SA Drought Hub Technical Report

Mixed Species Pastures Demonstration Sites

PROJECT LEAD: Barossa Improved Grazing Group (BIGG)
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PROJECT SUMMARY

Productive pastures are a key driver for livestock and mixed farm business profitability; hence it is critical farmers are utilising productive pasture species best suited to their environment. In this project various pasture species and mixes were evaluated for their productivity and quality at BIGG and MNHRZ field demonstration sites.

In BIGG's major trial at Angaston, the two treatments with the highest plant diversity: Oats Ryegrass Clover Brassica Herb, and Oats Ryegrass Clover, produced the highest total dry matter yield for the season. The former treatment also had the best feed quality. The trial also validated that within a multi-species pasture mix, different species perform well at different stages of the season.

MNHRZ's trials at Navan and Farrell Flat determined the dry matter production of numerous pasture and forage species/mixes. From these results, recommendations were developed for pasture options throughout the course of the season. These included using cereal based mixes early in the season, brassicas mid-season, and the good performance of mixes later in the season.

Farmers and advisers particularly benefited from this project, highlighted by approximately 200 farmers and 40 agribusiness reps/advisers attending BIGG's and MNHRZ's crop/pasture walks held throughout 2022.

EXECUTIVE SUMMARY

The objective of this project is to assess and communicate the value of pasture species/mixes in local farming systems. To achieve this, various pasture species/mixes were evaluated at four field demonstration sites, two by BIGG (Angaston, Birdwood) and two by MNHRZ (Navan, Farrell Flat). The trial assessment aims were achieved, with the pasture treatments being assessed throughout the season for dry matter production and quality at all sites, including residual soil water and nitrogen at the MNHRZ sites.

BIGG's major site at Angaston assessed two single species (Oats, Ryegrass) and three multi species (Oats Ryegrass, Oats Ryegrass Clover, Oats Ryegrass Clover Brassica Herb) at five timings throughout the season. The treatments which produced the highest total dry matter yield for the season, Oats Ryegrass Clover Brassica Herb and Oats Ryegrass Clover (4557 and 4409 kg DM/ha respectively), were also the treatments with the most plant diversity (a mix of ten and six varieties respectively). Although Oats produced the lowest total dry matter yield (3183 kg DM/ha - significantly less than Oats Ryegrass Clover Brassica Herb and Oats Ryegrass Clover), it did produce reasonable dry matter yield early in the season. In comparison, ryegrass either as a single species treatment or as a key component within the three multi species treatments, performed strongly later in the season.

Feed quality analysis determined there were marginal differences between treatments at each sampling time, however averaged across the season, Oats Ryegrass Clover Brassica Herb had the highest feed quality. Coupled with ORCBH also producing high dry matter yields, both early in the season (likely due to the contribution of its brassica content) and late in the season (likely due to the contribution of its ryegrass content), suggests it is a good option to help graziers fill the traditional winter feed gap, whilst providing a longer grazing period in a season like 2022 at Angaston.

The results also validated that within a multi-species pasture mix, different species perform well at different stages of the season and therefore compared to a single species pasture, can better respond to seasonal variation.

MNHRZ's sites at Navan and Farrell Flat determined dry matter production of individual pasture and forage species, and mixes at three timings throughout the season. The species included, cereals, ryegrass, brassica, pasture legumes and forage legumes. Key outcomes relating to dry matter production were as follows.

- Early Season: Cereals were the best source of early season feed, with barley varieties producing the highest levels of dry matter compared to other cereals. Higher seeding rates can result in significantly higher dry matter production. Of the mixes, cereal based mixes provided the highest amount of dry matter.
- Mid-Season: If pasture production is not required until 8-12 weeks into the season (mid to late winter), then brassica species can produce high levels of dry matter. The time period to grazing will depend on the environment, with the Navan site accumulating more dry matter in a shorter period of time. There was no significant difference in recovery of cereal species at this timing (as measured by yield of previously mown treatments), and, in some cases, recovery of mown canola/brassica species matched recovery of cereal treatments. Unmown canola/brassica species outperformed legume species with the exception of Morava vetch. Of the mixed species, cereal mixes recovered best from initial grazing compared to the canola/brassica and vetch mixes.
- Late Season: All legume, ryegrass and beet species performed equally well at Navan, suggesting that for late season feed following earlier grazing, selecting the cheapest option out of the species may be the best option. This will reduce financial exposure in a dry spring

where performance may be more limited than it was in this project. All pasture mixes performed well at Navan with the Tetrone ryegrass, persian clover mix also performing well at Farrell Flat where it recovered extremely well from a severe mowing treatment.

At the end of the season, soil testing was also conducted at Navan and Farrell Flat to determine residual soil water and nitrogen (given this may influence future rotational decisions and input costs in following crops). Analysis was completed for both sites assessing the 0-60cm plant available water and nitrogen, and 60-100cm plant available water. Navan soil water results were impacted by late season rainfall with soil nitrogen results indicating some trends towards high nitrogen levels with legume species, however these differences were not significantly different.

Communications and extension

Communications was also a major focus of the project, which was successfully delivered through showcasing the demonstration sites at BIGG's and MNHRZ's crop/pasture walks, and via associated articles and presentations. A highlight was approximately 200 farmers and 40 agribusiness reps/advisers attending the demonstration site crop/pasture walks that both groups held in 2022. This gave attendees a great opportunity to learn about and see first-hand the pasture species and mixes that perform well in their region.

Having trial sites established in different environments also proved valuable. For example, results from the MNHRZ trials established at cool (Navan) and cold (Farrell Flat) environments determined that due to slower growth rates early in the season in cold environments, brassica production was impacted and instead cereals are a better pasture production option. This type of information gives farmers increased confidence to implement strategies best suited to their environment. It also helps inform their 'pasture seed choices' and immediately be put into practice (i.e., this coming season).

Through better pasture choices and growing more productive high-quality pastures not only helps farmers better meet their livestock production needs, but if excess feed is available gives flexibility to retain extra stock or convert it into fodder. This then can be used to fill seasonal livestock feed gaps or be saved for dry times. Growing adequate pasture also gives the best opportunity to maintain paddock groundcover, therefore providing landcare benefits. This all helps build local farming systems resilience.

Apart from farmers and agribusiness reps/advisers visiting the project sites, other key groups also visited. In October, MNHRZ hosted University of Adelaide agriculture science students at both Navan and Farrell Flat, while the project was also promoted to the Federal Drought Hub Advisory Committee who visited BIGG's Angaston site in August and to the Federal Minister of Agriculture, Forestry and Fisheries who did the same in November.

BIGG's project results were also recently communicated to over 50 producers at its annual conference in February, while MNHRZ will be doing similar at its upcoming Autumn update.

PROJECT BACKGROUND AND OBJECTIVES

BIGG and MNHRZ have a strong interest in productive plant species and mixes in both livestock and cropping systems. BIGG producers have started trialling the use of mixed species pastures in their livestock production systems while MNHRZ have been running mixed pasture demonstrations in line with their annual cropping trials.

The objective of this project is to assess and communicate the value of pasture species and mixes in local farming systems. To achieve this, various pasture species/mixes were evaluated at four field demonstration sites in 2022. These were conducted by BIGG at Angaston (medium rainfall - major site) and Birdwood (high rainfall - minor site), and by MNHRZ at Navan (cool environment site) and Farrell Flat (cold environment site).

The assessment objectives for the trials were nearly all achieved. Limitations for this occurred at the Birdwood site, where bird and insect damage to plots resulted in uneven plant numbers and the exclusion of some treatments (in lieu of this, extra assessments were conducted at BIGG's Angaston site). At the Farrell Flat site, waterlogging during spring impacted the northern end of the site which affected the results of some species ('species waterlogging susceptibility' was though noted so to help improve awareness for farmers/advisers who utilise pastures in waterlogging prone areas). In addition, spray drift at Farrell Flat impacted some of the late season dry matter results. Apart from these restraints, all treatment assessments were conducted in a timely manner as planned. This ensured the pasture species/mixes were thoroughly evaluated at each demonstration site.

Communications were also an important component of the project. This was successfully delivered through showcasing the demonstration sites at BIGG's and MNHRZ's crop/pasture walks, and via associated articles and presentations.

A secondary objective of the project was to foster collaboration between BIGG And MNHRZ and the development of wider partnerships. These were both successfully achieved. In BIGG's case a new University of Adelaide project (Pasture Optimization for Drought Solutions) co-located their 'novel pasture species' trial at BIGG's Angaston site. While MNHRZ's Farrell Flat demonstration site was incorporated into its GRDC/SAGIT funded MNHRZ Frost Learning Centre. This added value for both MNHRZ projects, as livestock is a key risk management tool for growers who have significant areas with high frost damage/frequency on their farms.

METHODOLOGY

This project established four demonstration trials, two conducted by BIGG (Angaston, Birdwood) and two by MNHRZ (Navan, Farrell Flat). All sites were sown with a small plot seeder with the trials being assessed throughout the season. Site assessments and management was conducted by BIGG at Angaston, Coopers Farm Supplies at Birdwood and Agrlink at Navan and Farrell Flat.

The 2022 season was characterised by a late break (late May) but above average rainfall, particularly in October and November which were extremely wet.

BIGG - Angaston

The Angaston trial comprised five pasture treatments, two single species and three multi species treatments as follows:

1. Oats 120kg/ha
2. Ryegrass 30kg/ha
3. Oats 50kg/ha + Ryegrass 15kg/ha
4. Oats 50kg/ha + Ryegrass 15kg/ha + Clover 8kg/ha
5. Oats 50kg/ha + Ryegrass 15kg/ha + Clover 6kg/ha + Brassica/Herb 9kg/ha

The varieties and sowing rates used to 'make up' each treatment is detailed in Table 1.

Table 1: Varieties and sowing rate breakdown of the Angaston trial treatments.

Treatment	Treatment sowing rate (kg/ha)	Treatment breakdown
Oats 120kg/ha	120	Forester (120)
Ryegrass 30kg/ha	30	Vortex (18), Fuze (12)
Oats 50kg/ha Ryegrass 15kg/ha	65	Forester (50) Vortex (9), Fuze (6)
Oats 50kg/ha Ryegrass 15kg/ha Clover 8kg/ha	73	Forester (50) Vortex (9), Fuze (6) Lightning Persian (3), Zulu II Arrowleaf (2.5), Vista Balansa (2.5)
Oats 50kg/ha Ryegrass 15kg/ha Clover 6kg/ha Brassica/Herb 9kg/ha	79	Forester (50) Vortex (9), Fuze (6) Lightning Persian (2), Zulu II Arrowleaf (1.5), Vista Balansa (1.5) Tillage Radish (2.5), Blue Gorilla Forage Rape (1.5) Endurance Plantain (3), Punter Chicory (2)

The trial was sown on 23/5/22 in a Randomised Complete Block Design with four replications and 1.5 x 7 m plots. To necessitate best practice seeding depth of each treatment, two seeding passes were conducted. The oats/ryegrass components of each treatment were sown first at 25mm (including Gain+ZS fertiliser at 80kg/ha) and the clover/brassica/herb components sown second at a depth of 10mm.

Assessment of dry matter pasture production was conducted at five timings (2/8/22, 2/9/22, 27/9/22, 18/10/22, 11/1/23) throughout the season. A plate meter (5 samples/plot) was used to estimate production on 2/8/22. At the other four timings, dry matter cuts were undertaken by cutting a 2m section of plot row to a height of 5cm. The fresh samples were then oven-dried (for 24 hours at 60-70°C) and weighed.

Plot samples from each treatment were collected and baulked together at each timing for feed quality analysis (by FeedTest). Immediately after sampling on 2/8/22, 2/9/22, 27/9/22, including on

8/12/22 all plots were cut to 5cm with a lawnmower and the residue removed from the site. This was conducted to simulate grazing and therefore determine pasture production recovery after each mowing.

Dry matter production data was subjected to statistical analysis using Genstat (courtesy of Amanda Schapel, SARDI), with treatment mean comparisons undertaken using the Tukey test.

BIGG - Birdwood

The Birdwood trial comprised three treatments: a single species treatment (oats) and two oats/ ryegrass treatments. The varieties and sowing rates used to 'make up' each treatment are detailed in Table *2*.

Table 2: Varieties and sowing rate breakdown of the Birdwood trial treatments.

Treatment	Treatment sowing rate (kg/ha)	Treatment breakdown
Oats 80kg/ha	80	Forester (80)
Oats 80kg/ha Ryegrass 15kg/ha	95	Forester (80) Vortex (9), Fuze (6)
Oats 50kg/ha Ryegrass 15kg/ha	65	Forester (50) Vortex (9), Fuze (6)

The trial was sown on 23/5/22 in a randomised complete block design with three replications and 1.5 x 1.5 m plots. All treatments were sown at a depth of 25mm (including Gain+ZS fertiliser at 80kg/ha). Assessment of dry matter pasture production was conducted at three timings (22/7/22, 28/9/22, 14/12/22) by cutting a 0.1m^2 quadrat/plot, to a height of 5cm. The fresh plot samples were then weighed and based on a sub-sample moisture percentage; dry matter production was calculated.

At the 20/12/22 timing, samples from each plot were collected for feed quality. Each plot sample was bulked together in their treatments and sent to FeedTest for analysis. Immediately after sampling on 22/7/22 and 10/10/22, the trial was cut to 5cm with a lawnmower and the residue removed from the site.

MNHRZ - Navan and Farrell Flat

The objective of the trial was to plant individual pasture species which included a range of cereal, ryegrass, brassica, and clover/legume species to compare individual species dry matter and forage quality before using these species to create a range of mixes targeting one of the following: production at different or a range of feed gaps, cropping disease break, broadleaf and grass weed control and optimising fodder and future rotational decisions. This was replicated at two sites in a cool and cold environment to allow growers and advisers to tailor strategies depending on farm location and time of seeding. A cool environment is generally defined as an area that is below 250m altitude above sea level with cold environments found above this altitude. Plant growth is relatively unrestrained in cool environments when compared to cold environments. Winter day temperature decreases as altitude increases, meaning that the growth restraint increases with increasing altitude. After the first two sampling treatments, simulated grazing treatments were applied. This added value to livestock produces as a measure of the ability of species to recover from grazing.

The trial was incorporated with the current MNHRZ trial sites at Farrell Flat and Navan. This allowed each trial to be included in field walks conducted at the sites. The Navan site was located on a dark brown clay loam to a light clay loam over a strong brown medium clay with some limestone present throughout the profile (Harding, 2022) and the Farrell Flat site on a red clay loam over clay chromosol (Dalgleish et. al, 2012). Waterlogging during spring impacted the northern replicate of the Farrell Flat trial. Weed pressure was limited throughout most of the season with self-sown faba beans being hand pulled or selectively sprayed at both sites and sow thistle and prickly lettuce present at the end of spring. There was some spray drift onto the Farrell Flat site in late spring which had an impact on the third sampling results (22/11/22) of brassica and legume species.

The Navan trial was sown dry on the 24/5/22 and the Farrell Flat site sown into moisture on the 3/7/22, after the opening rain on the 30/5/22. This same rain event was sufficient for germination at the Navan site. Sampling was undertaken three times through the season for production and quality. Half plot mowing treatments were applied after the first two sampling times to allow for recovery from simulated grazing to be assessed. Both trials were terminated in late November after the third sampling. Soil sampling of individual plots to a depth of one metre was completed in December with sub samples taken from the 0-60cm layer and 60-100cm layer. Plant available water (PAW) was determined for both layers and the 0-60cm layer was analysed for soil nitrogen content. There was approximately 100mm of rainfall at Navan and 20mm at Farrell Flat between trial termination and soil testing which impacted residual soil water levels. All plots in each replicate were sampled at Navan while at Farrell Flat samples were only taken from one block due to waterlogging at the north end of the site.

The trial was designed using a randomised complete block design within pasture types (i.e. cereals species and species mixes kept together). Each pasture species/mix was replicated three times. The main reason for grouping pasture types together was to simplify weed control. Analysis of variation was completed on all replicated results from this trial with the post-hoc test Tukey's honestly significant difference test conducted to determine significant difference with 95% confidence. The significant difference is displayed with letters and the standard deviation of the mean displayed with error bars on each graph.

LOCATION

Where demonstration sites, field trials, events or other activities have been conducted, provide the following location details in the table below: latitude and longitude for field trials, or LGA for events and other activities.

Site # and name	Latitude (decimal degrees)	Longitude (decimal degrees)	LGA
Trial Site #1 / BIGG Angaston	34°53'43.16"S	139°10'73.71"E	DC of Barossa
Trial Site #2 / BIGG Birdwood	34°79'66.96"S	138°98'88.56"E	DC of Barossa
Trial Site #3 / MNHRZ Navan	34°12'24.94"S	138°44'24.49"E	DC of Clare & Gilbert Valley
Trial Site #4 / MNHRZ Farrell Flat Frost Learning Centre	33°51'17.41"S	138°45'48.16"E	DC of Clare & Gilbert Valley

RESULTS

BIGG - Angaston

Dry matter production

An assessment of dry matter pasture production was conducted at five timings (2/8/22, 2/9/22, 27/9/22, 18/10/22, 11/1/23) throughout the season. After each assessment, the plots were mowed to simulate grazing, therefore the data presented in Table *3* represents pasture production recovery. The same data is presented in Figure 1 and graphically shows the accumulation of dry matter throughout the season.

Table 3: Effect of pasture treatment on dry matter production during the season at Angaston.

Treatment	Dry matter (kg/ha)*				
	2/8/22	2/8-2/9/22	2/9-27/9/22	27/9-18/10/22	8/12/22-11/1/23
Oats 120kg/ha	689 ab	950 ab	747 a	494 a	304 a
Ryegrass 30kg/ha	628 a	891 ab	986 ab	969 b	548 ab
Oats 50kg/ha Ryegrass 15kg/ha	640 ab	826 a	833 ab	782 ab	629 ab
Oats 50kg/ha Ryegrass 15kg/ha Clover 8kg/ha	682 ab	1140 ab	1075 b	794 ab	719 b
Oats 50kg/ha Ryegrass 15kg/ha Clover 6kg/ha Brassica/Herb 9kg/ha	732 b	1314 b	933 ab	800 ab	780 b

Values in columns not followed by the same common letter differ significantly (P<0.1).
*Dry matter production was not measured between 18/10-8/12/22

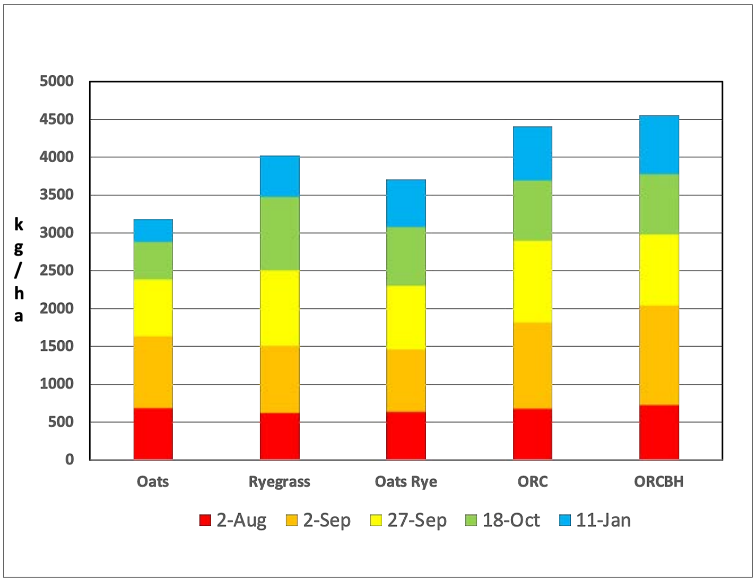

Figure 1: Effect of pasture treatment on dry matter production for the August 2022-January 2023 period (excluding 18/10-8/12/22) at Angaston.

In early August (first timing), Oats Ryegrass Clover Brassica Herb (ORCBH) produced the highest dry matter, recording significantly more dry matter (17%) than the Ryegrass treatment. In early September (second timing), ORCBH also had the highest production being significantly more (59%) more than Oats Ryegrass (this may be attributed to the contribution of the brassica component of ORCBH at highlighted in Figure 2).


Figure 2: Oats Ryegrass Clover Brassica Herb (left) and Oats Ryegrass (right) treatment production differences (1314 vs 826 kg DM/ha) when sampled on 2/9/22. (Taken by Brett Nietschke, brett.nietschke@biggroup.org.au).

In late September (third timing), Oats Ryegrass Clover (ORC) produced the highest production (possibly because its clover component had begun to 'kick-in'), significantly more (44%) than Oats which recorded the lowest. Similarly, in mid-October and mid-January (fourth and fifth timings), Oats recorded the lowest production. In mid-October, Ryegrass had the highest production, significantly more (96%) than Oats, while in mid-January both ORCBH and ORC was well over double the production of Oats. Irrespective of the statistical analysis outcomes, its worthy highlighting that at three of the five timings ORCBH produced the highest dry matter.

Total dry matter production measured for the season (i.e., between early August to mid-January) ranged from 3183 (Oats) to 4557kg/ha (ORCBH) (Figure 3). Both ORCBH and ORC produced significantly more dry matter than the two lowest yielding treatments, Oats (approximately 40% more) and Oats Ryegrass (approximately 20% more). ORCBH and ORC as the top yielding treatments were also the two treatments that had the most plant diversity, consisting of ten and six varieties respectively (Table *1*).

When comparing just the two single species treatments for total dry matter production, Ryegrass produced significantly more total dry matter (26%) than Oats (Figure *3*). This may be attributed to the longer than normal growing season which more favoured ryegrass plant growth.

Although Oats produced the lowest total dry matter for the season, it did produce reasonable dry matter yield at the beginning of the season. Later in the season (September- January) Oats 'ran out of puff', compared to Ryegrass which 'came into its own' during this period. This was highlighted in October (forth timing) when it was the treatment which recorded the highest production. Based on visual assessment of the plots at the third, fourth and fifth timings, ryegrass was also the dominant species component of the three multi-species treatments. This therefore implies ryegrass was the species that was 'doing the heavy lifting' for these treatments dry matter production late in the season.

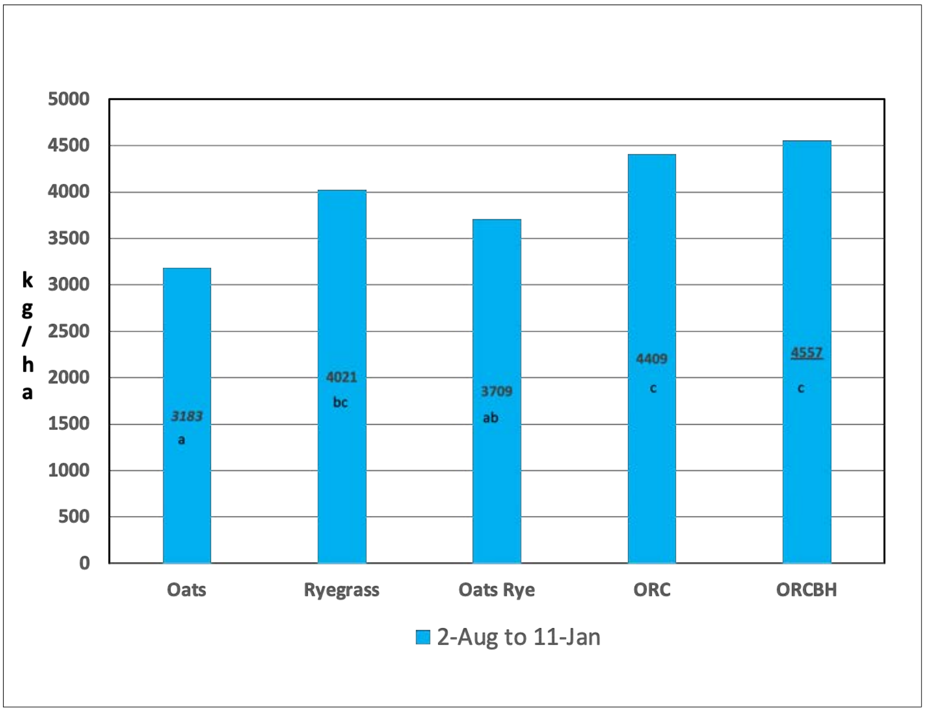

Figure 3: Effect of pasture treatment on total dry matter production measured for the August 2022-January 2023 period (excluding 18/10-8/12/22) at Angaston (treatment values not followed by the same common letter differ significantly (P<0.1)).

Pasture feed quality

An assessment of pasture quality was conducted at each of the five timings with plot samples from each treatment bulked together for analysis. The results for metabolisable energy, crude protein and digestibility at each timing (including averages across the season) are shown in Table *4*, Table *5* and Table *6* respectively.

Table 4: Effect of pasture treatment on metabolisable energy during the season at Angaston.

Treatment	Metabolisable energy (MJ/kg DM)					
	2/8/22	2/9/22	27/9/22	18/10/22	11/1/23	Average
Oats 120kg/ha	12.0	12.5	12.1	10.5	8.7	11.16
Ryegrass 30kg/ha	11.9	12.5	11.9	10.7	8.2	11.04
Oats 50kg/ha Ryegrass 15kg/ha	12.2	12.4	12.0	10.2	8.4	11.04
Oats 50kg/ha Ryegrass 15kg/ha Clover 8kg/ha	12.1	12.6	11.9	10.4	8.4	11.08
Oats 50kg/ha Ryegrass 15kg/ha Clover 6kg/ha Brassica/Herb 9kg/ha	12.2	13.1	12.0	10.2	8.6	11.22

Table 5: Effect of pasture treatment on crude protein during the season at Angaston.

Treatment	Crude protein (% of DM)					
	2/8/22	2/9/22	27/9/22	18/10/22	11/1/23	Average
Oats 120kg/ha	31.2	17.8	15.4	19.4	11.1	18.98
Ryegrass 30kg/ha	31.8	18.2	15.2	15.7	8.2	17.82
Oats 50kg/ha Ryegrass 15kg/ha	29.4	16.3	12.8	17.4	9.2	17.02
Oats 50kg/ha Ryegrass 15kg/ha Clover 8kg/ha	30.3	18.8	16.6	20.6	8.4	18.94
Oats 50kg/ha Ryegrass 15kg/ha Clover 6kg/ha Brassica/Herb 9kg/ha	29.2	20.3	18.4	20.0	9.1	19.40

Table 6: Effect of pasture treatment on digestibility during the season at Angaston.

Treatment	Digestibility (% of DM)					
	2/8/22	2/9/22	27/9/22	18/10/22	11/1/23	Average
Oats 120kg/ha	78.9	81.8	79.6	70.6	59.8	74.14
Ryegrass 30kg/ha	78.8	82.3	78.7	71.7	57.3	73.76
Oats 50kg/ha Ryegrass 15kg/ha	80.2	81.6	79.2	68.8	58.3	73.62
Oats 50kg/ha Ryegrass 15kg/ha Clover 8kg/ha	79.7	82.8	78.4	70.1	58.3	73.86
Oats 50kg/ha Ryegrass 15kg/ha Clover 6kg/ha Brassica/Herb 9kg/ha	80.3	85.5	79.0	68.4	59.3	74.50

There were very little differences in any of the treatments metabolisable energy, crude protein or digestibility, for each timing. This may be due to the treatments not being overly mature at each sampling (given they generally had been mowed less than a month before sampling), coupled with a much longer than normal growing season which slowed their maturity. A comparison of average metabolisable energy, crude protein and digestibility between treatments also verified there were marginal treatment differences (Table *4*, Table *5*, Table *6*).

Although the feed quality data was not analysed statistically (given testing was not replicated as plot samples were bulked together in their treatments), ORCBH produced the highest average metabolisable energy (Table *4*), the highest average crude protein (Table *5*) and the highest average digestibility (Table *6*). Oats produced the second highest averages for each of these criteria.

Of all feed quality testing, the largest difference between treatments was seen at the January 2023 sampling, where the crude protein of Oats was appreciably higher (11.1%) than the four other treatments (8.2-9.2%) (Table *5*). This was likely due to Oats being less mature compared to the other treatments, which were all dominated by ryegrass (on 11/1/23 ryegrass was flowering across the trial site, whereas the oats hadn’t yet reached this stage).

BIGG - Birdwood

Dry matter production

An assessment of dry matter pasture production was conducted at three timings (22/7/22, 28/9/22, 14/12/22) throughout the season. After each assessment, the plots were mowed to simulate grazing, therefore the data presented in Table 7 represents pasture production recovery. Total production for the season (i.e., July-December period) is also tabled.

Table 7: Effect of pasture treatment on dry matter production during the season at Birdwood.

Treatment	Dry matter (kg/ha)			
	22/7/22	22/7-28/9/22	28/9-14/12/22	Total (22/7-14/12/22)
Oats 80kg/ha	2192	6848	980	10020
Oats 80kg/ha Ryegrass 15kg/ha	2747	9533	1470	13750
Oats 50kg/ha Ryegrass 15kg/ha	2304	7076	2020	11400

Given the high variability in plant numbers across the site, including the exclusion of some trial treatments (due to bird and insect damage at the start of the season), the trial was simplified, and statistical analysis was not conducted on the data collected. However, the results suggest the treatment mixes were more productive than the monoculture Oats (at 80kg/ha) treatment which recorded the lowest dry matter at each timing. Across the season, the Oats 80kg/ha Ryegrass and the Oats 50kg/ha Ryegrass treatments produced more total dry matter (37% and 14% respectively) than Oats 80kg/ha (Table 7).

When comparing just the two Oats Ryegrass treatments, the treatment with the higher rate of Oats (80kg/ha) increased production at the first two timings, while Oats at 50kg/ha produced the highest dry matter at the final timing. This is likely due to the ryegrass component in this treatment 'taking over from the oats' later in the season (which also mirrors the Angaston results).

Pasture feed quality

An assessment of metabolisable energy, crude protein and digestibility was conducted on treatment samples collected on 14/12/22 (Table 8). For each of these criteria, Oats 80kg/ha Ryegrass produced the highest values.

Table 8: Effect of pasture treatment on pasture quality at Birdwood on 14/12/22.

Treatment	Pasture quality criteria		
	Metabolisable energy (MJ/kg DM)	Crude protein (% of DM)	Digestibility (% of DM)
Oats 80kg/ha	9.4	5.9	64.1
Oats 80kg/ha Ryegrass 15kg/ha	9.7	6.5	66.1
Oats 50kg/ha Ryegrass 15kg/ha	9.3	6.0	63.7

MNHRZ - Navan and Farrell Flat

Dry Matter - Navan

Table 9: Navan sole species and mixed species dry matter yield with mean significance listed. Statistical analysis was completed within the groups meaning there is no statistical comparison between the groups (mix vs sole and mown vs unmown). (*) denotes the plot not being sampled.

Navan	Dry Matter Yield (kg/Ha)							
Variety	20th July		1st/5th September				10th November	
	Unmown		Mown		Unmown		Mown	
Sole								
Commodus barley 200 seed/m2	822	ab	2883	a	*	*	*	*
Commodus barley 300 seed/m2	1061	a	3225	a	*	*	*	*
Kraken barley 200 seed/m2	874	ab	2777	ab	*	*	*	*
Bronco Oats 200 seed/m2	513	bcde	2181	ab	*	*	*	*
Mulgara Oats 200 seed/m2	536	bcde	3098	a	*	*	*	*
Bennett Wheat 200 seed/m2	453	bcdef	2417	ab	*	*	*	*
Scepter Wheat 200 seed/m2	712	abc	3043	a	*	*	*	*
Tetrone Ryegrass 15kg/Ha	233	def	1545	b	*	*	8691	a
Jester SU tol. Barrell Medic 10kg/Ha	112	ef	*	*	1429	cde	10103	a
Lightning Persian Clover 5kg/Ha	*	*	*	*	513	e	10941	a
Elite 2 Berseem 8kg/Ha	*	*	*	*	1586	cde	8236	a
Cefalu Arrowleaf 6kg/Ha	*	*	*	*	632	de	12923	a
Morava vetch 40kg/Ha	167	ef	1899	ab	2728	bcde	11635	a
Brigadier Fodder Beet 2.8kg/Ha	71	f	*	*	1613	cde	14213	a
Leafmore Brassica 5kg/Ha	467	bcdef	2695	ab	6434	a	7438	a
Feast Canola 2kg/Ha	322	cdef	3090	a	4482	ab	*	*
F2 Winter Canola 5kg/Ha	595	bcd	2857	ab	4468	ab	*	*
970CL 2kg/Ha	364	cdef	2538	ab	6326	a	*	*
Mix								
970CL, Morava	352	c	1834	b	4044.9	bc	12946	a
Commodus, Berseem, Persian	692	ab	3015	a	6348.2	a	8247	ab
Kraken, Tetrone, Morava	821	a	2422	ab	6522.0	a	8719	ab
Leafmore, Tetrone, Persian	389	bc	2732	ab	4126.9	bc	8446	ab
Tetrone, Persian	389	bc	2322	ab	4074.1	bc	12074	ab
Commodus, F2 Winter Canola, Jester Medic	961	a	2518	ab	5640.2	ab	6112	b
Leafmore, Morava	476	bc	2497	ab	4169.3	bc	8430	ab
Mulgara, Arrowleaf, Morava	655	abc	3196	a	5754.1	ab	10571	ab

Early season dry matter production typically requires the use of cereal species. This statement is supported by the results with some of the cereal treatments having significantly higher dry matter than most brassica, and all ryegrass and legume species. Some cereal species had higher dry matter accumulation than others, with both Commodus barley treatments, Kraken barley and Scepter wheat producing significantly more than most brassica and all legume and ryegrass species. Oat varieties and DS Bennett wheat did not produce significantly more dry matter than the brassica, legume, and ryegrass treatments. The impact of seeding rate was investigated with Commodus barley sown at 200 seeds/m2 (104kg/Ha) and 300 seeds/m2 (156kg/Ha). There was not a significant difference in early dry matter production between seeding rates.

There was no significant difference between the cereal based pasture mix treatments at the first time of sampling. In some cases, the brassica/legume and ryegrass/legume mixes produced significantly less dry matter than the cereal based pasture mixes but there was no significant difference between the non-cereal based mixes. The result clearly prove cereals are the best source of early season production. Barley had the highest production compared to legume and brassica species, but the trial was not able to differentiate differences between the sole cereal species.

The mid-season sampling included species and mixes that had a mowing treatment after the first sampling and an unmown treatment. In the mown treatment, there was no significant difference between most of the sole pasture species with the exception of Tetrone ryegrass, which produced significantly less dry matter than Commodus barley, Kraken barley, Mulgara oats, Scepter wheat and Feast canola. The brassica species recovered well from the early mowing treatment. This is an earlier stage than what is recommended for livestock to graze winter canola/forage brassica (250mm height or 1.5 t/Ha DM is recommended) (Fisher & Jones, 2018). However, when compared to the unmown brassica treatments, there was a large reduction in dry matter by the second sampling. For growers, this result shows that it is important to allow the brassica species to develop the recommended dry matter level before grazing with livestock, or risk overall productivity reduction of the pasture. The mown treatment mixes of Commodus barley, Berseem clover, Persian clover and Mulgara oats mix, arrowleaf clover, Morava vetch produced significantly higher dry matter production compared to the 970CL canola & Morava vetch mix with no significant difference to the remainder of the mixes. In this instance, there was no disadvantage to using a Leafmore brassica, Morava vetch mix or Tetrone ryegrass, Persian clover mix compared to a cereal based mix. The mown treatments were mown again after the completion of this sampling.

The unmown treatments from the mid-season sampling time saw no significant difference within the brassica species or within the legume/beet species. There was significant difference present between the brassica species and some the legume/beet species with the exception of Morava vetch. If there isn't a requirement to graze the pasture until midway through the season, then a brassica species or Morava vetch are viable options. There was no significant difference between the unmown cereal based mixes. The Commodus barley, berseem clover, persian clover and Kraken barley, Tetrone ryegrass, Persian clover mixes produced significantly higher dry matter than the canola/brassica and Morava vetch mixes and Tetrone ryegrass and Persian clover mix.

The third sampling showed how productive the clover and beet species could be with high levels of spring rainfall. All samples were taken from mown treatments with the mown Leafmore brassica included in this sampling for performance comparison. The winter canola was not sampled due to having finished flowering and was well into grain fill. There was no significant difference between any of the treatments meaning that for the purpose of late season dry matter production, there is no disadvantage in sourcing the lowest cost option out of the pasture options measured. The late season mown mixed species showed 970CL and Morava vetch mix producing significantly higher biomass than the Commodus barley, F2 winter canola and Jester medic mix with no difference between the remainder of the treatments.

Dry Matter - Farrell Flat

Table 10: Farrell Flat dry matter production of sole pasture species and mixes with mean significance listed. Statistical analysis was completed within groups meaning no statistical comparison between groups (mix vs sole and mown vs unmown). (*) denotes the plot not being sampled. Spray drift prior to the third sampling impacted legume/brassica species production.

Farrell Flat	Dry Matter Yield (kg/Ha)							
Variety	16th August		27-29th September				22nd November	
	Unmown		Mown		Unmown		Mown	
Sole								
Commodus barley 200 seed/m2	1464	b	3769	ab	*	*	*	*
Commodus barley 300 seed/m2	1940	a	3497	abcd	*	*	*	*
Kraken barley 200 seed/m2	1336	bc	4318	a	*	*	*	*
Bronco Oats 200 seed/m2	864	de	3736	abc	*	*	*	*
Mulgara Oats 200 seed/m2	960	cd	4338	a	*	*	*	*
Bennett Wheat 200 seed/m2	849	de	3981	a	*	*	*	*
Scepter Wheat 200 seed/m2	977	cd	3245	abcd	*	*	*	*
Tetrone Ryegrass 15kg/Ha	673	de	3390	abcd	*	*	3889	ab
Jester SU tol. Barrell Medic 10kg/Ha	*	*	*	*	1269	d	2236	b
Lightning Persian Clover 5kg/Ha	47	g	*	*	1188	d	4428	ab
Elite 2 Berseem 8kg/Ha	129	fg	*	*	1497	cd	7632	a
Cefalu Arrowleaf 6kg/Ha	*	*	*	*	611	d	2802	b
Morava vetch 40kg/Ha	403	efg	2031	bcd	3051	bcd	*	*
Brigadier Fodder Beet 2.8kg/Ha	*	*	*	*	*	*	*	*
Leafmore Brassica 5kg/Ha	691	de	1902	cd	4890	ab	*	*
Feast Canola 2kg/Ha	671	de	3174	abcd	5910	a	*	*
F2 Winter Canola 5kg/Ha	861	de	1795	d	4562	ab	*	*
970CL 2kg/Ha	575	def	2957	abcd	4115	abc	*	*
Mix								
970CL, Morava	692	cd	1884	c	4087	a	*	*
Commodus, Berseem, Persian	*	*	*	*	*	*	*	*
Kraken, Tetrone, Morava	1331	a	3861	a	6249	a	2623	b
Leafmore, Tetrone, Persian	*	*	*	*	*	*	*	*
Tetrone, Persian	489	d	2887	abc	4192	a	4632	a
Commodus, F2 Winter Canola, Jester Medic	1189	ab	3984	a	6771	a	2050	b
Leafmore, Morava	736	cd	2264	bc	4061	a	*	*
Mulgara, Arrowleaf, Morava	980	bc	3350	ab	6087	a	2129	b

The first sampling saw a significant response to seeding rate, with a 500kg/Ha response of Commodus barley to an additional 100 seeds/m^2, which was a seeding rate increase from 104kg/Ha to 156kg/Ha. When cereal species with equal plant densities are compared, Commodus and Kraken barley had the highest dry matter production. Commodus barley had significantly higher dry matter production compared to all cereals except Kraken barley. There was no significant difference between the legume species and canola/brassica species. Kraken barley, Tetrone ryegrass, Jester medic mix had significantly higher dry matter production than all mixes except for Commodus barley, F2 winter canola, Jester medic mix. This supports the results seen at Navan with cereals, especially barley being the optimum choice for early season dry matter production.

The sole species treatments, where they were mown after the first sample date, and sampled mid-season resulted in no significant difference between cereal and ryegrass treatments. F1 hybrid winter canola varieties (970CL and Feast) produced similar dry matter to cereals, after mowing. The F2 winter canola and Leafmore brassica had significantly lower dry matter than many of the cereal species. Mowing treatments were applied after the first grazing, which for the brassicas is earlier than recommended for initial grazing (Fisher & Jones, 2018). Of the unmown treatments, there was no significant difference between the forage brassica and winter canola species. Unmown Feast canola had significantly higher dry matter than all unmown legume species. When the canola/brassica results are compared to Navan, at the second sampling, dry matter production is similar, despite the three week difference in sampling timing. Considering trials germinated within a week of each other, the difference in growth rates is notable. There was no significant difference between the remainder of the canola/brassica species and Morava vetch. Clover species had much lower dry matter at this timing. There was no significant difference between the cereal based mixes. The Commodus barley, F2 winter canola, Jester medic mix and Kraken barley, Tetrone ryegrass, Persian clover mix had significantly higher dry matter compared to the brassica/winter canola, Morava vetch mixes. There was no significant difference between species in the unmown mixes. This is an encouraging result for the brassica/winter canola, Morava vetch mixes, because if the pasture isn’t required to be grazed by livestock early in the season, then these mixes can generate similar levels of dry matter to cereal based mixes.

The late season sampling timing had lower dry matter values when compared to Navan. The mowing treatment after the second sampling timing was more severe than the treatment at Navan, and would not be grazed to that extent in most paddock situations. There was also spray drift from the surrounding paddock prior to the third sampling that visually impacted the legume and brassica species. The severe mowing treatment and spray drift resulted in poorer dry matter recovery of 970CL canola, Morava vetch with the Leafmore brassica, Morava vetch mix not recovering at all. Late season waterlogging impacted some of the trial, with the sole brassica species experiencing severe waterlogging from which they did not recover. Due to trial design the mixed species were not impacted by severe waterlogging. Of the sole species, the Elite 2 berseem had significantly higher dry matter than Cefalu Arrowleaf and Jester medic. Lightning persian clover and Tetrone ryegrass did not have significantly different means to the Cefalu Arrowleaf or Elite 2 berseem. Tetrone ryegrass, persian clover mix had significantly higher dry matter than the cereal based mixtures. This shows the ability of the ryegrass and clover mix to tolerate overgrazing when compared to cereal mixtures once the cereals species had reached stem elongation. It also indicates that early maturity of cereals can curtail spring growth.

Pasture Quality

Quality results have not been received at the time of writing this report

Residual Soil Benefits

Navan Nitrogen:

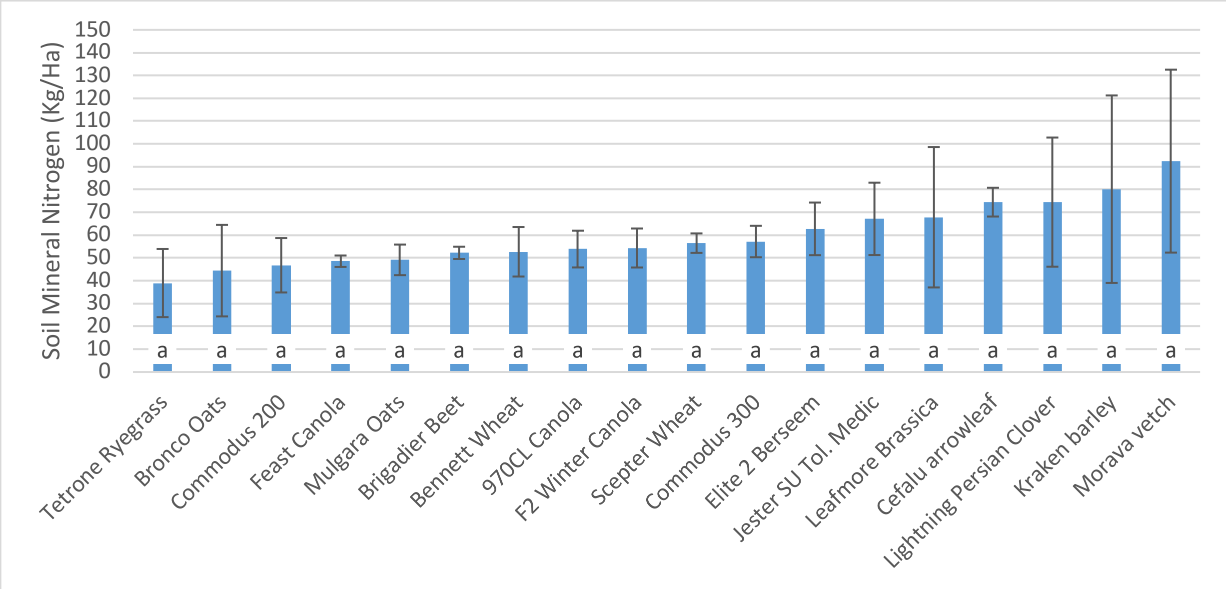

Figure 4: Soil mineral nitrogen 0-60cm (nitrate and ammonium) for sole species at Navan. Significant difference is indicated by letters and error bars show the standard deviation of the species mean.

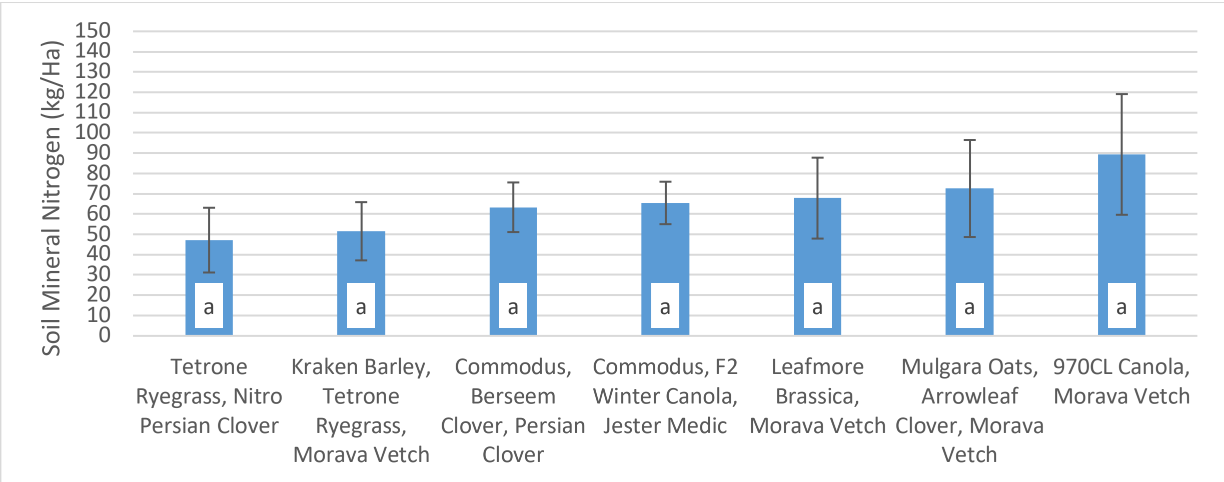

Figure 5: Soil mineral nitrogen 0-60cm (nitrate and ammonium) for mixed species at Navan. Significant difference is indicated by letters and error bars show the standard deviation of the mix mean.

There was no significant difference between the mean soil mineral nitrogen within sole species treatments at Navan. There was a trend of higher soil nitrogen of treatments with legume species present. The impact on soil nitrogen is predictable due to nitrogen fixation, however the trend was not statistically significant, with a P value for the sole species analysis of variance being 0.124. The same result was apparent with mixed species, having a P value of 0.109. There wasn't the range of variation between the means of the mixed species compared to the sole species. This might be explained by the legume fixing nitrogen but the cereal or brassica using soil mineral nitrogen. The net result would be a function of fixed and removed nitrogen.

There are a range of factors that could contribute to inability to detect significant soil nitrogen differences. The first is that high spatial variability that can be expected in soil test results collected within a small transect of the same soil type (Oliver et. al, 2020). Soil type variability may have also contributed. The trial was established on what could be best estimated as a consistent soil type by assessing the soil surface visually. When the soil sampling was completed, the subsoil type varied from a black medium clay vertosol to a red light clay to a calcareous clay. The trial was placed on a faba bean stubble with 95kg/Ha residual soil nitrogen measured in autumn prior to seeding. Having moderately high soil nitrogen may have meant that legume species wouldn't have needed to form the symbiotic relationship with rhizobia bacteria, and instead used soil nitrogen. A similar trial on low initial soil nitrogen status may have produced different results. There was no additional nitrogen applied to any species in this trial. Nitrogen mineralisation may have also contributed to the inability to detect significant difference. The soil type, a light clay loam over a strong brown medium clay with some limestone had an organic carbon concentration of 2.95% at 0-10cm and 1.43% at 10-22cm (Harding, 2022). With the wet spring conditions keeping the topsoil damp throughout spring, it is expected that there was some level of mineralisation that may have occurred. The final impact on soil nitrogen could also be that nitrogen fixed by legumes may not have entered the soil nitrogen pool because sampling was close to the end of the season. Very little root material or foliage had been broken down by soil microbes and processes to enter the available nitrogen pool.

Farrell Flat Soil Nitrogen:

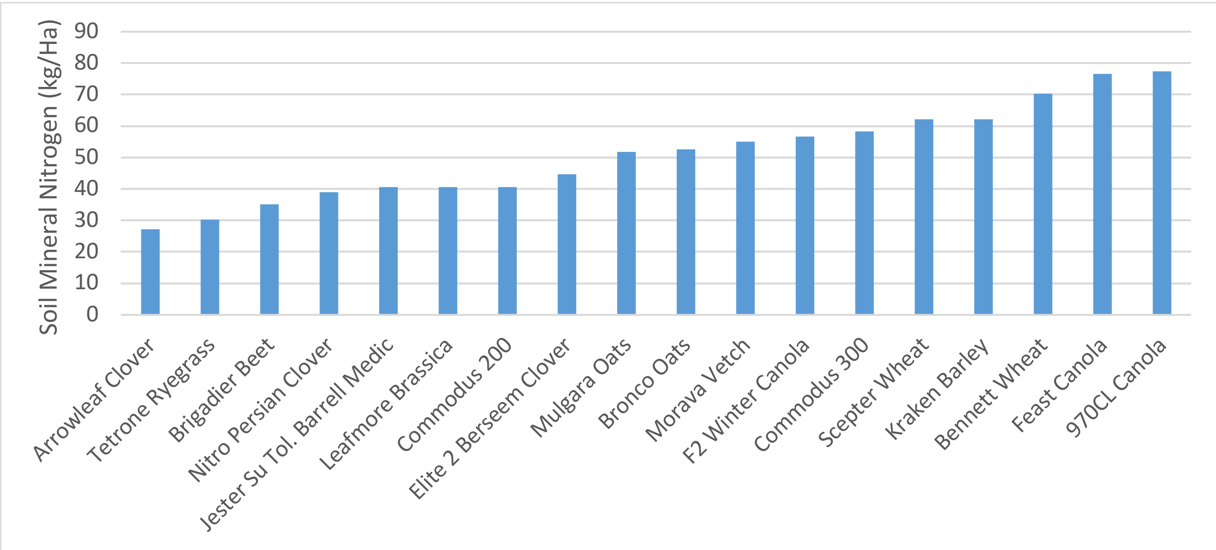

Figure 6: Soil mineral nitrogen 0-60cm (nitrate and ammonium) for sole species at Farrell Flat. The soil tests were not replicated

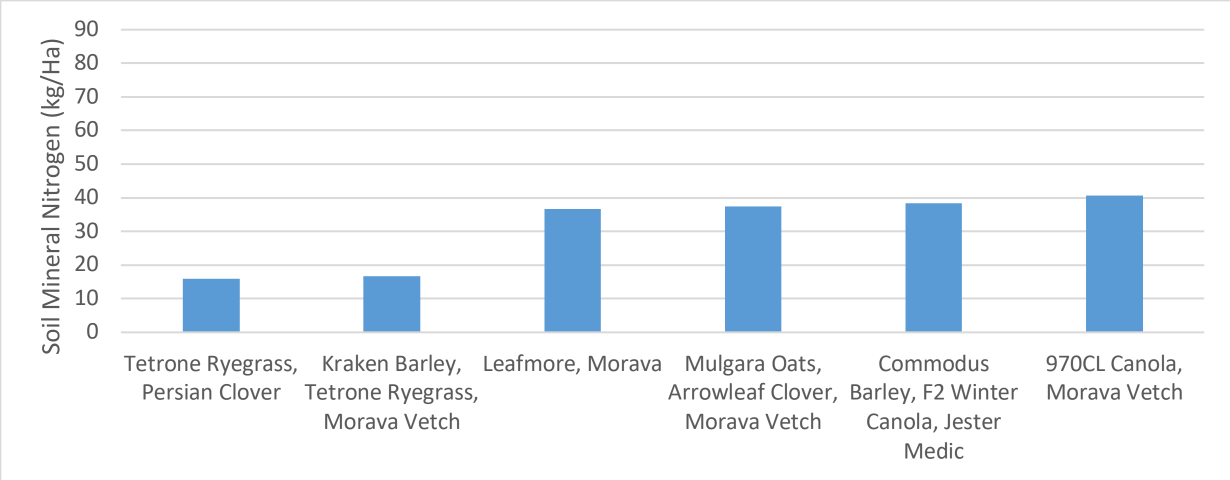

Figure 7: Soil mineral nitrogen 0-60cm (nitrate and ammonium) for mixed species at Farrell Flat. The soil tests were not replicated

Farrell Flat soil samples were not replicated due to significant waterlogging present at the north end of the trial. Instead, a single block at the south end of the trial was sampled. The results of the sole species nitrogen samples were unexpected. The legumes which had the highest dry matter at the final sampling time had the lowest soil nitrogen values whereas the cereals and brassicas (both recovered poorly from the final mowing treatment) had the highest soil nitrogen levels. Due to samples not being replicated and the number of issues that impacted the trial at the end of the season (spray drift, waterlogging, severe mowing treatment), these results should not be used on their own for pasture decision making. Similar to Navan, there was reduced nitrogen observed after the mixed species at Farrell Flat. As data is not replicated, it is difficult to draw any definitive conclusions, but results appear to follow a similar trend to Navan, with the Tetrone ryegrass, persian clover mix having the lowest nitrogen levels and 970CL Canola, Morava vetch having the highest.

Plant Available Water

Navan:

Sole:

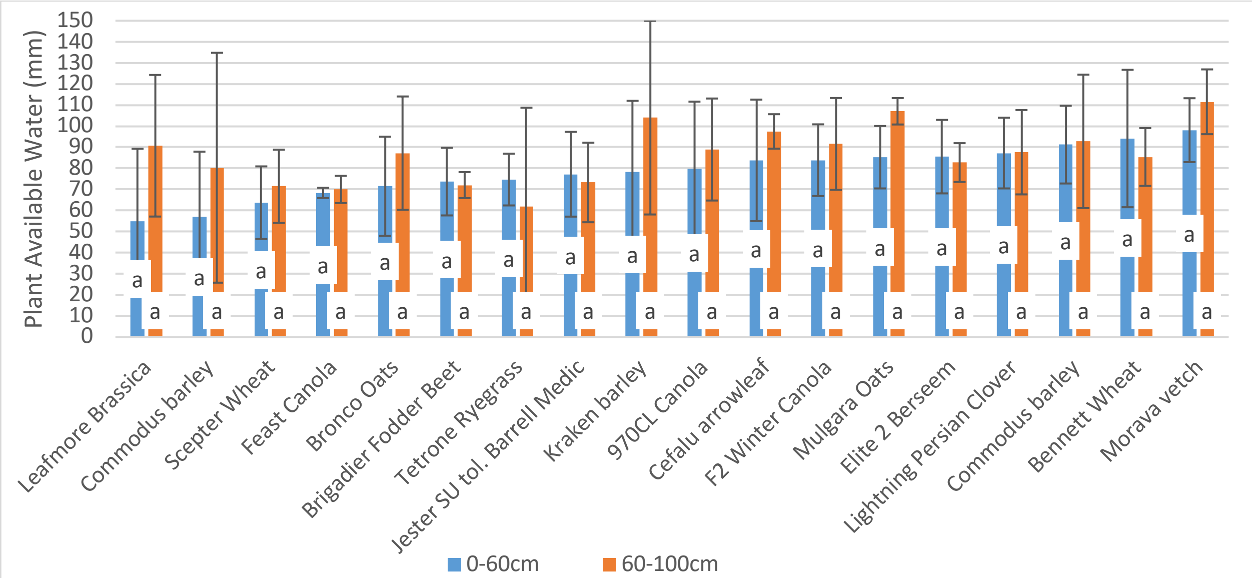

Figure 8: Plant available water for sole pasture species. Significant difference is indicated by letters and error bars show the standard deviation of the mix mean.

Mix:

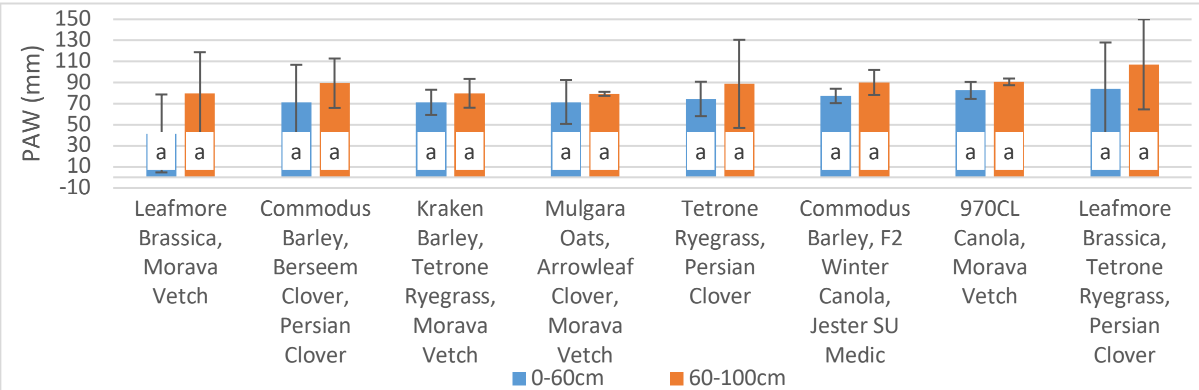

Figure 9: Plant available water for mixed pasture species. Significant difference is indicated by letters and error bars show the standard deviation of the mix mean.

Significant difference within the sole species treatments and within the mixed species treatments was not able to be detected. The P values for the analysis of variance conducted was 0.689 for the 0-60cm layer and 0.764 for the 60-100cm layer for the sole species. P values for the mixed species was 0.69 for the 0-60cm layer and 0.933 for 60-100cm layer. One factor that may have contributed to the results was very high spring rainfall. 100mm of rain fell between the final sampling in November and soil sampling in December in addition to significant spring rainfall prior to the final sampling. The trial was terminated after the final sampling meaning that there would have been very little water used after the final sampling. The trial would need to be repeated across a range of seasons in order to determine the impact of species selection on soil water use.

Farrell Flat:

Sole:

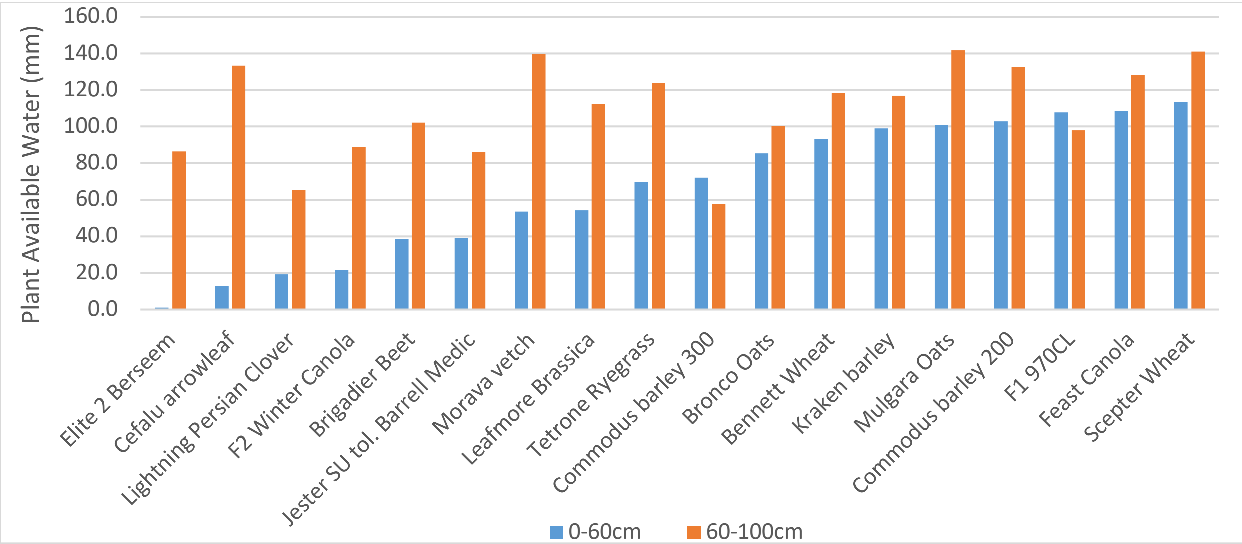

Figure 10: Plant available water for sole pasture species. The soil tests were not replicated

Mix:

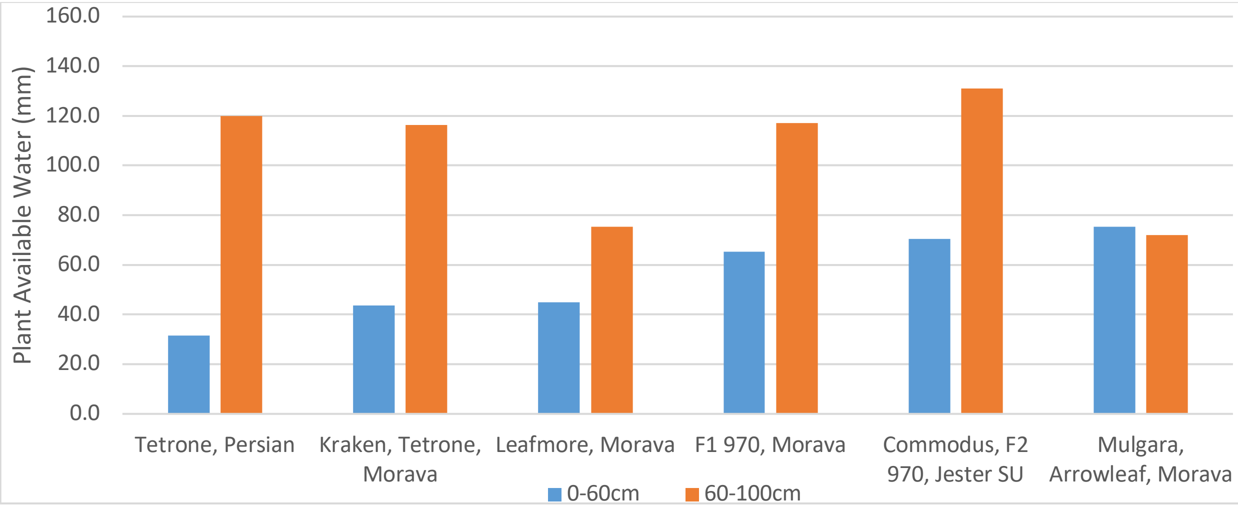

Figure 11: Plant available water for mixed pasture species. The soil tests were not replicated

It is not possible to draw definitive conclusions from soil samples that have not been replicated. There was 20mm rainfall between the final sampling and termination and soil testing. This may explain why the legume and ryegrass species have lower levels of plant available water in the top 60cm compared to the cereal species which did not recover much dry matter after the second mowing treatment. This aligns with visual observations where legume species produced some dry matter after the second mowing treatment. This trend is followed with the mixes, with the Tetrone ryegrass, persian clover mix producing the highest dry matter and the lowest level of 0-60cm PAW.

Waterlogging (Farrell Flat):

Figure 12**:** 23rd November waterlogging image. From left to right: Tetrone ryegrass (1), Commodus barley 300 (2), Commodus barley 200 (3), Bennett wheat (4). Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Figure 13: 23rd November waterlogging image. From left to right: Kraken barley (1), Scepter wheat (2), Bronco oats (3), Mulgara oats (4). Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

The Farrell Flat trial experienced severe waterlogging on part of the trial. While there were short periods of waterlogging that occurred in September that impacted the most northern bay's production. 135mm in October and 107mm in November (source Farrell Flat Mesonet Station) resulted in the severe waterlogging seen above, with all cereal species having very little biomass recovery after mowing. An indicative guide to waterlogging tolerance from this trial is: (Worst) barley, brassica/canola, wheat, oats, ryegrass (Best). The legume species didn't experience the worst of the waterlogging meaning visual comparisons were unable to be made. When assessing legume pasture choice, pasture breeders often state the waterlogging tolerance with other varietal information so informed decisions can be made using this information.

Images:

Navan:

Figure 14: Leafmore Brassica (L), Commodus barley 300 (C), Mulgara oats, arrowleaf clover and Morava vetch (R) taken before the first sampling on the 22nd July. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Figure 15: Mowing treatments: 1st mowing on 22nd July (L), and (C) and (R) image are from the second mowing treatment on the 8th September. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Figure 16: Jester Medic (L), Tetrone Persian (C), Leafmore brassica, Morava vetch (R) taken at the final sampling time on the 10th November. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Farrell Flat:

Figure 17: F2 Winter Canola (L), Mulgara Oats (C), Elite 2 Berseem (R) taken after the first sampling and mowing on the 17th August. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Figure 18: Species Mixes after mowing on the 11th October. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

Figure 19: Tetrone ryegrass (L) and Lightning Persian Clover (R) after the final sampling time on the 22nd November. Image taken by Ben Smith E: ben.smith@agrilinkag.com.au

CONCLUSION

Pasture species/mixes were evaluated at demonstration sites located at Angaston, Birdwood, Navan and Farrell Flat by BIGG and MNHRZ. The key findings from the trial demonstrations conducted by each group were as follows.

BIGG - Angaston and Birdwood

Of BIGG's two demonstration sites, Angaston was a major trial, while Birdwood was a simplified trial, hence the <u>focus of BIGG's findings is based on the results at Angaston</u>.

Two single species (Oats, Ryegrass) and three multi species (Oats Ryegrass, ORC, ORCBH) treatments were assessed for pasture production and quality at five timings during the season (July 2022-January 2023) at Angaston. This including mowed the trial after each assessment, which simulated grazing and allowed the determination of pasture production recovery after each mowing.

The treatment, ORCBH produced the highest <u>total</u> dry matter production for the season (4557 kg DM/ha), which was very similar to ORC (4409 kg DM/ha). These two treatments produced significantly more dry matter than the two lowest yielding treatments, Oats (approximately 40% more) and Oats Ryegrass (approximately 20% more). ORCBH and ORC as the top yielding treatments were also the two treatments that had the most plant diversity (a mix of ten and six varieties respectively).

Of the five sampling timings, ORCBH produced the highest dry matter yield for three timings: early August (first timing - significantly more production than Ryegrass), early September (second timing - significantly more production than Oats Ryegrass) and mid-January (fifth timing - significantly more production than Oats). For the other two sampling timings, ORC produced the highest dry matter yield in late September (third timing - significantly more production than Oats) and Ryegrass the highest dry matter yield in mid-October (fourth timing - significantly more production than Oats).

Although Oats produced the lowest total dry matter for the season (3183 kg DM/ha), it did produce reasonable dry matter yield early in the season. In comparison, ryegrass either as a single species treatment or as a key component within the three multi species treatments, performed strongly from September onwards. (Similarly, at Birdwood, ryegrass performed better later in the season while oats performed better earlier in the season).

Feed quality analysis determined there were marginal differences between treatments at each sampling time, however averaged across the season, ORCBH produced the highest metabolisable energy, crude protein, and digestibility. Coupled with ORCBH also producing high dry matter yields, both early in the season (likely due to the contribution of its brassica content) and late in the season (likely due to the contribution of its ryegrass content), suggests it is a good option to help graziers fill the traditional winter feed gap, whilst providing a longer grazing period in a season like 2022 at Angaston. In addition, a multi-species pasture mix is also more likely to provide a better-balanced diet for livestock. It is however noted that out of the five treatments evaluated, ORCBH had the highest seed cost.

MNHRZ - Navan and Farrell Flat

The Navan Pasture trial was located at the MNHRZ main site and the Farrell Flat Pasture trial at the GRDC/SAGIT funded MNHRZ Frost Learning Centre. This added value for both projects with livestock being a frost risk management tool and locations allowed growers/advisers in each specific region to compare results and optimise pasture selection. The co-location of trials also increased exposure at filed days and crop walks. The project successfully demonstrated a range of pasture species and mixes to fill different feed gaps throughout the season. Measurement of yield and quality at three samplings time has been completed (awaiting quality results to be returned). Key outcomes include:

- **Early Season**: Cereals are supported as the best source of early season feed. Barley varieties produced the highest levels of dry matter compared to the other cereals. Higher seeding rates can result in significantly higher dry matter production. Of the mixes, cereal based mixes provided the highest amount of dry matter.

- **Mid-Season**: If pasture production is not required until 8-12 weeks into the season (mid to late winter), then brassica species can produce high levels of dry matter. The time period to grazing will depend on the environment, with the Navan site accumulating more dry matter in a shorter period of time although both trials (Navan & Farrell Flat) germinated within 7 days of the other. There was no significant difference in recovery of cereal species at this timing (as measured by yield of previously mown treatments), and, in some cases, recovery of mown canola/brassica species matched recovery of cereal treatments. Unmown canola/brassica species outperformed legume species with the exception of Morava vetch. Of the mixed species, cereal mixes recovered best from initial grazing compared to the canola/brassica and vetch mixes.

- **Late Season:** All legume, ryegrass and beet species performed equally well at Navan, suggesting that for late season feed following earlier grazing, selecting the cheapest option out of the species may be the best option. This will reduce financial exposure in a dry spring where performance may be more limited than it was in this project. All pasture mixes performed well at Navan with the Tetrone ryegrass, persian clover mix also performing well at Farrell Flat where it recovered extremely well from a severe mowing treatment.

Trial sites being located in a cool environment (Tarlee) vs cold environment (Farrell Flat) has enabled tailored strategies to optimise production for each of these zones. With slower growth rates early in the season, selecting cereals for pasture production is recommended in cold environments. Cold conditions especially impacted canola/brassicas, as indicated by slower dry matter development. The difference in development between cool and cold environments of brassicas and canola needs to be understood as grazing too early in cold areas can reduce total season performance.

Soil testing and analysis was completed for both sites assessing the 0-60cm PAW and nitrogen and 60-100cm PAW. Replicated samples were completed at Navan while waterlogging meant that this couldn't be repeated at Farrell Flat. Navan soil water results were impacted by late season rainfall with soil nitrogen results indicating some trends towards high nitrogen levels with legume species, however these differences were not significantly different.

Waterlogging occurred at the Farrell Flat site in September/October. The waterlogging susceptibility of species in the trial has been noted and will be presented with results. This will improve awareness for growers/advisers who utilise pastures in the waterlogging prone areas of their property.

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APPENDIX 1: MEL SUMMARY DATA

This section is compulsory for all projects that cover more than one reporting period.

This section provides a collation of all data reported on through the MEL reports submitted to the SA Drought Hub. This information will be used to confirm that all deliverables for your project have been completed as outlined in the Project Details (Annexure D) Form for your project and may be used to communicate the results of your project.

LEARNING ACTIVITY SUMMARY

Activity name **To add more rows right click & select insert / insert rows below*	**Type of activity** • farm visits • seminars • Training • workshop • field days • crop/pasture walk	**Location of activity (LGA)**	**Primary category of participants** • Farmers/Producers, • Government extension officers, • Private consultant or agribusiness agent, • Businesses, • Local farmer groups / networks	**No. of participants (by category)** • Farmers/Producers, • Government extension officers, • Private consultant or agribusiness agent, • Businesses, • Local farmer groups / networks	**Primary focus area**	**Delivery style** • online • face-to-face • dual delivery	**No. of products developed, adapted or used to support activity** • decision tools • information sheets • fact sheets
EXAMPLE ROW: *Water management field day*	*Field day*	*Barossa*	*Farmers/Producers*	*Farmers / Producers x 16* *Gov extension officers x 1* *Private consultant or agribusiness agent x 3* *Local farmer networks x 2*	*Managing risks around water security. Improve the management of water resources on farm.*	*Dual delivery*	*Fact sheets x 2*
BIGG: Spring Pasture Walk & Beneficial Insect Workshop (16 September)	*Crop/Pasture Walk*	*DC of Barossa*	*Farmers/Producers* *Government extension officers* *Private consultant or agribusiness agent* *Businessess*	*27 Farmers/producers* *3 Government* *5 Private consultant or agribusiness agent*	*Mixed species pasture and hay options, beneficial insects, novel pasture species*	*Face to face*	*Trial plans and plot identification labels for farmer visual assessment of trial entries, insect traps*
BIGG: Angaston Pasture Walk (visit by Burra Ag Technology	*Crop/Pasture Walk*	*DC of Barossa*	*Farmers/Producers* *Private consultant or agribusiness agent*	*16 Farmers/producers*	*Mixed species pasture options*	*Face to face*	*Trial plans and plot identification labels for farmer*

Group in conjunction with BIGG Ewe containment project) (23 September)			*Businessess* *Local farmer groups/networks*	*2 Private consultant/agribusiness agent*			*visual assessment of trial entries*
BIGG: Mt Pleasant Pasture Walk (in conjunction with Coopers Farm Supplies) (30 September)	*Crop/Pasture Walk*	*DC of Barossa*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*30 Farmers/producers* *5 Private consultant or agribusiness agent*	*Mixed species pasture options-production and quality (focusing on brassicas and herbs)*	*Face to face*	*Trial plans and plot identification labels for farmer visual assessment of trial entries*
BIGG: Visit to the Angaston site by the Federal Drought Hub Advisory Committee (18 August)	*Farm visit*	*DC of Barossa*	*Government advisers and extension officers*	*4 Farmers/producers* *10 Government* *1 Private consultant or agribusiness agent*	*Policy, Research and Adoption*	*Face to face*	*Trial plans/information*
BIGG: Visit to the Angaston site by Senator the Hon Murray Watt, Federal Minister for Agriculture, Forestry and Fisheries (16 November)	*Farm visit*	*DC of Barossa*	*Government advisers and extension officers*	*3 Farmers/producers* *12 Government*	*Policy, Research and Adoption*	*Face to face*	*Trial plans/information*
BIGG: Presentation on BIGG's 2022 Mixed species activities at BIGG Annual Conference (15 February 2023)	*Conference*	*DC of Barossa*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*52 Farmers/producers* *3 Government* *15 Private consultant or agribusiness agent*	*Mixed species pasture options*	*Face to face*	*Powerpoint*
MNHRZ: Navan Winter Walk (22 July)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*24 Farmers/producers* *6 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*Plot identification labels for farmer visual assessment of trial entries*

MNHRZ: Navan Spring Walk (29 Sept)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*32 Farmers/producers* *8 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*Plot identification labels for farmer visual assessment of trial entries*
MNHRZ: Farrell Flat Winter Walk (5 August)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*26 Farmers/producers* *4 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*Plot identification labels for farmer visual assessment of trial entries*
MNHRZ: Farrell Flat Spring Walk (30 Sept)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Farmers/Producers* *Private consultant or agribusiness agent* *Businessess*	*34 Farmers/producers* *6 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*Plot identification labels for farmer visual assessment of trial entries*
MNHRZ: Navan, Uni of Adelaide 3rd year Ag Students (7 October)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Student/Lecturers*	*23 Other (Ag students/lecturers)* *2 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*nil*
MNHRZ: Farrell Flat, Uni of Adelaide 2nd year Ag Students (20 October)	*Crop/Pasture Walk*	*DC of Clare & Gilbert Valley*	*Student/Lecturers*	*23 Other (Ag students/lecturers)* *2 Private consultant or agribusiness agent*	*Discussing feed gaps, residual soil water/nitrogen, trial species/mixes*	*Face to face*	*nil*

COMMUNICATION ACTIVITY SUMMARY

Category **To add more rows right click & select insert / insert rows below*	**Overview**	**No. issues/posts/? (i.e. how many generated/ produced)**	**No. of subscribers/ visitors/ followers**	**Feedback (if available)**

EXAMPLE ROW: *Newsletter*	*SA Drought Hub Monthly Newsletter*	*6 (Jan to July 2022)*	*592*	*Hub partners like receiving updates on the Hub and FDF opportunities that are promoted through the newsletter.*
Newsletter	BIGG: Monthly newsletter	3 (Sept 2022, Oct 2022)	380	
Website				
Social media	BIGG: Facebook MNHRZ: Twitter	4 (Sept to Nov 2022) 2	453 607	
Media	BIGG: The Leader (local newspaper)	1 (Nov 2022)	6,650 (weekly circulation)	
Ad hoc communiques to partners				
Podcasts				
Other				

ON FARM TRIAL DEMONSTRATION SUMMARY

Project name **To add more rows right click & select insert / insert rows below*	**Activity (type and description)** • Demonstration Site • Trial Site	**Location of activity (LGA)**	**Number of visitors to trial/demonstration (please breakdown by stakeholder category if possible)** • Farmers/Producers, • Government extension officers, • Private consultant or agribusiness agent, • Businesses, • Local farmer groups / networks	**No. of farms participating in trial/demonstration**
EXAMPLE ROW: *Increasing soil water retention in cereal crop farming systems.*	*On-farm demonstrations of agronomic techniques to retaining soil moisture in the profile over Summer and Autumn to benefit early season crop establishment.*	*1 x Karoonda East Murray* *1 x Loxton*	• *Farmer / Producer x 30* • *Government extension officers x 5* • *Private consultant or agribusiness agent x 12* • *Local farmer Groups / networks x 3*	*2 Farms participating, Management strategies differ on each farm*
Evaluation of pasture species and mixes	Pasture demonstration sites	1x Angaston 1x Birdwood 1x Navan 1x Farrell Flat	• 196 Farmers/producers • 25 Government • 41 Private consultant or agribusiness agent 46 Other (Students/lecturers)	4 farms participating in demonstration trials

DROUGHT RESILIENCE TOOLS AND PRODUCTS SUMMARY

Type of tool/product **To add more rows right click & select insert / insert rows below*	**Primary focus area**	**Overview and purpose**	**Promotion strategies**	**Extent of uptake (if available)**
EXAMPLE ROW: *Feed base calculator*	*To determine the amount of feed available to livestock in a paddock.*	*This tool has been developed using information from a number of existing calculators to compliment local conditions and livestock management systems. The calculator will assist in managing paddock stocking rates to maintain sufficient ground cover and livestock nutrition.*	*Through local producer group networks, at field days, via node coordinators*	*25 producers are currently trialing the calculator on their properties.*
N/A				

COMMERCIALISATION OPPORTUNITIES

Type of opportunities **To add more rows right click & select insert / insert rows below*	**Stage of commercialization** • research and product development • on-farm demonstration/trial • market validation • commercialisation	**Comments**
N/A		