MLA PDS Alternate forage crops for Southern WA

Hosts: Pyle Family, Smith Family and Metcalfe Family

Samantha Cullen, Membership Officer, SCF

Introduction

In 2020 Stirlings to Coast Farmers (SCF) began a project with Meat & Livestock Australia (MLA) looking at alternative forage crops for southern WA. The project is entering its final year in 2022. The aim of the project is to measure the benefit alternate summer forages, such as Pallaton Raphno, sorghum, millet, and long-season (winter) canola, can contribute to livestock carrying capacity and livestock weight gains. The alternate forage crops will be compared to traditional summer feed sources such as dry pastures and crop stubbles.

As summer rainfall events happen more frequently on the south coast there is an opportunity for producers in the high rainfall zone (HRZ) to take advantage of these events by growing summer forage crops. To improve grower decision making SCF set out to explore what species are appropriate in our area and what benefits they can bring to the farming system. The project looked at Pallaton Raphno, millet and sorghum in the 2021 season, and the learnings are presented below.

Second year trial sites included:

- Pyle-
  South Stirlings, cross bred lambs grazing Pallaton Raphno vs canola stubble
- Smith-
  Green Range, cross bred lambs grazing millet vs barley stubble
- Metcalfe-
  Manypeaks, yearling cattle grazing Bunker sorghum vs ryegrass pasture

Aim

To demonstrate the feed value of alternate high biomass summer forage crops in increasing stocking rates and live weight gain of prime lamb or beef cattle relative to current HRZ systems.

PYLE SITE: PALLATON RAPHNO VS CANOLA STUBBLE

KEY MESSAGES:

- Pallaton Raphno had a higher nutritional value (NV) than the canola stubble control. This included a higher crude protein, digestibility and metabolisable energy.
- Excellent weight gain was achieved by lambs on the Raphno with 286g/head/day compared to 145g/head/day on the canola stubble.
- The Raphno at 4.05t/ha produced over 160% more biomass than the canola stubble pasture of 2.54t/ha.
- Lamb live weight gain was 7.66kg/ha/day for the Raphno, which was more than double the canola stubble at 3.57 kg/ha/day.

LOCATION- South Stirlings

SOIL TYPE- Sand

CONTROL- Canola stubble with a clover germinating underneath, 30ha, 670 lambs, 22.3 lambs/ha

VARIABLE- Pallaton Raphno, 59ha, 1580 lambs, 26.8 lambs/ha

Background

The demonstration compared two paddocks; a Pallaton Raphno stand and a regrowth canola stubble that contained germinated clover. After first trying Raphno in 2020, Pyle brothers, Tim and David, decided to plant another 60ha in 2021. A feature of this crop is its ability to thrive under grazing pressure. It can be grazed multiple times over summer and throughout the year depending on rainfall, grazing pressure, and pest management.

Method

In preparation for seeding, a knockdown spray was used and the paddock fertilised two weeks prior to seeding. The Raphno was planted on 20th September 2021 and a month later received a diamond back moth spray and 50L/ha of Flexi-N. Biomass cuts, soil samples and plant samples for nutritive value (NV) analysis were taken on 25th November, the same day lambs were weighed and introduced. At the conclusion of grazing, the canola stubble had been exhausted and the 670 sheep from the control mob were then added to the 1580 Raphno mob on the 17th December.

Four quadrant cuts were collected from the Raphno and canola stubble pasture to determine biomass prior to grazing. Nutritive values were analysed by Feedtest, Werribee, VIC. A proportion of the lambs were weighed from each group grazing the Raphno and canola stubble. The same numbers were weighed coming off the paddocks 22 days later.

Results and Discussion

Table 1. Pyle dry matter cuts before grazing

Forage	g of 0.1m² quad	t/Ha
Canola Stubble	25.4	2.54
Raphno	40.48	4.05

Table 2. Pyle Nutritional Value (NV) analysis of forages taken on November 25, 2021.

NV Analysis	Canola Stubble	Pallaton Raphno
Dry Matter (DM)	26.8 %	16.1 %
Moisture	73.2 %	83.9 %
Crude Protein	11.4 % of DM	16.6 % of DM
Acid Detergent Fiber	36.6 % of DM	20.4 % of DM
Neutral Detergent Fiber	54.0 % of DM	31.5 % of DM
Digestibility (DMD)	54.8 % of DM	82 % of DM
Digestibility (DOMD)	53.2 % of DM	76.3 % of DM
Est. Metabolisable Energy	7.8 MJ/kg DM	12.5 MJ/kg DM
Fat	3.6 % of DM	4.0 % of DM
Ash	8.3 % of DM	8.1 % of DM

Figure 1: Left, Pyle's 30ha Canola stubble control on the 25th Nov 2021. Right, the same crop 17th December 2021, when the control mob were removed.

Figure 2: Left, Pyle's 59ha Pallaton Raphno crop on the 25th Nov 2021. Right, the same crop 17th December 2021, when the control mob were added to this paddock.

Table 3: Pyle cross bred lamb liveweight gains grazing on a canola stubble compared to Pallaton Raphno at Takalarup in

Description	Canola stubble	Pallaton Raphno
Ha in paddock	30	59
Numbers (head)	670	1580
Stocking rate (lambs/ha)	22.3	26.8
Weight in (kg liveweight) or kg lwt	38.2	40.1
Weight out (kg lwt)	41.4	46.4
Weight gain (kg liveweight)	3.2	6.3
Average weight gain (grams/head/day)	145	286
Total weight gain (kg liveweight)	2,144	9,954
Total weight gain (kg livewieght/ha)	71.5	168.7
Value		
Store lambs @ $3/kg liveweight (at weigh in)	$114.6	$120.3
Finished lambs (weights out) @ $3/kg lwt (store condition) OR	$124.2	
Finished lambs @ 43% dressed weight @ 780 c/kg*		$155.6
Total value (above starting condition)	$6,432	$55,774
Revenue calculated per Ha (above starting condition)	$214.40	$945.32

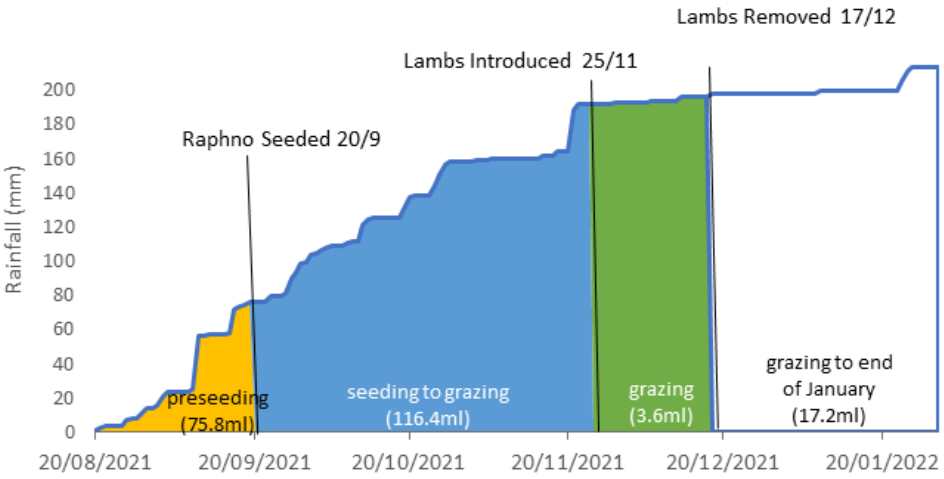

Figure 3. Summary of cumulative rainfall from August 20, 2021 until the end of January 2022. Data from Pyle's digital rain gauge located in the Raphno paddock.

Table 4. Pyle soil sample results taken November 25

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Raphno	0-10	5.6	0.1	21	23	Sand	97.5	1
Canola Stubble	0-10	5.8	0.1	26	28	Sand	97.5	1

The two paddocks grew vastly different biomass, with 2.54t/ ha for the control paddock and 4.05t/ha for the Raphno (Table 1). Nutritive value analysis revealed the Raphno was a much higher feed quality, possessing higher digestibility, metabolisable energy and crude protein than the canola stubble pasture mix (Table 2). It also had less acid detergent fibre (ADF) which is made up of cellulose and lignin which is the percentage that is undigestible.

At the commencement of grazing, lambs recorded average weights of 38.2kg and 40.1kg for the canola stubble and the Raphno, respectively. At the completion of grazing 22 days later, lamb weight gain averaged 145g/hd/day on canola stubble and 286g/hd/day on Raphno. This resulted in an extra 141g/hd/day produced on the Raphno, nearly double the average daily gain (ADG) of lambs on canola stubble. There were 670 lambs grazing the canola paddock that equated to 22.3 lambs/ha whereas the Raphno supported 26.8 lambs/ha (Table 3). David Pyle noted that the Raphno paddock was under stocked and ideally the stocking rate would have been above 30 lambs/ha.

At completion of the measured grazing period there was still plenty of biomass in the Raphno paddock (Figure 2). Lambs continued to graze the Raphno at a stocking rate of 38 lambs/ha for three weeks. That grazing pressure removed all leaf area from the Raphno. Seven weeks on David reported that the Raphno was looking good, roughly a foot tall, with blanket coverage. Unfortunately, they had a very dry summer, with only one 10mm rainfall event. However, that amount of rainfall was sufficient for the Raphno to respond and support another grazing event mid-March.

The comparison of feed types was only over 22 days of grazing. To determine the full value of growing Pallaton Raphno a rotational gross margin analysis would need to be made over the two years. Comparing the new system to the old land use. For example canola 2021, summer grazing values, barley 2022, compared to pasture 2021, Pallaton Raphno from September 20, 2021 to December 21, 2022.

Figure 1. Drone image of Pyle's Pallaton Raphno crop on November 29th, 2021.

SMITH SITE: MILLET VS BARLEY STUBBLE

KEY MESSAGES:

- The summer crop (millet) had a higher nutritive value (NV) than the barley stubble, higher crude protein, digestibility and metabolisable energy.
- There was a much greater biomass in the barley stubble 3.34t/ha compared to the 1.66t/ha of millet.
- Millet growth was highly variable and showed signs of heat and moisture stress before grazing.
- Lambs grazing the barley stubble were more profitable than the millet in the 2021/22 summer because of lower costs from utilising the existing stubble resource.

LOCATION- Green Range

SOIL TYPE- Sand

CONTROL- Barley stubble, 60ha, 120 lambs, 2 lambs/ha

VARIABLE- Millet, 80ha, 300 lambs, 3.75 lambs/ha

Background

The demonstration compared two paddocks; a millet stand and a barley stubble. After trying millet with some success in 2020, the Smiths planted another 80ha stand in 2021. A benefit of this crop is its fast growth and high yield along with its ability to germinate at soil temperatures of 15°C. Millet's ability to germinate at lower soil temperatures is important becuase it allows producers to sow earlier than other summer crops. By sowing millet earlier, producers can utilise greater soil moisture leading to earlier growth and biomass.

Smith's demonstration investigated lamb growth rates on millet compared to barley stubble. The control of barley stubble was selected because it is a traditional feed source available at this time of year.

Method

Shirohie millet was sown on November 14, 2021 at 50mm spacing with no compound fertiliser. After a 72 day growing window biomass cuts, soil samples and plant samples for nutritive value (NV) analysis were taken. The lambs were weighed and introduced to the paddock on January 25. Four quadrant cuts were collected from the barley paddock while six were collected from the millet to determine biomass prior to grazing. Plant samples were also collected for NV analysis. Nutritive value samples were analysed by Feedtest, Werribee, VIC.

A proportion of the lambs were weighed from each group going onto the millet and barley stubble. The same lambs were then weighed coming off the respective forages a month later. Due to the dry summer the millet was starting to show signs of heat and moisture stress. At the conclusion of grazing both the millet and barley stubble had been exhausted.

Results and Discussion

Table 1. Smith dry matter cuts prior to grazing

Forage	g of 0.1m² quad	t/Ha
Barley Stubble	33.35	3.34
Millet	16.55	1.66

Table 2. Smith NV analysis of forages collected on January 25, 2021.

NV Analysis	Barley Stubble	Millet
Dry Matter (DM)	73.9 %	25.5 %
Moisture	26.1 %	74.5 %
Crude Protein	3.2 % of DM	11.1 % of DM
Acid Detergent Fiber	42.9 % of DM	30.4 % of DM
Neutral Detergent Fiber	77.0 % of DM	55.7 % of DM
Digestibility (DMD)	47.9 % of DM	66.3 % of DM
Digestibility (DOMD)	47.4 % of DM	63.0 % of DM
Est. Metabolisable Energy	6.6 MJ/kg DM	9.8 MJ/kg DM
Fat	2.1 % of DM	3.2 % of DM
Ash	3.1 % of DM	6.0 % of DM

Figure 1. Left, Smith's 80ha millet crop on the 25th Jan 2022. Right, the same crop 8th March 2022, after the lambs had been removed.

Figure 2. Left, Smith's 60ha barley stubble on the 25th Jan 2022. Right, the same stubble 8th March 2022, after the lambs had been removed.

Table 3: Smith cross bred lamb liveweight gains grazing on a barley stubble compared to Shriohie millet at Green Range

Description	Barley Stubble	Millet
Ha in paddock	60	80
Numbers (head)	120	300
Stocking rate (lambs per Ha)	2	3.75
Weight in (kg lwt) or kg of liveweight	42.7	41.6
Weight out (kg lwt)	48.8	46.5
Weight gain (kg lwt) per lamb	6.1	4.9
Average weight gain (grams/head/day)	145.2	116.7
Total weight gain (kg lwt)	732	1470
Total weight gain (kg lwt/ha)	12.2	18.4
Value		
Store lambs @ $3/kg lwt (at weights in)	$128.1	$124.8
Finished lambs @ 43% dressed weight @ 800 c/kg	$167.9	$160.0
Total value	$4,776	$10,560
Revenue generated per Ha	$79.6	$132
Minus costs – Cost of planting Millet @ $90/ha and Barley $0/Ha	$0	$90
Profit (calculated per Ha)	$79.6	$42
Profit (above starting condition)	$4,776	$3,360

Figure 3. Images of the millet at the Smith Producer Demonstration site taken on the January 25, 2021 showing varied plant health and biomass.

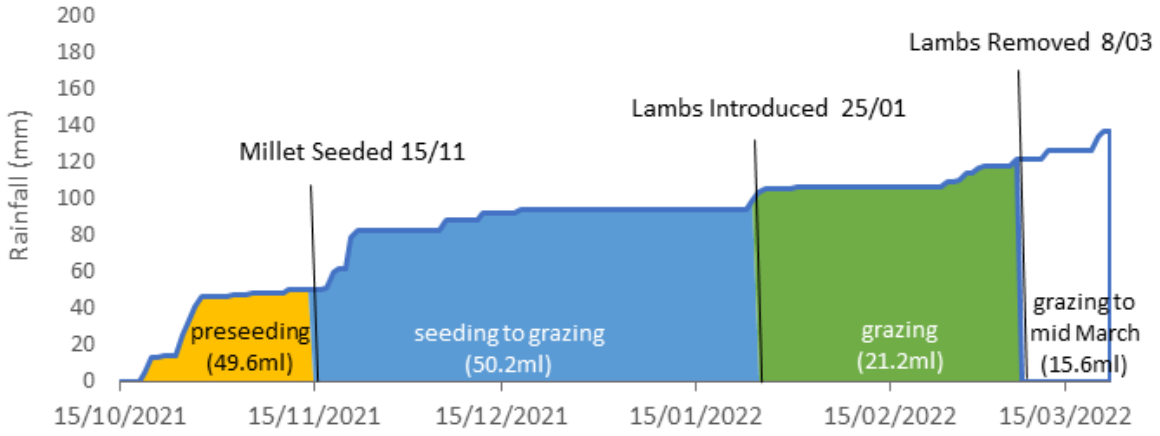

Figure 4. Summary of cumulative rainfall from October 15, 2021 until mid-March 2022. Data from a nearby digital rain gauge located off South Coast Highway.

Table 4. Smith soil sample results taken January 25, 2022.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Millet	0-10	5.1	0.7	65	37	Sand	94.5	2.2
Barley Stubble	0-10	4.8	0.9	53	21	Sand	96.0	1.4

The 2021 sown millet was seeded into optimum conditions and received 30mm of rain one-week post seeding (Figure 4). Unfortunately, only 17mm of additional rainfall was recorded over the next five weeks until grazing commenced. As a result the millet showed signs of heat and moisture stress when grazing commenced, (Figure 3), resulting in variable plant health and biomass.

Pasture cuts revealed a much larger biomass available prior to grazing in the control barley stubble 3.34t/ha compared to 1.66t/ha of millet (Table 1). Nutritive value analysis revealed the millet possessed a much higher feed quality, with higher digestibility, metabolisable energy and crude protein than the barley stubble (Table 2).

At the start of grazing lambs recorded average weights of 42.7kg and 41.6kg for the barley stubble and millet, respectively (Table 3). On completion of grazing 42 days later, lambs averaged 145.2g/hd/day on the barley stubble and 116.7g/d/day on millet (Table 3). However, the average live weight gain in kg/ha/day was higher for the millet (430g/ha/day) compared to 290g/ha/day for the barley stubble. In other words, more kilograms of lamb were grown per hectare on the millet forage compared to the barley stubble. Higher live weight gain was due to the higher stocking rate and feed quality in the millet. It was a very dry summer in 2021/22, and more rainfall would have increased the millet production.

Table 5: Calculation of the sowing costs for the Shirohie millet crop at the Smith's Green Range property summer 2021/22. Seeding and spraying costs have been calculated at contract prices.

Description	Millet Costs ($/ha)	
Seeding (contract)	*$*	*50.00*
Glyphosate ($6/Lt)	*$*	*12.00*
Spraying (contract)	*$*	*8.00*
Seed (4kg/ha Millet)	*$*	*20.00*
Total	*$*	*90.00*

Summary

Although the millet produced $132/ha compared to the barley stubble $79.4/ha, additional costs were associated with planting the millet crop at $90/ha. Barley costs were zero since we assume the cropping enterprise has already paid for the costs of growing the barley. Therefore total profit was $37.6 higher in the barley stubble compared to growing millet over the 2021/22 summer (Table 3).

As mentioned earlier, it was a very dry summer which limited the potential millet growth. With greater biomass production, the revenue generated would be higher for the same sowing costs.

Summer cropping requires producers to consider the risks and rewards. We measured losses in 2021/22 compared to barley stubble, but the data generated will help local producers consider their options in future years. The results confirm why some producers on the south coast won't consider growing summer crops. Even optimistic summer cropping producers should ensure they have significant soil moisture before planting summer crops.

METCALFE SITE: SORGHUM VS RYEGRASS PASTURE

KEY MESSAGES:

- The sorghum had a higher nutritional value (NV) than the ryegrass pasture, including safe levels of nitrate nitrogen and prussic acid.
- Steers achieved excellent weight gain on the sorghum, averaging 1kg/head/day.
- A small weight gain of 63.5g/hd/day was achieved by steers on the ryegrass with supplementation.
- Sorghum's greater water use efficiency and ability for quick regrowth allowed for multiple grazing events over summer and autumn.

LOCATION- Manypeaks

SOIL TYPE- Sand

CONTROL- Ryegrass pasture, 46ha, 89 weaner steers, ~2 steers/ha

VARIABLE- Sorghum, 34ha, 174 weaner steers, ~5 steers/ha

Background

The demonstration compared two paddocks; a sorghum stand and a senesced ryegrass pasture with supplementation. After observing other producers try sorghum, including a local feedlot that grew it under irrigation in 2020, Tim Metcalfe was interested in trialing the forage. He also viewed it as a great opportunity to make use of the remaining soil moisture after the wet 2021 winter.

Metcalfe's producer demonstration site investigated yearling steer growth rates on sorghum compared to senesced ryegrass pasture with silage and hay supplementation.

Method

The Bunker sorghum was planted on the 13th of November 2021, and received 30mm of rainfall nine days later. Other than being sprayed with a knockdown and insecticide, no other crop protection or fertilisers were applied. After a 69 day growing window biomass cuts, soil samples, nutritive value (NV), nitrate nitrogen and prussic acid (cyanide) levels were collected. The steers were weighed and introduced to the paddock seven days later after the prussic acid levels were confirmed safe. Four quadrant cuts were collected from each paddock to determine biomass prior to grazing. Nutritive value samples were analysed by Feedtest, Werribee, VIC.

A proportion of the steers were weighed from each group and selected to go onto the sorghum and ryegrass. The same number of steers were then weighed coming off the respective forages. Steers grazed the sorghum for 21 days before it was exhausted, whereas final weights were recorded 63 days after grazing the ryegrass. Each week the ryegrass steers received supplementation of four bales of silage and two bales of meadow hay.

Results and Discussion

Table 1. Metcalfe Dry Matter (DM) cuts before grazing

Forage	g of 0.1m^2 quad	t/Ha
Ryegrass	31.8	3.18
Sorghum	44.8	4.48

Table 2. Metcalfe Nutritive value analysis of the ryegrass and sorghum

NV Analysis	Ryegrass	Sorghum
Dry Matter (DM)	75.2 %	17.6 %
Moisture	24.8 %	82.4 %
Crude Protein	9.0 % of DM	10.0 % of DM
Acid Detergent Fiber	32.2 % of DM	30.8 % of DM
Neutral Detergent Fiber	61.7 % of DM	55.8 % of DM
Digestibility (DMD)	58.7 % of DM	69.2 % of DM
Digestibility (DOMD)	56.6 % of DM	65.4 % of DM
Est. Metabolisable Energy	8.5 MJ/kg DM	10.3 MJ/kg DM
Water Soluble Carbohydrates	4.0 % of DM	15.2 % of DM
Fat	3.0 % of DM	4.0 % of DM
Ash	3.7 % of DM	8.1 % of DM
Nitrate Nitrogen	-	220 mg/kg of DM
Cyanide (as Prussic acid)	-	<2.5 mg/kg

Figure 1: Sorghum paddock. Left pre-grazing, Right post grazing.

Figure 2: Ryegrass paddock. Left pre-grazing, Right post grazing.

Table 3: Metcalfe yearling steers liveweight gains from grazing sorghum and ryegrass.

	Ryegrass	Sorghum
Ha in paddock	46	34
Numbers (head)	89	174
Stocking rate (steers per Ha)	1.9	5.1
Weight in (kg lwt) or Kg of liveweight	311	395
Weight out (kg lwt)	315	416
Weight gain (kg lwt) per steer	4	21
Average weight gain (grams/head/day)	63.5	1000
Total weight gain (kg lwt)	356	3654
Total weight gain (kg lwt/ha)	7.7	107.5
Value @ 490 c/kg lwt*		
Value in	$1,523.9	$1,935.5
Value out	$1,543.5	$2,038.4
Total value added	$1,744.4	$17,904.6
Minus costs: Silage & Hay x 6 bales for 9 weeks	$2,160	
Minus Costs: Cost of sowing Sorghum @$90/ha		$3,060
Profit or Loss per Ha	$-9/Ha	$436/Ha

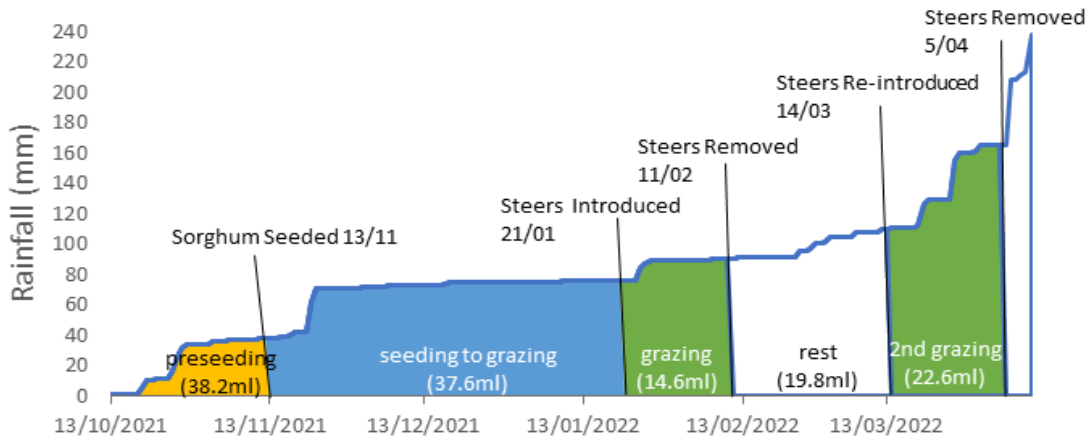

Figure 4. Summary of cumulative rainfall from October 13, 2021 until April 2022. at Metcalfe's digital rain gauge located next to the sorghum paddock.

Table 4. Metcalfe soil sample results taken on January 25, 2022.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Sorghum	0-10	5.2	0.1	14	15	Sand	96.6	1
Ryegrass	0-10	4.7	1.6	53	58	Sand	96.8	1

The 2021 sown sorghum had an ideal start receiving over 30ml in the first nine days post seeding. By the commencement of grazing the sorghum was over 1m high across most of the paddock (Figure 1 and 2). At the start of grazing the steers recorded average weights of 395kg and 311kg for the sorghum and the ryegrass, respectively.

After grazing Tim reported the steers on the sorghum had an average daily gain of 1kg/hd/day whereas the steers on the ryegrass had achieved just a little over maintenance with a small gain of 63.5g/hd/day. Steers on the sorghum were also given one bale of hay for roughage upon induction which they did not consume.

Pasture cuts revealed an extra 1.3t/ha was available on the sorghum paddock with 4.48t/ha available compared to 3.18t/ha in the ryegrass. Nutritive value analysis revealed the sorghum was a higher feed quality, possessing higher digestibility, metabolisable energy and crude protein than the senesced ryegrass pasture (Table 2). The sorghum was found to have a nitrate nitrogen level of 220mg/kg of DM, which is within the safe range of < 4500 mg/kg of DM and a prussic acid level of < 2.5mg/kg of DM also within a safe range of < 500 mg/kg (Table 5).

At completion of the measured grazing period Tim rested the paddock for just over a month and got a second three week grazing period from the sorghum (data not collected).

Update from May 9, 2022: Due to the excellent growing conditions, Tim reported another two succesful grazing events. Firstly, 93 heifers grazed the 34 Ha paddock between April 27 and May 5. On May 7, Tim placed 383 cross-bred lambs in the paddock, which will be trucked to the abottoir (Fletchers) on May 17. Data not collected.

Table 5. Level of prussic acid in forage (dry matter basis) and potential impact on livestock.

HCN, ppm (dry matter basis)	Effect on Livestock
0 - 500	Generally safe
600 - 1000	Potentially toxic, should not be the sole source of feed
> 1000	Dangerous to cattle do not feed

References

1.Rusche, Warren, "Level of prussic acid in forage (dry matter basis) and potential impact on livestock", Prussic Acid Poisoning, Last modified November 18, 2021, extension.sdstate.edu/prussic-acid-poisoning.

Thank you to Lucy Anderton for reviewing this article for the Stirlings to Coast Farmers members and staff.

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