FERTILISER TRIAL MONITORING

INTRODUCTION

The trials aim to determine Nitrogen (N) rate response in kikuyu and tall wheat grass pastures and then calculate the most economically robust rate to use. Kikuyu and tall wheat grass are two of the most widely adopted perennial pastures on the south coast. There is however very little information on their response to fertiliser rates including N.

These trials will investigate the impact of N rates on pasture growth and give a part indication of critical concentrations. They will also assess the impact of not applying the key macro nutrients (PKS) in a basal application scenario.

BACKGROUND

SITE ONE: Ian and Sam Lehmann

The site is approximately 13km from the Cranbrook town site on the corner of Brickhouse and Munrilliup Rd's. Around 24ha, it was established as a pure kikuyu stand in spring 2007. Funding for site establishment was provided through the National Landcare Program. The site is sandy and fairly flat with good plant density throughout.

FIGURE 1: KIKUYU PASTURE AT LEHMANN'S

SITE 2: John and Sally Harding

Around 26ha established as a pure tall wheatgrass stand in spring 2008. The site is 'crabhole country' which is fairly flat with slight rises throughout in the paddock which are generally very hard to establish ground cover (even cereal crops) on. There is good tall wheat grass density throughout, though less on the high spots and some blocks of saltbush recently planted on the more bare areas. Funding for the establishment of the site was provided through the National Landcare Program.

FIGURE 2: TALL WHEATGRASS PASTURE AT HARDINGS

TREATMENTS AND METHODOLOGY

The design, treatments and methodologies for the fertiliser trials are described below. Both trials were exactly the same, except for the pasture they were based on.

Treatments

1. Control 0 units of N plus PKS 350gm super + 571gm MAP + cu and zn
2. 25 units of N plus PKS 190gm urea + 350gm super + 571gm MAP + cu and zn
3. 50 units of N plus PKS 380gms urea + 350gm super + 571gm MAP + cu and zn
4. 100 units of N plus PKS 570gm urea + 350gm super + 571gm MAP + cu and zn
5. NKS 190gm urea + 194gm gypsum + 571gm MAP + cu and zn
6. NPS 190gm urea + 350gm super + cu and zn
7. NPKS (double rate) 25 units of N plus PKS 190gm urea + 700gm super + 571gm MAP + cu and zn
8. Nil

Three rates of N plus a control were applied on established kikuyu and tall wheat grass. Treatments were applied in autumn and spring when the kikuyu and tall wheat grass are actively growing. Basal rates of PKS and micros were applied with four replicates used. A further three treatments investigated the impact of no

application of P, K and S with basal amounts applied of the remaining macro and micro nutrients. Rates of nutrient application were,

- P – 10kg/ha 350gm super
- K – 80kg/ha 571gm MAP
- S – 10kg/ha (super) or 194gm of gypsum
- Cu – 5kg/ha
- Zn – 5kg/ha

Experimental Design

The trials were each designed as a randomised complete block design. There were 7 treatments including a control with four replicates of each treatment. Two pasture cages were placed in each plot with pasture cuts occurring 4 times throughout the year.

The aim is to measure the growth response of kikuyu and tall wheat grass to varying rates of N application. The application would be done at three different rates plus a control applied in spring and a further three treatments would investigate the impact of no application of P, K and S. This will be done by dropping out each major element. With the control for the N rate component indicating the impact of no N application.

Cuts from pasture cages were made to determine pasture growth rates from the plots. This would be combined with plant tissue testing which would be carried out in order to indicate possible critical concentrations.

Base line soil samples would be taken from each plot. This would then be repeated at the end of the trial to determine if there are any significant differences in soil parameters, like soil acidity, organic carbon, and nutrient level. Soil samples would be taken at depths of 0-10, 10-20 and 20-40cm

Randomisations

Harding's

NPS 32	NKS 31	NKS 30	NPS 29	
N 100 28	NPS 27	P*2KS 26	NKS 25	
N 25 24	N 100 23	N 0 PKS 22	N 100 21	Fence
P*2KS 20	Nil 19	N 25 18	Nil 17	
Nil	P*2KS	NPS	N 50	

16	15	14	13	
N 50 (was NPS) 12	N 25 11	N 100 10	N 0 PKS 9	
N 0 PKS 8	N 0 PKS 7	N 50 6	N 25 5	
NKS 4	N 50 3	Nil 2	P*2KS 1	

Lehmann's

NPS 32	NKS 31	NKS 30	NPS 29	
N 100 28	NPS 27	P*2KS 26	NKS 25	
N 25 24	N 100 23	N 0 PKS 22	N 100 21	
P*2KS 20	Nil 19	Nil 18	N 25 17	
Nil 16	P*2KS 15	NPS 14	N 50 13	**Fence**
N 50 (was NPS) 12	N 25 11	N 100 10	N 0 PKS 9	
N 0 PKS 8	N 0 PKS 7	N 50 6	N 25 5	
NKS 4	N 50 3	Nil 2	P*2KS 1	

Key Measurements:

- Pasture growth rates determined from pasture cuts taken from pasture cages and converted to tonnes/ha.
- Baseline soil samples to be taken from each plot at three different depths down to 40cm. Each plot would be sampled 10 times using a pogo (0-10) and then

bulked up to get a single sample for the plot. A sub soil sample would also be taken using a soil auger with at least five samples taken in each plot.

- End of trial sampling to investigate changes in soil nutrients, pH and organic carbon would be taken following the sampling methodology previously used.
- Pasture nutrient status would be determined from tissue tests taken when pastures are cut for weighing.
- Pasture digestibility and crude protein would also be taken

RESULTS AND CONCLUSIONS SO FAR

TABLE 1: BASAL SOIL NUTRIENT ANALYSES FOR BOTH SITES.

Trial	Depth	Ammoniu	Nitrate	P Colwell	K Colwell mg/Kg	Sulphur	OC %	Cond dS/m	pH Level (CaCl2)	pH Level (H2O)	PBI
Average values Lehmans	0-10	7.06	5.09	11.84	67.34	4.78	1.38	0.05	4.62	5.55	15.95
	10-20	2	1	16	42	3.8	0.58	0.040	4.6	5.5	17.3
	20-30	6	5	20	41	3.5	0.64	0.031	4.7	5.6	19.8
Average values Hardings	0 - 10	4.3	4.5	18.2	163.3	18.2	1.16	0.259	6.0	6.9	42.6
	10-20	7.22	4	34	120	14.7	2.02	0.214	4.7	5.5	27.2
	20-30										

Lehman's kikuyu fertilized pasture cuts – 9/9/11

Pasture cuts were taken on the 9-9-11 using a 0.1m2 quadrat, samples were dried and then weighed. Results of FOO are given in kg/ha.

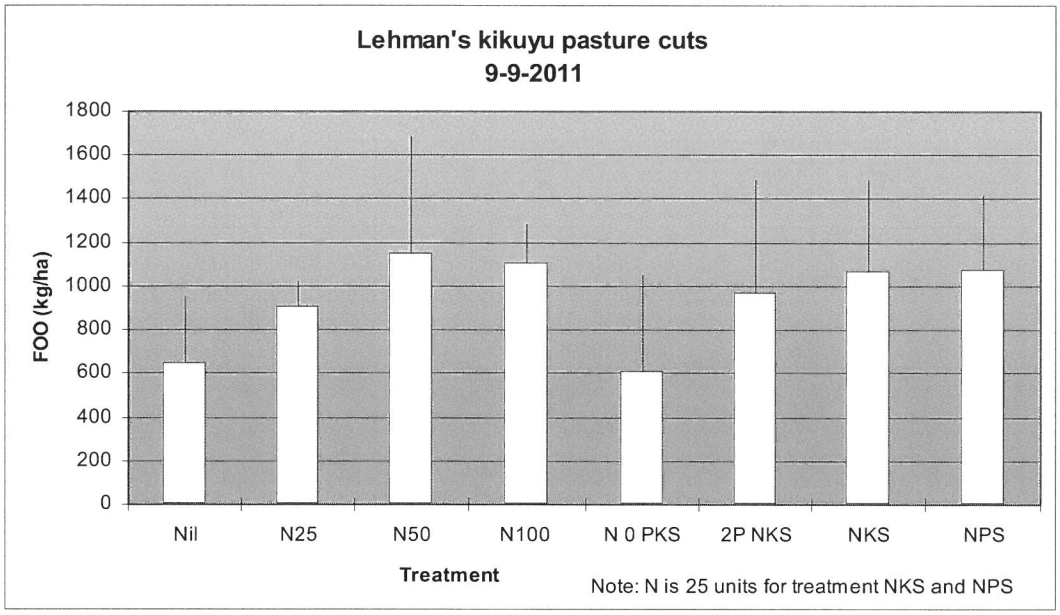


FIGURE 3: FEED ON OFFER FOR LEHMANN'S KIKUYU PASTURE FERTILISER TRIAL

Comments:

- Nil had no fertiliser at all and shows slightly higher (6%) FOO compared with and PKS only no N, meaning there was no response from PKS indicating that there was sufficient for production.
- Adding nitrogen to PKS had a large impact on production, 25 units gave a 40% increase, 50 units gave a 76% increase and 100 units gave a 70% increase.
- 50 units of N gave maximum return after which it appears to plateau.
- Interestingly adding twice the rate of P to the PKS (2P NKS) gave only a 6% increase in FOO, adding to the thought that P is not limiting production hence the small response.
- It is difficult to know what the impact of K or S has on production other than to say that the treatments NKS and NPS showed increases in FOO of 64 and 65% respectively compared with Nil. However when you take out the impact of 25 units of N (40%) then the remaining 25% could possibly be attributed to K and S.

Harding's tall wheat grass fertilized pasture cuts – 12/9/11

Pasture cuts were taken on the 12-9-11 using a 0.1m2 quadrat, samples were dried and then weighed. Results of DM (dry matter) are given in kg/ha.

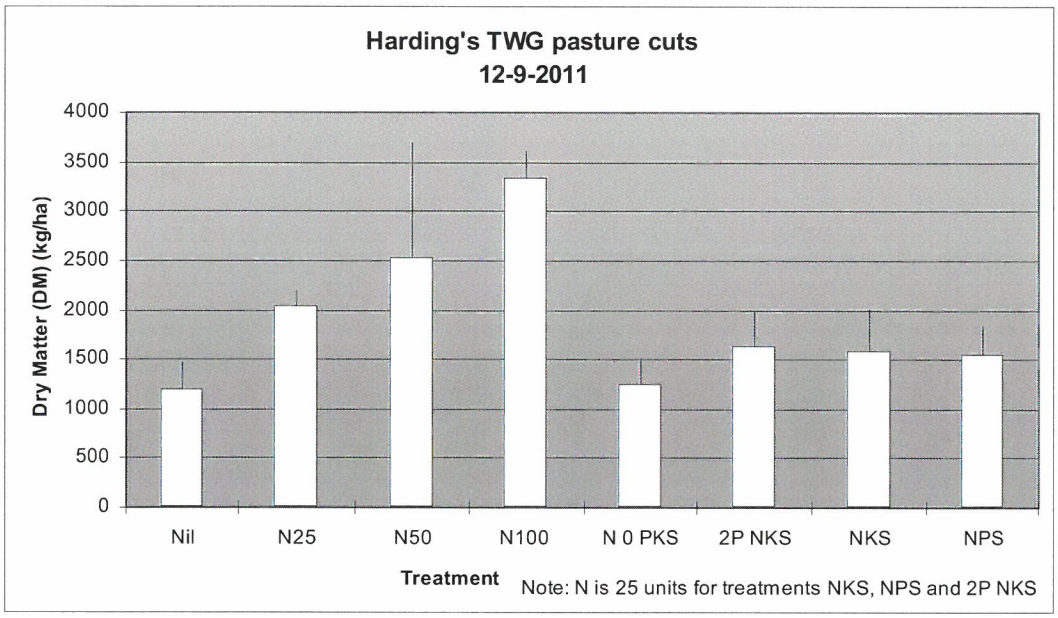


FIGURE 4: FEED ON OFFER (DRY MATTER) FOR HARDING'S TALL WHEATGRASS FERTILISER TRIAL

Comments:

- Nil had no fertiliser at all and shows slightly lower (5%) DM compared with and no N PKS only, meaning there was very little response from PKS indicating that there was sufficient in the soil for production.
- Adding nitrogen to PKS increased production for all rates. Nitrogen application of 25 units gave a 63% increase, 50 units gave a 102% increase and 100 units gave a 167% increase.
- Results show that production continues to increase indicating that higher rates of N need to be trialed before we know where dry matter production starts to level off.
- 25 units of N gave maximum response per unit of N, 31 kgDM/kgN (see Table 1). A summary of other nitrogen work in Australia on pastures in 2006 by Paul Sanford showed average N response of 19 kgDM/kgN (range 8-30) indicating that this is at the high end.
- P is not limiting production because twice the rate of P (2P NKS) gave 11% decrease in dry matter.
- Difficult to know what the impact of K or S has on production other than to say that the treatments NKS and NPS showed increases in DM of 33 and 30% respectively compared with Nil. However when you take out the impact of 25 units of N (63%) then you have a negative impact to K and S.

Table 2: Dry matter production and response to different rates of N application at Harding's, measurements taken 12-9-11.

Treatment	Dry Matter (kg/ha)	N response (kgDM/kgN)	% increase in DM
Nil	1251	0	0
N25	2041	31	63
N50	2528	25	102
N100	3348	21	167

FIGURE 5: Overview of Harding's trial site, note the response in the high N plots by the lush green colour and higher growth of pasture in the centre of the photo.

Slim and Sam Lehman – combined results for cuts taken 9/9/11 and 30/11/11

Pasture cuts were taken on the 09/09/11(91days of growth). Samples were dried and then weighed. Results of cuts are given in kg/ha. Fertiliser was applied on the 20/06/11. After the cuts an additional application of N was applied and the plots cut again on the 30/11/11 (71 days of growth). Rates of N are in Kg of N only, not fertiliser.

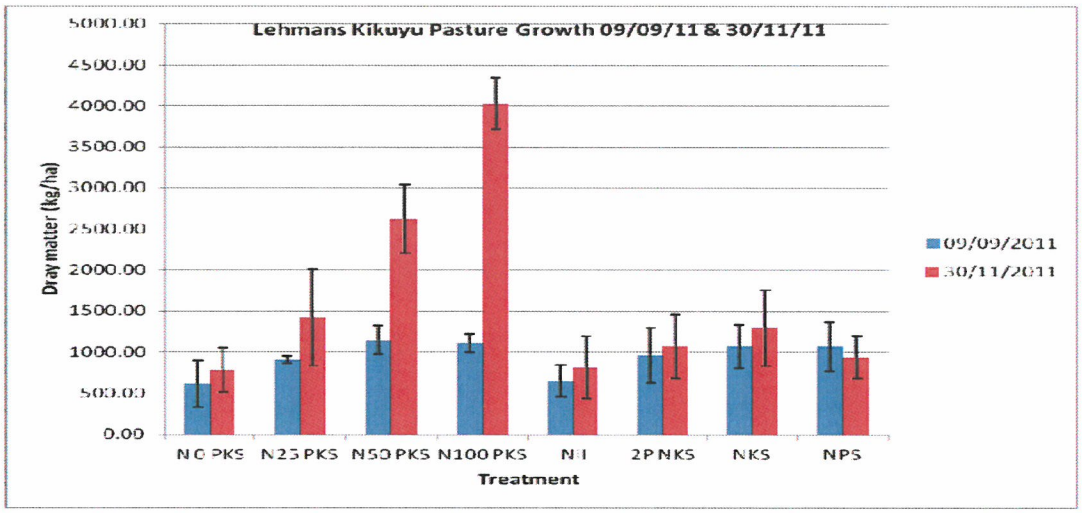


FIGURE 6: KIKUYU PASTURE GROWTH AT LEHMAN'S ON TWO SAMPLING DATES

Comments:

- **All N treatments had a base rate of 10kg/ha of P, 80kg/ha of K, 10kg/ha of S and 5kg/ha each of copper and zinc.**
- **N treatments were 0, 25, 50 and 100kg/ha of N applied after each cut (not urea).**
- The total pasture growth at 200kg/ha of N for 162 days was 5130kg/ha as opposed to 1397kg /ha with zero N (winter/spring combined).
- **50 units of N gave maximum growth in the winter cuts but 100 in the spring/summer for the kikuyu on an increasing plain.**
- Interestingly adding twice the rate of P to the PKS (2P NKS) gave only a 6% increase in pasture growth but is not significant
- There appears to be no significant impact of removing K and P at this stage (likely due to background levels).
- Tissue analysis showed not increase in nitrate concentration. There was a significant increase in total N at the 50 and 100 units of N – will likely increase crude protein levels.
- Soil was acidic at a pH of 4.6. There were sufficient levels of P, marginal to deficient levels of K and marginal levels of S (for clover). The phosphorous buffering index (PBI) was low (16).

Kikuyu Nitrogen Use Efficiency

Table 3: Total for winter (92 days June – August)

N applied kg/ha (2 applications winter/spring)	Total kg/ha produced (78days)	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied	% increase in DM
0	613			
25	907	294	12	48
50	*1150*	*537*	*11*	*88*
100	1105	492	5	61

Table 4: Total for spring/summer (72 Days Sept - Nov)

N applied kg/ha (2 applications winter/spring)	Total kg/ha produced (78days)	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied	% increase in DM
0	754			
25	1423	669	27	89
50	*2625*	*1871*	*37*	*249*
100	*4080*	*3326*	*33*	*441*

Table 5: Total for 162 days (June – Nov)

N applied kg/ha (2 applications winter/spring)	Total kg/ha produced (162days)	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied
0	1397		
50	2330	933	19
100	*3775*	*2378*	*24*
200	5134	3737	19

John and Sally Harding – combined results from 12/9/11 and 1/12/11

Pasture cuts were taken on the 12/09/11 (94 days of growth) with samples dried and then weighed. Fertiliser was first applied on the 20/06/11. After the cuts an additional application of N was applied at the rates indicated with a second cut carried out on the 01/12/11 (74 days of growth). Rates of N are in Kg of N only, not fertiliser.

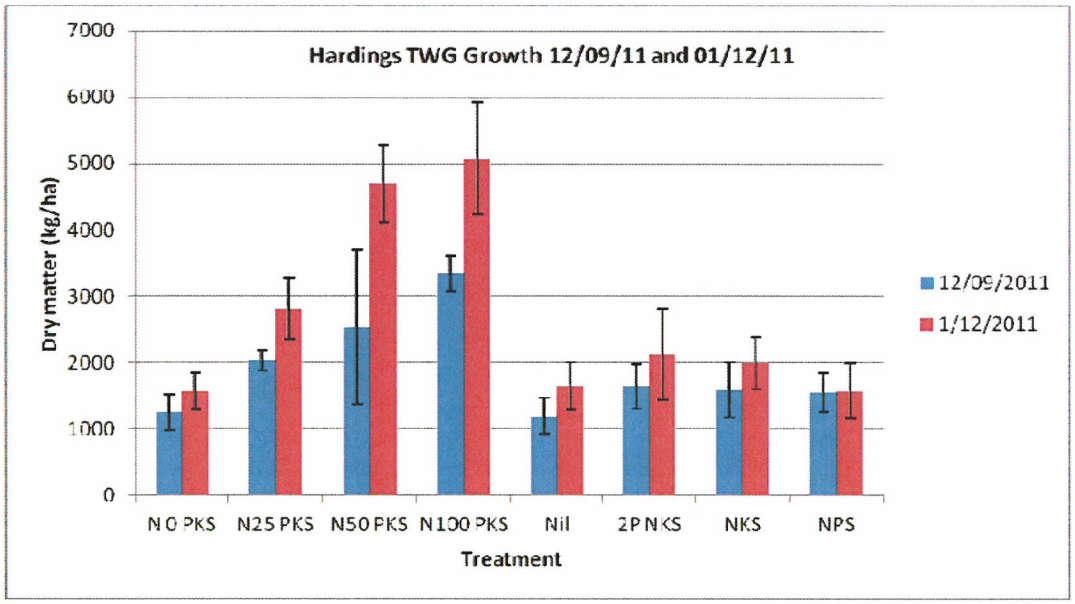


FIGURE 7: TALL WHEAT GRASS GROWTH AT HARDINGS ON TWO MEASUREMENT DATES

Comments:

- All N treatments had a base rate of 10kg/ha of P, 80kg/ha of K, 10kg/ha of S and 5kg/ha each of copper and zinc.
- **Total pasture growth at 200kg/ha of N was 8425kg/ha over a 168 day period as opposed to 2820kg/ha at Zero N (winter/spring combined).**
- Results show that production continues to increase with N application right up to 100kg/ha in autumn/ winter however there is a definite reduction in the response between the 50 and 100kg/ha rates in the spring/summer period
- P is not limiting production at this stage because twice the rate of P (2P NKS) produced no increase in production
- There appears to be no significant impact of removing K and P at this stage
- There are marginal levels of P, adequate levels of K and S, pH is good in the top soil. The soil was generally more fertile then Lehman's property but did have higher levels of salt.

Tall Wheat Grass Nitrogen use efficiency

Table 6: Total for winter (94 days June – August)

N applied kg/ha (2 applications winter/spring)	Total kg/ha produced	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied	% increase in DM
0	1251			
25	2040	789	**32**	63
50	*2528*	*1277*	***26***	*102*
100	*3348*	*2097*	***21***	*167*

Table 7: Total for spring/summer (74 Days Sept - Nov)

N applied kg/ha (2 applications winter/spring)	Total kg/ha produced	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied	% increase in DM
0	1572			
25	2807	1235	**49**	79
50	*4694*	*3122*	***62***	*199*
100	5078	3506	**35**	223

Table 8: Total for 168 days (June – Nov)

N applied kg/ha (2 applications winter/spring	Total kg/ha produced (168days)	Additional kg/ha (above 0 N)	N use efficiency (kg DM/kg N applied
0	2823		
50	4847	2047	41
100	*7222*	*4399*	*44*
200	8426	5603	28

As this trial is on-going, final results, conclusions and economic analyses are yet to be completed.

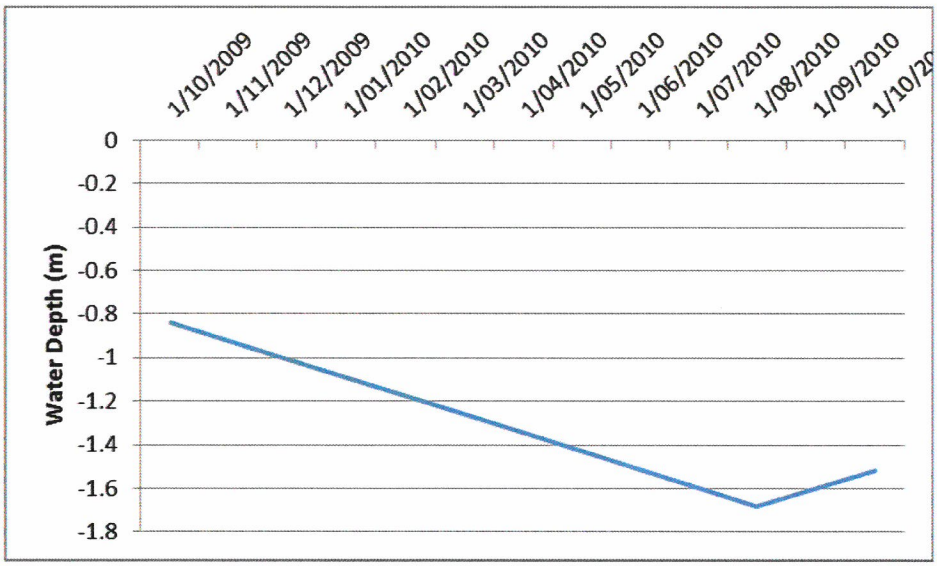


FIGURE 23: WATER LEVELS IN BORE SGS 23 IN THE CONTROL (ANNUAL) PADDOCK THROUGHOUT THE PROJECT

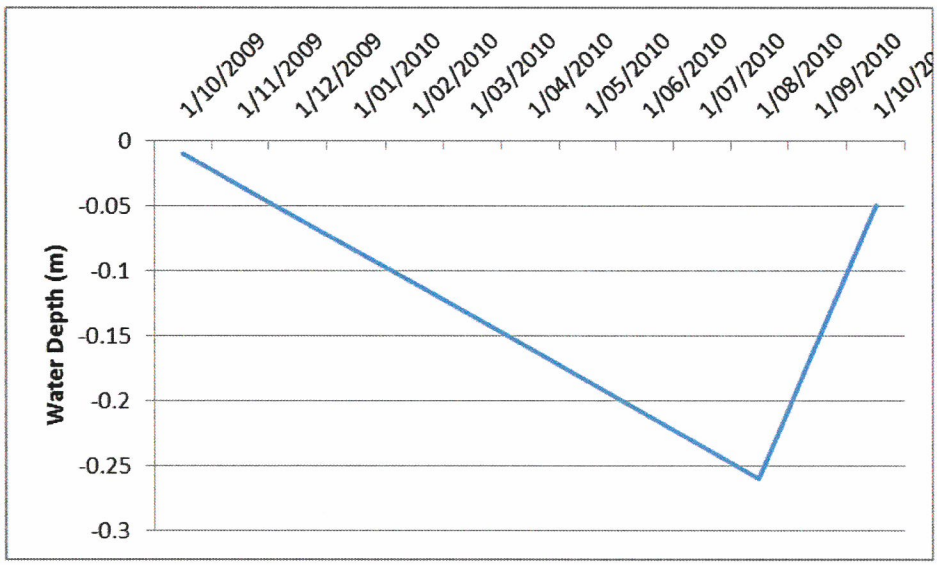


FIGURE 24: WATER LEVELS IN BORE SGS25, LOCATED IN THE HIGHLY SALINE AREA OF THE SALTBUSH/PERENNIAL PASTURE PADDOCK, THROUGHOUT THE PROJECT

PASTURE AND GRAZING

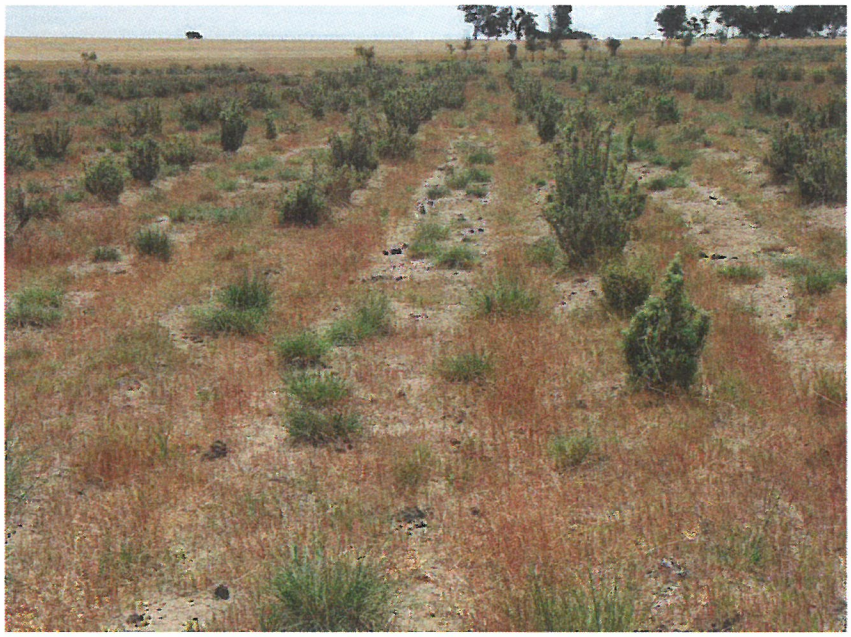
Feed on offer was higher throughout the project in the treatment paddocks, both saltbush alone and saltbush sown with inter-rows of perennial grasses, than in the unimproved control paddock. This paddock consisted of mostly barley grass and some native clovers. Rainfall for 2010 was below average and visual observations show that annual pasture production on this site was reduced. At all measurement dates, groundcover in the Evergraze quadrats was good, apart from the small section of highly saline ground in the saltbush and perennial pasture treatment. This quadrat remained bare, with no plant growth throughout the project.

(A)

(B)

FIGURE 25: CONTROL PADDOCK OF UNIMPROVED ANNUAL PASTURE AT WITHAM'S IN (A) NOVEMBER 2009 AND (B) FEBRUARY 2011

(A)



(B)

FIGURE 26: SALTBUSH ALLEYS WITH PERENNIAL GRASS INTER-ROWS OF TALL WHEATGRASS, PUCCINELLIA AND RHODES GRASS, (A) NOVEMBER 2009 AND (B) FEBRUARY 2011

(A)

(B)

FIGURE 27: SALTBUSH ONLY TREATMENT, (A) NOVEMBER 2009 AND (B) FEBRUARY 2011

COMMENTS

Throughout the duration of the project, feed on offer was higher in the saltbush alone and saltbush plus perennial pastures treatments than in the annual control treatment. The establishment of saltland pastures on mildly to moderately saline land gave improved pasture production for the summer/autumn winter feed gap, and with good inter-row species also provided improved feed for stock throughout the year.

SITE FOUR: Dean Hull

BACKGROUND

The site is located on a Sustainable Grazing of Saline Lands trial site originally established to determine a practical and cost effective raised bed technique to establish best-bet, productive, salt-tolerant pastures on saline and waterlogged land. Standard SGSL procedures were adopted on the site including site characterization and EM38 and EM31 measurements.

LOCATION AND SITE DESCRIPTION

The perennial pasture paddock is located low in the landscape with the annual (control) treatment located adjacent, but upslope, and suffers from less salinity and waterlogging issues. Perennial pasture still persisting at the site includes puccinellia, tall wheatgrass, and very limited tall fescue and Lucerne. The annual pasture is mostly barley grass, sub clover and some native clovers.

SITE AIM

To monitor grazing production and value of saltland and perennial pastures compared to annual pasture.

TREATMENT

For the current project, the objective is to examine the grazing production and value of the previously established pastures compared to the annual pasture growing in paddock next to the trial site. For this reason the raised bed treatments are being ignored, and the treated SGSL paddock is being considered as one treatment. Pastures originally sown in the paddock included Rhodes grass, lucerne, Puccinellia, tall wheat grass, tall fescue and balansa clover. On checking the site in November 2009, the pasture was found to consist mostly of annual ryegrass with some lucerne, tall wheat grass, balansa clover and Puccinellia remaining. There does not appear to be any tall fescue or Rhodes grass remaining. Treatments for this trial include:

1. control paddock (annual); and
2. saltland/perennial pastures.

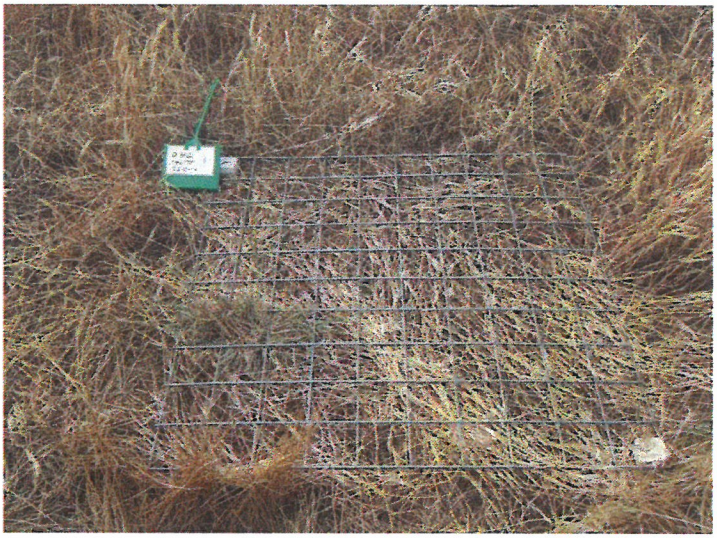


FIGURE 28: EVERGRAZE GRID QUADRAT FOR ESTIMATION OF FEED ON OFFER (FOO) AT HULL'S PERENNIAL PASTURE SITE

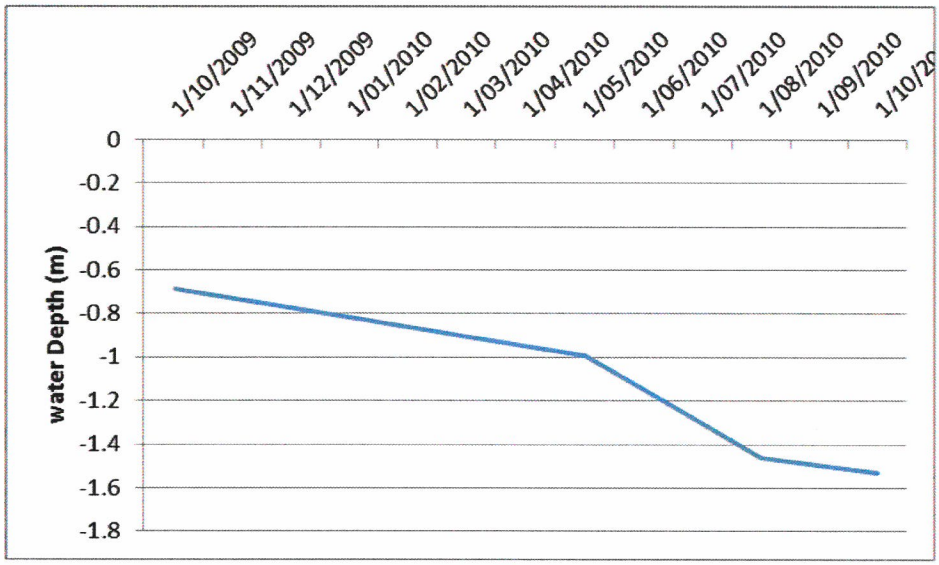
SOIL INFORMATION

Two main soil types were defined for the site – the annual pasture paddock (mid – lower slopes) was mostly deep sandy duplex with very dark, humic clayey sand to sandy loam topsoils with a bleached layer between 10 and 30 cm. Subsoils are commonly light medium clay and the presence of strong yellowish brown mottles indicates well drained soil and good aeration. The perennial pasture paddock is mostly brown loamy duplex with a very dark, humic sandy loam topsoil and light to light medium clay subsoil with massive structure. The pale colour of the lower part of the clay subsoil indicates bad aeration and waterlogging/soil saturation for at least part of the year.

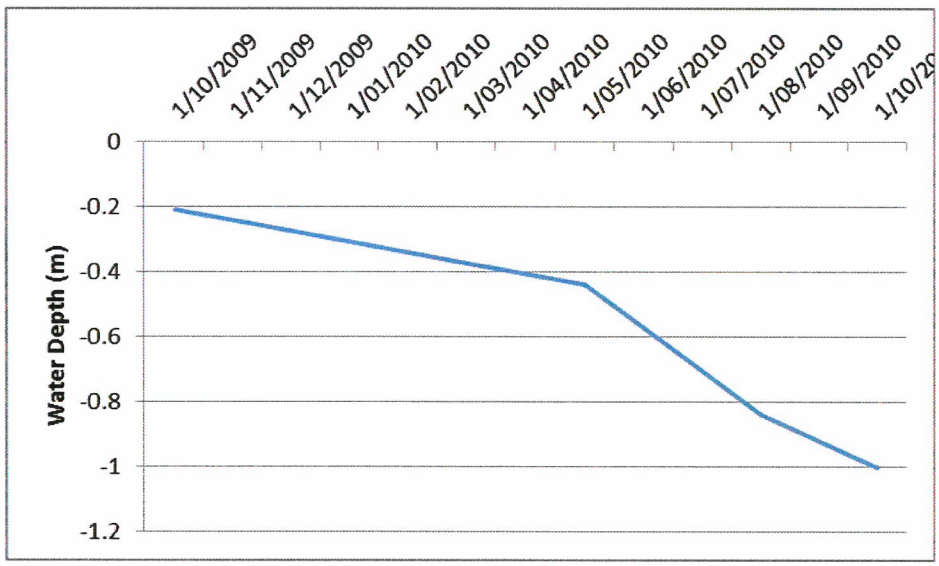
HYDROLOGY

As with the previous sites, bore water levels reflected the below average rainfall of 2010 with all bores across the site showing decreasing water levels.

(A)


1/10/2009
1/11/2009
1/12/2009
1/01/2010
1/02/2010
1/03/2010
1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
water Depth (m)

(B)


1/10/2009
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1/12/2009
1/01/2010
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1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
Water Depth (m)

(C)

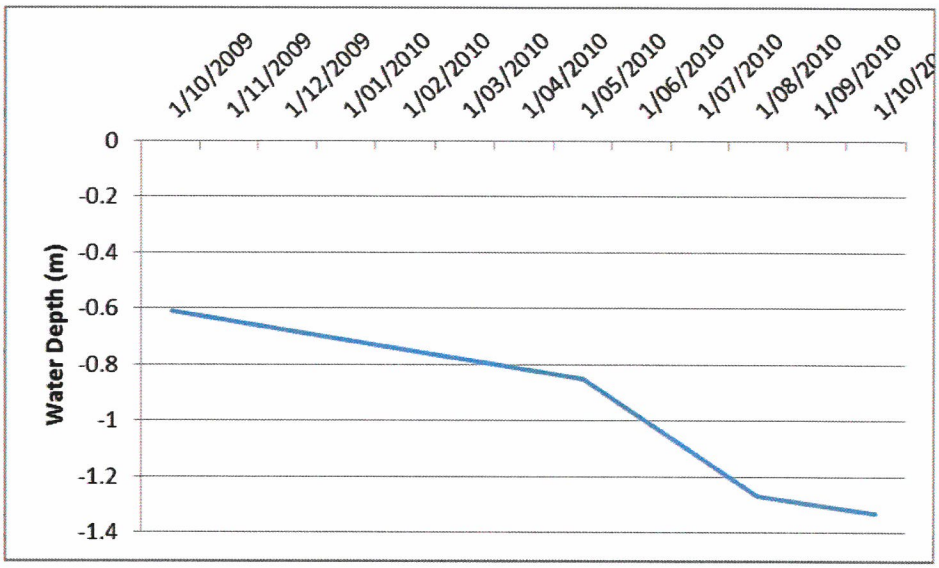

FIGURE 29: BORE WATER LEVELS OVER THE DURATION OF THE PROJECT IN BORES (A) SGS39, (B) SGS40 AND (C) SGS41

PASTURE AND GRAZING

The perennial pasture paddock produced more feed on offer over the duration of the project than the annual pasture paddock. More measurements over the annual growing season would have given a more accurate reflection of the growth in the annual pasture.

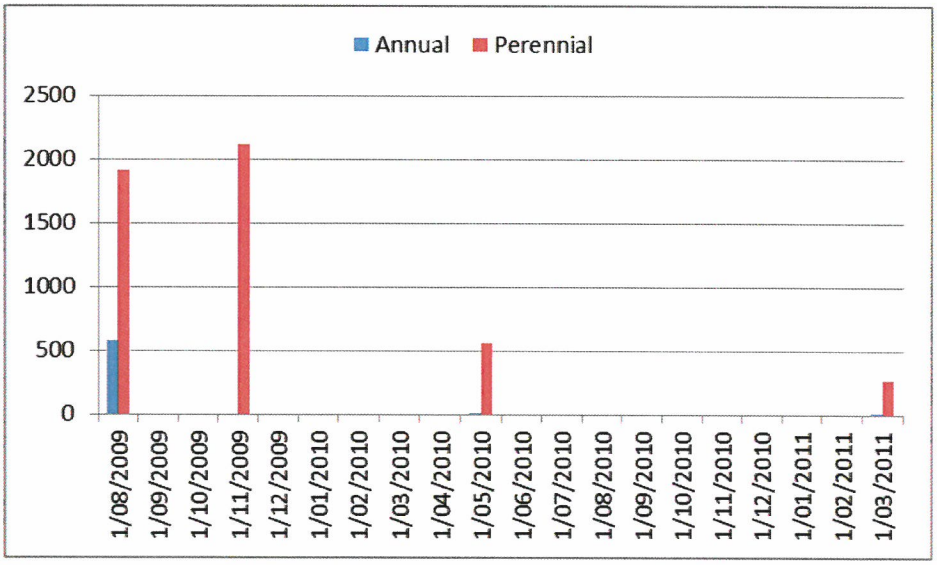

FIGURE 30: FEED ON OFFER (FOO) ESTIMATED FOR BOTH ANNUAL AND PERENNIAL PASTURES AT HULL'S

FIGURE 31: PERENNIAL PASTURE AT HULL'S, SEPTEMBER 2009

FIGURE 32: PERENNIAL PASTURE AT HULL'S, NOVEMBER 2009

COMMENTS

Visual observations indicate that during the winter/spring growing season there were significant amounts of annual ryegrass in the perennial pasture paddock boosting its grazing value for this period. Over the summer/autumn period the perennial pastures present supplied improved grazing value to the dry annuals in this paddock, whereas there was little feed on offer available over this period in the

annual paddock. For this site, perennial pastures greatly improved the grazing value over the whole year.

SUMMARY

- Over all sites, the perennial pastures out-performed the annual control pastures in available feed on offer.
- For those sites where salinity was a major issue and saltbush was the main pasture, annual pastures provided more higher value feed in late winter/spring. Saltbush and salt land pastures provided valuable grazing over the summer/autumn feed gap period when annual pastures produced nothing.
- Perennial pastures on relatively fresh sites outperformed the annual pastures during the dry year of 2010, likely due to their deeper root systems being able to access moisture at depth, and their ability to utilise the out of season rainfall that fell in this time.
- Two other sites of perennial pastures were withdrawn from the project due to ongoing issues with weeds on site and trouble establishing the perennials. The loss of these sites highlights the need for prior preparation of paddocks for future perennial pasture establishment, including the need for excellent weed control in the years preceding establishment of the perennial, and insect control in the year of establishment.
- All sites will be valuable on-going extension and demonstration sites to illustrate the value of saltland and perennial pastures in managing consistent feed production for stock in a changing and variable climate.