A GUIDE TO TESTING PRODUCTS AND MANAGEMENT PRACTICES FOR GOLF COURSE SUPERINTENDENTS: PART I GETTING STARTED

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Within the past two years, at least four new fungicide active ingredients, a new herbicide and a new insecticide were introduced for use in pest management at golf courses in California. Combined with the currently registered pesticides, fertilizers, amendments, and various new pieces of cultivation equipment and turfgrass management approaches, the task of selecting the correct blend of products and practices can sometimes be daunting. The only way to gain more confidence that a management system is the best one for your site is to start a testing program. This article is the first in a series of three articles that will describe how to set up a successful testing program at a golf course. Part I, Getting Started will describe the basic elements of testing program, attitude, components of an experiment, record keeping; Part II, Experiment Design will provide expanded details on how to set up experiments that will be simple and efficient, plot design, replication and randomization techniques will be discussed; Part III, Interpreting Results will provide a background on how to evaluate your findings and how to decipher scientific publications with an introduction to basic statistics. Combined, these three articles will provide sufficient information to develop an effective testing program.

You've got to have an ATTITUDE!

One of the most important factors to consider when setting up a testing program is your attitude. If you have a feeling that you want to prove a product works or doesn't work, your attitude will get in the way – your biased from the start and your bias may influence the way you perceive the results. Before venturing into the realm of testing products and processes, spend a minute of soul searching before you start a test – if you really want to see a product fail, it possibly will because your perception is biased toward failure. There is no reason to run a test under these conditions. If you are open minded, however, your level of bias will be lower and your results will be more valuable to your. With your attitude adjusted, you will run tests to COMPARE, EVALUATE, and DEMONSTRATE, never to prove.

The Experiment

A testing program is really a series of experiments that have several well-defined components that must be considered before and during the execution of each experiment. 1) Clearly state the OBJECTIVE of the test. Why is the test being conducted in the first place? 2) List the MATERIALS that were used and the METHODS of application or how the equipment was used. This should include the sprayer or spreader configuration and calibration information. 3) Once the experiment has been started, begin recording OBSERVATIONS for each product or process being tested. Observations can be descriptions of visual characteristics, numerical ratings (objective measurements, weights of clippings, soil electrical conductivity readings) or relative ratings (subjective performance estimates of quality 1 – 9 scales) of turf performance. 4) At the end of the experiment, reread all of the notes and write a discussion of that summarizes the findings and potential future tests. These four components, Objectives, Materials and Methods, Observations, and Discussion are the essential components of any testing program. Omit any one of these components and you will find that it is difficult to determine what actually happened during the experiment and you may never be able to reproduce the results.

An Example

Testing programs can take on many flavors. In this example, the superintendent suspects that fall aeration when soil salinity is elevated may have resulted in water channeling down the sand-filled aeration holes instead of uniformly flowing through the entire soil profile. The symptom is green polka dots throughout the low areas of the green surrounded by chlorotic plants. How would we test the hypothesis that there is no difference between the salt content of the sand extracted from aeration holes and the soil between the aeration holes? The experiment might look something like this:

Objective: Compare the soil electrical conductivity (EC) under chlorotic turf surrounding green polka dots of healthy turf to the soil EC under the green polka dots.

Materials and Methods: Three cup cutter samples will be taken from green 15 in the area where the chlorotic (yellow) turf with regularly spaced green polka dots are located (front left where traffic enters the green). A knife will be used to dig out the sand under the green polka dots and the sand will be placed into a coffee cup labeled "holes." Similar samples will be collected from between the aeration holes for comparison and placed into coffee cups labeled "between." Water will be added to each sand sample until they are saturated. A Cole Parmer TDS-4 meter will be used to measure soil salinity and values will be converted to saturated paste equivalent values.

Observations: The green polka dots of healthy turf occurred over aeration holes. The roots were white and more than an inch long in the aeration holes. The roots were short and off-white colored under the chlorotic turf. The EC for the sand in the aeration holes under the green turf was 2.2, 2.8, and 2.5 dS/m and the EC of the soil between the holes was 5.1, 4.6, and 4.8 dS/m.

Discussion: The salinity of the new sand under the green polka dots is lower than the surrounding older sand. This may indicate that water is channeling down the aeration holes rather than percolating uniformly through the soil or there is some other problem with the soil between the aeration holes (e.g. compaction, low soil air movement, pathogens may be present). Because poa only tolerates a soil EC of 3.0 dS/m, the front of green 15 needs to be leached to drop soil salinity levels between the aeration holes. Soil salinity should be monitored following leaching to be sure that the soil salts have been reduced to below 3.0 dS/m and the chlorosis disappears. Recovery should also be monitored. Traffic and compaction are probably making the problem worse so golfers should be rerouted using a rope barrier on Monday, Wednesday and Fridays to move golfers to the right-front side of the green.

The above experiment is an example of how golf course testing programs can be used to provide a wide variety of benefits. This simple test described can be conducted in a matter of about one hour and the results of the test will help improve management practices by identifying the need for increased leaching and modified traffic patterns. A golf course testing program should not be limited to evaluation of products.

The Power of Nothing

An introduction to experimentation would not be complete without stressing the value nothing. For readers familiar with experimentation, nothing will interpret into a non-treated control or check area. This is an important concept and it is not as easy to define as it sounds. The non-treated area is an area within the green, tee, fairway, etc. that is managed just like the area where the treatment (fertilizer application, pesticide application, cultivation) is going to take place with the exception that nothing will be applied or nothing will be changed in your typical management program. The non-treated check area will be the yardstick to measure product or process improvements in, or damage to turfgrass quality. The location of the non-treated control area is important because must fairly represent the entire area being treated for comparison. If the non-treated control area is not fairly placed, the test will be biased – the results may be confusing – your time may be wasted.

Where Plywood is King

A piece of plywood, used properly, can save thousands of dollars in unneeded fungicide applications. How is this possible? Combined with our understanding of the power of nothing described above, plywood is one of the most effective means of providing non-treated control plots. Simply place a piece of plywood (4'x8' or smaller but usually not less than 4'x4') on an area of turf that you wish to evaluate the performance of a fungicide for control of a conspicuous disease prior to application of a test fungicide. The area under the plywood will be the non-treated control.

For example, some superintendents treat greens whenever light green or yellow rings form on greens during the fall and spring. These rings are frequently caused by *Rhizoctonia cerealis*, a relative of *Rhizoctonia zeae* but without the punch of the more difficult to control *R. zeae*. *R. cerealis* produces the unsightly rings that frequently disappear without fungicide treatment in dry weather and reappear during heavy dew or rainfall (without fungicide treatment, *R. zeae* won't disappear but the turf will). If a few irregular rings caused by R. cerealis are not a serious aesthetic problem, why apply a fungicide? But what if the problem is *R. zeae*? The safe bet is to apply a fungicide but there are many reasons why a fungicide should not be applied to control *R. cerealis*.

These fungi produce sufficiently different symptoms that a superintendent can tell the two apart – but not without some testing first. When the irregular yellow rings show up, spray as you would normally (for Rhizoctonia, Prostar is a good choice). But this time, place a piece of plywood over some of the irregular yellow circles before spraying so that nothing is applied to these areas – the non-treated control plot. Mark the location of the corners of the plywood using turf paint so the non-treated areas can be easily identified for three to four days. Observe the plots daily for several days and record your observations. In this case, what would the objective of the study be? Can you list the materials and methods for the study proposed? What might the outcomes be? How much money might you save if the irregular yellow rings disappear in the non-treated control plots – and why?

Record Keeping

The foundation of any testing program is record keeping. Before starting any testing program buy several composition notebooks at a stationery store. These notebooks are inexpensive and they will provide a reliable place to keep a chronological log of your testing programs. Leave a few pages blank at the beginning of the book to use as an index. Use only ballpoint pens that do not have water-soluble ink. Tape a business card into the inside cover in hopes that someone will return the record book if it is misplaced. Write freely in the book any observations that you have regarding the performance of a product, the reaction of golfers to a management practice, or difficulty handling or applying a material. Excess information is better than insufficient information. This notebook will be the object of discussion in resolving disputes about which practice or technique is best and where or how a product was applied. Date each entry and take notes carefully so that your efforts are not wasted.

Stay tuned for the next installment of A Guide to Testing Products and Management Practices for Golf Course Superintendents: Part II Experiment Design. You will find out that it is easy to set up a meaningful experiment and even easier to design an experiment that leaves you with more questions than you had to start with. Keep It Simple Superintendent!

Part 2, Experimental Design

In Part 1, Getting Started, we left off with record keeping. This installment of How to Test Products and Practices will pick up from that point and provide some guidelines in experimental design - how to select treatments and how many treatments makes a good trial. The information provided here is only a launching point for to get you started in an testing program. If you enjoy the process and find on-site testing has been valuable, there are a few additional sources of information that will help you develop additional testing programs (Camper 1986, Hickey, K.D. 1986, Little and Jackson 1978). Unfortunately, most of these resources do not address turfgrass systems but they do provide a variety of ideas on testing practices.

Thinking Pays Off

Spending quality time thinking about an experimental project will pay off in the end. Gather up your ideas and find some supporting research before you develop your plan. The research can be something provided by a salesman, an article in a trade journal, or a scientific publication. If you can't find any supporting research for an idea that you want to test, you haven't looked hard enough. This doesn't mean that you shouldn't test something entirely new - it means that there are few ideas that are new and you should take advantage of other people's efforts so that you can contribute information builds on the information already available. In most cases your efforts will be directed at improving or modifying an existing process or use of a product. The payoff is in better performance, cost savings, and improved turf quality.

For example, what if you have heard that nitrate nitrogen fertilization may aid in root development and reduced shot growth compared to urea and ammonium nitrogen sources. A review of the literature finds some supporting evidence (Glinski et.al., 1990) so you want to see if nitrates improve rooting in a golf green. The publication or report should detail methods that can be adapted to a test under real golf course operational conditions. In this case, the best root to shoot ratios were obtained when the plants were supplied with three nitrate:ammonium in a ratio of 3:1. Although other ratios were evaluated, why not try the best case first compared to current nitrogen fertilization and fine tune the system later.