final report

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Improving feed value of perennial grasses

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Abstract

The Fitzgerald Biosphere Group (FBG) is an NRM/Grower Group on the South Coast of Western Australia, whose members run sheep and/or cattle and cropping enterprises.

Between 2014 and 2016 three different ways of improving feed value of perennial grasses were trialled at three different sites; one in the mid to low rainfall zone (450 – 350 mm) and two in the high rainfall zone (600-450 mm).

Barley was successfully used as a cover crop to help establish Gatton Panic, which in turn raised both the quality and quantity of pasture production. Digestibility and energy increased marginally but the biggest gain was in the increased overall bulk yield compared with the annual pasture.

The equipment that provided the most successful establishment of Dalliup oats and Margarita Serradella into an eight year old kikuyu stand was knife points with double disk openers and press wheels. Serradella pasture established a better stand than oats, while soil disturbance instigated germination of clover seed in the seed bank.

Comparison of two legume species sown into a ten year old kikuyu stand showed bladder clover persisted slightly better than serradella. Although straight kikuyu pasture produced the highest feed quantity, it was only marginally higher in digestible fibre than other pasture compositions.

The key message from these trials is that the right combination of species, establishment methods and seasonal conditions are the determinants of success.

Executive summary

The Fitzgerald Biosphere Group (FBG) is an NRM/Grower Group located on the South Coast of Western Australia, in the Shire of Jerramungup. Most of the farming businesses represented by the membership run mixed enterprises; sheep and/or cattle and cropping. Rainfall zones and soil types vary throughout the shire and influence the livestock to cropping ratio.

The overall objective of this project was to investigate different ways of improving feed value of perennial grasses. The project was carried out at three different sites within the Shire; SITE 1 in the mid to low rainfall zone (450 – 350 mm) and SITE 2 and SITE 3 in the high rainfall zone (600-450 mm).

The aim of the project at **SITE 1** was to trial a non-traditional perennial sub-tropical grass species (Gatton Panic). The objectives were;

1. To determine if seeding with a winter cover grass helps to establish Gatton Panic.
2. To determine if seeding with a soil wetter helps establish Gatton Panic better.
3. To determine if Gatton Panic could effectively extend the feed period and value of a pasture paddock over a two to three year period in either quantity or quality.

The soil type in the trial paddock is sand over gravel and consistent throughout the paddock. It is extremely prone to water repellence and wind erosion.

The trial ran for three years, from 2014 to 2016 with excellent establishment conditions being experienced in the first year, enabling the research questions to be answered as follows:

- A winter cover grass (barley) did help to establish Gatton Panic. The Panic grew at the base of each barley plant after it hayed off; the barley plant appearing to provide root and moisture channels.

- A soil wetter did not have a significant impact on plant establishment however, the summer of the establishment year was a wet one and different results may occur in drier conditions. It must be noted that in the second year of the trial, the soil wetter-applied site had higher pasture production yields.

- Gatton Panic raised both the quality and quantity of pasture production. It improved digestibility and energy marginally but the biggest gain was in the increased overall bulk yield compared with the annual pasture. It effectively extended the feed period and feed value of the pasture paddock throughout the trial.

The host farmer believed the Gatton Panic created a extremely good pasture option that complimented the existing range of annual and perennial pastures he currently grows.

The aim of the project at **SITE 2** was to investigate methods of establishing annual pasture species into long term (10-15 year) kikuyu stands to increase the amount of winter feed generated. The objectives were:

1. To determine what seeding method provides the best establishment of alternative pastures into a long term (eight year) Kikuyu stand.
2. To determine which species would establish better into the kikuyu stand: Dalliup oats or Margarita Serradella.
3. To determine if a knockdown on the kikuyu followed by soil disturbance would create an environment that entices pre-existing clover in the seed bank to germinate.

The soil type in the trial paddock is a duplex sandy gravel and the year of the trial, 2014, was characterised by a late break and a very dry summer. Nonetheless, the following useful information was established:

- In both oat and serradella sown pastures, knife points with double disk openers and press wheels provided the best seedling establishment. The wing points seemed to dry the soil out more and although they created an environment with less weed competition there was visibly less moisture in the soil.

- Serradella pasture established a better stand than oats.

- Soil disturbance did instigate germination of clover seed from the seed bank. The higher the tillage option the more the soil dried out, causing lower germination rates.

The aim of the project at **SITE 3** was to investigate persistence, pasture yield and pasture quality by establishing legumes into a long term (10-15 year) kikuyu. The objectives were:

4. To determine which pasture species (bladder clover or serradella) is the most persistent species when sown into kikuyu.
5. To determine which pasture composition would give the highest feed quantity over the life of the trial.
6. To determine which pasture composition would give the highest feed value.

The trial ran for two years – 2015 and 2016 – in a paddock with a duplex sandy gravel soil, chosen for its ten year old stand of kikuyu. The results of the trial showed:

- The most persistent pasture legume species sown into the kikuyu was the bladder clover. It was slightly more persistent throughout the year whereas the serradella was predominant during winter months but less so during the summer. Both legume species continued to emerge at very good densities in season two indicating the persistence was relatively good in both species, even though kikuyu was not suppressed in the second year.

- The highest feed quantity over the life of the trial was the kikuyu pasture with no companion species. It produced between 1500kg-2000kg/ha higher yield during the summer months than the composite pastures and only 500kg/ha less, in one circumstance, than the composite pastures during winter.

- The kikuyu pasture was also the pasture that contained the highest quality of feed. However, the kikuyu was only marginally higher in digestible fibre, with little other feed value differences between compositions.

The key take-home message from these trials is that the right combination of species, establishment methods and seasonal conditions are the determinants of success. Because this varies between soil types and rainfall zones, there is a need for locally-base trials.

When the project was being designed it was decided that no specialty machinery would be used so as to encourage other farmers to also try establishing the pasture with existing equipment. Farmers were willing to make modifications to existing machinery where necessary. We think this is an important consideration for future trials we undertake and manage.

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1 Background

The Fitzgerald Biosphere Group (FBG) is an NRM/Grower Group located on the South Coast of Western Australia, in the Shire of Jerramungup. For more than thirty years it has served the farming community, initially as a Landcare Group but in more recent times as a conduit for research, development and extension of sustainable agricultural practises. The group has a membership of approximately 70 and most of the farming businesses represented run mixed enterprises; sheep and/or cattle and cropping.

Rainfall zones and soil types vary throughout the shire and dictate, in part, the livestock to cropping ratio. At an FBG meeting in 2013, farmers in separate rainfall zones expressed interest in investigating different ways of improving the feed value of their perennial grasses.

Initially the FBG's contract with MLA had three objectives relating to improving feed value of perennial grasses: one objective relevant to the mid to low rainfall zone and two relevant to the high rainfall zone. These were:

1. To identify the value of wide furrows and a wetting agent to achieve improved establishment of panic grass.
2. To compare the effect of different machinery configurations on the establishment of new species when sown into a Kikuyu paddock.
3. To compare the performance of serradella and oats in providing winter feed within an existing Kikuyu sward.

As the project progressed each of the three host families involved came up with new questions related to the main objective being investigated at their trial site. As a consequence, three objectives at three trial sites ie nine objectives in all, were investigated. They are delineated in the objectives sections for each site. Following is some background information on the history and rainfall of the areas in which the trials were located and how these dictated the research questions the farmers were interested in pursuing.

SITE 1: Brian and Janet Penna - Improving summer feed content of annual pastures on the South Coast of WA by introducing Gatton Panic

Farmers operating in the mid to low rainfall zone (450 – 350 mm) expressed interest in establishing better perennial pasture species into an existing traditional pasture systems to try and increase the amount of summer feed generated off their paddocks and decrease the need for supplementary grain feeding.

Annual pastures are traditionally the main pasture species grown and consist primarily of annual ryegrass, brome and barley grass and legume species with a mostly clover and serradella base. They have been popular in these rainfall areas because they are annuals in a primarily cropping based rotation. However, with cropping inputs increasing there has been growing interest over the last five years in either increasing stocking numbers to mitigate some crop risk, or increasing the pasture phase to try and grow their own nitrogen.

The growers at the meeting were a mixture of cattle and sheep producers and expressed an interest in using sub-tropical grass species with greater effectiveness by seeding them in conjunction with traditional pastures.

SITE 2: Ross and Rhonda Williams - Improving winter feed content of kikuyu pastures on the South Coast in the winter months by establishing Serradella and oat pastures into kikuyu

Several coastal farmers were interested in establishing annual pasture species into their perennial pasture systems to try to increase the amount of winter feed generated off their paddocks. These coastal farmers are situated in the 600-450 mm rainfall zone of the Western Fitzgerald Biosphere where perennial pastures often play a big role in farming practices.

Kikuyu pastures have been popular in the area over the last 10-15 years and have provided a great source of stock feed throughout the year, particularly in summer time. However, farmers had noticed that winter feed is often compromised when the kikuyu stand smothers the winter grasses and legumes. The farmers also observed that there was less weight gain from livestock when the pasture was over eight to ten years old. Several farmers have cropped their kikuyu paddocks before either letting the kikuyu come back or reseeding the kikuyu stand to try and refresh the pasture.

The growers at the meeting were interested in investigating if 'renovating' the kikuyu stand could be achieved through co-habitation with a sown annual pasture to maintain the paddock in a pasture rotation, extend the feed period from a predominantly summer feed to an annually consistent feed period and if legumes would provide an added advantage of constantly producing nitrogen for the kikuyu to access.

Seeding methods that gave the best establishment results were to be measured over one year (2014) in the establishment phase [SITE 2]. Persistence in subsequent years (2015-16) was to measured at the same site but unforseen changes in circumstances for the Williams family required that an alternative site [SITE 3] be used.

SITE 3: Ken and Jan, Paul and Alice Reddington - Improving winter feed content of kikuyu pastures on the South Coast of WA by establishing legumes into kikuyu

Following on from the trial into establishment methods, persistence, pasture yield and pasture quality were measured in the subsequent years at Ken and Paul Reddington's property on a large scale trial. Instead of seeding oats and serradella, they wanted to compare two different legume species as they prefer to grow their own nitrogen. Therefore the trial assessed the growth habits of bladder clover and Margarita serradella sown into a ten year old kikuyu stand by using double disk openers, knife points and press wheels, sown in the paddock at the start of the 2015 growing season.

SITE 1: Brian and Janet Penna

Improving summer feed content of annual pastures on the South Coast of WA by introducing Gatton Panic

2 Projective objectives SITE 1

Farmers in our mid to low rainfall zone (450 – 350 mm) typically have had little local research into perennial pastures other than Lucerne so the aim of this part of the project was to trial a non-traditional perennial sub-tropical grass species. The species farmers wanted to trial most was Gatton Panic and they had the following objectives;

1. To determine if seeding with a winter cover grass helps to establish Gatton Panic.
2. To determine if seeding with a soil wetter helps establish Gatton Panic better.
3. To determine if Gatton Panic could effectively extend the feed period and value of a pasture paddock over a two to three year period in either quantity or quality.

3 Methodology SITE 1

3.1 Brian and Janet Penna

Location: Cowallup, WA
Annual Rainfall: 350 mm (low to mid rainfall zone)
Area (total/arable): 4000 ha
Cropping: 600 ha
Livestock enterprise: Beef cattle and sheep
Pastures (Annual/Perennials): 3000 ha

Trial site
soil type: Sand over gravel and consistent throughout the paddock. This soil is extremely prone to water repellence and wind erosion.

Rationale for paddock selection: The paddock selected was in a long pasture: cropping rotation and consistently receives between 300-400 mm rain per annum. It is surrounded by a cropping paddock, kikuyu pasture paddock and tagasaste pasture. Even though these paddocks are all under different management timelines and are not measurably comparative, it was deliberately selected so that Brian and Janet could relate how this paddock compared to their existing pasture systems.

Rationale for perennial selection: Brian has used Kikuyu and Tagasaste as his two main perennial pasture species historically. He was looking for a grass species to add to his grazing management strategy that had a more prostrate bearing to make it easier for cattle to graze.

3.2 Treatments

Site set-up and equipment
Setup began in June 2014 with Brian doing all of the site preparation, including weed and insect control throughout the winter months until the site was sown.

Spraying and fertilising equipment used during site preparation and over the following two seasons was the farmers own. Timing for insect control and fertiliser input was decided on between Brian and the FBG agronomist.

Seeding equipment used was the farmer's minimum tillage air seeder on nine inch row spacings. It was decided that no specialty machinery would be used, as farmers in the area are trying to establish pastures with existing equipment.

Seed was sourced through DAFWA in conjunction with a coastal pastures project at the beginning of 2014 and aproximately 13.17 ha of the paddock was sown on the 15th October 2014 at 5kg/ha with 10kg/ha of barley to make the seed feed more consistantly through the seeder and to give the panic protection from grazing animals while it emerged.

Monitoring points 1-4 were set up in the paddock and recorded through GIS with pasture cages being put at each point so that grazing could occur throughout the trial period.

Monitoring point set-up
Monitoring point 1 was set up in a part of the paddock with slightly higher gravel content than the rest of the paddock. This was to see if this would be an area of higher non-wetting properties. **Monitoring point 2** was set up in an area that represented the majority of the paddock in soil type and geographic presentation. **Monitoring point 3** was established to monitor a control location that had no Gatton Panic sown into it and provided a comparison of annual vs the annual/perrenial pasture mix in the rest of the paddock. Wetter was then applied to the north, north, west side of the paddock at 10L/ha around and **monitoring point 4** was set up to see if this aided with the panics' emergence.

3.3 Monitoring

Plant establishment numbers
Plant establishment numbers were taken using a 1/16th pasture analysis square, as per DAFWA protocol.

In the first year, final plant establishment was meassured on the 5th of January. Three readings were taken per site and recorded into average plants/m2. All of this data was taken using our GIS Pro recording software, using tablet and satellite mapping with GPS.

Pasture cuts
Pasture cuts were taken once pre-season (every 3 months) to ascertain growth rates. To take pasture cuts, one metre square pasture cages were laid out in four GPSed locations that represented the paddock in various treatments. These pasture cages protected the pasture growing within from both feral and domestic animal grazing. Pasture cuts were taken using a 1/16th pasture analysis square and pruning shears from beneath these pasture cages as per DAFWA guidelines, in consultation with Ron Masters.

Pasture cuts were stored in paper bags and dried in accordance to DAFWA regulations at either the Albany DAFWA facilities or the FBG facilities. FBG only has the capacity to dry a few small to medium sized samples so large samples had to be taken to Albany to dry.

The first pasture cuts were taken once the panic was viably established in April 2015. These pasture cuts continued to be taken over the following two seasons. Pasture cuts and compositions were taken by using a cage to protect growing pasture. Firstly, a photo of the cage and pasture within was taken to show how the pasture is growing relative to the rest of the paddock. Secondly, the pasture cage is removed and the 1/16th square placed in the

centre of the pasture cage protected area and a photo is taken, this can help assess composition if data is later lost. Thirdly, pasture cutting samples are taken from within the 1/16th square at a representative grazing height, as per DAFWA protocol and recommendations by Ron Masters. The pasture cage is then replaced over the pasture cut site.

In the second season during peak pasture growth, weights and feed tests were taken from within the 1/16th square and sent to the Feed Test laboratories in Victoria to have the feed value of each monitoring point assessed.

Pasture composition and ground cover scoring
These were done in conjunction with pasture cuts, using the sample that was cut.

3.4 Extension and Communication

The following extension opportunities were planned: presentations at FBG-held events, field walks, newsletter articles and posters. Staff updates at Advisory Committee meetings and monthly staff meetings.

4 Results SITE 1

4.1 Measured trial results

Emergence Results (2014 component: measured in first six months post seeding) to answer Objectives 1.1 and 1.2

Objective 1: Would seeding with a winter cover grass help to establish Gatton Panic?

The Gatton Panic was sown with 10kg of barley to provide a cover crop to both aid with establishment and to give grazing cover from native wildlife. The results exceeded our expectations. Gatton Panic grew at the base of each of the barley plants after the barley hayed off. It was our observation that the Gatton Panic was using the existing growing channels made by the barley and using the stubble to harvest dew down to the Gatton Panic plant.

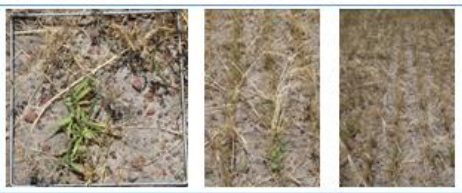
By using the barley as a companion seeding species and seeding early in the recommended seeding window, establishment was extremely successful. Unfortunately, apart from observation, this was a hard to measure. Brian Penna has used barley as a cover crop to plant kikuyu before and surmised that it was a good technique. However, growers must be careful not to seed barley at too high a rate as it can rob the summer pasture of too many nutrients.

Objective 2: Would seeding with a soil wetter help establish Gatton Panic better

The results for emergence can be seen below. Site 1 and 2 represent the paddock average performance and Site 3 represents the wetter-applied site within the paddock. The results show that the site with wetter applied had no difference in plant counts. Photos from each site show the number of plants emerged. However, when looking across the paddock, the wetter applied site appeared to be greener and leafier.

Figure 1:

Site Plant Counts—5th January 2015

Site	Average Plant Count (m2)	Photos
Site 1 (Individual m2 counts = 62, 32, 96)	63.3 Plants	
Site 2 (Individual m2 counts = 144, 112, 128)	128 Plants	
Site 3 **(Wetter Site)** (Individual m2 counts = 112, 112, 128)	117.3 Plants	

Pasture Growth Results (2015-2016 component) to answer Objective 1.3

Objective 3: Would Gatton Panic effectively extend the feed period and value of a pasture paddock over the period of two-three years in either quantity or quality.

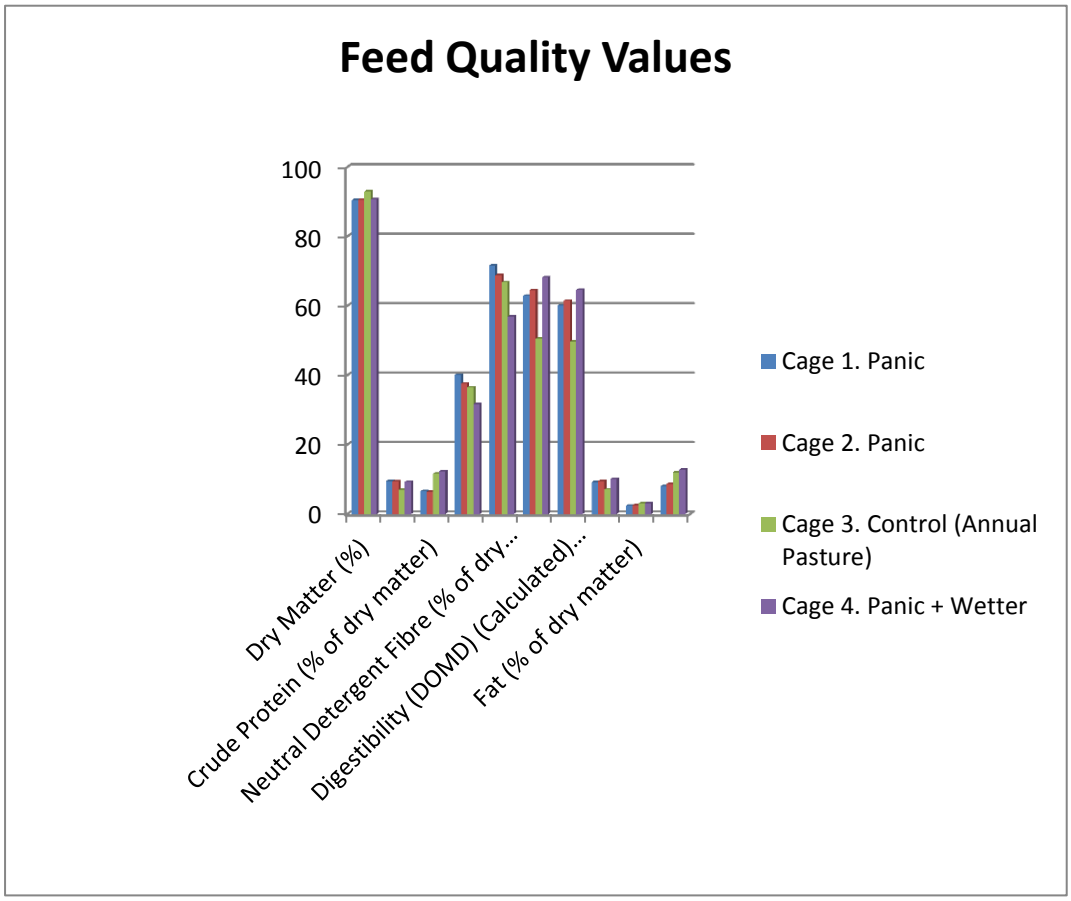
The second phase of the trial measured pasture growth rates as the Gatton Panic persisted throughout the following two seasons. Measurements taken ascertained how much the additional Gatton Panic added to the dry matter of the pasture, as well as the feed value:

a) Assess whether the feed value of the Gatton Panic was higher than a solely annual pasture stand in winter.
b) Assess whether the dry weight yield was higher with the addition of Gatton Panic into the annual yield.

a) Assess whether the feed value of the Gatton Panic was higher than a solely annual pasture stand in winter.

To evaluate whether the feed value of the Gatton Panic was any different to that of the annual pasture, feed tests were completed on each pasture cage at the annual pastures peak production period, July. The feed test measures dry matter and moisture content, crude protein, fibre, digestibility, energy, fat and ash.

Table 1: Results taken from each cage



Dry matter and moisture make up a total of 100% for each sample. The moisture was slightly lower in the annual pasture (cage 3) sample, which caused the dry matter percentage to be higher. Crude protein of the Gatton Panic sites ranged between 6.4% and 12.3% with the annual pasture site yielding 11.6%. There is not enough data to conclude that there is a pattern to the crude protein value of the feed. The fibre component showed no relationship between the pasture composition and percentage of both acid and neutral fibres. Digestibility on the other hand did reveal that the pasture cages that consisted of only annual pasture had a digestibility of only 49.7% whereas the sites that included a panic stand varied from 60.1% to 64.6%. Metabolisable energy was also affected by the addition of the Gatton Panic, ranging from 9.2% to 10.1%, whereas the annual pasture only contained 7.1% metabolisable energy. The fat and ash components of the testing revealed little difference between sites.

Overall there is little difference in the makeup of the feed values. However, there is a large difference in the amount of value gained by animal upon ingesting the feed as the addition of Gatton panic not only has a higher digestibility but also a higher energy component.

b) Assess whether the dry weight yield was higher with the addition of Gatton Panic into the annual yield

The quantity of feed was measured in two parts:

- Percentage of ground cover and percentage of ground cover that was Gatton Panic.
- The dry weight yield of each pasture cage.

The pasture measurements were taken in the middle of each season, every three months and readings taken over a 18 month period. Graphs 1-10 are associated with these results and can be found in Appendix 1.

Summer (January) Ground Cover and Growth
Over both seasons of the trial, summer rainfall conditions were well above average. As a result there was both a very good summer pasture of the Gatton Panic and the typical annual species of clover, ryegrass and windmill grass as well as several other grass species such as silver grass.

At the sites where Gatton Panic was grown, it did out-compete the regrowth annual pasture. This can be seen in the January Ground Cover percentage graph [Graph 1] that shows all sites having above 35% ground cover. At cages 1, 2 and 4, where the Gatton Panic was established into the annual pasture, it out-competed all other species.

In the dry feed, January Pasture Yield [Graph 2], it clearly shows the sites with the Gatton Panic as a companion species are higher yielding, between 9.6t/ha and 6t/ha, than the annual pasture site which yielded 3.5t/ha. This outcome is what we hypothesised and also meant that livestock on this paddock did not have to be supplementary fed over the summer period, resulting in the outcome we were hoping for.

Autumn (April) Ground Cover and Growth
Moving in to autumn it was expected that the Gatton Panic would start to be less competitive and that the annual pasture would be producing an increasing amount of both biomass and ground cover. As can be seen in Graph 3, the ground cover in the annual pasture site increased quite a lot from the January assessment with mostly clover and annual grass species. What was unexpected was the persistence of the Gatton Panic well into the autumn period where it still dominated the percentage of ground cover on the mixed perennial and annual sites.

The pasture cuts and dry feed calculations [Graph 4] show that there was still a lot higher biomass production in the sites that included Gatton Panic. The Gatton Panic sown sites yielded between 1.9t/ha 3.8t/ha, whereas, the annual pasture was only yielding 800kg/ha. This was an unexpectedly high feed value for the Gatton Panic, but was likely achieved through a high rainfall summer period.

Winter (July) Ground Cover and Growth
The ground cover during the winter months reflected the species grown [Graph 5] The ground cover overall increased as the winter growing annual species began to become a higher percentage of plant material. What was surprising was the percentage of Gatton Panic that persisted actively growing into the winter months. The annual pasture cage displayed equal ground cover to the combined species sites.

The dry weight yields for July [Graph 6] continued to show that the combined annual and perennial sites produced significantly more biomass that the annual pasture site. This was unusual as we expected the annual pasture site to perform considerably better during the winter months. The raw data, found in the appendix, details the species composition in more detail. This shows that the annual pasture had a strong increase in clover and ryegrass numbers.

Spring (October) Ground Cover and Growth
October was a particularly dry month with evidence of this seen in the October percentage of ground cover graph [Graph 7] . What is interesting is that the wetter-applied site continued to grow extremely well comparatively at 1-5% in the other plots, compared to 20% in the

wetter-applied plot. This could be a residual effect of the wetter as the label states that it could remain active for up to two years.

Almost all of the ground cover in the mixed annual and perennial species sites was Gatton Panic. Although this meant that livestock had to be rotated to a different paddock to prevent overgrazing, it was the first time since January.

The ground cover is directly reflected in the dry feed yield with 1.3t/ha produced off of the wetter-applied site [Graph 8]. Every other site produced less than 900kg/ha dry feed only. The annual pasture site dried off extremely fast and by this stage was producing only 76.8kg/ha.

4.2 Extension and communication

Date	Activity	Number of people
June 2015	Pop-Up field walk, Penna's property, Jerramungup, WA	12
July 2015	MMM Tour (Livestock and Grains downstream processing and research)	8
September 2015	Presentation at FBG Spring Field Day, Jerramungup, WA	*50*
February 2016	Article in *Sustainabulletin* (FBG newsletter)	*200*
March 2016	Presentation at FBG Farmer Updates, Jerramungup WA	65
Biannual meetings	FBG Advisory Committee meetings – Project update.	~15 on each occasion
May 2017	Article in *Sustainabulletin* (FBG newsletter)	200
Annual Field days and Farmer Updates	Poster display about trial	50 on each occasion

4.3 Participant reactions

Brian believed the Gatton Panic created a extremely good pasture option that complimented the existing range of annual and perennial pastures he currently grows. The Gatton Panic grew so successfully that Brian hosted a number of growers who came out to look at how it was growing and to ask for advice on how to establish it successfully. Brian was also excited by the new species of Panic that had an 80% germination rate in the first year. He believes that a higher strike rate in the initial year of growth would attract more farmers to grow Panic. The thing that worries most people is poor production in the first season if the strike rate is low.

Above: Karryn and Brian looking at Gatton Panic growing from the base of the barley plant stubble, January 2015

SITE 2: Ross and Rhonda Williams

Establishing Serradella and oat pastures into Kikuyu

1 Projective objectives SITE 2

The aim of this trial was to test three different aspects of establishing annual pasture into a perennial pasture stand. These were:

1. To determine what seeding method provides the best establishment of alternative pastures into a long term (eight year) Kikuyu stand.
2. To determine which pasture would establish better into the kikuyu stand: oats or serradella.
3. To determine if a knockdown on the kikuyu followed by soil disturbance would create an environment that entices pre-existing clover in the seed bank to germinate.

2 Methodology SITE 2

2.1 Ross and Rhonda Williams

Location: Gairdner, WA
Rainfall: 450 mm total annual rainfall
Area (total/arable): 629 ha
Cropping: 300 ha
Livestock enterprise: All year prime lamb
Pastures area Annual / Perennials: 300 ha

Soil type: Duplex Sandy Gravel

Rationale for paddock selection: A paddock for this trial was chosen primarily to represent the largest area of rainfall zone in the Jerramungup Shire. For the previous eight years the 35 ha paddock had been sown to kikuyu pasture and grazed by sheep. Ross thought the pasture had started to get old and that the sheep were no longer getting the same grazing quality or capacity from it.

2.2 Treatments

Site set-up and equipment
Fortunately for FBG and MLA the site setup and equipment costs were extremely low because Ross modified all of his equipment to fit the needs of the trial free of cost. Initially we wanted the trial strips to be wider, however the width of the combine limited the width of each individual plot to 1.2m.

The five seeding systems were chosen based on common seeding set ups in the area. These systems included;

- knife points with double disk openers and press wheels,
- winged points with double disk openers and press wheels,
- winged points with press wheels,
- knife points with press wheels, and
- double disk openers and press wheels

Knife Points with Double Disk Openners and Press Wheels | Winged Points with Double Disk Openners and Press Wheels | Winged Points with Press Wheels | Knife Points with Press Wheels | Double Disk Openners with Press Wheels

Diagram 1. Photographs of each seeding set up used underneath the International Combine

Pre-trial soil tests
Soil tests were taken from the site in June 2014, prior to seeding, at three different depths; 0-10cm, 10-20cm and 20-30cm.

Paddock preparation
Paddock preparation proved to be more difficult than originally planned due to poor opening rains, which meant the knockdown was not overly effective the first time because there was not much growth in the kikuyu. The second knockdown was done on the 18th of August 2014 and the paddock resown. To that point there had been almost no growth.

- First Spray: 15th July 2014 Glyphosate 2.5L/ha
- Resprayed: 18th August 2014 Paraquat 2L/ha

The trial was initially sown as a small plot trial on the 16th of July 2014. However, due to poor (and in places zero) establishment, the whole of the surrounding paddock was re-sprayed and then resown on the 26th August 2014.

- First sowing: 16th July 2014
- Resowing: 26th August 2014

The varieties used for the trial were recommended by DAFWA at the time and sourced through the farmer and DAFWA staff. These were;
- Serradella variety: Cadiz seeded at 8kg/ha
- Oat variety: Kojonup seeded at 100kg/ha

Trial plot layout
The trial layout is shown in Diagram 2. The farmer continued to seed the rest of the paddock in the same layout over again until we ran out of room. This provided FBG with three replications for each treatment.

During seeding the trial was marked using flagging tape to show what system, under which crop, was in each location in the paddock.

Two months after the successful seeding, plant counts and ground cover assessments were done using DAFWA guidelines sourced from Ron Masters. After all establishment assessments were done, the pasture was grazed as per normal practice to aid with the tight feed situation of the year.

As this trial was primarily set up to assess establishment methods, only super potash was applied during the trial period. All herbicides & insecticides not including the pre-sowing knockdown, were supplied by the farmer.

2.3 Monitoring

The site set-up only required initial soil testing, which was carried out by FBG staff. Throughout the season photographs and plant number measurements were taken by FBG staff using 1/16 squares, measuring tapes and cameras.

2.4 Extension and communication

The following extension opportunities were planned: presentations at FBG-held events, field walks, newsletter articles and posters. Staff updates at Advisory Committee meetings and monthly staff meetings.

3 Results SITE 2

3.1 Measured trial results

Pre-trial soil tests
Soil test results [Appendix 2 Table 1] indicated that the carbon levels in the soil were quite good for the area and could be a result of the eight years of perennial pasture. Nitrogen, phosphorous and potassium levels were also at expected levels, as the paddock had a good pasture fertiliser history. The pH levels in the soil were also typical for the area, with relative surface acidity of 4.6 and 4.58 with the soil gradually increasing in alkalinity as the profile deepens.

Objective 1. To determine what seeding method provides the best establishment of alternative pastures into a long term (eight year) Kikuyu stand

The trial results for the serradella plot showed that the knife points with double disk openers and press wheels provided the best emergence results but not necessarily the best ground cover. In Table 2 below it can be seen that serradella establishment was almost 100 plants per metre squared (p/m2) more than any other establishment method. However, this method did not provide the highest overall ground cover that could be achieved. The double disk opener with press wheel method provided the best overall ground cover, allowing pre-existing pasture species to continue to emerge as well as the serradella. The winged points and press wheels created more soil disturbance and dried the soil out significantly, this caused only the serradella to primarily germinate, however, it did result in low germination numbers and the poorest ground cover.

Table 2. Plant counts, ground cover and photographs of serradella establishment

	Knife Points with Double Disk Openers and Press Wheels	**Winged Points with Double Disk Openers and Press Wheels**	**Winged Points with Press Wheels**	**Knife Points with Press Wheels**	**Double Disk Openers with Press Wheels**
Serradella (p/m2)	304	117	58.7	42.7	208
% Green Ground Cover	25%	20%	10%	15%	30%
Serradella % Ground Cover	60%	50%	80%	10%	20%

Objective 2: To determine which pasture would establish better into the kikuyu stand: oats or serradella

The oat plots yielded a lower establishment rate than the serradella plots. It was hoped that as a perennial pasture that is relatively soft seeded, there would be a higher initial establishment rate. Table 3 and its adjoining photographs show establishment of each seeding method. The purpose of the oat establishment part of the trial was to assess the likelihood of establishing either a perennial grass pasture or renovation cereal crop. As with the serradella plots, knife points with double disk openers where the best method of establishment with 224 p/m2. The next best establishment results were achieved through using the winged knife points with double disk openers and press wheels. This ended up achieving 64 p/m2 less than the knife points, however, all of that ground cover consisted of oats. If establishing the highest volume of mixed pasture was the major objective, the knife points with double disk openers and press wheels are the best seeding option. If establishing the oats as a monoculture crop, the winged points with double disk openners and press wheels was the best option.

Table 3. Plant counts, ground cover and photographs of oat establishment

	Knife Points with Double Disk Openers and Press Wheels	Winged Points with Double Disk Openers and Press Wheels	Winged Points with Press Wheels	Knife Points with Press Wheels	Double Disk Openers with Press Wheels
Oats (p/m2)	224	160	32	10.2	80
% Green Ground Cover	20%	10%	2%	35%	25%
Oats % Ground Cover	70%	100%	90%	10%	25%

Objective 3: To determine if a knockdown on the kikuyu followed by soil disturbance would create an environment that entices pre-existing clover in the seed bank to germinate

As an experiment the farmer also wanted to add in an empty seed run that just applied fertiliser to assess if it would help establish any pasture out of the pre-existing seed bank. The results of the nil seed can be seen in Table 4. below. This part of the trial showed an emergence of almost 100% clover, however, this plot had the poorest ground cover of each option. It was concluded that there would be no advantage to seeding straight fertiliser when the cost of adding seed of any kind would boost ground cover significantly.

Table 4. Ground cover and photographs of pasture establishment

	Knife Points with Double Disk Openers and Press Wheels	Winged Points with Double Disk Openers and Press Wheels	Winged Points with Press Wheels	Knife Points with Press Wheels	Double Disk Openers with Press Wheels
Nil Treatment - % Green Ground Cover	25%	10%	5%	35%	35%

Table 5 below compares the average green ground coverage of each plot treatment. This table shows that overall, the oats yielded the worst ground coverage and the nil and serradella treatments resulted in the highest pasture establishment. In all but the oats plots, the double disk openers plus press wheels yielded the best and fastest ground cover. This was likely due to the fact that it was a relatively dry establishment period and less moisture was lost in the seeding practices that caused the minimum of soil disturbance.

Table 5. Comparing the average percentage of green ground coverage across serradella, oat and nil treatment plots

	Knife Points with Double Disk Openers and Press Wheels	Winged Points with Double Disk Openers and Press Wheels	Winged Points with Press Wheels	Knife Points with Press Wheels	Double Disk Openers with Press Wheels
Serradella %	25%	20%	10%	15%	30%
Oats %	20%	10%	2%	35%	25%
Nil %	25%	10%	5%	35%	35%

3.2 Extension and communication

Date	Activity	Number of people
September 2015	Presentation at FBG Spring Field Day, Jerramungup, WA	*50*
February 2017	Article in *Sustainabulletin* (FBG newsletter)	*200*
March 2016	Presentation at FBG Farmer Updates, Jerramungup WA	65
Biannual meetings	FBG Advisory Committee meetings – Project update.	~15 on each occasion
Annual Field days and Farmer Updates	Poster display about trial	50 on each occasion

3.3 Participant reactions

Ross and Ronda commented that although the zero seed option achieved higher or equal to, ground cover levels as the serradella in the 2014 season, this would probably not be typical of an average season. Both considered the 2014 season to be an extremely late break, which would inhibit the persistence of the trial into the coming year were it to extend longer. The main reason was because the plants were unlikely to reach maturity in time to set seed before the season ended, due to it seed being sown later than normal.

Ross commented that he would not have seeded the country without seed of any sort even if it was just to refresh the seed bank for the following season as he would have wanted to introduce new pasture species as well as add inoculant to the soil.

SITE 3: Ken and Jan, Paul and Alice Reddington

Improving winter feed content of kikuyu pastures on the South Coast of WA by establishing legumes into kikuyu

1. Projective objectives SITE 3

The aim of this trial was to test three different aspects of annual pasture establishment into a perennial pasture stand. These were:

1 To determine which pasture species (bladder clover or serradella) is the most persistent species when sown into kikuyu.
2 To determine which pasture composition would give the highest feed quantity over the life of the trial.
3 To determine which pasture composition would give the highest feed value.

2. Methodology SITE 3

2.1 Ken and Jan, Paul and Alice Reddington

Location: Bremer Bay, WA

Rainfall: 450-550 mm total annual rainfall

Area (total/arable): 2800 ha

Cropping: 1000 ha

Livestock enterprise: Beef cattle and sheep

Pastures area Annual /Perennials: 1500 ha

Rationale for paddock selection: The Reddingtons farm was chosen because the rainfall and soil type were similar to that of the Williams' farm – SITE 2 of this MLA project. The paddock chosen had a ten year old kikuyu stand that the Reddingtons were looking to renovate with the introduction of pasture species. This paddock represented many of the long term kikuyu pasture stands that are grown on cattle producing properties in the Gairdner/Bremer Bay region.

The two pasture species the Reddingtons wished to trial (clover and serradella) had been successfully established on that soil type previously. The paddock has been consistently grazed by both sheep and cattle and was constantly grazed throughout the life of the trial, therefore creating the need to use pasture cages for the duration of the trial.

2.2 Treatments

Project set-up and equipment
Seeding equipment for the trial was modified by the farmer in response to the results from the trial held at Ross and Ronda Williams. Trial strips were therefore ten metres wide i.e. the width of the Reddington's seeder and repeated twice for the trial area.

Serradella seed and inoculant were sourced through DAFWA contact Ron Masters while Bladder clover seed was sourced through Heritage Seeds. Fertiliser and chemicals to provide a knockdown were also supplied by the farmer.

The pasture received a summer double knockdown of 3L/ha Glyphosate, followed ten days later with another 1L/ha of Sprayseed. This provided an effective knockdown of the kikuyu and suppressed growth enough to allow the legumes to establish when sown in mid March. The kikuyu treatment was also knocked down but not sown, to provide a comparible control for pasture growth measurement.

The trial area covered approximately two hectares of the total paddock and during seeding this area was marked using flagging tap to show where each system was located in the paddock.

The rest of the paddock was sown with the left over seed, except for the controlled section that was not sown and contained kikuyu only.

2.3 Monitoring

Six monitoring point were set up in the paddock, two in each treatment, and recorded through GIS Pro with pasture cages being pegged to prevent lifting. Cages 1 and 4 were used to monitor serradella and kikuyu together. Cages 2 and 5 were used to monitor clover and kikuyu grown together. Cages 3 and 6 were used as a control and to monitor the growth of the kikuyu stand alone.

Throughout the season photographs, plant number measurements and pasture cuts were taken by FBG staff using; pasture cutting equipment, pasture cages and cameras. Pasture cuts were taken using a 1/16th pasture cutting square and pruning shears, from beneath pasture cages as per DAFWA guidelines.

Pasture composition and ground cover scoring was also done during this time, using the sample that was cut. Information was logged into the FBG GIS Pro iPad software. Pasture cuts were stored in paper bags and dried in accordance with DAFWA regulations at either the Albany DAFWA facilities or the FBG facilities. FBG only has the capacity to dry a few small to medium sized samples so large samples were taken to Albany to dry.

Measurements were taken once the annual pastures started to actively grow, in July/August so that the results would actively reflect an established pasture. At the mid point of each season (every three months), plant counts were taken with a 1/16th square, as well as composition and pasture cuts to measure feed yield. All of this data was recorded using our GIS Pro recording software, using the FBG iPad and satellite mapping with GPS.

Pasture cuts and compositions were taken from within the pasture cages. Firstly, a photo of the cage and pasture within was taken to show how the pasture is growing relative to the rest of the paddock. The pasture cage is then removed and the 1/16th square placed in the centre of the pasture cage protected area and a photo is taken. This is used to assess composition. Thirdly, pasture cutting samples are taken from within the 1/16th square at a representative grazing height, as per DAFWA protocol and recommendations of Ron Masters. The pasture cage is then replaced over the pasture cut site.

Pasture cuts continued until the spring of 2016 in order to measure pasture growth. Feed test samples were taken in July; the peak growing period for the annual pastures, and sent to laboratories in Victoria to have the feed value of each pasture composition type calculated.

2.4 Extension and communication

The following extension opportunities were planned: presentations at FBG-held events, field walks, newsletter articles and posters. Staff updates at Advisory Committee meetings and monthly staff meetings.

4 Results SITE 3

4.1 Measured trial results (Appendix 3, Graphs 1 to 5)

Objective 1: To determine which pasture species (bladder clover or serradella) is the most persistent species when sown into kikuyu

To measure which pasture species - serradella or bladder clover - is the most persistent species when sown into kikuyu we counted the number of plants that persisted over the same area during each sampling period using a 1/16th square and calculating the plants per metre squared as a result.

Graph 1 shows the plant numbers taken in each season. The serradella numbers varied a lot with cage 4 showing a typical growth pattern where numbers were highest in the winter months. Cage 1 on the other hand continued to show good growth throughout the summer and into the winter with the only population decline occurring in October 2015. The soil type was consistent across the paddock and there was no evidence of insect burden so the reason for the difference wasn't attributable to either of these. In 2015 September and October had a high number of hot (above 35 degree) days that strongly impacted on pasture survival and growth. By the time pasture cuts were taken in October, many of the annual pasture plants had already set seed. Clover in cage 2 showed a higher general growth rate than the clover in cage 5. However, as with the serradella, the number of plants was extremely variable between sample sites. The kikuyu site of cages 3 and 6 were equally as varied with plant number almost travelling in completely opposite directions. We found the method of counting the plants for persistence extremely varied across each pasture species.

The other way we assessed plant persistence of each species was by measuring the percentage of plant matter within each pasture cut. This way of measuring proved to be a lot more accurate and reflected the pasture composition a lot more than plant numbers. Graph 2 shows the pasture cut makeup of the serradella and kikuyu plot. This clearly shows that as the percentage of serradella increases in the winter months, the percentage of kikuyu harvested falls. In the summer months, the kikuyu pasture percentage increases to fill the feed gap created by a fall in annual pasture species as a percentage of pasture cut.

Graph 3 shows the clover percentage against the kikuyu percent averaged out over the two pasture cage sites. The feed percentages are not as dramatic as in the clover plots as they are in the serradella plots. However, they also show that as kikuyu percentages increase over the summer period, clover percentages decrease. What is interesting is that where the serradella almost completely died off over the summer months, the clover appeared to be more robust.

Objective 2: To determine which pasture composition would give the highest feed quantity over the life of the trial

Pasture yields used to determine which pasture composition would give the highest feed quantity over the life of the trial. The Pasture Yield graph [Graph 4] shows the dry feed yield in kg/ha from August 2015 to August 2016. The graph shows that the sites with the two legume species yielded similar to each other, with serradella sites providing a slightly higher average yield. However, it did demonstrate slightly more variability than the clover site. The 100% kikuyu site, cages 3 and 6, showed similar yields to the composite pastures during the winter months. However, during the summer months it can clearly be seen that the 100% kikuyu pasture yielded 1500-2000kg/ha above the composite pastures.

Objective 3: To determine which pasture composition would give the highest feed value

To determine which pasture composition would give the highest feed value, feed test samples were taken during peak annual species growth in winter. The results of these samples can be seen in the Feed Test Results graph [Graph 5].

There were very few differences in the quality of feed compositions. All assessment factors had less than a 5% variation between all compositions, with crude protein, digestibility, metabolisable energy, fat and ash contents being relatively equal. The only component that showed any value difference was the difference in both types of fibre. Fibre values were 2% higher in the kikuyu pasture than in the clover and kikuyu mix, which was 1% higher than the serradella and kikuyu composition.

After each of the assessments was taken it was evident that the 100% kikuyu pasture was the highest yielding pasture treatment. However, the yield increase was mostly during the summer months with the other two pasture compositions yielding slightly higher on occasion throughout the winter months. The composite percentages clearly showed that the clover and serradella proved to be good companion species, with clover providing a more consistent growth pattern.

4.2 Extension and communication

Date	Activity	Number of people
September 2015	Presentation at FBG Spring Field Day, Jerramungup, WA	*50*
February 2016	Article in *Sustainabulletin* (FBG newsletter)	*200*
March 2016	Presentation at FBG Farmer Updates, Jerramungup WA	65
Biannual meetings	FBG Advisory Committee meetings – Project update.	~15 on each occasion
May 2017	Article in *Sustainabulletin* (FBG newsletter)	200
Annual Field days and Farmer Updates	Poster display about trial	50 on each occasion

4.3 Participant reactions

Although there did not seem to be any feed benefit to either of the combined annual and perennial pasture species sites, Paul and Ken will continue to seed legumes into their kikuyu pasture on a regular basis. They see the advantages of growing their own nitrogen using legume species and had a general observation that the additional species helped to 'renovate' the pasture.

5 Discussion ALL SITES

SITE 1: Brian and Janet Penna - Improving summer feed content of annual pastures on the South Coast of WA by introducing Gatton Panic

This project succeeded in testing all of the grower aims. By using a winter cover grass at sowing, it provided grazing protection from vermin as well as provided both root and moisture channels that helped the Gatton Panic establish fast. There were several added advantages of this cover crop that we did not foresee going into the project.

The use of wetter on part of the trial did not seem to affect establishment greatly as the perennial sowing season started remarkably well. However, in the second year, whilst measuring the pasture production, the wetter applied site did grow a higher yielding pasture stand suggesting that in these soil types, there may be longer lasting effects of soil wetter than just one year.

The Gatton Panic effectively extended the feed period and value of the pasture paddock for the trial duration. The amount of feed grown exceeded initial expectations and has since encouraged several growers in the mid-low rainfall zone to try growing Gatton Panic on their own farms.

The Gatton Panic raised the quantity and quality of pasture produced in the paddock. The Gatton Panic stand improved the digestibility and energy of the pasture marginally. However, the biggest gain was seen in overall bulk yield produced over the traditional annual pasture.

There were very few limitations to this project as the initial year of establishment was ideal. The only affect this had was on one of the original project objectives: testing the theory of using soil wetter to increase the success of establishment. There may have been a more detectible difference in treatments had the first summer not been particularly wet. The cover crop provided adequate protection during establishment and was an idea that can be carried into many other pasture trials if vermin is an issue.

The duration of the trial was very good at three years, as it gave us sufficient time to capture results. If the initial establishment year was a failure it would have provided enough time to

The key to the success of this trial has been a combination of establishment methods and choosing an ideal season to establish the pasture crop in.

5.1 Outcomes in achieving objectives

Project objectives	Outcomes
1. To determine if seeding with a winter cover grass helps to establish Gatton Panic.	A winter cover grass does help to establish Gatton Panic. Observation of emerging Gatton Panic plants showed they grew at the base of each barley plant after it hayed off. The grass used the existing root channels made by the barley and also used the stubble to harvest dew
2. To determine if seeding with a soil wetter helps establish Gatton Panic better.	During the establishment phase, there was no conclusive measurable difference in plant counts between areas with and without wetter. Wet conditions were experienced during this phase and drier conditions may have resulted in more detectible differences between treatments. However, in the second year, measurements showed the wetter-applied site had higher pasture production yields.
3. To determine if Gatton Panic could effectively extend the feed period and value of a pasture paddock over a two to three year period in either quantity or quality.	Test results demonstrated that Gatton Panic raised both the quality and quantity of pasture production. It improved digestibility and energy marginally but the biggest gain was in the increased overall bulk yield compared with the annual pasture.

SITE 2: Ross and Rhonda Williams - Improving winter feed content of kikuyu pastures on the South Coast in the winter months by establishing Serradella and oat pastures into Kikuyu

The late break to the 2014 season and the very dry summer that followed had several implications for this trial. In the first instance, it meant it was hard to get an effective knockdown to work on the kikuyu as it needs to be actively growing to achieve control. This late knockdown delayed the winter pasture species establishment.

Unfortunately for FBG and Ross and Ronda, we were unable to use this paddock to do ongoing monitoring of the trial due to the sale of the property. Although this was unforeseeable and not expected, in the future it is something that we will need to be aware of when selecting trial sites.

In both Oat and Serradella sown pastures, the knife points with double disk openers and press wheels provided the best seedling establishment by far. This seeding method also allowed for clover to germinate as well as serradella. Fortunately this was the goal of the farmer. This seeding method is one of the most common amongst farmers in this rainfall zone. The wing points seemed to dry the soil out more and although it created an environment with less weed competition there was visually less moisture in the soil. On an establishment year such as 2014 when soil moisture was low and the break in the season was late, water conservative seeding methods definitely had the advantage.

The serradella pasture established a better stand than the oats and will prove to be a longer lasting, species diverse pasture. This is mainly due to the fact that oats are typically a single season option whereas the serradella would be more likely to persist in the following seasons. If it had been possible to establish plants earlier and with more long term success,

pasture cuts and feed tests would have been taken to establish which option had the better feed value, as well as establishment.

Soil disturbance did instigate growth of clover seed in the seed bank, which can be seen in the results where ground cover is equal to or more than the seeded Serradella over most seeding methods. The higher the tillage option the more the soil dried out, causing lower germination rates.

5.2 Outcomes in achieving objectives

Project objectives	Outcomes
1. To determine what seeding method provides the best establishment of alternative pastures into a long term (eight year) Kikuyu stand.	In both oat and Serradella sown pastures, knife points with double disk openers and press wheels provided the best seedling establishment by far. The wing points seemed to dry the soil out more and although they created an environment with less weed competition there was visually less moisture in the soil.
2. To determine which pasture would establish better into the kikuyu stand: oats or serradella.	The serradella pasture established a better stand than the oats.
3. To determine if a knockdown on the kikuyu followed by soil disturbance would create an environment that entices pre-existing clover in the seed bank to germinate.	Soil disturbance did instigate growth of clover seed in the seed bank. The higher the tillage option the more the soil dried out, causing lower germination rates.

SITE 3: Ken and Jan, Paul and Alice Reddington - Improving winter feed content of kikuyu pastures on the South Coast of WA by establishing legumes into kikuyu

The most persistent pasture legume species sown into the kikuyu was the bladder clover. It was slightly more persistent throughout the year whereas the serradella was more predominant during winter months but less so during the summer. Both legume species continued to germinate at very good rates in season two indicating the persistence was relatively good in both species, even though kikuyu was not suppressed in the second year. This also indicates that the Kikuyu may also provide an environment which softens the hard seed characteristics of serradella and bladder clover as these specieis would not normally be expected to regenerate in the second year.

The highest feed quantity over the life of the trial was the kikuyu pasture with no companion species. It produced between 1500kg-2000kg/ha higher yield during the summer months higher than the composite pastures and only 500kg/ha less, in one circumstance, than the composite pastures during winter. The kikuyu pasture was also the pasture that contained the highest quality of feed. However, the kikuyu was only marginally higher in digestible fibre, with little other feed value differences between compositions.

There were very few limitations to this project. The only problem that FBG encountered was measuring pasture in actively grazed paddocks. Pasture cages provided adequate protection from grazing by cows and sheep. However, yearling cattle and bulls were more curious and tended to push cages around the paddocks for fun. Cages were pegged down with giant tent

pegs to prevent the cages from being pushed over. This worked in most situations. In the future it would be recommended that all cages involved with actively grazed cattle pastures were pegged down and another replication added in case trial plot information cannot be gathered.

5.3 Outcomes in achieving objectives

Project objectives	Outcomes
1. To determine which pasture species (bladder clover or serradella) is the most persistent species when sown into kikuyu.	The most persistent pasture legume species sown into the kikuyu was the bladder clover. It was slightly more persistent throughout the year whereas the serradella was predominant during winter months but less so during the summer. Both legume species continued to emerge at very good rates in season two indicating the persistence was relatively good in both species, even though kikuyu was not suppressed in the second year.
2. To determine which pasture composition would give the highest feed quantity over the life of the trial.	The highest feed quantity over the life of the trial was the kikuyu pasture with no companion species. It produced between 1500kg-2000kg/ha higher yield during the summer months than the composite pastures and only 500kg/ha less, in one circumstance, than the composite pastures during winter.
3. To determine which pasture composition would give the highest feed value.	The kikuyu pasture was also the pasture that contained the highest quality of feed. However, the kikuyu was only marginally higher in digestible fibre, with little other feed value differences between compositions.

5.4 The value of the research results (Benefits/Costs)

These results give farmers in our area a clear message that it is possible to improve the feed value of their perennial grasses using different combinations of species and techniques, depending on their individual circumstances. Environmental benefits include increased ground cover and reduced water run off.

When the project was being designed it was decided that no specialty machinery would be used so as to encourage other farmers to also try establishing the pasture with existing equipment.

The key take-home messages from these trials is that the combination of the establishment method and good seasonal conditions were the determinants of success.

The costs associated with establishing the pasture and the resulting economic benefits in terms of feed quantity, quality, availability and feed conversion rates were not part of the scope of these trials. This could possibly be incorporated into a future trial comparing the benefits of different pastures grown in the area.

5.5 Promotion of research results and its effectiveness

The FBG used a range of extension messages to promote the trial. These included presentations at FBG-held events, field walks, newsletter articles and posters, aimed primarily at the farming community in the Jerramungup Shire – approximately 200 businesses in total. We know anecdotally that farmer to farmer learning is favoured so our approach is to facilitate those opportunities when we hold events, ideally by getting the

farmer to give his/her perspective in a presentation. If we are able to carry out a trial that the farmer identifies as beneficial, then the farmer him or herself will promote it 'in their own time' as it were.

We also hold Advisory Committee meetings two to three times a year. This committee is made up of FBG farmers and representatives from relevant agencies and its objective is to provide a forum for the exchange of farming related research ideas between famers, FBG staff and Board in an informal atmosphere. Staff provide updates of the work, and this has included updates on the MLA trial. This is an extension of the farmer to farmer learning concept.

Accurately gauging the success of the extension methods is not easy. Whilst surveys are a seemingly obvious way of doing this (and we do conduct surveys at each of our main events) they can be over-used to the extent that farmers don't want to engage. If a farmer reads about the trial through a newsletter or a poster, or even through an event, *and* adopts the practise we don't necessarily hear about it. That said, we have heard anecdotally that several growers have tried establishing Gatton Panic themselves.

Several FBG staff members assisted with field work and are familiar with aspects of the MLA trials. In addition, we hold monthly staff meetings in which we are updated on all projects the group is involved in. The benefit of these interactions is that these staff themselves are dealing with different farmers through their own work and can create opportunities to engage about the trials. The flow of information can work two ways with opportunities for staff to learn about adoption, albeit informally.

6 Conclusions/Key messages/recommendations

The key take-home message from these trials is that the right combination of species, establishment methods and seasonal conditions are the determinants of success. Because this varies between soil types and rainfall zones, there is a need for locally-based trials.

When the project was being designed it was decided that no specialty machinery would be used so as to encourage other farmers to also try establishing the pasture with existing equipment. Farmers were willing to make modifications to existing machinery where necessary. We think this is an important consideration for trials we run.

We know anecdotally that practise changes do occur when our farmers get the opportunity to see what other farmers in our area are doing. Measuring practise change in a meaningful way is difficult, although surveys may seem to be the most obvious means of doing this, this method is so over-used that farmers tend to disengage. There is also a time-lag factor to consider and that is that adoption isn't necessarily going to occur during the trial period itself or shortly thereafter. It may first need to be factored into a farm plan and budget, and the right seasonal conditions then need to occur before establishment attempts are made.

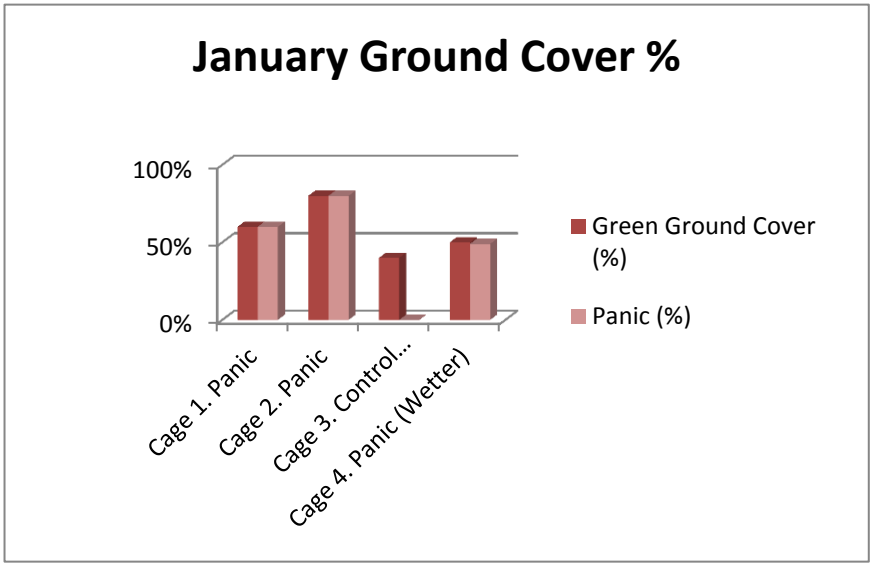
The costs associated with establishing the pasture and the resulting economic benefits in terms of feed quantity, quality, availability and feed conversion rates were not part of the scope of these trials. This could possibly be incorporated into a future trial comparing the benefits of different pastures grown in the area.

7 Appendices

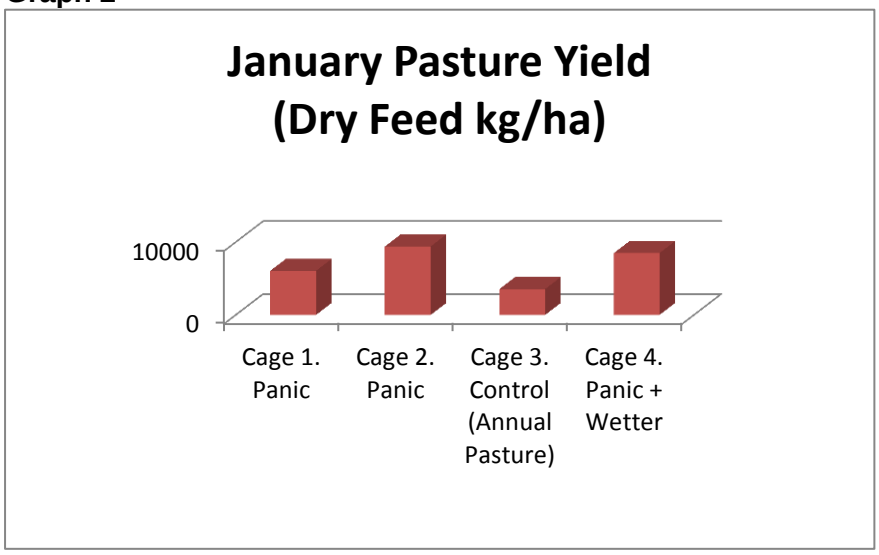
7.1 Appendix 1: SITE 1. Brian and Janet Penna. Improving summer feed content of annual pastures on the South Coast of WA by introducing Gatton Panic

7.1.1 Graphs 1-10 pertaining to results

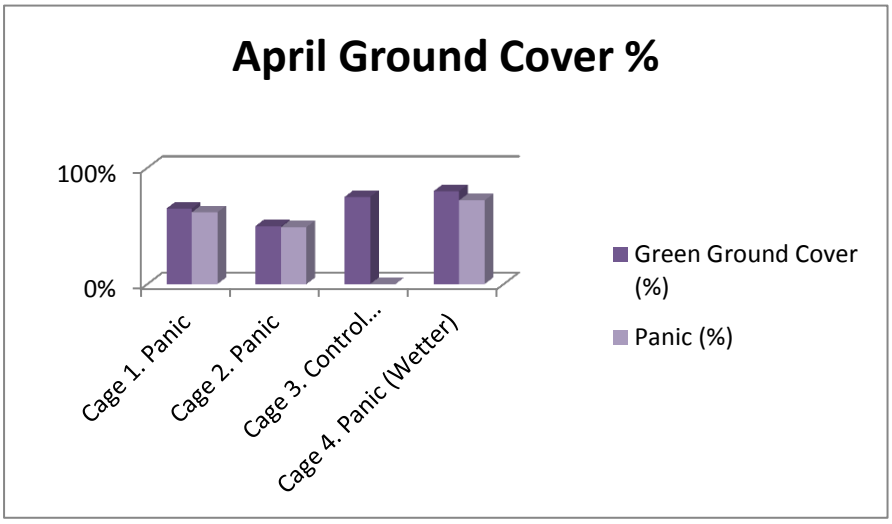
Graph 1



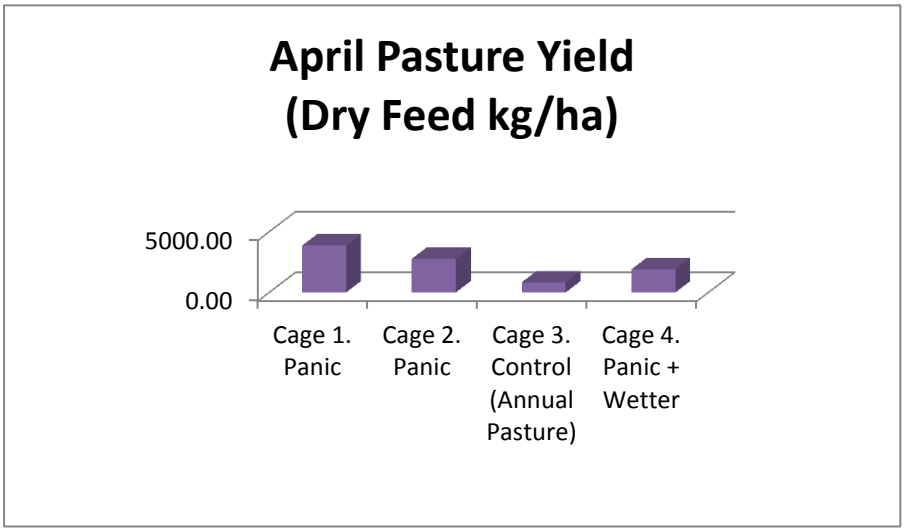
Graph 2



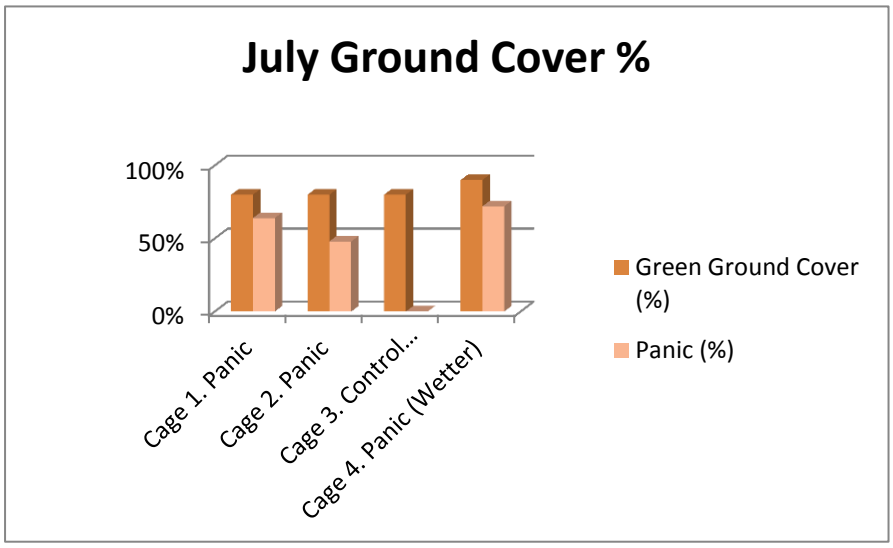
Graph 3



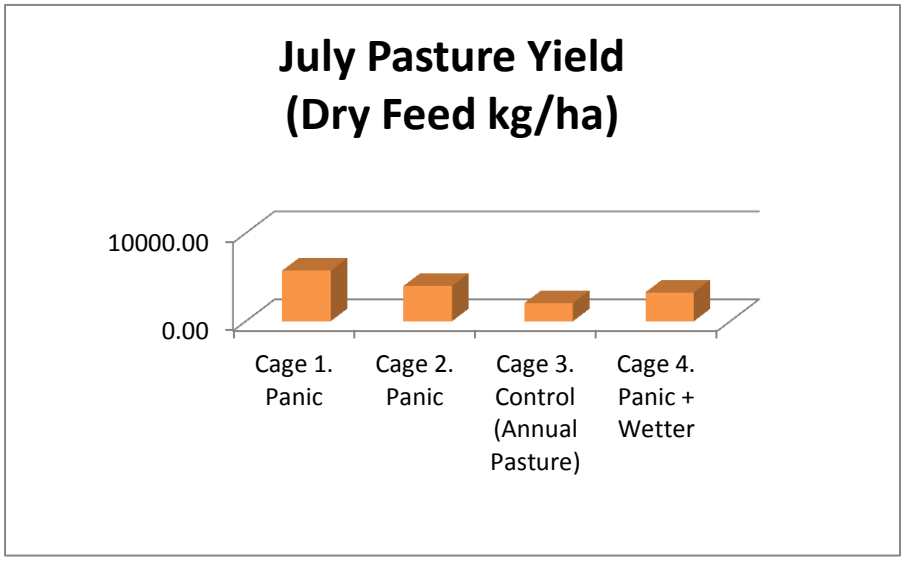
Graph 4



Graph 5



Graph 6



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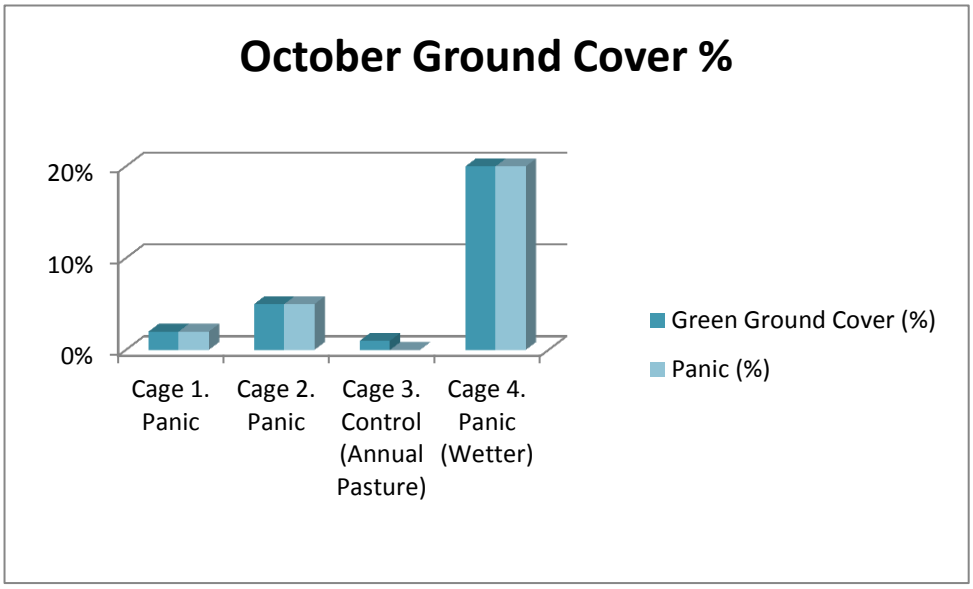

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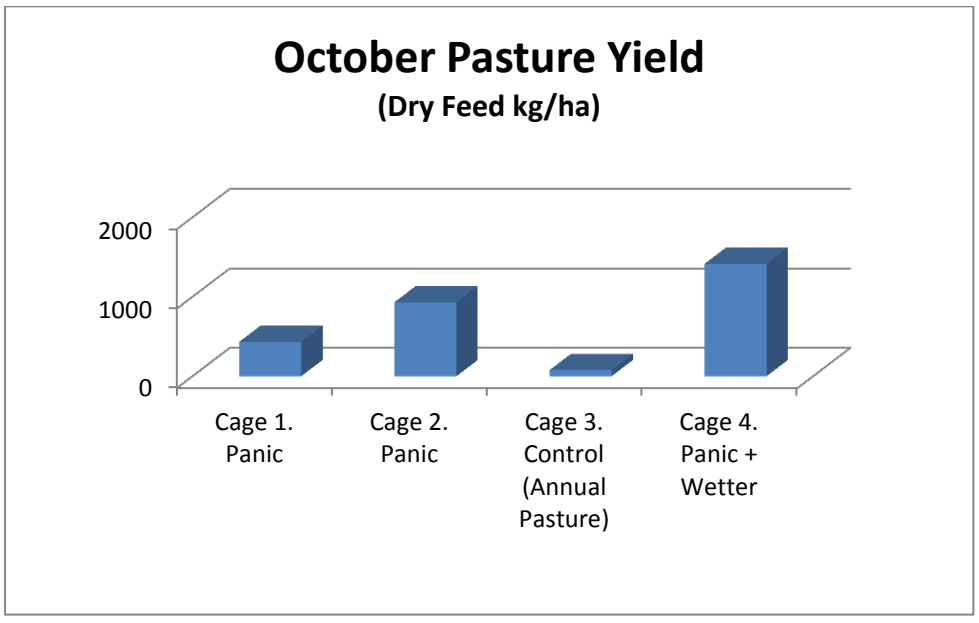

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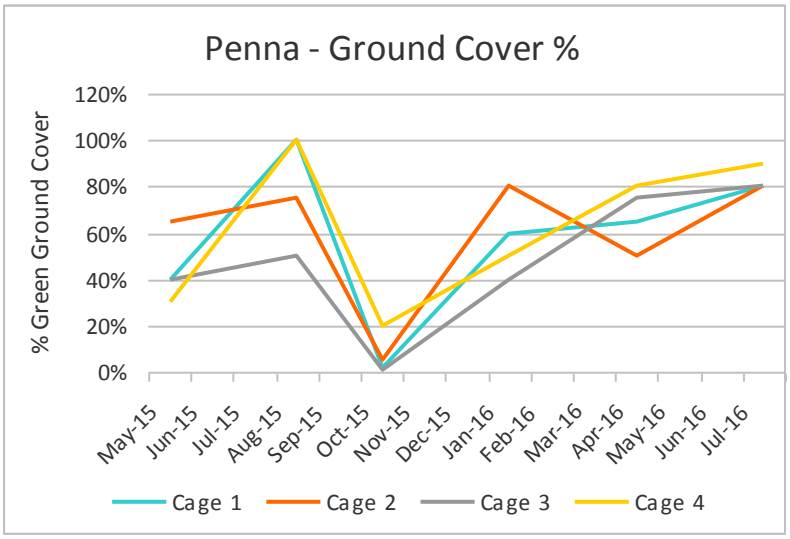
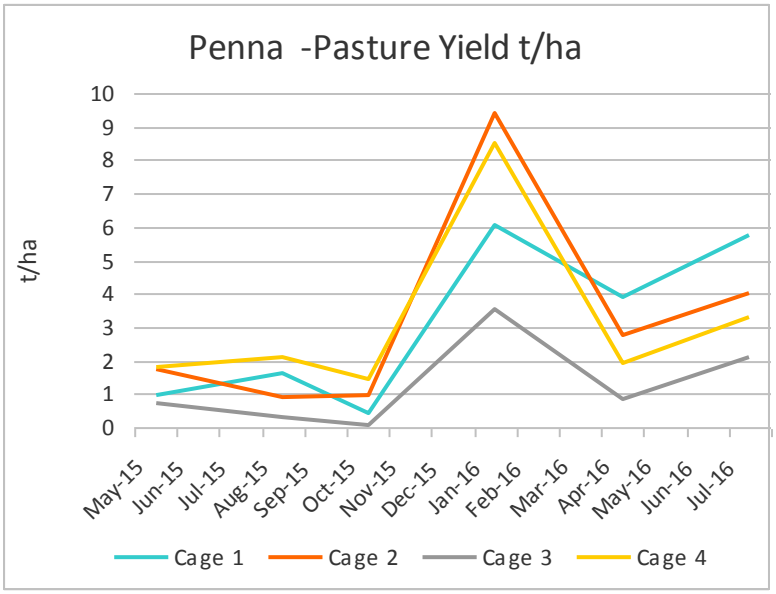


Graph 10



7.1.2 Photographs

Above: FBG staff, Georgina Griffiths and Jess Brown carrying out 2015 spring pasture cuts.

Above: Second year grazed Gatton Panic around pasture cutting cage 2

Above: Photo taken of pasture cage protecting pasture growing within the grazed paddock.

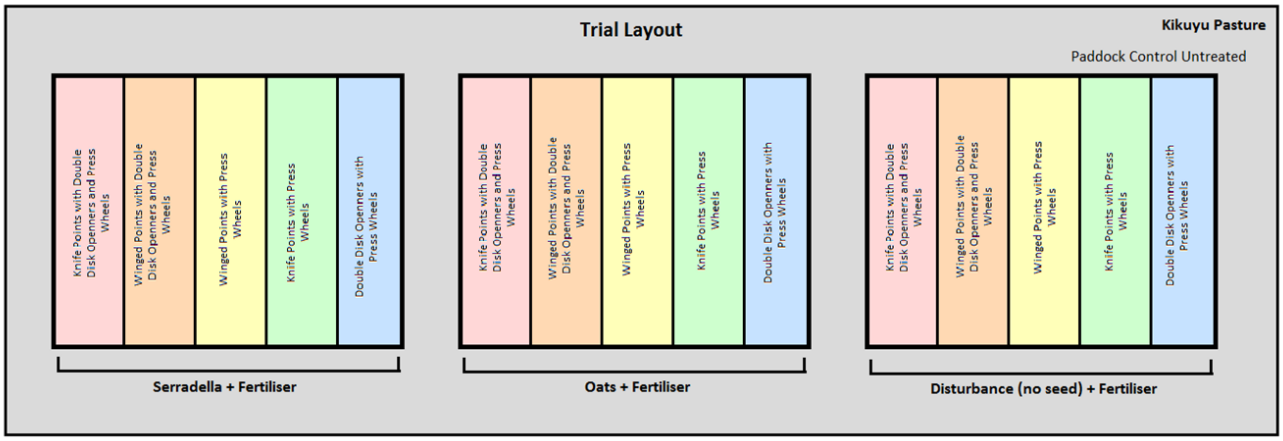
Above: Gatton Panic growing from the base of the barley plant stubble, January 2015

Above: Established Gatton Panic in year 1

Above: Gatton Panic within the 1/16th pasture cutting square used to measure pasture composition and to take the pasture cut for dry from.

7.2 Appendix 2 SITE 2: Ross and Rhonda Williams. Improving winter feed content of kikuyu pastures on the South Coast in the winter months by establishing Serradella and oat pastures into Kikuyu

7.2.1 Seeding layout for trial



7.2.2 Soil test results

Table 1

Soil Depth (cm)	Carbon [1] (%)	Nitrogen [1] (%)	C:N	pH ($CaCl_2$)	EC (mS/m)	Gravel [2] (%)	Sand (%)	Clay (%)	FC [3] (%)	Colwell (ppm) P	Colwell (ppm) K
0-10	1.99	0.152	13	4.60	7.8	15	94	0	22	14	98
10-20				4.58	3.2	63	92	2	20	9	94
20-30				4.85	2.4	74	90	2	19	7	116

7.2.3 Photographs

Above: Trial paddock at time of selection, October 2013, prior to seeding.

Above: Site immediately prior to second seeding on the 26th August

Below: sheep grazing the site, September 2014 due to feed shortage

Left: Cadiz serradella emerging through desiccated kikuyu stubble.

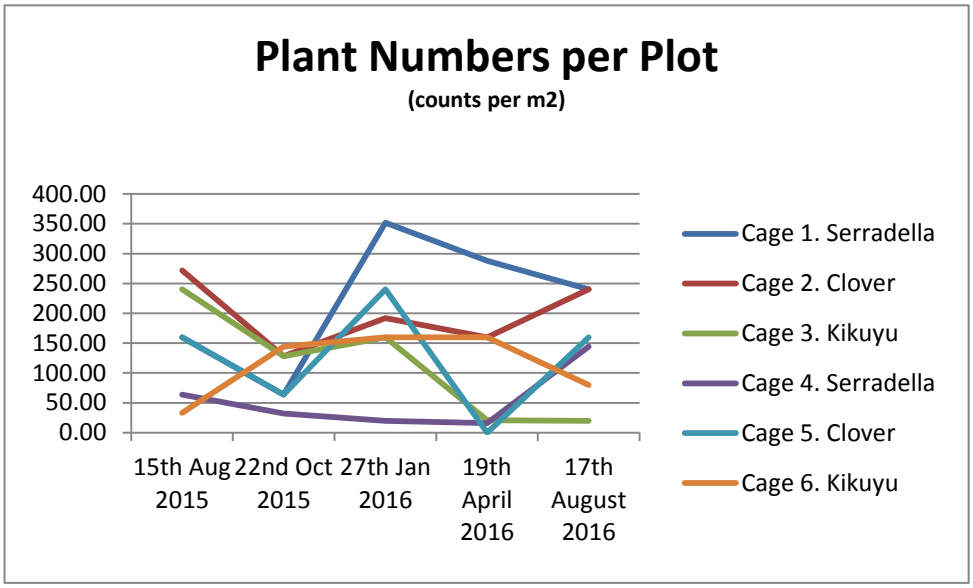
Right: Kojonup oats emerging in the knife points with double disk opener and press wheel plot

Ronda helping to take initial paddock assessment measurements

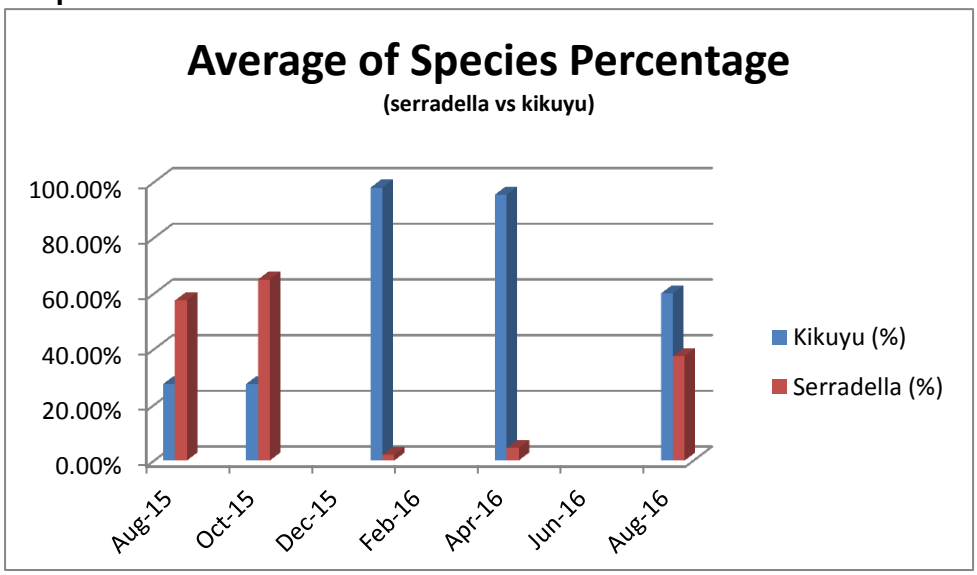
7.3 Appendix 3 SITE 3: Ken and Jan, Paul and Alice Reddington. Improving winter feed content of kikuyu pastures on the South Coast of WA by establishing legumes into kikuyu

7.3.1 Graphs pertaining to results

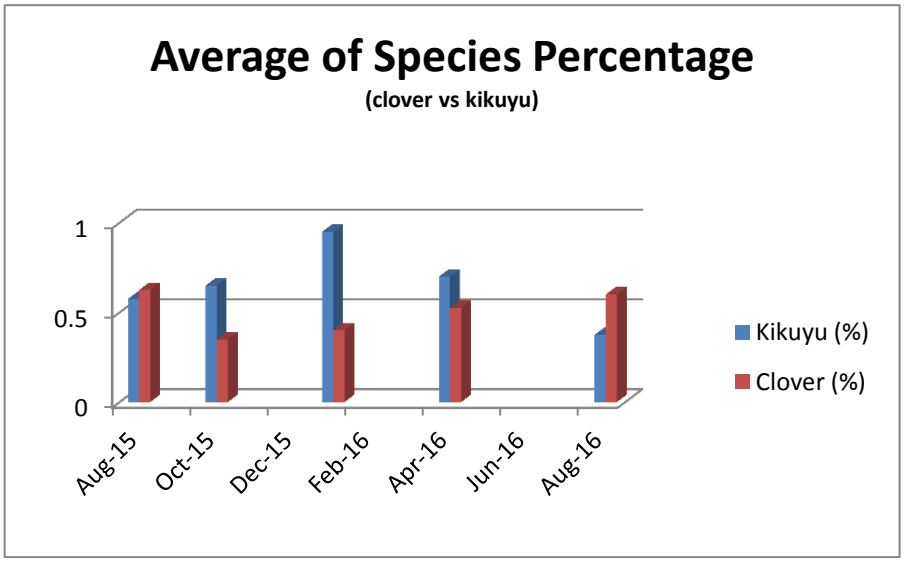
Graph 1



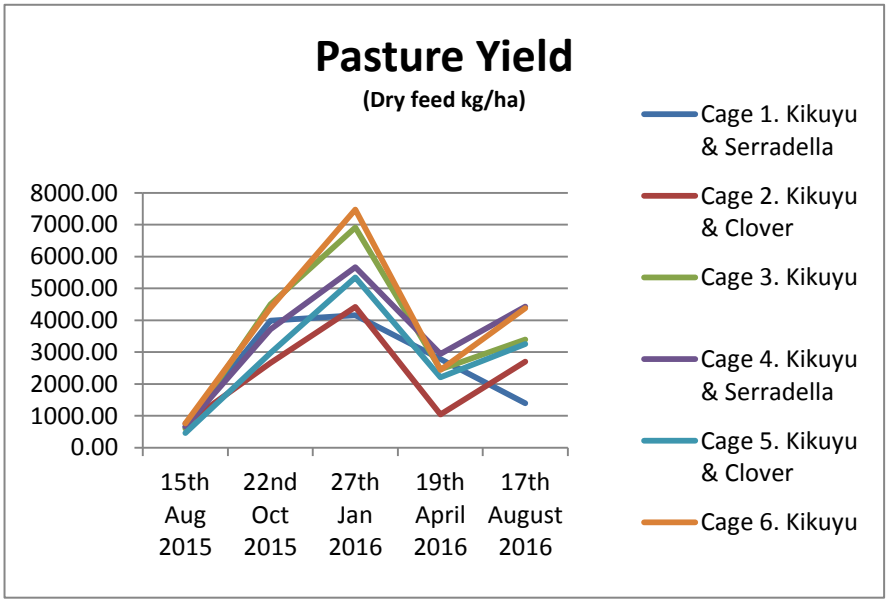
Graph 2



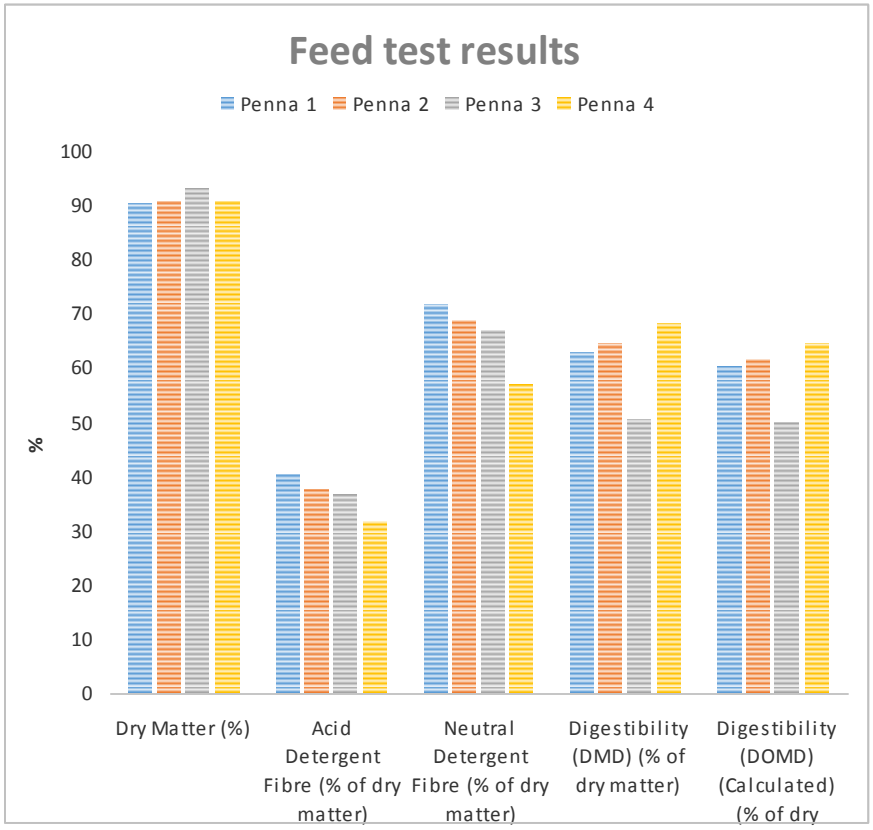
Graph 3



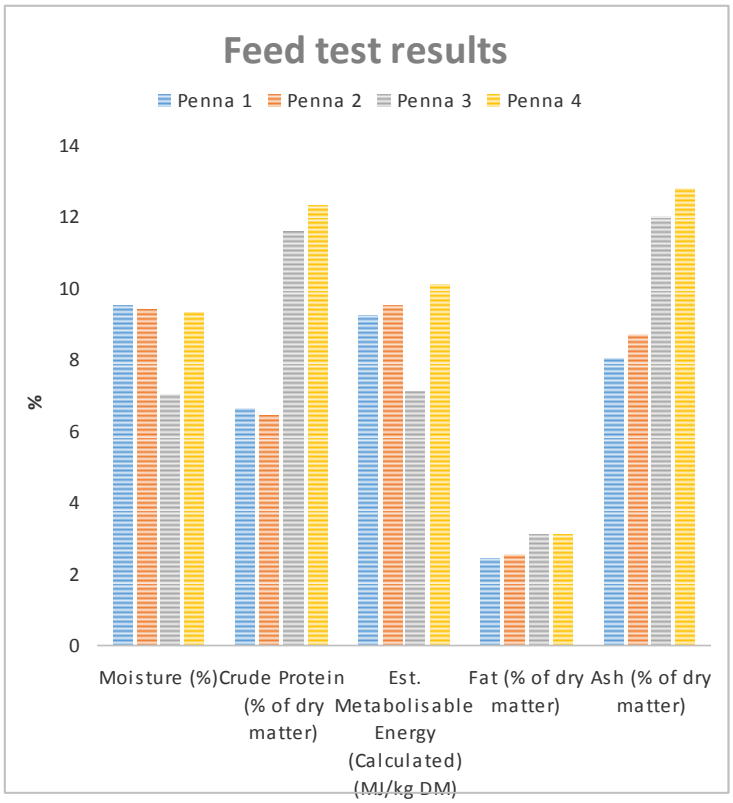
Graph 4



Graph 5



Graph 6



7.3.2 Photographs

Above: Trial paddock being grazed by yearling cattle, overlooking West Mt Barren.

Above: Pasture cage that has been 'rolled' by yearling cattle grazing the site.

Above: Karryn cutting and recording pasture cut samples.

Above: Location of the pasture cages show in the GIS Pro.