THE EFFECTS OF MAGNET TREATED IRRIGATION WATER ON KENTUCKY BLUEGRASS IN A GREENHOUSE ENVIRONMENT

Client:

Dean Pillar

Authors:

Max MacKenzie Myles Johb Nicholas Plantje

Table of Contents:

1.0 Executive Summary……3

2.0 Industry Analysis……3

2.1 Target Client……3

2.2 Trend Analysis……3

3.0 Background……4

3.1 Decision to Research Magnet Water……4

3.2 Water Use on Golf Courses……4

3.3 Decision to Use Seed to Establish Turf……4

3.4 Previous Research……4

3.5 Potential Client Bias……5

4.0 Industry Application Deliverable Outcome……5

4.1 Cost Savings……5

4.2 Recommendations……6

4.3 Photo……6

5.0 Applied Research Paper……7

5.1 Abstract……7

5.2 Introduction……7

5.3 Materials and Methods……8

5.4 Results and Discussion……9

5.5 Conclusion……12

6.0 Appendices……13

6.1 References……13

6.2 Supporting Information……14

6.2.1 Client Mentor Support Letter……14

6.2.2 Mentor Support Letter……15

1.0 Executive Summary

As water is such a valuable and diminishing resource, we looked at possible beneficial effects of using magnet treated irrigation water. After reading some previous research we decided that we could test some aspects of the magnet on turfgrass. We decided to see if magnet treated water has an effect on crop yield; specifically whether we could use 20% less water (was treated by being ran through magnet) and still see quality growth in turfgrass. We also collected data as a secondary consideration, on soil moisture to see if magnet treated water has an effect on soil moisture retention.

Throughout the research we began to conclude that there was no significant difference in wet yield weights or soil moisture retention between the plots that were irrigated at 80% (with the magnet) and the plots that were irrigated at full rate without the magnet. This tells us that we can use 20% less water with magnet and still receive similar results in growth and soil moisture retention.

Although we only tested the magnet treated water, there is much research that needs to be performed and considered on to ensure improved results. This being said, for superintendents looking to save water and money, we feel we have collected plausible data that indicates some of the benefits of using magnetic treated water are accurate.

2.0 Industry Analysis

2.1 Target Client

The goal of the research was to assess some claims made by Magnation, and to see whether these claims are valid, and if it could be beneficial for the turfgrass and golf course industry to use magnet treated water on their properties. The effects magnet treated water can be in considered across agricultural industries, while we focused of turf in a golf course application

2.2 Trend Analysis

As the planet's water supply is depleting and the concern of water consumption among golf course professionals is becoming more important, alternative methods of irrigating are going to become necessary. There is also a growing concern for being environmentally friendly in the golf course industry. Through analyzing these trends we looked at the potential of using magnet treated irrigation water to overcome, or minimize, these concerns.

3.0 Background

3.1 Decision to research magnetic water

After discussing the planet's water issues and growing concern of conservation, we looked into alternative ways of irrigating. After coming across the idea of magnet treated irrigation water we looked into the products offered by Magnation. On their website, they stated many benefits of utilizing their products, and we set out to test a few of them. These include whether you can use less water, and retain the same results in plant growth, and if the soil has better water retaining qualities after introducing the magnetized water.

Anecdotal evidence includes the evidence of one of our researchers, Max, had the opportunity to use a hose attachment magnet in the summer of 2013, and had noticed some improvements in the localized dry areas he was attending to. Although this was unmeasurable, it piqued his and our interests into researching magnetic treated water.

3.2 Water use on golf courses

Golf courses use a substantial amount of water to keep their turfgrass at a high quality. Approximately 2.08 billion gallons of water is used, per day, to irrigate golf courses in the United States of America (Lyman, 2012). In the future, it is widely accepted that there is going to be a global water shortage (Adams et al, 2009). If through the use of a magnet, we can decrease our water usage by 10-30% (Magnation, 2014), that could make a drastic difference in water used. For golf course superintendents looking to decrease their environmental footprint, they could utilize this idea, whilst also saving money on water and power.

3.3 Decision to use seed to establish turf

There are a few reasons why we used Kentucky Bluegrass from seed. This was one way we could help ensure that every single replicate was the same. Each plot was treated exactly the same as another. The only variable that was different was the amount of water received. We also used seed because this gave us ability to choose what kind of growing medium to use, as well as what cultivar of Kentucky Bluegrass to use. This was to ensure the most accurate results as possible.

3.4 Previous Research

Although there has been much research done on magnet treated water, there has been minimal specific to turfgrass on turfgrass and golf courses. After looking at some prior research in different industries, we decided to relate it to turfgrass and begin to access some qualities of magnet treated water on our own.

Some previous research on turfgrass found: that introducing a magnetic treatment to irrigation water resulted in significant increases in yield and water productivity (Maheshwari & Grewal, 2009). However, the research was limited to concluding that more tests need to be done under field conditions to further assess usefulness of magnetic treatment of irrigation water for crop production. Our research is tailored towards turfgrass production, which thus far, has been undocumented.

3.5 Potential Client Bias

One point of controversy that may arise from our project is the fact that our client mentor is a distributor for the Magnation company in Canada. We have avoided this controversy by remaining unbiased in the design of our experiment. The design of our experiment allows us to present our findings in a way that does not favour one outcome over another. When our data is collected and we interpret the results, we can be assured that every step was taken to remain impartial, whether the data is beneficial or detrimental to our client's company.

4.0 Industry Application Deliverable Outcome

4.1 Cost Savings

The results of our experiment provided evidence that a similar Kentucky Bluegrass turf plot can be achieved using 20% less irrigation water when applying it through a magnetic treatment. In the United States alone, around 2.08 billion gallons of water per day are applied to golf courses for irrigation purposes (Lyman, 2012). Reducing this number by 20% would translate to an annual savings of 41.6 million gallons of irrigation water. This savings relates directly to every golf course that implements a magnet treatment into their irrigation system. However, a 20% drop in irrigation requirements is a number that every superintendent can relate to as a positive impact for water reduction requirements.

Superintendents use a few different techniques to conserve water, starting with irrigating less often, but it also leads into use of wetting agents and hand-watering techniques. These techniques are all being used by superintendents across the industry: 92% using wetting agents, 78% using hand-watering, and 69% using less frequent irrigation practices (i.e. keeping turf drier) (Lyman, 2012). The results of our experiment provided evidence that magnet-treated irrigation water improves soil with better moisture retention qualities. This will help golf course superintendents to reduce their need for wetting agents, because the soil will retain moisture better and prevent the soil from becoming hydrophobic. This also aids in the need for frequent irrigation, because the magnet treated water will stay within the soil longer, and be available to the plant for a longer period of time.

Implementing magnetic water irrigation practices can be a large-scale operation, such as installing a magnet into the irrigation mainline; ensuring all water irrigating the golf course will be magnetized. This will bring about start-up costs of around $1000 per inch of pipe installed on. Speculating on water savings, energy savings (less frequent pump usage), and other inputs, this could possibly pay for itself in a fairly short-term timeframe. However, irrigation water doesn't have to be magnet-treated with on a large scale. There are hose attachments and even sprinkler head fittings that provide the same service, in a more specialized capacity. Since 78% of superintendents employ hand-watering techniques on their courses, the savings once again not only relates to water, but now translates into labour and time savings as well (less time/fewer times needed for hand-watering).

4.2 Recommendations

Implementing a magnetic irrigation treatment could prove to be a beneficial cultural practice for turf professionals and/or golf course superintendents. Our experimental results indicate that irrigating turf with magnet treated water will provide the same yield with less water, as well as improved soil moisture retention. However, further turf-related research should be done to bring about definitive results regarding other aspects of magnet treated irrigation water and its effects on turfgrass.

The first step would be to try and duplicate these experiment results in a field setting rather than in a greenhouse, to provide more real world deliverables for turf professionals. Although our research provides implications of being able to save water and increase moisture retention, it would be of great relevance to have similar data and results in a more realistic field setting.

As well as replicating this experiment in a field setting, a number of other dependent variables could be designed for measurement in regards to turfgrass and magnetized irrigation water. The number of claims about this subject is extensive, with a number of them being open for research possibilities, including time to germination, turf recovery time, or reduction in pipe scaling and pipe friction loss. The research behind magnetic irrigation water's effect on turfgrass is essentially just beginning.

4.3 Photo

Side View of Control vs. 80% Treatment (Tray 1)
%20 reduction of water with no significant difference

5.0 Applied Research Paper

5.1 Abstract

Water conservation and intelligent irrigation practices are becoming more of an important issue for turf professionals and horticulturalists all over the world. Magnetized irrigation water is starting to gain momentum as a sustainable practice, in agricultural circles. In turf, the possibilities for magnetized irrigation practices are increasing as well, which calls for the desire for turf-specific research into magnetic treated irrigation water. This experiment set out to determine the validity behind some of the turf-related claims associated with magnetized irrigation water. A number of Kentucky Bluegrass pots were established, and monitored for the effects of magnetized irrigation water on plant yield and soil moisture retention. The results showed that there is no difference in plant quality or soil moisture retention when using significantly less magnetized water versus using untreated irrigation water. This experiment suggests a need for a great deal of further research into the mode of action for magnetized irrigation water, as well as the number of other potential benefits is could possibly bring forth.

5.2 Introduction

The rising concern for water supply and consumption is prompting new ideas and strategies for irrigating in the horticulture industry. In Alberta in 2009, water used for irrigation purposes accounted for 43% of all licensed water use, totaling around 4.25 billion cubic meters (Government of Alberta, 2010). It is becoming increasingly important for turf professionals to not only be conscious of water usage, but to maximize utilization of water that is being applied for irrigation.

When it comes to environmental awareness, one of major driving forces behind energy conservation is water conservation. Water for irrigation and food production

constitutes one of the greatest pressures on freshwater resources. Agriculture accounts for 70% of global freshwater withdrawals (UNESCO, 2013). In the turfgrass industry, more and more golf courses are working towards minimizing water usage, for monetary and environmental reasons.

Magnetized irrigation water is currently being used in over ten countries for a variety of different agricultural reasons, from increased crop yield to faster seed germination (Qados and Hozyan, 2010).

One company is making claims about magnetized irrigation water and the positive effects that it will have on plant material (Maheshwari and Grewal, 2009). This research has been carried out on a number of different plant crops, although the direct research of magnetic irrigation water on turfgrass has been limited thus far. Our research design set out to determine, in a greenhouse setting, what kind of effects magnet -treated irrigation water has on turfgrass.

Although there are many stated benefits of using magnetized water for irrigation (Magnation Water Technologies, 2011), this experiment tests three claims:

- Increased plant yield
- Reduced water usage with no loss in plant yield
- Better soil moisture retention with magnetized irrigation water

The purpose of this experiment was to assess if these claims are valid, to further the limited research in this area, and to determine whether it would be valuable to golf course superintendents to implement magnetic irrigation water to their turfgrass. The experiment was then designed to determine the effects of magnet-treated irrigation water on Kentucky Bluegrass (*Poa pratensis L*.) in a greenhouse setting.

5.3 Materials and Methods

- Group conducted experiment to test the effects of magnetized water on the growth of Washington Kentucky Bluegrass (*Poa pratensis L.,#*173 9 CWA)
- There were a total of 16 plots for the growth experiment. The pots were set in a randomized block design, with one of each 3 treatments and control per tray (4 total in each tray)
- The soilless media chosen (Germination Mix) was tested for electrical conductivity (EC) and pH, and measured to fill each 5” pot
- Control water was tested for pH and EC, and then magnetized treatment water was tested for EC and pH
- The seeding rate for each pot was determined, and each pot was seeded using a vibrating hand seeder at 2lbs/1000square feet (standard rate for cultivar selected)
- The daily watering rate was determined for each pot and each treatment. Treatments consisted of magnetized water with rates of 130mL per day (full rate), 100mL per day (80% rate), and 65mL per day (half rate), and 130mL per day control,

to be applied each week day, totaling 2” of water per week (industry germination rate for KB)

- During establishment, treatments and control were applied to the experiment plots daily
- After a period of five weeks, the pots were clipped to a height of 2cm, and wet and dry weights were recorded. Pots were fertilized with a fertilizer (20-8-20 formulation) at a rate of 0.25lbs/1000square feet, then fertilized again two weeks later at the same rate
- A moisture meter was used to measure daily volumetric moisture content of each pot (to determine soil moisture retention)
- Plots were cut at once per week, with wet and dry weights being recorded
- After establishment, plots were watered via volumetric moisture content. Plots were watered to maintain full rate moisture of 30% (determined by watering to field capacity, then measuring moisture level). Treatment watering rates were reduced to 75mL 100% rate, 60mL 80% rate, and 37.5mL for 50% rate. Control received 75mL of untreated water.

5.4 Results & Discussion

Analysis of Variance results for:
Y Variable Range = $T$4:$T$51
Factor Range = $S$4:$S$51

Descriptive Statistics

Group	Mean	Std Dev.	Std Err	N
Control	53.106	6.947	2.006	12
50	41.829	8.841	2.552	12
80	53.031	7.635	2.204	12
100	54.306	8.605	2.484	12

Analysis of Variance for Y=Column T

Source	Type III SS	Df	Mean Sq.	F	Prob.
Model	1234.243	3	411.414	6.360	0.001
Error	2846.403	44	64.691		
Total	4080.646	47			

Post Hoc tests for Factor = Column S

Test	Group 1	Group 2	Mean Diff.	SE	q	Prob.
Student-Newman-Keuls	CT	50	11.277	2.322	4.857	0.004
		80	0.075	2.322	0.032	0.982
		100	-1.201	2.322	0.517	0.716
	50	80	-11.202	2.322	4.825	0.001
		100	-12.478	2.322	5.374	0.002
	80	100	-1.276	2.322	0.549	0.920

Fig.1 ANOVA Results for Average Soil Moisture Retained

Analysis of Variance results for: Wet Weights March 17
Y Variable Range = $B$45:$B$61
Factor Range = $A$45:$A$61

Descriptive Statistics

Group	Mean	Std Dev.	Std Err	N
50	8.315	0.117	0.058	4
80	8.135	0.091	0.046	4
100	8.145	0.061	0.031	4
Control	8.033	0.110	0.055	4

Analysis of Variance for Y=Wet Wt

Source	Type III SS	Df	Mean Sq.	F	Prob.
Model	0.164	3	0.055	5.789	0.011
Error	0.114	12	0.009		
Total	0.278	15			

Post Hoc tests for Factor = Trt

Test	Group 1	Group 2	Mean Diff.	SE	q	Prob.
Student-N	50	80	0.180	0.049	3.700	0.055
		100	0.170	0.049	3.495	0.029
		Control	0.283	0.049	5.808	0.007
	80	100	-0.010	0.049	0.206	0.887
		Control	0.103	0.049	2.107	0.162
	100	Control	0.113	0.049	2.313	0.269

Fig.2 ANOVA Results for Wet Weight of KB Clippings(Mar.17)

Analysis of Variance for Y=Dry Wt

Source	Type III SS	Df	Mean Sq.	F	Prob.
Model	0.011	3	0.004	2.305	0.129
Error	0.019	12	0.002		
Total	0.030	15			

Fig. 3 ANOVA Results for Dry Weight of KB Clippings (Mar.17)

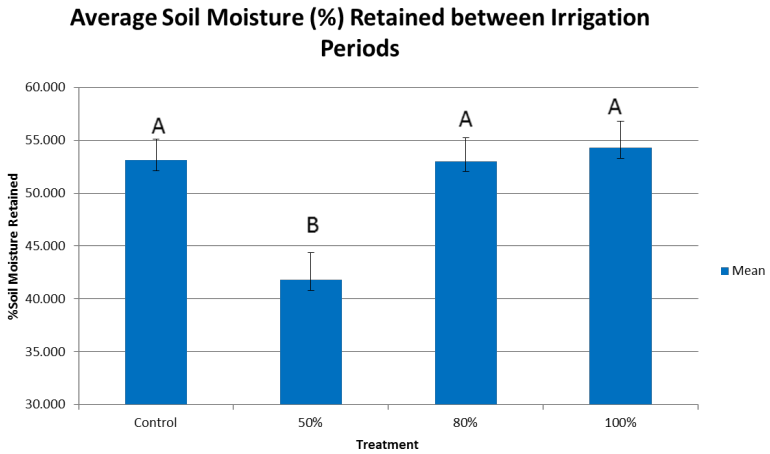

Fig.4 Average Soil Moisture Retained between irrigation periods on Kentucky Bluegrass

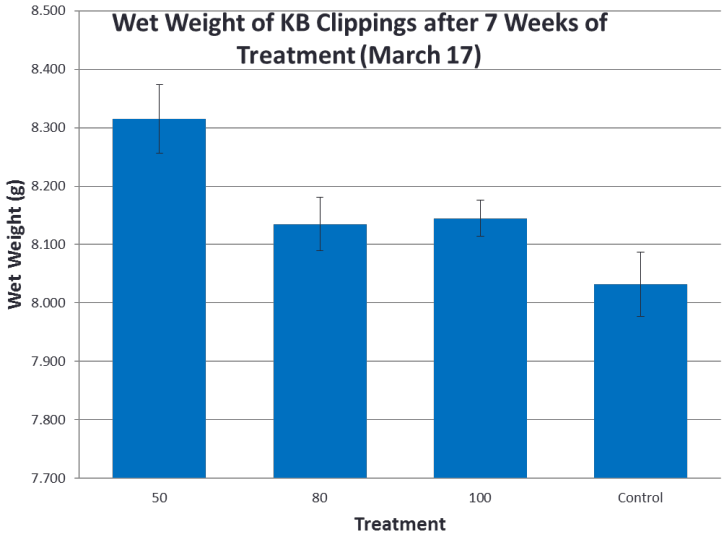

Fig.5 Wet weight of KB Clippings after a 7 week grow in period

Data was collected for average soil moisture retention, as well as for wet weight and dry weight of each pot's weekly clipping yield. A one-way analysis of variance (ANOVA) was performed on the moisture retention data, with $F(3,44)=6.36$, and a p-value of 0.001 (Figure 1). A Student-Newman-Keuls was used to compare the sample means, because there was found to be significant difference between the treatments (50%, 80%, 100%, Control). This meant that the null hypothesis was rejected (The null hypothesis stating that there is no significant difference between treatments, $P<0.05$). After performing the SNK test, it was found the 80% treatment

to be similar to 100% treatment (p=0.92), and the 80% treatment is not significantly different from the Control (p=0.98).

A one way analysis (ANOVA) was also performed on the wet clipping weights collected on March 17, where it was found that $F(3,12)=7.79$, and the p-value being 0.011 (Figure 2). The treatments showed significant difference (once again rejecting the null hypothesis where $p<0.05$), and a Student-Newman Keuls test was used to determine that the 80% treatment had no significant difference from the 100% treatment (p=0.887), and there was no significant difference between the 80% treatment and the Control (p=0.162).

After running an analysis of variance on the dry weight of KB clippings from the same date (Mar.17), there was found to be no significant difference between any of the treatments (p=.129).

5.5 Conclusion

Past research has proven magnet-treated irrigation water to have a positive effect on plant and food crops (Maheshwari and Grewal, 2009), but research on turfgrass has been limited at best. This experiment set out to determine whether or not magnet-treated irrigation water increases plant yield and soil moisture retention, and whether or not a similar or superior turf product can be achieved using less magnetized water.

The results of this experiment showed that there was no significant difference between the plots of 80% treated magnet water, the 100% treated magnet water, and the Control of untreated water. The 80% plots provided a non-statistically different yield when compared to the 100% plots and the Control. There was also no significant difference between average soil moisture retention of the 80% plots, 100% plots, and the Control plots.

This experiment suggests that magnet-treated irrigation water provides significant benefits to Kentucky Bluegrass grown from seed in a greenhouse environment. The experimental process performed suggests that a similar Kentucky Bluegrass turf product can be achieved using 20% less magnetized irrigation water. We were able to apply less water and dry down soil moisture significantly below field capacity without penalty to turf quality, as proven by yield and moisture; combined.

In the future, a number of additional claims about magnet-treated irrigation water could be tested, including germination rate, increased turf recovery, density, as well as many others. Another direction this research could take would be the mode of action for the magnet-treated irrigation water-that being, how and why it works.

6.0 Appendices

6.1 References

Adams, L., Boccaletti, G., Kerlin, M. & Stuchtey, M. (2009). Charting our water future. [report] pp. 40-50.

Crownover, Matt. "How Many Acres Are Needed for an 18 Hole Golf Course?." Golfsmith. N.p., 2013. Web. 6 Feb. 201

Evans, Robert, D K. Cassel, and R. E. Sneed. "Soil, Water, and Crop Characteristics Important to Irrigation Scheduling." North Carolina Cooperative Extension Service, June 1996. Web. 8 Feb. 2014.

Faten Dhawi, Jameel M. Al-Khayri, and Essam Hassan, Saudi Arabia, 2009. “Static Magnetic Field Influence on Elements Composition in Date Palm”. Research Journal of Agriculture and Biological Sciences, 5(2): 161-166, 2009.

Garcia, Mercedes F., Elvira M. Ramirez, and Maria V. Padrino. "Germination of Grass Seeds Subjected to Stationary Magnetic Field." (2007). Web. 6 Feb. 2014.

Government of Alberta. Facts About Water in Alberta. N.p.: n.p., 2010. 34-38. Web. 9 Mar. 2014. Rpt. of Water for Life: Facts and Information on Water in Alberta 2002. 2002.

Lyman, Gregory T. "How much water does golf use and where does it come from?" USGA Summit on Golf Course Water Use (2012). Web. 1 Apr. 2014.

Maheshwari, Basant L., and Harsharn S. Grewal. "Magnetic treatment of irrigation water: Its effects on vegetable crop yield and water productivity." Agricultural Water Management 96 (2009): 1229-36. Web. 6 Feb. 2014.

Milewski, John V. "The Effects of Magnetite, Magnetic Water, and Magnetic Monopoles on Plant Growth." Subtle Energies. N.p., Dec. 2006. Web. 8 Feb. 2014.
"Sustainable, Highest Quality Turf with Healthier Water." Magnation Water Technologies. Magnation Corporation, 2014. Web. 6 Feb. 2014.

"WASHINGTON II Kentucky Bluegrass Technical Data Sheet." IntegraTurf. N.p., 2010. Web. 6 Feb. 2014.

"Water Cooperation." UN Water. United Nations Educational, Scientific, and Cultural Organization, 2013. Web. 6 Feb. 2014.

6.2 Supporting Information

6.2.1 Client Mentor Support Letter

October 6, 2013

Mr. Max Mackenzie, Mr. Nicholas Platje and Mr. Myles Johb:

Please consider this letter as confirmation of my participation and support as a client mentor of the Magnation product research project being conducted at Olds College. Based on my personal experience with the product I am confident in the claims from the company that there is an improved plant response as well as a reduction in water consumption to maintain turf sward, field or greenhouse crop.

I am available throughout the Alberta Property Managers conference to review research protocols with you and answer any industry specific questions you may have. If there are any questions you have for me ahead of this date I may be reached at 250-883-3636 or at dpiller@telus.net.

I am very pleased to be a part of this research and thank you in advance for conducting the work.

Sincerely,

Dean Piller
Course Superintendent

5333 Cordova Bay Road, Victoria, British Columbia V8Y 2L3
Proshop (250) 658-4444 – Admin. (250) 658-4075 – Fax (250) 658-4951
website: www.cordovabaygolf.com email: info@cordovabaygolf.com

6.2.2 Mentor Support Letter

From: Ian Morrow <IMorrow@oldscollege.ca<mailto:IMorrow@oldscollege.ca>>
Date: November 8, 2013 at 5:12:55 PM MST
To: Nicholas Plantje
<Nicholas.Plantje@oldscollege.ca<mailto:Nicholas.Plantje@oldscollege.ca>>
Subject: Re: Client Mentor Letter

Hi Nick,

I would be more than happy to be a mentor for your group. Please keep me informed as to your progress and the next steps.

Regards,

Ian