final report

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Improving Beef Productivity

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Project Objective

The overall objective was too explore if there is a cost benefit in applying mineral sprays to pasture to optimise beef production

The specific measurable objectives were:

1) Measure the expected growth rate benefit of at least 200 gm/day in livestock grazing foliar sprayed pasture compared to the same class of livestock grazing similar un-treated (control) pasture;

2) Train producer members to monitor the expected impact of the foliar spray on pasture growth and consumption in terms of kg DM/Ha & kg LW gain before and after grazing. Given that 1 kg weight gain equates to approximately 35 MJ consumed & green feed contains about 11 MJ/kg DM, 1 kg live weight gain equates to approximately 3 kg DM consumed. Therefore a steer in the treated group growing at 200 gm/day should gain 6 kg (or $9 @ $1.50 / kg LWG) more than a steer in the control group over 30 days & this equates to an additional consumption of 18 kg DM or 900 kg DM per 50 steers. This variation in weight gain & pasture on offer should be detected through normal monitoring;

3) Train producer members to monitor the expected elevation in nutrient levels in the pasture, via tissue analysis, and animals, via blood sampling, on sprayed paddocks compared to control paddocks. Tissue & blood samples taken at the start & end of the trial should highlight the anticipated differences;

4) Undertake a cost benefit analysis on the foliar spray application in relation to measured outcomes. The anticipated benefit given 8 dse steers stocked at 2 steers / ha and spray costs of $4 / ha equate to $5 profit per steer per month.

Methodology

The following procedure was used on three group member properties over the three year duration of the trial:

- Appropriate sites to conduct the trials were selected on each of the three properties. Soil and plant tissue samples were collected to assess the mineral status and availability at each of these sites.

- The trial commenced during August - October in each year to coincide with livestock management and leaf area index to facilitate spray absorption and continued until the pasture began to hay-off.

- At each site a paddock was split into four with temporary or electric fencing to ensure both control and treated halves had similar pasture composition, water supply, feed on offer & terrain. The paddock was split into 4 to enable rotational grazing between two paddocks during the trial in both the treated & control groups;

- The treated half was sprayed with the foliar mineral spray one week prior to grazing to allow sufficient time for the foliar application to be absorbed by the pasture. The foliar spray consisted of a prescription mix of zinc, cobalt,

molybdenum, magnesium, manganese, selenium and boron based on the pasture tests performed prior to the trial commencing.

- A mob of cattle were weighed and a similar gross body weight was placed into both the treated and control paddocks. These groups were weighed again at the completion of the grazing to determine average weight gain in each paddock.

- Blood samples were taken from 5 animals in each of the control and treated groups at the start and again at the finish of the trial to assess respective mineral status.

- Pasture was sampled from the paddock prior to the trial and again from the sprayed and control paddocks at the completion to evaluate the mineral content using plant tissue analysis.

- The above procedure was repeated in each year of the three years of the trial. The trial was conducted over three years to help account for potential effects that seasonal variations may have on the outcomes.

- Soil & plant tissue analyses were carried out using ASPAC (Australian Soil & Plant Analysis Council) accredited laboratories – namely Aglab Services, Moolap, Vic & Australian Perry Agricultural Laboratory, Magill, SA. Blood analyses were performed by Regional Laboratory Services, Benalla, Vic.

Results

The trial was conducted on three properties in 2004 (Churinga Park, Hillcrest & Broadlands); one property in 2005 (Karowara); and two properties in 2007 (Karowara & Churinga Park). Exceptionally dry growing seasons in 2005 & 2006 prevented the trial being conducted except on Karowara in 2005. A change of management resulted in Hillcrest not participating in the trial in 2007.

Animal trace element status was assessed by liver biopsy in 2005 and blood test in 2004 & 2007. Liver biopsies were discontinued as the extra effort to perform these tests could not be justified in terms of expense and no significant difference in the results obtained. The trace elements monitored were selenium, copper, zinc and cobalt along with pepsinogen as an indicator of internal parasite (*Ostertagia ostertagii*) status.

Plant macro and trace element status was assessed using plant tissue analysis in each of the three years. A significant result was defined as at least a 10% increase in the level of a nutrient in the treatment sample compared to the control at the conclusion of the trial in each year.

Principal plant species at each trial site were:

- Churinga Park – clover, burr medic, annual ryegrass, soft brome & barley grass;
- Hillcrest – annual ryegrass and Persian clover;
- Broadlands - lucerne;
- Karowara – annual ryegrass and cape weed.

Weight gain:

2004:

- Churinga Park – the foliar treatment produced a 19kg weight gain over 51 days which equated to 373 gm/day.
- Broadlands – the foliar treatment produced a 2kg weight gain over 48 days which equated to 42 gm/day.
- Hillcrest – the final weight data was lost due to a technical failure with the weight recording system.

2005:

- Karowara – the foliar treatment produced a 5kg weight gain over 31 days which equated to 161 gm/day.

2007:

- Karowara - the foliar treatment produced a 16kg weight gain over 49 days which equated to 327 gm/day.
- Churinga Park - the foliar treatment produced a 5kg weight gain over 54 days which equated to 93 gm/day.

Blood / Liver tests:

2004:

- Churinga Park
    - **Selenium** – deficient throughout the trial, but improved over the 51 days. The foliar treatment did not produce a benefit over the control group.
    - **Copper** – started at a deficient level but became sufficient during the 51 day trial. The foliar treatment did not produce a benefit over the control group.
    - **Zinc** - started at a deficient level but became sufficient during the 51 day trial. The foliar treatment did not produce a benefit over the control group.
    - **Cobalt** - started at a deficient level but became sufficient during the 51 day trial for the treated group. The foliar treatment did produce a significant benefit over the control group.

- **Pepsinogen** - started at a high level in both the control and treated groups indicative of a significant *Ostertagia* infestation during the preceding 3 months. It decreased in the treated group and increased in the control group indicating the foliar treatment produced a significant benefit over the control group.

- Broadlands

  - **Selenium** – deficient throughout the trial and deteriorated over the 48 days. The foliar treatment did not produce a benefit over the control group.

  - **Copper** – started at a deficient level and remained deficient during the 48 day trial. The foliar treatment did produce a minor but not significant benefit over the control group.

  - **Zinc** - started at a deficient level but became sufficient during the 48 day trial. The foliar treatment did not produce a significant benefit over the control group.

  - **Cobalt** - started at a deficient level but became sufficient for the treated group during the 48 day trial. The foliar treatment did produce a significant benefit over the control group.

  - **Pepsinogen** - started at a high level in both the control and treated groups indicative of a significant *Ostertagia* infestation during the preceding 3 months. It decreased similarly in both the control and treated groups indicating the foliar treatment did not produce a significant benefit over the control group.

- Hillcrest

  - **Selenium** – deficient throughout the trial, but improved over the 59 days. The foliar treatment did not produce a benefit over the control group.

  - **Copper** – started at a good level in the control group and deficient level in the treated group and ended in the adequate range for both groups over the 59 day trial. The foliar treatment produced a benefit over the control group.

  - **Zinc** - started at a deficient level but became sufficient during the 59 day trial. The foliar treatment did not produce a benefit over the control group.

  - **Cobalt** - started at a high level and remained in the adequate range during the 59 day trial. The foliar treatment did not produce a significant benefit over the control group.

  - **Pepsinogen** - started at a high level in both the control and treated groups indicative of a significant *Ostertagia* infestation during the preceding 3 months. It decreased in both the control and treated groups

with the treated group showing a bigger but not significant benefit over the control group.

2005:

- Karowara
    - **Selenium** – sufficient throughout the trial, but improved over the 38 days between samplings. The foliar treatment did produce a significant benefit over the control group.
    - **Copper** – started at a deficient level in both groups and ended in the adequate range for both groups over the 38 days between samplings. The foliar treatment produced a significant benefit over the control group.
    - **Zinc** - started at a deficient level but became sufficient during the 38 days between samplings. The foliar treatment did not produce a benefit over the control group.
    - **Cobalt** - started at an adequate level and remained in the adequate range during the 38 days between samplings. The foliar treatment did not produce a benefit over the control group.

2007:

- Karowara
    - **Selenium** – deficient throughout the trial, but improved over the 54 days. The foliar treatment did produce a significant benefit over the control group.
    - **Copper** – started at a deficient level in both groups, but ended in the adequate range for the treated group only. The foliar treatment produced a minor benefit over the control group.
    - **Zinc** - started in the adequate range and remained there for the 54 days. The foliar treatment produced a minor benefit over the control group.
    - **Cobalt** - started at a good level and remained in the adequate range during the 54 day trial. The foliar treatment did produce a significant benefit over the control group.
    - **Pepsinogen** - started at a high level in both the control and treated groups indicative of a significant *Ostertagia* infestation during the preceding 3 months. It decreased marginally in both the control and treated groups with the treated group showing no benefit over the control group.
- Churinga Park

- **Selenium** – deficient throughout the trial, but improved over the 49 days. The foliar treatment did not produce a benefit over the control group.

- **Copper** – deficient throughout the trial, but improved over the 49 days. The foliar treatment did not produce a benefit over the control group.

- **Zinc** - started in the adequate range and remained there for the 49 days. The foliar treatment did not produce a benefit over the control group.

- **Cobalt** - started at an adequate level and ended at a high level in both groups during the 49 day trial. The foliar treatment did not produce a benefit over the control group.

- **Pepsinogen** – started and remained at a normal level in both groups throughout the 49 day trial. It decreased marginally in the control group and the treated group showed no benefit over the control group.

Plant tissue analysis

2004:

- Churinga Park – Significant elevation of calcium, magnesium, copper and cobalt.
- Hillcrest – Significant elevation of potassium, calcium, chloride, copper, zinc, molybdenum and selenium.
- Broadlands – Significant elevation of magnesium, sodium, chloride, boron and copper.

2005:

- Karowara – Significant elevation of copper, iron, aluminium and molybdenum.

2007:

- Churinga Park – Significant elevation of sodium, cobalt and molybdenum.
- Karowara – Significant elevation of potassium, sodium, copper, zinc, cobalt and molybdenum.

Discussion

The trial has revealed great variability in the outcomes both between properties and between years over the three years in which the trial was conducted. There are several factors which may have contributed to this variation including some differences in foliar formulation to suit specific pasture needs (based on pasture analysis prior to commencing the trial); variation in soil type and pasture species between properties; difficulty in accounting for variation in dry matter on offer between the treated and control paddocks due to excessive spring growth; confounding of results due to concurrent mineral treatments through water medication or direct animal treatment in the first year at two trial sites; and difficulty maintaining a consistent approach to product application across different trial sites in different years.

Despite the variations observed, the results indicate that foliar mineral applications can offer a cost effective method of mineral supplementation based on weight gain alone (refer Appendix 5, Table 10). These calculations based on a relatively short grazing period do not necessarily include the qualitative benefits observed by participants during the trial including:

- Subsequent increased pasture density at Karowara in 2008 where the foliar spray had been applied in 2005 & 2007;

- Lower blood pepsinogen indicating reduced worm burden (*Ostertagia ostertagii*) in animals grazing the treated pasture in 2004 at Churinga Park. Note: this was not evaluated on Karowara in 2005.

- Potentially enhanced disease resistance through elevated animal mineral and vitamin status at all trial sites over the duration of the trial and beyond.

A cost benefit in excess of $19/head for the foliar application was observed over a 51 day grazing period in 2004 on Churinga Park and $15/head benefit over 49 days was observed on Karowara in 2007 (Table 10). In contrast, there was net benefit of (-$5.50)/head for the foliar application over the 48 days of the trial on Broadlands in 2004 and (-$2)/head on Churinga Park for the 48 day trial in 2007. These calculations are based on amortizing the benefit of the foliar application over a 12 month period rather than apportioning the entire cost against the brief grazing period of the trial. This assumption is considered realistic as minerals applied by spraying on pasture would be expected to remain distributed in the soil – plant – animal grazing system with the only significant loss occurring when animals or animal product are removed from the system. The manufacture of the foliar spray used in the trial, Agmin Chelates, claims up to a 3 year benefit from one application based on their own studies (S. Ludvig pers.comm.). However, this claim does not appear to have been evaluated by independent research.

The overall objective was too explore if there is a cost benefit in applying mineral sprays to pasture to optimise beef production. This was achieved although the evidence was equivocal with a cost benefit only being apparent on some properties in some years. The erratic nature of the response observed may have been due to the various reasons already stated and this trial would need to be repeated on several properties over different seasons to clarify the most likely reason.

The first objective of achieving a growth rate of at least 200 gm/day was achieved twice out of the five trial results presented.

The second specific objective of measuring a response in weight gain and pasture consumed was partially met. The measured growth rate response was a clear objective and relatively easily accomplished with weighing the stock before and after grazing of the control and treated paddocks. This succinctly demonstrated the benefit of measurement to quantify a potential benefit from a specific treatment. In contrast the measurement of dry matter on offer before and after grazing in the treated and control paddocks was not as pronounced. This was due in part to spring pasture growth exceeding stocking density and making it difficult to readily quantify feed on offer. In addition, stocking rates were varied uniformly in both the control & treated paddocks in an endeavour to account for the extra pasture as a result of the spring flush and further complicated the assessment of dry matter production and utilisation.

The third specific objective to evaluate and demonstrate the benefit of plant tissue and blood analysis in monitoring the macro and trace element status of plants and animals was achieved. However, the considerable variation in plant results (refer Appendix 2, Table 5 & Appendix 3, Table 6) and blood results (Appendix 4, Table 7 & 8, & Appendix 5, Table 9) did not enable clear comprehensive conclusions to be drawn. The producer participants in the project were able to see several trends, but the outcomes varied between properties and seasons. Many more similar trials would need to be done across a range of years before clear and comprehensive conclusions could potentially be drawn.

The fourth & final objective of demonstrating a cost benefit of applying foliar pasture sprays through measured outcomes was also achieved. Improved growth rates as a result of the foliar application were measured at 5 of the 6 trial sites with the trial on the sixth site failing to be completed. In addition, elevation of plant and blood/liver mineral levels were observed in response to the foliar applications at all sites, although the results were variable and several were not significant. Taking the cost of the foliar application into consideration resulted in a cost benefit being evident at three out of five completed trials over three years (refer Table 10).

Conclusion

Foliar pasture sprays are capable of producing a cost effective increase in beef productivity during late winter / spring in the high rainfall zone of south east South Australia. Cost benefits up to $19 per hectare were achieved over 50 day grazing periods during the three years of the project. The results were quite encouraging although further work is required to determine the specific cause(s) of the variability in the outcomes achieved.

The foliar sprays were found to increase the trace and macro element levels in sprayed pasture and the trace element status of animals grazing the pasture. This resulted in increased growth rate in animals grazing the treated pasture compared to similar animals grazing non-sprayed pasture.

Acknowledgments

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Colin Trengove

Project Facilitator

Table 1: Weight Gain Results for Three Trial Sites in 2004 Appendix 1

BW	Oct	Nov	Gain	Diff'nce	Days	WG
	2/09/2004	**23/11/2004**	**kgs**	**kgs**		**gm/d**
Churinga Park						
Control	424	502	78			
Foliar	458	555	97	19	51	**373**
	17/09/2004	**15/11/2004**				
Hillcrest						
Control	228	--				
Foliar	317	--				
	6/10/2004	**23/11/2004**				
Broadlands						
Control	334	392	55			
Foliar	343	403	57	2	48	**42**

Table 2: Weight Gain Results for One Trial Site in 2005

BW	Oct	Nov	Gain	Diff'nce	Days	WG
	23/10/05	**23/11/05**	**kg**			**gm/d**
Karowara						
Control	366	425	58			
Foliar	372	435	63	5	31	**161**

Table 3: Weight Gain Results for Two Trial Sites in 2007

BW	Aug	Oct	Gain	Diff'nce	Days	WG
	30/08/07	**23/10/07**	**kgs**	**kgs**		**gm/d**
Churinga						
Control	521	627	106			
Foliar	506	617	111	5	54	**93**
	05/09/07	**24/10/07**				
Karowara						
Control	385	480	95			
Foliar	364	475	111	16	49	**327**

Table 7: Blood Trace Element Results on Three Trial Sites in 2004

	Churinga				Hillcrest				Broadlands		
	2/09/04	23/11/04	Diff'ce	Sig'ce	17/09/04	15/11/04	Diff'ce	Sig'ce	6/10/04	23/11/04	Diff'ce
Selenium											
Control	105	182	-77		66	140	-74		105	50	-55
Treated	157	215	-58	NS	58.8	124	-65.2	NS	157	61	-96 NS
Ideal	>250	>250			>250	>250			>250	>250	
Copper											
Control	12.4	14.8	-2.4		18.2	15.1	-3.1		12.4	12.1	-0.3
Treated	12	15.7	-3.7	NS	13.3	15.3	2	**	12	13.3	1.3 **
Ideal	>14	>14			>14	>14			>14	>14	
Zinc											
Control	13	18	-5		10.2	16.7	-6.5		13	16.6	3.6
Treated	12.5	16.6	-4.1	NS	11.9	17.5	-5.6	Ns	12.5	16.9	4.4 NS
Ideal	>14	>14			>14	>14			>14	>14	
Vitamin B12/Cobalt											
Control	*128*	*170*	-42		2855	211	2644		128	172	44
Treated	133	205	-72	**	2744	237	2507	Ns	133	249	116 ***
Ideal	>200	>200			>200	>200			>200	>200	
Pepsinogen											
Control	28	42	-14		17.8	15	2.8		28	5.9	-22.1
Treated	16.5	9.5	7	***	24.7	17.4	7.3	*	16.5	6	-10.5
Ideal	<5	<5			<5	<5			<5	<5	NS

Table 8: Liver Trace Element Results on Karowara in 2005

	Karowara			
	12/10/05	19/11/05	Difference	Significance
Selenium				
Control	3.6	4.2	0.6	
Treated	3.5	8.6	5.1	***
Ideal	3 - 25	3 - 25		
Copper				
Control	0.02	0.1	0.08	
Treated	0.03	0.31	0.28	***
Ideal	0.08-2.1	0.08-2.1		
Zinc				
Control	0.26	0.38	0.12	
Treated	0.29	0.4	0.11	*NS*
Ideal	0.3 - 0.8	0.3 - 0.8		
Vitamin B_{12}/Cobalt				
Control	561	702	141	
Treated	585	710	125	*NS*
Ideal	200-1500	200-1500		

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Table 9: Blood Trace Element Results on Two Trial Sites in 2007 Appendix 5

		Churinga				Karowara		
		29/10/2007	Difference	Sig'ce		29/10/2007	Difference	Sig'ce
Selenium								
Control	137	179	42		112	108	-4	
Treated	137	185	48	NS	112	184	72	***
Ideal	>250	>250			>250	>250		
Copper								
Control	11.1	13.1	2		6.5	12.7	6.2	
Treated	11.1	11.9	0.8	NS	6.5	13.9	7.4	*
Ideal	>14	>14			>14	>14		
Zinc								
Control	20.4	18.1	-2.3		18.4	18.1	-0.3	
Treated	20.4	18.4	-2	NS	18.4	19.2	0.8	*
Ideal	>14	>14			>14	>14		
Vitamin B12/Cobalt								
Control	*217*	*3451*	3234		353	287	-66	
Treated	217	2922	2705	NS	353	375	22	***
Ideal	>200	>200			>200	>200		
Pepsinogen								
Control	4.1	2.6	-1.5		15.5	12.9	-2.6	
Treated	4.1	4.6	0.5	NS	15.5	13.5	-2	NS
Ideal	<5	<5			<5	<5		

Table 10: Cost Benefit Analysis for Foliar Pasture Spray on Four Trial Sites 2004 - 07

	Karowara		*Churinga Park*		*Broadlands*
	2007	*2005*	*2007*	*2004*	*2004*
BENEFIT:					
Wt gain (kg/d)	0.327	0.161	0.093	0.373	0.042
Meat value $/kg	1.50	1.50	1.50	1.50	1.50
Value (c/hd/d)	0.49	0.24	0.14	0.56	0.06
No. days of trial	49	31	54	51	48
Value/head/trial	**$24.03**	**$7.49**	**$7.53**	**$28.53**	**$3.02**
COST:					
Foliar $/ha	50	50	50	50	50
Freight $/ha	5	5	5	5	5
Application $/ha	10	10	10	10	10
Total $/ha	65	65	65	65	65
Tot cost/ha/trial	**$8.73**	**$5.52**	**$9.62**	**$9.08**	**$8.55**
COST BENEFIT $/ha	**$15.31**	**$1.97**	**-$2.08**	**$19.45**	**-$5.52**