2017 STATISTICAL ANALYSIS SUMMARY

submitted to

Parjana® Distribution LLC

for research performed at

Michigan State University

submitted by

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January 10, 2018

Introduction

Parjana® is a company based in Detroit, Michigan that offers the Energy-passive Groundwater Recharge Product (EGRP®), a device that increases infiltration in poorly aggregated soils by enhancing the natural processes of capillary action, pressure differential, and hydrostatic pressure. The EGRP® system was invented in 1997 and Parjana® Distribution LLC (Parjana) was founded in 2012. To date, Parjana® validates the success of the EGRP® with case studies, observations, and testimonials regarding the increased drainage aspects of the system. Parjana®'s Executive Summary, available through their website, highlights case studies and observations. What has been lacking is the scrutiny of the scientific method to corroborate the claims and testimonials.

Undertaking a scientific study to address the claims was understandably challenging given that measuring soil water movement and/or soil drainage is a complex problem. Challenges of setting-up a replicated scientific study to address the claims include:

1. The difficulties in accurately measuring the amount of water that drains from a specific non-disturbed volume of soil.
2. Soil texture percentages can change over a relatively small area and differences in the percentage of soil textures naturally influence drainage. For example, a soil with a higher percentage of sand drains faster than soil with a greater percentage of clays due to sand having more macropores.
3. If the EGRP® system does drain water how big is the sphere of influence, that is, if the EGRP® system is installed in a 10 square foot area how far beyond that area does the system impact drainage?

Cognizant of those obstacles, a study was initiated at the Hancock Turfgrass Research Center (HTRC) at Michigan State University (MSU) in October of 2015.

Figure 1. Site location relative to the Hancock Turfgrass Research Center at MSU.

Methods and Materials

The EGRP®-based system was installed at the HTRC in a border area that had not previously been utilized for turfgrass research. The soil on the site is a Capac loam and the area was seeded in 2006 with a Rhino seed mix of 20% Raven Kentucky bluegrass (KBG), 20% Cascade chewings fescue, 20% Merit KBG, 20% Baron KBG, and 20% Stellar perennial ryegrass. The site received minimal fertility and pesticide inputs prior to the study and no fertilizer or pesticides have been applied to the site since installation of the product. The entire site, delineated in red in Figure 1, measures 210' by 85' (approximate latitude and longitude, for reference: 42°42'40.81"N, 84°28'20.17"W).

The study is comprised of three replications of two treatments (Figure 2 & 3), which include:

1. 20' x 20' plots with the EGRP® system installed and
2. 20' x 20' plots with no drainage installed.

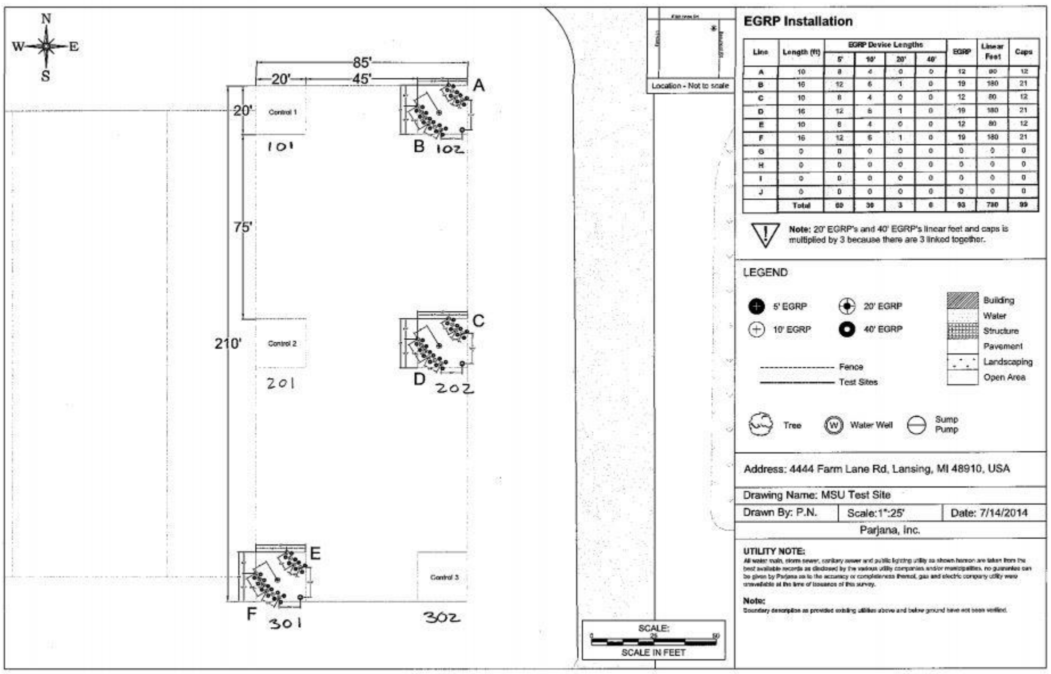

Figure 2. Layout design of the EGRP® installation.

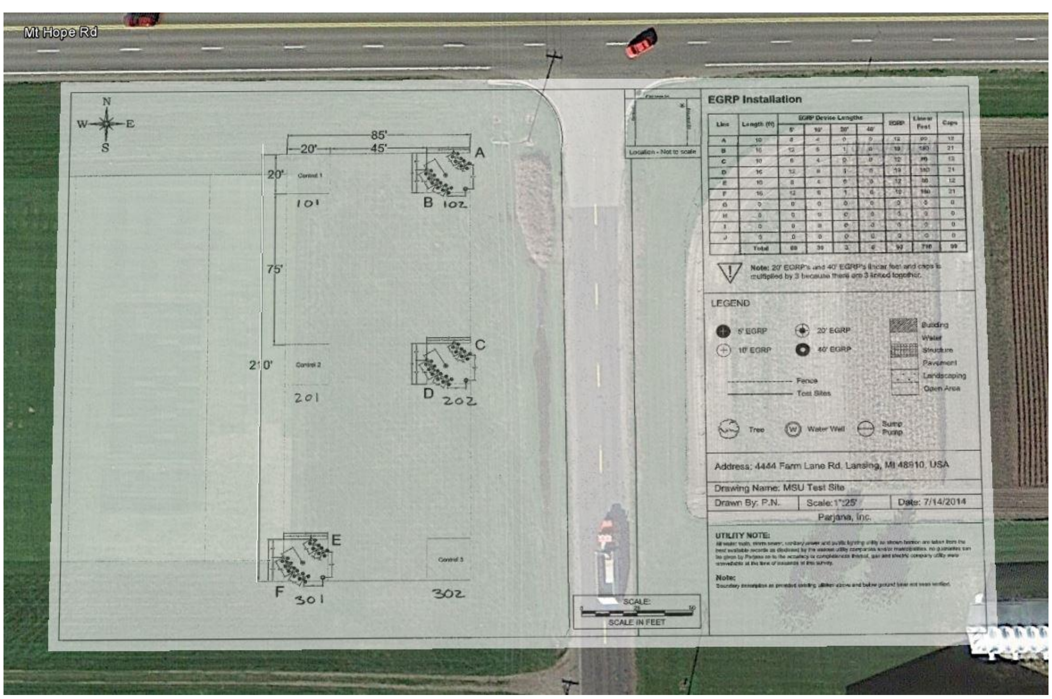

Figure 3. Layout overlay, to scale.

Each 20’ x 20’ treatment plot replication is separated by 45’ east to west and 75’ north to south to minimize the effects, if any, of the sphere of influence the EGRP® system may have on drainage in a check plot. The three 20’ x 20’ plots with the EGRP® system are comprised of several 5’and 10’ EGRP® with each array containing one 20’ and one 40’ EGRP®. Arraying the EGRP® in this manner facilitates a controlled scientific study. Parjana® claims to place EGRP® array on this site, as well as for their project applications, by utilizing geographic and hydrologic analysis to place EGRP® in an array assessed optimal for rapid infiltration.

The EGRP® were installed with an AMS T-Series Rig using custom-designed augers of varying dimensions based upon depth and soil-type. The rig drills down the length of the EGRP® to be installed, plus an additional 2’ (per procedure, 2’ of natural soil is packed down between the surface level and the top of the EGRP®). The augers typically drill down in sets of 3, depending on specific layout and array.

Toro Turf Guard sensors were placed in each plot as follows. A line was made with twine between the NW and the SE corners of each plot. Sensors were placed 7 feet into the plot from the SE corner marker on that diagonal line (Figure 4). The top of the sensors were buried at a 4-inch depth below the soil surface which means the Turf Guard sensors probes are approximately 5 inches and 10 inches from the soil surface. Turf Guard sensors measure and record the volumetric moisture content (VMC) on 5-minute intervals 24 hours per day. The data is accessed through a program known as Site Vision®. The objective of the study was to measure difference in VMC, if any, in an in-situ turfgrass root zone utilizing time domain reflectometry (TDR), between plots containing the EGRP® and those without.

Figure 4. Blue circles indicate sensor locations relative to EGRP®.

Results

In Table 1 through 3, 24 VMC measurements are reported. Reported dates and times were chosen as they either followed or were taken during a rain event and VMC differences monitored via Site Vision® seemed apparent. It is pertinent to state that in the absence of a rain event there were little differences among the plots regarding moisture retention and that each treatment mean reported in the tables is the mean of three replications.

In Table 1, two dates, June 3 and 6 resulted in statistically significant differences within the 10% level and on both occasions the VMC in plots with the EGRP® system were drier. In Table 2, there are four dates with statistically significant data within the 10% level, July 21 and August 24, and two of those dates are also significant within the 5% level, July 10 and August 17. On all four of those occasions the VMC in plots with the EGRP ® system were drier compared to the control plots. In Table 3, there is a significant data set within the 5% level, September 22, and another within the 10% level, October 8, and on both occasions the VMC in plots with the EGRP ® system were drier. Though not statistically significant, of the remaining 16 measurements reported in Tables 1 through 3 each one resulted in VMC in plots with the EGRP ® lower than that of those without a drainage system.

Table 1.

Volumetric moisture content obtained from a 5-inch depth.								
	June 1	June 3	June 6	June 9	June 18	June 19	June 20	June 21
Time of measurement	11:55 PM	5:00 AM	12:10 AM	12:25 AM	10:25 PM	12:15 AM	12:20 AM	12:25 AM
Condition	Drying	Drying	Drying	Drying	Raining	Drying	Drying	Drying
EGRP®	30.1	27.6	24.8	22.6	36.7	34.8	31.5	29.4
Control	34.8	33.4	31.2	30.6	38.5	42.0	39.9	37.7
LSD @ 0.05	8.3	6.5	10.1	13.6	26.9	18.5	15.2	13.8
Probability	0.13	0.06**	0.09**	0.12	0.80	0.23	0.14	0.12

***** LSD - Least Significant Difference; p=0.05.
** Data is statistically significant within a probability of 0.10.

Table 2.

Volumetric moisture content obtained from a 5-inch depth.								
	July 7	July 10	July 21	July 27	Aug 15	Aug 16	Aug 17	Aug 24
Time of measurement	10:50 AM	7:55 AM	12:00 AM	12:50 PM	6:40 AM	11:30 AM	TIME	12:25
Condition	Raining	Drying	Drying	Drying	Raining	Drying	Drying	Drying
EGRP®	36.9	25.4 b	22.7	20.4	31.7	29	26.2 b	21.2
Control	41.8	33.5 a	31.8	29.6	32.8	34.9	33.3 a	29.8
LSD @ 0.05	6.3	6.2	11.9	15.9	6.6	13.8	3.3	12.9
Probability	0.44	0.03*	0.08**	0.13	0.86	0.21	0.01*	0.10**

***** LSD - Least Significant Difference; p=0.05.
** Data is statistically significant within a probability of 0.05.
*** Data is statistically significant within a probability of 0.10.

Table 3.

Volumetric moisture content obtained from a 5-inch depth.								
	Aug 31	Sept 22	Sept 22	Oct 7	Oct 8	Oct 9	Oct 10	Oct 11
Time of measurement	11:50 PM	6:55 AM	11:45 PM	10:20 PM	1:55 AM	3:50 AM	12:20 AM	11:35 AM
Condition	Drying	Raining	Drying	Raining	Drying	Raining	Drying	Raining
EGRP®	19.4	27.4	24.9 b	39.8	36.7	44.7	38.4	52.7
Control	28.5	30.1	31.3 a	46.1	42.9	48.8	44.5	59.3
LSD @ 0.05	16.8	6.8	4.2	37.5	9.8	22.5	10.3	16.3
Probability	0.14	0.67	0.02**	0.54	0.10***	0.51	0.13	0.22

***** LSD - Least Significant Difference; p=0.05.

** Data is statistically significant within a probability of 0.05.

*** Data is statistically significant within a probability of 0.10.

Conclusions

TurfGuard soil moisture sensors measure the VMC in the soil; they do not measure the amount of water infiltration or drainage. With that stated, it is intuitive that following a rain event on an identical turfgrass surface rooted in comparative soils that plots that dry faster did so because they drained faster.

It is noteworthy that during periods of dry weather, and even light rain events, there were no differences in VMC observed among plots with or without the EGRP® system (data not shown). This is important because it suggest that the soil moisture in plots with the EGRP® do not become too dry and continue to maintain healthy soil conditions.

Future studies should incorporate TDR soil moisture sensors at a greater depth below the soil surface as well as another model of TDR moisture sensor on the opposite side of the plots. These additional moisture sensors would assist in modeling flow during the drainage process. Additionally, beyond reporting VMC it would be worthy to report changes in moisture content from saturation events with drainage down to field capacity. Finally, plots should be monitored year after year to allow Parjana® Distribution, LLC to quantify the acclimation of the product after installation.