The Use of Weather Stations

by Dan Dinelli

The health of turf and ornamental plants is affected by many factors: irrigation practices, including water quality; fertility; soil type and conditions; plants natural resistance to pests; inoculum pressure from disease; stress and wear from recreational activities and weather. Maintaining healthy plants requires an understanding of these integrated factors and management practices. Managers must work within acceptable parameters including costs and environmental considerations. It seems to always be a *balancing act* weighing all the factors together. We strive to understand the different stresses and minimize them to the best of our ability. Some stressful conditions are controllable, others are not. Weather is one of the most difficult factors, beyond human control. Yet, weather can be the greatest influence on turf quality. Consistent, accurate weather predictions can not even be relied on to plan management practices. With no control and lack of predictability, the next best thing is to have the ability to collect historical and present detailed weather data. With this information, degree day accumulations for insect activity and computerized disease models can be used to predict favorable conditions for pests. The use of a complete weather station, with disease model software, is a tool to do just that. In the spring of 1994 we at North Shore Country Club purchased a Metos weather station.

The Metos station is a complete weather station offering many features. Our Metos is equipped with 10 sensors. Two thermometers, one for air temperature, 5 inches above the turf and one for soil temperature 2½ inches below the turf in our 4th green. It is equipped with a rain gauge to measure rainfall and irrigation water. There are two leaf wetness sensors, a solarimeter to record solar radiation and day length. A soil moisture probe located 2½ inches deep, in the 4th green. Relative humidity is measured 6 inches above the turf. Wind speed and direction are sensed and recorded. It offers raw weather data, degree day calculations, evapotranspiration value, three disease models; Pythium Blight, Brown Patch, & Dollar Spot. Spray data can be entered into the program to track the impact of spray decisions on disease activity. The Metos micrologger automatically scans all sensors every 12 minutes, and stores this data for up to a week. Information is downloaded from the micrologger to the personal computer at the office any time. The data is stored on the harddrive, and used in the Metos software. One more attribute on the Metos is the solar powered charging system.

Singularly or collectively, data from these sensors offers us much information, improving and at times justifying many

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of our management practices. For example: The soil moisture sensor is a Watermark gypsum block with a range of .2 to 15 bar. The computer graphs the soil wetness with readings from 0 = completely saturated to 254 = completely dry. We were able to design a rating scale that helped us determine daily watering needs. This information was more helpful to use than calculated evapotranspiration (ET) values. However, the data from the two combined, gave an even clearer picture of moisture loss and needs. If one had greens constructed to USGA specifications, it would be interesting to have two soil moisture sensors. One close to the top to sense moisture available for shorter roots and ground conditions effecting playability. Another sensor located at the bottom of the sand layer, just above the perched water table. This deeper sensor may prove helpful assessing available water from the reservoir provided by the perched water table.

The Metos utilizes air temperature, relative humidity, wind speed and solar radiation to calculate evapotranspiration. Evapotranspiration (ET), according to the Penmann formula, gives an estimate of water lost by evaporation into the atmosphere and by transpiration from the turf plant. The Metos references ET as inches or millimeters of water loss per 24 hour period.

Information gathered from soil temperature has helped us to better judge the timing of our first fungicide application to control Summer patch (Magnaporthe poae) and Take-all patch (Gaeumannomyces graminis). Soil temperature data will also indicate the proper timing of pre-emergent herbicide treatments for crab grass control.

Microbial activity is governed largely by soil temperature and moisture. Nutrient release by some fertilizer carriers is also governed by soil moisture and temperature. With a better understanding of these factors, we can better understand and predict fertilizer activity.

Insect development relies on many factors. One of the largest factors is heat. Scientists have come up with a way to help better predict insect emergence and activity by tracking accumulated heat, expressed as degree days. The Metos calculates degree days by summing 120 air temperature measurements for the day, and dividing that sum by 120 to get an average temperature for the day. This integrated average is much more accurate than simply adding the day's maximum and minimum temperature and dividing by two. This was the method we used in the past. Once the average is obtained, the degree total for the day is this average minus the base temperature. We use a degree base of 50F. So for a day with an average temperature of 59F, at base 50F, the degree days for that day would be 9. Each day, this calculation is repeated and the result added to the previous days' figures to get the running total of accumulated degree day's value. If the average temperature for the day is less than the base, the degree days for that day are zero, not a negative number. Researchers have developed degree day thresholds for many insects. Knowing the degree day value and referencing it to a particular insects' development, in effect, creates a calendar of insect activity. Following such a calendar helps the turf manager to focus on intense scouting for a particular

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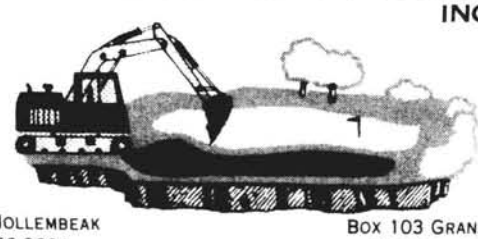

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insect and better target insecticide applications if needed.

Other biological activity can be predicted using degree day figures. Plants respond to accumulated heat as well. Some plant's determination to flower or set fruit can be predicted with degree days. Poa annua has a degree day model for its flowering period. Understanding the plants physiological state can better determine the timing of plant growth regulator applications. Because plants and insects share this heated phenomena, field observations of plant activity can also help in determining insect and weed activity. For example, it is noted that pre-emergent crabgrass controls should be applied when the Bridal Wreath Spirea (Spiraea x vanhouttei) blooms. In this case, the Bridal Wreath Spirea is an indicator plant for the conditions of crab grass germination. This next season we will make comparisons of DD values versus indicator plant responses. We have a garden of indicator plants growing on the golf course for this purpose. For further information on timing pest management with ornamental plant development, the book *"Coincide"*, by Donald A. Orton is a good reference.

Metos has three prediction models for turf diseases, Pythium Blight (Pythium aphanidermatum), Brown Patch (Rhyzoctonia solani), and Dollar Spot (Lanzia & Moellerodiscus spp.). The predictive models are based on complex mathematical calcuations to estimate severity and timing of disease events. The calculations include information collected from sensors of air temperature, soil temperature, rain or irrigation, relative humidity and length of leaf wetness. These predictive disease models are used as indicators of favorable environmental conditions for disease. It does not account for inoculum pressure, species or cultivar resistance to disease, fertility or future weather (environmental) conditions that may or may not favor further disease development. Ultimately, it is the turf manager who makes the decision on disease pressure versus needed controls.

Our first years experience with the Metos weather station has been educational, helpful and very interesting. It has proved itself as an important tool in our intergrated pest management program. Information from the Metos weather station helped in fine tuning our irrigation needs. It also helped our timing to scout for disease and insect activity. It is a powerful tool, offering an objective guide to pest management. People who may question our management activities can relate to a computer print out over a "judgment" based on experience. If ET value calls for irrigation, it is based on scientific calculations and not a persons "opinion". This "scientific" support of what we do is becoming increasingly important.

Considerable work is still needed to establish historical databases for weather data and to accumulate field observations that relate to it. More disease models need to be constructed. Degree day models need to be calculated for other pests as well as for beneficial insects. There is a lot of room for "home grown" research based on collected data coupled with field observations. We are looking at soil temperature readings to help fine tune the timing of green cover applications; day length and how it may effect plant responses; solar thermal units to further refine degree units; and soil temperature versus root growth. The uses and applications are limited to your imagination — that's what makes this tool is exciting!

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