AgriInnovation Program Stream B

2017-18 Annual Performance Report

Impact of turfgrass fertilization on nutrient losses through runoff and leaching

Name of Recipient: Canadian Ornamental Horticulture Alliance	
Project Title: Canadian Ornamental Horticulture Research and Innovation Cluster	
Project Number: AIP-CL20	Period Covered by Report: 2017-04-01 to 2018-03-31
Activity #: COHA 04 Name of Activity: Impact of turfgrass fertilization on nutrient losses through runoff and leaching	Principal Investigator: Yves Desjardins

1. Performance Measures. See Annex A for an explanation of each measure.

Innovation Items	Results Achieved	Provide a description (2-3 paragraphs) for each item produced and describe its importance to the target group or sector. Explain any variance between results achieved and targets. Use plain language.
# of new/improved practices	1	Results from our study show that properly maintained turfgrass reduces runoff volume and P losses compared to unmaintained turf. These results will be helpful to government agencies and municipalities considering the implementation of bylaws to restrict the use of fertilizers on turfgrass to protect water bodies. Our results will also be helpful for canadian sod growers by promoting the positive environmental impact that healthy turfgrass can have to improve water quality.

Information Items	Results Achieved	Provide the complete citation for each item. Please see Annex A for examples.
# of information events		M. Brownbridge et G. Grégoire, "Turfer Than It Looks: Sustainable turf systems and how they benefit our environment". Landscape Ontario IPM symposium. Toronto, ON, 2018/01/08. *350 attendees* G. Grégoire, "Diminuer la fertilisation de 40%, c'est possible?", Expo-FIHOQ, Drummondville, Qc, 2017/11/16. *100 attendees* G. Grégoire, "Recherches en cours à l'Université Laval », Nutrite Annual Meeting, Québec, Qc, 2017/11/09. *30 attendees* G. Grégoire, « Impact de la fertilisation de la pelouse sur les cours d'eau », Journée de formation de l'AREVQ, Terrebonne, Qc, 2017/06/15. *50 attendees* G. Grégoire, « L'entretien d'une pelouse durable: les bonnes pratiques environnementales », Salon Cour et Jardin, Québec, Qc, 2017/04/23. *30 attendees*

		G. Grégoire, « Mon gazon est plus beau que le tien ! ». Société d'horticulture de Ste-Foy, 2017/09/26. *30 attendees*
		Provide the # of attendees
# of individuals attending information events		See previous
		Provide the # of attendees who intended to adopt new information or technology
# of individuals attending information event who intend to adopt new innovation		Difficult to estimate. Several municipalities are aware of our results, but adopting bylaws based on our results is a process involving other elements than scientific results (politics, pressures from interest groups, etc.).

2. Executive Summary

Key Highlights -

In the last few years, turfgrass fertilization has been accused, by some environmental groups, to contribute to water pollution. This has led to public statements and recommendations by some authorities to stop fertilizing turfgrass or to use only natural fertilizers or composts. The effects of these recommendations on water quality are still unclear, and few studies have compared the nutrient losses from these two types of fertilizers and synthetic ones on turfgrass. The objectives of this project are to compare the effect of five different maintenance programs, based on real-life situations, on: turfgrass quality, nutrient losses through runoff and leaching, soil moisture and temperature, and soil fertility level.

In 2011, we built hydrologically-isolated plots and installed different equipment to measure water flow from the plots through runoff and leaching, as well as to collect water sample to analyze their content in nitrogen and phosphorus. We also installed soil moisture probes at depths of 10, 20 and 30 cm in each plot. Turfgrass was sodded on each plot, and different fertility regimes (i.e. treatments) were implemented. Two treatments are based on current industry practices, where we apply 150 kg of N / ha / yr, split in four applications, either using a synthetic or a natural fertilizer. The third treatment is based on a municipal by-law currently in effect, where we also apply 150 kg of N / ha / yr, but in one application in the spring using shrimp compost. Finally, two unfertilized treatments are also evaluated: one where cultural practices are put in place (aerification, topdress, overseeding), and one unmaintained and unfertilized treatment.

Results from the first years of data collection (2012 to 2016) show that losses in Nitrate-N through leaching are significantly higher in fertilized plots compared to the unfertilized ones. However, the average nitrate concentration in water was well below the Québec potable water standard, which is 10 mg / L of $N\text{-}NO_3$. In contrast, phosphorus losses through runoff were twice as high in the unfertilized plots compared to the

fertilized ones. This is likely due to a general thinning of the turfgrass stand, leading to decreased efficiency in nutrients interception and soil erosion prevention.

So far this project has demonstrated that turfgrass fertilization following industry practices does not pose a threat to water bodies. However, this project also demonstrated that further research is needed to optimize N application in order to reduce nitrate losses through leaching.

Success Story -

Our results demonstrated that fertilized turfgrass results in less phosphorus losses through runoff than unfertilized turfgrass. This is an important result, since phosphorus is the main nutrient responsible for water body eutrophication.

Our results show that properly managed turfgrass has a positive environmental impact on water quality. This data will be useful for canadian sod growers and turfgrass managers in maintaining existing markets and fighting increased regulations regarding turfgrass fertilization. Finally, we hope that our results will be useful for municipalities in establishing regulations based on sound scientific data instead of popular beliefs.

3. Objectives/Outcomes (technical language is acceptable for this section)

In the last few years, turfgrass fertilization has been accused, by some environmental groups, to contribute to water pollution. This has led to public statements and recommendations by some authorities to stop fertilizing turfgrass or to use only natural fertilizers or composts. The effects of these recommendations on water quality are still unclear, and few studies have compared the nutrient losses from these two types of fertilizers and synthetic ones on turfgrass. In addition to the fertilizer sources, the influence of other recommended practices (such as clipping removal or use of an alternative ground cover) on water quality are still unknown. The objectives of this project are to compare the effect of five different maintenance programs, based on real-life situations, on: turfgrass quality, nutrient losses through runoff and leaching, soil moisture and temperature, and soil fertility level.

The experiment was established in June 2011 as a completely randomized complete block design, with 10 m X 5 m plots placed on a 3% slope. Each of the plots was hydrologically isolated from the surrounding soil by enclosing them with a doubled plastic sheet. The plots were then allowed to set in for a period of one month, before being covered with Kentucky bluegrass sod. Since two of the treatments were designed to monitor nutrient losses from unfertilized plots, we covered those plots with turfgrass (mixed with broadleaves weeds) from nearby unmanaged sod plots that had not been fertilized since 5 years. This allowed us to obtain data from unfertilized plots without having to wait several years in order for the unfertilized turf to differentiate itself from the fertilized one.

Because of the limited number of plots available (15), we decided to evaluate five different maintenance approaches instead of using a factorial design with multiple parameters. These five evaluated maintenance regimes were replicated three times: standard treatment with maintenance practices (aerification, topdress, overseeding, etc.), natural treatment with maintenance practices, compost treatment with maintenance practices, unfertilized with maintenance practices and unfertilized without maintenance practices. The volume of water from runoff and leaching from each plot was measured after each rain event with the use of tipping buckets, water samples were taken to be analyzed for nutrient content. Soil moisture probes were

also installed in each plot at depths of 10, 20 and 30 cm and measured volumetric soil water content each hour. Soil temperature was also measured with a probe installed at a depth of 10 cm. Turfgrass quality was evaluated on a 1 to 9 scale each month.

Results

Results from the 2017 growing season (total of 1713 water samples collected) are currently being analyzed. We planned to be able the complete sample analysis earlier, but the research associate in charge of data analysis left for a maternity leave in September 2017, which resulted in a delay in data processing. We plan to finish the analysis when she comes back in March 2018, and to send the final results to COHA no later than July 2018.

However, results from 2012 to 2016 are available:

Runoff: Fertilized plots significantly reduced runoff volumes compared to unfertilized plots, regardless of the fertilizer source (Figure 1). Among the fertilized plots, those fertilized with the natural fertilizer resulted the lowest runoff volume. Losses in P were also significantly smaller in fertilized plots compared to the unfertilized plots Figure 2). P losses were smaller in plots fertilized with the natural fertilizer compared to other fertilizer sources, but this was a direct effect of the runoff volume, not of the P concentration in runoff water (data not shown). It is possible that the natural fertilizer had an impact on the water absorption speed by the soil, thus resulting in a lower runoff volume. We will measure soil water absorption dynamics in the spring of 2018.

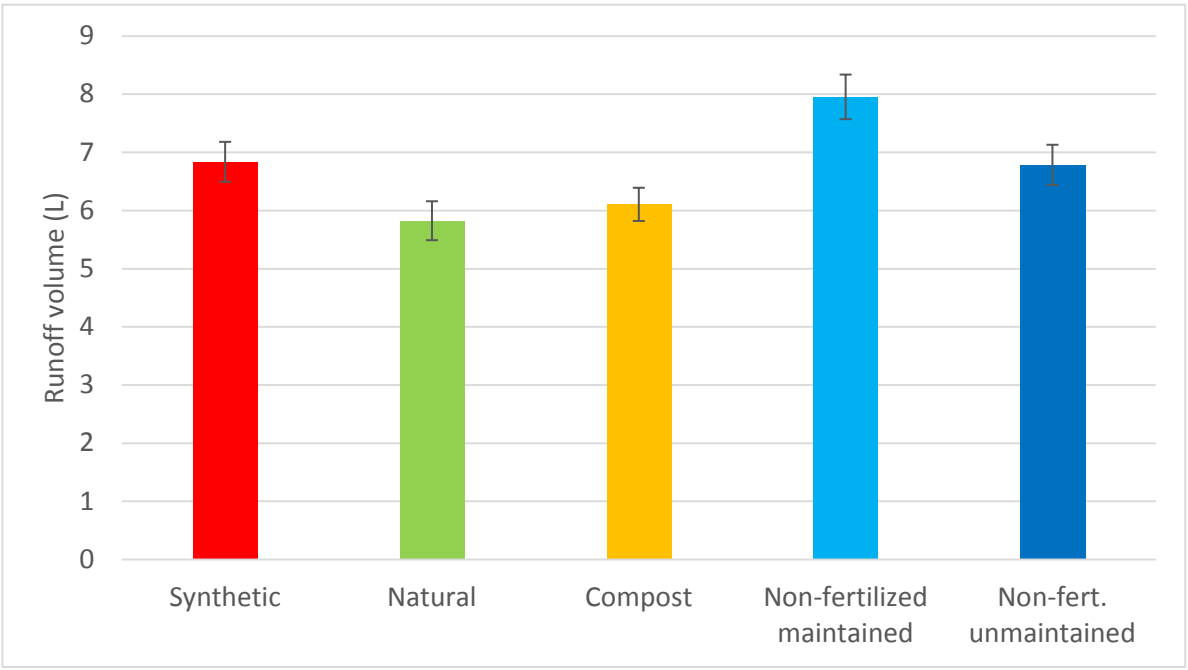

Figure 1. Total water volume losses per runoff event for the different treatments during the 2012-2016 period

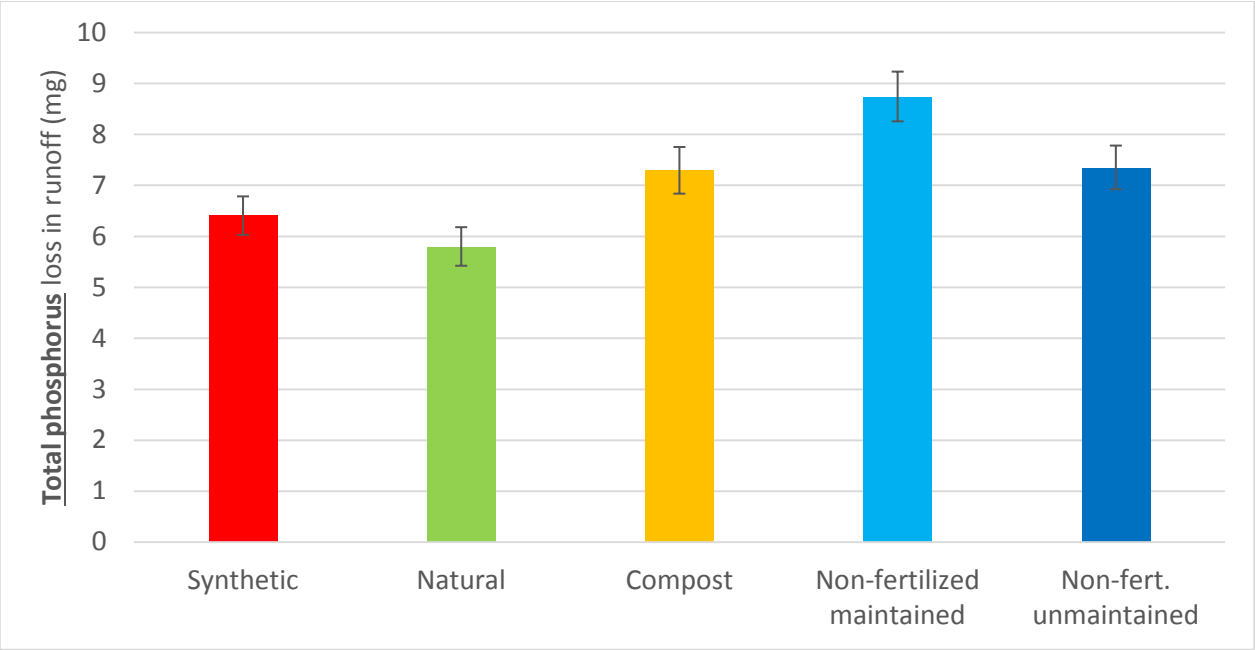

Figure 2. Total P losses by runoff event for the different treatments during the 2012-2016 period

Leaching: Losses of nitrate by leaching were generally small, and corresponded to 2 -4 % of the N applied through the fertilizer. However, these losses were significantly lower in unfertilized plots compared to the fertilized ones (Figure 3), which is explained by a higher NO_3-N concentration in the leachate from fertilized plots (Figure 4). Higher NO_3-N losses were also measured in plots receiving fertilizer (natural or synthetic) compared to plots receiving compost. This could be explained by the presence of some quick release N in both fertilizers, whereas the compost contains exclusively slow-release N. However, average nitrate-N concentrations were well below the Québec potable water standard, which is 10 mg / L of N-NO_3 (Figure 4).

Our results so far indicate that current fertilization practices result in little nutrient losses through runoff and leaching. Furthermore, unfertilized turf resulted in higher P losses than the fertilized treatments, indicating that banning turfgrass fertilization could be detrimental for water bodies. One unexpected result so far is the positive impact of the natural fertilizer on runoff reductions compared to other fertilized treatments. Even though N losses are relatively small compared to the overall amount applied, future research should investigate methods to further reduce these N leaching losses.

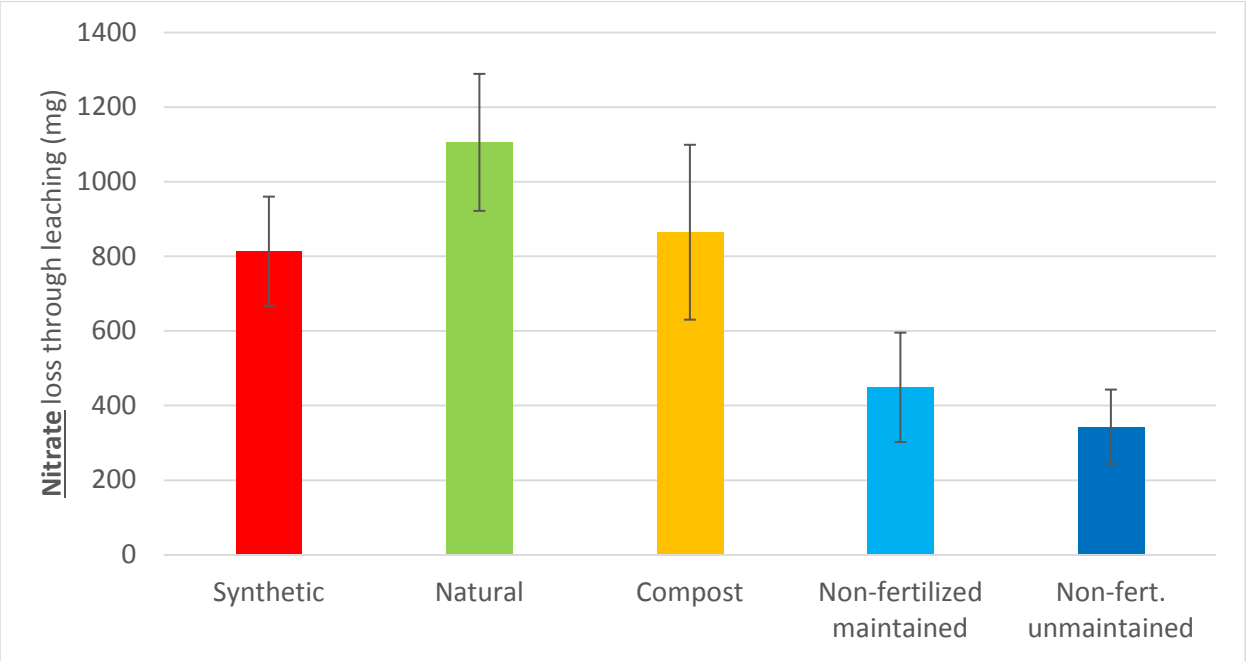

Figure 3. Nitrate losses per leaching event for the different treatments during the 2012-2016 period

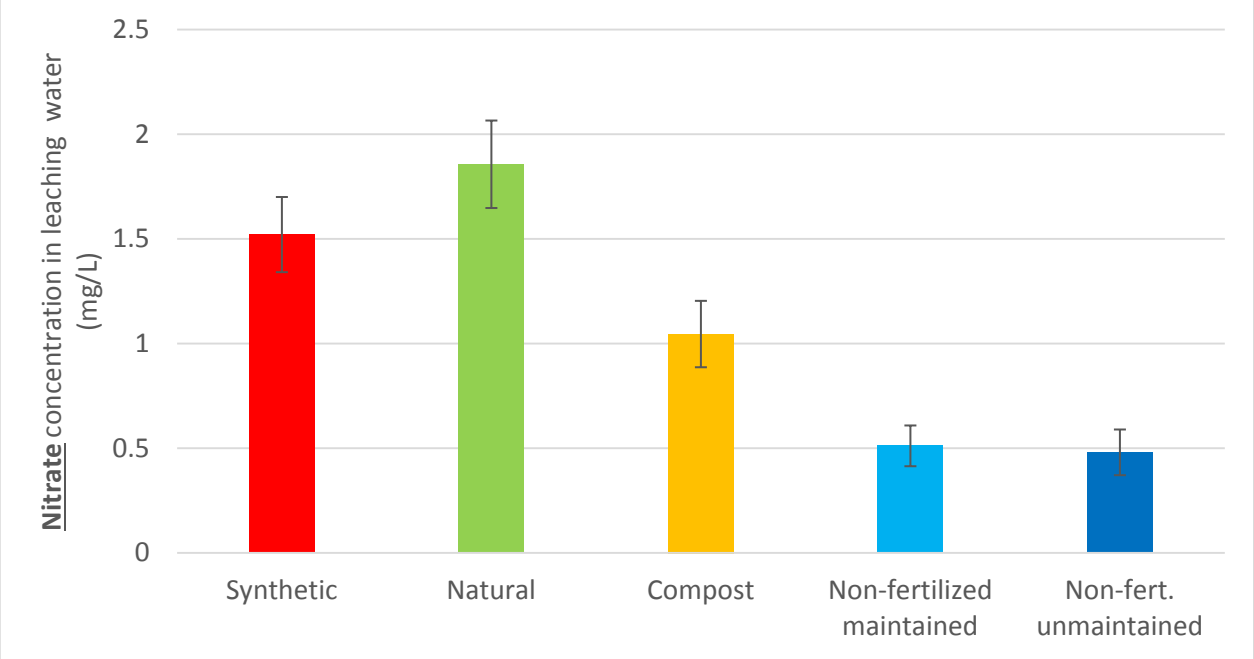

Figure 4. Average NO_3–N concentration in leachate for the different treatments during the 2012-2016 period

4. Issues

Among the challenges faced during the course of this project:

- Difficulty to find a graduate student. We needed to hire a second research associate in order for the work to be completed
- Large volume of data collected. We developed a process to automate data compilation from the 30 data loggers, each collecting up to several thousand data points over the growing season
- Time required to analyse the ~2000 water samples, compile the data and statistically analyze it was very demanding. In 2017, we hired an additional undergraduate student to start these analyses earlier (during the summer as they were collected). This resulted in a shorter completion time for the water sample

analysis. However, the research associate in charge of data compilation and statistical analysis left for a maternity leave in September 2017, so we were not able to finalize the results in time for the end of the project. Once she gets back to work (March 2018), statistical analysis will be completed and the final results will be sent to COHA no later than July 2018.

5. Lessons Learned:

When we started this project, phosphorus losses were one of our main interests, since P has been identified as the main element involved in water bodies degradation and eutrophication. However, during the course of the project, we met with different organizations involved in the preservation of water bodies, and learned nitrogen is now being considered a threat to water quality as well.

6. Future Related Opportunities:

As previously mentioned, our project showed that, while nitrate losses were relatively low, they were nonetheless higher in fertilized plots compared to the unfertilized ones. Future projects should focus on this element, since there are several aspects of N fertilization that could be optimized in order to reduce losses: rate, frequency of application, source, release dynamics, etc. We already submitted a new research project aimed at optimizing nitrogen application to reduce nitrate losses from turfgrass in the next round of the Research Clusters.

NOTE TO READER: This report has been edited from the original for formatting purposes only. There have been no changes made to the information provided by the researcher.