Evaluating the use of Biosolid based fertility treatments for use on high quality turf in the Chicago area in 2015.

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Introduction:

Fertility management is an issue that turfgrass managers deal with every year and there are a wide range of issues that golf course superintendents focus on when making decisions about seasonal practices. One focuses on the concentration of nutrients a second may focus on the length of production obtained from the product and a third factor that is considered even more important is cost and return on investment. Golf courses have many acres that require inputs and maintenance and so ensuring a budget is met and under control can be a difficult situation – if superintendents have the ability to control variables as much as possible it allows them to focus on the trouble areas to a greater extent – fertility is one area that they like to have control of and using products that are both environmentally safe, cost effective and consistent will create a beneficial response.

The objective of this study was to evaluate biosolid based fertility products over the winter of 2014 / 2015 on rough height turfgrass and also a second trial looking at a summer of turf growth in the Chicago area on tee height turfgrass.

Materials and methods:

Winter trial:
The project was initiated in September 2014 at the Midwest Golf House in Southwest Chicago on a mixed stand of Kentucky bluegrass *Poa pratensis* Perennial ryegrass *Lolium perenne* mowed at a height of 2". All materials were applied at a rate on 1lb N /1000ft^2 to plots that were 4ft x 6ft in size with four replications (Table 1). The experiment was designed in a randomized complete block design with four replications. Herbicides and fungicides were applied as needed and no other fertility applications were made through the season to the plots. Data was collected for color and quality and clipping yields were collected to gain a measurement of growth rate per m^2. Data was collected twice in 2014 and twice in 2015 and analyzed using PROC GLM from the SAS program.

Treatment	Rate
1. Check	
2. Thermal Process Biosolid	1lb/N/M
3. Nature Safe	1lb/N/M
4. Milorganite	1lb/N/M
5. Agrium 39-0-0	1lb/N/M

Summer trial:
The summer trial was initiated May 7th on a practice tee at Northshore Country Club, Glenview IL. The grass type was a mixed stand of creeping bentgrass *Agrostis stolonifera*, annual bluegrass *Poa annua* mowed at a height of 0.5" three times per week with clippings collected. Irrigation applied based on evapotranspiration rates and herbicides and fungicides were applied as needed. Color, quality, normalized difference vegetative index and fall clipping yield and shoot counts were collected. The experiment was laid out in a randomized complete block design with four replications. Plots were 6ft x 4ft and treatments were applied at two rates (1lb and 2lb N / 1000 ft^2) (Table 2) and the applications were split across two dates (May 7th and September 25th 2015)

1. 30-0-0	1lb/M/year 2 apps of .5lb/M
2. 30-0-0	2lb/M/year 2 apps of 1lb/M
3. Nature Safe 9-0-9	1lb/M/year 2 apps of .5lb/M
4. Nature Safe 9-0-9	2lb/M/year 2 apps of 1lb/M
5. Milorganite 6-2-0	1lb/M/year 2 apps of .5lb/M
6. Milorganite 6-2-0	2lb/M/year 2 apps of 1lb/M
7. TP Biosolids	1lb/M/year 2 apps of .5lb/M
8. TP Biosolids	2lb/M/year 2 apps of 1lb/M
9. Check	

Results:
Winter Trial:

Climatically the winter of 2014/15 did not cause as many issues for turfgrasses as the previous winter. Conditions were average for the most part of the season with the only exception being February which produced an average record cold temperature for the month. This however had limited impact on turf as the first Sunday of February (Super bowl Sunday) the area received over 20" of snow cover which insulated turf and prevented damage occurring similar to the previous winter.

The climactic data for the winter trial of 2013-2014 can be seen in figures 1 and 2. As noted temperatures in February were considered very harsh (Figure 1) and if snow cover had been limited then there was potential for serious damage. The fall precipitation was markedly limited with the exception of October 2013 which returned a total precipitation volume almost double the average (Figure 2). Precipitation events other than the heavy snow on February 2nd were limited and generally stuck to the average. There was a somewhat delayed warmup into June but at that stage the trial had been completed

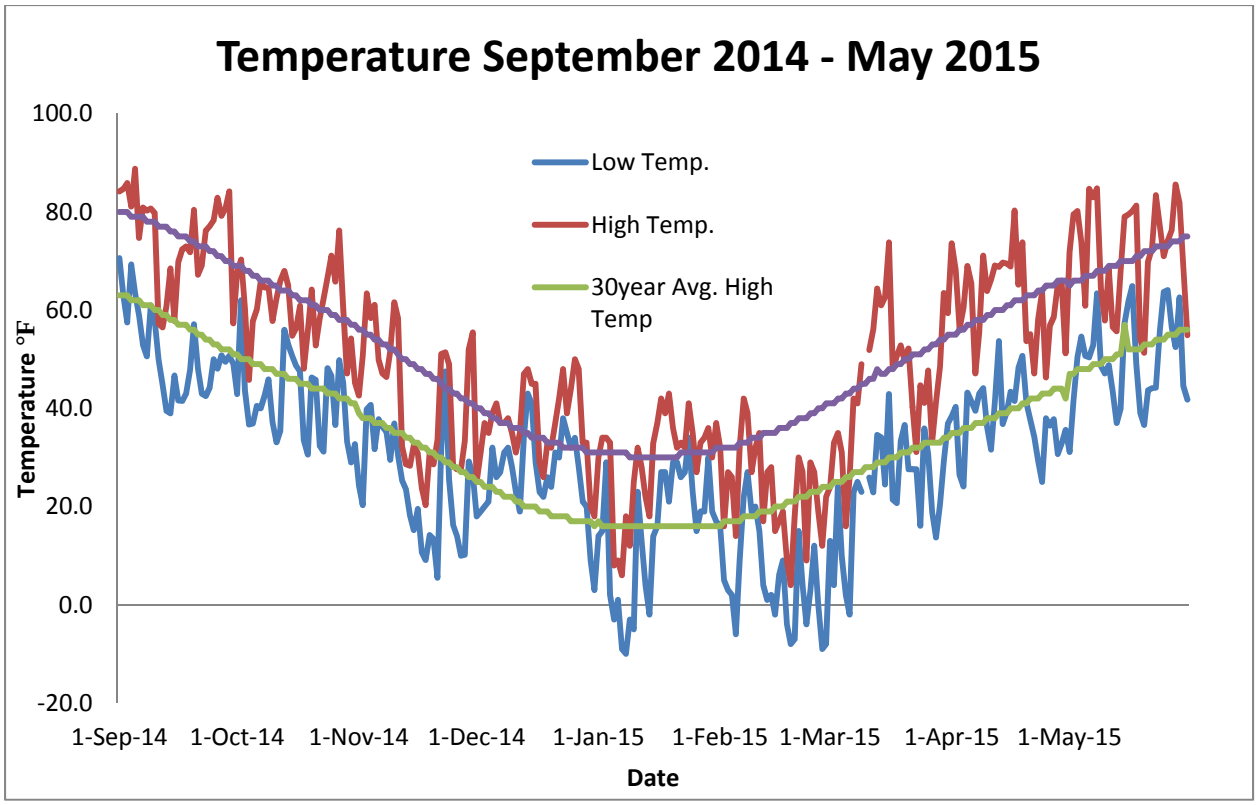


Figure 1 Daily high and low temperatures Sept 1 2014 – May 31st 2015 at Sunshine Course, Lemont IL compared to 30 year averages at O'Hare International airport

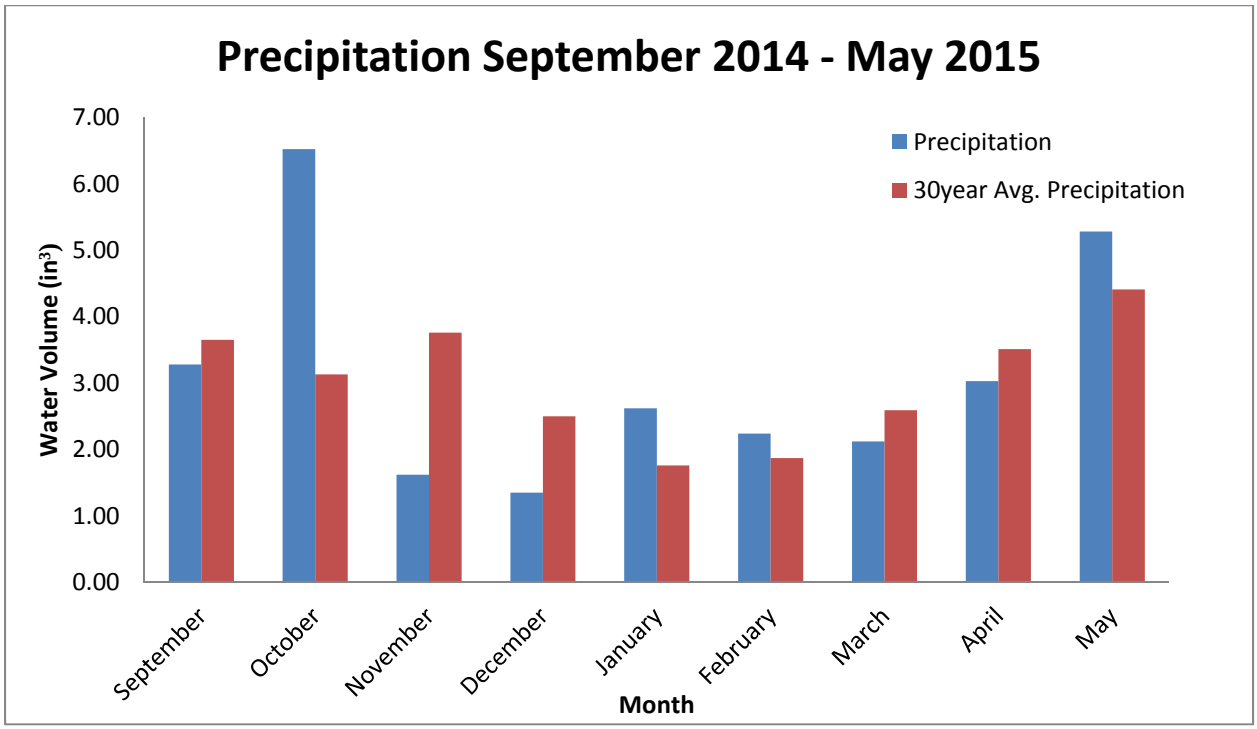


Figure 2. Monthly precipitation totals September 2014 – May 2015 at Sunshine Course, Lemont IL compared to 30 year averages at O'Hare International airport

The evaluation of the parameters indicated that there was a benefit to the application of the TP Biosolid material. Compared to the check plot the color was rated on average throughout the season as being significantly higher (*P*=0.05). The application of nitrogen to all plots did make a difference to the color (Picture 1) and so there was no difference between the nitrogen treatments in regards to color (Table 3). Quality data also followed a similar pattern with applications of TP Biosolid producing consistently higher rankings when compared to the check plots on average (Table 3). The clipping yield data on average showed no difference (Table 3), however as the data was averaged across the months there was potential for an impact due to changes in soil temperatures that could have affected the release of nitrogen in particular. In that case data was analyzed separately by month (Table 4). The monthly results show some stark differences within the treatments. Noticeably when soil temperatures were warmer in October there was a significant difference between the check, milorganite and TP Biosolid plots with the biosolid plots producing significantly higher yield. Once temperatures turned frigid however there was a decline across all treatments -0 however the November data indicated that there was still a significantly higher yield from the TP Biosolid compared to all treatments (Table 4). Once snow cleared and soil temperatures showed some form of recovery the synthetic nitrogen source (Lebanon 39-0-0) provided significantly higher yield in both April and May compared to all other treatments.

Table 3. Averages for parameters measured during evaluation of Biosolid material for use in rough height turfgrass in the Chicago area September 2014 – May 2015

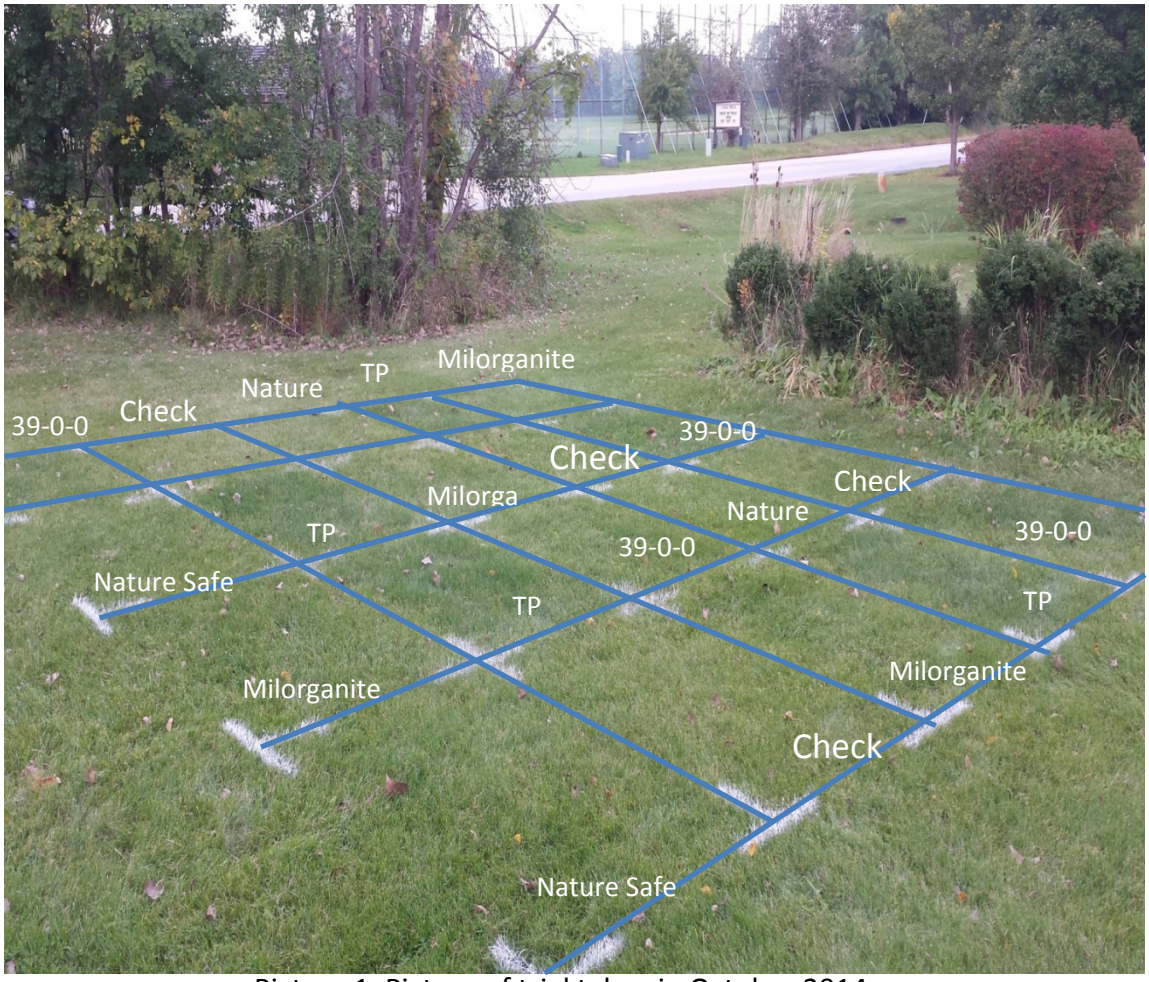
	Parameters		
Treatment	Color (1-9)	Quality (1-9)	Yield $g/m^2/d^1$
1. Check	5.9 b[†]	5.9 b	1.1 a
2. Thermal Process Biosolid	7.0 a	6.5 a	1.6 a
3. Nature Safe	6.5 a	6.1 ab	1.7 a
4. Milorganite	6.6 a	6.3ab	1.3 a
5. Agrium 39-0-0	6.7 a	6.5 a	2.0 a
LSD	0.5	0.5	0.9

[†]Means followed by a different letter are significantly different at *P*=0.05

Table 4. Daily growth rates (Yield) by month during evaluation of Biosolid material for use in rough height turfgrass in the Chicago area September 2014 – May 2015

	Yield $g/m^2/d^1$			
Treatment (1lb / N)	October	November	April	May
1 Check	1.7 c[†]	0.1 c	0.6 b	2.2 b
2 TP Biosolid	3.2 a	0.3 a	0.6 b	2.3 b
3 Nature Safe	2.7 ab	0.2 ab	0.7 b	3.2 ab
4 Milorganite	2.3 bc	0.1 bc	0.7 b	2.2 b
5 Lebanon 39-0-0	2.7 ab	0.1 bc	1.2 a	4.1 a
LSD	0.7	0.1	0.4	1.3

[†]Means followed by a different letter are significantly different at *P*=0.05



Picture 1. Picture of trial taken in October 2014.

Conclusion on winter trial:

The winter trial provided some interesting information on the products tested. The initial quick release of N from the biosolid lasted for the first two months prior to severe winter cool down and this was impressive. However the one issue that arose was related to the greening of the turf, which is a subjective conversation for superintendents. In spring – rough grass generally can grow aggressively and this leads to headaches with mowing schedules particularly when it rains. It is clear however that either nitrogen had been depleted or soil temperatures were not warm enough to create nitrogen fixing activity in the profile – which is what an organic nitrogen source would require. This affected all of the natural nitrogen sources – and particularly in the spring when conditions were cool and had an extended period of cloudy wet weather. There may have been some nitrogen lost from these natural products also during the extremely wet period in October – the synthetic form will have a coating on it that protects from immediate release especially in wet conditions such as were experienced in October and this may have contributed to the differences in the spring of 2015. Overall however performance of the

biosolid would not have any negative sentiment with it over the winter and could be considered an excellent option for superintendents in the area.

Results
Summer Trial 2015:

Climatically, 2015 was a very wet early season which was also cool (Figure 4), in mid-July conditions warmed up and also precipitation declined (Figure 5). Temperatures were ideal for actively growing grass all season and with more than sufficient rainfall there was plenty of opportunity for nitrogen fixation and no limitation on what natural / organic fertilizers could produce. Temperatures never rose to extreme levels which would be detrimental to turf health for any extended period of time and in actual fact many superintendents noted this year that grass growth was consistent and at times frustrating in trying to maintain due to excess moisture.

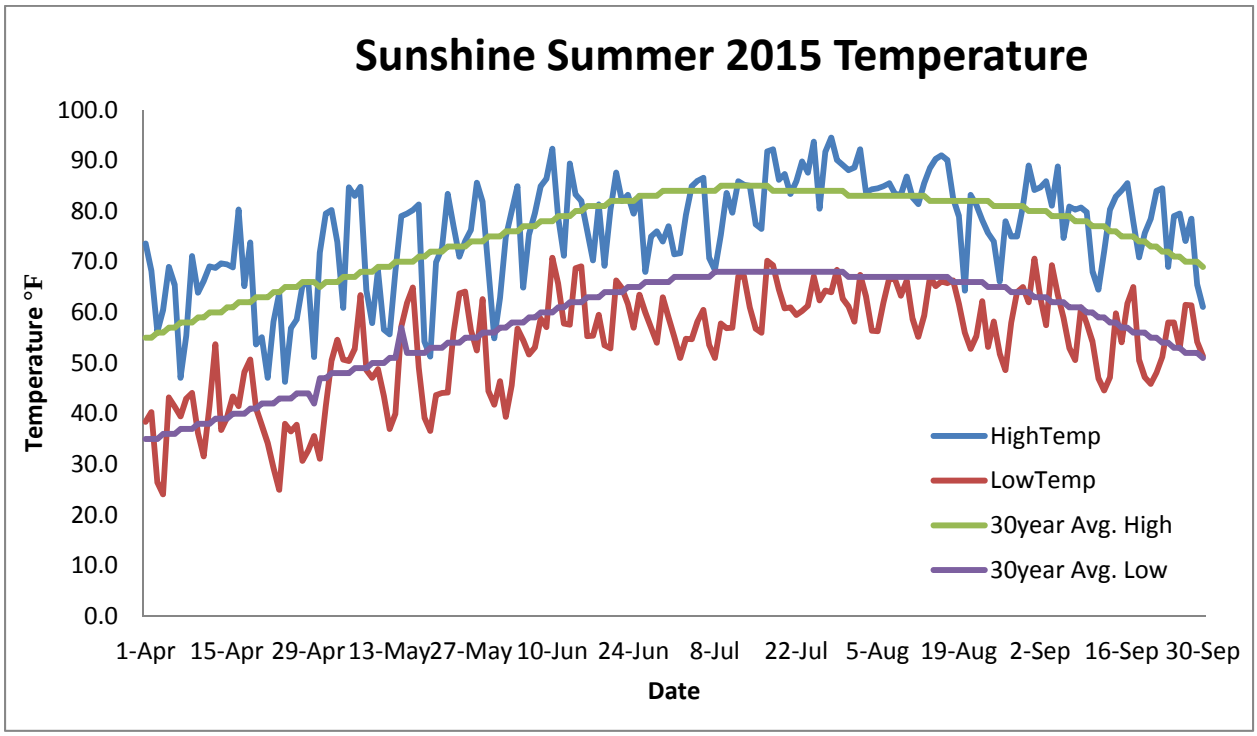


Figure 4. Daily high and low temperatures Apr 1 – Sep 30 2015, at Sunshine Course, Lemont (SW Chicago) compared to 30yr average temperatures at O'Hare Intl' Airport (15m north)

June was extremely wet and did cause issues for golf course managers all over the region, disease was actually a large issue as control applications could not be made for extended periods due to wet soils and also an inability to gain dry leaf surfaces to allow for fungicides to stick and prevent fungal growth and damage. Once again however, as conditions dried out in July and August the conditions proved ideal for turfgrass growth in all types of maintenance situations.

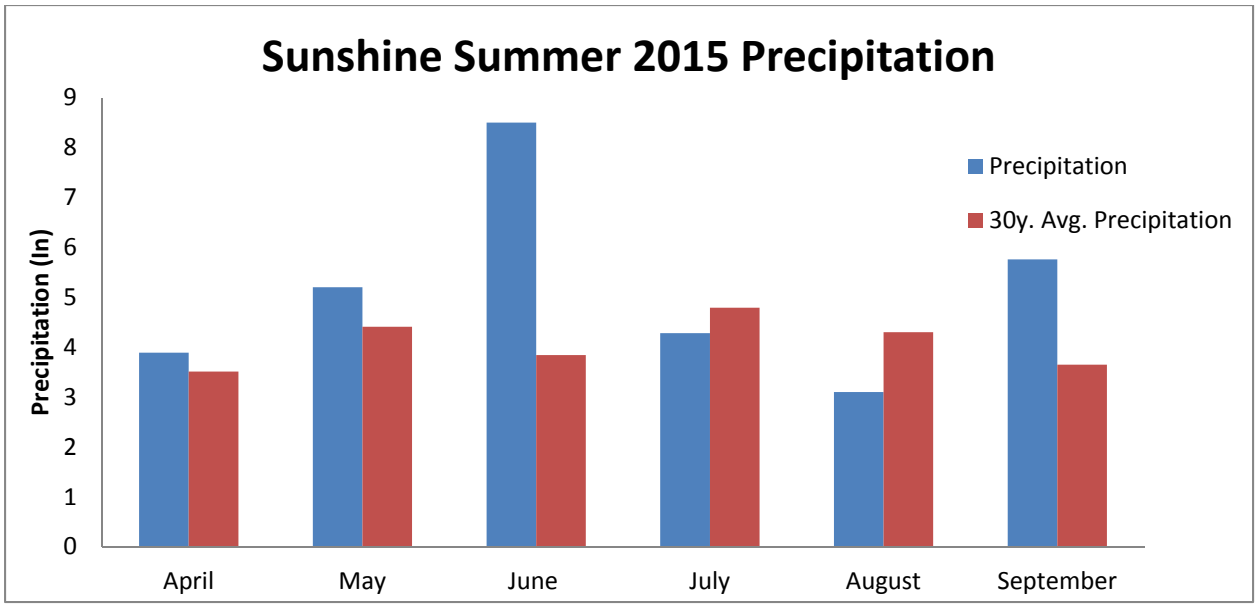


Figure 5. Total precipitation per month at Sunshine Course, Lemont (SW Chicago) from Apr 1 – Sep 30 2015 compared to 30yr average monthly precipitation totals at O'Hare Intl' Airport (15m north)

Parameters such as color, quality and NDVI indicated that applications of Thermal Processing Biosolid produced consistently higher quality and turfgrass color throughout the 2015 summer season. The product was found to have significantly higher color ratings than Nature Safe at the 1lb rate and Milorganite at the 1lb rate as well as the check plot. The visual estimation of turf density and quality provided no differences within the data (Table 5). The objective measurement of turfgrass quality, the normalized difference vegetation index (NDVI) data indicated that applications of TP Biosolid at 2lb produced significantly higher quality turf canopies than the check plot, the synthetic fertilizer (39-0-0) at 1lb rates but was not significantly higher than all other treatments (Table 5).

Table 5. Seasonal averages for parameters measured in trial evaluating Biosolid use at Northshore Country Club, Glenview IL, summer 2015

	Parameters		
Treatment / rate of N (lb)	Color	Quality	NDVI
1. 30-0-0 1lb	6.76 abc[†]	6.53 a	0.690 bc
2. 30-0-0 2lb	6.81 ab	6.51 a	0.700 abc
3. Nature Safe 9-0-9 1lb	6.46 bc	6.32 a	0.704 ab
4. Nature Safe 9-0-9 2lb	6.57 abc	6.31 a	0.699 abc
5. Milorganite 6-2-0 1lb	6.49 bc	6.46 a	0.701 abc
6. Milorganite 6-2-0 2lb	6.60 abc	6.42 a	0.701 ab
7. TP Biosolids 1lb	6.74 abc	6.44 a	0.699 abc
8. TP Biosolids 2lb	6.90 a	6.45 a	0.713 a
9. Check	6.38 c	6.25 a	0.683 c
LSD	0.38	0.38	0.018

[†]Means followed by different letters are significantly different at *P*=0.05.

Conclusions:

The Thermal Process biosolid material produced better or comparable results to all treatments in either trial. Variations between the TP product and some other materials were more likely related to nitrogen rate more than anything else. However the product still produced excellent quality turf both in the winter and summer trials and due to the lack of odor and ease of handling with proper fertilizer prill sizes the product certainly has an opportunity to be used in the turfgrass setting both on finer cut and higher cut turf. The only issue for the material which showed up for all other natural or organic materials was that in spring time when temperatures were cooler there was somewhat of a slower release of the material compared to the synthetic product. This did not occur in the summer trials and is a point that could have no effect on turfgrass manager purchasing decisions or a large one – depending on the golf course. Over the life of the trial the product has held its quality and we feel it's an excellent option for managers in the area.

Density and Yield:

Applications of TP biosolid at the 2lb/N/M rate provided the highest clipping yield on average over the season (Table 6). Milorganite and 30-0-0 at the 2lb N/M rate provided similar results but compared against all other treatments the 2lb rate of TP biosolid was most consistent. It was significantly higher (P=0.05) than 6 of the other treatments in the trial. Shoot density values were not as clearly separated and while the TP biosolid was one of the top 4 treatments it did not seem to produce as high a density of shoots per cm^2 but the density was equal to the average number of shoots in the best treatment. The application of synthetic nitrogen in this instance could have produced greater shoot density as there is a general opinion that shoot density increases with higher application rates of synthetic nitrogen sources.

Table 6. Clipping yield and shoot density counts for trial evaluating Biosolid use at Northshore Country Club, Glenview IL, summer 2015

	Parameters	
Treatment / rate of N (lb)	Clipping Yield ($g/m^2/d$)	Shoot Density ($shoots/cm^2$)
1. 30-0-0 1lb	0.54 bcde[†]	4.3 bcd
2. 30-0-0 2lb	0.78 ab	4.7 a
3. Nature Safe 9-0-9 1lb	0.49 cde	4.1 cde
4. Nature Safe 9-0-9 2lb	0.59 bcd	4.1 de
5. Milorganite 6-2-0 1lb	0.35 de	3.7 f
6. Milorganite 6-2-0 2lb	0.71 abc	4.5 abc
7. TP Biosolids 1lb	0.51 cde	4.4 abcd
8. TP Biosolids 2lb	0.85 a	4.5 ab
9. Check	0.32 e	3.8 ef
LSD	0.2	0.3

[†]Means followed by different letters are significantly different at *P*=0.05.