Long-term Evaluation and Improvement of Golf Turf Management Systems with Reduced Chemical Pesticide Inputs: 2006 Preliminary Report

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INTRODUCTION

2006 was the sixth year of a study assessing the feasibility and performance of golf course putting green turf comparing traditional management techniques with an IPM approach utilizing population-based pest management and to a system that utilizes biologically-based controls and reduced risk chemistry.

The work, initially funded by the USGA, was initiated on the Green Course at the Bethpage State Park, Long Island, New York in 2001. Funding for 2005-2007 is being provided by NE IPM (USDA). The Green Course is one of five public courses at the Park and accommodates approximately 50,000 rounds of golf annually. The greens are made of push-up native soil and have been heavily sand top-dressed for the last six years, and are typical of a high-use public course in a northern metropolitan community. A more detailed discussion of methodology and results from 2001 through 2003 can be found at http://usgatero.msu.edu/, and the 2004 and 2005 reports at http://nysipm.cornell.edu/reports/ann_rpt/default.asp. This is a preliminary report for 2006.

RESEARCH METHODOLOGY

Management Practices

The experiment was designed as a 3 x 2 factorial, with three pest-management and two cultural-management regimes.

Pest Management

Unrestricted: All legal and currently available chemical pesticides in New York State may be used. (typical of the pest management conducted at the other four courses in the park)

IPM: Cultural and biological approaches to prevent and minimize pest problems were emphasized, but any legal practice or pesticide could be used when based on pest population and pressure from current and historical scouting records.

Bio-Based Reduced Risk (formerly non-chemical treatment): Cultural and biological approaches to prevent and minimize pest problems were emphasized. Reduced risk chemical pesticides and biopesticides were used to prevent turf loss and product selection was strictly confined to those with low EIQ values.

Cultural Management

Current Standard: Cultural practices currently being employed at the five golf courses of the Bethpage State Park.

Alternative: Modified cultural practices; selected to reflect the most progressive practices that maximize turfgrass performance and minimize turf stress.

The experimental design resulted in six management systems. Each green served as a replicate, with all 18 greens of the Bethpage Green Course used to accommodate three

replications of the 6 management systems. After the first season (2001), the greens in the alternative culture, nonchemical (now "reduced risk") system were regrassed with velvet bentgrass (SR 7200) sod. In 2004, the "non-chemical" treatments were modified to "reduced risk" in recognition of the challenges in maintaining the integrity of the non-chemical treatments.

After three years of attempting to manage 70-yr. old mixed stands of bentgrass and annual bluegrass without synthetic pesticides in the Northeastern U.S. climate, we conceded that nonchemical management (management without any EPA-classified I, II, or III chemical pesticides) was not sustainable with current technology. Therefore, we decided that a more viable interim approach was to avail the project of tools designed to select very low risk products, even if the treatments were no longer technically "non-chemical".

In 2004 we introduced a significant change in the project by using the "Environmental Impact Quotient" (EIQ) (Kovach et al. 1992), to select the low-impact pest management products and practices in the IPM and reduced risk treatments. The EIQ model provides information on pesticides that will have the least harmful effects on non-target organisms, applicators and golfers. The superintendent chooses the lowest risk product amongst the legal products expected to be efficacious under the specific circumstances encountered.

Data Collection and Analysis

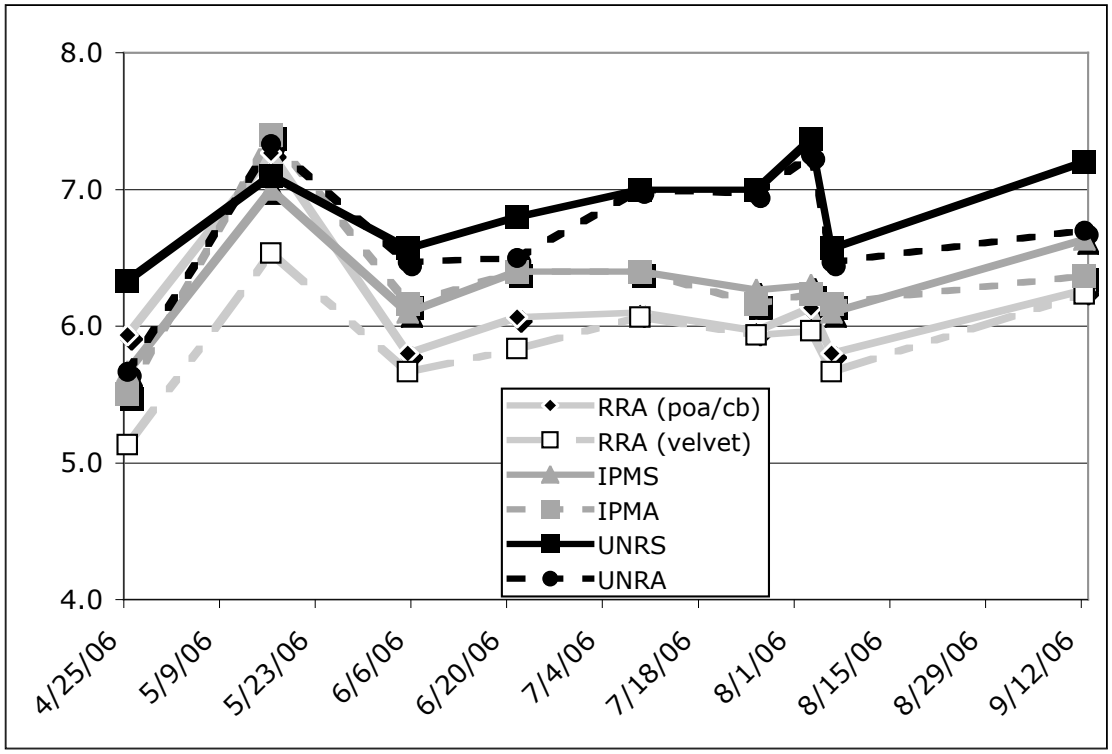
Turfgrass quality ratings are collected bi-weekly during the growing season on a scale of 1 to 9, where 1= poor quality, 9=excellent quality and 6 is considered acceptable quality. Ball roll measurements are recorded bi-weekly during the season with a USGA Stimpmeter. Three balls are rolled in two directions on a relatively level green area and six measurements are averaged. In addition, greens are scouted for pest presence and severity a minimum of three times per week.

RESULTS AND DISCUSSION

Turf Quality

In 2006, the quality ratings for all treatments were low in the early season (fig. 1). Thereafter, ratings only fell below acceptable (rating of 6) in the reduced risk treatments for the rest of the season, and only occasionally. The velvet bentgrass greens were the poorest quality of any of the treatments in both 2005 and 2006, and each season seem to struggle through the warm summer months. In addition, we continue to see increased annual bluegrass invasion in each surface that will require an herbicide application or complete re-grassing. However, no greens were closed in 2006—marking a significant improvement the quality of both reduced risk treatments.

Figure 1. Turfgrass Quality, 2006



RR=reduced risk pest mgt, IPM=IPM pest mgt, UNR=unrestricted pest mgt.
Std=Standard culture; Alt=Alternative culture
*Turfgrass quality ratings on a scale of 1-9 where 1= poorest quality, 9= highest quality and 6= acceptable quality.

Pest Incidence and Pesticide Use

The majority of pesticide applications are for disease management, particularly dollar spot. In general we continue to see a decline in overall weed and insect incidence on the Green Course putting greens. In 2005 and 2006, all greens received a limited-area application of a crab and goosegrass control product to the collar and first pass inside the green. There were no significant insect problems on the putting greens except for a few sporadic outbreaks of cutworms that were easily managed with an EPA-classified "reduced-risk" insecticide (spinosad) or a low-EIQ rated insecticide (deltamethrin).

Overall there were 32-41% fewer chemical pesticides applied to the reduced risk greens in 2006 (table 1) than 2005—more insecticides, but 60-80% fewer fungicides. Pesticides were considered "reduced risk" if classified as such by the EPA. They included polyoxin D zinc salt (Endorse), mono and di-potassium salts of phosphorus acid (Alude), boscalid (Emerald), azoxystrobin (Heritage) and spinosad (Conserve).

The number of pesticide applications to IPM and unrestricted greens are shown in table 2. The IPM greens received 66% fewer traditional chemical pesticides than the unrestricted greens. Although the IPM and unrestricted treatments received a similar number of fungicide applications, over two thirds were reduced risk products in the IPM treatments, whereas less than a third were reduced risk for the unrestricted greens. The IPM greens received 75% fewer chemical insecticides than the unrestricted greens, and only limited area herbicide applications were required in any treatment. Although numbers of pesticide applications are easily compared, they reveal nothing about the qualitative effect of these pesticides. A more meaningful

evaluation of the significance of the reductions and changes in pesticide use is gained by comparing the environmental impact (EIQ) (see section below).

Table 1. Number of Pesticide Applications on Reduced Risk Greens in 2006

Chemical	RR (poa/cb)	RR (velvet)
Insecticide	2	3
Herbicide	0.1	0.1
Fungicide	2	1
SubTOTAL	**4.1**	**4.1**
Reduced Risk		
Insecticide	0	0
Fungicide	7	3
Bio Fungicide	42	0
SubTOTAL	**49**	**3**
TOTAL APPS.	**53.1**	**7.1**

Table 2. Number of Pesticide Applications on Unrestricted and IPM Greens in 2006

Chemical	UNR	IPM Std	% red.	IPM Alt.	% red.
Insecticide	4	1	75%	1	75%
Herbicide	0.1	0.1	0%	0.1	0%
Fungicide	11	4	64%	4	64%
SubTOTAL	**15.1**	**5.1**	**66%**	**5.1**	**66%**
Reduced Risk					
Insecticide	0	1	0%	1	0%
Fungicide	4	10	-150%	10	-150%
Bio Fungicide	0	0	0%	0	0%
SubTOTAL	**4**	**11**	**-175%**	**11**	**-175%**
TOTAL APPLICATIONS	**19.1**	**16.1**	**16%**	**16.1**	**16%**

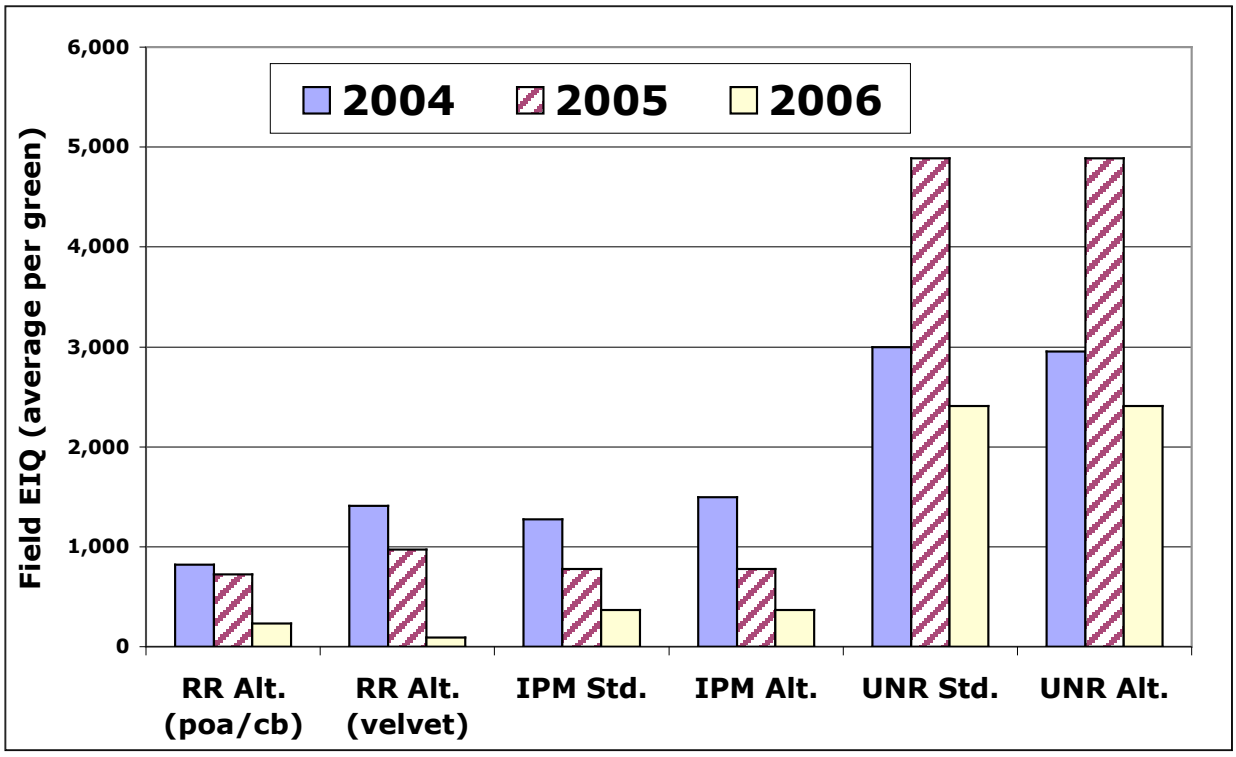
Environmental Impact

Comparing the number of pesticide applications is a fairly arbitrary method for assessing pesticide use when a variety of products are being used, and does not account for the potential environmental effect. However, few alternative tools for assessing and comparing environmental effects are available.

Since 2004 we have used the Environmental Impact Quotient (EIQ) (Kovach et al., 1992) for both selecting low impact products, and to assess the cumulative impact of all products applied during the season in each of the six management systems. The EIQ uses 13 criteria including acute and chronic human toxicity, soil and leaf persistence, toxicity to non-target organisms, and leaching and runoff potential to determine worker, consumer/user, and ecological impact—which are combined into one final quotient number. The model balances factors such as toxicity to fish with the probability for the pesticide to leach or runoff the initial application site. The final quotient, or "EIQ number" is produced for all pesticides assessed, and is multiplied by the actual rate of use to give a "field EIQ".

The field EIQ was calculated for each treatment, and totals are shown for 2004 - 2006 (Figure 2). In all years, the EIQ of unrestricted treatments had significantly higher field EIQs than both the IPM and reduced risk treatments. Caution should be used when interpreting the EIQ results. We suggest there may not be meaningful differences between IPM and RR treatments in most years. However, there are clear differences between the unrestricted treatment and the other two treatments (IPM and RR). The EIQ has proved to be an excellent resource for our Project Manager to select products that offer control at, or close to, the level of traditional synthetic pesticides and with greater environmental compatibility.

Figure 2. Environmental Impact of Pesticide Applications, expressed as Field EIQ



Labor

Over the last few years we have seen somewhat of a converging of labor hours among treatments, as seen in 2006 (Fig. 3). However, in the early phases of the project we had a clear distinction among labor hours for alternative and standard culture, as seen in 2002 (Fig. 4). Alternative culture treatments always had greater labor hours with significantly different mowing

and cultivation regimes. However, over time as treatments have become more homogeneous the labor differences have lessened.

Figure 3. Labor hours expended, extrapolated to 18 greens, 2006

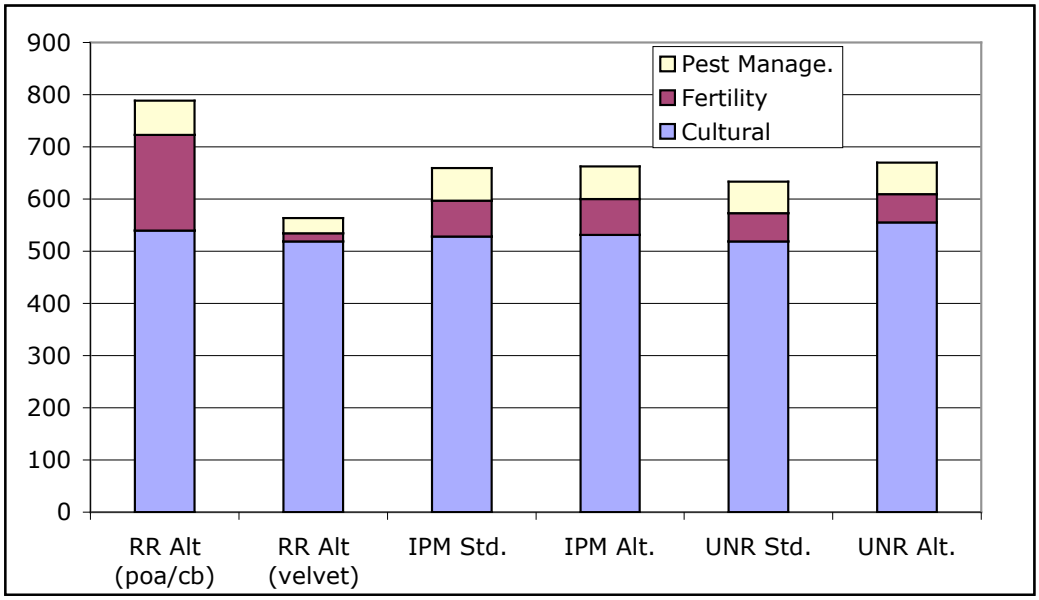
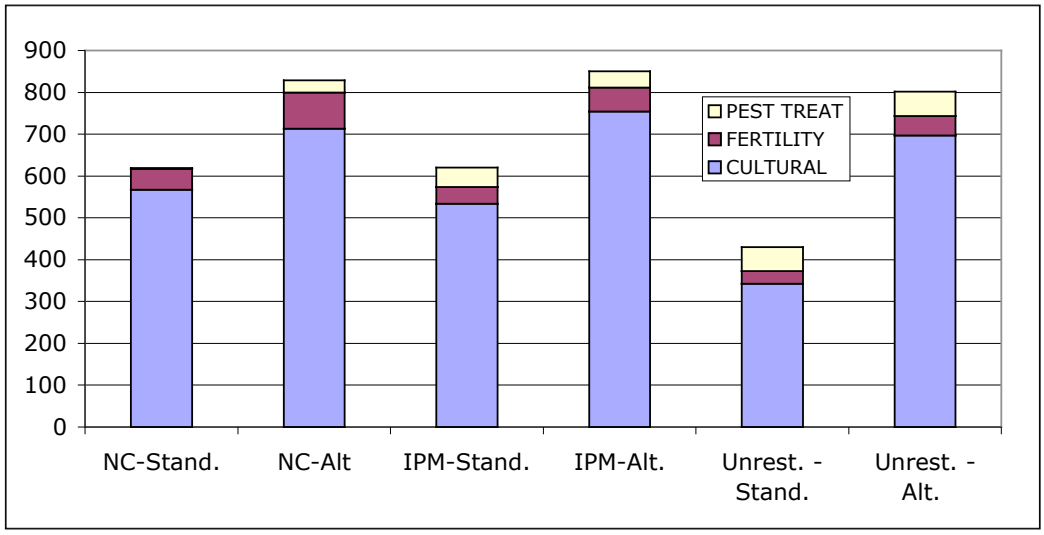


Figure 4. Labor hours expended, extrapolated to 18 greens, 2002

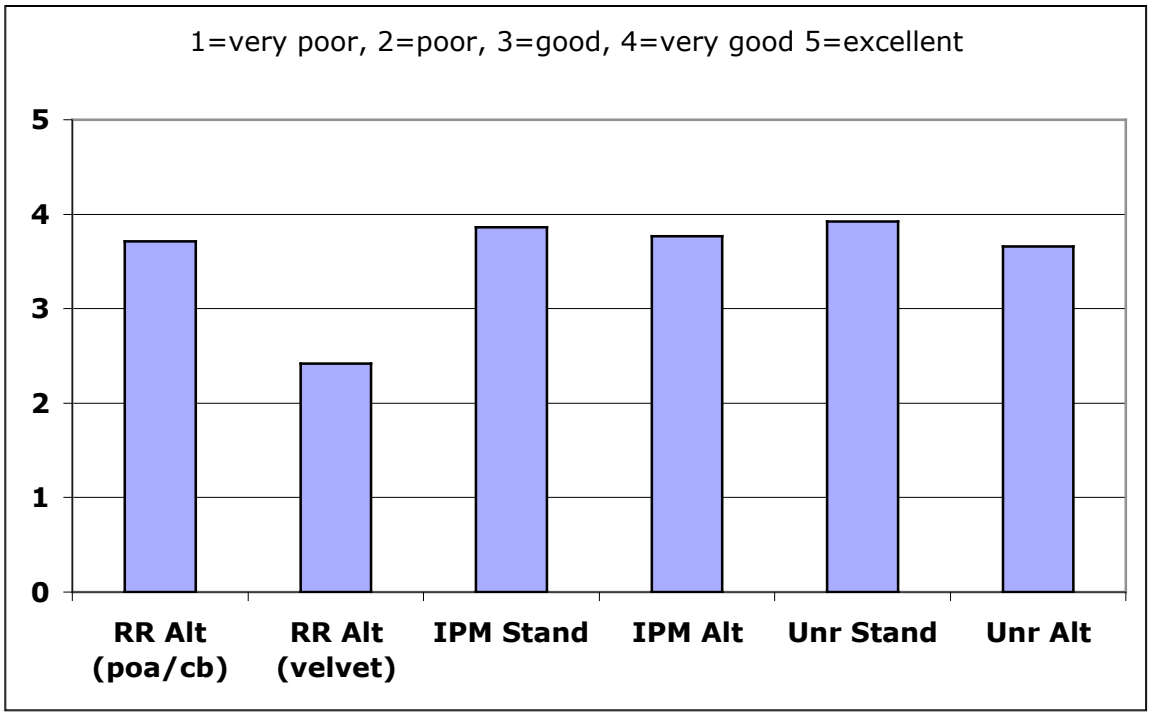


Golfer Satisfaction Survey

Golfers were surveyed annually from 2003-2006 to assess their perceptions of the visual and performance quality of greens managed under the various pest management and cultural treatments. In 2003-2005, the golfer ratings for the greens from all treatments averaged "good" to "very good" for overall quality and tracking (ability of a putt to hold a line), with the exception of the IPM alternative culture treatment in 2003 having a lower rating for tracking. For the first time in 2006 acceptance of the velvet greens fell, and each velvet green received average quality ratings of 2.2 to 2.75 (poor to good). See Fig. 5. Therefore, we concluded that golfers

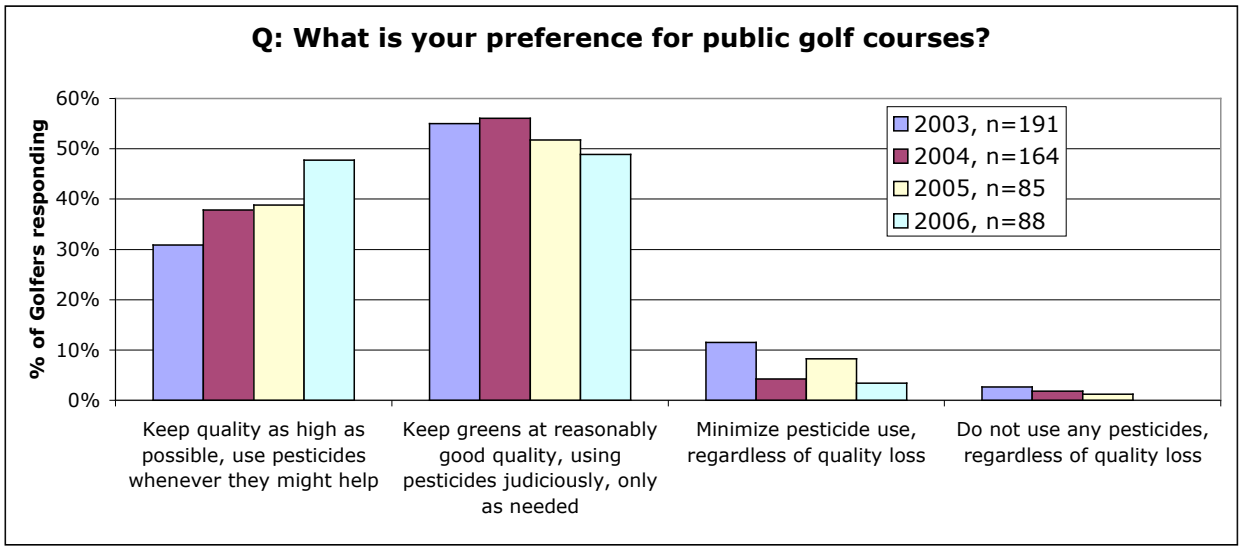
accepted the quality of greens as managed in all of our treatments in years 3-5, with the exception of times that turf was lost or greens were closed. However, 2006 data show that golfers no longer consider the velvet bentgrass greens to be of equal quality to the other treatments.

Fig. 5 Green Quality Rating by Golfers, 2006



Golfers were also queried on their opinion of pesticide use on golf courses. In all years, the majority chose an IPM approach, as shown for 2006 (figure 6). However, the trend was not as strong as in previous years.

Fig. 6 Golfer preferences on pesticide use, 2003-2006



Outreach and Impact

Results from this study have been publicized in a number of formal and informal settings, in addition to reporting to the funding agencies. To date we have given over 60 presentations and written 17 reports and articles, reaching several thousand golf course superintendents and environmental advocates. Discussion of this project has opened new dialog in many arenas where interested parties were previously adversarial.

ACKNOWLEDGEMENTS

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