

APPENDICES

Appendix A
Land-Grant Institutions, Colleges, and Professional Associations
Involved in the Nomination Process

Land-Grant Institutions Involved in Nomination Process

- | | |
|-------------------------------------|--|
| 1. Auburn University | 34. North Dakota State University |
| 2. University of Alaska | 35. Ohio State University |
| 3. University of Arizona | 36. Oklahoma State University |
| 4. University of Arkansas | 37. Oregon State University |
| 5. University of California | 38. Pennsylvania State University |
| 6. Colorado State University | 39. University of Rhode Island |
| 7. University of Connecticut | 40. Clemson University |
| 8. University of Delaware | 41. South Dakota State University |
| 9. University of Florida | 42. University of Tennessee |
| 10. University of Georgia | 43. Texas A&M University |
| 11. University of Hawaii | 44. Utah State University |
| 12. University of Idaho | 45. University of Vermont |
| 13. University of Illinois | 46. Virginia Polytechnic Institute and State University |
| 14. Purdue University | 47. Washington State University |
| 15. Iowa State University | 48. West Virginia University |
| 16. Kansas State University | 49. University of Wisconsin |
| 17. University of Kentucky | 50. University of Wyoming |
| 18. Louisiana State University | 51. Alabama A&M University |
| 19. University of Maine | 52. University of Arkansas at Pine Bluff |
| 20. University of Maryland | 53. Delaware State College |
| 21. University of Massachusetts | 54. Florida A&M University |
| 22. Michigan State University | 55. Fort Valley State College |
| 23. University of Minnesota | 56. Kentucky State University |
| 24. Mississippi State University | 57. Southern University |
| 25. University of Missouri | 58. University of Maryland - Eastern Shore |
| 26. Montana State University | 59. Alcorn State University |
| 27. University of Nebraska | 60. Lincoln University |
| 28. University of Nevada | 61. North Carolina A&T State University |
| 29. University of New Hampshire | 62. Langston University |
| 30. Rutgers State University | 63. South Carolina State College |
| 31. New Mexico State University | 64. Tennessee State University |
| 32. Cornell University | 65. Virginia State University |
| 33. North Carolina State University | 66. West Virginia State College |

Colleges Involved in Nomination Process

1. Abraham Baldwin Agricultural College, GA
2. Anoka Hennepin Technical College, MN
3. California State Polytechnic University - Pomona, CA
4. California Polytechnic State University - San Luis Obispo, CA
5. Catawba Valley Technical College, NC
6. Central Community College, NE
7. Central Oregon Community College, OR
8. Clark State Community College, OH
9. Cuyamaca College, CA
10. Danville Area Community College, IL
11. Delaware Valley College, PA
12. Eastern Kentucky University, KY
13. Faulkner State Community College, AL
14. Front Range Community College, CO
15. Grayson County College, TX
16. Hawkeye Community College, IA
17. Hinds Community College, MS
18. Horry-Georgetown Technical College, SC
19. Illinois Central College, IL
20. Iowa Lakes Community College, IA
21. Joliet Junior College, IL
22. Kirkwood Community College, IA
23. Kishwaukee College, IL
24. Lake City Community College, FL
25. Linn State Technical College, MO
26. Longview Community College, MO
27. Michigan State University Institute of Agricultural Technology, MI
28. Morehead State University, KY
29. Nebraska College of Technical Agriculture, NE
30. North Carolina State University - The Agricultural Institute, NC
31. Northeastern Junior College, CO
32. Ohio State University Agricultural Technical Institute, OH
33. Rochester Community and Technical College, MN
34. San Joaquin Delta College, CA
35. Sandhills Community College, NC
36. Southeast Technical Institute, SD
37. Southern Illinois University, IL
38. Spokane Community College, WA
39. State University of New York - Cobleskill, NY
40. State University of New York - Delhi, NY
41. Texas Tech University, TX
42. Texas State Technical College, TX

Colleges Involved in Nomination Process (continued)

43. University of Maryland - College Park Institute of Applied Agriculture, MD
44. University of Massachusetts - Amherst Stockbridge School of Agriculture, MA
45. Walla Walla Community College, WA
46. Walters State Community College, TN
47. Western Iowa Tech Community College, IA
48. Western Texas College, TX
49. Western Kentucky University, KY
50. Western Kentucky University Community College, KY
51. William Rainey Harper College, IL

Professional Associations Involved in Nomination Process

1. American Seed Trade Association
2. American Society of Horticultural Science
3. American Society of Agronomy
4. American Society of Golf Course Architects
5. American Sod Producers Association
6. Ben Warren Memorial Foundation (Sod production)
7. Canadian Golf Superintendents Association
8. Club Managers Association of America
9. Golf Course Builders Association of America
10. Golf Course Superintendents Association of America
11. Lawn & Landscape Maintenance
12. Musser International Turfgrass Association
13. National Agricultural Chemical Association
14. National Golf Foundation
15. National Institute on Parks and Grounds Management
16. O. J. Noer Research Foundation, Inc.
17. PGA of America
18. Professional Grounds Management Society
19. Professional Lawn Care Association of America
20. Responsible Industry for a Sound Environment
21. Sports Turf Managers Association
22. Turf and Ornamental Communicators Association
23. United States Golf Association Green Section
24. Weed Science Society of America

Appendix B
Nomination Form and Cover Letter

**DELPHI STUDY IN TURF
- NOMINATION FORM -**

Your Name: _____

Directions: Please list five persons who you feel are best qualified to forecast the future directions of turfgrass management. These may be persons on the national, state, or local level in any specific or broad area of turfgrass management. Nominees may include golf course superintendents, industry turf managers, consulting turf managers, researchers, educators, extension personnel, and others. Please include each nominee's address, telephone number, fax number, and e-mail, if available.

| # | Name | Location |
|---|------|-----------------------------------|
| 1 | Fax: | Address: Telephone: E-mail: |
| 2 | Fax: | Address: Telephone: E-mail: |
| 3 | Fax: | Address: Telephone: E-mail: |
| 4 | Fax: | Address: Telephone: E-mail: |
| 5 | Fax: | Address: Telephone: E-mail: |

Please check here if you wish to receive a summary of this study.

Thank you for your assistance.

Eddie Dean Seagle
ABAC 19, 2802 Moore Highway
Tifton, GA 31794-2601

FAX 912.386.3508
Office 912.386.3449
E-mail eseagle@abac.peachnet.edu



November 18, 1994

Name
 Land-Grant Institution Representative
 Address
 City, State Zip Code

Name,

As a leader in turfgrass management, your help is needed in conducting a **Delphi study** on the future of the field. In order to conduct this study I need your assistance in selecting the panel of professionals. Please nominate five persons who you feel are most qualified to forecast the future directions of the turfgrass industry. The most frequently nominated persons will be asked to share their visions.

A nomination form and postage-paid, return-addressed envelope are enclosed for your convenience. Please return the nomination by **December 12, 1994**. If you have any questions please feel free to call me at 912.386.3449 or fax 912.386.7006. Your nominations will be kept confidential and will not be released in any identifiable form unless required by law. Thank you for your professional assistance.

Sincerely,

Eddie Dean Sengle
 Research Associate

c: Dr. Maynard J. Iverson, Major Professor

Enclosure

NOTE: Research at the University of Georgia which involves human participants is carried out under the oversight of the Institutional Review Board. Questions or problems regarding these activities should be addressed to Dr. Heidi L. Roof, Coordinator, Human Subjects Research, Institutional Review Board, Office of V. P. for Research, The University of Georgia, 604A Graduate Studies Research Center, Athens, GA 30602. Phone: 706.542.6514.



November 18, 1994

Name
 College Turfgrass Representative
 Address
 City, State Zip Code

Name,

As a leader in turfgrass management, your help is needed in conducting a **Delphi study** on the future of the field. In order to conduct this study I need your assistance in selecting the panel of professionals. Please nominate five persons who you feel are most qualified to forecast the future directions of the turfgrass industry. The most frequently nominated persons will be asked to share their visions.

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Sincerely,

Eddie Dean Seagle
 Research Associate

c. Dr. Maynard J. Iverson, Major Professor

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November 18, 1994

Name
 Professional Turfgrass Association Representative
 Address
 City, State Zip Code

Name.

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 Research Associate

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Appendix C
First Follow-up of Non-Respondents
in the Nomination Process



December 2, 1994

Name
 Land-Grant Institution Representative
 Address
 City, State Zip Code

Name,

This is a reminder that your assistance is needed in the selection of a panel of professionals to participate in a research study to describe the turfgrass industry of the future. In my recent letter I asked you to nominate five persons you consider most able to forecast the future of our profession. I feel that you are in the best position to know who should serve on the panel of experts. Please feel free to consult with others in the selection of your nominees. Please list your own name if you consider it appropriate.

This is a national study and input from every state is vitally important. Please assist in having your state represented. Please return the nomination by **December 12, 1994**. If you have any questions please feel free to call me at **912.386.3449** or fax **912.386.7006**. Your nominations will be kept confidential and will not be released in any identifiable form unless required by law.

Thank you for responding if you have already done so.

Sincerely,

Eddie Dean Seagle
 Research Associate
 Agricultural Education

c: Dr. Maynard J. Iverson, Major Professor

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Thank you for responding if you have already done so.

Sincerely,

Eddie Dean Seagle
 Research Associate
 Agricultural Education

c: Dr. Maynard J. Iverson, Major Professor

Enclosure

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This is a national study and input from every state is vitally important. Please assist in having your state represented. Please return the nomination by **December 12, 1994**. If you have any questions please feel free to call me at 912.386.3449 or fax 912.386.7006. Your nominations will be kept confidential and will not be released in any identifiable form unless required by law.

Thank you for responding if you have already done so.

Sincerely,

Eddie Dean Seagle
 Research Associate
 Agricultural Education

c: Dr. Maynard J. Iverson, Major Professor

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Appendix D
Invitation Letter and
Biographical Information



Abraham Baldwin AGRICULTURAL COLLEGE

A Four-Year Unit of the University System of Georgia

Division of Agriculture and
Forest Resources

ABAC 4, 2802 Moore Highway
Tifton, GA 31794-2601
Telephone (912) 386-1253

February 1, 1999

Name
Title
Address
City, State Zip Code
Fax Number

Name.

This is to request your participation in a "futures" study that will attempt to describe the turfglass industry in the year 2020. The data collected will have a number of uses including educational and business planning. Characteristics of the turfglass industry in the year 2020 will be determined by the consensus of opinion of thirty-eight turfglass experts.

You were selected as one of the top thirty-eight turfglass experts in the nation. Requests for nominations were taken from land-grant institutions turfglass personnel (research, teaching, and extension), college turfglass program representatives (teaching and demonstration), and turfglass professional association executive and/or administrative personnel. I hope you will participate in this study. The process will require completing three survey instruments. The first round is attached and will be used in developing the instrument to be circulated in subsequent rounds.

Please return the completed instrument to me by February 28, 1999 by facsimile to 912.391.2492. This return date is very important for the completion of the study. When the study is completed, I will share the results with you and submit them for publication.

Participation in this study entails no risk and is voluntary. Benefits will be having spent time thinking about the future of the turfglass industry and obtaining consensus information that can be used in planning for the future. A returned, completed instrument will indicate your consent to participate. Your response will be kept confidential and not be released in any individually identifiable form unless required by law. If you have any questions, please feel free to call me at 912.386.3449.

Sincerely,

Eddie Dean Seagle
Associate Professor of Environmental Horticulture
Regents' Distinguished Professor for Teaching and Learning

cc: Dr. Maynard J. Iverson, Major Professor

NOTE: Research at the University of Georgia which involves human participants is carried out under the oversight of the Institutional Review Board. Questions or problems regarding these activities should be addressed to Dr. Heidi L. Roof, Coordinator, Human Subjects Research, Institutional Review Board, Office of V. P. for Research, The University of Georgia, 604A Graduate Studies Research Center, Athens, GA 30602. Phone: 706.542.6514.

| |
|---|
| DELPHI TEAM BIOGRAPHICAL INFORMATION |
|---|

Directions: Please supply the following information which will be used for statistical purposes only in analyzing the data collected.

| |
|---|
| 1. Name: |
| 2. Position/Title and Affiliation: |
| 3. Address |
| 4. City, State, Zip |
| 5. Age: _____ |
| 6. Sex: _____ |
| 7. Race (circle one): American Indian, Black, Caucasian, Hispanic, Oriental (Asian), Other (specify): _____ |
| 8. Number of Years in the Turfgrass Industry / Education: |
| 9. Number of Years of Formal Education (high school - college): |
| 10. If you have a degree(s) in agronomy / horticulture / agricultural education / related areas or special training in the agricultural sciences, please specify: |
| <p>11. Please circle all of the following categories that describe your current affiliation with the turfgrass industry.</p> <ul style="list-style-type: none"> * Author/publisher * Consultant * Educator * Extension specialist/agent * Federal employee * Private industry employee * Professional association staff/officer * Researcher * Self-employed * State commodity organization * Other (please specify: _____) |
| 12. Which category do you consider to be the most descriptive of your professional activities? |

Appendix E
First Round of the Delphi Instrument

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|--|
| First Round: Questionnaire for Development of the Delphi Instrument |
|--|

Note: The literature on turfgrass management appears under the following categories:

| Category | Subject |
|----------|---|
| #1 | Personnel Education and Staff Development |
| #2 | Technology |
| #3 | Availability of Turfgrass Cultivars |
| #4 | Turfgrass Management Services |
| #5 | Legal Issues |
| #6 | Chemical Issues |
| #7 | Environmental Issues |
| #8 | Best Management Practices |
| #9 | Other Issues and/or Circumstances |

Instructions: Please read the *example and guide questions* at the top of each sheet. Then write statements that describe how the category will appear or function in the year 2020. Try to generate several predictions or statements for each category. Don't worry about whether a statement sounds *minor or impossible* now. Feel free to "*dream a little*." In 20 years, the "*impossible*" may be commonplace.

Category #1: Personnel Education and Staff Development

Guide question — What is your opinion on what education and training will be needed for turfgrass managers in the year 2020?

Sample statement — *Formal, informal, and continuing education will continue to play a significant role in preparing turfgrass managers.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #2: Technology

Guide question — What is your opinion on the impact of higher technology on turfgrass managers in the workforce by the year 2020?

Sample statement — *As technology continues to expand, the competency level of the turfgrass manager will be measured in many ways.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #3: Availability of Turfgrass Cultivars

Guide question — What is your opinion on the availability of turfgrass cultivars and the role of the turfgrass manager in such decisions by the year 2020?

Sample statement — *The availability of turfgrass cultivars will depend upon extensive research, production, and marketing efforts.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #4: Turfgrass Management Services

Guide question — What is your opinion on the use of turfgrass management services by the year 2020?

Sample statement — *Turfgrass management services (in-house and contractual) will be a force to be reckoned with.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #5: Legal Issues

Guide question — In your opinion, what legal issues and programs will impact the turfgrass manager by the year 2020?

Sample statement — *Legal issues such as certification programs, licenses, etc. will impact the planning and management of turfgrass in the future.*

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b.

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c.

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d.

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< Please attach an additional sheet if more space is needed for response >

Category #6: Chemical Issues

Guide question — In your opinion, what chemical issues will impact turfgrass management by the year 2020?

Sample statement — *Availability and use of fertilizers and pesticides will likely be under more critical observation from the general public and turfgrass management teams in the future.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #7: Environmental Issues

Guide question — In your opinion, what environmental issues will be of the greatest concern to the turfgrass manager by the year 2020?

Sample statement — *The state of the environment will be a major focus of the general public and environmental support groups*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #8: Best Management Practices

Guide question — In your opinion, what best management practices will be of major importance to the turfgrass manager by the year 2020?

Sample statement -- *To manage turfgrass at a specified level of maintenance, the development, implementation, and evaluation of best management practices will likely be more critical.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Category #9: Other Issues and/or Circumstances

Guide question — What is your opinion of other issues and/or circumstances that will relate to turfgrass management by the year 2020?

Sample statement — *Many other issues and circumstances (eg. budgeting, resource management, etc.) will impact the effectiveness and the planning schedule of the turfgrass manager.*

a.

b.

c.

d.

< Please attach an additional sheet if more space is needed for response >

Appendix F
First Round Follow-up
to Non-Respondents



Abraham Baldwin

AGRICULTURAL COLLEGE

A Two-Year Unit of the University System of Georgia

Division of Agriculture and
Forest Resources

ABAC 8, 2802 Moore Highway
Tifton, GA 31794-2601
Telephone (912) 386-3255

February 15, 1999

Name
Title
Address
City, State Zip Code
Fax Number

Name.

This is a reminder that your participation is needed in a "futures" study that will attempt to describe the turfgrass industry in the year 2020. The data collected will have a number of uses including educational and business planning. Characteristics of the turfgrass industry in the year 2020 will be determined by the consensus of opinion of thirty-eight turfgrass experts.

You were selected as one of the top thirty-eight turfgrass experts in the nation. I hope you will participate in this study. The process will require completing three survey instruments. The first round is attached and will be used in developing the instrument to be circulated in subsequent rounds. Because your input is considered essential to this study, please take as much time as necessary to complete the instrument. If you desire not to participate, please let me know.

Participation in this study entails no risk and is voluntary. Benefits will be having spent time thinking about the future of the turfgrass industry and obtaining consensus information that can be used in planning for the future. A returned, completed instrument will indicate your consent to participate. Your response will be kept confidential and not be released in any individually identifiable form unless required by law. When the study is completed, I will share the results with you and submit them for publication.

If you have any questions, please feel free to contact me at return facsimile 912.391.2592, email (eseagle@abac.peachnet.edu), or phone 912.386.3449. Thank you for your assistance.

Sincerely,

Eddie Dean Seagle
Associate Professor of Environmental Horticulture
Regents' Distinguished Professor for Teaching and Learning

c: Dr. Maysard J. Iverson, Major Professor

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Appendix G
First Round Responses

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

Round One Comments

Category I: Personnel Education and Staff Development Comments

1. An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions.
2. Admission into the two year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management.
3. Turfgrass education programs will have stricter requirements for entrance and graduation.
4. Minimum grade point averages will be established for turfgrass majors.
5. Certification programs for all turfgrass professionals will be in place.
6. The demand for certified turfgrass professionals will increase.
7. Continuing education will be required for all professional turfgrass managers.
8. More emphasis will be placed on business and human resource management for turfgrass managers.
9. More emphasis will be placed on meeting the requirements of the many environmental regulations.
10. Less emphasis will be stressed in science for turfgrass managers.
11. Turfgrass managers will require excellent technical education plus business skills. Most importantly, they will require the skills to analyze problematic situations and to develop, evaluate, and implement solution strategies.
12. Because of the rapid pace of change in the turfgrass industry, turfgrass managers will require a commitment to lifelong education to grow in their competency and to stay abreast of new developments.
13. Strong technical background in agronomic science.
14. I totally agree with the sample statement. Much of this will be done via internet and computer.
15. New levels of expertise will develop to deal with more sophisticated equipment.
16. On-line diagnosis and discussion will be common.
17. All education will continue to play an important role in preparing turfgrass managers, in particular those with responsibility of managing golf courses, urban parks and recreational facilities, professional and collegiate sports fields, or own and operate professional lawn care.
18. Communication, labor management, and resource management (ie. Water, fertilizer, pesticides, etc.) Will play a much greater role. Job skills in these areas will be required.

19. Continuing education tied to state and national certification programs will increase. This will be needed to document competency dealing with pesticide laws and other environmental regulations.
20. Two and four-year college graduates will occupy positions on golf courses where no degree is required today. An increase in vocational training will take place to deal with other key positions (ie. mechanics, irrigation systems, etc.).
21. More training on managing for healthy grass and less reliance on chemicals as agronomic "crutches."
22. More training on recognizing "bad science" or selective advertising of "facts" as part of a sales or advertising "pitch."
23. More training on the technical aspects of how chemicals or chemical families actually work and how to integrate these materials properly into the operation of a golf course.
24. More training available "on line." This should give turf managers anywhere, better access to information on turfgrass management. This is especially important for superintendents in Europe who seek technical information which is not available there.
25. Turf managers will need more training in personnel management, computers, chemistry, environmental sciences, and meteorology.
26. There will be need for more continuing education.
27. Four year college training and 1 year internship.
28. Golf course management has always been a combination of art and science. As technology continues to explode at a rapid pace the superintendent will need to allow time to develop the artistic creativity so important in the aesthetic final results.
29. The science of turf is relatively new — from farmers 50 years ago to agritologists today.
30. Computer science skills will become more and more important as time goes by.
31. Continued training in technology, soil science, water, chemistry, and plant physiology will be necessary. But superintendents will also be expected to improve personnel and business management skills.
32. Advanced training may require exploration of guest services / education needs, etc. Some improved courses in psychology of recreation are needed. How can I create an atmosphere for maximized guest/member enjoyment while protecting the integrity of a great game.
33. Management will continue to be most important, availability of personnel or workers will be a problem. Hence, management of those available will be very important. So emphasis on management of personnel should be applied by educators.
34. Significant computer training.
35. Knowledge and use of Spanish language and culture.
36. Continuing education.

37. Same as today in agronomics and mechanics but with more emphasis on knowing and following strict federal regulations.
38. More emphasis on managing people.
39. Turf areas will require students with higher SAT's.
40. Formal — 4-5 year B.S. degree plus 1-2 years apprenticeship. Then serve as a foreman or assistant for at least two years.
41. Also, be well versed in all aspects of management including personnel management.
42. Continuing education on an annual basis.
43. Examination and certification standard to be met every 2-3 years to remain qualified.
44. Must be computer literate, aware of sources of information.
45. Be knowledgeable in areas of water management, soil fertility, turfgrass physiology, and environmentally conscientious.
46. Minimum of B.S. degree. I don't believe an A.S. will make it unless they are second career people that already have another degree.
47. Need business skills. May be gotten outside continuing education during career.
48. Need people management skills. May be gotten outside continuing education during career.
49. Over 31 years my job has become less agronomic and more business.
50. Interdisciplinary education and training at the 4-year level will be much more common for assistants and superintendents/managers.
51. Distance learning via the internet will be commonplace.
52. Training in communications and technologies will be more important than it is today. People will be hired strictly to take care technological needs.
53. An increase in contract maintenance will place a premium on management skills — thus a need for business management training.
54. Continuing increase in two and four year educational background.
55. Increase in dramatic fashion in turfgrass certificates (6-9 classes at 2 or 4 year institutions or through universities, extension.
56. More licensing, with increased educational requirements to be licensed and more annual continuing education required to maintain license.
57. Continuing education provided by the internet will be imperative.
58. More education in business, personnel management, and communications.

59. B.S. degree required for 90% of turf positions (management).
60. Continuing education will be required for 100% of managers, mainly because of legal issues.
61. Most (over 50%) turf crew leaders, foreman, irrigation technician, assistant superintendents and spray technicians will have B.S. degrees.
62. Outreach education will be redefined and ubiquitous (wide-spread) in the future. Technology associated with the Internet will open up a means of educating students and people in a new manner. The classroom of the future will have golf course superintendents, and staff workers listening to lectures from thousand's of miles away in real time.
63. Turfgrass managers in a supervisory capacity will be required to have a minimum of a four year degree in some area of the plant sciences.
64. All professional associations will have well established certification programs. One will not be eligible for certification without at least a 2 or 4-year degree in some area of the plant sciences.
65. All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides.
66. Complete 2 and 4 year degrees in the plant sciences will be available via the web.
67. We will need higher quality people attracted to be turfgrass managers — this will require recruitment at the high school level by companies, educational departments, and turfgrass associations.
68. Formal is a given requirement but equally important is work programs that set work standards and expectations at nearly every stage in their educational process.
69. Turf managers will need more continuing education to stay abreast in technology.
70. Entry level managerial and professional positions will require a minimum of a Master of science degree.
71. Certification requiring continuing education (CEU) will be commonplace, and lifelong learning will be an accepted norm.
72. Spanish will be important.
73. Continuing education will continue to play a major role in educating turfgrass managers and staff; and will be even more important for staff than it is now.
74. Environmental education will be a major need.
75. Educating staff on environmental issues and IPM will be critical.

Category II: Technology Comments

1. More opportunities will exist for continuing education through the internet.
2. Computers will play a major role in the educational, decision-making, and recordkeeping processes.
3. More sophisticated equipment will be available for construction and maintenance of turfgrass sites.
4. Current turfgrass mechanics will become turfgrass equipment technicians as in the automobile business.
5. Most mapping for turfgrass management will be done using aerial photographs, GPS, and GIS.
6. Computer technology has already had an impact on irrigation system design and operation, as well as business recordkeeping.
7. It will have an increasingly persuasive impact on all aspects of turfgrass management.
8. There will be greater emphasis on 4-year degrees.
9. M.S. training will be desirable.
10. Levels of expertise to handle new technology.
11. Higher technology will be a major force because labor costs will need to gradually decrease. Fewer higher skilled employees will be able to manage the golf course with better technology.
12. Computers, geographic information systems, remote sensing, data analysis, decision guidance, etc. will play a greater role. Turf managers will be required to document everything they do.
13. New technology will require better scrutiny by the turfgrass manager, universities, and other institutions will have less time and fewer resources to hold their hand in making decisions.
14. The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities. Also, bio-control agents will require constant monitoring.
15. Superintendents will need skills with the computer. Many/some now have them but do not use them well.
16. While "high tech" is great, the "basics" can never be overlooked. My concern? Too much emphasis on technology.
17. Technology will shape the future. Turf managers must be prepared to use advances in technology.
18. Specifically — water quality, turf nutrition, environmental protection.
19. Soil and water management classes will be increasingly more complex and important to understand to perform our jobs in the future.

20. Computerized control will become more evident throughout the industry. Robotics will soon appear in turf management, perhaps reducing concerns for safety in spraying, equipment operation, etc.
21. Turfgrass has been mowed by reel blade and bedknife technology for over 100 years. We will see laser cutting, water jets, reel against a vortex of arc on improved technology soon? Perhaps.
22. Subsurface irrigation techniques, subair utilization for heating and cooling and aeration of the soil, will become more commonplace. The use of grow lights and fans are changing climate conditions.
23. Technology will be ever changing and will require constant by management and personnel. This too will demand up to date educators that keep abreast of the changes and methods.
24. Technology to expand (example — long distance disease identification). Internet will provide valuable information in day to day operations.
25. Superintendents can share information across the internet.
26. Education and seminars can be experienced through satellite transmission.
27. Managers will need to be continuously in a learning mode because technology will change at an increasingly rapid rate.
28. More team efforts will be required.
29. Managers must keep abreast of technology and developments through continuing education.
30. Must be aware and know how to use technology (computers) and to obtain all types of "then" current information on turfgrass culture and management.
31. Must keep abreast of turfgrass management practices that ensure quality turfgrass in spite of limited resources.
32. Water (potable and non-potable)
33. In other words, produce under severe environmental conditions with limited and often adverse conditions, as well as often limited budgets.
34. Must be efficient.
35. Computer skills a must.
36. New application systems — new packaging (closed systems).
37. More genetic engineering.
38. More testing under real conditions.

39. High technology will be an integral part of every aspect of golf course management, from communications to irrigation systems to spray technology to sophisticated environmental monitoring of every area of the golf course.
40. Computer/technology specialists will be hired by golf courses as an essential part of the maintenance program.
41. Increased technological sophistication of turfgrasses, maintenance, including pest management. May result in well-trained managers and laborers (increase polarization of the workforce).
42. On-site monitors will become more useful. Can result in increased contract management, with highly skilled centralized staffing (again, polarization of the workforce).
43. More opportunities for highly skilled, specialized training and experience in sales/service. A technical hard and software for the turf industry. M.S. degrees very useful here.
44. More consultants will be available to provide education and on-site applied research for managers or groups of managers in a region. Less publicly supported experts. Look for increase in Ph. D.'s in consulting.
45. Technology will be computer-based increasing the need for more sophisticated computer skills.
46. As technology increases, very specific educational courses will be required for the turf manager in order for him (her) to become certified in that particular technique or specialty area.
47. The manager's competency must increase in order to evaluate tests related to water quality, pesticide persistence, IPM, etc.
48. He will be required to attend training in labor management, budgeting, etc.
49. The use of certain equipment will require him to be certified in order for the warranty to be valid.
50. Computer technology will be prevalent in all golf course operations. Computers and GIS systems will adjust mowing heights, fertility and pest applications to changing course conditions.
51. Technology will be so advanced that specialized courses will be offered (via colleges and the web) in such areas as irrigation, pesticide application, maintenance and operation of equipment, soil and plant analysis, etc.
52. Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved.
53. Technology will be so sophisticated and commonplace that every turfgrass manager regardless of level of responsibility will be required to have a minimum of a 2-year degree.
54. More effort on formal and continuing education by all groups will be needed to meet performance expectations.
55. Course curriculum will need to be evaluated more critically and frequently to meet market demands.
56. Turfgrass managers will be forced to keep pace with rapidly changing technology.

57. Turfgrass managers will use consultants extensively to keep pace with rapidly changing technology.
58. Turfgrass managers will use team approaches to deal with the turfgrass management issues, concerns, and changing technology.
59. High tech will give way to experience growing grass.
60. More sophisticated computer controlled equipment will require a higher level of technical competence to both operate and service.
61. Computer controlled irrigation will continue to advance to aid in water conservation.
62. Global positioning system equipment and use of GIS programs will help map maintenance areas on the course and control where nutrient and chemical applications can be made.
63. Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs.

Category III: Availability of Turfgrass Cultivars Comments

1. The number of turfgrass cultivars released will increase with seed companies and sod farms playing a major role and universities a smaller role.
2. The availability of released cultivars will be dependent on seed and vegetative production of turfgrasses.
3. Seed production in yield per acre will be more important to producers and methods to maintain seed yields developed beyond field burning.
4. Results of NTEP trials which will be expanded to more geographic locations will influence marketing decisions.
5. *Poa annua* cultivars will be available.
6. More pest tolerant cultivars of the turfgrasses will be developed through genetic engineering.
7. New cultivars with improved performance potential will continue to become available within the commonly used species; however, the greatest impact is likely to be realized for those species that are not commonly used (e.g. velvet and colonial bentgrasses.)
8. Several universities are adding breeders in the late 1990's. This will greatly increase cultivar availability.
9. There will be more cultivars thus choices for more specific environments and management practices and demands.
10. The number of turfgrass cultivars will continue to increase. However, the number of seed companies will decrease due to alignment with agrichemical corporations.
11. Genetic engineering will produce better varieties requiring fewer pesticides, lower quality water, etc.

12. Seeded varieties will dominate both cool and warm season commercial products. Turf managers will "sweeten" existing stands, improved releases, particularly where a disease or insect pest is involved.
13. Most seed and sod will be grown (produced) under a license agreement with a large agri-chemical company.
14. The acceptance of new turfgrass cultivars will depend on their performance in the field under real world conditions. Except for ryegrass used for overseeding, using a new grass is a huge risk for superintendents.
15. Our industry will have more new grass to choose from than ever before. New grasses mean more sales, more royalties, etc.
16. There is a perception that something new is always better. There will always be a segment of our industry that will want to try something new.
17. The decision on using new cultivars lies mostly with the golf course superintendent and golf course architect. The architects have a lot to say about using or not using new grasses. This role is not to be overlooked.
18. Cultivars will emerge from conventional breeding, transgenic mutation (engineering), radiation technology with vast improvement in pest resistance, adaptation, environmental and physiological stress tolerance (ie. cold and heat tolerance).
19. Improved turfgrass cultivars will have the single most important impact on the industry in the future. Cultivars exhibiting greater heat tolerance, drought, and salt tolerance, resistance to a variety of pests, improved color, density and growth characteristics will be organized.
20. Greater research is need to better enable incorporation of these cultivars into the turf-scape with as little disruption to the playing guest/member as possible.
21. Greater engineering will be commonplace and cultivars adapted to much narrower climatic conditions will be available. Native stock will be incorporated into genetic makeup of some of the cultivars. Perhaps there will be increased emphasis on vegetative reproduction, establishment vs. seed as the requirements become narrower in focus and use.
22. This should be left to private enterprise. The tax payer has no responsibility in this field anymore. Far more new developments will come on board if federal and state institutions are not funded for this work. It is not a tax payers responsibility.
23. Bermudagrasses will move northward with more site and specific uses on individual areas on course.
24. Bentgrasses will move southward with more disease and pest problems.
25. Shade and heat tolerant turfgrasses will be developed.
26. Turfgrasses that require less water will be needed.
27. Turf managers will be required to make more decisions regarding cultivars in the future because many more will be on the market at any one time.

28. Managers will need to know how to evaluate research data and learn how to separate general claims from research data that makes a difference in cultivar performance.
29. Managers will need to become more involved in cultivar testing.
30. Turfgrass cultivars developed through "genetic engineering" will be pest-free, adapted to regional areas, and in some cases just to local environments.
31. New cultivars will be stress tolerant (heat, drought, salinity, cold stress). Also, more wear resistant and adapted to more adverse environmental conditions than today.
32. They also will require less water and less fertilizers.
33. Also, be for more specialized (for specific uses) than today's cultivars.
34. New cultivars will be developed through research (extensive) that takes advantage of yet undeveloped technology.
35. I feel the future of our profession is mostly in the hands of turfgrass breeders.
36. We need varieties that use less water, less fertilizer to hold color, and salt tolerance.
37. The newer cultivars of bermudagrass, "super dwarfs" are a good example of new turfgrasses fitting the needs.
38. Genetic engineering will produce a wide array of new cultivars with tolerance or resistance to specific diseases, pests, and environmental stresses.
39. Cultivars will be developed for regional needs and specific uses, such as quick transition overseeding grasses.
40. Non-traditional grass species will be developed for turf use — grasses that have drought tolerance, salt tolerance, or pest resistance.
41. Biotechnology will have made significant contributions to new grasses (in addition to continued traditional breeding programs).
42. More regionally-specific grasses — for climate, soils, use in a locale.
43. Grasses available for recreation, aesthetics, function — not necessarily the same grasses.
44. Managers will select, or be involved in the selection.
45. With genetic engineering, the availability of cultivars will increase.
46. Cultivars will be developed for specific conditions and uses which may enhance the role of the turf manager as to choice of culture.
47. New turf cultivars will be released annually and utilized immediately.
48. The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents.

49. Herbicide resistance will be the norm for several species such as creeping bentgrass.
50. Genetically engineered plants will be the norm in 20 years. Biotechnology will give us cultivars that will change the way we manage turf from pest control methods to cultural practices. The downside of this new technology is that a few companies will monopolize it.
51. Approximately ten to twenty new grass species never before used for turfgrasses will be available to the turfgrass manager.
52. Turfgrass cultivars will be developed for specific uses, including low and high temperature stress, salinity, shade, traffic, etc.
53. The turfgrass manager will be faced with the challenge of knowing and understanding the unique characteristics of all available turfgrass cultivars which will number into the thousands.
54. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass (use in 33 also).
55. Gene technology will force the turf manager to make hard choices on his management practices — i.e. cost vs. Benefit.
56. Numbers of cultivars available to the turfgrass market will decrease.
57. Fewer seed companies will exist.
58. Cultivars will be region, pesticide and management specific.
59. Turf cultivars will continue to be released, but most will be adapted to regions, not entire U.S.
60. More cultivars than ever will be available.
61. Not all cultivars will perform well at all regional locations.
62. More genetically transformed cultivars will allow cultivars to be developed for resistance to specific pest problems and regional adaptation.

Category IV: Turfgrass Management Services Comments

1. More professional consulting services will be available to golf courses and athletic field areas.
2. Use of specialized equipment (e.g. cultivation) will be through services due to cost of equipment and interval of use.
3. Specialized services (hydromulching, verti-draining, etc.) Will become more popular than they are now.
4. It will increase, but the individual, on-site superintendent will continue to be the core of the industry.
5. There will likely be more consolidation of courses under management firms that will place their own superintendent on site.

6. Again there will be more offering specific input into turf management and equipment management.
7. Regulations may force contracting of more services.
8. Turfgrass management services will increase. They will range from custom application of products to golf courses through home lawns.
9. Documentation required to make pesticide applications and applicator licenses will make many turfgrass managers turn to management services.
10. The "private club" will turn to management services because members no longer will want to spend the time or money to manage the golf course.
11. Pest scouting and ecology services will increase to meet environmental regulations.
12. Much depends on the availability of labor. If labor is tight, then the use of outside contractors will become much more common. This is occurring even today.
13. Management companies which operate courses as a business will (in my opinion) manage more and more courses in the future. Especially, if there is an economic downturn. These companies that manage about 10% of courses today.
14. As our industry becomes both more technical and demanding, more consultants will be used by superintendents. They will pay people they trust to help them make decisions.
15. There will be more contracted services available and they will be widely used to reduce labor, equipment, staff risks to pesticides, and budgets.
16. Turfgrass management services/companies will offer the golf course superintendent additional opportunities to grow in professionalism and up the ranks through management firms — assistant superintendents, superintendents, superintendents at multiple courses, certified superintendent, director of agronomy, executive of the firm, etc.
17. Contractual services for aeration, fertilizer and pesticide application, renovation and construction will be much more common.
18. Avoidance of professional burnout may be assisted by virtue of having further avenues for utilization of the talents developed by our profession.
19. Greater consolidation of mismanaged clubs will continue.
20. Private turfgrass consultants will be useful but in-house competent turfgrass managers who are well trained will be important and the consultant will be available mostly on an as needed basis.
21. Private consultants will be more useful than extension-type people.
22. Turfgrass management services will definitely increase more so in non-private courses.
23. Contract labor will be a factor.
24. Contractual management services will be standard by 2020.

25. Contractual management services will lower management costs and lessen liability expense.
26. Management services will grow because they will have capital to acquire and use the equipment, materials, and other necessary supplies developed by the commercial segment of the industry.
27. The necessary equipment and materials will cost more.
28. Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered.
29. Also, EPA restrictions will be such that many homeowners will not meet qualifications to take care of their lawns — another loss of American freedom.
30. I am contracting out some things such as verticutting but prefer an "in-house" approach to fertilization and chemicals.
31. I do feel we will see an increase in contracted services.
32. Contract maintenance of golf courses will be the rule rather than the exception.
33. Contract services will increase as technology and legal restrictions increase.
34. Contracted services of all kinds will proliferate over the next 20 years.
35. Custom fertilizer and pesticide applications will continue to increase.
36. Custom aeration will increase in order to speed the process.
37. Overall management companies will not likely change. This tends to be cyclic.
38. New technologies developed for the information age will be available to turfgrass managers through the Internet. The new consultants and information on products and management practices will be on web pages.
39. Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology.
40. Pesticide and fertilizer application will only be available on a contractual basis and performed by individuals licensed by the federal government.
41. Turfgrass management services will continue to rapidly grow until it reaches a level when cost savings vs individual long-term commitment will be balanced.
42. Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis.
43. The business will level off in many parts of the country due to water shortages.
44. Contract maintenance services for everything from core cultivation to fertilization and pesticide applications will increase in use.

45. The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from applications and partly driven by an effort to reduce capitol expenditures on seldom used equipment.

Category V: Legal Issues Comments

1. Private and commercial applicators of nutrients will require licensing.
2. Nutrient management plans will need approval to help control inappropriate applications.
3. Records of application will be required indicating specific product information, application rates, environmental factors, and related site information.
4. Greater emphasis on professional certification of superintendents, assistants, and maintenance personnel with respect to pesticide handling, equipment operations, and general qualifications.
5. Environmental issues, including restrictions on fertilizer and pesticide use will continue to impact the industry.
6. The value of certification and licenses should increase.
7. This may dictate more contracting to licensed or trained individuals.
8. Legal issues will be the driving force in environmental and labor problems facing turfgrass managers. Liability for actions taken by turf managers will require more licensing, certification, etc. or insurance companies will drop the facility.
9. Applying pesticides will be a more difficult task requiring permits, justification, environmental impact, storage, etc. It will be the law.
10. Sexual harassment. Yes, it is happening now. It will only get worse as our industry integrates more females into the operation of a course.
11. Liability. All types. Hearing loss (due to operating loud equipment), back problems (from lifting), cancer (especially skin cancer), once it starts ...
12. Chemical Usage. Not using products according to the label.
13. Re-entry into treated courses by golfers and crew members. Heck, we continue to relive Lt. Pryor's story .. and that was over 15 years ago.
14. Water quality — managers will be required to sample water in lakes, streams, and wells associated with the property managed.
15. All workers will be required to be certified.
16. The golf course superintendent will be forced to be increasingly aware of risk management issues, such as legal aspects of equipment training, personal protective equipment, ADA issues, union workplace violence, hiring and firing issues, contract management, sexual harassment, environmental compliance, safe work practices, management of walking surfaces, tree liability, lightning.
17. Worker safety will be placed on an equal level with efficiency, productivity, cost control, etc.

18. The superintendent will be morally and perhaps legally required to facilitate adequate medical assistance to guests/members when necessary — eg. primary first aid, cpr, defibrillation, etc.
19. If the present litigious apiril continues, turfgrass managers will need to be constantly aware of problems in the area. More than likely, attorneys with expertise in this area will become available they can periodically address conferences and turf management schools. Additionally, be available for consultation on special issues.
20. Legal issues will drive management services into the market more rapidly.
21. Water will become more of an issue.
22. Worker protection will be more of a priority.
23. Environmental (water, pesticide and fertilizer) issues.
24. Genetically engineered and patented turfgrass cultivars.
25. Land use issues.
26. An increasing demand for environmental concerns — humans, wildlife, soil (productive), limited water supplies.
27. Safety factors on playing fields, litigation associated with poor playing fields will dictate need for intensive training, careful licensing, and monitoring of results by various committees and boards, most of all who will be totally uninformed about turfgrass care and management.
28. Federal, state, and municipal agencies will establish rules and regulations that will severely restrict normal maintenance practices, especially use of pesticides.
29. Certification and licenses are already here. Next step is risk management and safety.
30. Newer challenges for us are to know and understand preventive risk management — such issues as discrimination in hiring, promotions, firing; sexual harassment, safety will need better understanding of how to prevent law suits, insurance premiums, and citations.
31. Will need to establish and maintain a preventive risk management plan for loss, claims, and law suits.
32. Compliance with environmental, employee, and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues.
33. Use of pesticides, use of natural resources such as water, petroleum products, etc, and use/fate of fertilizers will form basis of legal issues, through regulations that will inspect turf managers.
34. Most of the legal issues will revolve around litigation with respect to safety issue. Athletic field conditions will be the focal point.
35. Environmental issues will continue to be at center stage.
36. Professional certification will not likely have much more influence than the present.
37. Certification for specific product usage, ground water protection, etc. will have a major impact.

38. The required certification and licenses will greatly increase for new construction projects.
39. Legal issues will evolve around the urban/rural interface and the role of golf courses in this battle (where do golf courses fit?)
40. As mentioned in #1, all turfgrass professional associations will have very sophisticated certification programs that will require a minimum of at least a 4-year degree and 5 years on the job experience before the certification exam can be taken.
41. All turfgrass personnel regardless of level will be required to have a license to operate various pieces of maintenance equipment.
42. Only individuals with specialized courses or certificates in the safe handling and use of pesticides in conjunction with the satisfactory completion of a federally administered written and practical exam will be licensed to apply pesticides.
43. Environmental compliance and associated cost will challenge the cost of operating clubs at members expectations.
44. Certification of turfgrass managers will be a requirement with specific continuing education requirements in order to prepare, write, and implement "BMP's," nutrient management plans, and apply prescription pesticides.
45. The turfgrass industry and turfgrass managers will be a highly regulated industry and profession, particularly as it relates to human and environmental safety issues.

Category VI: Chemical Issues Comments

1. Fewer pesticides will be available for use due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs.
2. Environmental consequences of agri-chemicals will become more important concerns than in the past (as well as human safety.)
3. Legislated restrictions on their use will be the primary problem the industry faces.
4. Availability and use of fertilizers and pesticides will likely be under more critical observation from the general public and turfgrass management teams in the future.
5. Grasses will be developed to allow for fewer inputs of this type.
6. Chemical issues will play an important role in turf management, especially in the high-density urban environment.
7. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs. Chemical issues will put pressure on the users of turf facilities to accept a more reasonable level of maintenance.
8. Bio-control will increase and turf managers will need to understand how to use these products in association with chemicals.

9. I hope not... pray, we do not have the radical environmentalism problems seen in Europe with the "greens." Nonetheless, more scrutiny will no doubt occur.
10. Re-entry of treated areas.
11. Even though the USGA, land grant colleges, and others are showing that runoff, ground water pollution, etc. are not the problems some expected, these concerns will always be issues.
12. Chemicals and how they affect people, wildlife, and our pets. Always concern about chemicals causing ... cancer.
13. Reduction in number of pesticides available.
14. Recordkeeping and storage regulations will be stressed.
15. Managers will have to use cultivars which are tolerant of pests.
16. Increased monitoring of surface and subsurface water, air, and soil will be required to evidence benign contamination from our practices.
17. Biologicals will be utilized in greater quantities.
18. But most importantly, new cultivars of turfgrasses will be utilized to produce playing conditions desired by the golfer with less manipulation on the hand of the superintendent.
19. A better understanding of some of the final effects of some of the pesticides will be understood and/or programs will reflect this improved awareness.
20. Knowledge in this area is important. The price of and the environmental concerns will demand knowledge in this area. Educators will render a valuable service, but they must be well informed in this field.
21. Pesticides will be developed to reduce the amount of pesticides used (ie. Lower rates).
22. Pesticides will be more specific.
23. More organic or natural occurring products will be developed.
24. Pesticides will continue to be watched closely.
25. Fertilizer use will be under strict control.
26. Biological control and cultivars that require less fertilizer and pesticides will become more popular.
27. Restrictions by all governmental and environmental agencies will dominate turfgrass and all agricultural crops. Many will make sense to knowledgeable practitioners.
28. Research by credible universities and industry must be accepted and followed.
29. Production of new cultivars as noted will help reduce chemical inputs.
30. There may be less demand for fertilizers and pesticides due to pest resistance and low fertility grasses.

31. This in turn will mean fewer research dollars by chemical companies, thus fewer new products. Which may mean that chemical technology may not develop at a rate to keep abreast of needs.
32. More foliar fertilizers, more slow release fertilizers.
33. Less and less chemicals with more being safer and specific to a target, such as Merit.
34. Better understanding of how minor elements affect turfgrass health.
35. More sampling and monitoring with better application systems.
36. Environmental monitoring of lakes, streams, underground aquifers, and off-site impact will be routine.
37. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type. Bio-controls will be more prominent than they are today.
38. Sample statement is correct — Availability and use of fertilizers and pesticides will likely be under critical observation from the general public and turfgrass management teams in the future.
39. Best management practices will be more universally practice to reduce inputs.
40. New grasses will have a very large impact on the reduction of chemical use.
41. In twenty years, the use of management inputs to turf will have decreased to the point where general public concern will be less than it is today.
42. We will lose many of the synthetic pesticides that we now have.
43. More organic and low active ingredient rate products will be available, but they will have a very specific use.
44. Fertilizer technology will not change, but much more “spoon-feeding” will be practiced.
45. From an environmental standpoint golf courses will be using compounds that are “safe” in the environment and have minor environmental impact due to extremely low concentrations. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars. Composts will lose interest, again due to the new genetically engineered cultivars.
46. There will be specialized bio-controls for almost all aspects of pest control in turfgrass management.
47. There will be very limited availability of pesticides for managing turfgrasses.
48. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass (use in #3 also).
49. Only federally licensed applicators will be allowed to handle and apply pesticides.
50. A minimum of 2-weeks notice will be mandated before the application of any pesticide.
51. FQPA, state regulations, local regulations will continue to drive the cost of chemicals and fertilizers higher.

52. Conversely, patent expiration of current brands will reduce cost of individual products but drive research to more innovative solutions.
53. Turfgrass chemicals and their use will be highly regulated, particularly as they relate to human and environmental safety issues.
54. Fewer turfgrass chemicals will be available to the industry and these materials will be very specific in their application and use.
55. Pesticides will be associated with cultivars that have specific adaptation to their use.
56. Biological pest management as a part of the total cultural practices system will be commonplace.
57. Pest resistance to pesticides will become more and more of an issue.
58. Concerns on liability with ground water contamination.
59. Concerns over use for a potential public contact and health issues related to efficient water use.
60. More regulation not less including licensing of turf managers to apply nutrients.

Category VII: Environmental Issues Comments

1. The fate of pesticides (fungicides, herbicides, insecticides, nematocides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program.
2. There will be greater concern for the environmental benefits from turfgrass across the cultural scheme from low to high maintenance.
3. Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass.
4. A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, and exotic species preservation.
5. Restrictions on pesticide use.
6. Surface water quality.
7. More use of treated water and less potable water.
8. More efficient use of water, nutrients, and fertilizers.
9. Using genetically-engineered ... anything. I'm not concerned but ... environmental radicals are raiding fields of genetically-engineered crops in Europe. What they do there may (I hope not) happen here.
10. Using potable water on grass when people and industry (jobs) need it. Water issues in general.
11. Using chemicals which may pollute, cause cancer, etc., etc., general chemophobia issues.
12. Cutting down trees - "tree hugger" issues.

13. The environmental issues of greatest concern will be 1) use of scarce water resources, 2) pollution of water resources, 3) loss of natural areas, and 4) effects of golf courses on people and wildlife.
14. Bio-remediation of polluted soils, lakes and streams.
15. Use of BMP's to prevent pesticide runoff and leaching.
16. Use of pesticides which are effective at ultra small rates.
17. Conservation of soil, water, and wildlife habitat will be a standard practice.
18. Water, the use of open space (habitat encroachment), fertilizers and pesticides will continue to be at the forefront of environmental concerns.
19. Golf has an opportunity to be a positive influence on wetland recovery for the country.
20. Golf has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow.
21. Water will continue to be increasingly less available and important to protect from contaminants.
22. Local issues need to be addressed in a conscientious and forthright manner, eg. Saving endangered species, protection of habitat renewal.
23. Greater emphasis will be placed on control of invasive, non indigenous species within local areas.
24. More than likely environmental issues will be stronger than now. Hence, golf course managers are going to have more and more responsibility in this area. Familiarity with the environmental requirements will be a must. Turf management schools will also need to be able to convey these requirements to students.
25. Less water usage.
26. Smaller acreage of turfgrasses, more natural areas.
27. Detection of minute pesticides will be traceable.
28. All of the above will put pressure on the superintendent.
29. Water use and quality will be #1.
30. Fertilizer use will be #2.
31. Pesticide use will be #3. (Not because it is less important, but because there is more control now).
32. Water usage — potable and non-potable. Water restrictions on use by green spaces, result of increased amounts needed for crop production and human needs.
33. Marginal soils for development of turfgrass areas — golf courses, sports fields — means additional cost to develop.
34. Lack of public relations — turfgrass industry speaks only to itself.

35. Increasing demand for green spaces may restrict development of golf courses, parks, sports fields, placing greater demand on limited facilities — which means need for more intensive turfgrass culture with its attendant need for more fertilizer and pesticides.
36. Pest-free, stress tolerant grasses will not be planted “overnight.”
37. Chemical pesticide use.
38. New packaging methods.
39. New application systems.
40. Water use will be the single largest environmental issue over much of the country. Lower-risk pesticides can be developed, but there is a finite amount of reasonable-quality water with a growing population that is placing greater and greater demands on this resource.
41. How the turf industry can positively or proactively influence environmental issues, such as bioremediation, habitat enhancement.
42. Negative concerns of “fate” will have been solved.
43. How to provide the needed turf award with the lowest input of natural resources and dollars.
44. The public perception, a environmental issue, ie. Turf must be based on facts, so public information programs should be mature by 2020.
45. Water quality will be the continuous environmental concern. Water quantity will become a more important issue in some areas of the country.
46. Land use and environmental stewardship will be a force.
47. Ground water and surface water monitoring will be required for all large turf areas.
48. Maintaining wildlife habitat will be required for large turf areas.
49. The use of pesticides will be monitored from the standpoint of wash areas and public health.
50. Water quality and use restrictions will be the hot topic. Southern grasses will be bred for sodium tolerance.
51. Regulatory compliance and the associated paperwork will compete with managing turf and people for the turf manager.
52. Quality people to infused new blood in the turf industry.
53. Water quality issues will be a major concern for turfgrass managers.
54. Chemical trespass (i.e. drift, volatilization, surface runoff, etc.) will be a major focus of the public and environmental regulations.
55. Water shortages.
56. Water quality management and protection.

- 57. Water conservation.
- 58. Air quality protection.
- 59. Water quality management and protection.

Category VIII: Best Management Practices Comments

- 1. Turf managers will be responsible for developing and implementing an appropriate nutrient management program.
- 2. Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs.
- 3. Turf managers will prefer growing grass on sandy soils.
- 4. Turf managers will be expected maintain desirable soil physical properties as a result of implementing best management practices.
- 5. While BMP's have become popular within the agricultural community, I believe that this simplistic approach will be supplanted by the development of a "systems" orientation within which unique solutions to complex problems will be employed.
- 6. Integrated programs that emphasize management steps to improve turf quality with limited pesticide use will be the primary emphasis.
- 7. Sunlight and shade issues. The basics. Turf growing in shade and/or pockets of poor air circulation is always weaker and more disease-prone than grass growing in the same soil located in full sun and air circulation.
- 8. Water management. In my opinion, golf courses continue to be overwatered, using the water we have better (more efficiently).
- 9. Drainage. The importance of good drainage for turf maintenance is usually overlooked. Nonetheless, to grow grass between dust (irrigation) and mud (drainage). You also cannot play golf (that's why we are here) or mow grass when the soil is saturated and poorly drained.
- 10. A balanced approach to managing grass. Moderation, the proper amounts of water, fertility, and plant protectant chemicals, reasonable mowing heights, green speeds, etc.\
- 11. Irrigation management practices will be critical to more efficiently use water resources and protect surface and ground water.
- 12. Pesticide use will come only after the steps in IPM are followed. Curative rather than preventive application for insects and diseases.
- 13. Pest scouting will be required before pesticides are applied. Increased monitoring of the weather and climate favorable to pests will be required.
- 14. The use of site-specific management and remote sensing will increase. Variable rate fertility will be commonplace.

15. Use of less water — recycled irrigation water, use of effluent water, reduction in total water use. Development of irrigation practices to avoid leaching and runoff.
16. Mowing — use of growth regulators to reduce mowing and soil compaction.
17. Use of non-polluting electric motors on much of the equipment.
18. IPM — to maximize pest control with minimum application of herbicides, insecticides, fungicides, and nematicides.
19. GIS and GPS technology applied with scouting techniques will enable pinpoint accuracy for turfgrass treatments.
20. Infrared spectrometry, tissue culture analysis, etc. will be coupled with computer technology for improved diagnostic and prediction models.
21. Cad-based GIS/GPS mapping of golf course sites will be common. Water flow and potential environmental impact predictions will precede fertilizer and pesticide use.
22. Biologicals will continue to replace need for synthetic pesticides.
23. A better understanding of the entire ecosystem surrounding the golf course will occur allowing us to make better informed decisions regarding our maintenance practices.
24. All the foregoing. But the management of golf course personnel will be most important. Knowledge of all methods, chemicals, equipment, water management, and fertilizers.
25. Best management practice will be a major factor in the way we manage golf courses. However, they must be written for site-specific areas of your course.
26. More use will be made of modeling. Best management for a specific site will be determined by considering climate, soil, rainfall, required turf quality, cultivars, etc. data bases. Array of data for different situations.
27. Establishing limits for tolerance of pests and condition of turf by facility personnel conducive to BMP may at a level substantially higher than today's standards — height of cut (higher), tolerance for pest infestations — weeds, diseases, insects.
28. Reduced levels of fertilizer and pesticides. This may mean lower quality of turf and acceptance of "brown" rather than "green" turfs.
29. Precision application of fertilizers, mowing, pesticides, water will be standard. Only those areas needing treatment will be treated. Sensing and precise treatment will be in order.
30. Low input sustainable turfgrass management will be the key.
31. Anyone who feels that member expectations and standards are going to go down is out of touch with reality. They will continue to go up. We will therefore need to keep producing more and more using less and less.
32. BMP's that accommodate greater use of low-quality water will become more critical as time passes.

33. BMP's that reduce our dependence on pesticide will be essential.
34. BMP's that treat run-off water via physical, chemical, and biological processes will be developed and used.
35. All are limited, as in a chain, however the solution of plant material will be of vital importance, because of changes in that area presently and in the near future.
36. Water — water use, appreciation of maintenance of quality will be of very high importance.
37. Pest management — many problems will be solved through grass selection and culture. Need for a continued pressure to reduce use of pesticides. When used, pesticides must be "friendly."
38. Using appropriate portions of the landscape as buffers within the ecosystem will be more common.
39. Turfgrasses will play a major role in the planning process for development of undisturbed watersheds.
40. There will be some legal requirement for the use of BMP's.
41. There will be some relaxation on demands for quality as related to decrease dependence on pesticides.
42. BMP's will likely increase in order to cut maintenance costs.
43. Best Management Practices or Integrated Pest Management will no longer be a voluntary practice in twenty years. The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow.
44. IPM will continue to play a major role as a best management practice.
45. Training and development of personnel will be a key to best management practices.
46. Nutrient management will be regulated and turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented.
47. Prescription pesticides will be a part of best management practices.
48. Growing grass with less water.
49. Land use controls to retain surface and sub-surface drainage on-site will be an integral part of golf course design. Some of the structural BMP's will require some level of maintenance.
50. Source prevention BMP's such as soil and plant tissue testing as part of nutrient management strategies will be more widely used.
51. More research will discover whether cultural practices such as aeration or thatch control or use of specific types of buffer systems or types of vegetation.

Category IX: Other Issues and/or Circumstances Comments

1. Turf managers will be expected to identify and implement the best use of time for professional development.
2. Turf managers will be more critically evaluated on which conference to attend and how many each year.
3. Turf managers will be more critically evaluated on which professional associations, trade journals, short courses, an how many.
4. Turf managers will be more critically evaluated on the best use of available funds in professional development.
5. Turf managers will be more accountable in financial support to foundations, universities, and other organizations — both personal and employer funding.
6. Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) At the local, state, national, and international levels.
7. Budgeting and resource management have always been important; however, optimization of resource use will be emphasized more in the future.
8. The demand for accredited educational programs that can be delivered to people who are employed full-time will increase.
9. Resource management from ecological aspects, wildlife, etc. will be even more important.
10. Bio-controls. The sense that things which are "natural" are somehow better. Better understanding both the promise and limitations of bio-control products, high expectations yet marginal or erratic performance at high costs.
11. Economic recession. We have a history of economic "booms and busts." There will probably be another recession. Our industry will be affected, lower budgets, some golf course foreclosures, etc.
12. Labor issues. More ethnic minorities work on courses, bilingual superintendents will be more common. Our industry has always relied on the bottom of the labor barrel. Today these are workers from outside the USA.
13. The demand by golfers for better and better golf courses. In my opinion, most golfers will not accept bad grass on the courses they play. I believe high expectations will continue into the future.
14. Public access to sports facilities will become a problem unless more economic turf management practices are implemented. This is especially true for golf.
15. The role of ecology, landscape restoration or preservation will make it increasingly difficult to develop land with sound management and long range planning.
16. Increased labor costs will decrease the number of people taking care of facilities, more automation.

17. Hardness of playing surface on sports fields.
18. Use of more soil amendments to improve root zone environment.
19. Turf managers will spend more time keeping records and in public relations.
20. Scheduling for successful maintenance will become critical as play increases. Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of guest/member.
21. Alliance and coalition building within the golf associations green industry professions must take place. Efforts in coordinate needs with other like industries should be undertaken, eg. Ski industry, etc.
22. Public relations programs for the turf management program will continue to improve.
23. Certification requirements will continue to be more stringent separating the truly skilled superintendents from his/her peers.
24. A superintendent with inadequate training or skills will readily be distinguished/separated from the skilled superintendent.
25. I have not previously addressed budget issues. The cost of operations are necessary for the golf course managers, and he must be mindful of the bottom line with rising price and additional competition. The manager who can operate the most economically will be in demand.
26. Cost to maintain courses must level off to be affordable.
27. More minorities and women to demand tee times.
28. Cultivar identification and legal use.
29. Recordkeeping and documentation.
30. Most have been covered in 1-8.
31. Equipment should be covered.
32. Mowers will be quieter, easier to operate, safer, many will be electric; and many will operate on energy sources different from today's gasoline and diesel engines.
33. Precision turf management will be standard.
34. Robotic mowers will be commonplace in 2020.
35. Shear and impact (reel and rotary, respectively) will remain basic manner for mowing.
36. Laser and other cutting methods will remain to expensive and produce unsatisfactory cutting units.
37. Technical skills will not be enough. Course managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, public relations, image management, member relations, and community relationships.

38. They will need to be planners, organizers, motivators, coordinators, evaluators, good purchasers, and good budget preparers.
39. Information availability will transform the way turf managers solve problems and handle daily operations.
40. Importance of grasses to people and their habitats, from a psychological and sociological perspective. Where grasses "must be used" in man's planned landscape for man's well-being and health.
41. Can we continue to reduce the dependence on non-renewable resources and increase our use of renewable or sustainable resources?
42. Can we not only be good stewards of our environments but positively add to our environments through proactive practices?
43. The state of the overall economy (particularly global) will always impact in a major way on the circumstances that weigh-in on turfgrass management.
44. The salary for labor will greatly increase.
45. More Hispanics will be employed in every U.S. location and Hispanic-specific training will be necessary.
46. As budgets increase, more emphasis will be placed upon computer technology, financial management, and training for the manager.
47. Cost of playing golf vs. other leisure activities.
48. Drive by corporations to increase productivity will reduce time and energy for leisure activities.
49. Water quantity and quality will be a limiting factor to turfgrass management.
50. Turfgrass managers will rely on consultants to assist in their decision making, due to rapid changing technology.
51. Training golf course superintendents to become club managers.
52. There will be increased instances of veteran superintendents being replaced by younger less experienced people who will work for less money.
53. There will be a need for even more specialized staff positions- i.e. electrical mechanics that can diagnose and repair more high tech equipment.

Appendix H
Review Draft of Instrument
from
First Round Comments

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

Directions: The following statements were developed from input you and other panelists provided on the first instrument circulated in February, 1999. The term, industry, as used in the title, refers to the whole of activity in the turfgrass profession. The purpose of this instrument is to determine whether or not these statements describe the turfgrass industry of the year 2020 in the United States. Please indicate your level of agreement or disagreement with each statement by circling the response at the end of each statement that best reflects your opinion. Approximate completion time is one hour.

Response Levels:

| | | |
|----|---|-------------------|
| SD | = | Strongly Disagree |
| D | = | Disagree |
| U | = | Undecided |
| A | = | Agree |
| SA | = | Strongly Agree |

Section I: Personnel Education and Staff Development

- Admission into the two year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management. . . . SD D U A SA
- An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions. . . . SD D U A SA
- All professional turfgrass-related associations will have well established certification programs for turfgrass professionals. . . . SD D U A SA
- Turfgrass managers will not be eligible for certification without at least a 2 or 4-year degree in an area of plant or soil sciences. . . . SD D U A SA
- Continuing education will be required for all professional turfgrass managers because of the rapid pace of change in the turfgrass industry and the commitment to lifelong education. . . . SD D U A SA
- More emphasis will be placed on business and human resource management for turfgrass managers. . . . SD D U A SA
- More emphasis will be placed on meeting the requirements of the many environmental regulations. . . . SD D U A SA
- More training will be available "on line" which should give turf managers better access to information on turfgrass management. . . . SD D U A SA
- Knowledge in and use of the Spanish language and culture will be needed by turf managers. . . . SD D U A SA
- All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides. . . . SD D U A SA

Comments on Section I:

Section II: Technology

- Computers will play a major role in the educational, decision-making, and recordkeeping processes of the turf manager's job. SD D U A SA
- More sophisticated equipment will be available for the maintenance of turfgrass sites. SD D U A SA
- Most mapping for turfgrass management will be done using aerial photographs, GPS, and GIS. SD D U A SA
- New technology will require improved critical thinking and problem solving skills in the turf manager. SD D U A SA

- | | | | | | | |
|-----|--|----|---|---|---|----|
| 15. | The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities. | SD | D | U | A | SA |
| 16. | Computerized control will become more commonplace throughout the turf industry with robotics reducing current concerns for safety in equipment operations. | SD | D | U | A | SA |
| 17. | Laser mowing will become an integral part of improved technology. | SD | D | U | A | SA |
| 18. | Water jet aeration will become a greater part of improved technology. | SD | D | U | A | SA |
| 19. | Subsurface irrigation techniques will become more commonplace. | SD | D | U | A | SA |
| 20. | Sub-air utilization systems and practices for heating and cooling and aeration of the soil will become more commonplace. | SD | D | U | A | SA |
| 21. | Computer technology specialists will be hired by golf courses as an essential human resource element in the maintenance program. | SD | D | U | A | SA |
| 21. | More consultants will be available to provide education and on-site applied research for turf managers in a particular region. | SD | D | U | A | SA |
| 23. | Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved. | SD | D | U | A | SA |
| 24. | Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs. | SD | D | U | A | SA |

Comments on Section II:

Section III: Availability of Turfgrass Cultivars

- | | | | | | | |
|-----|---|----|---|---|---|----|
| 25. | Seed production in yield per acre will be more important to producers. | SD | D | U | A | SA |
| 26. | <i>Poa annua</i> cultivars will be available. | SD | D | U | A | SA |
| 27. | More pest tolerant cultivars of the turfgrasses will be developed through genetic engineering. | SD | D | U | A | SA |
| 28. | New cultivars with improved performance potential will continue to become more available. | SD | D | U | A | SA |
| 29. | New cultivars will require a broader understanding of specific environments and cultural practices employed. | SD | D | U | A | SA |
| 30. | Seeded varieties will become more dominant in both cool and warm season climates. | SD | D | U | A | SA |
| 32. | Most seed and sod will be produced under a license agreement with a large agri-chemical company. | SD | D | U | A | SA |
| 33. | The acceptance of new turfgrass cultivars will depend on their performance in the field under real-world conditions. | SD | D | U | A | SA |
| 34. | Improved turfgrass cultivars will have the single most important impact on the industry in the future. | SD | D | U | A | SA |
| 35. | Cultivars exhibiting improved color, density, and growth characteristics will be available. | SD | D | U | A | SA |
| 36. | Bermudagrasses will move northward with more specific uses in the environment. | SD | D | U | A | SA |
| 37. | Bentgrasses will be used further south with more disease and pest problems. . | SD | D | U | A | SA |

38. Shade and heat tolerant turfgrasses will be developed. SD D U A SA
39. Turfgrasses that require less water will be needed. SD D U A SA
40. Turf managers will need to know how to evaluate research data. SD D U A SA
41. Turf managers will need to better distinguish between general claims and research data that makes a difference in cultivar performance. SD D U A SA
42. Turf managers will need to become more involved in cultivar testing. SD D U A SA
43. Turfgrass cultivars developed through "genetic engineering" will be adapted to regional areas. SD D U A SA
44. New cultivars will be more stress tolerant (heat, drought, salinity, cold stress). SD D U A SA
45. New cultivars will be more wear resistant. SD D U A SA
46. New cultivars will be adapted to more adverse environmental conditions. SD D U A SA
47. Biotechnology will make significant contributions to new cultivars. SD D U A SA
48. The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents. ... SD D U A SA
49. Herbicide resistance will be the norm for several species of turfgrasses. SD D U A SA
50. Genetically engineered cultivars will be the norm in 20 years. SD D U A SA

Comments on Section III:

Section IV: Turfgrass Management Services

51. More professional consulting services will be available to golf courses and athletic field areas. SD D U A SA
52. The use of specialized equipment in secondary practices (e.g. cultivation) will be through services, due to cost of equipment and interval of use. SD D U A SA
53. Specialized services (hydro-mulching, verti-draining, etc.) will become more popular than they are now. SD D U A SA
54. Services will increase, but the individual on-site superintendent will continue to be the core of the industry. SD D U A SA
55. There will likely be more consolidation of golf courses under management firms that will place their own superintendent on site. SD D U A SA
56. Regulations may force contractual services for aeration. SD D U A SA
57. Regulations may force contractual services for fertilizer and pesticide application. SD D U A SA
58. Documentation required to make pesticide application and applicator licenses will encourage many turfgrass managers to contract management services. ... SD D U A SA
59. Pest scouting will increase to meet environmental regulations. SD D U A SA
60. Ecology services will increase to meet environmental regulations. SD D U A SA
61. There will be more contracted services available which will reduce the need for labor and will reduce staff risks to pesticides. SD D U A SA

62. There will be more contracted services available which will reduce the need for equipment and adjust the budget that the superintendent must plan. . . . SD D U A SA
63. Turfgrass management companies will offer the golf course superintendent additional opportunities to grow in professionalism. . . . SD D U A SA
64. Contractual management services will be standard by the year 2020 which will lower management costs and lessen liability expense. . . . SD D U A SA
65. Management services will grow because they will have capital to acquire and use the equipment, materials, and other necessary supplies. . . . SD D U A SA
66. Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered. . . . SD D U A SA
67. Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology. . . . SD D U A SA
68. Chemical (pesticide and fertilizer) application will only be available on a contractual basis and performed by individuals licensed by the federal government. . . . SD D U A SA
69. Turfgrass management services will continue to rapidly grow until it reaches a level when cost savings vs individual long-term commitment will be balanced. . . . SD D U A SA
70. Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis. . . . SD D U A SA
71. The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from pesticide applications and partly driven by an effort to reduce capitol expenditures on seldom used equipment. . . . SD D U A SA
72. The use of contract maintenance services will be partly driven by an effort to reduce capital expenditures on seldom used equipment. . . . SD D U A SA

Comments on Section IV:

Section V: Legal Issues

73. Nutrient management plans will need approval to help minimize inappropriate applications. . . . SD D U A SA
74. Records of application for all chemicals will be required, indicating specific product information, application rates, environmental factors, and related site information. . . . SD D U A SA
75. A greater emphasis on professional certification of superintendents, assistants, and maintenance personnel (with respect to pesticide handling, equipment operations, and general qualifications) will be recognized. . . . SD D U A SA
76. Environmental issues, including restrictions on fertilizer and pesticide use, will continue to impact the industry. . . . SD D U A SA
77. Legal issues will be the driving force in environmental and labor problems facing turfgrass managers. . . . SD D U A SA
78. Liability for actions taken by turf managers will require more licensing and certification or insurance companies will cancel the facility's policy. . . . SD D U A SA
79. Applying pesticides will be a more difficult task, requiring permits, justification, environmental impact, storage, etc. . . . SD D U A SA

80. Sexual harassment will be a major issue as more females are employed in turfgrass maintenance. SD D U A SA
81. Liability issues will include hearing loss due to operating loud equipment, back problems from lifting, and cancer (especially skin cancer). SD D U A SA
82. Turf managers will be required, on a regular basis, to sample water in lakes streams, and wells associated with the property managed. SD D U A SA
83. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with equipment training and personal protective equipment.. SD D U A SA
84. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with union workplace violence and hiring and firing issues. SD D U A SA
85. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with contract management, sexual harassment, environmental compliance, safe work practices, walking surfaces, and tree liability. SD D U A SA
86. Worker safety will be placed on an equal level with efficiency, productivity, and cost control. SD D U A SA
87. Federal, state, and municipal agencies will establish more rules and regulations that will severely restrict standard maintenance practices, especially the use of pesticides. SD D U A SA
88. Turf managers will need to establish and maintain a preventive risk management plan for loss, claims, and law suits. SD D U A SA
89. Compliance with environmental regulations will require golf course superintendents to be well-rounded in their understanding of these issues. ... SD D U A SA
90. Compliance with employee and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues. SD D U A SA
91. All turfgrass personnel regardless of level will be required to have a license to operate various pieces of maintenance equipment. SD D U A SA

Comments on Section V:

Section VI: Chemical Issues

92. Fewer pesticides will be available for use, due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs. SD D U A SA
93. Legislated restrictions on pesticide use will be the primary problem the industry faces. SD D U A SA
94. Availability and use of fertilizers and pesticides will be under more critical observation from the general public and turfgrass management teams in the future. SD D U A SA
95. Chemical issues will play an important role in turf management, especially in the high-density urban environment. SD D U A SA
96. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs. SD D U A SA
97. Turf managers will have to use cultivars which are tolerant of pests. SD D U A SA

98. Biologicals will be utilized in greater quantities in turf management. SD D U A SA
99. Pesticides will be more specific in their mode of action. SD D U A SA
100. Biological control of pests in turfgrass will become more popular. SD D U A SA
101. Turf managers must have a better understanding of how minor elements affect turfgrass health. SD D U A SA
102. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type. SD D U A SA
103. Bio-controls will be more prominent than the present time. SD D U A SA
104. Best management practices will be more universally practiced to reduce inputs. SD D U A SA
105. From an environmental standpoint, golf courses will be using compounds that are "safe" in the environment and have minor environmental impact due to extremely low concentrations. SD D U A SA
106. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars. SD D U A SA
107. There will be specialized bio-controls for almost all aspects of pest control in turfgrass management. SD D U A SA
108. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass. SD D U A SA

Comments on Section VI:

Section VII: Environmental Issues

109. The fate of pesticides (fungicides, herbicides, insecticides, nematicides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program. SD D U A SA
110. There will be greater concern for the environmental benefits from turfgrass across the cultural scheme from low to high maintenance. SD D U A SA
111. Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass. SD D U A SA
112. A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, and exotic species preservation. SD D U A SA
113. Expanded use of treated water and less potable water will be the focus of turf managers. SD D U A SA
114. Environmental issues of great concern will be use of scarce water resources, and the pollution of water resources. SD D U A SA
115. Water will continue to be increasingly less available and important to protect from contaminants. SD D U A SA
116. Environmental issues of great concern will be the effects of golf courses on people and wildlife, and the loss of natural areas. SD D U A SA
117. Best Management Practice programs will help to prevent pesticide runoff and leaching. SD D U A SA
118. Golf courses will be a positive influence on wetland recovery for the country. SD D U A SA

119. Golf course management has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow. SD D U A SA
120. Greater emphasis will be placed on control of invasive, non-indigenous species of plants within local areas. SD D U A SA
121. The development of facilities on marginal soils for turfgrass areas (golf courses, sports fields) means additional cost to develop. SD D U A SA
122. Water use will be the single largest environmental issue over much of the country. SD D U A SA
123. The use of pesticides will be monitored from the standpoint of public health. SD D U A SA
124. Southern turfgrasses will be developed for sodium tolerance. SD D U A SA

Comments on Section VII:

Section VIII: Best Management Practices

125. Turf managers will be responsible for developing and implementing an appropriate nutrient management program. SD D U A SA
126. Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs. SD D U A SA
127. Turf managers will be expected to maintain desirable soil physical properties as a result of implementing best management practices. SD D U A SA
128. Integrated programs that emphasize management steps to improve turf quality with limited pesticide use, will be the primary emphasis. SD D U A SA
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130. Increased monitoring of the weather and climate to document conditions favorable to pests will be required. SD D U A SA
131. The use of site-specific management and remote sensing devices will increase. SD D U A SA
132. Variable rate fertility practices will be commonplace in cultural programs. SD D U A SA
133. The use of growth regulators to reduce mowing and soil compaction will increase. SD D U A SA
134. The use of non-polluting electric motors on turf equipment will increase. SD D U A SA
135. Infrared spectrometry will be coupled with computer technology for improved diagnostic and prediction models in turfgrass. SD D U A SA
136. Tissue culture analysis will be coupled with computer technology for improved diagnostic and prediction models in turfgrass. SD D U A SA
137. Water flow and potential environmental impact predictions will precede fertilizer and pesticide application and use. SD D U A SA
138. A better understanding of the entire ecosystem surrounding the golf course will occur allowing turfgrass managers to make better informed decisions regarding maintenance practices. SD D U A SA
139. Precision application of fertilizers will be standard; only those areas needing treatment will be treated. SD D U A SA
140. Low-input, sustainable turfgrass management will be the key. SD D U A SA

141. Best Management Practices that reduce dependence on pesticide use will be essential. SD D U A SA
142. Using appropriate portions of the landscape as buffers within the ecosystem will be more common. SD D U A SA
143. Turfgrasses will play a major role in the planning process for development of undisturbed watersheds. SD D U A SA
144. The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow. . . SD D U A SA
145. Nutrient management will be regulated by government officials. SD D U A SA
146. Turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented. SD D U A SA
147. Prescription pesticides will be a part of best management practices. SD D U A SA

Comments on Section VIII:

Section IX: Other Issues and/or Circumstances

148. Turf managers will be expected to identify and implement the best use of time for professional development. SD D U A SA
149. Turf managers will be more critically evaluated on membership in professional associations, receipt of trade journals, attendance at short courses and conferences, and how many. SD D U A SA
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151. Turf managers will be more accountable in financial support to foundations, universities, and other organizations. SD D U A SA
152. Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) at the local, state, national, and international levels. SD D U A SA
153. The demand for accredited educational programs that can be delivered to people who are employed full-time will increase. SD D U A SA
154. More ethnic minorities will seek employment on golf courses. SD D U A SA
155. Bilingual superintendents will be more common. SD D U A SA
156. Turf managers will spend more time keeping records and in public relations. . SD D U A SA
157. Scheduling for successful maintenance will become more critical as play increases. SD D U A SA
158. Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of the guests or members at golf courses. SD D U A SA
159. Mowers will be quieter, easier to operate, and offer higher safety. SD D U A SA
160. Mowers will operate on energy sources different from today's gasoline and diesel engines. SD D U A SA
161. Shear and impact (reel and rotary, respectively) will remain basic to mowing. SD D U A SA
162. Laser and other cutting methods will remain too expensive and produce unsatisfactory cutting units. SD D U A SA

163. In addition to technical skills, turf managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, public relations, image management, member relations, and community relationships. SD D U A SA
164. There will be a need for even more specialized staff positions such as electrical mechanics that can diagnose and repair more high tech equipment. . SD D U A SA

Comments on Section IX:

Additional Comments:

Thank you for your evaluation of these items. Your individual responses will be kept confidential. Please fax this completed instrument to:

229.391.2592 (fax)
Ed Seagle
Associate Professor
ABAC 6, 2802 Moore Highway
Tifton, GA 31794-2201

229.386.3449 (office telephone)
eseagle@abac.peachnet.edu

Appendix I
Members of the Instrument Review Panel

Members of the Instrument Review Panel

Advisory Committee Participants

| | |
|---|---|
| <p>Maynard J. Iverson, Ph. D., Major Professor Head, Agricultural Education 106 Four Towers University of Georgia Athens, GA</p> | <p>Keith Karnok, Ph. D. Professor of Crop and Soil Science 3111 Plant Sciences Building University of Georgia Athens, GA</p> |
| <p>Wayne Hanna, Ph. D. Professor of Crop and Soil Science United States Department of Agriculture Coastal Plain Experiment Station Tifton, GA</p> | <p>Will Hudson, Ph. D. Extension Entomologist College of Agriculture and Environmental Science Rural Development Center Tifton, GA</p> |

Other Participants

| | |
|---|---|
| <p>Polly Kalinova, Assist. Director, Arts Station Abraham Baldwin Agricultural College 2802 Moore Highway Tifton, GA</p> | <p>David H. Bowers, Ph. D. Consultant, Agricultural Science Tifton, GA</p> |
| <p>Beau Adams, GCS Henderson Memorial Golf Club #1 Al Henderson Drive Savannah, GA</p> | <p>Neil Aldridge Sea Island Golf Club 100 Retreat Avenue St. Simons Island, GA</p> |
| <p>Craig Banister Amelia Island Plantation Golf Club Fernandina Beach, FL</p> | <p>Hoke Brawner, AGCS The Hampton Golf Club 100 Tabbystone St. Simons Island, GA</p> |
| <p>Michael Allen Brown P. O. Box 3536 Savannah Golf Club Savannah, GA</p> | <p>Chad Carroll Southland Golf Club 5726 Southland Drive Decatur, GA</p> |
| <p>Thomas Fagan, AGCS 2150 Gulick Drive Fort Stewart Golf Course Fort Stewart, GA</p> | <p>Justin Goodbread Golden Isles Landscape & Irrigation Inc. Brunswick, GA</p> |

Members of the Instrument Review Panel (continued)

| | |
|---|---|
| <p>Jon-David Hatten Sea Island Golf Club 100 Retreat Avenue St. Simons Island, GA</p> | <p>James R. Haynes , AGCS The Landings Golf Club 71 Green Island Road Savannah, GA</p> |
| <p>Mark Hogarth 5445 Frederica Road Sea Palms Golf and Tennis St. Simons Island, GA</p> | <p>Robert C. Johnson Delta Technology and Sea Island Golf Club 100 Retreat Avenue St. Simons Island, GA</p> |
| <p>Eric Jones, GCS Sea Island Golf Club 100 Retreat Avenue St. Simons Island, GA</p> | <p>Matt Stone Henderson Memorial Golf Club #1 Al Henderson Drive Savannah, GA</p> |

Appendix J
Second Round Delphi Instrument
and
Cover Letter

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

Directions: The following statements were developed from input you and other panelists provided on the first instrument circulated in February, 1999. The term, industry, as used in the title, refers to the whole of activity in the turfgrass profession. The purpose of this instrument is to determine whether or not these statements describe the turfgrass industry of the year 2020 in the United States. Please indicate your level of agreement or disagreement with each statement by *circling* the response at the end of each statement that best reflects your opinion. Approximate completion time is one hour.

Response Levels:

| | | |
|----|---|----------------------------------|
| SD | = | Strongly Disagree |
| D | = | Disagree |
| U | = | Undecided |
| A | = | Agree |
| SA | = | Strongly Agree (circle only one) |

Section I: Personnel Education and Staff Development

- Admission into the two-year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management. . . . SD D U A SA
- An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions. . . . SD D U A SA
- All professional turfgrass-related associations will have well established certification programs for turfgrass professionals. . . . SD D U A SA
- All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides. . . . SD D U A SA
- Continuing education will be required for all professional turfgrass managers because of the rapid pace of change in the turfgrass industry and the commitment to lifelong education. . . . SD D U A SA
- Turfgrass managers must have at least a 2- or 4-year degree in an area of plant or soil sciences to be eligible for superintendent certification. . . . SD D U A SA
- More training will be available "on line" which should give turf managers better access to information on turfgrass management. . . . SD D U A SA
- Knowledge in and use of the Spanish language and culture will be needed by turf managers as becoming bilingual in the workplace receives attention. . . . SD D U A SA
- More emphasis will be placed on business and human resource management for turfgrass managers. . . . SD D U A SA
- More emphasis will be placed on meeting the requirements of the many environmental regulations. . . . SD D U A SA

Comments on Section I:

Section II: Technology

- Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved. . . . SD D U A SA
- Computers will play a major role in the educational, decision-making, and record-keeping processes of the turf manager's job. . . . SD D U A SA
- New technology will require improved critical thinking and problem solving skills in the turf manager. . . . SD D U A SA

- | | | | | | | |
|-----|---|----|---|---|---|----|
| 14. | More sophisticated equipment will be available for the maintenance of turfgrass sites. | SD | D | U | A | SA |
| 15. | Most mapping for turfgrass management will be done using aerial photographs, Global Positioning Systems, and Geographic Information Systems. | SD | D | U | A | SA |
| 16. | The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities. | SD | D | U | A | SA |
| 17. | Computerized control will become more commonplace throughout the turf industry with robotics reducing current concerns for safety in equipment operations. | SD | D | U | A | SA |
| 18. | Laser mowing will become an integral part of improved technology. | SD | D | U | A | SA |
| 19. | Water jet aeration will become a greater part of improved technology. | SD | D | U | A | SA |
| 20. | Subsurface irrigation techniques will become more commonplace. | SD | D | U | A | SA |
| 21. | Sub-air utilization systems and practices for heating and cooling and aeration of the soil will become more commonplace. | SD | D | U | A | SA |
| 22. | Computer technology specialists will be hired by golf courses as an essential human resource element in the maintenance program. | SD | D | U | A | SA |
| 23. | More consultants will be available to provide education and on-site applied research for turf managers in a particular region. | SD | D | U | A | SA |
| 24. | Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs. | SD | D | U | A | SA |

Comments on Section II:

Section III: Availability of Turfgrass Cultivars

- | | | | | | | |
|-----|---|----|---|---|---|----|
| 25. | Seed production in yield per acre will be more important to producers. | SD | D | U | A | SA |
| 26. | <i>Poa annua</i> cultivars will be available in the turfgrass industry. | SD | D | U | A | SA |
| 27. | More pest-tolerant cultivars of the turfgrasses will be developed through genetic engineering. | SD | D | U | A | SA |
| 28. | New cultivars with improved performance potential will continue to become more available. | SD | D | U | A | SA |
| 29. | New cultivars will require a broader understanding of specific environments and cultural practices employed. | SD | D | U | A | SA |
| 30. | Seeded varieties will become more dominant in both cool and warm season climates. | SD | D | U | A | SA |
| 31. | Most seed and sod will be produced under a license agreement with a large agri-chemical company. | SD | D | U | A | SA |
| 32. | The acceptance of new turfgrass cultivars will depend on their performance in the field under real-world conditions. | SD | D | U | A | SA |
| 33. | Improved turfgrass cultivars will have the single most important impact on the industry in the future. | SD | D | U | A | SA |
| 34. | Cultivars exhibiting improved color, density, and growth characteristics will be available. | SD | D | U | A | SA |

35. Bermudagrasses will move northward with more specific uses in the environment. SD D U A SA
36. Bentgrasses will be used further south with more disease and pest problems. . SD D U A SA
37. Shade- and heat-tolerant turfgrasses requiring less water will be developed. ... SD D U A SA
38. Turfgrass cultivars developed through "genetic engineering" will be adapted to regional areas. SD D U A SA
39. New cultivars will be more stress tolerant (heat, drought, salinity, cold, and wear) as they become adapted to more adverse environmental conditions.. ... SD D U A SA
40. Biotechnology will make significant contributions to new cultivars. SD D U A SA
41. The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents. ... SD D U A SA
42. Herbicide resistance will be the norm for several species of turfgrasses. SD D U A SA
43. Genetically engineered cultivars will be the norm in 20 years. SD D U A SA
44. Turf managers will need to better distinguish between general claims and research data that make a difference as they become more involved in cultivar testing and performance. SD D U A SA

Comments on Section III:

Section IV: Turfgrass Management Services

45. More professional consulting services will be available to golf courses and athletic field areas. SD D U A SA
46. The use of specialized equipment in secondary practices (e.g. cultivation) will be through services, due to cost of equipment and interval of use. SD D U A SA
47. Specialized services (hydro-mulching, verti-draining, etc.) will become more popular than they are now. SD D U A SA
48. Services will increase, but the individual on-site superintendent will continue to be the core of the industry. SD D U A SA
49. There will likely be more consolidation of golf courses under management firms that will place their own superintendent on site. SD D U A SA
50. Regulations may require contractual services for aeration of turfgrass sites ... SD D U A SA
51. Chemical (pesticide and fertilizer) application will only be available on a contractual basis and performed by individuals licensed by the federal government. SD D U A SA
52. Documentation required to make pesticide application and applicator licenses will encourage many turfgrass managers to contract management services. ... SD D U A SA
53. Pest scouting will increase to meet environmental regulations. SD D U A SA
54. Ecology services will increase to meet environmental regulations. SD D U A SA
55. There will be more contracted services available which will reduce the need for labor and will reduce staff risks associated with pesticides.. SD D U A SA
56. There will be more contracted services available which will reduce the need for equipment and adjust the budget that the superintendent must plan. SD D U A SA

57. Turfgrass management companies will offer the golf course superintendent additional opportunities to grow in professionalism. SD D U A SA
58. Contractual management services will be standard by the year 2020 which will lower management costs and lessen liability expense. SD D U A SA
59. Management services will grow because they will have the capital to acquire and use equipment, materials, and other necessary supplies. SD D U A SA
60. Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered. SD D U A SA
61. Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology. SD D U A SA
62. Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis. SD D U A SA
63. The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from pesticide applications and partly driven by an effort to reduce capital expenditures on seldom-used equipment. SD D U A SA

Comments on Section IV:

Section V: Legal Issues

64. Nutrient management plans will need governmental approval to help minimize inappropriate applications. SD D U A SA
65. Applying pesticides will be a more difficult task, requiring permits, justification, environmental impact, storage, etc. SD D U A SA
66. Federal, state, and municipal agencies will establish more rules and regulations that will severely restrict standard maintenance practices, especially the use of pesticides. SD D U A SA
67. Records of application for all chemicals will be required, indicating specific product information, application rates, environmental factors, and related site information. SD D U A SA
68. A greater emphasis on professional certification of superintendents, assistants, and maintenance personnel (with respect to pesticide handling, equipment operations, and general qualifications) will be recognized. SD D U A SA
69. Worker safety will be placed on an equal level with efficiency, productivity, and cost control. SD D U A SA
70. Environmental issues, including restrictions on fertilizer and pesticide use, will continue to impact the industry. SD D U A SA
71. Legal issues will be the driving force in environmental and labor problems facing turfgrass managers. SD D U A SA
72. Liability for actions taken by turf managers will require more licensing and certification, or insurance companies will cancel the facility's policy. SD D U A SA
73. Liability issues will include hearing loss due to operating loud equipment, back problems from lifting, and cancer (especially skin cancer) which will greatly impact medical coverages and policies. SD D U A SA
74. Turf managers will be required, on a regular basis, to sample water in lakes, streams, and wells associated with the property being managed. SD D U A SA

75. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with equipment training and personal protective equipment. . . . SD D U A SA
76. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with union workplace violence and hiring and firing issues. . . . SD D U A SA
77. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with contract management, sexual harassment, environmental compliance, safe work practices, walking surfaces, and tree liability. . . . SD D U A SA
78. Turf managers will need to establish and maintain a preventive risk management plan for loss, claims, and law suits. . . . SD D U A SA
79. Compliance with environmental regulations will require golf course superintendents to be well-rounded in their understanding of these issues. . . . SD D U A SA
80. Compliance with employee and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues. . . . SD D U A SA
81. All turfgrass personnel, regardless of level, will be required to have a license to operate various pieces of maintenance equipment as an expression of competency. . . . SD D U A SA

Comments on Section V:

Section VI: Chemical Issues

82. Availability and use of fertilizers and pesticides will be under more critical observation from the general public and turfgrass management teams in the future. . . . SD D U A SA
83. Fewer pesticides will be available for use, due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs. . . . SD D U A SA
84. Legislated restrictions on pesticide use will be the primary problem the industry faces. . . . SD D U A SA
85. Chemical issues will play an important role in turf management, especially in the high-density urban environment. . . . SD D U A SA
86. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs. . . . SD D U A SA
87. Pesticides will be more specific in their mode of action. . . . SD D U A SA
88. Biological control of pests in turfgrass will become more popular and such methods will be used more frequently. . . . SD D U A SA
89. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type. . . . SD D U A SA
90. From an environmental standpoint, golf courses will be using compounds that are "safe" in the environment and have minor environmental impact due to extremely low concentrations. . . . SD D U A SA
91. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars. . . . SD D U A SA
92. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass. . . . SD D U A SA

93. Turf managers must have a better understanding of how minor elements affect turfgrass health. SD D U A SA

Comments on Section VI:

Section VII: Environmental Issues

94. The fate of pesticides (fungicides, herbicides, insecticides, nematicides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program. SD D U A SA
95. A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, exotic species preservation, people responses, and the loss of natural areas. SD D U A SA
96. Expanded use of treated water and less potable water will be the focus of turf managers. SD D U A SA
97. Best Management Practice programs will help to prevent or minimize pesticide runoff and leaching. SD D U A SA
98. Golf course management has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow. SD D U A SA
99. The development of facilities on marginal soils for turfgrass areas (e.g. golf courses, sports fields) will require additional costs to develop. SD D U A SA
100. Greater emphasis will be placed on control of invasive, non-indigenous species of plants within local areas. SD D U A SA
101. The use of pesticides will be monitored from the standpoint of public health. . SD D U A SA
102. Environmental issues of great concern will be the use of scarce water resources, and the prevention of water pollution. SD D U A SA
103. Southern turfgrasses will be developed for sodium tolerance. SD D U A SA
104. Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass at all maintenance levels. . SD D U A SA
105. Golf courses will be a positive influence on wetland recovery for the country. SD D U A SA
105. Bio-technology programs will be more available as alternative methods are developed through concern about the planet's natural resources. SD D U A SA

Comments on Section VII:

Section VIII: Best Management Practices

107. Turf managers will be responsible for developing and implementing an appropriate nutrient management program. SD D U A SA
108. Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs. SD D U A SA
109. Turf managers will be expected to maintain desirable soil physical properties as a result of implementing best management practices. SD D U A SA

110. Turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented. SD D U A SA
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126. Turfgrasses will play a major role in the planning process for development of undisturbed watersheds. SD D U A SA
127. The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow. ... SD D U A SA

Comments on Section VIII:

Section IX: Other Issues and/or Circumstances

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132. Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) at the local, state, national, and international levels. . . . SD D U A SA
133. Turf managers will spend more time keeping records and practicing public relations. . . . SD D U A SA
134. In addition to technical skills, turf managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, and foster favorable public relations and image management to their employer and to members of the community SD D U A SA
135. The demand for accredited educational programs that can be delivered to people who are employed full-time will increase. . . . SD D U A SA
136. Staff development seminars and in-services will be a means of educating employees and exhibiting progressive management styles. . . . SD D U A SA
137. Golf courses and other turfgrass areas will have on-site laboratories as a means of conducting various research programs, cooperating with state and federal agencies. . . . SD D U A SA
138. More grants will be made available from the private sector for funding research. . . . SD D U A SA
139. More ethnic minorities will seek employment on golf courses. . . . SD D U A SA
140. Turf managers will foster an environment that encourages diversity from management to the labor force as "team efforts" continue to be the norm. . . . SD D U A SA
141. Scheduling for successful maintenance will become more critical as play increases. . . . SD D U A SA
142. Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of the guests or members at golf courses. . . . SD D U A SA
143. Mowers will be quieter, easier to operate, and offer higher safety. . . . SD D U A SA
144. Mowers will operate on energy sources different from today's gasoline and diesel engines. . . . SD D U A SA
145. Shear (reel) and impact (rotary) mowing equipment will remain basic to mowing SD D U A SA
146. Laser and other cutting methods will remain too expensive and produce unsatisfactory cutting units. . . . SD D U A SA
147. There will be a need for even more specialized staff positions such as electrical mechanics that can diagnose and repair more high tech equipment. . . . SD D U A SA

Comments on Section IX:

Additional comments relating to the characteristics of the U.S. turf industry in the year 2020:

Thank you for your evaluation of these items. Your willingness to serve on this panel and your dedication to the completion of this survey is indicative of your support of higher education and the high level of professionalism that you have achieved in your career. Be assured that your individual responses will be kept confidential. Please fax this completed instrument to:

229.391.2592 (fax)

Ed Seagle

Associate Professor of Environmental Horticulture
Abraham Baldwin Agricultural College and
ABAC on the Island at St. Simons Island
Distinguished Professor for Teaching and Learning
Board of Regents'
University System of Georgia
ABAC 6, 2802 Moore Highway
Tifton, GA 31794-2201

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Abraham Baldwin AGRICULTURAL COLLEGE

A Two-Year Unit of the University System of Georgia

Division of Agriculture and
Forest Resources

ABAC 6, 2802 Moore Highway
Tifton, GA 31794-2801
Telephone (912) 386-3253

facsimile TRANSMITTAL

To: Name

Fax: Number

From: Ed Seagle

Date: March 22, 2001

Subject: "Futures" study for turfgrass management

Pages: 10

Your willingness to participate in this project is greatly appreciated. The first round responses to the categories identified have been developed into the attached survey instrument. A delay between the first and second rounds occurred due to circumstances beyond my control. Thank you for your input and for completing this instrument and returning it to me by facsimile (229.391.2592) at your earliest convenience. Have a great week. Thank you for your participation.

From the desk of...

Ed Seagle
Associate Professor of Environmental Horticulture
Distinguished Professor of Teaching and Learning
Abraham Baldwin Agricultural College and
ABAC on the Island at St. Simons
ABAC 6, 2802 Moore Highway
Tifton, GA 31794-2801
(229) 386-3449...Office
(229) 391-2592...Fax

Appendix K
Second Round Follow-up to Non-Respondents



Abraham Baldwin

AGRICULTURAL COLLEGE

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Division of Agriculture and
Forest Resources

ABAC 8, 2802 Moore Highway
Tifton, GA 31794-2601
Telephone (912) 386-3253

facsimile TRANSMITTAL

To: Name

Fax: Number

From: Ed Seagle

Date: March 29, 2001

Subject: Reminder: "Futures" study for turfgrass management

Pages: 1

Good morning. As a reminder, I faxed a copy of the survey instrument to you on March 23, 2001. I hope you have received it. I have attached another copy for your convenience. Thank you for taking the time to complete the document. Your input is appreciated. Please return the completed instrument to me by fax (229.391.2592) at your earliest convenience. Have a great weekend. Thanks, again.

From the desk of...

Ed Seagle
Associate Professor of Environmental Horticulture
Distinguished Professor of Teaching and Learning
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Appendix L
Third Round Delphi Instrument
and
Cover Letter

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

THIRD ROUND

Directions: The Round Two responses were summarized and are repeated below as the group mean for each item. Your individual response to the item in Round Two is indicated in the third column. For this round, please rate each item again after considering the group mean and your response in Round Two. Please indicate your level of agreement or disagreement with each statement by *circling* the response at the end of each statement that best reflects your opinion. Approximate completion time is one hour. Thank you for your response.

(circle only one)

Response Levels:

| | | | | |
|---|---|----|---|-------------------|
| 1 | = | SD | = | Strongly Disagree |
| 2 | = | D | = | Disagree |
| 3 | = | U | = | Undecided |
| 4 | = | A | = | Agree |
| 5 | = | SA | = | Strongly Agree |

GMR = Group Mean Response from Round Two
 YPR = Your Previous Response in Round Two

Section I: Personnel Education and Staff Development 1 2 3 4 5

| Question | GMR | YPR | New Response |
|---|-----|-----|--------------|
| 1. Admission into the two-year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management. | 3.5 | | SD D U A SA |
| 2. An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions. | 3.2 | | SD D U A SA |
| 3. All professional turfgrass-related associations will have well established certification programs for turfgrass professionals. | 3.6 | | SD D U A SA |
| 4. All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides. | 3.5 | | SD D U A SA |
| 5. Continuing education will be required for all professional turfgrass managers because of the rapid pace of change in the turfgrass industry and the commitment to lifelong education. | 4.4 | | SD D U A SA |
| 6. Turfgrass managers must have at least a 2- or 4-year degree in an area of plant or soil sciences to be eligible for superintendent certification. | 4.4 | | SD D U A SA |
| 7. More training will be available "on line" which should give turf managers better access to information on turfgrass management. | 4.7 | | SD D U A SA |
| 8. Knowledge in and use of the Spanish language and culture will be needed by turf managers as becoming bilingual in the workplace receives attention. | 4.0 | | SD D U A SA |
| 9. More emphasis will be placed on business and human resource management for turfgrass managers. | 4.4 | | SD D U A SA |
| 10. More emphasis will be placed on meeting the requirements of the many environmental regulations. | 4.4 | | SD D U A SA |

Comments on Section I:

Section II: Technology GMR = Group Mean Response from Round Two
 YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | GMR | YPR | New Response |
|---|-----|-----|--------------|
| 11. Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved. | 3.7 | | SD D U A SA |
| 12. Computers will play a major role in the educational, decision-making, and record-keeping processes of the turf manager's job. | 4.8 | | SD D U A SA |
| 13. New technology will require improved critical thinking and problem solving skills in the turf manager. | 4.3 | | SD D U A SA |
| 14. More sophisticated equipment will be available for the maintenance of turfgrass sites. | 4.6 | | SD D U A SA |
| 15. Most mapping for turfgrass management will be done using aerial photographs, Global Positioning Systems, and Geographic Information Systems. | 4.1 | | SD D U A SA |
| 16. The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities. | 4.1 | | SD D U A SA |
| 17. Computerized control will become more commonplace throughout the turf industry with robotics reducing current concerns for safety in equipment operations. | 3.5 | | SD D U A SA |
| 18. Laser mowing will become an integral part of improved technology. | 3.1 | | SD D U A SA |
| 19. Water jet aeration will become a greater part of improved technology. | 3.4 | | SD D U A SA |
| 20. Subsurface irrigation techniques will become more commonplace. | 2.8 | | SD D U A SA |
| 21. Sub-air utilization systems and practices for heating and cooling and aeration of the soil will become more commonplace. | 3.1 | | SD D U A SA |
| 22. Computer technology specialists will be hired by golf courses as an essential human resource element in the maintenance program. | 3.3 | | SD D U A SA |
| 23. More consultants will be available to provide education and on-site applied research for turf managers in a particular region. | 4.0 | | SD D U A SA |
| 24. Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs. | 4.1 | | SD D U A SA |

Comments on Section II:

Section III: Availability of Turfgrass Cultivars

GMR = Group Mean Response from Round Two
 YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | GMR | YPR | New Response |
|---|-----|-----|--------------|
| 25. Seed production in yield per acre will be more important to producers. | 3.7 | | SD D U A SA |
| 26. <i>Poa annua</i> cultivars will be available in the turfgrass industry. | 4.0 | | SD D U A SA |
| 27. More pest-tolerant cultivars of the turfgrasses will be developed through genetic engineering. | 4.2 | | SD D U A SA |
| 28. New cultivars with improved performance potential will continue to become more available. | 4.5 | | SD D U A SA |
| 29. New cultivars will require a broader understanding of specific environments and cultural practices employed. | 4.0 | | SD D U A SA |
| 30. Seeded varieties will become more dominant in both cool and warm season climates. | 3.4 | | SD D U A SA |
| 31. Most seed and sod will be produced under a license agreement with a large agri-chemical company. | 3.1 | | SD D U A SA |
| 32. The acceptance of new turfgrass cultivars will depend on their performance in the field under real-world conditions. | 4.4 | | SD D U A SA |
| 33. Improved turfgrass cultivars will have the single most important impact on the industry in the future. | 3.4 | | SD D U A SA |
| 34. Cultivars exhibiting improved color, density, and growth characteristics will be available. | 4.4 | | SD D U A SA |
| 35. Bermudagrasses will move northward with more specific uses in the environment. | 3.4 | | SD D U A SA |
| 36. Bentgrasses will be used further south with more disease and pest problems. | 3.4 | | SD D U A SA |
| 37. Shade- and heat-tolerant turfgrasses requiring less water will be developed. | 4.3 | | SD D U A SA |
| 38. Turfgrass cultivars developed through "genetic engineering" will be adapted to regional areas. | 4.0 | | SD D U A SA |
| 39. New cultivars will be more stress tolerant (heat, drought, salinity, cold, and wear) as they become adapted to more adverse environmental conditions. | 4.3 | | SD D U A SA |

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|-----|---|-----|--|--|--|--|--|--|--|----|---|---|---|----|
| 40. | Biotechnology will make significant contributions to new cultivars. | 4.2 | | | | | | | | SD | D | U | A | SA |
| 41. | The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents. | 2.3 | | | | | | | | SD | D | U | A | SA |
| 42. | Herbicide resistance will be the norm for several species of turfgrasses. | 3.8 | | | | | | | | SD | D | U | A | SA |
| 43. | Genetically engineered cultivars will be the norm in 20 years. | 3.8 | | | | | | | | SD | D | U | A | SA |
| 44. | Turf managers will need to better distinguish between general claims and research data that make a difference as they become more involved in cultivar testing and performance. | 4.3 | | | | | | | | SD | D | U | A | SA |

Comments on Section III:

Section IV: Turfgrass Management Services

GMR = Group Mean Response from Round Two
YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | GMR | YPR | New Response | | | | | | | | | | | |
|--|-----|-----|--------------|--|--|--|--|--|--|----|---|---|---|----|
| 45. More professional consulting services will be available to golf courses and athletic field areas. | 4.2 | | | | | | | | | SD | D | U | A | SA |
| 46. The use of specialized equipment in secondary practices (e.g. cultivation) will be through services, due to cost of equipment and interval of use. | 3.9 | | | | | | | | | SD | D | U | A | SA |
| 47. Specialized services (hydro-mulching, verti-draining, etc.) will become more popular than they are now. | 3.9 | | | | | | | | | SD | D | U | A | SA |
| 48. Services will increase, but the individual on-site superintendent will continue to be the core of the industry. | 4.5 | | | | | | | | | SD | D | U | A | SA |
| 49. There will likely be more consolidation of golf courses under management firms that will place their own superintendent on site. | 4.1 | | | | | | | | | SD | D | U | A | SA |
| 50. Regulations may require contractual services for aeration of turfgrass sites. | 2.7 | | | | | | | | | SD | D | U | A | SA |
| 51. Chemical (pesticide and fertilizer) application will only be available on a contractual basis and performed by individuals licensed by the federal government. | 2.6 | | | | | | | | | SD | D | U | A | SA |
| 52. Documentation required to make pesticide application and applicator licenses will encourage many turfgrass managers to contract management services. | 3.2 | | | | | | | | | SD | D | U | A | SA |

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|-----|--|-----|--|-------------|
| 53. | Pest scouting will increase to meet environmental regulations. | 4.0 | | SD D U A SA |
| 54. | Ecology services will increase to meet environmental regulations. | 4.1 | | SD D U A SA |
| 55. | There will be more contracted services available which will reduce the need for labor and will reduce staff risks associated with pesticides. | 3.7 | | SD D U A SA |
| 56. | There will be more contracted services available which will reduce the need for equipment and adjust the budget that the superintendent must plan. | 3.4 | | SD D U A SA |
| 57. | Turfgrass management companies will offer the golf course superintendent additional opportunities to grow in professionalism. | 3.5 | | SD D U A SA |
| 58. | Contractual management services will be standard by the year 2020 which will lower management costs and lessen liability expense. | 2.9 | | SD D U A SA |
| 59. | Management services will grow because they will have the capital to acquire and use equipment, materials, and other necessary supplies. | 3.4 | | SD D U A SA |
| 60. | Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered. | 3.5 | | SD D U A SA |
| 61. | Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology. | 3.1 | | SD D U A SA |
| 62. | Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis. | 3.0 | | SD D U A SA |
| 63. | The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from pesticide applications and partly driven by an effort to reduce capital expenditures on seldom-used equipment. | 3.8 | | SD D U A SA |

Comments on Section IV:

Section V: Legal Issues

GMR = Group Mean Response from Round Two
YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | | GMR | YPR | New Response |
|----------|--|-----|-----|--------------|
| 64. | Nutrient management plans will need governmental approval to help minimize inappropriate applications. | 3.2 | | SD D U A SA |
| 65. | Applying pesticides will be a more difficult task, requiring permits, justification, environmental impact, storage, etc. | 4.0 | | SD D U A SA |

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|-----|---|-----|--|--|-------------|
| 66. | Federal, state, and municipal agencies will establish more rules and regulations that will severely restrict standard maintenance practices, especially the use of pesticides. | 3.8 | | | SD D U A SA |
| 67. | Records of application for all chemicals will be required, indicating specific product information, application rates, environmental factors, and related site information. | 4.4 | | | SD D U A SA |
| 68. | A greater emphasis on professional certification of superintendents, assistants, and maintenance personnel (with respect to pesticide handling, equipment operations, and general qualifications) will be recognized. | 4.2 | | | SD D U A SA |
| 69. | Worker safety will be placed on an equal level with efficiency, productivity, and cost control. | 3.8 | | | SD D U A SA |
| 70. | Environmental issues, including restrictions on fertilizer and pesticide use, will continue to impact the industry. | 4.3 | | | SD D U A SA |
| 71. | Legal issues will be the driving force in environmental and labor problems facing turfgrass managers. | 3.7 | | | SD D U A SA |
| 72. | Liability for actions taken by turf managers will require more licensing and certification, or insurance companies will cancel the facility's policy. | 3.8 | | | SD D U A SA |
| 73. | Liability issues will include hearing loss due to operating loud equipment, back problems from lifting, and cancer (especially skin cancer) which will greatly impact medical coverages and policies. | 3.5 | | | SD D U A SA |
| 74. | Turf managers will be required, on a regular basis, to sample water in lakes, streams, and wells associated with the property being managed. | 3.9 | | | SD D U A SA |
| 75. | The golf course superintendent will be forced to be increasingly aware of risk management issues associated with equipment training and personal protective equipment. | 4.2 | | | SD D U A SA |
| 76. | The golf course superintendent will be forced to be increasingly aware of risk management issues associated with union workplace violence and hiring and firing issues. | 3.8 | | | SD D U A SA |
| 77. | The golf course superintendent will be forced to be increasingly aware of risk management issues associated with contract management, sexual harassment, environmental compliance, safe work practices, walking surfaces, and tree liability. | 4.2 | | | SD D U A SA |
| 78. | Turf managers will need to establish and maintain a preventive risk management plan for loss, claims, and law suits. | 3.9 | | | SD D U A SA |
| 79. | Compliance with environmental regulations will require golf course superintendents to be well-rounded in their understanding of these issues. | 4.4 | | | SD D U A SA |

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|-----|---|-----|--|--|--|----|---|---|---|----|
| 80. | Compliance with employee and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues. | 4.3 | | | | SD | D | U | A | SA |
| 81. | All turfgrass personnel, regardless of level, will be required to have a license to operate various pieces of maintenance equipment as an expression of competency. | 2.8 | | | | SD | D | U | A | SA |

Comments on Section V:

Section VI: Chemical Issues GMR = Group Mean Response from Round Two
 YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | GMR | YPR | New Response | | | | | | | |
|--|-----|-----|--------------|--|--|----|---|---|---|----|
| 82. Availability and use of fertilizers and pesticides will be under more critical observation from the general public and turfgrass management teams in the future. | 4.2 | | | | | SD | D | U | A | SA |
| 83. Fewer pesticides will be available for use, due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs. | 4.0 | | | | | SD | D | U | A | SA |
| 84. Legislated restrictions on pesticide use will be the primary problem the industry faces. | 3.3 | | | | | SD | D | U | A | SA |
| 85. Chemical issues will play an important role in turf management, especially in the high-density urban environment. | 4.1 | | | | | SD | D | U | A | SA |
| 86. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs. | 4.1 | | | | | SD | D | U | A | SA |
| 87. Pesticides will be more specific in their mode of action. | 4.3 | | | | | SD | D | U | A | SA |
| 88. Biological control of pests in turfgrass will become more popular and such methods will be used more frequently. | 3.6 | | | | | SD | D | U | A | SA |
| 89. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type. | 4.1 | | | | | SD | D | U | A | SA |
| 90. From an environmental standpoint, golf courses will be using compounds that are "safe" in the environment and have minor environmental impact due to extremely low concentrations. | 3.9 | | | | | SD | D | U | A | SA |
| 91. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars. | 4.0 | | | | | SD | D | U | A | SA |
| 92. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass. | 3.2 | | | | | SD | D | U | A | SA |

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|-----|---|-----|--|----|---|---|---|----|
| 93. | Turf managers must have a better understanding of how minor elements affect turfgrass health. | 3.7 | | SD | D | U | A | SA |
|-----|---|-----|--|----|---|---|---|----|

Comments on Section VI:

Section VII: Environmental Issues GMR = Group Mean Response from Round Two
YPR = Your Previous Response in Round Two

1 2 3 4 5

| | Question | GMR | YPR | New Response |
|------|--|-----|-----|--------------|
| 94. | The fate of pesticides (fungicides, herbicides, insecticides, nematocides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program. | 4.2 | | SD D U A SA |
| 95. | A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, exotic species preservation, people responses, and the loss of natural areas. | 4.3 | | SD D U A SA |
| 96. | Expanded use of treated water and less potable water will be the focus of turf managers. | 4.5 | | SD D U A SA |
| 97. | Best Management Practice programs will help to prevent or minimize pesticide runoff and leaching. | 4.3 | | SD D U A SA |
| 98. | Golf course management has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow. | 4.2 | | SD D U A SA |
| 99. | The development of facilities on marginal soils for turfgrass areas (e.g. golf courses, sports fields) will require additional costs to develop. | 4.1 | | SD D U A SA |
| 100. | Greater emphasis will be placed on control of invasive, non- indigenous species of plants within local areas. | 3.7 | | SD D U A SA |
| 101. | The use of pesticides will be monitored from the standpoint of public health. | 4.1 | | SD D U A SA |
| 102. | Environmental issues of great concern will be the use of scarce water resources, and the prevention of water pollution. | 4.5 | | SD D U A SA |
| 103. | Southern turfgrasses will be developed for sodium tolerance. | 4.1 | | SD D U A SA |
| 104. | Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass at all maintenance levels. | 3.9 | | SD D U A SA |
| 105. | Golf courses will be a positive influence on wetland recovery for the country. | 3.9 | | SD D U A SA |

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|--|-----|--|--|--|--|----|---|---|---|----|
| 106. Bio-technology programs will be more available as alternative methods are developed through concern about the planet's natural resources. | 3.8 | | | | | SD | D | U | A | SA |
|--|-----|--|--|--|--|----|---|---|---|----|

Comments on Section VII:

Section VIII: Best Management Practices

GMR = Group Mean Response from Round Two
YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | | GMR | YPR | New Response | | | | | | | |
|----------|--|-----|-----|--------------|--|--|----|---|---|---|----|
| 107. | Turf managers will be responsible for developing and implementing an appropriate nutrient management program. | 4.3 | | | | | SD | D | U | A | SA |
| 108. | Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs. | 4.4 | | | | | SD | D | U | A | SA |
| 109. | Turf managers will be expected to maintain desirable soil physical properties as a result of implementing best management practices. | 3.9 | | | | | SD | D | U | A | SA |
| 110. | Turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented. | 3.4 | | | | | SD | D | U | A | SA |
| 111. | Integrated programs (e.g. integrated pest management and best management practices) that emphasize management steps to improve turf quality with limited pesticide use will be the primary emphasis. | 3.9 | | | | | SD | D | U | A | SA |
| 112. | Pest scouting will be required before pesticides are applied. | 3.7 | | | | | SD | D | U | A | SA |
| 113. | Increased monitoring of the weather and climate to document conditions favorable to pests will be required. | 3.8 | | | | | SD | D | U | A | SA |
| 114. | The use of site-specific management and remote sensing devices will increase. | 4.1 | | | | | SD | D | U | A | SA |
| 115. | Variable rate fertility practices will be commonplace in cultural programs. | 3.9 | | | | | SD | D | U | A | SA |
| 116. | Using appropriate portions of the landscape as buffers within the ecosystem will be more common. | 4.2 | | | | | SD | D | U | A | SA |
| 117. | The use of growth regulators to reduce mowing and soil compaction will increase. | 3.6 | | | | | SD | D | U | A | SA |
| 118. | The use of non-polluting electric motors on turf equipment will increase. | 3.9 | | | | | SD | D | U | A | SA |

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|------|--|-----|--|--|--|--|--|--|--|--|----|---|---|---|----|
| 119. | Infrared spectrometry will be coupled with computer technology for improved diagnostic and prediction models in turfgrass. | 3.8 | | | | | | | | | SD | D | U | A | SA |
| 120. | Tissue culture analysis will be coupled with computer technology for improved diagnostic and prediction models in turfgrass. | 3.6 | | | | | | | | | SD | D | U | A | SA |
| 121. | Water flow and potential environmental impact predictions will precede fertilizer and pesticide application and use. | 3.5 | | | | | | | | | SD | D | U | A | SA |
| 122. | A better understanding of the entire ecosystem surrounding the golf course will occur allowing turfgrass managers to make better informed decisions regarding maintenance practices. | 4.1 | | | | | | | | | SD | D | U | A | SA |
| 123. | Precision application of fertilizers will be standard; only those areas needing treatment will be treated. | 3.9 | | | | | | | | | SD | D | U | A | SA |
| 124. | Prescription pesticides will be a part of best management practices. | 3.8 | | | | | | | | | SD | D | U | A | SA |
| 125. | Low-input, sustainable turfgrass management will be the key. | 3.5 | | | | | | | | | SD | D | U | A | SA |
| 126. | Turfgrasses will play a major role in the planning process for development of undisturbed watersheds. | 3.6 | | | | | | | | | SD | D | U | A | SA |
| 127. | The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow. | 3.0 | | | | | | | | | SD | D | U | A | SA |

Comments on Section VIII:

Section IX: Other Issues and/or Circumstances

GMR = Group Mean Response from Round Two
 YPR = Your Previous Response in Round Two

1 2 3 4 5

| Question | GMR | YPR | New Response |
|--|-----|-----|--------------|
| 128. Turf managers will be expected to identify and implement the best use of time for professional development. | 3.9 | | SD D U A SA |
| 129. Turf managers will be more critically evaluated on membership in professional associations and receipt of trade journals, attendance at short courses and conferences, and how many and which ones to attend. | 3.6 | | SD D U A SA |
| 130. Turf managers will be more critically evaluated on the best use of available funds in professional development. | 3.8 | | SD D U A SA |
| 131. Turf managers will be more accountable in financial support to foundations, universities, and other organizations. | 3.1 | | SD D U A SA |

| | | | |
|------|---|-----|-------------|
| 132. | Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) at the local, state, national, and international levels. | 3.4 | SD D U A SA |
| 133. | Turf managers will spend more time keeping records and practicing public relations. | 4.1 | SD D U A SA |
| 134. | In addition to technical skills, turf managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, and foster favorable public relations and image management to their employer and to members of the community | 4.5 | SD D U A SA |
| 135. | The demand for accredited educational programs that can be delivered to people who are employed full-time will increase. | 4.2 | SD D U A SA |
| 136. | Staff development seminars and in-services will be a means of educating employees and exhibiting progressive management styles. | 4.2 | SD D U A SA |
| 137. | Golf courses and other turfgrass areas will have on-site laboratories as a means of conducting various research programs, cooperating with state and federal agencies. | 2.8 | SD D U A SA |
| 138. | More grants will be made available from the private sector for funding research. | 3.1 | SD D U A SA |
| 139. | More ethnic minorities will seek employment on golf courses. | 4.0 | SD D U A SA |
| 140. | Turf managers will foster an environment that encourages diversity from management to the labor force as "team efforts" continue to be the norm. | 3.9 | SD D U A SA |
| 141. | Scheduling for successful maintenance will become more critical as play increases. | 4.1 | SD D U A SA |
| 142. | Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of the guests or members at golf courses. | 3.5 | SD D U A SA |
| 143. | Mowers will be quieter, easier to operate, and offer higher safety. | 4.2 | SD D U A SA |
| 144. | Mowers will operate on energy sources different from today's gasoline and diesel engines. | 3.8 | SD D U A SA |
| 145. | Shear (reel) and impact (rotary) mowing equipment will remain basic to mowing | 3.9 | SD D U A SA |
| 146. | Laser and other cutting methods will remain too expensive and produce unsatisfactory cutting units. | 3.2 | SD D U A SA |
| 147. | There will be a need for even more specialized staff positions such as electrical mechanics that can diagnose and repair more high tech equipment | 3.7 | SD D U A SA |

Comments on Section IX:

Additional comments relating to the characteristics of the U.S. turf industry in the year 2020:

Thank you for your evaluation of these items. Your individual responses will remain confidential. I look forward to receiving your reply. Please fax this completed instrument to:

229.391.2592 (fax)

Ed Seagle

Associate Professor of Environmental Horticulture
Abraham Baldwin Agricultural College and
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A Two-Year Unit of the University System of Georgia

Division of Agriculture and
Forest Resources

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Tifton, GA 31794-2801
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facsimile TRANSMITTAL

To: Name

Fax: Number

From: Ed Seagle

Date: April 19, 2001

Subject: "Futures" study for turfgrass management: Round Three

Pages: 14

Thank you for completing the Second Round instrument. Responses were analyzed with the mean score and your response for each statement included in this Third Round instrument. Please complete this instrument, whether your response changes or not, and the biographical information sheet. Upon completion, please return them to me by fax (229.391.2592) at your earliest convenience. Your input is greatly appreciated and much needed. I will share the results with you. Have a great week. Thanks, again.

From the desk of...

Ed Seagle
Associate Professor of Environmental Horticulture
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Appendix M**Third Round Follow-up to Non-Respondents**



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Forest Resources

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facsimile TRANSMITTAL

To: Name

Fax: Number

From: Ed Seagle

Date: May 4, 2001

Subject: "Futures" study for turfgrass management: Round Three Reminder

Pages: 14

Thank you for completing the Second Round instrument. Responses were analyzed with the mean score and your response for each statement included in this Third Round instrument. Please complete this instrument, whether your response changes or not, and the biographical information sheet. Upon completion, please return them to me by fax (229.391.2592) at your earliest convenience. Your input is greatly appreciated and much needed. I will share the results with you. Have a great week. Thanks, again.

From the desk of...

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facsimile TRANSMITTAL

To: Name

Fax: Number

From: Ed Seagle

Date: May 11, 2001

Subject: "Futures" study for turfgrass management: Round Three Reminder

Pages: 14

Thank you for completing the Second Round instrument. Responses were analyzed with the mean score and your response for each statement included in this Third Round instrument. Please complete this instrument, whether your response changes or not, and the biographical information sheet. Upon completion, please return them to me by fax (229.391.2592) at your earliest convenience. Your input is greatly appreciated and much needed. I will share the results with you. Have a great week. Thanks, again.

From the desk of...

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Appendix N
Comments from Second Round

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

Round Two Comments

Section I: Personnel Education and Staff Development

1. Admission into the two-year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management.
Should by demand of administrators, may be for more students at any cost.
Two-year program may have been phased out.
2. An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions.
Not all; by when?
3. All professional turfgrass-related associations will have well established certification programs for turfgrass professionals.
Certainly not at the state level.
Most do so now.
4. All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides.
Will vary from state to state.
5. Continuing education will be required for all professional turfgrass managers because of the rapid pace of change in the turfgrass industry and the commitment to lifelong education.
Needed? Truly for all.
6. Turfgrass managers must have at least a 2- or 4-year degree in an area of plant or soil sciences to be eligible for superintendent certification.
National. When?
Four-year and beyond.
7. More training will be available "on line" which should give turf managers better access to information on turfgrass management.
8. Knowledge in and use of the Spanish language and culture will be needed by turf managers as becoming bilingual in the workplace receives attention.
Needed by many turf managers.

9. More emphasis will be placed on business and human resource management for turfgrass managers.

Relative to what?

10. More emphasis will be placed on meeting the requirements of the many environmental regulations.

Comments on Section I:

Two year programs will be a technical compliment to a four year program.

I am a 4-year+ person - because of the need to have math, chemistry, ecology, etc. in the curriculum, a 2-year trained person can do the job but he would be more in need of a good, qualified consultant.

Two-year programs as they exist today probably will not exist. They may evolve into "specialty" training centers for single categories.

Section II: Technology

11. Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved.

By when? Vary from state to state, not all.

12. Computers will play a major role in the educational, decision-making, and recordkeeping processes of the turf manager's job.

13. New technology will require improved critical thinking and problem solving skills in the turf manager.

14. More sophisticated equipment will be available for the maintenance of turfgrass sites.

15. Most mapping for turfgrass management will be done using aerial photographs, Global Positioning Systems, and Geographic Information Systems.

Slightly over-rated.

Aerial photography will be replaced by "sensors" mounted on equipment. Subsurface irrigation technology not likely to be pursued. Laser technology available today - burns and fragmented leaves. Not likely to be perfected. Costs?

16. The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities.

17. Computerized control will become more commonplace throughout the turf industry with robotics reducing current concerns for safety in equipment operations.

18. Laser mowing will become an integral part of improved technology.

Eventually.

19. Water jet aeration will become a greater part of improved technology.
20. Subsurface irrigation techniques will become more commonplace.
21. Subair utilization systems and practices for heating and cooling and aeration of the soil will become more commonplace.
22. Computer technology specialists will be hired by golf courses as an essential human resource element in the maintenance program.

But only some.

23. More consultants will be available to provide education and on-site applied research for turf managers in a particular region.
24. Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs.

Eventually.

Comments on Section II:

Sub-Air and sub-irrigation look good on paper but have not proved their worth in the real world.

Section III: Availability of Turfgrass Cultivars

25. Seed production in yield per acre will be more important to producers.
26. *Poa annua* cultivars will be available in the turfgrass industry.
Desirable Poa annua cultivars. Eventually - not soon.
27. More pest-tolerant cultivars of the turfgrasses will be developed through genetic engineering.
28. New cultivars with improved performance potential will continue to become more available.
29. New cultivars will require a broader understanding of specific environments and cultural practices employed.
30. Seeded varieties will become more dominant in both cool and warm season climates.
31. Most seed and sod will be produced under a license agreement with a large agri-chemical company.
32. The acceptance of new turfgrass cultivars will depend on their performance in the field under real-world conditions.
33. Improved turfgrass cultivars will have the single most important impact on the industry in the future.

In this area (southeast), the most important will be to keep government and bureaucracy out of the industry.

34. Cultivars exhibiting improved color, density, and growth characteristics will be available.

For certain species.

35. Bermudagrasses will move northward with more specific uses in the environment.

36. Bentgrasses will be used further south with more disease and pest problems.

37. Shade- and heat-tolerant turfgrasses requiring less water will be developed.

In time.

38. Turfgrass cultivars developed through "genetic engineering" will be adapted to regional areas.

Perhaps.

39. New cultivars will be more stress tolerant (heat, drought, salinity, cold, and wear) as they become adapted to more adverse environmental conditions.

In time.

Strongly agree if these cultivars are developed for adaptation to diverse conditions.

40. Biotechnology will make significant contributions to new cultivars.

41. The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents.

Or 5 years.

Strongly agree if seed propagated and strongly disagree if vegetatively propagated.

Good cultivars resistant to pests (diseases, insects, and weeds) will be used indefinitely. If looking in one or more areas of stress, pest resistance will be replaced.

42. Herbicide resistance will be the norm for several species of turfgrasses.

43. Genetically engineered cultivars will be the norm in 20 years.

44. Turf managers will need to better distinguish between general claims and research data that make a difference as they become more involved in cultivar testing and performance.

Cultivar testing will be done by breeders, universities, and specialty research groups; not by end user.

Comments on Section III:

The future of our profession is in the hands of the plant breeders.

Section IV: Turfgrass Management Services

45. More professional consulting services will be available to golf courses and athletic field areas.

46. The use of specialized equipment in secondary practices (e.g. cultivation) will be through services, due to cost of equipment and interval of use.
47. Specialized services (hydromulching, verti-draining, etc.) will become more popular than they are now.
48. Services will increase, but the individual on-site superintendent will continue to be the core of the industry.
49. There will likely be more consolidation of golf courses under management firms that will place their own superintendent on site.
50. Regulations may require contractual services for aeration of turfgrass sites.
51. Chemical (pesticide and fertilizer) application will only be available on a contractual basis and performed by individuals licensed by the federal government.

When?

52. Documentation required to make pesticide application and applicator licenses will encourage many turfgrass managers to contract management services.

Contract application services.

53. Pest scouting will increase to meet environmental regulations.
54. Ecology services will increase to meet environmental regulations.
55. There will be more contracted services available which will reduce the need for labor and will reduce staff risks associated with pesticides.

Superintendents (managers) will be trained to handle pesticide applications. Two years of agronomy will train specialists.

56. There will be more contracted services available which will reduce the need for equipment and adjust the budget that the superintendent must plan.
57. Turfgrass management companies will offer the golf course superintendent additional opportunities to grow in professionalism.
58. Contractual management services will be standard by the year 2020 which will lower management costs and lessen liability expense.
59. Management services will grow because they will have the capital to acquire and use equipment, materials, and other necessary supplies.
60. Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered.

Lawns in urban and suburban areas are becoming smaller because of limited land availability and water restrictions and limitations. Lawn care companies and management firms may decrease.

61. Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology.

When?

Some, not much.

62. Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis.

When?

63. The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from pesticide applications and partly driven by an effort to reduce capital expenditures on seldom-used equipment.

Comments on Section IV:

More contract services which involve restricted use pesticides and/or very costly equipment needed to do infrequent tasks, ie. nematicides for the former and deep tine aeration for the latter.

Section V: Legal Issues

64. Nutrient management plans will need governmental approval to help minimize inappropriate applications.

When?

65. Applying pesticides will be a more difficult task, requiring permits, justification, environmental impact, storage, etc.

Does so already.

66. Federal, state, and municipal agencies will establish more rules and regulations that will severely restrict standard maintenance practices, especially the use of pesticides.

Hope not.

Applicators will have to be thoroughly trained and certified.

67. Records of application for all chemicals will be required, indicating specific product information, application rates, environmental factors, and related site information.

More bureaucracy.

68. A greater emphasis on professional certification of superintendents, assistants, and maintenance personnel (with respect to pesticide handling, equipment operations, and general qualifications) will be recognized.

69. Worker safety will be placed on an equal level with efficiency, productivity, and cost control.

Together or lower?

70. Environmental issues, including restrictions on fertilizer and pesticide use, will continue to impact the industry.
71. Legal issues will be the driving force in environmental and labor problems facing turfgrass managers.
72. Liability for actions taken by turf managers will require more licensing and certification, or insurance companies will cancel the facility's policy.

When?

73. Liability issues will include hearing loss due to operating loud equipment, back problems from lifting, and cancer (especially skin cancer) which will greatly impact medical coverages and policies.

More and more government influences.

- *Worker training is critical as is accurate and knowledgeable use of pesticides, ie. Never apply fertilizers or pesticides to saturated soils.*

74. Turf managers will be required, on a regular basis, to sample water in lakes, streams, and wells associated with the property being managed.
75. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with equipment training and personal protective equipment.
76. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with union workplace violence and hiring and firing issues.

Hope not.

In the south?

77. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with contract management, sexual harassment, environmental compliance, safe work practices, walking surfaces, and tree liability.

More and more clutter.

78. Turf managers will need to establish and maintain a preventive risk management plan for loss, claims, and law suits.

When?

79. Compliance with environmental regulations will require golf course superintendents to be well-rounded in their understanding of these issues.
80. Compliance with employee and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues.

When?

81. All turfgrass personnel, regardless of level, will be required to have a license to operate various pieces of maintenance equipment as an expression of competency.

Silent spring impact.

Comments on Section V:

Some hands-on superintendents will probably decide that the paperwork is too complex - they will be happier as assistants.

No doubt that superintendents must be adequately trained in all aspects of this chapter. And, most likely, will have to have "specialists" in several areas, especially in pesticides. Clubs and municipalities will have specialists in human resources. Private clubs may have volunteers.

Section VI: Chemical Issues

82. Availability and use of fertilizers and pesticides will be under more critical observation from the general public and turfgrass management teams in the future.
83. Fewer pesticides will be available for use, due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs.

Eventually.

Entrepreneurs will keep trying.

84. Legislated restrictions on pesticide use will be the primary problem the industry faces.

Water?

85. Chemical issues will play an important role in turf management, especially in the high-density urban environment.

Those acquainted with these issues already doing so.

86. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs.

87. Pesticides will be more specific in their mode of action.

88. Biological control of pests in turfgrass will become more popular and such methods will be used more frequently.

Show me one that works!

89. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type.

90. From an environmental standpoint, golf courses will be using compounds that are "safe" in the environment and have minor environmental impact due to extremely low concentrations.

Eventually.

This is true for insecticides and fungicides, but not for herbicides and fertilizers.

91. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars.
92. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass.

Eventually.

93. Turf managers must have a better understanding of how minor elements affect turfgrass health.
- They must have a better understanding of many aspects in plant and soil sciences to sort out the claims being made by manufacturers, consultants, sales personnel, etc.*

Scientists must first develop.

Comments on Section VI:

Bioengineering of plants will reduce pesticide usage, but not eliminate it. That's 50 - 75 years from now.

Section VII: Environmental Issues

94. The fate of pesticides (fungicides, herbicides, insecticides, nematicides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program.
95. A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, exotic species preservation, people responses, and the loss of natural areas.
96. Expanded use of treated water and less potable water will be the focus of turf managers.
97. Best Management Practice programs will help to prevent or minimize pesticide runoff and leaching.
98. Golf course management has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow.
99. The development of facilities on marginal soils for turfgrass areas (e.g. golf courses, sports fields) will require additional costs to develop.
- Already does.*
100. Greater emphasis will be placed on control of invasive, non-indigenous species of plants within local areas.
101. The use of pesticides will be monitored from the standpoint of public health.
102. Environmental issues of great concern will be the use of scarce water resources, and the prevention of water pollution.

103. Southern turfgrasses will be developed for sodium tolerance.
Northern as well.
Not much of a problem except a few coastal areas.
Sodic and saline.
104. Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass at all maintenance levels.
Will be reverse. Managers may help but will not be their responsibility.
105. Golf courses will be a positive influence on wetland recovery for the country.
Could be.
106. Bio-technology programs will be more available as alternative methods are developed through concern about the planet's natural resources.

Comments on Section VII:

Water issues (quantity and quality) are not well represented in this survey but will have more impact than pesticide/fertility aspects over the next 20 years. Water conservation greatly stimulates use of water resources of less quality; which adds many constituents to the system; will enhance grass development; influence all management aspects.

I have yet to see an effective biological control/entity that works. I do not view sodium as a deterrent to turf in the south except in a few coastal area. This is an overblown issue.

Section VIII: Best Management Practices

107. Turf managers will be responsible for developing and implementing an appropriate nutrient management program.
108. Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs.
109. Turf managers will be expected to maintain desirable soil physical properties as a result of implementing best management practices.
By whom?
Not necessarily related.
110. Turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented.
When? Variable from state to state.

111. Integrated programs (e.g. integrated pest management and best management practices) that emphasize management steps to improve turf quality with limited pesticide use will be the primary emphasis.
Water?
Maybe.
112. Pest scouting will be required before pesticides are applied.
When?
Superintendent should know.
Integrated pest management includes monitoring.
113. Increased monitoring of the weather and climate to document conditions favorable to pests will be required.
114. The use of site-specific management and remote sensing devices will increase.
115. Variable rate fertility practices will be commonplace in cultural programs.
When?
116. Using appropriate portions of the landscape as buffers within the ecosystem will be more common.
For what?
117. The use of growth regulators to reduce mowing and soil compaction will increase.
118. The use of non-polluting electric motors on turf equipment will increase.
Noise?
119. Infrared spectrometry will be coupled with computer technology for improved diagnostic and prediction models in turfgrass.
For some.
120. Tissue culture analysis will be coupled with computer technology for improved diagnostic and prediction models in turfgrass.
Not any time soon.
By some.
121. Water flow and potential environmental impact predictions will precede fertilizer and pesticide application and use.
These must be determined before turf is established.

122. A better understanding of the entire ecosystem surrounding the golf course will occur allowing turfgrass managers to make better informed decisions regarding maintenance practices.

123. Precision application of fertilizers will be standard; only those areas needing treatment will be treated.

When?

124. Prescription pesticides will be a part of best management practices.

Define?

125. Low-input, sustainable turfgrass management will be the key.

Eventually.

#125 is going to be the key.

126. Turfgrasses will play a major role in the planning process for development of undisturbed watersheds.

Grasses of all types.

127. The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow.

Hope not.

We are still free of governmental influence in personnel and private matters. Let's hope it's still so 20 years from now.

Comments on Section VIII:

Because of the small size of most professionally managed turf areas, the application (practical use) of site-specific remote sensing is ore hype than need.

Integrated Pest Management and Best Management Practices will be encouraged but not mandated.

Section IX: Other Issues and/or Circumstances

128. Turf managers will be expected to identify and implement the best use of time for professional development.

By whom?

129. Turf managers will be more critically evaluated on membership in professional associations and receipt of trade journals, attendance at short courses and conferences, and how many and which ones to attend.

Hope not.

130. Turf managers will be more critically evaluated on the best use of available funds in professional development.

Good idea.

131. Turf managers will be more accountable in financial support to foundations, universities, and other organizations.
132. Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) at the local, state, national, and international levels.

May be, but such activities take time from club and may not be condoned.

133. Turf managers will spend more time keeping records and practicing public relations.
134. In addition to technical skills, turf managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, and foster favorable public relations and image management to their employer and to members of the community.
135. The demand for accredited educational programs that can be delivered to people who are employed full-time will increase.
136. Staff development seminars and in-services will be a means of educating employees and exhibiting progressive management styles.
137. Golf courses and other turfgrass areas will have on-site laboratories as a means of conducting various research programs, cooperating with state and federal agencies.

A few only, not all.

Too expensive and same is conducted by universities: common labs.

138. More grants will be made available from the private sector for funding research.
139. More ethnic minorities will seek employment on golf courses.
140. Turf managers will foster an environment that encourages diversity from management to the labor force as "team efforts" continue to be the norm.
141. Scheduling for successful maintenance will become more critical as play increases.
142. Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of the guests or members at golf courses.

With noise reduction practices used.

143. Mowers will be quieter, easier to operate, and offer higher safety.
144. Mowers will operate on energy sources different from today's gasoline and diesel engines.

When?

145. Shear (reel) and impact (rotary) mowing equipment will remain basic to mowing.
146. Laser and other cutting methods will remain too expensive and produce unsatisfactory cutting units.
For how long?
147. There will be a need for even more specialized staff positions such as electrical mechanics that can diagnose and repair more high tech equipment.

Comments on Section IX:

Because of quality control (calibrations, problems, etc.) I think on-site labs are impractical and many already generate erroneous data. For example, for our infrared analyzer, we can not produce reliable data if the equipment is used by more than one technician. Even then it must be very carefully calibrated and never abused.

Additional comments relating to the characteristics of the U.S. turf industry in the year 2020:

Blue tooth technology will be incorporated into the maintenance and utility of equipment as well as impacting play.

Professionalism will continue to prevail - from table manners to Robert's Rules of Order in meetings. Greater awareness of cultural differences must occur to enable civility in the workplace. Emphasis must be on "leaders" not "managers". Business skills will be of even greater importance 20 years from now. Good effort. Thanks for including me.

Most of the items are estimates or forecasts. Some are "hoped for"; others are "hope nots". The business part of the industry would prefer as little governmental influence as possible. Some regulations are necessary. Unfortunately, one started it grows and grows and becomes more and more stifling, slowly smothering progress. Until recently, basic research was important to industry. Some is still needed, but only basic research by government. Henceforth, product development - including new cultivars - should be the parameter of private industry. More growth would result. Also, where profit is involved bias enters in. So, if government is involved and researchers enjoy pecuniary return in addition to salaries bias increases. Further, this is not the taxpayers responsibility. More government application could be applied for educational purposes, preferably on the student level. And strictly through college-type institution for the benefit of incipient turf managers. After this point, the professional turf manager and what would be a stronger business opportunity. Government, over the long haul, impedes progress. The less influence, the healthier an industry will be. Some of the items listed indicate inevitable regulatory action. Care should be taken to prevent excess. Turning development loose without government competition and judicious regulations will benefit a vital industry.

Biotechnology and robotics will make a significant impact on the turf industry by 2020.

Survey comments appropriate for 2020. Many technological advancements, especially in bioengineering of grasses, will occur and be put to use. Precision turf culture will be routine. Fewer pesticides will be needed - they will be specific, not broad spectrum. Alternative energy sources will be available - fuel cells, perhaps solar, electrical. Use of marginal lands will expand. Water limitation will be most critical factor facing the industry. So called "quality" standards (golf courses) will likely decrease. "Augusta" quality (perceived by lay individuals) will not be possible because of limited resources, ie. water, energy. Bioengineering will help but few, if any, turf areas will be groomed and manicured to levels comparable to Augusta today. Grasses, especially those used on greens will be regional-specific. This survey is an outline that is a good basis for a book.

Appendix O
Comments from Third Round

CHARACTERISTICS OF THE U. S. TURF INDUSTRY IN THE YEAR 2020

Round Three Comments

Section I: Personnel Education and Staff Development

1. Admission into the two-year turfgrass programs of study will depend more on post-high school education and work experience in turfgrass management.
This has been the trend for 20+ years in at least one two-year program. Experience is required and most accepted applicants have attended college previously, some with four-year degrees in other majors.
2. An associate degree in turfgrass management from an accredited institution should be sufficient for entry level employment positions.
3. All professional turfgrass-related associations will have well established certification programs for turfgrass professionals.
4. All personnel involved with the application of pesticides will have to complete specialized programs of study (i.e. 2-year degrees or comparable certificate programs) specifically dealing with the safety and use of pesticides.
5. Continuing education will be required for all professional turfgrass managers because of the rapid pace of change in the turfgrass industry and the commitment to lifelong education.
6. Turfgrass managers must have at least a 2- or 4-year degree in an area of plant or soil sciences to be eligible for superintendent certification.
7. More training will be available "on line" which should give turf managers better access to information on turfgrass management.
8. Knowledge in and use of the Spanish language and culture will be needed by turf managers as becoming bilingual in the workplace receives attention.
9. More emphasis will be placed on business and human resource management for turfgrass managers.
10. More emphasis will be placed on meeting the requirements of the many environmental regulations.

Comments on Section I:

Specialized training will be mandatory. A superintendent will probably have charge of several courses, i.e. municipal, state, etc.

Section II: Technology

11. Turfgrass managers will have to demonstrate by formal examination their competency in the understanding and use of current technology in which they are involved.
Demonstrate to whom? No doubt certification programs will require this. Hopefully, government will not be a part to such requirements.
12. Computers will play a major role in the educational, decision-making, and recordkeeping processes of the turf manager's job.
13. New technology will require improved critical thinking and problem solving skills in the turf manager.
14. More sophisticated equipment will be available for the maintenance of turfgrass sites.
15. Most mapping for turfgrass management will be done using aerial photographs, Global Positioning Systems, and Geographic Information Systems.
No aerial photographs.
16. The impact of bio-engineering will require a better understanding of how to integrate this technology into existing facilities.
17. Computerized control will become more commonplace throughout the turf industry with robotics reducing current concerns for safety in equipment operations.
18. Laser mowing will become an integral part of improved technology.
19. Water jet aeration will become a greater part of improved technology.
20. Subsurface irrigation techniques will become more commonplace.
21. Subair utilization systems and practices for heating and cooling and aeration of the soil will become more commonplace.
22. Computer technology specialists will be hired by golf courses as an essential human resource element in the maintenance program.
23. More consultants will be available to provide education and on-site applied research for turf managers in a particular region.
24. Advances will be made in determining the "quality" and "health" of the turf in the field as a way to help guide cultural programs.

Section III: Availability of Turfgrass Cultivars

25. Seed production in yield per acre will be more important to producers.
Can it become more important?
26. *Poa annua* cultivars will be available in the turfgrass industry.
27. More pest-tolerant cultivars of the turfgrasses will be developed through genetic engineering.

28. New cultivars with improved performance potential will continue to become more available.
29. New cultivars will require a broader understanding of specific environments and cultural practices employed.
30. Seeded varieties will become more dominant in both cool and warm season climates.
31. Most seed and sod will be produced under a license agreement with a large agri-chemical company.
32. The acceptance of new turfgrass cultivars will depend on their performance in the field under real-world conditions.
33. Improved turfgrass cultivars will have the single most important impact on the industry in the future.
Proper management techniques will be equally important. One of the developers on Penncross creeping bentgrass said that the greatness and longevity of the popularity of this cultivar was largely due to turf managers learning how to manage it.
34. Cultivars exhibiting improved color, density, and growth characteristics will be available.
35. Bermudagrasses will move northward with more specific uses in the environment.
36. Bentgrasses will be used further south with more disease and pest problems.
37. Shade- and heat-tolerant turfgrasses requiring less water will be developed.
38. Turfgrass cultivars developed through "genetic engineering" will be adapted to regional areas.
39. New cultivars will be more stress tolerant (heat, drought, salinity, cold, and wear) as they become adapted to more adverse environmental conditions.
40. Biotechnology will make significant contributions to new cultivars.
41. The longevity of cultivars will be only 3 or 4 years because of continuous improvements, genetic changes in population, and plant protection patents.
This question probably be asked separately for seeded and vegetative varieties. Seeded varieties already in 3 to 6 year cycle. Vegetative varieties last longer because of the time to scale up production. They are probably 5 to 10 years.
42. Herbicide resistance will be the norm for several species of turfgrasses.
43. Genetically engineered cultivars will be the norm in 20 years.
44. Turf managers will need to better distinguish between general claims and research data that make a difference as they become more involved in cultivar testing and performance.

Section IV: Turfgrass Management Services

45. More professional consulting services will be available to golf courses and athletic field areas.
46. The use of specialized equipment in secondary practices (e.g. cultivation) will be through services, due to cost of equipment and interval of use.
47. Specialized services (hydromulching, verti-draining, etc.) will become more popular than they are now.
48. Services will increase, but the individual on-site superintendent will continue to be the core of the industry.
49. There will likely be more consolidation of golf courses under management firms that will place their own superintendent on site.
50. Regulations may require contractual services for aeration of turfgrass sites.
51. Chemical (pesticide and fertilizer) application will only be available on a contractual basis and performed by individuals licensed by the federal government.
52. Documentation required to make pesticide application and applicator licenses will encourage many turfgrass managers to contract management services.
53. Pest scouting will increase to meet environmental regulations.
54. Ecology services will increase to meet environmental regulations.
55. There will be more contracted services available which will reduce the need for labor and will reduce staff risks associated with pesticides.
56. There will be more contracted services available which will reduce the need for equipment and adjust the budget that the superintendent must plan.
Management companies will increase, but must demonstrate they can produce at less cost and better quality of turf.
57. Turfgrass management companies will offer the golf course superintendent additional opportunities to grow in professionalism.
58. Contractual management services will be standard by the year 2020 which will lower management costs and lessen liability expense.
59. Management services will grow because they will have the capital to acquire and use equipment, materials, and other necessary supplies.
60. Home owners will use management services because of reduced costs, more leisure time, and quality of services delivered.

61. Complete soil and plant analysis will be routinely done on site by turfgrass managers trained in the use of specialized technology.

It would be difficult to justify the cost of establishing and maintaining labs. Statements in this section and some responses suggest more contractual services, except #61. If there would be a trend to more services, I doubt if soil and plant analyses would be excluded.

62. Public institutions, grounds, and parks will primarily be managed by private firms on a contractual basis.
63. The use of contract maintenance services will be partly driven by a need to shift liability for consequences resulting from pesticide applications and partly driven by an effort to reduce capital expenditures on seldom-used equipment.

Section V: Legal Issues

64. Nutrient management plans will need governmental approval to help minimize inappropriate applications.
65. Applying pesticides will be a more difficult task, requiring permits, justification, environmental impact, storage, etc.
66. Federal, state, and municipal agencies will establish more rules and regulations that will severely restrict standard maintenance practices, especially the use of pesticides.
- I believe this will happen! It already has in some parts of the country.*
67. Records of application for all chemicals will be required, indicating specific product information, application rates, environmental factors, and related site information.
68. A greater emphasis on professional certification of superintendents, assistants, and maintenance personnel (with respect to pesticide handling, equipment operations, and general qualifications) will be recognized.
69. Worker safety will be placed on an equal level with efficiency, productivity, and cost control.
70. Environmental issues, including restrictions on fertilizer and pesticide use, will continue to impact the industry.
- No.*
71. Legal issues will be the driving force in environmental and labor problems facing turfgrass managers.
72. Liability for actions taken by turf managers will require more licensing and certification, or insurance companies will cancel the facility's policy.
73. Liability issues will include hearing loss due to operating loud equipment, back problems from lifting, and cancer (especially skin cancer) which will greatly impact medical coverages and policies.

74. Turf managers will be required, on a regular basis, to sample water in lakes, streams, and wells associated with the property being managed.
75. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with equipment training and personal protective equipment.
76. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with union workplace violence and hiring and firing issues.
77. The golf course superintendent will be forced to be increasingly aware of risk management issues associated with contract management, sexual harassment, environmental compliance, safe work practices, walking surfaces, and tree liability.
78. Turf managers will need to establish and maintain a preventive risk management plan for loss, claims, and law suits.
79. Compliance with environmental regulations will require golf course superintendents to be well-rounded in their understanding of these issues.
80. Compliance with employee and accessibility regulations will require golf course superintendents to be well-rounded in their understanding of these issues.
81. All turfgrass personnel, regardless of level, will be required to have a license to operate various pieces of maintenance equipment as an expression of competency.

Section VI: Chemical Issues

82. Availability and use of fertilizers and pesticides will be under more critical observation from the general public and turfgrass management teams in the future.
83. Fewer pesticides will be available for use, due to development costs, regulation, newer pest-tolerant cultivars, and greater dependence on integrated pest management programs.
84. Legislated restrictions on pesticide use will be the primary problem the industry faces.
85. Chemical issues will play an important role in turf management, especially in the high-density urban environment.
86. Demand for perfect turf is currently making it difficult for turf managers to implement sound integrated management programs.
87. Pesticides will be more specific in their mode of action.
88. Biological control of pests in turfgrass will become more popular and such methods will be used more frequently.
89. Pesticides will be of the low-risk, quickly degradable, pest-specific, immobile type.
90. From an environmental standpoint, golf courses will be using compounds that are "safe" in the environment and have minor environmental impact due to extremely low concentrations.
91. Chemical use will be integrated closely with the new genetically engineered turfgrass cultivars.

92. The development of new turfgrass cultivars that are resistant to a wide range of pests will reduce or eliminate the need for pesticides on turfgrass.
93. Turf managers must have a better understanding of how minor elements affect turfgrass health.

Section VII: Environmental Issues

94. The fate of pesticides (fungicides, herbicides, insecticides, nematocides, etc.) and fertilizers applied to turf areas will be more critical and an integral component of the chemical management program.
95. A more comprehensive approach to environmental issues will be employed, with respect to chemical fate, beautification, wildlife sanctuaries, exotic species preservation, people responses, and the loss of natural areas.
96. Expanded use of treated water and less potable water will be the focus of turf managers.
97. Best Management Practice programs will help to prevent or minimize pesticide runoff and leaching.
98. Golf course management has positioned itself as an example of environmental stewardship and can take a leadership role for other industries to follow.
99. The development of facilities on marginal soils for turfgrass areas (e.g. golf courses, sports fields) will require additional costs to develop.
100. Greater emphasis will be placed on control of invasive, non-indigenous species of plants within local areas.
101. The use of pesticides will be monitored from the standpoint of public health.
102. Environmental issues of great concern will be the use of scarce water resources, and the prevention of water pollution.
103. Southern turfgrasses will be developed for sodium tolerance.
104. Turf managers will be responsible for informing and educating governmental agency personnel, environmental groups, and the general public on the environmental benefits of turfgrass at all maintenance levels.
105. Golf courses will be a positive influence on wetland recovery for the country.
106. Bio-technology programs will be more available as alternative methods are developed through concern about the planet's natural resources.

Section VIII: Best Management Practices

107. Turf managers will be responsible for developing and implementing an appropriate nutrient management program.
108. Turf managers will be responsible for implementing integrated pest management programs, and held accountable for such programs.

109. Turf managers will be expected to maintain desirable soil physical properties as a result of implementing best management practices.

Proper soil management is the "key" to success that many turf managers overlook.

110. Turfgrass managers will be required to have fertilizer and pesticide application programs approved before they can be implemented.
111. Integrated programs (e.g. integrated pest management and best management practices) that emphasize management steps to improve turf quality with limited pesticide use will be the primary emphasis.
112. Pest scouting will be required before pesticides are applied.
113. Increased monitoring of the weather and climate to document conditions favorable to pests will be required.
114. The use of site-specific management and remote sensing devices will increase.
115. Variable rate fertility practices will be commonplace in cultural programs.
116. Using appropriate portions of the landscape as buffers within the ecosystem will be more common.
117. The use of growth regulators to reduce mowing and soil compaction will increase.
118. The use of non-polluting electric motors on turf equipment will increase.
- Probably fuel cells rather than electrical motors.*
119. Infrared spectrometry will be coupled with computer technology for improved diagnostic and prediction models in turfgrass.
120. Tissue culture analysis will be coupled with computer technology for improved diagnostic and prediction models in turfgrass.
121. Water flow and potential environmental impact predictions will precede fertilizer and pesticide application and use.
122. A better understanding of the entire ecosystem surrounding the golf course will occur allowing turfgrass managers to make better informed decisions regarding maintenance practices.
123. Precision application of fertilizers will be standard; only those areas needing treatment will be treated.
124. Prescription pesticides will be a part of best management practices.
125. Low-input, sustainable turfgrass management will be the key.

126. Turfgrasses will play a major role in the planning process for development of undisturbed watersheds.

If turfgrass is introduced, the area probably will no longer be "undisturbed".

127. The government (state or national) will mandate and define the "best management practices" which the golf course managers will have to follow.

Yes; however, these mandates will have industry input and support. Otherwise, state and national governments will have to deal with an angry industry.

Too costly.

Section IX: Other Issues and/or Circumstances

128. Turf managers will be expected to identify and implement the best use of time for professional development.
129. Turf managers will be more critically evaluated on membership in professional associations and receipt of trade journals, attendance at short courses and conferences, and how many and which ones to attend.
130. Turf managers will be more critically evaluated on the best use of available funds in professional development.
131. Turf managers will be more accountable in financial support to foundations, universities, and other organizations.
132. Turf managers will be more accountable for the time that is reserved for supporting turf-related associations (officer, board member, committee member, etc.) at the local, state, national, and international levels.
133. Turf managers will spend more time keeping records and practicing public relations.
134. In addition to technical skills, turf managers will need to know people management, risk management, environmental stewardship, communication skills, business administration, and foster favorable public relations and image management to their employer and to members of the community.
135. The demand for accredited educational programs that can be delivered to people who are employed full-time will increase.
136. Staff development seminars and in-services will be a means of educating employees and exhibiting progressive management styles.
137. Golf courses and other turfgrass areas will have on-site laboratories as a means of conducting various research programs, cooperating with state and federal agencies.
138. More grants will be made available from the private sector for funding research.
139. More ethnic minorities will seek employment on golf courses.
140. Turf managers will foster an environment that encourages diversity from management to the labor

force as "team efforts" continue to be the norm.

141. Scheduling for successful maintenance will become more critical as play increases.
142. Night-time maintenance, split shifts, part-time employees, etc. will be required to accomplish tasks while minimizing impact of the guests or members at golf courses.
143. Mowers will be quieter, easier to operate, and offer higher safety.
144. Mowers will operate on energy sources different from today's gasoline and diesel engines.
145. Shear (reel) and impact (rotary) mowing equipment will remain basic to mowing.
146. Laser and other cutting methods will remain too expensive and produce unsatisfactory cutting units.
147. There will be a need for even more specialized staff positions such as electrical mechanics that can diagnose and repair more high tech equipment.

Equipment will have more definitive diagnostic units to tell exactly what is wrong. Mechanic will replace component packages rather than a part.

Additional comments relating to the characteristics of the U.S. turf industry in the year 2020:

A good survey. Responses are, in most cases, in agreement. Differences are a result of experience and training (my guess).

Water, the quantity used, and the result of golf course maintenance operations on quality will remain foremost in the public's eye. In California, and sooner than wanted, energy consumption will be scrutinized. Years of excesses will slowly come to a halt - hopefully. But, superintendents have always shown the ability to adapt to circumstances and golf course maintenance standards will continue to improve, with assistance from research and product improvements.

Not sure that on-site research will be required by employers of turfgrass managers. Well-designed research will be costly. We can expect more, less, or same change as we had from 1981 to 2000 or 1961 to 1980. In the final report, the distribution of responses may be of as much interest as a mean value. A wide distribution (indicating disagreement among respondents) could have the same mean as a narrow distribution. Also, responses from professional categories (educator, consultants, etc.) Could be of interest if there are enough people responding from each category. Also, age and/or years in the profession.

I have reviewed your survey. You have put a lot of time into it. I am glad y conclusions were somewhat in line with the other respondents. This study will, to quite an extent, predict trends in the field of turf management and production. I hope I am around in twenty years to see how close we came with your estimates. Trends and cycles, short term and long term, often differ from our present thinking and attitudes. I have now been around long enough to witness some of these variables in the ecology and environment. As an educator you have the opportunity to monitor and record these undulations. The weather is cyclic; now the cycle is back toward warmer summers and winters. During some of those wetter years, the USGA trended toward sandier, more permeable soil mixes for golf greens. Now the permeability rates are up to twenty-four inches per hour as against 0.5 to 1.5 inches originally established by the USGA in 1960. That means more and more irrigation. Ore leaching of nitrogen. But, water conservation is no more in vogue. So a situation of opposites. Use less water and less nitrogen. It requires fuel to

produce nitrogen fertilizers, and fuel is a t a premium now. In the earlier years of the Soil Conservation Service, farm ponds were the thing for water conservation. The EPA became popular and severely restricts the building of ponds and lakes because of the wildlife, wetland issue. So farmers had to rely on deep wells to get water from the aquifer. After twenty years of the pond building moratorium, the government is now considering paying framers to build ponds and lakes in order to reduce the pressure on our underground water resource. So your study and studies like it should benefit us in predicting trends. Or particularly, they should help us become ore judicious with our long range decisions.

Appendix P
Medians and Interquartile Ranges
for
Rounds Two and Three

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 1 | 25 | 4 | 2 | 4 | 1 | -1 |
| 2 | 25 | 3 | 2 | 4 | 2 | 0 |
| 3 | 25 | 4 | 1 | 4 | 1 | 0 |
| 4 | 25 | 4 | 1 | 4 | 1 | 0 |
| 5 | 25 | 5 | 1 | 5 | 1 | 0 |
| 6 | 25 | 5 | 1 | 5 | 1 | 0 |
| 7 | 25 | 5 | 0 | 5 | 0 | 0 |
| 8 | 25 | 4 | 1 | 4 | 0 | -1 |
| 9 | 25 | 4 | 1 | 4 | 1 | 0 |
| 10 | 25 | 4 | 1 | 5 | 1 | 0 |
| 11 | 25 | 4 | 1 | 4 | 1 | 0 |
| 12 | 25 | 5 | 0 | 5 | 0 | 0 |
| 13 | 25 | 4 | 1 | 4 | 1 | 0 |
| 14 | 25 | 5 | 1 | 5 | 1 | 0 |
| 15 | 25 | 4 | 1 | 4 | 1 | 0 |
| 16 | 25 | 4 | 0 | 4 | 1 | 1 |
| 17 | 25 | 4 | 1 | 4 | 1 | 0 |
| 18 | 25 | 3 | 0 | 3 | 0 | 0 |
| 19 | 25 | 4 | 1 | 4 | 1 | 0 |
| 20 | 25 | 3 | 2 | 3 | 2 | 0 |
| 21 | 25 | 3 | 1 | 3 | 1 | 0 |
| 22 | 25 | 3 | 1 | 3 | 1 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 23 | 25 | 4 | 0 | 4 | 0 | 0 |
| 24 | 25 | 4 | 0 | 4 | 0 | 0 |
| 25 | 25 | 4 | 1 | 4 | 1 | 0 |
| 26 | 25 | 4 | 0 | 4 | 0 | 0 |
| 27 | 25 | 4 | 1 | 4 | 1 | 0 |
| 28 | 25 | 5 | 1 | 5 | 1 | 0 |
| 29 | 25 | 4 | 0 | 4 | 1 | 1 |
| 30 | 25 | 4 | 1 | 4 | 1 | 0 |
| 31 | 25 | 3 | 1 | 3 | 1 | 0 |
| 32 | 25 | 4 | 1 | 4 | 1 | 0 |
| 33 | 25 | 4 | 2 | 4 | 1 | -1 |
| 34 | 25 | 4 | 1 | 4 | 1 | 0 |
| 35 | 25 | 4 | 2 | 4 | 1 | -1 |
| 36 | 25 | 4 | 1 | 4 | 1 | 0 |
| 37 | 25 | 4 | 1 | 4 | 1 | 0 |
| 38 | 24 | 4 | 1 | 4 | 1 | 0 |
| 39 | 23 | 4 | 1 | 4 | 1 | 0 |
| 40 | 25 | 4 | 1 | 4 | 1 | 0 |
| 41 | 24 | 2.5 | 1.5 | 2.5 | 1 | -0.5 |
| 42 | 25 | 4 | 1 | 4 | 1 | 0 |
| 43 | 25 | 4 | 1 | 4 | 2 | 1 |
| 44 | 25 | 4 | 1 | 4 | 1 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 45 | 25 | 4 | 1 | 4 | 0 | -1 |
| 46 | 25 | 4 | 0 | 4 | 0 | 0 |
| 47 | 25 | 4 | 0 | 4 | 0 | 0 |
| 48 | 25 | 5 | 1 | 5 | 1 | 0 |
| 49 | 25 | 4 | 0 | 4 | 0 | 0 |
| 50 | 25 | 3 | 1 | 3 | 1 | 0 |
| 51 | 25 | 2 | 1 | 2 | 1 | 0 |
| 52 | 25 | 3 | 2 | 3 | 2 | 0 |
| 53 | 25 | 4 | 0 | 4 | 0 | 0 |
| 54 | 25 | 4 | 0 | 4 | 0 | 0 |
| 55 | 25 | 4 | 1 | 4 | 1 | 0 |
| 56 | 25 | 3 | 1 | 3 | 1 | 0 |
| 57 | 25 | 4 | 1 | 4 | 1 | 0 |
| 58 | 25 | 3 | 2 | 3 | 2 | 0 |
| 59 | 25 | 4 | 1 | 4 | 1 | 0 |
| 60 | 25 | 4 | 1 | 4 | 1 | 0 |
| 61 | 25 | 3 | 2 | 3 | 2 | 0 |
| 62 | 24 | 3 | 2 | 3 | 1.5 | -0.5 |
| 63 | 25 | 4 | 1 | 4 | 0 | -1 |
| 64 | 25 | 3 | 2 | 3 | 2 | 0 |
| 65 | 25 | 4 | 0 | 4 | 1 | 1 |
| 66 | 25 | 4 | 0 | 4 | 0 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 67 | 25 | 4 | 1 | 4 | 1 | 0 |
| 68 | 25 | 4 | 1 | 4 | 1 | 0 |
| 69 | 25 | 4 | 0 | 4 | 0 | 0 |
| 70 | 25 | 4 | 1 | 4 | 1 | 0 |
| 71 | 25 | 4 | 1 | 4 | 0 | -1 |
| 72 | 25 | 4 | 1 | 4 | 1 | 0 |
| 73 | 25 | 4 | 1 | 4 | 1 | 0 |
| 74 | 25 | 4 | 0 | 4 | 0 | 0 |
| 75 | 25 | 4 | 0 | 4 | 0 | 0 |
| 76 | 25 | 4 | 1 | 4 | 0 | -1 |
| 77 | 25 | 4 | 0 | 4 | 0 | 0 |
| 78 | 25 | 4 | 0 | 4 | 0 | 0 |
| 79 | 24 | 4 | 1 | 4 | 1 | 0 |
| 80 | 25 | 4 | 1 | 4 | 1 | 0 |
| 81 | 25 | 3 | 1 | 3 | 1 | 0 |
| 82 | 25 | 4 | 0 | 4 | 1 | 1 |
| 83 | 25 | 4 | 0 | 4 | 0 | 0 |
| 84 | 25 | 3 | 1 | 3 | 1 | 0 |
| 85 | 25 | 4 | 0 | 4 | 0 | 0 |
| 86 | 25 | 4 | 1 | 4 | 1 | 0 |
| 87 | 24 | 4 | 1 | 4 | 1 | 0 |
| 88 | 25 | 4 | 1 | 4 | 1 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 89 | 25 | 4 | 0 | 4 | 0 | 0 |
| 90 | 25 | 4 | 0 | 4 | 0 | 0 |
| 91 | 25 | 4 | 1 | 4 | 2 | 1 |
| 92 | 25 | 4 | 2 | 4 | 2 | 0 |
| 93 | 25 | 4 | 1 | 4 | 0 | -1 |
| 94 | 25 | 4 | 1 | 4 | 1 | 0 |
| 95 | 25 | 4 | 1 | 4 | 1 | 0 |
| 96 | 25 | 5 | 1 | 5 | 1 | 0 |
| 97 | 25 | 4 | 1 | 4 | 1 | 0 |
| 98 | 25 | 4 | 0 | 4 | 0 | 0 |
| 99 | 25 | 4 | 0 | 4 | 0 | 0 |
| 100 | 25 | 4 | 1 | 4 | 1 | 0 |
| 101 | 25 | 4 | 0 | 4 | 0 | 0 |
| 102 | 25 | 5 | 1 | 5 | 1 | 0 |
| 103 | 24 | 4 | 0.5 | 4 | 0.5 | 0 |
| 104 | 25 | 4 | 0 | 4 | 0 | 0 |
| 105 | 25 | 4 | 1 | 4 | 1 | 0 |
| 106 | 25 | 4 | 0 | 4 | 1 | 1 |
| 107 | 25 | 4 | 1 | 4 | 1 | 0 |
| 108 | 25 | 4 | 1 | 4 | 1 | 0 |
| 109 | 25 | 4 | 1 | 4 | 1 | 0 |
| 110 | 25 | 4 | 1 | 4 | 1 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 111 | 25 | 4 | 0 | 4 | 0 | 0 |
| 112 | 25 | 4 | 1 | 4 | 1 | 0 |
| 113 | 25 | 4 | 1 | 4 | 0 | -1 |
| 114 | 25 | 4 | 0 | 4 | 0 | 0 |
| 115 | 25 | 4 | 0 | 4 | 0 | 0 |
| 116 | 25 | 4 | 0 | 4 | 1 | 1 |
| 117 | 25 | 4 | 1 | 4 | 1 | 0 |
| 118 | 25 | 4 | 0 | 4 | 0 | 0 |
| 119 | 25 | 4 | 1 | 4 | 1 | 0 |
| 120 | 25 | 4 | 1 | 4 | 1 | 0 |
| 121 | 25 | 4 | 1 | 4 | 1 | 0 |
| 122 | 25 | 4 | 0 | 4 | 0 | 0 |
| 123 | 25 | 4 | 0 | 4 | 0 | 0 |
| 124 | 25 | 4 | 1 | 4 | 1 | 0 |
| 125 | 24 | 4 | 1 | 4 | 1 | 0 |
| 126 | 25 | 4 | 1 | 4 | 1 | 0 |
| 127 | 25 | 3 | 2 | 3 | 1 | -1 |
| 128 | 25 | 4 | 0 | 4 | 0 | 0 |
| 129 | 25 | 4 | 1 | 4 | 1 | 0 |
| 130 | 25 | 4 | 1 | 4 | 0 | -1 |
| 131 | 25 | 3 | 2 | 3 | 2 | 0 |
| 132 | 25 | 4 | 1 | 4 | 1 | 0 |

Medians and Interquartile Ranges for Rounds 2 and 3 and
the Difference Between Interquartile Ranges by Item (continued)

| Item | N | Round 2 | | Round 3 | | Change in Interquartile Range R3 - R2 |
|------|----|---------|-----------------------------------|---------|-----------------------------------|--|
| | | Median | Interquartile Range Q3 - Q1 | Median | Interquartile Range Q3 - Q1 | |
| 133 | 25 | 4 | 0 | 4 | 0 | 0 |
| 134 | 25 | 4 | 1 | 5 | 1 | 0 |
| 135 | 24 | 4 | 0.5 | 4 | 0.5 | 0 |
| 136 | 25 | 4 | 0 | 4 | 0 | 0 |
| 137 | 25 | 3 | 1 | 3 | 1 | 0 |
| 138 | 25 | 3 | 2 | 3 | 2 | 0 |
| 139 | 25 | 4 | 0 | 4 | 0 | 0 |
| 140 | 24 | 4 | 1 | 4 | 1 | 0 |
| 141 | 25 | 4 | 0 | 4 | 0 | 0 |
| 142 | 25 | 4 | 1 | 4 | 1 | 0 |
| 143 | 25 | 4 | 0 | 4 | 0 | 0 |
| 144 | 25 | 4 | 1 | 4 | 1 | 0 |
| 145 | 25 | 4 | 0 | 4 | 0 | 0 |
| 146 | 25 | 3 | 0 | 3 | 1 | 1 |
| 147 | 25 | 4 | 1 | 4 | 1 | 0 |

Appendix Q
Statistical Summary of All Data

Statistical Summary of All Data *

| Instrument Site Name | Number Of Responses | Response Mean | Response Std Dev | Response Minimum | Response Mode | Response Q1 | Response Q3 | Response Range | Number Of Responses | Response Mean | Response Std Dev | Response Minimum | Response Mode | Response Q1 | Response Q3 | Response Range |
|----------------------|---------------------|---------------|------------------|------------------|---------------|-------------|-------------|----------------|---------------------|---------------|------------------|------------------|---------------|-------------|-------------|----------------|
| 1 | 25 | 3.52 | 1.160 | 4 | 4 | 2 | 4 | 2 | 25 | 3.60 | 1.041 | 4 | 4 | 3 | 4 | 1 |
| 2 | 25 | 3.20 | 1.259 | 3 | 4 | 2 | 4 | 2 | 25 | 3.36 | 1.221 | 4 | 4 | 2 | 4 | 2 |
| 3 | 25 | 3.52 | 1.046 | 4 | 4 | 3 | 4 | 1 | 25 | 3.52 | 0.919 | 4 | 4 | 3 | 4 | 1 |
| 4 | 25 | 3.60 | 1.155 | 4 | 4 | 3 | 4 | 1 | 25 | 3.76 | 1.052 | 4 | 4 | 3 | 4 | 1 |
| 5 | 25 | 4.40 | 0.817 | 5 | 5 | 4 | 5 | 1 | 25 | 4.40 | 0.764 | 5 | 5 | 4 | 5 | 1 |
| 6 | 25 | 4.48 | 0.823 | 5 | 5 | 4 | 5 | 1 | 25 | 4.56 | 0.584 | 5 | 5 | 4 | 5 | 1 |
| 7 | 25 | 4.76 | 0.436 | 5 | 5 | 5 | 5 | 0 | 25 | 4.72 | 0.542 | 5 | 5 | 5 | 5 | 0 |
| 8 | 25 | 4.04 | 0.841 | 4 | 4 | 4 | 5 | 1 | 25 | 3.96 | 0.935 | 4 | 4 | 4 | 4 | 0 |
| 9 | 25 | 4.36 | 0.638 | 4 | 4 | 4 | 5 | 1 | 25 | 4.32 | 0.627 | 4 | 4 | 4 | 5 | 1 |
| 10 | 25 | 4.44 | 0.507 | 4 | 4 | 4 | 5 | 1 | 25 | 4.52 | 0.510 | 5 | 5 | 4 | 5 | 1 |
| 11 | 25 | 3.72 | 0.843 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.843 | 4 | 4 | 3 | 4 | 1 |
| 12 | 25 | 4.84 | 0.374 | 5 | 5 | 5 | 5 | 0 | 25 | 4.84 | 0.375 | 5 | 5 | 5 | 5 | 0 |
| 13 | 25 | 4.24 | 0.724 | 4 | 4 | 4 | 5 | 1 | 25 | 4.28 | 0.738 | 4 | 4 | 4 | 5 | 1 |
| 14 | 25 | 4.64 | 0.490 | 5 | 5 | 4 | 5 | 1 | 25 | 4.72 | 0.459 | 5 | 5 | 4 | 5 | 1 |
| 15 | 25 | 4.08 | 0.954 | 4 | 5 | 4 | 5 | 1 | 25 | 4.12 | 0.928 | 4 | 4 | 4 | 5 | 1 |
| 16 | 25 | 4.04 | 0.735 | 4 | 4 | 4 | 4 | 0 | 25 | 4.04 | 0.790 | 4 | 4 | 4 | 5 | 1 |
| 17 | 25 | 3.56 | 0.961 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.891 | 4 | 4 | 3 | 4 | 1 |
| 18 | 25 | 3.12 | 0.600 | 3 | 3 | 3 | 3 | 0 | 25 | 3.12 | 0.600 | 3 | 3 | 3 | 3 | 0 |
| 19 | 25 | 3.40 | 0.958 | 4 | 4 | 3 | 4 | 1 | 25 | 3.36 | 0.908 | 4 | 4 | 3 | 4 | 1 |
| 20 | 25 | 2.88 | 1.093 | 3 | 2 | 2 | 4 | 2 | 25 | 2.76 | 1.091 | 3 | 2 | 2 | 4 | 2 |
| 21 | 25 | 3.00 | 1.041 | 3 | 3 | 3 | 4 | 1 | 25 | 3.08 | 1.038 | 3 | 3 | 3 | 4 | 1 |

| | | | | | | | | | | | | | | | | |
|----|----|------|-------|-----|---|-----|-----|-----|----|------|-------|---|---|---|---|---|
| 22 | 25 | 3.28 | 0.792 | 3 | 3 | 3 | 4 | 1 | 25 | 3.32 | 0.749 | 3 | 3 | 3 | 4 | 1 |
| 23 | 25 | 3.96 | 0.611 | 4 | 4 | 4 | 4 | 0 | 25 | 3.96 | 0.611 | 4 | 4 | 4 | 4 | 0 |
| 24 | 25 | 4.08 | 0.400 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.440 | 4 | 4 | 4 | 4 | 0 |
| 25 | 25 | 3.80 | 1.000 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.937 | 4 | 4 | 3 | 4 | 1 |
| 26 | 25 | 3.96 | 0.790 | 4 | 4 | 4 | 4 | 0 | 25 | 4.00 | 0.708 | 4 | 4 | 4 | 4 | 0 |
| 27 | 25 | 4.24 | 0.779 | 4 | 4 | 4 | 5 | 1 | 25 | 4.16 | 0.747 | 4 | 4 | 4 | 5 | 1 |
| 28 | 25 | 4.52 | 0.510 | 5 | 5 | 4 | 5 | 1 | 25 | 4.56 | 0.507 | 5 | 5 | 4 | 5 | 1 |
| 29 | 25 | 4.04 | 0.735 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.726 | 4 | 4 | 4 | 5 | 1 |
| 30 | 25 | 3.36 | 1.036 | 4 | 4 | 3 | 4 | 1 | 25 | 3.48 | 1.085 | 4 | 4 | 3 | 4 | 1 |
| 31 | 25 | 3.16 | 0.899 | 3 | 3 | 3 | 4 | 1 | 25 | 3.04 | 0.889 | 3 | 3 | 3 | 4 | 1 |
| 32 | 25 | 4.32 | 0.557 | 4 | 4 | 4 | 5 | 1 | 25 | 4.28 | 0.614 | 4 | 4 | 4 | 5 | 1 |
| 33 | 25 | 3.36 | 1.288 | 4 | 2 | 2 | 4 | 2 | 25 | 3.40 | 1.118 | 4 | 4 | 3 | 4 | 1 |
| 34 | 25 | 4.32 | 0.477 | 4 | 4 | 4 | 5 | 1 | 25 | 4.36 | 0.490 | 4 | 4 | 4 | 5 | 1 |
| 35 | 25 | 3.44 | 1.228 | 4 | 4 | 2 | 4 | 2 | 25 | 3.44 | 1.044 | 4 | 4 | 3 | 4 | 1 |
| 36 | 25 | 3.44 | 1.084 | 4 | 4 | 3 | 4 | 1 | 25 | 3.36 | 0.908 | 4 | 4 | 3 | 4 | 1 |
| 37 | 25 | 4.32 | 0.628 | 4 | 4 | 4 | 5 | 1 | 25 | 4.40 | 0.578 | 4 | 4 | 4 | 5 | 1 |
| 38 | 24 | 3.96 | 0.807 | 4 | 4 | 3.5 | 4.5 | 1 | 25 | 3.92 | 0.863 | 4 | 4 | 4 | 4 | 0 |
| 39 | 23 | 4.35 | 0.648 | 4 | 4 | 4 | 5 | 1 | 24 | 4.37 | 0.576 | 4 | 4 | 4 | 5 | 1 |
| 40 | 25 | 4.12 | 0.882 | 4 | 4 | 4 | 5 | 1 | 25 | 4.08 | 0.863 | 4 | 4 | 4 | 5 | 1 |
| 41 | 24 | 2.80 | 1.063 | 2.5 | 2 | 2 | 3.5 | 1.5 | 25 | 2.76 | 0.970 | 3 | 2 | 2 | 2 | 1 |
| 42 | 25 | 3.68 | 0.691 | 4 | 4 | 3 | 4 | 1 | 25 | 3.60 | 0.764 | 4 | 4 | 3 | 4 | 1 |
| 43 | 25 | 3.80 | 1.000 | 4 | 4 | 3 | 4 | 1 | 25 | 3.80 | 1.041 | 4 | 4 | 3 | 5 | 2 |
| 44 | 25 | 4.32 | 0.802 | 4 | 5 | 4 | 5 | 1 | 25 | 4.36 | 0.638 | 4 | 4 | 4 | 5 | 1 |
| 45 | 25 | 4.20 | 0.578 | 4 | 4 | 4 | 5 | 1 | 25 | 4.16 | 0.554 | 4 | 4 | 4 | 4 | 0 |
| 46 | 25 | 3.84 | 0.800 | 4 | 4 | 4 | 4 | 0 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 |
| 47 | 25 | 3.88 | 0.726 | 4 | 4 | 4 | 4 | 0 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 |
| 48 | 25 | 4.52 | 0.586 | 5 | 5 | 4 | 5 | 1 | 25 | 4.56 | 0.507 | 5 | 5 | 4 | 5 | 1 |
| 49 | 25 | 4.08 | 0.494 | 4 | 4 | 4 | 4 | 0 | 25 | 4.08 | 0.494 | 4 | 4 | 4 | 4 | 0 |
| 50 | 25 | 2.64 | 0.861 | 3 | 3 | 2 | 3 | 1 | 25 | 2.60 | 0.913 | 3 | 2 | 2 | 3 | 1 |
| 51 | 25 | 2.52 | 0.963 | 2 | 2 | 2 | 3 | 1 | 25 | 2.48 | 1.005 | 2 | 2 | 2 | 3 | 1 |
| 52 | 25 | 3.20 | 1.081 | 3 | 3 | 2 | 4 | 2 | 25 | 3.20 | 1.081 | 3 | 3 | 2 | 4 | 2 |
| 53 | 25 | 4.00 | 0.708 | 4 | 4 | 4 | 4 | 0 | 25 | 4.04 | 0.611 | 4 | 4 | 4 | 4 | 0 |
| 54 | 25 | 4.08 | 0.703 | 4 | 4 | 4 | 4 | 0 | 25 | 4.08 | 0.641 | 4 | 4 | 4 | 4 | 0 |
| 55 | 25 | 3.64 | 0.908 | 4 | 4 | 3 | 4 | 1 | 25 | 3.60 | 0.866 | 4 | 4 | 3 | 4 | 1 |

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|----|----|------|--------|---|---|---|---|---|----|------|-------|---|---|---|---|---|
| 56 | 25 | 3.32 | 0.9889 | 3 | 3 | 3 | 4 | 1 | 25 | 3.36 | 1.036 | 3 | 3 | 3 | 4 | 1 |
| 57 | 25 | 3.48 | 1.046 | 4 | 4 | 3 | 4 | 1 | 25 | 3.48 | 0.963 | 4 | 4 | 3 | 4 | 1 |
| 58 | 25 | 2.88 | 0.928 | 3 | 3 | 2 | 4 | 2 | 25 | 2.88 | 0.928 | 3 | 3 | 2 | 4 | 2 |
| 59 | 25 | 3.40 | 0.708 | 4 | 4 | 3 | 4 | 1 | 25 | 3.44 | 0.651 | 4 | 4 | 3 | 4 | 1 |
| 60 | 25 | 3.40 | 0.866 | 4 | 4 | 3 | 4 | 1 | 25 | 3.40 | 0.817 | 4 | 4 | 3 | 4 | 1 |
| 61 | 25 | 3.12 | 0.973 | 3 | 4 | 2 | 4 | 2 | 25 | 3.04 | 0.935 | 3 | 3 | 2 | 4 | 2 |
| 62 | 24 | 2.92 | 0.830 | 3 | 2 | 2 | 4 | 2 | 25 | 2.88 | 0.781 | 3 | 3 | 2 | 3 | 1 |
| 63 | 25 | 3.76 | 0.664 | 4 | 4 | 3 | 4 | 1 | 25 | 3.80 | 0.646 | 4 | 4 | 4 | 4 | 0 |
| 64 | 25 | 3.20 | 0.958 | 3 | 4 | 2 | 4 | 2 | 25 | 3.24 | 0.926 | 3 | 4 | 2 | 4 | 2 |
| 65 | 25 | 4.04 | 0.790 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.688 | 4 | 4 | 4 | 5 | 1 |
| 66 | 25 | 3.88 | 0.781 | 4 | 4 | 4 | 4 | 0 | 25 | 3.92 | 0.703 | 4 | 4 | 4 | 4 | 0 |
| 67 | 25 | 4.36 | 0.567 | 4 | 4 | 4 | 5 | 1 | 25 | 4.36 | 0.569 | 4 | 4 | 4 | 5 | 1 |
| 68 | 25 | 4.16 | 0.851 | 4 | 4 | 4 | 5 | 1 | 25 | 4.16 | 0.800 | 4 | 4 | 4 | 5 | 1 |
| 69 | 25 | 3.88 | 0.726 | 4 | 4 | 4 | 4 | 0 | 25 | 3.88 | 0.726 | 4 | 4 | 4 | 4 | 0 |
| 70 | 25 | 4.36 | 0.700 | 4 | 4 | 4 | 5 | 1 | 25 | 4.32 | 0.691 | 4 | 4 | 4 | 5 | 1 |
| 71 | 25 | 3.72 | 0.891 | 4 | 4 | 3 | 4 | 1 | 25 | 3.76 | 0.831 | 4 | 4 | 4 | 4 | 0 |
| 72 | 25 | 3.76 | 0.598 | 4 | 4 | 3 | 4 | 1 | 25 | 3.76 | 0.598 | 4 | 4 | 3 | 4 | 1 |
| 73 | 25 | 3.60 | 0.764 | 4 | 4 | 3 | 4 | 1 | 25 | 3.64 | 0.700 | 4 | 4 | 3 | 4 | 1 |
| 74 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 |
| 75 | 25 | 4.16 | 0.473 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.473 | 4 | 4 | 4 | 4 | 0 |
| 76 | 25 | 3.76 | 0.779 | 4 | 4 | 3 | 4 | 1 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 |
| 77 | 25 | 4.12 | 0.440 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.440 | 4 | 4 | 4 | 4 | 0 |
| 78 | 25 | 3.88 | 0.526 | 4 | 4 | 4 | 4 | 0 | 25 | 3.92 | 0.494 | 4 | 4 | 4 | 4 | 0 |
| 79 | 24 | 4.38 | 0.495 | 4 | 4 | 4 | 5 | 1 | 25 | 4.40 | 0.500 | 4 | 4 | 4 | 5 | 1 |
| 80 | 25 | 4.32 | 0.477 | 4 | 4 | 4 | 5 | 1 | 25 | 4.24 | 0.523 | 4 | 4 | 4 | 5 | 1 |
| 81 | 25 | 2.80 | 0.866 | 3 | 2 | 2 | 3 | 1 | 25 | 2.72 | 0.891 | 3 | 2 | 2 | 3 | 1 |
| 82 | 25 | 4.16 | 0.625 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.800 | 4 | 4 | 4 | 5 | 1 |
| 83 | 25 | 4.00 | 0.764 | 4 | 4 | 4 | 4 | 0 | 25 | 4.04 | 0.676 | 4 | 4 | 4 | 4 | 0 |
| 84 | 25 | 3.16 | 0.899 | 3 | 4 | 3 | 4 | 1 | 25 | 3.24 | 0.926 | 3 | 4 | 3 | 4 | 1 |
| 85 | 25 | 4.16 | 0.625 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.625 | 4 | 4 | 4 | 4 | 0 |
| 86 | 25 | 4.08 | 0.997 | 4 | 4 | 4 | 5 | 1 | 25 | 4.24 | 0.779 | 4 | 4 | 4 | 5 | 1 |
| 87 | 24 | 4.33 | 0.702 | 4 | 5 | 4 | 5 | 1 | 25 | 4.28 | 0.738 | 4 | 5 | 4 | 5 | 1 |
| 88 | 25 | 3.68 | 1.070 | 4 | 4 | 3 | 4 | 1 | 25 | 3.64 | 1.036 | 4 | 4 | 3 | 4 | 1 |
| 89 | 25 | 4.12 | 0.600 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.600 | 4 | 4 | 4 | 4 | 0 |

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|-----|----|------|-------|---|---|---|-----|-----|----|------|-------|---|---|---|---|---|
| 90 | 25 | 3.88 | 0.526 | 4 | 4 | 4 | 4 | 0 | 25 | 3.88 | 0.526 | 4 | 4 | 4 | 4 | 0 |
| 91 | 25 | 4.00 | 1.080 | 4 | 5 | 4 | 5 | 0 | 25 | 3.96 | 1.099 | 4 | 5 | 3 | 5 | 2 |
| 92 | 25 | 3.20 | 1.000 | 4 | 4 | 2 | 4 | 2 | 25 | 3.24 | 1.012 | 4 | 4 | 2 | 4 | 2 |
| 93 | 25 | 3.68 | 0.900 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.891 | 4 | 4 | 4 | 4 | 0 |
| 94 | 25 | 4.28 | 0.459 | 4 | 4 | 4 | 5 | 1 | 25 | 4.28 | 0.459 | 4 | 4 | 4 | 5 | 1 |
| 95 | 25 | 4.36 | 0.490 | 4 | 4 | 4 | 5 | 1 | 25 | 4.36 | 0.490 | 4 | 4 | 4 | 5 | 1 |
| 96 | 25 | 4.56 | 0.507 | 5 | 5 | 4 | 5 | 1 | 25 | 4.52 | 0.510 | 5 | 5 | 4 | 5 | 1 |
| 97 | 25 | 4.32 | 0.691 | 4 | 4 | 4 | 5 | 1 | 25 | 4.36 | 0.638 | 4 | 4 | 4 | 5 | 1 |
| 98 | 25 | 4.12 | 0.600 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.526 | 4 | 4 | 4 | 4 | 0 |
| 99 | 25 | 4.08 | 0.641 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.473 | 4 | 4 | 4 | 4 | 0 |
| 100 | 25 | 3.68 | 0.802 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.679 | 4 | 4 | 3 | 4 | 1 |
| 101 | 25 | 4.12 | 0.526 | 4 | 4 | 4 | 4 | 0 | 25 | 4.08 | 0.494 | 4 | 4 | 4 | 4 | 0 |
| 102 | 25 | 4.52 | 0.510 | 5 | 5 | 4 | 5 | 1 | 25 | 4.56 | 0.507 | 5 | 5 | 4 | 5 | 1 |
| 103 | 24 | 4.17 | 0.565 | 4 | 4 | 4 | 4.5 | 0.5 | 25 | 4.28 | 0.459 | 4 | 4 | 4 | 5 | 1 |
| 104 | 25 | 3.80 | 0.707 | 4 | 4 | 4 | 4 | 0 | 25 | 4.00 | 0.646 | 4 | 4 | 4 | 4 | 0 |
| 105 | 25 | 3.76 | 0.779 | 4 | 4 | 3 | 4 | 1 | 25 | 3.72 | 0.738 | 4 | 4 | 3 | 4 | 1 |
| 106 | 25 | 3.80 | 0.646 | 4 | 4 | 4 | 4 | 0 | 25 | 3.72 | 0.738 | 4 | 4 | 3 | 4 | 1 |
| 107 | 25 | 4.32 | 0.477 | 4 | 4 | 4 | 5 | 1 | 25 | 4.32 | 0.477 | 4 | 4 | 4 | 5 | 1 |
| 108 | 25 | 4.36 | 0.490 | 4 | 4 | 4 | 5 | 1 | 25 | 4.40 | 0.500 | 4 | 4 | 4 | 5 | 1 |
| 109 | 25 | 3.80 | 0.578 | 4 | 4 | 3 | 4 | 1 | 25 | 3.80 | 0.578 | 4 | 4 | 3 | 4 | 1 |
| 110 | 25 | 3.56 | 0.961 | 4 | 4 | 3 | 4 | 1 | 25 | 3.36 | 0.995 | 4 | 4 | 3 | 4 | 1 |
| 111 | 25 | 4.00 | 0.817 | 4 | 4 | 4 | 4 | 0 | 25 | 4.00 | 0.817 | 4 | 4 | 4 | 4 | 0 |
| 112 | 25 | 3.76 | 0.879 | 4 | 4 | 3 | 4 | 1 | 25 | 3.84 | 0.800 | 4 | 4 | 3 | 4 | 1 |
| 113 | 25 | 3.84 | 0.625 | 4 | 4 | 3 | 4 | 1 | 25 | 3.88 | 0.600 | 4 | 4 | 4 | 4 | 0 |
| 114 | 25 | 4.20 | 0.500 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.473 | 4 | 4 | 4 | 4 | 0 |
| 115 | 25 | 4.00 | 0.764 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.600 | 4 | 4 | 4 | 4 | 0 |
| 116 | 25 | 4.20 | 0.500 | 4 | 4 | 4 | 4 | 0 | 25 | 4.24 | 0.523 | 4 | 4 | 4 | 5 | 1 |
| 117 | 25 | 3.56 | 0.870 | 4 | 4 | 3 | 4 | 1 | 25 | 3.56 | 0.821 | 4 | 4 | 3 | 4 | 1 |
| 118 | 25 | 3.84 | 0.688 | 4 | 4 | 4 | 4 | 0 | 25 | 3.88 | 0.666 | 4 | 4 | 4 | 4 | 0 |
| 119 | 25 | 3.80 | 0.707 | 4 | 4 | 3 | 4 | 1 | 25 | 3.80 | 0.707 | 4 | 4 | 3 | 4 | 1 |
| 120 | 25 | 3.56 | 0.768 | 4 | 4 | 3 | 4 | 1 | 25 | 3.56 | 0.651 | 4 | 4 | 3 | 4 | 1 |
| 121 | 25 | 3.56 | 0.712 | 4 | 4 | 3 | 4 | 1 | 25 | 3.64 | 0.637 | 4 | 4 | 3 | 4 | 1 |
| 122 | 25 | 4.08 | 0.572 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.375 | 4 | 4 | 4 | 4 | 0 |
| 123 | 25 | 3.92 | 0.641 | 4 | 4 | 4 | 4 | 0 | 25 | 4.00 | 0.578 | 4 | 4 | 4 | 4 | 0 |

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|-----|----|------|-------|---|---|---|-----|-----|----|------|-------|---|---|---|-----|-----|
| 124 | 25 | 3.80 | 0.764 | 4 | 4 | 3 | 4 | 1 | 25 | 3.76 | 0.724 | 4 | 4 | 3 | 4 | 1 |
| 125 | 24 | 3.50 | 0.978 | 4 | 4 | 3 | 4 | 1 | 24 | 3.63 | 0.876 | 4 | 4 | 3 | 4 | 1 |
| 126 | 25 | 3.52 | 0.872 | 4 | 4 | 3 | 4 | 1 | 25 | 3.56 | 0.821 | 4 | 4 | 3 | 4 | 1 |
| 127 | 25 | 3.00 | 0.913 | 3 | 4 | 2 | 4 | 2 | 25 | 3.04 | 0.841 | 3 | 3 | 3 | 4 | 1 |
| 128 | 25 | 3.88 | 0.600 | 4 | 4 | 4 | 4 | 0 | 25 | 3.92 | 0.572 | 4 | 4 | 4 | 4 | 0 |
| 129 | 25 | 3.52 | 0.823 | 4 | 4 | 3 | 4 | 1 | 25 | 3.56 | 0.712 | 4 | 4 | 3 | 4 | 1 |
| 130 | 25 | 3.72 | 0.891 | 4 | 4 | 3 | 4 | 1 | 25 | 3.88 | 0.781 | 4 | 4 | 4 | 4 | 0 |
| 131 | 25 | 3.04 | 1.099 | 3 | 4 | 2 | 4 | 2 | 25 | 3.08 | 1.038 | 3 | 3 | 2 | 4 | 2 |
| 132 | 25 | 3.36 | 0.811 | 4 | 4 | 3 | 4 | 1 | 25 | 3.32 | 0.853 | 4 | 4 | 3 | 4 | 1 |
| 133 | 25 | 4.12 | 0.332 | 4 | 4 | 4 | 4 | 0 | 25 | 4.16 | 0.375 | 4 | 4 | 4 | 4 | 0 |
| 134 | 25 | 4.48 | 0.510 | 4 | 4 | 4 | 5 | 1 | 25 | 4.52 | 0.510 | 5 | 5 | 4 | 5 | 1 |
| 135 | 24 | 4.17 | 0.565 | 4 | 4 | 4 | 4.5 | 0.5 | 24 | 4.17 | 0.565 | 4 | 4 | 4 | 4.5 | 0.5 |
| 136 | 25 | 4.12 | 0.526 | 4 | 4 | 4 | 4 | 0 | 25 | 4.08 | 0.494 | 4 | 4 | 4 | 4 | 0 |
| 137 | 25 | 2.72 | 0.843 | 3 | 2 | 2 | 3 | 1 | 25 | 2.68 | 0.802 | 3 | 2 | 2 | 3 | 1 |
| 138 | 25 | 3.04 | 0.935 | 3 | 4 | 2 | 4 | 2 | 25 | 3.12 | 1.093 | 3 | 3 | 2 | 4 | 2 |
| 139 | 25 | 3.88 | 0.726 | 4 | 4 | 4 | 4 | 0 | 25 | 3.92 | 0.641 | 4 | 4 | 4 | 4 | 0 |
| 140 | 24 | 3.75 | 0.608 | 4 | 4 | 3 | 4 | 1 | 24 | 3.75 | 0.608 | 4 | 4 | 3 | 4 | 1 |
| 141 | 25 | 4.16 | 0.473 | 4 | 4 | 4 | 4 | 0 | 25 | 4.12 | 0.440 | 4 | 4 | 4 | 4 | 0 |
| 142 | 25 | 3.52 | 0.823 | 4 | 4 | 3 | 4 | 1 | 25 | 3.64 | 0.700 | 4 | 4 | 3 | 4 | 1 |
| 143 | 25 | 4.16 | 0.374 | 4 | 4 | 4 | 4 | 0 | 25 | 4.20 | 0.409 | 4 | 4 | 4 | 4 | 0 |
| 144 | 25 | 3.72 | 0.737 | 4 | 4 | 3 | 4 | 1 | 25 | 3.80 | 0.764 | 4 | 4 | 3 | 4 | 1 |
| 145 | 25 | 3.96 | 0.611 | 4 | 4 | 4 | 4 | 0 | 25 | 3.96 | 0.676 | 4 | 4 | 4 | 4 | 0 |
| 146 | 25 | 3.16 | 0.688 | 3 | 3 | 3 | 3 | 0 | 25 | 3.24 | 0.664 | 3 | 3 | 3 | 4 | 1 |
| 147 | 25 | 3.76 | 0.779 | 4 | 4 | 3 | 4 | 1 | 25 | 3.76 | 0.779 | 4 | 4 | 3 | 4 | 1 |

* This appendix shows the statistics for all the responses received. Earlier tables represented matched responses.

Appendix R
Experts Invited to Serve on the Delphi Panel

Experts Invited to Serve on the Delphi Panel

| Name | Affiliation | City, State |
|-------------------------|--------------------------------------|----------------------|
| Dr. James B. Beard | Texas A&M University | College Station, TX |
| Dr. Lee Burpee | University of Georgia | Griffin, GA |
| Dr. Bob Carrow | University of Georgia | Griffin, GA |
| Dr. Nick Christians | Iowa State University | Ames, IA |
| Dr. Stephen Cockerham | University of California | Riverside, CA |
| Ms. Cindy Code | <i>Lawn & Landscape</i> | Cleveland, OH |
| Dr. Karl Danneberger | Ohio State University | Columbus, OH |
| Dr. Joe DiPaola | Novartis Crop Protection | Greensboro, NC |
| Dr. Joe Duich | Penn State University | State College, PA |
| Dr. Milt Engelke | Texas A&M University | Dallas, TX |
| Mr. Douglas Fender | Turfgrass Producers International | Rolling Meadows, IL |
| Dr. Reed Funk | Rutgers University | New Brunswick, NJ |
| Dr. Victor Gibeault | University of California | Riverside, CA |
| Mr. Gary Grigg, CGCS | Royal Poinciana Golf Club | Naples, FL |
| Dr. Wayne Hanna | USDA - Agricultural Research Service | Tifton, GA |
| Mr. Ted Horton, CGCS | Pebble Beach Company | Pebble Beach, CA |
| Dr. Richard Hurley | Rutgers University | East Stroudsburg, PA |
| Mr. Ray Jensen | Turfgrass Consultant | Tifton, GA |
| Dr. Keith Karnok | University of Georgia | Athens, GA |
| Mr. Mike Kenna | USGA Green Section | Stillwater, OK |
| Dr. Gil Landry | University of Georgia | Griffin, GA |
| Mr. Bill Liles | Prokoz, Inc. | High Point, NC |
| Dr. William Meyer | Rutgers University | New Brunswick, NJ |
| Mr. James Moore | USGA Green Section | Waco, TX |
| Mr. Randy Nichols, CGCS | Cherokee Town & Country Club | Dunwoody, GA |
| Dr. Charles Peacock | North Carolina State University | Raleigh, NC |

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|---------------------|----------------------------|---------------------|
| Dr. A. J. Powell | University of Kentucky | Lexington, KY |
| Dr. Paul Rieke | Michigan State University | East Lansing, MI |
| Dr. Robert Shearman | University of Nebraska | Lincoln, NE |
| Mr. Trevor Smith | Predator Ridge Golf Resort | Vernon, BC |
| Mr. Jim Snow | USGA Green Section | Far Hills, NJ |
| Dr. A. J. Turgeon | Penn State University | University Park, PA |
| Dr. Don Waddington | Penn State University | University Park, PA |
| Dr. Coleman Ward | Auburn University | Auburn, AL |
| Dr. Tom Watschke | Penn State University | University Park, PA |
| Dr. Jim Watson | Toro Company | Littleton, CO |
| Dr. Richard White | Texas A&M University | College Station, TX |
| Mr. Stanley Zontek | USGA Green Section | West Chester, PA |