

## Graduate Education in Turfgrass Science: The Graduate Student Perspective

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### ABSTRACT

During a special session on turfgrass education at the 1988 ASA annual meetings, discussion focused on the future of graduate education in turfgrass science. It soon became apparent that a better understanding of the current programs in turfgrass education was needed. On that basis, a study was initiated in 1989 with the objective of assessing the educational background, practical experience, research areas, and career goals of graduate students in turfgrass science. Questionnaires were sent to 67 turfgrass teaching-research-extension faculty at 30 universities to be completed by their graduate student(s). Questions were divided into four categories: (i) student profile, (ii) educational background and current degree program, (iii) prior work experience, and (iv) career goals. Thirty-six surveys were returned from 18 universities. Forty-two percent of the respondents were pursuing the M.S. degree while 58% were working on their doctorate. The average age of all students was 30 yr. Most students held an undergraduate degree in either agronomy or horticulture. Areas of graduate turfgrass research included more traditional areas such as fertility-nutrition, general management (cultural systems), and physiology. There was little research in the areas of biotechnology or molecular biology. Although most students had prior experience in turfgrass maintenance practices, many felt that they needed more practical turfgrass experience. Few turfgrass programs offered advanced undergraduate or graduate-level courses. There is a need for more advanced courses to be offered so that turfgrass graduate students can acquire more formal training in turfgrass science and learn about such topics as the environment and soils as they relate to turfgrass. Generally, students stated that the education they were receiving was adequate in meeting their career goals. Although most students expressed a concern for environmental issues related to the turfgrass industry, few students were addressing this issue in their research.

**I**N RECENT YEARS, there has been a decrease in the overall enrollment of agronomy students at land-grant institutions (Bacon and Beyrouthy, 1985). In addition, en-

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rollment in 4-yr baccalaureate degree (B.S.) programs in turfgrass management are lower than those in 2-yr programs (Dudeck and Peacock, 1991). If this trend continues, it may affect future enrollment in turfgrass science graduate programs throughout the country. The situation has generated deep concern about the present and future direction of turfgrass graduate education at land-grant institutions.

As a result of open discussion at a special evening session on turfgrass education sponsored by the C-5 Division at the 1988 annual meeting of the American Society of Agronomy, a comprehensive survey was conducted of the students in turfgrass graduate programs in the USA. Similar types of surveys have been used to evaluate the organization, teaching methods, and topical content of beginning crop science courses in the USA (Karnok and Connors, 1986; Connors and Karnok, 1986). Likewise, Dudeck and Peacock (1991) and Peacock and Dudeck (1991) found such surveys valuable when evaluating both 2-yr and 4-yr turfgrass management teaching programs in the country. Karnok et al. (1993b) utilized a survey to evaluate the overall organization of 4-yr turfgrass management programs. The questionnaire for each of the above surveys was completed by faculty members of each respective institution. None of the above studies addressed graduate education nor considered the student perspective as it related to turfgrass science.

The study presented here was designed to determine the student profile, educational background, prior work experience, career goals, and concerns of students enrolled in turfgrass graduate programs in the USA.

### MATERIALS AND METHODS

Questionnaires were mailed in July 1989 to 67 turfgrass research-teaching-extension faculty at 30 land-grant institutions. Faculty members were requested to have their graduate student(s) fill out the questionnaire(s). If the faculty member did not have any graduate students at the time, they were requested to indicate as such and to return the cover letter marked appropriately. A follow-up mailing of surveys was conducted in August 1989 to those who had not responded. The majority of the questions required short multiple choice or single word responses. Four questions required a response of at least several sentences.

The questionnaire included 26 questions that were or-

**Table 1. Universities and departments with turfgrass graduate programs that responded to the graduate student survey.**

University	Department
Auburn University	Agronomy and Soils
Clemson University	Horticulture
Cornell University	Floriculture and Ornamental Horticulture
Iowa State University	Horticulture
Kansas State University	Horticulture
Michigan State University	Crop and Soil Science
North Carolina State University	Crop Science
Purdue University	Agronomy
Rutgers University	Crop Science
Texas A&M University	Soil and Crop Science
University of Arizona	Plant Sciences
University of Georgia	Agronomy
University of Illinois	Horticulture
University of Massachusetts	Plant and Soil Sciences
University of Minnesota	Horticulture
University of Nebraska	Horticulture
University of Tennessee	Ornamental Horticulture and Landscape Design
University of Wisconsin	Soil Science

**Table 2. Past degrees and majors of students enrolled in turfgrass graduate programs.**

Past degree	Past major	Past degree program	
		M.S.	Ph.D.
B.S.	Agronomy	47	37
	Horticulture	26	47
	Engineering	20	0
	Biology	0	11
	Other	0	5
B.A.	Biology	7	0
M.S.	Agronomy	NA <sup>t</sup>	47
	Horticulture	NA	43
	Botany	NA	5
	Entomology	NA	5

<sup>t</sup> NA = not applicable.

**Table 3. Practical turfgrass management experience for students entering a graduate turfgrass program.**

Degree program pursued	Prior turfgrass experience	Amount of experience	
		Mean	Range
		yr	
		yr	yr
M.S.	87	2.9	0-10
Ph.D.	76	2.7	0-8
Overall	81	2.8	0-10

**Table 4. Type of turfgrass experience gained by students before starting a graduate turfgrass program.**

Turfgrass experience	Degree	
	M.S.	Ph.D.
Golf course	33	33
General grounds	19	21
Chemical lawn care company	10	11
Sod-seed production	5	7
Irrigation company	5	0
Landscaping	5	7
Other	23	21

<sup>t</sup> Primarily students that gained experience working with turfgrass professors on turfgrass plots during a previous degree program, not necessarily a turfgrass degree.

ganized into four categories: (i) student profile, (ii) educational background and current degree program, (iii) prior work experience, and (iv) career goals. The student profile included general background information such as degree pursued (M.S. or Ph.D.), age, and sex. The educational section included questions concerning past degrees and majors, turfgrass courses that had been or would be taken, thesis or dissertation topic, and teaching experience. The prior work experience section included questions concerning the amount and type of past turfgrass management experience. The final section concerned future career goals and issues facing the turfgrass industry.

Statistical analyses were not performed since the intent of the survey was not to compare programs at different schools, but rather to provide an overview of graduate turfgrass management programs. Data are presented in percentage, and terms such as higher or greater refer to the relative numerical values only.

## RESULTS AND DISCUSSION

Thirty-six completed questionnaires were returned by graduate students from 18 institutions (Table 1). Institutions responding represented mostly large agronomy or horticulture programs in the northeastern, north central, and southeastern USA. Twenty-two percent of graduate students who responded were females and 78% were males. Fifty-eight and 42% of the respondents were pursuing Ph.D. and M.S. degrees, respectively. The overall average age of the graduate students who responded was 30 yr and ranged from 22 to 46 yr. The average age for Ph.D. students was 31 yr with a range of 24 to 46 yr; the M.S. students ranged in age from 22 to 40 yr with an average age of 28 yr.

The majority of the students working on either a M.S. (73%) or Ph.D. (84%) had a B.S. in agronomy or horticulture (Table 2). Only 7% of the students pursuing a M.S. had received a B.A. in biology, and no students had received degrees in botany or plant physiology. In contrast, 20% of those pursuing M.S. degrees had a B.S. in engineering. With the exception of 10% of the Ph.D. students, all of the Ph.D. students had their M.S. degree in either agronomy or horticulture. The fact that most turfgrass graduate students come from agronomy or horticulture undergraduate programs might prompt a greater effort to attract students to turfgrass graduate programs from other plant or environmental sciences. The infusion of students from more basic plant, cell, and soil disciplines into turfgrass graduate programs would be an opportunity to expand the horizons of turfgrass science.

Although 87% of the M.S. students and 76% of the Ph.D. students had previous practical turfgrass management experience before entering a graduate turfgrass program, there was a substantial range in the amount of practical experience that graduate students possessed (Table 3). Overall, the average amount of turfgrass experience was 2.8 yr and ranged from 0 to 10 yr.

Most students had gained their turfgrass experience by working either on a golf course, with a lawn care company, or in a general grounds position (Table 4). Many M.S. and Ph.D. students who listed other experience in-

dicated they acquired practical experience in turfgrass management while working on turfgrass plots during their previous degree rather than any of the listed choices. This practical experience may have been the stimulus for some students from other areas of agronomy or horticulture to become interested in turfgrass science as a graduate program. It may also explain why a large number of graduate students lacked a basic turfgrass management course in their previous degree program and why they later took one while enrolled in graduate school. In addition, being attracted to study turfgrass from experiences gained in practical turfgrass management may explain the traditional or conservative nature of research projects later pursued by graduate students and the generally high level of satisfaction expressed in their programs.

The number of students that had a turfgrass management course in a past degree program varied (Table 5). At least one course in turfgrass management had been taken by most (67%) graduate students during their B.S. program, while 38% of the Ph.D. students took a turfgrass management course during their Ph.D. degree program. Overall, few M.S. or Ph.D. students took additional turfgrass courses beyond the first course in turfgrass management. It is probable that most schools do not offer specific turfgrass courses related to such areas as pests and soils; thus, the percentage of students taking such courses would be expected to be low. Peacock and Dudeck (1991) reported that the topical content of baccalaureate programs in turfgrass management offered an overall balance of topics in turfgrass management. However, they did not discuss other courses related to, but not specifically focused on, turfgrass management principles and practices. It is assumed that a high percentage of turfgrass students obtained considerable information concerning pests (weeds, insects, and diseases) and soils from courses in weed science, plant pathology, entomology, and soils without reference to specific turfgrass situations. If this is the case, most of the knowledge in these areas was obtained from courses that focused on cropping systems associated with production agriculture rather than turfgrass management.

The fact that few turfgrass graduate students took any turfgrass courses beyond the basic turfgrass management course may reflect the undergraduate character of most turfgrass courses that graduate students, especially Ph.D. students, could not take for program credit. The 38% of the Ph.D. students who took the basic turfgrass management course may reflect the number of students entering turfgrass graduate programs from other agronomic or horticultural areas. The favorable job market for turfgrass graduates relative to most other disciplines in plant agriculture may explain these transfers. The lack of advanced undergraduate or graduate-level turfgrass courses in M.S. or Ph.D. programs may speak to a lack of emphasis placed on instruction by most turfgrass faculty (Bacon and Beyrouy, 1985). If faculty are not rewarded for their teaching efforts, there is little incentive to offer advanced turfgrass courses with small enrollments. This lack of advanced instruction may impact negatively on the breadth or vision of turfgrass graduates reinforcing the narrow perspective characteristic of research-oriented graduate programs.

**Table 5. Turfgrass courses taken by students enrolled in turfgrass graduate programs.**

Degree when course(s) taken	Course	Present degree program		
		M.S.	Ph.D.	Total
		- %		
B.S.	Turfgrass Management	67	67 <sup>t</sup>	67
	Advanced Turfgrass Management	33	19	25
	Golf Course Management	13	5	8
	Perennial Grasses	13	0	6
	Turfgrass Disease	7	5	6
	Turfgrass Ecology and Morphology	7	0	3
M.S.	Turfgrass Management	20	10 <sup>t</sup>	15
	Advanced Turfgrass Management	13	0	6
	Golf Course Management	7	5	6
	Turfgrass Disease	7	5	6
	Turfgrass Soils	0	5	3
Ph.D.	Turfgrass Management	NA <sup>t</sup>	38 <sup>t</sup>	38
	Turfgrass Pests	NA	24	24
	Turfgrass Soil Management	NA	5	5

<sup>t</sup> Some Ph.D. students may have taken Turfgrass Management more than once under different degree programs, thus % may not equal 100.  
<sup>t</sup> NA = not applicable.

**Table 6. Turfgrass graduate students that have taken or plan to take courses in the area of biotechnology.**

Course	Degree program		
	M.S.	Ph.D.	Total
Tissue Culture	7	33	22
Molecular Biology	7	5	6
Molecular Genetics	0	10	6
Molecular Biochemistry	0	5	3

**Table 7. Research area of turfgrass graduate students.**

Research area	Degree		
	M.S.	Ph.D.	Total
Fertility-nutritoin Management	27	25	26
Physiology	20	20	20
Soils	6	5	6
Breeding	0	15	7
Turfgrass pests			
Weeds	27	5	16
Disease	0	10	5
Insects	0	0	0

**Table 8. Turfgrass professions desired by M.S. and Ph.D. students following completion of degree.**

Course	Degree	
	M.S.	Ph.D.
	% —	
College-university teaching	10	24
College-university research	17	23
Cooperative extension	10	26
Industry research and development	20	15
Junior college, 2-yr technical school teaching	3	6
Golf course management, construction design	10	3
Landscape maintenance	6	0
Other (chemical lawn care, general grounds, seed/sod production)	24	

With the developing role of biotechnology in agriculture, it was important to ascertain the number of turfgrass graduate students working in that area. In general, few turfgrass students took or planned to take biotechnology-related courses (Table 6). Tissue culture was the one exception. This may be indicative of few students who enter turfgrass graduate programs having any background in biotechnology. In addition, few turfgrass graduate students are pursuing this area since the turfgrass industry has not been more involved in biotechnology-related work.

The research of most graduate students was in traditional areas such as fertility (26%), management (20%), and physiology (20%) (Table 7). Only 6% of the students were conducting turfgrass research directly involving soil problems. The 20% of turfgrass graduate students engaged in physiological research and the dearth of those pursuing research in biotechnology or molecular biology may reflect the sources of funding for turfgrass research. There are virtually no federal programs that support research on turfgrass or ornamentals; industry, with few exceptions, is loath to support any but the most practical or immediately applicable kinds of investigation. This undoubtedly influences the research pursued by turfgrass faculty and that by their graduate students. Recognizing this strong and not always constructive influence of funding sources on the character of turfgrass research might prompt some faculty to encourage their students to pursue more basic or future-oriented areas of investigation. The highly traditional nature of the graduate research revealed in this survey does not speak well to future innovation or growth in turfgrass science.

Some graduate programs have a teaching requirement that nonfunded students or those on research assistantships may satisfy by teaching a laboratory section in some type of plant biology. Most turfgrass graduate students were on research assistantships as evidenced by the 62 and 80% of the Ph.D. and M.S. students, respectively, on research assistantships, whereas only 10% of the Ph.D. and 6% of the M.S. students were on teaching assistantships. The remainder of the students indicated they were on some other type of financial aid (14% Ph.D. and 7% M.S.) or were receiving no departmental or university support.

Ninety-seven percent of the graduate students stated that they had or planned to acquire teaching experience before completing their degree program. The question did not offer the opportunity for students to elaborate on what constituted *experience*. However, in a nationwide survey of turfgrass teaching faculty at 4-yr schools in the USA, 82% of the respondents indicated that they taught at least part of the laboratory portion of the introductory turfgrass management course (Karnok et al., 1993a). Eighteen percent indicated that graduate students were responsible for the laboratory. It appears unlikely that the graduate students' self-perceived teaching experience is being attained in the lecture portion of these courses. It is more probable that the teaching experience is not independent and is limited to assisting faculty in either or both the lecture and laboratory portions of these courses.

Graduate students were asked to address what they considered the most important issues in their graduate program. Graduate school funding was the most common concern. Many graduate students in turfgrass science had returned to school, as indicated by the wide age range (22-46 yr) and the average age (30 yr), following a period of employment. Most of these students found it financially difficult to go back to school. Therefore, some type of graduate assistantship funding was usually required by most students.

Another concern of many students was the lack of adequate practical turfgrass experience. Most students felt they needed more practical experience to balance their academic work. Sixty-seven percent of all graduate students took the basic turfgrass management course during their graduate program (Table 5). This was indicative of a general deficiency in the number of actual turfgrass courses for graduate students. Many students were concerned that they needed other advanced turfgrass courses during their graduate program.

There was almost an equal distribution of Ph.D. students who desired positions in college-university teaching (24%), research (23%), and extension (26%) (Table 8). The M.S. students preferred positions in industry research and development (20%). In addition, M.S. students desired positions in college-university teaching (10%), research (17%), extension (10%), and golf course management (10%). The group of M.S. students (37%) proposing to enter college-university teaching, research, and extension may be disappointed with these opportunities unless they pursue their Ph.D., since M.S.-level positions at the college-university level are limited. Master's students also indicated interest in the lawn service industry, general grounds management, and seed-sod production.

Considering their anticipated chosen profession, educational background, research, teaching, and practical experience, graduate students were asked if they thought the graduate education they were receiving would prepare them for their overall career goals. Eighty-six percent of the Ph.D. and 64% of the M.S. students stated that they felt they were being appropriately trained. Reasons given by those who felt their educational program and experience were not adequate included: (i) lack of practical experience, (ii) limited experience dealing with people, and (iii) the problem of relating research to practical applications. Several M.S. students indicated that they were not prepared, in the business sense, to go out and manage a lawn care company or golf course operation.

Students in graduate turfgrass programs were asked what were the important issues facing the turfgrass industry. The majority of students indicated concern about environmental issues that impact turfgrass. The area of major concern was the utilization of pesticides and fertilizers in turfgrass management and how the amounts of each could be reduced to limit potential groundwater pollution. Also, a concern was indicated about the efficient use of water in certain parts of the country, particularly for golf course operation.

The increased visibility of turfgrass management, especially golf courses, dictates that present and future turf-

grass scientists and managers are able to communicate and relate to the general public concerning issues related to the turfgrass industry. However, as mentioned before, the research topics of most of the graduate students did not involve ecological or integrated pest management aspects of turfgrass management. Therefore, some of the main concerns of many graduate students were not being addressed through either their research or their overall graduate degree program. Ultimately, a major concern to both M.S. and Ph.D. students was the availability of jobs and associated salary levels that awaited them when they finished school. The concern of future employment expressed by turfgrass graduates reflects the uncertainties all students face when completing formal education and entering professional life.

## SUMMARY AND CONCLUSION

Graduate students in turfgrass management programs across the USA completed a detailed survey concerning their education, experience, research, and career goals. The results were informative and interesting. The *typical* graduate student in turfgrass science was 30 yr old and received some type of financial support from his or her department. Most students had a former degree in either agronomy or horticulture. Many of the students had prior experience in turfgrass management before entering graduate school; those that lacked practical experience felt that it was important to gain practical experience, but were unsure of how to gain experience at that time in their career.

The areas of graduate research indicated traditional areas such as fertility and management. With the exception of tissue culture, there appeared to be little interest in biotechnology, with few students either taking courses or conducting research in that area. Most graduate students had teaching experience, but the amount and quality of teaching experience obtained was not discernible. They consider college-university teaching, research, and extension as some of the preferred careers along with industry research and development. The majority (77%) of the graduate students stated that the education they were receiving would prepare them for their career goals in the area of turfgrass. Issues of personal concern to the graduate students were graduate school funding, job availability and salary levels, and pesticide and water use in the turfgrass industry were of general concern.

The fact that almost a third of the respondents did not have a turfgrass management course before entering their graduate program indicates the appeal of turfgrass science as a vehicle for graduate research and education. Some

of the graduate students in turfgrass programs had no academic training and little practical experience in turfgrass science. This indicates that students may be attracted to turfgrass programs for reasons as varied as working for a turfgrass professor as an undergraduate while pursuing a degree in some other area of agronomy or horticulture, or just being interested in golf. The discipline appears to have the versatility to prepare scientists to function competently across a broad range of agricultural and biological areas.

The lack of upper-level undergraduate and graduate-level turfgrass courses at most universities indicates the need to develop courses in turfgrass science that are attractive to students in other disciplines so enrollment will be sufficient to offer the courses. This might be performed by incorporating aspects of environmental issues in the context of turfgrass and landscape management in conjunction with soils, ecology, and agronomy. If we are going to be the educators of the future, we should set an example by our educational efforts. We need to bring this breadth to both our undergraduate and graduate teaching and research programs in the field of turfgrass science.

The results of this survey present the opportunity for discussion concerning the future for scientists in this field, how students are being prepared, and the role of turfgrass science in the academic and research communities.

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