**2014 MSU Parjana Drainage Study Protocol II**

Time Domain Reflectometry (TDR) is the most accepted method to measure the volumetric moisture content (VMC) in the turfgrass root zone. By knowing the VMC the soils plant available water (the amount of soil water between field capacity and permanent wilting point) can be closely estimated. Numerous golf course superintendents and athletic field managers utilize TDR’s to determine when to syringe or irrigate a site. For the Parjana drainage study TDR’s will be utilized to determine how much quicker the inserted devices dispel of gravitational water in the soil profile. To perform the study a golf course fairway will be identified with similar topography that is capable of being wetted or dried upon command.

Plot size will be determined by Parjana engineers based upon the sphere of influence of the Parjana drainage devices. Assuming a plot size of 8 feet by 8 feet a TDR will be placed in the middle of each plot. In-situ TDR’s will give continuous readouts of the soils VMC. This technology will allow us to flood the area several times and monitor dry down (or drainage) not just on the surface but in the soil profile itself. Additionally, weather permitting; the research site will have several dry down periods to gather data on the VMC with and without Parjana drainage devices in the soil. Obviously this is important because managers of high profile turfgrass sites will question if the Parjana drainage devices drain too much water.

For statistical analysis the study will require a minimum of three replications (four might be better but is not necessary). The study would be comprised of two treatments:

**Treatment 1:** plots with Parjana drainage devices installed and

**Treatment 2:** plots of the same size with no drainage

Data collection will include:

* VMC measurements via in-situ TDR placed in the center of each plot at an equal depth.
* TDR measurements taken with hand held devices. This allows for VMC readings nearer to the surface. These measurements will be obtained weekly and sometimes daily when planned wettings and dry downs are taking place (add $1250.00 per year if we add these measurements).
* Visual observations will be obtained weekly at the same time hand held TDR measurements are obtained and will be obtained more often if differences occur during a dry down or if disease differences occur (add $750 per year for these observations)
* In-situ water infiltration measurements. This is a controlled measure and will give us the best indication of differences between plots with and without Parjana drainage devices (add $3000.00 to perform this one time and an additional $1500.00 for every time we collect this data afterward).

If data is collected from the site in 2014 that indicates the Parjana drainage devices function adequately the site should be maintained and data collection continued annually to determine the lifespan of the Parjana drainage devices.

As a deliverable a research report (with pictures) will be sent to Parjana by December of 2014. More importantly I give numerous presentations around the world annually and I write a bi-monthly column in GCM magazine where I will share the data with my perspective audiences.

Funding for the original study outlined in Protocol was $8500.00. Additional funding in Protocol II can be determined by adding the highlighted sections above.