Survey of Pest Management Practices on US Golf Courses

Travis W. Shaddox[1], J. Bryan Unruh[2], Mark E. Johnson[3], Clark D. Brown[4], and Greg Stacey[3]

KEYWORDS. pesticide, turfgrass

ABSTRACT. Integrated pest management (IPM) is an important component of golf course maintenance and includes conventional chemical pesticide use as well as nonchemical cultural management practices. Determining how frequent pest management practices are used on golf courses is critical when developing educational and outreach programs. The objective of this study was to determine the frequency of pest management practices and pesticide mixing and storage facilities on US golf courses. A survey was sent to 14,033 operational US golf facilities with 10% responding. Reliance on all conventional chemical pesticides increased from 2015 to 2021. The reliance on biological control products declined to 14% and reliance on the nonpesticide practice of using plant growth regulators remained equivalent to 2015. The most common pest management practices included monitoring weather patterns and scouting for pests, with 93% of golf facilities reporting the use of both. The use of written IPM and pesticide application plans increased from 44% to 63% of golf facilities between 2015 and 2021, respectively. Generally, mixing and storage facilities remained unchanged from 2015 to 2021. US golf facilities continue to use nonchemical pest management practices, but reliance on chemical pesticides has increased.

An estimated 14,145 golf facilities exist in the United States totaling ~1 million irrigated acres of turfgrass (Shaddox et al. 2022). Golf courses contribute ~$21 billion in output impact to the US economy (Haydu et al. 2018). The performance expectations of golf course turfgrass often requires use of pest management practices to maintain aesthetics and playability (Held and Potter 2012). Because pesticide use increases maintenance costs and may influence environmental risk, it is essential that IPM practices are regularly assessed and evaluated.

The first known comprehensive survey assessment of pest management on US golf facilities was conducted in 2007 by Lyman et al. (2012) and was repeated in 2016 (Gelernter et al. 2016). These surveys indicated that reliance on nonpesticide pest management practices increased from 2007 to 2015, whereas reliance on conventional pesticides declined over the same period. Among the nonpesticide management practices, improving turfgrass health, monitoring weather, and scouting for damage were used at 97% of US golf facilities and were the most frequent practices among 18-hole golf facilities in 2015 (Gelernter et al. 2016). Evidence provided by Lyman et al. (2012) and Gelernter et al. (2016) have proven to play a critical role in education and advocacy programs (McKeel 2021).

Before application, pesticides are commonly stored and mixed in a concentrated form. Improper storage and/or handling of these concentrated forms poses a potential risk of point-source pollution. To address this concern, many golf facilities store and mix pesticides in dedicated locations designed to contain the pesticide until application (Gelernter et al. 2016); however, storage and mixing facilities do not exist on all golf facilities. Thus, to measure progression, it is essential that the presence and attributes of storage and mixing facilities are periodically documented.

To provide educators, policymakers, and professionals with the most accurate evidence of golf course pest management practices, it is important to assess how golf course pest management practices have changed since 2007 and 2015. Therefore, the objective of this study was to determine the use frequency of pest management practices and pesticide storage and mixing facility attributes on US golf facilities.

Materials and methods

The survey instrument (Supplemental Fig. 1) contained identical questions as previously used by Gelernter et al. (2016). The instrument was distributed in English via online software (Qualtrics, Provo, UT, USA). A link to the survey was sent via e-mail using the mailing lists of the National Golf Foundation and the Golf Course Superintendents Association of America (GCSAA), which resulted in the link being sent to 14,033 unique golf facilities. A golf facility was defined as a business where golf could be played on one or more golf courses. The survey and the instrument link were also promoted on social media by staff of GCSAA. The survey was available for completion for 7 consecutive weeks beginning on 1 Apr 2022. Five e-mail reminders were sent to encourage survey participation as well as survey completion by respondents who had started but not completed the survey. Respondents remained anonymous within the data file by omitting their names and assigning a unique identification number. One response was allowed per golf

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[1]Bluegrass Art and Science, 760 Winter Hill Lane, Lexington, KY 40509, USA

[2]West Florida Research and Education Center, University of Florida, 4235 Experiment Drive, Jay, FL 32565, USA

[3]Golf Course Superintendents Association of America, 1421 Research Park Drive, Lawrence, KS 66049, USA

[4]National Golf Foundation, 501 N. Highway A1A, Jupiter, FL 33477, USA

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Mark E. Johnson is the associate director of environmental programs at the GCSAA. Clark D. Brown is the director of research at the National Golf Foundation, which was responsible for managing the survey instrument and data collection. Greg Stacey is the senior manager of market research and data at the GCSAA.

T.W.S. is the corresponding author. E-mail: TravisShaddox@gmail.com.

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
3.7854	gal	L	0.2642

course. Validation that a respondent was linked to a golf facility was determined by cross-referencing the information contained in the National Golf Foundation database (i.e., golf facility name, facility type, number of holes, and location) with the answers provided by the respondent on those same criteria. Data were merged with data from the same survey conducted in 2006 and 2014 to allow for a measurement of change over time. Responses were received from 1444 facilities (Fig. 1), which represented 10.1% of the known total of US golf facilities.

To provide a valid representation of US golf courses, data were weighted. Responses were categorized into one of 35 categories depending on the facility type (public or private), number of holes (9, 18, or 27+), and public green fee (<\$55 or ≥\$55) (Supplemental Table 1). The weights were calculated by determining the proportion of each group within the total survey response. Reliance on pesticides was calculated by determining the difference between respondents who answered "increased" with respondents who answered "decreased."

Data analysis was conducted using PROC SURVEYfreq in SAS (version 9.4; SAS Institute, Inc., Cary, NC, USA). To determine if survey responses changed over time, years were paired. Similarly, budget categories were paired to determine differences among budgets. Differences among all-pairwise comparisons were determined using chi-square test at the 10% significance level.

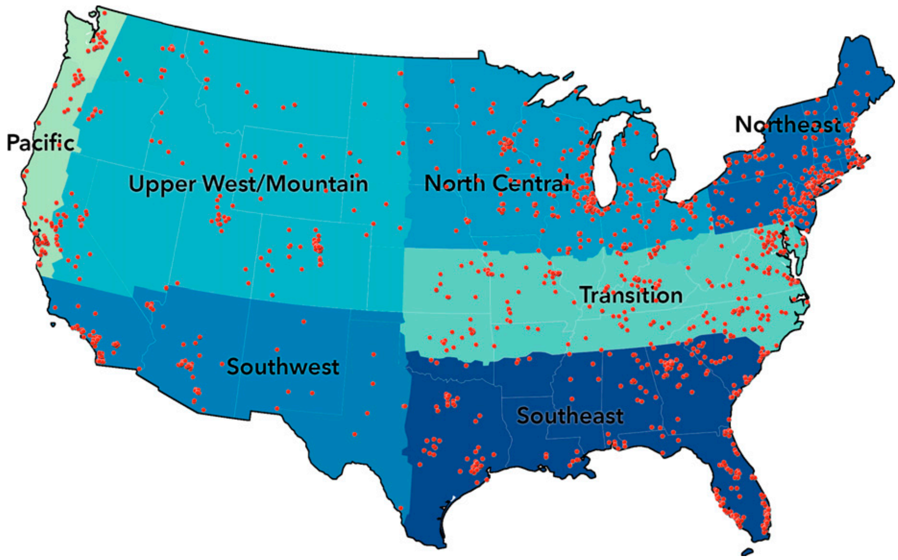

Fig. 1. Survey distribution and the seven agronomic regions of the United States.

Results and discussion

Golf course superintendents reported an increase in their reliance on pesticides from 2015 to 2021 (Fig. 2). Reliance on fungicides, herbicides, and insecticides increased between 2015 and 2021 to 9%, 8%, and 5% of golf facilities, respectively. Reliance on plant-growth regulators remained consistent (~45%) with 2015 and reliance on biocontrol products (such as polyoxin D, phosphites, and corn gluten meal) declined from 25% to 14% between 2015 and 2021. The greatest increase in pesticide reliance in the 3 years before each survey occurred with nematicides. Before 2008, the nematicide fenamiphos was considered an industry standard for the treatment of nematodes in turfgrass (Crow et al. 2005); however, the sale and distribution of fenamiphos was

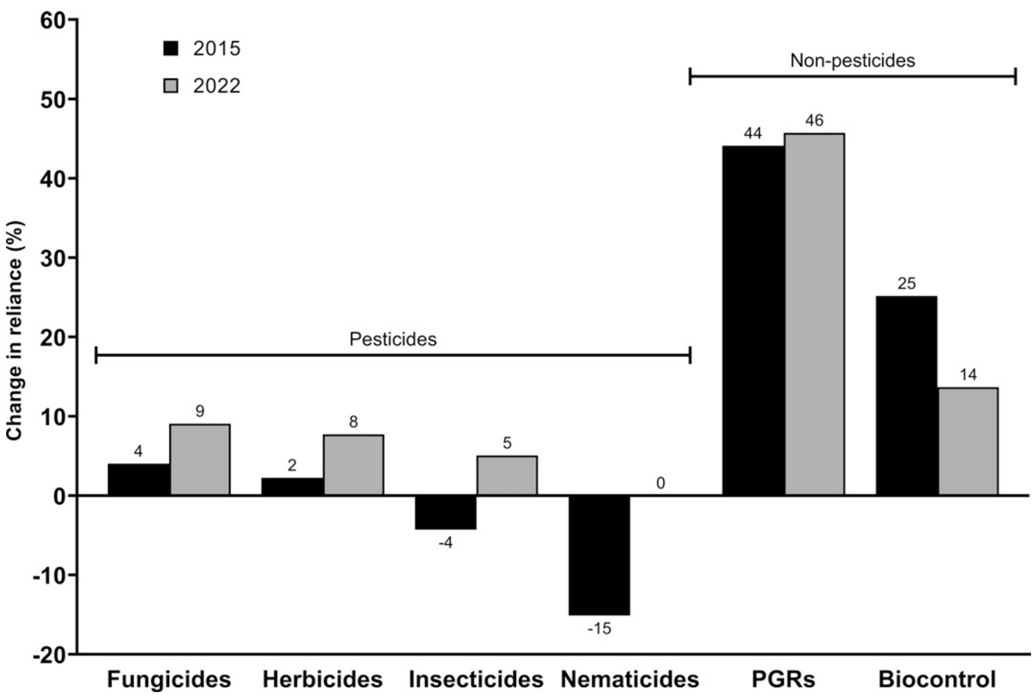

Fig. 2. Change in reliance of US golf facilities on pest management practices during the 3 years before 2015 and 2021. Reliance percentages were calculated by determining the difference between respondents who answered "increased" with respondents who answered "decreased"; PGRs = plant growth regulators.

prohibited in the turf and ornamental market in 2008 and existing stocks of fenamiphos were prohibited from use in 2014 (Keigwin 2011). These restrictions likely resulted in reliance on nematicides decreasing by 15% in 2015. From 2015 to 2021, new a.i. (such as abamectin and fluopyram) have been documented to control nematodes and result in increased turfgrass quality (Crow 2020). Thus, it is likely the increased reliance on nematicides measured from 2015 to 2021 is a result of new nematicides in the turfgrass market.

The pest management practices that golf course superintendents rely on the most were plant growth regulators (PGRs) and biological control practices, although reliance on biological control practices declined by nearly 50% from 2015 to 2021. Plant growth regulators have been shown to suppress weeds (Beam and Askew 2017), suppress seed head production (Peppers et al. 2020), and occasionally reduce disease severity (Inguagiato et al. 2010). Many PGRs are naturally occurring and possess a nontoxic mode of action (i.e., gibberellins, indole-3-butyric acid, and ethylene) and, thus, are not classified as conventional pesticides but rather biological pesticides by the US Environmental Protection Agency (Reilly et al. 2002). As such, PGRs are generally considered less toxic than conventional pesticides. The nontoxic mode of action along with application scheduling via the use of predictive models (Reasor et al. 2018) may have contributed to the consistent reliance on PGRs from 2015 to 2021.

Response options in the survey instrument included 17 management practices (Supplemental Fig. 1). Of those 17, the use of seven declined, nine remained the same, and one increased from 2015 to 2021 (Table 1). Monitoring weather patterns and scouting for pests were the most common management practice and were used by 93% of golf facilities. Of the management practices that were used less frequently in 2021 than in 2015, monitoring weather patterns conducive to outbreaks, improving turfgrass health, implementing cultural practices, and spot treating damage continued to be used at >86% of golf facilities. Although the use of remote sensing increased from 17% to 21% between 2007 and 2021, the frequency of using remote sensing declined from 31% to 21% between 2015 and 2021. One limitation to remote sensing is the correlation of the remote sensing data with turfgrass performance. This is a common research area, and we postulate that the usefulness of remote sensing data to the end-user will increase in time, which, if true, may lead to increased use of remote sensing technology. Further remote sensing research may hasten implementation of remote sensing into golf facility management practices. The sole management practice that was used more frequently in 2021 than in 2015 was the use of predictive models, which was used by 60% of golf facilities in 2021 and only 52% in 2015. Recent research has confirmed that modeling turfgrass growth can result in more efficient use of resources (Kreuser et al. 2017). In addition, weather-based disease warning systems using predictive models have been developed to accurately time fungicide applications (Smith et al. 2018). Thus, using predictive models to increase resource efficiency is supported by current evidence.

Use of written IPM and pesticide application plans on US golf facilities increased from 2015 to 2021, whereas the use of pesticide emergency response plans remained equivalent to 2015 (Table 2). The percentage of golf facilities that use either an IPM or pesticide application plan increased from 66% to 71% from 2015 to 2021. The use of a written pest management plan was associated with the golf facility budget (Fig. 3). Golf facilities with annual budgets exceeding $1 million more frequently had written IPM plans, pesticide emergency response plans, and either an IPM or pesticide application plan than golf facilities with annual budgets less than $1 million.

Table 1. Frequency of US golf facilities that responded that they use the listed pest management practice sometimes or frequently in 2007, 2015, and 2021.

	2007	2015	2021
Management practice	**Golf facilities (%)**		
Monitor weather patterns	96 a[i]	95 ab	93 b
Scouting	95 a	95 a	93 a
Pesticide resistance management strategies	ND[ii]	92 a	90 a
Monitor weather patterns conducive to outbreaks	ND	93 a	90 b
Improve turfgrass health	ND	95 a	90 b
Cultural practices	95 a	96 a	90 b
Spot treat damage	ND	92 a	86 b
Record pest outbreaks	83 a	77 b	75 b
Higher pest tolerance	71 a	72 a	66 b
Predictive models	56 a	52 b	60 a
Pest-tolerant turfgrass	61 a	52 b	55 b
Map pest damage	ND	52 a	53 a
Pest identification by university or independent laboratory	ND	51 a	49 a
Photograph documentation	14 b	37 a	36 a
Biological controls	47 a	41 b	33 c
Traps	28 b	34 a	33 a
Remote sensors	17 c	31 a	21 b

[i] Within rows, values followed by a common letter are not significantly different according to chi-square test at the 10% significance level.
[ii] No data; question was not asked in 2007.

Table 2. Frequency of written pest management plans on US golf facilities in 2007, 2015, and 2021.

	2007	2015	2021
Pest management plan	**Golf facilities (%)**		
Integrated pest management (IPM) plan	41 a[i]	32 b	44 a
Pesticide application plan	63 a	58 b	63 a
Pesticide emergency response plan	52 b	53 ab	57 a
Either IPM plan or pesticide application plan	71 a	66 b	71 a

[i] Within rows, values followed by a common letter are not significantly different according to chi-square test at the 10% significance level.

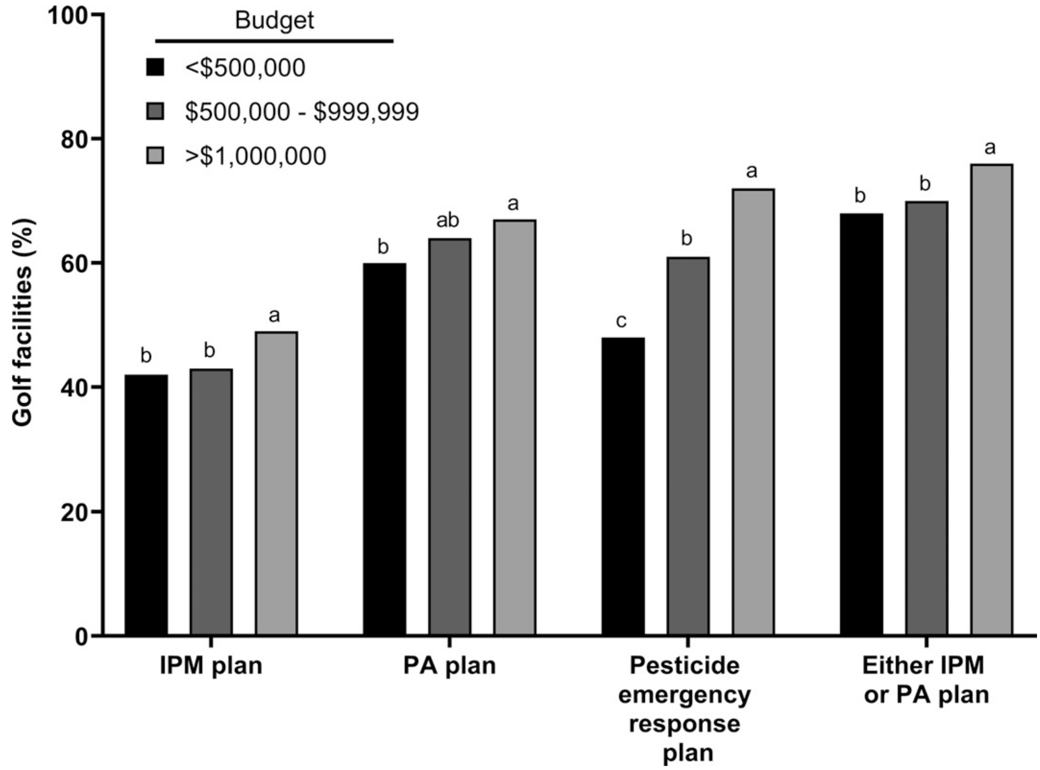

Fig. 3. Frequency of written pest management plans on US golf facilities in 2021 as influenced by the facility's annual budget. Bars with a common letter are not significantly different according to chi-square test at the 10% significance level; IPM = integrated pest management, PA = pesticide application.

The attributes of the pesticide mixing and loading areas in 2021 remained equivalent to those from 2015 with two exceptions (Table 3). First, the presence of spill kits in the mixing and loading area increased from 54% to 60% and, second, the presence of floors that contain any spills increased from 30% to 33% between 2015 and 2021. The frequency of two attributes increased from 2007 to 2021: the presence of spill kits and the collection of rinsate. All other attributes were equivalent in 2021 to preceding years. The increased use of spill kits and rinsate collection are critical components of golf course best management practices as both reduce the risk of environmental impairment by reducing the risk of unwanted chemicals from entering the environment.

Seven of the 11 attributes of pesticide storage facilities on US golf facilities in 2021 remained equivalent to those reported in 2007 (Table 4). The frequency of the storage facility to be locked declined from 90% to 87% from 2007 to 2021 but did not change from 2015 to 2021. Passive venting declined from 58% to 52% from 2007 to 2021, but the frequency increased from 2015 to 2021. Finally, explosion-proof electrical fixtures declined from 25% to 21% from 2007 to 2021. Respondents reported 65% of golf facilities had spill kits in the storage facility, which was an increase from 2007 and 2015 to 2021. Similar to the mixing and loading area, the inclusion of spill kits is a relatively minor expense that can have a significant impact on reducing environmental risk.

Table 3. Frequency of mixing and loading area attributes on US golf facilities in 2007, 2015, and 2021.

	2007	2015	2021
Attribute	Golf facilities (%)		
Spill kit	53 b[i]	54 b	60 a
Anti-siphoning on water line	52 a	52 a	53 a
Impervious floor	40 a	37 a	38 a
Emergency water shut-off	37 a	37 a	37 a
Recycle pesticide containers	35 ab	38 a	34 b
Floor contains spills	31 ab	30 b	33 a
Roof	28 a	27 a	29 a
Water-filling capacity > 50 gal (189.3 L) per minute	29 a	28 a	27 a
Collect rinsate	22 b	24 ab	26 a
Stand-alone pesticide mixing tank	14 a	14 a	14 a

[i] Within rows, values followed by a common letter are not significantly different according to chi-square test at the 10% significance level.

Conclusions

US golf facilities increased their reliance on fungicides, herbicides, insecticides, and nematicides from 2015 to 2021. Increased availability of new pesticide chemistries may have played a role in increasing US golf facility reliance. The use of predictive models to manage pests increased from 2015 to 2021. Recent confirmatory research has validated the use of predictive models and may have contributed to

Table 4. Frequency of storage facility attributes on US golf facilities in 2007, 2015, and 2021.

	2007	2015	2021
Attribute	Golf facilities (%)		
Can be locked	90 a[i]	89 ab	87 b
Signage indicating pesticides inside	78 a	78 a	76 a
Impervious floors	64 a	58 b	66 a
Spill kit	60 b	60 b	65 a
Emergency shower/eyewash	66 a	64 a	64 a
Floor can contain spills	57 a	54 a	57 a
Passive venting	58 a	48 c	52 b
Dedicated storage building	47 a	49 a	49 a
Impervious shelving	45 a	41 b	47 a
Powered venting	40 a	42 a	41 a
Explosion-proof electrical fixtures	25 a	24 ab	21 b

[i] Within rows, values followed by a common letter are not significantly different according to chi-square test at the 10% significance level.

the increased use of predictive models on US golf facilities. Monitoring weather patterns and scouting were the most common pest management practice on US golf facilities in 2021. The use of IPM and pesticide application plans increased from 2015 to 2021, and facilities with annual budgets that exceed $1 million used these plans more frequently than lower-budget facilities. Mixing and loading area attributes remained mostly unchanged from 2015 to 2021.

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2022 GCSAA Pest Management Survey

Thank you for agreeing to participate in our golf course nutrient use survey! To begin, we have some general questions about you and your course. All of your individual responses will be kept strictly confidential.

NEW22_INT1 For starters, please provide your contact information. Drawing winners will be notified at the conclusion of the project.

- ❍ Name: (1) ____
- ❍ E-mail address: (2) ____
- ❍ Golf Course Name: (3) ____

NEW22_INT2 Are you a GCSAA member?

- ❍ Yes - Please specify your member ID, if available (1) ____________________
- ❍ No (2)

Q1 State

Q2 What is the 5-digit zip code of your golf facility?

Q3 How many total golf holes do you have at your facility? (Select one)

- ❍ 9 holes (1)
- ❍ 18 holes (2)
- ❍ 27 holes (3)
- ❍ 36 holes (4)
- ❍ 45+ holes (If 45+, ENTER NUMBER) (5) ____________________

Q4 What is the price of a peak-season green fee (including cart rental) at your golf course? (If you're at a private golf club: Please indicate the "guest fee" including cart rental) (Enter dollar amount, excluding the dollar sign)

Q5 Excluding capital improvement expenditures, which of the following best describes the annual maintenance budget for your golf course? This would include payroll/salaries, operating equipment leases, water, fertilizer/chemicals, etc. (Select one)

- ❍ Less than $250,000 (1)
- ❍ $250,000 to $499,999 (2)
- ❍ $500,000 to $749,999 (3)
- ❍ $750,000 to $999,999 (4)
- ❍ $1,000,000 to $1,249,999 (5)
- ❍ $1,250,000 to $1,499,999 (6)
- ❍ $1,500,000 or higher (7)
- ❍ Unknown (8)
- ❍ Prefer not to answer (9)

Supplemental Fig. 1. The Golf Course Superintendents Association of America pest management survey sent to 14,033 US golf facilities on 1 Apr 2022 and completed by 1444 golf facilities.

Q7 If your facility has 36 or more holes, please complete the survey based on the 18 holes that receive the most play. How many holes will you be reporting data for? (Select one)

- ❍ 9 holes (1)
- ❍ 18 holes (2)
- ❍ 27 holes (3)
- ❍ 36 holes (4)
- ❍ 45+ holes (IF 45+, ENTER NUMBER) (5) ____________________

1. [Q3] Please indicate which of the attributes apply to your pesticide storage facility. (SELECT ALL THAT APPLY)

- ❑ Impervious floor (1)
- ❑ Floor can contain liquid spills (2)
- ❑ Area can be locked or restrict access (3)
- ❑ Passive venting (4)
- ❑ Powered venting (5)
- ❑ Impervious shelving (6)
- ❑ Explosion proof electrical fixtures (7)
- ❑ Storage is a separate, dedicated building (8)
- ❑ Emergency shower or eyewash nearby (9)
- ❑ Spill kit located nearby storage area (10)
- ❑ Signage on the exterior indicating pesticides or chemicals stored inside (11)
- ❑ Other (Specify All) (12) _______________________________
- ❑ None of the above (13)
- ❑ Do not store pesticides at our facility (17)

2. [Q4] Please indicate which of the attributes apply to your pesticide mixing and loading area. (SELECT ALL THAT APPLY)

- ❑ Impervious floor (1)
- ❑ Floor can contain liquid spills (2)
- ❑ Water filling capacity above 50 gallons per minute (3)
- ❑ Anti-siphoning device on water line (4)
- ❑ Spill kit located nearby mix/load area (5)
- ❑ Recycle pesticide containers (6)
- ❑ Emergency shut-off valve for water input (7)
- ❑ Roof or overhead enclosure to protect from weather (8)
- ❑ Collect pesticide rinsate (9)
- ❑ Stand-alone pesticide mixing tank (10)
- ❑ Other (Specify All) (11) _____________________________
- ❑ None of the above (13)

3. [Q4B] Does your facility have a WRITTEN emergency response plan for pesticide emergencies? (SELECT ONE)

❍1 YES ❍2 NO ❍3 UNKNOWN

Supplemental Fig. 1. Continued.

7. An **Integrated Pest Management (IPM) plan** is a written, comprehensive document that contains the strategies and tactics that will be implemented to manage pests on the golf course. IPM strategies and tactics include: integration of cultural, biological and chemical controls as a means of minimizing hazards to humans and the environment, pest monitoring, pest identification, use of damage thresholds, etc.

   7A) [Q6_A] Does the golf course utilize a WRITTEN Integrated Pest Management (IPM) plan? (SELECT ONE)

   ❍1 YES ❍2 NO ❍3 UNKNOWN

   [IF "YES" AT PREVIOUS QUESTION:]

   7B) [Q6_B] Which of the following best describes your integrated pest management plan? (SELECT ONE)

   ❍1 Required by a federal, state or local government and/or tribal authority
   ❍2 Result of voluntary participation with a non-regulatory organization (*e.g.,* watershed protection or environmental conservation organization)
   ❍3 Voluntary (*e.g.,* board, committee or superintendent initiated)
   ❍4 Unknown

8. A **pesticide application plan** is a written document that lists all the pesticide applications (and may include nutrient and plant growth regulator applications) planned for the year.

   8A) [Q7_A] Does the golf course utilize a WRITTEN pesticide application plan? (SELECT ONE)

   ❍1 YES ❍2 NO ❍3 UNKNOWN

EW22_COVIDP1 All things considered, would you say your course used more or less PEST CONTROL PRODUCTS as a result of the COVID-19 pandemic, say versus what it normally uses?

❍ Pesticide use increased as a result of the COVID-19 pandemic (1)

❍ Pesticide use has stayed about the same (2)

❍ Pesticide use decreased as a result of the COVID-19 pandemic (3)

Display This Question: If NEW22_COVIDP1 = 1 Or NEW22_COVIDP1 = 3

NEW22_COVIDP2 What would you say were the primary (contributing) factors of the change in pesticide use resulting from COVID?

Display This Choice: If NEW22_COVIDP1 = 1

❑ More rounds (more wear and tear) (1)

Display This Choice: If NEW22_COVIDP1 = 3

❑ Fewer rounds (less wear and tear) (2)

❑ Budgetary reason(s) (3)

❑ Product (nutrient) cost (4)

Display This Choice: If NEW22_COVIDP1 = 3

❑ Restriction/mandates (5)

Display This Choice: If NEW22_COVIDP1 = 3

❑ Conservation measures (6)

Display This Choice: If NEW22_COVIDP1 = 3

❑ Product availability (supply chain issue) (7)

❑ Other (please specify) (8) ____

Supplemental Fig. 1. Continued.

9. [Q8] How often do you use the following practices to manage pests? (SELECT ONE FOR EACH)

	Never	Rarely	Sometimes	Frequently	Unknown
1) Use of predictive models	❍1	❍2	❍3	❍4	❍5
2) Scouting/monitoring	❍1	❍2	❍3	❍4	❍5
3) Use of traps	❍1	❍2	❍3	❍4	❍5
4) Cultural practices (*e.g.,* increased mowing heights, manage soil salinity, adjusted fertilizer practices, improved plant health)	❍1	❍2	❍3	❍4	❍5
5) Biological controls (*e.g.,* biopesticides such as polyoxin D, phosphites, corn gluten meal, etc; release of biocontrol agents such as parasitic wasps, ladybird beetles/ ladybugs)	❍1	❍2	❍3	❍4	❍5
6) Higher tolerance of pest damage/Higher pest damage thresholds	❍1	❍2	❍3	❍4	❍5
7) Routinely monitor weather patterns	❍1	❍2	❍3	❍4	❍5
8) Use of pest tolerant turf species	❍1	❍2	❍3	❍4	❍5
9) Use of remote sensors (hand-held or machine/drone mounted devices that gather information on soil or plant characteristics)	❍1	❍2	❍3	❍4	❍5
10) Record pest outbreaks (*e.g.,* timing, nature and/or degree of pest infestations)	❍1	❍2	❍3	❍4	❍5
11) Map pest damage	❍1	❍2	❍3	❍4	❍5
12) Photographic documentation (aerial/drone or regular photographs)	❍1	❍2	❍3	❍4	❍5
13) Spot treatment with pesticides	❍1	❍2	❍3	❍4	❍5
14) Pesticide resistance management strategies (e.g., rotate different modes of pesticide action or different pesticide chemistries, use more cultural & biological controls, etc.)	❍1	❍2	❍3	❍4	❍5
15) Increase pest tolerance through improved turf health	❍1	❍2	❍3	❍4	❍5
16) Pest identification by university or independent laboratory/diagnostician/specialist	❍1	❍2	❍3	❍4	❍5
17) Monitor weather conditions conducive to pest outbreaks	❍1	❍2	❍3	❍4	❍5

Supplemental Fig. 1. Continued.

10. [N/A] How has your reliance on the following chemical pesticides changed over the past several years? (SELECT ONE FOR EACH)

	Increased	Decreased	Stayed the same	Unknown
Fungicides	❍1	❍2	❍3	❍4
Herbicides	❍1	❍2	❍3	❍4
Insecticides	❍1	❍2	❍3	❍4
Nematicides	❍1	❍2	❍3	❍4
Plant growth regulators	❍1	❍2	❍3	❍4

12. [N/A] How has your reliance on biological control practices for pest control changed over the past several years? (Examples include, but are not limited to, biological pesticides such as polyoxin D, phosphites, corn gluten meal, etc; release of biocontrol agents such as parasitic wasps, ladybird beetles)

❍1 Increased ❍2 Decreased ❍3 Stayed the same ❍4 Unknown

Q33 Thank you for taking time to participate in the survey. Please feel free to provide any comments in the space provided AND/OR click Next to submit your survey.

Supplemental Fig. 1. Continued.

Supplemental Table 1. **2021 pest management survey responses and weighting factors categorized by region (see Fig. 1), facility type, number of holes, and green fee.**

Region	Facility type	Holes (no.)	Green fee ($)	Golf facilities (no.)	Golf facilities (%)	Survey responses (no.)	Survey responses (%)	Wt
Northeast	All	9	All	647	4.6	28	1.9	2.378
Northeast	Public	18	< 55	508	3.6	26	1.8	2.011
Northeast	Public	18	≥ 55	557	4.0	65	4.5	0.882
Northeast	Private	18	All	579	4.1	99	6.9	0.602
Northeast	All	27+	All	179	1.3	27	1.9	0.682
North Central	All	9	All	1144	8.2	22	1.5	5.351
North Central	Public	18	< 55	1183	8.4	64	4.4	1.902
North Central	Public	18	≥ 55	472	3.4	73	5.1	0.665
North Central	Private	18	All	451	3.2	83	5.7	0.559
North Central	All	27+	All	305	2.2	33	2.3	0.951
Transition	All	9	All	640	4.6	17	1.2	3.874
Transition	Public	18	< 55	818	5.8	61	4.2	1.380
Transition	Public	18	≥ 55	355	2.5	52	3.6	0.702
Transition	Private	18	All	520	3.7	90	6.2	0.595
Transition	All	27+	All	176	1.3	27	1.9	0.671
Southeast	All	9	All	458	3.3	6	0.4	7.855
Southeast	Public	18	< 55	744	5.3	59	4.1	1.298
Southeast	Public	18	≥ 55	503	3.6	66	4.6	0.784
Southeast	Private	18	All	684	4.9	136	9.4	0.518
Southeast	All	27+	All	348	2.5	62	4.3	0.578
Southwest	All	9	All	241	1.7	4	0.3	6.200
Southwest	Public	18	< 55	169	1.2	13	0.9	1.338
Southwest	Public	18	≥ 55	335	2.4	44	3.0	0.783
Southwest	Private	18	All	225	1.6	40	2.8	0.579
Southwest	All	27+	All	168	1.2	15	1.0	1.152
Upper West/Mountain	All	9	All	384	2.7	12	0.8	3.293
Upper West/Mountain	Public	18	< 55	179	1.3	27	1.9	0.682
Upper West/Mountain	Public	18	≥ 55	272	1.9	59	4.1	0.474
Upper West/Mountain	Private	18	All	149	1.1	35	2.4	0.438
Upper West/Mountain	All	27+	All	75	0.5	13	0.9	0.594
Pacific	All	9	All	162	1.2	6	0.4	2.778
Pacific	Public	18	< 55	52	0.4	3	0.2	1.784
Pacific	Public	18	≥ 55	184	1.3	42	2.9	0.451
Pacific	Private	18	All	112	0.8	26	1.8	0.443
Pacific	All	27+	All	55	0.4	9	0.6	0.629