Optimising perennial pasture legumes

Learnings from the 'Growing red meat productivity through the selection and establishment of perennial legumes' project

UNIVERSITY of TASMANIA

TIA
Tasmanian Institute of Agriculture

mla
MEAT & LIVESTOCK AUSTRALIA
DONOR COMPANY

This project was funded by the Tasmanian Institute of Agriculture and Meat and Livestock Australia, through the MLA Donor Company.

About the project

Project: Growing red meat productivity through the selection and establishment of perennial legumes.

Funding body: TIA and the MLA Donor Company managed under the Livestock Productivity Partnership (LPP). LPP was a collaborative research and development (R&D) partnership involving MLA Donor Company (MDC), NSW Department of Primary Industries (NSW DPI), University of New England (UNE), Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Tasmanian Institute of Agriculture (TIA) and the University of Melbourne (UM), aimed at boosting livestock productivity and developing new Research and Development capacity.

Research team: Dr Rowan Smith, Dr Beth Penrose, Dr Adam Langworthy, Gary Martin, Emily Hall, Joanna Talbot, Bruce Dolbey, and Anthony Cruikshank

◂ **Cover:** Red and white clover in a mixed pasture with perennial grasses.
▸ **Right:** Legume experiment Cressy, Northern Midlands, Tasmania ready for biomass harvest. The aim of this experiment was to determine the effect of sowing method on legume establishment when sown with either cocksfoot or phalaris.

The Tasmanian Institute of Agriculture (TIA) has been involved in a project to help farmers grow the productivity of Tasmania's red meat sector through the selection and establishment of perennial legumes.

The five-year project, led by TIA Senior Research Fellow, Dr Rowan Smith, has investigated perennial legume species that can successfully persist under low rainfall conditions to fill feed gaps, and improve tolerance and productivity under waterlogging.

The project has trialled different species and tested how novel sowing practises could advantage legumes during establishment. The research team has worked closely with local red meat producers to ensure the findings are relevant and valuable.

"The current low proportion of legumes in Tasmanian pastures is limiting the profitability and productivity of the Tasmanian red meat industry," Dr Smith said.

"The project aimed to enhance the legume component of pastures, improve productivity and build resilience to a changing climate."

The project took a region-focused approach to improve the proportion of legumes in the high rainfall regions of the north-west and low-medium rainfall region of the Tasmanian Midlands.

"By successfully establishing perennial legumes, producers can extend their growing seasons beyond what is currently being achieved and enhance the resilience of their feedbase to the changing and variable climate, while improving feed quality" Dr Smith said.

"We've taken regular feed tests in paddocks to assess how legume content changes feed quality through the growing season."

The following is a summary of the research and producer case studies undertaken as part of the project.

Contents

Summary

A study in 2011 found a lack of legumes in Tasmanian pastures (Smith et al. 2012). Average percentage composition (cover) of annual and perennial legumes combined accounted for only 12% of total composition, with the main species being white clover and subterranean clover. A follow up survey in 2022 using the same method reported little change in legume content, with a small increase to 13% (Smith et al. 2023).

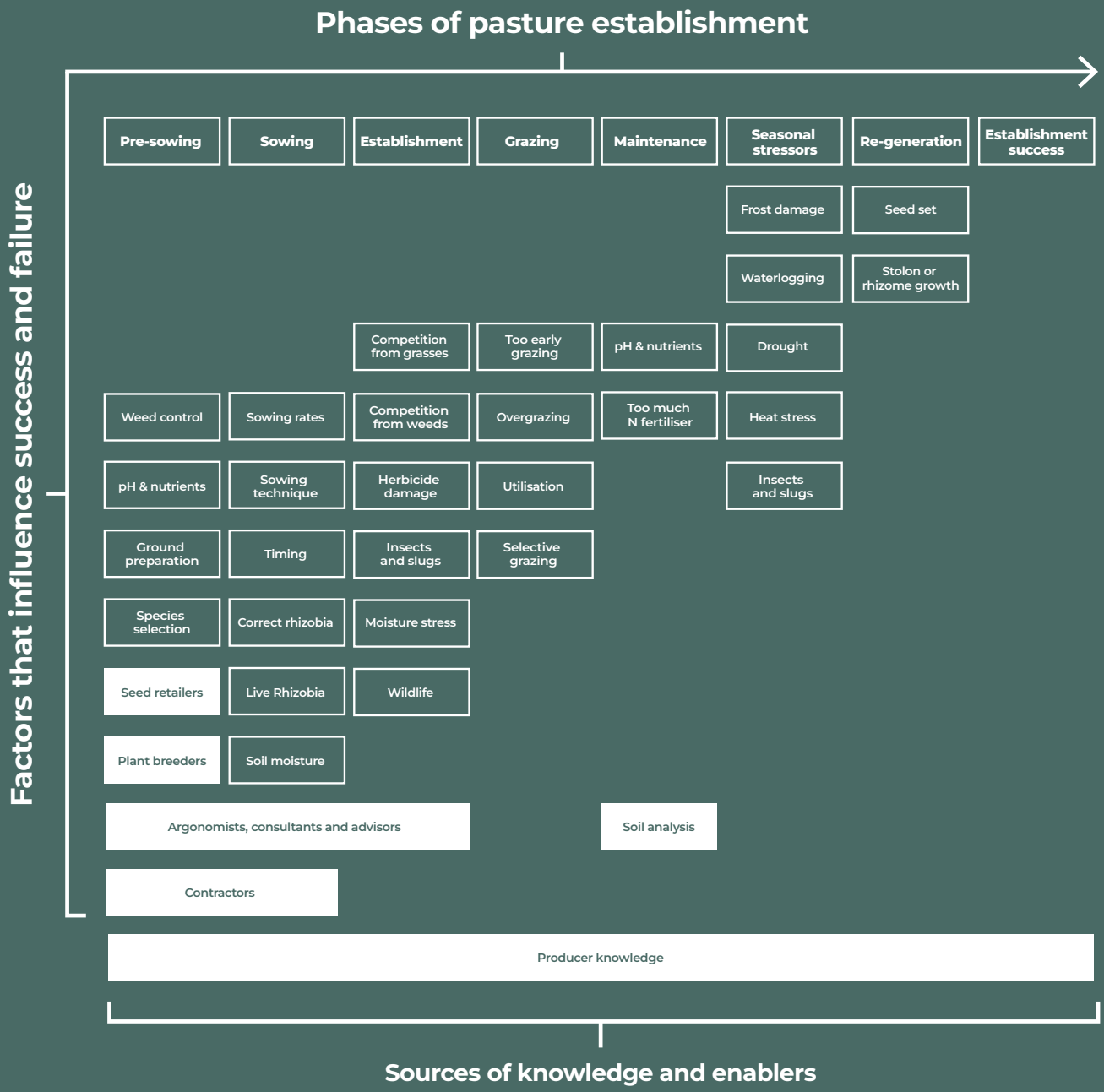
These observations are not uncommon across much of the South-eastern Australian feedbase. Identifying the reasons for legume failure and revealing some solutions is paramount given that they have the potential to improve overall pasture yields, fill feed gaps, fix nitrogen through the symbiosis with rhizobia, and improve feed quality and animal performance.

With this in mind, the challenge for producers is to prepare, sow, establish and maintain legumes through seasonal stresses with the end game of optimising utilisation (turning grass/legume into red meat). Reasons for success and failure are likely to be varied across eco-geographic regions and farming systems. Establishing a higher proportion of legumes in a mixed pasture increases the chance of maintaining a high proportion of legume within the pasture as it matures and persists.

This project sought to address the low proportion of perennial legumes in rainfed red meat grazing systems. The focus in the sheep producing low-medium rainfall Midlands region was on establishing and re-establishing perennial legumes in mixed pasture swards for lamb production using a range of sowing techniques and adapted species. Pasture renovation and over-sowing experiments in the Midlands regions have provided key insights into how difficult it is to establish long-lived perennial plants in a seasonally moisture stressed environment.

This project sought to determine if there were sowing methods that might favour legumes; these have focused on spatial separation of the grass and legume component. There is no conclusive evidence from our experiments that alternative sowing methods result in increased legume component above the traditional mixed row sowing of legumes and grasses together. Of the sowing methods, broadcast rolling is susceptible to surface soil moisture deficit and as such should be used where soil moisture is good or where irrigation can be applied. Matrix sowing appears a good method, though adoption from producers may be restricted due to requiring two passes with the drill.

Over-sowing perennial legumes into existing swards is very challenging. Competition from the existing pasture is high. Greater success is likely to be found with annuals, which have greater seedling vigour. Long-term persistence of annuals will be more related to seed set rather than surviving in competition with existing pasture species through moisture deficits. Use of herbicide to reduce vigour of the existing pasture greatly improved legume establishment.



▲ **Above:** Figure 1. Phases of pasture establishment and factors that influence success and failure of legumes.

Image: Caption

Summary continued

In the beef producing high rainfall North-west the focus was on improving the quality of winter wet pastures for beef production using waterlogging tolerant species. This project sought to evaluate the merits of strawberry clover and Lotus sp. in growing under such conditions and their potential for replacing or complimenting more commonly sown species such as white clover. Strawberry clover remains the best available waterlogging tolerant option for high rainfall mixed pastures. Feed quality of strawberry clover appears to be similar to white clover in dry matter digestibility and metabolisable energy in field grown legume only samples across seasons. There is good availability of strawberry clover seed for sowing. Strawberry clover should be sown in mixes in combination with white clover where seasonal waterlogging is likely. Our research suggests there is sufficient variability in germplasm to develop more productive cultivars without the risk of losing waterlogging tolerance.

The establishment of involve and partner activities on commercial farms has proven a successful method of engaging producers and getting them to trial novel sowing techniques and pasture mixes with legume content. Attendance at field days has been strong where they have been held on commercial farms alongside sowing/pasture demonstrations, while attending existing producer group events and presenting research updates has been an efficient way to engage red meat producers.

Deep rooted alternatives to perennial ryegrass and white clover pastures

McGlone family, Borrowah Pastoral, Alcomie

Background

The McGlone family have trialled different deep rooted perennial pasture mixes to assess how they perform compared to traditional perennial ryegrass and white clover pastures on their grazing property at Alcomie. The high rainfall region of the northwest of Tasmania has traditionally been regarded as one of the most reliable rainfall zones in the state. Inevitably, ryegrass has become the staple pasture species in the area, with perennial ryegrass and white clover pastures dominating the grazing landscape. However, in recent years the reliability of rainfall in the area has been questioned. Recent dry spells, unseasonal weather events and above average temperatures have limited the growth potential of ryegrass pastures and tested its ability to persist in dry times. The McGlones trialled two different pasture mixes to 1). Promote the establishment and persistence of legumes in their pasture feed base and 2). Find alternative deep rooted pasture species that are more resilient to climate variability

Snapshot

- McGlone family, Borrowah Pastoral, Alcomie
- 500 ha bullock fattening property
- 1250 mm average annual rainfall
- The Alcomie area is known for red krasnoezen soils and is traditionally perennial ryegrass and white clover country

▲ **Above:** Pasture Mix 2 containing lucerne, red clover, cocksfoot and chicory, sown at the McGlones property, Alcomie. The image was taken on a misty morning on 5 December, 2024.

Establishment

In the middle of February 2024, a 5 ha paddock was sprayed out and direct drilled with a mix of 4 kg/ha rape cv. Interval and 0.5kg/ha turnips cv. Barkant. This break crop was used to assist with weed control and provide valuable winter feed. The crop was sown with 100 kg/ha of DAP (18% N, 20 % P) and received an additional application of 150 kg/ha of urea (46 % N). The fodder crop was grazed over August/September. After grazing, the paddock was sprayed out with a glyphosate spray that also contained a preventative insecticide as well as sodium molybdate. The paddock was lightly cultivated prior to sowing. Two different pasture mixes were sown side by side on the 2nd of October 2024 (Table 1). The seed was sown with slug bait to reduce the risk of seedling loss, a problem that is common in mid-high rainfall zones of Tasmania. One of the main issues encountered in the establishment of the pasture mixes was persistent browsing by wild ducks. The chicory appeared to be the most affected by this browsing.

▾ **Table 1:** Pasture mixes trialled at the McGlones property at Alcomie. The seed cost for Mix 1 was $330/ha inc gst and for Mix 2 it was $206/ha inc gst. These seed costs were calculated using spring 2024 seed prices.

Pasture Mix 1	Pasture Mix 2
15 kg/ha Perennial ryegrass	5 kg/ha Lucerne (Dormancy 7)
4.2 kg/ha Red clover	3.2 kg/ha Red clover
2 kg/ha White clover	3 kg/ha Cocksfoot (Continental)
1 kg/ha Plantain	1 kg/ha Chicory

▴ **Above:** Picture showing the rape and turnip crop at Alcomie. Taken on 15 August prior to grazing.

Key aspects to Pasture Mix 1

Traditionally, red meat producers in the high rainfall zone of the Northwest have sown perennial ryegrass and white clover pastures. There has been long held contention in the pasture space regarding the optimum sowing rates of ryegrass to achieve both economic and pasture production efficiencies. It has been shown that ryegrass pastures sown at higher sowing rates have greater herbage accumulation, greater ryegrass tiller density and greater yields in the first year of establishment. However, these initial differences in production dissipate by the end of the third year after sowing (DairyNZ, 2024). Additionally, sowing with higher rates of ryegrass increase the competition for establishing legumes and herbs. We opted for a 15 kg/ha sowing rate of perennial ryegrass for this pasture mix to favour the establishment of the legumes and herbs. Increasing the perennial legume content in pastures can reduce the requirement of nitrogen fertiliser application. When growing conditions allow, legumes fix nitrogen from the atmosphere through their root system and make it available to other pasture species.

We selected a ryegrass that had low aftermath heading for this pasture mix. Ryegrass cultivars with low aftermath heading have a reduced number of seed heads emerging after the spring flush which has positive impacts on pasture quality. The legume content in this pasture mix consists of white and red clover with the red clover having a deeper root system. This deeper root system can take advantage of unseasonal rainfall events as well as being more resilient during times of moisture stress. Plantain was included in this pasture mix and initial observations show that the paddock has a strong background population of naturalised plantain which is more prostrate in growth habit compared to forage varieties. Plantain has diuretic properties and has been found to increase the frequency of urination resulting in a more even spread of N across a paddock.

▲ **Left:** Side-by-side comparison of the two pasture mixes (Mix 1 left and Mix 2 right). The large proportion of background plantain is evident across the two mixes. **Right:** Perennial ryegrass-based pasture Mix 1 showing a high proportion of plantain and white clover.

Key aspect to Pasture Mix 2

Cocksfoot formed the base of Mix 2 and was sown with lucerne to assess how it established and performed in a mixed sward. Lucerne can be a challenge to establish in a mixed pasture due to competition from weeds and other sown pasture species. Cocksfoot is slower to establish than ryegrass, allowing the lucerne a chance to establish without being outcompeted by a more vigorous grass species. Lucerne has a deep taproot, meaning that it is resilient during times of moisture stress.

Once moisture becomes available, lucerne recovers quickly from dry spells and provides a high value feed source. The north facing hills around Alcomie dry out quickly between rainfall events in the warmer months. During prolonged dry periods, the persistence of the shallower rooted ryegrass can be compromised. Cocksfoot tends to remain greener longer into summer and can utilise summer rainfall more effectively and help to fill summer feed gaps. Chicory was also included in this mix to add a deep-rooted herb option. Chicory has excellent feed quality and thrives in the summer heat when moisture is available.

▲ **Left:** Pasture mix 2 establishing at Alcomie. Sown chicory and background plantain were quick out of the ground compared to the cocksfoot and legumes in the mix (Picture taken 12/11/2024). **Right:** Chicory dominating in pasture mix 2 (picture taken 5/12/2024).

Learnings from Involve and Partner activities at Alcomie

One of the main challenges faced at the McGlones was weed control when sowing legumes and herbs in the same pasture mix. Chemical options for selective broadleaf weed control exits for herbs and legumes, however, when grown in the same pasture mix, options are reduced. Further research will aim to assess legume and herb combinations that complement each other and allow for the use of selective herbicides. An additional challenge seen in Mix 2 was poor establishment of the cocksfoot. Early observations of competition from chicory may have contributed to the poor establishment of the cocksfoot which is slow to establish in comparison. The sowing rate of chicory in Mix 2 was 1 kg/ha. This pasture trial suggests that a sowing rate of 0.5 kg/ha is enough to achieve good numbers, particularly in favourable establishment conditions.

The McGlone's have undergone previous trial work as part of our perennial legume project and associated Involve and Partner activities. In Autumn 2022, a degraded perennial ryegrass pasture was sprayed out and sown down with 4 different pasture mixes. However, low soil moisture at the time of desiccant spray application meant that the old and existing perennial ryegrass plants were dormant and not actively growing. Therefore, the desiccant spray was largely ineffective. Once moisture became available, the pre-existing and background ryegrass in the paddock dominated the pasture mixes. This resulted in a poor establishment of sown grasses and legumes.

The key learning from this work highlighted the importance of paddock preparation, especially when you are aiming to significantly change the pasture species in a paddock or sow something that is slower to establish. Perennial ryegrass has extremely good early vigour. Sowing in autumn enhances ryegrasses advantage over other slower growing pasture species as it can establish before temperatures cool and day lengths shorten.

Dryland pasture legumes to meet feed demand

John and Kate Simpson: Horfield, Northern Midlands

Background

John and Kate Simpson purchased Horfield in 2018 and since that time have been experimenting with pasture mixes to fill feed gaps. Like many mixed cropping/grazing enterprises, juggling cropping rotations and the availability of water for irrigating fodder or pasture has been a challenge. In addition, seasonal rainfall patterns at Nile leave paddocks waterlogged in winter and extremely dry and compacted in summer. In autumn 2023, the Simpsons trialled two different pasture mixes following a canola crop (Table 2). Mix 1 was a recommended blend from a seed merchant and Mix 2 was a deep-rooted perennial pasture mix recommended by TIA.

▲ **Above:** Side-by-side comparison of the two pasture mixes taken on 2 February, 2024; Mix 1 right and Mix 2 left.

Snapshot

- John and Kate Simpson, Horfield, Nile Tasmania
- 230 ha mixed cropping and heifer agistment enterprise
- 115 ha irrigated
- 626 mm annual rainfall
- Running agistment heifers (450-480 head from May to November with 200 kept all year round)
- The Simpsons have a strong emphasis on growing feed for agistment heifers that can tolerate winter waterlogging and persist in hot dry summers

Establishment

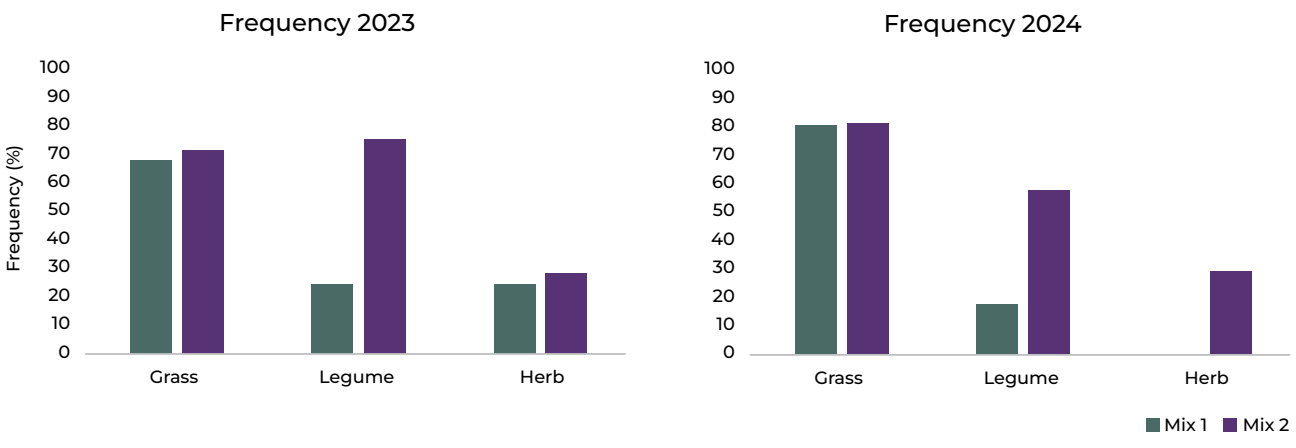
Autumn establishment in 2023 was very slow at Horfield. The Autumn break came late and by this time, soil temperatures had dropped, meaning a very slow and late establishment of the sown perennial pasture. The chicory and clover content in the pasture mixes were particularly affected by these cold conditions as they favour sowing into warmer soil temperatures (>10°C). John and Kate noticed that the higher sowing rate and plant numbers in Mix 2 appeared to supress weeds in the trial strip, which may have aided the establishment of the pasture. We calculated the seed cost for each mix using the sowing rates displayed in Table 2; Mix 1 was $138/ha inc gst. The calculated seed cost for Mix 2 was $448/ha inc gst, however, it must be noted that Mix 2 was sown at almost double the recommended sowing rates. These seed prices were calculated using Spring 2024 seed prices and should be used as a guide only.

Pasture frequency assessment

As part of our Involve and Partner activities at the Simpsons, we monitored the composition change in pasture species for the two pasture mixes sown. Frequency assessments were conducted using the Evergraze method where we assessed the presence of a pasture species within 100 10 x 10 cm squares. The first frequency assessment was conducted in July 2023 and the second in May 2024. Figure 1 shows the frequency change for the grass, legume and herb component of each mix. The graphs show that Mix 2 contains high legume and herb frequency compared to Mix 1. The grass component in both mixes increased and the legume component decreased since the first frequency assessment was taken.

▾ **Table 2:** Pasture mixes trialled at Horfield (Note: Mix 2 was sown at a higher rate due to contractor miscommunication. The values below are the actual sown rates in the paddock. Recommended sowing rates for each pasture species in Mix 2 are lower than they appear in this table).

Mix 1	Mix 2
7.3 kg/ha perennial ryegrass	6.6 kg//ha cocksfoot
4.4 kg/ha tall fescue	4.4 kg/ha phalaris
1.5 kg/ha red clover	8.8 kg/ha red clover
1.5 kg/ha persian clover	2.2 kg/ha strawberry clover
0.9 kg/ha timothy grass	2.2 kg/ha chicory

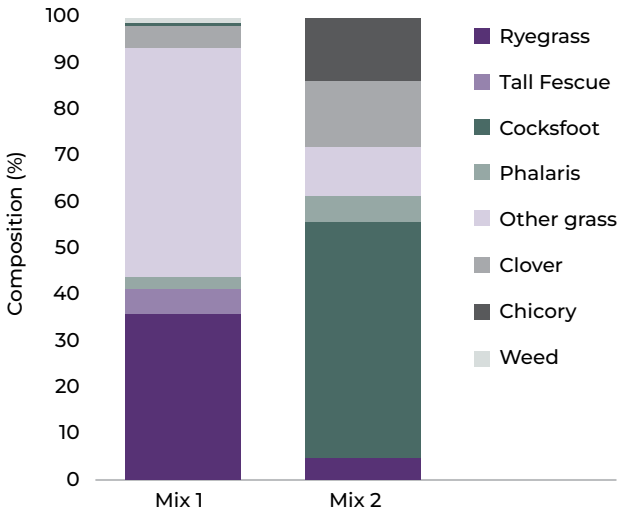


▴ **Figure 1:** Changes in frequency of the grass, legume and herb component of each pasture mix between July 2023 and May 2024.

Pasture composition

To further investigate the species composition of each pasture mix, pasture cuts were regularly taken prior to grazing. Figure 2 shows the dry matter composition for each pasture mix from a pasture cut that was taken in November 2024. We can see that for Mix 1, ryegrass accounted for 36% of the total dry matter yield, a value that decreased from 72% when the pasture mix was first sampled in November 2023. In contrast, the composition of other grasses in Mix 1 (vulpia and other weedy annual grasses) increased from 14.5% in November 2023 to 49% in November 2024.

There were different trends in species composition change that occurred in Mix 2. In the cut taken in November 2023, background ryegrass was the dominant grass component (21%) with only 13% phalaris and 12.3% cocksfoot. In November 2024, cocksfoot made up 51% of total dry matter in Mix 2 with phalaris making up only 5.5%. The clover and chicory composition were sitting at 14% and 13.5% respectively. The swing in grass component in favour of cocksfoot can be explained by the slower establishment of the cocksfoot. It is important to note that the total dry matter of any one species in a pasture sward can vary significantly throughout the season based on the growth curve of each species within the pasture mix. For example, in dryland situations, the legume composition of a pasture would be expected to be greatest in mid-late spring when optimal clover growing conditions are present.



▲ **Figure 2:** Comparison of dry matter composition Comparison of dry matter composition between the two trialled pasture mixes at Horfield (November 2024).

Feed quality differences

Four pasture samples were taken for the purpose of measuring the feed quality of each pasture mix. Each sample was taken prior to grazing. The feed test results shown in Table 3 demonstrate that Mix 2 had favourable feed test values for many of the main indicators of feed quality:

- Mix 2 had lower NDF values in every feed test that was taken. Neutral Detergent Fibre (NDF) is an estimate of the percentage of total cell wall content in forages. Pastures containing a lower NDF value are better quality as they result in higher levels of animal intake which means greater animal weight gain.
- Mix 2 had higher crude protein (CP) values in all feed tests. CP is a measure of the nitrogen content in feed. Animals that are actively growing have a greater requirement for protein in the diet compared to animals that are maintaining weight. Feeds with <6% CP are generally considered deficient and will limit rumen function.
- Mix 2 also had higher ME values for each test taken. Metabolizable Energy (ME) is the amount of energy within feed that an animal can use for metabolic activities such as milk production, pregnancy, maintenance and growth. Pasture with an ME > 11.5 MJ/kg DM and a CP > 15% are considered good quality feed for weaner cattle, though this may vary for other stock classes.

As perennial ryegrass flowers and turns reproductive the quality in the feed drops quickly. The picture below shows the two pasture mixes side by side in January 2024. Mix 1 (left hand side), has a high ryegrass composition and has become long and stalky after the emergence of seed heads. The cocksfoot dominant Mix 2 (right hand side) remains green, with few seed heads visible.

The legume component of a pasture is important for maintaining good feed quality as the grass component in pasture turns reproductive and senesces. Chicory is also known to have very good feed quality characteristics, and the deep rooting nature of this species means that it can access moisture at depth in the soil profile. These factors contribute to the results shown in Table 3.

▲ **Left:** Establishing chicory plant in mid-September, 2023 under attack from Red Legged Earth Mite.
▲ **Right:** Side by side comparison of the two pasture mixes taken on the 2nd of February, 2024; Mix 1 right and Mix 2 left.

▼ **Table 3:** Feed test results for the two pasture mixes at Horfield.

Sample Date	Pasture Mix	NDF%	CP%	DMD%	ME/MJ/kg/DM
13 Nov 2023	Mix 1	49.9	12.1	69.4	10.2
	Mix 2	41.9	16.4	72.9	10.8
6 Feb 2024	Mix 1	55.9	10.6	60.1	8.3
	Mix 2	53.7	12.5	60.3	9.1
29 Aug 2024	Mix 1	49.5	20.9	70.8	10.4
	Mix 2	44.6	26.0	70.2	10.6
6 Nov 2024	Mix 1	48.2	9.8	74.2	10.9
	Mix 2	44.3	15.5	72.4	11.0

Key points

Feed base diversity across farm can help fill seasonal feed gaps.

Having a higher legume content in pastures can help to prolong feed quality when traditional ryegrass pastures run to head.

Soil temperatures play a key role in establishment of legumes and chicory.

Deep rooted dryland pasture mixes may offer a feasible alternative to irrigating forage crops for summer feed.

Alternative species for the nexus between persistence and production

Bruce family: Western Plains, Stanley

Background

Traditionally, mid-high rainfall areas on the North-West coast of Tasmania are known to grow some of the most productive perennial ryegrass and clover pastures in the state. The grazing region around Stanley has mild winters due to coastal influences. Despite this, winter wet conditions can cause issues with pasture utilisation as pastures can become muddy and spoiled in drizzly/rainy weather, increasing pasture wastage. Summer dry conditions, can also hinder the persistence of shallow rooted perennial pasture species. To combat these issues, the Bruce family grow deep-rooted perennial pastures of cocksfoot, prairie grass and lucerne. Ian Bruce believes that cocksfoot is stronger in its ability to stand up in winter conditions, unlike ryegrass that tends to be pushed into the mud and underutilised in the wet. In addition, the deep rooting structure of the mix will be more resilient in dry conditions and be able to utilise summer rainfall more effectively. With other paddocks sown to perennial ryegrass on their property, growing this alternative pasture mix provides diversity to the whole-farm feed base.

As part of TIA's Involve and Partner activities we followed the establishment and growth of a mixed pasture sown at Western Plains in Spring 2022.

Snapshot

- Iain Bruce, Western Plains, Stanley Tasmania
- 625 ha grazing enterprise
- Currently running 360 breeding cows, 100 replacement heifers, 170 trade heifers, 330 trade steers and 475 weaners
- 930 mm annual rainfall
- Growing mixed deep rooted perennial species which tolerate winter pugging and summer drying
- Establishing lucerne alongside other pasture species can be a challenge

▲ **Above:** A mixed cocksfoot, prairie grass and lucerne pasture on *Western Plains* with the iconic Stanley Nut in the background.

▸ **Image:** Mixed pasture sown at Western Plains in Spring 2022. This picture was taken on 29 September, 2023.

Paddock preparation, sowing and establishment

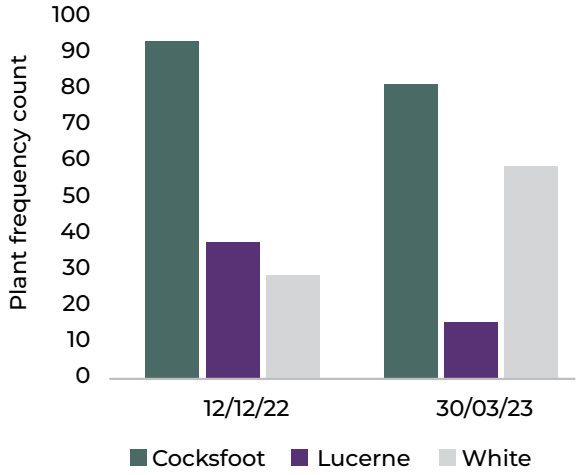
One challenge to the establishment of this pasture was the success of lucerne in the pasture mix. Lucerne is generally grown as a monoculture, in part due to competition issues during establishment. Typically, the Bruce's aim to have spring sown perennial pastures in the ground by mid September. The free draining ferrosols of the peninsula allow for spring sowing, which advantages legume establishment due to rising soil temperatures. Paddocks earmarked for renovation are sprayed out with glyphosate and left for a few weeks before being cultivated with a mouldboard plough, rotary hoed, seeded with a rotera airseeder drill and rolled following sowing. The slower establishment of the cocksfoot and prairie grass compared to perennial ryegrass aided the establishment of the lucerne. In addition, the paddock did not receive fertiliser at the time of sowing, which reduced competition from establishing grasses and advantaged lucerne establishment. Iain noted that slugs are a common issue effecting pasture establishment in the area. To combat this, slug bait was applied with the seed at sowing and a further application of slug bait was spread 14 days later.

▾ **Table 4:**

Pasture sown at Western Plains
4 kg/ha cocksfoot
2 kg/ha prairie grass
8 kg/ha lucerne

Plant frequency

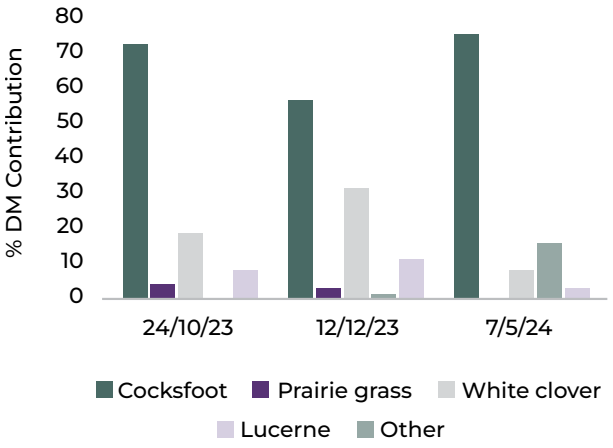
Plant frequency counts were taken in the paddock. Frequency of occurrence of plants (presence or absence) are a useful measure of the persistence of a species as well as the composition of a mixed pasture within a defined area. In this case a 1 m^2 quadrat was broken up into 100 squares (10cm x 10cm). Thus, the score was a score out of 100 rather than an absolute plant count. Initial observations of the paddock (frequency counts taken in mid-December 2022 and late February 2023) indicated a good germination. Prairie grass was not included in these frequency counts however, white clover which germinated from an existing seed bank was included. Figure 3 demonstrates that plant frequency of cocksfoot and lucerne decreased over time, most likely through competition within the pasture, however the white clover content increased.



▴ **Figure 3:** Plant frequency counts from the pasture sown at Western Plains.

Pasture composition

As well as monitoring plant numbers in this pasture, we also assessed the dry matter composition change of the pasture species over time. The initial cut taken on the 24th of October 2023 indicated a high proportion of cocksfoot in the newly establishing pasture, with negligible lucerne present. Interestingly, the background white clover accounted for 18% of the dry matter, a figure that increased to 30% in the December cut. As of the 7th of May 2024, the composition of the pasture remained dominated by cocksfoot (71.5% of total dry matter). The lucerne content in the pasture had increased to 15% and the background white clover proportion had dropped to 7.5% (Figure 4). This highlights differences in the relative growth profiles of lucerne and white clover. After observing how this pasture established in the first 24 months, the Bruce's made the decision to decrease future sowing rates of cocksfoot to benefit the establishment of lucerne in the pasture sward. They hope that by decreasing the cocksfoot rate and increasing the rate of lucerne sown, they will achieve a more balanced sward with a higher proportion of legume.



▲ **Figure 4:** Composition of the pasture mix at Western Plains at 3 different sample timings.

▲ **Top:** Cattle grazing pasture at Western Plains. Lucerne is well suited to the soils on the peninsula due to the free draining nature of the soils. **Middle:** Prairie grass seed head. **Bottom**: Cocksfoot and Lucerne pasture at Western Plains.

Feed Test Results

Four pasture samples were taken prior to grazing or cutting silage for the purpose of measuring the feed quality of the pasture. The feed test results shown in Table 5 demonstrate that as temperature started to warm up in December 2023, feed quality, particularly Metabolisable Energy (ME) and Dry Matter Digestibility (DMD) increase. As the growing conditions slow in May the DMD and ME start to decrease and the NDF % increases. Interestingly, in May the crude protein percentage was the highest it has been in all four tests. This may be attributable to the higher lucerne content (15% of total DM) in the pasture at the time of the sample being taken.

▾ **Table 5:** Feed test results from pasture mix sown at Western Plains.

Sample Date	DMD %	NDF %	CP %	ME MJ/ kg DM
24 Oct 2023	60.5	51.2	14.3	9.1
12 Dec 2023	71.6	46.2	16.7	11.2
7 May 2024	69.2	51.1	23.3	10.6
11 Nov 2024	70.8	50.8	13.8	10.4

Importance of legume content for pasture quality and animal performance

We know that there are significant benefits to be made by incorporating perennial legumes into pasture systems. One of the key benefits to an increased legume component is seen through an increase in pasture feed quality later into the growing season and reduced fluctuations in quality as the grass component of a pasture turns reproductive. In general, legumes have a higher feed quality than grasses, particularly in summer when temperatures are high.

The Bruce's finish cattle for Greenham Tasmania with animals produced on Western Plains supplying the Cape Grim beef brand. The quicker animals reach target weights and condition scores, the quicker they can be turned off the property. Table 6 demonstrates the importance of feed quality to achieving target daily weight gains. It is seen that when grazing a pasture at 2500 kg DM/ha, a 400 kg steer can have an average daily gain (ADG) of anywhere between -0.44 kg/day when ME and Digestibility are 7.5 and 50 % respectively, to 1.09 kg/day when ME is 12 and digestibility is 80%. We could predict that a 400 kg steer grazing the pasture at 2500 kg DM/ha in May when the ME is 10.6 and the digestibility is 69.2 % could have an ADG of approximately 860 g/day. As a reminder, this feed test value was attained by having a dry matter pasture composition of 15 % lucerne, 7.5% white clover and 71.5% cocksfoot.

▾ **Table 6:** Average daily gain for a range of feed quality and steer liveweights when grazing a pasture at 2500 kg DM/ha. Data sourced from PROGRAZE.

Feed available (Kg DM/ha)	2500 kg DM/ha			
M/D (MJ ME/kg DM)	7.5	9	10.5	12
Digestibility%	50	60	70	80
200 kg – ADG (kg/day)	-0.02	0.42	1.09	1.31
300 kg – ADG (kg/day)	-0.24	0.3	0.98	1.22
400 kg – ADG (kg/day)	-0.44	0.2	0.86	1.09
500 kg – ADG (kg/day)	-0.72	0.07	0.7	0.92

The importance of perennial legumes for maintaining feed quality

Hughes family: Jessiefield, Longford

Background

Longford red meat producers, the Hughes', are growing a wide range of pasture mixes at their Longford property Jessiefield. As part of our project we tracked the seasonal changes in feed quality for a range of pastures including ryegrass dominant, mixed ryegrass and clover and clover dominant pastures. Our main aim was to assess how the seasonal fluctuations in feed quality can be reduced by growing pastures that contain a higher legume content. The Hughes' utilise a range of pasture mixes in their grazing rotation. Legume monoculture combinations of white and red clover are also sown in irrigated areas as these offer superior weight gain for lambs and complement weed management for their cropping rotations.

Snapshot

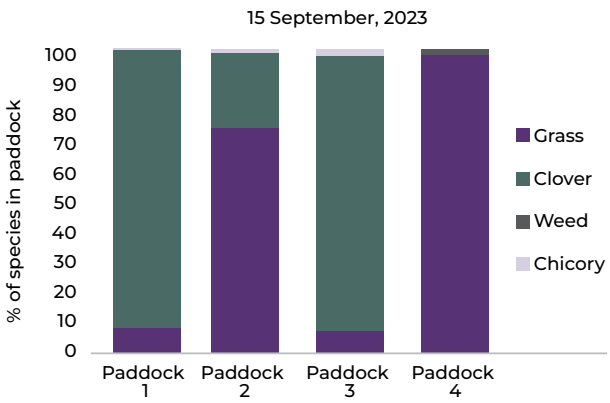
- Jock Hughes, Cluden Newry Angus, Longford
- 1350 ha mixed cropping and grazing enterprise
- 200 ha of irrigated area
- 620 mm annual rainfall
- Growing a range of different forage crops and pasture mixes for fattening lambs and conditioning bulls

▲ **Above:** Jock Hughes in a paddock of white clover and chicory which was used to finish lambs.

Pasture composition from four different pastures at Jessiefield

Four feed tests were taken from paddocks containing differing species compositions in two different seasons; September 2023 and February 2024 (Figure 5). The grass component listed was mostly perennial ryegrass. In spring, Paddock 1 and Paddock 3 were dominated by clovers, with 91.8% and 90.5% of clover, respectively. Paddock 1 had been planted as a white clover monoculture to fatten lambs and was later broadcast with chicory to determine if this had a positive effect on reducing the incidence of sudden lamb death. In spring 2023, Paddock 1 was over-sown with ryegrass as a means to reduce animal health issues and improve grazing flexibility in the paddock. The pasture composition in Paddocks 1 and 3 had changed significantly when they were tested again in February, 2024. Figure 5 shows that Paddock 1 had become ryegrass dominant in February (90.9%) with only 8.9% clover. Similarly, the composition of Paddock 3 had changed with chicory becoming the dominant species (75.5%) and the clover content dropping to 24.4% which is reflective of the growth curve for chicory. Paddock 4 was only sampled in spring 2023 and shows that 98.2% of the pasture was ryegrass with no clover present.

In Spring 2023, Paddock 2 contained 25.2% clover and 73.7% ryegrass. This legume proportion falls within our project target of 20-25% perennial legume component in perennial pastures. Interestingly, the species composition remained similar for both pasture cuts in Paddock 2. Paddocks 1 and 3 are designated to fatten lambs who selectively graze certain species in the pasture. This may have contributed to the larger swings in pasture composition we saw in these two paddocks.

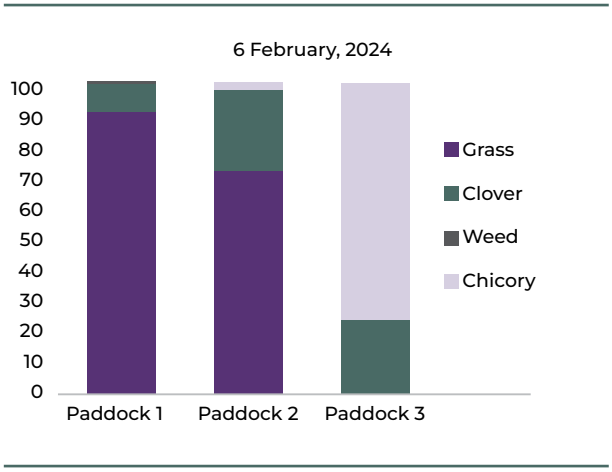


▲ **Figure 5:** Left: Pasture composition from botanical separations taken on 15 September 2023.

▲ **Above:** Lambs grazing a legume and chicory pasture mix at Jessiefield; 14 November, 2023.

Chicory

The large increase in chicory composition in February for Paddock 3 is reflective of the growing season of chicory which loves warm conditions. Once chicory has sufficient moisture and temperature to grow, it will grow prolifically and look to flower and turn reproductive. In this situation, grazing management is vital to maintaining chicory in a vegetative state and preventing the formation of a seed head. This can be a challenge in fat lamb systems when paddocks are often set stocked. The lambs tend to selectively graze the chicory leaf and surrounding legume and allow the chicory plant to grow rank. This explains the shift in pasture composition shown for Paddock 3 in Figure 5. Once the chicory plant has gone reproductive, feed quality and palatability drop off and it is very hard to clean up the stalky matter. In late August 2024, Jock trialled mulching a small area of chicory in Paddock 4 to determine whether taking the top off the chicory would initiate extra vegetative growth in the spring. There were no visual differences in production between the mulched and non mulched areas, though measurements were not conducted.



▲ **Figure 5:** Above: Pasture compositions from botanical separations taken on 6 February 2024.

▸ **Above:** Left: Chicory and white clover pasture at Jessiefield; 29 September, 2023. Right: Picture taken from Jocks Lucerne paddock showing the rank and stalky chicory matter that had been left behind after grazing.

▾ **Table 7:** Feed test results for paddocks taken in September 2023 and February 2024.

Paddock	NDF%		CP%		DMD%		ME MJ/kg DM	
	Sept 2023	Feb 2024	Sept 2023	Feb 2024	Sept 2023	Feb 2024	Sept 2023	Feb 2024
Paddock 1	25	56	30.1	14.5	84	66.7	13.0	9.3
Paddock 2	35	47.7	24.8	18.75	83	72.05	12.5	10.5
Paddock 3	23	28.5	31.2	17.9	86	66	13.4	10.1
Paddock 4	29		18.7		92		13.5	

Feed quality

Feed tests were conducted at two different timings (Spring 2023 and February 2024) on the paddocks to assess i). How the differing pasture composition affected feed quality and 2). Seasonality affects on feed quality (Table 7). Paddocks 1 and 3 were clover dominant in spring and had the highest crude protein (CP) percentages. CP is a measure of the nitrogen content in feed. Animals that are actively growing have a greater requirement for protein in the diet compared to animals that are maintaining weight.

Neutral Detergent Fibre (NDF) values increased in February for all paddocks. NDF is an estimate of the percentage of total cell wall content in forages. Pastures containing a lower NDF value are usually better quality as they result in higher levels of animal intake and thus animal weight gain.

Key findings from conducting these feed tests were:

- All indicators of feed quality (NDF %, CP %, DMD % and ME MJ/kg DM) were lower in February compared to the feed tests taken in September.
- Paddocks 1 and 3 had large fluctuations in clover content with much greater levels seen in September 2023 compared to February 2024. This may explain the large reduction in CP % and DMD % values when the paddocks were tested in February 2024 compared to September 2023 results.
- Paddock 2 which had a stable composition of ryegrass and clover for the September and February feed tests, had the highest CP %, DMD % and ME MJ/kg DM in February. This demonstrates that having a stable legume component (~20-25%) in your perennial pastures can help to reduce the fluctuations experienced in grass dominant pastures.
- Paddock 4, which was only tested in September, had the lowest CP % but highest DMD % and ME compared to the other paddocks. In spring, the ryegrass would have been in an actively growing vegetative stage with very little lignin in plant cell walls.

Key points

Increasing legume content can increase the feed value of pastures.

Producers should aim to increase their legume component in pastures to 20-25%.

Pastures with higher legume content tended to have higher CP values, lower NDF values and buffered against large reductions in feed quality in February.

Irrigated diverse fodder mix

Headlam family: Ratharney, Tasmania's Midlands

Background

Midlands sheep producers, the Headlam family, are aiming to extend the grazing phase of their cropping rotation to compensate for a reduction in poppy area and provide a longer rest period for soils. The challenge is to find a long-term irrigated pasture mix that can achieve weight gains equivalent to lambs grazing annual crops of brassica or straight legume pastures (~300 g/day) without the risk of animal health issues.

There has been significant irrigation expansion in the midlands of Tasmania, predominantly in areas of better soil types and on river valley flats. The recent irrigation expansion has led to increased areas of pasture and fodder crops being grown for intensive grazing in rotation with other cash crops.

Irrigated areas on Ratharney follow a ten year cropping rotation with a 3-4 year cropping phase followed by a 6-7 year pasture phase. Poppy crops have historically been a staple in the Headlam's cropping rotation and are usually followed by a forage brassica crop for autumn and winter feed to fatten lambs and provide valuable winter feed for ewes. The Headlam's are re-strategizing their cropping/grazing rotations and trialling alternative pasture mixes that can provide flexibility to the rotation while maintaining animal productivity.

Snapshot

- Chris and Claire Headlam, Ratharney, Woodbury
- 1820 ha cropping and sheep production
- 450 ha of centre pivot irrigation
- 5, 500 merino ewes
- 430 mm annual rainfall
- Chris grows poppies, grass seed and fodder crops under irrigation for fat lamb production

▲ **Above:** Attendees at Ratharney legume event discuss the diverse pasture mix sown by the Headlam's; November, 2023.

Trialling a diverse forage mix

After harvesting poppies from a 90 ha pivot circle, a forage brassica/oat mix was planted in February 2022. This forage mix was grazed during autumn and winter. The paddock was then sprayed out, multi disced and drilled to a regenerative forage mix. A massive downpour shortly after sowing caused germination to fail. On 7 December 2022, a portion of the paddock was re-sown with the diverse forage mix listed in Table 8. We calculated the seed costs for the diverse forage mix shown in Table 8 using Spring 2024 seed prices. The total cost of seed worked out at $300/ha inc gst, though this price should be used as a guide only.

▾ **Table 8:** Diverse forage mix sown at Ratharney

Diverse forage mix
2 kg/ha Chicory
3 kg/ha Lucerne
8 kg/ha Red clover
2.5 kg/ha Phalaris
2.5 kg/ha Cocksfoot

Pasture longevity and weed control

To increase the longevity of the pasture mix, phalaris and cocksfoot were included (Table 8). It is expected that over time the chicory and red clover numbers in the pasture will decline, leaving a stand of phalaris, cocksfoot and lucerne. This mix of pasture species will be highly responsive to summer irrigation but resilient in times of water stress. Initially, the Headlam's were worried about the large number of weeds germinating in the paddock. Given the diverse nature of the pasture mix, selectively spraying weeds was not an option. However, after a few rounds of grazing and the competitive nature of the pasture, the weeds were smothered and numbers in the pasture are now negligible.

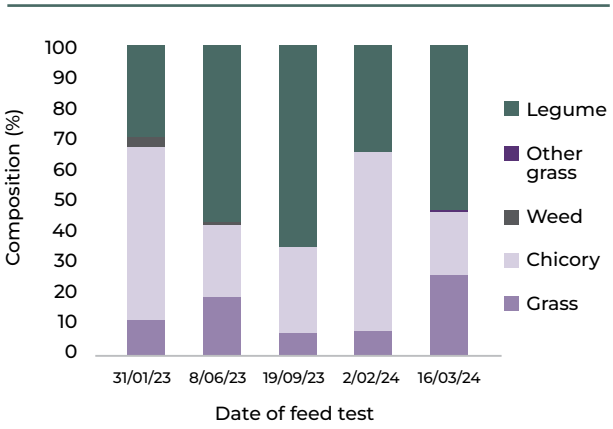
Grazing management

The Headlam's have broken the 90 ha pivot circle into 30 ha paddocks. Each 30 ha paddock is being divided into 10 ha grazing blocks using strip fences. There have been 1700 merino ewe lambs rotationally grazing the 10 ha blocks, spending five days in each block. One challenge identified in maintaining quality in this pasture mix is managing the flowering of the chicory. Rotational crash grazing is one method that can be used to extend the quality of the pasture.

▴ **Above:** Diverse forage mix sown at Ratharney. This picture was taken on 11 September, 2024. Due to the cool conditions, the chicory is less dominant in the mix which allows the cocksfoot and phalaris space to grow.

Pasture composition

Figure 6 demonstrates the trends in species composition change since the pasture was sown. We can see that the grass component of the mix has remained below 20% of the total dry matter yield up until the latest cut in September 2024 where grass accounted for 26.3% of total dry matter. The legume component of the pasture has fluctuated substantially. Chicory has also changed through the seasons, with higher proportions seen in the warmer months which fits with its seasonal growth curve of being summer active. Chicory thrives in summer temperature if moisture is available. In the case of moisture stress, it remains resilient due to its deep taproot. It will be interesting to track how the chicory persists over the coming seasons as anecdotal reports indicate that chicory tends to drop out of a pasture mix after 3 growing seasons. We expect the grass component of this pasture mix to continue to increase as it becomes a well-established component of the mix. It is predicted that the legume component of lucerne and red clover will continue to change with the growing season.



▲ **Figure 6:** Comparison of dry matter composition change over time for the diverse pasture trial at Ratharney.

▲ **Above:** Diverse pasture mix at Ratharney. This picture was taken on September 11, 2024 and shows the stubble left behind from the chicory flowering over the previous summer.

Feed quality and pasture composition results

Table 9 shows the feed test results from samples taken throughout 2023 and 2024. It is evident that during the warmer months of January, September and November feed quality, particularly Metabolisable Energy (ME) and Dry Matter Digestibility (DMD) are higher compared with the winter month of June. Interestingly, the feed test values for February 2024 are only slightly better than those taken in June 2023. We attribute this to the reproductive stage of the pasture, particularly, the chicory as this had become rank and stalky. Sheep will selectively graze and most likely be consuming higher quality than a the feed test suggests as they will leave the stalks. The legume component in the pasture in February 2024 (34%) was also low compared to other testing times, except for January 2023 (29.5%). We know that legumes have high crude protein (CP) values. CP is a measure of the nitrogen content in feed and animals that are actively growing have a greater requirement for protein in their diet compared to animals that are maintaining weight. Having a stable legume component in the feed base can help to improve liveweight gains and help buffer reductions in feed quality when the other pasture species lose quality.

▾ **Table 9:** Feed test results from pasture mix sown at Western Plains.

Sample Month	DMD %	NDF %	CP %	ME MJ/kg DM
January 2023	73.0	33.0	19.3	11.4
June 2023	64.0	43.0	21.8	9.6
September 2023	78.0	27.0	29.2	11.9
February 2024	66.7	40.3	22.0	10.0
September 2024	78.5	28.9	28.2	12.1
November 2024	73.1	27.6	22.4	11.9

Key points

Greater grazing flexibility can be achieved by using perennial pastures under irrigation.

The legume component of a pasture is important in extending the feed quality throughout the season.

Feed quality can be maintained later into the growing season through careful grazing management.

▴ **Above:** Top: Chris Headlam and Rowan Smith (TIA) in the diverse fodder mix at Ratharney, Woodbury. Bottom: Diverse Forage mix being sown at Ratharney, Woodbury on 7 December, 2022.

Trialling Spring sown perennial pastures

Knox Heggaton and Dylan Browning: Scone, Northern Midlands Tasmania

Background

Over the years of managing Scone, a grazing property near Perth in the Northern Midlands of Tasmania, Knox Heggaton has devised a pasture renovation strategy that has worked for their sheep grazing system. Traditionally, pastures selected for renovation have been sprayed out and cultivated in early spring and sown with a break crop of turnips. In the following year, a rape crop is sown to provide valuable summer feed for lambs. Finally, after a third glyphosate application, a perennial pasture mix is sown in Autumn and establishes over winter. However, in recent years perennial pastures sown in Autumn at Scone have been affected by slugs, with some paddocks receiving 3-4 applications of slug bait. Additionally, some producers are commenting on the increasing unreliability of autumn rainfall to establish crops and perennial pastures before cold winter weather sets in. To combat these issues, Knox and his team are trialling spring sown perennial pasture mixes.

Snapshot

- Knox Heggaton and his team manage Scone, Perth Tasmania
- 600 ha composite ewe and fat lamb operation
- 120 ha of irrigated land under 6 pivot irrigators
- 630 mm average annual rainfall
- Traditionally perennial pastures at Scone have been sown in Autumn but issues with slugs have been increasing in recent years. Knox and his team are trialling Spring sowing perennial pastures.

▲ **Above:** Pasture mix 2 sown at Scone with the iconic Western Tiers in the background. This picture was taken on 2 April, 2025 after a failed autumn break.

▸ **Right:** Pasture mix 2 sown in August 2024 at Scone. This picture was taken on the 13th of November 2024.

Establishment

Two paddocks were selected for pasture renovation. Each paddock had a break crop of forage rape and ryegrass sown prior to a final desiccant spray in the first week of August 2024. The paddocks were heavily grazed in the second week of August to reduce plant residue. The new pasture was sown into the rape stubble on the 20th of August with 150 kg/ha of 14-16-11 (14 % N, 16 % P, 11 % K) fertiliser. Each paddock was sown to a different pasture mix (Table 10). Establishment in each paddock was very slow, with wet and cold conditions persisting into October. Soil temperatures in the top 10 cm of the soil finally reached 10 degrees in the first week of October. From that point, soil temperatures started to rise but moisture became limiting.

One potential issue when sowing legumes following a brassica crop is the prior use of herbicides. In this case, the paddock history revealed that Lontrel Advanced (a.i. Clopyralid) had been used in the previous brassica crop to control weeds. Luckily, the plant back period for clovers had lapsed since the time of application. The plant back period is always displayed on the label of chemicals and is the recommended wait time between herbicide application and planting susceptible pasture species and crops. It is an important reminder to consider prior chemical use when deciding on a pasture mix.

▾ **Table 10:** Pasture mixes trialled at Scone. We calculated the seed cost for each mix using spring 2024 seed prices; Mix 1 was $203/ha inc gst and Mix 2 was $259/ha inc gst.

Mix 1	Mix 2
Phalaris cv. Australian @ 4 kg/ha	Cocksfoot cv. Aurus @ 4 kg/ha
Cocksfoot cv. Howlong @ 3 kg/ha	Phalaris cv. Holdfast @ 2 kg/ha
Tall fescue cv. Quantum Max P @ 2 kg/ha	Red clover cv. Rubitas @ 4 kg/ha
White clover cv. Huia @ 1 kg/ha	Lucerne cv. SARDI Grazer @ 3 kg/ha
Red clover cv. Rubitas @ 1 kg/ha	Strawberry clover cv. Palestine @ 1 kg/ha

Weed control

As a consequence of sowing into cool soil temperatures, sown pasture species, particularly legumes, are slower to establish. This leaves establishing pastures vulnerable to weed burden. Toad rush became a major issue in both paddocks and threatened to smother out establishing grass and legume plants as the wet and cool conditions were favourable to its growth. Once conditions started to warm there was also a large germination of fat hen in both paddocks.

Weed control using herbicide application was difficult in these paddocks. Firstly, Mix 2 contained a combination of both lucerne and clovers, which significantly reduced the chemical options available for use. Secondly, the slow growing conditions experienced through spring meant that the legumes were slow to develop trifoliate leaves. Most selective herbicides safe to use in new legume pastures require legumes to be a certain growth stage. This meant that spraying was delayed while the legumes grew to reach an adequate size. Lastly, October and November bought very dry conditions, meaning that both paddocks became moisture stressed towards the back half of Spring. Best practice is to apply herbicide when all plants are actively growing. This ensures a more effective weed kill and minimises damage to non-target species.

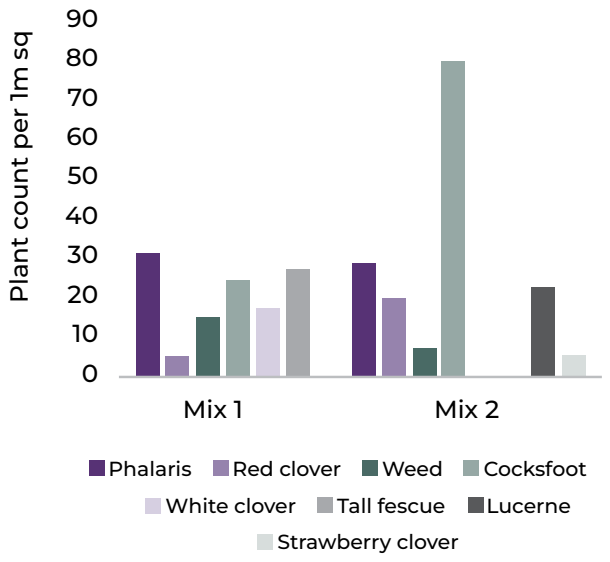
On the 20th of November, both paddocks were sprayed with a selective herbicide targeting toad rush and fat hen. Pasture Mix 2 containing both grass, lucerne and clover received an application of Diflufenican and Bromoxynil. Observations on the 3rd of December 2024 showed yellowing on the lucerne plants and significant burn on the establishing clovers. Bromoxynil is recommended for use <20 °C. Temperatures in late November can be warm, which may have contributed to excess burning on non-target species. Pasture Mix 1 received a herbicide combination of MCPB, MCPA and Flumetsulam on the same day. Observations also indicated some burning on the young clover plants in the paddock, though not as severe as Mix 1. New growth on the legumes appeared to be unaffected by the sprays. Both sprays did an excellent job on the toad rush and fat hen in the paddock.

▲ **Above:** Spray damage on old leaves of the lucerne with young, unaffected leaves starting to emerge.

Plant counts

Plant counts were conducted on the 3rd of December to assess the early establishment of each pasture mix. Figure 7 shows that Mix 1 had a grass component of phalaris (31.3 plants/m^2), cocksfoot (24.6 plants/ m^2) and tall fescue (27.3 plants/ m^2). The grass component in Mix 2 was more cocksfoot dominant with 80 cocksfoot plants/ m^2 and 28.6 phalaris plants/ m^2. The other main differences were seen in the legume component of each mix. White clover was the dominant legume in Mix 1 (17.3 plants/m^2) and there were only 5.3 red clover plants/m^2. Mix 2 had a larger number of legumes present with lucerne (22.6 plants/ m^2), red clover (20 plants/ m^2) and strawberry clover (5.3 plants/ m^2) present. We will continue to monitor both pasture mixes over the coming seasons to determine how they perform in the grazing system at Scone.

▸ **Image:** Left: red clover plant displaying chemical burn after receiving a selective herbicide to control fat hen and toad rush. The new leaves emerging look unaffected by the chemical. Right: Mix 2 sown at Scone. The toad rush and fat hen are beginning to dessicate after receiving a herbicide application.



▲ **Figure 7:** Plant counts for both pasture mixes taken on the 3rd of December 2024.

Key points

- Increasing unreliability of autumn rainfall and issues with slug damage can affect the success of autumn sown perennial pastures.
- Spring sown legumes can be slow to establish in cool and waterlogged conditions which can reduce establishment through increased weed competition.
- Weed control options must be considered prior to sowing lucerne and clovers in the same pasture mix.

Incorporating legumes into a pasture improvement program

Pilkington family; Killara, Redpa

Background

Killara Pastoral, owned and operated by the Pilkington family, is a 1455 ha property near Arthur River in Tasmania's North-West. The Pilkington family run a 1120 head cow-calf operation with weaned calves typically grown out to weights of 450 kg on an additional 243 ha property at Montagu. With an average annual rainfall of 1150 mm, the Pilkington family face waterlogging challenges like many other farms in the area. To alleviate these challenges, an extensive pasture renovation phase began at Killara. The aim was to improve drainage in winter waterlogged areas and establish persistent perennial pastures that increase animal production.

Snapshot

- Killara is a 1455 ha family operated 1120 head cow-calf operation
- Typically, calves are grown out to weights of 450 kg on an additional 243 ha property at Montagu
- Annual rainfall 1150 mm
- Currently undergoing extensive pasture improvement in areas that have become degraded over time

▲ **Above:** Rowan Smith (TIA), Trixie the Blue Heeler, David and Andrew Pilkington standing in an autumn 2023 sown mixed pasture at Killara, Redpa.

Hump and hollow drainage

In Winter wet areas prone to waterlogging, it is common to find undesirable and unproductive species that significantly reduce pasture production and grazing profitability. The Pilkingtons identified areas of Killara that had become degraded over time and overgrown with pin rushes which are an indicator species of poorly drained areas. In these areas, hump and hollow drains were formed, with the pin rushes mounded onto the humps.

The formation of hump and hollow drainage involves the removal of topsoil from the hollows which can pose a challenge when establishing pastures in these areas. The hollows can have very low pH levels and nutrient retention is difficult due to persistent waterlogging. The hollows often become a sacrifice area of the paddock, allowing the humps sufficient drainage to improve pasture production particularly during the wetter months.

As part of our Involve and Partner activities we followed the pasture improvement program in two paddocks that had hump and hollow drainage installed as well as a full pasture renovation

Monitoring the pastures

Once both paddocks had established, we began tracking feed quality changes over time. Feed tests were taken and the results appear to show a gradual increase in feed quality for both paddocks as the pastures established (Table 11). The Dry Matter Digestibility (DMD), Crude Protein (CP) and Metabolisable Energy (ME) trended upward and the Neutral Detergent Fibre (NDF) trended downwards. These changes may be influenced by seasonal growth curves of the pastures however, it may also be attributed to the establishment and increased legume component in the pasture. As the legume component of the pasture establishes, the proportion of legume as a percentage of total pasture biomass increases.

We know that legumes have a high level of CP. CP is a measure of the nitrogen content in feed. Animals that are actively growing have a greater requirement for protein in the diet compared to animals that are maintaining weight. Feeds with <6% CP are generally considered deficient and will limit rumen function and animal performance. Pastures with an ME >11.5 MJ/kg DM and a CP >15% are considered good quality for weaner cattle, though this may vary for other stock classes.

Generally, pastures with a high clover content have lower NDF values. NDF is an estimate of the percentage of total cell wall content in forages. Pastures containing a lower NDF value are usually better quality and lead to higher levels of animal intake and thus animal weight gain.

▾ **Below:** Left: Paddock 2 after the formation of hump and hollow drainage and sowing in March 2023. Right: Paddock 2 in September, 2023 after the pastures first graze. Notice how quickly the pin rush residue decomposed.

▴ **Above:** Left: Strawberry clover growing under waterlogged conditions. Right: Hump and hollow drainage at Killara with the humps demonstrating more pasture growth compared to the hollows.

▾ **Table 11:** Feed test results from the two new paddocks sown at Killara.

Paddock	Sample Date	DMD %	NDF %	CP %	ME MJ/ kg DM
Paddock 1	29-5-23	76.5	44.0	21.0	11.5
	24-10-23	77.0	41.9	22.7	11.5
	6-5-24	84.1	37.1	24.6	12.8
Paddock 2	24-10-23	66.1	45.2	17.2	11.5
	6-5-24	84.6	36.2	24.9	12.7

Key points

- In the high rainfall zone of the North West coast, persistent waterlogged is a major issue for livestock produces
- Hump and hollow drainage is one method to reduce water-logging and improve pasture growth, though the removal of topsoil from the hollows can make pasture establishment in these areas difficult.
- As the two pastures established at Killara, the feed quality increased. This may be attributed to an increased proportion of legume as the perennial legume component of the pasture established.

▸ **Right:** Hump and hollow drainage at Killara. The water accumulates and drains through the hollow and the hump remains dry and productive during wet times.

Tips for the preparation, sowing, establishment and maintenance of perennial pastures to advantage legumes

Emily Hall and Rowan Smith

Background

The following has been prepared using key industry resources and findings from TIA's perennial legume project 2025 (MLA project code: P.PSH.2052), 'Growing red meat productivity through the selection and establishment of perennial legumes'. It may be used as a guide to aid in the preparation, sowing, establishment and maintenance of pastures with the aim of increasing perennial legume content in Tasmanian rainfed pastures.

Preparation

Determine why the previous pasture failed and rectify any underlying soil constraints, drainage issues, pest and weed burdens or management factors that may have contributed to its failure.

- **Conduct a soil test:** Correct any issues prior to sowing. The optimal pH range for plants is between 5.5 and 8 (CaCl2) whereas most soil organisms function best between pH CaCl2 6.0 and 7.0. Consider incorporating lime to achieve best results.
- **Reduce weed burden:** Weed control should commence 12 months before planned pasture renovation. Control strategies include winter 'spray grazing', pasture topping, summer chemical fallows and the use of multi-year break crops. IMPORTANT: ensure all plant back periods for the prior use of chemicals has lapsed before sowing susceptible legumes.
- **Assess presence of pests:** Common pests to watch out for include red legged earth mite and lucerne flea. Control strategies for these can be combined with a desiccant spray prior to sowing. Assess the risk of slug damage prior to sowing by leaving boards or wet paper at monitoring sites. Apply bait as required and directed on the product label.
- **Species selection:** It is vital to choose the right plant for the right place. For more information on species and cultivar selection for Tasmanian pastures, access the Species for Profit manual through the nre.tas website or check out the Pasture Trial Network (PNT) to see how commercially available cultivars of major pasture species perform in Tasmania. An important consideration is to choose companion pasture species that are compatible for selective herbicide application. Combining herbs and legumes in a pasture mix reduces your selective herbicide options.
- **Purchase certified seed with correct and live rhizobium:** Ensure you purchase recently inoculated seed; the inoculation date may be on the bag or ask your seed merchant. Rhizobia survival rates vary between 2 weeks and 6 months depending on pasture species and rhizobia strain. Survival rates decline on seed stored in hot conditions.

▲ **Above:** TIA Feedbase Researcher Rowan Smith and technical officer Anthony Cruikshank sowing a legume trial at 'Ratho', Bothwell.

Sowing

Timing of sowing and sowing method can significantly affect the successful establishment of a pasture. Here are some important factors to consider around sowing:

- **Timing and seasonal outlook:** Ensure adequate soil moisture and temperatures for the species you are sowing. If the seasonal outlook is unfavourable, consider holding off your renovation or sowing an annual fodder crop to fill feed gaps.
- **Sowing rates:**
  - Determine the germination percentage of the seed you're sowing and take this into account when deciding on a sowing rate. Sowing rates assume 100% germination.
  - Think about advantaging the legume component in your pasture by increasing the sowing rate of legumes and decreasing the rate of grass. Are you sowing enough clover seed to achieve your desired content in the pasture?
- **Fertiliser at sowing:** Fertiliser is required to ensure rapid, healthy and vigorous seedling growth. Banding fertiliser with seed at sowing is 40% more efficient compared to broadcasting fertiliser. Consult your local agronomist for detailed advice on your sowing fertiliser requirements.

Establishment

Post emergent management of a new pasture is vital for ensuring the ongoing success and production of your investment. Things to keep in mind include:

- **Conduct regular post emergent checks:** Keep a close eye on germinating weeds and the presence of pasture pests. Act immediately if necessary.
- **Weed control:** Some selective herbicides are safe to use in new legume pastures provided the legumes are at an adequate growth stage. Ensuring that plants are not under any type of moisture or temperature stress at the time of spraying is paramount to reducing damage to young legume plants. Legume plants may be lost due to incorrect herbicide selection and deviation from label instructions. Please discuss your herbicide options and best time to spray with your local agronomist.
- **The timing of first grazing:** When plants reach 10-15 cm and are anchored well into the soil with adequate soil moisture, a quick graze to 2.5 cm will assist tillering and allow light penetration to establishing legumes.
- **Do not make hay or silage from newly sown pastures in the first year.**

Maintenance

The ongoing maintenance of your pasture will ensure optimum performance and longevity. A few things to remember include:

- **Build a seed bank:** Consider allowing the new pasture to set seed in the first season, particularly if there are annual species in the pasture mix.
- **Rotational grazing:** Set stocking weakens plants and reduces the ability of the plant to withstand stresses including periods of dry, waterlogging or pest attack. Rotational grazing increases pasture productivity and improves the persistence of your pasture.
- **Pests and weeds:** Continue to monitor for pasture pests/weeds and act if populations warrant action. For more information, visit the Tasmanian Pasture and Forage Pests guide through the nre.tas website.
- **Pasture manipulation by grazing:** Heavy grazing in spring can help to prevent grass dominance, reduce seed set of annual grass weeds and favour clover seed production. Ensuring that summer feed and residue is cleaned up prior to the autumn break can advantage legumes and optimise feed quality.
- **Monitor soils:** Continue to conduct regular soil tests to monitor soil pH and fertility over time. Excessive use of nitrogen fertiliser is likely to advantage grasses, which will become dominant. Phosphorus and potassium are key macronutrients for healthy legumes.

▲ **Above:** Top: Red and Strawberry clover establishing underneath cocksfoot plants at a trial site near Perth, Tasmania. Bottom: Germinating perennial pasture trial at Pipers River.

Findings from the perennial legume project

Key take away messages from TIAs sowing experiments for the successful establishment of perennial legumes:

- Best results were achieved where preparation work reduced weed competition
- Broadcast sowing methods are reliant on favourable surface soil moisture and good seed soil contact to aide germination.
- It was inconclusive that alternate row and matrix sowing to spatially separate the grass and legume components of pasture mixes was any better than conventional direct drilling in mixed row.

Re-introducing or oversowing perennial legumes into a grass dominant pasture is difficult. Results suggest that:

- Some form of competition reduction advantages legumes. This may include a non- lethal dose of glyphosate prior to sowing, or some form of cultivation
- Success is more likely when sowing vigorous establishing legumes, particularly annuals. Small seeded perennial legumes are less vigorous and can be quickly out competed by existing grasses.

The trend towards a reduction in chemical use and cultivation provides limitations on existing methods for pasture renovation.

- Strip till offers a method of renovating pasture with minimal soil disturbance and no chemical use, though large changes in botanical composition with perennial plants is unlikely, or successive passes over multiple years may be required.

▲ **Above:** Red clover and ryegrass establishing at a legume trial at 'Greenhythe', Hillwood. The alternate row sowing method was one method trailed at the site.

Further resources

- Species for Profit – Tasmanian graziers guide to pasture, forage and fodder crops Edition 2 2021. Visit: **Species for Profit – Edition 2 2021**
- Tasmanian Pasture and Forage Pests – Identification, biology and control. Visit: **Pasture Pests Book final.indd**
- Pasture Trials Network (PTN). Visit: **Pasture Trial Network 3.0.10**

For more information email **Rowan.Smith@utas.edu.au**
or visit **utas.edu.au/tia-legumes-project**

Scan here for more project information

Acknowledgements

The 'Growing red meat productivity through the selection and establishment of perennial legumes' project was co-funded by the Tasmanian Institute of Agriculture and Meat and Livestock Australia through the MLA Donor Company.
Authors: Rowan Smith and Emily Hall.

Our project team would like to acknowledge the contributions of all Involve and Partner producers who engaged with the project and provided access to their land for the purpose of trials or demonstration sowings. This work could not have taken place without the support of these producers.

MLA Project Code: P.PSH.2052

UNIVERSITY of TASMANIA

TIA

Tasmanian Institute of Agriculture

mla MEAT & LIVESTOCK AUSTRALIA DONOR COMPANY

Contact us

+61 3 6226 2463
tia.enquiries@utas.edu.au
utas.edu.au/tia

@TasInAg
@tas_institute_of_ag
@TasInAg
@TasInstituteofAg