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Development of Irrigation and Nitrogen Fertilization Programs on Tall Fescue to Facilitate Irrigation-Water Savings and Fertilizer-Use Efficiency

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APPENDIX C

Analysis of survey data

A Survey of Professional Turfgrass Managers in Southern California Concerning Their Use of Turfgrass Best Management Practices

Summary. The best management practices (BMPs) related to turfgrass management encompass a wide variety of activities, including fertilization, irrigation, mowing, pest control, and soil management. There is a great deal of literature relating proper implementation strategies or evaluating the efficacy of specific BMPs. However, little attention has been given to determining just how effective information regarding BMPs is being assimilated and utilized by professional turfgrass managers. The objectives of this study were to assess the current perception and implementation of several important turfgrass BMPs and to determine whether or not those perceptions and implementations differed between turfgrass advisors and managers and between general and sports turfgrass managers. We surveyed professional managers attending the University of California, Riverside, Turfgrass Research Conference and Field Day in the fall of 1998 and 1999. Turfgrass managers, especially sports turfgrass managers, were found to be the most committed to implementing the BMPs in the survey. Overall, the survey respondents considered BMPs to be important and not highly difficult to implement. The limitations to the adoption of BMPs were indicated to be a lack of financial backing, employee training, and necessary time – all of which could be remedied with a sufficient commitment of resources by the turfgrass industry.

There are numerous definitions of the phrase "best management practice," which vary depending on the specific context involved, as well as the currently accepted standards and goals of agronomic management. In general, however, best management practices (BMPs) are considered to be a set of guidelines or procedures which have been determined, as part of an overall program, to be an effective and practical (technically, socially and economically) method for reducing, preventing, or controlling undesirable effects of management; promoting or maintaining beneficial effects of management; and/or protecting the environment or natural habitat (Campbell, 1996; Hubbard et al., 1998; King County, Wash. Dept. of Transportation, 2000; Lindsey et al., 1998; Logan, 1990; Ohio State Univ. Ext., 1996; The One Plan, 2001; South Carolina Forestry Commission, 2001; U.S. EPA, 2000; Yergert et al., 1993).

Turfgrass-related BMPs encompass a wide variety of activities, including fertilization, irrigation, mowing, pest control, and soil management. There is a great deal of literature relating proper implementation strategies or evaluating the efficacy of specific BMPs. However, little attention has been given to determining just how effective information regarding BMPs is being assimilated and utilized by professional turfgrass managers.

The BMP information, once determined by scientific research, needs to be made readily available to those making turfgrass management decisions. This function is often served by educational outreach programs which disseminate and promote BMPs. A logical starting point for such programs is to determine what BMPs turfgrass managers (and their advisors) are aware of, and which BMPs, if any, are currently being implemented. The objectives of this study were to assess the current perception and implementation of several important turfgrass BMPs and to determine whether or not those perceptions and implementations differed between turfgrass advisors and managers and between general and sports turfgrass managers.

Materials and Methods

We surveyed professional managers attending the University of California, Riverside, Turfgrass Research Conference and Field Day in the fall of 1998 and 1999. The conferences were attended by professional turfgrass managers, personnel working in the turfgrass industries, educators, and consultants from the southern California region. The participants were asked to complete the surveys during a 10-min period following a short presentation regarding BMPs for managing tall fescue (*Festuca arundinacea* Schreb.). There were 191 surveys collected from the 1998 conference and 190 surveys collected from the 1999 conference, for a total of 381 surveys. In 1999, the survey asked the participants if they had answered the survey in the previous year. Responses of "yes" or "not sure" eliminated 76 surveys, leaving a total of 305 surveys as part of the data set. Although this was a sample of convenience (Guilford, 1978; Iversen and Norpoth, 1976; Kish, 1965; Vogt, 1999), which does require caution in terms of generalizability of the data, we believe the survey respondents represented a cross-section of the decision-makers in the turfgrass industry in southern California. A recent survey conducted by Templeton et al. (2000) on the environmental horticulture industry in California included a number of comparable job categories. The distribution they found was similar to our sample.

The survey instrument consisted of three sections (Table C-1): the first section requesting basic information about the conference participants, the second section gauging their activities and perceptions of eight BMPs, and a third section asking about their perceptions regarding the associated tall fescue BMP presentation. This last section was not analyzed statistically and the responses are not discussed herein.

The majority of the survey focused on gauging the respondent's activities and perceptions of eight BMPs, including water conservation; fertility program development; turfgrass selection; mowing program development; integrated pest management (IPM); protecting groundwater and surface water from potential contamination from turfgrass chemicals and fertilizers; protecting nontarget plants, animals and humans from the potential toxic effects of turfgrass chemicals; and protecting native habitats during turfgrass construction and maintenance. The respondents indicated, for each BMP, their perceptions regarding its importance, if it was being currently implemented, if they were likely to continue or to start the practice, and their perceptions regarding its difficulty level. The survey also asked the respondents to identify the factors which have limited their ability to adopt BMPs and which of six fertilization and six irrigation practices they consistently performed.

There were several types of questions in the survey, including: (1) questions which asked for simple, basic information about the respondents themselves, which was then summarized or averaged (questions 1, 2b, and 2c); (2) questions which asked for a single response from a list of possible responses for which the percentages of respondents which indicated each possible answer were determined (questions 2a, 3, 9, and 10); (3) questions which asked survey respondents to "check all that apply" from a list of possible responses for which the percentages of respondents which indicated each choice were determined (questions 4, 6, 7 and 8); and (4) questions which included a series of BMPs which asked respondents to note, for each BMP, on a 1 to 5 scale its importance (1 = not important, 5 = very important), how often it was being currently implemented (1 = never, 5 = always), if they were likely to continue or start the BMP (1 = not likely, 5 = very likely), and its difficulty level (1 = easy, 5 = hard) (questions 5a-h).

In order to facilitate statistical analysis by the chi-square statistic, turfgrass industry job classifications were coded into "advisors" and "managers" and the managers further coded into "general" and "sports" turfgrass managers (Table C-2). Sod and turfgrass seed producers were not included in any of the coding or chi-square analyses because their management practices are substantially different from typical turfgrass managers. Respondents who indicated "other" or who indicated multiple turfgrass industry job classifications were also not included.

The responses to two sets of questions were then analyzed with chi-square tests of independence in a 2 2 frequency table for both "advisors" versus "managers" and "general" versus "sports" turfgrass managers. The first set of questions to be analyzed in this manner were regarding the factors limiting the adoption of BMPs and the implementation of specified fertilization and irrigation practices, with each factor or practice coded as "yes" (if checked) or "no" (not checked). The second set of questions were regarding the series of eight BMPs, with the responses from the original 1 to 5 scales being coded into "low to moderate" (1 to 3) and "high" (4 to 5).

Results and Discussion

The respondents to the surveys were primarily managers of public (government/public property) sites (41%), golf courses (19%), private (commercial/residential) sites (8%), and manufacturers or sales representatives of turfgrass-related products (6%) (Table C-2). The vast majority of the respondents were from southern California (88%) and they had an average of 13 years of experience in the turfgrass industry. The respondents managed a wide variety of turfgrasses, including bermudagrass (*Cynodon* L. C. Rich) (82%), tall fescue (57%), perennial ryegrass (*Lolium perenne* L.) (56%), kikuyugrass (*Pennisetum clandestinum* Hochst. ex Chiov.) (40%), annual bluegrass (*Poa annua* L.) (27%), and creeping bentgrass (*Agrostis palustris* Huds.) (25%). Most notably, the respondents were decision-makers, with a total of 88% indicating they were always or usually responsible for turfgrass management decisions or recommendations at their site.

Factors Limiting Adoption of Best Management Practices (BMPs)

The single most common factor which limited the ability of all survey respondents to adopt BMPs was cost or financial limitations (58%) (Table C-3). About a third of all respondents also chose employee skill level and time (37% and 35%, respectively) as important limitations. Notably only 8% of all respondents indicated that not considering BMPs to be important was a limiting factor for adopting BMPs. However,

advisors (18%) were more likely than managers (6%) and general turfgrass managers (9%) more likely than sports turfgrass managers (2%) to indicate this as a limiting factor. Also, lack of organization or planning was more of a limiting factor for general turfgrass managers (26%) than sports turfgrass managers (14%).

Fertilization and Irrigation Practices

Fertilization practices:

The majority of all respondents indicated that they consistently apply appropriate amounts of nitrogen specific for turfgrass species and requirements of turfgrass use (61%), apply nitrogen based on seasonal growth patterns and need (59%), and apply different combinations of slow- and fast-release nitrogen sources according to seasonal growth and expected rainfall (53%) (Table C-4). More than a third (37%) of all respondents also indicated that they conduct soil fertility tests every 1 to 2 years. The least common practices were applying P_2O and K_2O relative to annual nitrogen applied (26%) and avoiding fertilization prior to rain (12%).

There were no statistically significant differences between advisors and managers for any of the fertilization practices. However, 23% to 37% more sports turfgrass managers than general turfgrass managers indicated that they were consistently performing several of the practices.

Irrigation practices:

The vast majority of all respondents (86%) indicated that they consistently check irrigation systems for proper function (Table C-5). Approximately two-thirds of all respondents also indicated that they consistently adjust irrigation clocks at least every 3 months (68%) and size nozzles for balanced precipitation on rotor systems (62%). About half of all respondents consistently cycle irrigation on slopes to prevent runoff (55%) and irrigate according to weather station or soil moisture sensor data (49%). Only 41% of all respondents indicated they consistently check system operating pressures.

There were no statistically significant differences between advisors and managers for any of the irrigation practices. However, significantly more general turfgrass managers (81%) than sports turfgrass managers (49%) indicated they consistently adjusted irrigation clocks at least every 3 months. Also, 20% more sports turfgrass managers than general turfgrass managers noted they irrigated according to weather station or soil moisture sensor data.

Perceptions and Commitment to BMPs in Terms of Different Job Categories

Overall, the majority of respondents considered all eight of the BMPs to be highly important (i.e., rating them 4 or 5 on the 1 to 5 scale, with 5 being highest), ranging from 64% for protecting native habitats during maintenance and construction to 83% for fertility program development (Table C-6). The respondents also considered the BMPs to not be highly difficult – only 22% to 37% rated the BMPs with a 4 or 5 (on the 1 to 5 scale, with 5 being most difficult). Despite the recognition of the importance of the BMPs and the fact that they are generally not highly difficult to implement, only about half to two-thirds of all respondents were conducting the practices with high frequency (ratings of 4 or 5 on the 1 to 5 scale, with 5 being most frequent), or were highly likely to continue or start a practice (ratings of 4 or 5 on the 1 to 5 scale, with 5 being most likely). For all eight of the BMPs in the survey, there were statistically significant differences between the responses of advisors and managers and between general and sports turfgrass managers, as noted below.

Water conservation

More turfgrass managers than advisors considered water conservation to be highly important (83% to 69%, respectively). Managers were also more likely to be implementing water conservation with a high frequency than advisors (60% and 44%, respectively) and to continue or start the practice (73% and 53%, respectively). There were no significant differences between general and sports turfgrass managers in terms of their perceptions and commitment to water conservation.

Fertility program development

There were no significant differences between advisors and managers in terms of their perceptions and commitment to fertility program development. However, more sports turfgrass managers than general turfgrass managers considered this practice to be highly important (90% to 78%, respectively). Sports turfgrass managers, when compared to general turfgrass managers, were also more frequently implementing

(76% to 48%, respectively) and more likely to continue or start the practice (79% to 59%, respectively).

Turfgrass selection

Managers were somewhat more likely than advisors to view turfgrass selection as highly important (75% to 61%, respectively). However, only about half of all respondents were either performing this practice highly frequently (47%) or likely to start or continue this practice (55%). Overall, only 33% of the respondents considered the practice to be highly difficult, although more sports turfgrass managers (43%) than general turfgrass managers (30%) considered it to be highly difficult.

Mowing program development

Only 53% of advisors considered mowing program development to be highly important as compared to 82% of managers. Similarly, managers were conducting this practice more highly frequently and were more likely to continue or start the practice than were advisors (differences of 28% and 29%, respectively). Overall, 79% considered the practice to be highly important, and only 24% considered it to be highly difficult to implement. There were no statistically significant differences between general and sports turfgrass managers in regards to this BMP.

Integrated pest management (IPM)

IPM was viewed by managers to be more highly important than it was by advisors (73% and 58%, respectively), and managers were more highly likely to continue or start the practice than advisors (58% and 42%, respectively). Less than half of both managers and advisors practiced IPM highly frequently (49% and 42%, respectively). Most of the general and sports turfgrass managers considered IPM to be highly important (70% and 78%, respectively), but sports turfgrass managers were more frequently conducting IPM and more highly likely to continue or start IPM than general turfgrass managers (a difference of 24% and 17%, respectively).

Protecting water sources from chemicals and fertilizers

There were no statistical differences between advisors and managers when it came to protecting groundwater and surface water sources from potential contamination from turfgrass chemicals and fertilizers, and only one difference between general and sports turfgrass managers (19% more sports turfgrass managers were more highly likely to be frequently conducting the BMP than general turfgrass managers).

Protecting non-targets from chemicals

Managers were more attentive to protecting non-target plants, animals and humans from the potential toxic effects of turfgrass chemicals than were advisors. There were 15% more managers than advisors who considered the BMP to be highly important, and 16% to 17% were more highly likely to be conducting this practice or likely to continue or start this practice, respectively. There were no statistically significant differences between general and sports turfgrass managers in regards to this BMP.

Protecting native habitats during construction and maintenance

The only statistically significant difference between managers and advisors in regards to protecting native habitats during turfgrass construction and maintenance was that more managers than advisors were highly likely to continue or start the practice (55% and 36%, respectively). However, sports turfgrass managers and general turfgrass managers considered the BMP quite differently. Sports turfgrass managers considered the practice to be more highly important than general turfgrass managers (76% and 61%, respectively) and were more highly likely to be frequently conducting the BMP or highly likely to continue or start the BMP (a difference of 14% and 17%, respectively). Further, 40% of sports turfgrass managers, compared to 26% of general turfgrass managers considered protecting native habitats to be highly difficult to implement.

Conclusions

Overall, the survey respondents considered BMPs to be important, although turfgrass managers, especially sports turfgrass managers, were the most likely to be committed to the BMPs listed in the survey. The survey respondents also did not generally consider the BMPs to be difficult to implement. Together, this suggests that what is needed is a greater commitment on the part of the turfgrass industry as a whole to provide the financial backing, employee training, and necessary time which has previously limited the adoption of

important BMPs. Outreach programs will play an important role in this effort, and in order to most effectively create such programs, more in-depth and rigorous surveys of the turfgrass industry are necessary.

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Table C-1. Survey questions.

SECTION 1

1. Did you complete this survey in 1998? *1999 only. Choices: yes; no; or not sure*.

2a. Which of the following indicates how you are primarily involved with turfgrass (choose only one)? *Choices: golf course management; professional consulting/horticulture advising; manufacture/sales of turfgrass-related products; public (government/public property) site management; private (commercial/residential) site management; sports turfgrass management; sod production; turfgrass seed production; turfgrass research; or other.*

2b. Number of years you have been involved with the activity checked above?

2c. What is the county and state where you primarily perform this activity (please specify one county)?

3. How often are you responsible for making decisions or recommendations about turfgrass management practices (turfgrass selection, irrigation practices and system maintenance, fertilization programs, mowing, pesticide applications, etc.)? *Choices: always; usually; rarely; or never.*

4. If you manage turfgrass, please indicate the turfgrass species at your site (check all that apply). *Choices: bermudagrass; tall fescue; creeping bentgrass; perennial ryegrass; kikuyugrass; annual bluegrass; St. Augustinegrass [*Stenotaphrum secundatum *(Walt.) Kuntze]; Kentucky bluegrass (*Poa pratensis *L.); zoysiagrass (*Zoysia *Willd.); and other(s).*

SECTION 2

5. Examine each of the BMPs described below and note whether or not you consider it to be an important management practice, whether or not you are currently performing the practice, whether or not you are likely to either continue or initiate this practice in the future, and whether or not you feel the practice is easy or very difficult to carry out. *Responses on a 1 to 5 scale for the following: importance (1 = not, 5 = very); doing this now? (1 = never, 5 = always); likely to continue/start? (1 = not likely, 5 = very likely); difficulty level (1 = easy, 5 = very hard).*

The BMPs:

a) water conservation (ET_o-based water budgets, seasonal adjustments of irrigation clocks, irrigation system checks, etc.)
b) fertility program development (fertilization based on plant species, type of use, and seasonal and climatic requirements, soil type; use of appropriate fertilizer type, amount, and frequency of application)
c) turfgrass selection [choose species and cultivars that, for example, require less water, possess more tolerance to stress (including pests) or possess other traits that would result in the successful management of turfgrass, etc.]
d) mowing program development (Mowing height/frequency based on species/cultivar requirements, plant growth and/or stress, etc.)
e) integrated pest management (managing the "most healthy" turfgrass as possible via sound agronomic principles as the best prevention to pests, defining threshold pest activity/amount prior to pesticide applications, etc.)
f) protecting ground water and surface water from potential contamination from turfgrass chemicals and fertilizers
g) protecting non-target plants, animals and humans from the potential toxic effects of turfgrass chemicals
h) protecting native habitats during turfgrass construction and maintenance

6. What factor(s) have limited your ability to adopt BMPs in the past (check all that apply)? *Choices: cost/financial limitations; availability of BMP information; lack of organization/planning; government regulations; employee skill level; time; BMPs not considered important; no personal authority to implement BMPs; client/owner/public unaware of or disinterested in BMPs; and other(s)*

7. Which of the following fertilization practice(s) do you consistently perform (check all that apply)? *1999 only. Choices: apply appropriate amount of nitrogen (N) specific for turfgrass species and requirements of turfgrass use; apply different combinations of slow- and fast-release N sources according to seasonal growth and expected rainfall; apply N based on seasonal growth patterns and need; apply P_2O_5 and K_2O relative to annual N applied; conduct soil fertility tests every 1 to 2 years; and avoid fertilizing prior to rain.*

8. Which of the following irrigation practice(s) do you consistently perform (check all that apply)? *1999 only. Choices: irrigate according to weather station/soil moisture sensor data; check system operating pressures; adjust irrigation clocks at least every 3 months; check irrigation systems for proper function; cycle irrigation on slopes to prevent runoff; and size nozzles for balanced precipitation on rotor systems*.

SECTION 3

9. Was the information presented today and contained in the proceedings/handout on BMPs useful? *Choices: very useful; somewhat useful; not useful; or not sure.*

10. Would you be likely to adopt or change irrigation or fertilization practices based on information presented? *Choices: very likely; somewhat likely; not likely; or not sure.*

11. Comments and suggestions about the presentation or this questionnaire.

Table C-2. Information concerning respondents surveyed over two years at the University of California, Riverside, Turfgrass Research Conference and Field Day.

Turfgrass industry job classification	Respondents		Category		Average number of years of experience	Frequency of decision-making	
	Number	Percent	Advisor/ manager	General/ sports turfgrass		Always /usually	Rarely /never
						--------- % --------	
Public (government/public property) site management	124	41	Manager	General	13	89[z]	11
Golf course management	59	19	Manager	Sports	14	85	15
Private (commercial/residential) site management	24	8	Manager	General	11	96	4
Manufacture/sales of turfgrass-related products	18	6	Advisor	–	14	83	17
Professional consulting/horticultural advising	14	5	Advisor	–	16	93	7
Sports turfgrass management	13	4	Manager	Sports	14	92	8
Sod production	12	4	–	–	8	75	25
Turfgrass research	4	1	Advisor	–	18	100	0
Turfgrass seed production	4	1	–	–	15	75	25
Other	7	2	–	–	10	100	0
Multiple classifications	25	8	–	–	15	84	16
Total[y]	305	100			13	88	12

[z] Percentages under always/usually and rarely/never total 100% of respondents for a given turfgrass industry job classification.

[y] Includes one survey respondent that did not answer the question regarding turfgrass industry job identification.

Table C-3. Influence of job and turfgrass management categories on the perception of factors limiting the adoption of best management practices of survey respondents.

Limiting factor	Job category[z]			Turfgrass management category[y]			All survey respondents[x]
	Advisor	Manager	χ^2	General	Sport	χ^2	
	------- *% yes*[w] -------			------- *% yes*[w] ------			*% yes*[w]
Cost/financial limitations	54	59	0.27[NS]	60	57	0.13[NS]	58
Employee skill level	25	39	2.02[NS]	38	40	0.05[NS]	37
Time	25	36	1.41[NS]	38	34	0.27[NS]	35
Availability of BMP information	32	21	1.81[NS]	21	22	0.02[NS]	21
Lack of organization/planning	14	22	0.95[NS]	26	14	3.94[*]	21
Government regulations	7	19	2.52[NS]	21	15	0.99[NS]	18
No personal authority to implement BMPs	14	20	0.50[NS]	23	14	2.18[NS]	19
BMPs not considered important	18	6	4.63[*]	9	2	3.66[+]	8
Other	11	5	1.27[NS]	4	9	2.84[+]	7

[z] Total number of respondents: 234.

[y] Total number of respondents: 206.

[x] Total number of respondents from all job classifications: 275.

[w] Respondents could check ("yes") for as many of the listed factors limiting the adoption of best management practices as applied to their situation.

[NS],[+],[*] Nonsignificant or significant at $P \leq 0.10$ or 0.05, respectively, by the chi-square test of independence in a 2x2 frequency table.

Table C-4. Influence of job and turfgrass management categories on the reported frequency of consistently performing selected fertilization best management practices by survey respondents.

Fertilization BMP	Job category[z]			Turfgrass management category[y]			All survey respondents[x]
	Advisor	Manager	χ^2	General	Sport	χ^2	
	------- *% yes*[w] -------			------- *% yes*[w] ------			*% yes*[w]
Apply appropriate amount of nitrogen specific for turfgrass species and requirements of turfgrass use	33	60	0.89[NS]	46	83	11.95[***]	61
Apply nitrogen based on seasonal growth patterns and need	33	59	0.81[NS]	54	69	2.01[NS]	59
Apply different combinations of slow- and fast-release nitrogen sources according to seasonal growth and expected rainfall	67	52	0.26[NS]	43	66	4.51[*]	53
Conduct soil fertility tests every 1 to 2 years	0	36	1.68[NS]	23	57	10.73[***]	37
Apply P_2O_5 and K_2O relative to annual nitrogen applied	33	25	0.10[NS]	20	34	2.44[NS]	26
Avoid fertilizing prior to rain	0	11	0.37[NS]	9	14	0.63[NS]	12

[z] Total number of respondents: 94 (data available for 1999 survey only).

[y] Total number of respondents: 91 (data available for 1999 survey only).

[x] Total number of respondents from all job classifications: 107 (data available for 1999 survey only).

[w] Respondents could check ("yes") for as many of the listed fertilization best management practices as applied to their situation.

[NS],[*],[***] Nonsignificant or significant at $P \leq 0.05$ or 0.001, respectively, by the chi-square test of independence in a 2x2 frequency table.

C-5. Influence of job and turfgrass management categories on the reported frequency of consistently performing selected irrigation best management practices by survey respondents.

Irrigation BMP	Job category[z]			Turfgrass management category[y]			All survey respondents[x]
	Advisor	Manager	χ^2	General	Sport	χ^2	
	------- *% yes*[w] -------			------- *% yes*[w] ------			*% yes*[w]
Check irrigation systems for proper function	67	88	1.13[NS]	87	89	0.05[NS]	86
Adjust irrigation clocks at least every 3 months	100	69	1.36[NS]	81	49	10.67[***]	68
Size nozzles for balanced precipitation on rotor systems	33	61	0.90[NS]	67	51	2.07[NS]	62
Cycle irrigation on slopes to prevent runoff	67	58	0.08[NS]	61	54	0.41[NS]	55
Irrigate according to weather station/soil moisture sensor data	33	51	0.34[NS]	43	63	3.49[+]	49
Check system operating pressures	33	40	0.06[NS]	39	43	0.14[NS]	41

[z] Total number of respondents: 92 (data available for 1999 survey only).

[y] Total number of respondents: 89 (data available for 1999 survey only).

[x] Total number of respondents from all job classifications: 103 (data available for 1999 survey only).

[w] Respondents could check ("yes") for as many of the listed irrigation best management practices as applied to their situation.

[NS],[+],[***] Nonsignificant or significant at $P \leq 0.10$ or 0.001, respectively, by the chi-square test of independence in a 2x2 frequency table.

Table C-6. Influence of job and turfgrass management categories on the perception and commitment to eight best management practices.

Perception/commitment to best management practices	Job category[z]			Turfgrass management category[y]			All survey respondents[x]
	Advisor	Manager	χ^2	General	Sports	χ^2	
	------- % high[w]------			----- % high[w]----			% high[w]
Importance							
Water conservation	69	83	3.53^{+}	84	81	0.35^{NS}	79
Fertility program development	81	82	0.06^{NS}	78	90	4.70*	83
Turfgrass selection	61	75	3.26^{+}	74	79	0.80^{NS}	75
Mowing program development	53	82	15.07***	81	83	0.16^{NS}	79
Integrated pest management (IPM)	58	73	3.09^{+}	70	78	1.38^{NS}	73
Protecting water sources from chemicals and fertilizers	69	77	1.04^{NS}	77	78	0.01^{NS}	75
Protecting non-target plants, animals and humans from chemicals	69	84	4.16*	84	82	0.22^{NS}	82
Protecting native habitats during	53	66	2.49^{NS}	61	76	4.82*	64
Frequency of current implementation							
Water conservation	44	60	3.26^{+}	57	67	1.73^{NS}	56
Fertility program development	64	57	0.56^{NS}	48	76	15.98***	61
Turfgrass selection	44	45	0.01^{NS}	42	53	2.31^{NS}	47
Mowing program development	39	67	10.73***	64	74	0.16^{NS}	64
Integrated pest management (IPM)	42	49	0.60^{NS}	41	65	11.86***	49
Protecting water sources from chemicals and fertilizers	56	54	0.03^{NS}	48	67	6.82**	52
Protecting non-target plants, animals and humans from chemicals	58	74	3.80*	72	78	0.76^{NS}	71
Protecting native habitats during construction/maintenance	36	48	1.68^{NS}	43	57	3.64^{+}	45
Likelihood to continue/start implementation							
Water conservation	53	73	5.85*	74	69	0.58^{NS}	68
Fertility program development	64	66	0.06^{NS}	59	79	8.37**	69
Turfgrass selection	53	55	0.06^{NS}	54	57	0.16^{NS}	55
Mowing program development	39	68	11.12***	66	71	0.47^{NS}	65
Integrated pest management (IPM)	42	58	3.23^{+}	52	69	6.02**	57
Protecting water sources from chemicals and fertilizers	64	62	0.06^{NS}	61	64	0.19^{NS}	62
Protecting non-target plants, animals and humans from chemicals	58	75	4.06*	74	75	0.01^{NS}	71
Protecting native habitats during construction/maintenance	36	55	4.64*	50	67	5.45*	53
Difficulty level							
Water conservation	33	30	0.12^{NS}	34	24	2.37^{NS}	30
Fertility program development	25	22	0.18^{NS}	22	22	0.01^{NS}	22
Turfgrass selection	39	34	0.31^{NS}	30	43	3.83*	33
Mowing program development	31	23	1.04^{NS}	25	18	1.33^{NS}	24
Integrated pest management (IPM)	39	37	0.06^{NS}	36	38	0.02^{NS}	37
Protecting water sources from chemicals and fertilizers	36	36	0.00^{NS}	39	31	1.33^{NS}	35
Protecting non-target plants, animals and humans from chemicals	28	30	0.10^{NS}	33	25	1.50^{NS}	30
Protecting native habitats during construction/maintenance	28	31	0.14^{NS}	26	40	4.40*	32

[z] Total number of respondents: 256.
[y] Total number of respondents: 220.
[x] Total number of respondents from all job classifications: 305.
[w] Responses originally on a 1 to 5 scale (5 = highest) with 1 to 3 coded as "moderate/low" and 4 to 5 as "high."
$^{NS,+,*,**,***}$ Nonsignificant or significant at $P \leq 0.10$, 0.05, 0.01, or 0.001, respectively, by the chi-square test of independence in a 2x2 frequency table.