final report

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SFS BBN - Tropical pastures

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Executive Summary

Producers in Gippsland have begun to use tropical grasses in their pastures and have a need to find productive feeds that fill feed gaps in summer and autumn. With the region receiving summer rainfall, having milder climatic conditions and the potential for more summer rainfall in the future, it is beneficial for producers to find species that utilise these conditions.

The aims of this project has been to evaluate the establishment, performance and persistence of tropical grasses and possible companion legumes, whilst considering potential animal performance of these pastures in Gippsland. This project is a MLA's Producer Research Site program, a component of MLA's southern Feedbase Investment Plan. In particular, this project supports the MLA funded project B.PSP.0001 – Increase feedbase production and quality of sub-tropical grass-based pastures.

There were three sites established across central to eastern Gippsland to cover different soil types and climatic conditions. At each site the tropical grasses, Panic, Digit, Bambatsi, and Rhodes, were compared against Kikuyu and summer active Fescue to provide feed over the summer and autumn. Six companion legume species were also sown at each site, with variety selection determined by site soil and seasonal parameters.

The project found that all tropical grasses tested can establish, but invasion of annual grasses and broadleaf weeds over the winter compromised their persistence, especially the grass species with erect growth habits.

Slow establishment of the different species was an issue. Each trial lost a number of plants due to weed competition. Soil fertility and weed seed burdens on each site played a key role in establishment success. This was particularly evident in the success of the Bairnsdale trial site, which had good soil nutrition and had been cropped prior to sowing, unlike the other trial sites. The lower soil fertility at Seaspray and Bengworden restricted plant growth which may have allowed weeds to establish.

Continental Tall Fescue, used as a comparative species at all trial sites, unexpectedly persisted and produced well in both clay and sand textured soils, was the pick of the species trialled - provided good soil fertility can be maintained. Panic, Digit and Rhodes grass were not suitable in the clay soils, and only Bambatsi and Kikuyu maintained plant numbers. In lighter textured soils where Panic, Digit and Rhodes grass are already adapted, they failed to persist because of competition from annual grasses and Kikuyu and Tall Fescue maintained levels within the pasture.

For companion legumes, the trial found that Subterranean clovers, Arrowleaf clover and Persian clover were the best performing clovers. These legumes were found to be the most suitable for establishment planting in autumn, through established summer active pastures. However, where there was competition from existing pastures, establishment was still poor. A better approach would have been to use herbicide suppression of the grasses at sowing.

This project received additional collaborative support from Agriculture Victoria, allowing the group to increase the scope of the research undertaken.

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1 Background

1.1 Southern Farming Systems Gippsland Branch and Better Beef Group

All members of the producer group involved with the trial on subtropical grasses are, or have been, members of Southern Farming System (SFS), with an additional cross-over of members from the Better Beef groups in Gippsland.

The project involved eight farming enterprises from across central and eastern Gippsland, covering approximately 38,600 ha. The eight producers' properties size ranged between 1,000 to 19,500 hectares, larger than the average for the region. Of the eight producers involved in the trial, all produced cattle (7,834 head), one also produced goats (1,200 head), six of the eight produced sheet (35,740 DSE) and six producers ran a cropping enterprise in conjunction with their livestock business. Those that crop tend to do so with a crop phases of 5 years followed by 5 years of a pasture phase.

The farm businesses involved in this project had a pasture systems are based around perennial ryegrass, phalaris and sub clover. Kikuyu has been a tropical grass grown in the district for many years, mainly in small areas on light soils for groundcover purposes.

The SFS Members within the Producer Group aim to improve the profitability of farming systems in the high rainfall farming zone and in particular Gippsland. The Gippsland branch of SFS was formed in 2001 and is a not for profit producer group. Janice Dowe is the Gippsland SFS branch co-ordinator and also the PRS group co-ordinator supported by Wayne Burton, AgVic. The Better Beef Network (BBN) is a state wide organisation whose Gippsland Branch aims to increase the productivity and net value of the beef industry in Gippsland.

To improve the profitability of their farming businesses, all members of the group are involved in trialling different practices on their own properties and have had experience with hosting trials for organisations they are involved in. Through SFS a number of members have trialled and/or are now growing Premier Digit Grass which has been part of a pasture cropping project. Other on-farm projects members have been involved in through SFS are trialling organic amendment at four different rates to add organic carbon, reduce the reliance on inorganic fertilisers and to improve yields. The majority of the farmers are heavily involved in the research trial site at Bairnsdale and the projects that occur on the site.

The group members actively seek information to improve their profitability and soil asset.

1.2 Issues faced by the group

There are a number of issues that producers face in Gippsland. The group face production and environmental issues over summer and autumn. The group have a summer and early autumn feed gap which they replace with supplementary feeding or silage. Both management practices are expensive and time consuming to do.

A number of group members currently use Kikuyu, but they find the species a challenge to deal with in the farming system, especially if cropping, due to its growing habit.

Whilst Kikuyu does offer some positive attributes, such as erosion protection it can be hard to establish and manage to maintain quality and have concerns of it spread into areas where they don't want it.

In addition, some producers would also like to grow a legume component to supplement the Kikuyu with a source of nitrogen to provide winter feed. Group members also need strategies to better manage Kikuyu to prevent it from out competing other useful pasture species. The group currently uses Whittet Kikuyu but there may be other varieties or tropical grasses more suitable for their pasture systems.

Trial areas of Premier Digit grass had been established successfully on farms in East Gippsland. Producers are asking questions about its establishment, grazing management, control of weeds within it and its potential invasion into non-target areas.

The producers also struggle to keep groundcover on lighter soil texture areas which have a tendency to blow in summer, losing nutrients, organic matter and opening up the areas to summer growing weeds which are difficult to control like African Love Grass. When these areas lose groundcover, their recovery is slow and show poor responses to autumn rainfall.

1.3 Producer management practices

The group's common practice prior to the project was to fill summer feed gaps with supplementary feed or silage and graze stubbles. The main species grown for summer feed was limited to fescues or phalaris where paddock conditions were suitable.

Most farmers had some Kikuyu growing on lighter country and valued it as groundcover. One farmer had sown Premier Digit grass. No producers were using tropical pastures within their cropping systems, where they have 5 years of pasture followed by 5 years of crop.

1.4 Motivation of the group

Gippsland weather patterns are generally milder than in other parts of Victoria and Bairnsdale receives a quarter of its average annual rainfall over summer and this figure is higher on coastal areas and is predicted to increase with climate change.

The group have an interest in tropical pastures, primarily because of this summer rainfall that they believe is being under-utilised and wasted. They want to use this rainfall to fill the summer feed gap, thereby reducing supplementary feeding and to have something that will compete against other summer active weeds. They also see benefits in tropical grasses providing groundcover, stabilising sandy soils prone to erosion and to expand the diversity of feeds they have available.

For those who have cropping as an enterprise, producers are also interested in how they could make tropical grasses fit a winter cropping program. There are a number of tropical grasses that are available and the producer group were keen to find the most productive species that fits easily into their farming systems and provides a feed option over the summer period using the "Right plant Right place" logic.

2 Projective Objectives

This project forms part of MLA's Producer Research Site program that is part of the southern Feedbase Investment Plan. In particular, this project supports the MLA- funded project B.PSP.0001 – Increase feedbase production and quality of sub-tropical grass-based pastures.

The project objectives were to:

1. Evaluate the establishment, performance and persistence of sub-tropical grass species in three locations in Gippsland, Victoria
2. Evaluate the establishment, performance and persistence of a range of companion legume species in sub-tropical grass pastures in Gippsland, Victoria
3. Estimate the potential animal performance of the legume/grass pastures for seasonal conditions in Gippsland, Victoria.

3 Methodology

3.1 Site information and experimental design

There were 3 sites were chosen for the project which represented the main soil types in Gippsland and they were:

- Sand (Seaspray site)
- Sandy loam (Bengworden site)
- Clay (Bairnsdale site)

As Gippsland also has different climatic conditions from west to east, one site was in in central and the two in the east (Figures 1, 2 and 3) for climatic data.

Over the project the region has experienced both the wettest and driest weather conditions. Although this has made managing the trial difficult, it showed which species were able to handle the different conditions.

The sites were located on low phosphorus soils on sand and sandy loam and a moderate P soil on clay at Bairnsdale with an Olsen P of around 10 mg/kg (Table1). The Bengworden site also had low levels of potassium and aluminium levels that could affect highly sensitive species to aluminium toxicity. The species and cultivars sown at each site are summarised in Table 2.

Seaspray: This site was within 5km of the coast line with an average annual rainfall of 595 mm. It was south of the Strzelecki Ranges which can have a more westerly weather pattern and can benefit more from showers. The soils are a sand in undulating country. The paddock has not had fertiliser for many years. The paddock was sown down to phalaris and sub clover in the 1960's. In autumn 2014, the pasture composition was mainly native grasses (Austro-danthonia) with some sub clover.

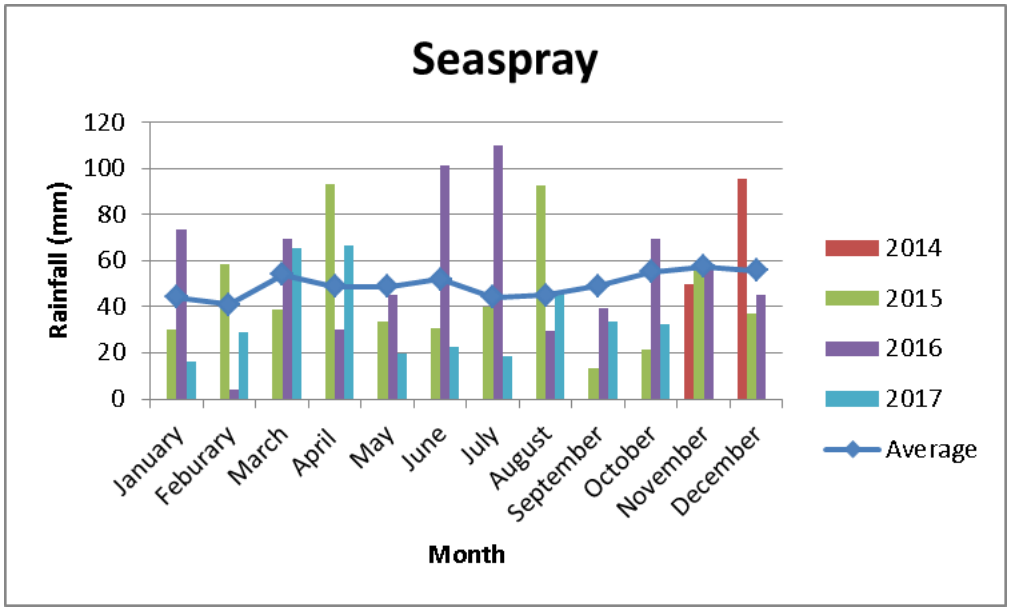

Figure 1: Rainfall for Seaspray over the project period compared to the average rainfall. (Source: BOM)

Bengworden: The site has an average annual rainfall of 625 mm and the sandy loam soil is situated in the dune country behind the Gippsland Lakes. The paddock has not been sown to anything for a number of years but had a pasture of ryegrass, Microlaena, Couch, Kikuyu and clovers during the winter. In autumn 2014, the pasture composition was mainly annual ryegrass and clovers during the winter.

Meerlieu weather station is the closest to the Bengworden site. This site experiences a more easterly weather pattern and in 2016 (see figure 2) it was also one of the wettest. Fortunately it's a sandy loam soil and on a rise, so was well drained and did not suffer the yield losses that were experienced elsewhere due to waterlogging.

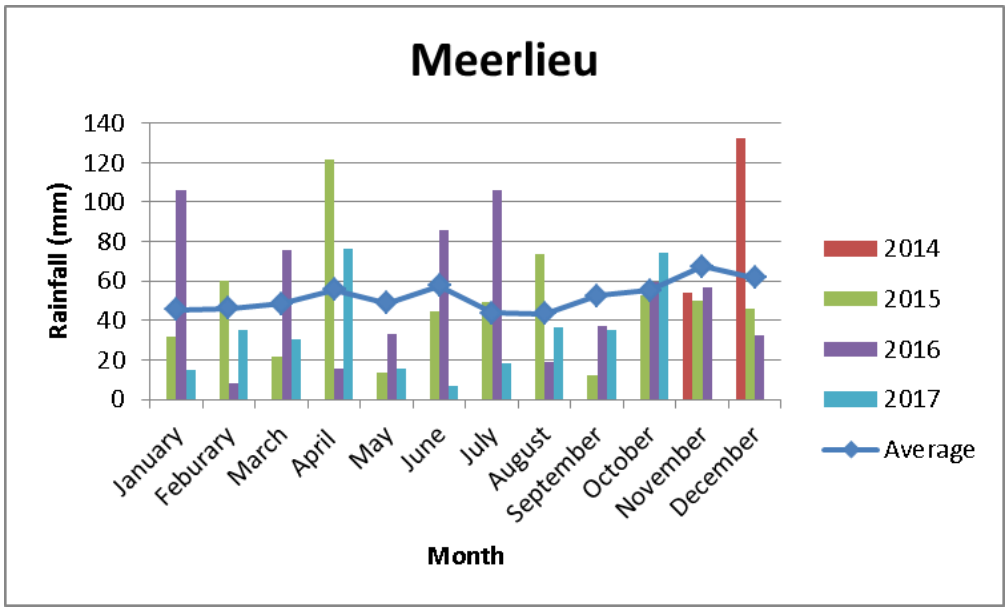

Figure 2: Rainfall for Meerlieu for the project period compared to the average. Source: BOM)

Bairnsdale: The site is located at the SFS Trial farm on the Bengworden Road and has an average annual rainfall of 647 mm with clay soil. The paddock had previously been in a cropping and pasture rotation with the last crop being a cereal. In autumn 2014, the pasture composition was mainly annual ryegrass and some capeweed with clovers returning during the winter.

At Bairnsdale in the first year of the project, the area experienced one of the wettest on record and the clay soils became waterlogged over winter. The monthly rain dramatically fell from November 2016 just as the tropical grasses were starting to come out of their dormancy.

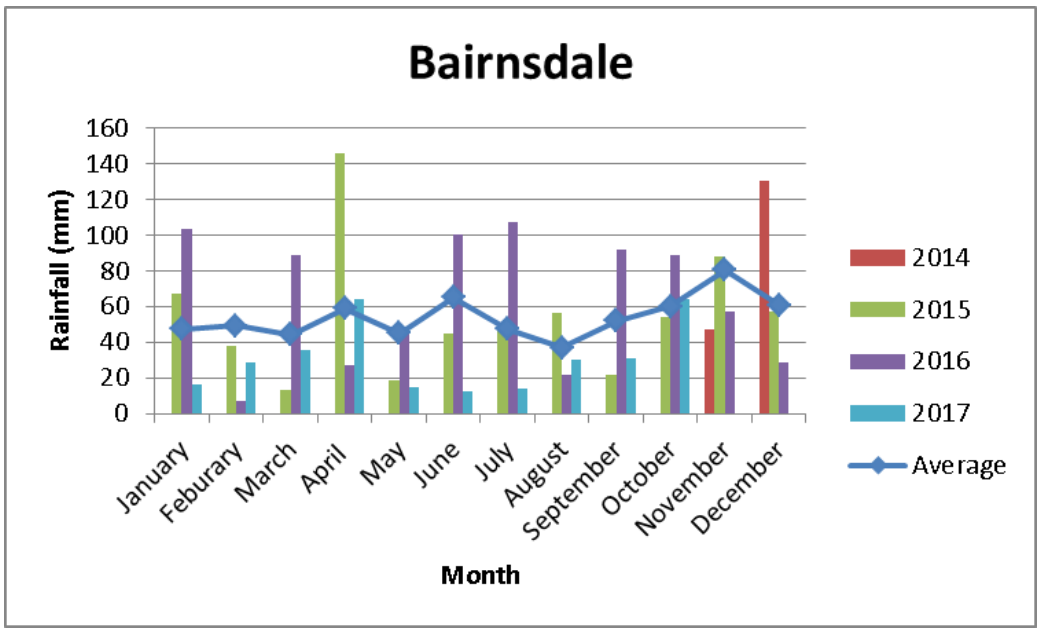

Figure 3: Rainfall at Bairnsdale over the project period compared to the average. (Source: BOM)

The three trial sites were a randomised block design replicated three times, testing six sub-tropical grasses including two reference species Kikuyu and summer active Tall Fescue (Table 2) and 6 legume species (Table 3).

3.2 Site establishment & management

Each site was soil tested 0-10 cm and sent to Nutrient Advantage laboratory for analysis. A summary of the key soil factors is shown in Table 1. Detailed reports can be seen in Appendix 1.

Table 1. Soil test results for sites, September 2014.

Site	Seaspray	Bengworden	Bairnsdale
Soil Texture	Sand	Sandy loam	Clay
pH (H_2O)	6	5.5	6.1
pH ($CaCl_2$)	4.8	4.4	5.4
Phosphorus (Olsen P) mg/kg	5.9	6.5	10.1
Sulphur (KCL40) mg/kg	10	11	15
Available Potassium mg/kg	140	98	130
Sum of cations (CEC) meq/100g	4.77	4.31	6.7
Al mg/kg	<9	28	<9

In preparation for sowing, producers sprayed sites with 2 separate applications of glyphosate. The Seaspray site was also fenced to keep out rabbits between grazings. Sites were sown on the 19 - 20 November 2014, using a cone seeder with knife points. Plot sizes were 2.4 m wide by 9 m long with a gap of 0.5 m between plots to allow for any spread of grasses, and a 1m pathway between replicates. Seed was sown with 100 kg/ha DAP. The species and cultivars sown at each site are summarised in Table 2. The seed was sourced from a supplier in NSW who advised on sowing rates. The Tall Fescue used in the trial was a continental type and so has summer activity.

Table 2. The six grasses sown in 2014.

Grass	Sowing Rate (kg/ha)	Trial/Reference Species
Panic cv Gatton	15	Trial
Digit cv Premier	12	Trial
Bambasti panic	13	Trial
Rhodes cv Katambora	11	Trial
Kikuyu cv Whittet	12	Reference
Tall Fescue cv Barnaby	17	Reference

After sowing in 2014, sites were locked up and allowed to establish until there was enough feed to take the first measurement. Prior to the first grazing a selective herbicide was used to remove the broadleaf weeds that were an issue at all 3 sites with Tigrex.

In preparation for sowing the legumes, the sites were heavily grazed, slashed and sown when the tropical grasses went dormant. Six legume species with their appropriate rhizobia were over-sown into each trial site on the 15 -16 June 2015. The legume species/cultivars were varied to suit soil type and seasonal conditions. The sowing rates used were recommended from suppliers where the seed was sourced from. The legume, cultivar and sowing rate are summarised in table 3. In hindsight the

Yellow Serradella sowing rate was too low and suited to a mix but not as a lone species and probably required a sowing rate of approximately 5 to 7 kg/ha.

Due to the low pH levels of the soils at Seaspray and Bengworden, 2.5 t/ha of lime was applied. The legumes were sown with 140 kg/ha of superphosphate at Seaspray, 500 kg/ha at Bengworden (Due to low P levels and high Phosphorus Buffering Index) and 50 kg/ha at Bairnsdale. The sites were sown with a cone seeder fitted with knife points and shallow sown as to try and not pull up the grass runners or plants. At the Bairnsdale site red legged earth mites were a problem which resulted in an insecticide being applied annually.

Table 3. The legumes sown in 2015.

Seaspray	Rates kg/ha	Bengworden	Rates kg/ha	Bairnsdale	Rates kg/ha
Yellow serradella cv Yellowtas	1	Yellow serradella cv Yellowtas	1	Yellow serradella cv Yellowtas	1
Sub clover cv Urana	6	Sub clover cv Urana	14	Sub clover cv Leura	6
Balansa clover cv Cobra	5	Balansa clover cv Cobra	5	Balansa clover cv Cobra	5
Gland clover cv Prima	5	Gland clover cv Prima	5	Gland clover cv Prima	5
Bladder cv cv Bartolo	3	Bladder cv cv Bartolo	3	Burr Medic cv Cavalier	15
Arrowleaf clover cv Arrowtas	10	Arrowleaf clover cv Arrowtas	10	Persian clover	10

After sowing in 2015, sites were locked up to allow clovers to establish and set seed until the first grazing of the grasses at the end of 2015. But the legumes establishment was poor due to late sowing and wet conditions. The summer active Tall Fescue also hindered the legume establishment, due to the fescue continuing to grow during the winter and providing competition to the legumes. The plants that did establish were encouraged to flower and set seed. This meant the grasses were not cut and the first grazing did not occur until after flowering. The last observations of the sites in May 2017 found that the legume species were still not in adequate numbers but due to being allowed to set seed, were in greater numbers than in the during the first year.

In August 2016 the Seaspray and Bairnsdale sites had an application of 300 kg/ha of 3 in 1 superphosphate to lift both phosphorus and potassium levels.

At each grazing the sites were assessed for biomass, grazed for 24 hrs with high numbers of sheep to remove feed and mown back to 3 cm in height.

There was difficulty in managing the competing demands of each of the grasses and legumes and the harvesting demands of the different species, especially summer active Tall Fescue which needed more frequent cutting than the tropical grasses.

It must be noted that the trial management hasn't played to some species strengths. Kikuyu and Tall Fescue production would have been better under high stocking rates with sheep or grazing fescue every 20 days to stop it from losing palatability over late spring.

Barnaby Tall Fescue was voluntary recalled by Heritage seeds after concerns that there was suspected endophyte contamination within seed which can be toxic to grazing livestock. Heritage seeds asked for all plots to be sprayed out.

3.3 Monitoring

When each site was grazed, pre and post grazing quadrant cuts were taken from each site, pasture composition and the palatability of each species assessed. Grazing occurred for 24hrs only, with plots mown to ensure an even start for pastures following each grazing.

Establishment counts - Seedling density of grasses and legumes was assessed 6-8 weeks after sowing using a 50 cm rod placed randomly between a row and counted either side and repeated 3 times in each plot. Plants per linear metre were converted to plants/m^2, accounting for the planter's row spacing of 20 cm.

Plant persistence – Plant counts were taken in each autumn/winter following the establishment year as an indication of the grasses and legumes ability to persist. The 50 x 50 cm assessment area was taken in the middle of each plot.

Botanical composition - This was assessed before each dry matter yield harvest by visual assessment within a 50 by 50 cm quadrant per treatment.

Dry matter production (kg DM/ha) - This was to be assessed when the highest yielding species had no more than 2.0 to 3.0 t DM/ha (green) available. Cutting was avoided when the legumes were flowering. Three hand cuts (0.5 x 0.5 m) were taken to 2 cm above ground level (estimated grazing height) and placed in bags, labelled and weighed. The sample was oven dried at 80^{o}C for 48 hours to obtain dried weight to allow calculation of kg DM/ha.

Feed tests – The leaves of each grass species was collected from their respective plots and bulked together. Then mixed and any dead material removed of which there was only a minimal amount. A subsample taken for quality testing and any dead material removed Analysis of the samples was carried out by Agrifood Technology. Sampling was done in autumn 2015 and 2017.

Palatability ranking- Following grazing each treatment plot in one replicate was ranked according to the following criteria.

1- Heavily grazed
2- Well grazed
3- Acceptable level of grazing
4- Poor grazing
5- Very poor grazing

Grazfeed- From the grazing data and feed quality collected, the information was analysed using Grazfeed, CSIRO to determine the animal production for each of the grass species.

3.4 Extension and Communication

The PRS group had their first project meeting on 4 February, 2014 to discuss the project topic and to seek agreement with Paul Sanford Senior Research Officer DAFWA on participatory R&D activities, what research questions were to be investigated and plan how the project might proceed.

Annual review meetings with the researchers and producers, focussing on the progress of the project and sharing learnings, were held in May/June 2015 - 2017. This coincided with the finishing of the grass season grazing and analysis.

The trial was also covered through the SFS Gippsland Facebook page, producer group tours, field days and articles in SFS newsletters and reporting.

4 Results

The preparation for sowing the grasses used was standard of two knockdown herbicide sprays. At Bairnsdale this was enough, but at Seaspray and Bengworden the sites had not been sown down for many years and the sowing of the trial gave the ground disturbance needed to stimulate further weed germinations.

Sub-tropical grasses are generally slow to establish and this slow nature in establishment played to the weeds advantage. Both Bambatsi and Premier Digit grass appeared to have the slowest establishment with Kikuyu having the fastest.

A higher sowing rate for the sub-tropical species was used than normally recommended (2 to 5 kg/ha of high quality seed). These rates are generally not used due to the high cost of seed and because high seed numbers can compete with each other for moisture. In this instance higher seed numbers were beneficial as low numbers established possibly due to weed competition or poor quality seed. The seed germination of the seed was not tested by the PRS group prior to sowing and so it is not known if this played a role in diminished establishment of Bambatsi which had the poorest establishment.

Summer active Tall Fescue had a different growth pattern to the sub-tropical grasses, it would continue to grow over winter whilst the tropical grasses would become dormant and the fescue would go to seed in November when the rest were just starting to grow. The sub-tropical grasses would become reproductive in February to April depending on the season. In drier times, the species seemed to run up to head early than in the wetter years.

Both Kikuyu and Rhodes grasses spread by rhizomes and stolons and Kikuyu in particular could form a mat but the other grasses had erect growth habits. Kikuyu was observed to smother out annual ryegrass at the Bairnsdale site and spread into other plots.

4.1 Seaspray

4.1.1 Seaspray establishment

Grasses

The Tall Fescue had the highest establishment, followed by Kikuyu and then Panic. Bambatsi, Digit and Rhodes were much poorer in comparison indicating possibly a poorer seed quality. Generally desirable establishment for tropical grasses is 10 to 20 seedlings/m^2 which was achieved at this site.

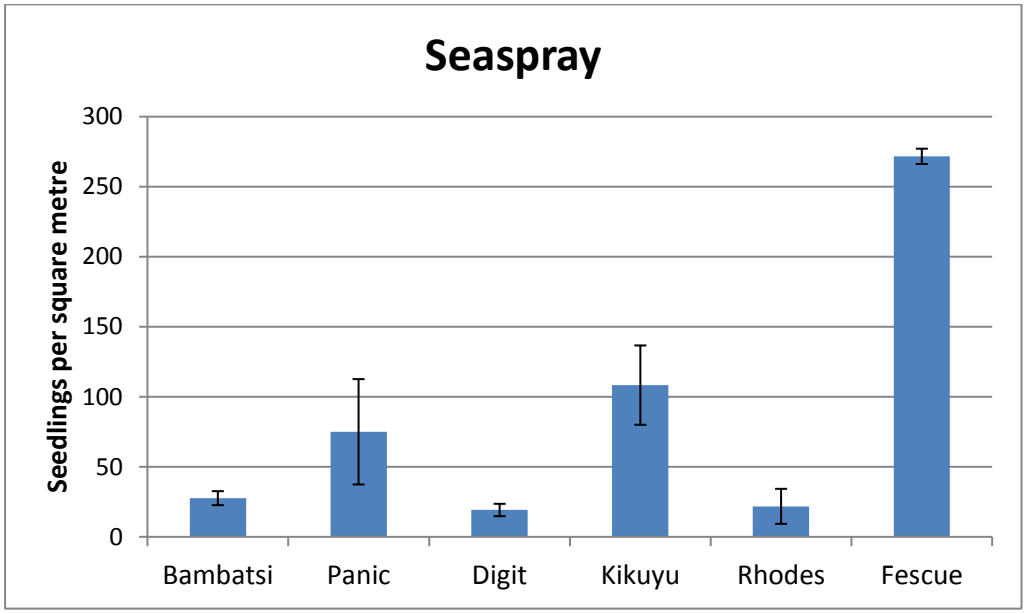

Figure 4. Mean establishment plant counts for grasses (seedlings/m^2) at Seaspray January 2015. Bars indicate the standard errors.

Legumes

The legume establishment was generally quite patchy due to the competition of both the sown species and annual grasses that emerged. Table 4. shows that the best establishment of clovers tended to be in those plots with low numbers of sown grasses and in particular Bambatsi. However, Kikuyu had good establishment of legumes and this could be attributed to it preventing annual grasses from establishing. Arrowleaf clover had the best establishment and Yellow Serradella the worst which may be attributed to its low sowing rate.

A poor re-germination of the legumes in May of 2016, resulted in only Arrowleaf clover and 2 serradella plants re-establishing.

Table 4. Legume plant establishment (plants/m^2) in September 7, 2015 within different grass treatments.

Sown grasses	Yellow Serradella	Sub clover	Balansa clover	Gland clover	Bladder clover	Arrowleaf clover
Panic	3	10	0	0	0	20
Digit	0	7	0	0	0	3
Bambasti	0	7	10	3	33	43
Rhodes	0	0	0	3	0	7
Kikuyu	3	27	7	10	0	7
Tall Fescue	0	0	0	13	0	3
Average	**1**	**9**	**3**	**5**	**6**	**14**

Figure 5: The Arrowleaf clover plants that established grew well as seen in the photo taken October 2016. (left Simon Hunt, Stephen Pasture Seeds and Les Kewming, Agriculture Victoria)

4.1.2 Seaspray dry matter yields

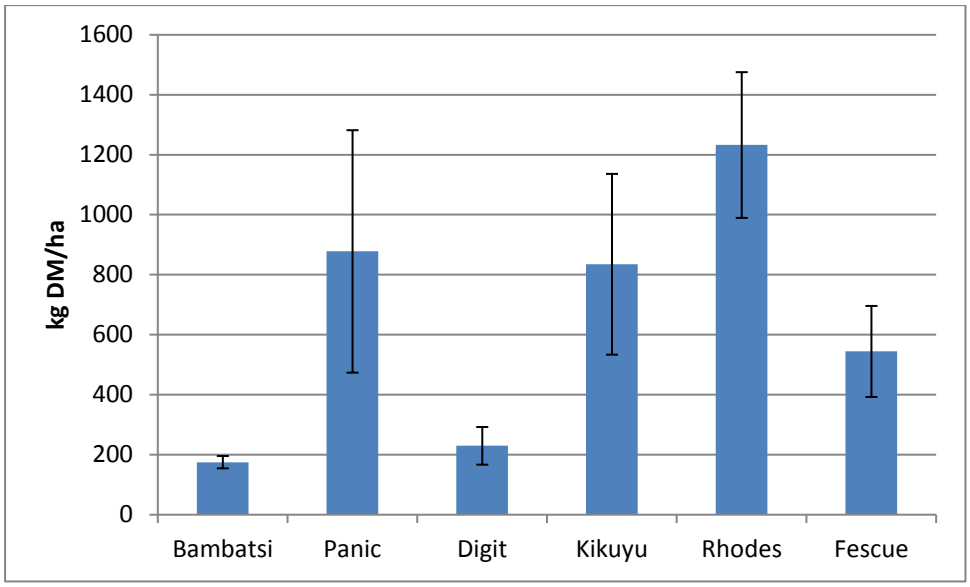

Figure 5. Dry matter yields for different grasses at the first harvest March 3, 2015 indicating their rate of establishment at Seaspray excluding the 2 cm of material left at harvest (approximately equivalent to 600 kg DM/ha).

Fescue was one of the slowest species to establish and Rhodes grass was the fastest as shown in figure 5. Rhodes grass is a short lived species (3 to 5 years) which is described as having aggressive growth. The Rhodes grass produced stolons which were found to not anchor into the soil as easily as Kikuyu and sheep were able to pull/graze these plants out which hindered its establishment in the plots.

Panic and Kikuyu also produced feed quickly and they were also the most palatable. It was thought that Panic would be quite tough and coarse for the sheep, but that was not the case and it was sought out.

Figure 7: Sheep grazing the trial at Seaspray in March 2015.

The rain dramatically fell away from November 2016 just as the sub-tropicals were starting to come out of their dormancy. This appeared to slow their regeneration and therefore delayed the first grazing. It became obvious that there is little summer growth without summer rainfall unless the species can draw on available moisture at depth. Figure 6 shows good production in yield of Tall Fescue in November and this was because it was in its most active growth phase and had run up to seed head. Summer feed production in 2016 was comparable between fescue and some of the tropical grasses.

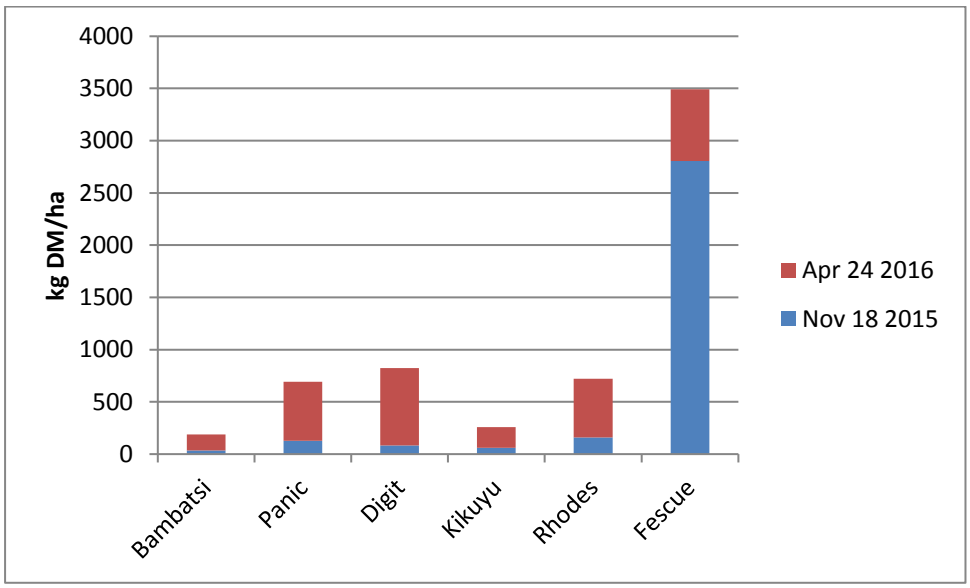

Figure 6. Dry matter yields for different grasses in November 2015 and April 2016 cuts at Seaspray excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

In 2017 when there was more moisture available at the Seaspray site, the subtropical grasses summer production was similar to the fescue which would have coincided with them starting to become reproductive.

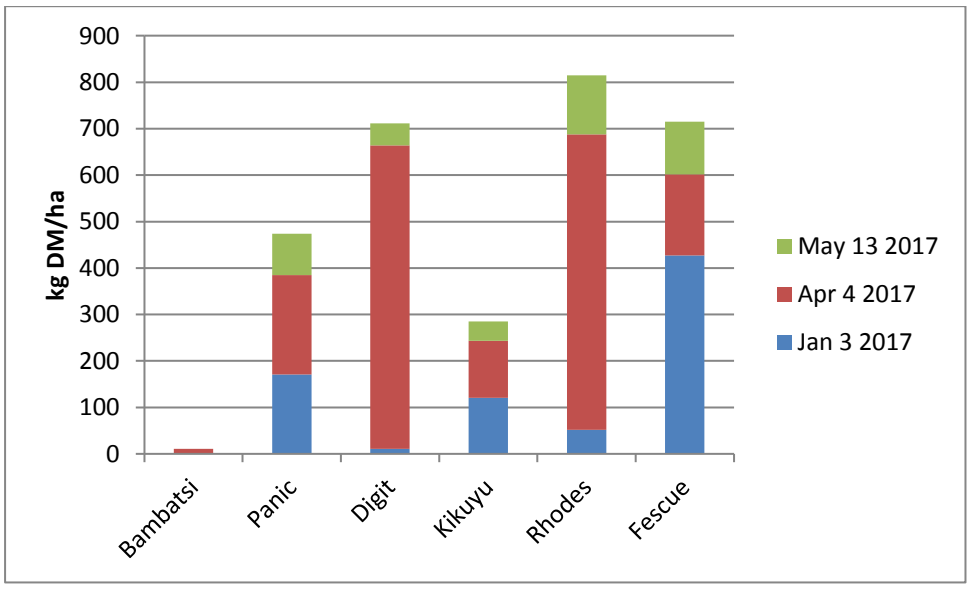

Figure 7. Dry matter yields for different grasses in January, April and May 2017 cuts at Seaspray excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

Over the trial the Tall Fescue thrived and was the stand out species for production at the Seaspray site (Figure 8). This is without capturing additional winter production. After a slow start Digit grass outperformed the other tropical grasses in yield production.

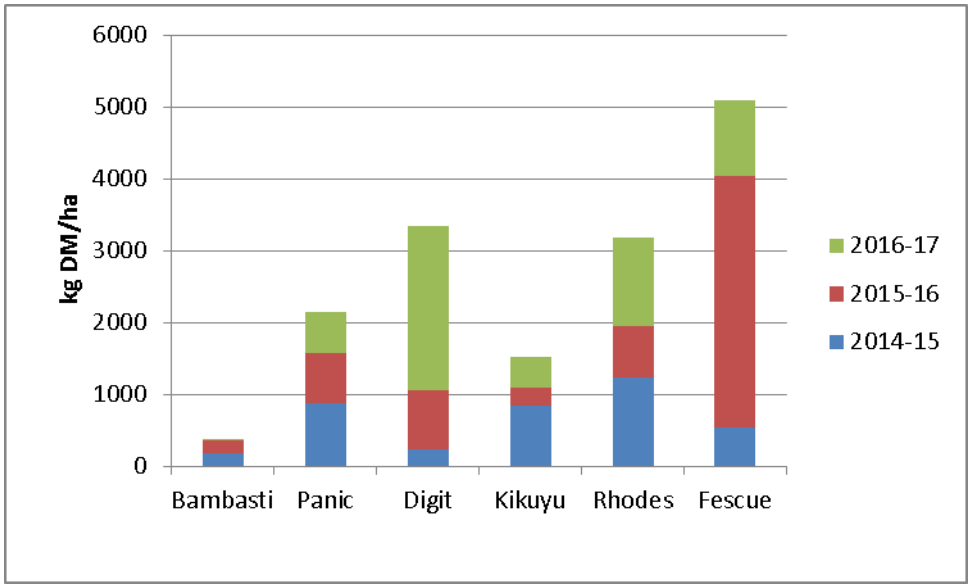

Figure 8. The total amount of DM measured through cuts at the Seaspray site over the three years.

4.1.3 Seaspray persistence and composition

In 2015 and 2017 pasture composition and persistence counts were measured. It showed that the pastures were generally being overrun with weeds except for the Kikuyu and Tall Fescue which maintained high groundcover (Table 6). At Seaspray, Bambatsi had died out by year three which supports other trials that it is not suited to light textured soils. The other species suffered a 60-80% loss. Those plants that survived to the end of the project were generally larger plants.

Table 6. Pasture composition measured in 2015, 2016, 2017 at Seaspray

Date of Assessment	Sown Species	Grass %	Annual Grass %	Broadleaf Weed %	Bareground %	Dead %
2.3.15	Kikuyu	66	2	7	25	0
	Fescue	45	20	27	8	0
	Panic	30	8	40	19	3
	Digit	20	12	60	8	0
	Rhodes	55	3	31	11	0
	Bambatsi	15	73	8	0	4
27.5.16	Kikuyu	75	5	0	20	0
	Fescue	60	5	10	25	0
	Panic	50	20	5	25	0
	Digit	50	5	20	25	0
	Rhodes	50	5	20	25	0
	Bambatsi	5	35	50	10	0
3.1.17	Kikuyu	75	15	10	0	0
	Fescue	60	35	5	0	0
	Panic	23	51	26	0	0
	Digit	4	60	36	0	0
	Rhodes	16	54	30	0	0
	Bambatsi	0	45	55	0	0

When legumes were assessed in spring (October 2016 and 2017), Balansa and Gland clover were not observed and the other sown legumes made little contribution to the sward.

Table 7. Mean percentage (%) of sown legume as visually assessed in spring 2016, 2017.

Sown grasses	Yellow Serradella	Sub clover	Bladder clover	Arrowleaf clover
Panic	3	1	0	0
Digit	0	2	0	0
Bambasti	0	0	2	0
Rhodes	5	0	0	2
Kikuyu	5	3	0	3
Tall Fescue	0	0	0	0

Note: Balansa and Gland clover were not recorded.

Typically the number of tropical grass plants that is expected in a pasture is between 4-9 plants/m², compared to Tall Fescue which is 15-30 plants/m². At Seaspray, Bambatsi and Digit did not reach that number of plants (Figure 9), having 1 to 3 plants/m² respectively.

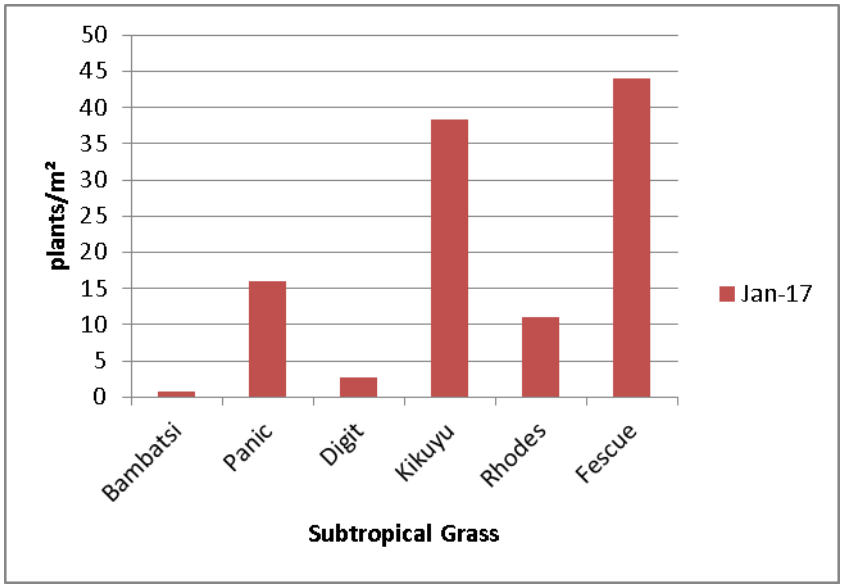

Figure 9: Persistence of the species (plant number/m^2) 2017 at Seaspray

4.2 Bairnsdale site

4.2.1 Bairnsdale establishment

Grasses

This site had the best soil nutrition and history of weed control and so the species established well including Bambatsi which prefers a clay soil and can cope well with poor drainage.

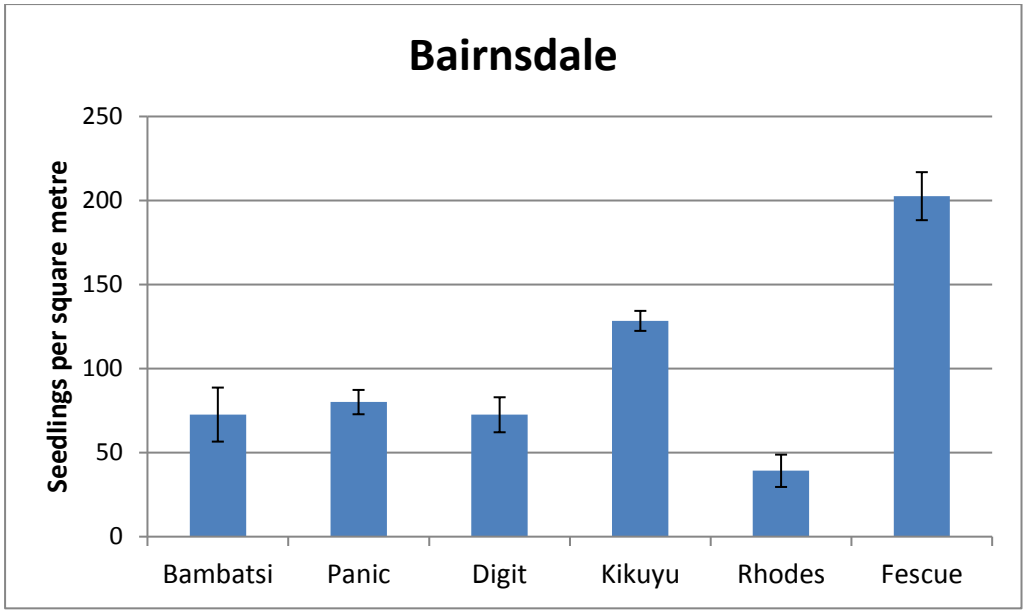

Figure 10. Mean establishment plant counts/m² for grasses at Bairnsdale January 2015. Bars indicate the standard errors.

Legumes

All legumes sown on this site established with reasonable plant numbers except for Serradella which had only patchy establishment. The Burr Medic and Persian clover on average had the best establishment. The winter of 2016 was very wet and it was found observationally that most of the legumes struggled or did not regerminate in the numbers they established at.

Table 8. Legume establishment (plants/m^2) in September 8, 2015 within different grass treatments at Bairnsdale

Sown grasses	Yellow Serradella	Sub clover cv Leura	Balansa clover	Gland clover	Burr Medic	Persian clover
Panic	17	20	7	0	63	33
Digit	3	10	10	7	20	30
Bambasti	0	13	30	7	70	7
Rhodes	0	0	0	7	33	27
Kikuyu	0	7	30	10	10	37
Tall Fescue	0	17	17	13	13	10
Average	**3**	**11**	**16**	**7**	**35**	**24**

4.2.2 Bairnsdale dry matter yields

The Tall Fescue was the slowest to establish at Bairnsdale and therefore its initial production of dry matter was low (Figure 11) but it increased dramatically in the following years (Figure 13).

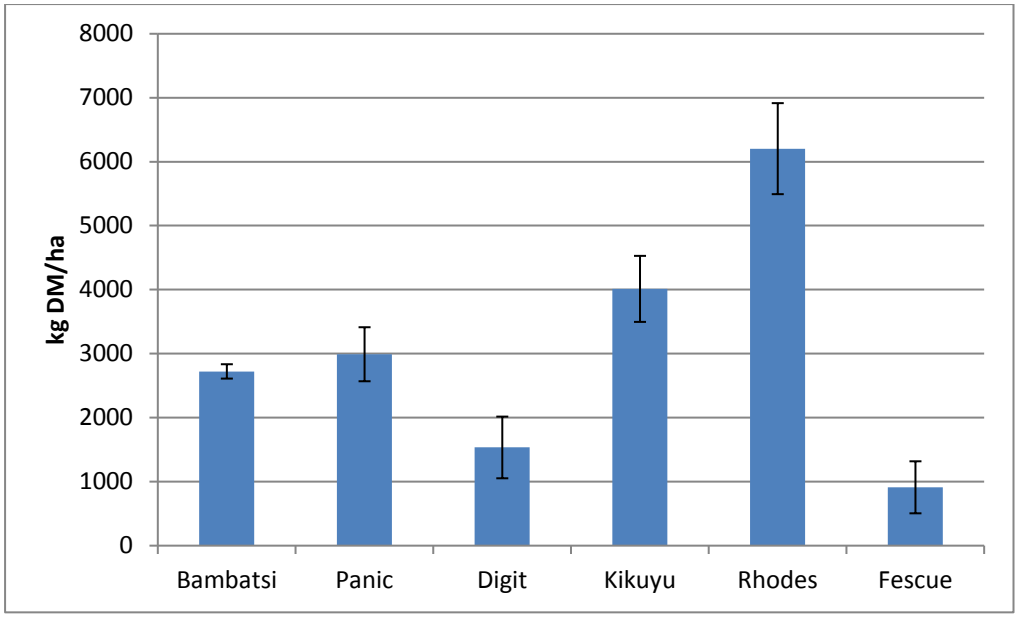

Figure 11. Dry matter yields for different grasses at the first harvest March 3, 2015 indicating their rate of establishment at Bairnsdale excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

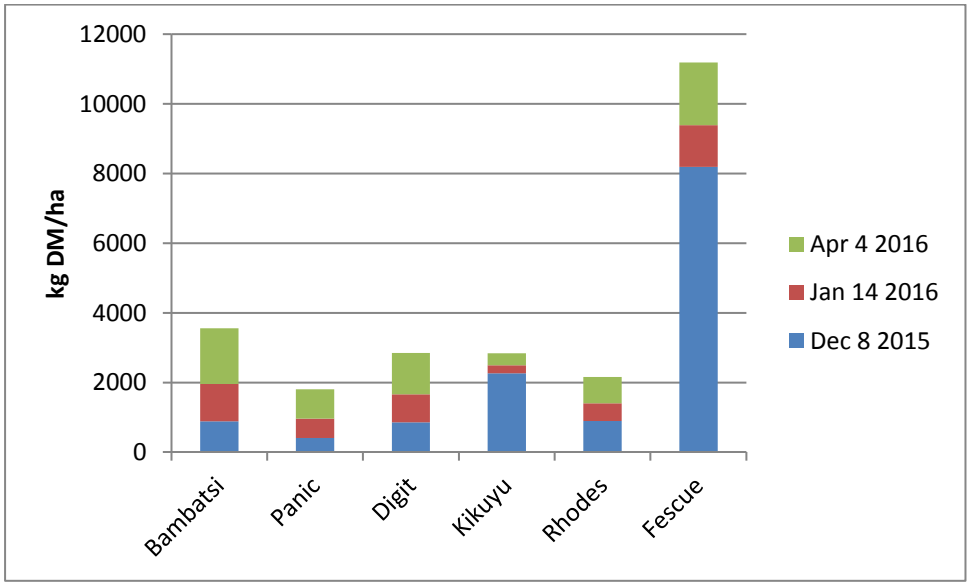

Figure 12. Dry matter yields for different grasses in December 2015 and January and April 2016 cuts at Bairnsdale excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

As the grasses came out of dormancy in 2016 - 2017 the region entered its driest period in many years and production fell (Figure 13) and as the grasses failed to grow there were only two cuts taken late in the season.

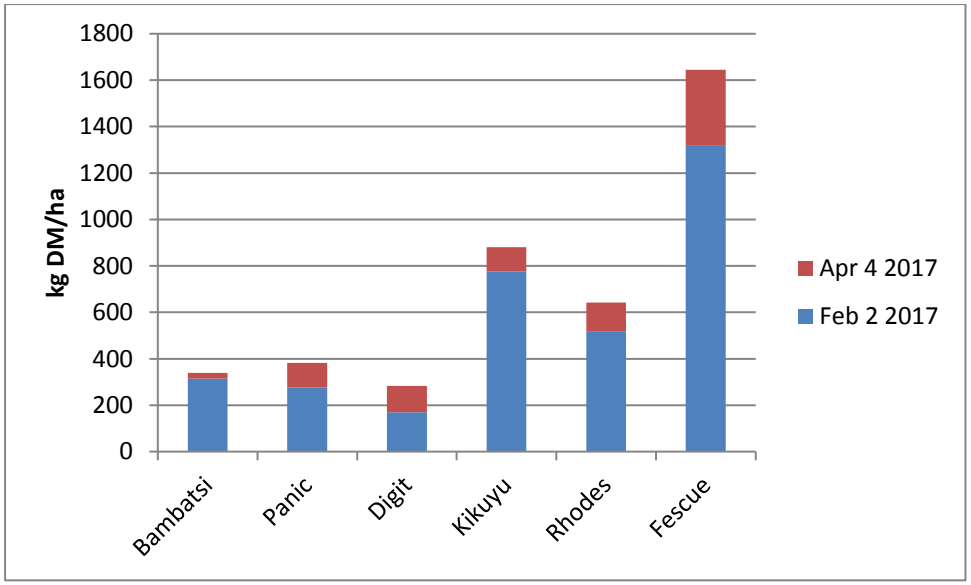

Figure 13. Dry matter yields for different grasses in February and April 2017 cuts at Bairnsdale excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

The seasonal weather effects can be seen by the amount of dry matter produced when comparing the three years production (Figure 14). Over the three years the Bairnsdale site had the highest production of dry matter measured in pasture cuts. This was attributed to the sites improved fertility compared to Seaspray and Bengworden. The lower production of Rhodes in the 2015 -16 is due to not liking waterlogging conditions. The Panic grass appeared to struggle in the clay soils at Bairnsdale.

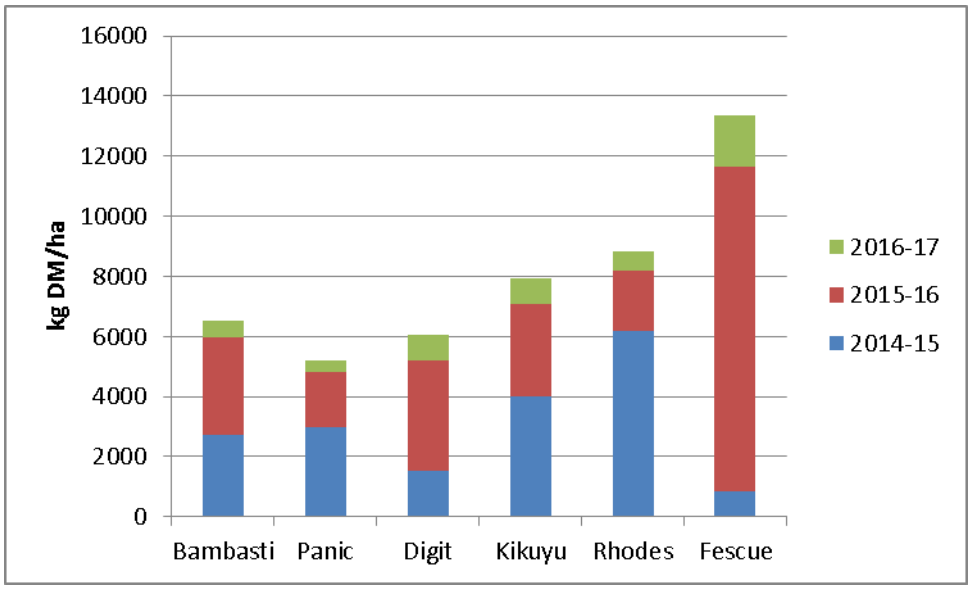

Figure 14: The total amount of DM measured through cuts at the Bairnsdale site over the three years.

4.2.3 Bairnsdale persistence and composition

The composition and persistence counts have seen the Panic, Digit and Rhodes all decline significantly from 2015 to 2017 (Table 9 and Figure 15). Plant losses were similar to Seaspray but those plants that survived at Bairnsdale (Kikuyu and Tall Fescue) have maintained levels. Kikuyu was observed to have spread into other plots highlighting its ability to colonise areas where there is good fertility.

Table 9. Percentage of sown grass as assessed in March 2015, May 2016 and January 2017 at Bairnsdale.

Date of Assessment	Sown species	Sown grass %	Annual Grass %	Broadleaf %	Bare-ground %	Dead %
2.3.15	Kikuyu	87	0	13	0	0
	Fescue	54	7	15	24	0
	Panic	90	0	10	0	0
	Digit	40	18	15	27	0
	Rhodes	80	0	20	0	0
	Bambatsi	37	13	37	13	0
27.5.16	Kikuyu	50	0	0	25	25
	Fescue	50	25	0	0	25
	Panic	50	50	0	0	0
	Digit	25	50	0	0	25
	Rhodes	50	25	0	0	25
	Bambatsi	25	50	0	0	25
6.1.17	Kikuyu	70	15	15	0	0
	Fescue	59	29	12	0	0
	Panic	10	75	15	0	0
	Digit	5	75	20	0	0
	Rhodes	30	65	5	0	0
	Bambatsi	21	52	27	0	0

When the legumes was assessed in spring (October 2016 and 2017), Gland clover was not observed and the other sown legumes had made little contribution to the sward.

Table 10. Mean percentage (%) of sown legume as visually assessed in spring 2016, 2017.

Sown grasses	Yellow Serradella	Sub clover Leura	Balansa Clover	Cavalier Medic	Persian Clover
Panic	2	3	0	5	4
Digit	0	2	0	2	3
Bambasti	0	2	3	5	0
Rhodes	2	0	0	0	2
Kikuyu	0	0	2	0	2
Tall Fescue	0	0	0	0	0

Note: Gland clover recorded was not recorded.

All tropical species except Digit remained in the pasture at a good number of plants/m² although Panic species was much poorer than others.

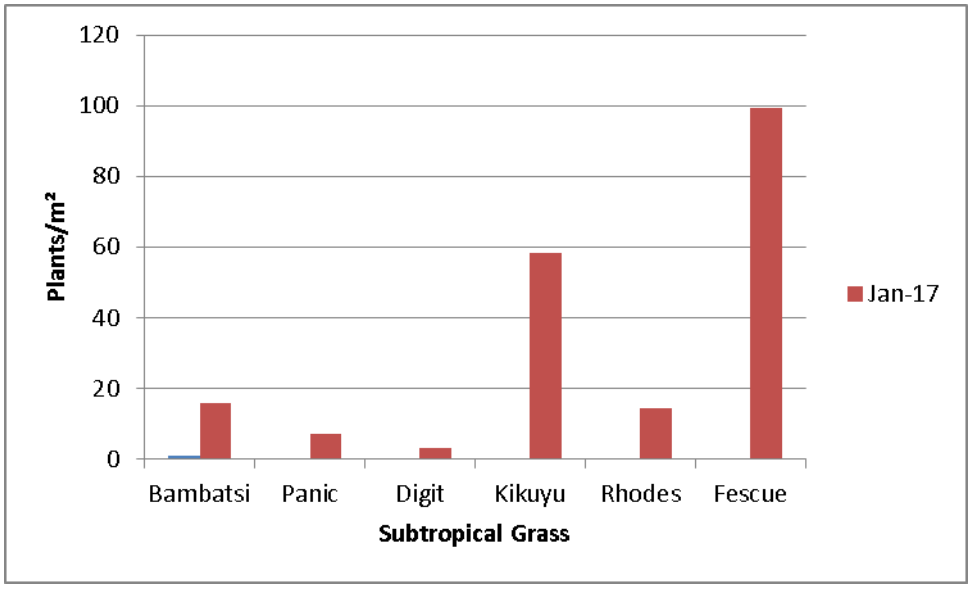

Figure 15: Persistence of the species (plant number/m^2) 2015-2017 at Bairnsdale

4.3 Bengworden site

4.3.1 Establishment

This site had not been worked prior to the sowing of the trial but had been grazed 3-4 times per year and had a mix of perennial and annual grasses. This meant that the actual sowing of grasses and legumes, encouraged the weed seed germination which provided competition for the sown grasses and legumes.

Grasses

The Kikuyu and Tall Fescue had the highest establishment and all species exceeding 25 seedlings/m^2, except for Digit with 8 seedlings/m^2.

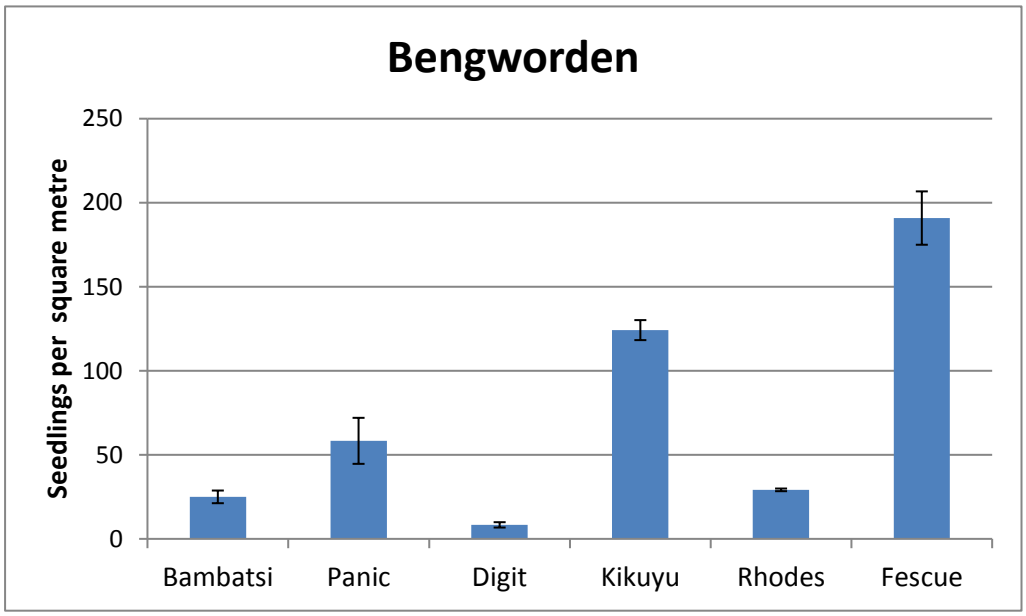

Figure 16. Establishment plant counts/m^2 for grass species at Bengworden January 2015. Bars indicate the standard errors.

Legumes

The legumes struggled as there were already a high number of clover plants that had germinated in autumn 2015. The fertiliser that was used at sowing seemed to promote the established plants to the detriment of the trial species. The only legumes that germinated with a numbers were the Arrowleaf clover and Bladder clover. Yellow Serradella and Sub clover cv Urana were not recorded in the pasture assessments and only one plot had plants of Gland clover to be measured (Table 11). In 2016 and 2017 the sown legumes had disappeared and the existing clovers had taken over.

Table 11. Legume establishment (plants/m^2) in September 8, 2015 within different grass treatments at Bengworden

Sown grasses	Balansa clover	Bladder clover	Arrowleaf clover	Gland clover
Panic	0	0	10	10
Digit	0	7	10	0
Bambasti	10	33	13	0
Rhodes	0	0	10	0
Kikuyu	7	0	0	0
Tall Fescue	0	0	0	0
Average	**3**	**7**	**7**	**2**

4.3.2 Bengworden dry matter yields, persistence and composition

Figure 17 shows fescue struggled to grow in the lower fertility conditions and all tropical species showed lower growth compared to Bairnsdale but were comparable to Seaspray with about 700 kg DM/ha being cut in the first harvest of Panic and Kikuyu. Rhodes production at the Seaspray site was higher with approximately 1200 kg DM/ha recorded.

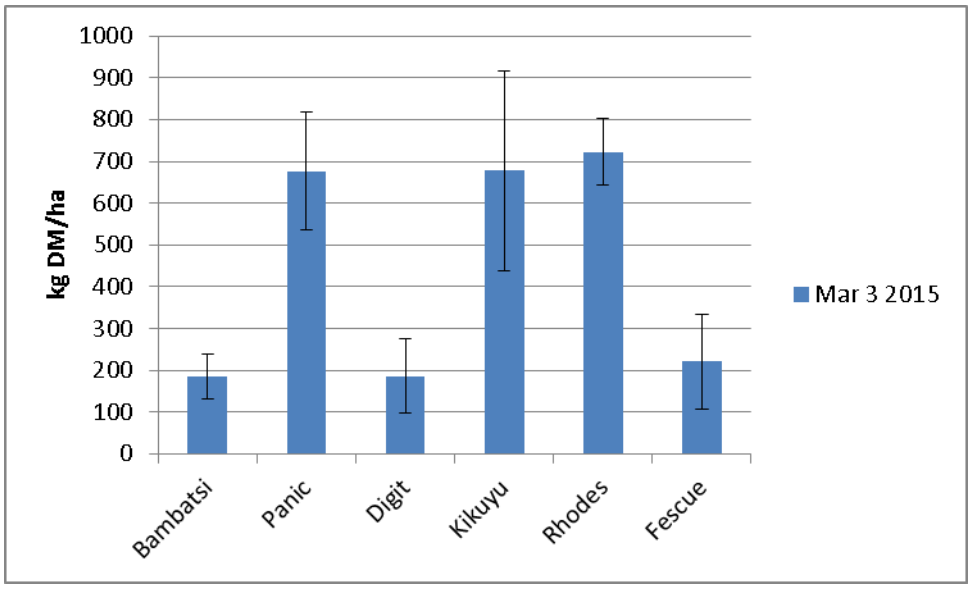

Figure 17. Dry matter yields for different grasses at the first harvest 3 March 2015 indicating their rate of establishment at Bengworden excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

Rhodes produced the most dry matter from the 2016 cuts which was similar to results at Seaspray but notably the Tall Fescue struggled with weed competition and low fertility.

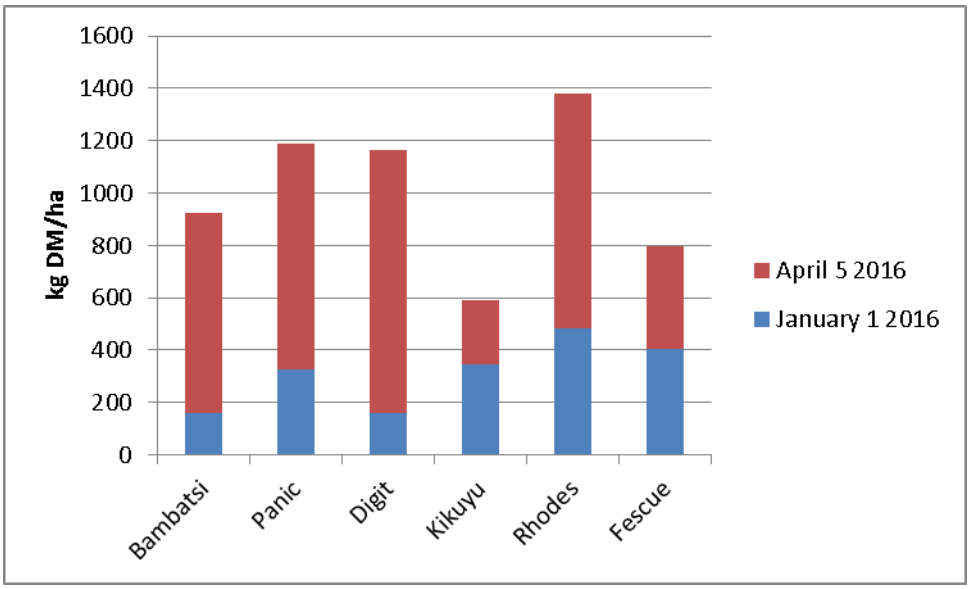

Figure 18. Dry matter yields for different grasses in January and April 2016 cuts at Bengworden excluding the 2 cm of material left at harvest (equivalent to 600 kg DM/ha).

By 2017, after the dry summer, the trial was abandoned due to poor species survival and there were no further cuts taken.

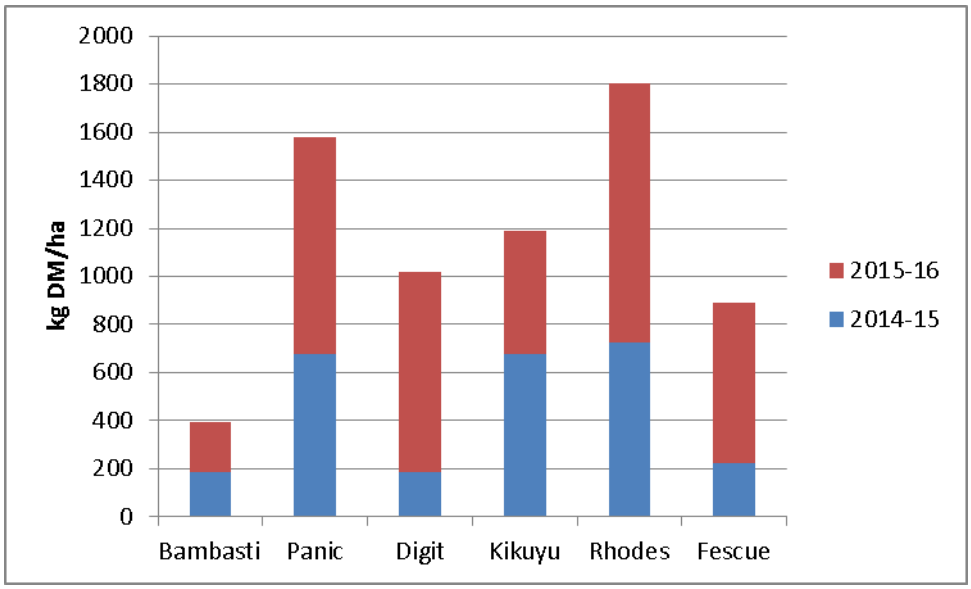

Figure 19. The total amount of DM measured through cuts at the Bengworden site over the three years.

4.3.3 Bengworden persistence and composition

Table 12. shows the decline in species and competition mainly from annual grasses. By 2017 there were no Bambatsi in the plots and the number of plants had dropped even further.

Table 12. Percentage of sown grass (%) as assessed in March 2015 and May 2016 at Bengworden.

Date of Assessment	Sown Species	Grass %	Annual Grass %	Broadleaf %	Bare-ground %	Dead %
2.3.15	Kikuyu	70	20	0	10	0
	Fescue	28	55	0	17	0
	Panic	49	13	15	23	0
	Digit	8	80	0	12	0
	Rhodes	38	33	12	17	0
	Bambatsi	15	30	22	33	0
27.5.16	Kikuyu	25	75	0	0	0
	Fescue	40	50	10	0	0
	Panic	25	65	10	0	0
	Digit	10	90	0	0	0
	Rhodes	25	75	0	0	0
	Bambatsi	5	90	5	0	0

4.4 Estimated animal production and preference

4.4.1 Palatability

The grass species the stock most avoided grazing appeared to be Tall Fescue and Kikuyu treatments and this is because of the bulk of feed that they produced which reduced feed quality and they are both known that heavy grazing is needed to keep them vegetative and palatable. Sheep appeared to preferentially graze Panic although it appeared quite coarse. Bambatsi was largely overtaken by weed species but they grazed it well when they could find it. Generally, the tropical grasses remained palatable to the end of the summer season as sheep grazing the trials at that time ate everything except for the stalks.

The results indicate that producers shouldn't be concerned about stock not eating the tropical grasses and if they are green, they will be actively sought after during summer.

Table 13. Mean palatability ranking from all sites after each grazing which followed cuts indicating sheep grazing preference where 1 was heavily grazed and 5 was very poorly grazed.

Sown grasses	2015	2016	2017	Average
Panic	1.9	2.8	2.7	2.5
Digit	2.8	3.1	2.4	2.8
Bambasti	2.3	2.4	2.4	2.4
Rhodes	2.0	3.2	2.7	2.6
Kikuyu	2.2	2.8	4.0	3.0
Tall Fescue	3.0	3.1	2.9	3.0

4.4.2 Feed quality

The feed tests collected reflect the green leaf area of the plant only. Lower quality is expected in stems.

Feed quality was highest in Kikuyu at early March cut with fresh growth, followed by Panic and Fescue. All of the summer active species had good protein levels except for Bambasti. Most temperate improved pastures like perennial ryegrass or phalaris would be typically dry and brown during summer and have low protein content.

Table 13. Feed quality results of green leaf from different grasses sampled 3 March 2015 Bairnsdale site

Sown grasses	DM%	Crude Protein%	Neutral Detergent Fibre % of DM	Digestibility (DMD) % of DM	Metabolisable Energy (MJ/kg DM)
Kikuyu	20.3	15.3	57.6	71.3	10.6
Panic	21.5	13.2	64.0	63.4	9.3
Digit	24.1	11.3	66.3	56.4	8.1
Bambasti	28.0	8.9	65.6	56.1	8.0
Rhodes	22.2	11.1	65.8	59.7	8.6
Fescue	31.7	11.8	60.4	62.5	9.1

The feed test carried out in early April 2017 showed the quality of grasses was better than March 2015. This is due to the climatic conditions at the time of sampling. In March 2015 the conditions were drier at Bairnsdale compared to the conditions at Seaspray in April 2017 where conditions were wet.

Table 14. Feed quality results of green leaf from different grasses sampled 12 April 2017 Bairnsdale site

Sown grasses	DM%	Crude Protein%	Neutral Detergent Fibre % of DM	Digestibility (DMD) % of DM	Metabolisable Energy (MJ/kg DM)
Kikuyu	23.3	18.5	54.9	73.0	10.9
Panic	23.5	21.6	46.5	77.6	11.7
Digit	34.7	14.5	62.7	64.4	9.5
Bambasti	56.5	17.3	53.5	70.3	10.5
Rhodes	26.5	15.9	57.6	68.8	10.2
Fescue	33.9	18.5	54.2	75.3	11.3

The levels of protein that weaners (25 kg) require for maintenance is 9-12 % and generally any green feed provides enough protein for maintenance. If weaners are growing at 100 g/day they need 12-14% which all species achieved in the April 2017 sampling. For finishing lambs (35 kg) at higher growth rates of 200 g/day, requires approximately 15-18% of protein.

The energy content of the tropical grasses tested slightly better than good hay with an ME value of 8.6 MJ/kg/DM in 2015 except for Bambatsi and Digit. Kikuyu had the best energy content and would

exceed Oats at about 10.0 MJ/kg/DM. Barley is normally 12.9 MJ/kg/DM which is generally considered equivalent in value to feed levels found in actively growing improved pasture during the normal growing season.

4.4.3 Estimated animal production

The predicted weight gains are estimates only, based on available green feed on offer (FOO) at harvest, and feed test quality of leaf material - not stem. Therefore, animal production is likely to be lower on farm than trial estimates predict.
Grazfeed also allows for a cutting height of 300 kg DM/ha and in these trials the cutting height left approximately 600 kg DM/ha and so there is another 300 kg DM/ha that stock could potentially have access to.

Tropical grasses are useful for maintenance of stock to eliminate handfeeding rather than to maximise growth. The two limiting factors during summer and early autumn can be both lack of available feed and reduced protein.

Two likely scenarios the producer group expressed interest in looking at were to:

- Maintain/increase bodyweight of Merino ewe weaners 7 months old (23 kg) with a mature weight of 50 kg (August borne lambs)
- Maintain stock to eliminate handfeeding of British Breed cows (480 kg) maximum weight 500 kg and calves (7 months old) weighing 220 kg from August calving.

Seaspray

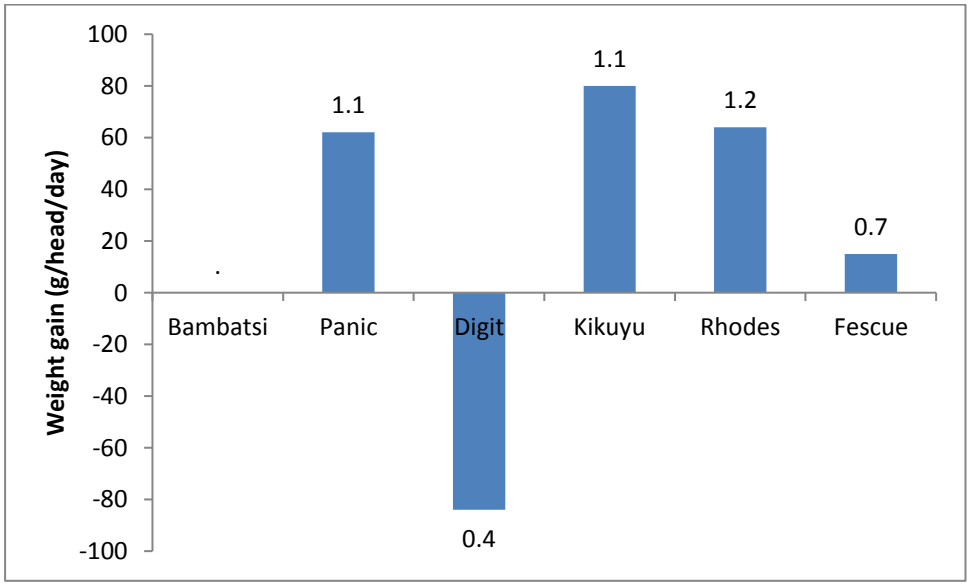

Figure 20. Predicted liveweight change (g/head/day) using Grazfeed based on ewe weaners grazing in March 2015 at Seaspray. Intake of kg DM/head/day is shown above the bars. Note: March 2015 feed test figures used (table 13) and FOO values from 3 March 2015 following establishment.

Bambatsi had insufficient FOO (174 kg DM/ha) for survival and so figures are not shown. Stock were also predicted to lose weight on Digit because of insufficient FOO (229 kg DM/ha) (Fig 20). Kikuyu did particularly well due to its high quality of leaf matter tested at that time. This is compared to DAFWA animal grazing trials where it was found Kikuyu frequently only achieved maintenance or small liveweight gains (50 g/hd/day) (Paul Sanford, pers. communication). Panic usually achieved slightly higher weight gains.

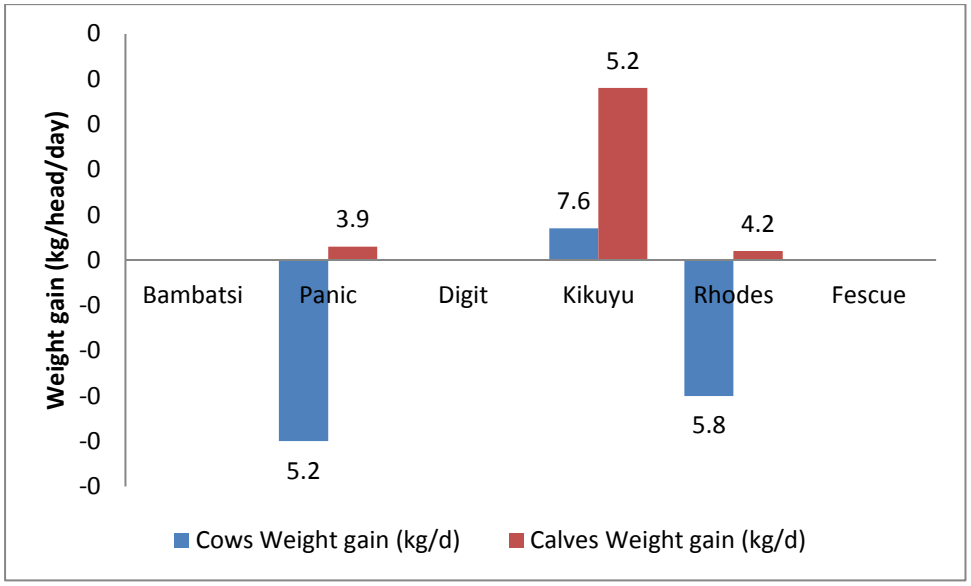

Figure 21. Predicted liveweight change (kg/head/day) using Grazfeed based on cow and calves grazing in March 2015 at Seaspray. Intake of kg DM/head/day is shown above the bars. Note: March 2015 feed test figures used (table 13) and FOO values from 3 March 2015 following establishment.

The only species able to maintain condition of both cows and calves following establishment at Seaspray was Kikuyu (Fig 21). Bambatsi, Digit and Fescue had insufficient FOO for grazing without detrimental weight losses.

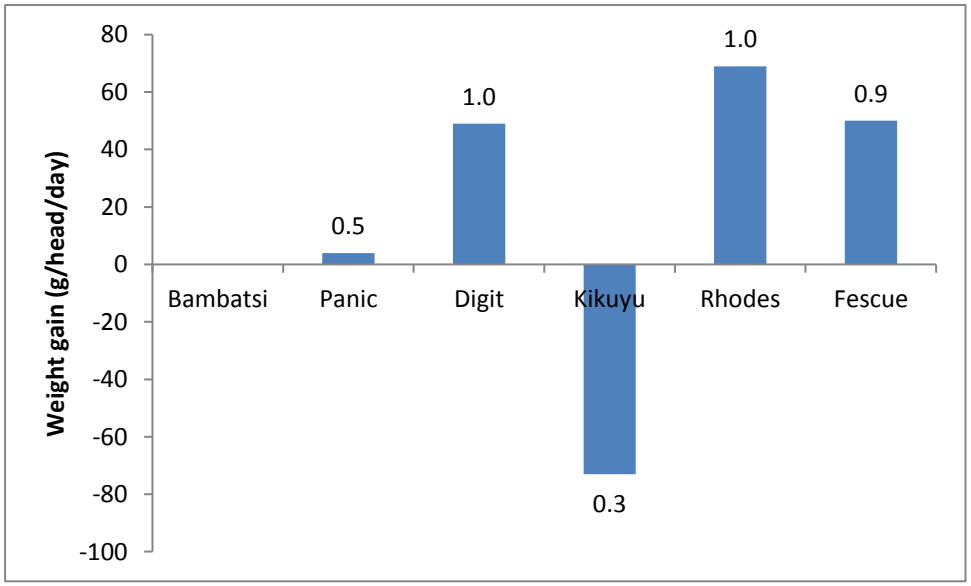

Figure 22. Predicted liveweight change (g/head/day) using Grazfeed based on cows and calves grazing in April 2017 at Seaspray. Intake of kg DM/head/day is shown above the bars. Note: April 2017 feed test figures used (table 14) and FOO values from 4 April 2017.

The lower weight gains in April 2017 were due to the dry summer and the lack of feed produced at Seaspray and would have been detrimental for stock performance (Figure 23).

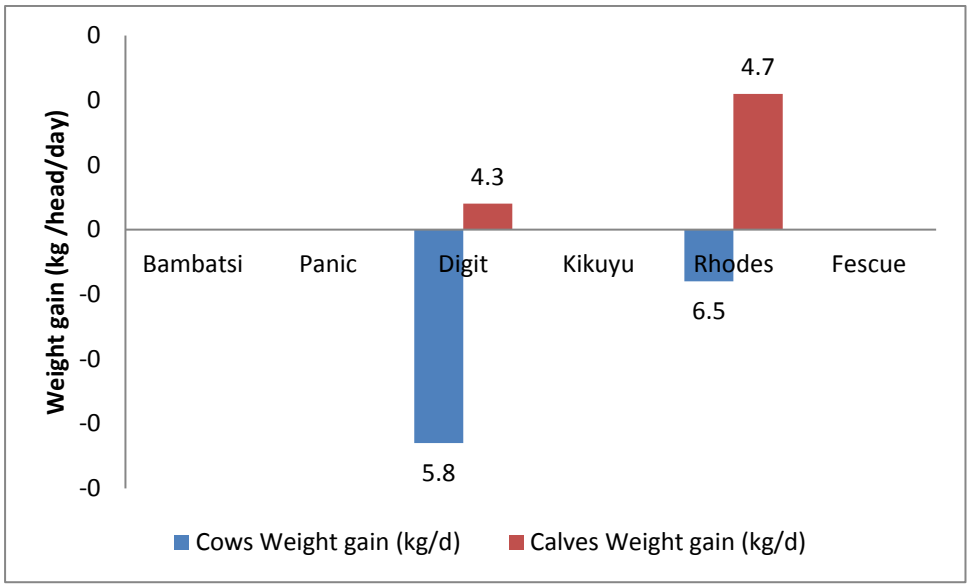

Figure 23. Predicted liveweight change (g/head/day) using Grazfeed based on cows and calves grazing in April 2017 at Seaspray. Intake of kg DM/head/day is shown above the bars. Note: April 2017 feed test figures used (table 14) and FOO values from 4 April 2017.

Bairnsdale

Due to the higher FOO available at the Bairnsdale site in March 2015, animal production is predicted to be higher for ewe weaners (Figure 24) and cows and calves (Figure 25) than at Seaspray.

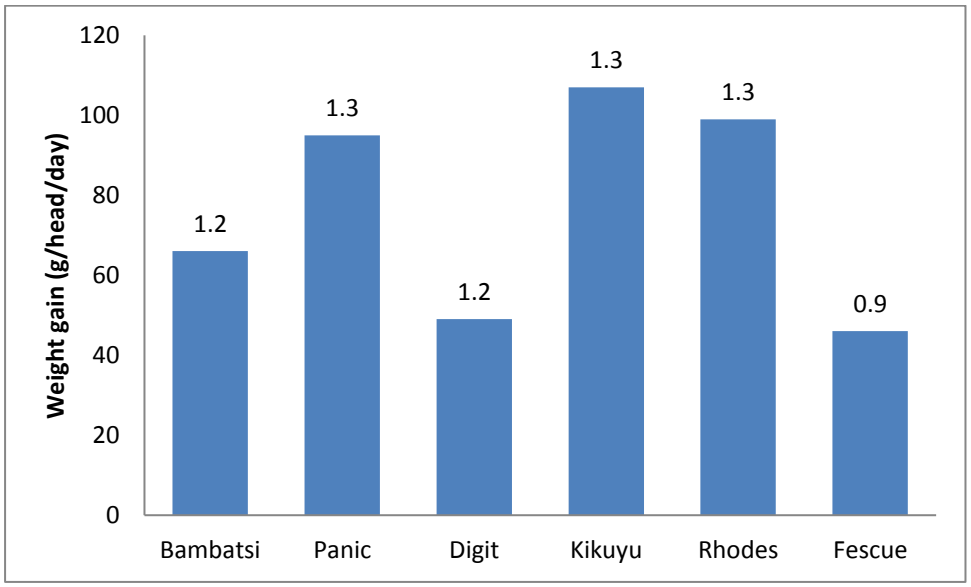

Figure 24. Predicted liveweight change (g/head/day) using Grazfeed based on ewe weaners grazing in March 2015 at Bairnsdale. Intake of kg DM/head/day is shown above the bars. Note: March 2015 feed test figures used (table 13) and FOO values from 3 March 2015 following establishment.

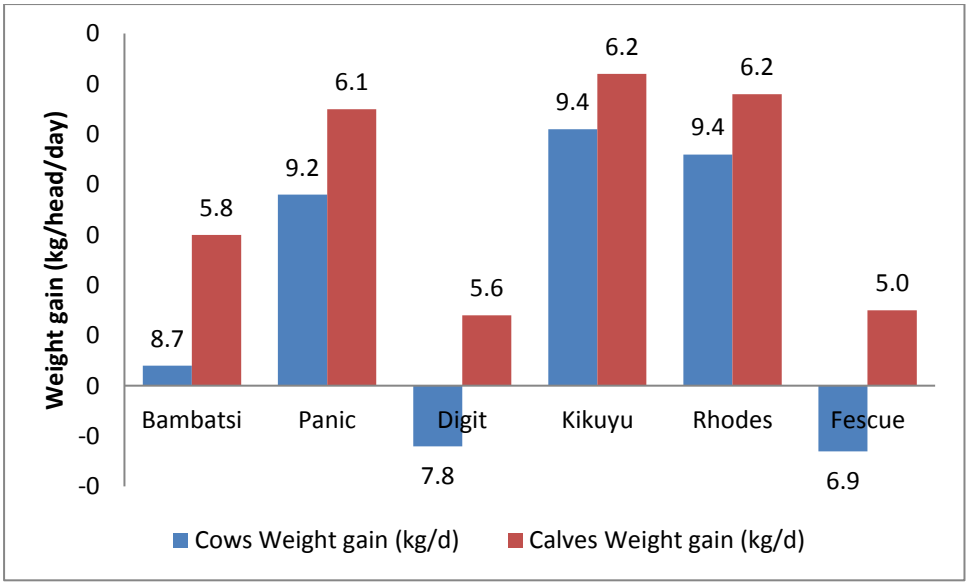

Figure 25. Predicted liveweight change (kg/head/day) using Grazfeed based on cows and calves grazing in March 2015 at Bairnsdale. Intake of kg DM/head/day is shown above the bars. Note: March 2015 feed test figures used (table 13) and FOO values from 3 March 2015 following establishment.

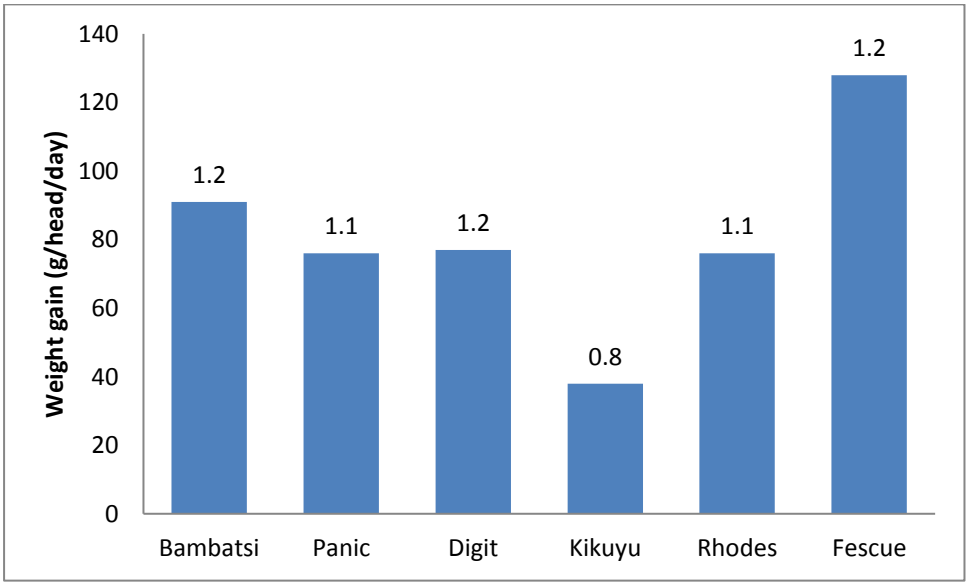

Figure 26. Predicted liveweight change (g/head/day) using Grazfeed based on ewe weaners grazing in April 2016. Intake of kg DM/head/day is shown above the bars. Note: April 2017 feed test figures used (table 14) and FOO values from 4 April 2016.

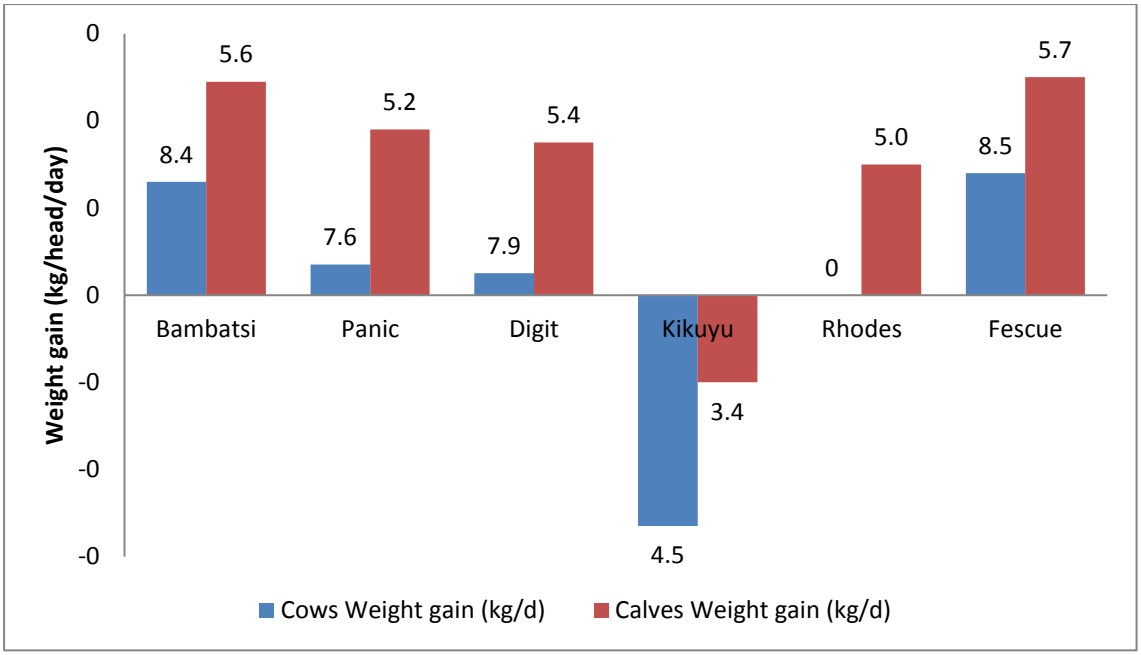

Figure 27. Predicted liveweight change (kg/head/day) using Grazfeed based on cows and calves grazing in April 2016 at Bairnsdale. Intake of kg DM/head/day is shown above the bars. Note: April 2017 feed test figures used (table 14) and FOO values from 4 April 2016.

The figures (20 to 27) show that tropical grasses generally, provided there is over 1000 kg DM/ha available (including harvest area of approximately 300 kg DM/ha), then weight gains can generally be acceptable in cows with calves provided digestibility was above 68%. Weaner ewes needed above 800 kg DM/ha and at least 60% digestibility to achieve some weight gain which was achievable as the summer active grasses were green and contained adequate protein (> 8% DM). This indicates the potential to graze without the need to supplementary feed. These production figures would only be relevant for a couple of weeks before pasture composition changed or FOO dropped below the minimum pasture quantities mentioned above.

4.5 Extension and communication

A summary of communication activities where the project was extended to the farming community is shown in Table 16.

Table 16. Extension activities and communications delivered.

Date	Activity	Number of people
February 2014	Project planning initial meeting	9
December 2014	Committee meeting report presentation	10
2014	Factsheet snapshot. Growing sub-tropical grasses.	Circulation 5000
	Email PRS group	Circulation 15
January 2015	SFS Seasonal Newsletter Article	Circulation 600
February 2015	SFS Gippsland Branch results and field day	20
June 2015	Annual Review Meeting	10
	Facebook - trial info updated	10
July 2015	SFS Seasonal July Newsletter Article	Circulation 600
August 2015	Stock and Land Article	Circulation 7000
September 2015	Glengarry Beef Check group	7
October 2015	Stratford Farm Check Group.	30
October 2015	SFS Gippsland newsletter update	Circulation 40
October 2015	SFS field day, Bairnsdale	30
	Facebook - trial info update	17
November 2015	MLA Friday Feedback magazine - A tropical solution for wet southern summers	Circulation 5000
March 2016	SFS Trial Results booklet article	Circulation 600
January & April 2016	SFS Gippsland newsletter update	Circulation 80
February 2016	SFS field day	30
March 2016	Facebook - trial info update	31
	Bairnsdale BWBL group visit to Bengworden site	15
May 2016	Annual review	12
June 2016	MLA producer PRS workshop	2
June 2016	Paper. Project notes for national workshop.	Researchers workshop 60
October 2016	SFS Spring field day	32
January 2017	Extraction phone meeting	5
March 2017	SFS Results Day	36
June 2017	Final review workshop	6

5 Discussion

5.1 Research objectives

5.1.1 Tropical grass establishment and performance

Objective 1 was about evaluating the establishment, performance and persistence of tropical grass species in three locations in Gippsland, Victoria to find out if they were better suited than the currently used Kikuyu or continental/summer active Tall Fescue.

This project showed that Gippsland producers could establish tropical grasses and like that of any pasture establishment program; weed control and good soil health were needed. However, at all sites most of the tropical grasses, other than Kikuyu did not persist due to either annual grass invasion or due to unsuitable soil conditions.

Summer active Tall Fescue was a standout for establishment numbers, persistence and production in all three soil types. As a general rule tropical grasses are sown in areas where temperate grasses do not persist because they generally have lower feed quality and do not provide winter production. It was assumed that the lighter textured soil (sand) would not be suitable for continental Tall Fescue as in WA it becomes too hot for the species to survive. This did not occur at Seaspray (sand) and maybe due to a milder coastal environment. Also WA may have deeper sands and there could be clay at depth at Seaspray which allows roots to extract moisture from.

The trials didn't capture the full production of Tall Fescue as the trial mainly focussed on capturing summer/autumn feed benefits but it was noted that it grew all year round and certainly provided growth during winter unlike the other tropical grasses which went dormant. It showed lower feed quality in March feed tests compared to some of the other grass species. Pasture management would normally involve trying to keep Tall Fescue short over late spring/early summer by heavy grazing or slashing to try to maintain quality.

The Bairnsdale site had a clay soil and in 2016 the area experienced one of the wettest on record and the tropical grasses all struggled with the waterlogged conditions except for Bambatsi which although had poor establishment numbers in comparison was the only grass to maintain its content whilst the others declined heavily in plant numbers.

Panic, Digit, Rhodes grass and Bambatsi also all failed to persist in the sandy loam and sand dune soils. It has been found in WA that one reason for subtropicals like Panic, Bambatsi and Premier Digit have poor persistence is due to annual grasses taking over or frosts killing the plants.

Most of the grasses were slow to establish despite ideal summer rainfall. This was probably related to seedling vigour and possibly due to low phosphorus at the Bengworden and Seaspray trial sites. The grasses were sown at all sites with a standard sowing rate of 100kg/ha of DAP, but a capital phosphorus application was only applied in the following autumn when the legumes were sown and so was not available to assist the newly sown seedlings at those sites.

It would have been preferable to crop the sites for several years prior to establishing the trials to reduce weeds, which occurred at the Bairnsdale site but not at Bengworden and Seaspray. It is generally recommended to use two knockdown herbicides in preparation for sowing of subtropical grass and although this occurred it was not enough to deplete the weed seed burden at these sites. If weed control had reduced the annual grass and broadleaf weeds, then the new tropical grasses may have persisted.

The sowing rates that were used were found to be much higher than generally commercially recommended. The rates used could have been argued that they would result in faster ground cover to help reduce weeds but over time the annual grasses reinvaded.

In Gippsland Kikuyu has been used as a pasture during the summer for many years. Producers have used it mainly to protect sandy/lighter soils and to stop them from eroding through wind. Premier Digit grass is another tropical species that has been used by some producers. Although Bambatsi maintained plant numbers it was not as productive as summer active Tall Fescue and therefore would not be recommended for a permanent pasture. It may however be a suitable species to possibly survive within a winter pasture cropping program in clay soils.

The trials probably haven't continued long enough to indicate persistence especially of the Tall Fescue which has shown so much promise. In NSW and WA, Digit and Panic are the tropical grasses respectively of choice compared to Kikuyu. However, neither of these species could be recommended with confidence to be long term permanent pastures in sands in Gippsland.

The tropical grasses may potentially fit a winter cropping program as they would be dormant during winter and only starting to grow in mid to late November. Rhodes grass was fast to establish because it is only a short lived species and it could complement a crop program in sands or sandy loam soils. In the sand soils, its persistence was seen to decline after 2 years. Any grasses that are grown need to not impact on crop yield and be easily removed if required.

5.1.2 Legume compatibility with tropical grasses

Objective 2 was about evaluating the establishment, performance and persistence of a range of companion legume species in tropical grass pastures in Gippsland. Legumes play an important role in tropical grass pastures, in providing a source of nitrogen to optimise growth and prevent costly nitrogen fertiliser being used and to boost winter feed growth.

The companion legumes were sown in mid June 2015 at each site. It was very cold and wet following this and this impacted on their establishment. Plant numbers were poor in 2015 but through careful management improved in 2016. At the end of the trial period the legumes had increased in plant numbers but only contributed up to 5% of the plant composition whilst 20 to 30% of total dry matter would be desirable. Management of the legumes meant that there was no cuts/grazing until after seed set which did not ideally suit the Tall Fescue.

This trial indicated that over-sowing legumes into existing pasture which had only been slashed and heavily grazed was not sufficient to allow good establishment. This to a certain extent can be overcome with the establishment of the clovers first, with grasses established in the following late

spring. The FIP tropical research project also used selective herbicides to supress grass growth so that sub clover could be more successfully established.

The species that did best were sub clovers and Arrowleaf clover and Persian clover at the Bairnsdale site. Arrowleaf clover can extend the growing season for about one month longer than sub clover pastures and so fits well with Gippsland's seasonal conditions and tropical grasses. It was not sown at Bairnsdale because it does not tolerate waterlogging. At Bairnsdale the decrease in legume plant numbers was a result of the wet season in 2016 which was underwater for a number of weeks when the legumes were trying to re-establish.

Grazing the Kikuyu at the end of the season opened the pasture up for successful re-germination of the legumes, but where the Kikuyu had formed a mat, the legumes were not able to germinate. It should be easier to keep sub clover in panic grass pastures than Kikuyu because of the openness and gaps within its pasture. Keeping legumes within tropical pastures will be an ongoing issue and a number of management tools will be needed to ensure they are able to regenerate such as appropriate fertiliser, grazing management and the strategic use of herbicide to suppress tropical grasses in times when late breaks occur or clover numbers are starting to decline.

5.1.3 Estimated animal production from tropical grasses

Project objective 3 was to estimate the potential animal performance of the legume/grass pastures for seasonal conditions in Gippsland.

This objective was met through Grazfeed calculations using dry matter production achieved in autumn, inconjunction with the feed tests that were taken. The feed samples collected contained mainly leaf material with minimum amount of stem material which would have been lower in digestibility. So it is expected that animal production would be lower than calculated especially when grazing with cattle which cannot selectively graze leaf material as well as sheep can. Although this would be offset in some instances as in Grazfeed, the maximum amount of digestibility for grasses that can be entered is 70%. Some grasses were higher than this as in indicated in April 2017 feed tests.

In addition, the FOO readings used in Grazfeed did not account for dry matter that was left behind after cutting. Taking these considerations into account, the analysis of typical grazing scenarios indicated that ewe weaners on most tropical grasses would achieve maintenance to small livestock weight gains when FOO was approximately 800 kg DM/ha and at least 60% digestibility with protein levels above 8%. Where FOO was at least 1000 kg DM/ha then weaner sheep could maximise intake and eat 1.1 to 1.2 kg DM/day/head and achieve weight gains of 50 to 70 g/day.

It was estimated that cows and calves required at least 1000 kg DM/ha of available FOO to have acceptable weight gains provided digestibility was above 68% which feed tests indicated was unlikely to be achieved in March 2015 but was met in April 2017 in Kikuyu, Panic and Fescue treatments.

Having available FOO during summer and autumn is not guaranteed because growth is reliant on summer rainfall but the Bairnsdale site in early 2015 showed the potential of the tropical grasses to

produce feed in the above average rainfall conditions under good fertility and where weeds had not yet become an issue. Under these conditions which produced higher FOO, maintenance of cows and weight gains of calves are more likely to be achieved.

The trials also highlighted some grazing preferences for certain species giving an indication of potential palatability with tropical grasses comparing well to tall fescue. Panic grass appeared to have one of the highest palatability's.

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

The trials showed that most of the tropical grasses, except for Bambatsi could potentially be used in Gippsland for a source of summer and early autumn feed that would not need to be resown each year. The trial also showed that continental Tall Fescue is highly productive and the species of choice for summer production in the clay soil. The summer active Tall Fescue was unbothered by potential cold, waterlogged, frost prone soils which can impact potentially on the persistence of some of the tropical grasses (Panic, Digit and Rhodes) over winter.

Tall Fescue also performed well and persisted in the sandy soils (3 years) of Gippsland where the climate has milder summer temperatures compared to northern NSW and South coast of WA where it does not survive.

Kikuyu showed that it can grow in any soil type, although its persistence can be impacted on by annual grass pressure which was seen at the Bengworden site and also experienced at the EverGraze Proof site at Hamilton 2006 to 2010.

Both the Kikuyu and Tall Fescue maintained high groundcover contents and therefore reduced the amount of weeds that reinvaded the sites.

It must be noted, that summer production of feed only occurs if there is summer rainfall to support growth. This was shown with the drier than average December in 2016 which continued until April 2017 restricting feed production.

The main benefit to producers with summer active species is to reduce the cost and time taken to supplementary feed. For 100 cows this is estimated to take 1 hour per day occurring every second day, three times a week. A reliable feed source at this time also reduces the need to make and conserve as much hay or silage over later spring.

Having areas devoted to summer active species may also reduce some risks with failed springs. If rain occurs summer active species can respond, whilst perennial ryegrass does not grow where temperatures exceed 18 degrees and many cultivars of phalaris can become dormant over summer.

Another unexpected benefit was the feed quality revealed in feed tests of Kikuyu of the leaf material in March 2015 and April 2017. It is often perceived as having poor quality, probably because under lax grazing it is allowed to build up dead material. Kikuyu does not necessarily have to have a

reproductive period where feed quality drops or become unproductive if good grazing pressure is maintained.

Below is a calendar of when tropical grasses are likely to grow given the observations made in this trial and the mean monthly temperatures. This calendar enables producers to match tropical grass production to feed requirements of grazing stock.

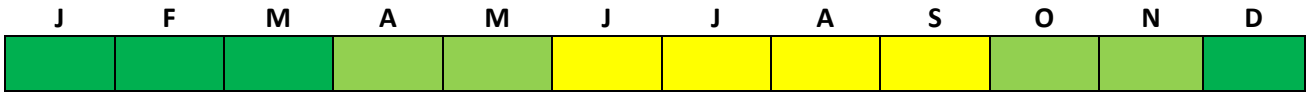

Fig 28. Potential growth rates of tropical grasses in Gippsland based on trial observations and mean temperatures.

Key to potential growth over calendar months provided adequate rainfall

- High
- Moderate
- Minimum/Nil

The costs of establishment of tropical pastures are similar to those of a spring sown temperate pasture where legumes have to be separately introduced. Seed costs of the tropical grasses is likely to be similar to that of other species as less seed is normally sown due to the small seed size. For example Kikuyu seed costs approximately $50/kg of seed but only 2 kg/ha is needed due to the high number of seeds contained within one kilogram.

5.3 Promotion of research results and its effectiveness

The project was promoted in many ways and these are listed in Table 16. The most effective way of building knowledge and achieving practice change has been through producers being involved in the project. For example two members of the PRS group who had producer research sites have gone on to sow paddocks with those grasses that showed potential on their properties. One producer sowed more summer active fescue on sand based soil and another sowed Panic and Rhodes grass. Another producer who was part of the group also planted summer active fescue and inter row sowed it with lucerne for the first time.

Through discussions with the researcher, producers developed knowledge about how to increase production of existing Kikuyu pastures over winter by introducing legumes and other species like vetch or oats. This is revealed in the following producer comments:

- “The project is giving us ideas, but we will have to try them first.”
- “I won’t broadcast seed directly into Kikuyu and will check if there is a seed bank first.”
- “I would consider using Kikuyu suppression to increase legume content.”
- “Possibly try growing a Serradella nursery.”

There has been a shift in mind-set of producers from just using winter growing species to also including summer active species, particularly summer active Tall Fescue. Producer comments in relation to the benefits of having summer active pastures were:

- "We need to be thinking about summer systems and management."
- "Using more summer Tall Fescue and lucerne to use summer rainfall."
- "Having a winter and summer combo of feed."

The main barriers mentioned by the Producer Group have been around seed costs and potential risks of failure. These include:

- High costs of having to buy seed at retail prices and access to seed with supporting knowledge at a local level.
- The need to have seed with good germination.
- The need to be able to reduce seeding costs as there are establishment risks with season and lack of summer rainfall.

Other risks producers were concerned about were:

- Getting legumes to establish and regenerate with the tropical grasses.
- Managing the tropical grasses so that they don't become a monoculture.
- The lack of local animal production data.
- Potential weediness as there is limited chemicals available to take out weeds.

To overcome some of the barriers the producers felt that:

- Seed costs could be reduced by local seed production or possibly purchasing B Grade seed if it's cheaper.
- There was a need to have more knowledgeable local advisors, local agronomy packages which contain relevant information for Gippsland that was easy to obtain.
- Summer species uptake would be improved by producing cost benefit analysis of animal production from summer active species versus supplementary feeding.
- Trying the tropical species at a paddock scale. The researcher mentioned that in WA, the Department of Agriculture and Forestry provided 25 kg bags of seed to growers to trial on farm to increase potential adoption.

5.4 Effectiveness of the participatory research process

How the group added value to the research topic

The group helped shape the inputs into the trial as they with the researcher indicated that the Seaspray and Bengworden sites needed liming and the phosphorus levels needed to be lifted for legume survival. Together with the researcher the appropriate rates fertiliser rates were determined prior to the legumes being sown.

The producers were able to give the researcher feedback in terms of what they saw as potential fits of tropical grasses in the farming system and what they saw were the advantages. For example the group expressed interest in using tropical for silage and described them with the potential to be "living haystacks" so they didn't have to cut as much silage or feed it out. The mixed farming group also saw a potential fit with their winter cropping program which the researcher hadn't been much involved with.

Due to the trial design the plots were grazed as one, but the producer group would like to have seen each of the species grazed to its particular growing habits.

The experience of the PRS process
Producers felt that the researcher input was very valuable as the producers and agronomists had had little experience in tropical grasses. The researcher shared WA research and their key findings and gave producers ideas on establishment and potential uses.

Examples of FIP research findings and information that was well received by the producers included:

- Used 0.5 to 1.0 L/ha of Clethodim (Select) to suppress kikuyu at break of season is a cheap option $3 to $4/ha that helps increase legume content.
- Increasing legume content of Kikuyu pastures on average improves GM by $40/ha (modelling from moving from low to medium sub clover content).
- Introducing vetch/oats into tropical pastures also helped lift winter production.
- If you didn't have a seed bank of sub clover then direct drilling of sub clover has a strike rate of being 90% successful but broadcast seeding works only 1 year in 10.
- Panic is erect and is suitable for silage and for cattle grazing.
- Panic grass could be used in pasture cropping and fit a winter cropping program as it may not hinder cropping operations. This is due to its growing habits and when it is dormant.
- Panic grass requires about 6 L/ha of glyphosate to kill it which lends itself to over-spraying.
- Rhodes grass may be a useful as a short-lived species.

6 Conclusions/ Key Messages /Recommendations

The key messages and conclusions from this project are that:

- Continental (summer active) Tall Fescue can be used for filling summer and autumn feed gaps on all soil types including sands in the milder summer climate of Gippsland.
- Gippsland is a suitable location for growing sub-tropical pastures with its summer rainfall and with the possibility of more summer rainfall, the sub-tropical grasses will have an even greater fit in pastures over time.
- Sub-tropical grasses are better to be used on areas where summer active Tall Fescue is unlikely to be as productive which is on the lighter textured soils provided annual grasses are controlled.
- Good weed preparation is needed 12 months before sowing summer active Tall Fescue or tropical grasses to reduce seed set of problem summer and winter weeds (eg wire weed and annual ryegrass) because they are generally slower to establish than the weeds.
- Establishment and survival of legumes into existing pastures is difficult and interventions to suppress the pasture with herbicide may be needed to improve legume establishment or alternatively the legumes should be sown first with the tropical grasses sown in the following spring.

The Producer Group recommends that the most productive grasses from the trial be demonstrated in a paddock situation and grazed as per farm practices to look at their fit in grazing and cropping rotations and to generate better animal production data. Also the persistence of grasses needs to

be known as any sown pastures need to survive for more than 5 years for pay back of the initial investment to be achieved.

Each of the different species had strengths and weaknesses and there needs to be further work done on getting complimentary blends that provide good summer and winter production rather than only produce feed at one part of the year.

7 Bibliography

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9 Appendix

9.1 Soil Test Results

		Trial Site		
		Seaspray	Bengworden	Bairnsdale
Soil Texture		Sand	Sandy Loam	Clay
pH (in water)		6	5.5	6.1
Organic Carbon	%	2.1	2.7	1.6
Nitrate N	mg/kg	3.9	2.8	30
Olsen P	mg/kg	5.88	6.48	10.1
PBI		6.1	72	54
Sulphates S	mg/kg	10	11	15
CEC		4.77	4.31	6.7
Ca	%	63	58	70
Mg	%	25	26	21
Na	%	2.3	3.5	2.5
K	%	7.5	5.8	4.9
Available K	mg/kg	140	98	130
Al	mg/kg	<9	28	<9
Ca/MgRatio		2.5	2.3	3.4
Zn	mg/kg	2.6	0.94	1.7
Cu	mg/kg	0.19	0.32	1
Fe	mg/kg	110	400	270
Mn	mg/kg	11	13	11