FINAL REPORT FOR LIVING WATER WAITUNA FPA DEMONSTRATION TRIAL

Living Water Waituna Fine Particle Applications (FPA) demonstration project in the Waituna catchment area, demonstrating the outcomes of using the FPA method of applying nitrogen fertiliser to pasture compared with the normal granular nitrogen fertiliser applications.

A REPORT PREPARED FOR

LIVING WATER

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INTRODUCTION

The project was based on the demonstration of outcomes and effects from the application of nitrogenous fertiliser (urea) through a Fine Particle Application (FPA) spreading method, when compared to the current common practice of the granular application of nitrogenous fertilisers. The purpose of the demonstration was to show that nitrogen fertiliser is utilised more efficiently by plants if it is applied more uniformly using FPA spreading technology.

The demonstration was run to assist Waituna Catchment farmers with reducing nitrogen fertiliser use without reducing total pasture grown.

EXPECTED OUTCOME

The expected outcome was that a similar quantity of pasture would be grown using 30kgs of Urea applied with FPA technology as to the quantity grown by applying 60kgs of granular Urea by way of the current common method of fertiliser application.

THE FPA SYSTEM

The FPA system uses precisely the same fertiliser as used in any granular fertiliser application, i.e. the granular fertiliser is acquired in the same form and at the same site where the granular fertiliser itself is manufactured or stored by the fertiliser manufacturer. The difference however, arises from the way the product is applied.

FPA have developed a process that involves the grinding up of the granular fertiliser into a fine particle size (less than 1mm), that when applied, is distributed more evenly over the pasture achieving a better overall distribution pattern across the paddock. The fertiliser is in a state of suspension at a rate of 70% solids. The product is not dissolved during this process, thereby reducing volatilisation. The urea applied through the FPA method is evenly spread over pasture using the FPA patented specialised spreading technology.

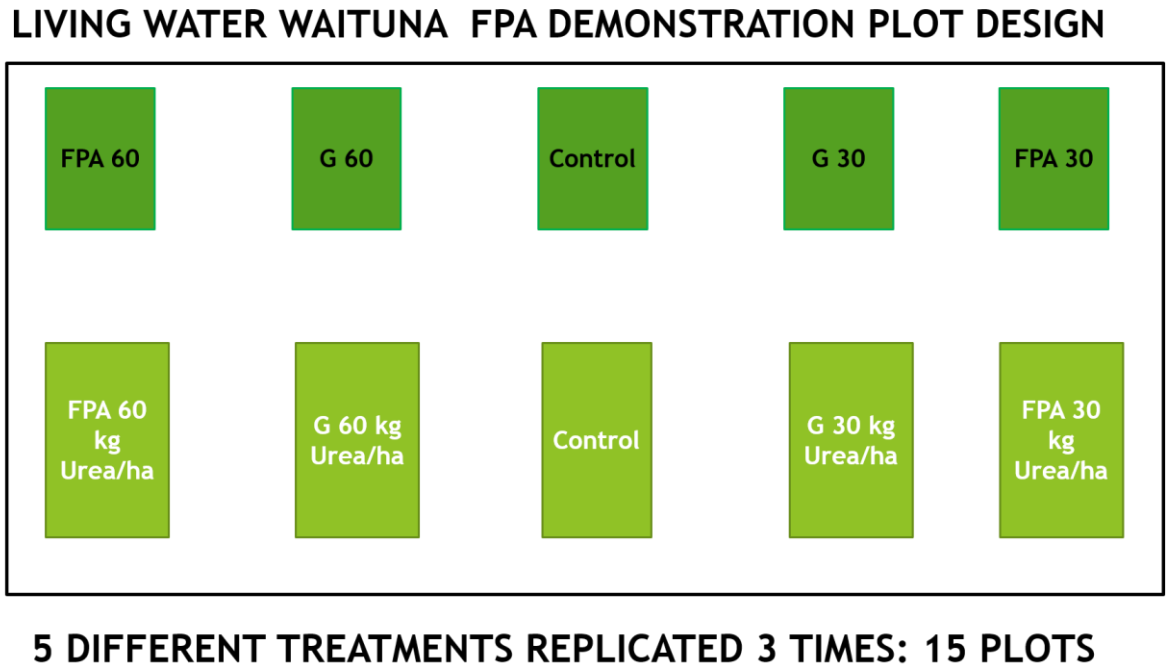
METHODOLOGY

The plot demonstration method is a strong method for technology transfer and provided strong visual evidence of the benefits from using the FPA spreading method.

Site selection

The site selected was in a support block of a current dairy farm in the Waituna Catchment area. This was chosen as it has had no recent animal influence on it which assists in removing any potential animal effect on the site. Furthermore, the soil fertility status was at a suitable level so as not to affect the outcome of the demonstration trial. There were also no trees, structures or other obstacles surrounding the site that potentially could affect the outcomes.

Setup of demonstration plots – design of plot demonstration



The above graphic depicts the layout of the demonstration plots for one complete set of treatments. The remaining two sets of treatments were set up the same, linearly adjoining the first set. Three groups of five plots per set were set up as depicted above. The plots were all 3 metres long by 3 metres wide, totalling 9m^2 per plot.

Key to the plot codes:

FPA 30 and FPA 60:	Plots with the FPA application method applied at 30kgUrea/ha and 60kgUrea/ha respectively.
G 30 and G 60:	Plots with the granular application method applied at 30kgUrea/ha and 60kgUrea/ha respectively
C:	The control plot where no fertiliser was applied.

Plot preparation and fertiliser application methodology

Initial work of setting up the plots, doing a cut to establish a pasture residual consistent across all plots, and applying the first round of fertiliser, began in late March 2017. Twelve cuts were then taken over the period until 12 June 2018.

Each individual plots' pasture cover was measured with a Rising Plate Meter and the pasture height recorded for each plot with a random selection of 10 readings taken per plot. Each plot was then mowed with a rotary mower, to the same residual height equating to approximately 1450kgDM/ha or 4cm compressed height.

After measuring each plot and mowing each plot, the pasture cut from each plot was bagged and weighed individually with wet weights recorded.

Once the weighing was completed, the plots were prepared for the nitrogen fertiliser applications. Each "Control" plot was covered with a plastic cover for the duration of the application process. The G60, G30 and F30 plots were covered with black plastic to prevent these plots receiving any urea, while the F60 plots were left open. All the granular plots, both G 30 and G 60 were covered while the FPA applications were being made. The FPA truck did one pass across the whole site applying at a 30kgUrea/ha rate to all the FPA 60 plots. Then a second pass was done after the FPA 30 plots were uncovered and the FPA 60 plots were still left uncovered. The second pass then added Urea at the rate of 30kgUrea/ha to the FPA 30 plots while the FPA 60 plots received a second pass of 30kgUrea/ha, now totalling an application rate of 60kgUrea/ha.

The G 30 and G 60 plots were then uncovered and each of these plots were then hand dressed at their respective relevant rates of granular Urea by hand sowing evenly over these plots at their respective rates of 30kgUrea/ha and 60kgUrea/ha. The fertiliser for these plots was weighed at the site just before application.

Photos 1: showing the plots set out and marked

Photo 2: The FPA truck applying the fertiliser to the plots

At collection time, the plots were mowed to a constant residual equal to 1450kgDM/ha. The pasture was mowed into a collection box on the mower, then emptied into bags which was then immediately weighed and recorded against each plot. This process established the total growth for each period as well as the daily growth rate for that specific period. Once the fertiliser applications were completed, the black plastics were folded up and taken to the workshop to dry out at which time the covers were swept to gather up all the dried FPA applied fertilised. This was then weighed and used to check the calibration of the FPA truck.

Five samples of pasture were taken throughout the period of the demonstration and were analysed for internal quality by an independent laboratory, for Dry Matter (DM), Metabolisable Energy (ME), Crude Protein (CP) and N%DM.

The results of the average of all 5 sampling events for each treatment are shown in the table "Average for the whole season", below.

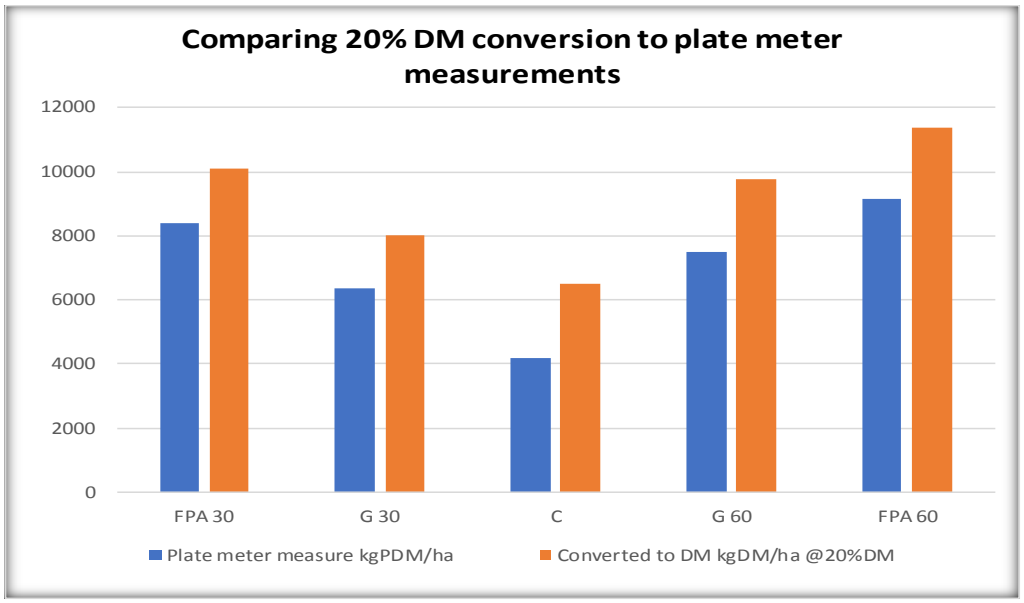
RESULTS AND DISCUSSION

Measuring pasture growth:

For the purposes of this demonstration trial pasture growth was measured in three different ways, namely:

1. Using the rising plate meter and the Southland DM conversion formula of cm height x 140 + 500;
2. Weighing the wet mass of pasture from the cuts; and
3. Converting the wet weights into DM by multiplying the wet weight by 20%.

The report covers the difference in DM production outcomes between these methods and an additional two methods. These included the use of the actual individual treatments measured DM% and using the overall measured average DM% of all plots and treatments together.



During the season, five sets of pasture samples were taken from the cuts throughout the season and sent off for DM and internal quality testing. The table below provides the average results of the five pasture analysis tests undertaken through the season. This indicates the overall internal quality of the pasture.

Table of the average DM and internal quality measures for all treatments from five sampling tests.

Average pasture quality results for the five sampling tests during the season				
	DM%	MJME/kgDM	CP%	N%DM
Control	15.9	11.4	27.1	4.3
FPA 30	15.0	11.5	30.2	4.8
FPA 60	15.4	11.4	30.9	4.9
G 30	16.3	11.3	28.1	4.5
G 60	15.5	11.3	30.4	4.9
Average	15.6	11.4	29.4	4.7

The results indicate a difference of 8.7% in DM% between the highest and lowest DM% measured on the basis of each treatment's actual average DM%. Internal quality as measured by Metabolisable Energy (MJME/kgDM) showed a 1.8% difference from the highest to the lowest measure and Crude Protein % (CP%) showed a 14% difference from highest value to lowest value. Note that these ranges included the internal quality of the Control plots. The average DM% for all tests was measured at 15.6%. The N%DM in the samples averaged 4.7% with the highest N%DM level relating to both FPA60 and G60, and with FPA30 at 4.8 N%DM. This N%DM is indicative of the level of Nitrogen in the DM which is directly related to the uptake level of Nitrogen by the plant.

The table below provides the Total tDM/ha grown of each treatment as measured by the Plate meter and the conversion of wet weight cuts per treatment converted to DM at the 20%DM conversion factor.

Table comparing the tDM/ha and % difference between the different means of DM measurements.

Treatments	Plate meter tDM/ha	Final total tDM/ha at 20% DM conversion from wet weight	Difference tDM/ha @20% vs Plate meter tDM/ha	% Difference tDM/ha @20% vs Plate meter tDM/ha
FPA 30	8.4	10.1	1.7	20.3%
G 30	6.3	8.0	1.7	26.3%
C	4.2	6.5	2.3	56.1%
G 60	7.5	9.8	2.3	30.8%
FPA 60	9.2	11.4	2.2	23.9%

TOTAL PASTURE GROWN

The table below compares the different PDM measures' effect on total cumulative tDM as per:

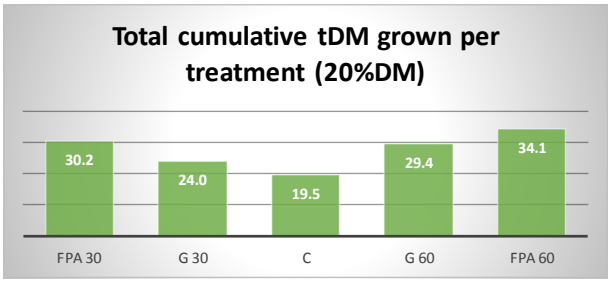
- The 20%DM conversion;
- The use of the actual DM laboratory tested results per treatment type; and
- The average of the DM content of the tested results of all treatments per treatment.

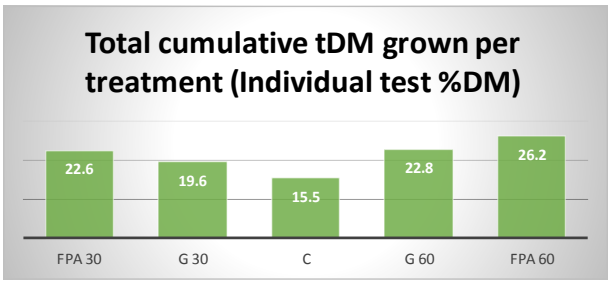
Despite there being a difference in the physical quantities, the trends in the differences between the various treatments are consistent between treatments. Therefore, although using the conversion of 20%DM the total cumulative tons DM grown results in a higher cumulative total DM grown than the two measuring the individual treatments actual total DM and the average total DM per treatment, the differences between the different treatment remain very similar in trend but different in terms of quantity.

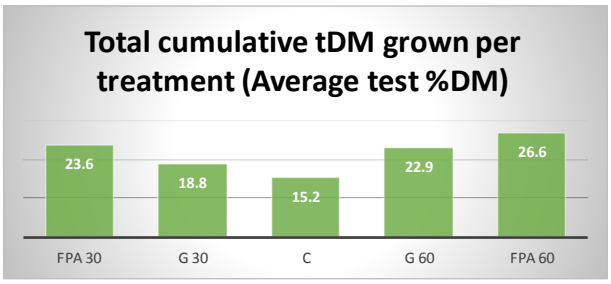
TOTAL CUMULATIVE TONS DM (tDM) GROWN PER TREATMENT			
	20% DM	Individual test DM	Average tested DM
FPA 30	30.2	22.6	23.6
G 30	24.0	19.6	18.8
C	19.5	15.5	15.2
G 60	29.4	22.8	22.9
FPA 60	34.1	26.2	26.6

Note: this is equivalent to the cumulative growth over 3 ha

The charts below present these differences in DM graphically:





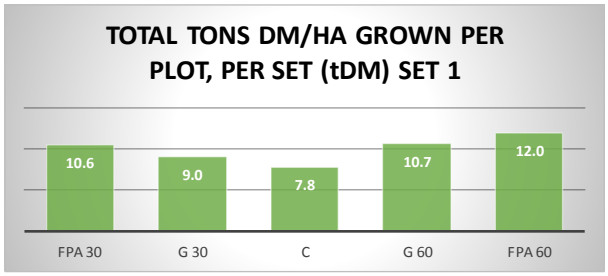


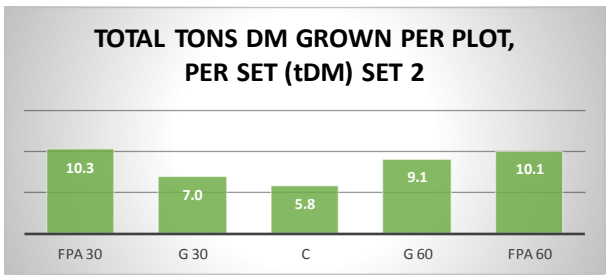
The last two graphs show very small differences within each treatment due them being based on the same set of data, that being the average of the pasture tests.

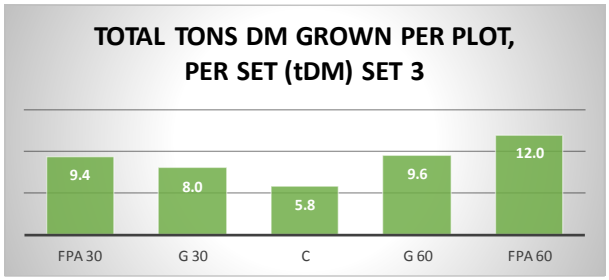
The table below presents the Total tDM per plot as well as the graphical presentation of the Total tDM grown per treatment per ha.

TOTAL tDM/ha GROWN PER PLOT, PER SET (tDM)	
	20% DM
SET 1	
FPA 30	10.6
G 30	9.0
C	7.8
G 60	10.7
FPA 60	12.0
SET 2	
FPA 30	10.3
G 30	7.0
C	5.8
G 60	9.1
FPA 60	10.1
SET 3	
FPA 30	9.4
G 30	8.0
C	5.8
G 60	9.6
FPA 60	12.0

Graphical presentation of the table above:







CUMULATIVE PASTURE GROWTH

The tables below present the total cumulative growth in tDM per treatment over all plots, while showing the difference in total cumulative growth depending on the measure used, i.e., 20%DM conversion or conversion of individually tested DM yield and using the average tested DM yield.

Total Cumulative growth per treatment (kgDM/ha) at 20%DM												
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18
FPA 30	1,872	3,380	4,836	5,536	7,498	16,662	19,699	21,490	22,016	25,965	28,091	30,225
G 30	1,766	2,812	3,967	4,502	5,924	13,400	16,090	17,546	17,928	20,724	22,262	24,023
C	1,558	2,305	3,136	3,563	4,416	9,915	12,498	14,068	14,367	16,644	17,733	19,475
G 60	1,918	3,049	4,450	5,083	6,982	16,156	19,272	21,239	21,748	25,440	27,355	29,351
FPA 60	1,827	3,647	5,284	6,129	8,419	18,345	22,021	24,383	25,244	30,054	32,096	34,077

Note: This table presents the results of total kgDM/ha grown as measured at a 20%DM content.

Total Cumulative growth per treatment (kgDM/ha) at measured per treatment DM%												
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18
FPA 30	1,400	2,529	3,618	4,141	5,608	12,463	14,735	16,075	16,468	19,422	21,012	22,608
G 30	1,443	2,298	3,241	3,678	4,840	10,948	13,145	14,335	14,647	16,932	18,188	19,627
C	1,240	1,835	2,496	2,836	3,515	7,892	9,948	11,198	11,436	13,249	14,116	15,502
G 60	1,488	2,366	3,453	3,945	5,418	12,537	14,955	16,482	16,877	19,742	21,227	22,777
FPA 60	1,405	2,805	4,063	4,713	6,474	14,107	16,934	18,751	19,413	23,112	24,681	26,205

Note: This table presents the results of total kgDM/ha grown as measured at the average of 5 DM tests on a per treatment basis.

Total Cumulative growth per treatment (kgDM/ha) at measured average DM%												
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18
FPA 30	1,462	2,641	3,778	4,325	5,857	13,016	15,389	16,788	17,199	20,284	21,945	23,612
G 30	1,380	2,197	3,099	3,517	4,627	10,468	12,569	13,707	14,006	16,190	17,391	18,767
C	1,217	1,800	2,450	2,783	3,450	7,746	9,763	10,990	11,223	13,002	13,853	15,214
G 60	1,498	2,382	3,476	3,971	5,454	12,621	15,055	16,592	16,990	19,874	21,370	22,929
FPA 60	1,427	2,849	4,128	4,788	6,577	14,331	17,203	19,048	19,721	23,478	25,073	26,621

Note: This table presents the results of total kgDM/ha grown as measured at the average of 5 DM tests over all treatments.

As an example, the second table above denoted "Total Cumulative growth per treatment (kgDM/ha) at measured per treatment DM%" which is likely the most accurate measurement of DM, by virtue of the use of the actual average measured DM% per treatment, **FPA30** grew only 168kgPDM less than the G60 grew on a total of 22,777kgDM, which **equates to half the amount of fertiliser applied through FPA30, which for all intents and purposes, is basically the same kgPDM as G60.** These results strongly indicate that there are significant farm system benefits to be gained using the FPA system which enables significant PDM production output with half the nitrogen input as normally used.

The table below presents the tDM/ha and percentage differences between the various DM measures used.

It is clear that, although there are quantitative differences between the various comparisons as found in both tables, the trends in these differences in each comparison remain the same as seen in the cumulative total DM per plot or per ha.

Table comparing the tDM/ha and % difference between the different means of DM measurements.

Treatments	Plate meter tDM/ha	Final total tDM/ha at 20% DM	Final total tDM/ha at measured per treatment %DM	Final total tDM/ha at measured average %DM	Treatments	% Difference tDM/ha @20% vs Plate meter tDM/ha	% Difference tDM/ha measured per treatment vs Plate meter tDM/ha	% Difference tDM/ha measured average vs Plate meter tDM/ha
FPA 30	8.4	10.1	7.5	7.9	FPA 30	20%	-10%	-6%
G 30	6.3	8.0	6.5	6.3	G 30	26%	3%	-1%
C	4.2	6.5	5.2	5.1	C	56%	24%	22%
G 60	7.5	9.8	7.6	7.6	G 60	31%	1%	2%
FPA 60	9.2	11.4	8.7	8.9	FPA 60	24%	-5%	-3%

The table below compares the **net yield** in kgDM between the different combinations of treatments, as they result from the different PDM conversion factors, i.e., the 20%, the measured per treatment DM% and the overall measured average %DM. For example, FPA 60 grew 10.054tDM/ha more than G30 did, when converted at a rate of 20%DM.

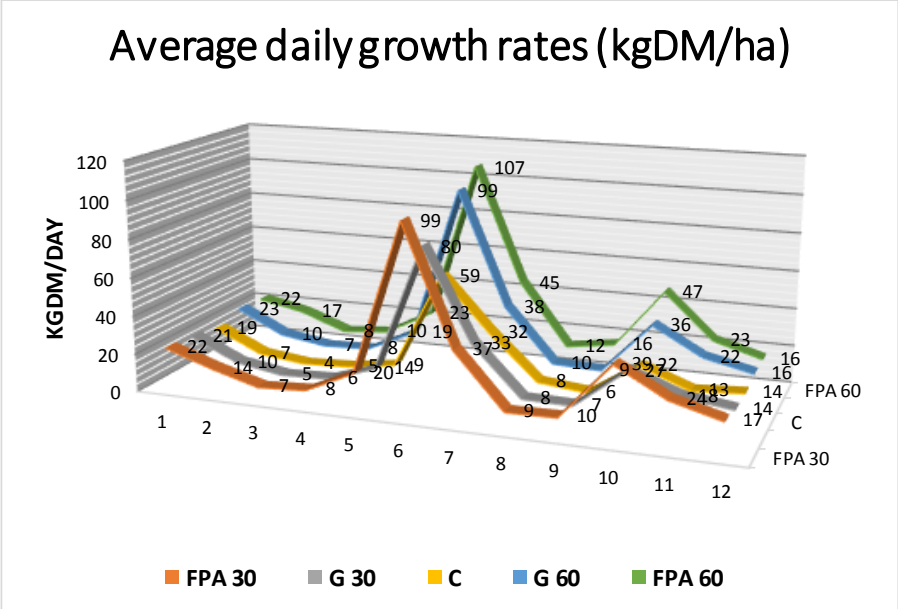
Comparative Net Difference in kgDM/ha for	kgDM/ha grown at 20%DM	Measured kgDM/ha per treatment DM%	Overall measured kgDM/ha average DM%
FPA 30 vs G60	+874	-168	+682
FPA 30 vs G30	+6202	+2982	+4845
FPA 60 vs G60	+4726	+3429	+3692
FPA 60 vs G30	+10054	+6579	+7854

PASTURE GROWTH RATES (kgDM/day)

A key measure of success of pasture growth per treatment is the daily growth rate for the entire demonstration period. The table below indicates by way of the averages and means, that FPA60 had the highest average growth rates over the period of the trial at 29kgDM/ha/day. FPA30 produced the second highest average and mean growth rate, the latter even surpassing the average and mean growth rates of G60. **This latter result meets the expected outcome as stated in the beginning of this report.** The columns highlighted indicate the differences in growth rates between the FPA plots and the Granular plots, as well as the Control plots. They indicate that when growth rates on the Granular plots were respectively low and high, the FPA plots were still returning higher growth rates, under the same conditions.

Table of growth rates kgDM/ha/day per growth period

	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18	Averages	Mean	Total days
Days/period	28	36	70	28	33	31	27	64	18	34	29	41	37	34.2	439
FPA 30	22	14	7	8	20	99	37	9	10	39	24	17	26	19	
G 30	21	10	5	6	14	80	33	8	7	27	18	14	20	15	
C	19	7	4	5	9	59	32	8	6	22	13	14	16	12	
G 60	23	10	7	8	19	99	38	10	9	36	22	16	25	18	
FPA 60	22	17	8	10	23	107	45	12	16	47	23	16	29	22	



The table below compares the actual growth rates achieved per period throughout the demonstration trial, with those growth rates that exclude the periods when farmers would not normally apply Nitrogen fertiliser, due to too high temperatures and no rainfall as well as the winter period when soil temperatures are very low.

Actual growth rate kgDM/day		Growth rates kgDM/day excl low growth rate periods	
Ave	Mean	Ave	Mean
26	19	29	23
20	15	23	18
16	12	19	15
25	18	28	22
29	22	33	27

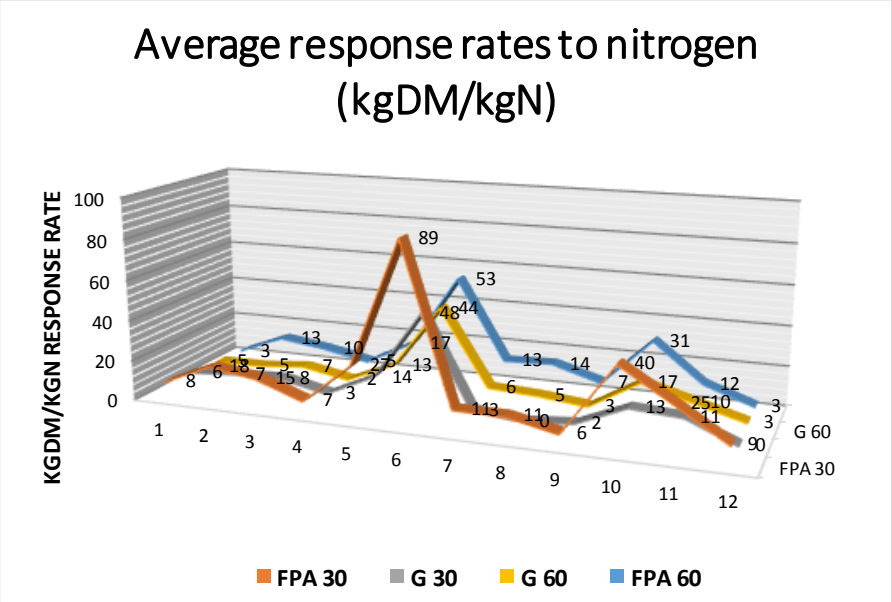
PASTURE DRY MATTER RESPONSE RATES (kgDM/kg Nitrogen applied)

Table of response rates to N applications in kgDM/kgN													
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18	Averages
FPA 30	8	18	15	7	27	89	11	11	6	40	25	9	22
G 30	6	7	8	3	14	48	3	0	2	13	11	0	9
G 60	5	5	7	2	13	44	6	5	3	17	10	3	10
FPA 60	3	13	10	5	17	53	13	14	7	31	12	3	15

Pasture response rates to fertiliser, i.e., kgPDM per kg Nitrogen applied, is a key productivity factor that can impact the farm system financially. In the table above, the highlighted cells indicate where FPA30 was significantly higher than G60, achieved under the same conditions.

In this demonstration, the response rates achieved by the FPA system are more than double the granular bulk applied response rates as in the case of FPA30 compared with G60, where on average, FPA30 returned an average response rate of 22kgDM/kgN applied, while G60 returned an average response rate of only 10 kgDM/kgN applied. That is, that FPA30, at half the rate of Nitrogen applied as G60, FPA30 returned a response rate of 2.1 times that of G60.

This indicates that FPA30 provides farmers with a considerable advantage to make significant productivity gains through the type of fertiliser application method used. The initial product used is the same, that being granular fertiliser. However, the method of application yields vastly improved outcomes in terms of pasture growth rates and pasture response rates.



THE ECONOMICS OF THE LIVING WATER WAITUNA FPA DEMONSTRATION

This section discusses the economic outcome of the demonstration trial. Two PDM rates have been used to emphasise that the FPA system will deliver results that follow the same trends which ever conversion measurement of pasture dry matter is used. These results are presented in the two tables below, where the first one is based on the use of a 20% DM conversion rate, while the second table uses the overall average %DM rate resulting from the average of all the laboratory DM tests of all the five different treatments at 15.6%.

Economics at 20%DM conversion rate				
FPA grown over granular	**G30**	**F30**	**G60**	**F60**
kg Urea/ha	**30**	**30**	**60**	**60**
Average Cumulative kgDM grown/ha to date	8008	10075	9784	11359
Cumulative kgDM grown/ha to date less cumulative Control growth	1522	3590	3299	4874
KgDM/ha grown from applied N	**1522**	**3590**	**3299**	**4874**
Total Units N applied (kgN/ha)	165.6	165.6	331.2	331.2
Response ratio kgDM/kg N	**9.2**	**21.7**	**10.0**	**14.7**
Total Spreading Cost $/ha 12 applications	$120	$355	$151	$451
Cost of Urea $/ha @$476/ton	$171.36	$171.36	$342.72	$342.72
Total Cost of **urea + application**/ha applied ($/ha)	$291.36	$526.20	$493.56	$793.56
Total Cost $/kgDM grown	**$0.191**	**$0.147**	**$0.150**	**$0.163**
Cost of **Nitrogen**/ha ($N/ha)	$171.36	$171.36	$342.72	$342.72
Nitrogen Cost $/kgDM grown	**$0.113**	**$0.048**	**$0.104**	**$0.070**

The economics analysis of the demonstration shows significant benefits to using FPA applications when it comes to response rates, with **FPA30** obtaining the best response rates at **21.7kgDM/kgN** for the whole season including severe low growth conditions during the summer. The **cost per kgDM** grown indicates that **FPA30** has a significantly lower cost than the **G30 treatments by 23% at $0.147/kgDM** grown. **F30 is lower than the cost of G60 Total Cost/kgDM grown at 2% less. F60** treatment cost to date is 7.9% more costly than its **G60** equivalent treatment.

When comparing per treatment type, based on **$ cost of N/kgDM grown**, **F30's advantage in cost is significant at 57.5% less than** its G30 equivalent. The results clearly indicate that **F30 can produce at least the same quantity of total DM as the G60, if not slightly more, then F30's advantage is still 53.8% less than G60 $ cost of N/kgDM grown.**

Economics at 15.6%DM conversion rate				
FPA grown over granular	**G30**	**F30**	**G60**	**F60**
kg Urea/ha	**30**	**30**	**60**	**60**
Average Cumulative kgDM grown/ha to date	6246	7858	7631	8860
Cumulative kgDM grown/ha to date less cumulative Cont	1188	2800	2573	3802
KgDM/ha grown from applied N	**1188**	**2800**	**2573**	**3802**
Total Units N applied (kgN/ha)	165.6	165.6	331.2	331.2
Response ratio kgDM/kg N	**7.2**	**16.9**	**7.8**	**11.5**
Total Spreading Cost $/ha 12 applications	$120	$355	$151	$451
Cost of Urea $/ha @$476/ton	$171.36	$171.36	$342.72	$342.72
Total Cost of urea + application/ha applied ($/ha)	$291.36	$526.20	$493.56	$793.56
Total Cost $/kgDM grown	**$0.245**	**$0.188**	**$0.192**	**$0.209**
Cost of Nitrogen/ha ($N/ha)	$171.36	$171.36	$342.72	$342.72
Nitrogen Cost $/kgDM grown	**$0.14**	**$0.06**	**$0.13**	**$0.09**

The table above provides an analysis of the demonstration trial at a PDM conversion rate of 15.6%DM. The results still indicate significant benefits to using FPA applications when it comes to response rates, with **FPA30** obtaining the best response rates at **16.9kgDM/kgN** for the whole season despite the severe low growth conditions during the 2017 winter and the 2017/18 summer. The **cost per kgDM** grown indicates that **FPA30** has a significantly lower cost than the **G30 treatments by 23% at $0.147/kgDM** grown. **F30 is lower than the cost of G60 cost/kgDM grown at 2% less. F60** treatment cost to date is 8.1% more costly than its **G60** equivalent treatment.

When comparing the costs per treatment type based on **$ cost of N/kgDM grown**, then **F30's advantage in cost is significant at 57.1% less than** its G30 equivalent. The results clearly indicate that **F30 can produce at least the same quantity of total DM as the G60, if not slightly more, then F30's advantage is still 53.8% less than G60 $ cost of N/kgDM grown.**

FARM SYSTEM BENEFITS

FPA provides significant benefits at the farm system level. These benefits stem from the technology that produces a fine particle of less than 1 mm, that when applied to pasture achieves the following:

- A good even and significantly improved coverage of the plant leaf material with the fine particles;
- This enables faster uptake of the nitrogen in the urea form as well as faster and greater uptake through the leaves;
- Greater uptake of both urea and ammonium, which provides energy efficiency benefits for the plant compared to normal urea, where more nitrogen is taken up;
- It provides for greater dispersion of nitrogen through the soil profile, providing access to a larger root surface area;

- Significantly, FPA provides for the situation where, due to the faster uptake of nitrogen, it results in lower losses of ammonia and nitrous oxide gases and furthermore achieves lower nitrate leaching losses.
- As a result of the fineness of the FPA particles and the significantly improved uniformity that results from its application technology plants are able to take advantage of the nutrients being readily available which enables faster growth rates as well as significantly more total pasture Dry Matter (DM).
- When the normal commercial nitrogen fertilisers available in the industry are applied through the FPA system, there are significant productivity gains to be realised through both pasture growth rates (kgDM/day) and pasture response rates (kgDM/kg N applied). These can lead to significant financial gains by reducing farm working expenses ($FWE/kgMS and /Ha).

CONCLUSION

It is clear from the above discussion that the hypothesis as stated at the start, whereby 30kg Urea applied with FPA application technology would grow the same quantity of pasture dry matter as would 60kg Urea applied in granular form under the existing bulk spreading method, was successfully achieved.

The results even under different conversion rates for dry matter measuring, the results still returned the same trend as under the use of the rising plate meter and two measures of laboratory tested dry matter percentage. Therefore, the trial results hold under a range of different dry matter testing.

In measuring both the growth rates (as measured in **kgDM/ha/day**) and the response rates (as measured in **kgDM grown/kg Nitrogen applied**), returned significantly higher rates than those of the granular applied Nitrogen. In fact, FPA30 delivered an average growth rate of 26kgDM/ha/day, while the G60 growth rates were 25kgDM/ha/day, **the same growth rate after applying G60 at double the Nitrogen input of FPA30**. The response rates showed that **FPA 30 delivered 2.12 times** that delivered by G60 (at the 20%DM conversion rate). The same holds for the conversion using the average of treatments %DM at 15.6%DM.

The economic analysis also showed that, when comparing the per treatment type based on the **cost of N/kgDM grown**, **F30's advantage in cost is significant at 57.5% less than** its G30 equivalent.

The results clearly indicate that **F30 can produce at least the same quantity of total DM as the G60, if not slightly more,** with **F30's advantage still 53.8% less than G60 $ cost of N/kgDM grown.**

Therefore, this leads to the conclusion that FPA 30kgUrea/ha equivalent will produce the same quantity of pasture dry matter as G 60kgUrea/ha at a lower cost of Nitrogen/kgDM and a marginally lower cost/kgDM grown of 2% when compared to the cost/kgDM grown under G 60 application.

On the basis of this demonstration trial and its findings, the original hypothesis, that a similar quantity of pasture would be grown using 30kgs of Urea applied with FPA technology as to the quantity grown by applying 60kgs of granular Urea by way of the current common method of fertiliser application, holds.

PHOTOGRAPHIC REPRESENTATION OF THE DEMONSTRATION TRIAL WORK

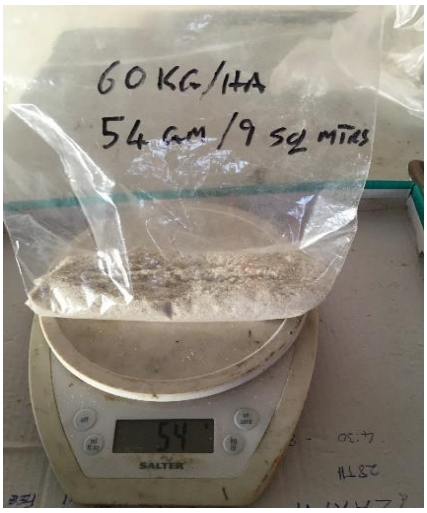
P 1: Green bags from each plot containing cut wet pasture after weighing and recording weights

P 2: FPA truck applying fertiliser in fine particle form

P 3: Plots covered with black plastic ready for fertiliser application by FPA truck

Left 4: Covers from plots being swept to recover the fine particles for weighing to confirm the calibration of the truck application.

P 5: Cover showing partially swept fine particles



P 6: The scale recording the sweepings of fine particles to confirm the truck calibration

P 7: Photo showing the uniformity of spread of fertiliser under the FPA system.

PASTURE QUALITY ASSESSMENT PHOTOS

FPA 30 plot Autumn 2018

Compare the FPA 30 plot with the G 30 plot adjacent to each other and note the difference in pasture density of the FPA 30 as well as the lack of weeds due to high levels of competition through significantly higher growth rates. G 30 plot Autumn 2018

G 30 plot Autumn 2018

FPA 60 plot Autumn 2018

Compare the FPA 60 plot with the G 60 plot adjacent to each other and note the difference in pasture density of the FPA 60 (lodging) as well as the lack of weeds due to high levels of competition through significantly higher growth rates.

G 60 plot Autumn 2018