OTRF Project No.

OTRF Funded Research Project

■ Interim Report ☐ Final Report

Title	**Evaluation of Compost Topdressing applications and Compost Tea applications on Sports Field Turfgrass Swards.**
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Executive Summary

An evaluation of compost topdressing and compost tea applications commenced in May of 2015 in two separate trials. The purpose of the trials was to determine if the topdressing or the teas had an effect on actively worn Kentucky bluegrass. Year two data of the small plot work of both the compost topdressing and compost tea trials was completed on Oct. 15th, 2016. The data for the topdressing trial shows that the best treatments are the vermicompost materials at the depths of 0.25 and 0.5 cm applied three times in a growing season. These treatments had high quality, good greenness, and low hardness values. The data for the compost teas was not promising, however the microbial populations will be measured at the end of 2017 to determine if there was an effect on the soil biota. The demonstration trial is evaluating the combination of topdressing with and without an annual compost tea application.

The demonstration trial using in-use fields commenced June 9th 2016 for the topdressing events and the teas were applied during the first and second week of July 2016. The fields were arranged in a split design where topdressing is the overall treatment and was split with tea treatments. The intention is to evaluate the combination of topdressing with compost and the use of teas to help minimize the impact of wear during the play season. Nineteen fields are being evaluated across three cities: Lethbridge, Calgary, and Edmonton, Alberta.

Background

As municipalities across Canada are collecting and composting the green waste of local residents, we are

beginning to see an overabundance of compost accumulating in compost facilities. The extra amounts of compost being produced by our cities will eventually lead to a mandate of municipal parks having to incorporate more compost into their greenspaces. Currently there is very little information available regarding the effects of compost topdressing and compost tea applications on sports fields and their effects on wear tolerance and overall stand quality. There has been a lot of research done on the effects of both compost and compost tea on disease suppression in both field crops and turf (Boulter et al. 2000; Stofella and Kahn, 2001**;** Al-Mughrabi et al., 2004), and on the incorporation of compost during the establishment period (Fritz et al., 2012; Larkin, 2008; and Linde and Hepner, 2005) and on using compost topdressing as the only nutrient source on turf (Gardner, 2004; Johnson et al. 2005; Garling and Boehm, 2001), in contrast there has only been one study on a simulated cool season athletic field. Miller and Henderson (2012) reviewed the effects of various organic amendments and overseeding on a Kentucky bluegrass stand, however their focus was for a football field with wear being applied only in the fall. This gap in the literature warrants a further investigation into both compost topdressing and compost teas on athletic fields.

Archana et al. (2012) examined various compost teas produced from different compost sources to discover that there were differences in both overall yield of pak choi, and plant nutritional status between compost sources. They found that the mineral N and gibberellin (G4) concentrations in the tea were associated with higher performance of the pak choi (Archana et al., 2014). The two best performers in Archana et al. (2012) study were teas from either vermicompost or thermophilic compost sources. Thermophilic compost from municipal compost facilities is readily available for the public to use, and there are several vermicompost facilities across the country. Even though many of the provincial websites recommend topdressing home lawns with compost and/or vermicompost, there is limited scientific evaluation of these products and their teas that quantify the ecological response of turfgrass and the surrounding rhizosphere to compost, vermicompost, aerated vermicompost tea, and thermophilic compost tea applications.

To produce best management practices for the incorporation of both compost topdressing and compost tea applications on municipal fields in western Canada, a series of investigations that determine optimal rates, timings and frequencies is warranted.

Objectives

OBJECTIVE 1 – ***To evaluate rates and timings of municipal compost and vermicompost on worn Kentucky bluegrass, and their long-term effects on wear tolerance***. Second growing season data has been collected and analyzed as seasonal means for this report. (ongoing)

OBJECTIVE 2- ***To evaluate the effects of compost tea made from either municipal or vermicompost on preventing wear damage on Kentucky bluegrass turf***. Second growing season data has been collected and summarized with the first season's data in the results below. Tea sources are planned to be screened in March to investigate the general population of the teas. (ongoing)

OBJECTIVE 3- ***To evaluate the effects of both compost topdressing and compost teas on an in-use play field.*** Three locations that represent three distinct geographical regions of Alberta were chosen: Lethbridge, Calgary, and Edmonton. Six fields are being monitored in Lethbridge, six in Calgary, and seven in Edmonton. Year one data has been collected. (ongoing)

Methods & Results

Research Plot Work: Objectives One and Two:

This section is divided into the two separate objectives to summarize the treatments and the year one results. However, both trials were arranged in a randomized complete block design repeated 4 times on plots that are 2m x 2m in dimension (Fig. 1). The trials were placed on a Kentucky bluegrass stand maintained at 6.35 cm (2.5“) height of cut, mown weekly with a ride-on rotary mower. New blades were put on the mower at the start of the season (May 4th, 2015, May 2nd,2016) and checked and sharpened (if needed) monthly to ensure a consistent mowing quality during the trial. Wear with the Brinkman wear simulator commenced on May 6th, 2015, May 2nd,2016. Plots were then worn on a weekly schedule where wk 1 was M,W,F and wk 2 was T,Th with 6 passes per time in order to simulate an average of 10 soccer games per week. Wear simulation on the plots ceased on September 15th, 2015 and September 16th, 2016.

Figure One: Plot map of the Compost Topdressing Trial and the Compost Tea Trial (highlighted plots) at the PTRC, Olds, AB.

101	109	201	209	301	309	401	409
102	110	202	210	302	310	402	410
103	111	203	211	303	311	403	411
104	112	204	212	304	312	404	412
105	113	205	213	305	313	405	413
106	114	206	214	306	314	406	414
107	115	207	215	307	315	407	415
108	116	208	216	308	316	408	416
101	102	103	104	105	106	201	202
203	204	205	206	301	302	303	304
305	306	401	402	403	404	405	406

OBJECTIVE 1 – *To evaluate rates and timings of municipal compost and vermicompost on worn Kentucky bluegrass, and their long-term effects on wear tolerance*.

Treatment Summary:

1. Three Compost Rates and One Untreated Control
2. Frequency: one-time application vs three-time applications per growing season
3. Compost type (2): Municipal (Thermophilic Compost) vs. Vermicompost

Depth of Compost	Volume (L*m^2)	Frequency (per growing season)	Compost Type*
0.25 cm	5	1 X	MC
0.5 cm	10	3 X	VC
1.0 cm	20		

Table One: Compost Topdressing Summary of Treatments±

±Summary of the 3 factors tested: topdressing amount (vol and depth); frequency of application, and Compost type

*Compost Type: MC = Municipal Compost, VC = Vermicompost

Methodology: Rates were applied by volume to the plots. For example, 10 liters of material applied to a 2x2m plot resulted in a topdressing depth of 0.25cm. Data summarized in this report are represented in volume per plot. Compost was pre-measured by volume into bags for ease and accuracy of application. Compost was hand spread evenly on each plot, and swept-in using stiff push brooms. The first application was on June 5th, 2015, followed by July 17th, and August 21st 2015 for the second and third applications. Visual Quality, NDVI, Clegg Impact hammer testing, 1.5" & 3"moisture levels, and light box images were taken weekly from June 3 – Oct 13th, 2015, and from May 4th – Oct. 4th, 2016. All data was analyzed using JMP 11 for ANOVA, and subsequent means comparisons. Student's t-tests ($p \leq 0.05$) were used for means comparisons when appropriate.

Year Two Results and Discussion for Objective One:

Topdressing with both types of compost improved the overall performance of all plots. Plots that did not receive topdressing had statistically lower performance ratings with respect to the visual quality, NDVI ratings, 1.5" moisture levels, 3" moisture levels, surface hardness, and turfgrass coverage when compared to the plots that received compost topdressing (Table Two). Interestingly, the plots that received compost topdressing had lower moisture contents at both the 1.5" and 3: depths. This suggests that even after just two seasons of topdressing with compost, the soil structure has been improved to demonstrate greater distribution of the moisture from the surface to through the profile. Infiltration rates were not taken in year one or year two, but these data warrant the collection of water infiltration rates in the third and final season of data collection. Topdressing three times a year resulted in plots with softer surface hardness ratings. These data demonstrate the importance of maintaining a topdressing program on play fields with respect to maintaining lower surface hardness ratings. The two compost types performed statistically similarly, except for the visual quality ratings and the surface hardness ratings where the plots receiving vermicompost had higher quality ratings and lower surface hardness ratings. This may be due to the greater uniformity that the vermicompost product has when compared to the municipal sourced compost.

Main Effect	Quality¥	NDVI	1.5" VWC*	3" VWC*	Clegg (g)	Surface Coverage (%)
Frequency (X y^{-1})						
3	5.99 z	0.704 a	55.58 b	75.67 b	75.83 c	77.76 a
1	6.01 z	0.698 a	59.17 b	80.22 b	80.43 b	76.70 a
0	5.84 z	0.670 b	65.80 a	88.82 a	86.33 a	69.16 b
Volume (L*m^{-1})						
40	6.03 z	0.700 a	55.70 b	75.02 c	75.05 c	77.29 a
20	6.07 z	0.702 a	59.11 b	81.54 bc	78.78 bc	77.26 a
10	5.90 z	0.698 a	57.31 b	77.28 c	80.56 b	77.13 a
0	5.75 z	0.669 b	65.8 a	89.81 a	86.33 a	69.16 b
Compost±						
MC	5.80 b	0.697 a	58.05 b	79.84 b	80.87 b	76.15 a
VC	6.20 a	0.706 a	56.70 b	76.06 b	75.39 c	78.31 a
UTC	5.84 b	0.670 b	65.80 a	88.82 a	86.33 a	69.16 b

Table Two: Summary of the Main Effects for two season mean of all parameters tested.

¥ Quality is rated on a 1-9 scale: 9 = ideal perfect stand; 1 = brown dead turf

* VWC = Volumetric Water Content measured on a % scale

± Compost Type: MC = Municipal Compost, VC = Vermicompost

OBJECTIVE 2- ***To evaluate the effects of compost tea made from either municipal or vermicompost on preventing wear damage on Kentucky bluegrass turf***.

Tea Type	**Frequency**
Municipal Compost tea	Spring and Fall
Vermicompost tea	monthly
Aged Vermicompost tea	

Table Three: Summary of the Compost tea treatments.

Methodology:
Compost teas were made from municipal-sourced compost, vermicompost, and aged vermicompost materials. Aged compost was made 3 days before the brewing process and required the addition of oats, and molasses to encourage a higher fungal component for the tea (Fig. 2a). Compost was placed in large compost tea bag, and suspended in a 50 L barrel of water collected from the irrigation pond (Fig 2b). The barrels were aerated for 4 hours and the tea was then transferred into 2L bottles for application with a precision CO_2 driven sprayer. 750ml m^{-2} of tea was applied to the appropriate plots. The tea applications were on: June 5th, 2015, followed by July 7th, August 17th and September 14th 2015 in year one and on: May 20th, June 13th, July 28th, and August 26th, 2016. Visual Quality, NDVI, Clegg Impact hammer testing, 1.5" & 3" moisture levels, and light box images were taken weekly from June 3 – Oct 13th 2015 and from May 4th – Oct. 4th, 2016. All data was analyzed using JMP 11 for ANOVA, and subsequent means comparisons. Student's t-tests ($p \leq 0.05$) were used for means comparisons when appropriate.

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Year Two Results and Discussion for Objective Two:
Just like the year one results, the results of year one and two combined display no statistical differences for each parameter tested regardless of tea formulation or frequency. There was some greater recovery in year two during the unseasonably rainy summer we had in the months of July and August. Due to the high rainfall amounts the wear was cancelled 6 times because of standing water on the plots. The evidence thus far displays that the use of teas without a topdressing program in place is not beneficial in preventing wear damage.

Figure 2: 2a is the vermicompost plus oats and molasses after aging for 3 days. 2b is a picture of the set-up of the brewing process. Aeration of the tea is important to keep the compost microbes alive and multiplying as oxygen is required for their sustained survival.


OBJECTIVE 3- ***To evaluate the effects of both compost topdressing and compost teas on an in-use play field.***

Site Summary:

a) *City of Lethbridge:* Lethbridge Sports Park (previously Sherring Park).
   - Six irrigated Sports fields: two primarily used for Rugby (Fields One and Two); four multi-use fields (Fields Three – Six)
   - Soil Characteristics*: CEC(meq/100g) 30.92; OM (%): 6.34; S (ppm): 28; P†(mg/kg) 384.5; Ca†(mg/kg) 4098.17; Mg†(mg/kg) 784.67; K†(mg/kg) 943.5; and Na†(mg/kg) 64.
   - Plant population and wear June 7th 2016: Field One and Two (Rugby fields) 52% KBG; 20% ABG; 18% wear; Fields 3-6: 85% KBG, 15% ABG

b) *City of Calgary:* Inland Athletic Park
   - Six irrigated Sports fields: two Rugby (Fields One and Two); four soccer fields: Two youth fields (5a and 5b) and two full sized (fields 4 and 6)
   - Soil Characteristics*: CEC (meq/100g) 26.67; OM (%): 11.09; S (ppm): 19; P†(mg/kg) 85; Ca†(mg/kg) 4079; Mg†(mg/kg) 403.33; K†(mg/kg) 568.83; and Na†(mg/kg) 99.17.
   - Plant population and wear June 9th 2016: Field One and Two (Rugby fields) 38.75% KB; 10% AB; 15% PR, 22.5% dandelions, 5% clover; 8.75% wear; Youth Fields (5a&b): 43.5% KB, 3% AB, 3% PR, 9.5% dandelions, 41% wear, Full Soccer fields (4&6): 43% KB, 6% AB, 10% PR, 10% dandelions, 3% clover, 28% wear.

c) *City of Edmonton:* Queen Elizabeth High School and Poplar Park
   - *i.* Queen Elizabeth High School:
     - Three irrigated multi-use Sports Fields (Fields: 1-3) that are part of the high school and one elementary school field system.
     - Soil Characteristics*: CEC (meq/100g) 36.9; OM (%): 6.17; S (ppm): 54.33; P†(mg/kg) 746.33; Ca†(mg/kg) 4557.33; Mg†(mg/kg) 649.33; K†(mg/kg) 703.33; and Na†(mg/kg) 44.
     - Plant Population and wear June 22nd, 2016: 70% KB and 30% wear
   - *ii.* Poplar Park:

- Four non-irrigated youth soccer fields (Fields: 1,2,3, and 7). Location is part of a park complex that includes an elementary school. Often school children are having recess on fields 2 and 7. Fields have low populations of desirable turfgrass species, however the manager has been implementing an overseeding with KB and PR.
- Soil Characteristics*: CEC (meq/100g) 31.94; OM (%): 14.03; S (ppm): 58.25; P†(mg/kg) 915; Ca†(mg/kg) 3831.75; Mg†(mg/kg) 510; K†(mg/kg) 750; and Na†(mg/kg) 30.75
- Plant Population and Wear June 22nd, 2016: 35% KB, 10% PR, 5% TF, 5% Downy Brome, 45% wear.

Methodology and summary of results:

The centre third of each field was topdressed with either Vermicompost or Municipal compost on June 7th, 9th, and 22nd at Lethbridge, Calgary, and Edmonton respectively. The centre third of each field was divided in half again and compost tea was applied on July 11th, 13th, and 14th at Lethbridge, Calgary and Edmonton respectively (Fig. 3 a). Fields were rated for quality, colour, NDVI, and overall turf coverage monthly (Fig 3b). Currently analysis at each park is being organized for further statistical review between parks and within parks to look at main effects of the treatments. The initial combined analysis did not show any main effect results for any of the parameters tested, although this is not surprising as only one application was made of each treatment, and the small-plot work did not show a good spread in the data until after year two. The current plan is to continue with one more application of each treatment on each field and to continue evaluation. The separation of the data by park, may result in significant results, as each park represented different management styles, irrigation availability and use scheduling.

Figure 3: 3a is the application of the tea being applied to a Rugby field in Lethbridge, AB on July 11th, 2014. 3b is the Field Scout's GreenIndex Colour board for the GreenIndex app, used to determine NDVI of the overall canopy.