Local Land Services North Coast

# REPORT

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# Evaluation of Bahia grass *(Paspalum notatum)* pastures in response to fertiliser applications on sandy loam soil of the far north coast of NSW

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## Introduction

Bahia grass (Paspalum notatum) is an introduced warm season perennial grass native to America. Bahia is very common and readily adapted to low fertility soils, many therefore believe it is a useful pasture species in these areas. Its thick mat forming growth habit also makes it a good competitor against Giant Parramatta grass and other identified weed species. On the far north coast of NSW production and feed quality of bahia grass on un-fertilised sandy soil is low to moderate for grazing beef cattle. It is however far more tolerant to grazing than other pasture species suited to soils of low fertility. The highly competitive nature of bahia also means that once established it is very hard and costly to eradicate. Studies in America suggest that fertiliser, in particular Nitrogen applications, increased carrying capacity and forage quality of bahia grass but failed to enhance individual animal performance (Pitman et.al 1992). Many beef producers on the far north coast of NSW were curious to see if similar results could be achieved on sandy low fertility soils. The hypothesis was: Fertiliser would improve production and feed quality of bahia grass which would increase carrying capacity and therefore increase beef production per hectare. This however needed to be assessed economically.

## Aim

To determine if fertiliser applications are an economical way to increase production and feed quality of bahia grass pastures on sandy loam soils.

## Materials and Methods

This trial was conducted on a commercial beef breeding property near Ellangowan, NSW (29° 01′ S, 153° 12′E) on an established bahia grass (variety 'Competidor') pasture with predominantly sandy loam soil. There had been no use of any fertiliser for the previous seven years.

Soil fertility testing was conducted 2 weeks prior to commencement of the trial in order to establish the existing level of soil fertility, and to develop the required fertiliser program for the trial plots.

The trial consisted of 4 replicates each with 11 randomly allocated 5 metre x 2 metre plots, with 0.6 metre buffers between each plot and replicate. To maintain commercial relevance, the chosen fertiliser program for the plots was developed in align with what the local beef industry considered as commercially viable options in terms of available fertiliser products and application rates as of 2016/2017, relevant to the soil fertility of the site. The treatments are in Table 1.

**Table 1: Plot Treatments and product application rates**

| Plot Number | Treatments | Application Rate (kg/ha) |
|---|---|---|
| 1 | NIL (Control) | NIL (Control) |
| 2 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| 3 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| | Urea | 100 |
| 4 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| | Urea | 200 (100kg/ha every 2nd grazing) |
| 5 | Urea | 100 |
| 6 | Lime | 3000 |
| 7 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| | Lime | 3000 |
| 8 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| | Urea | 100 |
| | Lime | 3000 |
| 9 | Single superphosphate | 100 |
| | Triple superphosphate | 100 |
| | Muriate of Potash | 30 |
| | Urea | 200 (100kg/ha every 2nd grazing) |
| | Lime | 3000 |
| 10 | Single superphosphate | 200 |
| | Triple superphosphate | 200 |
| | Muriate of Potash | 60 |
| 11 | Single superphosphate | 200 |
| | Triple superphosphate | 200 |
| | Muriate of Potash | 60 |
| | Lime | 3000 |

The plots were cut to a height of 50mm with a house hold push mower on the 28th September 2016. 50mm was chosen to represent a residual pasture height post grazing throughout the trial. Lime was also applied to the relevant plots on 28th September 2016, this was to allow time for the lime to get into the soil before any applications of nitrogen fertilisers to reduce risk of volatilisation of nitrogen.

All plots received their first fertiliser treatments on the 22nd October 2016. Treatments 4 and 9 received 100kg/ha Urea at every second pasture cut.

All plots were mown for dry matter yields and feed quality analysis leaving a residual of 50mm on monthly intervals, commencing on the 14th December 2016. Total plot weights of fresh pasture were recorded with a sub sample of each taken to be oven dried for 48 hours at temperature of 64°C, for dry matter yield calculations and feed quality. Feed quality analysis was conducted by NSW Department of Primary Industries Feed Quality Service, a NATA accredited laboratory.

There was no grazing of the trial area as the aim was to accurately measure the production and quality of the bahia grass in response to fertiliser applications, and it was felt that grazing could have resulted in different residual heights being left.

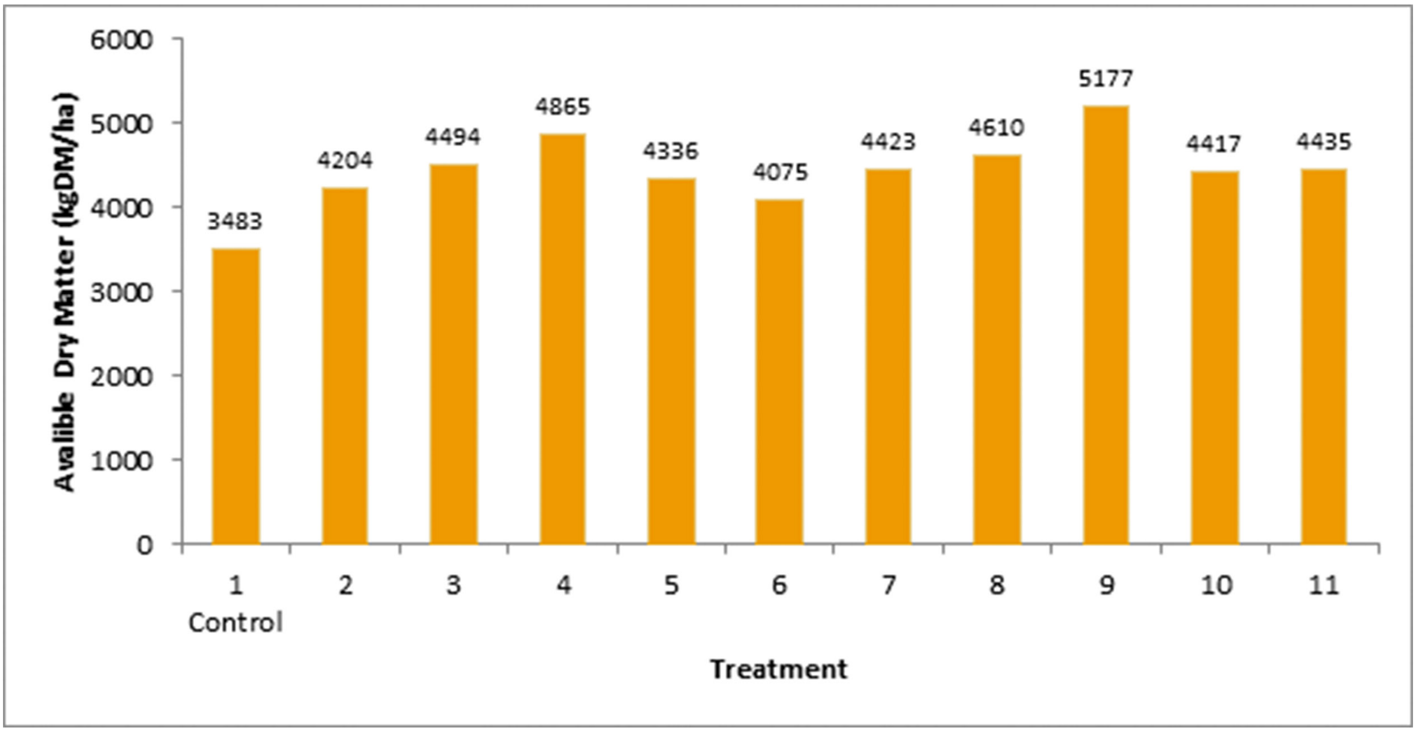
Feed intakes for beef cattle were estimated by use of the following equations (Belyea et.al 1993):

- Animal Intake as a % of Liveweight in Dry Matter (DM) = (120/NDF% of feed)
- kg/DM/head/day intake = Animal Liveweight (kg) x by Animal Intake as a % of Liveweight in DM

# Results

'Competidor' bahia grass on sandy loam soil demonstrated a yield increase in response to all the fertiliser treatments trialled (Figure 1). Treatments 3,4,5,8 and 9 had the highest yields, with treatments 4 and 9 having the highest yields over all. The lowest yield response to an applied product was treatment 6, lime only, however, it still produced 592 kg DM/ha more than the control.

**Figure 1: Average Available Dry Matter yield (kg DM/ha) for all treatments, from October 2016 to May 2017**




The application of fertiliser slightly increased the Metabolisable Energy, Crude Protein and slightly decreased the Neutral detergent Fibre (NDF) of the bahia grass across all treatments (Table 2). Treatment 6 (lime only) had the least improvement in Metabolisable Energy and Crude protein and was virtually the same as the control. Treatments 4, 7, 8 and 9 all had the largest increase in crude protein, 16.7, 14.4, 15 and 16.6% respectively.

| Results | Units | 1 Control | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NDF | % | 76 | 74 | 76 | 74 | 73 | 76 | 73 | 74 | 73 | 75 | 73 |
| ADF | % | 34 | 33 | 34 | 33 | 33 | 36 | 33 | 32 | 31 | 35 | 36 |
| CP | % | 11.5 | 13 | 13.4 | 16.7 | 13.9 | 11.9 | 14.4 | 15 | 16.6 | 14.7 | 13.1 |
| Metabolisable Energy | MJ/kg DM | 6.4 | 7.0 | 6.5 | 7.2 | 7.0 | 6.5 | 7.0 | 7.1 | 7.0 | 6.8 | 6.6 |
| DMD | % | 47 | 50 | 47 | 51 | 50 | 47 | 50 | 51 | 50 | 49 | 48 |

**Table 2: Average nutritional quality for all treatments, from October 2016 to May 2017**

Visually a response to the various fertiliser applications could be seen with treatments 3,4,5,8 and 9 showing a darker green leaf colour (Photo 1) and treatments 10 an 11 showing a higher population of self-sown Wynn-cassia (Photo 2).

**Photo 1: Treatments 3,4,5,8 and 9 across the 4 replicates showing darker green leaf colour**

**Photo 2: Treatment 10 from Replicate 2 demonstrating the increase in self-sown Wynn-cassia**

The treatment cost per hectare and associated feed cost per kilogram of dry matter are presented in Table 3 below, these costs do not include labour or machinery operating costs they are product only. They are based on the following prices as of Summer 2016/17,

Single superphosphate $395/t, Triple superphosphate $963/t, Urea $560/t and Muriate of Potash $790/t, Agricultural lime $90/t.

**Table 3: Treatment cost per hectare and associated feed cost**

| | Treatment | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cost** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| **$/ha** | $0 | $159 | $216 | $327 | $56 | $270 | $429 | $485 | $597 | $318 | $588 |
| **$/kg DM** | $0 | $0.04 | $0.05 | $0.07 | $0.01 | $0.07 | $0.10 | $0.11 | $0.12 | $0.07 | $0.13 |

Table 4 shows the economics of the treatments relative to animal production likely from a 500kg first cross Brahman cow, dry, but pregnant. The control (Treatment 1) resulted in an estimated financial loss of $0.60 per 500kg breeder per day. This was due entirely to an estimated weight loss of 0.3kg per day based on animal value of $2.00/kilogram liveweight. Treatment 5 (Urea) was the most cost effective application, in that it reduced the liveweight loss from 0.3kg/day to a loss of 0.2kg/day and for a feed cost of $0.08 per head per day; the total financial loss associated to urea was $0.48/head/day.

All other fertiliser treatments resulted in a higher financial loss than the control due to an increase in feed cost.

**Table 4: Estimated performance and economics of a 500kg First cross Brahman cow, dry but pregnant grazing bahia grass following fertiliser applications**

| | Units | 1<br>Con | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DM Intake | kg DM/hd | 7.5 | 8 | 7.5 | 8 | 8 | 7.5 | 8 | 8 | 8 | 8 | 8 |
| CP | g/hd/day | 892 | 1072 | 1005 | 1336 | 1112 | 952 | 1152 | 1200 | 1328 | 1176 | 1048 |
| Metabolisable Energy | MJ /hd / Day | 48 | 56 | 49 | 58 | 56 | 49 | 56 | 57 | 56 | 54 | 53 |
| ADG | kg/hd/day | -0.3 | -0.25 | -0.28 | -0.2 | -0.2 | -0.28 | -0.2 | -0.22 | -0.19 | -0.22 | -0.25 |
| Feed cost | $/hd/day | 0 | 0.32 | 0.38 | 0.56 | 0.08 | 0.52 | 0.80 | 0.88 | 0.96 | 0.56 | 1.04 |
| Animal change in value | $/hd/day | -0.60 | -0.40 | -0.56 | -0.40 | -0.40 | -0.56 | -0.40 | -0.44 | -0.38 | -0.44 | -0.50 |
| Financial change<br>(feed cost + Animal Value) | $/hd/day | -0.60 | -0.72 | -0.94 | -0.96 | -0.48 | -1.08 | -1.20 | -1.32 | -1.34 | -1.00 | -1.54 |

# Discussion

Fertiliser applications did increase dry matter yield and feed quality of bahia grass on light sandy loam soils. The largest increase in both dry matter yield and feed quality was seen in treatments 3,4,5,8 and 9. This can be attributed to these treatments having nitrogen applied through urea, thus adding support to the work by Pitman et.al (1992).

No single treatment was found to be profitable as the cost of the fertiliser application simply increased the cost of the grass the cattle would consume, yet a dry pregnant first cross Brahman cow would still continue to lose weight and therefore value. It is plausible to use a nitrogen application to improve DM yield and feed quality which would help to reduce weight loss as in Treatment 5, but depending on the paddock size, the price of fertiliser and number of cattle that would graze the pasture it may financially still be a greater loss than not applying any nitrogen and suffering a greater level of animal weight loss.

One of the most interesting findings in this trial was that whilst increases in metabolisable energy and crude protein were possible as a result of the fertiliser, the Neutral Detergent Fibre (NDF) levels remained very high. This has a major influence on the feed intake and subsequent nutrient intake by grazing cattle. The NDF of the control plot resulted in an estimated intake of 7.5kg DM/head/day for a 500kg first cross Brahman cow, dry but pregnant, essentially half the theoretical capacity of an animal this weight, the treatments which had the lowest NDF, 5,7,9,and 11 only resulted in an estimated increase of 0.5kg DM/head/day to 8kg. Therefore, it's plausible to state that the high fibre levels of the bahia grass are the crucial limiting factor to animal production, and it is unlikely that fertiliser can be used to economically improve individual animal intakes and production.

Should these results be applied to a dry empty 500kg first cross Brahman cow which only needs 54MJ/ME/ day for maintenance then, it would suggest that a single application of 100kg/ha of urea would help to achieve maintenance or even a slight weight gain.

Lime applications did not appear to add any significant cost effective improvement to the production and feed quality during this trial. This could however be attributed to the fact that rainfall was below average during this time and that a lime application to soil surface takes a few months to incorporate and begin working. In terms of a cost effective soil treatment for increasing production from bahia grass, lime is unlikely to be appropriate. However the long term benefits of improving soil pH are well documented through many agricultural soil management publications and should be considered as a long term soil improvement plan.

The application of Phosphorus, Sulphur and Potassium alone also resulted in an increase in both dry matter yield and feed quality but not to the extent of the treatments that had Nitrogen included. Doubling the rate of Phosphorus, Sulphur and Potassium did lead to a visual increase in self-sown wynn-cassia, and a very slight increase in yield and feed quality probably due to the wynn-cassia. However, the economics of using double fertiliser rates of these nutrients are questionable in comparison to a single application of urea at 100kg/ha (Treatment 5 Urea only, vs Treatment 10 double rate Phosphorus, Sulphur and Potassium), Treatment 5 cost $56/ha whereas Treatment 10 cost $318/ha, say the paddock was 20 hectares a cash out lay of $1,120 is needed for urea only, versus $6,360 for a double rate of Phosphorus, Sulphur and Potassium. There is well documented evidence that legumes in grass pastures improve feed quality, but in the case of this trial to increase the wynn-cassia legume component the fertiliser application of Phosphorus, Sulphur and Potassium had to be doubled, this in turn would expose a business to a higher cash outlay therefore more financial risk than doing away with a legume in a bahia pasture and apply nitrogen. It needs to be mentioned that once the soil fertility was improved it's likely that lower rates of Phosphorus, Sulphur and Potassium could possibly be used to maintain similar levels of legume which could change this argument.

# Conclusion

Fertiliser applications to bahia grass on light Sandy Loam soils is not an economical way to increase beef production. Bahia grass will respond to applications of fertiliser in particular Nitrogen, and this will lead to an increase in DM yields, a slight improvement in metabolisable energy, crude protein and NDF. However, not at a point in which individual animal performance can increase enough to cover the additional cost of the fertiliser application based on fertiliser prices at the time of writing.

The increase in yield would provide opportunities for some producers to potentially run more animals on the same land area which could aid in spelling other country, but a producer needs to be aware that with the exception of dry empty adult cattle, it's unlikely any other class of beef animal will achieve maintenance, and as such will be losing weight and associated value each day.

To achieve some animal production from cattle grazing bahia grass on light sandy loam soils this study suggests that producers should look at alternative means of meeting the nutrient demand, such as supplements direct to the animal. The economics of this would need to be looked at and considered at an individual basis, relative to type of stock, number of stock and length of time supplements would be required.

For many bahia grass is and will still remain a viable alternative to what would otherwise grow in their environment, this study simply highlights animal production issues associated with bahia grass and aims to arm producers with information to make management decisions as to how much country they will allow to grow bahia grass, or should they attempt to remove or prevent bahia grass growing on more productive areas of the farm.

# References

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