Consumer Purchase Likelihood of Landscape Management Pest Scouting Program

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Abstract. **The US landscape industry consists of 632,000 businesses with >1 million persons employed in 2022. The most common service that landscape service providers (LSPs) perform is pest management. Over the past 25 years, LSPs have been challenged to adopt more holistic approaches to pest management via the use of nonchemical and less toxic chemical controls. Integrated pest management (IPM), specifically scouting, may be a useful approach for LSPs to manage pests more sustainably and market new services, such as biological control releases. Scant literature is available on LSP scouting practices or consumer acceptance of scouting services. The goal of this study was to determine if IPM-aware consumers were more likely to purchase a scouting program offered by an LSP. An online survey was distributed across the United States through a third-party panel service. The final sample included 928 usable responses. Data were analyzed using a binary logistic regression model. Fifty-seven percent of respondents reported having some knowledge or were very knowledgeable of IPM. Respondents 65 years of age and older were 13.1% points less likely to purchase a scouting service. Education level did not influence purchase likelihood. Consumer knowledge of IPM had a positive influence on the purchase likelihood, respondents with "some knowledge" (5.6%) and "very knowledgeable" (8.6%) were more likely to buy IPM services. Further, if the consumer was open to purchasing the scouting program, it is plausible that they might be more willing to allow an LSP to use a combination of chemical and nonchemical methods to manage pests.**

In 2022, the US landscape industry had more than 632,000 businesses and employed more than 1 million people (IBISWorld 2022). Considering the highly competitive environment, companies need to find new opportunities and niche service areas to differentiate themselves, which can translate to higher profitability. The term "landscape service" encompasses many areas, with landscape pest management being the most common service providers perform. Landscape pest management is typically implemented with at least some chemical pesticides. Nevertheless, consumer concerns related to pesticide use and environmental health have challenged the green industry to implement more holistic approaches to disease and insect control, such as IPM. IPM is a systematic, scientific approach to managing pests at acceptable levels by integrating nonchemical and chemical control methods into a comprehensive plan (Deguine et al. 2021; Ehler 2006; Wearing 1988).

Most of the current work on consumer IPM topics focuses either on specific landscape topics that relate to IPM, such as pollinators, or on the actual retail purchase looking at the attributes of plant products (e.g., Getter et al. 2016; Khachatryan et al. 2020; Klingeman et al. 2009; Rihn and Khachatryan 2016; Rihn et al. 2016, 2022, 2023; Sellmer et al. 2003; Stewart et al. 2002; Warner et al. 2022; Wei et al. 2019, 2020; Yiridoe et al. 2005). However, considering that a successful IPM approach includes several components, it is critical to evaluate how consumer preferences change for each of the components (e.g., mechanical/physical controls, cultural controls, biological controls, and chemical controls) (Ehler 2006). Scouting, defined as the active process of looking for pests and monitoring those levels before deciding to take controlling action, is one of the foundations of IPM (Deguine et al. 2021; Ehler 2006; Stewart et al. 2002; Wearing 1988).

Despite its importance, the literature concerning LSP scouting practices or consumer knowledge and acceptance of scouting services offered by LSPs is limited and dated. The findings of these studies highlight the desire of both professional and consumer respondents to reduce pesticide use, that consumers were slightly less tolerant of plant damage, and that consumers were also more likely to choose disease-resistant dogwood (*Cornus* sp.) cultivars (Klingeman et al. 2000, 2004). These results were observed even with only 40% of participants self-reporting that they had a working knowledge of IPM (Klingeman et al. 2000, 2004). Published work has yet to focus on the potential demand for a scouting program to reduce pesticide usage and negative environmental impacts. If such efforts led to opportunities for LSPs to provide alternative pest management services, there might be some potential positive economic impact for both landscapers and their customers. This research is an effort to extend the literature to include information about consumer IPM knowledge and their willingness to purchase an LSP scouting program.

The objectives of our study were to 1) identify if consumer awareness about IPM affected their willingness to purchase a LSP offered scouting program, and 2) quantify how consumer demographic characteristics influenced scouting program purchase likelihood.

Materials and methods

Survey development. The data for the study were obtained through an online survey distributed by a third-party contractor who recruited and compensated participants (Qualtrics Panel Services; Qualtrics LLC, Provo, UT, USA). The survey was conducted per the Clemson University Institutional Review Board–approved protocol (IRB2022–0415). The final sample size included 928

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Table 1. Survey questions used to determine awareness of integrated pest management (IPM) and willingness to purchase for scouting programs and biological controls offered by landscape/lawn service providers.

Question	Response options	Dummy code for logit model
Awareness of IPM	No knowledge at all	100
	Some knowledge	010
	Very knowledgeable	001
Likelihood of purchase of scouting program offered by a landscape/lawn service (definition provided)	yes/no	1/0
Have you ever heard of biological controls?	yes/no	1/0
If a landscape contractor offered nonchemical options as preventative measures, would you purchase this option?	yes/no/maybe	1/2/3

complete questionnaires. Respondents qualified for the study if they were 18 years of age or older and if they had a lawn/landscape service at the time of the survey. The second section of the survey instrument collected demographic data, including the number of adults and children in the household, age (at the time of the survey), gender, race, education level, state of residence, region, and self-reported income level (Table 1).

Participant awareness of IPM practices was evaluated using a 3-point Likert scale question (1 = "no knowledge at all," 2 = "some knowledge," and 3 = "very knowledgeable") (Table 1) (Jeffers et al. 2009). To evaluate the purchase likelihood of a landscape scouting program, respondents were asked to indicate if they would purchase a scouting program offered by a LSP (1 = "yes," 0 = "no"). Respondents were also asked if they had heard of biological controls.

Statistical analyses. Cross-tabulations were performed using the xtab function of R statistical software (ver. 3.6.2 for Windows; R Foundation for Statistical Computing, Vienna, Austria) to better understand the relationship of the dependent variable (purchase decision) with the respondents' demographic characteristics. For example, how many respondents who reported having some IPM knowledge would purchase a scouting program vs. those without knowledge? To better understand the relationship of the dependent variable (purchase decision) and the combination of demographics, considering the binary nature of the dependent variable a logistical regression model was used (Heiss 2016; Jeffers et al. 2009; Misango et al. 2022; Wooldridge 2015). Due to the categorical nature of the independent variables, dummy variables were created by coding IPM awareness, income bracket, age bracket, and education level as factors [Heiss 2016; Jeffers et al. 2009; Wooldridge 2015 (see Supplemental Material for model specification)]. For example, if a respondent indicated that they were "very knowledgeable" of IPM, the dummy variable code entered into the regression model would be 0, 0, 1 (no knowledge, some knowledge, very knowledgeable).

Results and discussion

Demographic characteristics and purchase likelihood. The demographics of the survey respondents are presented in Table 2. Seventy-six percent of respondents claimed to garden at least one to two times per week or more. The highest number of respondents who said they would purchase a scouting program are from the US Department of Agriculture, National Agricultural Statistics Service (2023) Northeastern region (17.4%), followed by the Southern (13.8%) and Pacific regions (10.7%) (Table 3). Respondents between ages 33 and 64 years indicated they would purchase a scouting program (50.8%). The "18 to 33 years of age" and the "65 and older years of age" groups had only 15% and 17%, respectively, who indicated they would purchase a scouting program (Table 3). Further evaluation of age × income using a chi-square test indicated that age and income brackets interacted with respondents' willingness to purchase a scouting program ($P < 0.001$). Results from these two age groups could be related to functions of lower disposable income with both younger and older participants or smaller properties that may not need as much maintenance.

Of all respondents, 57.2% self-reported some knowledge or that they were very knowledgeable of IPM on the scale provided (Table 2). A consumer base knowledgeable of IPM could potentially lead to the acceptance of biological control applications by LSP in place of chemical applications, potentially leading to a reduction in overall pesticide use in the landscape. Biological control applications would also provide a premium service for LSP to offer, with reduced worker exposures and the need for personal protective equipment.

Respondents' knowledge of biological controls was evaluated via asking if they had heard of biological controls (Table 1). A total of 61.5% of respondents indicated they had heard of biological controls, compared with 57.1% of respondents who indicated that they were "somewhat knowledgeable" (41.6%) or "very knowledgeable" (15.6%) about IPM. When the "heard of biological control" and "IPM awareness" variables were cross-tabulated, 29.3% of respondents who were "somewhat knowledgeable" and 14.3% who were "very knowledgeable" had heard of biological controls (Table 3); possibly indicating a new potential market for LSP pest management applications to consumers who are becoming more aware of IPM and its components over time.

These results show that consumers in this sample appear to be knowledgeable about IPM, pointing to the potential marketability of IPM and consumer acceptance of IPM practices over more traditional controls. With at least some evidence of consumer acceptance and knowledge of IPM and biological controls, LSP could offer scouting programs as a sales opportunity for biological control agent releases instead of chemical pesticides. A study published in 2002 implemented an IPM pilot program where scouting services were provided to participating landscapers and found that landscapers who followed a holistic IPM program vs. a traditional spray program were still profitable (Stewart et al. 2002), and concluded that additional work was necessary to determine the aesthetic thresholds for insect damage

Table 2. Demographic information of survey respondents to an online scouting program purchase likelihood survey (n = 928).

Variable	Response (% of total)
Gender	
Male	44.4
Female	55.6
Education level	
High school	32.7
Associate degree	17.4
Bachelor's degree	24.8
Master's degree	21.6
Doctorate	3.7
Age group, yr	
18 to 33	16.2
33 to 48	37.7
49 to 64	20.8
65 and older	24.6
Income bracket	
Less than $10,000	3.7
$10,000–$40,000	26.5
$40,000–$70,000	23.2
$70,000–$100,000	16.3
$100,000–$150,000	18.9
More than $150,000	11.5
Gardening habits	
0 times per week	22.59
1–2 times per week	52.3
3–4 times per week	18.4
>5 times per week	5.8
IPM awareness[i]	
No knowledge at all	42.8
Some knowledge	41.6
Very knowledgeable	15.6
Purchase a scouting program	
Yes	82.1
No	17.9
Awareness of biological controls	
Yes	61.5
No	38.5
US region[ii]	
Northeastern	20.7
Eastern Mountain	10.6
Southern	17.6
Great Lakes	8.4
Upper Midwest	2.4
Heartland	4.2
Delta	3.9
Northern Plains	1.8
Southern Plains	10.2
Mountain	4.0
Northwest	4.5
Pacific	12.2

[i] IPM = integrated pest management.
[ii] US Department of Agriculture, National Agricultural Statistics Service (2023).

for consumers. A study in 2004 looked at consumer willingness to pay for biological control applications in the landscape and reported that more than 50% of survey respondents were accepting of biological control releases (Jetter and Paine 2004). Many of the predatory biological control agents do not require personal protective equipment and have little to no restricted entry intervals (Jeffers and Chong 2021). Potential cost reductions could result in more profitable billable hours by LSP by providing nonchemical treatments and scouting services.

Prediction of purchase likelihood. Unlike a simple or multiple linear regression analysis, the properties of logit assessment only allow the parameter estimates of the model to be interpreted as having a negative or positive influence on the dependent variable (Uberti 2022). Since logit models indicate the probability of the dependent variable (purchase likelihood), model marginal effects can be interpreted as the percentage point increase or decrease in the probability of purchase likelihood (Uberti 2022).

Results from the logit model applied here indicate that the purchase likelihood of a scouting program decreases for older consumers. Specifically, respondents' purchase likelihood in the 65 years of age and older group had a 13.1% point decrease in purchase likelihood ($P < 0.001$) in contrast to those between 18 and 33 years of age (Table 4). One potential explanation for this result could be that older persons are more likely to be retired and have more time to spend in their landscape, possibly negating a need for a landscape operator to perform scouting services, or that a fixed income level could restrict the acquisition of new services.

Consumer self-reported knowledge of IPM increased the purchase likelihood of scouting programs. The likelihood of scouting program purchase increased by 5.6% points for respondents with "some knowledge" and by 8.6% points ($P < 0.05$) for respondents who identified as "very knowledgeable" ($P < 0.001$) in contrast to those respondents who were "not knowledgeable" or who reported "some knowledge" (Table 4). The variable of "heard of biological controls" or knowledge of biological controls as a check on respondent knowledge of IPM increases purchase likelihood by six percentage points [$P < 0.05$ (Table 4)].

Conclusions and future work

IPM consists of several important components, among which scouting services are the most important. However, despite the increasing demand for IPM both among professionals and consumers over the past decade, the literature regarding consumer knowledge and willingness to pay for scouting services is scarce. This research extends the IPM

Table 3. Survey respondents integrated pest management (IPM) knowledge and purchase likelihood of a landscape service provider scouting program by demographic information (n = 928).

	IPM knowledge level (%)			Purchase a scouting program (%)	
Variable	No knowledge (n = 397)	Some knowledge (n = 386)	Very knowledgeable (n =145)	No (n =166)	Yes (n =762)
Gender					
Male	14.0	19.3	11.1	5.39	39.0
Female	28.8	22.3	4.53	12.5	43.1
Education level					
High school	16.9	13.8	1.94	7.44	25.2
Associate degree	8.19	7.65	1.51	2.91	14.4
Bachelor's degree	10.6	11.1	3.13	3.56	21.2
Master's degree	5.93	7.78	7.76	3.45	18.1
Doctorate	1.19	1.19	1.29	0.54	3.13
Age group, yr					
18 to 33	3.66	9.27	3.99	2.26	14.7
33 to 48	10.6	17.1	10.0	3.66	34.1
49 to 64	12.1	7.54	1.19	4.09	16.7
65 and older	16.5	7.65	0.43	7.87	16.7
Income bracket					
Less than $10,000	1.19	2.16	0.32	0.65	3.02
$10,000–$40,000	12.5	11.9	2.16	5.82	20.7
$40,000–$70,000	12.3	9.48	1.40	4.96	18.2
$70,000–$100,000	6.57	7.65	2.05	2.69	13.6
$100,000–$150,000	6.90	6.36	5.60	2.37	16.5
More than $150,000	3.34	4.09	4.09	1.40	10.1
Gardening habits					
0 times per week	15.7	7.22	0.54	6.79	16.7
1–2 times per week	22.1	23.7	6.47	8.30	44.0
3–4 times per week	3.88	8.51	6.03	2.37	16.1
>5 times per week	1.08	2.16	2.59	0.43	5.39
IPM awareness					
No knowledge at all	–	–	–	11.0	31.8
Some knowledge	–	–	–	5.71	35.9
Very knowledgeable	–	–	–	1.19	14.4
Purchase a scouting program					
Yes	31.8	35.9	14.4	–	–
No	11.0	5.71	1.19	–	–
Awareness of biological controls					
Yes	17.9	29.3	14.3	8.08	53.5
No	24.9	12.3	1.29	9.81	28.7
US region[i]					
Northeastern	8.51	9.05	3.13	3.34	17.4
Eastern Mountain	4.53	4.42	1.62	2.37	8.19
Southern	7.54	6.57	3.23	3.56	13.8
Great Lakes	4.42	3.13	0.86	1.72	6.68
Upper Midwest	1.19	0.97	0.22	0.32	2.05
Heartland	2.26	1.19	0.75	0.86	3.34
Delta	1.29	1.72	0.86	0.32	3.56
Northern Plains	0.86	0.86	0.11	0.32	1.51
Southern Plains	3.77	5.06	1.19	1.62	8.41
Mountain	1.72	1.83	0.43	0.86	3.13
Northwest	1.94	2.16	0.43	1.08	3.45
Pacific	4.74	4.63	2.80	1.51	10.7

[i] US Department of Agriculture, National Agricultural Statistics Service (2023).

literature by evaluating consumers' willingness to purchase scouting services.

Survey results indicate that a potential market exists for LSPs to offer a scouting service. One potential issue related to marketing a scouting program is the consumer knowledge level of IPM. Though their knowledge level of IPM may be low, the knowledge that a scouting program is a saleable product could empower landscapers to educate their clientele when discussing

Table 4. Logit regression model estimates indicating the purchase likelihood of a scouting program offered by a landscape service provider (n = 928).

	Logit model coefficient estimates		Logit model marginal effects	
Variable	Estimate	*SE*	Marginal effect (%)	*SE*
Constant	0.958	0.511		
Income bracket				
Less than $10,000[i]				
$10,000–$40,000	0.054	0.495	0.7	0.063
$40,000–$70,000	0.169	0.504	2.1	0.062
$70,000–$100,000	0.367	0.527	4.4	0.058
$100,000–$150,000	0.536	0.545	6.2	0.056
More than $150,000	0.442	0.581		
Awareness of IPM[ii]				
No knowledge at all[i]				
Some knowledge	0.440*[iii]	0.205	5.6*	0.025
Very knowledgeable	0.801*	0.378	8.6**	0.033
Age group, yr				
18 to 33[i]				
33 to 48	0.272	0.309	3.5	0.038
49 to 64	−0.214	0.312	−2.9	0.044
65 and older	−0.868**	0.297	−13.1**	0.051
Education level				
High school[i]				
Associate's degree	0.340	0.262	4.1	0.029
Bachelor's degree	0.237	0.256	2.9	0.031
Master's degree	−0.303	0.287	−4.2	0.042
Doctorate	−0.068	0.552	−0.9	0.075
Biological control knowledge				
Yes	0.453*	0.191	6.0*	0.027

[i] Base variables.
[ii] IPM = integrated pest management.
[iii] *, ** indicate significant difference at $P = 0.05$, $P = 0.01$.

a scouting program as an alternative to purely chemical management in the landscape, which could serve as one means to augment a potential revenue stream. Further, if the consumer were open to purchasing the scouting program, they might be willing to accept slightly more aesthetic damage to the landscape and allow the operator to use a combination of chemical and nonchemical control methods, as proficient LSPs would understand this approach to landscape management is more environmentally protective. However, research is needed to investigate whether consumers are willing to accept a minimum threshold of damage if the landscape is managed with environmentally protective (IPM-based) methods and still perceive their landscape as attractive.

Future work should also seek to estimate how much a consumer is willing to pay for a scouting service, including adding a range of price points and the option to include the scouting service within regular landscape program fees that can be contrasted with demographic characteristics. Additionally, it would be useful to also include a variable for location (e.g., urban, suburban, or rural) to determine if the relative location of respondents influences purchase likelihood and aesthetic tolerance threshold.

One challenge related to documenting consumer awareness of the IPM is the limited scale used in this study. Future work should look at a self-stated Likert scale, where the knowledge level of IPM is more nuanced. For example, the scale could be 1 to 5 with 1 = "no knowledge at all" and 5 = "high working knowledge." Further, adding a question to verify consumer knowledge of IPM would be beneficial. Additional work is needed to identify differences between stated vs. actual knowledge/preference. This could be accomplished by giving survey respondents a set of questions to assess their knowledge/preference, similar to a 2002 study about lacebug (*Stephanitis pyrioides*) damage on azalea (*Rhododendron* sp.) (Klingeman et al. 2000).

The results of this study indicate a potential new revenue stream for LSPs who are willing to market and implement scouting programs and holistic pest management techniques. Further research is needed to draw more distinct conclusions, but if verified, landscapers could develop a new premium service market that includes such services as scouting and biological control applications. Many of the biological control options have reduced personal protective equipment requirements, which could lead to increased profit margins and reduce worker fatigue, which might also help to retain employees. Future studies should look at the marketability of IPM programs to consumers and the potential economic benefits to the LSP.

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Supplemental Material

R code and output for logit regression model used to estimate consumer purchase likelihood R statistical software (R ver. 3.6.2 for Windows; R Foundation for Statistical Computing, Vienna, Austria).

```
library(car)
scoutinglogitmodel <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ), family = binomial (link=logit), data = scouting)
scoutinglogitmodel2 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol), family = binomial (link=logit), data = scouting)
scoutinglogitmodel3 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol) + (factor(heardofbiocontrol)*factor(ipmaware)), family = binomial (link=logit), data = scouting)
scoutinglogitmodel4 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol) + (factor(region)) + (factor(heardofbiocontrol)*factor(ipmaware)), family = binomial (link=logit), data = scouting)
summary(scoutinglogitmodel)
Call:
glm(formula = Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol), family = binomial (link = logit), data = scouting)
Deviance Residuals:
```

Min	1Q	Median	3Q	Max
−2.3925	0.3558	0.4754	0.6714	1.1958

Coefficients:

	Estimate	*SE*	*z* value	Pr(>|z|)
(Intercept)	0.95817	0.51083	1.876	0.06070
factor(incbrac)2	0.05393	0.49515	0.109	0.91327
factor(incbrac)3	0.16918	0.50360	0.336	0.73691
factor(incbrac)4	0.36716	0.52671	0.697	0.48575
factor(incbrac)5	0.53560	0.54538	0.982	0.32607
factor(incbrac)6	0.44220	0.58080	0.761	0.44643
factor(ipmaware)2	0.43997	0.20483	2.148	0.03172*
factor(ipmaware)3	0.80115	0.37898	2.114	0.03452*
factor(agebrac)2	0.27242	0.30891	0.882	0.37784
factor(agebrac)3	−0.21406	0.31283	−0.684	0.49380
factor(agebrac)4	−0.86776	0.29657	−2.926	0.00343**
factor(educ)2	0.34000	0.26238	1.296	0.19503
factor(educ)3	0.23767	0.25626	0.927	0.35369
factor(educ)4	−0.30267	0.28694	−1.055	0.29150
factor(educ)5	−0.06898	0.55248	−0.125	0.90063
factor(heardofbiocontrol)1	0.45269	0.19143	2.365	0.01804*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```
(Dispersion parameter for binomial family taken to be 1)
Null deviance: 871.74 on 927 degrees of freedom
Residual deviance: 798.76 on 912 degrees of freedom
(119 observations deleted due to missingness)
AIC: 830.76
Number of Fisher Scoring iterations: 5
(Dispersion parameter for binomial family taken to be 1)
Null deviance: 871.74 on 927 degrees of freedom
Residual deviance: 798.76 on 912 degrees of freedom
(119 observations deleted due to missingness)
AIC: 830.76
```

R statistical software code and output for logit regression model specification.

```
library(car)
scoutinglogitmodel <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ), family = binomial (link=logit), data = scouting)
scoutinglogitmodel2 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol), family = binomial (link=logit), data = scouting)
```

```
scoutinglogitmodel3 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol) + (factor(heardofbiocontrol)*factor(ipmaware)), family = binomial (link=logit), data = scouting)
scoutinglogitmodel4 <- glm(Scouting ~ factor(incbrac) + factor(ipmaware) + factor(agebrac) + factor(educ) + factor(heardofbiocontrol) + (factor(region)) + (factor(heardofbiocontrol)*factor(ipmaware)), family = binomial (link=logit), data = scouting)
> library(car)
> AIC(scoutinglogitmodel)
[1] 834.366
> AIC(scoutinglogitmodel2)
[1] 830.7614
> AIC(scoutinglogitmodel3)
[1] 831.9197
> AIC(scoutinglogitmodel4)
[1] 845.4811
```