

COMPARATIVE SPORTS TURF FERTILISER TRIAL FOR BRISBANE CITY COUNCIL SPORTS FIELDS



Trial Site: **Queensland Sports and Athletics Centre (QSAC)**
Kessels Road, Nathan
Mt Gravatt, QLD 4122

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1 Acknowledgement

This study was undertaken during COVID lockdowns which caused continual disruptions throughout the trial.

Australian Sports Turf Consultants would like to acknowledge the following organisations who contributed to this research study:

Brisbane City Council	https://www.brisbane.qld.gov.au/
Fernland	https://fernland.com.au/
Globe Growing Solutions	https://globegrowingsolutions.com.au/
Greenway Turf Solutions	https://www.greenwayturfsolutions.com/
ICL Australia	https://icl-growingsolutions.com/en-au/
Lawn Pride	https://lawnpride.com.au/
Living Turf	https://www.livingturf.com.au/
Nuturf	https://nuturf.com.au/
Terra Firma	https://tff.com.au/

A special thank you to the Queensland Sports and Athletics Centre (QSAC) Ground Staff and former Ground Manager Matthew Oliver for providing access to a trial site and maintaining the site for the duration of the trial.

Regards,

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2 Table of Contents

1	Acknowledgement	2
2	Table of Contents	3
3	Background	4
4	Materials and Methods	4
5	Results	7
5.1	Turf Quality	7
5.2	Turf Colour	7
5.3	Turf (Canopeo) Green Cover	8
5.4	Leaf Tissue Nutritional Testing	9
6	Discussion	12
7	Appendices	13
7.1	Appendix 1 – Fertiliser Tier	13
7.2	Appendix 2 – Mean Data	14
7.3	Appendix 3 – Soil Nutritional Test Results	21
7.4	Appendix 4 – Leaf Tissue Test Results	22
7.5	Appendix 5 – Types of Fertiliser	27
7.6	Appendix 6 – Brisbane 2021 Temperature Data	29

3 Background

A research trial was conducted to evaluate various fertiliser technologies used for turfgrass maintenance. The study aimed to assess 23 distinct fertiliser products sourced from eight different suppliers (Fernland, Globe Growing Solutions, Greenway Turf Solutions, ICL, Lawn Pride, Living Turf, Nuturf and Terra Firma). Among these products, 21 were granular fertilisers, while one was an organic granule coated with fertiliser. The trial aimed to compare these products based on their efficacy and longevity, highlighting the performance variations attributed to their respective technologies.

The trial was financially supported by the Brisbane City Council (BCC) and the eight participating fertiliser companies, which also provided the fertiliser samples for the study. The BCC's interest in this research was to gain insights into the performance of different fertiliser products. This knowledge would assist the Council make informed decisions regarding the selection and application of fertilisers across its extensive network of over 500 sporting fields. Given the significant investment the BCC makes in maintaining and enhancing these facilities, optimizing fertiliser use and expenditure becomes crucial for achieving desired outcomes.

4 Materials and Methods

A replicated complete block design trial was established at Queensland Sports and Athletics Centre (QSAC), Kessels Road, Nathan, Mt Gravatt, QLD 4122 on the 11 March 2021. Each plot measured 2m x 2m, with 3 replicates (Table 2) across an existing 'Wintergreen' (*Cynodon dactylon*) turf surface. Each plot had the equivalent of 250 kg/ha of fertiliser product applied.

Assessments were undertaken by Australian Sports Turf Consultants (ASTC) on 7 occasions (Table 1) throughout the duration of the short trial. The following data was collected during each of the seven visits:

- Subjective turf quality (subjective);
- Quantitative turf colour using a Field Scout TCM 500 NDVI Turf Colour Meter. The collected NDVI is analysed to provide a Grass Index Rating proving a turf colour value $(=(\text{NDVI} \times 6.6) + 2.26)$ between 1 and 9 (1 = poor, 6 = acceptable and 9 = excellent) and
- Turf green cover (%) using the [Canopeo](#) mobile phone app. This is a tool used for measuring the fractional green canopy cover, in this application, of the turfgrass.

Prior to the application of the fertiliser treatments a representative soil sample (to a 100 mm depth) and leaf tissue sample were collected from across the trial area (Plate 3). During the study, leaf samples were collected from each treatment (a representative sample from across the three replicates) and sent for leaf tissue nutritional testing, conducted by Phosyn Analytical, Burleigh heads QLD 4220. Leaf tissue nutritional was conducted on 6 occasions, which correlated to approximately Day 0, 1, 1.5, 2, 3 and 4-months post fertiliser application.

Immediately following the application of fertiliser products, heavy rain fell across the trial area. Heavy rain also fell from the 2 to the 6 April 2021 during the trial.

The green couch trial area was routinely mown at 18 mm with a cylinder mower and irrigated to maintain unstressed growth. Armyworm control was provided after the lawn pests were observed on the 8 April 2021. All maintenance work was carried out by QSAC Ground Staff.

The trial area was frequently trafficked with machinery, including the moving of hurdles on and off the track, and training or mustering by athletes.

All data was analysed using standard Analysis of Variance (ANOVA) using Genstat software. Comparison of means were made using Fischer's protected Least Significant Difference at a 5% (LSD (5%)) probability level. Graphs were constructed using Microsoft Excel.

Figure 1 Trial layout, with each plot measuring 2m x 2m. The total area was 16m x 18m = 288m²

NORTH (fenced cage)								
14	6	18	3	16	10	4	11	7
8	7	19	2	12	14	18	12	6
11	4	12	18	4	8	8	2	9
9	1	2	20	11	9	1	15	23
21	3	23	6	1	13	16	5	21
10	20	13	7	22	17	17	14	20
16	5	15	21	15	5	3	22	10
17	22	spare	23	19	spare	19	13	spare
Block I			Block II			Block III		

Note: Please refer to Table 2 to see the fertiliser products/names

Table 1 Data was collected on the following dates

Assessment Duration	Date
Before fertiliser application (0 days)	11 March 2021
1 week after treatment (7 days)	18 March 2021
1 month after treatment (28 days)	8 April 2021
1 month after treatment (49 days)	29 April 2021
2 months after treatment (64 days)	14 May 2021
3 months after treatment (89 days)	8 June 2021
4 months after treatment (119 days)	8 July 2021

Plate 1 Trial setup on 11 March 2021



Table 2 Fertiliser products trailed. The treatment numbers (1 to 23) are also provided

Company	Fertiliser Grade Tier					
	High 'A Grade'		Medium 'B Grade'		Lower 'C Grade'	
Fernland	2	Flora Fert 12-1-22 +Fe	10	Combi Green 17-2-8.3	17	Onyx 11-0-3
Globe	3	Globe BCC – Mini Blend 25.2-13.3-13.3	11	2Spec Origin 27-1-10	18	2Spec Elevate 23-1-10
Greenway Turf Solutions	4	GTS GALAXY PRO 21-2.1-4.8	12	BEST Turf GOLD 24-1-4	19	GTS Flex N 33-0-11
ICL Australia	5	Sierrablen Sportsturf 22-2.2-8.3	13	ProTurf Hi-N 20-0-5.8	20	Sportsmaster Fairway 12-2.6-7.4
Lawn Pride	6	Lawn Pride Maintain PRO	14	Lawn Pride Maintain 26-1-9	21	Lawn Pride Protect N
Living Turf	7	MP All Season 19.7-0-16	15	NX Gold 29-0-8	22	MP Origin 28-1-8
Nuturf	8	Custom Blend 20-1-8	16	Black Label 24-2-9	23	Couch King 23-1-10
Terra Firma	9	Grassmaster (organic granule) 10.5-2-8				
Control	1	Control				

Plate 2 Fertiliser treatments (left to right and top to bottom) 23, 19, 3, 9, 13, 17, 8, 4, 2, 5, 6, 7, 22, 12, 10, 11, 14, 21, 11 (again), 20, 15, 16, 18, 22 (again) were photographed

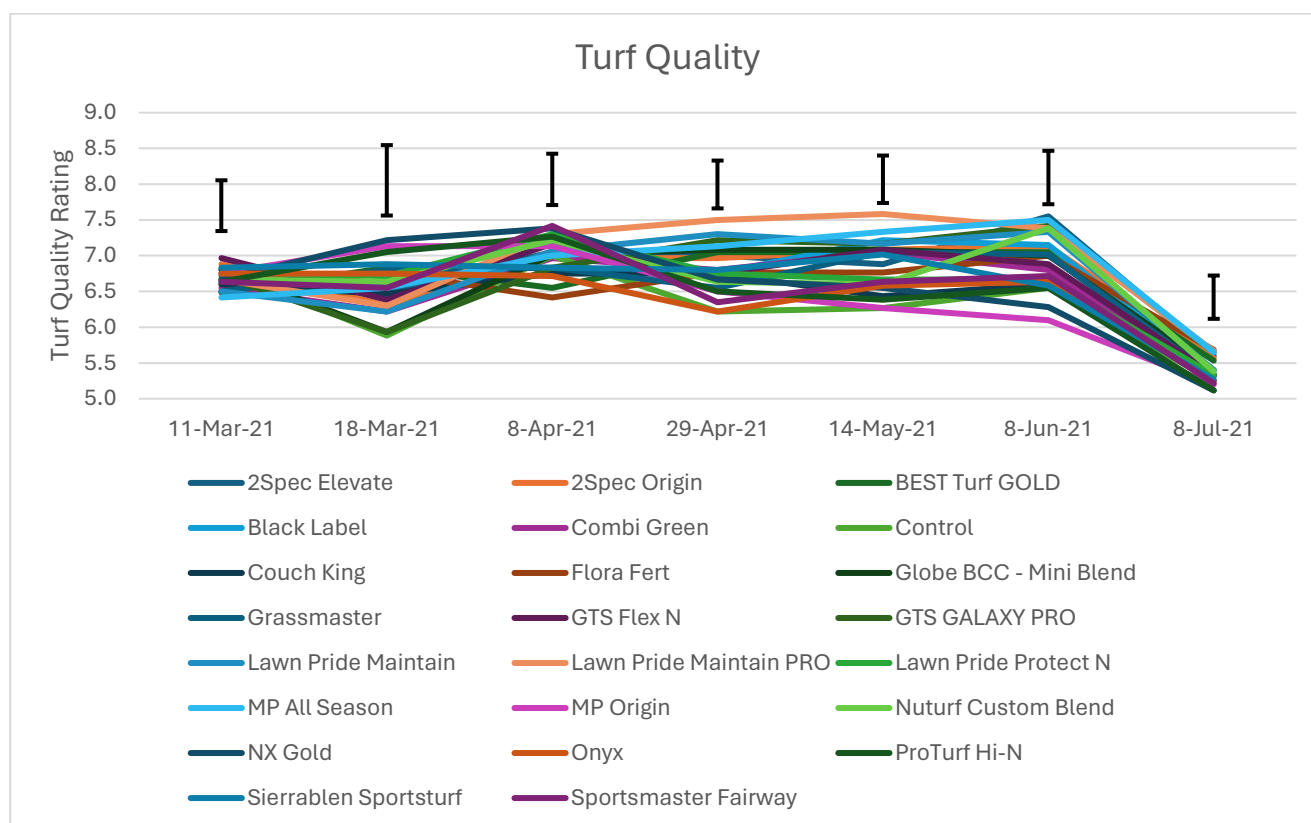


5 Results

5.1 Turf Quality

Over the 4 month trial, turf quality (Figure 2) only fell below an acceptable level (a 6 rating) for three treatments (control, GTS GALAXY PRO) and Globe BCC – Mini Blend) on the 18 March 2021 and then for all treatments with the cooler change seen in June 2021 (Figure 5). During the 6 assessment dates following fertiliser application (Table 1) there was no significant difference (Appendix 2 – Mean Data) in turf quality between the fertiliser products applied. This included the control.

Figure 2 Mean subjective turf quality assessments undertaken over the course of the fertiliser trial (1 = poor, 6 = acceptable and 9 = excellent)



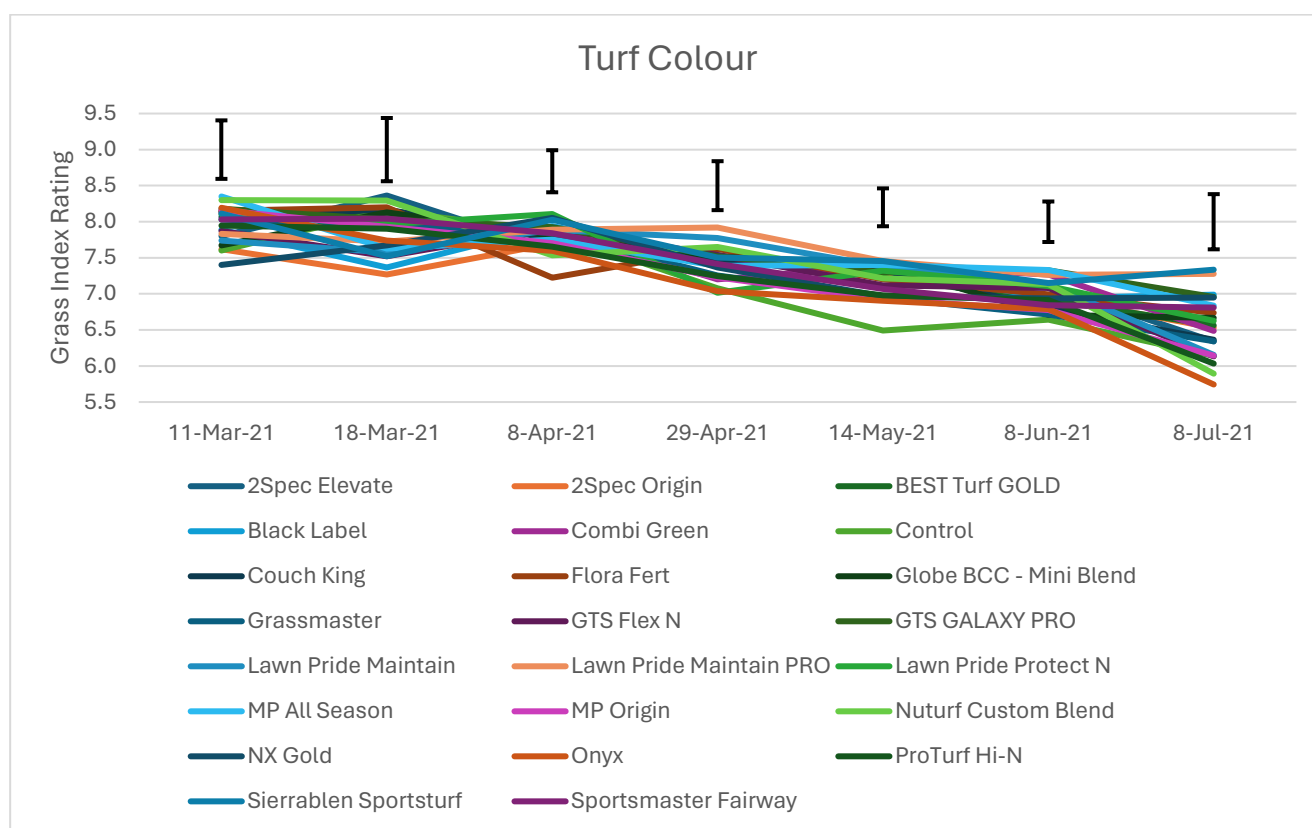
5.2 Turf Colour

Figure 3 below shows mean turf colour data collected over the fourth month trial. In July 2021, when there was a cooler change, only 2 fertiliser treatments fell below the acceptable turf colour level of 6 (rating). This was for Onyx (5.7 rating) and Nuturf Custom Blend (5.9 rating). Following product application of all treatments on the 11 March 2021, there was no significant difference in turf colour (using the Turf Colour Meter) on the 18 March, which is not really a surprise due to the short timeframe, but also not on the 8 April, although plots colours were certainly visible at that time (Plate 4).

There was no significant difference in turf colour between the fertiliser treatments on the 29 April 2021, yet on the 14 May Lawn Pride Maintain PRO and Sierrablen Sportsturf were significantly different, with higher turf colour, compared to the other fertiliser treatments (Appendix 2 – Mean Data). This was also visible within the aerial photograph taken (Plate 5) on the same day.

There was no significant difference between the treatments on the 8 June 2021, yet some plots were still noticeably darker than others, including GTS GALAXY PRO, Lawn Pride Protect N and Sierrablen Sportsturf (Plate 6). Sierrablen Sportsturf did however return a significantly higher turf colour value than all other treatments in July 2021. Onyx was also significantly different to all other treatments, including the control, with a lower scoring mean colour rating of 5.7.

Figure 3 Mean quantitative turf colour assessments undertaken over the course of the fertiliser trial using a Turf Colour Meter (Grass Index Rating and Turf Colour Rating is 1 = poor, 6 = acceptable and 9 = excellent)

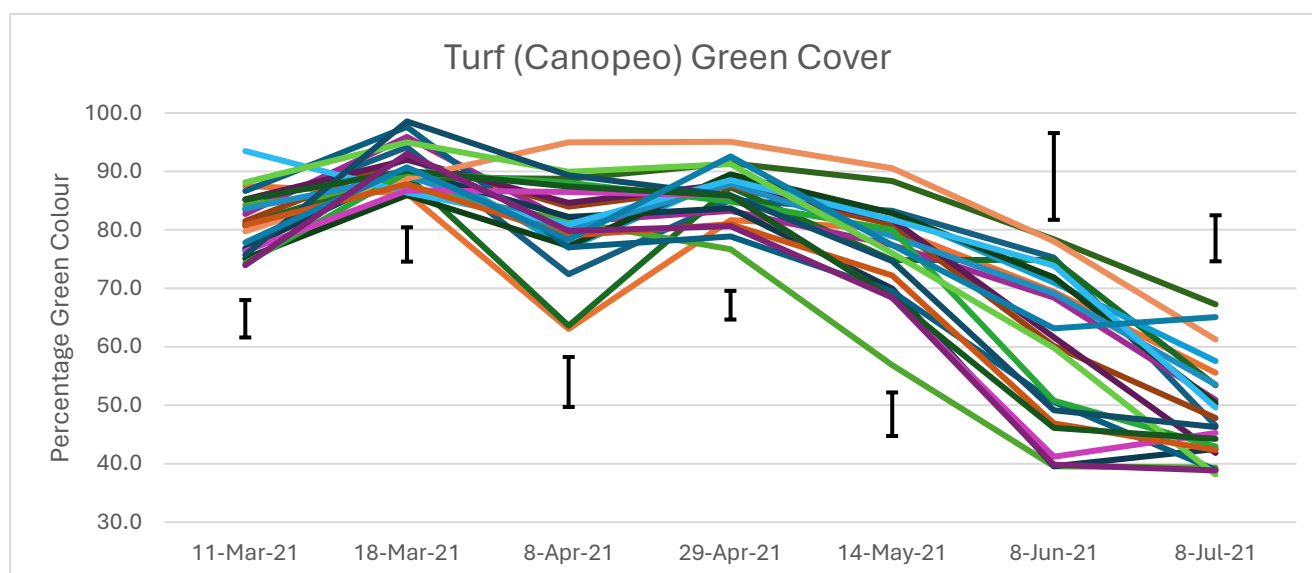


5.3 Turf (Canopeo) Green Cover

It was not until the assessment conducted on the 14 May 2021 that there was a significant difference between fertiliser treatments (Appendix 2 – Mean Data). GTS GALAXY PRO provided a significantly higher turf green cover than all other treatments. All treatments were also significantly higher than the control treatment.

In July 2021 both Lawn Pride Maintain PRO and Sierrablen Sportsturf returned significantly higher turf green cover values than all other treatments.

Figure 4 Mean turf Canopeo (percentage green turf) cover assessed over the duration of the trial. Please refer to the legend shown in Figure 3, which is the same for the figure below



5.4 Leaf Tissue Nutritional Testing

Raw leaf nutritional test data is provided within Appendix 4 – Leaf Tissue Test Results for Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Sulphur and Iron. For the treatments that had the highest levels of Nitrogen and Iron following product application can be seen in (Table 3).

Table 3 Highest nitrogen (ppm) and iron (ppm) levels seen within the treatments following products applications on the 11 March 2021

	8 April 2021	29 April 2021	14 May 2021	8 June 2021	8 July 2021
Nitrogen	Lawn Pride Maintain PRO (3.13 ppm)	Lawn Pride Maintain PRO (3.16 ppm)	Lawn Pride Maintain PRO (4.14 ppm)	Lawn Pride Maintain PRO (2.73 ppm)	Lawn Pride Maintain PRO (3.40 ppm)
Iron	2Spec Elevate (6077 ppm)	GTS GALAXY PRO (6254 ppm)	Black Label 24-2-9 (6630 ppm)	GTS GALAXY PRO (6275 ppm)	Combi Green 17-2-8.3 (6120 ppm)

Plate 3 Aerial view of the trial on 11 March 2021 prior to the application of fertiliser treatments

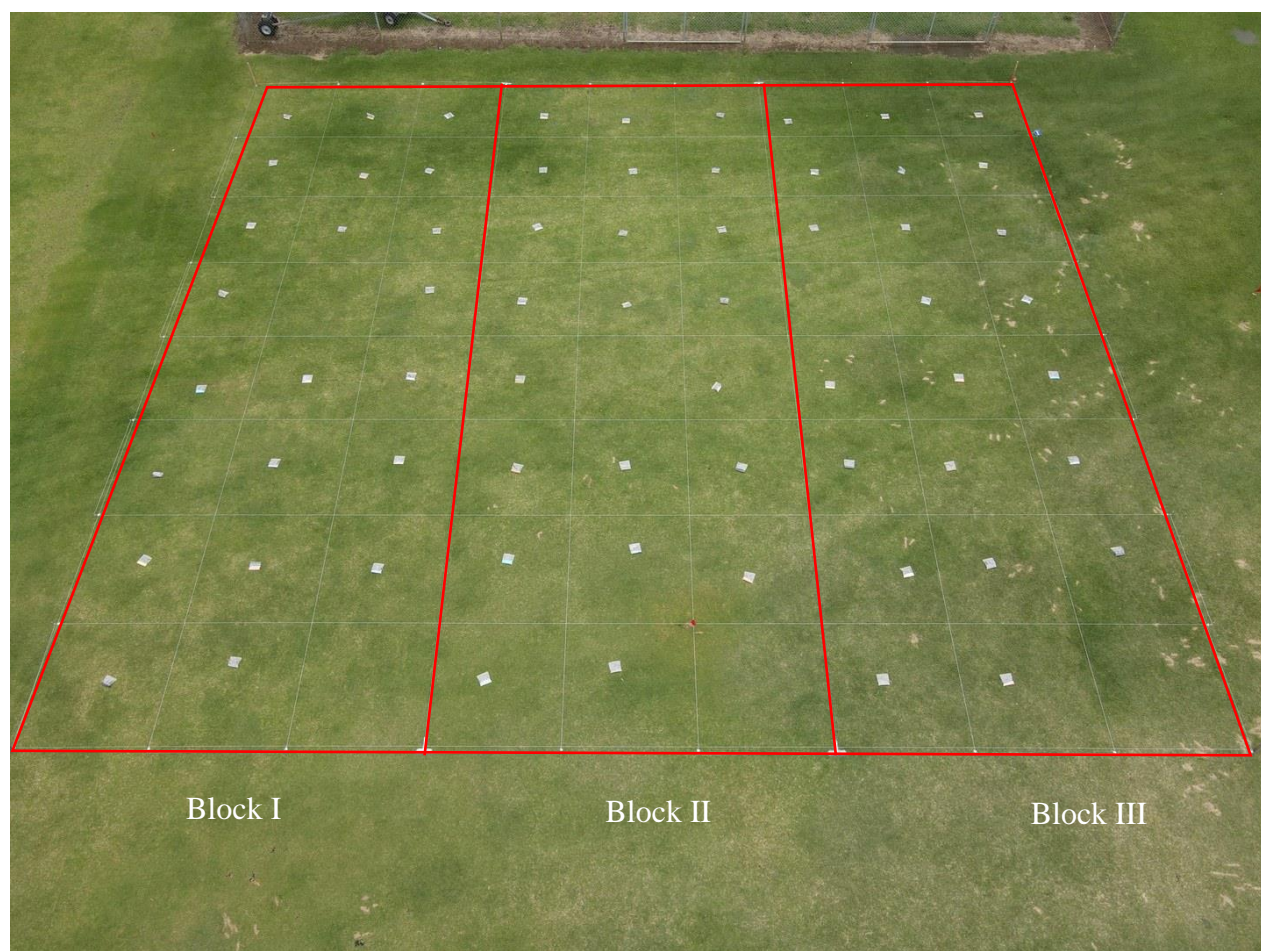


Plate 4 Aerial view of the trial on 7 April 2021, 27 days after the application of fertiliser treatments



Plate 5 Aerial view of the trial on 14 May 2021, 49 days after the application of fertiliser treatments



Plate 6 Aerial view of the trial on 8 June 2021, 89 days after the application of fertiliser treatments



Plate 7 Aerial view of the trial on 7 July 2021, 118 days after the application of fertiliser treatments



6 Discussion

Turf quality readings provided little benefit in comparing the fertiliser products. This parameter would provide more useful over a longer period of time, rather than only a short 4-month replicated study.

On the 14 May Lawn Pride Maintain PRO and Sierrablen Sportsturf returned a significantly higher turf colour than all other treatments. On the 8 July 2021, Sierrablen Sportsturf was the only variety to return a higher turf colour rating than all other treatments. As for turf Canopeo green cover, only on two occasions were there statistical differences between the treatments. These included for GTS GALAXY PRO in May and both Lawn Pride Maintain PRO and Sierrablen Sportsturf in July. Two of the latter three products also rated high in turf colour during May and Sierrablen Sportsturf rated a higher turf colour in May and July.

The GTS GALAXY PRO fertiliser was clearly noticeable in the plots e.g. Plate 3 to Plate 7, yet did not return a statistically different [the] highest turf colour compared to the other treatments. This was also surprising given the turfgrass where GTS GALAXY PRO has been applied had the highest level of nitrogen (ppm) present within its green couch foliage (leaf blades) following leaf tissue nutritional testing.

It was also surprising that the Sierrablen Sportsturf treatment, which rated higher in colour and turf (Canopeo) green colour on multiple occasions, did not have the higher level of Nitrogen or Iron present in the turfgrass foliage following nutrient testing.

Considerable rain fell following product applications and during the trial may have affected the results, including the longevity of the products. The same goes with the use and traffic across the trial area. Such traffic is visible in Plate 3 to Plate 7.

Fertiliser was applied at the equivalent rate of 250 kg/ha to meet with Brisbane City Council application guidelines, as part of their current Sports Field Enhancement Program which is aimed to supplement a Club's existing [fertiliser] program. It would prove beneficial to trial and compare a higher application rate e.g. at 300 kg/ha in a future trial or case study to monitor the product longevity at what would be considered a "typical" application rate for sports turf.

Along with an increased fertiliser rate it would also be desirable to undertake the trial in more of a controlled environment and possibly using new or relatively newer established turfgrass. This would be to limit unauthorised use of the area and to ensure turf health is not compromised e.g. from thatch or possible disease scarring etc. This would be to reduce possible interactions that could affect the results.

We would like to thank Brisbane City Council and the fertiliser suppliers for committing to be involved in the study. It is one of the first times such a comparative trial has been run comparing so many products.

7 Appendices

7.1 Appendix 1 – Fertiliser Tier

The type and quality of fertiliser supplied for the trial fit within the following three (3) tiers. The ‘C grade’ fertiliser is what was previously used by Brisbane City Council (BCC) and the ‘A Grade’ and ‘B Grade’ tier products are now used on Brisbane City Council’s Tier 1 (Premier) and Tier 2 community sports fields.

Table 4 Fertiliser grade specification

		Previous Council Specification Fertiliser	Fertiliser to be used on Tier 2 Sports Fields	Fertiliser to be used on Tier 1 Sports Fields
Tier:		Low Grade - 'C Grade'	Medium Grade - 'B Grade'	High Grade - 'A Grade'
Features	Longevity	< 6 weeks (1.5 months)	8-12 weeks (2 - 3 months)	12 weeks+ (>3 months)
	Prill sizing	>230SGN (Average prill greater than 2.3mm)	230-170SGN	230-170SGN
	Prill Sizing comment	Large prills common in ag-grade fertilisers	Smaller SGN for improved distribution and more even application of product/unit area	Smaller SGN for improved distribution and more even application of product/unit area
	Technology*	Compound fertiliser or small percentage of stabilised urea.	Blend of slow or controlled release technologies 20-50% of product make-up.	Slow or controlled release technologies >80% of make-up.
Price range/25kg bag		\$30 - \$40	\$40 - \$55	\$70 - \$90
Price Range/Metric Tonne		\$1200-\$1600	\$1600 - \$2200	\$2800 - \$4950

8 * Please refer to Appendices

Appendix 1 – Fertiliser Tier for further information on the fertiliser technology.

8.1 Appendix 2 – Mean Data

Table 5 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 11 March 2021

	TCM		Quality		Canopeo	
2Spec Elevate	7.8	a	6.6	a	83.5	a
2Spec Origin	7.6	a	6.9	a	87.5	a
BEST Turf GOLD	8.1	a	6.5	a	81.0	a
Black Label	7.9	a	6.7	a	76.6	a
Combi Green	8.1	a	6.6	a	82.7	a
Control	7.6	a	6.8	a	84.3	a
Couch King	8.1	a	6.6	a	76.9	a
Flora Fert	8.2	a	6.5	a	81.5	a
Globe BCC - Mini Blend	7.7	a	6.8	a	75.1	a
Grassmaster	8.0	a	6.5	a	86.6	a
GTS Flex N	7.9	a	7.0	a	85.2	a
GTS GALAXY PRO	8.2	a	6.7	a	80.7	a
Lawn Pride Maintain	7.7	a	6.5	a	83.6	a
Lawn Pride Maintain PRO	7.8	a	6.7	a	79.8	a
Lawn Pride Protect N	8.1	a	6.8	a	74.3	a
MP All Season	8.4	a	6.4	a	93.5	a
MP Origin	8.2	a	6.8	a	76.4	a
Nuturf Custom Blend	8.3	a	6.7	a	88.2	a
NX Gold	7.4	a	6.7	a	75.7	a
Onyx	8.2	a	6.8	a	80.8	a
ProTurf Hi-N	7.9	a	6.6	a	85.2	a
Sierrablen Sportsturf	8.1	a	6.8	a	77.9	a
Sportsmaster Fairway	8.0	a	6.6	a	74.0	a
LSD (5%)	0.81	-	0.61	-	11.98	-

Table 6 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 18 March 2021

	TCM		Quality		Canopeo	
2Spec Elevate	8.4	a	6.5	a	94.1	a
2Spec Origin	7.3	a	6.3	a	86.3	a
BEST Turf GOLD	8.1	a	6.8	a	89.3	a
Black Label	7.4	a	6.6	a	92.8	a
Combi Green	8.0	a	6.2	a	95.9	a
Control	8.2	a	5.9	a	87.3	a
Couch King	8.2	a	6.5	a	90.1	a
Flora Fert	8.2	a	6.8	a	92.2	a
Globe BCC - Mini Blend	8.1	a	5.9	a	85.9	a
Grassmaster	7.9	a	6.8	a	97.6	a
GTS Flex N	7.5	a	6.4	a	92.0	a
GTS GALAXY PRO	8.0	a	5.9	a	88.9	a
Lawn Pride Maintain	7.6	a	6.2	a	89.2	a
Lawn Pride Maintain PRO	7.7	a	6.3	a	88.8	a
Lawn Pride Protect N	8.0	a	6.7	a	89.8	a
MP All Season	7.6	a	6.6	a	86.4	a
MP Origin	7.9	a	7.1	a	86.7	a
Nuturf Custom Blend	8.3	a	6.6	a	95.0	a
NX Gold	7.7	a	7.2	a	98.6	a
Onyx	7.7	a	6.8	a	87.8	a
ProTurf Hi-N	7.9	a	7.1	a	90.1	a
Sierrablen Sportsturf	7.5	a	6.9	a	90.7	a
Sportsmaster Fairway	8.0	a	6.6	a	93.0	a
LSD (5%)	0.88	-	1.09	-	10.88	-

Table 7 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 8 April 2021

	TCM		Quality		Canopeo	
2Spec Elevate	7.6	a	7.1	a	72.4	a
2Spec Origin	7.7	a	7.0	a	63.0	a
BEST Turf GOLD	7.8	a	6.6	a	63.6	a
Black Label	7.9	a	7.0	a	77.0	a
Combi Green	7.9	a	7.0	a	81.3	a
Control	7.9	a	7.0	a	81.5	a
Couch King	7.8	a	6.8	a	82.2	a
Flora Fert	7.2	a	6.4	a	84.0	a
Globe BCC - Mini Blend	7.8	a	7.0	a	77.2	a
Grassmaster	7.8	a	6.8	a	77.0	a
GTS Flex N	7.9	a	7.2	a	84.6	a
GTS GALAXY PRO	7.9	a	6.8	a	88.7	a
Lawn Pride Maintain	7.9	a	7.1	a	79.9	a
Lawn Pride Maintain PRO	7.9	a	7.3	a	95.0	a
Lawn Pride Protect N	8.1	a	7.3	a	88.1	a
MP All Season	7.8	a	7.0	a	81.0	a
MP Origin	7.7	a	7.1	a	86.5	a
Nuturf Custom Blend	7.5	a	7.2	a	89.9	a
NX Gold	8.1	a	7.4	a	89.3	a
Onyx	7.6	a	6.7	a	79.0	a
ProTurf Hi-N	7.7	a	7.3	a	87.4	a
Sierrablen Sportsturf	8.0	a	6.8	a	78.3	a
Sportsmaster Fairway	7.8	a	7.4	a	79.8	a
LSD (5%)	0.5838	-	0.8522	-	16.51	-

Table 8 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 29 April 2021

	TCM		Quality		Canopeo	
2Spec Elevate	7.5	a	7.0	a	85.1	a
2Spec Origin	7.5	a	7.0	a	81.7	a
BEST Turf GOLD	7.5	a	7.1	a	87.3	a
Black Label	7.5	a	6.8	a	88.9	a
Combi Green	7.2	a	6.8	a	83.3	a
Control	7.1	a	6.2	a	76.7	a
Couch King	7.5	a	6.8	a	83.7	a
Flora Fert	7.6	a	6.8	a	87.4	a
Globe BCC - Mini Blend	7.5	a	7.1	a	89.5	a
Grassmaster	7.3	a	6.6	a	78.9	a
GTS Flex N	7.5	a	6.8	a	87.9	a
GTS GALAXY PRO	7.5	a	7.2	a	91.4	a
Lawn Pride Maintain	7.8	a	7.3	a	87.8	a
Lawn Pride Maintain PRO	7.9	a	7.5	a	95.1	a
Lawn Pride Protect N	7.0	a	6.8	a	84.8	a
MP All Season	7.4	a	7.1	a	88.5	a
MP Origin	7.2	a	6.5	a	85.9	a
Nuturf Custom Blend	7.7	a	6.6	a	91.3	a
NX Gold	7.4	a	6.7	a	85.9	a
Onyx	7.0	a	6.2	a	80.9	a
ProTurf Hi-N	7.2	a	6.5	a	85.9	a
Sierrablen Sportsturf	7.5	a	6.8	a	92.6	a
Sportsmaster Fairway	7.4	a	6.4	a	80.6	a
LSD (5%)	0.68	-	0.66	-	9.13	-

Table 9 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 14 May 2021

	TCM		Quality		Canopeo	
2Spec Elevate	7.3	ab	6.9	a	83.3	ab
2Spec Origin	7.2	ab	7.1	a	80.2	ab
BEST Turf GOLD	7.2	ab	7.1	a	74.8	ab
Black Label	7.3	ab	7.2	a	82.9	ab
Combi Green	7.4	ab	7.1	a	77.4	ab
Control	6.5	ab	6.3	a	56.8	b
Couch King	7.3	ab	6.4	a	70.0	ab
Flora Fert	7.2	ab	6.8	a	80.9	ab
Globe BCC - Mini Blend	7.4	ab	7.1	a	82.9	ab
Grassmaster	6.9	ab	7.1	a	69.5	ab
GTS Flex N	7.1	ab	7.1	a	81.7	ab
GTS GALAXY PRO	7.3	ab	7.2	a	88.4	a
Lawn Pride Maintain	7.4	ab	7.2	a	78.9	ab
Lawn Pride Maintain PRO	7.5	a	7.6	a	90.6	ab
Lawn Pride Protect N	7.3	ab	6.7	a	80.0	ab
MP All Season	7.4	ab	7.3	a	81.8	ab
MP Origin	6.9	ab	6.3	a	68.4	ab
Nuturf Custom Blend	7.2	ab	6.6	a	76.0	ab
NX Gold	7.0	ab	6.6	a	74.6	ab
Onyx	6.9	ab	6.6	a	72.2	ab
ProTurf Hi-N	7.0	ab	6.4	a	68.4	ab
Sierrablen Sportsturf	7.5	a	7.0	a	77.4	ab
Sportsmaster Fairway	7.1	ab	6.6	a	68.4	ab
LSD (5%)	0.53	-	0.80	-	14.39	-

Table 10 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 8 June 2021

	TCM		Quality		Canopeo	
2Spec Elevate	7.1	a	7.6	a	75.3	a
2Spec Origin	7.0	a	7.1	a	69.4	a
BEST Turf GOLD	6.9	a	7.1	a	74.9	a
Black Label	6.9	a	7.2	a	71.0	a
Combi Green	7.3	a	6.8	a	68.4	a
Control	6.6	a	6.6	a	39.6	a
Couch King	6.8	a	6.6	a	39.6	a
Flora Fert	7.0	a	7.0	a	60.2	a
Globe BCC - Mini Blend	6.7	a	7.0	a	71.9	a
Grassmaster	6.7	a	7.0	a	50.6	a
GTS Flex N	7.1	a	6.9	a	61.6	a
GTS GALAXY PRO	7.3	a	7.4	a	78.4	a
Lawn Pride Maintain	7.1	a	7.3	a	69.1	a
Lawn Pride Maintain PRO	7.3	a	7.4	a	78.1	a
Lawn Pride Protect N	7.1	a	6.7	a	50.8	a
MP All Season	7.3	a	7.5	a	73.9	a
MP Origin	6.8	a	6.1	a	41.2	a
Nuturf Custom Blend	7.1	a	7.4	a	59.8	a
NX Gold	6.9	a	6.3	a	49.2	a
Onyx	6.8	a	6.6	a	46.9	a
ProTurf Hi-N	6.9	a	6.6	a	46.1	a
Sierrablen Sportsturf	7.2	a	6.6	a	63.1	a
Sportsmaster Fairway	6.8	a	6.7	a	39.8	a
LSD (5%)	0.56	-	0.93	-	29.12	-

Table 11 Mean quantitative turf colour meter (TCM) grass index ratings, subjective turf quality ratings and percentage turf green (Canopeo) readings taken across the turf plots on 8 July 2021

	TCM		Quality		Canopeo	
2Spec Elevate	6.3	ab	5.6	a	46.5	ab
2Spec Origin	6.5	ab	5.6	a	55.6	ab
BEST Turf GOLD	6.6	ab	5.5	a	53.4	ab
Black Label	7.0	ab	5.3	a	57.6	ab
Combi Green	6.5	ab	5.3	a	50.9	ab
Control	6.1	ab	5.3	a	39.3	ab
Couch King	6.4	ab	5.3	a	42.5	ab
Flora Fert	6.7	ab	5.7	a	47.8	ab
Globe BCC - Mini Blend	6.7	ab	5.4	a	50.4	ab
Grassmaster	6.3	ab	5.3	a	39.0	ab
GTS Flex N	6.1	ab	5.3	a	41.8	ab
GTS GALAXY PRO	7.0	ab	5.7	a	67.3	ab
Lawn Pride Maintain	6.2	ab	5.4	a	53.5	ab
Lawn Pride Maintain PRO	7.3	ab	5.7	a	61.3	a
Lawn Pride Protect N	6.6	ab	5.3	a	42.9	ab
MP All Season	6.8	ab	5.7	a	49.6	ab
MP Origin	6.1	ab	5.2	a	45.3	ab
Nuturf Custom Blend	5.9	ab	5.4	a	38.2	ab
NX Gold	6.9	ab	5.1	a	46.3	ab
Onyx	5.7	b	5.3	a	42.4	ab
ProTurf Hi-N	6.0	ab	5.1	a	44.2	ab
Sierrablen Sportsturf	7.3	a	5.3	a	65.1	a
Sportsmaster Fairway	6.8	ab	5.2	a	38.9	ab
LSD (5%)	0.77	-	0.45	-	14.99	-

8.2 Appendix 3 – Soil Nutritional Test Results

Table 12 A representative soil sample was collected from within and across the trial area prior to the commencement of fertiliser treatment applications. The guideline is based on a “desirable” range for green couch

Analysis	Guideline	22.03.2021
pH [1:5 H ₂ O]	6.0 - 7.0	7.5
Organic Matter %	3 – 8	1.7
CEC (meq/100g)	3 - 10	6.17
EC [1:5 H ₂ O] (dS/m)	0.23 - 0.75	0.06
NO ₃ -N (ppm)	10.0 - 25.0	1
Phosphorus (ppm) [Olsen]	7.0 - 14.0	12
Potassium [Am.Acet] (meq/100g)	0.2 - 0.5	0.2
Calcium [Am.Acet] (meq/100g)	5 - 10	4.61
Magnesium [Am.Acet] (meq/100g)	1.0 - 3.0	1.18
Sulphur [MCP] (ppm)	11.0 - 20.0	9
Boron [CaCl ₂] (ppm)	1.0 - 2.0	0.4
Copper [DTPA] (ppm)	0.3 - 5.0	0.7
Iron [DTPA] (ppm)	5 - 120	54
Manganese [DTPA] (ppm)	2.0 - 50.0	6.8
Zinc [DTPA] (ppm)	0.5 - 5.0	4.4
Sodium [Am.Acet] (meq/100g)	< 0.3	0.1
Aluminium [KCl] (meq/100g)	< 0.5	0.08
Chloride (ppm)	< 50	37
Ca base saturation (%)	65 - 85%	74.7
K base saturation (%)	2 - 7 %	3.3
Mg base saturation (%)	10 - 20%	19.1
Na base saturation (%)	< 1%	1.7
Al base saturation (%)	< 5%	1.3
Ca : Mg Ratio	2 - 5	3.92
Exchangeable Sodium Percentage (%)	< 6 %	1.64

Low	Adequate	High	Very High
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Recommendations based on the SLAN Method = Sufficiency Level of Available Nutrients & not the BCSR Method = Base Cation Saturation Method. **Laboratory testing** by Eurofins APAL, Burleigh QLD. **Source references** Bruce & Rayment (1982), Leake & Haege (2014), McFarlane (1999), Metson (1961), Rayment & Bruce (1984) and Raymont & Lyons (2011).

Disclaimer

Care has been taken to ensure that the information contained within this report is reliable and that the recommendations reflect considerable professional judgement. Australian Sport Turf Consultants Pty Ltd as Trustee for (ATF) Matthew Roche Family Trust, however, does not guarantee that the report is without flaw or is wholly appropriate for all purposes and, therefore, disclaims all liability for any loss, damage, injury or other consequence which may arise from reliance on information contained herein. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD. This document shall not be duplicated or used for any purposes other than those for which it is being provided.

8.3 Appendix 4 – Leaf Tissue Test Results

Table 13 Day 0 (pre-treatment application) and 1 month post treatment application leaf tissue test results

Date	Date	Fertiliser Tier	Product Supplier	Guideline Product	Treatment #	N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	S (ppm)	Fe (ppm)
						4 – 5	0.3 – 0.6	2.2 – 3.5	0.25 – 0.75	0.2 – 1.0	0.2 – 1.0	50 – 300
Day 0	11.03.2021	NA	NA	Control	1	2.67	0.51	1.61	0.48	0.19	0.45	770
1 month	8.04.2021	NA	NA	Control	1	2.38	0.48	1.22	0.48	0.18	0.29	406
		A	Fernlands	Flora Fert 12-1-22 +Fe	2	2.75	0.48	1.27	0.46	0.18	0.34	1239
		A	Globe	Globe BCC – Mini Blend	3	2.95	0.41	1.31	0.48	0.16	0.42	1632
		A	Greenway Turf Solutions	GTS GALAXY PRO	4	2.28	0.43	1.26	0.46	0.19	0.28	2343
		A	ICL Australia	Sierrablen Sportsturf	5	2.88	0.4	1.23	0.44	0.14	0.55	766
		A	Lawn Pride	Lawn Pride Maintain PRO	6	3.13	0.49	1.29	0.54	0.18	0.32	599
		A	Living Turf	MP All Season	7	2.93	0.44	1.35	0.47	0.16	0.34	855
		A	Nuturf	Custom Blend 20-1-8 86% CRN	8	2.38	0.46	1.15	0.48	0.18	0.39	2194
		A	Terra Firma	Grassmaster (grade TBC)	9	2.4	0.44	1.23	0.51	0.17	0.29	1320
		B	Fernlands	Combi Green 17-2-8.3	10	2.34	0.38	0.97	0.52	0.18	0.29	4422
		B	Globe	2Spec Origin	11	2.64	0.41	1.00	0.46	0.15	0.3	2104
		B	Greenway Turf Solutions	BEST Turf GOLD	12	2.68	0.4	0.98	0.5	0.16	0.32	3400
		B	ICL Australia	ProTurf Hi-N	13	2.46	0.38	1.11	0.55	0.16	0.37	835
		B	Lawn Pride	Lawn Pride Maintain	14	2.69	0.45	1.08	0.5	0.17	0.30	2112
		B	Living Turf	NX Gold	15	2.54	0.39	1.06	0.48	0.15	0.32	542
		B	Nuturf	Black Label 24-2-9	16	2.3	0.34	0.85	0.58	0.17	0.51	3987
		C	Fernlands	Onyx 11-0-3	17	2.16	0.33	0.76	0.53	0.14	0.28	973
		C	Globe	2Spec Elevate	18	2.44	0.35	0.93	0.66	0.20	0.26	6077
		C	Greenway Turf Solutions	GTS Flex N	19	2.21	0.36	0.96	0.5	0.14	0.31	2025
		C	ICL Australia	Sportsmaster Fairway	20	2.01	0.36	0.72	0.54	0.17	0.25	2399
		C	Lawn Pride	Lawn Pride – Protect N	21	2.53	0.35	1.01	0.46	0.15	0.27	647
		C	Living Turf	MP Origin	22	2.24	0.36	0.87	0.57	0.14	0.32	1033
		C	Nuturf	Couch King 23-1-10	23	2.6	0.36	0.89	0.55	0.16	0.30	633

Note: The guideline refers to the “desirable” nutrient status for green couch (N: 4-5ppm, P: 0.3-0.6ppm, K: 2.2-3.5ppm, Ca: 0.25-0.75ppm, Mg: 0.2-1.0, S: 0.2-1.0 and Fe: 50-300ppm. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD. -, refers to less than.

Table 14 Leaf tissue test results 1.5 months post treatment application

Date	Date	Fertiliser Tier	Product Supplier	Guideline Product	Treatment #	N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	S (ppm)	Fe (ppm)
						4 – 5	0.3 – 0.6	2.2 – 3.5	0.25 – 0.75	0.2 – 1.0	0.2 – 1.0	50 – 300
1.5 Months	29.04.2021	NA	NA	Control	1	1.48	0.36	0.62	0.48	0.14	0.22	1109
		A	Fernlands	Flora Fert 12-1-22 +Fe	2	1.86	0.36	0.92	0.47	0.17	0.28	2501
		A	Globe	Globe BCC – Mini Blend	3	1.96	0.32	0.98	0.49	0.17	0.31	3586
		A	Greenway Turf Solutions	GTS GALAXY PRO	4	2.03	0.33	0.85	0.50	0.18	0.25	6254
		A	ICL Australia	Sierrablen Sportsturf	5	2.31	0.34	1.13	0.44	0.15	0.42	854
		A	Lawn Pride	Lawn Pride Maintain PRO	6	3.16	0.39	1.18	0.57	0.20	0.30	1020
		A	Living Turf	MP All Season	7	2.10	0.40	0.99	0.46	0.14	0.31	1182
		A	Nuturf	Custom Blend 20-1-8 86% CRN	8	1.81	0.38	0.89	0.43	0.15	0.32	2576
		A	Terra Firma	Grassmaster (grade TBC)	9	1.52	0.35	0.80	0.45	0.14	0.25	2209
		B	Fernlands	Combi Green 17-2-8.3	10	1.70	0.34	0.89	0.54	0.18	0.27	6035
		B	Globe	2Spec Origin	11	1.80	0.37	0.92	0.45	0.14	0.34	1154
		B	Greenway Turf Solutions	BEST Turf GOLD	12	2.04	0.40	0.98	0.46	0.16	0.31	3192
		B	ICL Australia	ProTurf Hi-N	13	1.79	0.39	0.92	0.44	0.13	0.32	613
		B	Lawn Pride	Lawn Pride Maintain	14	1.91	0.39	1.02	0.46	0.17	0.27	3681
		B	Living Turf	NX Gold	15	2.16	0.41	1.04	0.48	0.15	0.30	1288
		B	Nuturf	Black Label 24-2-9	16	2.02	0.39	1.06	0.63	0.21	0.29	5677
		C	Fernlands	Onyx 11-0-3	17	1.61	0.31	0.65	0.45	0.12	0.27	904
		C	Globe	2Spec Elevate	18	1.83	0.34	0.75	0.50	0.16	0.25	5531
		C	Greenway Turf Solutions	GTS Flex N	19	1.68	0.35	0.85	0.44	0.13	0.28	1983
		C	ICL Australia	Sportsmaster Fairway	20	1.65	0.39	0.83	0.49	0.17	0.25	629
		C	Lawn Pride	Lawn Pride – Protect N	21	1.99	0.32	0.90	0.44	0.15	0.29	449
		C	Living Turf	MP Origin	22	1.82	0.4	0.86	0.46	0.13	0.29	1231
		C	Nuturf	Couch King 23-1-10	23	1.61	0.32	0.76	0.48	0.15	0.26	507

Note: The guideline refers to the “desirable” nutrient status for green couch (N: 4-5ppm, P: 0.3-0.6ppm, K: 2.2-3.5ppm, Ca: 0.25-0.75ppm, Mg: 0.2-1.0, S: 0.2-1.0 and Fe: 50-300ppm. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD.

Table 15 Leaf tissue test results 2 months post treatment application

Date	Date	Fertiliser Tier	Product Supplier	Guideline Product	Treatment #	N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	S (ppm)	Fe (ppm)
						4 – 5	0.3 – 0.6	2.2 – 3.5	0.25 – 0.75	0.2 – 1.0	0.2 – 1.0	50 – 300
2 Months	14.05.2021	NA	NA	Control	1	1.94	0.34	0.62	0.60	0.16	0.37	694
		A	Fernlands	Flora Fert 12-1-22 +Fe	2	2.42	0.42	0.96	0.52	0.17	0.37	2492
		A	Globe	Globe BCC – Mini Blend	3	2.41	0.38	1.00	0.63	0.19	0.34	3474
		A	Greenway Turf Solutions	GTS GALAXY PRO	4	2.81	0.41	1.09	0.55	0.20	0.30	2292
		A	ICL Australia	Sierrablen Sportsturf	5	2.70	0.39	1.15	0.44	0.14	0.51	435
		A	Lawn Pride	Lawn Pride Maintain PRO	6	4.14	0.53	2.08	0.53	0.22	0.48	226
		A	Living Turf	MP All Season	7	3.10	0.44	1.20	0.50	0.16	0.55	765
		A	Nuturf	Custom Blend 20-1-8 86% CRN	8	2.15	0.37	0.82	0.53	0.17	0.36	3085
		A	Terra Firma	Grassmaster (grade TBC)	9	2.02	0.35	0.77	0.52	0.15	0.37	1520
		B	Fernlands	Combi Green 17-2-8.3	10	2.12	0.4	0.88	0.61	0.20	0.26	4020
		B	Globe	2Spec Origin	11	2.60	0.41	1.07	0.50	0.17	0.35	1892
		B	Greenway Turf Solutions	BEST Turf GOLD	12	2.19	0.40	0.82	0.50	0.16	0.30	3926
		B	ICL Australia	ProTurf Hi-N	13	2.00	0.35	0.77	0.48	0.13	0.35	1185
		B	Lawn Pride	Lawn Pride Maintain	14	4.01	0.58	2.15	0.58	0.22	0.47	291
		B	Living Turf	NX Gold	15	2.07	0.32	0.72	0.51	0.14	0.35	1040
		B	Nuturf	Black Label 24-2-9	16	1.94	0.35	0.77	0.70	0.21	0.30	6630
		C	Fernlands	Onyx 11-0-3	17	1.74	0.29	0.55	0.48	0.13	0.29	776
		C	Globe	2Spec Elevate	18	2.68	0.60	1.43	0.63	0.23	0.31	1486
		C	Greenway Turf Solutions	GTS Flex N	19	1.93	0.34	0.67	0.51	0.14	0.28	3185
		C	ICL Australia	Sportsmaster Fairway	20	1.56	0.33	0.61	0.48	0.14	0.31	849
		C	Lawn Pride	Lawn Pride – Protect N	21	2.21	0.34	0.74	0.49	0.14	0.34	493
		C	Living Turf	MP Origin	22	2.09	0.33	0.65	0.52	0.14	0.30	1306
		C	Nuturf	Couch King 23-1-10	23	2.29	0.35	0.80	0.46	0.13	0.37	469

Note: The guideline refers to the “desirable” nutrient status for green couch (N: 4-5ppm, P: 0.3-0.6ppm, K: 2.2-3.5ppm, Ca: 0.25-0.75ppm, Mg: 0.2-1.0, S: 0.2-1.0 and Fe: 50-300ppm. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD.

Table 16 Leaf tissue test results 3 months post treatment application

						N (ppm) 4 – 5	P (ppm) 0.3 – 0.6	K (ppm) 2.2 – 3.5	Ca (ppm) 0.25 – 0.75	Mg (ppm) 0.2 – 1.0	S (ppm) 0.2 – 1.0	Fe (ppm) 50 – 300
Date	Date	Fertiliser Tier	Product Supplier	Guideline Product	Treatment #							
3 Months	8.06.2021	NA	NA	Control	1	1.61	0.39	0.63	0.5	0.15	0.15	1065
		A	Fernlands	Flora Fert 12-1-22 +Fe	2	1.78	0.42	0.81	0.45	0.17	0.17	804
		A	Globe	Globe BCC – Mini Blend	3	1.52	0.35	0.8	0.52	0.16	0.16	520
		A	Greenway Turf Solutions	GTS GALAXY PRO	4	1.94	0.35	0.75	0.5	0.18	0.18	6275
		A	ICL Australia	Sierrablen Sportsturf	5	2.21	0.38	1.05	0.5	0.17	0.17	521
		A	Lawn Pride	Lawn Pride Maintain PRO	6	2.73	0.42	1.07	0.56	0.19	0.19	590
		A	Living Turf	MP All Season	7	2.22	0.54	1.03	0.5	0.16	0.16	859
		A	Nuturf	Custom Blend 20-1-8 86% CRN	8	1.92	0.47	0.81	0.51	0.16	0.16	1545
		A	Terra Firma	Grassmaster (grade TBC)	9	1.87	0.42	0.82	0.49	0.14	0.14	610
		B	Fernlands	Combi Green 17-2-8.3	10	1.64	0.4	0.78	0.57	0.19	0.19	2883
		B	Globe	2Spec Origin	11	2.12	0.42	0.9	0.49	0.15	0.15	1195
		B	Greenway Turf Solutions	BEST Turf GOLD	12	1.86	0.42	0.86	0.49	0.17	0.17	2777
		B	ICL Australia	ProTurf Hi-N	13	1.77	0.34	0.7	0.5	0.13	0.13	1155
		B	Lawn Pride	Lawn Pride Maintain	14	2.3	0.55	1.17	0.51	0.18	0.18	1376
		B	Living Turf	NX Gold	15	1.76	0.4	0.8	0.51	0.16	0.16	297
		B	Nuturf	Black Label 24-2-9	16	1.79	0.39	0.79	0.51	0.16	0.16	1165
		C	Fernlands	Onyx 11-0-3	17	1.62	0.35	0.59	0.48	0.13	0.13	469
		C	Globe	2Spec Elevate	18	2.1	0.5	0.94	0.6	0.18	0.18	3294
		C	Greenway Turf Solutions	GTS Flex N	19	2.04	0.43	0.78	0.51	0.15	0.15	2413
		C	ICL Australia	Sportsmaster Fairway	20	1.62	0.38	0.74	0.48	0.15	0.15	351
		C	Lawn Pride	Lawn Pride – Protect N	21	1.94	0.35	0.82	0.47	0.14	0.14	285
		C	Living Turf	MP Origin	22	1.75	0.38	0.74	0.46	0.13	0.13	538
		C	Nuturf	Couch King 23-1-10	23	1.71	0.36	0.82	0.52	0.15	0.15	310

Note: The guideline refers to the “desirable” nutrient status for green couch (N: 4-5ppm, P: 0.3-0.6ppm, K: 2.2-3.5ppm, Ca: 0.25-0.75ppm, Mg: 0.2-1.0, S: 0.2-1.0 and Fe: 50-300ppm. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD.

Table 17 Leaf tissue test results 4 months post treatment application

						N (ppm) 4 – 5	P (ppm) 0.3 – 0.6	K (ppm) 2.2 – 3.5	Ca (ppm) 0.25 – 0.75	Mg (ppm) 0.2 – 1.0	S (ppm) 0.2 – 1.0	Fe (ppm) 50 – 300
Date	Date	Fertiliser Tier	Product Supplier	Guideline Product	Treatment #							
4 Months	8.07.2021	NA	NA	Control	1	1.60	0.42	0.68	0.61	0.19	0.08	620
		A	Fernlands	Flora Fert 12-1-22 +Fe	2	2.14	0.44	0.80	0.47	0.16	-0.05	3161
		A	Globe	Globe BCC – Mini Blend	3	2.24	0.45	0.97	0.57	0.19	0.06	2392
		A	Greenway Turf Solutions	GTS GALAXY PRO	4	2.01	0.4	0.67	0.64	0.18	0.05	1474
		A	ICL Australia	Sierrablen Sportsturf	5	2.09	0.54	1.36	0.76	0.24	0.21	271
		A	Lawn Pride	Lawn Pride Maintain PRO	6	3.40	0.56	1.35	0.70	0.28	0.10	587
		A	Living Turf	MP All Season	7	2.76	0.42	0.98	0.42	0.14	-0.05	809
		A	Nuturf	Custom Blend 20-1-8 86% CRN	8	2.71	0.39	0.83	0.45	0.14	-0.05	691
		A	Terra Firma	Grassmaster (grade TBC)	9	2.15	0.46	0.78	0.43	0.12	-0.05	410
		B	Fernlands	Combi Green 17-2-8.3	10	1.82	0.36	0.56	0.61	0.18	-0.05	6120
		B	Globe	2Spec Origin	11	1.99	0.41	0.74	0.48	0.14	-0.05	1014
		B	Greenway Turf Solutions	BEST Turf GOLD	12	2.03	0.45	0.74	0.60	0.18	-0.05	3531
		B	ICL Australia	ProTurf Hi-N	13	1.82	0.31	0.53	0.51	0.14	-0.05	375
		B	Lawn Pride	Lawn Pride Maintain	14	2.42	0.55	1.11	0.52	0.19	0.06	884
		B	Living Turf	NX Gold	15	1.91	0.34	0.56	0.52	0.14	-0.05	576
		B	Nuturf	Black Label 24-2-9	16	1.86	0.38	0.73	0.58	0.19	0.06	2605
		C	Fernlands	Onyx 11-0-3	17	1.43	0.33	0.57	0.45	0.12	-0.05	522
		C	Globe	2Spec Elevate	18	2.22	0.53	0.98	0.69	0.23	0.09	2436
		C	Greenway Turf Solutions	GTS Flex N	19	2.15	0.46	0.75	0.44	0.14	-0.05	2897
		C	ICL Australia	Sportsmaster Fairway	20	1.55	0.44	0.73	0.62	0.20	0.09	632
		C	Lawn Pride	Lawn Pride – Protect N	21	2.05	0.31	0.52	0.49	0.13	-0.05	466
		C	Living Turf	MP Origin	22	1.87	0.39	0.62	0.56	0.15	-0.05	732
		C	Nuturf	Couch King 23-1-10	23	1.73	0.39	0.71	0.47	0.14	-0.05	207

Note: The guideline refers to the “desirable” nutrient status for green couch (N: 4-5ppm, P: 0.3-0.6ppm, K: 2.2-3.5ppm, Ca: 0.25-0.75ppm, Mg: 0.2-1.0, S: 0.2-1.0 and Fe: 50-300ppm. Analytical testing conducted by Eurofins APAL, Burleigh Heads QLD.

8.4 Appendix 5 – Types of Fertiliser

a. Controlled Release Fertiliser (CRF)

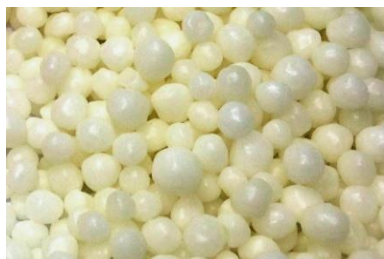
Fertilizer in which nutrient release is controlled, meeting the stated release rate of nutrient and the stated release time at a specified temperature. (ISO 8157:2015)

Requires good quality polymer coating and consistent manufacturing conditions.

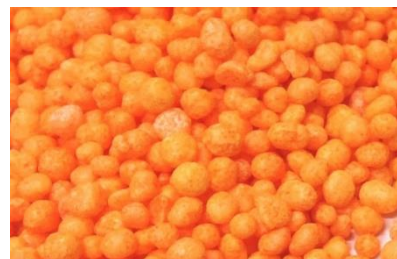
Examples:



Polymer coated NPK



Polymer coated urea



Polymer Sulphur coated

b. Slow Release Fertiliser (SRF)

Fertilizer, of which, by hydrolysis and/or by biodegradation and/or by limited solubility, the nutrients available to plants is spread over a period of time, when compared to a "reference soluble" product. (ISO 8157:2015)

i.e. minerals that take time to dissolve or be released:

Examples:



Elemental Sulphur



Reactive Phosphate Rock



Methylene Urea/ IBDU

c. Chemical Inhibitors

Chemicals that depress microbial activity to slow conversion of nitrogen to different forms. It does not control or slow the delivery of N to crops. (Chemical inhibitors can not be deemed slow or controlled release under ISO definition).

Product	eNtrench	Entec	Agrotain
Chemical	Nitrapyrin	3,4-dimethylpyrazole phosphate (DMPP)	N-(n-butyl) thiophosphoric triamide (NBPT)
Action	Slows ammonium to nitrate conversion		Slows urea to ammonia conversion
Period of use	Half-life 7-22 days @ 21°C ³	7 days at 28°C ¹ 21 days at 20°C >12 weeks at 10°C	Half-life 1.7 hrs (low pH) to 3 days (high pH) ²

References: ¹Entec activity versus ammonium sulphate. Reference: Irigoyen *et al.* (2003) *Australian Journal of Soil Research* 41, 1177-1183; ²Engel *et al.* (2015) *Soil Sci. Soc. Am J.* 79(6), 1674-1683 and ³Touchton *et al.* (1979) *Agronomy Journal* 71(5), 865-869.

Technology Comparison

	Controlled release	Slow release	Chemical inhibitors
Long-term nutrients	✓	✓	✗
Predictable release	✓	✗	✗
Reduce side dressings	✓	?	✗
Has affect on N form	✓	?	✓
Close root growth	✓	✓	✗
Control over P & K	✓	✓	✗
Longevity	Up to 12 months (shorter longevities made for fast growing crops)	Variable, difficult to predict	Short term, strongly affected by soil pH & temp, e.g. Entec ¹ : <ul style="list-style-type: none"> • 7 days 28°C • 21 days 20°C • >12 weeks 10°C

Reference: ¹Entec activity versus ammonium sulphate. Reference: Irigoyen *et al.* (2003) *Australian Journal of Soil Research* 41

8.5 Appendix 6 – Brisbane 2021 Temperature Data

Figure 5 The daily range of reported temperatures (gray bars) and 24-hour highs (red ticks) and lows (blue ticks), placed over the daily average high (faint red line) and low (faint blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. Source: <https://weatherspark.com>

