Final report

PDS 1807: Bulking up pastures with cereals

Project code: L.PDS.1807

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Date published: 3 January 2021

PUBLISHED BY
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Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

The bulking up pastures with cereals project ran from 2019 to 2021 in Western Australia's Lakes region. It aimed to demonstrate that sowing cereals & canola into legume pastures can improve sheep profitability and productivity, by increasing carrying capacity/stocking rates through improved pasture composition, quality and quantity. This was done by bulking pastures with cereals, to give early season growth when pastures are sparse. A cheap, effective way to reduce the autumn-summer feed gap, providing feed in poor seasons, it can help producers reach stocking rate potential, which is regionally low. Using paired-paddock methodology, and ungrazed treatments of varying seed and fertiliser rates, the project showed that fertiliser level had no significant impact on cereal pasture feed quality or quantity. Seeding rates impacted pasture quantity early in the season only. Any addition of cereal to pasture led the late season (spring) pastures having lower quality and quantity Grazing resulted in the cereal components of pastures being significantly reduced.

Condition scores were higher in mobs that grazed cereal bulked pastures. Analysis showed sowing cereals into pastures can provide benefits of $19/ha, with reduced supplement feeding of 4% and increased stocking rates of 9%. There was much variation across sites and years, which reduces result reliability. However, the project led to high increases in adoption, skills, knowledge and confidence in the bulking pastures with cereals.

Executive summary

Background

The project was undertaken because there has been a gradual increase of cropping in the Eastern Wheatbelt, resulting in regressions in pasture quality, with low seed and fertilizer inputs, and poor density. Impacting nearly all mixed enterprise farmers in the area, stocking rates have decreased, leading to lower profitability. In addition, due to the high impact of poor seasons on local pastures, producers are significantly under stocked to minimize their risk, and the trend is to further de-stock as a poor season unfolds, which can be avoided with better, earlier pastures. The project's timing is also a result of a series or late or false season breaks. Stocking rate potential (carrying capacity) declines rapidly - on a dense pasture, it can drop by 1 DSE / Ha each week the season break is delayed, while on a poor pasture it could drop from 6 to 1 DSE / Ha in 2-3 weeks. In addition, the last 5 years have seen increased interest in running more livestock in the area, and the ability to increase livestock returns through better and bulkier pastures with higher density, driven by high meat and wool prices.

Earlier pasture establishment and higher pasture density (both early and throughout the season) means an increase in stocking potential and profitability. Bulking legume pastures with fast growing, cheap, cereals would lead to increasing pasture quantity and density, particularly early in the season. Bulking pastures with crop species is currently an uncommon practice in the area due to fears of competition with the legumes and leading to poor pasture quality. This is where the demonstration sites will assist- by showing what the practice can produce, the impacts on pastures, and the impacts on profitability.

Objectives

The project aimed to demonstrate that sowing cereals into legume pastures can improve sheep profitability and productivity in the Lake Grace area. This was by increasing carrying capacity through improved pasture composition, quality and quantity of pastures.

The objectives were to demonstrate these impacts on five properties in the Lakes region of Western Australia, with sites running for three years. It was expected that this would show an increase in pasture quality and quantity, which in turn would increase livestock carrying capacity and stocking rates. These increases were expected to improve productivity and profitability key performance indicators and lead to higher adoption rates of the practice throughout the area. It was also key to alleviate fears about cereals outcompeting legumes, or the legumes being grazed out of the pastures, by determining pasture composition.

Methodology

Using paired-paddock methodology, the performance of sheep grazing pastures with cereals added was compared to sheep grazing traditional pastures (usually a mix of sub-clover and ryegrass). There were also strip tests of varying sowing and fertiliser rates, to determine the most productive and profitable mixes. Pasture cuts were taken of the grazed pastures and the ungrazed strips throughout the season, and sheep condition score was collected. These results were combined with input costs to determine the impact on carrying capacity, financial and productivity performance.

Results/key findings

There was great variation in results across the three years, making the results less reliable. However, when combining the three years of feed quality and quantity results, it was shown that:

- Fertiliser level had no significant impact on feed quality or quantity.
- Seeding rate significantly impacted early season feed quantity, but had no impact on FOO later in the season
- Pasture quality was reduced in late winter and spring by the addition of cereals.
- Grazed pastures' cereal component was 29% less in July compared to the ungrazed pastures, and 41% lower in August, showing that cereals were grazed out as the season progressed.
- Sowing cereals into pastures can provide benefits of $19/ha.
- The results indicate that sowing cereals is only profitable if early growing season FOO increases by more than 30%.
- Analysis showed that it is only profitable to sow cereals into a proportion of pasture, due to a diminishing return trend revealed in the analysis.
- 60kg/ha cereal was shown to be the most profitable seeding rate.
- To capitalise on the benefits of sowing cereals stocking rate must be increased. When additional FOO was 72% it was optimal to run a 9% higher stocking rate.
- Condition scores are higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures, and predominantly led to improvement in condition over late pregnancy to lactation.

The post project data showed that the project resulted in increased producer confidence in using cereals to bulk up pastures, to an average level of 7.9 out of 10. This was 7.8 in core producers and 8 in observer producers, compared to the original average of 6.8.
80% of core producers now utilise the practice of bulking pastures with cereals, while 49% of observers do. In addition, a further 35% of observer producers surveyed intend to implement adding cereals to bulk up their pastures. A further indication of the project's success was that no producers responded requiring more information. Producers agreed that they found the project to be valuable, ranking it 7.4 out of 10, and 97.7% would recommend the PDS program to others. Satisfaction with the project was ranked at 7.9 out of 10

Overall, extension and communication activities were very successful, and reached a much wider audience than expected due to high interest in the project in all sheep producing regions of WA. This was partly due to the project being shared through grower group and AgPro channels and being presented at various events over the three years. The success is also due to the timing of the project, following a series of late season breaks or poor seasons where pasture was limited.

Benefits to industry

This project has benefited WA sheep producers by helping increase knowledge and skills, adoption rates and awareness regarding cereals in pastures. Sowing cereals into or with legume pastures is a practice that is now being seen as common across W.A., helping red meat producers achieve sustainably higher stocking rates through more reliable early season feed. This leads to higher profitability, but has also reduced risk, making producers better equipped to handle poor seasons as they have earlier, more reliable feed. The findings of the project are easily implemented on farm, as

it is a simple practice that can be easily adopted or tried for one pasture cycle or season. This means increased likelihood of adoption beyond the project.

The use of cereals also means increased grazing ease, being higher and therefore more accessible to animals when traditional clover pastures are more prostrate. Although not looked at in this project, this means benefits would also be applicable to cattle enterprises.

Future research and recommendations

Further extension could include simply better promoting case studies to a national audience and continuing to share the project's findings through presentations with grower groups and at events. Further demonstrations sites could be run focusing on increased seed rate and fertiliser rate's impacts on profitability or looking at the use in cattle enterprises.

PDS key data summary table

Project Aim:
To demonstrate that sowing cereals & canola into legume pastures can improve sheep profitability and productivity, by increasing carrying capacity/stocking rates through improved pasture composition, grazing, quality and quantity in the Lake Grace area.

	Comments		Unit
Production efficiency benefit (impact)			
Pasture productivity – kg DM/ha	*Increased feed on offer (FOO) was converted to percentage due to the variation across sites*	192	%
Impact on feed requirements	*Decrease in supplementary feeding*	-4	%
Stocking rate – DSE, AE or LSU/ha	Optimal management change	9	%
Increase in income		$67.00	/ha
Additional costs (to achieve benefits)		$48.00	/ha
Net $ benefit (impact)		**$19.00**	**/ha**
Number of core participants engaged in project		15	
Number of observer participants engaged in project		90	
Core group no. ha		130,000	
Observer group no. ha		600,000	
Core group no. sheep		80,000	hd sheep
Observer group no. sheep		250,000	hd sheep
% change in knowledge, skill & confidence – core		15%	
% change in knowledge, skill & confidence – observer		18%	
% practice change adoption – core	*Expect measure doesn't capture all changes*	66%	
% practice change adoption – observers	*Plus an additional 35% intend to adopt*	35%	
% of total ha managed that the benefit applies to		100%	
Key impact data			
Gross Margin / Ha	**$19.00/ha**		

Table of contents

1. Background

In Western Australia's (WA) Eastern Wheatbelt, over time the percentage of land being cropped has gradually increased to now account for 70-80% of farm area. This has led to regressions in pasture quality, with low seed and fertilizer inputs, and poor density. Due to these poor pastures, stocking rates have decreased, leading to lower profitability. This impacts nearly all mixed enterprise farmers in the area (estimated 70% of producers in the area).

Another issue arising from poor pasture composition and density is that during below average seasons, stocking rate potential (carrying capacity) declines rapidly. For example, on a well-managed dense pasture, the carrying capacity can drop by 1 DSE / Ha each week the season break is delayed; whereas a poor pasture could drop from 6 to 1DSE / Ha in 2-3 weeks. This was evident with 2017's late season break, with the low-density pastures 'falling off a cliff'. Due to the high impact of poor seasons on local pastures, producers are significantly under stocked to minimize their risk, feeding into the issue of lower stocking rates & profitability. In addition to being under stocked, the trend is to further de-stock as a poor season unfolds by selling more stock, which can be avoided with better, earlier pastures.

As usual, there is a 'production' problem and a 'confidence' problem- needing to not only increase production but increase confidence in the tools available to improve profitability and production benchmarks. This is where PDS's can demonstrate the performance of the tools across different seasons, properties and soil types (which vary greatly in the region), showing unbiased and objective results and practices which can lead to adoption.

In the last 5 years, there has been an increased interest in livestock and gradual increase in amount of stocked area. This has been on the back of strong meat and wool prices, as well as diminishing returns from cropping. There is strong potential and interest in running more livestock in the area, and the ability to increase livestock returns through better and bulkier pastures with higher density. The time for improving the problems outlined above is now- the question has always been: How?

The answer is in improving pastures at the break of season. Currently, pastures in the area are being improved though quality rather than quantity, however producers are often hesitant to pay for the appropriate level of inputs required, meaning inadequate pasture improvement on nearly all mixed farms. A more attractive, less costly method to improve the feed base is to bulk up pastures by sowing cereals & canola with the legumes (usually a sub clover, Dalkeith commonly used in the area).

Bulking legume pastures would lead to increasing pasture quantity and density, as well making feed more accessible to sheep. There is evidence from recent Grain & Graze research that grazing 'erect' pastures, such as cereals, leads to increased condition and weight gain compared to more prostrate pastures of equal or higher Feed on Offer (FOO). It is assumed that this is due more erect pastures being more accessible & easier to graze (GRDC)

In addition, faster-growing cereals and canola (especially rapid growing and easily managed triazine tolerant varieties) can fill the early feed gap, essentially extending the season-a key driver of stocking rate. Earlier establishment and higher pasture density (both early and throughout the season) means an increase in stocking potential and profitability.

Producers are also interested in sowing these pastures earlier (dry sowing) to take advantage of the rapid cereal growth immediately before their cropping program, to fill the feed gap even earlier.

Bulking pastures with crop species is currently an uncommon practice in the area due to fears of outcompeting (or 'choking out') legumes and leading to poor pasture quality. In addition, there are grower concerns that the legumes will be grazed out if grazed early with cereals. The demonstration site will alleviate this through demonstrating cereals are preferentially grazed. At least four LIFT members have used cereals to bulk up pastures in the last 10 years, with none labelling it a 'common practice' on their farms.

The target audience for this project and its outcomes begins with the LIFT grower group and producers in the Lakes regions, but its findings are applicable to all sheep producers in WA who face similar challenges. This is because we have seen increasingly variable seasons and late or false autumn breaks across all sheep producing areas. The results of this producer demonstration site project will therefore be shared as widely as possible throughout WA to increase producers' skills, knowledge and confidence in bulking pastures with cereals, to see if it would be beneficial for their enterprises.

2. Objectives

The project aimed to demonstrate that sowing cereals & canola into legume pastures can improve sheep profitability and productivity, by increasing carrying capacity/stocking rates through improved pasture composition, grazing, quality and quantity in the Lake Grace area.

To achieve this, the original project objectives are as outlined:

Using 5 PDS sites in the Lake Grace region of WA, by December 2021, the project will lead to 80% of core producers and 60% of the wider observe group adopting the practice of bulking pastures with cereals and canola. This will be achieved by:

1. Demonstrating and analysing the benefits of sowing cereals in legume pastures in terms of:
    - Livestock- carrying capacity and stocking rate (estimated minimum 10% DSE/ha increase), as well as impact on productivity benchmarks (lambs/ha, CS/weight gain)
    - Profitability- impact of increased carrying capacity on current financial benchmarks (GM/ha, GM/DSE)
    - Pasture composition, quality and quantity (estimated 20% increase in energy, digestibility, protein)
2. Through annual field days and other communication activities, share the demonstration sites and results to increase confidence and understanding of feed base management to the wider producer group of 90, to lead to a 70% adoption rate.
3. Demonstrate the difference cereal sowing rates, as well as fertilizer application, can have on pasture composition, quality and quantity, as well as profitability.
4. Measure species composition throughout the season to alleviate fears of cereals outcompeting legumes or legumes being grazed out.

The objectives were each met successfully. The project demonstrated the benefits of sowing cereals into legume pastures in terms of being able to increase carrying capacity and stocking rate, and the impact this had on profitability.

This was due to the measured increase in feed quality and quantity, where differences in sowing rate and fertiliser rates further demonstrated the impact on pasture and potential profitability. The results of the project were shared as planned in objective 2, with annual field days, summaries and

presentations to a wide audience. The methods used to achieve these objectives, and their results, will be explained in further detail within this report.

3. Demonstration Site Design

3.1 Methodology

3.1.1 Demonstration site set up

This was a paired paddock sized demonstration site. This involves the paddock containing strips, with the remainder of the paddock being sown with the producer's usual legume sowing rate plus 40kg/ha of cereals, to be grazed. The second paddock is a control treatment, of the farmers' usual pasture and an identical mob of sheep. These pastures were established subclover, with a weed bank of ryegrass, barley grass silvergrass and capeweed.

The sites were to be repeated over three years on five host properties each year. In some cases, hosts could not continue the next year and new sites were found. This enabled comparison across different environments, management systems, as well testing the accuracy of results. The hosts were based in the Lakes area, across the shires of Lake Grace, Hyden, and Newdegate.

The paddock was sown into at least 4 strips before or at the break of season (early April to late May) before the producers' cropping programs. This was to be in the 4 strips as follows, running the width of the airseeder and length of the paddock, with 4-5units of phosphorous in a compound fertiliser:
Strip 1. (Control) Usual legume sowing rate
Strip 2. Usual legume sowing rate + 20kg/ha cereals.
Strip 3. Usual legume sowing rate + 40kg/ha cereals.
Strip 4. Usual legume sowing rate + 60kg/ha cereals.
Strip 5. (No Fertiliser) Usual legume sowing rate + 40kg/ha cereals

However, after the initial meeting, producers decided to increase the scope of the project. Producers were interested in comparing the impact of fertilizer compared to seeding rate. This involved including varying fertilizer rates, and cereal seeding rates, with each site having the strips outlined above as a minimum.

Regular condition scoring of sheep was undertaken, and pasture cuts taken from each treatment at the commencement of grazing. Species composition results will also be taken from within the pasture cages, to determine the impact of grazing on species composition.

3.1.2 Demonstration site measurements: Feed

Feed value of the pastures were measured every month. Members of the core group helped to take 0.1sqm pasture cuts from the treatments and were sent for analysis of Feed On Offer (kgDM/ha), digestibility, (%DM), crude protein (%DM) and metabolisable energy (MJ/kgDM). Both paddocks were grazed for the same duration, with pasture cages placed throughout the control pasture paddock and the cereal pasture treatment. The strip treatments had exclusion fencing.

Treatments were analysed at grazing commencement, and throughout the season to compare the difference in feed quality and quantity. The grower group members who carried out this work took photographs of their quadrats, to visually show the difference in feed on offer and plant height.

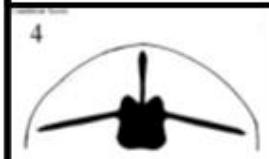
3.1.3 Demonstration site measurements: Ewe condition score and lambing percentage

Producers undertook regular condition scoring of sheep throughout the grazing season. Grazing commenced when the cereals passed the 'pinch and twist' test, the point at which plants aren't pulled from the ground by grazing. Stocking rates and grazing timing were determined by each host producer.

Sheep grazing commenced when pastures were able to be grazed, usually when cereals passing the 'pinch and twist' test and continued through to the end of the season. Each site was stocked at similar DSE's- the class of sheep determined at the start of season meetings, and dependent on the season outlook and current sheep condition.

Condition score of the two mobs at each site was measured and compared to see the impact of varying cereal and fertiliser treatments on sheep productivity. Condition scoring was the preferred method, which is assessing the level of body fat and tissue over the loin area. This was because condition scoring is a more accurate comparison of sheep's health than weight changes. Weights are less subjective, but will vary based on animal age, pregnancy status and adult standard reference weight. The industry standard condition scoring method is outlined in Fig. 1 below. (LifeTimeWool.com).

Figure 1: Condition scoring assesment

1 	**Backbone** The bones form a sharp narrow ridge. Each vertebra can be easily felt as a bone under the skin . There is only a very small eye muscle. The sheep is quite thin (virtually unsaleable)	**Short Ribs** The ends of the short ribs are very obvious. It is easy to feel the squarish shape of the ends. Using fingers spread 1cm apart, it feels like the fingernail under the skin with practically no covering
2 	**Backbone** The bones form a narrow ridge but the points are rounded with muscle. It is easy to press between each bone. There is a reasonable eye muscle. Store condition- ideal for wethers and lean meat.	**Short Ribs** The ends of the short ribs are rounded but it is easy to press between them. Using fingers spread 0.5cms apart, the ends feel rounded like finger ends. They are covered with flesh but it is easy to press under and between them.
3 	**Backbone** The vertebrae are only slightly elevated above a full eye muscle. It is possible to feel each rounded bone but not to press between them. (Forward store condition ideal for most lamb markets now. No excess fat).	**Short Ribs** The ends of short ribs are well rounded and filled in with muscle. Using 4 fingers pressed tightly together, it is possible to feel the rounded ends but not between them. They are well covered and filled in with muscle.
4 	**Backbone** It is possible to feel most vertebrae with pressure. The back bone is a smooth slightly raised ridge above full eye muscles and the skin floats over it.	**Short Ribs** It is only possible to feel or sense one or two short ribs and only possible to press under them with difficulty. It feels like the side of the palm, where maybe one end can just be sensed.
5 	**Backbone** The spine may only be felt (if at all) by pressing down firmly between the fat covered eye muscles. A bustle of fat may appear over the tail (wasteful and uneconomic).	**Short Ribs** It is virtually impossible to feel under the ends as the triangle formed by the long ribs and hip bone is filled with meat and fat. The short rib ends cannot be felt.

Due to difficulties collecting data, condition score changes have been used to model the impact on lambing percentage, using the Lifetime Ewe Condition Score Calculator.

3.2 Economic analysis

Economic analysis was undertaken by Mike Young, who used collected production data to determine the economic impacts of bulking pastures with cereals. This was using the Australian Farm Optimising model, with full methodology and explanation in Appendix 7.8.4, with the model also determining optimal management options and a cost:benefit analysis. The local benchmarking data was used to determine if the model was appropriate for the area.

Lifetime Ewe Management Condition Score calculator was used for modelling, to determine the impact on carrying capacity, sheep weight gain, wool growth and lamb survival, for each of the varying sowing rates and the control strip. This was supported by the animal production data, of condition scores and lambing percentages. Lambing percentage was collected from the producers for each mob. If this was unfeasible, percentages were modelled using the Lifetime Ewe Condition Score Profile Comparison Calculator. This assumes that the condition score advantage occurred in late pregnancy, and that the ewes did not fall below condition score 3 before giving birth. This analysis included impact of condition score changes on lamb, ewe and weaner survival, as well as birth weight.

3.3 Extension and communication

Extension was at the core of this project, with many observer producers relying on extension and communication activities to receive updates about the host sites. This included annual field days, to give involved producers and industry the ability to see the visual impact of bulking up pastures with cereals. It also provided a forum beyond the WhatsApp chat to discuss results and distribute producer fact sheets. Annual summary articles were produced for the group, as well as progress reports and annual reports for MLA. The benchmarking workshops were held twice during the project with summarised results discussed with the wider observation group at the spring field days (2019, 2020). For core producers, there was the additional yearly planning workshop, where the plan for the season and results from the past year was discussed. This included a review of condition scoring, pasture cuts and pinch and twist skills.

The project also aimed to be shared as widely as possible, including presentation of data at field days, workshops and conferences. At the conclusion of the project, case studies on five of the host producers have also been published. The full communication plan can be seen in Appendix 7.3.

3.4 Monitoring and evaluation

The monitoring and evaluation process is outlined in the monitoring and evaluation report (MER) attached in Appendix 7.2. This shows the processes used for data collection, with the metrics measured including:

- Total number of attendees
- Practice change – intended and actual
- Stocking rate (DSE/Ha)
- Pasture productivity (kg DM/Ha)
- Pasture quality (crude protein %, digestibility, metabolisable energy)
- Reproductive efficiency (lamb weaning %, Lambs/Ha)
- Carrying Capacity (DSE/Ha)
- Gross Margin /DSE

- Gross Margin/Ha

4. Results & Discussion

4.1 Demonstration site results

4.1.1 Feed quality and quantity

When combining the three years of feed quality and quantity results, it was shown that:

- Fertiliser level had no significant impact on feed quality or quantity
- Seeding rate significantly impacted early season feed quantity, but had no impact on FOO later in the season
- Pasture quality was reduced in late winter and spring by the addition of cereals.

The full analysis is available in Appendix 7.5.4. However, as pointed out in the statistical analysis report, there was great variation in results across the three years due to seasonality. It may be best to assess the results on a per year basis, as seen in Table 1 below.

Table 1: Statistically significant impacts of a variety of factors on pastures bulked with cereals.

Red indicates not statistically significant, green indicates a statistically significant result.

	2019	2020	2021	Average
Fertiliser had an impact on feed quality				
Fertiliser impacted feed quantity				
Seeding rate impacted pasture quality				
Seeding rate impacted pasture quantity				

Table 1 summarises the varying impact of the treatments across each year the demonstration sites ran. Full feed test results can be seen in Appendix 7.5, which show that the biggest influence on feed quality and quantity was the season, cut timing and the site location. The analysis undertaken indicated that 80% of the variation in quantity results was due to known factors, showing that there were unmeasured influences, experimental error, or that the relationship between seeding/fertiliser rates and FOO is not linear. This indicates that further investigation may be required, under scientific trial circumstances, despite this not being the aim of demonstration sites. Additional funding could have reduced some but not all of these external influences on the data.

Looking at results each year, we can see the variation and patterns. 2019 results showed that pastures with cereals had on average higher biomass, metabolizable energy and were more digestible. There were also small but positive trends with fertiliser resulting in higher biomass and quality.

2020 showed pastures bulked with cereals had much more feed on offer at every stage of the season compared to traditional pastures. There was no statistically significant impact from seeding rate or fertilizer level.

2021 results were more interesting, with the following findings:

- Pastures bulked with cereals have more feed on offer during the first half of winter, but by August there was no significant difference.
- 1kg of cereal added to pastures resulted in an increase in feed on offer by 4-5kg/ha in autumn to mid-winter.
- In terms of quality, sowing rates impact only August quality, with each additional kg/ha leading to a feed quality decrease of 0.1%
- Site location & pasture cut timing had a significant impact on feed quality and quantity, more so than other factors.
- Fertiliser did not have an impact on 2021 feed quality and quantity.

Overall, the implications for producers are that pastures bulked with cereals clearly increases feed on offer in the crucial early season, and the seeding rate is important. From a quality point of view, grazing management is essential in order to capture the benefits of cereals early in the season and not negatively impact later season feed quality. Further investigation into the most profitable and/or productive cereal seeding rate and pasture mix would further increase the impact of this project, with the analysed economic results in section 4.2 not being easily calculated from the demonstration sites. However, early season field walks, particularly in 2019, showed clear increases in FOO as seeding rate increased.

4.1.2 Species composition

Species composition proved a difficult measure, with much variance between producers' interpretations of the pastures. June estimates tended to include grasses such as barley grass with the cereal component, so grasses were combined with cereals for the estimates. Due to the low amount of grasses in the region's pastures, this does not heavily impact the measures. Accurate estimates were further challenged with cereal head development in August, with a large portion of cereal pastures comprising of stem and seed heads. This is why pasture tests and species composition were not measured beyond August. In addition, producers are labelling the results 'debatable' as there is a great variety of initial species composition, which impacts each sites' results and therefore the average. They placed little value on the measurements, preferring to see the visual differences at the host sites or utilise photos taken.

Each year, and each site, showed that regardless of the cereal sowing rate, when cereals are added to pastures, they make up a majority of the pasture in autumn and winter in ungrazed pasture. When pastures were grazed, the cereal component was 29% less in July compared to the ungrazed pastures, and 41% lower in August, showing that cereals were grazed out as the season progressed. This was the key finding from the species composition data, and can be seen in table 2 below, showing the average composition of the pastures over the three years. Full data can be seen in Appendix 7.5.

Table 2: Average species composition in grazed and ungrazed cereal pastures.

Grazed (% cereal & grasses)			Ungrazed (% cereal & grasses)		
June	**July**	**August**	**June**	**July**	**August**
68.2	61.7	53.5	78.8	90.8	94.3

4.1.3 Sheep data

- 2020 Sheep condition is higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures.
- 2021 Sheep condition is higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures.

Sheep data proved difficult to collect, due to producers needing to rotate pastures and manage mobs in some challenging seasons. For example, in 2019 no host sites were able to adequately record condition score. To compensate, the economic analysis has determined optimal management choices based on productivity and profitability KPIs (section 4.2).

Lambing percentages were recorded sporadically, due to varying seasons and therefore very different lambing averages each year. The data was excluded as it was not reliable, but can be obtained by utilising condition score data, using the Lifetime Ewe Condition Score Calculator.

The condition score data collected during the project showed that the condition score advantage gained by grazing pastures bulked with cereals ranged up to 0.62 CS per animal, which is considerable when a ewe is lambing and has extremely high energy requirements. Most sites grazed lambing ewes in June and ran the ewes and lambs together through to August. We do not have condition score data for late winter, but the July condition scores were all based on the last week of July, averaging the third week of ewe lactation.

The average condition score advantage of 0.1CS was not as high as expected at the beginning of the project. This could be explained by good nutritional management demonstrated by the host producers, with high rates of supplement feeding in the control pastures. Full condition score data can be seen in Appendix 7.6. The key finding from the sheep data is that condition scores are higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures, and predominantly led to improvement in condition over late pregnancy to lactation.

4.1.4 Benchmarking

The benchmarking results were collected for the years of 2019 and 2020 from core producers and are available in Appendix 7.7. These workshops were extremely beneficial to producers, for some learning the fundamentals of benchmarking and how to approach it. Others noted that the data was much more powerful and useful now that they knew how to interpret it and compare to local benchmarks.

The average impact of bulking up pastures with cereals was an autumn FOO increase of 192%. Autumn carrying capacity estimates were estimated to be 4.5DSE/ha and 2.7 lambs/ha at the start of

the project. Benchmarking showed a 0.1DSE increase by bulking up pastures with cereals, but no change in average lambs/ha with this benchmarking data.

The original plan was to compare the producers' performance in the control paddock and the paddock surrounding the treatment strips. However due to the very varied differences across the sites, and the years, the benchmarking data was not included as the basis of the economic analysis.

4.2 Economic analysis

The economic analysis evolved during the course of the project, beyond a simple Benefit-Cost analysis. A full explanation is available in Appendix 7.8, outlining the model used to undertake the valuation.

4.2.1 Analysis of seeding rate

The statistical analysis of feed quality and quantity indicated that seeding rate was significantly ($p<0.05$) impacting early FOO and DMD in the later stages of the growing season. Fig. 2 shows that profit was maximised at the highest seeding rate used in the trial (60kg/ha). This returned a profit of $19 per sown hectare in the model. It should be noted that extrapolating the results to a wider range of seeding rates is likely to be inaccurate because it is expected that the relationship is not linear and will diminish.

Figure 2: Profit per sown hectare at three different seeding rates tested in the trial.

4.2.2 Optimal management

The results reflect that optimal management at the most profitable seeding rate of 60 kg/ha. The key livestock management changes that were optimal when sowing cereals into pastures were

(i) Increase stocking rate: Stocking rate increased by 9%.
(ii) Reduce supplementary feeding: Supplement fed reduced by 4%.

The key point of the project is the utilisation of feed. If livestock management does not change as a result of sowing cereals then producers will not receive any financial benefits: increasing feed alone does not provide any income. The income calculated comes primarily from running more sheep but

also partly due to saved costs on supplementary feeding. Originally, we were to measure and analyse the impact on increased condition score, however removing this and assuming optimal nutrition management on farm provided a simpler method of focusing on stocking rate and carrying capacity, the key focus of the project.

The model calculated that it was optimal to sow cereals into 30% of pastures on farm. It is not optimal to sow cereals in to pastures on poor soils because it incurs the same machinery cost but provides less benefits. This is explored later in the analysis.

It must be kept in mind that that these results are based on the impacts on feed seen at these sites. When considering how the findings apply to other areas, and in other seasons, it must be remembered that both the optimal sown area and the optimal stocking rate will change. For example, if bulking pastures lead to higher percentage increase, the stocking rate increase is higher, and amount of supplement feed reduced lower. In turn, this results in profit higher than the $19/ha calculated.

The costs and benefits of each impact of sowing cereals into pasture is outlined, based on producers' inputs and increase in feed, as measured. This is where the benchmarking data was to be utilised to determine gross margin per hectare and DSE. This has been calculated as gross margin per hectare of pasture bulked with cereal, as seen in Table 3 below.

Table 3: Financial costs and benefits of bulking pastures with cereals.

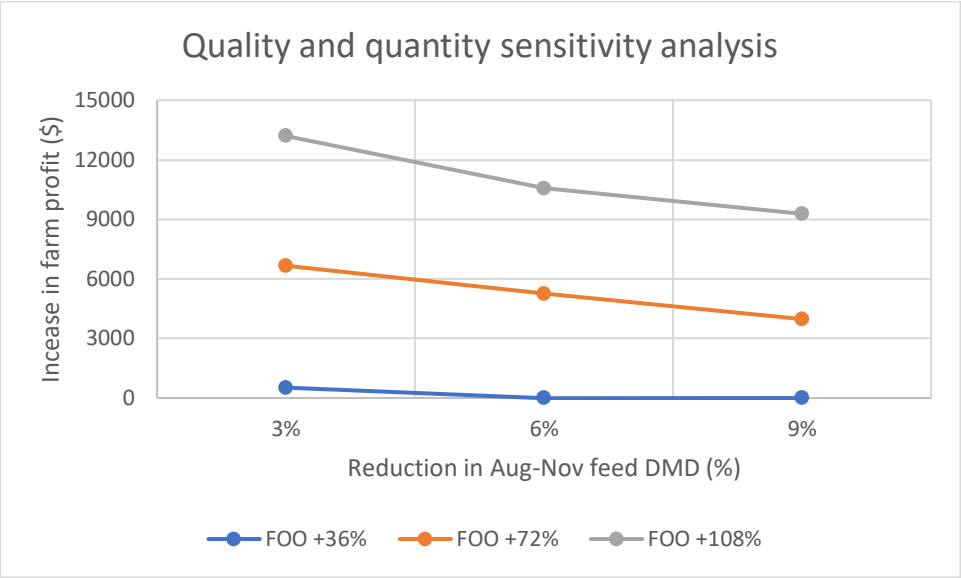
Component analysis (per ha of cereal bulked pasture)	
Seeding costs	-$17
Labour ($35/hr)	-$4
Fertiliser (35 kg/ha)	-$19
6% reduction in DMD August-November	-$8
70% Increase in early FOO	$67
Net	$19

4.2.3 Sensitivity analysis

As outlined in the statistical analysis section there was large variation in the effects of sowing cereals into pastures and not enough trial data to be highly confident in the resulting relationships. Thus, in this section a sensitivity analysis is provided looking at the result for different changes in FOO and DMD due to sowing cereals.

The results indicate that sowing cereals into pastures becomes profitable if early FOO increases by more than 30% compared to without sowing cereals. The resulting reduction in August to November feed quality has less impact on farm profit. However, not shown in the results, but important nonetheless is that if the reduction of feed quality in the latter stages of the growing season results in lower quality dry feed, then profit is significantly reduced. Thus, future work should focus on more accurately quantifying the FOO benefits but also examine the impact on later season feed quality.

Figure 3: Change in whole farm profit at different levels of early growing season FOO and mid-late growing season DMD due to sowing cereals into pastures. Percentages are in comparison to pasture without cereals.



The analysis has shown, using data obtained from a producer demonstration trail, that sowing cereals into pastures can provide benefits of $193/ha. The benefits are sensitive to the amount of additional FOO provided from sowing cereals. The results indicate that sowing cereals is only profitable if early growing season FOO increases by more than 30%.

Due to labour constraints, seeding timeliness, soil productivity and the diminishing marginal benefits of additional early feed it is only profitable to sow cereals into a proportion of pasture. The proportion of area is sensitive to the amount of extra FOO provided. When additional FOO was 72% it was optimal to sow cereals into 30% of pastures. To capitalise on the benefits of sowing cereals stocking rate must be increased. When additional FOO was 72% it was optimal to run a 9% higher stocking rate.

72% was the additional FOO produced early in the growing season by the addition of cereals, an average across the host sites. If sowing cereals increases early season FOO by 72% then the model determined that it is most optimal to sow 30% of pastures with cereal. This means that although sowing cereals is profitable it has a diminishing return and thus is not profitable to sow cereals into all the farm's pasture. Part of the reason is that sowing cereals into pastures on poor soils is not optimal, as the cost of doing so remains the same while the increase in FOO and return is lower. Other reasons could include opportunity cost of labour, and although early growing season FOO is important, it becomes less important as pasture availability increases. For example, if FOO is at 500kgDM/ha, then an additional 500kgDM/ha is very beneficial, however if FOO is at 3000kgDM/ha then an additional 500kgDM/ha has less impacts and is not as beneficial.

Capturing these non-linear relationships is one of the strong points of whole-farm modelling. If we used a simple gross margin method, as was the original plan, we would have determined that pasture improvement with cereals generates a certain return per hectare, but it would not capture the diminishing relationship, which is particularly important when looking at early season feed.

Overall, the economic valuation report provides some guidance into the potential benefits of sowing cereals into pastures and describes the management methods required to capitalise on the benefits.

However, the data used in the analysis is very variable without the desired number of replications. Thus, the results are not perfect. Further work could examine a larger range of seeding rates and include feed measurements that include the dry feed period. Furthermore, from an economical point of view it would be more beneficial to measure feed growth rate rather than FOO. Further analysis would be beneficial to see profit at different levels of improvements - currently the analysis only shows the profit at 30% of pastures sown with cereals. As profit is not always the only decision driver, it would be interesting for producers to be able to see these results, to help reduce seasonal risk.

4.3 Extension and communication

Overall, extension and communication activities were very successful, and reached a much wider audience than expected due to high interest in the project in all sheep producing regions of WA.

Table 4: Activities and outcomes of the project.

Engagement / Adoption Activities	Details	Attendees and resources
Annual field days	Each field day will outline current results, as well as discuss pasture management and assessment tools, risk mitigation in poor seasons for livestock and feed base management and feed budgeting. At each day, attendees will help collect feed tests and take pasture measurements. Every year: 1 field day held post-seeding in the autumn feed gap, open to the wider group and any other interested industry members. Discussing: • Project plan • Cereal growth rates • Early (dry) sowing • Value of autumn feed, especially in poor seasons, and its role in carrying capacity and risk mitigation 1 Field day in September, open to the wider producer group and any other interested industry members Discuss: • Project and current results	Appendix 7.9 shows the handouts used at each field day. These were handed out to producers on arrival. Attendance: • Field day held 6/7/21 with 19 producers in attendance, • LIFT field day held 27/8/21 with 42 producers in attendance. • Field day held 2/7/20, with 17 producers in attendance. • No 2020 second field day as it was a very busy season for producers, with a lot of events that had been postponed earlier due to COVID restrictions. • First field day held 8/7/19, with 13 producers in attendance. • 15 producers in attendance at second field day held on 19/9/19.

	• Role of benchmarking • Pasture management, pinch and twist, pasture assessment, • Risk mitigation in poor seasons, • Other options to increase the feed base. • Discuss option of sowing the pastures earlier in following years and observe FOO-quantity, species composition and sheep grazing preferences and condition. • Take pasture cut from each strip and control at the spring field day.	
Producer guides / fact sheets	To be distributed at each field day, with a summary of the project's current findings as well as guides with sowing timing, rates, SR, grazing timing etc. Also to be shared online.	As mentioned above and available in Appendix 7.1
Annual summary articles	Outlining project results and aims. Was distributed through the LIFT network, as well as interested grower groups, including Southern Dirt, Facey Group and others. Reached a very wide industry network.	Available in Appendix 7.10
Workshop	Benchmarking workshops were run with core producers to collect and discuss the importance of benchmarking, and the results from the project.	2x benchmarking workshops held, One in June 2020 and the 2021 workshop held in March. Results available in Appendix 7.7. On average, 16 producers were in attendance at each workshop
Case studies	Case studies on each of the 5 host producers, to be shared with group and mainstream agricultural media.	The case studies are attached in Appendix 7.11, completed in 2021. They have been distributed through AgPro, LIFT and MLA channels, and will continue to be after the project's completion.
Other (please provide details):	Potential to discuss projects at other events e.g. Sheep Updates, Sheep's Back and local field days	Discussed at all AgPro "StockPro" meetings (over 30 groups across WA) and through the network of over 300 producers, presented at MLA's WA MeatUp Forum, and data has been part of several consultants' presentations around the state for the last 2 years.

4.4 Monitoring and evaluation

46 surveys were completed for the pre project survey. A further 8 were incomplete. 44 surveys were completed for the post project survey. The questions and results summary can be seen in Appendix 7.1 and 7.12, and the raw results in the Excel file included with this report.

The post project data showed that the project resulted in increased producer confidence in using cereals to bulk up pastures, to an average level of 7.9 out of 10. This was 7.8 in core producers and 8 in observer producers, compared to the original average of 6.8.

There was an increase in producers' knowledge, skills, with more correct responses to the survey questions. Producers agreed that they found the project to be valuable, ranking it 7.4 out of 10, and 97.7% would recommend the PDS program to others. Satisfaction with the project was ranked at 7.9 out of 10.

Data was also collected looking at the impact implementing bulked pastures had on farm. This gave different results from the benchmarking data, as the survey relied on estimates rather than producers having the data in front of them. Average impact on autumn FOO was an increase of 192%, and autumn carrying capacity of 4.5DSE/ha and 2.7 lambs/ha. Compared to the pre-project data this is slightly higher, with a 0.1DSE increase but no change in average lambs/ha.
For core producers, average GM/ha was $252.7, and $58.5/DSE, a significant decrease from the pre-project survey responses. This most likely reflects seasonal differences rather than the impacts of this trial, so economic analysis is more reflective of the financial impact of bulking pastures with cereals.

The post project surveys looked at two ways of bulking up pastures with cereals:
1. Adding cereals into existing pastures, usually by seeding cereals into pastures, or spreading seed.
2. Adding cereals to resown pastures, usually by adding it to pasture seed mixes.

Results revealed that 30% of producers have implemented sowing cereals into existing pastures, and 23% intend to adopt. There was also an increase in producers who responded as using this as a regular practice, while 9% believe it is not needed on their property, or not relevant to them. Informal follow up questions indicated that this was often due to low stocking rate systems, or concerns about cereal disease carryover.

30% of all producers surveyed have implemented adding cereals to reseeded pasture mixes, with 27% planning on adoption. 3% believe it is not relevant or needed on their property. There was an increase of 16% of producers who responded that this was a normal practice, which indicated that perhaps the adoption rate is higher than 30%. The same could apply to practice change of sowing cereal into existing pastures, with results indicating that a much higher percentage of producers responded that it was a normal practice post project.

When the data was broken down into core and observer producers, and those utilising cereals in any way to bulk up pastures, results were clearer. Overall 80% of core producers now utilise the practice, while 49% of observers do. In addition, 35% of observer producers surveyed intend to implement adding cereals to bulk up their pastures. A further indication of the project's success was that no producers responded requiring more information.

4.5 Outcomes in achieving objectives

The original project objective was that "using 5 PDS sites in the Lake Grace region of WA, by December 2021, the project will lead to 80% of core producers and 60% of the wider observer group adopting the practice of bulking pastures with cereals and canola."

This objective was successfully met, with a total of 14 sites between 2019 and 2021. 80% of core producers now utilise the practice, while 49% of observers do. In addition, 35% of observer producers surveyed intend to implement adding cereals to bulk up their pastures.

It should be noted that canola was removed after 2018, when the project originally began, due to being unsuitable economically and not providing the early season growth compared to other cereals.

This aim was to be achieved by:

1. Demonstrating and analysing the benefits of sowing cereals & canola in legume pastures in terms of:

- Livestock- carrying capacity and stocking rate (estimated minimum 10% DSE/ha increase), as well as impact on productivity benchmarks (lambs/ha, CS/weight gain)
- Profitability- impact of increased carrying capacity on current financial benchmarks (GM/ha, GM/DSE)
- Pasture composition, quality and quantity (estimated 20% increase in energy, digestibility, protein)"

This objective was clearly met, with increased carrying capacity, productivity and profitability clearly demonstrated through raw and analysed data, as was pasture composition, quality and quantity. Condition score was collected, while lambs/ha can be modelled based on the condition score changes.

The estimated 20% increase in pasture energy, protein and digestibility was not achieved, with conflicting results across the three years. However, the impact of sowing pasture into cereals on composition, feed quality and quantity were clearly demonstrated.

The 10% increase in carrying capacity and stocking rate was analysed within the economic modelling, with determined optimal management strategies created by the modelling. This also further built on the profitability outcomes.

2. Through annual field days and other communication activities, shared demonstration sites and results to increase confidence and understanding of feed base management to the wider producer group of 90, to lead to a 70% adoption rate.

This objective was successfully met through the communication activities outlined in Appendix 7.3. Post project surveys showed an increase in producer confidence, leading to 80% of core producers utilising cereals to bulk up pastures, and 49% of observer producers, with an additional 35% of observer producers intending to implement the practice. It is believed that the adoption rate is higher across the producer group of 90, with not all surveys returned. In addition, there has been widespread adoption across the state as a result of the project that is not captured. Full results of adoption are available in Appendix 7.13.

3. Demonstrate the difference cereal sowing rates, as well as fertilizer application, can have on pasture composition, quality and quantity, as well as profitability.

Objective three was well and truly met, with the core producer team and hosts deciding to expand the project scope to include different fertiliser rates. The impact was successfully captured and demonstrated as shown in Appendices 7.3 - 7.11, and in the results sections above, 4.1 and 4.2.

4. Measure species composition throughout the season to alleviate fears of cereals outcompeting legumes or legumes being grazed out.

This objective proved more challenging due to varying opinions as to how to measure composition. Despite contradicting measurement methods, the objective was achieved, and it was clearly demonstrated that cereals and legumes do not have negative impacts on one another when in a grazed pasture, and both will remain in the pasture until pasture senescence.

5. Conclusion

The project's timing was ideal, prompted by and continuing through a series of late breaks. These highlighted the issue of poor pastures and the impact this has on carrying capacity, and in turn profitability of sheep enterprises in the area. Through the findings, extension, and communication activities, this PDS has increased involved producers' and the wider industry's understanding of the role cereals can play in pastures, with higher productivity and profitability. High adoption rates and increase in producers' knowledge, confidence and skill were recorded in the surveys, indicating success in assisting change. The project has also highlighted the opportunities available by maximising stocking potential and increasing carrying capacity.

Overall, there was great variation in results across the three years due to seasonality, as well as much variance explained by site location. This indicates that further demonstration sites could be beneficial. When combining the three years of feed quality and quantity results, it was shown that:

- Fertiliser level had no significant impact on pasture quality or quantity.
- Seeding rate significantly impacted early season feed quantity, but had no impact on FOO later in the season
- Pasture quality was reduced in late winter and spring by the addition of cereals.

When pastures were grazed, the cereal component was 29% less in July compared to the ungrazed pastures, and 41% lower in August, showing that cereals were grazed out as the season progressed. This was the key finding from the species composition data.

The key finding from the sheep data is that condition scores are higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures, and predominantly led to improvement in condition over late pregnancy to lactation.

The economic analysis showed that bulking pastures with cereals can provide benefits of $19/ha. The benefits are sensitive to the amount of additional FOO provided from sowing cereals. The results indicate that sowing cereals is only profitable if early growing season FOO increases by more than 30%. The most profitable seeding rate was 60 kg/ha, provided that optimal management was involved, which meant reducing supplementary feeding by 4%, while increasing stocking rate by 9%.

Due to labour constraints, seeding timeliness, soil productivity and the diminishing marginal benefits of additional early feed it is only profitable to sow cereals into a proportion of pasture. The

proportion of area is sensitive to the amount of extra FOO provided- for example, when additional FOO was 72%, it was optimal to sow cereals into 30% of pastures. To capitalise on the benefits of sowing cereals stocking rate must be increased. When additional FOO was 72% it was optimal to run a 9% higher stocking rate.

Overall, the economic evaluation report provides some guidance into the potential benefits of sowing cereals into pastures and describes the management methods required to capitalise on the benefits. However, the data used in the analysis is very variable without the desired number of replications.

6. Benefits to industry

This project has benefited W.A. sheep producers by helping increase confidence, knowledge and skills, adoption rates and awareness regarding cereals in pastures. The project aimed to help producers improve declining pastures, which it has clearly demonstrated with a cheap, simple method. Sowing cereals into or with legume pastures is a practice that is seen much more frequently across W.A. in the past three years, helping red meat producers achieve sustainably higher stocking rates through reliable early season feed. This leads to higher profitability and productivity but has also reduced risk, making producers better equipped to handle poor seasons as they have earlier, more reliable feed of better quality. Producers will still look for the optimal cereal and fertiliser rate, but we were able to show them through the economic modelling (Fig. 2) that for seed only, the most profitable seeding rate was 60 kg/ha. The use of cereals also means increased grazing ease, with plants being higher and therefore more accessible to animals when traditional clover pastures are more prostrate. Although not looked at in this project, this means benefits would also be applicable to cattle enterprises.

The findings of the project are easily implemented on farm, as it is a simple practice that can be easily adopted or tried for one pasture cycle or season. This means increased likelihood of adoption beyond the project. Further extension could include promotion of case studies to a national audience and continuing to share the project's findings through presentations with grower groups and at events.

Further work could examine a larger range of seeding rates and include feed measurements that include the dry feed period. Furthermore, from an economical point of view, it would be more beneficial to measure feed growth rate rather than FOO. Further analysis would be beneficial to see profit at different levels of improvements-currently the analysis only shows the profit at 30% of pastures sown with cereals. As profit is not always the only decision driver, it would be interesting for producers to be able to see the analysis, to help reduce seasonal risk. Further demonstrations sites could be run focusing on increased seed rate and fertiliser rate's impacts on profitability.

7. Appendix

7.1 Pre PDS survey

7.1.1 Survey Questions

MLA Producer Demonstration Sites

Pre-Project Survey: Core and Observer Participants

Increasing carrying capacity and poor season resilience: Bulking pastures & diversity: L.PDS.1807

The following questions are used to determine your level of understanding of bulking pastures with cereals. The knowledge and skills audit is used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. It will also be used:

To improve the content of future project meetings; and as part of the evaluation process for the project

The information will be completely confidential and individuals will not be identified in the analysis of data.

Name: _____

Date: **/ /**

MLA may contact me to further assess the impact of their programs? ☐ Yes ☐ No

MLA may send me newsletters and inform me of future events? ☐ Yes ☐ No

Section A – Demographic Information

A1. Your contact details

a. Property name .....

b. Business / trading name .....

c. Property address .....

d. Email address .....

e. Mobile .....

A2. What area do you manage? *(please write the number of hectares that you managed)*

a. Hectares .....

A3. What numbers of livestock do you run? *(please write the number of head against each of the categories of livestock that you run)*

a. Number of ewes .....

b. Number of lambs turned off per year.....

c. Total number of sheep.....

Section B – Knowledge and Skills *(If you do not know, please select the 'Unsure' option)*

B1. What results in the most early season feed in a normal season? ***(Tick one of the options below)***

a. Higher fertiliser rates ..... ☐

b. Higher seeding rates ..... ☐

c. Unsure..... ☐

B2. Could cereals in pastures increase carrying capacity over autumn: ***(Tick one of the options below)***

a. Yes ☐

b. No ..... ☐

c. Unsure ..... ☐

B3. What do you believe would happen to species composition in a cereal-legume pasture? ***(Tick the answer that applies to you)***

a. Cereals get grazed out early..... ☐

b. Cereals 'choke out' legume during season ..... ☐

c. Legume outcompetes cereal..... ☐

d. Any grasses present would dominate ..... ☐

e. Unsure ..... ☐

B4. What do you think has the fastest growth rate? ***(Tick the answer that applies to you)***

a. Clover ..... ☐

b. Ryegrass..... ☐

c. Cereals ..... ☐

d. Barley grass..... ☐

e. Capeweed..... ☐

f. Unsure ..... ☐

Section C – Confidence and Practices

C1. How confident are you in bulking your legume pastures with cereals?

(please rate out of 10, with 1 being poor and 10 being very good, by circling your choice below)

1 2 3 4 5 6 7 8 9 10

Poor Excellent

C2. Do you currently use the following practices?

	Normal practice	Sometimes	Rarely	Never	Not Applicable
Add cereals to reseeded pasture seed mix					

Sow cereals into existing pastures					

C3. For the key metrics you are seeking to demonstrate in this PDS, please advise what is your current performance

Metric	Current performance
Autumn feed on offer (kg DM/ha)	
Autumn Sheep carrying capacity (DSE/ha)	
Lambs/ha	

CORE PRODUCERS ONLY

Metric	Current performance
GM/ha	
GM/DSE	

7.1.2 Survey Results

46 surveys were completed for the project. A further 8 were incomplete. The questions can be seen in Appendix 7.1.1, and the raw results in the Excel file included with this report.

Results were:

- 48% of producers believed fertilizer would lead to the highest increases in early season feed.
- 32% believed increasing early season feed would be most responsive to increasing seed rate, and 20% was unsure.
- Producers rated their confidence in bulking legume pastures with cereals as 6.8 out of 10.
- 96% believe sowing cereals in pastures can increase carrying capacity over autumn. 4% were unsure.
- 27% of producers thought that grazing could lead to cereals getting grazed out early, and 27% believed cereals will 'choke out' legumes throughout the season.
- A further 29% thought legumes will outcompete cereals, 0 thought pastures would dominate and 18% were unsure.
- 16% believed ryegrass had the fastest growth rate, 48% cereals, and 16% barley grass.
- None-one believed clover had the highest growth rate, 2% believed cape weed and 18% were unsure.
- 11% of producers normally add cereals to reseeded pasture seed, while 16% do sometimes.
- 36% rarely use the practice, and further 36% have never added cereals to reseeded pasture.
- 8% of producers normally sow cereals into existing pastures, while 20% do sometimes.
- 37% rarely use the practice, and further 35% have never added cereals to reseeded pasture.

7.2 Project Monitoring and Evaluation Plan

PRODUCER DEMONSTRATION SITE MER – L.PDS.1807

PRODUCER GROUP NAME: Lakes Information and Farming Technology (LIFT)

Project Objective (Key Result Area)

Over the next three years, in the Lakes area of Western Australia's Wheatbelt, the Lakes Information and Farming Technology group aim to demonstrate and analyse the benefits of sowing cereals and canola into legume pastures. This involves five producer demonstration sites, looking at the impact on pasture composition, quality and quantity, profitability and stocking rate. By December 2021, the project is estimated to have led to 80% of core producers and 60% of the wider observe group adopting the practice of bulking pastures with cereals and canola.

Evaluation Level	Project Performance Measures	Evaluation Methods
Inputs – what did we do?	• Five Trial site hosts selected and set up • Initial planning meeting with the core producer group • Seven producers on 5 on-farm trial sites demonstrating varying fertiliser and cereal sowing rates • 15 Core producers directly involved with all aspects of the PDS project • 90 farm business observers managing approximately 250,000 sheep and covering 600,000ha • $68,937 total funding from MLA to be used for professional technical expertise, data collection, project management, travel, field days and case study production. • $35,250 (minimum) in-kind contribution from host producers, in terms of time, seed for trial, fertiliser, spraying, fencing, site and stock	• Records and documentation of all project activities • Documentation of all meeting notes

	management, as well as assistance in taking measurements and pasture samples.	

Outputs – what performance metrics are we capturing?	• Collection of data from five trial sites including control data:
	  • Livestock profitability and production (benchmarking)
	  • Feed composition, quality and quantity
	  • Livestock performance
	
	Communications
	  • Pre-project workshop for host producers
	  • Two field days per year
	  • Two benchmarking workshops for core producers
	  • Annual project summary distributed through LIFT network, as well as wider industry networks (eg rural media, grower group newsletter, presentation opportunities)
	  • Final report to also be shared with the wider community via publication in interested media, eg Farm Weekly, Countryman
	  • Five case studies produced on host sites and producers
		• All data recorded from trial sites and included in milestone reports
		• Case studies from the five host sites involved
		• All media outputs included in milestone reports.
		• Pre and Post PDS surveys to evaluate producers interest and better capture stock numbers, opinions,

Changes in knowledge, attitudes and skills – How well did we do it?	• All the core producers that attend the first workshop will increase their understanding of the factors surrounding pasture management, the difference between stocking rate and carrying capacity, as well as the skills required to carry out the PDS; the pinch and twist test to check that the cereals are ready for grazing, FOO measurements and importance to stock management, condition scoring and the impact of condition on production • All the group members will have been exposed to the facts surrounding the benefits of bulking up pastures, including the skills described at the core member workshop. It is expected that 30% of them will see social media posts, 80% will read the article in the newsletter, and 50% of them will come to at least 1 field day.	• Count of attendees at all events • Pre and post PDS surveys to evaluate producer uptake of the tool, as well as changes in skills, knowledge, attitudes and opinions towards the tool (as well as increasing share of livestock enterprise on farm)

Practice changes – Has it changed what people do?	• It is expected that 60% of the producers that attend the field days will try bulking up pastures on their own properties, on top of 80% of the core producers.	• Pre and post PDS surveys to evaluate producer uptake of the tool • Longer term surveys conducted by MLA (secondary impact information)

Benefits – Is anyone better off?	• Improved sheep nutrition due to improve pasture quality and quantity.
	• Wider use of other management tools learnt along the way; stocking rate, condition scoring, FOO calculations.
	• Increased sheep productivity- wool, meat and reproductive performance due to improved nutrition
	• Increase in profitability of sheep enterprise due to increase DSE/ha, total DSE, GM/ha and GM/DSE.
		• Benefit cost analysis of the practice
		• Surveys of wider group at end of trial
		  ○ Stocking rates
		  ○ Carrying Capacity
		  ○ FOO in autumn
		  ○ Change in practice
		• Longer term surveys conducted by MLA (secondary impact information)

General outcomes – Is the industry better off?	• Wider uptake of bulking pastures with cheaper alternatives such as crops, as a direct result of these PDSs but also result of the popularity of the tool, promoting itself amongst farmers who try it and then commend it to others. • What are the unintended/unexpected benefits or consequences? • Project learnings, barriers / enablers to adoption	• Surveys of the wider group to evaluate continued and new use of bulking pastures with cereals and canola, and new uptake, as word spreads. • Survey of core producers on key learnings

7.3 Communications Plan

March 2019

Project name L.PDS.1807: Increasing Carrying Capacity and poor season resilience: Bulking pastures & diversity

Project overview

MLA Program Manager	Alana McEwan-Brown (Russell Pattinson – PDS national coordinator)
MLA $	$68,937
In kind investment $	**$35,250**
Project objectives	Using 5 PDS sites in the Lake Grace region of WA, by December 2020, the project will lead to 80% of core producers and 60% of the wider observe group adopting the practice of bulking pastures with cereals and canola. This will be achieved by: 1. Demonstrating and analysing the benefits of sowing cereals & canola in legume pastures in terms of: • Livestock- carrying capacity and stocking rate (estimated minimum 10% DSE/ha increase), as well as impact on productivity benchmarks (lambs/ha, CS/weight gain) • Profitability- impact of increased carrying capacity on current financial benchmarks (GM/ha, GM/DSE) • Pasture composition, quality and quantity (estimated 20% increase in energy, digestibility, protein) 2. Through annual field days and other communication activities, share the demonstration sites and results to increase confidence and understanding of feed base management to the wider producer group of 90, to lead to a 70% adoption rate. 3. Demonstrate the difference cereal sowing rates, as well as fertilizer application, can have on pasture composition, quality and quantity, as well as profitability. 4. Measure species composition throughout the season to alleviate fears of cereals outcompeting legumes or legumes being grazed out.
What were/are the deliverables from the project?	1. Three years of data from five demonstration sites (2019 to 2021), of research and experiences. 2. Use the data and producer experiences to determine if sowing cereals into pastures is a productive and profitable practice for the area. 3. Demonstrate the differences between pastures and pastures sown with cereals, with variable seeding rates and fertiliser rates. 4. Demonstrate the increased carrying capacity compared to current financial benchmarks.

What are the 'outcomes' for producers?	1. Quantify the actual profitability of bulking pastures with cereals in the Lakes area. 2. Quantify the actual profitability of adding fertilisers to pastures with variable rates of cereals. 3. Identify the optimal cereal sowing rate and fertiliser rate. 4. Give involved producers confidence and the knowledge to increase autumn feed availability.
Measure of success of communication plan and / or activities (KPIs and how measured)	• Five demonstration sites per year to provide research and a basis for extension activities. • Five host producers sharing their experiences through the sites, field days and media releases. • Five final case studies published, one for each site. These will outline producers' experiences, each system, pasture and stock performance. • Annual project summaries distributed to the primary and secondary audiences, as well as overall summaries to the wider industry. • Annual reports and progress reports. • Sharing with the wider producer community through: Media releases through rural media, social media and grower group networks, sharing project findings
Primary audience (include regions/species)	Lakes Information and Farming Technology members
Secondary audience (include regions/species)	Local producers in the Lakes area and wider Wheatbelt sheep zone.

Communications Plan / Activities

Activity	Responsibility	Target Audience	Key messages and must-have elements	Timing	Estimated reach
Field days in the Lakes region, with fact sheets distributed	Georgia	Primary and secondary	Presentation of results and producer experiences	June 2019, 2020, 2021 September 2019, 2020, 2021	15 core, 90 observer, wider Lake Grace area
Pre-season planning meetings	Georgia	Primary	Summarise learnings from past year of project, prepare and plan the upcoming year	February 2019, 2020, 2021	15 Core producers
Annual summary articles, including producer guides	Georgia and host producers	Primary, secondary and wider industry audiences	Summarise and distribute findings and results	March 2019, 2020, 2021	15 core, 90 observer, wider industry
Progress reports and annual reports	Georgia	MLA	Summarise and distribute findings and results	2019, 2020, 2021	MLA
Final report and host producer case studies	Georgia	MLA, primary, secondary and wider industry	Summarise and distribute findings and results, capturing producer experiences and results	2021	15 core, 90 observer, wider industry, MLA
Ongoing communication with host producers, managing sites	Georgia	Primary and host producers	Planning discussions, seasonal and progress updates	2019, 2020, 2021	10
Benchmarking data collection	Georgia	Host producers	Collection of KPI's for host sites' production and productivity	2019, 2020, 2021	10
Benchmarking workshop	Georgia	Host producers	Sharing of results	March 2020, 2021	10

7.4 Treatments

7.4.1 2019

Smith site:

Animals grazing May 10, pregnant ewes. CS taken but animals are needing to be rotationally grazed due to poor pasture growth and late season break. Control paddock's existing pasture similar to that that was bulked up. The following was sown early April, with scope barley into existing sub clover pasture:

1. Control strip, no additives or treatment
2. 60kg scope
3. 40kg scope
4. 20kg scope
5. 60kg scope+40kg fert
6. 40kg scope 40kg fert
7. 20kg scope+ 40kg fert
8. Cultivated, no additives

Marshall site:

CS taken and sheep began grazing July 4. Fertiliser and cereal treatments were added to an existing clover pasture, waiting on treatment and sowing data confirmation. (7 different treatments)

1. 60kg cereal + 50kg compound
2. 40kg cereal + 50kg compound
3. 20kg cereal + 50kg compound
4. 40kg cereal + 50kg compound
5. 20kg cereal + 0kg compound
6. 40kg cereal + 0kg compound
7. 60kg cereal + 0kg compound

Pearce site:

Pregnant ewes began grazing in mid-June. The pasture is re-sown, put in April 29, and includes replicated strips:

1. 25kg Spartacus + 25kg vetch
2. 25kg Spartacus + 25kg vetch + 100kg fert
3. 25kg Spartacus + 25kg vetch+ 70kg fert
4. 25kg Spartacus + 25kg vetch
5. 25kg Spartacus + 25kg vetch+100kg fert
6. 25kg Spartacus + 25kg vetch+ 70kg fert
7. 25kg Spartacus + 25kg vetch+ 70 fert
8. 50kg Spartacus + 50kg vetch+70kg fert
9. 25kg vetch+70kg fert
10. 50kg Spartacus + 25kg vetch+ 3kg canola +70kg fert
11. 25kg Spartacus + 25kg vetch+70kg fert
12. 50kg Spartacus + 50kg vetch+70kg fert
13. 25kg vetch + 70kg fert

14. 25kg Spartacus + 25kg vetch+ 70 fert

Gray site:

Plan to wean lambs in July onto pasture, at high stocking rate. Due to not being able to collect livestock performance data over season, control is included in the strips detailed below. If possible, lamb weights will be taken after grazing to compare to the farm's normal clover, and clover and vetch pasture. This is dependent on the season and paddock availability.

Sown 26 April, vetch was added to a poor sub clover pasture in addition to the oats.

5. Oats @ 20kg + Vulga Vetch @ 20 kg + Compound Fertilizer @ 50kg
6. Oats @ 40kg + Vulga Vetch @ 40 kg + Compound Fertilizer @ 50kg
7. Oats @ 60kg + Vulga Vetch @ 60 kg + Compound Fertilizer @ 50kg
8. Oats @ 60kg + Vulga Vetch @ 60 kg + No Compound
6. Oats @ 40kg + Vulga Vetch @ 40 kg + NO Compound
8. Oats @ 20kg + Vulga Vetch @ 20 kg + NO Compound
9. No treatment
10. 50kg compound fertilizer
11. Vulga Vetch @ 20 kg + Compound Fertilizer @ 50kg
12. Vulga Vetch @ 40 kg + Compound Fertilizer @ 50kg
13. Vulga Vetch @ 60 kg + Compound Fertilizer @ 50kg

Taylor site:

Is not continuing this year. This was one of the two agreed sites to have full livestock data measured.

7.4.2 2020

Four sites were established in 2020, with sowing occurring in April. The fifth site was delayed due to a machinery breakdown, and then not sown due to host illness. The delay meant no replacement site, as it would not have been early sown. Each site is grazing lambing ewes.

Smith site:
Barley sown late May, into a combination of clover and vetch. Is being grazed and will be cut as a fodder crop in September. There were no varying strips to measure, only the control and the pasture with 40kg of cereal added to the existing clover and vetch pasture. Sheep condition scored June, in early August after lambing, and finally when sheep are removed from the paddock at the end of the season. No variations in fertilizer or seeding rates.

Marshall site:
Seeded April 25th, with cereals pastures of oat or barley at 60kg/ha, with 60kg fertilizer. The pastures are a mix of clover and rye. Sheep were condition scored in April at preg scanning, averaging 2.5 CS, and will be condition scored again at the end of July when grazing ceases. No variations in fertilizer or seeding rates.

Thompson site:
Sown barley in early April, into existing clover which germinated as a result of February rain.
Strips:
1. control
2. 0kg spartacus barley + 30kg compound

3. 20kg spartacus barley + 30kg compound
4. 30kg spartacus barley + 28kg vetch + 2kg bartolo clover + 30kg compound
5. 30kg spartacus barley
6. 40kg spartacus barley+ 30kg compound
7. 60kg spartacus barley + 30kg compound

Dean site:
Oats, sown on April 22nd into old clover and rye based pasture.
Strips:
1. 0kg c +30kg compound
2. 20kg c + 30kg compound
3. 40kg c + 30kg compound
4. 60kg c + 30kg compound
5. 40kg cereal

7.4.3 2021

In 2021 6 sites were established, with sowing occurring in April and early May. Grazing commenced at each site in mid-June, and is to end in September.

Taylor site:

Barley sown 20th of April 2021 into clover and ryegrass pasture, strips of:

- 0kg cereal+ 30kg compound
- 40kg cereal +30kg compound
- 60kg cereal+30kg compound
- 40kg cereal +0kg compound
- 20kg cereal+30kg compound
- 50kg cereal+30kg compound
- 0kg cereal+0kg compound

Smith site:

Sown 25th of April, the site had a combination of barley into clover & ryegrass. Strips were:

- 20kg cereal+45kg compound
- 40kg cereal+45kg compound
- 26kg cereal+45kg compound
- 60kg cereal+0kg compound
- 0kg cereal+0kg compound

Thompson site:

Sown with planet barley into clover, ryegrass and vetch, 15/4/21. Strips were:

- 40kg cereal+ 0kg compound
- 40kg cereal+ 30kg compound
- 60kg cereal+30kg compound
- 40kg cereal+30kg compound
- 20kg cereal+30kg compound
- 0kg cereal+30kg compound
- 0kg cereal+0kg compound

White site:

Sown into existing clover, vetch and ryegrass pasture on 6/4/21 with Scope barley. Strips were:

- 45kg cereal + 0kg compound +50L Flexi-N
- 45kg cereal+ 50kg compound + 50L Flexi-N
- 45kg cereal + 25kg compound + 0L Flexi-N
- 45kg cereal+ 25kg compound+100L Flexi-N
- 0kg cereal+ 0kg compound

Wyatt site:

Sown on 9/4/2021

- No cereal + 30kg compound fertiliser
- 20kg/ha cereals + 30kg compound fertiliser.
- 40kg/ha cereals + 30kg compound fertiliser.
- 60kg/ha cereals + 30kg compound fertiliser.
- 40kg/ha cereals + no fertiliser
- No cereal, no fertiliser

Brown site:

Sown 20/4/2021 with barley, into existing clover and ryegrass pasture.

- 20kg cereal +30kg compound
- 40kg cereal +30kg compound
- 40kg cereal +0kg compound
- 60kg cereal +30kg compound
- 0kg cereal +30kg compound
- 0kg cereal +0kg compound

7.5 Feed results

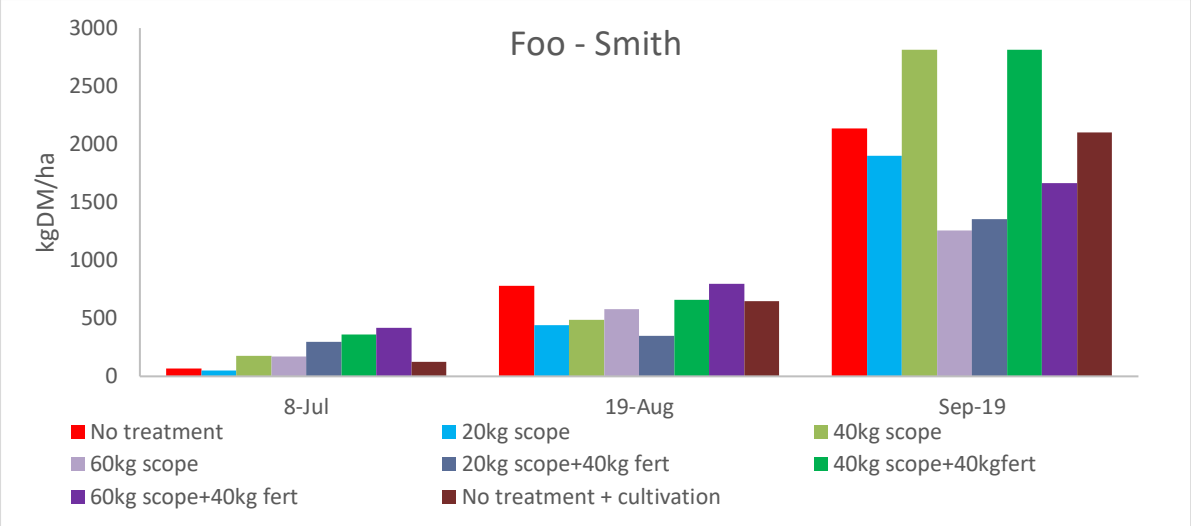
7.5.1 2019

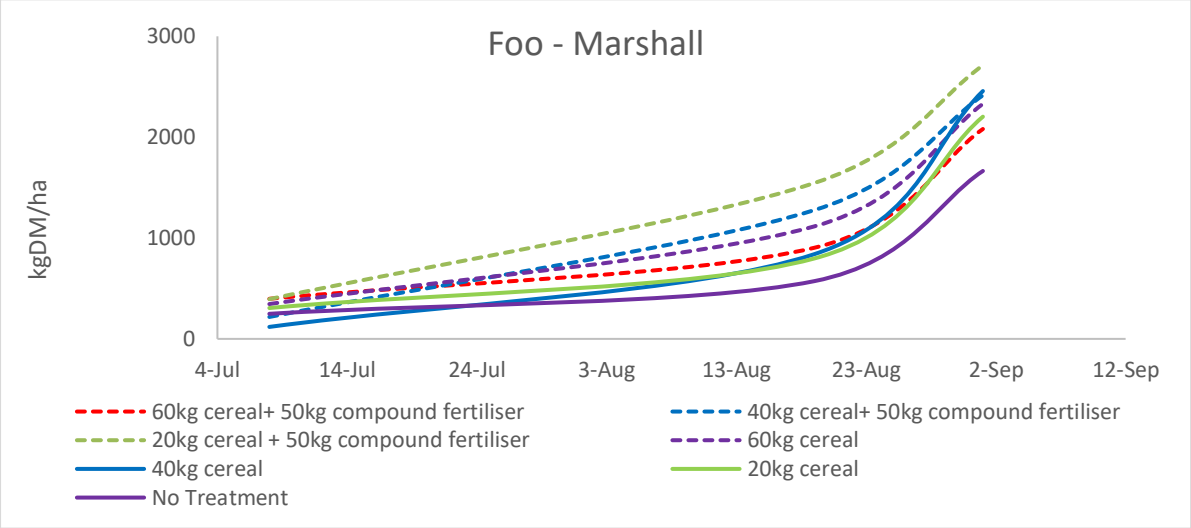
Species composition

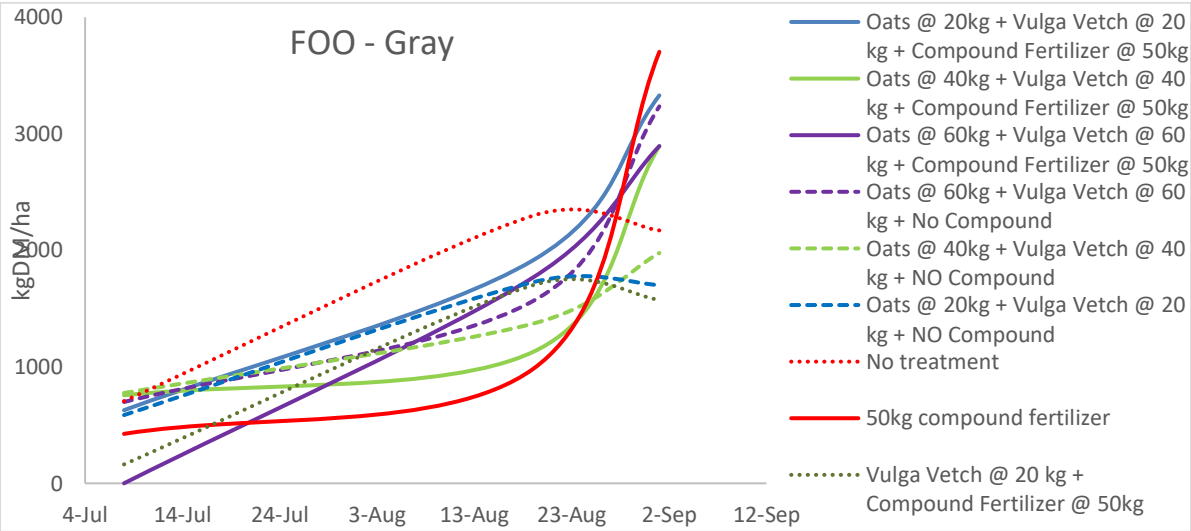
Ryegrass and barley grass are also a large component at most sites, with very little clover biomass at this point of the season. Pastures which include vetch as their legume have higher legume biomass and species composition compared to those with a clover legume base.

	Grazed (% cereal & grass)			**Ungrazed (% cereal & grass)**		
SITE	**June**	**July**	**August**	**June**	**July**	**August**
Taylor	60	50	40	70	90	95
Gray	90	70	50	90	85	85
Wyatt	65	65	60	85	95	95
White	75	60	60	75	90	95
Smith	60	55	50	60	95	95
AVERAGE	**70**	**62**	**52**	**76**	**91**	**93**

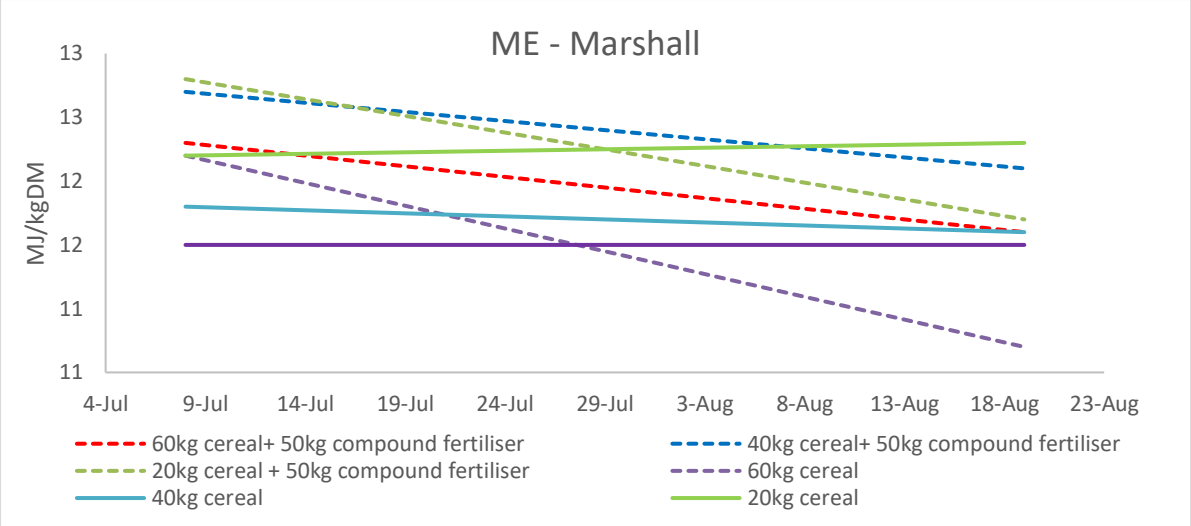
Feed on Offer Results

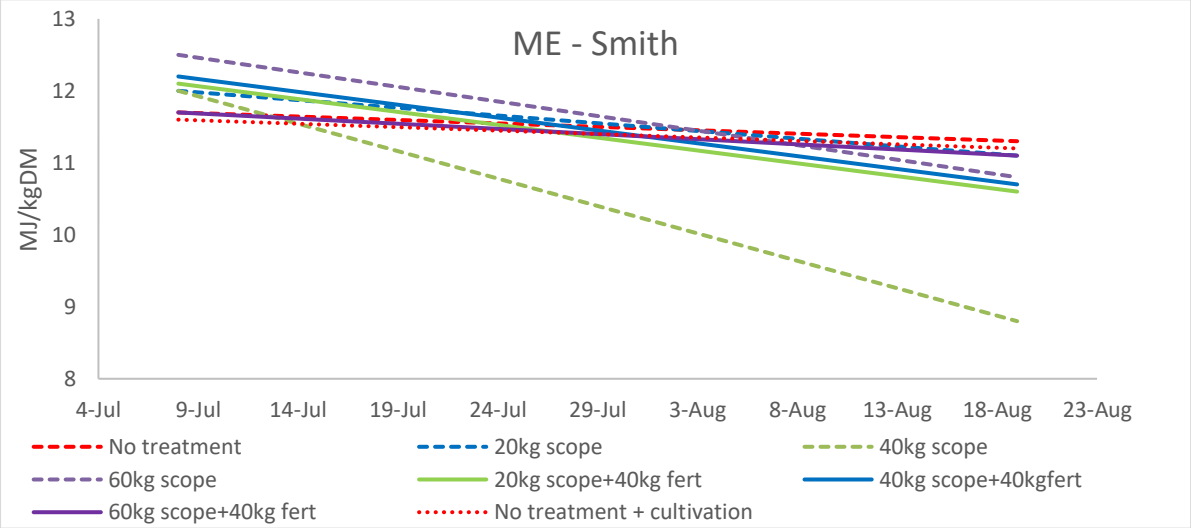


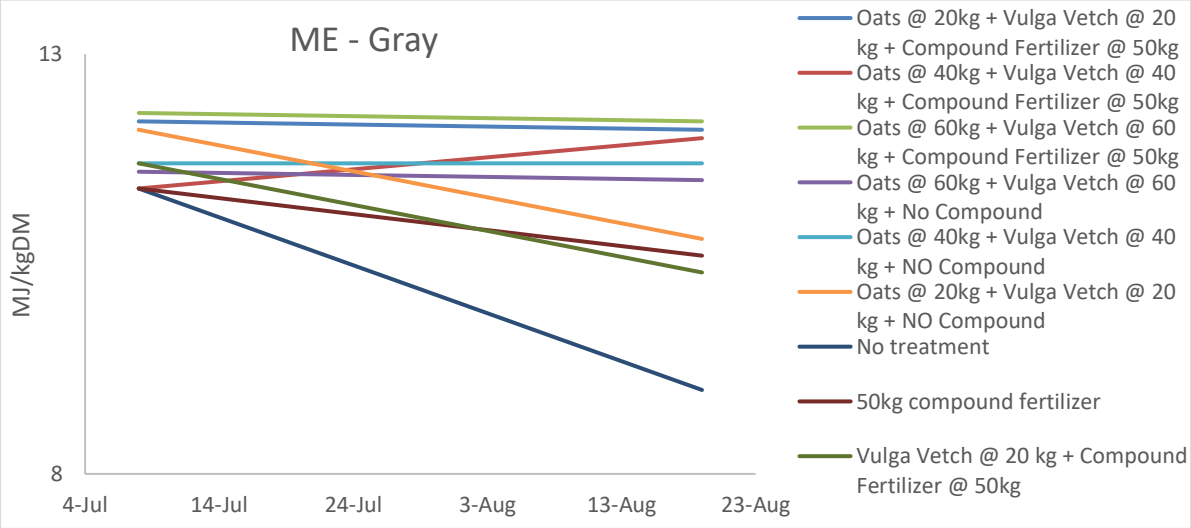




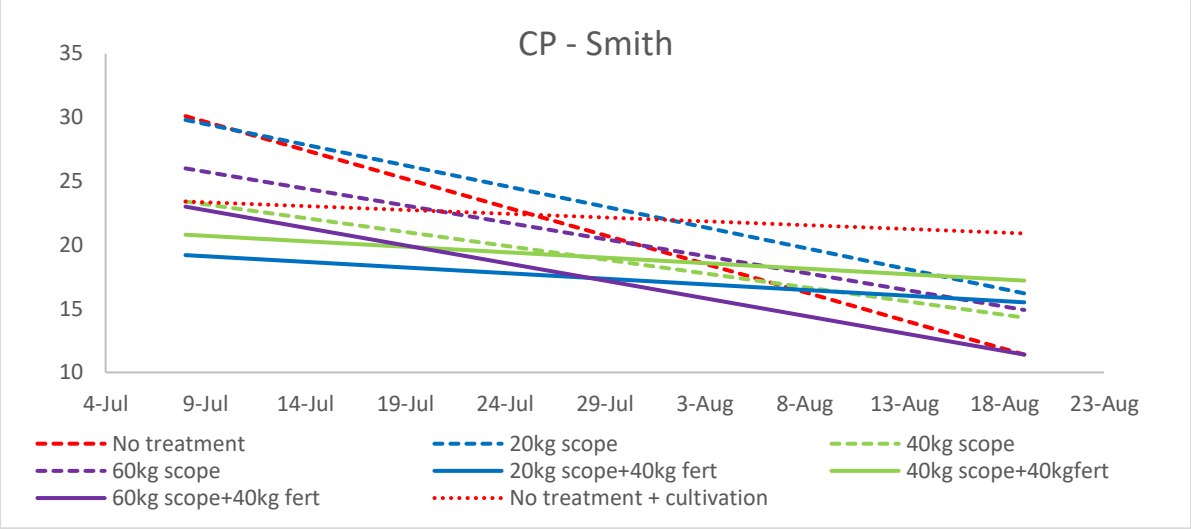
Metabolisable Energy Results

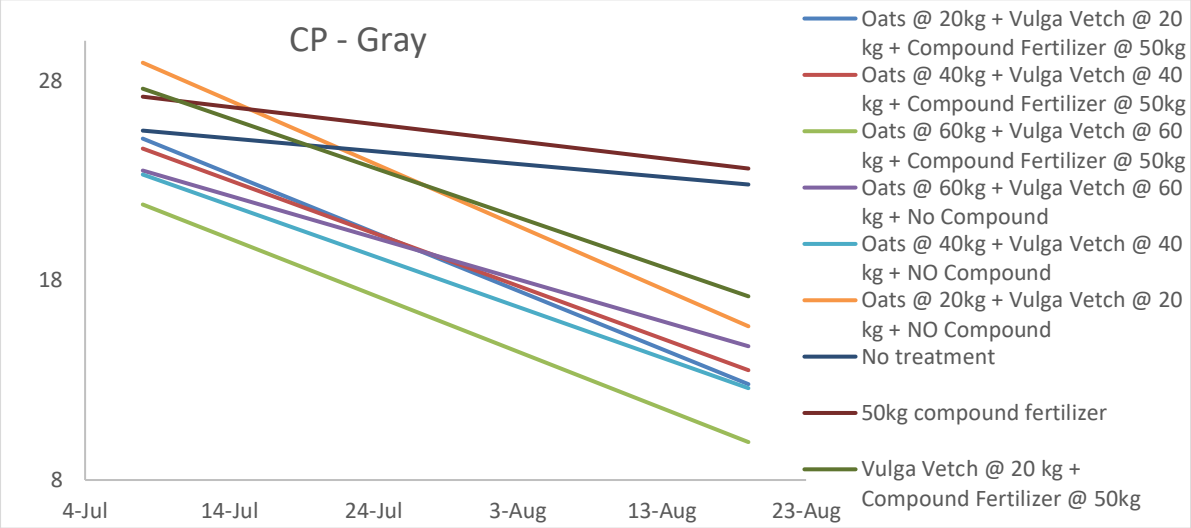


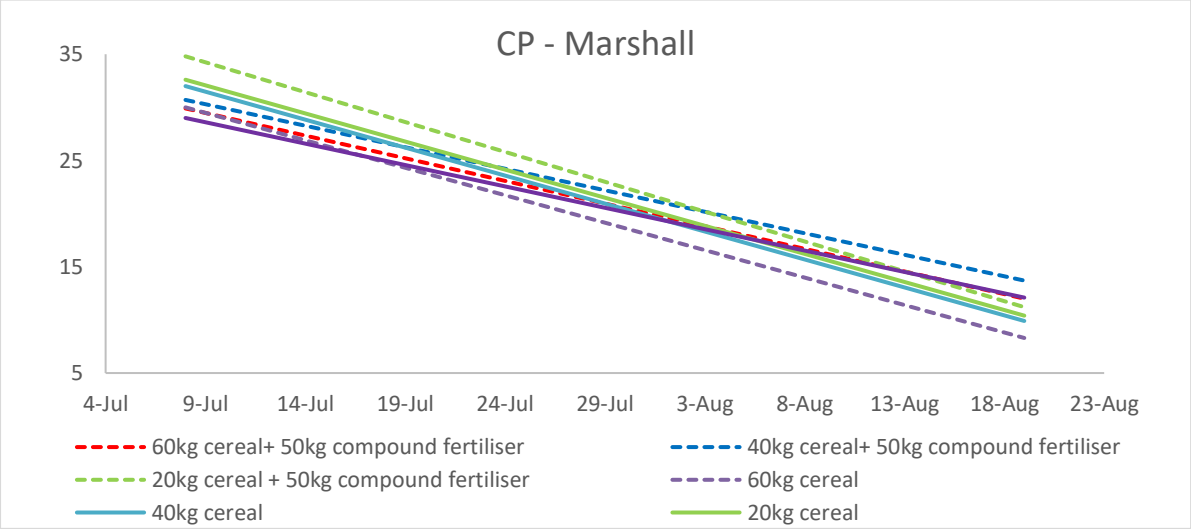




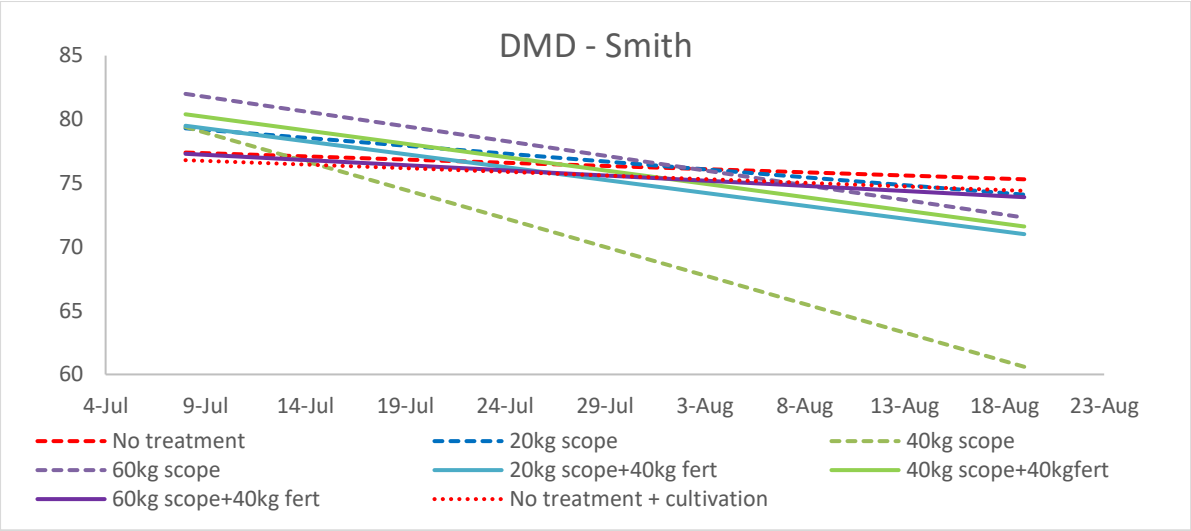
Crude Protein Results

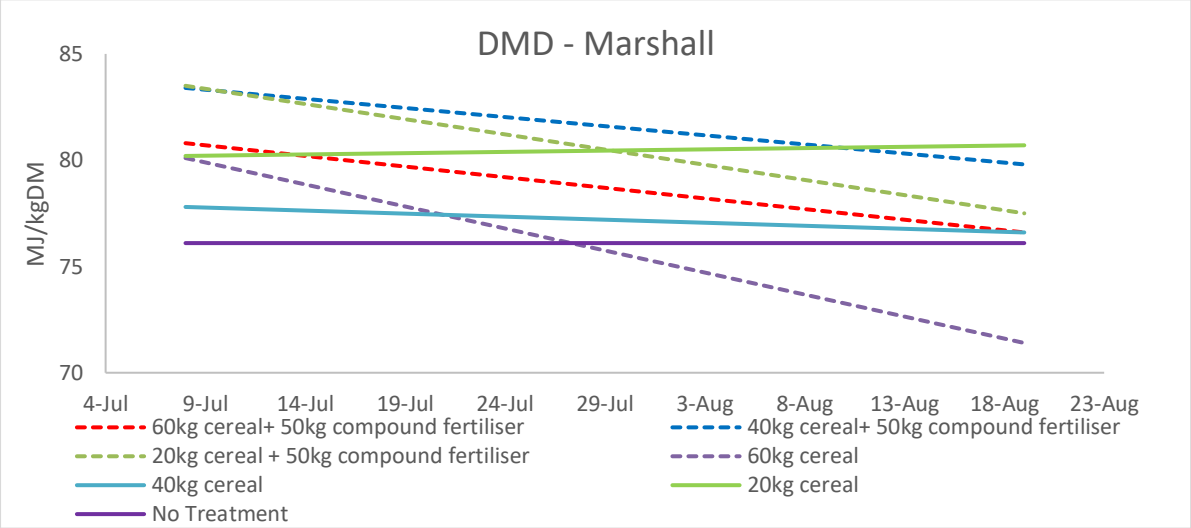


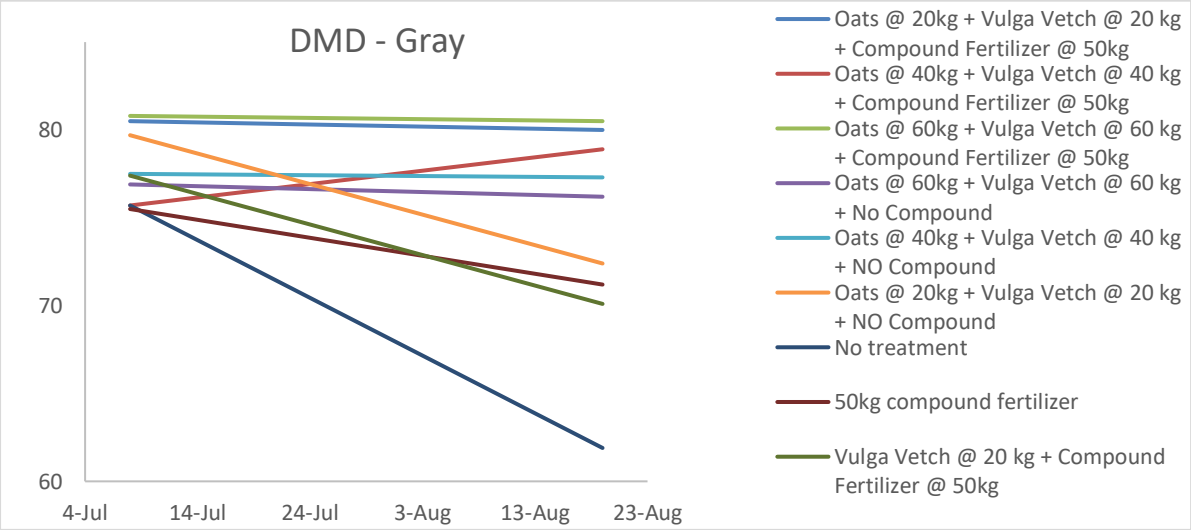




Dry Matter Digestibility Results





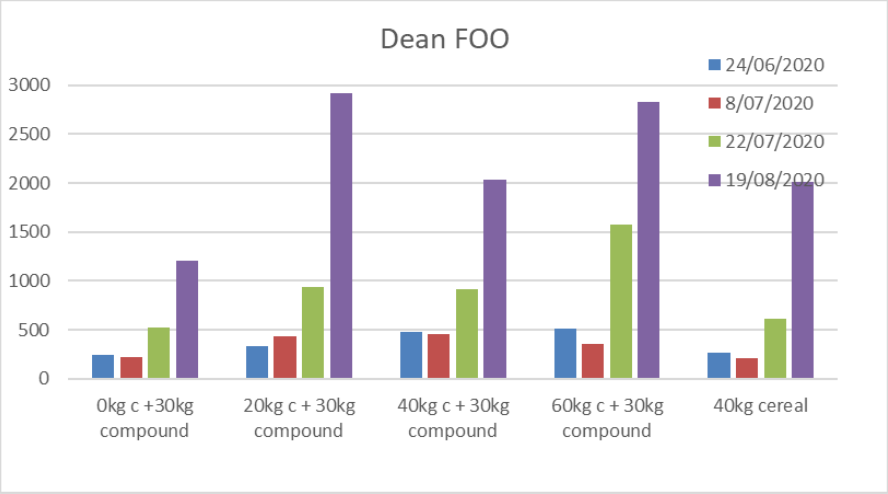


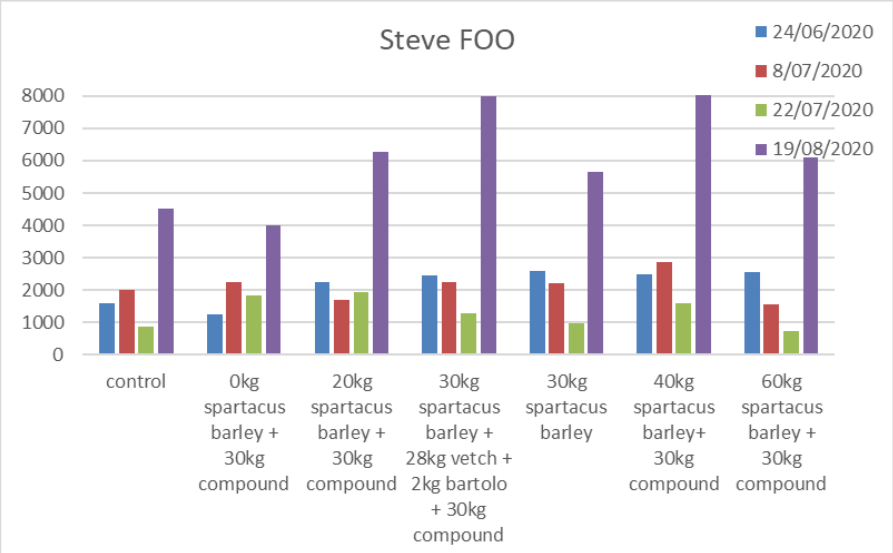
7.5.2 2020

Species Composition

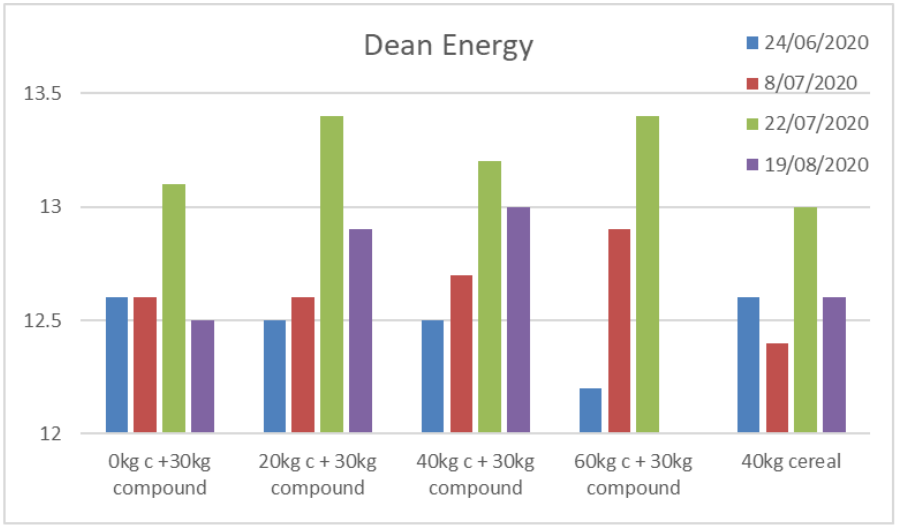
	Grazed (% cereal & grass)		Ungrazed (% cereal & grass)	
SITE	**June**	**June**	**June**	**July**
Marshall	65	70	90	90
Smith	68	75	85	85
AVERAGE	**66.5**	**72.5**	**87.5**	**87.5**

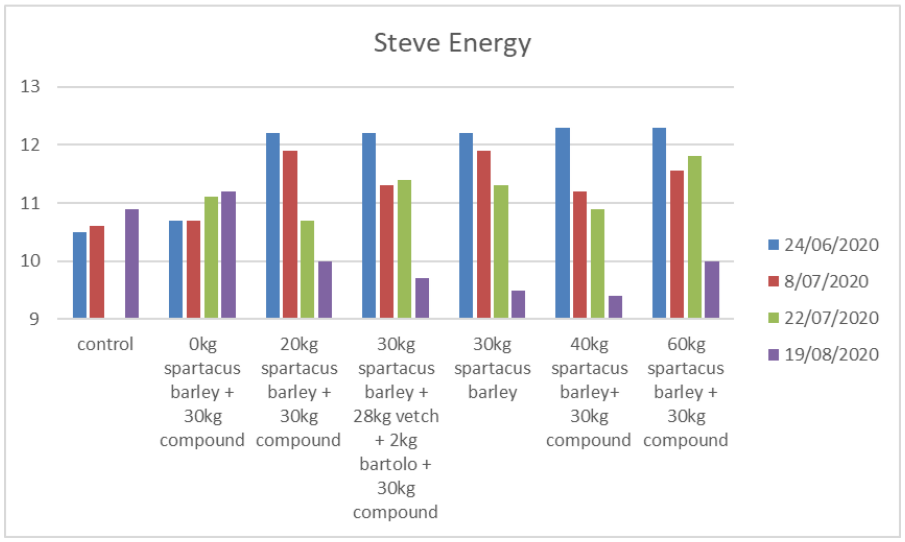
Feed on Offer



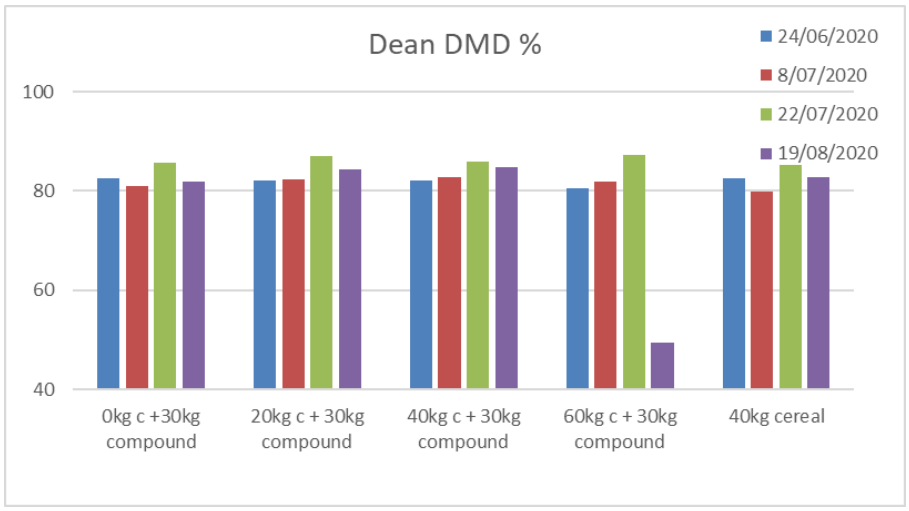


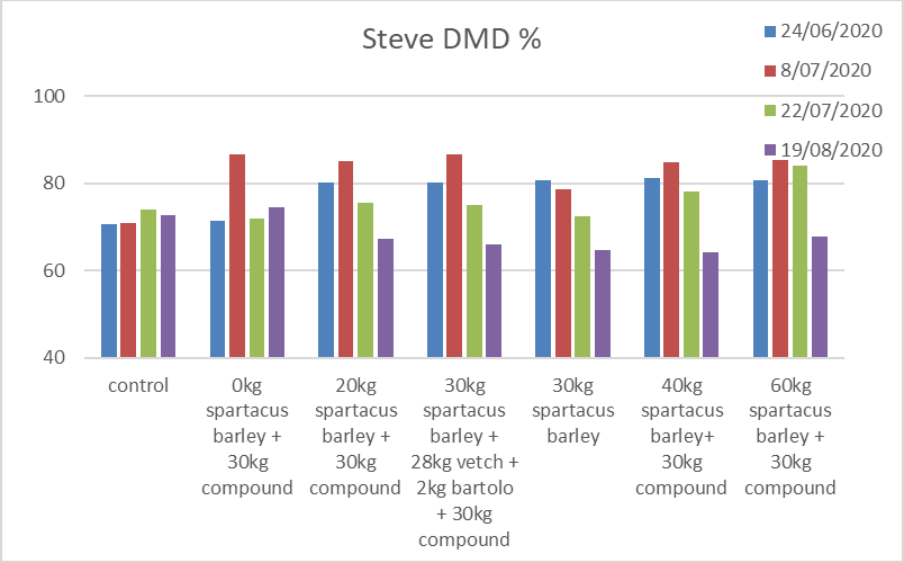
Metabolisable energy



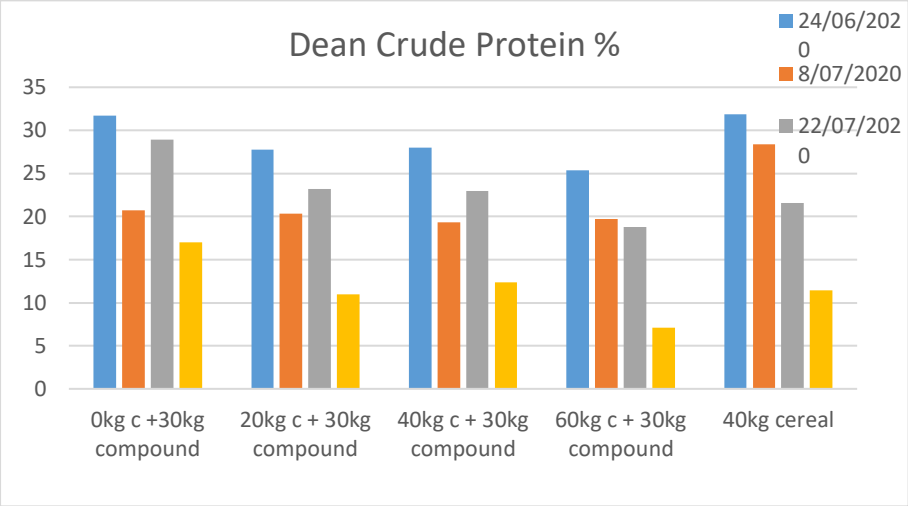


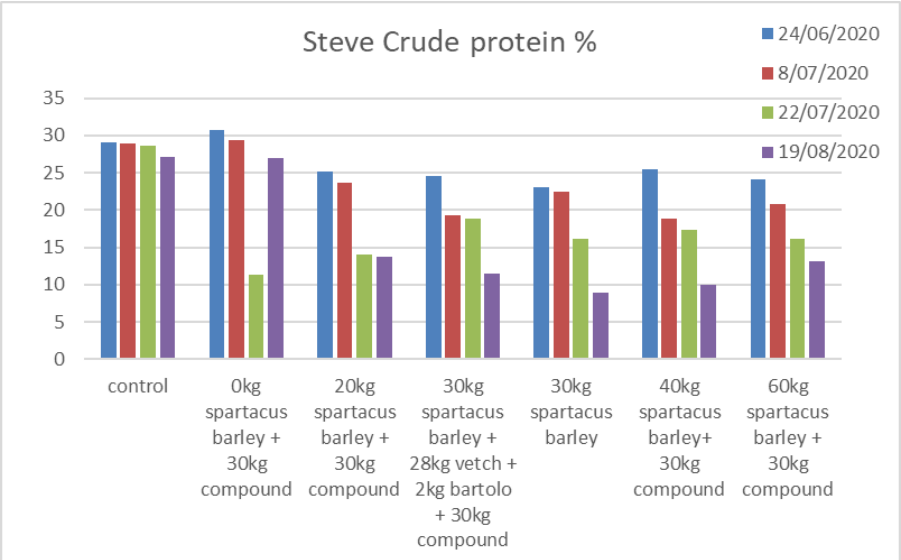
Dry Matter Digestibility





Crude Protein



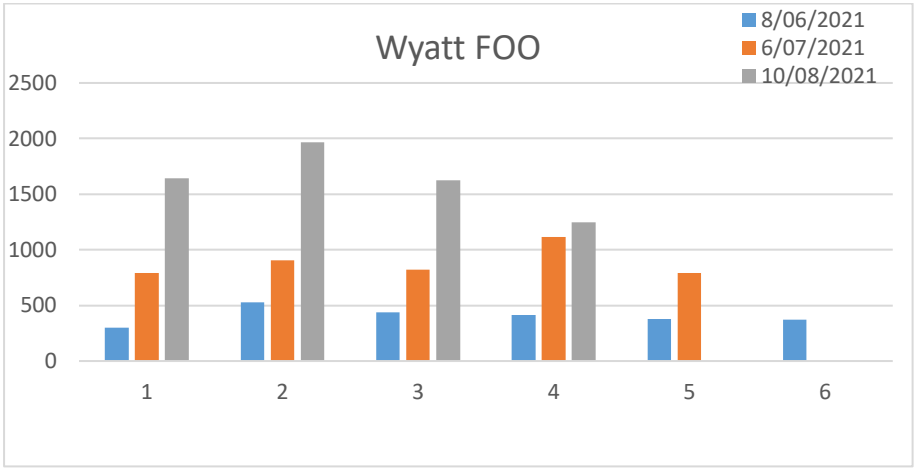


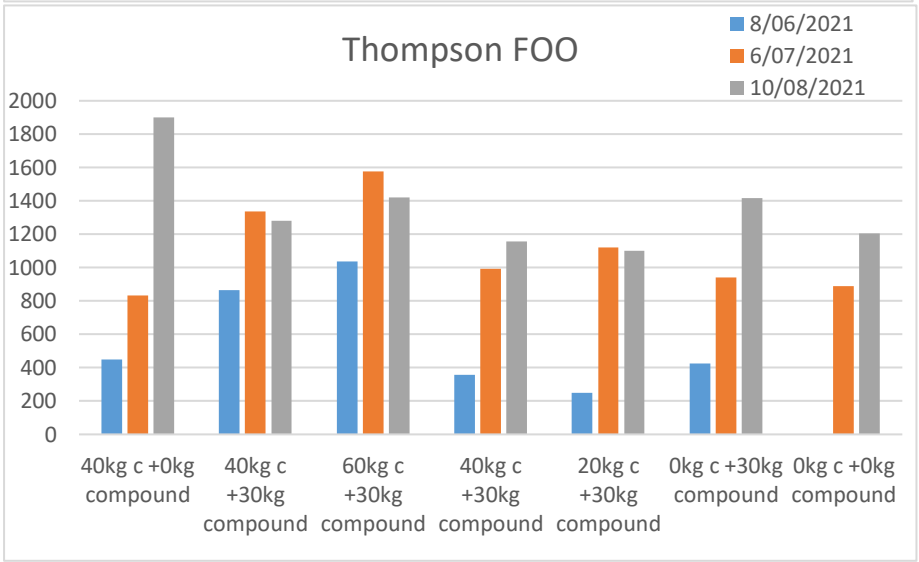
7.5.3 2021

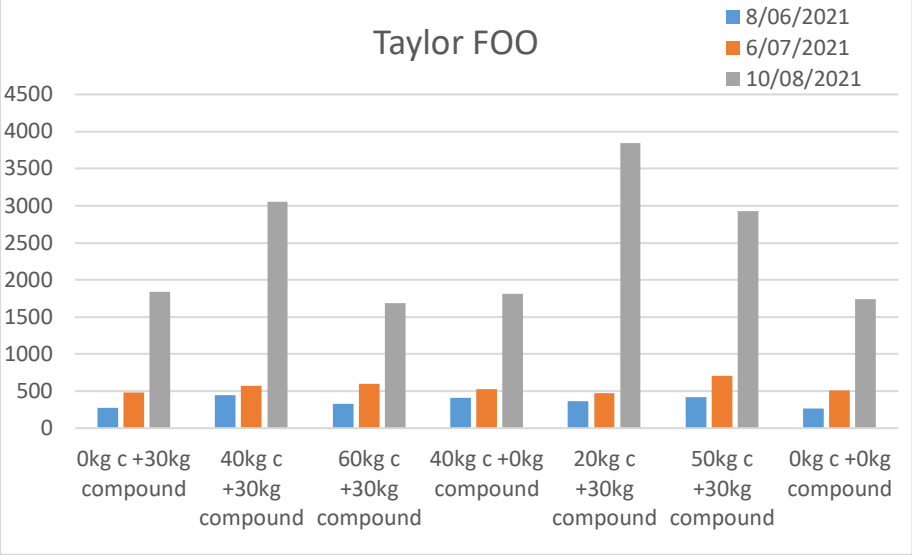
Species composition

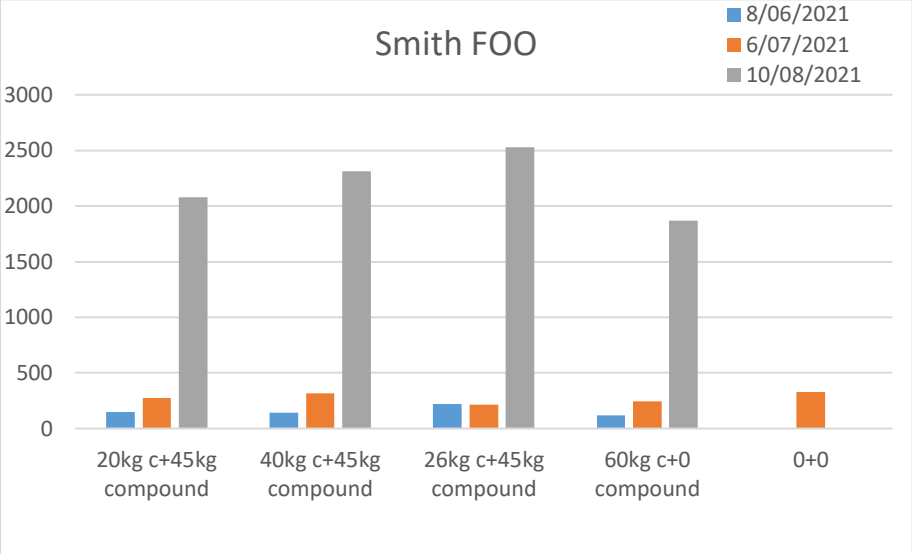
	Grazed (% cereal)			Ungrazed (% cereal)		
SITE	**June**	**July**	**August**	**June**	**July**	**August**
Thompson	65	60	60	80	95	98
Taylor	60	50	40	70	90	95
Brown	70	60	55	80	90	95
Wyatt	65	65	60	85	95	95
White	75	60	60	75	90	95
Smith	60	55	50	60	95	95
AVERAGE	**65.8**	**58.3**	**54.2**	**75**	**92.5**	**95.5**

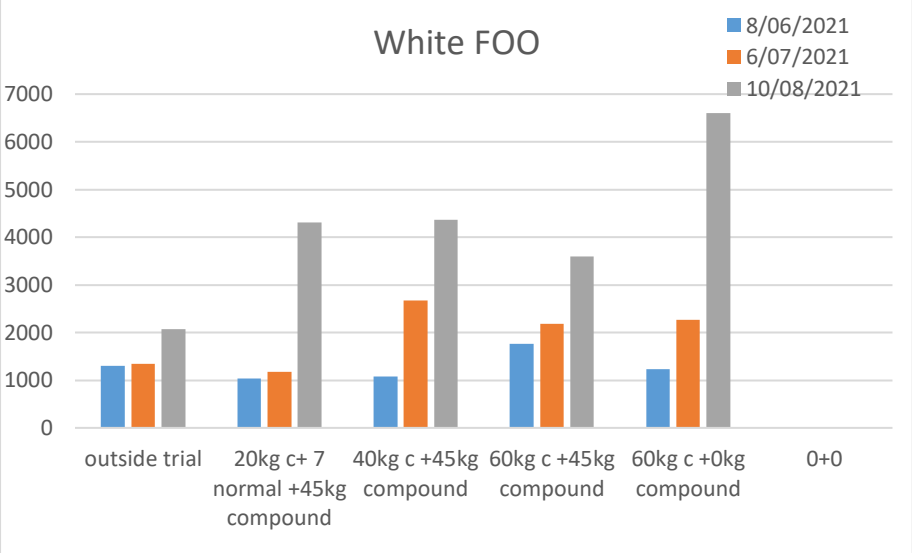
Feed quantity

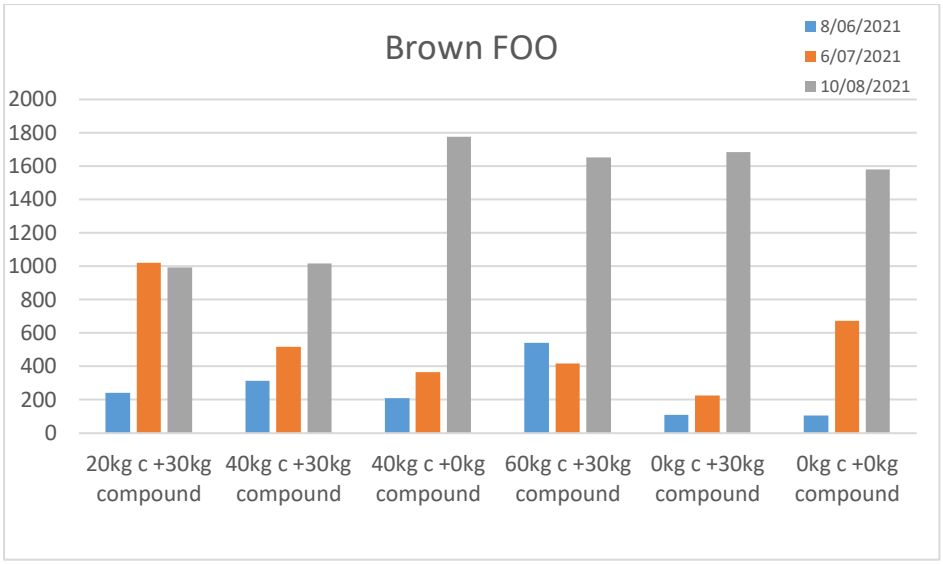




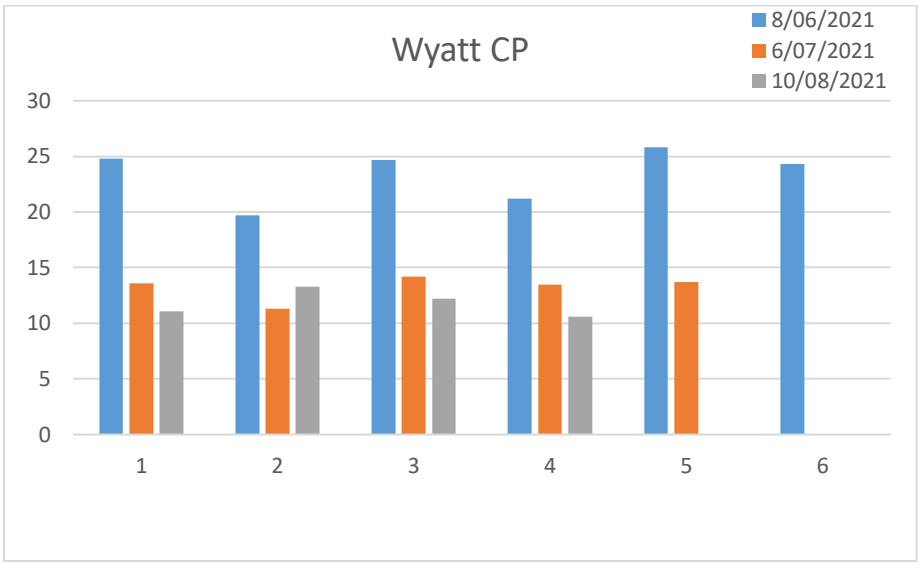

Taylor FOO
8/06/2021
6/07/2021
10/08/2021
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0kg c +30kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +0kg compound
20kg c +30kg compound
50kg c +30kg compound
0kg c +0kg compound

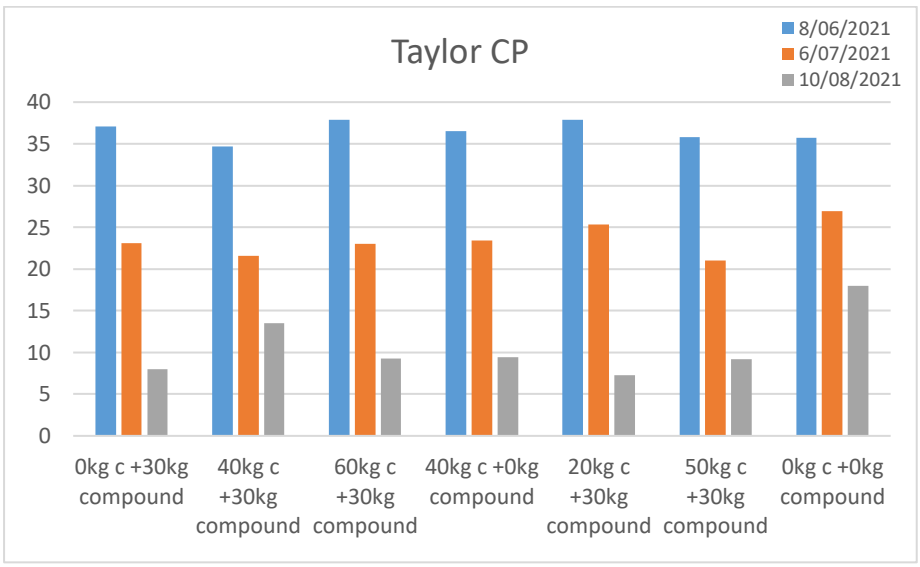

Smith FOO
8/06/2021
6/07/2021
10/08/2021
3000
2500
2000
1500
1000
500
0
20kg c+45kg compound
40kg c+45kg compound
26kg c+45kg compound
60kg c+0 compound
0+0

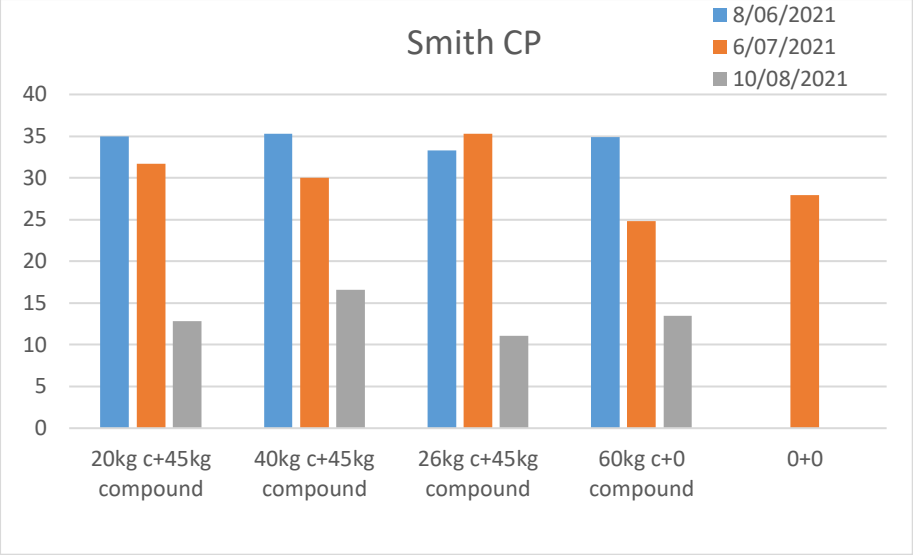

White FOO
8/06/2021
6/07/2021
10/08/2021
7000
6000
5000
4000
3000
2000
1000
0
outside trial
20kg c+ 7 normal +45kg compound
40kg c +45kg compound
60kg c +45kg compound
60kg c +0kg compound
0+0

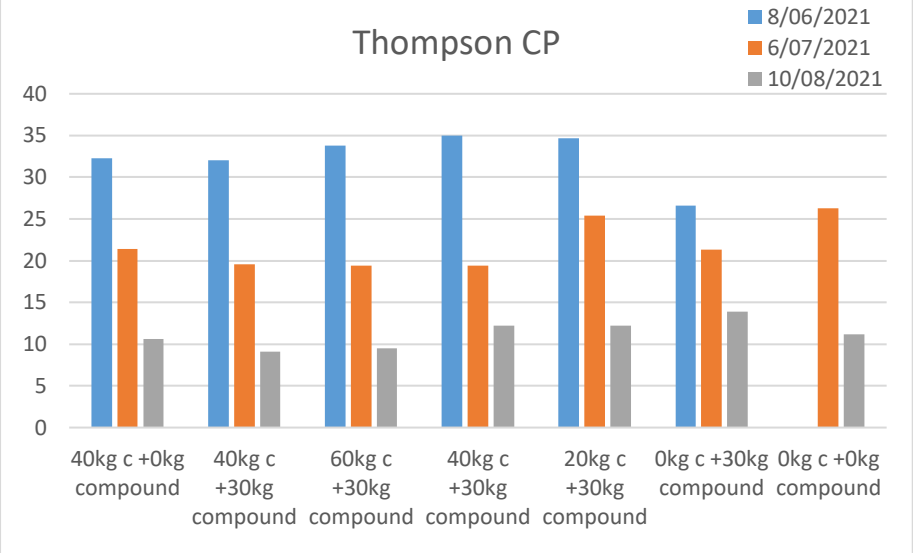


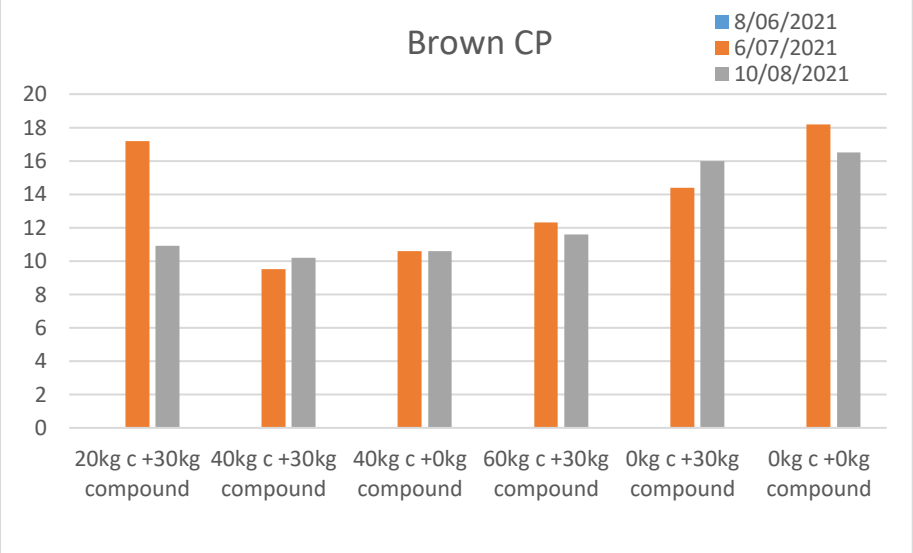
Crude Protein

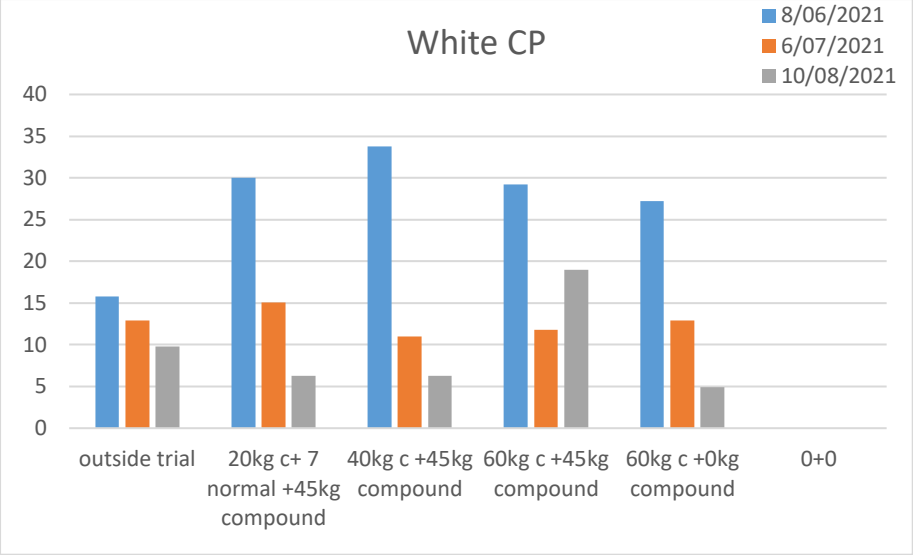




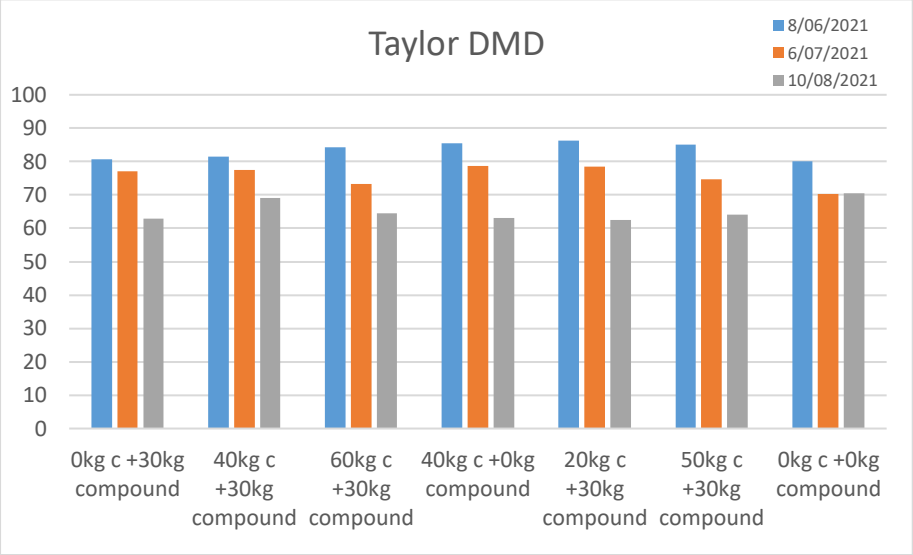

Smith CP
8/06/2021
6/07/2021
10/08/2021
40
35
30
25
20
15
10
5
0
20kg c+45kg compound
40kg c+45kg compound
26kg c+45kg compound
60kg c+0 compound
0+0

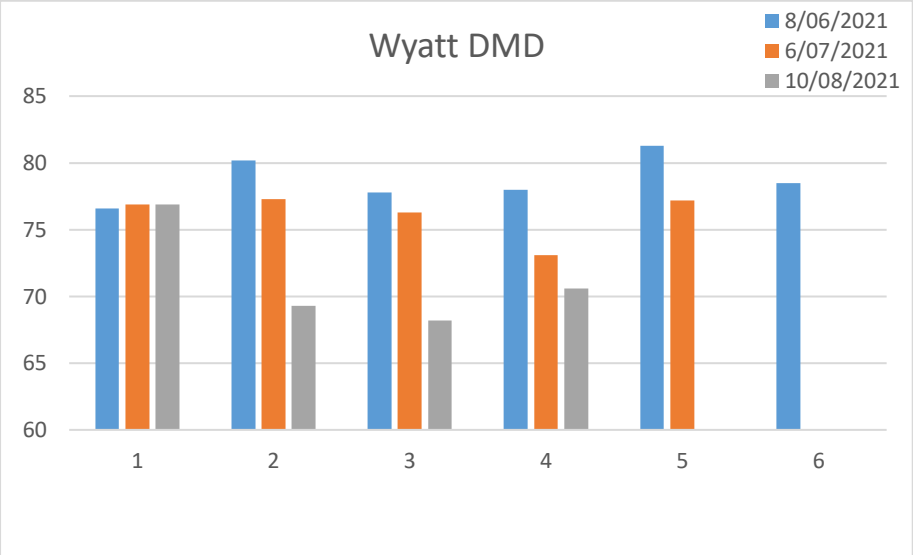

Thompson CP
8/06/2021
6/07/2021
10/08/2021
40
35
30
25
20
15
10
5
0
40kg c +0kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +30kg compound
20kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound

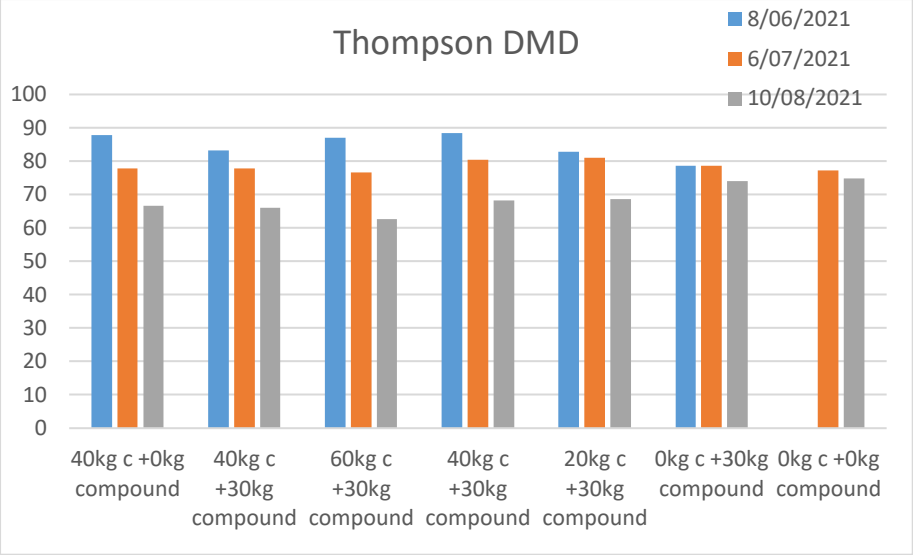

Brown CP
8/06/2021
6/07/2021
10/08/2021
20
18
16
14
12
10
8
6
4
2
0
20kg c +30kg compound
40kg c +30kg compound
40kg c +0kg compound
60kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound

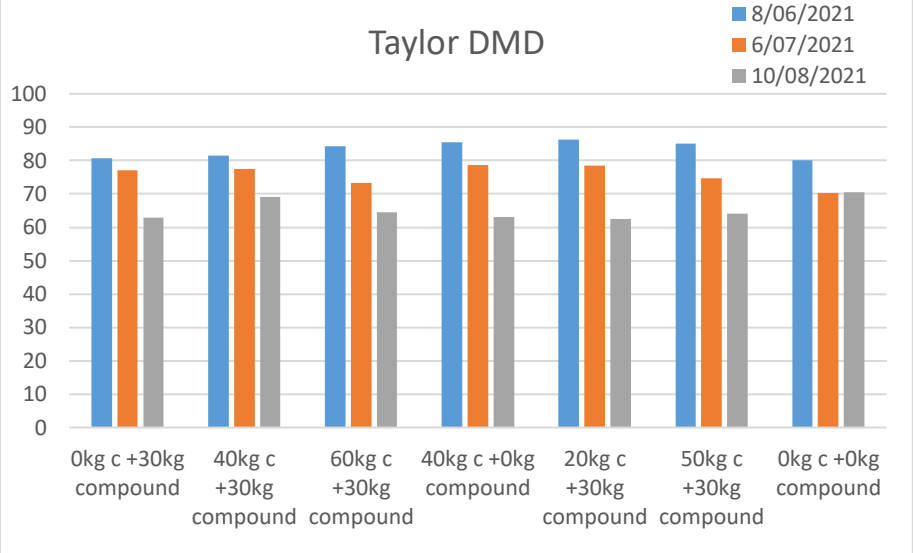


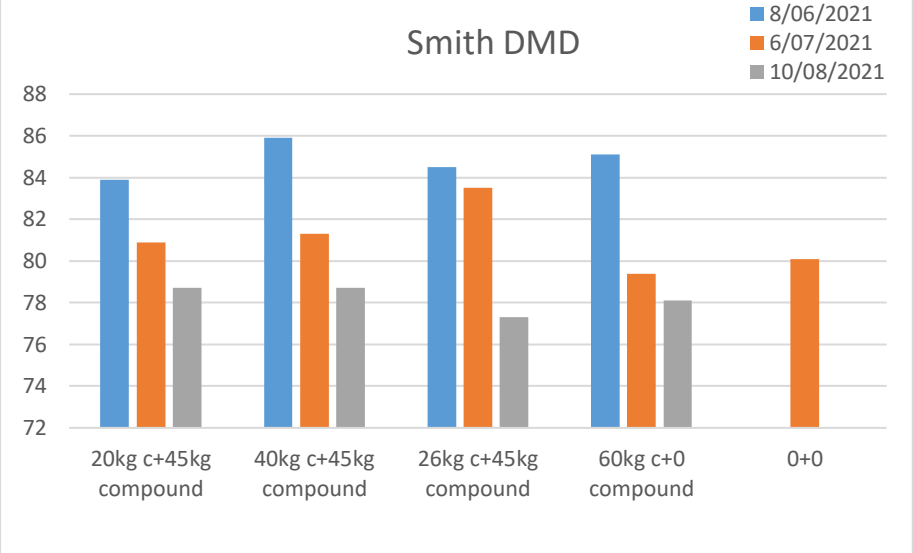
Digestibility






Thompson DMD
8/06/2021
6/07/2021
10/08/2021
100
90
80
70
60
50
40
30
20
10
0
40kg c +0kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +30kg compound
20kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound


Taylor DMD
8/06/2021
6/07/2021
10/08/2021
100
90
80
70
60
50
40
30
20
10
0
0kg c +30kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +0kg compound
20kg c +30kg compound
50kg c +30kg compound
0kg c +0kg compound


Smith DMD
8/06/2021
6/07/2021
10/08/2021
88
86
84
82
80
78
76
74
72
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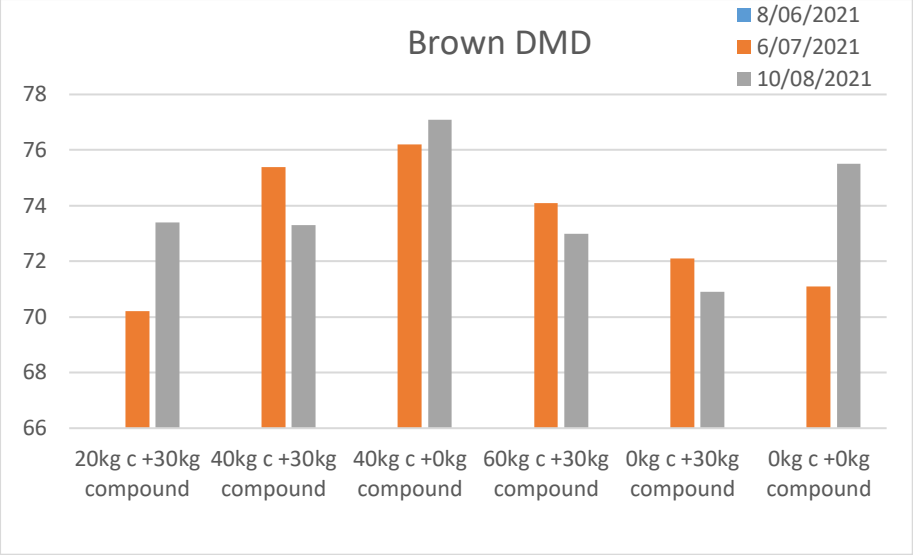
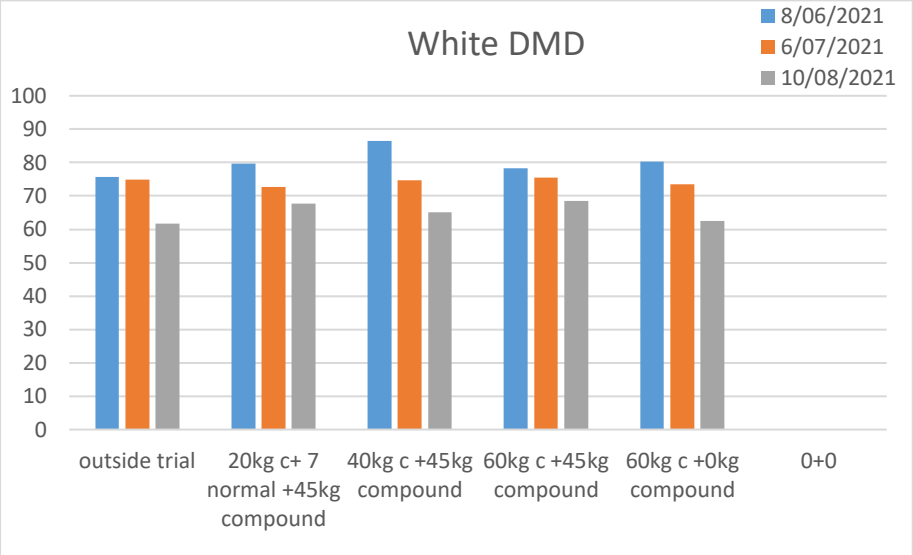
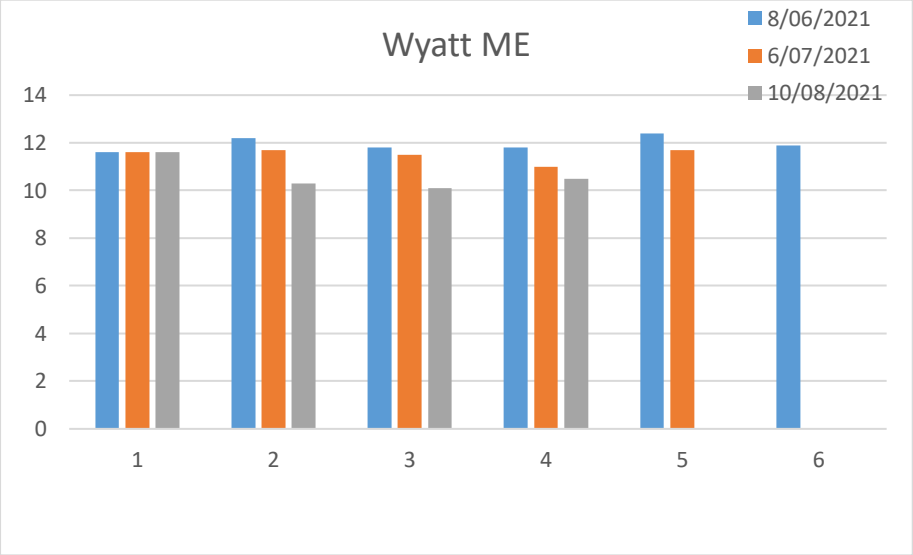
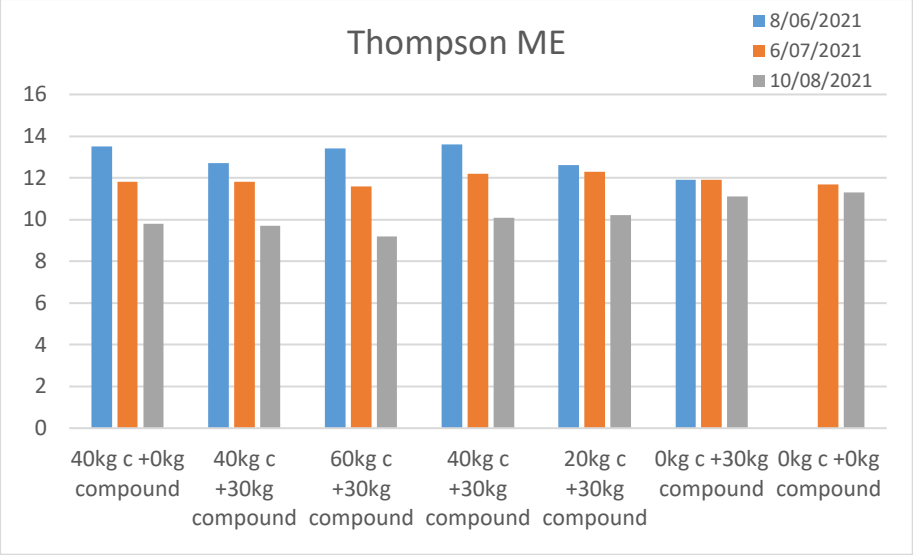
26kg c+45kg compound
60kg c+0 compound
0+0

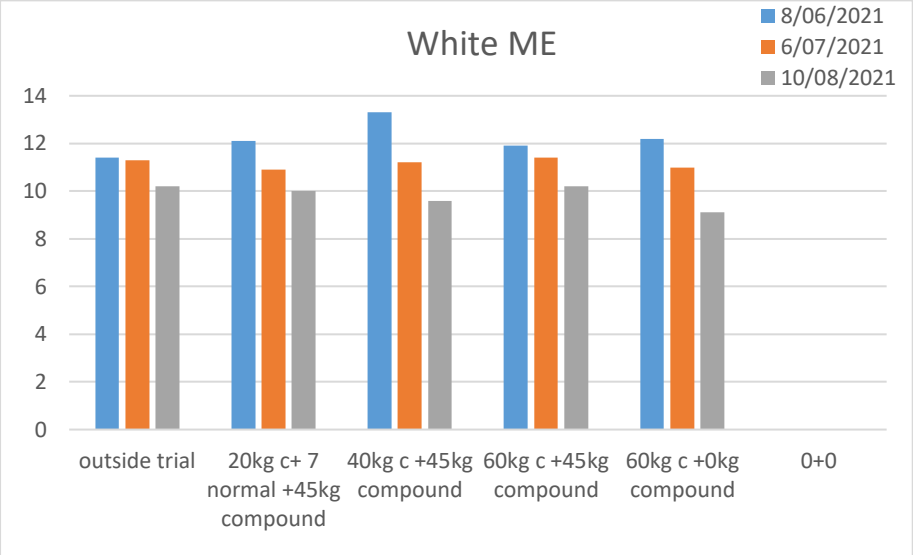

Brown DMD
8/06/2021
6/07/2021
10/08/2021
78
76
74
72
70
68
66
20kg c +30kg compound
40kg c +30kg compound
40kg c +0kg compound
60kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound

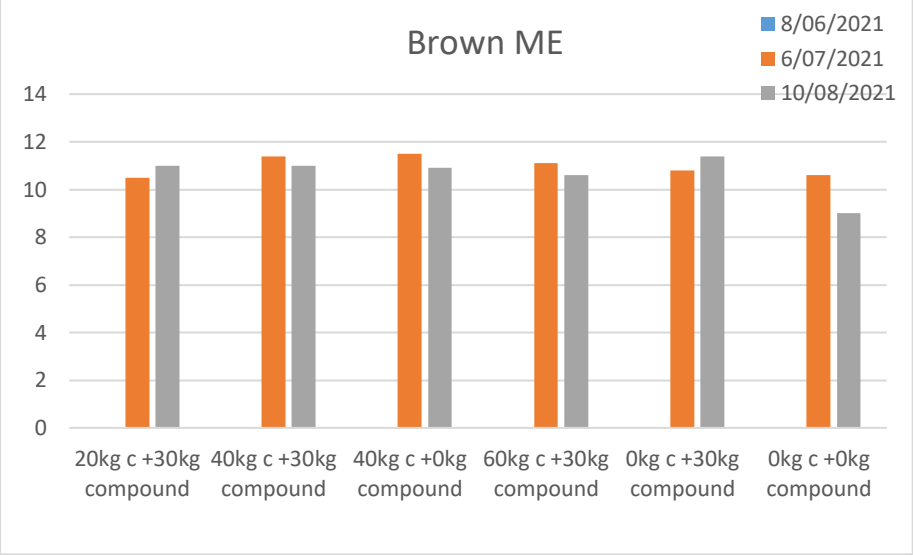

White DMD
8/06/2021
6/07/2021
10/08/2021
100
90
80
70
60
50
40
30
20
10
0
outside trial
20kg c+ 7 normal +45kg compound
40kg c +45kg compound
60kg c +45kg compound
60kg c +0kg compound
0+0

Energy


Wyatt ME
8/06/2021
6/07/2021
10/08/2021
14
12
10
8
6
4
2
0
1
2
3
4
5
6


Thompson ME
8/06/2021
6/07/2021
10/08/2021
16
14
12
10
8
6
4
2
0
40kg c +0kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +30kg compound
20kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound


White ME
8/06/2021
6/07/2021
10/08/2021
14
12
10
8
6
4
2
0
outside trial
20kg c+ 7 normal +45kg compound
40kg c +45kg compound
60kg c +45kg compound
60kg c +0kg compound
0+0


Brown ME
8/06/2021
6/07/2021
10/08/2021
14
12
10
8
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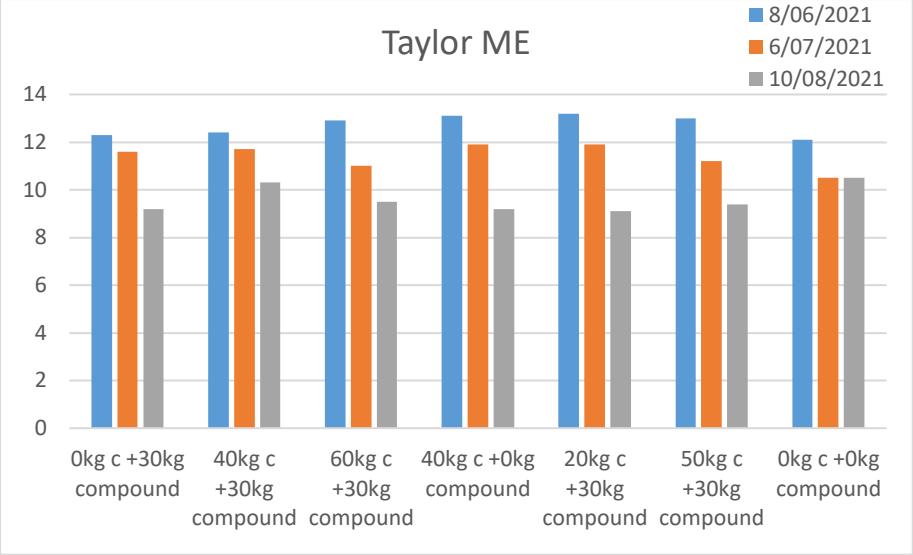
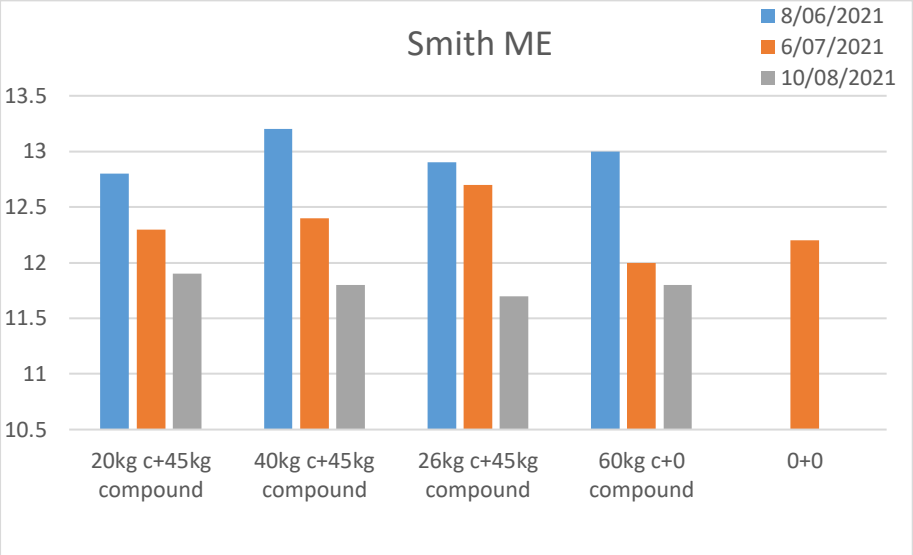
4
2
0
20kg c +30kg compound
40kg c +30kg compound
40kg c +0kg compound
60kg c +30kg compound
0kg c +30kg compound
0kg c +0kg compound


Taylor ME
8/06/2021
6/07/2021
10/08/2021
14
12
10
8
6
4
2
0
0kg c +30kg compound
40kg c +30kg compound
60kg c +30kg compound
40kg c +0kg compound
20kg c +30kg compound
50kg c +30kg compound
0kg c +0kg compound


Smith ME
8/06/2021
6/07/2021
10/08/2021
13.5
13
12.5
12
11.5
11
10.5
20kg c+45kg compound
40kg c+45kg compound
26kg c+45kg compound
60kg c+0 compound
0+0

7.6 Animal results

7.6.1 2019

Due to a shortage of green feed in the area, one of the two sites recording sheep weights and condition (Taylor) could not participate this year. The second, Pearce, had a severe feed shortage, resulting in rapid pasture rotations after an initial condition score of 3 in both the control and cereal-pasture mob.

7.6.2 2020

Treatment	**Condition Score Average**			
	May-June	July	Difference over time	Condition score advantage
Smith control	2.7	2.8	0.1	
Smith cereal bulked	2.7	2.8	0.1	0.0
Marshall control	2.5	2.5	0	
Marshall cereal bulked	2.5	2.7	0.2	0.2

7.6.3 2021

Condition scores collected at the start of the season varied from 2.8 to 3.3 CS, averaging 3.1. Final data is to be collected in September.

Treatment	**Condition Score Average**			
	June	**July**	**Difference over time**	**Condition score advantage**
Smith control	2.7	2.8	0.1	
Smith cereal bulked	2.7	2.8	0.1	0.0
White control	2.5	2.5	0	
White cereal bulked	2.5	2.7	0.2	0.2
Brown control	3	3	0	
Brown cereal bulked	3	3	0	0.0
Wyatt control	3.2	3.05	-0.15	
Wyatt cereal bulked	3.2	3.2	0	0.15
Taylor control	3	2.9	-0.1	
Taylor cereal bulked	3	3.1	0.1	0.2
Thompson control	3	2.95	-0.05	
Thompson cereal bulked	3	3.08	0.08	0.13
Average	**2.9**	**2.92**	**0.02**	**0.11**

7.7 Benchmarking results

7.7.1 2020

	Minimum	Maximum
Fertiliser cost/ha	$0	$15
DSE/ha	2	7
Lambs/ha	1.1	2.3
GM/ha	$129	$197
GM/DSE	$44	$55

	Low 30%	Average	Top 30%
Land (Ha)			
Winter Grazed	1,418	1,367	1,452
Forage Crop	0.0	33.0	0.0
Sheep Used	1418	1400	1452
Stubble	989	1964	2344
General - Production Parameters			
Kg Wool / WGHa	14.0	17.3	18.9
Lambs / Ewe Ha	1.8	2.5	2.5
Lambs / WGHa	1.3	1.6	1.7
Stocking Rate DSE / WGHa	3.1	3.8	4.2
Total Kg	20,780	22,336	23,660
Kg Wool / hd	5.25	5.07	4.75
General - Finance Parameters			
Sale Price Average ($/hd)	$145	$138	$124
Net Wool Price	$10.62	$9.30	$8.38
Shearing Cost/Head	$11.57	$9.26	$7.40
Dip Drench Medicine cost/dse	$6.11	$2.58	$0.34
General - Flock Parameters			
Lambing %	80%	88%	86%
Losses %	2.91%	3.45%	3.34%
Ewes % flock structure	64%	61%	66%
Income / DSE			
Wool Proceeds	$45	$41	$37
Profit from Livestock Trading	$54	$50	$48
Total Sheep Income	$99	$91	$85
Expenses / DSE			
Sheep Costs	$21	$17	$13
Fertiliser	$0	$2	$2
Feed	$24	$20	$14
Pasture	$0	$3	$6
Total Variable Costs	$46	$43	$36
Gross Margin / DSE	$53	$48	$49
Income / Ha			
Wool Proceeds	$142	$157	$162
Profit from Livestock Trading	$166	$183	$181
Total Sheep Income	$307	$340	$344
Expenses / HA			
Sheep Costs	$75	$72	$62
Fertiliser	$1	$10	$12
Feed	$94	$86	$61
Pasture	$1	$14	$27
Total Variable Costs	$171	$181	$163
Gross Margin / WGHa	$136	$159	$181
Gross Margin / Sheep Used Ha	$136	$155	$181
Wool Production/WGHa/100mm GSR	7.5	9.6	10.9
S.Rate DSE/WGHa/100mm GSR	1.7	2.1	2.4
Gross Margin/WGHa/100mm GSR	$73	$87	$102
Operating Efficiency	46%	50%	44%

7.8 Economic Analysis Report

Economic Valuation: Whole of project analysis: bulking pastures with cereals

Method

The analysis was carried out using Australian Farm Optimising Model (AFO), a whole farm optimisation model. AFO was selected as the appropriate tool to quantify the profitability of sowing cereals into pastures because it can accurately represent the machinery cost and labour requirements of seeding cereals into pasture. Furthermore, AFO can efficiently examine the optimum utilisation of feed resources across the whole farm. It models the whole flock and optimises animal and pasture management across the whole farm through the entire year. Using this modelling method provides information regarding how best to utilise the benefits provided by sowing cereals into pastures and the associated profit.

AFO description

AFO is a bio-economic model that maximises farm profitability by determining the best combination of activities on the farm within the constraint of a limited set of production resources. The sheep and pasture enterprise represents the whole flock and includes a powerful feed budgeting module that optimises management of the feed resource across the whole farm. Being an optimizing model, it calculates the optimum stocking rate and optimum utilisation of all feed resources, ensuring that each system (with and without sowing cereals) being compared is evaluated with maximum profitability.

For this analysis the inputs selected for AFO were those of a typical mixed farm in the great southern with an annual rainfall of 550-600mm. The farm is 2130ha with predominately sand gravel and sandy loam soils. In the future this analysis could be repeated for other locations to provide a more complete picture.

Full documentation on the model can be found here: https://australian-farm-optimising-model.readthedocs.io/en/latest/index.html

Representation of sowing cereals into pastures

Based off the information obtained from the statistical analysis in part A sowing cereals into pasture increase early season FOO and reduces late season feed quality. Based on the statistical analysis the relationship between FOO/DMD and cereal seeding rate is:

$$FOO\ increase\ (\frac{kg}{ha}) = 4.6 * seed_{rate}$$

$$DMD\ reduction\ (\%) = -0.1 * seed_{rate}$$

The analysis examines the profitability at three seeding level (20, 40 & 60 kg/ha) as per the trial. Although fertiliser was shown not to effect FOO it is likely that farmers will still apply fertiliser to maintain soil fertility in future years thus fertiliser application was still included at 35kg/ha.

Due to the erect growth of cereals the feed height was scaled up for pastures with cereals and hence the feed availability to livestock was increased.

Additional factors included in the analysis are machinery running costs, labour requirement, seed cost and fertiliser cost. Because no spraying is occurring sowing cereals into pasture can occur prior

to crop sowing. This saves pasture sowing competing with crop sowing and it also means that grazing is not interrupted as it would be if it were spring sown.

On the sandy loam soil the variable cost of seeding is 17$/ha. This represents fuel, oil, grease, repairs and maintenance. The seeding rate is on average 9ha/hr which includes a factor for inefficiencies and hold ups. Every hour of seeding requires an hour of operator labour plus half an hour of helper labour.

Possible method limitations

1. There is no representation of rotational effects of sowing cereals into pasture. It is possible that sowing cereals into pastures increases disease build up and/or nutrient depletion. Due to lack of data this was not represented. However, it was assumed that 45kg/ha of fertiliser was applied to help maintain soil nutrients.
2. There was no inclusion of dry feed effects from sowing cereals due to no measurements of quantity of quality during the summer period. However, the analysis indicated that if dry feed quality is reduced the profitability of sowing cereals significantly drops.
3. Modelling was done assuming an average weather year. This may not capture the additional benefits of sowing cereals into pastures in a late break season. This limitation could easily be over come using the seasonality version of the AFO model however that was beyond the timeframe/budget of this analysis. Future work could address this limitation if it is believed that sowing cereals into pasture can be used as a tactic in poor years.

Results and discussion

Analysis of seeding rate

The statistical analysis in part A indicated that seeding rate was significantly ($p<0.05$) impacting early FOO and DMD in the latter stages of the growing season. Fig. 2 shows that profit was maximised at the highest seeding rate used in the trial (60kg/ha). This returned a profit of $15 per sown hectare. It should be noted that extrapolating the results to a wider range of seeding rates is likely to be inaccurate because it is expected that the relationship will diminish.

Figure 1: Profit per sown hectare at three different seeding rates tested in the trial.

Optimal management

This section outlines the management changes that are optimal to make to get the best return from sowing cereals into pastures. The results in this section reflect the optimal management at the most profitable seeding rate of 60 kg/ha.

The key livestock management changes that were optimal when sowing cereals into pastures were

(iii) Increase stocking rate. Stocking rate increased by 9%.
(iv) Reduce supplementary feeding. Supplement fed reduced by 4%.

If livestock management does not change as a result of sowing cereals then the farmer will not receive any financial benefits. This is because increasing feed alone does not provide any income. The income comes primarily from running more sheep but also partly due to saved costs on supplementary feeding.

It was optimal to sow cereals into 30% of pasture. It was not optimal to sow cereals in to pastures on the poor soils because it incurs the same machinery cost but provides less benefits.

If the benefits are found to be greater than that used in this analysis, then both the optimal sown area and the optimal stocking rate will further increase. However, on the contrary if the benefits included in the analysis are found to be greater than reality the area sown and the stocking rate will not increase to the extend outlined above.

Component analysis

In this section the costs and benefits of each component related to sowing cereals into pasture is outlined.

Component analysis	
Seeding costs	-$17
Labour ($35/hr)	-$4
Fertiliser (35 kg/ha)	-$19
6% reduction in DMD August-November	-$8
70% Increase in early FOO	$67
Net	$19

Sensitivity analysis

As outlined in the statistical analysis section there was large variation in the effects of sowing cereals into pastures and not enough trial data to be highly confident in the resulting relationships. Thus, in this section a sensitivity analysis is provided looking at the result for different changes in FOO and DMD due to sowing cereals.

The results indicate that sowing cereals into pastures becomes profitable if early FOO increases by more than 30% compared to without sowing cereals. The resulting reduction in August to November feed quality has less impact on farm profit. However, not shown in the results, but important nonetheless is that if the reduction of feed quality in the latter stages of the growing season results in lower quality dry feed, then profit is significantly reduced. Thus, future work should focus on more accurately quantifying the FOO benefits but also examine the impact on dry feed quality.

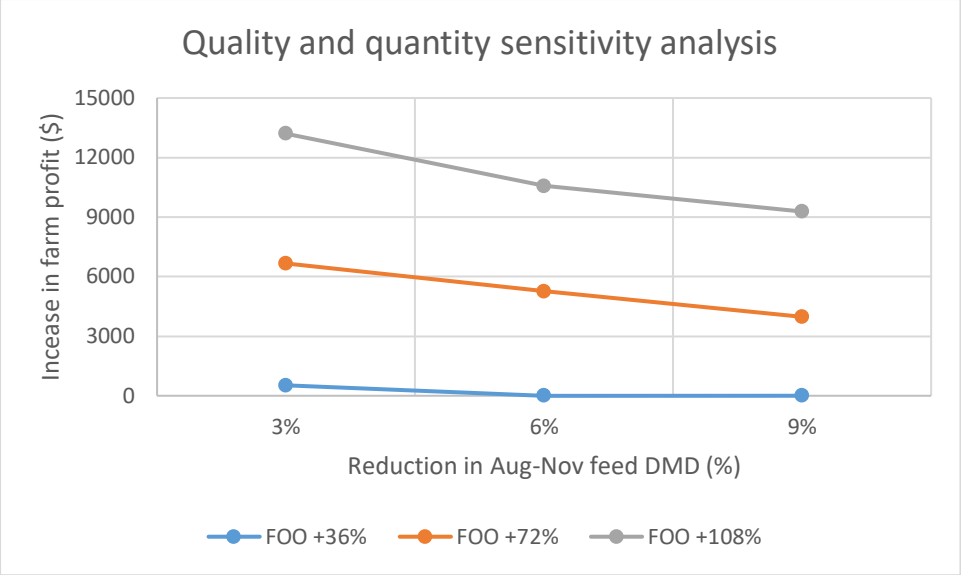


Figure 2: Change in whole farm profit at different levels of early growing season FOO and mid-late growing season DMD due to sowing cereals into pastures. Percentages are in comparison to pasture without cereals.

Conclusions

The analysis has shown, using data obtained from a producer demonstration trail, that sowing cereals into pastures can provide benefits of $19/ha. The benefits are sensitive to the amount of additional FOO provided from sowing cereals. The results indicate that sowing cereals is only profitable if early growing season FOO increases by more than 30%.

Due to labour constraints, seeding timeliness, soil productivity and the diminishing marginal benefits of additional early feed it is only profitable to sow cereals into a proportion of pasture. The proportion of area is sensitive to the amount of extra FOO provided. When additional FOO was 72% it was optimal to sow cereals into 30% of pastures. To capitalise on the benefits of sowing cereals stocking rate must be increased. When additional FOO was 72% it was optimal to run a 9% higher stocking rate.

Overall the report provides some guidance into the potential benefits of sowing cereals into pastures and describes the management methods required to capitalise on the benefits. However, the data used in the analysis is very variable without the desired number of replications. Thus, the results are not perfect. Further work could examine a larger range of seeding rates and include feed measurements that include the dry feed period. Furthermore, from an economical point of view it would be more beneficial to measure feed growth rate rather than FOO.

7.9 Statistical analysis results

7.9.1 2020 Report

Stats Analysis for cereal bulking.
By M.Young

MRY's assumptions

1. Each strip is managed the same (on a given farm – ie they don't have to be managed the same for each farm because property is a factor in the analysis)
2. Each strip is on the same soil (eg same paddock – so that we know soil is not impacting the results)

Analysis

The aim of the analysis is to determine if seeding rate and/or fertiliser rate significantly impacts the FOO, DMD and energy. If so what is the relationship?

The hypothesis is that increasing seeding level and fertiliser rate will increase FOO and decrease DMD and ME.

The analysis is completed using a statistical regression model. The factors included are property, fertiliser rate, seeding rate and time of year.

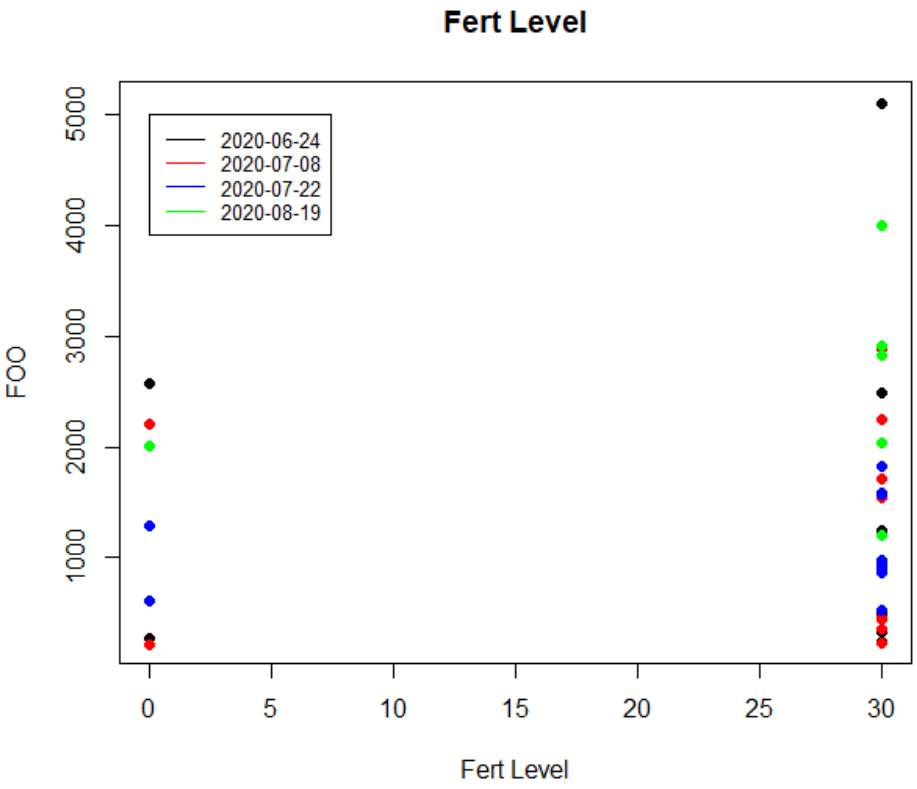
Results

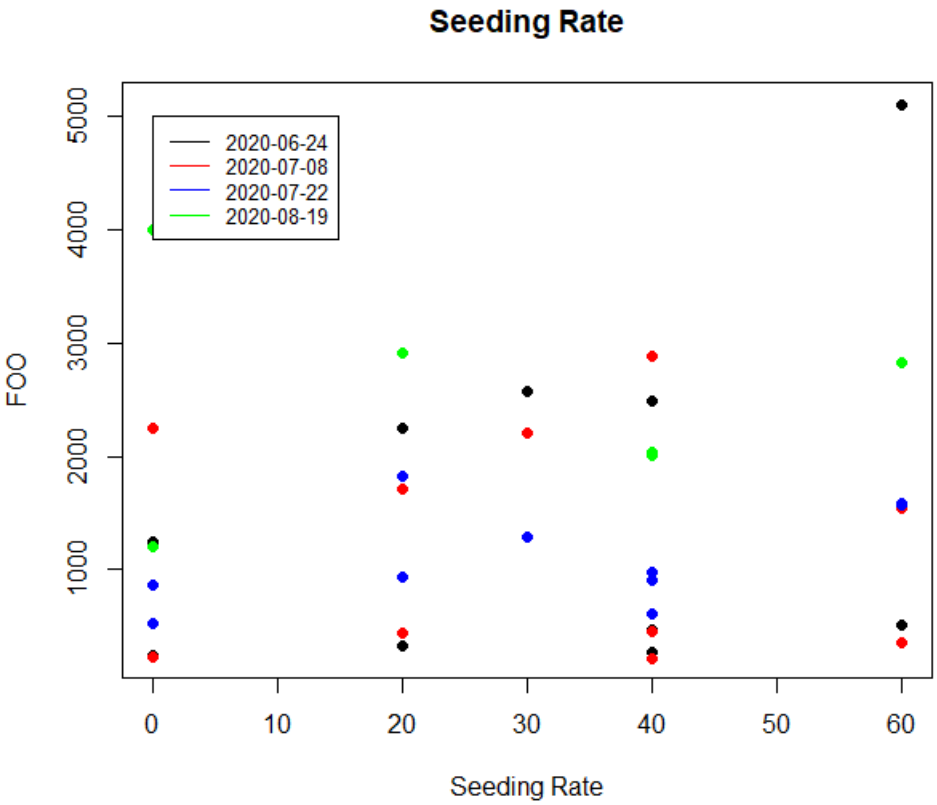
The results suggest that both seeding rate and fertiliser level are having no significant effect on FOO, DMD or ME. However, both property and the time of year are having a significant effect on FOO, DMD and ME.

The results are not as expected. However, I am not confident in the conclusion due to the ratio of variables measured vs trials. To be confident in the results more trials are required. A lot of variables are being tested (Two levels of fertiliser application, four levels of seeding rate and 4 times of year) compared to the number of trials, so this may result in error/bias.

As you can see in the plots there is only two levels of fertiliser measured and there is a large amount of variation. I have only included plots for FOO.

Due to the variation and minimal data points it is difficult to determine if a linear regression model is the best fit. Logically speaking a linear regression model would be expected to fit the data well. However, if variables are measured at extreme levels a linear model may not suit, because for example fertiliser would only increase FOO up until a certain level. However, the regression model only explains 65% of the variation in the data. Other factors that could explain variation may be the variety of cereal. It may be the case that a more complex model will fit the data better but that is beyond the scope of this data and this analysis.


Fert Level
2020-06-24
2020-07-08
2020-07-22
2020-08-19
FOO
1000
2000
3000
4000
5000
0
5
10
15
20
25
30
Fert Level


Seeding Rate
2020-06-24
2020-07-08
2020-07-22
2020-08-19
FOO
1000
2000
3000
4000
5000
0
10
20
30
40
50
60
Seeding Rate

```
Call:
lm(formula = bulking$foo ~ bulking$farm + bulking$fert_level +
    bulking$seed_rate + bulking$TOY)

Residuals:
    Min      1Q  Median      3Q     Max
-2307.2 -1171.3  -119.4   605.5  6044.1

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           -13.724    993.177  -0.014    0.989
bulking$farmSteve    2725.401    569.210   4.788 3.44e-05 ***
bulking$fert_level     -8.332     23.805  -0.350    0.729
bulking$seed_rate      13.007     14.142   0.920    0.364
bulking$TOY2020-07-08 -326.326    803.990  -0.406    0.687
bulking$TOY2020-07-22 -443.807    803.990  -0.552    0.585
bulking$TOY2020-08-19 3774.114    803.990   4.694 4.53e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1798 on 33 degrees of freedom
Multiple R-squared:  0.6512,   Adjusted R-squared:  0.5878
F-statistic: 10.27 on 6 and 33 DF,  p-value: 2.066e-06
```

7.9.2 2021 Report

Analysis of bulking pastures with cereals 2021 statistical analysis
M.Young

Aim

The aim of the analysis is to determine if seeding rate and/or fertiliser rate significantly impacts the foo, dmd and energy. If so, what is the relationship.

The hypothesis is that increasing seeding level and fertiliser rate will increase FOO and decrease DMD and ME.

Method

A linear regression model was fitted to the data. Where FOO was explained as a function of location, fertiliser rate, seeding rate and time of year (the same was done for DMD and ME). The model only explains 75-85% of the variation in FOO which indicates that either

(i) there are additional factors that affect FOO that were not recorded in the trial
(ii) there were experimental inconsistencies
(iii) the relationship between FOO and fert/seeding rate is not linear, for the measured range.

Due to the variation and minimal data points it is difficult to determine if a linear regression model is the best fit. Logically speaking a liner regression model would be expected to fit the data well. However, if variables are measured at extreme levels a linear model may not suit because for example fertiliser would only increase foo up until a certain level.

Results 2021

Note – in the results below significant means $p<0.05$.

The results suggest that:

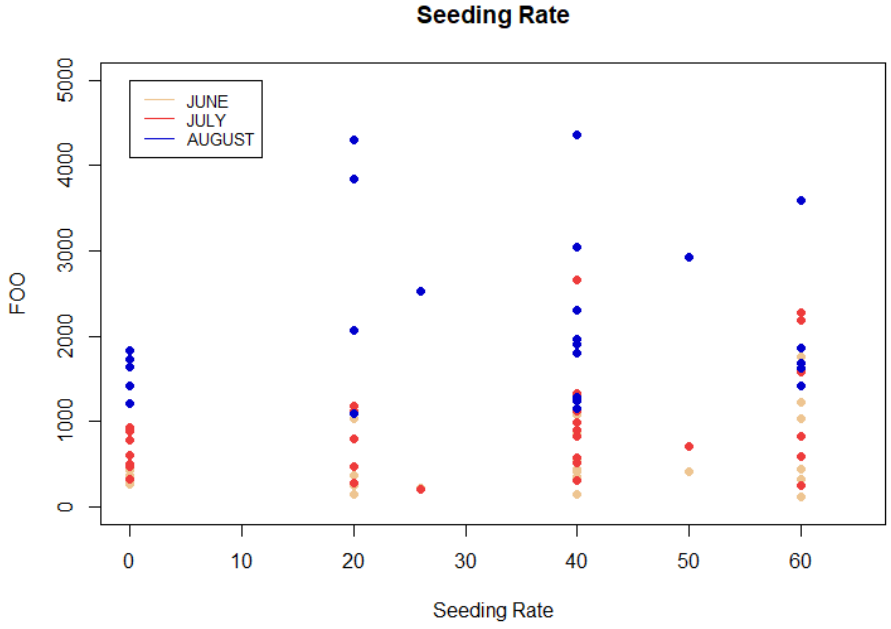
(i) Fertiliser level is not having a significant effect on FOO, DMD or ME.

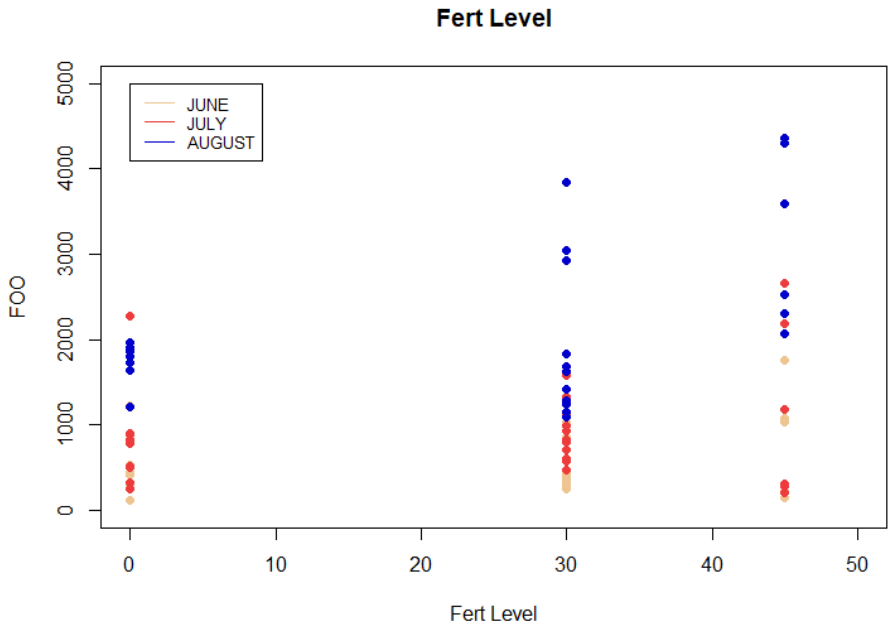
(ii) Sowing rate of cereals is having a significant effect on FOO in the first half of winter period but by August there is no significant difference in FOO. In early winter each additional kg/ha sowing rate increases the FOO by 4-5kg/ha.

(iii) Sowing rate has no significant effect on feed quality early in winter however by August there is a significant effect. For each additional kg/ha sowing rate the feed quality decrease by 0.1%.

(iv) Both property and the time of year are having a significant effect on FOO, DMD and ME.

Some of the results are as expected and others are not. However, I am not completely confident in the results due to the high ratio of experimental factors (fertiliser levels, seeding rates, locations and times of the year) vs number of trials. To be confident in the results more trials are required. As you can see in the plots there is a lot of variation within the results which makes it statistically difficult to be confident in any relationships.





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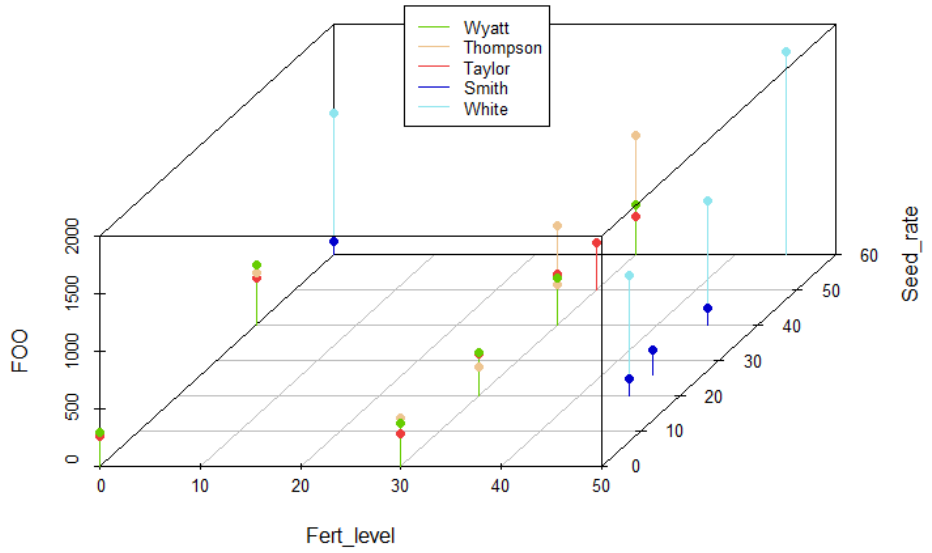

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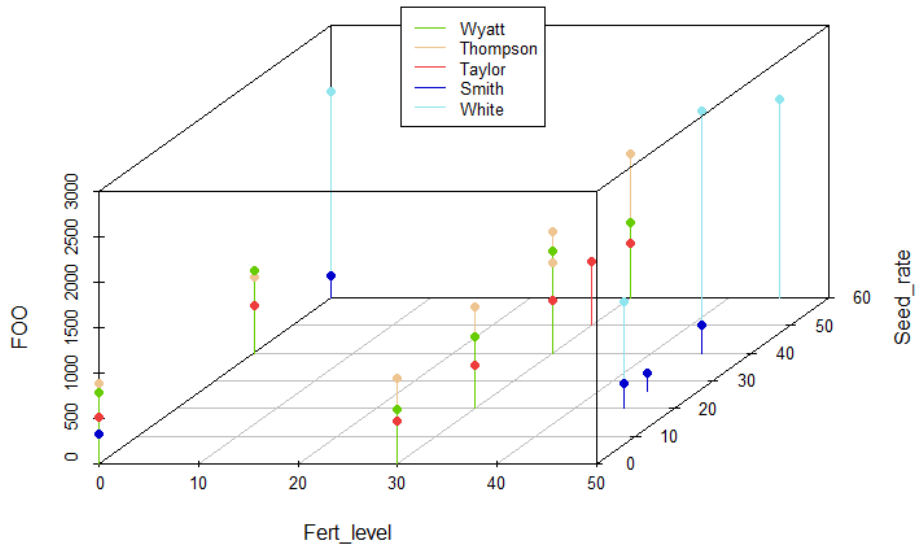
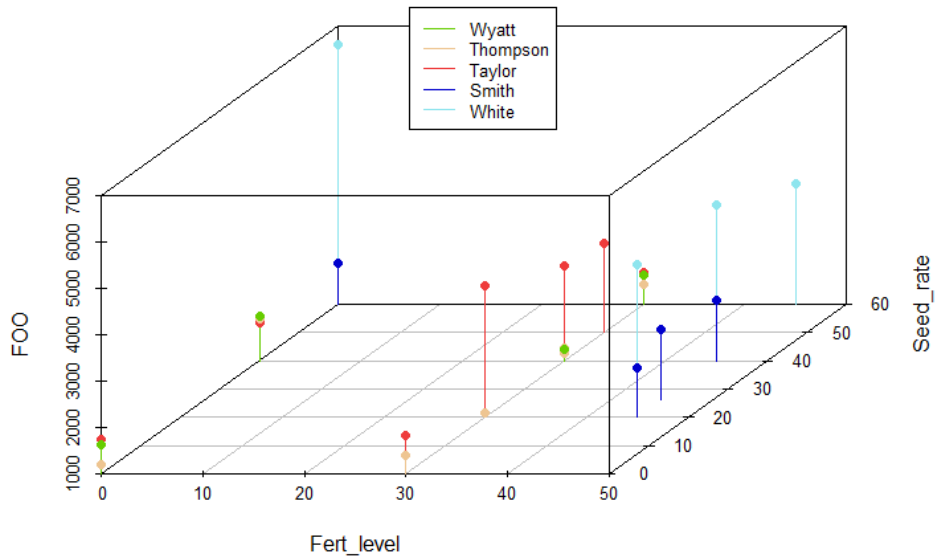


AUGUST



7.9.3 Whole of project

Bulking pastures with cereals statistical analysis- Whole project
M.Young

Aim

The aim of the analysis is to determine if seeding rate and/or fertiliser rate significantly impacts the foo, dmd and energy. If so, what is the relationship.

The hypothesis is that increasing seeding level and fertiliser rate will increase FOO and decrease DMD and ME.

Method

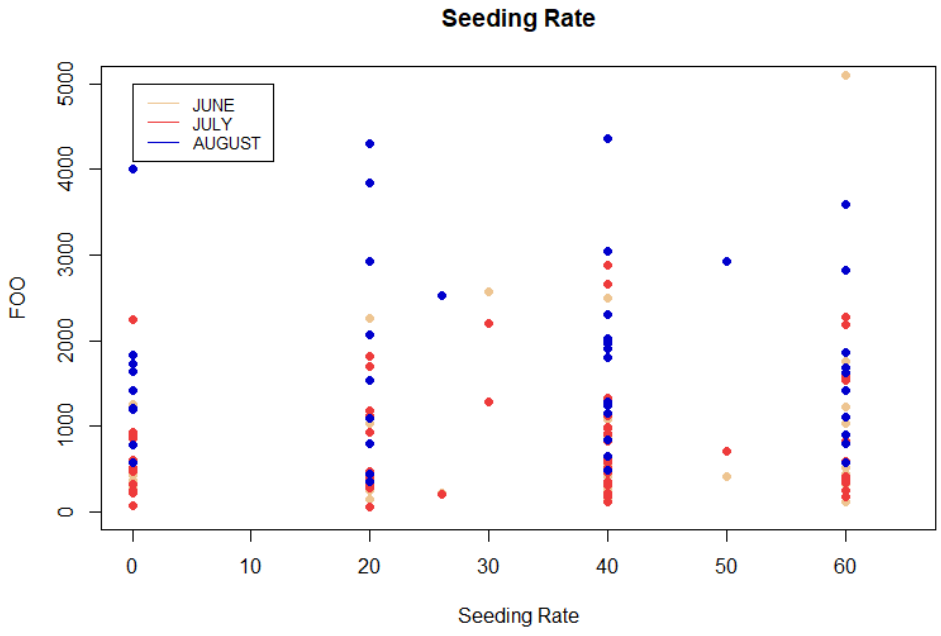
A linear regression model was fitted to the data. Where FOO was explained as a function of location, fertiliser rate, seeding rate and time of year (the same was done for DMD and ME). The model only explains 75-85% of the variation in FOO which indicates that either

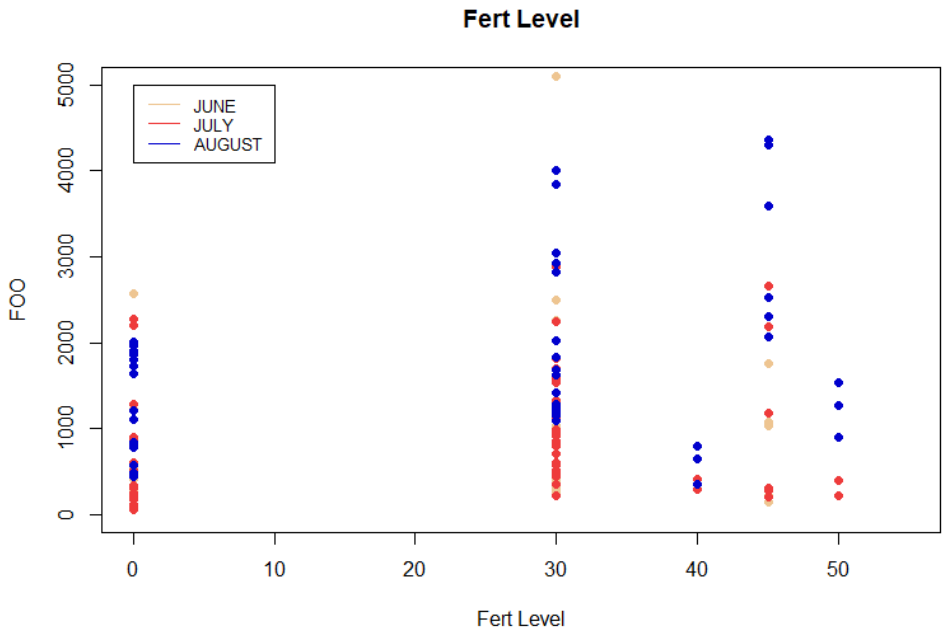
(i) there are additional factors that affect FOO that were not recorded in the trial
(ii) there were experimental inconsistencies
(iii) the relationship between FOO and fert/seeding rate is not linear, for the measured range.

When the data from all three years (19, 20 & 21) were combined the key were:

(i) Fertiliser level had no significant impact on FOO or pasture quality.
(ii) Seeding rate had a significant impact of FOO early in the season (June). There was no significant effect of sowing cereals on July and August FOO.
(iii) Seeding cereals into pasture reduce feed quality later in August.

Note: Combining all the years doesn't provide me with significantly more confidence in the results because although there is more data points a seasonality factor has now been introduced.




Fert Level
JUNE
JULY
AUGUST
FOO
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1000
2000
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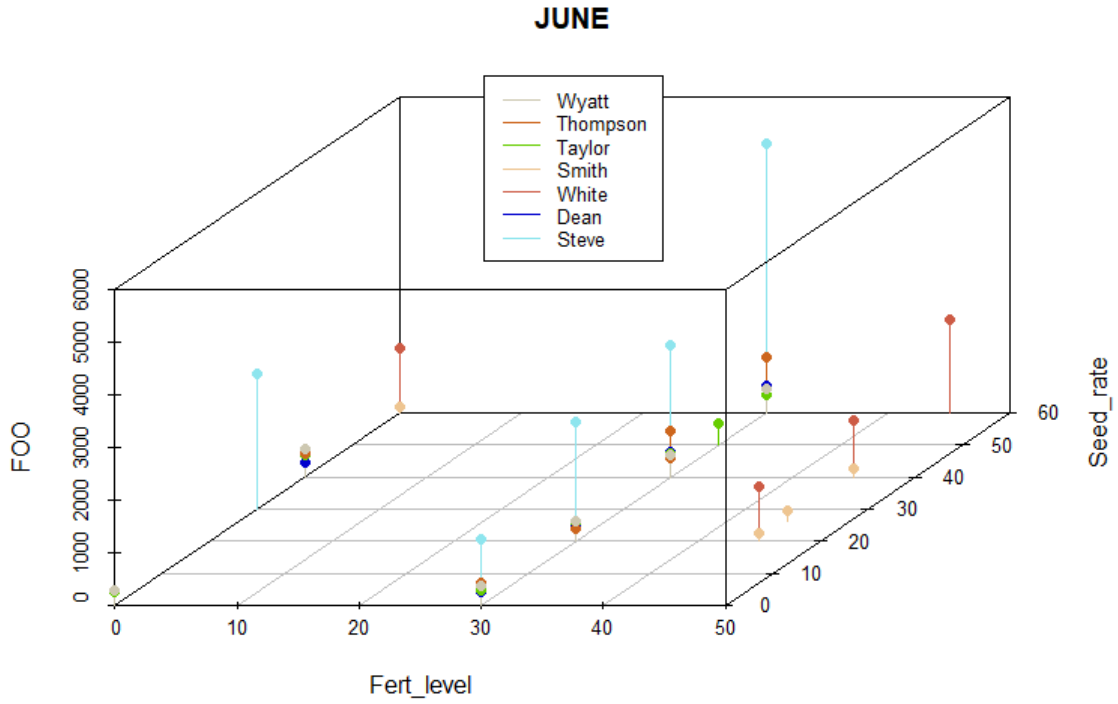
50
Fert Level


JUNE
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Thompson
Taylor
Smith
White
Dean
Steve
FOO
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4000
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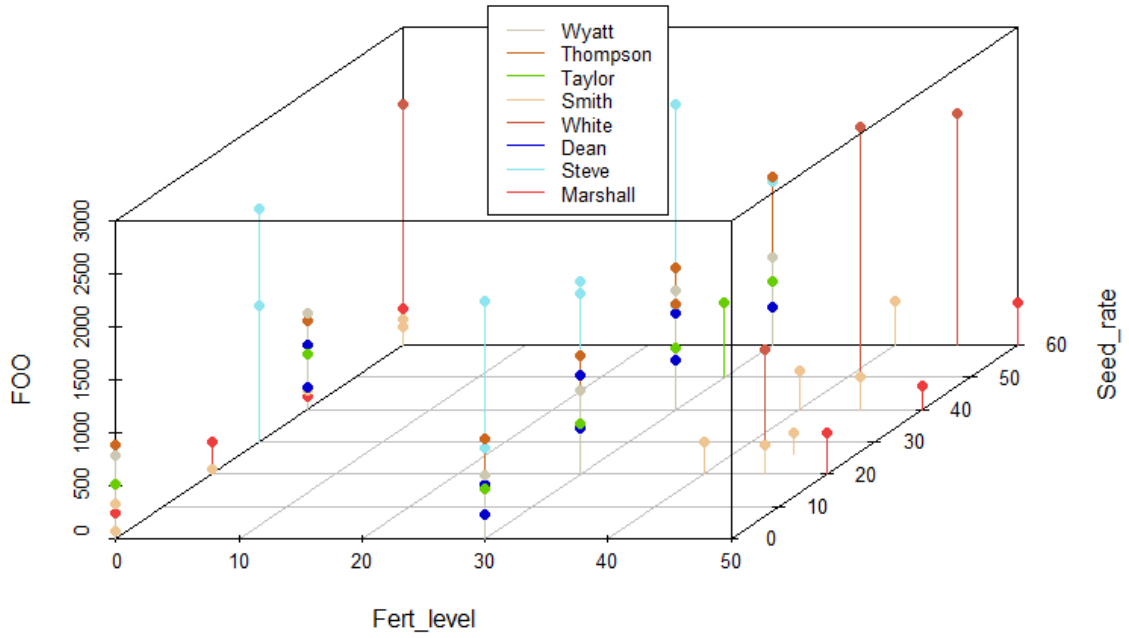
60
Seed_rate

JULY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Dean
Steve
Marshall
FOO
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Fert_level
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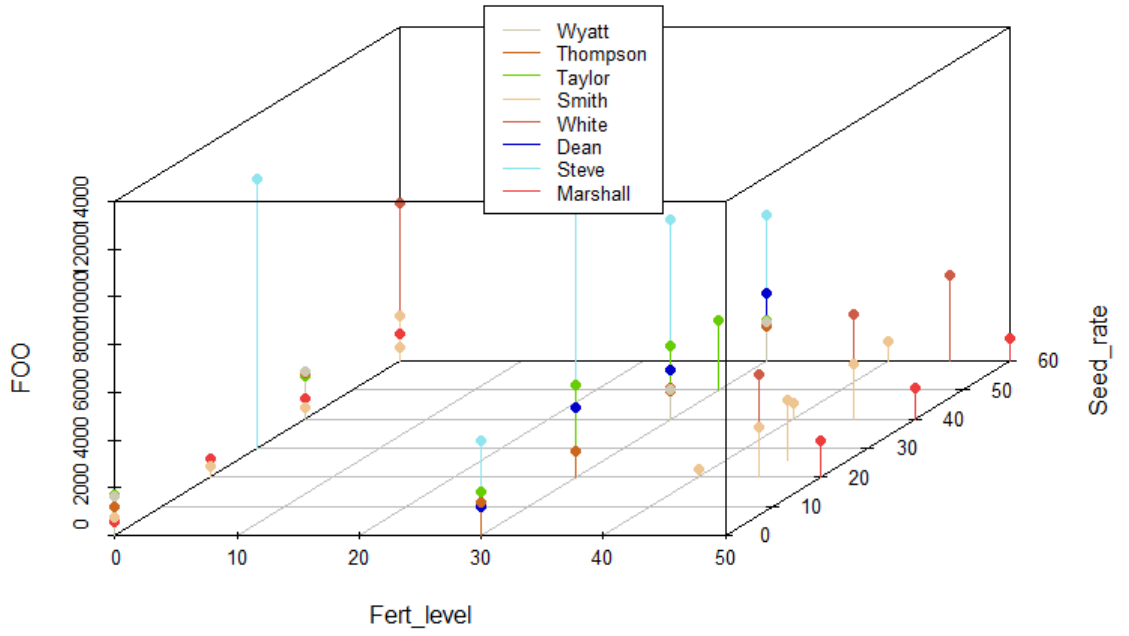
Seed_rate

AUGUST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Dean
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Marshall
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30
40
50
Fert_level
0
10
20
30
40
50
60
Seed_rate

7.10 Field day fact sheets

7.10.1 2019

Bulking up pastures with cereals PDS

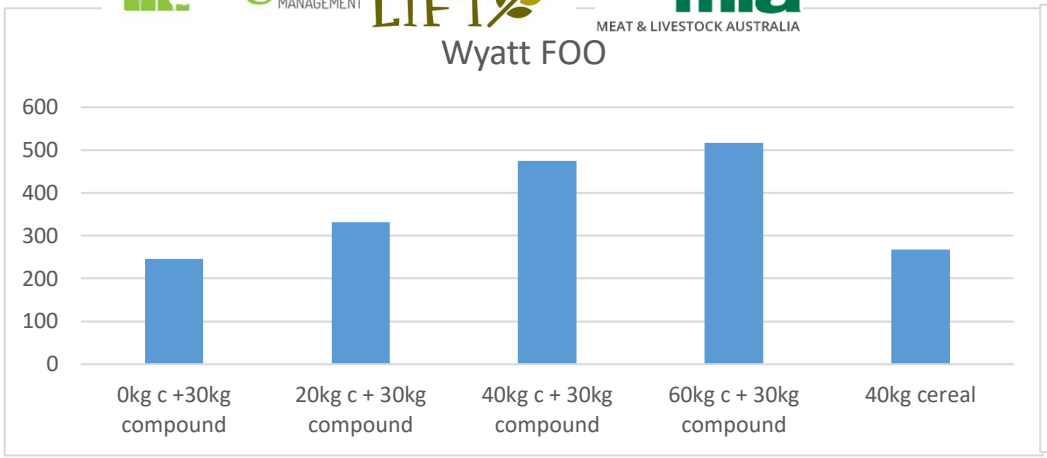
		8-July	8-July	8-July	8-July	19-Aug	19-Aug	19-Aug	19-Aug
Property	**Treatment**	**FOO KG**	**DM%**	**CP%**	**ME**	**FOO KG**	**DM%**	**CP%**	**ME**
Smith	nil	697	14.3	30.1	11.7	781	20.7	11.4	11.3
Smith	20kg scope	531	13.4	29.8	12	443	21.2	16.2	11.1
Smith	40kg scope	1786	13.6	23.4	12	489	18.9	14.3	8.8
Smith	60kg scope	1710	15.3	26	12.5	579	17.5	14.9	10.8
Smith	20kg scope+40kg fert	2973	14.9	19.2	12.1	350	17.1	15.5	10.6
Smith	40kg scope+40kgfert	3611	14	20.8	12.2	657	15.5	17.2	10.7
Smith	60kg scope+40kg fert	4166	13	23	11.7	796	21.9	11.4	11.1
Smith	nil + cultivation	1256	13.1	23.4	11.6	650	17.5	20.9	11.2
Gray	1. Oats @ 20kg + Vulga Vetch @ 20 kg + Compound Fertilizer @ 50kg	3137	12.7	25.1	12.2	1913	22.4	12.8	12.1
Gray	2. Oats @ 40kg + Vulga Vetch @ 40 kg + Compound Fertilizer @ 50kg	3777	12.2	24.6	11.4	1127	23.7	13.5	12
Gray	3. Oats @ 60kg + Vulga Vetch @ 60 kg + Compound Fertilizer @ 50kg	3491	13.1	21.8	12.3	1766	23.9	9.9	12.2

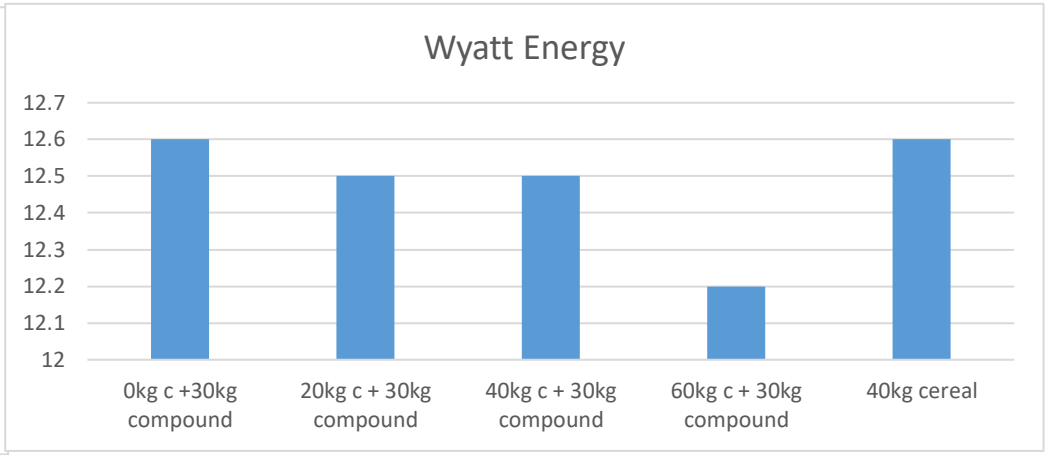
Gray	4. Oats @ 60kg + Vulga Vetch @ 60 kg + No Compound	3876	12.4	23.5	11.6	1564	18.8	14.7	11.5
Gray	5. Oats @ 40kg + Vulga Vetch @ 40 kg + NO Compound	2929	13.2	23.3	11.7	1370	22.4	12.6	11.7
Gray	6. Oats @ 20kg + Vulga Vetch @ 20 kg + NO Compound	3528	10.1	28.9	12.1	1726	22.4	15.7	10.8
Gray	7. No treatment	2123	12.6	25.5	11.4	2296	17.6	22.8	9
Gray	8. 50kg compound fertilizer	812	14.3	27.2	11.4	980	16.2	23.6	10.6
Gray	9. Vulga Vetch @ 20 kg + Compound Fertilizer @ 50kg	1327	14.5	27.6	11.7	1700	20	17.2	10.4
Gray	10. Vulga Vetch @ 40 kg + Compound Fertilizer @ 50kg	2383	14.5	26.8	11.9	970	16.6	22.8	10.4
Gray	11. Vulga Vetch @ 60 kg + Compound Fertilizer @ 50kg	2081	13.5	27.6	12.2	871	18.9	17.8	11.5
Marshall	1. control	1988	11.5	29.9	12.3	903	23.1	12	11.6
Marshall	2. 20kg cereal	2175	12.4	30.7	12.7	1277	21.2	13.7	12.1
Marshall	3. 40kg cereal	3944	11.9	34.8	12.8	1545	20.6	11.2	11.7
Marshall	4. 60kg cereal	3455	11.5	30	12.2	1115	23.9	8.3	10.7
Marshall	5. 20kg cereal+40kg fert	1186	14.5	32	11.8	840	23	9.9	11.6
Marshall	6. 40kg cereal+40kgfert	3059	12.5	32.6	12.2	797	25.4	10.4	12.3
Marshall	7. 60kg cereal+40kg fert	2487	14.1	29	11.5	572	22.3	12.1	11.5
Marshall	8. control + cultivation	3275	12.7	25.1	12.2				

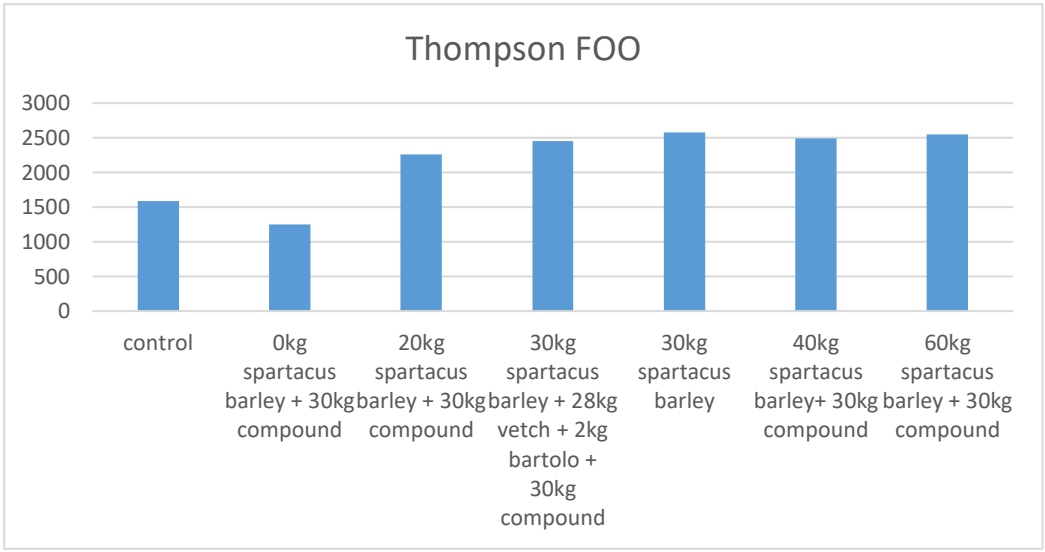
MP1	1.	25kg Spartacus + 25kg vetch	*Insufficient*	*feed*	*amount*	*to test*	broken cage	13.8	25.5	12.1
MP2	2.	25kg Spartacus +25kg vetch +100kg fert	*Insufficient*	*feed*	*amount*	*to test*	400	16.6	25.2	12.2
MP3	3.	25kg Spartacus + 25kg vetch+ 70kg fert	*Insufficient*	*feed*	*amount*	*to test*	350	15.6	25.2	11.9
MP4	4.	25kg Spartacus + 25kg vetch	*Insufficient*	*feed*	*amount*	*to test*	450	15.2	23.5	11.6
MP5	5.	25kg Spartacus + 25kg vetch+100kg fert	*Insufficient*	*feed*	*amount*	*to test*	1700	14.5	23.4	11.9
MP6	6.	25kg Spartacus + 25kg vetch+ 70kg fert	*Insufficient*	*feed*	*amount*	*to test*	broken cage			
MP7	7.	25kg Spartacus + 25kg vetch+ 70 fert	*Insufficient*	*feed*	*amount*	*to test*	broken cage			
MP8	8.	50kg Spartacus + 50kg vetch+70kg fert	*Insufficient*	*feed*	*amount*	*to test*	600	14.8	25.1	11.82
MP9	9.	25kg vetch+70kg fert	*Insufficient*	*feed*	*amount*	*to test*	600	14.8	28.6	12.1
MP10	10.	50kg Spartacus + 25kg vetch+ 3kg canola +70kg fert					broken			
MP11	11.	25kg Spartacus + 25kg vetch+70kg fert	*Insufficient*	*feed*	*amount*	*to test*	broken			
MP12	12.	50kg Spartacus + 50kg vetch+70kg fert	*Insufficient*	*feed*	*amount*	*to test*	500	17.3	24.1	12
MP13	13.	25kg vetch + 70kg fert	*Insufficient*	*feed*	*amount*	*to test*	1600	13.8	27.8	12.3
MP14	14.	25kg Spartacus + 25kg vetch+ 70 fert	*Insufficient*	*feed*	*amount*	*to test*	500	19.3	16.8	12.3
ALL SITES		**MIN**	**531**	**10.1**	**19.2**	**11.4**	**350**	**13.8**	**8.3**	**8.8**
ALL SITES		**MAX**	**4166**	**15.3**	**34.8**	**12.8**	**2296**	**25.4**	**28.6**	**12.3**
ALL SITES		**AVE**	**2557**	**12.9**	**29.2**	**12.2**	**919**	**18.7**	**18.6**	**11.6**

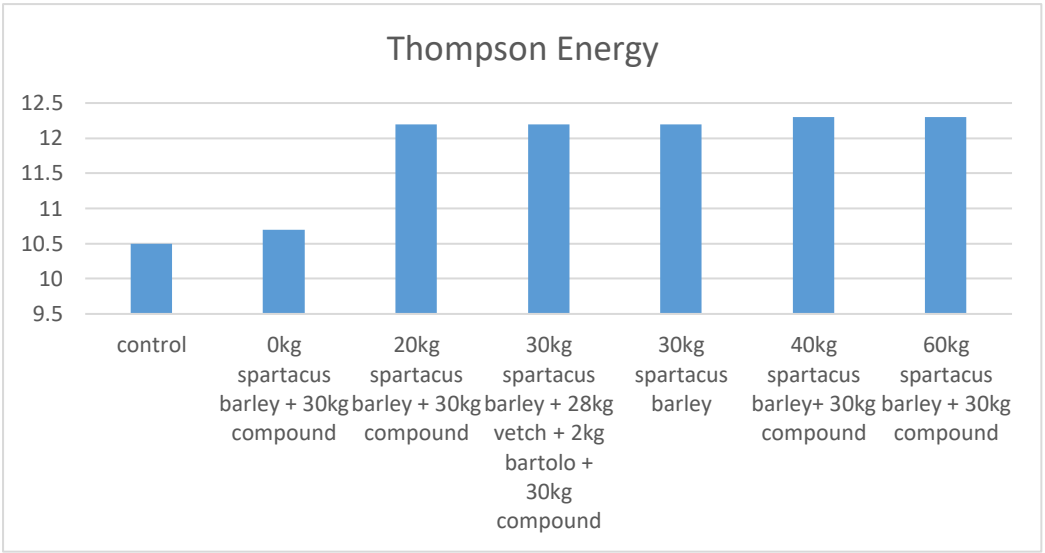
7.10.2 2020

Bulking up pastures with cereals PDS 2020 Field Day



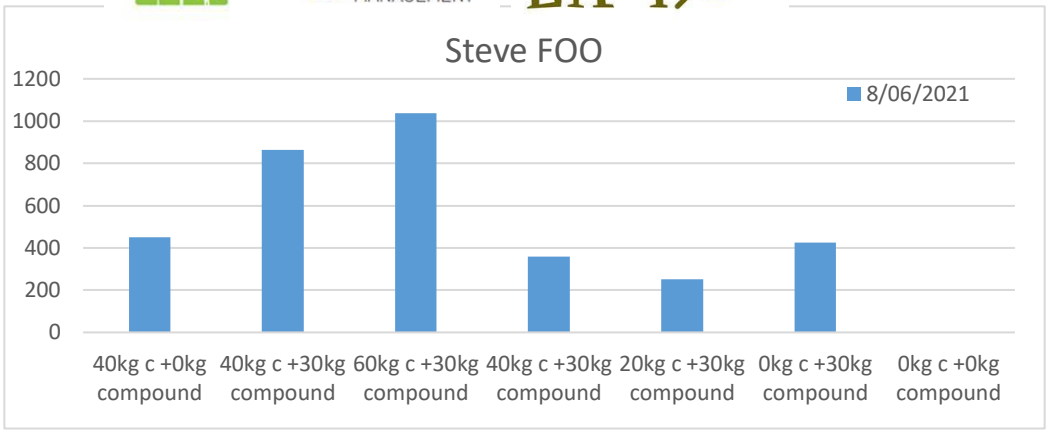


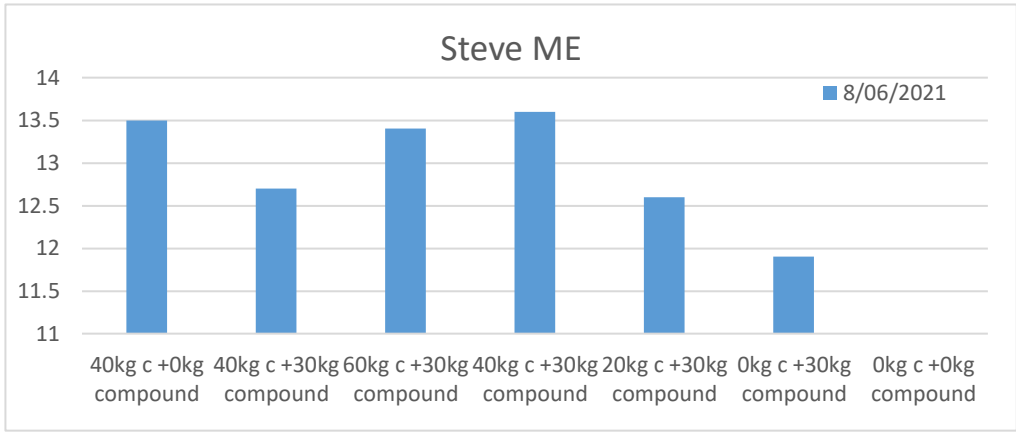


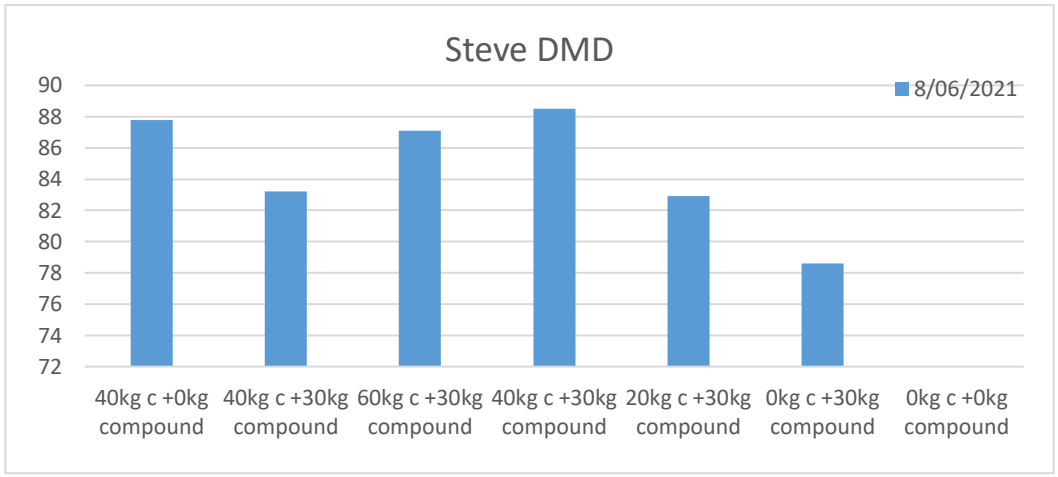


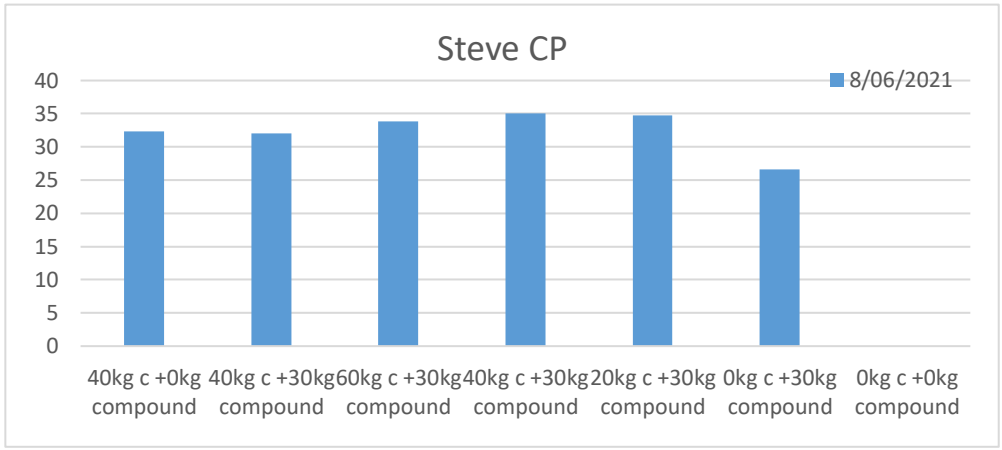
7.10.3 2021

Bulking up pastures with cereals PDS









7.11 Annual summaries

7.11.1 2019

Bulking up pastures with cereals PDS

Summary 2019

The Bulking pastures & diversity project, looking at increasing carrying capacity and poor season resilience in WA's Lakes region has commenced in a dry year. With a late break, producers found that cereal pastures are providing more feed than legume and grass pastures early in the season. Results showed pastures with cereals to have much higher energy, protein and digestibility early in the season, as well as more biomass. This has been extremely valuable, reducing hand feeding requirements. Producers expanded the project to include different cereal and fertiliser rates in 2019, but want further results before making conclusions.

Key findings:

- Feed quality was improved by the addition of cereals, having higher energy than legume pastures.
- Feed quantity increased significantly with the addition of cereals to pastures, with a similar reaction to increased fertilizer rates.
- Regardless of the cereal sowing rate, when cereals are added to pastures, they make up a majority of the pasture in autumn and winter before sheep grazing.
- Producers have tried a mix of sowing cereals into reseeded pastures, as well as adding cereal seed to their pasture seed.
- Of the producers surveyed 96% believe sowing cereals in pastures can increase carrying capacity over autumn. 4% were unsure.
- 48% of producers believed fertiliser would lead to the highest increase in early season feed, and 32% believed feed on offer to be most responsive to increased seeding rates.

7.11.2 2020

Bulking up pastures with cereals PDS: Summary 2020

Key Site Results:

- Producers have tried a mix of sowing cereals into reseeded pastures, as well as adding cereal seed to their pasture seed.
- Pastures bulked with cereals have much more feed on offer at every stage of the season compared to traditional pastures.
- Site location & pasture cut timing are having significant impacts on feed quality and quantity, while there is no statistically significant impact from seeding rate or fertilizer level.
- Regardless of the cereal sowing rate, when cereals are added to pastures, they make up a majority of the pasture in autumn and winter before sheep grazing.
- Sheep condition is higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures.
- In 2019, feed quality was improved by the addition of cereals, having higher energy than legume pastures, and feed quantity increased with the addition of cereals to pastures, with a similar reaction to increased fertilizer rates.

A statistical analysis was also completed to determine any trends. The results suggest that both seeding rate and fertiliser level are having no significant effect on FOO, DMD or ME. However, site location and the time of year had significant effects on FOO, DMD and ME. The results are not as expected, considering feed quality for 2019 showed that pastures with cereals had higher metabolisable energy than those without, and were more digestible.

Feed quantity

The first feed tests were taken at the end of June, then two in July as we were in the area and noticing rapid growth, and the last cut taken at the end of August. Feed test results were gathered from 4 sites, however due to incomplete data the Marshall and Smith data has been excluded from the feed analysis. This leaves us with the full results from Dean and Steve. FOO was much higher than previous years, ranging from 211kgDM/ha to a huge 8370kgDM/ha. This was due to Steve's site, which had very high FOO early in the season, and went to head in August. This also meant that pasture cuts finished a month earlier than last year, as grain heads were full at by end of August.

Feed Quality

Metabolisable energy ranged from 9.4MJ/kgDM to 13.4MJ/kgDM, with a much lower range than the previous year. Digestibility was between 64.1% and 87.3%, with the Dean site having lower digestibility than average. Crude protein varied greatly between treatments and sites, from 8.9% to 31.7%, similar to 2019's results.

Species Composition

Species composition was difficult to assess this year due to varying germination times. In addition, the two sites (Smith and Marshall) that were grazed had issues with the trial that resulted in no data being collected after the end of July. Overall, it was clear that cereal dominated the pastures early in the season, and grazing resulted in cereals being eaten first, drastically changing species composition. In pastures without cereal, the grasses (rye grass, barley grass) dominated early in the season before clover established, but the grazing preference was for clover as soon as it was of an

accessible height. The impact of grazing on the vetch component seemed to mimic that of the cereals, however its growth was more similar to clover, establishing later than the cereals.

7.11.3 2021

Bulking up pastures with cereals PDS

Summary 2021

Key Site Results:

- Producers have tried a mix of sowing cereals into reseeded pastures, as well as adding cereal seed to their pasture seed.
- Pastures bulked with cereals have more feed on offer during the first half of winter, but by August there was no significant difference.
- 1kg of cereal added to pastures resulted in an increase in feed on offer by 4-5kg/ha in autumn to mid winter.
- In terms of quality, sowing rates impact only August quality, with each additional kg/ha leading to a feed quality decrease of 0.1%
- Site location & pasture cut timing had an significant impact on feed quality and quantity, more so than other factors.
- Fertiliser did not have an impact on 2021 feed quality and quantity.
- Regardless of the cereal sowing rate, when cereals are added to pastures, they make up a majority of the pasture in autumn and winter before sheep grazing.
- Sheep condition is higher in mobs that grazed pastures bulked with cereals than those grazing traditional pastures.

More results pending the whole of project analysis, stay tuned!

7.12 Case studies

7.12.1 Grant Marshall

The increase in cropping area in WA's Eastern Wheatbelt has seen a decrease in the amount of area for pastures. This combined with the below average rainfall seasons and drop in pasture quantity and quality has led to a decrease in stocking rates and many growers destocking. To aid in improving and bulking up these pastures to increase carrying capacity, cereals such as wheat, barley and canola are being added to legumes such as sub clover and vetch, to increase pasture quality and quantity. The Lakes Information and Farming Technology producer group in partnership with AgPro Management engaged in a 3 year Producer Demonstration Site project funded Meat & Livestock Australia, to demonstrate the productivity and profitability benefits of sowing cereals & canola into legume pastures in the Lake Grace area.

Grant Marshall is located north west of Lake Grace on his family farm. He runs a mixed farming system on the 6000ha property, consisting of 60% crop and 40% sheep. Prior to taking part in this project Grant said “we just seeded clover and we weren’t seeding any cereal or other pastures with them.” Like other core producers involved in the project Grant outlined that in 2019 he saw first hand the benefit that the addition of mixing cereals with his legumes can make in a dry year. He said “it has been a lifesaver and a bit of a game changer really.”

On an average year the property receives 300mm annual rainfall with a growing season rainfall of between 200-250mm. Soil type varies with areas of lake bank country with high pH as well as sand/clay and gravel/clay. The 40% sheep in the system is made up of 4,000 breeding ewes, with the younger 50% mated to merino rams and older 50% of ewes mated to terminal sires to breed cross bred lambs.

Seeding of the pastures occurred in early April in a 60ha paddock, prior to the start of the seeding of the cropping program. Grant said “it’s a good way to give the seeding equipment a run and make sure it is all working.” The cereal added to the pastures was Spartacus barley, sown at 60kg/ha. Spartacus barley was chosen as it is an IMME tolerant variety which Intervix can be used on. The Intervix was applied to take out grasses such as barley grass throughout the season. Grant said that “the Intervix means we don’t have to worry about spray topping early and it is a way of managing weeds for the following seasons crop.” The paddock was then used to wean and fatten up crossbred lambs on. This gave Grant the opportunity to increase weight gain faster and sell the lambs into the market earlier. The addition of the cereals into the pasture “gives us up to 5 DSE/ha now in the middle of winter, if we didn’t add the cereals we would be back on 3.5 DSE/ha” he said.

Grant noticed multiple benefits from incorporating cereals into his pastures. He said that “the clover appears to germinate better with the loosening of the ground.” This increased his overall germination rate of sub-clover seed that was in the seed bank from previous years. There was a noticeable difference in the ryegrass establishment. Grant said “putting the cereal in stirs the ryegrass up more and we get more of a germination of ryegrass.” This was noticed as one of the trial strips in the project at Grants property that had the seeder disturbing the soil without any seed being planted. He said “this was handy to know if you didn’t want to go out and seed cereal as you can get a germination from the ryegrass still.” It was also a benefit if the paddock was going back into a crop rotation the following year as grant outlined you get more of a weed kill with the extra established ryegrass. Comparing all of the trial strips Grant described the control strip that had not been disturbed as being like an air strip with little to no establishment of pastures/weed.

Since 2019 Grant has continued to add cereals to his sub-clover pastures and believes that “it has been a life saver” to his pastures. He described the addition of cereals into his pasture as “a game changer and a cheap insurance so you don’t end up having to sell sheep because you have no feed.” One thing Grant said he has changed since taking part in the project was “I’ve lowered the rate that the barley is sown at to say 30-40kg/ha as the barley competed to much with the clover.” The barley competition decreased the growth and establishment of the clover. As Grant has increased the number of hectares that he plants to cereals he has found that the larger paddocks don’t get an even grazing. To help solve this problem he said “we are looking at getting hotwires to divide larger paddocks to get more of an even grazing and rotation going.” This will create small paddocks that can then be grazed more intensively and evenly. The hot wires will then be removed prior to the seeding the following year to turn the paddock back into the larger scale cropping paddock.

When asked about any take home messages, he would like to say to other producers Grant said “I feel like now if I don’t do it I’m not doing it properly. It’s like not having lupins in the silo. it’s just cheap insurance really.” He said that the key is to “graze it earlier then you think you need to as the Spartacus barley tillers early” and “don’t have too big of a paddock.” To continue to increase his pasture production Grant is wanting to look more into other cereals that can be mixed in with the sub-clover to increase his FOO. He is especially interested in new IMME tolerant oat varieties as well as long season cereal varieties.

7.12.2 Dean Wyatt

The increase in cropping area in WA’s Eastern Wheatbelt has seen a decrease in the amount of area for pastures. This combined with the below average rainfall seasons and drop in pasture quantity and quality has led to a decrease in stocking rates and many growers destocking. To aid in improving and bulking up these pastures to increase carrying capacity, cereals such as wheat, barley and canola are being added to legumes such as sub clover and vetch, to increase pasture quality and quantity. The Lakes Information and Farming Technology producer group in partnership with AgPro Management engaged in a 3 year Producer Demonstration Site project funded Meat & Livestock Australia, to demonstrate the productivity and profitability benefits of sowing cereals & canola into legume pastures in the Lake Grace area.

Dean Wyatt is a cropping and sheep producer located halfway between Lake Grace and Hyden, near a small town called Pingaring. In the last 5 years, including while the project was running, Dean has seen his average yearly rainfall drop from 325mm to 250mm with the opening rainfall occurring later in the Autumn months. This combined with paddocks that weren’t good for crop production and little to no shelter for lambing, is why he decided to bulk up his pasture with the addition of cereals.

The 4,200ha property is made up of 65% cropping and 35% sheep production, with 2,600 merino ewes mated to merino rams. Prior to adding cereals to his pasture Dean said “we relied on sub-clovers and medics as well as supplementary feeding in that autumn feed gap.” Dean also uses confinement feeding as a way to manage the autumn feed gap as well as to fatten up lambs towards the end of the season.

Spartacus barley was the cereal used as pasture in 2021. It was sown in early April prior to the start of Deans cropping seeding program beginning. The barley was sown at 50kg/ha with 30kg/ha of compound fertilizer and 30L/ha of FlexiN applied to the paddock. Dean said that “we have also gone over the pasture before with another 30L/ha of FlexiN later in the season to give it a boost.” Previously this paddock produced low yielding crops and low amounts of pasture due to the high amount of limestone in the soil. The paddock was spray topped towards the end of the season to prevent ryegrass from setting seed.

Pregnant ewes were moved into the paddock in early May to mid-May. Dean said “this depended on if pastures germinated really quickly or not.” He then grazed it for 10 days before moving the mob back out to allow the paddock to rest. In June it was divided into 3 smaller sized paddocks using portable hotwires. “We try and split our mobs up into 100 ewes or less” Dean said, “Prior to them being put into the smaller paddocks in June ready for lambing.” Apparently, it’s pretty quick to put the fencing up and down when splitting the paddocks. “We use 2 wires and a portable solar energizer and they don’t get through into other paddocks” he promised. By splitting the paddock this way, Dean is able to have smaller mobs for lambing and achieve more even grazing of the paddock. Once the ewes finished lambing, the hotwires were removed and small mobs were brought together. The mob then stayed in the paddock until weaning.

"We've been able to lift our stocking rate a bit and increase our cropping area." Dean claimed, with the use of the cereals making a difference to both pasture production and lambing percentage. Dean said that "I've seen a real difference with maiden ewes especially." He outlined that ewes seem to stay at the birthing site for longer, and are not moving around for feed and forgetting about the lamb. He also believes that the shelter that cereal pasture offers is important due to limited shelter available in the landscape. "If you've ever been to Lake Grace, you'll know the wind howls through the landscape, and there are few places to hide!". Dean laughed.

Despite the benefits of bulking cereals with pastures, one issue Dean found was Spartacus barley setting seed and turning early. The benefit of the Spartacus barley is it's allowance to use Imi chemicals to spray out weeds. "Whether we need to use oats or another longer season cereal."

Overall, adding cereals to bulk up pastures has enabled producers like Dean in areas of lower rainfall to increase their pasture production and stocking rate. For those wanting to add cereals to bulk up pasture Dean said "chuck a paddock in and give it a go, it's cheap." He found that keeping the seeding rate above 50 kg/ha is important for weed competition and providing pasture early in the season. "I've still got a lot of knowledge to gain on stocking rates and to know how many sheep to put on there" Dean admitted. He plans to continue using cereals in his pasture program in the future, and wants to continue gaining that knowledge and skill.

7.12.3 Ashton Gray

The increase in cropping area in WA's Eastern Wheatbelt has seen a decrease in the amount of area for pastures. This combined with the below average rainfall seasons and drop in pasture quantity and quality has led to a decrease in stocking rates and many growers destocking. To aid in improving and bulking up these pastures to increase carrying capacity, cereals such as wheat, barley and canola are being added to legumes such as sub clover and vetch, to increase pasture quality and quantity. The Lakes Information and Farming Technology producer group in partnership with AgPro Management engaged in a 3 year Producer Demonstration Site project funded Meat & Livestock Australia, to demonstrate the productivity and profitability benefits of sowing cereals & canola into legume pastures in the Lake Grace area.

Ashton Gray decide to take on this approach to increase his pasture production for grazing and sileage production. Recently returned to the farm after years as an agronomist, he has been dubbed the 'trials guy' of the region, with a curious mind and desire to solve problems. He farms with his siblings and parents in Tarin Rock, 300km south-east of Perth near Lake Grace. The property is 7,500ha, a combination of leased and owned land consisting of predominately medium gravel/loams and duplex loam/clay soil types. These varying soil types gives the family plenty of challenges when it comes to pasture and crop production. Good pastures are vital, as they run 3,500 Merino ewes mated to Merino sires, and 300 Merino ewes mated to terminal sires for their stud, High Valley. Over the previous year lambing occurred in April, however they are looking at changing to June for the 2022 season.

Traditionally the Grays cropped 50% of the property, due to the gravel soil types producing low yielding crops- "We planted sub-clover based pastures on the gravels instead, using self-regenerating sub-clover pastures, in a 1:1 pasture and cropping rotation." However, Ashton said that the use of a reefinator has changed the land use, making it a little more suitable for cropping the gravel soils. This has led to their system shifting to 70% cropping and 30% pasture. Combining this increase in crop area with changing rainfall patterns has meant that higher pasture production per

hectare is needed. “Traditionally our annual rainfall is meant to be a 350mm zone, but we are probably seeing more of a 200 – 250mm annual rainfall” he explained.

“Since we have increased the cropping percentage, we have become more reliant on sowing fodder crops, just because of the growth rate response” Ashton said. These were grazed early in the season while clover-based pastures were “still struggling”, and then locked up to be cut for sileage. As part of this project, Ashton trialed Volga vetch under the fodder cereal crop, but found that sub-clover with the cereals proved to be a better option for a longer pasture phase. However, the family cut some of the cereal fodder paddocks for silage, and this is where the vetch is now used. Ashton explained that “For the silage, barley or an oat is mixed with the vetch to give bulk and quality. Vetch gets good height and is easy to cut”. The sileage is stored in bunkers, with often enough being cut to supply them for 1 to 2 years.

Ashton said, “The silage allows for an early cutting opportunity to allow you to capture that weed seed.” The fermentation process that occurs once the silage has been cut and stored breaks down the weed seeds that have been captured. Unlike hay this then prevents the spreading of weed seeds in the area where the silage is then fed out to sheep. It is fed out using a mixall with scales. “Sometimes we will mix it with barley or lupins as well to get that desired ration.” Ashton added. These additions are to increase protein, and used if sheep are lambing, or need to increase body weight.

The addition of the cereals to the sub-clover pastures gave the Grays a significant increase in feed on offer in the paddock. “The effects were clear as day- early in the season cereal pastures could be grazed, while the clover only pastures couldn’t.” The project data supported this, with bulked pastures having up to 60% more feed on offer in June. Paddocks that have cereals added to the sub-clover now have a higher stocking density and allow Ashton to rest other pasture paddocks for longer periods. “I’ve found a real value in deferred grazing using the pasture bulked with cereals.” he explained. “Although I’d like clearer results for the impact of rates of fertilizer and seed!”

The Grays regularly bulk pastures with cereals now, for both sileage and pasture. Cereals are sown with either the sub-clover or the vetch from mid-March to mid-April, prior to the start of their cropping program. The paddocks are given 4-5 weeks to grow prior to grazing. The family doesn’t use a set stock rate to graze the paddocks, but instead move the sheep on when the paddock has been well grazed. “It depends if it’s a fodder or pasture cereal- we use different metrics to gauge when it’s time to move” he added. This is to prevent over grazing and to give paddocks a rest period to increase pasture production. Ashton said “the cereals also get good cover over the paddock going into summer, preventing erosion risk”

The Grays will continue using this method of adding cereal fodders to bulk up pasture for both his cereal/vetch silage mix and sub-clover pasture. Cereal fodders have allowed the property to increase feed on offer throughout the year, in different forms- a green or dry pasture, as well as silage. The introduction of adding cereal fodder to the sub-clover has increased their stocking density on each paddock whilst also making feed available earlier in the year and for a longer period. Ashton said “the important part is getting those plants established before the cold weather” and found that this aids in increased pasture production. Ashton is pleased to have used this project to ensure high quality feed available to livestock throughout the year, reducing risk and achieving higher stocking rates on farm.

7.12.4 Nathan Brown

The increase in cropping area in WA's Eastern Wheatbelt has decreased the area utilised for pastures. This, combined with the below-average rainfall seasons and drop in pasture quantity and quality, has led to a decrease in stocking rates and many growers destocking entirely. To aid in improving and bulking up these pastures to increase carrying capacity, cereals are being added to legumes such as sub-clover and vetch. The Lakes Information and Farming Technology producer group in partnership with AgPro Management engaged in a 3 year Producer Demonstration Site project funded Meat & Livestock Australia, to demonstrate the productivity and profitability benefits of sowing cereals & canola into legume pastures in the Lake Grace area.

Nathan Brown, a fourth-generation family farmer in Jerramungup, decided to try the cereal approach.

The Brown property is 5,000ha, with an average growing season rainfall of 260mm. Consisting of 50% cropping and 50% pasture, the Browns graze 13,000 Merino ewes on clover and ryegrass-based pastures. Previous years have seen below average rainfall on the property, enhancing the need for bulking up pastures. Prior to adding cereals to pastures in 2019, they relied on volunteer pasture as their winter and spring feed but noticed that over time that weeds and volunteer pastures decreased due to improved cropping technology.

In 2019, Nathan saw firsthand the impact that cereals had on bulking up his pastures after trialling one paddock. When approached about being involved in the project, he agreed as he was keen to see exactly what was being grown, so they could use it for future planning. At the beginning of 2020, he decided to increase the area of cereals planted into pasture beyond the project.

At the end of April 2021 Nathan sowed 700 hectares to cereal pastures using a disk seeder. These consisted of Spartacus barley and a wheat/ryecorn mix. Nathan selected Spartacus barley in order to allow the use of Intervix later in the season, to spray out problem grasses and broadleaf weeds.

Pregnant ewes were moved into the paddocks at the beginning of July, three weeks before lambing. With abundant pastures, the ewes remained in the paddocks until a few weeks after mulesing in spring. Lambing into the cereal pasture has had a positive impact on both the ewes and lambs. In a very windy year, cereals have offered shelter for the lambs. "There's valuable shelter, especially the ryecorn as it seems to be less palatable," Nathan said.

Nathan also noticed other grazing preferences – the ewes preferred to eat the erect cereals compared to the less erect plants, such as the sub-clover. This has given his sub-clover in these paddocks the opportunity to grow, and he hopes they will dominate in spring.

The bulked up cereal pastures have also had a positive impact on his stocking rate and carrying capacity.

"Previously we would have been aiming to have 4–5 lambing ewes per hectare on a standard pasture, but now we have 10 lambing ewes per hectare," Nathan said. This has allowed him to double his carrying capacity in each paddock, while deferring others for spring feed and manipulation.

The impact of cereal pastures in a poor season with a late break was also highlighted, with increased carrying capacity. "It really saved us in that dry year (2019) and enabled us to still have eight lambing

ewes to a hectare. Instead of having to sell our ewes, we were able to maintain the breeding ewe flock," he said.

When asked about any issues that have arisen while taking part in the project, Nathan pointed out that as they increased their winter DSE, they inadvertently also increased their summer DSE, which meant thinking up new management strategies for this.

He said they do a large amount of summer agistment to decrease supplementary feeding needs. However, like many in the state, he is interested in confinement feeding, and has recently built confinement feeding pens to hold 4,500–5,000 sheep. These will be used in seasons when they run out of summer feed, and in late break years to defer grazing and allow pastures to establish. This could become a regular practice in order to increase early season feed availability.

Nathan's paddocks average 100ha, which he believes is fine for single bearing ewes, but is too big for his smaller twin ewe mobs.

"Next year, we need to plan in our rotation that there is at least 150 to 200ha of smaller 50–60ha paddocks for smaller twinning flocks" he said. He also wants to seed the pastures in March to ensure early pasture establishment and prevent any impacts on the cropping program. He is also waiting for the fertiliser rate results to see if it's worthwhile increasing fertiliser rates earlier in the season.

In addition, he is considering changing the ratio of the ryecorn in the rye/wheat mix. Comparing the different cereals used, Nathan said that the ewes seemed to eat down the barley paddocks faster than the ones with wheat/ryecorn, and the ryecorn was left standing. This does ensure that there is constant ground coverage and shelter but is a waste if the sheep won't eat it.

Overall, adding cereals into pastures is something that Nathan will continue doing in the future. He has been able to double his carrying capacity during the winter and spring period, and during drier seasons, the cereal pastures have aided in decreasing the risk of carrying larger numbers of stock.

For others looking at adding cereals into their pastures, Nathan said it's something all mixed cropping and livestock enterprises should consider. "If you're already growing crop, then to do this is nothing," he said. "Instead of harvesting it with a header, you're harvesting it with mouths."

Nathan will continue trying different pasture mixes, looking to better monitor food on offer to maximise growth and stocking rates through planning in varying seasons.

7.12.5 Steve Thompson

The Lakes Information and Farming Technology producer group in partnership with AgPro Management engaged in a 3 year Producer Demonstration Site project funded Meat & Livestock Australia, to demonstrate the productivity and profitability benefits of sowing cereals & canola into legume pastures in the Lake Grace area.

Steve Thompson farms 20km south of Newdegate, in Western Australia. Averaging 240mm growing season rainfall, he runs a mixed enterprise on 5,000ha of arable land, with 80% cropping and 20% pasture. The business runs dual purpose Merino ewes, bred for both wool and meat production. The property's soil types are variable, ranging from gravel, sand/gravel and a small portion of sand/clay, which means Steve has always struggled to find the right pasture mix for each paddock. Previously, Steve's pasture choices involved a large amount of sub-clover, and on some of his sandier soils he

tried serradella. A combination of dry seasons and little feed availability resulted in Steve looking for other pasture options to bulk up his pasture production. This is what led to his involvement in the 'Bulking up pastures with cereals' PDS project, which he saw as an opportunity to increase carrying capacity and system resilience.

"Three years of dry autumns combined with low rainfall and little water availability pushed me to give Ed a call to try and help solve the problem," Steve said.

"To keep running sheep in the area, we needed to do something."

In 2020, Steve joined the PDS project. He'd planted an oat/vetch mix, using RM4 vetch. He found that RM4 produced larger biomass and faster growth rates compared to other vetch varieties. The mix produced larger amounts of biomass from the oats, but Steve said the only problem was the high competition that came from the oats against the vetch.

This year, Steve planted a barley/vetch mix as well as a barley/serradella mix. Paddocks were sown late April and were opened to pregnant ewes in the third week of June, where they lambed into abundant feed compared to the rest of the district. The ewes had been put in confinement feeding prior to going into the paddock for lambing, to allow the pastures and bulked cereals to get away.

The ewes were divided into mobs of 200 within the paddock and sectioned off using hot wires during lambing, which were then removed. The increase in feed on offer with the cereal added meant that the ewes and lambs could stay in the paddock without needing to be disturbed and moved straight after lambing. "The ewes were only removed from the paddock for a week in August so that I could spray and then they were returned," Steve said. "A combination of deferring grazing and increased feed availability in the paddock meant that the ewes were not moving around while lambing."

Steve also believes that the cereals provide shelter for the lambs due to the plant's growth height.

When asked about the comparison of the DSE/ha of his barley/vetch paddock to his traditional sub-clover paddock, Steve said that it has at least doubled his carrying capacity during the season, and has left him with paddocks that can either be locked up for weaners or be put into the crop rotation.

"The barley/vetch paddock was carrying around 15 DSE/ha compared to a paddock with sub-clover, which was carrying around 3.8 DSE/ha" he said.

When asked if he would do anything differently in the following year, Steve said that the main change from 2021 will be simply to seed pasture in the last week of March to prevent being rushed with the cropping program. His only concern is that the pasture won't get a proper knock down, and risks increased weed competition throughout the season.

He is also looking at using a Clearfield canola and vetch mix in 2022, as he believes his cereal pastures can lead to weed control issues the following year. He hopes that being able to spray out the grasses will decrease weeds in the following year's crop, and canola will act as early season feed while the vetch will be for the later winter/spring period.

Steve had a glowing recommendation for the findings from the PDS project.

"A combination of deferring feed and sowing cereals works, and I couldn't run sheep without it now," he said.

He now wants to focus further on understanding Feed On Offer and identifying the carrying capacity of paddocks with cereals in them, as he believes he is still not using his cereal pastures to their fullest potential. This will ensure he can get the most value out of the feed for his flock.

7.13 Post PDS survey

7.13.1 Core producer questions

MLA Producer Demonstration Sites

Skills Audit template – Post-PDS

Core Participants

PDS Name: Increasing carrying capacity and poor season resilience: Bulking pastures & diversity
PDS Code: L.PDS.1807

Event name: _____

The following questions are used to determine your level of understanding of bulking pastures with cereals. The knowledge and skills audit is used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. It will also be used:

1. To improve the content of future project meetings; and
2. as part of the evaluation process for the project

The information will be completely confidential, and individuals will not be identified in the analysis of data.

Name: _____

Date: / /

MLA may contact me to further assess the impact of their programs? ☐ Yes ☐ No

MLA may send me newsletters and inform me of future events? ☐ Yes ☐ No

Section A – Your Thoughts on the PDS

A1. Overall, how **satisfied** are you with this PDS?

1	2	3	4	5	6	7	8	9	10
Poor									Excellent

A2. How **valuable** was this PDS in assisting you manage your livestock enterprise?

1	2	3	4	5	6	7	8	9	10
Poor									Excellent

A3. Would you **recommend** MLA's PDS program to others? ☐ Yes ☐ No ☐ Not Sure

A4. General Feedback

Please provide feedback to help us improve the PDS program:

Section B – Knowledge and Skills (If you do not know, please select the 'Unsure' option)

B1. What results in the most early season feed in a normal season? *(Tick one of the options below)*

d. Higher fertiliser rates ☐
e. Higher seeding rates ☐
f. Unsure ☐

B2. Could cereals in pastures increase carrying capacity over autumn: *(Tick one of the options below)*

d. Yes ☐
e. No ☐
f. Unsure ☐

B3. What do you believe would happen to species composition in a cereal-legume pasture? *(Tick the answer that applies to you)*

f. Cereals get grazed out early ☐
g. Cereals 'choke out' legume during season ☐
h. Legume outcompetes cereal ☐
i. Any grasses present would dominate ☐
j. Unsure ☐

B4. What do you think has the fastest growth rate? *(Tick the answer that applies to you)*

g. Clover ☐
h. Ryegrass ☐
i. Cereals ☐
j. Barley grass ☐
k. Capeweed ☐
l. Unsure ☐

Section C – Confidence and Practices

C1. How confident are you in bulking your legume pastures with cereals?

(please rate out of 10, with 1 being poor and 10 being excellent, by circling your choice below)

1	2	3	4	5	6	7	8	9	10
Poor									Excellent

C2. Have you begun implementing changes regarding the following practices, as a result of participating in this PDS?

	Already used before PDS	Implemented this Practice (please indicate on what % of your enterprise this practice has been adopted e.g. 50%)	Intend to implement	Not ready yet (need more training, advice)	Not needed on my property / not relevant
Add cereals to reseeded pasture seed mix					
Sow cereals into existing pastures					

C3. If you have implemented changes, what impact did they have on *[please insert baseline data]* e.g. weaning rate (%)? *(Please do not answer if you are unsure)*

Metric	Current performance
Autumn feed on offer (kg DM/ha)	
Autumn Sheep carrying capacity (DSE/ha)	
Lambs/ha	

CORE PRODUCERS ONLY

Metric	Current performance
GM/ha	
GM/DSE	

C4. If you ticked "not ready yet', please indicate what additional information, training or advice you require

_____
_____
_____

C5. If you ticked "not needed on my property", please indicate why

_____
_____
_____

7.13.2 Observer producer questions

MLA Producer Demonstration Sites

Skills Audit template – Post-activity

Observers

PDS Name: Increasing carrying capacity and poor season resilience: Bulking pastures & diversity

PDS Code: L.PDS.1807

Event name: _____

The following questions are used to determine your level of understanding of *[insert topic]*. The knowledge and skills audit is used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. It will also be used:

3. To improve the content of future project meetings; and

As part of the evaluation process for the project

The information will be completely confidential, and individuals will not be identified in the analysis of data.

Name: _____

Date: / /

MLA may contact me to further assess the impact of their programs? ☐ Yes ☐ No

MLA may send me newsletters and inform me of future events? ☐ Yes ☐ No

Section A – Your Thoughts on the Event

A1. Overall, how **satisfied** are you with this event?

1	2	3	4	5	6	7	8	9	10
Poor									Excellent

A2. How **valuable** was this event in assisting you manage your livestock enterprise?

1	2	3	4	5	6	7	8	9	10

Poor Excellent

A3. Would you **recommend** this event to others? ☐ Yes ☐ No ☐ Not Sure

A4. General Feedback

Please provide feedback to help us improve the PDS program:

Section B – Knowledge and Skills

B1. What results in the most early season feed in a normal season? *(Tick one of the options below)*

g. Higher fertiliser rates ☐

h. Higher seeding rates ☐

i. Unsure ☐

B2. Could cereals in pastures increase carrying capacity over autumn: *(Tick one of the options below)*

g. Yes ☐

h. No ☐

i. Unsure ☐

B3. What do you believe would happen to species composition in a cereal-legume pasture? *(Tick the answer that applies to you)*

k. Cereals get grazed out early ☐

l. Cereals 'choke out' legume during season ☐

m. Legume outcompetes cereal ☐

n. Any grasses present would dominate ☐

o. Unsure ☐

B4. What do you think has the fastest growth rate? *(Tick the answer that applies to you)*

m. Clover ☐

n. Ryegrass ☐

o. Cereals ☐

p. Barley grass ☐

q. Capeweed ☐

r. Unsure ☐

Section C – Confidence and Practices

C1. How confident are you in bulking your legume pastures with cereals?

(please rate out of 10, with 1 being poor and 10 being excellent, by circling your choice below)

1	2	3	4	5	6	7	8	9	10
Poor									Excellent

C2. For the following practices, do you plan to make changes to your business as a result of attending this event?

	Confirmed what I'm already doing	Intend to implement	Not ready yet (need more training, advice)	Not needed on my property / Not relevant
Add cereals to reseeded pasture seed mix				
Sow cereals into existing pastures				

C3. If you ticked "not ready yet', please indicate what additional information, training or advice you require

_____
_____
_____

C4. If you ticked "not needed on my property / not relevant", please indicate why

☐ Not a producer

☐ Other (please provide details)

_____
_____
_____

7.13.3 Survey results

44 surveys were completed for the post project survey. The questions can be seen in Appendix 7.12.1 and 7.12.2, and the raw results in the Excel file included with this report.

Results were:

- Producers rated their satisfaction with this PDS as 7.9 out of 10.
- They believed that the PDS's value was 7.4 out of 10, and 97.7% would recommend PDS's to others.
- 52.3% of producers believed fertilizer would lead to the highest increases in early season feed, and 47.7% believed higher seeding rates would have more of an impact.
- 100% believed that cereals in pastures could increase autumn carrying capacity
- 43% of producers thought that grazing could lead to cereals getting grazed out early, and 54% believed cereals will 'choke out' legumes throughout the season.
- 20% believed ryegrass had the fastest growth rate, 41% cereals, and 11% barley grass. None-one believed clover had the highest growth rate, and 22% were unsure.
- Producers rated their confidence in bulking legume pastures with cereals as 7.9 out of 10
- 27% of producers normally add cereals to reseeded pasture seed, while 30% have implemented this practice during the PDS 23% intent to and 9% believe it is not relevant or needed on their property.
- 30% of producers normally sow cereals into existing pastures, while 30% have implemented this practice. A further 27% intent to implement, while 3% believe it is not relevant or needed on their property.
- For those that implemented, average impact on Autumn FOO was an increase of 192%
- Autumn carrying capacity averaged 4.5DSE/ha and 2.7 lambs/ha.