LIVING WATER WAITUNA FPA DEMONSTRATION TRIAL

LIVING WATER

Fonterra Dairy for life

Department of Conservation Te Papa Atawbai

FPA® DIRECT

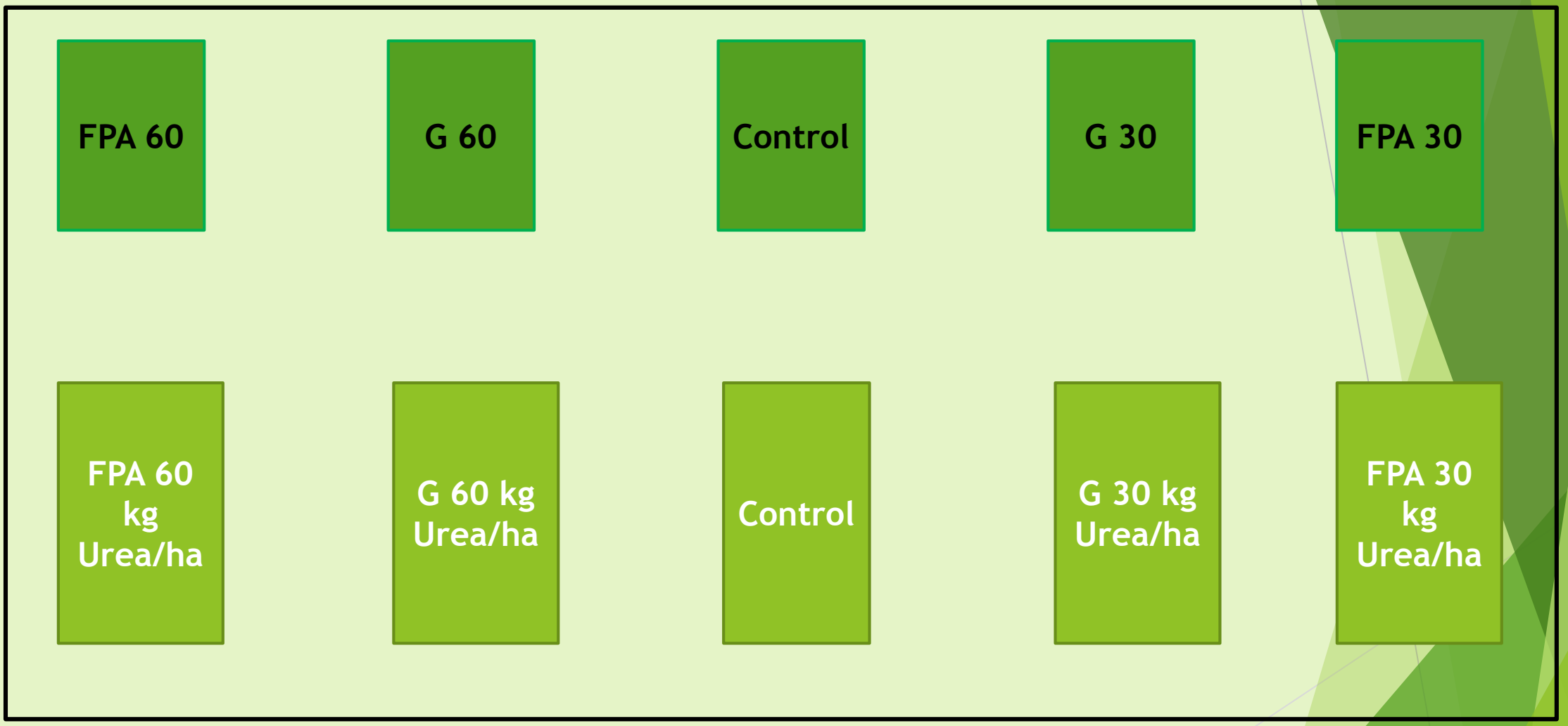
CONCEPT AND AIM OF THE DEMONSTRATION TRIAL

- The demonstration of outcomes and effects from the application of nitrogenous fertiliser (urea)
- Using Fine Particle Application (FPA) spreading method
- Comparing FPA to current common practice of the granular application of nitrogenous fertiliser.

- **The purpose of the demonstration:**
- To show nitrogen fertiliser is utilised more efficiently if applied more uniformly using FPA spreading technology.
- **Expected outcome:**

  A similar amount of pasture will be grown using 30kg's of Urea applied via FPA as grown using 60kg of granular Urea.

LIVING WATER WAITUNA FPA DEMONSTRATION PLOT DESIGN



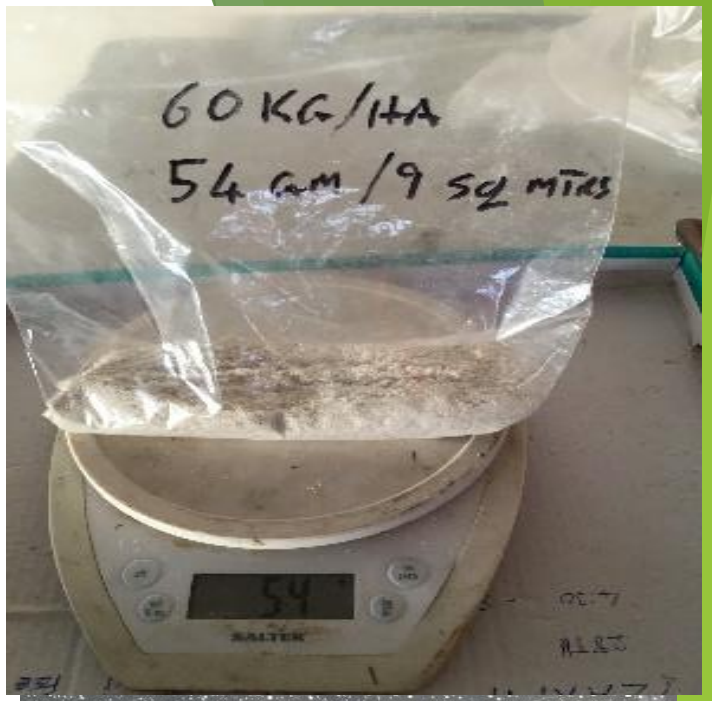
5 DIFFERENT TREATMENTS REPLICATED 3 TIMES: 15 PLOTS

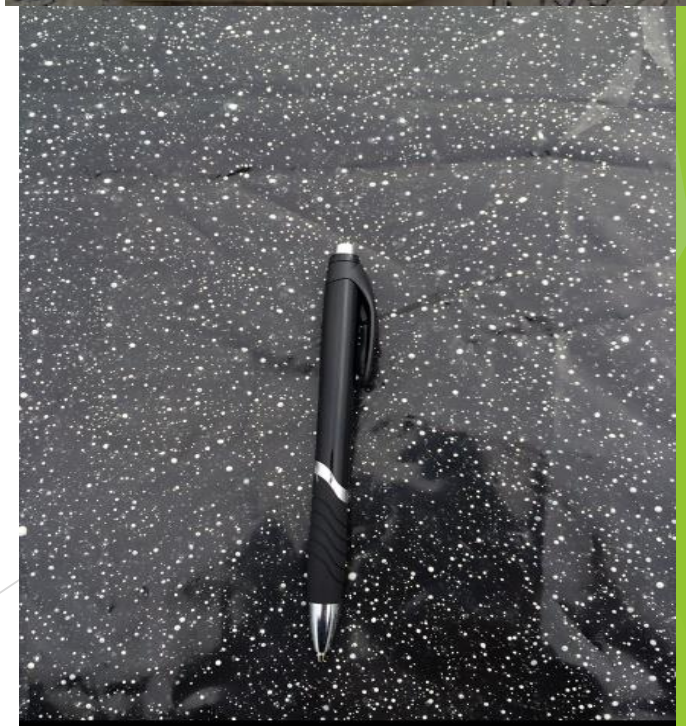
MONITORING PROCESS FOLLOWED

- Trial plots set up March 2017
- First cut and weigh 26 April 2017
- Twelve cut and weigh exercises
- Two months missed – slow winter growth and summer drought
- Last cut and weigh 12 June 2018
- Five sets of pasture samples taken and tested for PDM and internal quality

MONITORING PROCESS PHOTOS

MONITORING PROCESS PHOTOS





RESULTS

DIFFERENT METHODS USED FOR MEASURING DM

- Rising platemeter (height x 140 + 500 equation)
- Pasture cut and weigh
- Pasture weight conversion to DM at 20%
- Comparative use per treatment of five pasture samples/treatment for DM, ME, CP & N%DM.

DIFFERENT METHODS USED FOR MEASURING DM

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

Individual treatment averages and whole data average based on pasture internal quality tests

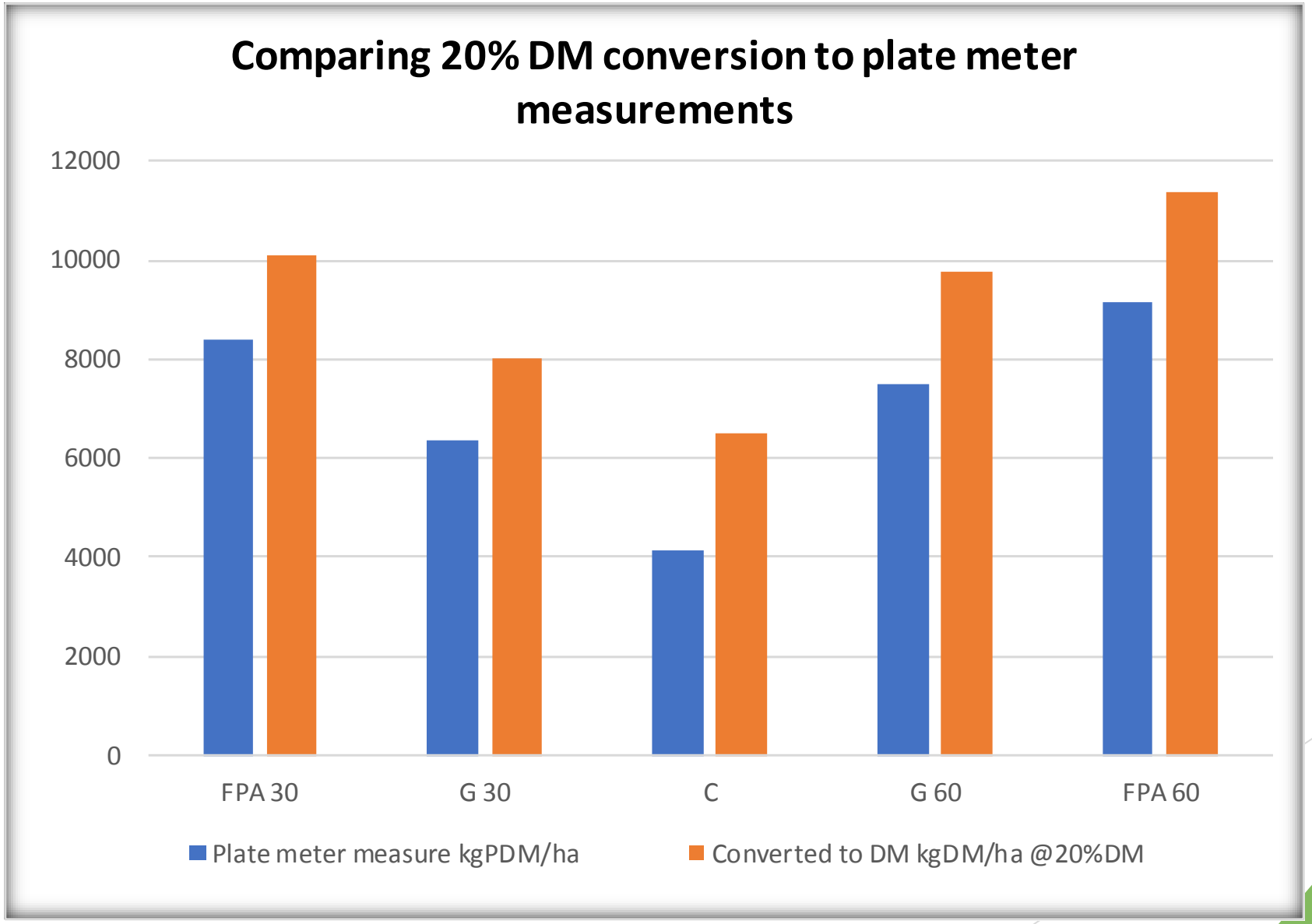
DIFFERENCES BETWEEN METHODS USED FOR MEASURING DM

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%

Individual treatment averages and whole data averages based on pasture tests

DIFFERENT METHODS USED FOR MEASURING DM



NET DIFFERENCE IN TOTAL GROWTH BETWEEN DIFFERENT TREATMENTS USING DIFFERENT DM MEASURING METHODS

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

Quantified differences between treatments resulting from comparative measurements.

TOTAL PASTURE GROWN

Total cumulative growth per treatment – 20% DM

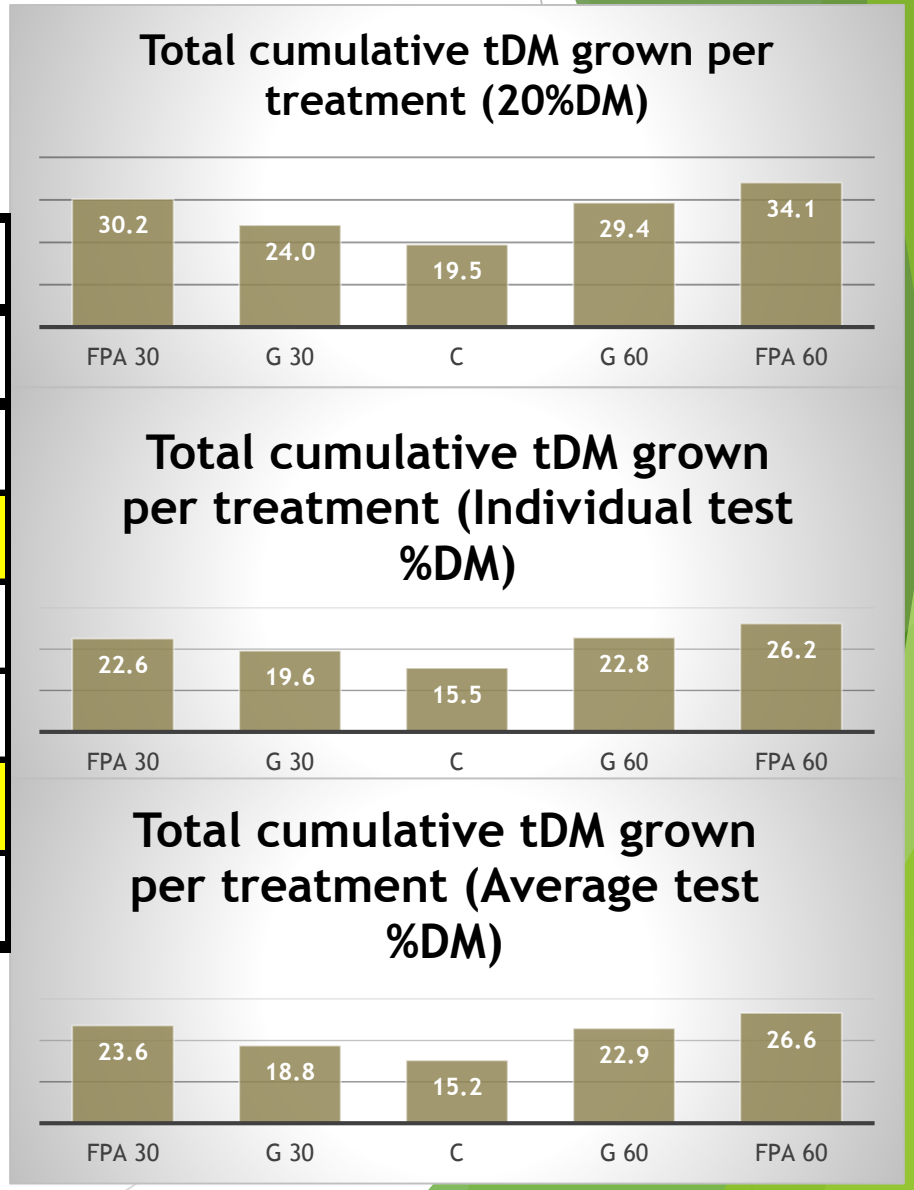
TOTAL CUMULATIVE DRY MATTER GROWTH kgDM PER TREATMENT												
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18
FPA 30	1,872	3,380	4,836	5,536	7,498	16,662	19,699	21,490	22,016	25,965	28,091	30,225
G 30	1,766	2,812	3,967	4,502	5,924	13,400	16,090	17,546	17,928	20,724	22,262	24,023
C	1,538	2,285	3,117	3,543	4,397	9,896	12,478	14,049	14,347	16,624	17,714	19,456
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 tDM per treatment

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

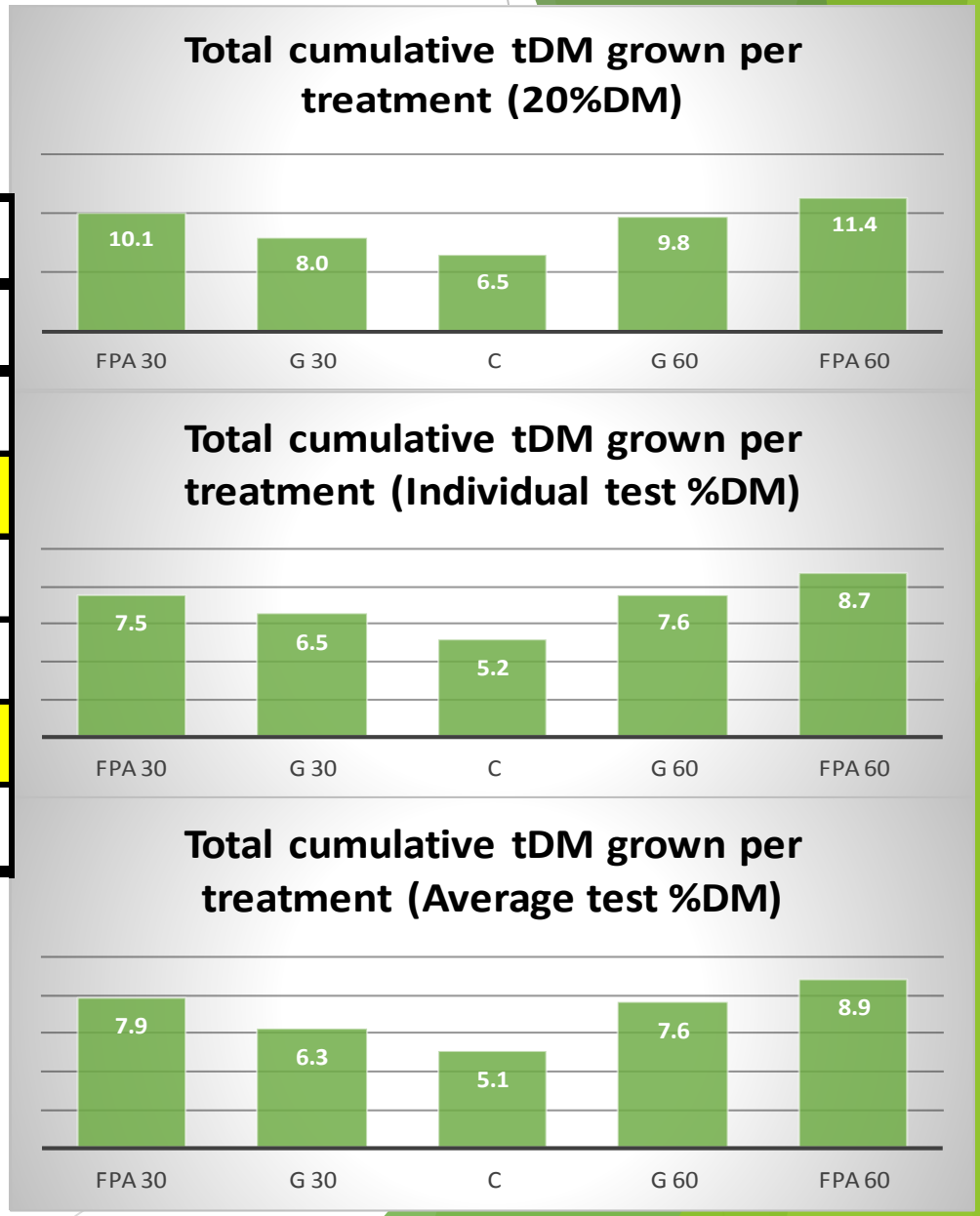
Note: this is equivalent to the cumulative growth over 3 ha



Total growth tDM per treatment/ha

TOTAL CUMULATIVE TONS DM (tDM) GROWN PER TREATMENT PER HA			
	20% DM	Individual test DM	Average tested DM
FPA 30	10.1	7.5	7.9
G 30	8.0	6.5	6.3
C	6.5	5.2	5.1
G 60	9.8	7.6	7.6
FPA 60	11.4	8.7	8.9

Note: this is equivalent to the cumulative growth per ha



PASTURE GROWTH RATES

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

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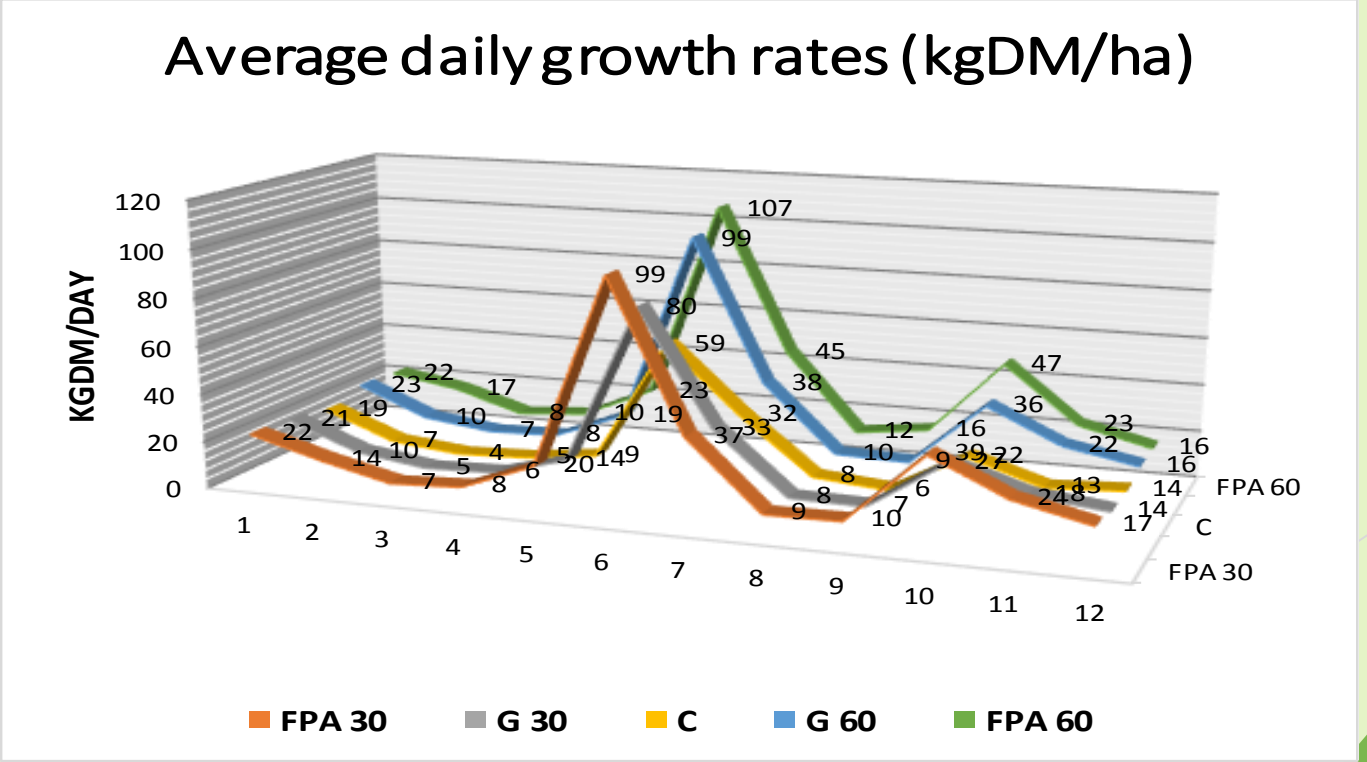
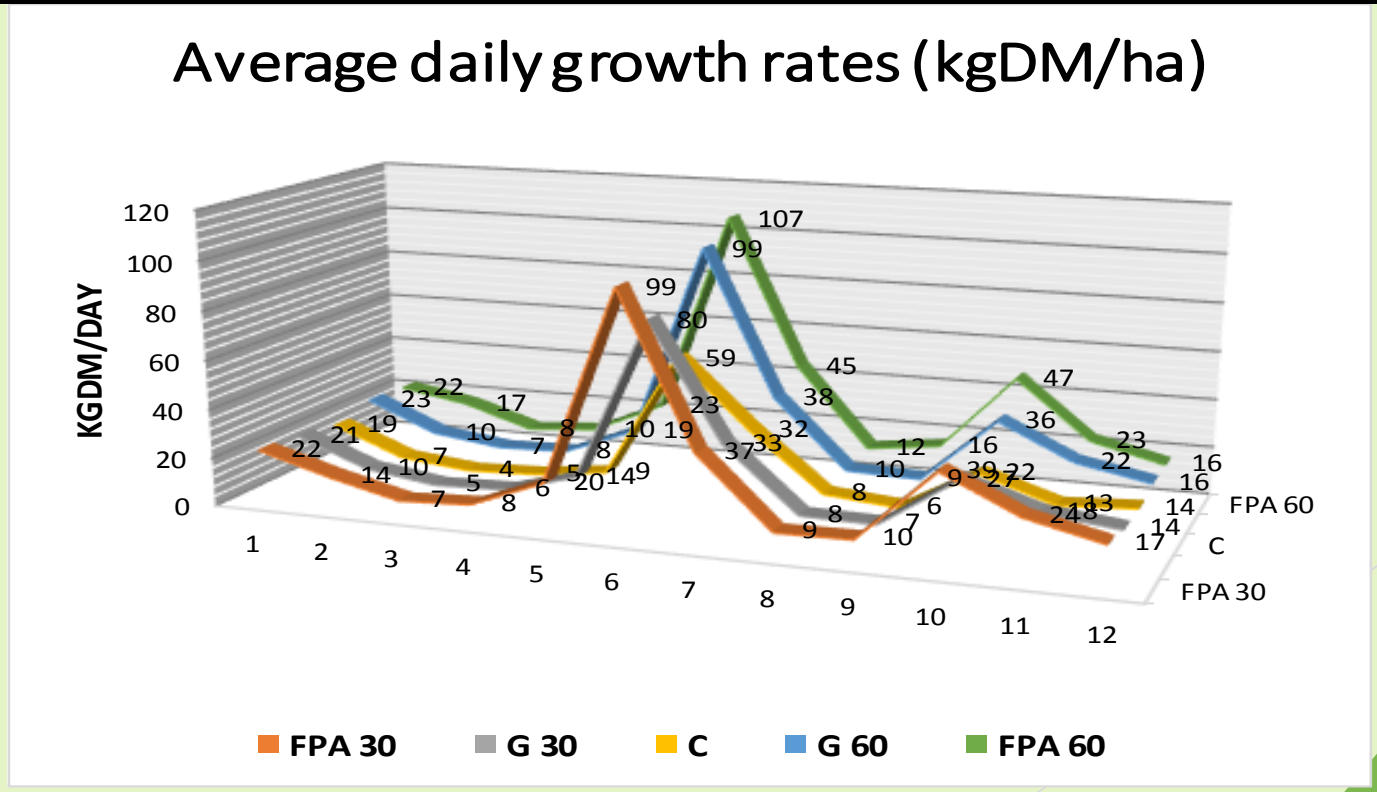
	26/04/17	1/06/17	10/08/17	7/09/17	10/10/17	10/11/17	7/12/17	9/02/18	28/02/18	3/04/18	2/05/18	12/06/18	Averages	Mean
Days/period	28	36	70	28	33	31	27	64	18	34	29	41	37	34.2
FPA 30	22	14	**7**	**8**	20	99	37	9	10	39	24	17	26	19
G 30	21	10	**5**	**6**	14	80	33	8	7	27	18	14	20	15
C	19	7	**4**	**5**	9	59	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



PASTURE RESPONSE RATES

Table of response rates to N applications in kgDM/kgN

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



ECONOMIC ANALYSIS

ECONOMIC ANALYSIS

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**

ECONOMIC ANALYSIS

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**

SUMMARY OF ECONOMIC ANALYSIS

Response rates:

- **FPA30** achieved **21.7kgDM/kgN – W**hole season;

Cost per kgDM:

- **FPA30** achieved lower cost than **G30 by 23% at $0.147/kgDM** grown;
- **FPA30 is lower than cost of G60 cost/kgDM grown at 2% less;**

Cost of N/kgDM grown:

- **FPA30's cost advantage is significant at 57.5% less than** its G30 equivalent;

FPA30 can produce at least the same quantity of total DM as G60; and

FPA30's advantage is still 53.8% less than G60 $ cost of N/kgDM grown.

WHAT WAS THE EXPECTED OUTCOME?

A similar amount of pasture will be grown using 30kg's of Urea applied via FPA as grown using 60kg of granular Urea.

WAS THE EXPECTED OUTCOME ACHIEVED?

Comparative net difference in kgDM/ha for different treatments			
	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	3429
FPA 60 vs G30	10054	6579	7854

FPA30: cumulative kgDM grown/ha: 10.075tDM/ha

G60: cumulative kgDM grown/ha: 9.784tDM/ha

N cost $/kgDM grown: FPA30 = $0.048
N cost $/kgDM grown: G60 = $0.104

FARM SYSTEM BENEFITS

FPA BENEFITS TO THE FARM SYSTEM

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:

- Even and improved coverage of the plant leaf material – fine particles;
- Enables faster uptake of N in urea form enabling faster and greater uptake through the leaves;
- Greater uptake of both urea and ammonium providing energy efficiency benefits for plants;
- Provides greater dispersion of nitrogen through soil profile, providing access to larger root surface area;
- Significantly, FPA provides faster uptake of N resulting in lower losses of ammonia and nitrous oxide gases;
- The fineness of the FPA particles and improved uniformity due to its application technology, plants can take advantage of nutrients being more readily available, enabling faster growth rates and significantly more total pasture Dry Matter (DM) grown;
- When granular N fertilisers are applied through the FPA system, significant productivity gains are realised through both pasture growth rates (kgDM/day) and pasture response rates (kgDM/kg N applied), leading to increased farm productivity and financial gains.

LITERATURE REVIEW

SEPTEMBER 2017

FPA LITERATURE REVIEW

- Six papers reviewed:
  - One peer reviewed and published paper
  - Five unpublished

  Authors:
  - **AgConsult. Winton Trials**
  - **M. Zaman and JD Blennerhassett, Summit-Quinphos. 2009.**
  - **K. Dawar, M. Zaman, J.S. Rowarth, J. Blennerhassett, M.H. Turnbull. 2010 (Peer reviewed and published paper)**
  - **M. Mahoney; Agronomy Field Trial Report, Incitec Pivot, February 2010.**
  - **M. Zaman, M.L. Nguyen, M.M. Barbour, M.H. Turnbull, 2010**
  - **B.F. Quin, J.D. Blennerhassett and M. Zaman. 2005**

SUMMARY OF BENEFITS – FPA VS GRANULAR

AgConsult. Winton Trials	FPA DAP produced >10% more pasture, i.e., 3 times the response; Visual assessment saw a change to the pasture sward in favour of ryegrass.
M. Zaman and JD Blennerhassett, Summit-Quinphos. 2009.	Significantly more pasture DM; FPA is a good management tool for enhancing N response and greater potential for improved economic returns if applied under the right conditions.
K. Dawar, M. Zaman, J.S. Rowarth, J. Blennerhassett, M.H. Turnbull. 2010 ++	More N recovery in the shoots. Mitigates against N losses, improving NUE.
M. Mahoney; Agronomy Field Trial Report, Incitec Pivot, February 2010.	Outstanding result in cumulative DM production and N uptake.

++: Peer reviewed published paper.

SUMMARY OF BENEFITS – FPA VS GRANULAR

- **M. Zaman, M.L. Nguyen, M.M. Barbour, M.H. Turnbull, 2010**

- **B.F. Quin, J.D. Blennerhassett and M. Zaman. 2005**

- Applying to leaves increased photosynthetic rate, WUE and sward growth.
- FPA improves nitrogen uptake opportunity, and is a likely explanation for the much superior response with FPA products in the Taranaki Trial.

Grass quality comparison photos

FPA 30 plot Autumn 2018

G 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.

Grass quality comparison photos

FPA 60 plot Autumn 2018

G 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.

THANK YOU

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