USGA-SPONSORED RESEARCH

Highlights of the USGA-sponsored Research Program.

by DR. MIKE KENNA

USGA Research Project Categories

Turfgrass Breeding: Plant breeding projects intended to develop turfgrasses with better resistance to stress and pest problems.

Cultural Practices: Projects that evaluate cultural practices that have the potential to improve the ability of golf course turf to tolerate stress.

Alternative Pest Management: Evaluation of alternative pest control methods for use in integrated turf management systems.

Pesticide and Nutrient Fate: Projects that determine how pesticides and fertilizers can be applied to golf courses while protecting environmental quality.

Construction and Maintenance of Greens: Identification of the best combinations of putting green construction, grow-in procedures, and post-construction maintenance practices.

IN 1982 the United States Golf Association set out on a historic course when it decided to significantly increase the funding for research to improve the grasses and the maintenance programs used to benefit the game of golf. This article highlights some of the accomplishments of projects completed through January 1998. The overarching goals of the Research Program are to: 1) Reduce turfgrass water requirements, pesticide use, and maintenance costs; 2) Protect the environment while providing good quality playing surfaces; and 3) Encourage young scientists to become leaders in turfgrass research. The specific areas within these overarching goals covered in this article include Turfgrass Breeding, Cultural Practices, Alternative Pest Management, and Pesticide and Nutrient Fate.

Turfgrass Breeding

The turfgrass breeding projects are directed at reducing water and pesticide use through the development of resistance to several stress and pest problems. The programs have focused on the improvement of bentgrass, bermudagrass, buffalograss, *Poa annua*, seashore paspalum, and zoysiagrass. The turfgrasses resulting from the sponsored research will help meet the future needs of golf courses. Table 1 was prepared to summarize the accomplishments of USGA-sponsored breeding projects from 1983 through 1997.

Breeding and Development of Bentgrass, Texas A&M University

After 13 years of improving bentgrass, six varieties with improved heat tolerance and disease resistance were released, and three advanced lines are ready for release (see Table 1). It is important to note that several young scientists were trained and are becoming leaders in the turfgrass industry. New, innovative screening techniques were developed throughout the course of the project. For example, methods to evaluate heat tolerance (heat bench), rooting depth (slant tube), linear gradient irrigation system (LGIS), insect and disease resistance, and salinity tolerance were developed and used.

Breeding Seed- and Vegetatively-Propagated Turf Bermudagrasses, Oklahoma State University

Two seeded, fine-textured, cold-hardy bermudagrasses were released that allow greater ease in establishment versus vegetative establishment (see Table 1). This program developed a reproducible technique for evaluating cold tolerance of bermudagrass plants that shortens cultivar development time and incorporated the use of molecular tools to identify cold-hardy genes. In addition, bermudagrasses from throughout the world were collected to add greater genetic diversity for cold hardiness, seed yield, and acceptable turf quality. The project reached out to other scientists in the southern Great Plains region to aid in the development of bermudagrasses with better spring-dead-spot and insect resistance. Five graduate students and two postdoctoral students have been trained on the project.

Breeding, Evaluation, and Culture of Buffalograss, University of Nebraska

This comprehensive program increased the awareness and interest in buffalograss as a turfgrass species because of its inherent drought resistance and low maintenance. The project developed six vegetative buffalograss cultivars with better turf quality, tolerance to lower cutting heights, and extended range of adaptation (see Table 1). Improved sod production techniques and sod quality of the new cultivars was achieved. Two seeded varieties were developed in cooperation with the Native Turfgrass Development Group. Through a team research approach, the project successfully developed management and establishment studies to coincide with the release of the cultivars. Finally, more than 10 graduate students received M.S. or Ph.D. degrees during the project.

Development of Multiple Stress-Tolerant Seashore Paspalums, University of Georgia

Seashore paspalum offers an alternative to bermudagrass with its greater salinity tolerance and lower nitrogen requirement (i.e., approximately half that of bermudagrass). In just five years, three cultivars were selected for commercialization (see Table 1). The program also has directed efforts toward developing management programs for the new cultivars — specifically, extensive field testing for weed and insect control. In addition, the extensive worldwide collection assembled (germplasm) is very diverse and has great potential to produce outstanding varieties for golf courses in the future.

Breeding and Development of Zoysiagrass, Texas A&M University

Zoysiagrass fairways can produce a high quality golf surface in the transition zone and southern United States. Some of the cultivars developed offer an alternative for partly shaded tees and surrounds and can help prevent bermudagrass encroachment into bentgrass greens. Four new vegetative cultivars were developed with improvements made for fine texture, salinity tolerance, shade tolerance, and color retention (see Table 1). Improvements also were made in sod production quality (i.e., establishment rate and recoverability after harvest). Unfortunately, the cold hardiness of these varieties is inadequate for use in the upper transition zone of the United States. The project cooperated with other scientists throughout the United States to investigate adaptation and resistance to insects. Seven postdoctoral students worked on the project over the last 14 years.

Improvement of *Poa annua* for Golf Courses, University of Minnesota

After years of industry efforts to eradicate annual bluegrass from golf course putting greens, this project took a new approach. Thousands of annual bluegrasses from throughout the United States were collected and evaluated in order to develop an improved variety. After nearly 15 years of work, the first commercially available creeping bluegrass (*Poa annua var. reptans*) variety was released for use on putting greens (see Table 1). A great deal was learned about the growth, seeding habit, genetics and population dynamics of *Poa annua*. In addition, three Ph.D. students received their degrees while working on the project.

Cultural Practices

A series of research projects with the aim to reduce water use, pesticide use, and maintenance costs were conducted in different regions of the United States. This was necessary because of regional differences in climate, soil, and stress conditions. The studies have led to new screening techniques, maintenance programs that conserve water, and management programs for new varieties.

Interseeding New Bentgrasses, Irrigation Management, and Selection of Bentgrasses with Superior Drought Resistance, Texas A&M University

This project addressed interseeding new bentgrass varieties into an older variety, blending bentgrass varieties, and comparing irrigation frequency and amounts. First, interseeding a new bentgrass cultivar into Penncross was somewhat successful. A population shift of 5 to 30 percent was observed following a single interseeding in conjunction with minimal cultivation followed by topdressing. Second, when establishing new greens, blending dif-

Developing herbicide-, disease-, and stress-resistant turfgrasses using genetic engineering has a promising future. Dr. Lisa Lee, while at Rutgers University, worked on developing herbicide-resistant bentgrasses. Michigan State University also has an active program that is developing genetically engineered bentgrasses under the direction of Drs. Mariam Sticklen and Joe Vargas.

Table 1
Summary of USGA Turfgrass Breeding Projects — 1983 to 1997

Turfgrass	*University*	*Status of Varieties*
Creeping Bentgrass		
Agrostis stolonifera var. *palustris*	Texas A&M University	Crenshaw (Syn3-88), Cato (Syn4-88) and Mariner (Syn1-88), Century (Syn92-1), Imperial (Syn92-5), Backspin (92-2) were released. All are entered in 1993 NTEP trials (National Turfgrass Evaluation Program, Beltsville Agricultural Research Center, Beltsville, MD 20705).
	University of Rhode Island	Providence was released.
	Pennsylvania State University	Pennlinks was released.
Colonial Bentgrass		
Agrostis tenuis	DSIR-New Zealand and University of Rhode Island	A preliminary line, BR-1518, was entered in the NTEP trials. This line was not developed any further.
Bermudagrass		
Cynodon dactylon	New Mexico State University	NuMex Sahara, Sonesta, Primavera, and other seed-propagated varieties were developed from this program.
	Oklahoma State University	Two seeded types, OKS 91-11 and OKS 91-1, were entered in the 1992 NTEP trials. OKS 91-11 was released.
C. transvaalensis	Oklahoma State University	A release of germplasm for university and industry use is under consideration. New triploid ($2n = 3x = 27$) and hexaploid ($2n = 6x = 54$) F_1 hybrids are under evaluation.
C. dactylon X C. transvaalensis	University of Georgia	Tifton 10 and Tifton 94 (MI-40) were released; a Tifway mutant, Tifeagle (TW-72), was released for vegetative production.
Buffalograss		
Buchloe dactyloides	University of Nebraska	Vegetative varieties 609, 315, and 378 were released. Seeded varieties Cody and Tatanka were released. Three new vegetative selections, NE 86-61, NE 86-120, and NE 91-118, are currently being processed for release.
Alkaligrass		
Puccinellia sp.	Colorado State University	Ten improved families were developed; nothing released.
Blue grama		
Bouteloua gracilis	Colorado State University	Elite, Nice, Plus, and Narrow populations were developed; nothing released.
Fairway Crested Wheatgrass		
Agropyron cristatum	Colorado State University	Narrow leafed and rhizomatous populations were developed; nothing released.
Curly Mesquitegrass		
Hilaria belangeri	University of Arizona	Seed increases of *fine* and *roadside* populations are available for germplasm release and further improvement.
Annual Bluegrass		
Poa annua var. *reptans*	University of Minnesota	Selections #42, #117, #184, #208, and #234 were released. Small amounts of MN #184 are commercially available.
Zoysiagrass		
Zoysia japonica and *Z. matrella*	Texas A&M University	Ten vegetative selections were entered in the 1991 NTEP trials. Diamond (DALZ8502), Cavalier (DALZ8507), Crowne (DALZ-8512), and Palisades (DALZ8514) were released in 1996.
Seashore Paspalum		
Paspalum vaginatum	University of Georgia	Germplasm has been assembled and is under evaluation. Two green types (AP 10, AP 14) and one fairway type (PI 509018-1) are being evaluated on golf courses.

ferent bentgrass varieties had distinct effects on turf quality. Superior varieties had a positive impact on the stand, while lesser varieties had a negative impact on the quality. Lastly, frequent irrigation caused a decrease in turf quality and an increase in algae. However, some varieties proved to be more tolerant of frequent irrigation. Less frequent irrigation allowed a favorable water balance in specific cultivars without sacrificing putting green quality. Greenhouse and field drought resistance results were correlated, indicating that plant-water-status measurements (i.e., water potential at zero turgor, osmotic potential at full turgor, relative water content, apoplastic water fraction, bulk modulus of tissue elasticity, and turgid weight to dry weight ratios) could be used as a screening technique in breeding programs.

Methods to Convert a Putting Green from Penncross to a New Variety, North Carolina State University

A molecular method for measuring change in bentgrass populations over time was developed. The greatest conversion from Penncross putting greens plot to A4 bentgrass occurred with JobSaver® aerification tines plus Primo®, resulting in a conversion of 20 percent. The least effective treatments were verticutting and verticutting plus Primo®. Results indicated that conversion from Penncross is probably feasible, but it will take a number of years. Complete conversion from Penncross to another variety will require fumigation or total renovation.

Growth and Performance Differences Among New Bermudagrass Cultivars and Ecotypes, Auburn University

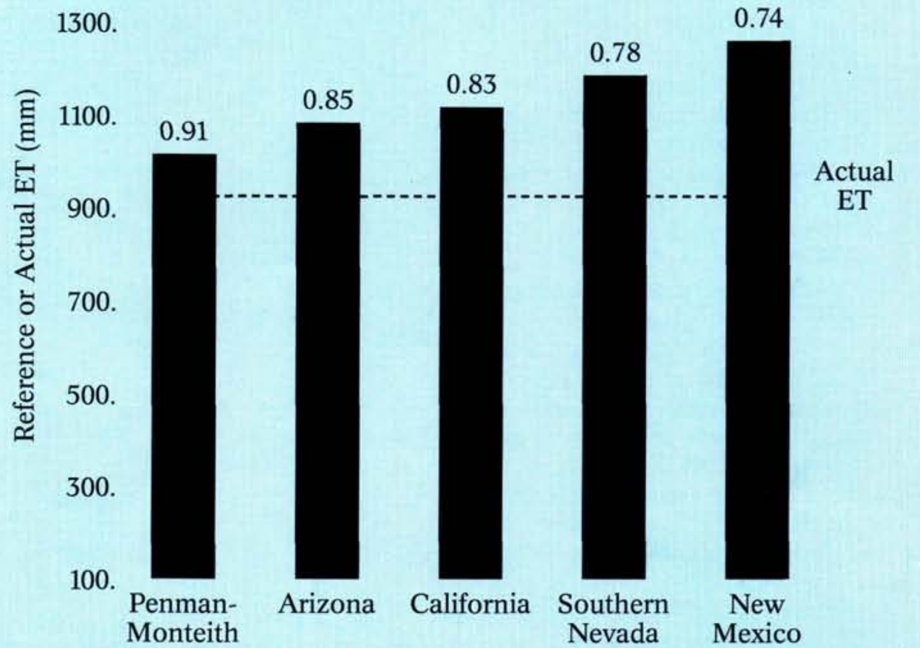
Off-types, or ecotypes, often appear in hybrid-bermudagrass putting greens over time. Some of the off-types have shown potential suitability as putting green turfgrasses in the southeastern United States. However, proper thatch management of ultra-dwarf cultivars and off-types was possible only with intensive management (i.e., aerification, topdressing, grooming procedures, etc.). Newly released TifEagle and the ecotype Mobile 9 performed well and showed promise in this study.

Biochemical and Molecular Analyses of Cold Acclimation in Bermudagrass, Clemson University

Differences in cell membrane composition between cold-hardy and cold-sensitive bermudagrass cultivars were identified during cold acclimation. Biochemical analyses of total cell membrane lipids identified important differences in the fatty acid chains of phospholipids (see Figures 1 and 2). Bermudagrasses with 18 carbon fatty acid chains and three double bonds were better able to acclimate to cold temperatures. This was quantified by calculating the double bond index (DBI). Considerable genetic variability among bermudagrasses and seashore paspalums was documented and should help turfgrass breeders develop cold-hardy, warm-season grasses.

Figure 1

Total ET — Bermudagrass



Evapotranspiration (ET) estimation methods may differ by as much as 30 percent, which demonstrates the importance of matching crop coefficients (Kc) with the method used to estimate ET. The summer ET_0 was obtained from five Penman Equations under investigation (vertical bars). Actual ET is presented as the dashed line. The number above each bar represents the appropriate seasonal crop coefficient.

Turfgrass Irrigation with Municipal Effluent: Nitrogen Fate, Turf Crop Coefficients, and Water Requirements, University of Arizona

The five popular methods of estimating evapotranspiration (ET) differ by as much as 30 percent, demonstrating the importance of matching crop coefficient (Kc) with the method used to estimate ET (see Figure 1). Estimated winter crop coefficients for bermudagrass fairways overseeded with ryegrass were more variable than summer crop coefficients. Turf irrigated with effluent water generated higher growth rates and raised seasonal Kc by three percent. Water that moved through the ten-foot-deep lysimeter had negligible amounts of fertilizer nitrogen. Tissue analysis revealed that 30 percent of the applied nitrogen was in clippings.

Putting Green Characteristics Associated with Surface Depressions Caused by Selected Forms of Traffic, Rutgers University

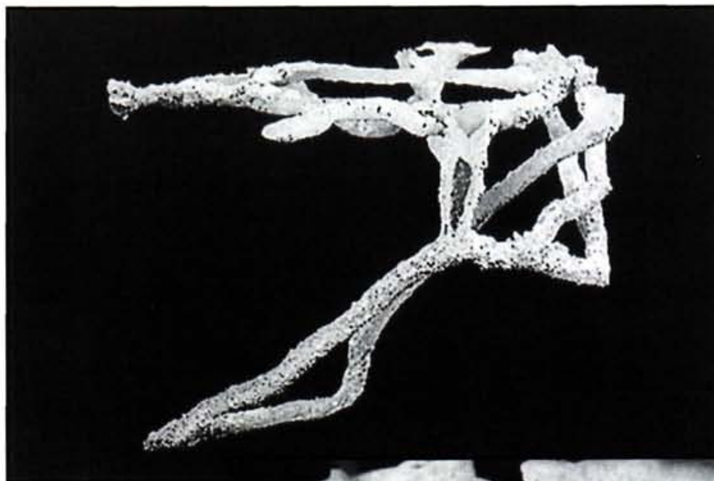
When tested on amended-sand and soil-base putting greens, rigid wheel chair tire (2.5 cm) traffic caused greater depressions than pneumatic tires (3.5 cm) on the putting green surface. A relatively inexpensive penetrometer was used to predict the damage caused by assistive equipment. Some assistive devices can be used by handicapped golfers on putting greens without reducing putting quality. However, the impact of these assistive devices varies, depending on green construction materials, management practices, and environmental conditions. Wheel traffic caused greater ball roll deflection than foot traffic, and pneumatic tires caused less damage than rigid tires. As one would expect, moist soils resulted in more damage than dry soils.

Alternative Pest Management

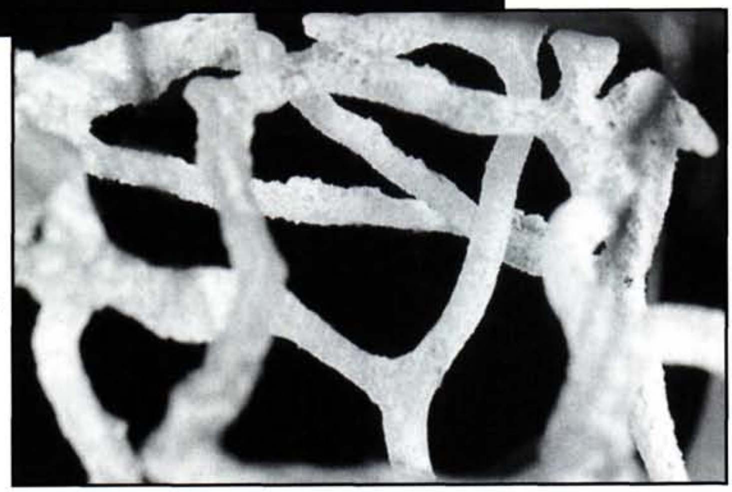
The purpose of these research projects was to evaluate alternative methods of pest control for use in integrated turf management systems. Alternative pest management methods are intended to reduce the amount of pesticide needed to maintain golf course turfgrasses. An alternative method of pest control needs to be highly effective and must be field-tested under realistic golf course conditions in order to receive widespread acceptance by golf course superintendents.

The USGA has provided funding for the development and evaluation of alternative methods of pest control. Even though a great deal of time and effort have been devoted to the area of biological control, there are very few scientifically documented cases where these alternative controls perform as well as their pesticide counterparts.

In addition to new biological controls, more information is needed on the life cycle and behavior of common turfgrass pests. The correct treatment thresholds, cultural practices, use of resistant grasses, proper pesticide timing, and placement all need to be considered carefully in all turfgrass management programs, especially in the case of soil-borne insect or disease problems.



Examples of the use of wax castings to capture the burrowing of mole crickets in large soil areas.



The tawny mole cricket has a unique Y-shaped tunneling behavior which allows for easy feeding, escape from predators, and selection of comfortable temperature and soil moisture conditions.

Development of Improved Turfgrass with Herbicide Resistance and Enhanced Disease Resistance through Transformation, Rutgers University

Creeping bentgrass is one of the more disease-susceptible grasses maintained for turf purposes. This project has produced genetically engineered (transgenic) plants with disease resistance, salinity tolerance, and herbicide resistance genes. There are several herbicide- and pest-resistant plants showing promise in the field that are ready to be integrated into the breeding program for cultivar development.

Genetic Engineering of Creeping Bentgrass with a Disease Resistance (Chitinase) Gene and the Bialaphos-Herbicide Resistance Gene, Michigan State University

This project has genetically engineered plants under evaluation in the field that are ready to be integrated into a breeding program for cultivar development. Researchers were able to incorporate the chitinase gene into bentgrass plants. This gene has the potential to aid in bentgrass disease resistance because chitinase digests the cell walls of fungal pathogens. The bialaphos gene also was successfully incorporated into bentgrass plants, making them tolerant of the pesticide. Bialaphos has both herbicidal and fungicidal properties.

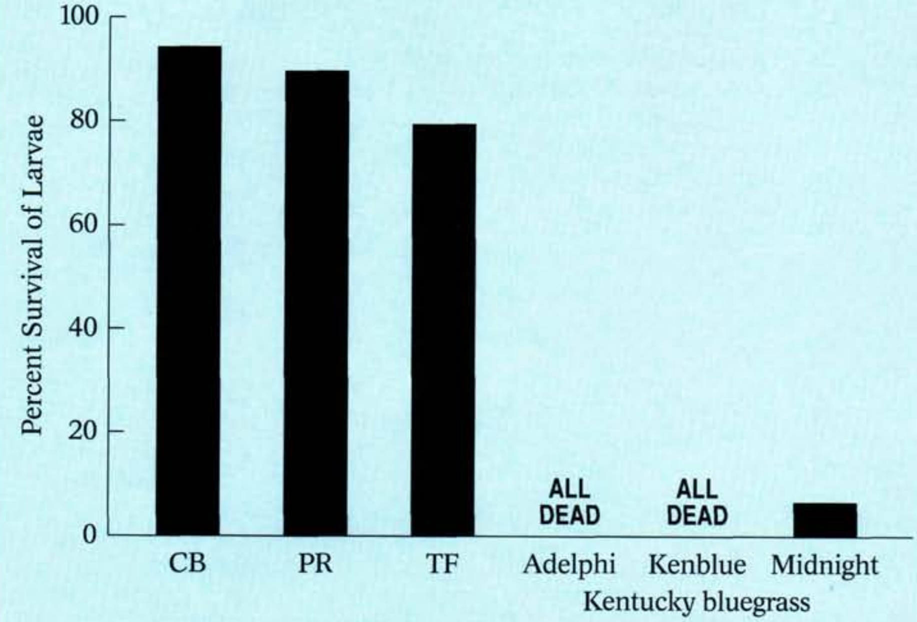
Genetic Basis of Biological Control in a Bacterium Antagonistic to Turfgrass Pathogens, Cornell University

Using molecular biology, a bacterium strain was discovered that reduced the germination of soil-borne diseases, especially *Pythium*. Researchers established the relationship between seed or plant exudates and the germination of *Pythium*. This information can be valuable to plant breeders for incorporation into breeding programs (i.e., breed turfgrasses with low exudate levels). The study also provided convincing evidence for a biological control mechanism in which the bacterial agent interacts directly with the plant and only indirectly with the pathogen.

Cultural Control, Risk Assessment, and Environmentally Responsible Management of White Grubs and Cutworms in Turfgrass, University of Kentucky

This project has developed effective control strategies for cutworms and white grubs using cultural, environmental, and insect behavioral considerations that will reduce pesticide usage. The tremendous biodiversity of beneficial insects in golf course turfgrasses and the importance of certain predators in the reduction of pest populations were clearly demonstrated. Effective control strategies for cutworms, such as mowing putting greens early in the morning, not disposing of clippings near the putting green, or controlling insect populations in the surround areas, will reduce pesticide use on golf courses. Cutworms do not like Kentucky bluegrass as a food source when compared to bentgrass, ryegrass, and tall fescue (see Figure 2). Endophyte-infected cultivars did not provide significant resistance to cutworms. Two insecticides (Merit and Mach 2) were effective control measures and had low impact on beneficial and non-target arthropod species.

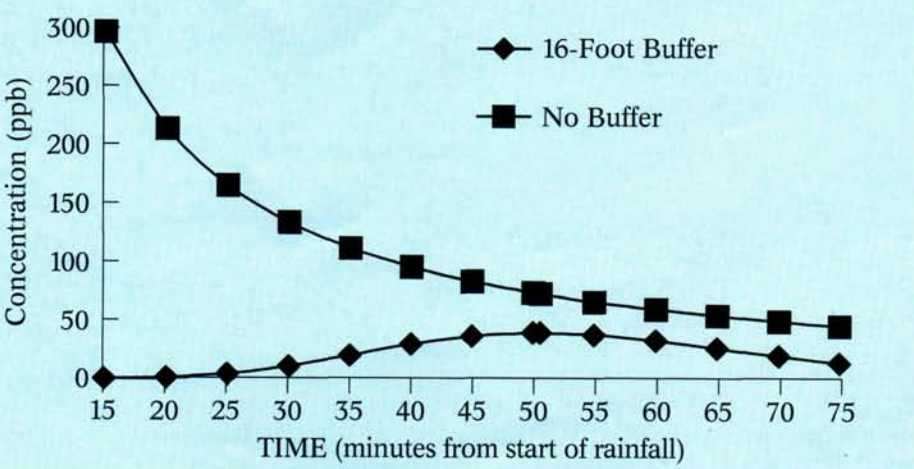
Figure 2
High survival of black cutworms reared on creeping bentgrass (CB), perennial ryegrass (PR), and tall fescue (TF), and lack of suitability of three diverse cultivars of Kentucky bluegrass



Behavioral Studies of the Southern and Tawny Mole Cricket, North Carolina State University

Behavioral, biological, and environmental factors that influence mole cricket activity on golf courses were identified. The tawny mole cricket has a unique Y-shaped tunneling behavior that allows for easy feeding, escape from predators, and selection of comfortable temperature and soil moisture conditions. The two species are aware of the presence of the other, but a pheromone is not involved in their ability to detect each other. Management factors (i.e., soil texture, moisture, temperature, pesticides, etc.) that influence mole cricket behavior were identified and should be considered together to achieve better insect control.

Figure 3
Plot of the predicted concentration of 2,4-D in surface runoff versus time in the 1996 buffer length experiment
***, ** Significant at alpha levels 0.05 and 0.01, respectively**



Pasteuria sp. for Biological Control of the Sting Nematode in Turfgrass, University of Florida

A new species (*Pasteuria*) of bacterium that parasitizes the sting nematode (*Belonolaimus longicaudatus*) was discovered. Results demonstrated that the sting nematode relationship with *Pasteuria* is density dependent. For example, as the number of nematodes increases, so does the number of *Pasteuria* bacteria. The study showed that a relatively small amount of *Pasteuria*-infested soil can be introduced into a USGA green with a high number of sting nematodes and bring about suppression within about 12 months.

Pesticide and Nutrient Fate

Understanding and quantifying the fate of applied turfgrass pesticides and fertilizers are required to understand the environmental impacts of golf courses. From 1991 through 1994, the USGA sponsored comprehensive research that examined the fate of pesticides and nutrients applied to golf course turfgrasses. Three key findings from this research were: 1) measured nitrogen and pesticide leaching generally is minimal when these materials are applied properly; 2) the turf-soil ecosystem enhances pesticide degradation; and 3) current agricultural models need calibration/validation in order to accurately predict the fate of pesticides and fertilizers applied to turfgrasses grown under golf course conditions.

As a continuation of a responsible and scientifically based investigation of the environmental impact of golf courses, the USGA sponsored additional research to understand the effects of turfgrass pest management and fertilization on water quality and the environment.

Evaluation of Best Management Practices to Protect Surface Water from Pesticides and Fertilizer Applied to Bermudagrass Fairways, Oklahoma State University

Chemical losses in surface runoff from turf can be reduced by maintaining non-treated buffers between surface water and areas treated with chemicals (see Figure 3). The effective buffer length is dependent upon site conditions (i.e., longer buffers, in excess of 16 feet, will perform better). A three-inch buffer mowing height was more effective than 0.5 or 1.5 inches. Chemical applications following heavy irrigation or rainfall events should be avoided. Finally, select pesticides and nutrients with low runoff potential (i.e., low solubility, high adsorption coefficient).

Evaluation of Management Factors Affecting Volatile and Dislodgeable Foliar Residues of Turfgrass Pesticides, University of Massachusetts

Of the 13 pesticides examined, 10 were deemed safe based on U.S. Environmental Protection Agency Hazard Quotients (HQ). Organophosphorous insecticides with high vapor pressures and inherent high toxicity (i.e., ethoprop, isazofos, and diazinon) were deemed not completely safe to humans under certain conditions. The critical vapor pressure below which no turfgrass pesticide will volatilize to the extent that it will result in an inhalation HQ greater than 1.0 was found to be between 3.3×10^{-6} and 5.6×10^{-6} mm Hg. Thatch management or the use of spreader/stickers will likely be ineffective in mitigating unwanted pesticide volatilization.

Mobility and Persistence of Turfgrass Pesticides in a USGA Green, University of Florida

The research project found that most pesticides are bound to the thatch. Clippings were not a major pathway for removal of pesticides from treated turfgrass areas. Even after several weeks of light, infrequent irrigation, heavy rain can still cause fenamiphos to leach. Fenamiphos was not a major concern from a volatility viewpoint. The amount of dislodgeable residues decreased rapidly after irrigation was applied. Finally, a synthetic coating applied to sand demonstrated the ability to increase pesticide retention in the rootzone.

Modeling Pesticide Transport in Turfgrass Thatch and Foliage, University of Maryland

The thatch produced by different grasses did not have the same ability to retain pesticides. Bentgrass thatch retained (or adsorbed) more pesticide than zoysiagrass thatch. The amount of highly soluble 2,4-D retention to thatch and soil was less than carbaryl retention. Desorption losses of both pesticides were greatest during the first leaching event after application and declined with subsequent events. There was a significant interaction between the solubility of the pesticide and the medium (soil or thatch type) to which it was applied.

Evaluation of the Potential Movement of Pesticides Following Application to Golf Courses, University of Georgia

If high-sand-content putting green rootzones are considered a worst-case scenario, pesticide transport in soil water was not a major problem when the pesticides were applied correctly and not irrigated heavily. Irrigation management is an essential factor in pesticide movement. High soil moisure content (at or above field capacity) at the time of application results in the greatest potential for runoff. In this study, the small buffer zone between the point of application and the exit point did not reduce the fraction of applied water-soluble pesticide transported from the site, but diluted the solution concentration due to reduced area of treatment. Pressure injection of pesticides reduced the quantity found in runoff. The research further documented that the water solubility of the pesticide influenced the amount of pesticide transported from the fairways. The more water-soluble pesticides were more easily transported from the treated fairway. The less water-soluble pesticides were resistant to transport in surface runoff.

Quantifying the Effect of Turf on Pesticide Fate, University of Illinois

This study compared bare soil with three levels of turf/thatch cover. Plots were vertically mowed so that 100, 66, and 33 percent of the turf/thatch remained. Pesticides were then applied and the results document that a healthy turf with thatch prevents most of the pesticide from moving into the soil. As the amount of turf and thatch decreased, the amount of pesticide reaching the soil increased. As would be expected, the bare soil plots had the greatest amount of pesticide found in the soil.

Degradation of Fungicides in Turfgrass Systems, Purdue University

Two-thirds of the applied fungicides remained bound to the leaf surface, unavailable for microbial degradation or loss into the environment. The amount of pesticide adsorbed to the leaf surface was dependent on the chemical characteristics of the applied material (i.e., adsorption coefficient, water solubility). Analysis of leaf fungicide residues indicated that the dissipation rates were similar, regardless of application frequency. The similarity of the fungicide dissipation curves suggests that there was no change in the loss mechanism and that enhanced microbial degradation was not present on the leaf surface.

Model Calibration and Validation for Turf Pesticides in Runoff and Leachate, Environmental and Turf Services

PRZM 2.0, a computer model used to estimate pesticide fate, overestimated runoff and was less effective in predicting runoff than GLEAMS. With adjustments to the runoff curve number and the pesticide degradation rate, the GLEAMS model was able to accurately predict pesticide runoff from a bermudagrass fairway. If a thatch layer is used in any prediction model, the physical characteristics must be accurately described. Modeling leaching data was more problematic than runoff data; however, the new PRZM 3.0 model shows more promise for accurate prediction of pesticide transport from turfgrass systems.

Conclusion

The USGA will continue to fund research in the foreseeable future. The goals remain: 1) reduce turfgrass water requirements, pesticide use, and maintenance costs; 2) protect the environment while providing good quality playing surfaces; and 3) encourage young scientists to become leaders in turfgrass research. Rather than focusing on variety or cultivar development, breeding efforts will focus on creating new and innovative germplasm for seed companies to use in their commercial breeding programs. Putting green rootzone and golf course construction projects are underway and will be emphasized in the future. Integrated turfgrass management (cultural practices) and environmental research projects also will be continued. If you would like more information about these or other projects, please see the USGA website (*http://www.usga.org*) or contact the USGA Green Section Research Office (405-743-3900 or *mkenna@usga.org*).

DR. MICHAEL P. KENNA *has been Research Director of the USGA Green Section since February 1990. His position was created out of a need to extend greater administrative support to the USGA's growing turfgrass and environmental research program, which distributes more than $1.5 million in grants annually.*