PROCEEDINGS OF THE SOUTHWEST TURFGRASS ASSOCIATION ANNUAL CONFERENCE

Ruidoso Convention and Civic Events Center
Ruidoso, New Mexico

TURF

MANAGEMENT
EDUCATION
RESEARCH

PROCEEDINGS OF THE SOUTHWEST TURFGRASS ASSOCIATION 2001 ANNUAL CONFERENCE

October 9-12, 2001

Presented by

Southwest Turfgrass Association
and
Cooperative Extension Service
New Mexico State University

CONTRIBUTORS

2001 Southwest Turfgrass Association
Annual Conference

BARBECUE

Rain Bird Golf/United Green Mark
Lebanon Turf Products

MEAL or BREAK

Chaparral Sand & Gravel
Curtis & Curtis Seed, Inc
Dow AgroSciences
Southwest Organics, Inc.
Southwest Turf Services, Inc.

The Southwest Turfgrass Association expresses appreciation and thanks to the above companies for their contributions to our program.

TABLE OF CONTENTS

The Ten Pitfalls of Golf Course Management

Dr. James Baird
Agronomist, Northeast Region
United States Golf Association Green Section
P. O. Box 4717
Easton, PA 18043

The Ten Pitfalls of Golf Course Maintenance

James H. Baird, Ph.D.
Agronomist, Northeast Region
United States Golf Association Green Section

An article by the same title was written by Robert Brame, Director, North Central Region, USGA Green Section, in the September/October 1992 issue of the *Green Section Record.* The article highlighted the top ten hidden or not easily recognized dangers or difficulties of golf course maintenance based on a 1990 survey of the Green Section agronomists who, at that time, visited approximately 1700 golf courses annually. This presentation reevaluates the Ten Pitfalls of Golf Course Maintenance more than a decade later.

1. Communication and Public Relations

It is safe to say that more superintendents have lost their job due to poor communication rather than poor grass growing ability. However, excelling at communication and public relations does not stop with the health of the turf or the happiness of the course officials/owner. Maintaining open communication with employees, golf professionals, and golfers about topics such as employment expectations, maintenance expenditures, environmental issues, or playing conditions is also critical for achieving success. And never forget about your family, especially during the heat of the battle in the summer. Most often the spoken word is the best form of communication. However, other avenues of communication include letters, memos, reports, newsletters, signs, information boards, electronic mail, and websites. And don't forget that the appearance of the golf course, the turf care facility, and its employees sends a strong yet silent message to the golfing public. Finally, documentation is a critical component to effective communication and public relations. Maintain complete and up to date records, take many photos or digital images, and utilize instruments, whether it be a soil profiler or a weather station, to aid in documentation.

2. Overwatering

It is by far easier to apply more water than the plant needs especially when anticipating periods of high evapotranspiration. However, overwatering causes many adverse effects to the plant including shallow rooting and poor hardiness to stress caused by disease, etc. Wet conditions also adversely affect playability by producing softer conditions that can reward poor shots. Good water management involves both irrigation and drainage. While overwatering can still occur with a new irrigation system, the technology available today can help turf managers apply water more efficiently and effectively.

3. **[Maintaining] Fast Green Speeds**

Some things never change and the desire for faster greens is nearly always the main subject of discussion at Green Section Turf Advisory Service Visits. Today, it seems that fast greens are not good enough for just tournament or weekend play. Now, if the greens are not fast "24/7" then something is wrong. What is wrong is that golfers fail to understand that the fast greens they see on television were prepared that way for only one week out of the season. Shaving down the height of cut adversely affects both shoot and root density and invites invasion of *Poa annua* and moss. Alternatives to lowering the height of cut to increase green speed include rolling, increasing the frequency of mowing, aggressive cultivation including light and frequent topdressing to provide a smoother and firmer surface, maintaining balanced fertility, and judicious use of irrigation.

4. **Use of Pesticides**

In the early 1990s, the primary concern was over or unnecessary use of pesticides on golf courses. While the same can be said in certain situations or parts of the country today, there seems to be more widespread use of snake oil products or technologies that do nothing to significantly improve turfgrass health for the amount of money you pay. Good environmental stewardship and turf management begin by employing an Integrated Pest Management program that includes pest scouting, site specific chemical application, wise use of pesticides and fertilizer based upon their potential environmental fate, and reliance upon scientific research when choosing what's best for your golf course.

5. **Continuity of Course Officials/Green Chairperson**

Just when you begin to become comfortable with and educate someone it seems that its time to start the process all over again. Furthermore, most short term course officials or green chairpersons feel that somehow they must leave their mark on the golf course, usually involving the planting of unwanted or undesirable trees throughout the golf course. Developing longer terms for course officials, overlap from one committee to the next, and a contract or master plan for the long term vision of the golf course are a few ideas to maintain continuity and provide steady improvement to the golf course.

6. **Pesticide Storage and/or Maintenance Buildings**

Far more clubhouses are being renovated or rebuilt compared to turf care facilities. There are several reasons to rebuild or renovate older facilities including meeting current health/safety guidelines, allowing adequate storage of equipment, providing living quarters for employees, improving employee morale and work ethic, and improving the overall aesthetics of the golf course.

7. **Tree Management**

Trees are an integral part of the turf landscape on many golf courses. They offer aesthetic beauty but more importantly they can help protect golfers from errant shots played from closely joined holes. On the other hand, trees have been overplanted and many have reached the point of maturity where they now adversely affect air movement and sunlight penetration onto the turf surface. There are several criteria that should be considered when deciding whether or not to remove trees from the golf course including: safety, species, health, life expectancy, impact on playability, impact on turfgrass health, impact on traffic flow, and impact on aesthetics and surrounding trees.

8. **Amount of Play**

Increasing play seven days a week makes it difficult to complete important turf maintenance practices on the golf course such as spraying and cultivation. Reduction or even elimination of practices such as aeration, verticutting, and topdressing has resulted in increased thatch accumulation in many parts of the country.

9. **Labor: Not Enough and/or Under Qualified**

On average, labor comprises 60-75% of the total golf course maintenance budget. Strategies to help increase the golf course maintenance labor pool with competent, hard-working individuals include providing competitive wages, bonus contracts for seasonal laborers who stay through dates agreed upon, and hiring retirees for part-time labor. Other labor saving ideas include use of plant growth regulators for mowing reduction, efficient equipment such as spinner type topdressing units, and creation of more naturalized areas in out of play areas on the golf course.

10. **Equipment: Not Enough and/or Poor Quality**

A good rule of thumb to keep in mind regarding turf equipment is that 10-15% of the total replacement value should be spent toward the purchase of new machinery each season. Another rule of thumb is that a machine should be replaced when the total repair cost (parts and labor) equals 50% of the initial purchase price. In order to maintain a fleet of newer and more technologically advanced equipment, it would be wise to consider leasing a majority of the equipment for a period of every 3-5 years. There are several other advantages to leasing including tax benefits, preservation of working capital, and customized financing and lease payment options.

The Effects of Shade on Turf

Dr. James Baird
Agronomist, Northeast Region
United States Golf Association Green Section
P. O. Box 4717
Easton, PA 18043

The Effects of Shade on Turf

James H. Baird, Ph.D.
Agronomist, Northeast Region
United States Golf Association Green Section

Shade and poor air movement from trees or other stationary objects are a leading cause of turfgrass failure and poor performance on golf courses throughout much of the country. On sports fields, trees are usually not a concern, however the surrounding stadium or other structures can cause a significant reduction in sunlight and air movement onto turf.

Sunlight is essential for life on earth. Plants and other photosynthetic organisms use carbon dioxide from the atmosphere and water to convert energy from sunlight into energy for growth and development in the form of carbohydrates. In doing so, oxygen is released to the atmosphere for utilization by all aerobic organisms. When turf is shaded by trees or other structures, the plant is affected not only by reduced light quantity but also altered light quality. As a result, the shade environment negatively impacts both turf form and function.

In general, plants utilize less than 5% of incoming solar radiation for photosynthesis. Capturing only 5% of sunlight doesn't seem like an arduous task for the plant. However, many factors affect light interception other than trees or structures. The amount of incoming solar radiation that reaches the turfgrass plant varies from month to month, day to day, and minute to minute depending on time of year, angle of the sun, day length, and cloud cover. In addition, turf canopy architecture (upright vs. prostrate) and other plant and environmental factors also influence interception and photosynthesis. So just how much light is needed for turf survival? Most turfgrass species are adversely affected by fewer than 4-5 hours of direct, daily sunlight.

Tree canopies and other structures such as buildings not only reduce light quantity but also alter the spectral composition of light received by the turfgrass plant. For example, research conducted at Ohio State University found that trees alter the light quality that passes through the canopy by decreasing the red to far-red ratio by 7.8% for deciduous trees and 19.0% for coniferous trees. The higher proportion of far-red light can trigger a physiological response that increases biosynthesis of the hormone gibberellic acid (GA) in grasses, resulting in a taller and more spindly growth habit with longer and narrower leaves.

Characteristic morphological changes to shaded plants include a taller and more upright growth habit, reduced tillering and shoot density, and decreased root/shoot ratio. Physiological changes include lower carbohydrate reserves, reduced transpiration, lower respiration, increased succulence, and reduced cuticle thickness.

Just like most golfers are not willing to part with trees on the golf course, it would be nearly impossible to move the stadium or other objects near the playing field. Therefore, the following is a list of management practices that will increase the chance for turf survival under low light conditions.

Height of Cut

Raising the height of cut from 1" to 1.25" increases the leaf surface area by 25%. Furthermore, increasing the height of cut to 1.5" would provide plants with 50% more surface area. Thus, by raising the height of cut, more leaf area is available for photosynthesis in order to help compensate for reduced light. In addition, taller cut turf will have better rooting and overall stress tolerance.

Fertility

Research has shown that turf grown under shade requires less nitrogen than turf grown in full sunlight. Unfortunately, no studies have been done to identify specific rates of nitrogen required by shaded turf. However, a good place to start is to apply 1/4 to 1/2 of the amount of nitrogen on your shaded turf compared turf that receives full sunlight. Keep in mind that the fall is a critical time to supply nitrogen to turf in order to hasten recovery from summer stress and to provide energy reserves for winter.

Plant Growth Regulation

Use of the plant growth regulator Primo (trinexapac-ethyl) has been found to improve turf cover and overall health under shaded conditions most likely due to its ability to aid in conservation of carbohydrates in the plant. Season long applications of Primo are recommended beginning with the onset of active shoot growth in spring. Consult the label for specific use information and precautions.

Irrigation

It is important to keep in mind the fact that shaded turf loses less water from evapotranspiration. Therefore, shaded turf will require less irrigation as compared to the turf exposed to full sunlight.

Traffic

Often times, turf performs well under low light conditions as long as it receives little or no traffic. Although this is unlikely in most sports turf situations, avoiding heavy traffic on severely shaded areas of the field would help increase the chance of turf survival.

Management of Weeds in Cool Season Turf

Mr. Ronald Calhoun
Research/Extension Specialist
Turfgrass Weed Management
Michigan State University
286 Plants and Soil Science Building
East Lansing, MI 48824

Management of Weeds in Cool Season Turf

Ronald Calhoun
Michigan State University

Weed management in turfgrass stands can be accomplished in various ways. Traditional methods include cultural management, mechanical, and chemical controls. It is difficult for weeds to become established in a properly maintained turf. Many weed species need light to germinate, so a tall, dense turf helps prevent weed seeds from germinating. The primary and most effective weed control tactic for turf managers is proper mowing. In fact, it has been estimated that regular mowing eliminates some 80 percent of 'weedy' species. Other cultural practices, such as judicious fertilization, can further reduce weed competition by increasing turfgrass vigor. The best defense against weed invasion is a dense, healthy turfgrass stand. Additional factors such as drainage, compaction, shade, and proper irrigation also contribute to effective management of weeds in turfgrass. Chemicals controls, although powerful and effective, are but one tool in the turfgrass weed management arsenal. Weed control from herbicide applications will be temporary at best, unless the cultural and environmental conditions that initially favored the weed infestation are corrected. In many situations herbicide applications may be necessary to remedy several seasons of neglect.

Annual and Perennial Grass Control

Weeds in turf can be classified as broadleaves, grasses and sedges. These plants can be further divided according to their life cycles as annuals, biennials or perennials. Annual grasses are well regulated in healthy vigorous turf. Increasing mowing height is particularly effective in controlling annual grassy weeds like crabgrass, goosegrass, and foxtail. Preemergence herbicides may be used to control crabgrass with good to excellent results. As annual grass seeds germinate the growth of the fragile seedling is arrested when the herbicide is present in sufficient concentration. Preemergence herbicides (before emergence) are commonly used on properties with a history of heavy annual grass pressure. Preemergence herbicides are typically water-insoluble, bind very tightly to the soil and therefore pose little or no risk of leaching to groundwater. These products are fairly economical and easy to apply. They also have the advantage of controlling the annual grass crop before it interferes with the performance and aesthetic characteristics of the lawn. Annual grasses can also be controlled postemergence (after emergence) but usually with more difficulty. Postemergence grass herbicides are not as plentiful as preemergence products.

Currently, four choices exist for the postemergence control of annual grasses such as crabgrass. Product choice depends on the maturity of the weed. Dithiopyr (Dimension) is a preemergence herbicide that provides postemergence control of crabgrass at the one-to three-leaf stage of growth only. Metharsenate (MSMA) is an older product that does not have great efficacy on crabgrass when applied at rates that are safe to cool-season turf. Generally, two applications spaced 10 to 14 days apart are needed to provide desirable control. Fenoxaprop-p-ethyl (Acclaim Extra) provides good to excellent crabgrass control up to the three-tiller growth stage. Fenoxyprop offers improved efficacy and turf safety over MSMA. As crabgrass matures or becomes drought stressed, the efficacy of this product decreases. Quinclorac (Drive) is the newest entry in this category. Quinclorac will control of crabgrass beyond the three-tiller growth stage with a single application. Quinclorac also has postemergence activity on certain broadleaf weeds, including dandelion, clover and speedwell.

Germinating perennial grasses such as quackgrass and nimblewill will be controlled by preemergence herbicide applications, but once established, perennial grasses are very difficult to control. Chemical control of perennial grasses is often very difficult because turfgrass species are also perennial grasses. It is challenging to find a compound that will control the weedy perennial grass without harming the desirable turf. Quackgrass (*Elytrigia repens*) is an aggressive grass that spreads by an extensive rhizome system. There is currently no selective control for quackgrass. Frequent mowing and increased fertility is usually an effective combination to reduce quackgrass infestations. Using a suitable non-selective herbicide and reestablishing the area can renovate turf stands with persistent quackgrass. Some perennial grassy weeds are other turf species out of place, such as creeping bentgrass or tall fescue in a Kentucky bluegrass lawn. Often the best remedy in these situations is to remove the affected sod and reestablish the area.

Although preemergence herbicides are primarily used for annual grass control, some have activity on a limited spectrum of broadleaf weeds. A preemergence grass herbicide can, therefore, also serve as a narrow-spectrum, preemergence broadleaf herbicide for weeds such as spurge and oxalis. Isoxaben (Gallery) is a broad-spectrum preemergence herbicide controlling more than 30 broadleaf weeds. Isoxaben offers a preventive approach to broadleaf weed control and an additional weed control option for sensitive sites where a postemergence herbicide would not be preferred. Postemergence broadleaf herbicides move more readily through soils than preemergence herbicides. However, relatively low use rates and short soil half-lives reduce the risk for high levels of these compounds to reach groundwater. The efficacy and economy of postemergence broadleaf herbicides has made it difficult for preemergence broadleaf herbicides to get a foothold in the marketplace. Additionally, since the weeds are never visible, clients are sometimes skeptical of preemergence broadleaf programs and paying four-to-ten times more than a traditional postemergence application.

Using Broadleaf Herbicides

Postemergence broadleaf herbicides, typified by 2, 4-D, have been around since the 1950s and are readily available, economical, and highly effective. These characteristics have positioned 2,4-D and other broadleaf herbicides as the typical first choice for broadleaf weed control. Postemergence broadleaf herbicides used in turfgrass management only control existing weeds. The activity of broadleaf herbicides, for the most part, depends on the timing of application in relation to the growth stage of the weed. In general, younger plants are easier to control than mature plants. Herbicide uptake and translocation are favored in younger plants. In addition to growth stage, the time of year plays a major role in determining the effectiveness of a herbicide application. Care should be taken to avoid applications during extreme stress periods such as drought or heat. In general, broadleaf herbicides have a greater potential for injury than preemergence herbicides. Herbicide efficacy is diminished and turf may be damaged when herbicides are applied during periods of stress.

Fall is the best time to control perennial broadleaf weeds, biennials, and seedling winter annuals. As a rule of thumb, the younger a plant is, the easier it is to control. Winter annuals are easily controlled with fall herbicide applications. Established perennials are also effectively controlled in the fall because they are actively growing and storing food reserves in their roots. This increases the movement of herbicide into the underground storage parts of the plants. Non-target injury from volatility and/or spray drift is less likely to occur in the fall because ornamental plantings are hardening off for the winter and vegetable gardens have run their course. Non-target injury is most likely in the spring, when plants are breaking bud and flowering. Succulent new growth is extremely sensitive and easily injured by exposure to most postemergence broadleaf herbicides.

Spring is a good time to control broadleaf weeds, though not as good as fall, spring is be the best time to control germinating summer annuals and perennial broadleaf weeds. Again, turf vigor and stand density will provide a more satisfactory long-term result than postemergence herbicides. In the spring, perennial broadleaf weeds are beginning active growth by utilizing reserves stored in the roots for new top growth with very little translocation to the roots. Herbicide applications at this time often fail to provide acceptable results because only the above-ground portion of the weed is destroyed. The herbicide does not move to the root system and the plant is able to regenerate new vegetative tissues from the energy stored in the underground plant parts. Therefore, the effectiveness of spring applications is highly regulated by the growth stage of the broadleaf weeds. Exceptions for spring weed control are creeping perennial broadleaf weeds that flower in mid-to-late spring. Research has repeatedly shown that these weeds (speedwell, ground ivy, wild strawberry) are particularly vulnerable to broadleaf herbicide applications at this time.

Summer is the most difficult time to control broadleaf weeds. When plants are drought stressed, they respond by slowing or stopping growth and modifying their leaves to reduce transpiration. The primary method to reduce transpiration is to increase the waxy coating on the surface of the leaves. The additional wax makes it more difficult for the herbicide solution to stay on the plant foliage and for the herbicide to penetrate the wax and enter the plant. Spot treating with ester-formulated herbicides is recommended for summertime broadleaf weed control because the esters are better able to penetrate the waxy cuticle of the leaf. Spot treating is recommended in the summer to reduce the overall herbicide load applied to the turf and thus reduce the potential for volatility to non-target plants.

Difficult-to-Control Broadleaf Weeds in Turf

As discussed earlier, the standard broadleaf herbicide in the turf industry is 2, 4-D, a broad-spectrum herbicide that is the main ingredient in many of the packaged broadleaf herbicide mixtures. For 50 years, broadleaf weed control has been accomplished with phenoxy herbicides such as 2, 4-D, 2, 4-DP, MCPA and MCPP. Dicamba, a benzoic acid, is another traditional broadleaf herbicide. These products are the standards against which any new herbicides are measured. Mixtures of these herbicides are common and numerous. Probably the mixture most familiar to turf managers would be some combination of 2, 4-D + MCPP + dicamba. This three-way mixture is inexpensive, has good coolseason turf safety and provides control of a wide range of weeds. This combination is synergistic and it provides better weed control than if the constituent herbicides were applied separately. The predominance of three-way herbicides can be illustrated by viewing a list of "hard to control" weeds. These lists usually reflect weeds that persist after two applications of three-way herbicides have been applied.

These herbicides and herbicide combinations still dominate the weed control landscape, but in recent years new herbicides have become available. Triclopyr and clopyralid are pyridine herbicides. These products are very active on a number of broadleaf weeds and are primarily used in cool-season turf. Triclopyr is used alone and in combination with other herbicides. Triclopyr is active against many weeds that are traditionally labeled hard-to-control (2, 4-D didn't work). For this reason, triclopyr is probably the first alternative to try when a 2, 4-D mixture has failed to provide acceptable control. Because of their complementary weed activity, combinations of triclopyr + 2, 4-D can be very effective.

Many formulations of these products exist, from pure acids to salt-based amines and the alcohol-based esters. To recap, amine formulations are very common and have low potential for volatility. Ester formulations are more effective than amines, but high volatility potential limits their use because of increased risk for off-site damage. Factors that determine which formulations to use include the growth stage of the weeds, climatic conditions and sensitivity of landscape plants, which was discussed earlier.

Postemergence grass herbicides are sometimes tankmixed with broadleaf herbicides to increase the range of weeds controlled by a single application i.e. plaintain and crabgrass. MSMA is available in a prepackaged product with 2,4-D, MCPP, and dicamba. Fenoxyprop-p-ethyl (Acclaim Extra) is not commonly used with 2,4-D as this combination can result in poor weed control and significant cool-season turfgrass injury. Conversely, quinclorac (Drive) may be tank mixed with 2, 4-D or products containing 2, 4-D. There also appears to be synergism between 2, 4-D and quinclorac. Several years of research indicate that the weed control potential (ground ivy, speedwell, violets, and clover) of several broadleaf herbicides can be dramatically increased by tank mixing them with quinclorac. Products containing 2, 4-D have benefited the most from this combination. These combinations deserve consideration to be used for callbacks and mid-to late-summer weed control applications.

Non-selective Weed Control

Several non-selective herbicides are now available for use in turf and landscape situations. Pelargonic acid (Scythe), diquat (Reward) and glufosinate (Finale) are contact-type herbicides; in other words, they are not translocated in the plant. These herbicides provide rapid foliar burn, usually within hours up to a couple of days. Their best uses are on annual vegetation, for edging and for rapid foliar burn. Glyphosate (Roundup Pro) remains as the only systemic or translocated non-selective herbicide available. Glyphosate is the best choice for perennial vegetation control.

Wildlife Links

Dr. Kimberly S. Erusha
Director of Education
United States Golf Association
P. O. Box 708
Far Hills, NJ 07931

Wildlife Links

A program to enhance wildlife habitat on America's golf courses

by Kimberly S. Erusha, Ph.D,
Director of Education, United States Golf Association

The United States Golf Association (USGA) took a new step forward by partnering with the National Fish and Wildlife Foundation (NFWF) to launch the *Wildlife Links* research program. Established in 1995, Wildlife Links represents golf's first comprehensive investigation of the game's relationship with wildlife and its habitat.

The program's overall goal is to protect and enhance, through proper planning and management, the natural resources found on golf courses. Golf courses offer excellent opportunities to provide important wildlife habitat in urban areas. With more than 17,000 golf courses in the United States comprising in excess of 2.5 million acres, great potential exists for golf courses to be an important part of the conservation landscape. This goal includes providing golf course architects and superintendents with information they need to promote the wildlife on their golf facilities, while still providing quality playing conditions for the game of golf.

The USGA contributes $200,000 annually to fund a competitive grants program for research, management, and education projects needed to provide the game of golf with state-of-the-art information on wildlife management issues. The program is administered by the Washington DC-based NFWF, a nonprofit environmental organization dedicated to conservation of our nation's resources.

An advisory panel of experts representing federal and state agencies, conservation organizations, and universities guides the Wildlife Links program. The advisory panel refines research priorities, reviews proposals from qualified researchers, and monitors and evaluates the approved research projects. NFWF takes the leadership role in ensuring that research projects address golf's highest priorities, and complement associated projects underway with other agencies and organizations.

Wildlife Links Advisory Committee	
Dr. Peter Stangel, chair	National Fish & Wildlife Foundation
Mila Plavsic	U.S. Fish & Wildlife Service
Ron Dodson	Audubon International
Paul Engman	Fairfax Country Park Authority
Kimberly Erusha	U.S. Golf Association
Jim Felkel	U.S. Environmental Protection Agency
Laura Hood Watchman	Defenders of Wildlife
Tom Franklin	The Wildlife Society
Jim Snow	U.S. Golf Association

Certain issues receive research priority. For example, determining how golf courses can be maintained as biologically productive sites for wildlife; providing solid recommendations regarding wildlife issues to incorporate into long-term management strategies; and educating golfers and the general public about these issues.

Golf courses, especially in more developed regions, hold great potential as hospitable areas for many species of animals and plants. The Wildlife Links Program represents golf's best mechanism to examine these issues and develop appropriate strategies.

2001 Wildlife Links Program Funded Projects:

Habitat Value of Wetlands for Water Birds in Urbanized and Agricultural Landscapes
University of Florida
Principal Investigator: Dr. Martin B. Main
Amount Funded: $50,800 (2001-2002)

This project will compare water bird use of created wetland habitats with water bird use of isolated, naturally occurring wetlands that are relatively similar in structure. The project will also identify important habitat features that influence use of wetlands by water birds and develop management recommendations that may be used to enhance wetland habitats on golf courses and agricultural operations.

Sublethal Effects of Pesticide Exposure
Savannah River Ecology Laboratory &
Furman University, Aiken & Greenville, SC
Principal Investigator: Dr. Travis J. Ryan
Amount Funded: $87,600 (2001-2003)

The sublethal effects of a pesticide commonly applied to golf courses on an amphibian will be examined to determine exposure impacts. The results of this research will be of great value to golf course superintendents who are interested in maintaining ecologically friendly golf courses.

Assessment of Midwestern Golf Courses as Breeding Habitat for the Red-Headed Woodpecker
Ohio State University, Columbus, OH
Principal Investigator: Dr. Amanda D. Rodewald
Amount Funded: $59,800 (2001-2002)

This project will, (1) document the occurrence of red-headed woodpeckers on golf courses in Ohio, Indiana, and Illinois, (2) identify habitat and landscape features of golf courses used by red-headed woodpeckers, (3) describe nesting sites on golf courses, and (4) develop and distribute a set of management prescriptions to create and/or maintain red-headed woodpecker habitat on Midwestern golf courses.

Pole Creek/Boreal Toad Recovery Project
Winter Park, CO
Principal Investigator: Gregory P. Horstman
Amount Funded: $55,300 (2001-2003)

The Pole Creek Golf Course is currently the only known viable breeding site for the state endangered boreal toad in Grand County, Colorado. This project will focus on a population inventory, habitat analysis, and limiting factor determination for this very small, remnant population of toads.

Enhancing Amphibian and Reptile Biodiversity on Golf Courses Through Use of Seasonal Wetlands
University of Georgia and Savannah River Ecology Laboratory
Principal Investigator: Dr. J. Whitfield Gibbons

Researchers at the University of Georgia are collecting census data and conducting experiments related to amphibian and reptile use of seasonal wetlands on golf courses. They hope to compile results into a wetland design and management plan for existing and future golf courses.

Burrowing Owl Conservation on Golf Courses
University of Arizona
Principal Investigator: Dr. Courtney Conway
Amount Funded: $29,900 (2000-2003)

This project will install 150 nesting burrows for the declining burrowing owl on five golf courses in the Northwest. Burrow occupancy and reproductive success will be monitored to determine the types of locations on golf courses where burrowing owls can reproduce successfully. Results explaining how to install artificial burrows will be distributed to golf course superintendents so that golf courses can contribute significantly to national recovery efforts.

Native Biodiversity and Golf Courses in Midwestern Landscapes
Miami University, Oxford, OH
Principal Investigator: Dr. Robert Blair
Amount Funded: $29,600 (2000-2002)

The conservation value of golf courses in midwestern landscapes will be examined by focusing on two indicator taxa: birds and butterflies. Specifically, this project will examine the landscape features that most benefit native species of birds and butterflies on golf courses and in adjacent habitats.

Golf Courses as Hotspots for Biodiversity in the Desert Southwest
USDA Forest Service, Rocky Mountain Research Station
Albuquerque, NM
Principal Investigator: Judy Perry
Amount Funded: $27,700 (2000-2003)

This project is investigating the distribution and abundance of birds and other wildlife on golf courses in the southwestern United States' Middle Rio Grande Valley. In addition, this project will determine how golf course vegetation impacts wildlife habitat value, and will examine whether golf courses mitigate loss of other southwestern riparian zones.

Corridor Establishment for an Endangered South Florida Butterfly
University of Florida, Gainesville, FL
Principal Investigator: Dr. Thomas Emmel
Amount Funded: $25,000 (1999-2002)

Dr. Emmel is working to restore and improve remaining tropical hardwood hammock habitat surrounding golf courses in the Florida Keys to increase breeding and corridor habitat for the endangered Shaus Swallowtail butterfly. Wild lime trees, which are the butterfly's larval host plant, along with other native adult nectar sources will be planted and butterfly populations monitored to detect movement along the newly created corridor and new population establishment.

Effects of Golf Course Construction on Amphibian Movement and Population Size
University of Rhode Island, Kingston, RI
Principal Investigator: Dr. Peter Paton
Amount Funded: $24,000 (1998-2001)

Dr. Paton is conducting a series of field experiments to investigate amphibian use of travel corridors, including the effects of turf on movement patterns and habitat selection. Data collected is being used to develop construction and management criteria for golf course managers that minimize the impact on amphibian movement patterns.

Avian Community Response to Golf Courses
Clemson University, Clemson, SC
Principal Investigator: Dr. David H. Gordon
Amount Funded: $24,000 (1998-2002)

David Gordon is assessing the value of golf course landscapes to avian communities. The results of the assessment will be used to produce a technical manual with management and design recommendations, as well as a brochure and color poster targeted at golf course stakeholder groups.

Wetlands Management Manual for Golf Courses
Authors: Don Harker & Gary L. Libby
Amount Funded: $35,000 (1996-1998)

Wetlands management is one of the most important yet least understood land management topics facing golf course personnel. The *Wetlands Management Manual* will make understanding this topic less of a daunting task. The book will be an illustrated manual that uses a general overview to walk managers through understanding wetlands. this manual will help managers to conserve, create and restore, and better manage wetlands on their golf courses.

Integrating Soil Test Reports into Your Turf Management Program

Dr. Robert Flynn
Extension Agronomist
New Mexico State University
67 East Four Dinkus Road
Artesia, NM 88210

Integrating Soil Test Reports into Your Turf Management Program

Robert Flynn, Ph.D.
Associate Professor of Agronomy and Soils
New Mexico State University Extension Plant Sciences Department
67 E. Four Dinkus Rd
Artesia, NM 88210
rflynn@nmsu.edu, 505-748-1228 voice, 505-748-1229 fax

Soil testing can be used to budget the fertilizer and amendment needs of native soil turf. Golf courses, parks, and athletic areas will undoubtedly perform better with additional inputs. How much and when can be assessed with soil testing and its interpretation for the grass of your choice. Once an interpretation has been completed the manager needs to locate sources of nutrients that will meet the needs of the grass of choice. Additionally, certain soil characteristics such as salinity, calcium carbonate content, and compaction can impact the effectiveness of a fertilizer program.

The Soil Test Interpretation

Any given soil testing lab that services farms and the general public will usually send back soil test results plus suggested nutrient application rates. For example, a soil testing low in nitrogen, high in phosphorus, and moderate in potassium may suggest 2.0 lb N, 1.0 P_2O_5, and 0.0 lb K_2O per 1,000 square feet. A soil test from NMSU should look something like this when the land area covers acres of ground:

Nutrient Recommendation	N	P_2O_5	K_2O
	lbs/ac	lbs/ac	lbs/ac
Recommended Nutrient Rate:	150	0	40

It is typically left up to the client to determine what blend of fertilizer to actually apply. This can change from year to year depending on material availability or what the newest trend in products is. Table 1 contains a list of nitrogen fertilizers with their respective costs and Table 2 contains some examples of phosphorus and potassium fertilizers. With a little bit of effort the least cost blend of fertilizer could be calculated by hand. With a lot less effort a computer spreadsheet and training is available upon request that can calculate the cheapest fertilizer blend to meet your needs. The spreadsheet also allows you to enter the actual cost of the blend you are interested in. Other factors, of course, can change the desired blend such as a need for elemental sulfur, zinc, iron, boron, or other nutrient.

Since nitrogen and potassium are required in the above suggested nutrient recommendation then the nitrogen can be chosen from Table 1 and the potassium from Table 2. Since phosphorus is not really needed in this example then blends with high levels of phosphorus should be avoided. Urea was chosen as the nitrogen source and muriate of potash was chosen as the potassium source. The soil test is representative of 20 acres so when these two fertilizers are blended there is a per acre cost of $50.51. Urea would need to be applied 333 lb/A and just 66 lb/A of muriate of potash would have to be applied to meet the nutrient suggestion. A total of 7, 978 lb of the blend would need to be applied to 20 acres as given below:

Suggested Fertilizer Blend	333	lbs/ac	Urea 45%	6,667	lbs primary N total
TotalTotal Blend (lbs/ac):399	0	lbs/ac		0	lbs primary P total
Blend Cost ($/ac): $50.51	66	lbs/ac	Muriate of potash (KCL)	1,311	lbs primary K total
20 Acres to fertilize				7,978	**Total Blend (lbs)**

Another fertilizer consisting of ammonium sulfate and a 6-6-18 blend could be chosen, as given below, to meet the N and K needs:

Suggested Fertilizer Blend	651	lbs/ac	Ammonia Sulfate	13,016	lbs primary N Total
TotalTotal Blend (lbs/ac):873	0	lbs/ac		0	lbs primary P total
Blend Cost ($/ac): $86.67	222	lbs/ac	6-6-18	4,444	lbs primary K total
20 Acres to fertilize				17,460	Total Blend (lbs)

Note that the chosen fertilizer with an analysis of 6-6-18 contains some phosphorus, even though it is not needed. Since more of this total blended material is needed (10,000 more pounds to cover 20 acres) and the cost is $36.16 per acre more to meet the same nutrient recommendation. Which would you choose?

Another soil test based example

Another location was found through soil testing to have sufficient potassium but was low in phosphorus and nitrogen. For an athletic field the total amount is given for the year:

Nutrient Recommendation	N	P_2O_5	K_2O
	lbs/ac	lbs/ac	lbs/ac
Recommended Nutrient Rate:	127	120	0

Now lets choose ammonium sulfate as the nitrogen source and 10-34-0 as the phosphorus source and get the season totals:

Suggested Fertilizer Blend		485 lbs/ac Ammonia Sulfate	19,393 lbs Total Needed
Total Blend (lbs/ac):	716	231 lbs/ac 11-52-0 (MAP)	9,231 lbs Total Needed
Blend Cost ($/ac):	$84.08	0 lbs/ac	0 lbs Total Needed
			28,624 lbs primary N Total

An early season application of all the phosphorus would take 231 lb per acre of 11-52-0. At $0.24 per pound this means a cost of $55.44 per acre or $1.27 per 1,000 square feet. The remainder of the cost ($28.64 per acre or $0.66/1000 sq ft) can be divided into four equal applications over the growing season. Nitrogen applications need to be made in increments so as not to waste the nitrogen fertilizer with leaching.

Of course all of these costs could be potentially reduced with the use of organic amendments, such as compost, which can increase the nutrient reserve. Compost plus application costs need to be factored into the budget over the long term. Compost will typically have a carry-over effect into the next year that can be assessed with soil testing.

Table 1. Fertilizer nitrogen cost from the National Ag Statistics Service, USDA, 1999.

Item (Name)	National Ave. Cost Dollars/Ton	N %	N $/lb	P_2O_5	K_2O %	S
10-10-10	$171	10	$0.47	10	10	0
10-3-3	$133	10	$0.55	3	3	0
10-6-4	$151	10	$0.55	6	4	0
13-13-13	$193	13	$0.36	13	13	0
15-15-15	$349	15	$0.78	15	15	0
16-0-13	$131	16	$0.30	0	13	0
16-16-16	$264	16	$0.44	16	16	0
16-4-8	$228	16	$0.58	4	8	0
16-6-12	$163	16	$0.31	6	12	0
17-17-17	$212	17	$0.24	17	17	0
19-19-19	$216	19	$0.19	19	11	0
24-8-0	$156	24	$0.24	8	0	0
6-6-6	$197	6	$1.26	6	6	0
8-8-8	$159	8	$0.61	8	8	0
Ammonia Sulfate	$195	21	$0.46	0	0	24
Ammonium Nitrate	$247	34	$0.36	0	0	0
Anhydrous Ammonia	$323	82	$0.20	0	0	0
Aqua Ammonia	$93	20	$0.23	0	0	0
Calcium Nitrate[1]	$360	16	$1.16	0	0	0
N Solutions 28%	$197	28	$0.35	0	0	0
N Solutions 30%	$128	30	$0.21	0	0	0
N Solutions 32%	$172	32	$0.27	0	0	0
Nitrate of Soda	$265	16	$0.83	0	0	0
Urea 45% N[§]	$270	45	$0.30	0	0	0

Note: These costs come from 1999 National Ag Statistics Service for the SW region.

[1]Note: These costs come from 2001 price quote from a dealer in the Las Cruces area.

[§] Note: Urea is used as the cost baseline for N.

Special thanks to Michael Sporcic, NRCS State Agronomist for compiling the data.

Table 2. Fertilizer phosphorus and potassium cost from the National Ag Statistics Service, USDA, 1999.

Item	National Ave. Cost	N	P_2O_5		K_2O		S
	($/ton)	(%)	(%)	($/lbs)	(%)	($/lbs)	(%)
Primarily potassium							
0-15-40	$199	0%	15%		40%	$0.25	0%
0-18-36	$192	0%	18%		36%	$0.27	0%
3-10-30	$178	3%	10%		30%	$0.27	0%
5-10-15	$170	5%	10%		15%	$0.47	0%
5-10-30	$184	5%	10%		30%	$0.26	0%
6-6-18	$209	6%	6%		18%	$0.48	0%
9-23-30	$215	9%	23%		30%	$0.27	0%
Muriate of potash (KCl)	$168	0%	0%		61%	$0.14	0%
Sulfate of Potash-Magnesia (K-mag)[1]	$280	0%	0%		22%	$0.64	18%
Primarily phosphorus							
0-20-20	$200	0%	20%	$0.36	20%		0%
10-20-10	$200	10%	20%	$0.28	10%		0%
10-20-20	$213	10%	20%	$0.24	20%		0%
10-34-0	$292	10%	34%	$0.34	0%		0%
11-52-0 (MAP)	$319	11%	52%	$0.24	0%		0%
16-20-0	$277	16%	20%	$0.45	0%		15%
18-46-0 (DAP)[1]	$327	18%	46%	$0.24	0%		0%
5-10-10	$151	5%	10%	$0.47	10%		0%
5-20-20	$193	5%	20%	$0.27	20%		0%
6-12-12	$164	6%	12%	$0.40	12%		0%
6-24-24	$231	6%	24%	$0.27	24%		0%
8-20-5	$248	8%	20%	$0.47	5%		0%
8-32-16	$235	8%	32%	$0.22	16%		0%
Triple Superphosphate[1]	$367	0%	46%	$0.40	0%		0%

[1] Note: These costs come from 1999 National Ag Statistics Service for the SW region.

Note: MAP is used as theNote: MAP is used as the costNote: MAP is used as the cost baseline for P.

Special thanks to Michael Sporcic, NRCS State Agronomist, for compiling the data.

IPM for Schools and Other Public Grounds

Mr. Jeffrey Gregos

Program Manager, Turfgrass Field Research
University of Wisconsin/O. J. Noer Turfgrass Facility
3101 Highway M
Verona, WI 53593

IPM for Schools and Other Public Grounds

Dr. John Stier
University of Wisconsin-Madison
Presented by
Jeffrey Gregos

Public concern over children's potential exposure to pesticides has led to efforts to require Integrated Pest Management (IPM) at schools nationwide. Several states have already passed legislation requiring IPM practices in schools, including Florida, Minnesota, Michigan, Maryland, and Texas. Federal legislation is pending.

The University of Wisconsin-Extension (UWEX) teamed with the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) to develop a volunteer IPM training program for building and grounds managers of K-12 schools. The goal is to help schools develop IPM procedures to reduce children's exposure to pesticides.

The Wisconsin program is unique for two reasons. First, equal attention is given to indoor and outdoor pest management. In most states only indoor pesticide use is of concern. Secondly, while several states have developed training materials or manuals, we provide hands-on training plus web-based, hard copy and telephone support, something few other states provide (Cornell extension in New York provides some training).

Program Development

In 1998 a committee of UWEX specialists, WDATCP, professional pest control operators (PCOs), school personnel, toxicologists, and parents developed a strategy to get IPM into schools. A three-part program was designed: 1) Development of a school-specific IPM manual, 2) A pilot training program in 1999, and 3) A full-scale program in 2000.

Phase I: School IPM Manual

The 200 page manual is placed in a three-ring binder to allow easy removal of sheets for photocopying. This format allows users to install their own information in one ready-reference source, e.g., pesticide labels, application records, maps of school grounds, etc. Action points are provided for each type of pest. An appendix contains auxiliary information (pesticide lists, explanations of management practices, etc.). The main sections of the manual are:

- How to use the manual
- Essential elements of IPM
- Turf management
- Outdoor insects and diseases
- Outdoor vertebrate pests

- Indoor pests
- Developing pest management plans

One of the concepts embodied in the manual is the division of often-scarce school resources according to need. For example, schools often stretch fertilizer and pesticide treatments equally across the grounds, yet certain areas are used more intensively than others and require different levels of management (athletic fields vs. landscape). Another concept is to utilize monitoring techniques to prevent pest problems from becoming unmanageable and to document efficacy of various control measures.

The manual contains sample policies and pest reporting sheets which managers can use without restriction. Information such as the pesticide use policy may dictate that pesticides are only applied during non-school hours or between school sessions. Some managers customize the sheets for their situation.

- Pest management plan
- Pesticide use policy
- Licensing/training information
- Labels/MSDS
- Pest reporting
- Pesticide use logs
- Building/grounds maps

Other information assists managers with pesticide information.

- Posting and notification guidelines
- How to select a professional pest control operator
- Pesticide selection
- Corn gluten meal

The manual has been requested by a number of schools, parks, and municipalities throughout the U.S. Parts of the manual were used by a private company in Michigan for production of a CD on school safety training. The IPM Institute of North America has utilized the manual in production of its School IPM certification process. The manual is available on-line at http://ipcm.wisc.edu/programs/school.

Phase II: 1999 Pilot Program.

We visited six school districts three times during 1999. During the first visit in early spring we met with building and grounds managers, administrators (principals and athletic directors), and PCOs hired by the school. We discussed IPM, the manual, their pest problems, and conducted indoor and outdoor pest assessments. Schools were visited later in the spring to assist in the development of IPM plans and practices. During autumn schools received a third visit to determine the extent to which IPM had been implemented. Eighteen other school districts received the manual only in early spring as they wished to try IPM without assistance.

Results of Pilot Program.

We enjoyed enthusiastic cooperation at each school we visited. All of the PCOs we met were already practicing IPM in the schools though the schools didn't realize it. The following examples characterize the impact of the IPM program. One school district quit the routine spraying of classrooms for lice which is an ineffective and unnecessary use of pesticide. Several schools experienced indoor insect problems which ceased once we discussed sanitation and they changed their open food policy to restricting food to the cafeteria. Some schools applied herbicide once or more annually but didn't fertilize, a practice which is counterproductive. Another school used herbicides to eliminate weeds in baseball infields (we suggested dragging the infields with a spiker instead). All of the schools we visited developed IPM policies and procedures. Of the schools we didn't visit, less than five looked at the manual; only one adopted IPM procedures and policies.

Phase III: Full scale training and education.

The state legislature approved spending of $55,000 to UWEX for the implementation of the full-scale program in 2000. Four regional one-day seminars were held during April in key suburban areas since this is where the majority of public concerns were raised. Parents in rural areas had minimal concern since pesticides are used routinely for farming, while parents in inner city areas had other concerns for their school-age children. The 250 seminar attendees were from 115 school districts (27%), representing 947 public schools (46%). School IPM manuals were given to each attendee. During summer we provided hands-on training at 13 school districts; personnel from nearby schools/districts were invited to participate. Approximately 200 school personnel, representing 37 districts, attended the training sessions.

Future of Wisconsin School IPM Extension Training

Legislation to require IPM at schools has passed both houses of the Wisconsin legislature and is waiting approval by the governor. We have continued our seminars in 2001, including the addition of an advanced IPM course plus a seminar series exclusively targeted for professional lawn care companies who service schools.

Compacted Turf

Mr. Jeffrey Gregos
Program Manager, Turfgrass Field Research
University of Wisconsin/O. J. Noer Turfgrass Facility
3101 Highway M
Verona, WI 53593

Compacted Turf

Dr. John Stier
University of Wisconsin-Madison
Presented by
Jeffrey Gregos

INTRODUCTION

Compacted turf can be found almost anywhere turf is present. On golf courses, the most commonly hit areas are the ends of cart paths and tee/green entrance and exit points. Large-scale compaction may occur on fairways from the operation of heavy-duty equipment during construction. Compaction problems may be compounded by loss of soil structure due to overtilling prior to establishment, sodic problems which result in a loss of soil structure, or poor drainage. Clay soils are more subject to compaction than silt or loam soils, while properly graded sand-based root zones are the least subject to compaction.

COMPACTION CAUSES MULTIPLE PROBLEMS

Compaction causes several problems which may not readily be evident until another stress (drought, heat, etc.) occurs. Compaction from foot traffic and most turf-type equipment occurs primarily in the upper three inches of soil. Interestingly enough, when turf tires are used, most equipment produces only 4-7 psi, similar to the 6 psi caused by a person standing. Walking and running produce greater pressures. Since the top three inches is where the bulk of turf roots grow, compaction-related problems include:

- Poor root growth
- Reduced surface infiltration and internal drainage
- Greater potential for thatch development
- Lower turf carbohydrate levels
- Increase in certain weed species (e.g., *Poa annua*)

Root growth is reduced in compacted soils because the bulk density is increased, thus there is less room for roots to grow. There is also less oxygen in the soil environment which is needed for root respiration (energy production for growth and uptake). A reduction in bulk density may at first increase available soil moisture and shoot growth, particularly in sandy soils, but increased compaction ultimately reduces the amount of available soil moisture capacity and shoot growth.

Of course, root growth reduction has several secondary impacts, including lack of environmental stress tolerance, reduced turf stability, a lower nutrient and water uptake efficiency, and less resistance to root-rot diseases such as summer patch and damage from white grubs. Nutrient and moisture uptake are decreased, leading to a less efficient turf system. Compaction ultimately results in a thin turf stand with slow growth and poor recuperative potential.

WATER RELATIONS

Evapotranspiration rates are typically reduced by compaction, sometimes by as much as 20-25%. A common mistake is to apply more water to compacted turf in an attempt to increase the growth rate. Since compaction reduces pore space and average pore size, adding more water is not necessarily the answer. Many compacted turfs need to be irrigated more frequently but at lower rates.

WHEN IS SAND NOT SAND?

Most people know that clay soils are more subject to compaction compared to sandy soils. This is why many putting greens and tees now are often constructed using sand-based root zones. However, when sands are selected that have a wide particle size range, excessive compaction may still result. This is the reasoning behind the size gradation and percentages allowed according to the United States Golf Association (USGA) guidelines.

Another common mistake is to mix sand into an existing soil in order to improve internal drainage and decrease compaction. This approach rarely works because in order to be effective, sufficient sand must be present to bridge the gaps between sand particles. Sand usually has to be present at a minimum of 60-70% by volume in order to achieve this degree of bridging. Incorporation of sand into an existing soil in the necessary amounts is at best a daunting task; at worst, it is a logistical and economical improbability.

REDUCING COMPACTION PROBLEMS

There are three primary approaches to reducing compaction problems. The first approach is to use a turfgrass species or cultivar that has an aggressive creeping growth habit. Such species will likely develop some thatch and have a greater shoot density that will minimize compaction when traffic is applied. Minimal research has been done in this area, though, and turf selection by itself is not likely to reduce the need for other measures.

Traffic control and water management are both vital to reducing the potential for compaction. Most golf courses already do this by refusing to allow carts on the course following a severe rainstorm, and by routing traffic around areas that are wet due to an irrigation leak or other problem. Drainage, either internal or surface, should be provided to areas that are inherently moist due to grade or other reason. Internal drainage may be improved by tiling. In cases where internal drainage is not practical or is insufficient, the area should be graded to provide at least a 1% slope to drain the water away from areas considered in-play.

Cultivation is the time honored and often the most commonly used short-term approach to compaction management. Cultivation, otherwise known as aeration, can be accomplished in several ways. Aeration with solid tines or long drills can temporarily increase internal drainage and may result in scattered points of increased turf growth as roots fill the holes and shoot growth is increased. Aeration holes, regardless of whether solid or hollow tines are used, rarely last long unless they are filled with properly graded sand. In loam, silt, and clay soils, one of the best long-lasting approaches is to use hollow tine aeration followed by heavy topdressing using properly graded sand. The sand prevents the native soil from filling in the aeration hole, providing a channel from the surface to below the core hole through which water will drain and roots will grow. Spiking and slicing are relatively ineffective at reducing compaction problems but may be useful in certain situations.

Overview of USGA Turfgrass and Environmental Research

Dr. Michael Kenna

Research Director
USGA Green Section
P. O. Box 2227
Stillwater, OK 74076

Overview of USGA Turfgrass and Environmental Research

Michael P. Kenna, Ph.D.
Research Director
USGA Green Section

The USGA Green Section has been directly involved in every phase of golf course maintenance and management from the control of diseases, insects, and weeds to the breeding and release of improved strains of bentgrass, Kentucky bluegrass, bermudagrass, zoysiagrass, and buffalograss. The Green Section has been involved in research pertaining to cultural practices, equipment development, soils, sands, fertilizers, irrigation, and other materials and practices used in golf course maintenance. This not-for-profit agency, free from commercial connections, was a pioneer and remains today a chief authority in turfgrass management for golf.

As the game of golf has grown, so has the knowledge on how to produce, establish, and maintain the turfgrasses used for golf course playing surfaces. The growth in the number of golfers and the number of rounds played has required construction of more golf courses able to withstand an increased number of rounds. At the same time, golf courses have experienced increased maintenance costs and tougher government regulation concerning water use and environmental issues. The interaction of the increase in the game's popularity with higher maintenance costs and government regulation created several problems needing solutions. Research was needed to solve these problems; however, significant funding for this research was not available to the universities able to address these problems.

Recently, the Green Section embarked on the most intensive turfgrass and environmental research effort in the history of golf. During the period form 1982 to 2000, the USGA placed more than $20 million in funding for university research projects. The goal is to achieve a significant reduction in water and pesticide use, and to investigate the effects of golf courses on the environment. New grasses, improved maintenance practices, and information pertaining to the environment are generated each year by the research program.

In 1982, the USGA initiated the Turfgrass Research Program to support an annual series of grants to universities. These projects included the general categories of the Turfgrass Information File, Plant Stress Mechanisms, Cultural Practices, and Turfgrass Breeding. In 1990, the USGA began a project to evaluate the impact of golf courses on the environment. Studies continue to examine questions such as whether fertilizers and pesticides contaminate ground water, and, if they do, what can be done to mitigate this impact. Additional studies, work toward the development of alternative (non-chemical) methods of pest control, and evaluate the influence of golf courses on people and wildlife.

Golf courses are more than avenues for recreation. They are valuable open spaces, natural sanctuaries, and wildlife habitats, especially in areas of urban expansion. To this end, the USGA is committed to increasing environmental awareness and enhancing wildlife habitats through proper golf course management programs. In 1991, the USGA initiated a cooperative effort with the Audubon International. The Audubon Cooperative Sanctuary Program, has increased the awareness about the positive benefits of golf courses, and encourages and recognizes golf courses that take a leadership role in conservation projects.

Turfgrass Breeding

From the early days of research effort in the 1920's to the present, the USGA has sponsored turfgrass breeding programs to develop improved cultivars for the game of golf. Since 1982, twelve universities have conducted breeding programs on fifteen different turfgrass species. Three general approaches were implemented in this breeding effort.

First, plant-breeding efforts focused on improving the stress tolerance of widely used turfgrass cultivars in order to increase their range of use in the United States. For example, increasing the heat tolerance of creeping bentgrass has allowed this species to be used more successfully in the Southern United States. On the other hand, increasing the cold tolerance of bermudagrass has allowed more usage of this species in the transition zone of the USA. Developing more aggressive growing and better establishing zoysiagrasses has helped to increase there usage.

A second approach was the introduction of new species from other parts of the world, or looking at old problems in a new way. For example, *Poa annua* var *reptans* for use as a putting green turfgrass species. In many parts of the United States, and world for that matter, this invasive grass becomes the predominate species on the putting green, tees, and fairways. Can it be improved and produced as a turfgrass cultivar? The research effort at the University of Minnesota, under the direction of Dr. Donald White, was able to develop one *Poa annua* var *reptans* cultivar, DW-184. The USGA will continue this research effort at Pennsylvania State University with Dr. David Huff.

Reduce Water and Pesticide Use

- *Improve the stress-tolerance and adaptation of cool-season and warm-season turfgrasses*
- *Introduce new species from other parts of the world*
- *Domesticate and develop native species into low maintenance turfgrasses.*

The last approach has increased the plant breeding efforts on potential turfgrass species that are native to the United States. The development of turf-type buffalograss for use in golf course roughs, and maybe even fairways, is one successful example. Other species, like alkaligrass, crested wheatgrass, blue grama, or saltgrass have made significant progress but need further improvement effort. The amount of water and pesticides the new turfgrasses use has been an important goal throughout the breeding program. This is true whether working to improve the adaptation of existing turfgrass species like bentgrass or bermudagrass, making an effort to domesticate native species like buffalograss, or trying to utilize the tenacity of a difficult-to-control species like *Poa annua* var *reptans.*

The USGA, in cooperation with the Golf Course Superintendents Association of America (GCSAA) and the National Turfgrass Evaluation Program (or NTEP), are sponsoring commercial variety trials on golf courses. These trials are established on practice putting greens and are maintained the same way the golf course superintendent prepares the golf course. Fifteen trials where established throughout the United States to evaluate the new bentgrass and bermudagrass varieties.

A question often asked today is "How will molecular genetics help in the future?" Over the last 75 years, a tremendous amount of effort

Table 1. Turfgrass Breeding Programs and Cultivars.

Bentgrass	
Pennsylvania State	*Pennlinks*
Univ. of Rhode Island	*Providence*
Texas A&M University	*Crenshaw, Cato, Mariner, Imperial, Century*
Cool-Season Grasses	
Rutgers University	*Kentucky Bluegrass, Perennial Ryegrass, Fine Fescues, Tall Fescue*
Bermudagrass	
University of Georgia	*TifEagle, Tifsport*
New Mexico State University	*Sahara*
Oklahoma State University	*OK 91-11, OK 95-1*
Zoysiagrass	
Texas A&M University	*Diamond, Cavalier, Crowne, Palisades*
Seashore Paspalum	
University of Georgia	*Sea Isle I, Sea Isle 2000*
Poa annua* var *reptans	
University of Minnesota	*DW-184*
Pennsylvania State University	*Experimental Lines*
Native Grasses	
University of Nebraska	*Buffalograss – 609, 315, 378, Cody, Tatanka*
Colorado State University	*Alkaligrass, Crested wheatgrass, Blue grama, Saltgrass*
Arizona State University	*Curly Mesquitegrass, saltgrass*

has been exerted toward improving turfgrass species with conventional plant breeding. During the past decade, we have just begun to scratch the surface of turfgrass improvement using cell and molecular techniques. These efforts have included: turfgrass and molecular marker analysis; biological control, including endophytes; genes with potential for turfgrass improvement; and *in vitro* culture and genetic engineering.

An interesting pioneering effort is genetic transformation. This research effort has been possible due to the advances made with important food and fiber crops. However, a pleasant surprise is how easily the success with agricultural crops can be applied to turfgrass species. The successful development of transgenic turfgrass clones with herbicide and disease resistance demonstrate the usefulness, and potential impact, that *biotechnology* will have on the turfgrass industry.

With regard to biotic stresses such as disease and insect problems, several research ideas are being addressed. For example, at Rutgers University a combination of conventional and molecular plant improvement techniques are being used to improve host plant resistance. Research with the chitinase gene demonstrates that we can identify the DNA sequences of genes that may transfer or increase disease resistance. There are a tremendous number of potential candidate genes that need to be evaluated for turfgrass. For example, bacterio-opsin, pokeweed antiviral protein, glucose oxidase, other chitinases and delta-9 desaturase are just a few that are being evaluated today.

Drought Avoidance

- *Deep root systems*
- *High root density*
- *Thick cuticle*
- *Rolled leaf blades*
- *Slow leaf extension*

Drought Tolerance

St. Augustinegrass

- *high dehydration tolerance*

Buffalograss

- *escapes drought by summer dormancy*

In summary, the USGA has a long history of sponsoring turfgrass improvement research specific for golf courses. Recent breeding efforts have focused on improving stress tolerance on widely used turf species, introducing new species from other parts of the world, or domesticating grasses native to the United States. Since 1990, the USGA also has supported new research efforts using biotechnology as a means for improving important turfgrass species for herbicide and pest resistance.

Cultural Practices

During the past two decades, we have seen work on methods to improve turfgrass management in the areas of water use, nutrition, soil compaction, salinity management and cultural practices, particularly in relation to golf course turf. The goal of all this research is to improve the quality of playing surfaces while reducing potential negative impact on the environment.

During the 1980s, much of the research effort focused on understanding, determining, and measuring water use/need for our most important turfgrass species. A great deal of effort throughout the United States went toward developing Et_o or reference evapotranspiration values for different species, which could be used, along with other plant criteria and atmospheric, soil, and electronic irrigation systems data, to refine irrigation regimes.

$$\mathbf{Et_{grass} = ET_o \times K_c}$$

The Et_o approach combined with timed irrigation systems improves irrigation efficiency

Although a study at the University of Arizona revealed a variation of as much as 30 percent in Et_o values calculated by five different methods, the Et_o approach, along with timed irrigation systems, are generally credited with improved irrigation efficiency industry-wide.

During the 1980s, studies also were conducted on the interaction between turfgrass morphology and rate of water use. The concept of morphology-based drought resistance was better defined and categorized into drought "Avoidance" and "Tolerance" mechanisms.

The interaction between water use, species morphology, and cultural practices like mowing, fertilization, and irrigation frequency came under study, and several projects looked at the interaction of two or more cultural practices. For example, the effects of different irrigation rates and potassium applications on golf turf.

Many studies in the 1980s evaluated new aerification methods as a means of reducing soil compaction and thus improving turfgrass rooting and water use rates, as well as soil oxygen levels.

Studies comparing the use of hollow and solid tine cultivation found hollow tine slightly more effective but concluded that both significantly reduce compaction.

A number of studies indicate that vigorous cultivation -- that is, verti-drain and core aerification combined -- greatly improve turfgrass water use efficiency by enhancing water uptake from deeper within the profile of soils prone to surface compaction.

The increased use of treated wastewater for golf course irrigation led to funding research in this area. One such study showed that turfgrass irrigated with effluent water had higher growth rates than turf irrigated with potable or city water. In addition, the effluent water that moved through a ten-foot soil profile contained negligible amounts of residual nitrogen and, therefore, contributed minimally to ground water pollution.

Table 2. Potential Evapotranspiration Rates (ET_{grass}).

Relative Rank	ET_{grass} ($mm\ d^{-1}$)	Cool Season	Warm Season
Very low	< 6		Buffalograss
Low	6 – 7		Bermuda hybrids Centipedegrass Bermudagrass Blue grama
Medium	7 – 8.5	Hard Fescue Chewings Fescue Red Fescue	Bahiagrass Seashore Paspalum St. Augustinegrass Zoysiagrass
High	8.5 – 10	Perennial Ryegrass	
Very High	> 10	Tall Fescue Creeping Bentgrass Annual Bluegrass Kentucky Bluegrass Italian Ryegrass	

Due to the increasing incidence of reclaimed irrigation water on golf courses, the USGA, in cooperation with other golf organizations, sponsored a symposium on the topic. The result was publication of the book, Waste Water Reuse for Golf Course Irrigation.

In summary, studies funded over the past two decades have established the USGA as a conservationist organization. In addition to supporting the use of reclaimed water in golf course irrigation, the Association has funded research which identified and further classified drought resistant turfgrass species, and led to maintenance programs that conserve substantial volumes of water, reduce soil compaction and fertilizer needs, and decrease mowing frequency, all without impairing functional quality or aesthetic appeal.

Reclaimed Water

- *Increased usage by golf courses*
- *Higher turfgrass growth rates*
- *Minimal downward movement of nutrients*

Pesticide and Nutrient Fate

The university research investigating pesticide and nutrient fate was the first extensive self-examination of golf's impact on the environment. What has the environmental research program told us? The research shows that under *most* conditions, the *small amounts* of pesticides and nutrients that *move* through the soil are found at *levels below* the health and safety standards established by the U.S. Environmental Protection Agency. These words have been selected very carefully:

- *Most* conditions - *There are some conditions where we have some problems.*
- *Small amounts* of pesticides and nutrients - *its not zero!*
- *Move - Yes, they do move sometimes.*
- *However,* at *levels below* health standards

The studies demonstrated that the turfgrass canopy, thatch, and root system, *when properly managed*, were an effective filter or sponge. An example of this ability to filter pesticides is supported by the data from studies conducted at the University of Nebraska and Iowa State University.

In Figure 1, the bars are the four pesticides evaluated: metalaxyl, pendimethalin, isazofos, and chlorpyrifos. The pesticide concentration is expressed in parts per million, and as you can see, we are dealing with very small amounts - no more than 0.35 ppm.

Each bar is broken down into the verdure or leaves, thatch, the first 3 cm of soil, then the next 2 cm of soil, an so on. Most of these pesticides stayed in the leaves, thatch or top 10 centimeters of soil at both the Nebraska and Iowa study sites (sandy loam soils).

These results are expected because pesticides tend to interact with the thatch and soil. The word sorption is a term that includes the process of adsorption and absorption. Adsorption refers to the binding of a pesticide to the surface of soil particles or organic matter. Absorption implies that the pesticide penetrates into a soil particle.

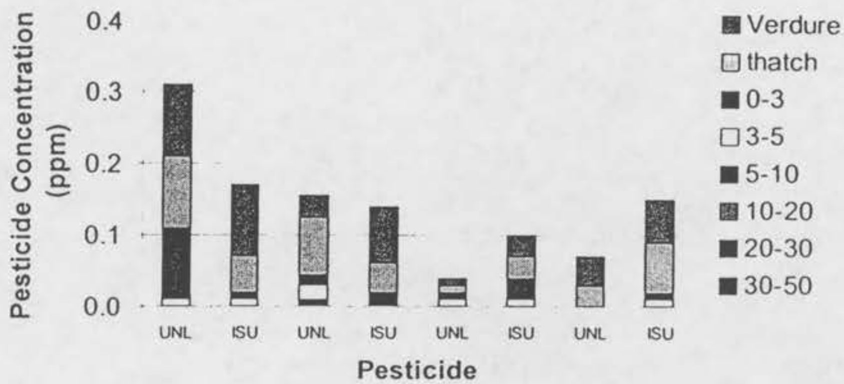

Figure 1. The studies demonstrate that the turfgrass canopy, thatch, and root system, when properly managed, were an effective filter.

Adsorption of pesticides is affected by the partition coefficient that is reported as K_d or more accurately, as K_{oc}. A K_{oc} less than 300 to 500 is considered low. The strength of adsorption is inversely related to the pesticide's solubility in water and directly related to its partition coefficient. For example, chlorinated hydrocarbons, such as chlorpyrifos are strongly adsorbed, while phenoxy herbicides like 2,4-D are much more weakly adsorbed.

An interesting result from USGA-sponsored research is how well thatch adsorbs pesticides. In Figure 2, work by Drs. Carroll and Hill, at University of Maryland, demonstrate the adsorption differences between thatch and soil. In this figure, adsorption percentage of 2,4-D for thatch and soil is plotted over 24 hours. The dark circles, in the top line, are the measured adsorption for thatch, while the red triangles below are for soil. The amount of 2,4-D adsorbed to thatch was 20 to 30 percent higher than for soil. The decomposing organic matter that turfgrasses produce in the thatch layer has proven to be an excellent filter for pesticides.

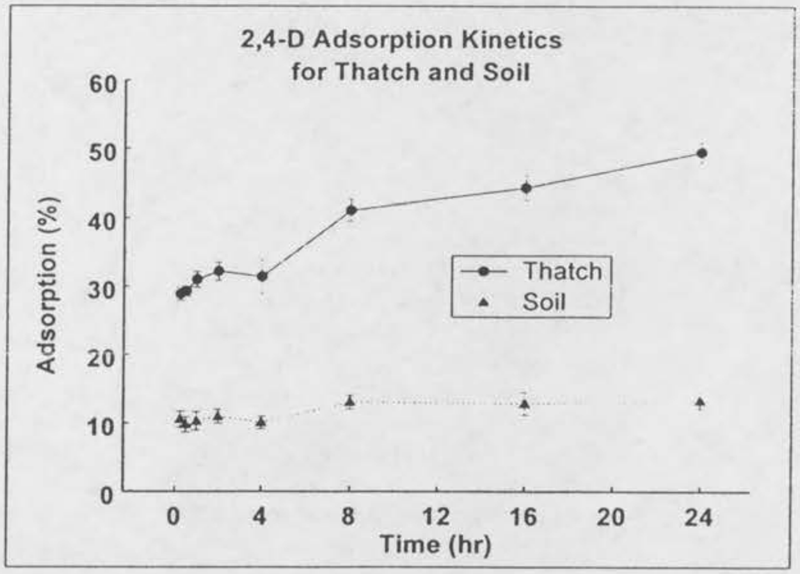

Figure 2. An interesting result from USGA-sponsored research is how well thatch adsorbs pesticides. Research at University of Maryland demonstrates the adsorption differences between thatch and soil.

Therefore, the pesticide solubility and the pesticides affinity to adhere to soils or sorption must be considered together. Solubility is the extent to which a chemical will dissolve in a liquid. Water solubility is usually a good indicator of soil mobility, although it is not necessarily the best criterion. In Figure 3, note that the products with low solubility (or pSw indicated on the x-asis) near the origin for this graph did not move. However, a higher amount (more than 10%) was transported off the plots for those pesticides with high solubility (or a pSw > 5 mg L^{-1}).

As one would expect, the results from all of the USGA-sponsored studies documented that heavy textured soils adsorbed pesticides and fertilizers better than light textured or sandy soils. First, clay or silt particles are much smaller than fine or coarse sand. This impacts the amount of surface area able to bind or adsorb pesticides and nutrients and influences the soil porosity. Second, the chemical properties, or cation exchange capacity, of clay and silt provide more binding sites for nutrients and pesticides. Last, the physical properties of heavy textured soils, particularly the porosity, slow the downward movement of water. So remember - particle size, cation exchange capacity, and porosity in the following two examples.

In Table 3, research at Cornell University is summarized as the percent of the total applied mecoprop that was found in leachate. This amount of mecoprop moved through fifteen inches of the different soils. The three soils, along the top of the table, included a coarse sand, sandy loam, and silt loam. So we are going from a light textured to heavy textured soil. There are two rainfall levels, first a moderate amount typical of upstate New York, and a high amount that was one of the wettest years in the history of the state. It is important to note that this data simulated a newly established bentgrass fairway. As you can see, there are potential problems when establishing turf on light textured soils, particularly coarse sands with little organic matter.

In Figure 4, nitrogen-leaching data during turf establishment from many of the USGA-sponsored studies is averaged over different soil types. Nitrogen recovered in leachate is expressed in parts per million. Along the bottom of the graph, there are five soil types, a straight sand typical for putting greens, the same sand amended with peat moss, a loamy sand, a sandy loam, and a silt loam. The last three were from fairway trials.

The bars are the average amount of nitrogen that leached, while the top line (solid) is the maximum and the bottom line

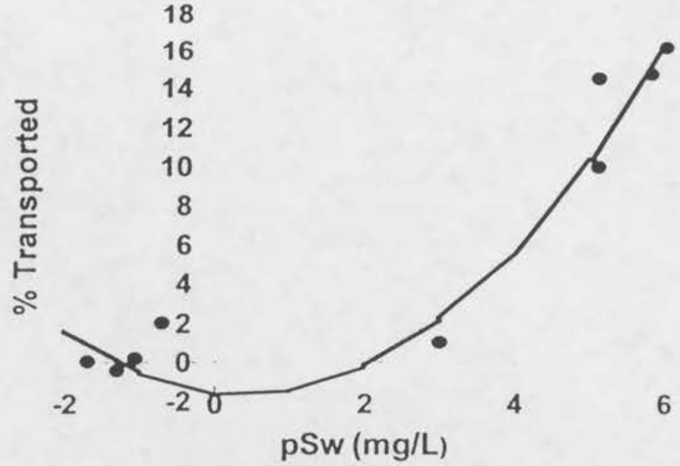

Figure 3. The water solubility of a pesticide is a good indicator of soil mobility.

Table 3. Percent of Total Applied Mecoprop (MCPP) in Leachate – Cornell University.

	Soil		
Precipitation	Coarse Sand	Sandy Loam	Silt Loam
	----------------	%	----------------
Moderate	35	2	1
High	74	1	1

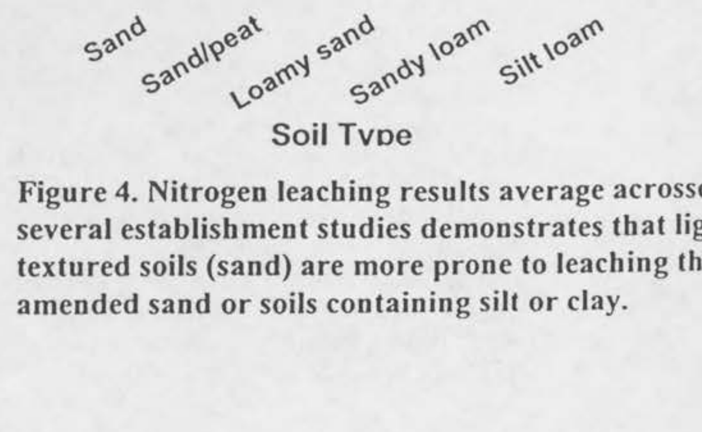

Figure 4. Nitrogen leaching results average acrossed several establishment studies demonstrates that light textured soils (sand) are more prone to leaching than amended sand or soils containing silt or clay.

(dashed) is the minimum that leached for each soil type. Again, as we would expect during turfgrass establishment in these soils, the light textured sands are more prone to nitrogen leaching than amended sand or soils containing more silt or clay.

Another, more important, message from the research was that pesticide and nutrient runoff were more of a threat to water quality than leaching. In addition, the data indicate that we need to improve the prediction models applied to turfgrass systems. During the last three years, the research program has made an effort to obtain more information on pesticide and nutrient runoff from heavy textured soils.

The USGA also has supported early efforts to use previous research results to fine tune pesticide fate models so they do a better job predicting the impact of golf course turf on water quality. However, there is still much more to do in these two research areas!

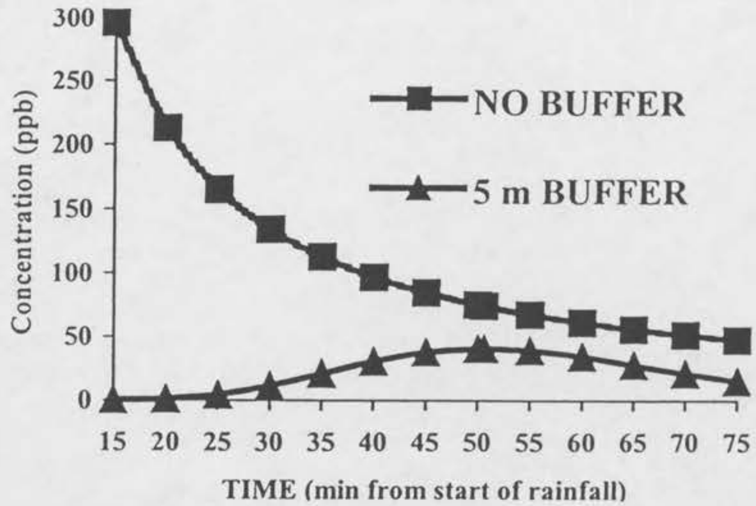

Figure 5. The effect of buffers on 2,4-D concentration in surface runoff, in parts per billion, is plotted over 75 minutes of intense rainfall. The 2,4-D concentration was higher for plots without a buffer (the line with the squares) than the plots with a buffer (the line with the diamonds below).

At Oklahoma State University, research conducted by Dr. Baird evaluated the effect of buffers on 2,4-D concentration in surface runoff. The concentration, in parts per billion, is plotted over 75 minutes of intense rainfall. In Figure 5, the 2,4-D concentration was higher for plots without a buffer (the line with the squares) than the plots with a buffer (the line with the diamonds below).

The pesticide and nutrient fate research program has had a positive impact on golf. The program was run in an unbiased fashion, results have been published in peer-reviewed scientific journals, and the message, *be careful and responsible* is getting out to golf course superintendents around the country. Third, the pesticide's solubility and ability to adsorb to thatch or soil plays an important role in potential leaching or runoff. Fourth, pesticide and nutrient runoff are more threatening to water quality than leaching. Last, research results indicate that we need to improve pesticide fate models. Future efforts will focus on scaling up the size of research plots to simulate entire fairways or greens. Some of these studies will be conducted on golf courses. The new projects will strengthen the position that properly constructed and maintained golf courses have very little impact on water quality.

Golf courses are more than avenues for recreation. They are valuable open spaces, natural sanctuaries, and wildlife habitats, especially in areas of urban expansion. To this end, the USGA is committed to conducting turfgrass and environmental research to provide answers to the important issues facing the game of golf.

What has the environmental research program told us?

- *Turfgrass canopy and thatch serve as a filter*
- *Soil texture affects the fate of pesticides and fertilizer*
- *Solubility affects on pesticide transport*
- *Runoff is more threatening to water quality than leaching*
- *Need to improve fate simulation models*

Privatization: Public versus Private

Mr. Pat Montoya
General Manager, Sodexho and
New Mexico State University Grounds Department
Box 30001, MSC 3545
Las Cruces, NM 88003

Introduction to Presentation by Pat Montoya
"Privatization: Public *vs.* Private"
Southwest Turfgrass Association Annual Conference – 2001

While there is a generality of the functions of organizations, whether public or private, functions that bear identical labels take on rather different meanings in a public or private setting (Allison, 1980). What distinguishes public from private organizations is neither their size nor their desire to plan, but the environments under which they acquire or utilize resources, labor, and materials (Galbraith, 1962).

It can be argued that, as government is different from private enterprise, a public organization differs from a business organization. There are measures for thinking that the field of public administration can be differentiated from other similar fields, but is this simply because this field is attached to government? When public organization managers are asked what they see as distinctive about their work, they clearly distinguish their perception of their own work from their perception of work in the private sector. Public managers argue that the purpose of government operations is more ambiguous than that of private industry. For example, government agencies are typically more interested in service than in production or profit, and goals are usually stated in those terms. Public managers also argue that goals are difficult to define because government organizations are limited in the degree of efficiency they can attain.

In light of the above discussion, this paper is limited to those aspects that reveal the differences between public and private organizations. This paper supports the argument that public and private organizations are distinctly different with only superficial similarities.

Identifying the characteristics of public *vs.* private organizations has proven difficult. In analyzing the major approaches that attempt to differentiate between public and private organizations, it is noted that none of the approaches can succeed in drawing a clear line between sectors. There will always be intermediate types and overlaps on various aspects between the public and private sectors. Associations which represent a sampling of public and private entities classify their members by a number of basic characteristics and magnitudes. That grouping makes it reasonable to speak of typical government and business organizations.

The following exposition describes differences between public and private organizations. These differences include environmental factors, such as markets and constraints; internal structures and processes, which concern organizational goals and authority; and personnel.

Environmental factors are the first contrast between public and private institutions. Public organizations are subject to less public scrutiny than their private counterparts. Therefore, there is less incentive for efficiency. Revenue funding for a public organization depends on appropriation from the political arena, not on market performance. In addition, public organizations are constrained by political influence, such as special-interest groups. Legal requirements also differ from those which apply to private organizations.

Sigmund Freud was well aware of constraints, and, in his book *Civilization and its Discontents* (1961), he examined the impact of civilization on the possibilities for human satisfaction. At its base, civilization implies constraints; individuals relinquish part of their autonomy and submit to the restrictions of the group.

A business firm defines procedures to purchase goods and services. These procedures might allow the company to buy from vendors other than the lowest bidder or to avoid the bidding process and negotiate with the vendor directly. In contrast, a government agency must formally advertise for bids, accept the lowest bid, and have no other association with the vendors. When a private firm develops a good working relationship with a contractor, it will tend to use that vendor over and over, without seeking another. However, when a government agency has a satisfactory relationship with a contractor, ordinarily that agency can not use the vendor again without requesting a new bid.

Another example of an environmental factor is the operational budget. Public groups receive their money from taxpayers. First, the agency must convince the budget administrator that its need for money is more important than the needs of another agency. Then, the agency must use its entire budget, or else the surplus is taken for other uses and not returned. In contrast, a business acquires capital by sales, loans, or selling shares, and it may disburse profits to shareholders or employees, or it may reinvest them in the company.

All the complexities of doing business with the government are well known by citizens and firms alike. The complexities in hiring, purchasing, contracting, and budgeting are the result of the "bureaucracy's love of red tape" (Wilson, 1989). Max Weber's analysis of the ideal-type bureaucracy depicts the structure of this purchasing system as an example of a perfect system, and a manager simply must contend with and face the complexities therein.

The next difference between public and private organizations is the internal structure and process. Public organizations have vague, multiple goals that are difficult to measure and which might conflict with another agency's goals. The complexity of goal problems in public organizations has exceeded that of the private sector.

The goal of a private business is profit. Profit is a distinct goal that can be identified and measured. However, no single, measurable, bottom lines are present for public organizations. The inability to measure makes comparisons among public institutions meaningless, and objective evaluation is also difficult (Wilson, 1989).

Public organizations might be more prone than private sector organizations to pursue growth as a goal. Public organizations are pushed toward growth from two directions. First, the inability to accomplish goals leads the organization to believe that, if it were larger and had more resources, it could come closer to goal accomplishment. Second, failing to seek growth could be interpreted to mean that the organization is not committed to its mission.

The power structure of a public entity is fragmented and weak when contrasted with a private business. First, public employees can bypass direct authority with an appeals process that enables their case to be heard by authorities higher up in the chain of command than their immediate supervisor (NMSU EEO Director, personal communication). Next, there is a higher rate of turnover among top leaders within the public sector because of elections and political appointments, resulting in disruptions to the operation. In general, top public executives have shorter terms of office. Last, there is a greater reluctance by public supervisors to delegate, more levels to review, and greater use of regulations policy and procedures books.

Finally, personnel is another major factor considered in differentiating public *vs.* private organizations. In general, public employees usually have higher dominance and flexibility needs but lower work satisfaction and organizational commitment.

A private firm hires, promotes, demotes, and fires personnel with considerable, though not absolute, freedom. In contrast, a federal government agency is regulated by several government agencies: by Congress as to how many persons the agency may hire and at what rate of pay; by the Office of Personnel Management (OPM) as to what rules must be followed when selecting and assigning personnel; by the Office of Management and Budget (OMB) as to how many persons of each particular task it may employ; by the Merit Systems Protection Board (MSPB) as to what procedures it must follow in disciplining of personnel;

and by the courts as to whether it has followed the rules of Congress, OPM, OMB, and MSPB.

Another example which depicts public *vs.* private organizations is the Pendleton Act. The Pendleton Act has three goals: to hire public employees on the basis of merit rather than political appointments, to manage employees effectively, and to treat equal employees equally. Private corporations are subject to Affirmative Action to try to ensure that minorities are adequately represented in all echelons of the organization but are not affected by the Pendleton Act.

Probably the most important distinction between public and private organizations is a fundamental, constitutional difference. In a private corporation, the CEO is the centralized, single individual who carries out all the functions of general management. However, in the federal government, the functions of general management are constitutionally spread among the three branches of government: the executive, the legislative, and the judiciary.

The above examples are only a few of the distinguishing characteristics between public and private organizations. Although not exhaustive, the above discussion provides at least some of the most important differences between public and private organizations.

Private and public organizations might mirror each other in their hierarchical structure, but this similarity is superficial. The operation of these entities demonstrates how different the public and private sectors truly are.

2000-2001 Board Members

SOUTHWEST TURFGRASS ASSOCIATION
2000-2001 Board Members

President - John Mondragon

Vice President - Jim McLain

Past President - Don (Doc) Carmichael

Executive Director - Curtis Smith

Industrial Representative - Bob Kay

Northern Director - Tom Glacken

Northern Director - Pat Brockwell

Southern Director - Gene Little

Southern Director - John White

Southern Director - Ralph (Bud) Jones

Research and Education Director - Bernd Leinauer

2001 Exhibitors

2001 EXHIBITORS
SOUTHWEST TURFGRASS ANNUAL CONFERENCE AND TRADE SHOW
(as of 9/10/01)

United Green Mark, Inc.
6609 Edith Blvd., NE
Albuquerque, NM 87113
(505) 344-3474

Golf Enviro Systems, Inc.
13215 Darr Drive
Colorado Springs, CO 80908
(800) 225-1311

Loving & Associates, Inc.
2629 Texas, NE
Albuquerque, NM 87110
(505) 299-1122

Aquatic Consultants, Inc.
P. O. Box 44247
Rio Rancho, NM 87174
(505) 890-5753

APSCO - Club Car
406-B Fairgrounds Road
Alamogordo, NM 88310
(505) 439-5620

Gail's Flags, Inc.
P. O. Box 14186
Ft. Worth, TX 76117
(817) 831-4505

Lebanon Turf Products
2255 E. Sunset, #1008
Las Vegas, NV 89119
(702) 260-9853

Watermaster Irrigation Supply, Inc.
P. O. Box 64208
Lubbock, TX 79464
(806) 797-9044

Estes, Inc.
4302 Locust
Lubbock, TX 79404
(806) 749-1999

Western Organics, Inc.
9000 Bates Rd., SE
Albuquerque, NM 87105
(505) 877-8672

Aquatrols
5 N. Olney ave.
Cherry Hill, NJ 08003
(856) 751-0309

ExerPlay, Inc.
P. O. Box 1160
Cedar Crest, NM 87008
(505) 281-0151

Ewing Irrigation/Ewing Golf
3630 Durazno
El Paso, TX 79905
(915) 544-7575

Schaeffer Manufacturing Co.
P. O. Box 306
Roswell, NM 88202
(505) 622-7140

Chaparral Sand & Gravel
112 E. Lisa, #336
Chaparral, NM 8021
(505) 824-1411

Grasshopper Company
P. O. Box 637
Moundridge, KS 67107
(620) 345-8621

Vopak USA, Inc.
3301 Edmunds, SE
Albuquerque, NM 87102
(505) 842-6303

Southwest Organics, Inc.
11120 Sidney Ave., NE
Albuquerque, NM 87111
(505) 299-4830

Southwest Recreational Industries
12 Unser Blvd., #G
Rio Rancho, NM 87124
(505) 994-3050

Curtis & Curtis, Inc.
4500 North Prince
Clovis, NM 88101
(505) 762-4759

Syngenta
1601 Appalachian Trail
Lewisville, TX 75077
(972) 317-6194

Austin Turf and Tractor
1707 Colt Circle
Marble Falls, TX 78654
(830) 693-6477

Lasco Fittings, Inc.
P. O. Box 14425
Scottsdale, AZ 85267
(520) 472-8979

Turf-Seed, Inc.
P. O. Box 250
Hubbard, OR 97032
(503) 692-1803

The Andersons, Inc.
602 Spruce Circle
Louisville, CO 80027
(303) 664-9145

Applied Biochemists
11042 N. 24th Ave., Suite 105
Phoenix, AZ 85029
(602) 861-1257

Foley United
393 Troy Street
River Falls, WI 54022
(715) 426-5151

Mesa Tractor
3826 4th St., NW
Albuquerque, NM 87107
(505) 344-1631

Aerway
P. O. Box 950
Wylie, TX 75098
(817) 847-1080/(817)605-7699

Helena Chemical Company
251 John Grisham/Box 629
Mesquite, NM 88048
(505) 233-3171

Desert Greens Equipment
5225 Pino Road, NE
Albuquerque, NM 87109
(505) 822-0311

Sierra Contracting, Inc.
1309 Sudderth Drive
Ruidoso, NM 88345
(505) 378-1091

Sierra Irrigation
480 6th Street
Las Cruces, NM 88005
(505) 523-4500

Rio Grande Golf Course Supts. Assn.
37 Vallecitos
Tijeras, NM 87059
(505) 281-5942

B & C Turf Equipment
8888 Sandhill Court
El Paso, NM 79907
(915) 858-8400

Equipment Supply Co., Inc.
2224 Marshall Street
Lubbock, TX 79415
(806) 747-0004

J. R. Simplot Co./BEST
1604 Rustler Trail
Camp Verde, AZ 86322
(520) 567-7072

BWI Companies
3240 94th Street
Lubbock, TX 79423
(806) 780-7337

Southwest Turf Services, Inc.
115 Dogwood
Levelland, TX 79336
(806) 894-6240

Neumark Company
811 Rankin Rd., NE
Albuquerque, NM 87107
(505) 345-7847

E-Z-Go/Textron
P. O. Box 110
Cedar Crest, NM 87008
(505) 934-3946

P G Enterprises, LLC
5031 Camino De Carino, NE
Albuquerque, NM 87111
(505) 864-9590

Martin Biological Solutions
1409 Fairgrounds Rd., Suite 113
Socorro, NM 87801
(505) 835-2948

Organic Technology International
14013 Encantado Rd., NE
Albuquerque, NM 87123
(505) 291-1400

Feed Bag, Inc.
P. O. Box 1803
Clovis, NM 88101
(505) 763-8808

Gardner Turfgrass
P. O. Box 18
Santa Teresa, NM 88008
(505) 589-0401

Pavement Sealants & Supply, Inc.
P. O. Box 906
Belen, NM 87002
(505) 861-0818

Hunter Industries
14448 S. 40th St.
Phoenix, AZ 85044
(480) 759-8530

Simpson Norton Corp.
4900 Pan American Frwy., NE
Albuquerque, NM 87109
(505) 830-0002

SISCO
4610 McLeod, NE
Albuquerque, NM 87109
(505) 881-4050

Keeton Industries, Inc.
300 Lincoln Court
Fort Collins, CO 80524
(970) 493-4831

Flowtronics PSI
10661 Newkirk Street
Dallas, TX 75220
(214) 357-1320

A & L Labs
302 34th
Lubbock, TX 79404
(806) 763-4278

2000-2001 Members

2000-2001 MEMBERSHIP - SOUTHWEST TURFGRASS ASSOCIATION

Aguilar	Antonio	P O Box 30001, MSC 3545	Las Cruces, NM 88003	New Mexico State Univ.
Alford	Ron	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Amezquita	Julio	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Andrews	Marvin	4001 Highway 47 SE	Albuquerque, NM 87105	Isleta Eagle Golf
Apodaca	Miguel	500 Laser Roa, NE	Rio Rancho, NM 87124	Rio Rancho Public Schools
Aragon	Ines	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Aragon	Raymond	P O Box 1209	Los Lunas, NM 87031	Village of Los Lunas
Aranda	Ruben	P O Box 702	Grants, NM 87020	OMI
Arnold	Brandon	300 N. Turner	Hobbs, NM 88240	City of Hobbs
Baca	Bennie	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Baca	Connie	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Baca	Danny	100 S. Main	Belen, NM 87002	City of Belen
Baca	Ricardo	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Bader	Raymond	1030 N. Zaragosa Rd., #A	El Paso, TX 79907	Texas Ag. Ext. Serv.
Baker	Dave	500 Sycamore	Clovis, NM 88101	City of Clovis
Baltensperger	Arden	1807 Halfmoon	Las Cruces, NM 88005	Retired
Barker	Jeff	1301 W. Clinton	Hobbs, NM 88240	Hobbs Municipal Schools
Barr	Jeffrey	P O Box 30	Los Alamos, NM 87544	Los Alamos County
Barrett	Jose E.	7969 San Paulo	El Paso, TX 79970	City of El Paso
Barta	Joseph	P O Box 1209	Los Lunas, NM 87031	Village of Los Lunas
Bates	Greg	300 N. Turner	Hobbs, NM 88240	City of Hobbs
Benavidez	Orlando	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Bishop	Howard	P O Box 1310	Artesia, NM 88211	City of Artesia
Blewett	David	P O Box 1838	Roswell, NM 88201	City of Roswell
Boling	Mark	2305 W. Briscoe	Artesia, NM 88210	Central Garden & Pet
Borowsky	Matthew	P O Box 32	Lincoln, NM 88338	G B A, Inc.
Borunda	Ron	2351 Hamilton Rd.	Alamogordo, NM 88310	Desert Lakes GC
Bowen	Keith Paul	915 N. 1st St.	Bloomfield, NM 87413	City of Bloomfield
Bradshaw	Phillip	P O Box 1209	Los Lunas, NM 87031	Village of Los Lunas

Brockwell	Pat	53 Cerro Del Alamo	Santa Fe, NM 8505	Pueblo de Cochiti Golf Course
Bryan	Moses	1300 Colonial Pkwy.	Clovis, NM 8810	Colonial Park CC
Buckland	Don	P O Box 1103	Ruidoso, NM 88355	
Bunch	Clint	500 Sycamore	Clovis, NM 88101	City of Clovis
Burleson	Tom	1101 West 4th	Roswell, NM 88201	City of Roswell
Cabazos	Ed	P O Box 1154	Silver City, NM 88061	Fore Star Golf
Cannon	Melvina	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Carbajal	Rudy	P O Box 30001, MSC 3545	Las Cruces, NM 88003	New Mexico State Univ.
Carmichael	Don	1500 Arizona Ave.	Alamogordo, NM 88310	Desert Lakes GC
Casados	Johnny	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Cass	John David	P O Box 1110	Artesia, NM 88210	Helena Chemical Co.
Castaneda	Lucy	3601 University Blvd., SE	Albuquerque, NM 87131	UNM Champion.GC
Castillo	Robert	1101 West 4th	Roswell, NM 88201	City of Roswell
Chavez	Anselmo	1101 West 4th	Roswell, NM 88201	City of Roswell
Chavez	David	6401 Osuna NE	Albuquerque, NM 87121	City of Albuquerque
Chavez	Kim	P O Box 2727	Milan, NM 87021	Village of Milan
Cheatham	Wayne	300 N. Turner	Hobbs, NM 88240	McAdams Park
Chiwewe	Patrick	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of NM
Cichuniec	Bo	P O Box 2295	Ruidoso, NM 88355	The Links
Clark, Jr.	Robert H.	4001 Highway 47 SE	Albuquerque, NM 87105	Isleta Eagle Golf
Clees	James	P O Box 168	Alto, NM 88312	Alto Lakes GC
Couder	Steve	300 N. Turner St.	Hobbs, NM 88240	City of Hobbs
Craft	John	P O Box 1310	Artesia, NM 88211	City of Artesia
Craig	Veronica	P O Box 999	Mesilla Park, NM 88047	Sunland Nursery Co.
Crawford	Andrew	3391 Venus St.	Las Cruces, NM 88012	Fore Star Golf
Crosswhite	Toppie	400 Crosswhite Road	Hobbs, NM 88242	T's Turf Green
Culver	Gary	P O Box 168	Alto, NM 88312	Alto Lakes GC
Daniell	Rick	1510 Menaul NW	Albuquerque, NM 87107	Bernalillo Co. Extension Office
Davee	Phelps	500 Country Club Place	El Paso, TX 79922	El Paso Country Club
Dawson	Eddie	801 Leroy	Socorro, NM 87801	New Mexico Tech
Dennis	Richard	4735 Golden Barrel NW	Albuquerque, NM 87114	PBI Gordon Corp.
Dominguez	Jimmy	500 Sycamore	Clovis, NM 88101	City of Clovis
Dominguez	Paul	P O Box 5116	Lubbock, TX 79408	Hillcrest Country Club

Downing	Richard	P O Box 129	Eunice, NM 88231	Eunice Public Schools
Dunlap	Jay	1950 Copper Loop	Las Cruces, NM 88005	The Greenhouse
Dunlap	Loren	P O Box 486	Belen, NM 87002	Rio Grande Golf
Dyess	Eddie	101 W. College Blvd.	Roswell, NM 88201	New Mexico Military Inst.
Ellis	Tom	P O Box 210049	Tucson, AZ	Facilities Mgmt.
Enriguez	Rogelio	7969 San Paulo	El Paso, TX 79970	City of El Paso
Escarcega	Frank	P O Box 1119	Van Horn, TX 79855	Town of Van Horn
Esquivel, Jr.	Ruben	1306 E. College	Roswell, NM 88201	City of Roswell
Estrada	Jorge	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Ewell	Lyn	903 10th St., SW	Albuquerque, NM 87102	Albq. Biological Park
Fierro	Abel	P O Box 517	Van Horn, TX 79855	Town of Van Horn
Fisher	Chris	500 Sycamore	Clovis, NM 88101	City of Clovis
Flores	Ruben	501 North Guadelupe	Santa Fe, NM 87501	Santa Fe Natl Cemetery
Fluitt	Brad	2111 Clubhouse Lane	San Angelo, TX 76904	Bentwood Country Club
Forster	Scott	P O Box 168	Alto, NM 88312	Alto Lakes GC
Fowler	James	P O Box 3003, MSC 3LEY	Las Cruces, NM 88003	New Mexico State Univ.
Francke	Erich	1301 W. Clinton	Hobbs, NM 88240	Hobbs Municipal Golf
Gabaldon	Ray	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Gaddy	Louis	P O Box 2	Ft. Wingate, NM 87316	BIA, Wingate High School
Gallegos	Michael	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Gallegos	Molly	1710 Girard SE	Albuquerque, NM 87121	City of Albuquerque
Galvan	Lalo	P O Box 1310	Artesia, NM 88210	City of Artesia
Garza	Orlando	P O Box 2308	Carlsbad, NM 88221	Guadalupe Pest Control
Glacken	Tom	2604 Aztec NE	Albuquerque,NM 87107	New Mexico Dept. of Agric.
Gonzales	Lawrence	915 Locust SE	Albuquerque,NM 87106	Albq. Public Schools
Gonzales	Leroy	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Goshorn	Rick	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Gray	Kelly	P O Box 198	Cloudcroft, NM 88317	Cloudcroft Municipal GC
Griego	Clarence	250 Isidro Sanchez Rd.	Bernalillo, NM 87004	Bernalillo Public Schools
Griego	Rodney	313 Cree Meadows	Ruidoso, NM 88345	Village of Ruidoso
Guck	Clay	100 Golf Course Road	Belen, NM 87002	Tierra Del Sol Country Club
Gunn	Geoff	1950 Copper Loop	Las Cruces, NM 88005	The Greenhouse
Gutierrez	Frank	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico

Gutierrez	Henry	P O Box 1569	Carlsbad, NM 88221	City of Carlsbad
Hansen	Jim	P O Box 8	Glorieta, NM 87535	Glorieta Conference Ctr.
Hargrove	Carroll	P O Box 1838	Roswell,NM 88201	City of Roswell
Harlowe	Bob	2351 Hamilton Rd.	Alamogordo, NM 88310	Desert Lakes GC
Harris	Chad	P O Box 5116	Lubbock, TX 79408	Hillcrest Country Club
Harris	Ron	1306 East College	Roswell, NM 88201	City of Roswell
Hays	Greg	103Innsbrook Drive	Ruidoso, NM 88345	Innsbrook Village
Hendley	Steve	P O Box 1569	Carlsbad, NM 88221	City of Carlsbad
Hernandez	Joe	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Herrera	Joe	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Herrera	Servando	7969 San Paulo	El Paso, TX 79970	City of El Paso
Hodge	Gary	601 Laguna Blvd., SW	Albuquerque, NM 87104	Albq. Country Club
Hubbard	Paul	103 Innsbrook Drive	Ruidoso, NM 88345	Innsbrook Village
Humbles	Dan	4100 Sara Rd.	Rio Rancho, NM 87124	Sodexho Marriott Serv.
Humphrey	Jeremy	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Huslig	Todd	P O Box 5760	Bernalillo, NM 87004	Santa Ana Golf
Jackson	Edward	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Jaramillo	Michael	P O Box 1209	Los Lunas, NM 87031	Village of Los Lunas
Jennings	Robert	Holloman AFB, Box 830	Holloman AFB, NM 88330	Miranda's Landscape
Johns	Ronnie	100 West 1st	Portales, NM 88130	City of Portales
Jones	Michael	201 W. 19th St.	Roswell, NM 88201	New Mexico Military Inst.
Jones	Ralph (Bud)	1051 Willow St.	Las Cruces, NM 88001	New Mexico State Univ.
Juarez	Marcos	300 N. Turner St.	Hobbs, NM 88240	City of Hobbs
Jurado	Jose	7969 San Paulo	El Paso, TX 79970	City of El Paso
Kane	Scott	2722 Northacres	Hobbs, NM 88240	Evergreen Lawn Kare
Kastelic	Gene	P O Box 8	Belen, NM 87002	Valley Improvement
Kay	Bob	6609 Edith Blvd., NE	Albuquerque, NM 87113	United Green Mark
King	John	6401 Osuna Rd., NE	Albuquerque, NM 87109	City of Albuquerque
Lara	Richard	7969 San Paulo	El Paso, TX 79970	City of El Paso
Latta	Ken	GERMANY		
Leinauer	Bernhard	Box 30003, MSC-3AE	Las Cruces, NM 88003	NMSU/CES Plant Sciences
Lies	Matt	300 N. Turner	Hobbs, NM 88240	City of Hobbs
Loera	Felix	500 Sycamore	Clovis, NM 88101	City of Clovis

Madril	Johnny	2722 Northacres/702 Sockwell	Hobbs, NM 88240	Evergreen Lawn Kare
Maestas	Allen	P O Box 1293	Albuquerque, NM 87103	City of Albuquerque
Maldonado	Anthony	300 N. Turner St.	Hobbs, NM 88240	City of Hobbs
Marken	Lawrence	P O Box 1293	Albuquerque, NM 87103	City of Albuquerque
Marquez	Richard	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Marrufo	Christopher	P O Box 1188	Silver City, NM 88061	Town of Silver City
Martinez	Ben	P O Drawer 37	Espanola, NM 87532	City of Espanola
Martinez	Henry	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Martinez	Jose	P O Box 1310	Artesia, NM 88211	City of Artesia
Martinez	Michael	3101 Old Pecos Trail	Santa Fe, NM 87505	Quail Run Golf Course
Martinez	Remigio	P O Box 2727	Milan,NM 87021	Village of Milan
Martinez	Ted	7184 Club Dr.	Odessa, TX 79763	Odessa Country Club
McClenin	Carol	903 10th St., SW	Albuquerque, NM 87102	Albq. Biological Park
McLain	Jim	801 Leroy, Phys. Plant	Socorro, NM 87801	New Mexico Tech
Miller	Larry	P O Box 2295	Ruidoso, NM 88355	The Links
Miller	Stacy	500 Sycamore	Clovis, NM 88101	City of Clovis
Mills	Marty	Box 497	Cloudcroft, NM 88317	The Lodge Golf Course
Mills	Mike	Box 227	Cloudcroft, NM 88317	Otero Co. Electric
Mitchell	Ken	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Mondragon	John	P O Box 7819	Albuquerque, NM 87194	Inman Irrigation
Montes	Jesus	103 Innsbrook Drive	Ruidoso, NM 88345	Innsbrook Village CC
Montes	Martin	103 Innsbrook Drive	Ruidoso, NM 88345	Innsbrook Village CC
Morales	Frank X.	7969 San Paulo	El Paso, TX 79970	City of El Paso
Moreno	Miguel	3120 Sun Bowl Dr.	El Paso, TX 79968	Univ of Texas/El Paso
Mumma	Andy	3900 Hawkins NE, #D	Albuquerque, NM 87109	Sunrise Landscape
Myers	Mike	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Navarro	Victor	903 10th St., SW	Albuquerque, NM 87102	Albq. Biological Park
Neal	Tracy	P O Box 7300	Tesuque, NM 87574	Design With Nature
Nunez	Joseph	100 S. Main St.	Belen, NM 87002	City of Belen
Oehm	Larry	105 Forrest Dr.	Cannon AFB, NM 88103	Whispering Winds GC
Ogletree	Lowell	7969 San Paulo	El Paso, TX 79970	City of El Paso
Olivas	Robert	P O Drawer 17	Espanola, NM 87532	City of Espanola
Otto	Larry	300 N. Turner	Hobbs, NM 88240	Ocotillo Park GC

Pacheco	Antonio	P O Box 328	Roswell, NM 88202	City of Roswell
Pedraza	Genaro	P O Box 1188	Silver City, NM 88061	Town of Silver City
Perea	Robert	P O Box 6311	Albuquerque, NM 87197	Albq. Chemical Co.
Peters	Anthony	915 N. 1st St.	Bloomfield, NM 87413	City of Bloomfield
Price	Julee	3900 Hawkins NE, #D	Albuquerque, NM 87109	Sunrise Landscape
Propsner	William	511 W. Texas	Artesia, NM 88210	City of Artesia
Puleo	Joseph	500 Laser Rd., NE	Rio Rancho,NM 87124	Rio Rancho Public Schools
Rapp	Jim	7545 N. Mesa	El Paso, TX 79912	Home Depot
Reeve	Karl	P O Box 1310	Artesia, NM 88211	City of Artesia
Renteria	Luis	1702 W. Fox	Carlsbad, NM 882210	City of Carlsbad
Robles	Daniel	3120 Sun Bowl Dr.	El Paso, TX 79968	Univ of Texas/El Paso
Rocha	Jose	7969 San Paulo	El Paso, TX 79970	City of El Paso
Rodriguez	Edward T.	408 N. Canyon	Carlsbad, NM 88220	Carlsbad Mun. Schools
Rodriguez	Jesus	P O Box 28125	Santa Fe, NM 87592	Santa Fe CC Golf
Rodriguez	Raul	P O Box 517	Van Horn, TX 79855	Mountain View GC
Rodriguez	Victor	7909 Edith BLvd., NE	Albuquerque, NM 87113	Hilltop Landscape
Rodriguez	William	1702 W. Fox	Carlsbad, NM 88220	City of Carlsbad
Romero	Robert	250 Isidro Sanchez Rd.	Bernalillo, NM 87004	Bernalillo Public Schools
Roybal	Ruben	6 Park Road	Las Vegas, NM 87701	Green Acres
Salas	Rafae	l313 Cree Meadows Dr.	Ruidoso, NM 88345	Village of Ruidoso
Samudio	Cipriano	6401 Osuna NE	Albuquerque, NM 87109	City of Albuquerque
Sanchez	Henry	1000 West College Ave.	Silver City, NM 88061	Western New Mexico Univ.
Savedra	Roger	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Saverance	Nathan	1101 W. 4^{th}	Roswell, NM 88201	City of Roswell
Schell	Jack	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Schintgen	Michael	313 Cree Meadows	Ruidoso, NM 88345	Village of Ruidoso
Schmid	Ivan	1306 East College	Roswell, NM 88201	City of Roswell
Schroeder	Jerry	1801 3rd Ave.	Kearney, NE 68845	Howard Johnson Ent.
Segura	Ramon	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Shipman	Harold	1101 W. 4th	Roswell, NM 88201	City of Roswell
Silva	David	P O Box 30001, MSC 3545	Las Cruces, NM 88003	New Mexico State Univ.
Slough	Robert	P O Box 40	Bernalillo, NM 88004	Sandoval Co./Public Works
Smith	Curtis W.	9301 Indian Sch. Rd.NE, #112	Albuquerque, NM	NMSU/CES Plant Sciences

Street	Tracey	2351 Hamilton Rd.	Alamogordo, NM 88310	Desert Lakes GC
Sylvas	Ed	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Talavera	Sabino	P O Box 517	Van Horn, TX 79855	Mountain View GC
Taylor	J. Kirk	P O Box 168	Alto, NM 88312	Alto Lakes Golf & CC
Taylor	Raymond	4018 Lovington Hwy.	Hobbs, NM 88240	Pro Treat
Tetreault	Dave	313 Cree Meadows	Ruidoso, NM 88345	Village of Ruidoso
Thomson	Bob	P O Box 1838	Roswell, NM 88201	City of Roswell
Ticho	William	307 Savanna Ave.	WSMR, NM 88002	White Sands Missile Range
Tingley	Alvin G.	P O Box 457	Ruidoso, NM 88355	PGA Member
Torres	Raul	7969 San Paulo	El Paso, Tx 79970	City of El Paso
Torrez	Paul	915 Locust SE	Albuquerque, NM 87106	Albq. Public Schools
Tratechaud	Paul	P O Box 50336	Albuquerque, NM 87181	Valle Escondido HO
Triplett	Byron	7969 San Paulo	El Paso, TX 79970	City of El Paso
Troeger	Karl	P O Box 168	Alto, NM 88312	Alto Lakes GC
Trujillo	Ricardo	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Turnham	Dan	10801 Academy NE	Albuquerque, NM 87111	Tanoan Country Club
Turpen	Mark	924 Menaul Blvd., NE	Albuquerque, NM87107	Sunset Memorial Park
Tye	Rick	P O Box 21037	Albuquerque, NM 87109	City of Albuquerque
Tyler	Larry	P O Box 2	Ft. Wingate, NM 87316	BIA, Wingate High School
Urban	Matthew	P O Box 1154	Silver City, NM 88061	Fore Star Golf
Vallejos	Felix	1818 Camino Del Servcia NE	Albuquerque, NM 87131	Univ. of New Mexico
Vallejos	Leroy	100 S. Main St.	Belen, NM 87002	City of Belen
Van Hecke	Patricia	300 N. Turner	Hobbs, NM 88240	City of Hobbs
Velasquez	Nellie	300 N. Turner St.	Hobbs, NM 88240	City of Hobbs
Villa	Raul	101 W. College Blvd.	Roswell, NM 88201	New Mexico Military Inst.
Wagner	Lee	16000 Ashford	Horizon City, TX 79928	Evergreen Alliance
Wall	John	ENMU - Station 23	Portales, NM 88130	Eastern New Mexico Univ.
Ward	Shari	7804 Tiburon NE	Albuquerque, NM 87109	Leeco Grounds Mgmt.
Ware	Jim	P O Box 30001, MSC 3545	Las Cruces, NM 88003	New Mexico State Univ.
Watchman	Delbert	915 N. 1st St.	Bloomfield, NM 87413	City of Bloomfield
Weaver	Randy	6200 College Avenue	Snyder, TX 79549	Western Texas College
White	John	808 N. Alameda	Las Cruces, NM 88005	Dona Co. Extension Office
Whitehead	Wade	300 N. Turner St.	Hobbs, NM 88240	City of Hobbs