and ryegrass options.

Late season (post grazing) dry matter production – species mixtures

All mixtures at Hart and Farrell Flat produced moderate to high dry matter, averaging 3608 kg/ha and 1984 kg/ha, respectively. There were no or only minor differences between the mixtures at each site. The results show that in many cases, mixing the sole species assessed in these trials is a viable strategy to maximise fodder production across the season, while also improving pasture quality and livestock performance. This approach has been demonstrated in previous trial seasons (Nietschke and Smith 2024) and helps fill key feed gaps, with cereals and brassicas providing early-season feed and other species, such as legumes (and brassicas), contributing higher-quality forage later in the season as some cereal species/varieties mature and decline in feed quality.

When creating species mixtures, it is important to balance the seeding rates of the individual components, as there is the risk of one or more species outcompeting the others. The current trials, together with previous field research (Nitschke and Smith 2024), provide guidance on appropriate seeding rates that can form the basis of discussions for individual farms. Commercially available seed blends, such as AGF WinterMax, also offer a pre-mixed option with comparable dry matter production. In this blend, species ratios have been optimised, which was evident in the plots where all species were present, and none appeared to outcompete. This approach allows growers to sow mixed pastures without the added complexity of blending seed or adjusting individual seeding rates.

Table 4. Dry matter weights for all treatments at Hart and Farrell Flat, October 2025 in the 'grazed' plots. Results were analysed using Tukey's test, and single-species treatments and mixtures were analysed separately at each site.

Crop type	Variety	Farrell Flat Dry matter Oct 14 (kg/ha)	Hart Dry matter Oct 9 (kg/ha)
Cereal	Commodus barley		2288^{bcdef}
	Express oats	3321^{cde}	
	Forester oats	3609^{def}	1660^{bcd}
	Magnate barley	5273^{ef}	2201^{bcdef}
	Mohawk wheat	4585^{def}	2573^{cdef}
	Neo barley	5449^{f}	
	Newton barley	5628^{f}	2997^{f}
	Titan barley	5378^{ef}	
Ryegrass	Dazzler ryegrass	3973^{cdef}	2792^{ef}
	Prodigy ryegrass	3616^{cdef}	
Brassica	Blue Gorilla brassica	3325^{cde}	
	Captain canola	2948^{bcd}	
	Greenland brassica	2960^{bcd}	1740^{bcde}
	Hybra brassica	2948^{bcd}	
	Puna chicory	428^{a}	399^{a}
	Retained winter canola	2637^{abcd}	1495^{abc}
	Tillage radish	2636^{abcd}	1873^{bcdef}
Pasture legume	AGF Balansa	2128^{abc}	1350^{ab}
	Benetas vetch	2285^{abc}	
	Jester medic		2776^{def}
	Timok vetch	2583^{bcd}	2419^{bcdef}
	Trigonella	1061^{ab}	1828^{bcde}
Mixtures	Benetas vetch + Forage brassica	2924^{a}	
	Prodigy ryegrass + AGF Balansa + Forester oats	3125^{ab}	
	Timok vetch + Greenland forage brassica		1822^{a}
	Timok vetch + Magnate barley + Trigonella		2279^{a}
	AGF Winter Max	3892^{ab}	1700^{a}
	Retained winter canola + Commodus barley		2134^{a}
	Titan barley + Benetas vetch + Retained winter canola	4489^{b}	

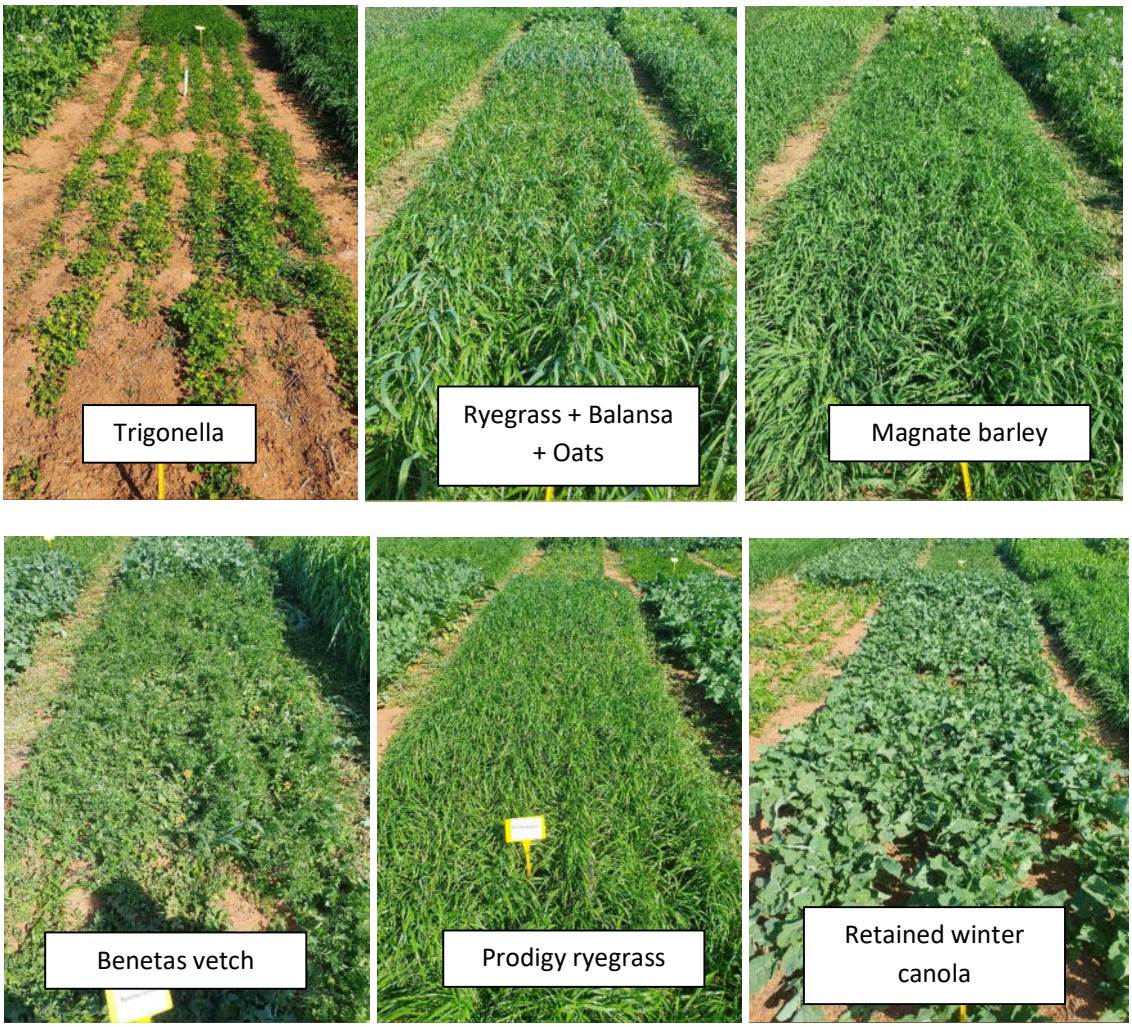


Figure 1. Photos of selected treatments at Farrell Flat taken on 26 September 2025. The front half of each plot shown had been 'grazed' in early September.



Figure 2. Project extension, mixture pasture species trial at the Hart Field Day 2025.



Figure 3. Trial extension at the MNHRZ Spring Walk 26 September, 2025.

Pasture quality

At Farrell Flat differences in crude protein (CP) and metabolisable energy (ME) were observed between crop types and sampling times (Table 5). In the first sampling, pasture legumes and brassicas generally had higher CP than cereals. Legume species such as Timok vetch and AGF balansa recorded some of the highest CP values, while brassicas, including Captain canola and Hybra brassica, also maintained relatively high CP and ME. In contrast, cereal species tended to have lower CP at this timing, with varieties such as Forester oats and Magnate barley among the lowest. The ryegrass species maintained moderate to high CP. ME was highest for brassicas, cereals and some legume species and lowest for other legumes, ryegrass and chicory.

At the second sampling, feed quality declined across most species, particularly in cereals where CP levels dropped to around 12–13%. This decline in CP reflects advancing crop maturity. Despite this, cereals still maintained moderate ME levels. Legumes continued to provide higher CP than cereals at this later timing, with Timok and Benetas vetch maintaining CP levels around 13–14%. Brassicas remained relatively stable in both CP with ME reducing across the season, although variability was evident between species. Puna chicory had modereate ME but variable CP, while retained winter canola maintained moderate quality across both timings.

At Hart, feed quality similarly differed between crop species/varieties and sampling times (Table 6). At the first sampling, brassica and cereal species generally provided the highest feed quality. Brassicas maintained relatively high CP and ME, indicating they are high quality feed. Legume species, including Trigonella, Timok vetch and AGF balansa also recorded high CP levels but lower ME levels. In contrast,

cereals had lower CP overall, although ME remained moderate across varieties. Ryegrass produced intermediate feed quality.

By early October, feed quality declined across most species, particularly in cereals similar to Farrell Flat. Crude protein levels in cereals dropped markedly, in some cases falling below 10%, reflecting advancing maturity (Table 6). Despite this, ME values remained relatively stable, indicating that energy content declined less rapidly than protein. Brassicas maintained moderate CP and ME across both sampling times, with less decline compared to cereals.

Legumes continued to provide the highest CP at the later sampling, maintaining a clear advantage over cereals and ryegrass. However, some variability between legume species was evident. Ryegrass maintained moderate CP and ME across both timings, with less decline than cereals but not reaching the levels observed in legumes.

Overall, brassicas and legumes provided consistently high CP levels across the season whereas cereals had moderate CP early but this reduced later in the season as they matured. Cereals and brassicas had high ME early in the season, with brassicas maintaining this quality whilst many cereals varieties ME reduced across the season. Legumes generally had low to moderate ME levels.

These results reinforce the complementary role of species within mixed pastures, where cereals contribute bulk dry matter and legumes and brassicas improve overall feed quality, particularly later in the season.

Table 5. Crude protein and metabolisable energy measurements for all sole species at Farrell Flat from the two times of sampling. Results were analysed using Tukey's test.

Species	Variety	2 September		14 October	
		Crude Protein (%)	Metabolisable Energy (%)	Crude Protein (%)	Metabolisable Energy (%)
Brassicas	Captain Canola	13.4 c	30.2 defg	13.5 efg	19.6 hi
	Greenland Brassica	13.7 c	28.8 cdefg	13.5 fg	18.2 gh
	Hybra Brassica	13.8 c	25.7 abcd	13.8 g	16.3 efg
	Retained W Canola	13.3 c	31.0 fg	13.1 bcdefg	20.8 i
	Puna Chicory	8.4 a	26.0 bcde	13.5 efg	21.5 i
	Tillage Radish	12.6 c	29.7 defg	12.3 a	16.1 efg
Cereals	Forester Oats	13.9 c	26.0 bcd	13.5 fg	14.3 cde
	Magnate Barley	13.8 c	28.0 cdefg	12.5 abc	11.4 ab
	Mohawk Wheat	13.7 c	30.7 efg	13.0 bcdefg	12.8 abc
	Neo Barley	13.6 c	29.0 cdefg	12.3 ab	11.1 ab
	Newton Barley	11.8 bc	29.4 cdefg	13.1 cdefg	13.6 bcd
	Titan Barley	13.8 c	29.9 defg	12.7 abcd	10.5 a
Legume	AGF Balansa	9.6 ab	25.1 abc	13.6 fg	17.2 fgh
	Benetas Vetch	13.5 c	31.9 g	13.3 defg	21.0 i
	Timok Vetch	12.4 c	28.7 cdefg	13.0 abcdef	17.0 fg
	Trigonella	12.2 bc	26.6 bcdef	13.6 fg	16.4 efg
Ryegrass	Dazzler Ryegrass	13.6 c	21.1 a	12.7 abcde	14.0 cde
	Prodigy Ryegrass	13.6 c	22.3 ab	13.2 cdefg	15.4 def

Table 6. Crude protein and metabolisable energy measurements for all sole species at Hart from the two times of sampling. Results were analysed using Tukey's test.

Species	Variety	1 September		9 October	
		Crude Protein (%)	Metabolisable Energy (%)	Crude Protein (%)	Metabolisable Energy (%)
Brassica	Greenland Brassica	23.5 bcd	13.4 c	17.4 cd	13.4 cde
	Retained W Canola	25.5 bcd	12.9 bc	16.6 c	13.5 de
	Puna Chicory	23.6 bcd	8.7 a	21.1 d	13.4 cde
	Tillage Radish	24.1 bcd	12.4 abc	16.3 bc	12.3 a
Cereal	Commodus Barley	20.0 ab	13.0 bc	9.4 a	13.1 bcd
	Forester Oats	20.8 abc	13.7 c	12.2 ab	13.7 e
	Magnate Barley	17.0 a	13.5 c	9.8 a	12.9 b
	Mohawk Wheat	25.9 cd	13.3 c	11.1 a	13.0 bc
	Newton Barley	23.1 bcd	12.2 abc	10.7 a	13.3 bcde
Legume	AGF Balansa	20.1 abc	9.7 abc	17.8 cd	13.2 bcd
	Jester Medic	23.3 bcd	8.5 ab	16.7 c	12.1 a
	Timok Vetch	27.4 d	11.9 abc	17.4 cd	12.1 a
	Trigonella	25.2 bcd	10.4 abc	17.8 cd	13.0 bcd
Ryegrass	Dazzler Ryegrass	21.3 abc	12.0 abc	11.6 a	13.3 bcde

Soil Tests

Residual soil available N (0 - 60 cm) from the various pasture treatments was measured in December. There were significant differences between pasture types at both Farrell Flat and Hart, with legumes generally having higher soil N compared to non-legume treatments (Tables 7 and 8).

At Farrell Flat, pasture legumes resulted in the highest levels of residual N (Table 7). Balansa clover recorded the greatest soil N (159 kg N/ha), significantly higher than all other treatments. Timok vetch also had high residual soil N levels (98 kg N/ha). In contrast, cereals, brassicas and most mixtures had lower residual N, ranging from 33 to 62 kg N/ha, with no significant differences among many of these treatments. Ryegrass (34 kg N/ha), retained winter canola (41 kg N/ha) and several mixtures were among the lowest, indicating limited N contribution to the system. Mixtures that included legumes tended to have slightly higher residual N than non-legume treatments, but these increases were moderate compared to the sole legume treatments.

A similar trend was observed at Hart, although overall soil N levels were lower than at Farrell Flat. This was due to both lower biomass levels and potentially lower mineralisation from less rainfall. Legume species again provided the greatest contribution to soil N, with Timok vetch (98 kg N/ha) and Jester medic (66 kg N/ha) significantly higher than all other treatments. Most cereals, brassicas and mixtures had relatively low residual N between 30 and 50 kg N/ha, with limited separation between treatments. Ryegrass and some mixtures that included legumes showed moderately higher soil N, but these were still well below the levels observed in the sole legume treatments.

Overall, these results highlight the strong role of pasture legumes in increasing soil N compared to cereals, brassicas and ryegrass. While mixtures that include legumes can contribute to soil N, their

impact is generally diluted relative to pure legume stands. These findings reinforce the importance of including legumes in pasture systems where building soil N for subsequent crops is a priority, particularly in mixed farming systems aiming to reduce fertiliser inputs.

Table 7. Soil available nitrogen (0-60 cm) sampled in selected pasture treatments at Farrell Flat taken in December 2025.

	Pasture	Soil available nitrogen (kg N/ha)	
Ryegrass	Prodigy ryegrass	34	a
Mixture	Benetas Vetch, Forage brassica	36	a
Brassica	Retained winter canola	41	a
Mixture	Titan Barley, Benetas Vetch, Retained winter canola	48	a
Mixture	Wintermax	49	a
Cereal	Titan Barley	59	ab
Mixture	Prodigy ryegrass, agf Balansa, Forester Oats	62	ab
Legume	Timok Vetch	98	b
Legume	Balansa agf	159	c

Table 8. Soil available nitrogen (0-60 cm) sampled in selected pasture treatments at Hart taken in December 2025.

	Pasture	Soil available nitrogen (kg N/ha)	
Mixture	Timok, Greenland Forage Brassica	30	a
Mixture	AGF Winter max	31	a
Brassica	Retained Winter Canola	32	a
Cereal	Commodus Barley	33	a
Mixture	Retained Winter Canola, Commodus Barley	36	ab
Ryegrass	Dazzler Ryegrass	47	ab
Mixture	Timok Vetch, Magnate Barley, Trigonella	51	ab
Legume	Jester Medic	66	b
Legume	Timok Vetch	98	c

CONCLUSION

Trial outcomes:

Overall, while dry conditions reduced pasture yields in 2025 especially at Hart, the relative performance of species and mixtures and key outcomes remained consistent. Across both Farrell Flat and Hart cereals provided the most reliable source of early and later season dry matter, with barley varieties generally outperforming wheat and oats. Brassicas offered competitive early feed but were more variable, while ryegrass and legumes contributed less early on but improved later in the season, particularly ryegrass and vetch.

A range of species mixtures performed well, often matching single-species options and providing consistent feed across varying seasonal conditions. Looking across research from 2022–2025, mixtures are most effective when cereals and brassicas supply reliable early-season feed, while legumes and some brassicas deliver higher-quality forage later as cereals mature and feed quality declines.

In a time with high fertiliser prices, the residual soil N left by legume pastures can add value to the farming system for crops sown after the legume pasture.

Benefits to industry:

The results from this project, combined with previous MNHRZ pasture work (2022–2024), provide a strong evidence base to support pasture selection and the use of mixed-species systems across a range of environments in the Mid-North. These findings demonstrate how different species and mixtures can be used to balance feed supply, improve feed quality and capture rotational benefits such as increased soil N.

The outcomes can be applied immediately, particularly when planning pasture programs, selecting species or mixtures to address seasonal feed gaps, and incorporating legumes to improve soil fertility for subsequent crops. Systems based on cereals (particularly barley) for reliable biomass, combined with legumes and brassicas for improved feed quality, and supported by appropriate herbicide strategies, offer a practical and adoptable approach for mixed farming enterprises.

Adoption of these practices has the potential to improve livestock performance and profitability, while reducing reliance on supplementary feeding. Continued extension through crop walks, field days and reporting, along with previous project outputs, will support further uptake and refinement of these systems across the region.

Future adoption opportunities:

Future work could focus on further quantifying livestock performance outcomes, expanding research into non-arable and semi-arable pasture systems, increasing demonstration activities across a broader range of farming systems, and investigating the role of perennial pastures in medium rainfall environments.

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