WEST MIDLANDS GROUP

Increasing the productivity and stability of poor sands in the West Midlands by better managing perennial grasses

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Increasing the productivity and stability of poor sands in the West Midlands by better managing perennial grasses was delivered by the West Midlands Group. This project was supported by the Northern Agricultural Catchments Council, through funding from the Australian Government's National Landcare Program.

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1.0 AIM

The aim of this project was to quantify the impact fertiliser can have on the growth and grazable biomass of perennial grass pastures.

2.0 BACKGROUND

The idea for this trial stemmed from recent research that indicated that many perennial pastures are deficient in the key nutrients required for growth and this subsequently impacted on production (Bowden, Valentine & Moore, 2013).

It is well understood that the poorer sands in the West Midlands are prone to nutrient leaching and excess recharge. Deep-rooted species such as perennial grasses help access nutrients at depth that have leached and reduce these problems. The greater water use throughout the season should subsequently reduce further leaching and recharge issues. However, these benefits from perennial grasses may potentially be reduced if root growth is reduced from deficiencies in essential nutrients.

In the West Midlands region there has been very little work has been completed on the optimal rates for fertiliser application on perennial grasses to increase the growth response. Therefore, the objective of this trial is to measure the growth response to several fertilisers with different levels of macro and micro nutrients.

3.0 DEMONSTRATION SITE/S DETAILS

Three sites were selected in the West Midlands region to reflect the variation in age of perennial grass stands, soil types and fertility. Consideration of these points along with visibility from the roadside for community engagement led to sites being established in Dandaragan, Badgingarra, and Warradarge. All three sites have established perennial grasses with minimal fertiliser history and are on prominent farms within each township (Table 1).

Table 1. Year sown, pasture mix, fertiliser history and soil type for all three demonstration sites.

Site	Charles Roberts Dandaragan	Annabelle Coppin Badgingarra	Will Browne Warradarge
Sown	2012	2015	2014
Mix	Gatton Panic	Gatton Panic (some Rhodes Grass)	Gatton Panic (some Rhodes Grass)
Fertiliser	100kg/ha NKS in 2017	80kg/ha Super Potash, 2017 70kg/ha Super Potash, 2016	150kg/ha Super Potash, 2017
Soil type	Deep brown sand	Deep white sand	Deep white sand

Sites were established on the 23rd and 24th of October 2017 at Dandaragan (Charles Roberts), Badgingarra (Annabelle Coppin), and Warradarge (Will Browne). A uniform section of the paddock was selected and pegged out for 5 treatment plots (Table 2) and a control plot. Each plot was 80m long by 15m wide covering approximately 0.12ha. 25kg of fertiliser was applied to each plot using a ute mounted spreader resulting in fertilising rates of 208kg/ha being applied. Dry matter cuts were taken on the 23rd and 24th October when the fertiliser was applied, again on the 15th December, and a final cut on the 1st March 2018. Stock exclusion cages were used on each treatment to keep stock out, and allow measurements of ungrazed pasture growth.

Table 2. Analysis of nutrients (kg/ha) for each fertiliser treatment applied in October 2017 at a rate of 208 kg/ha.

Fertiliser:	Price Ex. GST ($/ha)	N	P	K	S	Cu	Zn	Mn	Mg
Urea	88.40	46							
Triple super (TSP)	147.68		20.5	1					
NKS21	94.22	28.7		12.5	5.7				
Graze Extra	96.51	26.2	3.8	8.5	6.2				
Summit Hort	127.50	12.1	4.7	11.3	15.9	0.02	0.04	0.3	1.05

At each sampling three 0.1 m^2 quadrants of pasture were cut in each of the pasture exclusion zones. These samples were bulked together for analysis by CSBP for dry matter weight and a standard plant tissue test was conducted. A standard test measured the nitrogen, phosphorus, potassium, sulfur, copper, zinc, manganese, calcium, magnesium, sodium, iron, boron, nitrate and chloride content in the plant tissue.

Soil testing to 50 cm was conducted at all three sites by taking three soil cores in each treatment, and bulking together in 0-10, and 10-50 cm soil layers, and analysed by CSBP with a comprehensive soil test.

4.0 RESULTS

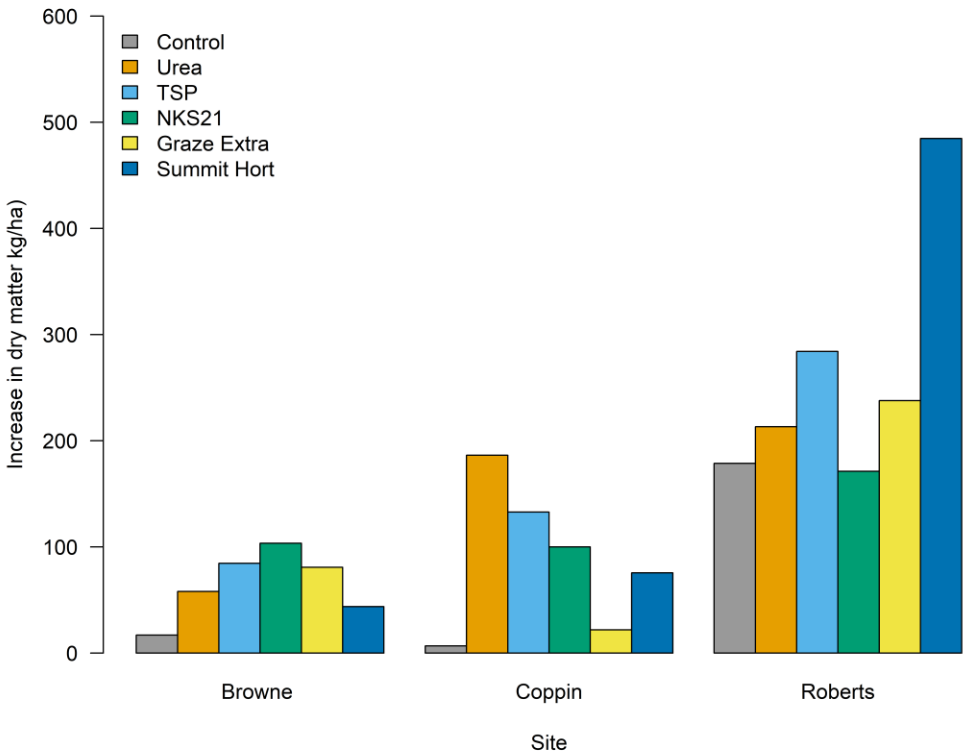

Figure 1. Perennial grass growth between December and March for each of the three sites.

There was a general increase in perennial grass growth observed during the December to March period following rainfall in January, although the response to the various fertiliser treatments was quite small and varied between sites (Figure 1). The application of urea may have given a larger response at the Coppin and Roberts sites compared to the Browne site as there was some light rainfall in the 3 days after fertiliser application that may have minimised the potential for volatilisation. Perennial grass growth was higher in general at the Roberts site, and this may have been due to a better soil type and paddock rotation history. There was no consistent effect of fertiliser or nutrient type on the growth of perennial grasses.

Table 4. Cost per kilogram of additional biomass production of the individual treatments.

		Biomass production Dec-Mar (kg/ha)	Increase biomass production from control (kg/ha)	Cost biomass production ($/kg)
Roberts	Control	1787		
	Urea	2132	345	0.26
	TSP	2842	1055	0.14
	NKS21	1713	-74	
	Graze Extra	2378	591	0.16
	Summit Hort	4847	3060	0.04
Coppin	Control	67		
	Urea	1864	1797	0.05
	TSP	1328	1261	0.12
	NKS21	1000	933	0.10
	Graze Extra	219	152	0.63
	Summit Hort	756	689	0.19
Browne	Control	170		
	Urea	580	410	0.22
	TSP	846	676	0.22
	NS21	1034	864	0.11
	Graze Extra	808	638	0.15
	Summit Hort	438	268	0.48

The cost of fertiliser at a rate of 208kg/ha varied between $88.40/ha for urea and $127.50 for Summit Hort (Table 2). The cost per kilogram of biomass production varied between treatments as locations (Table 4). The lowest cost per kilogram of additional growth was at Roberts's Dandaragan site for the Summit Hort treatment, costing $0.04/kg. Also at this site was the least cost efficient treatment, NKS21, which recorded a negative growth when adjusted for the control growth (Table 4). Due to the low production and relatively high cost of Graze Extra the highest cost for additional growth was at Coppin's in Badgingarra. 152kg of additional growth costed $0.63/kg for this treatment.

The leaf tissue concentration of nitrogen was not affected by the application of nitrogen containing fertilisers (Table 5). Nitrogen concentration was greatest at the Roberts site, and may be the reason why perennial grass growth was generally higher at this site compared to the others. The low amount of rainfall following application may not have been enough to move the urea into the soil to protect from volatilisation, and this is likely to contribute to the small increase in pasture growth.

Table 5. Leaf tissue test for nitrogen in October 2017, December 2017 and March 2018.

Site	Treatment	Nitrate (mg/kg)		
		24/10/2017	15/12/2017	1/03/2018
Roberts	Control	120	70	58
	Urea	262	42	112
	TSP	55	87	51
	NKS21	360	86	143
	Graze Extra	211	99	69
	Summit Hort	N/A	< 40	< 40
Coppin	Control	< 40	< 40	< 40
	Urea	< 40	< 40	< 40
	TSP	< 40	< 40	< 40
	NKS21	< 40	43	< 40
	Graze Extra	< 40	< 40	< 40
	Summit Hort	41	43	< 40
Browne	Control	< 40	< 40	< 40
	Urea	< 40	55	< 40
	TSP	< 40	< 40	< 40
	NKS21	< 40	44	< 40
	Graze Extra	126	113	< 40
	Summit Hort	< 40	< 40	< 40

The amount of trace elements taken up by the perennial grasses was generally not affected by the application of trace elements in the ‘Summit Hort’ fertiliser (Table 6). The only increase from fertilisation was for manganese and was consistent at all three sites.

Table 6. Leaf tissue trace element concentration in March 2018.

Site	Fertiliser	Copper mg/kg	Iron mg/kg	Zinc mg/kg	Magnesium %	Manganese mg/kg
Browne	Control	2.24	106	9.83	0.21	14.95
	Summit Hort	2.09	108	9.01	0.19	20.44
Coppin	Control	3.75	191	9.31	0.3	10.9
	Summit Hort	2.75	156	8.37	0.25	14.36
Roberts	Control	1.21	218	15.81	0.35	50.88
	Summit Hort	0.99	389	16.58	0.4	69.17

5.0 CONCLUSION

These demonstration trials have shown that the application of fertiliser to perennial grasses resulted in only small and variable gains in pasture production during the summer period from October to March. The fertiliser was applied late in the season to avoid annual species taking up the nutrients and reducing the effect of the fertiliser on the perennial grasses. The trade-off for this is that it was hard to time the application of fertiliser before a rainfall event to get the nutrients into the soil to allow plant uptake. For many of the fertilisers applied, rainfall was not critical to prevent volatilisation and loss of nutrients to the atmosphere, and these may suit the late season application to perennial grasses. However, the application of urea to boost pasture growth needs to be timed with or immediately following a significant rainfall event to allow the benefits of nitrogen application to be achieved.

The largest amount of pasture growth occurred at the Roberts site. This site is a brown sandy soil, while the other sites are predominantly grey to white sands that are less fertile. There was also an application of NKS type fertiliser during the winter period at the Roberts site, and this is likely to have increased soil supply of nitrogen. While perennial grasses are well adapted to many soil types in the region, including the weaker sands not suited to cropping, the increased production from the Roberts site may also be a function of being a better soil type. It would be interesting to see how much more production can be gained from perennial grasses that are established on better quality soils where nutrients can be better managed to increase pasture production and carrying capacity.

Economically, there is a large amount of variation in the cost per kilogram of additional biomass production. Ranging from $0.04/kg to $0.63/kg in the treatments that had growth above that of the control (Table 4). There are many factors that could impact this including the rainfall, soil type, fertiliser history, and timing of application. It is important to note that this cost only takes into account the fertiliser cost and doesn't include labour or equipment costs. The return on investment will vary depending on the individual system and ensuring that any additional growth is utilised and converted to increased livestock profits. Replicated trials will be needed in order to accurately quantify this.

One of the limiting factors of applying fertiliser on perennials is that you need to apply it late enough so that the fertiliser isn't utilised only by any present annual grasses although there needs to be rainfall events to dissolve and move the fertiliser into the soil and subsequent rainfall to drive plant production.

This trial used demonstration strips and there was no replication within each site therefore the results can only be used to direct future research. Without replication statistical analysis could not be performed on the data and the results of this trial should only be used as a guide when conducting future research on fertilising perennials.

Key outcomes:

- All fertilisers gave some level of increase in perennial grass growth
- There was greater variability in grass growth between sites
- Perennial grass growth dependant on soil fertility and paddock history

6.0 ACKNOWLEDGMENTS

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7.0 REFERENCES

Bowden, Valentine and Moore (2013). Summary of nutrient status of perennial grasses in the Northern Agricultural Region. DAFWA Caring for our Country, Transforming the Northern Sandplain project. Unpublished.