Local Land Services North Coast

REPORT

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Evaluation of Bahia grass *(Paspalum notatum)* pastures in response to fertiliser applications on the mid 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. However on more fertile alluvial soils it is considered to be an invasive pasture species, in particular kikuyu pastures. It is a low yielding grass and has a thick mat forming growth habit which makes it a good competitor against giant Parramatta grass (*Sporobolus fertilis*) and other identified weed species. This growth habit also makes it difficult to establish other pasture and legume species. On the North coast of NSW production and feed quality of Bahia grass on un-fertilised sandy soil is low to moderate for grazing beef cattle. The highly competitive nature of Bahia also means that once established it is very hard and costly to eradicate with many graziers viewing it as a weed on more productive soils. Studies in Florida- USA 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). The question that is often asked should we get rid of it, or manage Bahia for pasture production. Some of the benefits of Bahia are it tolerates low fertility soils and heavy grazing and also tolerates; water logging and acid soils well.

Aim

To determine if fertiliser applications are an economical way to increase production and feed quality of Bahia grass pastures and increase carrying capacity and therefore beef production per hectare . A suitable site was sought on a commercial cattle property, with no recent fertiliser history; however soil tests did reveal good soil fertility. The site is a heavy alluvial soil (clay loam). The site was an established Bahia pasture.

Materials and Methods

This trial was conducted on a beef breeding property, Missabotti NSW, 10kms North of Bowraville, on an established Bahia grass pasture (Variety –Argentine) , clay loam soil. There was no legume content at all. There had been no use of any fertiliser for the previous seven years.

Soil fertility testing was conducted 5 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 12 randomly allocated 5 metre x 3 metre plots. To maintain commercial relevance, the chosen fertiliser program for the plots was based on the soil test

recommendations (relevant to the soil fertility of the site) and developed in alignment with what the local beef industry considers standard practice for fertiliser application in terms of available fertiliser products and application rates as of 2016. The treatments are listed below:

Table 1: Bahia grass treatments

Plot No	Treatment	Application Rate kg/ha
1	Control nil treatment	
2	Lime only	3000
3	Croplift 15®	100
4	Croplift 15®	200
5	Lime	3000
	Croplift 15®	100
6	Lime	3000
	Croplift 15®	200
7	Urea	100
8	Urea	100
	Croplift 15®	100
9	Urea	100
	Croplift 15®	100
	+ Urea after every second grazing/ pasture cut	+ 100
10	Lime	3000
	Urea	100
	Croplift 15®	100
11.	Lime	3000
	Urea	100
	Croplift 15®	100
	+ Urea after every second grazing	+100
12.	Single superphosphate	100

Croplift 15®; (N: 14.2% P: 12.9% K: 0.0% S 10.7%)
Urea; (N: 46%, P: 0% K: 0% S: 0%)

Single superphosphate; (N: 0% P: 8.8% K: 0 S: 11%)

Method

- The trial commenced on 31st of October 2016 when plots were fenced by electric wire to prevent cattle grazing the site. There was no grazing of the trial area to enable accurate measurement of 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.
- The plots were cut to a height of 50mm with a ride on mower prior to fertiliser application. 50 mm was chosen to represent a residual pasture height post grazing throughout the trial.
- Lime was applied to the relevant plots on the 31 October 2016.
- All plots received their first fertiliser treatments on the 13th December 2016, after sufficient rainfall.
- Treatments 9 and 11 received 100kg/ha Urea at every second pasture cut.
- Grass samples from all of the plots were collected; the first pasture cut was on the 9 January 2017. Samples from each plot were grouped for analysis. Plots were then mown leaving a residual of 50mm.

- Total plot weights of fresh pasture were recorded from Jan 2017 until May 2017. Samples of each plot were 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.
- Feed intakes for beef cattle were estimated by GrazFeed®, relevant pasture analysis values were used, with Grazfeed® Livestock default values being used.

Results

The Bahia grass demonstrated a yield increase in response to nearly all the fertiliser treatments trialled (Figure 1) when compared to the control sites. The exception being Treatment 2 (lime only) and 12 (Single Super phosphate). Treatments 3, 4, 5,6,8,9 and11 had some of the higher averaged yields, with treatments 3 and 4 having the highest yields over all. Treatment 3 and 4 had increases of 32% and 37% respectively in more dry matter compared to the control plot (Treatment 1). Treatment 12 (Single super phosphate), had a slightly lower yield response then the Control site (Treatment 1) and the Lime only site (Treatment 2).

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

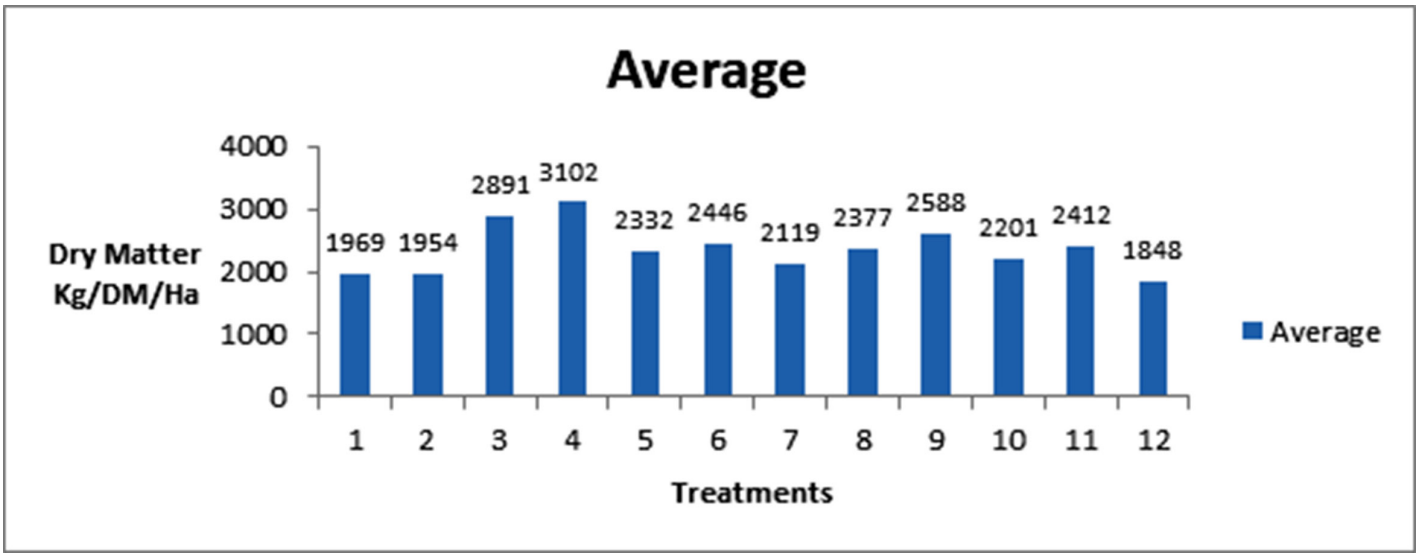


Table 2 shows results for nutritional quality. The application of fertiliser increased the Metabolisable Energy (ME), with the exception of Treatment 5 (Lime and Fertiliser), which showed no or little change in comparison to the Control plots (Treatment 1). Treatments that saw a significant increase in ME were Treatments 6, 9, 10 and 11 respectively. There was only a slight increase in Treatment 12; Single Super Phosphate (SSP).

There were variable increases in Crude Protein. All treatments that received nitrogen as part of the fertiliser treatment showed increased crude protein, which is expected. However there was only a marginal increase in Crude Protein (CP) in treatment 5 (Lime and Fertiliser). One thing to note that on the final pasture cut in Mid-May 2017, there was a spike in Crude Protein levels. This is likely due to being cut shorter (less DM) more vegetative and higher protein. Which is consistent with the grazing recommendations for Bahia, grazing at a lower height than other Tropical grasses.

Fertiliser treatments decreased the Neutral detergent Fibre (NDF) of the Bahia grass across all treatments (Table 2). NDF values are important because they reflect the amount of forage the animal can consume. As NDF percent increases, the dry matter intake decreases. Treatments 2 (lime only) and 4 (Fertiliser double rate) had the least improvement, with Treatment 4 only marginally better than the control site. Treatment 5 which showed little response to fertiliser for Dry matter Yield, ME/MJ and Crude Protein, thou it did show a slight decrease in NDF, thou DMD still remained low.

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

		Treatments											
Results	**Units**	**1 (Control)**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Neutral Detergent fibre	%	71	70	67	71	69	67	68	68	67	67	67	68
Acid Detergent Fibre	%	40	40	38	39	39	37	38	38	38	37	37	38
Crude Protein	%	12	12	14	13	12	13	13	14	15	14	14	12
Metabolisable Energy	MJ/kg DM	8	8.2	8.4	8.2	7.9	8.8	8.3	8.4	8.6	8.6	8.9	8.1
Dry Matter Digestibility	%	56	58	58	57	55	61	58	58	59	59	61	58

Photo 1: The Demonstration site. After fertiliser treatments and prior to first pasture cut (9 January 2017). The site is a well-established Bahia Pasture, no legume content.

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, Crop Lift 15® $696/t, Single superphosphate $395/t, Urea $560/t and Agricultural lime $90/t.

Table 4: Treatment cost per hectare and associated feed cost for the period of the 9th January 2016 till 15th May 2017.

	Treatments											
Cost	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
$/ha	$0	$270	$70	$140	$340	$410	$56	$126	$238	$396	$508	$39
Kg DM/ Ha	9 846	9 771	14 457	15 513	11 660	12 234	10 599	11 890	12 945	11 008	12 062	9 245
$/kg DM	$0.0	$0.03	$0.005	$0.009	$0.029	$0.034	$0.005	$0.01	$0.02	$0.04	$0.042	$0.004
$/T DM	$ 0	$27	$4.85	$9.03	$29	$33.5	$5.30	$10.60	$18.40	$36	$42.10	$4.20

Table 5 shows the economics of the treatments relative to animal production likely from a 550kg first cross Brahman cow, dry, but pregnant. The data from the Feed Test analysis was entered into the GrazFeed® Program, livestock default values were used.

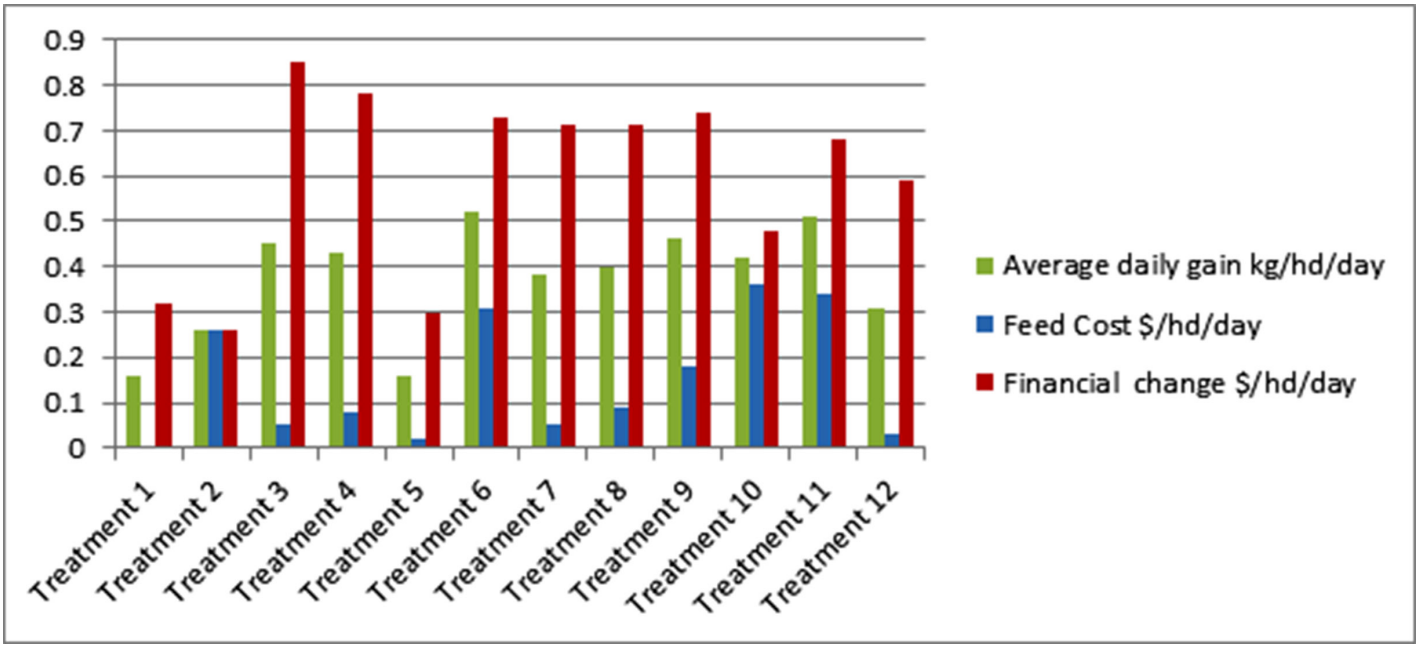
Table 5: Estimated performance and economics of a 550kg First cross Brahman cow, dry but pregnant grazing Bahia grass following fertiliser applications.

Treatments													
	Units	**1 Control**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
DM Intake	kg DM/ hd	8.5	8.6	9.1	9.1	8.6	9.2	8.9	8.9	9.1	9.0	8.2	8.6
Crude Protein	g/hd/day	1039	1040	1290	1117	1095	1220	1121	1258	1356	1288	1292	1053
ME - Energy	MJ /hd / Day	68	71	75	70	69	79	74	75	76	77	79	71
Average Daily Gain	kg/hd/ day	0.16	0.26	0.45	0.43	0.16	0.52	0.38	0.4	0.46	0.42	0.51	0.31
Feed cost	$/hd/day	0.0	$0.26	$0.05	$0.08	$0.02	$0.31	$0.05	$0.09	$0.18	$0.36	$0.34	$0.03
Animal change in value $2/kg	$/hd/day	0.32	0.52	0.9	0.86	0.32	1.04	0.76	0.8	0.92	0.84	1.02	0.62
Financial change $2 (feed cost - Animal Value)	$/hd/day	0.32	0.26	0.85	0.78	0.3	0.73	0.71	0.71	0.74	0.48	0.68	0.59

The control (Treatment 1) resulted in a weight gain of 0.16kg per day, and an estimated average financial gain of $0.32 per 550kg breeder per day. This was due entirely to an average weight gain of 0.16kg per day based on animal value of $2.00/kilogram live weight. Treatment 3 (Croplift 15 100kg/ ha) was the most cost effective application, with an estimated average weight gain of 0.45kg/day. An increase in $0.85 in value per day, in comparison to the control site of $0.32, a difference of $0.53per day based on increased live weight.

All other fertiliser treatments resulted in a higher financial gain, with the exception of Treatment 2 and Treatment 5. With the benefits of the lime not likely to be seen for some time. Financial gain will obviously increase as does the price of Price per kilogram of liveweight. Figure 2 shows the increase in financial gain per treatment, showing the benefits of lower cost of production of dry matter (feed).

Figure 2: Feed cost, Weight gain and financial change per treatment.



Discussion

Discussion is based around a 550kg Brahman first cross cow (breeder), due to this being of most relevance to producers on the north coast. However dry matter intake will change with each class of stock.

The results from the demonstration site showed feed quality from the control site were of reasonable quality to begin with. This is due to the high soil fertility of the demonstration site, requiring minimal fertiliser inputs and improvements. It is hard to say if varietal differences would have had an impact of the results. The site had the preferred Bahia cultivar "Argentine", as opposed to the less desirable, with lower palatability variety "Pensacola". The season was very dry, with well below average rainfall from October 2016 to May 2017, with the exception being March, above average (data from BOM, Bowraville Recreational site.

Fertiliser applications did increase dry matter yield and feed quality of Bahia grass at the site. Increase in dry matter yield was seen in all treatments with the exception of Treatment 2 (lime only) and treatment 12 (Single superphosphate), with marked increases in treatments 3 and 4 at the time of the first cut in comparison to other treatments. As the season progressed the difference in dry matter yields were not as pronounced. The control site, Treatment 1 (Nil) and Treatment 2 (lime only) and Treatment 12, treated with only single super phosphate showing no, if any increase in Dry matter production. However there was an increase in the ME (energy) quality in treatments 2 and 12 in comparison to the control site (T1). Treatment 5 initially showed a marked increase in ME, but later declined similar to the control site as the season progressed.

All treatments, with the exception of treatments 2 and 5 showed an increase in the value of the animal. This was due largely to the site already having good nutrient levels and soil type. Being a heavier soil, nutrients are less susceptible to leaching and likely to stay where they are put. However had the plot been on a different site, such as a soil with low fertility and lighter, sandy soils, the economics of pasture improvement may not be viable.

Treatment 3 and 4 were the most profitable. Treatment 4 receiving double the recommended rate of fertiliser still was not as profitable as treatment 3 (not double the profit). The biggest increases were those treatments that received Nitrogen applications either in the form of a fertiliser blend or as Urea. The fertiliser (Croplift 15®) contained the same nutrients, Phosphorous and sulphur, with added nitrogen as Treatment 12; 100kg/Ha SSP. Treatment 12; SSP, had similar dry matter and feed quality compared to the control treatment. Suggesting that the main limiting factor in this pasture system is the availability of nitrogen.

NDF and Feed intake

Increases in metabolisable energy and crude protein occurred as a result of the applied fertiliser. The majority of the treatments decreased the Neutral Detergent Fibre (NDF) of the pasture. With significant decreases in treatment 3, 6, 9 and 10. The difference between the control site and treatment 6 which had the biggest decrease in NDF. Treatment 6 had 360grams difference in weight gain per day, or for a 550kg first cross Brahman cow, dry but pregnant grazing compared to the control site. Treatment 1 (control) showing that there would be an increase in 1.12kgs per week, with Treatment 6 gaining 3.64 per week, more than double the control site.

However when compared to a fertilised kikuyu pasture, the NDF of the even the lowest Bahia treatments in terms of NDF was still significantly higher compared to Kikuyu values. This is an important consideration as NDF has a major influence on the feed intake and subsequent nutrient intake by grazing cattle. The higher the NDF, the less feed intake. The control site had an estimated feed intake of 89% of potential intake. When compared to Treatment 6, with the lowest NDF value, treatment 6 had a Dry matter intake of 95%. Other treatments with low NDF values also had higher potential feed intake values. Therefore, it's plausible to state that the high fibre (NDF) levels of the Bahia grass are a crucial limiting factor to animal production.

Lime

The pH of the site was 4.8 (CaCl2), and Aluminium of 37 mg/kg. Lime applications did not appear to add any significant cost effective improvement to the production and feed quality during this trial. This could be attributed to the fact that rainfall was below average during this time and that a lime application to the soil surface takes a few months to incorporate and begin working. Bahia grass is also tolerant of acid soils. In terms of a cost effective soil treatment for increasing production from Bahia grass, lime is unlikely to be appropriate in the short term. However it may be an opportunity for less acid tolerant pastures species to persist, if soil acidity is addressed. 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 Soil Analysis Report, (Nutrient Advantage®) provided the basis for the fertiliser treatments. Treatment 5 was based on the soil test recommendations. Treatment 5 would appear to not have received the benefit of the applied Nitrogen. It was a treatment that was limed prior. This is possibility due to not having enough time and rainfall prior to the fertiliser application (containing nitrogen). However Treatments 6, 10, and 11 all had both the lime and nitrogen applied at the same time as treatment 5. Treatment 6 had the same product applied but double the rate of Treatments 10 and 11, suggesting the extra N applied at the double rate was sufficient to give a response. Treatments 6, 10, 11 all had increases in Dry matter production and feed quality. Once again suggesting that nitrogen is the limiting factor.

While the site is productive and will support most classes of livestock it could be argued that the site may be better suited to a higher yielding pastures species, such as kikuyu. Fertilised kikuyu can produce more than 20 tonnes/ha of dry matter per year and have growth rates over 140kg/dm/ per day per hectare at the peak of the season. Kikuyu can have a digestibility of 70% and 19% crude protein (Rose, C). With Bahia being nearer to 13 tonnes per hectare (Rose, C) and digestibility based on this site of 55% (control) with the highest being 65%.

Bahia due to its competitive nature makes it very hard to establish other pasture species such as clovers reducing potential yield on fertile sites. Bahia lacks the flexibility to introduce establish winter pastures such as rye grass, unless some sort of herbicide or mechanical intervention is used to reduce the competiveness of the Bahia prior to new pasture establishment. However it is more of a case of the right pasture for the right paddock. Bahia is certainly suited to sites with a high erosion risk, such as river flats.

Currently there are relatively cheap herbicide options available for the control of Bahia. However there is a cost of establishing new pastures and the loss of production during the establishment phase.

The other argument is Bahia, unless controlled on fertile soils, poses an ongoing risk of spreading through the entire pasture and lowering productivity.

Conclusion

The benefits of applied fertiliser were not overly pronounced, this was largely due to the natural fertility of the site and soil type, a clay loam river flat. Had the season also been a normal season with average rainfall, the results may have been different. There still was an increase in production and financial gains to be had by adding the correct fertiliser treatment, based on soil test recommendations.

On a low fertility site with lighter soils the benefits of fertiliser may be marginal, and may not provide an economic return. It could be argued without the application of fertilisers to maintain current nutrient levels of this site, that there will be a slow, but gradual decrease in production as the soil nutrient bank is depleted without being replaced, as with any pasture. Hence the recommended fertiliser rate (without lime), while only a maintenance rate showed the best return (Treatment 3).

Nitrogen was clearly a limiting factor of the site, as the addition of nitrogen showing a greater increase in Dry matter production, compared to other Treatments. Added nitrogen did lead to, improved metabolisable energy, crude protein and NDF. This is important as the main factors that drive production include how much the animal eats and the concentration of nutrients in the feed it is eating. Ongoing nitrogen applications (Urea after every second grazing) in this scenario was not the most profitable alternative. Although Nitrogen applications alone did increase dry matter production and feed quality.

The increase in yield through the correct fertiliser treatment would provide opportunities for some producers to potentially run more animals on the same land area which could aid in spelling other country, or increase weight gain of current livestock. Higher yielding tropical pastures may be more suited to this site to take advantage of the site's high soil fertility. A true comparison would be to compare the dry matter yield and the financial increase per stock unit when compared to other summer grasses, such as kikuyu, Rhodes and Setaria for example.

For many, Bahia grass is and will still remain a viable alternative to what would otherwise grow in their environment. Some of the benefits of Bahia is it is competitive and hence good for weed control. It is higher yielding and more responsive to fertiliser than carpet grass (*Axonopus fissifolius*) (Rose, C). On less fertile soil Bahia is generally viewed as being a good fit. However it has it draw backs. It has the potential to become a weed on fertile soils, and it is very hard to maintain legume content and it is lower yielding and lower quality than other tropical pastures.

This study highlights animal production issues associated with Bahia grass and aims to provide producers with information to make management decisions as to how much country they will allow Bahia grass to grow on, or should they attempt to remove or prevent Bahia grass growing on more productive areas of the farm.

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