IPM Leading To Holistic Plant Health Care – Part 2

Dan Dinelli
North Shore Country Club

PART 2—Continued from the December 1996 issue.

IV. CULTURAL METHODS

The following is an overview of cultural practices that I feel made a significant favorable impact under our growing conditions. By no means does this include all cultural methods used.

Proper pruning and thinning of trees: This ensures better air movement and solar radiation on the turf canopy. Root pruning of trees that surround all greens, tees and fairways: This practice is done every five to seven years. A powered pipe puller with a vibrating plow is used. Irrigation needs are reduced by this practice.

Overseeding is done using improved cultivars. On greens, tees and fairways, compatible cultivars are used in blends of bentgrass. We choose fine leaf texture and upright growth habit varieties. In the roughs, mixtures are used utilizing endophyte-enhanced varieties when possible. We look for similar leaf texture, growth habit, color and fertility requirements in our compatibility evaluations. Our goal is to achieve genetic diversity with adaptive potential.

Dew and guttation water is removed daily. First task of the day is to either mow or drag. A length of high-pressure spray hose is used between two trucksters to manually remove the exudates on fairways. This has improved early morning playing conditions and removes free water favorable for disease development.

Vertical mowing is done each time the greens are mowed. On tees and fairways, brushing or combing is done with each mowing. This, with overseeding upright, fine leaf textured cultivars, keeps turf grain free. Golfers like this for better golf ball lie and trueness in ball roll. When this is achieved, slightly higher mowing heights can be used without sacrificing playability.

Recently, we have used yard waste compost as a soil amendment, fertilizer and disease suppressant on fairways.

Rolling greens after mowing is done prior to golf events. This allows faster ball roll without lower mowing heights. With the incorporation of a high sand upper root zone, compaction and wear has not been observed.

Fertility Management

The following is our basic fertility program. Though we constantly fine-tune our program, I feel the products used have given us a great life support system for plant health and essential soil microorganisms required to build a strong, healthy, aggressive growing plant while improving the productivity of the soil naturally. Annual soil tests are performed, both acid extraction and base saturation. With this, tissue tests are performed periodically as a "snapshot" of the plant's activity. We strive towards balancing nutrients to turfgrass requirements, noting proper ratios of nutrient elements to one another and pH.

The backbone of our fertility program is based upon many natural and organic fertilizers. Products used are derived from activated sewage sludge, hydrolyzed feather meal, meat meal, bone meal, poultry meal, blood meal, fish meal, langbeinite and sunflower seed hull ash. These carriers contain carbohydrates, fats, proteins, sugars, humus and humic acid. Also, over 12 amino acids and vitamins like E, B_{12}, riboflavin, biotin, chorine, thiamin, folic acid and niacin. These biostimulants enhance biological activity as well as being a source of plant food nutrients. When applying fertilizer, the program is to apply light and frequent applications, stimulating microbial activity without excessive top growth. Occasionally, foliar sprays are used with readily available elements: Calcium glucoheptonate as chelated calcium, ferric nitrate as soluble iron, potassium nitrate, magnesium sulfate, sodium silicate. Hormonal applications are made as biostimulators. Seaweed extract is used as a source of cytokinin.

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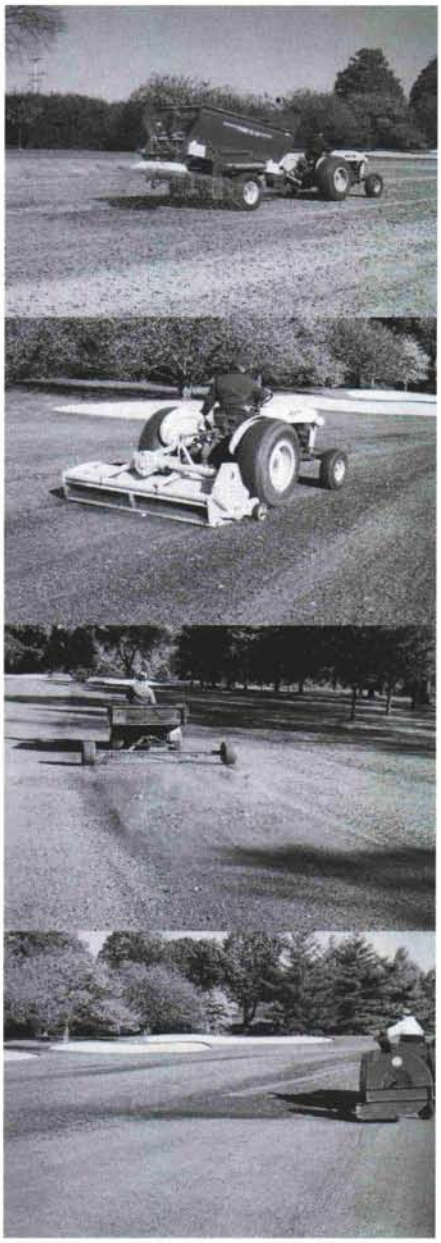
Recently, we have used yard waste compost as a soil amendment, fertilizer and disease suppressant on fairways. Overall results of this topdressing amendment have proven well, with fewer localized dry spots, reduced thatch and increased earthworm activity. Integrating these various inputs has created an environment for the turf plant to better withstand harsh environments, suppress disease and offer better playing conditions, promoting a dense stand of turf with good wear tolerance and surface resiliency.



Cultivation

Compaction relief by deep shatter tining is done on greens and tees. This practice has helped our rooting tremendously. Half inch tines are used, penetrating 10 inches deep. Holes are left open to allow root mass to develop. As the internal holes collapse (two to three years' time), trails of organic matter is left, allowing for deep root penetration without the visible hole. This tool has greatly improved our soil gasses exchange and water percolation.

On tees, fairways and roughs, coring is done spring and fall. On tees, the cores are removed. On fairways and roughs, the cores are broken up and worked back into the thatch and soil profile. On fairways, we have included a topdressing of yard waste compost as part of the operation. The procedure on fairways is to: (1) pull up cores, (2) break up cores with vertical mower, (3) topdress with well decomposed yard waste compost, (4) mix and drag in virgin soil/compost mix, (5) blow off debris from fairway into rough, and (6) pick up debris from rough with rotary mower equipped with bagging attachment.

Mid-season cultivation on greens and tees is done by high-pressure water injection when needed.

Irrigation

Information from our weather station, combined with daily field monitoring, dictates our irrigation needs. The weather station figures evapotranspiration (ET) according to the Penmann formula. A soil moisture sensor is located 2 inches deep in our fourth green. The readings reflect soil water tension or suction. This physical force of soil water is a direct indicator of how hard the plant's root system has to work to extract water from the soil. The sensor uses centibars as a measure 0 - 200. The drier the soil, the higher the reading. We target consistent soil moisture of 50 - 60 centibars, avoiding severe drying cycles.

On the average, this constitutes daily light watering opposed to deep infrequent watering. Periodic rains are often enough to purge and ensure soil moisture deeper in the root zone. Each day during course set up, the turf is surveyed for malfunctioning heads and dry spots. Soil moisture along with rooting assessment is done while changing the cups on the greens. Collectively, information is gathered to judge irrigation needs.

Several water treatment additives are injected into our irrigation system. Surfactants are used according to label directions to aid in water retention and percolation. Another injection system incorporates urea-sulfuric acid. The acid is injected at a rate of one gallon per 35,000 gallons of water on the average of every third watering cycle. This system helps manage high bicarbonate levels in the irrigation water. It is not my intent to use this material to alter soil pH. The overall goal is to have irrigation water that moves through the soil profile well, will not precipitate calcium and offer quality water for life support systems. A third injection system involves a bioreactor to incorporate antagonistic bacteria for disease suppression. This is covered in "Biological Controls."

V. CHEMICAL METHODS AND CONSIDERATIONS

Our plant protectant program is designed to minimize the use of chemicals. When used properly on turf, chemicals pose little threat to wildlife and human health. However, animal tolerances differ with each individual.

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All human activities have an element of risk. Peanuts, for example, are found in many health foods, but people have died eating them due to their hypersensitive reactions. The reasons we strive to avoid chemicals are due to their known side effects, including modifications in carbohydrate metabolism, alterations of tissue and nutrient contents, changes of microbial composition, and reduced nitrogen mineralization.

Plant pathogens have developed resistance to certain fungicides. Under certain conditions, an increase of incidence and severity of both target and nontarget diseases occur with fungicides. Pesticide degrading microorganisms are enhanced with multiple use pesticides. Pesticides are expensive. Costs are driven up from the extensive testing required by the Environmental Protection Agency (EPA).

When pesticides are used, they are chosen carefully and used according to label instructions. Considerations are made on how they may affect biologicals, especially the microorganisms we are using. Every effort is made to maximize the chemicals used. The pH is tested to assure alkaline hydrolysis is minimized. Covered spray booms are used equipped with flat fan high pressure nozzles. This assures good spray distribution deep into the sward. Being covered, drift is prevented putting all the product on the target.

With the exception of putting greens and some diseases, I adhere to a curative chemical program. Many of the patch diseases caused by ectotrophic root-infesting fungi, Pythium and winter diseases are still controlled by preventive applications, when conditions favor these diseases. I look forward to better using biologicals for these organisms, along with better prediction by disease forecasting models or immunoassays. The Pythium and Brown Patch model I use from the weather station works well indicating the need to scout. Nontraditional chemical controls are also considered. Ammonium sulfate, for example, is used as a nutrient and pH alteration. The acidifying effect has helped control take-all patch. Antitranspirants and surfactants have been used to minimize powdery mildew.

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What has made the largest impact on reducing chemical use is my attitude toward diseases. In the past, strict preventive spray programs were followed. If any symptoms of disease (with some tolerance for Dollar Spot) was observed, first I tried to figure how the disease "got through" the preventive spray program. Then I would figure what should be sprayed the next day to stop any further disease development.

I have learned that tolerance of some plant diseases is OK. Many times the symptoms go away by microbial antagonism, immunity or change in environmental conditions. I have also learned that it was I who demanded the perfect disease-free turf, not the golfer. Golfers do not recognize minor disease symptoms unless they are on the putting greens.

Our program has largely moved to a preventive program by the use of cultural, biological and biostimulant approaches. This has afforded us to move to a curative chemical approach. This change is challenging for several reasons. First, a more intimate understanding of the plant's ecosystem is needed to understand plant health care. It is easier to budget for preventive spray programs. And it is unnerving to monitor disease symptoms taking a "wait and see" approach.

VI. BIOLOGICAL PRACTICES AND CONTROL

A brief study of microbiology quickly demonstrates that microbial activity governs the world. Though largely invisible with the naked eye, microorganisms' effects on earth are colossal. Their powerful world is a network of living organisms with great diversity. Each has developed a way to inhabit their ecological

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niche. The basic population interactions are antagonism, competition, predation, parasitism and pathogenicity. It is an understanding of these functions that enables us to harness their powers to favor turf ecology. Interrelationships occur throughout the plant, both above ground and below. Microorganisms, topography, climate and parent material of soil largely dictate what plant communities may thrive.

My overall management of plant health care has grown from turfgrass management to turfgrass bionomics. The goal is to enrich microbial activity, enhance resident antagonists and inoculation of antagonists to suppress disease.

Countless microorganisms exist, but few are commercially available. It is difficult to make generalizations or summarize microbial management. It is a dynamic science that I do not know enough about to make accurate broad statements. In the past, names like *Rhizoctonia, Fusarium,* and *Typhula* meant plant diseases. Now science has discovered that species of *Rhizotonia* control Brown Patch, *Fusarium* species control Dollar Spot and *Typhula phacorrhiza* controls plant pathogenic *Typhula*. The following is a list of organisms I have used: *Bacillus subtilus, Bacillus licheniformes, Bacillus megaterium, Bacillus thuringiensis, Pseudomonas aureofaceans, Pseudomonas cepacia, Pseudomonas fluorescens, Trichoderma harzianum,* three proprietary strains of *endo-Mycorrhiza* VAM, *Azospirillum brasilense, endophytes* and *Steinemema riobravis.* I have seen good results with some of these organisms, and others were difficult to quantify.

Scientifically, I can share some data collected. VAM *Mycorrhizal* inoculation increased our root colonization from 34% to 55%. Root depth increased from 6.7 cm to 10.3 cm. *Trichoderma harzianum* successfully colonized the turf's root system of 5x10 to the fifth colony forming units (CFUs).

Microorganisms are living organisms requiring specific needs. Those needs may not be met from one course to the next. Before subscribing to broad applications, small areas are tested for effectiveness. For organisms to be effective, thresholds must be overcome maintaining high enough populations. In soils, this is a difficult task, for competition with native populations is immense. Often frequent applications are needed to ensure high enough counts.

I have used an irrigation injection system for two seasons. It is a self-contained microbial fermentation device that delivers microorganisms each time we water. This approach overcomes many of the difficulties posed in the past. As this system is perfected, known antagonistic microorganisms inoculate the turf each night while irrigating. The system delivers live organisms (opposed to dormant) at high counts. The procedure is done at night, overcoming ultraviolet light degradation. Since the incorporation of this device, I now water early at night. Any free water on the plant is laced with antagonistic organisms preventing plant pathogens from developing. I have seen good results implementing this procedure. As the system improves multiplying high counts and as more microorganisms become available for use, I can see this becoming a very common practice.

My experiences with biologicals as a whole have been favorable. However, there are many more questions than answers at this time. Science is just now learning how to take apart the components of the ecosystem and understand the functions of the turfgrass community.

Greens, tees and often fairways are disturbed sites. I look forward to welcome the challenge as science moves from theory to function in restoring these sites for optimum turfgrass health that is in harmony with nature. Genetic modification of turfgrass cultivars teamed with management of favorable microbial populations is a long-term view of sustainable procedures in holistic plant health care.

If golfers only knew!

My experiences and practices are based on 20 years of experience at North Shore Country Club located 20 miles north of Chicago, Illinois. It is a temperate climate suited for cool-season grasses in hardness zone 5 (average annual minimum temperature of -20°F). Though it is an agronomically diverse region of over 145 different soil types, we basically have heavy clay loam soil. The golf course was designed by H. S. Colt and C. H. Alison and built in 1924. We maintain tees and fairways on virgin soils, and the greens are based on push-up construction utilizing virgin soil as the base with a modified high sand/peat layer approximately 3" deep via topdressing. Grasses on greens, tees and fairways are creeping bentgrass and Poa annua. ■