HISTORICAL PERSPECTIVES, EMERGENCE OF TURFGRASS SCIENCE, AND ENVIRONMENTAL ISSUES

by

Dr. James B Beard

Golf courses evolved and persisted over several centuries principally on the coastal areas along the seas around the United Kingdom. The construction of golf courses on upland clay soil areas was restricted for most of this period due to severe earthworm problems that made the putting greens unplayable for a major portion of the year. In the late 1800's several different organic and inorganic chemicals were identified that acted either as (a) irritants in which the earthworms emerged onto the surface and were physically removed or (b) as toxic agents. Other than the suppression of rabbits and the control of weeds, primarily by mowing, this was one of the earliest pest control practices employed on golf turf areas. As golfers demanded improved turf quality on greens a number of other problems, such as environmental stress and pest problems, were identified and appropriate plant protectant agents developed.

Historical Pesticide Perspectives. Some environmentalist point out that a very few pesticides were used on golf courses prior to World War II and that after 1960 there was a great expansion in the number of plant protectants used. This is correct! However, it should be recognized that most of the pesticides used from 1920 through 1960 were (a) nonbiodegradable, (b) applied at high rates, (c) persistent, (d) inorganic materials containing either arsenic, lead, mercury, cadmium, copper, sulfur, or nicotine compounds (Table 1), which are noted for their toxicities to humans (4). Since 1960 the modern trend has been to use biodegradable, short residual, low application rate, organic compounds having low toxicities to humans and animals.

During this same pre-WWII period the fertilizers used were either (a) manures, which were readily available from the many horses used for power and from animal agriculture widely distributed throughout the country-side, or (b) water-soluble materials such as ammonium sulfate, ammonium nitrate, and calcium nitrate. All these have rapid nutrient release times of only 3 to 5 weeks.

Table 1. Common pest controls used on turfs from 1900 to 1960:

Pesticide	Pest(s) Controlled
Lead arsenate	Insects and annual grasses.
Nicotine compounds	Insects
Carbon bisulfide	Ants
Copper Compounds (Paris green, Bordeaux mixture)	Diseases
Mercury chlorides (Corrosive sublimate)	Diseases
Cadmium compounds	Diseases
Sulfuric acid	Weeds
Sodium arsenite	Weeds
Sodium chlorate	Annual grasses
Strychnine	Animals
Calcium cyanide	Burrowing animals

Maintenance Intensity Issues. The speed of modern communications has lead to a global orientation for many activities of civilizations, including those of recreation. The turf maintenance philosophies have evolved to what some people like to describe as two distinct approaches. One is the "traditional" or so-called low-maintenance approach of the United Kingdom and the other is a "United States" approach frequently referred to as a high-maintenance approach. Point in fact, there is a wide range in the intensities of maintenance on golf courses from high to low in both the United States and around the world (2). However, this is not the perception derived from televised golfing events where the golf courses viewed typically have a very high turf-surface quality and associated intensity of turf culture.

A great diversity in climatic and soil conditions occurs in various countries around the world, as well as within individual countries. Maintaining comparable competitive turf conditions under these varied climatic and soil conditions of individual countries requires different intensities of cultural practices, especially the nutrient, water, and plant protection inputs.

Unfortunately, the standard many golfers use in assessing a golf course is the greenness of the playing surfaces. This evolved from the United Kingdom where the temperature and rainfall conditions are particularly favorable for grass growth throughout the golfing season and where serious attacks by a majority of the turfgrass pests are not a problem. When this dark green criterion was brought from the UK to hot, humid and/or arid regions of the world, such parts of the United States, it required a major increase in cultural inputs to produce a comparable, year-round greenness in the playing surfaces (1, 2).

Emergence of Turfgrass Science. To meet this demand for greenness and uniformity of playing surfaces, the golfers, through their national and regional organizations made a plea for technical information to achieve these objectives. This was accomplished by research conducted principally through the state land-grant university-college systems in the United States. The state agricultural experiment station researchers, along with innovative developments by the turfgrass manufacturing industry, resulted in numerous advances in turfgrass science that have in fact made golf course maintenance more environmentally friendly than in the past (1). Included are:

- The development of slow-release fertilizers that minimize nutrient loss by volatilization and leaching and a nutrient release profile two to three times longer, eg. methylene ureas, sulfur coated, IBDU, UF, and polymer coated nitrogen carriers.
- Irrigation systems that apply water more uniformly and efficiently, including computer monitoring and prediction modeling of evapotranspiration (ET) rates in order to apply water amounts that meet the specific needs of individual grass and soil conditions.
- Biodegradable, short residual, low application rate, organic pesticides specific to individual pests, thereby avoiding the use of broad spectrum, long residual chemicals that persist through one or more growing seasons.
- Turfgrass cultivars with improved resistance to environmental stresses, insects, and diseases.

These four major groupings are representative of the larger number of advances achieved through turfgrass science. These contributions have made turfgrass culture on golf courses very environmentally friendly.

Environmental Issues. Certain environmental activists have made unsubstantiated allegations about pesticide and fertilizer usage on golf courses, primarily concerning adverse effects on ground and surface water quality (3). Research during the past eight years has demonstrated that the turfgrass ecosystem in the upper 6 to 12 inches (150-300 mm) of the soil has a root system which in the process of ongoing decomposition supports one of the most diverse, large decomposer organism complexes known (5). Further, that the pesticides legally registered for use on turfs in the United States are readily decomposed by this turf ecosystem, with the exception of a few nematicides used primarily in Florida. Also, research has shown that the same fine, fibrous root system with extensive root hair development is highly efficient in the uptake of applied nutrients. On-site research has shown no significant problems with surface or ground water quality if the fertilizer is applied (a) while the turfgrass roots are actively growing and (b) in amounts commonly recommended (5).

A third issue relates to accusations that turfgrasses are very high users of water. However, research has shown the evapotranspiration rate of plants, including grasses, trees and shrubs, is related to the amount of leaf area. Subsequent studies document that trees and shrubs use far more water than mowed turfgrasses (5). For example, a 12-inch (300 mm) diameter tree used 80 times more water than the turfgrass area under the tree canopy. World plant distributions further support this premise in that the great grasslands are found principally in the semi-arid portions of the world, whereas the great forests are found in high rainfall areas.

Another perception that often is misunderstood is the assumption by many that pesticides and fertilizers are applied to the entire area of the golf course. However, a survey has shown that on average only 21% of the golf course area is maintained as closely mowed, high quality turfgrass surfaces; while the remainder of the area or 79% is maintained as high cut rough, woodland, water and wetland areas (3). Thus, the environmental status for much of the golf course area provides a favorable habitat for wildlife.

Studies have shown the diversity and number of wildlife found on the golf course exceeds that of both adjacent urban areas and animal-crop-horticultural production areas (5). This should be kept in mind, as many activists would argue that the golf course should have a wildlife species population and diversity similar to the original native landscape. However, this is an idealistic approach that does not recognize the reality of the situation where the alternative more likely is that the land would be used for urban development or production agriculture.

Note: These same historical perspectives and trends may also be considered in relation to other types of turf facilities, such as sports fields and lawns.

References:

1. Beard, J.B. 1973. Turfgrass: Science and Culture. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, USA. 658 pp.

2. Beard, J.B. 1982. Turf Management for Golf Courses. Macmillan Publishing Co., New York, N.Y., USA. 642 pp.

3. Beard, J.B. 1994. Environmental protection and beneficial contributions of golf course turfs. Science and Golf II. Proceedings of the World Scientific Congress of Golf. E&FN Spon, London, England, UK. p. 399-408.

4. Beard, J.B., H.J. Beard, and D.P. Martin. 1977. Turfgrass Bibliography From 1672 to 1972. Michigan State University Press. East Lansing, Michigan, USA. 730 pp.

5. Beard, J.B and R.L. Green. 1994. The role of turfgrasses in environmental protection and their benefits to humans. Journal of Environmental Quality. 23(3):452-460.

Clarification: Concerning the Earthworm Happenings article in the May-June issue the phrase "the environmental quality agency in the United Kingdom has essentially eliminated the use of all effective materials utilized in earthworm control," change all to most. Currently, carbendazim and gamma HCH + thiophanate methyl have registration for the control of worm cast formation in turfs. The question being asked in the UK is whether these remaining registrations may also be rescinded.

UPCOMING JB VISITATIONS:

Provided for Institute Affiliates who might wish to request a visitation when I'm nearby:

- Sept. 23 to 25 - Columbus, Ohio.
- Sept. 28 to Oct. 4 - Rome and Turin, Italy.
- Oct. 18 to 25 - Tokyo, Japan.
- Nov. 3 to 7 - Indianapolis, Indiana.
- Nov. 13 to 15 - Rochester, New York.