

Value of Pyrethroid Insecticides to Urban Pest Management Professionals

Pyrethroid Benefits Project



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Executive Summary

With pyrethroid insecticides currently being examined by the Environmental Protection Agency (EPA) for registration review, the objective of this research was to develop a better understanding of where and how insecticides are being used in the urban landscape and the implications of lost or reduced access to pyrethroid insecticides by the professionals who service these landscapes. This objective was accomplished using data from an internet survey of the members of the National Pest Management Association (NPMA) and National Association of Landscape Professionals (NALP).

The results of the survey show that pyrethroid insecticides are the most widely used class of insecticides by both association members' businesses—97 percent of NPMA and 95 percent of NALP respondents reported pyrethroid use at their businesses. A majority from both associations (65 and 71 percent of NPMA and NALP respondents) indicated that there are not enough acceptable alternatives to pyrethroid insecticides.

Considering the potential for lost or reduced access to pyrethroid insecticides, 85 percent of respondents said their businesses' insecticide costs would increase, while 68 percent said their insecticide application frequencies would increase, and 63 percent said their training and management requirements would increase. Alternatively, 54, 48, and 46 percent, said their businesses' ability to control invasive pests, practice integrated pest management, and manage insect resistance would decrease. A decrease in customer satisfaction and retention would also be expected by 59 percent of respondents.

Respondents from businesses with sales in excess of \$1 million in 2015 were not as concerned about increasing record keeping requirements if they lost pyrethroid insecticides, but they were concerned about customer satisfaction and retention decreasing, and their reduced ability to control invasive pests. Respondents from medium-sized businesses with eleven to fifty full-time employees were significantly concerned about increased record keeping requirements and ability to control invasive pests without pyrethroid insecticides, but were less concerned about customer satisfaction and retention. Respondents who have worked in the industry longer did not express as much concern that lost or reduced access to pyrethroid insecticides would decrease their customer satisfaction and retention, ability to manage insect resistance, and ability to control invasive pests.

Overall, the results of the survey show that lost or reduced access to pyrethroid insecticides would have significant negative impact on the ability of industry professionals to manage pests in the urban landscape. In particular, the negative impacts would be increased insecticide costs and application frequencies, decreased ability to practice integrated pest management, and decreased ability to control invasive pests.

Introduction

Federal regulations require the Environmental Protection Agency (EPA) to consider the benefits of a pesticide's use, as well as its risks, when making registration determinations (Cornell University Cooperative Extension 2012). Pesticides serve a critical role in agriculture by helping farmers protect their crop yields from insects, weeds, and disease. They serve a critical role outside of agriculture in controlling public health pests such as mosquitoes, ticks and cockroaches that may carry disease. They also serve a role in the urban landscape by making it possible to maintain healthy lawns, shrubs, and trees, which provide a range of benefits including reduced soil erosion, storm runoff, noise pollution and air pollution.

With pyrethroid insecticides currently being examined by the EPA in registration review, the objective of this research was to develop a better understanding of where and how insecticides are being used in urban areas and the implications of lost or reduced access to pyrethroid insecticides by the professionals who service these areas. This objective was accomplished using data from an internet survey of the members of the National Pest Management Association and National Association of Landscape Professionals. The survey solicited information on members' roles and experiences in the industry. It asked about the types of insect pests managed by their businesses as well as how these pests are managed. It asked about their perceptions of how lost or reduced access to pyrethroid insecticides would impact their businesses, for example, the cost of insecticides and their ability to practice integrated pest management. Finally, it asked members to characterize their businesses in terms of the number of employees, gross sales, and types of customers serviced. Factor analysis was used to explore what types of considerations their businesses faced with respect to pest management decisions. Regression analysis was used to determine how the characteristics of the individual's business, industry experience, and considerations for pest management related to their perceptions regarding lost or reduced access to pyrethroid insecticides.

The next section discusses the results of the survey. Details of the survey design, administration, and data analysis are provided in subsequent sections. Appendices include additional survey results and copies of the surveys.

Results

A total of 146 completed surveys were received from members of the National Pest Management Association (NPMA). The National Association of Landscape Professionals (NALP) members contributed another 149 responses. More than 90 percent of NPMA respondents provide service to residential and commercial customers, while just fewer than 80 percent also service food handling establishments (Table 1). More than half (54 percent) reported that they specialized in managing exterior pests, while a third said they specialized in interior pest management (Figure 1). About 90 percent of NALP members also indicated that they serviced residential customers, while about 80 percent indicated servicing commercial customers. The primary specialties reported by

these respondents included lawn care (70 percent) and landscape maintenance (23 percent). Just fewer than 50 percent of the NPMA respondents, and just over 50 percent of the NALP respondents, worked at businesses that had a single location (Figure 2). About 33 percent of NPMA and 25 percent of NALP respondents worked at businesses with multiple locations in multiple states. The fact the NPMA respondents tended to work at larger business is also apparent from the reported number of full-time employees and gross sales (Figures 3 and 4): 35 and 42 percent of NPMA respondents worked at businesses with more than 100 full-time employees and more than \$5 million in gross sales, which compares to 27 and 32 percent of NALP respondents.

Almost half (49 percent) of the NPMA respondents indicated they owned their business, with slightly fewer (46 percent) of the NALP respondents indicating ownership (Table 2). Alternatively, a third of the NPMA and two-fifths of the NALP respondents said they managed their business. Interestingly, 52 percent of the NALP respondents said they applied pesticides while only 26 percent of the NPMA respondents said they did. Another common category of responses voluntarily reported by the NPMA respondents was as a technical manager, director, specialist, or support (16 respondents in total—Table A2). Together these results suggest the NPMA members tend to be managers and owners of larger businesses who are not as directly responsible for applying pesticides. NALP members appear to include more small business owners and managers who are more directly involved with the application of pesticides. Regardless, both memberships share remarkably similar level of experience in the industry—about 24 years on average (Table 3).

Pyrethroids are used ubiquitously by both groups of respondents (97 and 95 percent for NPMA and NALP) (Figure 5). For the NPMA respondents, the next most commonly used insecticide is fipronil (91 percent), followed by neonicotinoids (87 percent), 25b exempt pesticides (63 percent), and organophosphates (45 percent). The next most commonly used insecticide class by NALP respondents is neonicotinoids (89 percent) followed by fipronil (58 percent), organophosphates (57 percent), and 25b exempt pesticides products (7 percent). Almost all NPMA respondents (99 percent) reported use of liquid sprays and bait formulations, though 90 percent also reported using aerosols, dusts, and granule formulations (Figure 6). Nearly all NALP respondents (99 percent) reported treating with liquid sprays closely followed by granules (94 percent). Aerosols and baits were also reported by more than half (62 and 52 percent), while dusts and impregnated fertilizers were reported by less than 33 percent of the NALP respondents.

NPMA members were asked to rate fifteen out of sixteen different considerations for managing insect pests reported in Table 4 as a) not at all important, b) not too important, c) important, or d) very important. More than 90 percent said customer safety was very important. Almost 90 percent said consistent pest control was very important. The next highest ranked considerations in terms of the number of respondents who rated it as very important was applicator safety, product efficacy, long-lasting control, time and labor, and controlling insects with a single application. Insecticide cost and being a restricted use product were rated as very important by less than 33 percent of NPMA respondents. NALP members were similarly asked to rate fourteen of the sixteen different considerations reported in Table 4. Like the NPMA members, about 90 percent said customer and

applicator safety were very important. Unlike the NPMA members, the NALP members more frequently indicated that considerations like managing resistant pests, pollinator safety, and non-target insect safety were very important—results that are consistent with the interior and structural focus of NPMA members as compared to the lawn care and landscape focus of NALP members. Insecticide cost was also rated as very important more often by the NALP members, while being a restricted use product was also rated by less than a third of NALP members as very important.

The responses by each membership group to these sixteen items were highly correlated. To better understand this correlation, a factor analysis was completed using the thirteen items that were answered by both groups. Factor analysis presumes that there are some underlying motives that are shared by individuals and cause them to respond similarly to questions. It provides a tool for ascertaining what responses are being driven by the same motivations based on the observed correlation within individuals' responses. This analysis identified three motives that we label as business health, environmental health, and human health. The business health motive was driven most by considerations for convenience and ease of use, broad spectrum of control in a single treatment, time and labor, insecticide cost, flexibility in application method, long-lasting control, and product efficacy including speed of knockdown and control considerations. The environment health motive was driven most by considerations for pollinator safety, safety to non-target organisms, and management of pesticide resistant pests. The human health motive was driven most by considerations for safety to the customer and safety to applicator.

Almost 90 percent NPMA respondents used pyrethroids as a broad-spectrum insecticide to control a range of pest problems (Table 5). More specific insect pests managed with pyrethroids in the past year included cockroaches (74 percent), ants (73 percent), mosquitoes (71 percent), bed bugs (65 percent), and flies (63 percent). The primary insect pests managed with pyrethroids in the past year by the NALP respondents' included chinch bugs (74 percent), web-making caterpillars (70 percent), grubs (65 percent), armored and soft scales (60 percent), spider mites (60 percent), and leafminers, aphids, and psyllids (54 percent).

A majority of both the NPMA and NALP respondents (65 and 71 percent) agreed that there are not enough acceptable alternatives to pyrethroid insecticides (Figure 7). A majority of all respondents indicated that losing access to pyrethroid insecticides would increase or substantially increase the cost of insecticides (85 percent), application frequency (68 percent), and training and management requirements (63 percent). Alternatively, a majority of all respondents thought that losing access to pyrethroid insecticides would decrease or significantly decrease their customer satisfaction and retention (59 percent) and ability to control invasive pests (54 percent) (Table 6). Most noted that record keeping and other paperwork requirements would not change with lost or reduced access to pyrethroid insecticides (63 percent). While 40 percent of respondents suggested this loss would increase or substantially increase health and safety risks to themselves and their customers, 49 percent assumed there would be no change. Just under half indicated their ability to manage resistant pests (45 percent) and to practice integrated pest management (48 percent) would decrease or substantially decrease.

Multivariate regression analysis was used to explore how respondents' perceptions about the impact of losing access to pyrethroid insecticides varied based on their association membership, industry experience, the size of their business in terms of full-time employees and gross sales, and the respondent's business, environment, and human health motives (Table 9). The regression analysis results showed that NPMA respondents were significantly less likely to say lost access to pyrethroids would increase their costs or health risks to themselves or their customers. They were also less likely to say it would decrease their customer satisfaction, ability to manage insect resistance and ability to practice integrated pest management. Respondents who have worked in the industry longer were less likely to say the loss of pyrethroids would decrease their customer satisfaction, ability to manage insect resistance, and their ability to control invasive pests. Respondents at medium-sized businesses with 11 to 50 full-time employees were significantly more likely to point to increases in record keeping and paperwork requirements, but less likely to worry about decreases in customer satisfaction and retention or their ability to control invasive pests. Respondents at businesses with gross sales over \$1 million were significantly less concerned about increased record keeping and paperwork requirements, but significantly more concerned about decreases in their customer satisfaction and retention, and their ability to control invasive pests. Respondents with stronger business health motives were significantly less likely to be concerned about decreases in customer satisfaction, the ability to manage resistant insects, their ability to practice integrated pest management, and the ability to control invasive pests. Respondents with stronger environment health motives were significantly less concerned that the loss of pyrethroids would increase insecticide application frequencies. Respondents with stronger human health motives were more concerned about decreases in customer satisfaction, their ability to manage insect resistance, and their ability to control invasive pests with lost or reduced access to pyrethroid insecticides.

Analysis of the correlation in individual responses (Table 10) after controlling for association membership, industry experience, the size of the business in terms of full-time employees and gross sales, and the respondents' business, environment, and human health motives reveals that the remaining systematic variation can be explained by how the question was framed. That is, whether an increase or significant increase reflected a negative (e.g., increased cost) or positive (e.g., increased customer satisfaction and retention) impact on the respondents' business.

Methods

The data used to achieve the objectives of this research come from an internet survey of members of the National Pest Management Association (NPMA) and National Association of Landscape Professionals (NALP). AgInfomatics developed the survey instrument with suggestions from the leadership in NPMA and NALP, and technical experts in AMVAC Chemical Corporation, BASF Crop Protection, Bayer Crop Science LP, FMC Corporation, Syngenta Crop Protection, LLC, and Valent USA (MGK). The finished survey was then supplied to Market Probe, a multinational survey research firm. Market Probe loaded the survey into their system and supplied AgInfomatics with the log-on and access protocols. These log-on and access protocols where

communicated to executive staff within the two associations. The associations asked members for voluntary cooperation in completing the survey and provided the survey site address and login protocols. Next, both association newsletters and other electronic communication were used to convey this request to members for cooperation. The same mechanisms were used to send out reminders to complete the survey. The goal for both associations was to achieve 150 responses, and as noted earlier, the NPMA had 146 responses, while the NALP had 149 responses.

The survey instrument included four sections. The first section asked about the respondent's role and experience in the industry. The second asked about how the respondent's business manages pests, which included questions about the classes of insecticides used and relative importance of alternative pest management considerations. The third section asked respondents to consider how lost access to pyrethroid insecticides would impact their business with questions regarding the type of insects managed with pyrethroid insecticides, thoughts on the availability of acceptable alternatives, and changes in the business ranging from insecticide costs, record keeping requirements, and the ability to control invasive pests. Two additional questions in this section provided an unstructured opportunity for respondents to convey how lost access to pyrethroid insecticides and lost access to pyrethroid and neonicotinoid insecticides would impact their businesses. The final section asked more detailed questions about the respondent's company, including its primary specialty, types of customers, geographic extent, size in terms full-time employees and gross sales, and product formulations used in the past year. Copies of both survey instruments can be found in the appendix.

In addition to providing a general summary of responses to the survey questions for each group, we performed a multivariate regression analysis of the responses for how lost access to pyrethroid insecticides would impact the respondent's business. The goal of this multivariate analysis was to better understand how these perceived impacts varied in the characteristics of the respondent and the respondent's business. The nine business impacts included in the survey are reported in Table 6 along with a descriptive summary of individual responses. These individual responses are broken down for NPMA and NALP respondents in Table A4 in the appendix.

With the exception of the "don't know" response category, the five remaining categories can be assigned a natural ordering where significant decrease is represented by one, decrease is represented by two, no change is represented by three, increase is represented by four, and significant increase is represented by five. A common strategy for analyzing categorical data with such as these is an order probit model, though linear models have returned to popularity for such data due to their ease of interpretation, robustness of results, and lack of reliance on non-linearity for model identification. We first used ordinary least squares (OLS) models, which were applied to each of the nine response variables independently. However, since the individual's nine responses were likely correlated, we also estimated a linear model that assumes the regression errors are multivariate normally distributed:

$$(1) \quad y_i^k = \mathbf{x}_i \boldsymbol{\beta}^k + \varepsilon_i^k \text{ for } k = 1, \dots, 9$$

where y_i^k is the response of the i th individual to the k th potential business impact, x_i is a vector of explanatory variables, β^k is a conformable vector of estimable parameters, and ε_i^k is the i th individual's regression error for the k th business impact. The expectation of ε_i^k is assumed to be zero, while the covariance of the vector $(\varepsilon_i^1, \dots, \varepsilon_i^9)$ is assumed to be an estimable, 9×9 symmetric and positive definite matrix Σ . This type of simultaneous linear model with correlated errors can be estimated using maximum likelihood techniques and the user written `cmp` command for Stata (Roodman 2011). The `cmp` command also estimates ordered probit equations with correlated errors using simulated maximum likelihood routines. With the ordered probit model, the response is defined by:

$$(2) \quad y_i^k = \begin{cases} 1 & \text{for } \mu_1^k > \mathbf{x}_i \beta^k + \varepsilon_i^k \\ 2 & \text{for } \mu_2^k > \mathbf{x}_i \beta^k + \varepsilon_i^k \geq \mu_1^k \\ 3 & \text{for } \mu_3^k > \mathbf{x}_i \beta^k + \varepsilon_i^k \geq \mu_2^k \text{ for } k = 1, \dots, 9 \\ 4 & \text{for } \mu_4^k > \mathbf{x}_i \beta^k + \varepsilon_i^k \geq \mu_3^k \\ 5 & \text{for } \mathbf{x}_i \beta^k + \varepsilon_i^k \geq \mu_4^k \end{cases}$$

where x_i , β^k , and ε_i^k are defined as in equation (1) and μ_1^k , μ_2^k , μ_3^k , and μ_4^k are estimable parameters.

The vector of explanatory variables included measures of association membership, industry experience, the size of the business, and relative importance of pest management considerations. Specifically, the NPMA Member variable in the regression was set equal to one if the respondent was from the NPMA and zero if the respondent was from the NALP. The Experience variable was taken directly from the respondent's reported industry experience with the pest management industry (question 2 on the survey).

Business size by full-time employment was measured with three variables: 11 to 50 Employees, 51 to 100 Employees, and More than 100 Employees. The 11 to 50 Employees variable was set equal to one if the respondent chose that category for question 13 on the survey or zero for any other response. The 51 to 100 Employees variable was set equal to one if the respondent chose that category for question 13 on the survey or zero for any other response. The More than 100 Employees variable was set equal to one if the respondent chose that category for question 13 on the survey or zero for any other response. The excluded responses for this variable were the zero and one to ten for question 13.

Business size by gross sales was measured with two variables: \$1 to \$5 Million Sales and More than \$5 Million Sales. The \$1 to \$5 Million Sales variable was set equal to one if the respondent chose that category for question 15 on the survey or zero for any other response. The More than \$5 Million Sales variable was set equal to one if the respondent chose that category for question 15 on the survey or zero for any other response. The excluded responses for this variable were the Less than \$250,000; \$250,000 or more, but less than \$500,000; and 500,000 or more, but less than \$1 million for question 15.

The survey asked NPMA respondents to rate the relative importance of fifteen alternative pest management considerations as not at all important (set equal to 1), not too important (set equal to 2), important (set equal to 3), and very important (set equal to 4). Similarly, the survey asked NALP respondents to rate the relative importance of fourteen alternative pest management considerations. Thirteen of the sixteen alternative considerations were common across both surveys. Due to high correlation among responses to these thirteen common considerations, factor analysis was used to reduce the number of highly correlated variables for further regression analysis (Basilevsky 1994). The premise of factor analysis is that underlying unobserved motivations drive individual responses to the various survey items resulting in correlation across responses. Factor analysis provides a tool to identify these underlying motivations and to create new variables that measure them for subsequent interpretation and analysis. STATA's factor command was used to perform the factor analysis (StataCrop 2013). The parallel analysis paradigm (Ledasma and Valero-Mora 2007), which performs well in simulation studies and is considered less ad hoc and subjective than the widely-used Kaiser rule or Cattell's Scree test (Courtney 2013), was used to identify three statistically significant factors (see Table 7). After performing a varimax rotation to determine factor weights and facilitate interpretation (see Table 8), STATA's predict command was used to generate scores for each factor and respondent, using the default regression method (StataCrop 2013). These factor scores provide controls for systematic differences in respondents' motivations as related to their businesses pest management decisions.

The magnitude of the factor loadings for the first factor are highest for convenience and ease of use; broad spectrum of insects controlled in a single application; time and labor; insecticide cost; flexibility in application method; long lasting control; and product efficacy including speed of knockdown and control. All of these considerations relate to how cost effectively the business can provide its services, which is why we chose to label it business health. The magnitude of the factor loadings for the second factor are highest for pollinator safety, safety to non-target organisms, and management of resistant pests, which are environmental consequences of pest management and why we labeled it environment health. The magnitude of the factor loading for the final factor is highest for safety to consumer and applicator, which was labeled human health.

The regression results using the `cmp` command are reported in Tables 9 and 10. Table 9 includes the linear parameter estimates (*t*-statistic) and the error standard deviation estimates (90 percent confidence intervals). Table 10 includes the error correlation estimates (90 percent confidence intervals). Table 9 is replicated with OLS estimates in Table A5 and Tables 9 and 10 are replicated with the ordered probit estimates in Tables A6 and A7 of the appendix to demonstrate the robustness of the results. The significant correlation in the errors in Table 10 suggests that there may be important unobserved factors that further influenced individual responses. To explore this hypothesis, we analyzed this correlation matrix using the `factormat` command in STATA (StataCrop 2013), which effectively performs a factor analysis based on a correlation matrix. The eigenvalues reported in Table 11 suggest two underlying factors based on both the Kaiser rule and Cattell's Scree test. The first of these two factors has large loadings for ability to manage insect resistance, ability to control invasive pests, ability to

practice integrated pest management, and customer satisfaction and retention, which are items where an increase or significant increase to the respondent's business would reflect a positive impact. Alternatively, the second factor has large loadings for training and management requirements, cost of insecticide products, health and safety risks to applicator and customers, record keeping and other paperwork, and application frequency, which are items where an increase or significant increase to the respondent's business would reflect a negative impact.

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Table 1: Types of customers serviced by the company

	NPMA	NALP
	<i>% of Respondents</i>	
Residential	91.8	87.9
Commercial	92.5	79.2
Food Handling Establishments	77.4	NA
Other	19.9	8.1
Number of Respondents	146	149

Note: Other specific responses are reported in Table A1 in the appendix.

NA: Not Applicable.

Table 2: Roles in the pest management industry

	NPMA	NALP
	<i>% of Respondents</i>	
I am a business owner	49.3	45.6
I am a business manager	34.2	40.3
I apply pesticides	26.0	52.3
Other	22.6	8.1
Total Responses	146	149

Table 3: Years of experience in the industry.

	NPMA	NALP
	<i>Years</i>	
Mean	24.5	24
Standard Deviation	12.5	11.4
Median	23.5	25
5 th Percentile	5	5
95 th Percentile	45	42
Minimum	1	1
Maximum	50	50
Total Responses	146	149

Table 4: Relative importance of alternative considerations for making insect pest management decisions

		Not Important	Somewhat Important	Important	Very Important
		<i>% of Respondents</i>			
Insecticide Cost	NPMA	2.7	20.5	47.9	28.8
	NALP	1.3	4.0	38.9	55.7
Broad spectrum of insects controlled in a single application	NPMA	0.7	4.1	43.2	52.1
	NALP	1.3	5.4	40.3	53.0
Product Efficacy including speed of knockdown and control	NPMA	0.0	0.7	29.5	69.9
	NALP	0.7	2.0	16.1	81.2
Convenience & ease of use	NPMA	1.4	17.1	43.2	38.4
	NALP	0.7	2.7	38.3	58.4
Time and labor	NPMA	0.7	2.7	32.2	64.4
	NALP	0.7	2.7	26.8	69.8
Long lasting control	NPMA	0.0	2.1	28.1	69.9
	NALP	0.7	2.7	33.6	63.1
Flexibility in application method	NPMA	0.0	7.5	45.2	47.3
	NALP	0.7	2.7	48.3	48.3
Pollinator safety	NPMA	0.7	8.2	36.3	54.8
	NALP	1.3	3.4	24.2	71.1
Management of resistant pests	NPMA	0.7	11.0	30.8	57.5
	NALP	0.7	2.7	19.5	77.2
Safety to Non-Target Insects	NPMA	0.7	13.7	41.1	44.5
	NALP	1.3	4.0	30.9	63.8
Safety to applicator (e.g., personal protective equipment)	NPMA	0.0	0.7	13.7	85.6
	NALP	0.7	0.0	10.1	89.3
Safety to customer	NPMA	0.0	0.0	6.8	93.2
	NALP	0.7	0.7	8.1	90.6
Insecticide being a Restricted Use Product	NPMA	13.0	25.3	29.5	32.2
	NALP	15.4	25.5	26.2	32.9
Ability to control insects with a single application	NPMA	0.0	2.7	34.2	63.0
Consistent control of a pest	NPMA	0.0	0.7	9.6	89.7
Unique control of a pest or pest spectrum	NALP	1.3	5.4	44.3	49.0

Table 5: Primary insects managed with pyrethroid insecticide applications in the past year

NPMA	
	<i>% of Respondents</i>
Occasional pest invaders	89.7
Cockroaches	74.0
Ants	73.3
Mosquitoes	70.5
Bed bugs	65.1
Flies	63.0
Termites (including pre-treats)	28.1
Turf pests	25.3
Plant pests	21.2
None of these	0.7
Total Responses	146

NALP	
	<i>% of Respondents</i>
Chinch bugs (lawn)	73.8
Web-making caterpillars (Eastern tent, fall webworm) bagworms.	69.8
Grubs, adults (Japanese beetle), larvae on turf (Japanese beetle, white grubs)	65.1
Scales, armored and soft	60.4
Spider mites	59.7
Leafminers (boxwood, birch), aphids, psyllid (boxwood)	54.4
Emerald ash borer or other tree and shrub borers	28.9
Sawflies (evergreens)	28.2
Clearwing (ash, peach, dogwood) and flat head (birch, apple)	17.4
Gypsy moth	13.4
None of these	3.4
Total Responses	149

Table 6: Impact on business of losing access to pyrethroid insecticides (295 Respondents)

	Significant Increase	Increase	No Change	Decrease	Significant Decrease	Don't Know
	<i>% of Respondents</i>					
Cost of Insecticide Products	41.0	44.1	4.4	1.0	1.7	7.8
Application Frequency	24.8	43.4	12.9	5.1	2.1	11.8
Record Keeping and Other Paperwork	7.8	19.6	62.7	2.4	2.0	5.4
Customer Satisfaction and Retention	12.9	9.5	12.2	37.0	22.0	6.4
Training and Management Requirements	17.6	45.8	28.2	2.4	2.8	3.4
Ability to Manage Insect Resistance	12.9	22.7	12.9	24.8	20.7	6.1
Ability to Control Invasive Pests	14.6	18.6	8.5	29.2	25.0	4.1
Ability to Practice Integrated Pest Management (IPM)	12.2	12.2	25.7	28.5	19.3	2.1
Health and Safety Risks to You and Your Customers	12.2	28.5	36.6	7.8	2.4	12.6

Note: Separate results for the NPMA and NALP respondents are reported in Table A4 in the appendix.

Table 7: Factor analysis eigenvalues, cumulative variance, and p -values based on parallel analysis paradigm (Ledasma and Valero-Mora 2007) for the thirteen alternative pest management considerations

Factor	Eigenvalue	Cumulative Variance	p -value
1	3.26	0.81	0.000
2	0.87	1.03	0.000
3	0.55	1.16	0.000
4	0.18	1.21	0.452
5	0.12	1.24	0.652
6	0.07	1.26	0.808
7	-0.02	1.25	0.991
8	-0.03	1.24	0.991
9	-0.13	1.21	1.000
10	-0.14	1.18	1.000
11	-0.19	1.13	1.000
12	-0.25	1.07	1.000
13	-0.27	1.00	1.000

Table 8: Varimax rotation factor loadings and uniqueness for three significant factors on the thirteen alternative pest management considerations

	Business Health	Environment Health	Human Health	Uniqueness
Convenience & Ease of Use	0.610	0.200	0.057	0.585
Broad Spectrum of Insects Controlled in a Single Application	0.531	0.057	0.079	0.708
Time and Labor	0.518	0.166	0.203	0.663
Insecticide Cost	0.499	0.288	0.050	0.665
Flexibility in Application Method	0.494	0.232	0.101	0.692
Long Lasting Control	0.482	0.056	0.230	0.712
Product Efficacy Including Speed of Knockdown and Control	0.418	0.005	0.355	0.699
Pollinator Safety	0.056	0.688	0.215	0.478
Safety to Non-Target Insects	0.181	0.681	0.115	0.490
Management of Resistant Pests	0.322	0.434	0.300	0.619
Safety to Customer	0.092	0.209	0.659	0.514
Safety to Applicator (e.g., personal protective equipment)	0.099	0.251	0.588	0.582
Insecticide Being a Restricted Use Product	0.163	0.211	0.115	0.916

Table 9: Linear parameter estimates (*t*-statistic) and the error standard deviation estimates [90 percent confidence intervals] for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork
NPMA Member	-0.292*** (2.98)	-0.131 (1.11)	-0.090 (0.98)
Experience	0.0029 (0.74)	-0.0005 (0.11)	0.0041 (1.10)
11 to 50 Employees	-0.078 (0.38)	-0.264 (1.04)	0.474** (2.40)
51 to 100 Employees	-0.156 (0.54)	-0.351 (1.03)	0.230 (0.86)
More than 100 Employees	-0.037 (0.13)	-0.476 (1.43)	0.269 (1.05)
\$1 to \$5 Million Sales	0.107 (0.53)	0.004 (0.02)	-0.671*** (3.48)
More Than \$5 Million Sales	-0.029 (0.10)	0.146 (0.45)	-0.419* (1.69)
Business Health	-0.033 (0.57)	0.057 (0.81)	-0.013 (0.24)
Environment Health	0.023 (0.37)	-0.173** (2.27)	-0.090 (1.54)
Human Health	-0.026 (0.41)	0.053 (0.68)	-0.010 (0.16)
Constant	4.39*** (32.59)	4.23*** (26.00)	3.37*** (26.76)
Sigma	0.76 [0.70, 0.83]	0.90 [0.83, 0.98]	0.723 [0.666, 0.786]
Respondents	272	260	279

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table 9 (continued): Linear parameter estimates (*t*-statistic) and the error standard deviation estimates [90 percent confidence intervals] for impacts of lost access to pyrethroid insecticides

	Customer Satisfaction and Retention	Training and Management Requirements	Ability to Manage Insect Resistance
NPMA Member	0.334** (2.11)	0.072 (0.65)	0.300* (1.82)
Experience	0.0191*** (3.01)	-0.0003 (0.08)	0.0142** (2.15)
11 to 50 Employees	0.666* (1.92)	-0.054 (0.23)	-0.159 (0.46)
51 to 100 Employees	0.426 (0.89)	0.143 (0.45)	-0.339 (0.69)
More than 100 Employees	0.685 (1.48)	0.261 (0.86)	-0.341 (0.71)
\$1 to \$5 Million Sales	-0.630* (1.85)	-0.024 (0.11)	-0.079 (0.23)
More Than \$5 Million Sales	-0.982** (2.18)	-0.267 (0.90)	-0.155 (0.34)
Business Health	0.188** (2.02)	0.068 (1.06)	0.250** (2.56)
Environment Health	-0.072 (0.71)	-0.032 (0.45)	0.006 (0.06)
Human Health	-0.188* (1.81)	-0.017 (0.24)	-0.337*** (3.14)
Constant	1.97*** (9.11)	3.76*** (25.11)	2.55*** (11.39)
Sigma	1.253 [1.153, 1.360]	0.871 [0.802, 0.945]	1.308 [1.205, 1.421]
Respondents	276	285	277

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table 9 (continued): Linear parameter estimates (*t*-statistic) and the error standard deviation estimates [90 percent confidence intervals] for impacts of lost access to pyrethroid insecticides

	Ability to Control Invasive Pests	Ability to Practice Integrated Pest Management	Health and Safety Risks to You and Your Customers
NPMA Member	0.278 (1.64)	0.370** (2.41)	-0.205* (1.74)
Experience	0.0174** (2.55)	0.0063 (1.02)	0.0059 (1.26)
11 to 50 Employees	0.623* (1.75)	0.284 (0.89)	0.204 (0.82)
51 to 100 Employees	0.078 (0.16)	0.125 (0.28)	-0.003 (0.01)
More than 100 Employees	0.512 (1.08)	0.450 (1.05)	0.197 (0.57)
\$1 to \$5 Million Sales	-0.746** (2.14)	-0.235 (0.75)	-0.233 (0.95)
More Than \$5 Million Sales	-1.013** (2.19)	-0.616 (1.48)	-0.306 (0.91)
Business Health	0.242** (2.43)	0.220** (2.45)	0.093 (1.34)
Environment Health	0.010 (0.09)	-0.034 (0.34)	0.056 (0.76)
Human Health	-0.216* (1.95)	-0.113 (1.13)	-0.068 (0.89)
Constant	2.34*** (10.17)	2.40*** (11.42)	3.48*** (21.76)
Sigma	1.349 [1.243, 1.464]	1.232 [1.135, 1.336]	0.901 [0.828, 0.981]
Respondents	283	289	258

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table 10: Error correlation estimates [90 percent confidence intervals] for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork	Customer Satisfaction and Retention	Training and Management Requirement	Ability to Manage Insect Resistance	Ability to Control Invasive Pests	Ability to Practice Integrated Pest Management
Application Frequency	0.319 [0.205, 0.424]							
Record Keeping and Other Paperwork	0.370 [0.264, 0.467]	0.257 [0.144, 0.364]						
Customer Satisfaction and Retention	0.118 [-0.003, 0.236]	0.160 [0.043, 0.273]	0.162 [0.046, 0.274]					
Training and Management Requirement	0.498 [0.399, 0.585]	0.426 [0.323, 0.519]	0.424 [0.322, 0.516]	0.112 [-0.004, 0.225]				
Ability to Manage Insect Resistance	0.195 [0.076, 0.308]	0.176 [0.057, 0.290]	0.249 [0.135, 0.357]	0.575 [0.490, 0.649]	0.139 [0.023, 0.252]			
Ability to Control Invasive Pests	0.119 [0.001, 0.234]	0.203 [0.087, 0.314]	0.278 [0.167, 0.382]	0.643 [0.568, 0.707]	0.218 [0.105, 0.326]	0.735 [0.675, 0.784]		
Ability to Practice Integrated Pest Management	0.104 [-0.015, 0.219]	0.167 [0.050, 0.279]	0.175 [0.059, 0.287]	0.623 [0.546, 0.689]	0.185 [0.071, 0.294]	0.666 [0.595, 0.726]	0.572 [0.489, 0.645]	
Health and Safety Risks to You and Your Customers	0.432 [0.327, 0.526]	0.360 [0.247, 0.464]	0.394 [0.286, 0.493]	0.228 [0.109, 0.340]	0.465 [0.366, 0.554]	0.304 [0.190, 0.410]	0.272 [0.156, 0.381]	0.239 [0.122, 0.349]

Table 11: Factor analysis eigenvalues and cumulative variance for impact of lost access to pyrethroids on pest management

Factor	Eigenvalue	Cumulative Variance
1	3.12	0.78
2	1.34	1.12
3	0.07	1.14
4	0.02	1.14
5	-0.03	1.13
6	-0.06	1.12
7	-0.09	1.10
8	-0.15	1.06
9	-0.24	1.00

Table 12: Varimax rotation factor loadings and uniqueness for two significant factors on the impact of lost access to pyrethroids on pest management

	Stewardship Concerns	Business Concerns	Uniqueness
Ability to Manage Insect Resistance	0.822	0.137	0.305
Ability to Control Invasive Pests	0.808	0.149	0.325
Ability to Practice Integrated Pest Management (IPM)	0.754	0.092	0.423
Customer Satisfaction and Retention	0.744	0.064	0.442
Training and Management Requirements	0.111	0.714	0.478
Cost of Insecticide Products	0.084	0.636	0.588
Health and Safety Risks to You and Your Customers	0.245	0.604	0.575
Record Keeping and Other Paperwork	0.200	0.531	0.679
Application Frequency	0.153	0.500	0.727

Figure 1: Primary specialty of the business

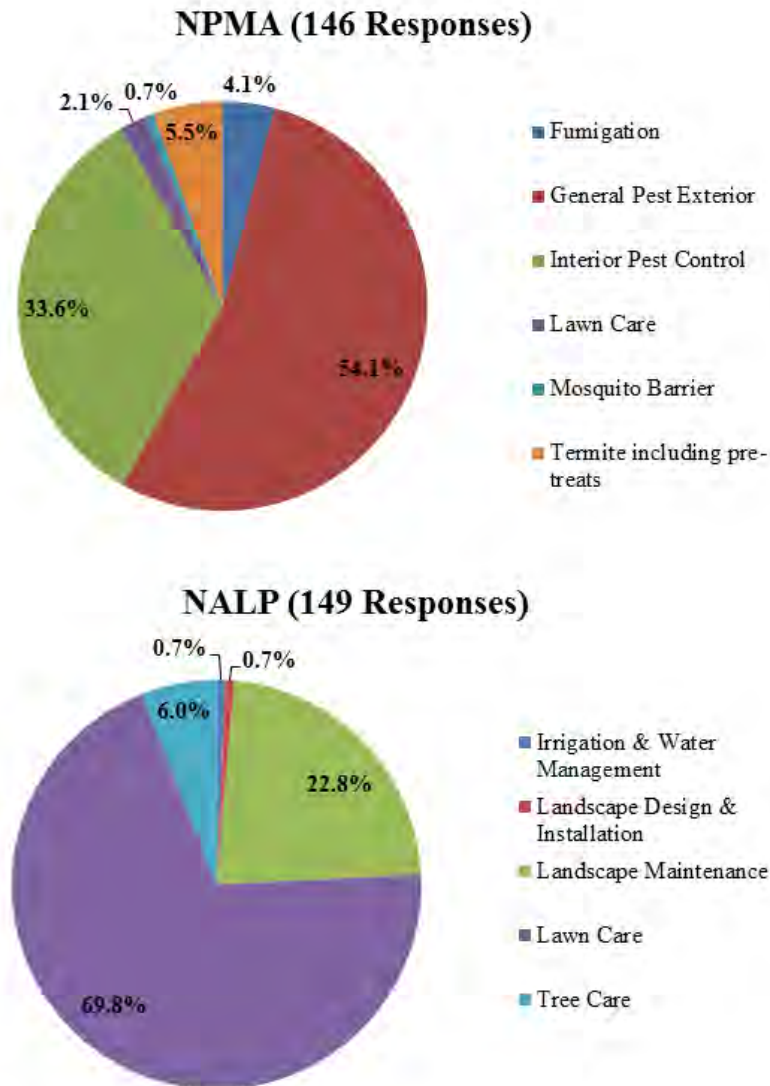
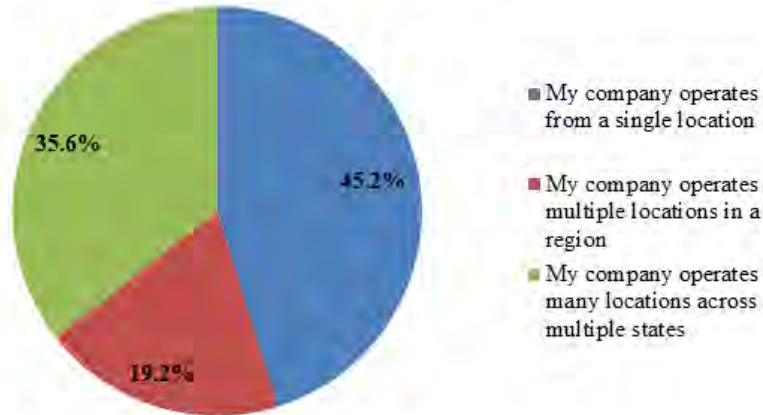


Figure 2: Geographic extent of the business' service

NPMA (146 Responses)



NALP (149 Responses)

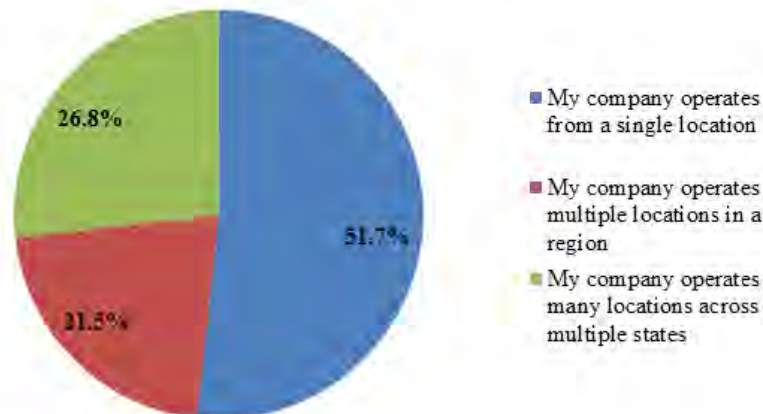


Figure 3: Number of year-around, full-time workers employed by the business

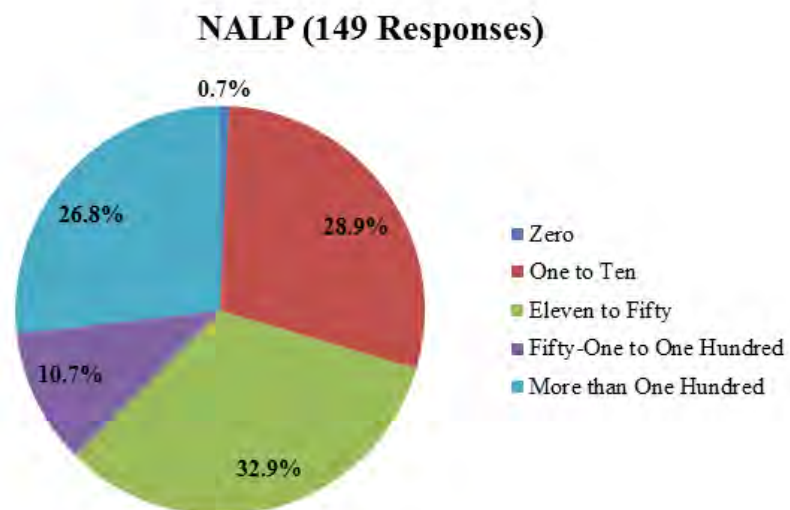
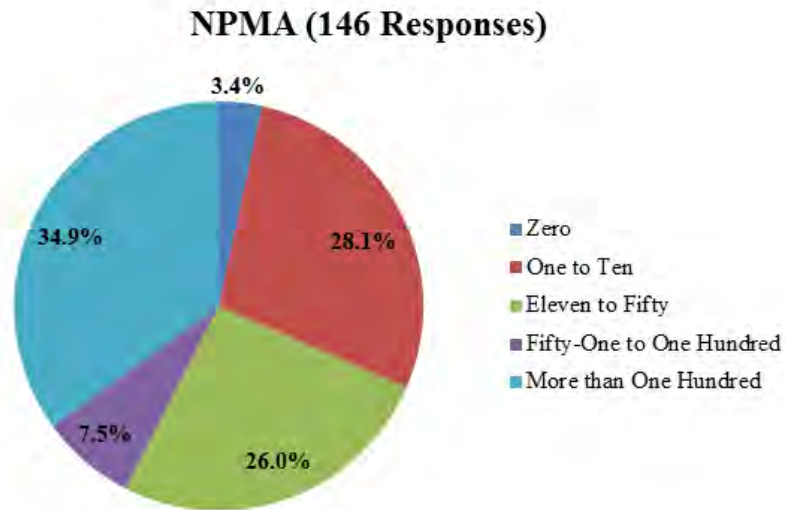


Figure 4: 2015 gross sale

NPMA (146 Responses)



NALP (149 Responses)

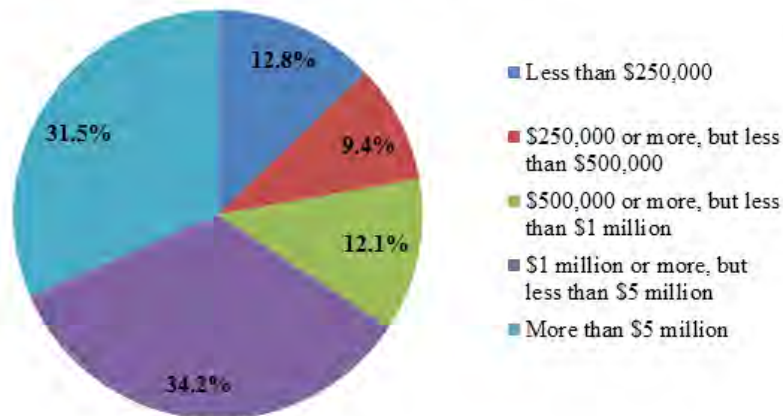
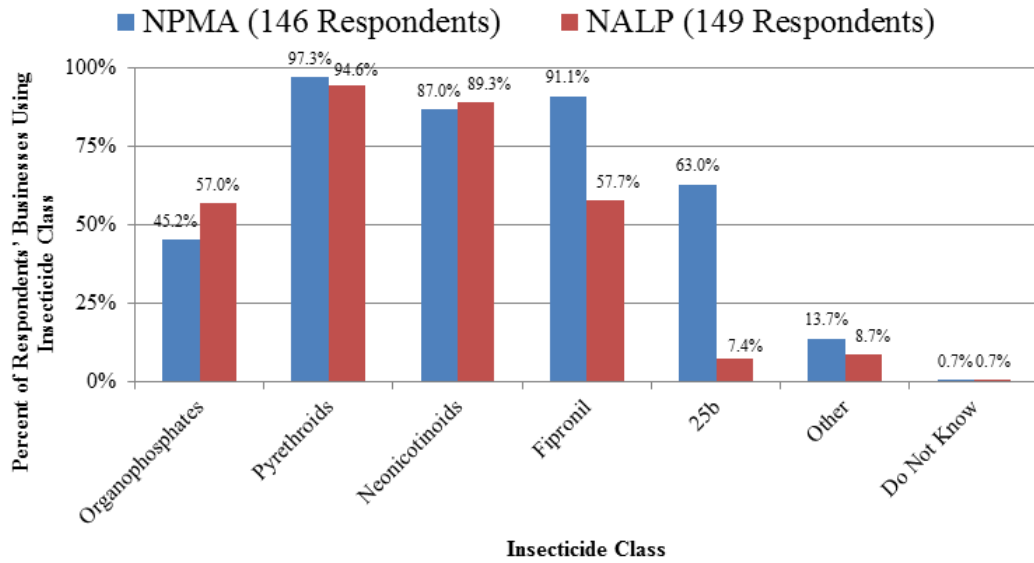
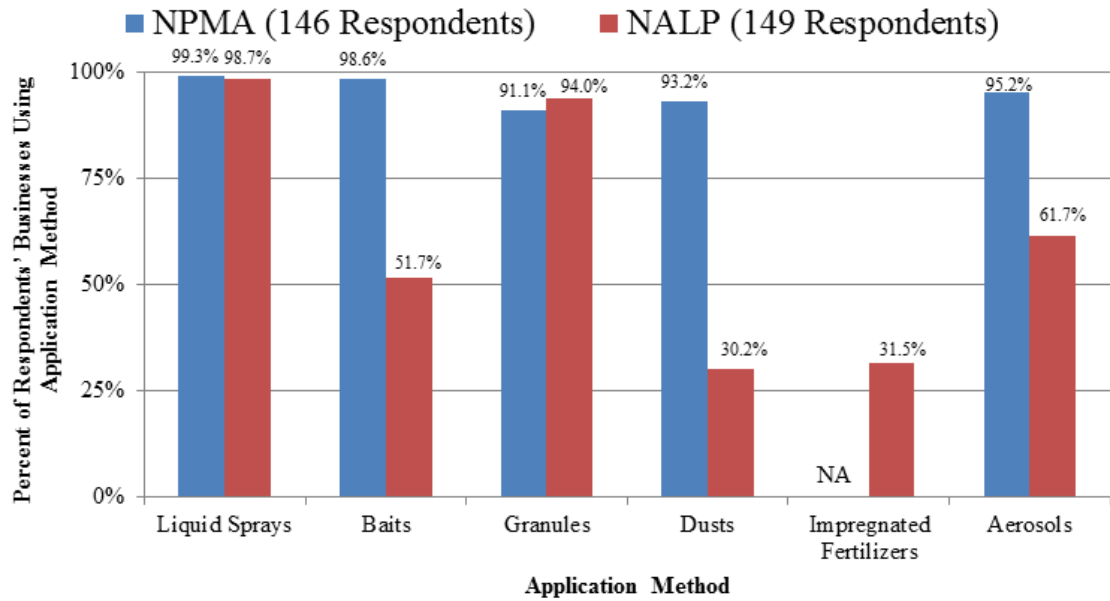


Figure 5: Classes of insecticides used by business



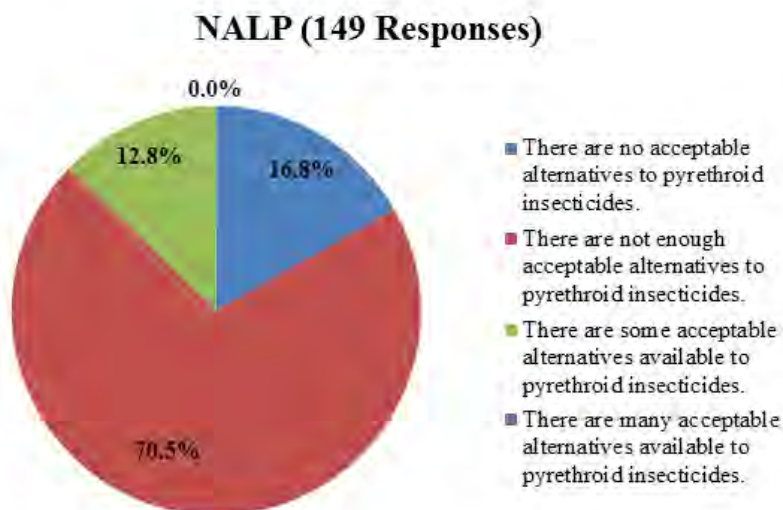
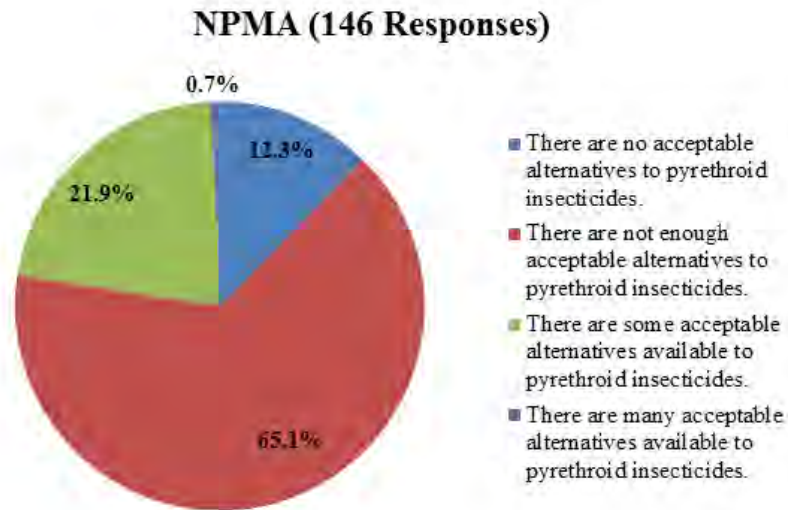
Note: Other types of insecticides specified by the respondents are reported in Table A3 in the appendix.

Figure 6: Insecticide product forms used by business



NA: Not Applicable.

Figure 7: Perceptions of the availability of pyrethroid alternatives



Appendix

Table A1: Other types of customers serviced that were specified by the respondents

Other specify:	NPMA	NALP
	<i>Number of Respondents</i>	
Apartments	1	
Athletic fields and Municipal	1	
College/Professional Football stadium		2
Food plants primarily		1
Food processing	1	
Food Processing and Food Distribution	1	
General office and institutional customers	1	
Government	1	
Government installations, health care facilities, transportation facilities	2	2
Healthcare, Food Plant, Pharmaceutical, etc..	1	
Home sales and new construction	2	
Housing	1	
Industrial	1	
Industrial, medical	1	
Industrial, Schools, Government	1	
Institutional		1
Large industrial	2	
Medical facilities	1	
Medical, Pharma	1	
Military bases	1	
Military Installations/Department of Defense	1	
Mosquito, athletic field	1	
Municipal		1
Municipal mosquito mgmt,		1
New home owners and investors and builders	2	
Professional end users	1	
Public buildings/Gov't		1
Public health, animal health, structural fumigation	1	
Retail, Warehouse industrial		1
Schools	1	
Schools and daycares	1	1
Tax payers	1	
Termite, Government and Ancillary (Bird, canine, wildlife, etc)		1
Wholesale	1	

Table A2: Other roles in the pest management industry specified by the respondents

Other specify:	NPMA	NALP
	<i>Number of Respondents</i>	
Administrative assistant		1
Consultant to 500 franchise locations		1
Director of Education		1
Distributor sales rep		1
Franchisor		1
Hort/Agronomy Regional Technical Director		1
I am National Technical Director for Lawn Care Franchise		1
I provide technical support to those who apply pesticides	2	
Lawn Care equipment specialist		1
Manufacturer	1	
Pesticide Dealer		1
Publicly Traded Company	1	
Representative		1
Sales Rep		1
Semi-retired consultant	1	
Technical & Regulatory	1	
Technical Director	11	
Technical Manager	2	
Technical Specialist	1	
Technical support	2	
Technical/Scientist	1	
Trainer	1	
Training Director	1	
Work for a pest company		1

Table A3: Other types of insecticides that a company used that were specified by respondents

Other specify:	NPMA	NALP
	<i>Number of Respondents</i>	
Acelepryn		2
Anthramilic diamides		1
Arilon	1	
Borates (Niban), IGR(Precore, Gentrol)	2	
Botanical	1	
Carbamate		1
Carbaryl		1
Confrac Bait Blox, Demand CS, Demon WP, MaxForce, Nyguard IGR, Herbicides, Ultracide	1	
Ecotec, dormant oil		1
FUMIGANTS	2	
Fumigants (phos, SF, MB)	1	
Fumigants for stored product pests	1	
HORT OILS		1
Horticulture oils		1
I have sold all of these over the past 25 years		1
IGR, Borate	1	
IGRs	1	
Igrs (JHAs & CSIs), Fumigants, Inorganics (borates, silica aerogel)	1	
IGR's, Pheromones as in mating disruption, botanicals (pyrethrins), Pyrroles	1	
IGRs, Spinosad, Bt		1
Imidachloprid		1
Oxadiazines, IGRs, avermectins, borates, BT's, pyrroles, Hydramethylnon,	1	
Phenylpyrrole (Phantom SC)	1	
Pyrethrins/pyrethroids	1	
Pyrethrum, Boric acid, IGR's	1	
Pyrroles (Chlorphenapyr)	1	
Rotenoids	1	
Seven		1
Tempo SC, deltamethrin	1	
Triple crown, aloft		1
Total Responses	146	149

Table A4: Impact on business of losing access to pyrethroid insecticides by association (146 APMA and 149 NALP Respondents)

		Significant Increase	Increase	No Change	Decrease	Significant Decrease	Don't Know
		<i>% of Respondents</i>					
Cost of insecticide products	NPMA	29.5	50.0	6.8	0.7	2.1	11.0
	NALP	52.3	38.3	2.0	1.3	1.3	4.7
Application frequency	NPMA	23.3	41.1	17.8	4.1	1.4	12.3
	NALP	26.2	45.6	8.1	6.0	2.7	11.4
Record keeping and other paperwork	NPMA	8.2	17.1	65.8	1.4	2.7	4.8
	NALP	7.4	22.1	59.7	3.4	1.3	6.0
Customer satisfaction and retention	NPMA	15.8	7.5	17.1	33.6	19.2	6.8
	NALP	10.1	11.4	7.4	40.3	24.8	6.0
Training and management requirements	NPMA	18.5	45.2	28.1	2.1	2.1	4.1
	NALP	16.8	46.3	28.2	2.7	3.4	2.7
Ability to manage insect resistance	NPMA	13.0	21.9	19.2	24.0	17.1	4.8
	NALP	12.8	23.5	6.7	25.5	24.2	7.4
Ability to control invasive pests	NPMA	12.3	21.9	11.6	28.8	20.5	4.8
	NALP	16.8	15.4	5.4	29.5	29.5	3.4
Ability to practice Integrated Pest Management (IPM)	NPMA	11.6	11.6	36.3	26.0	13.0	1.4
	NALP	12.8	12.8	15.4	30.9	25.5	2.7
Health and safety risks to you and your customers	NPMA	8.2	26.0	44.5	8.9	2.1	10.3
	NALP	16.1	30.9	28.9	6.7	2.7	14.8

Table A5: Ordinary least squares parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide		Record Keeping and
	Products	Application Frequency	Other Paperwork
NPMA Member	-0.274*** (2.73)	-0.123 (1.00)	-0.097 (1.03)
Experience	0.0014 (0.34)	-0.0005 (0.10)	0.0037 (0.98)
11 to 50 Employees	-0.096 (0.46)	-0.302 (1.13)	0.475** (2.33)
51 to 100 Employees	-0.130 (0.43)	-0.390 (1.10)	0.231 (0.84)
More than 100 Employees	-0.036 (0.12)	-0.466 (1.34)	0.272 (1.04)
\$1 to \$5 Million Sales	0.098 (0.47)	0.059 (0.23)	-0.659*** (3.31)
More Than \$5 Million Sales	-0.047 (0.16)	0.147 (0.44)	-0.408 (1.60)
Business Health	-0.025 (0.42)	0.073 (1.00)	-0.014 (0.25)
Environment Health	0.045 (0.69)	-0.182** (2.29)	-0.090 (1.50)
Human Health	-0.035 (0.55)	0.046 (0.56)	-0.007 (0.12)
Constant	4.46*** (32.18)	4.22*** (24.90)	3.37*** (25.99)
R ²	0.044	0.044	0.056
Respondents	272	260	279

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A5 (continued): Ordinary least squares parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Customer Satisfaction and Retention	Training and Management Requirements	Ability to Manage Insect Resistance
NPMA Member	0.333** (2.03)	0.081 (0.73)	0.285* (1.67)
Experience	0.0210*** (3.16)	0.0000 (0.00)	0.0154** (2.25)
11 to 50 Employees	0.617* (1.65)	-0.040 (0.17)	-0.188 (0.51)
51 to 100 Employees	0.298 (0.58)	0.126 (0.39)	-0.366 (0.69)
More than 100 Employees	0.524 (1.05)	0.265 (0.85)	-0.500 (0.96)
\$1 to \$5 Million Sales	-0.573 (1.56)	-0.008 (0.04)	-0.011 (0.03)
More Than \$5 Million Sales	-0.820* (1.69)	-0.272 (0.90)	-0.011 (0.02)
Business Health	0.184* (1.90)	0.070 (1.08)	0.228** (2.21)
Environment Health	-0.053 (0.51)	-0.039 (0.54)	0.015 (0.14)
Human Health	-0.208* (1.93)	-0.010 (0.13)	-0.334*** (3.01)
Constant	1.94*** (8.61)	3.74*** (24.45)	2.53*** (10.91)
R ²	0.095	0.013	0.087
Respondents	276	285	277

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A5 (continued): Ordinary least squares parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Ability to Control Invasive Pests	Ability to Practice Integrated Pest Management	Health and Safety Risks to You and Your Customers
NPMA Member	0.266 (1.52)	0.358** (2.28)	-0.199 (1.60)
Experience	0.0183*** (2.60)	0.0060 (0.95)	0.0057 (1.16)
11 to 50 Employees	0.617* (1.67)	0.281 (0.86)	0.270 (1.03)
51 to 100 Employees	0.028 (0.06)	0.150 (0.32)	0.071 (0.19)
More than 100 Employees	0.426 (0.87)	0.472 (1.07)	0.308 (0.83)
\$1 to \$5 Million Sales	-0.751** (2.08)	-0.218 (0.68)	-0.263 (1.02)
More Than \$5 Million Sales	-0.911* (1.90)	-0.629 (1.47)	-0.369 (1.03)
Business Health	0.239** (2.33)	0.226** (2.46)	0.117 (1.58)
Environment Health	0.006 (0.05)	-0.026 (0.26)	0.044 (0.57)
Human Health	-0.212* (1.86)	-0.113 (1.10)	-0.073 (0.91)
Constant	2.33*** (9.86)	2.42*** (11.20)	3.46*** (20.60)
R ²	0.102	0.054	0.051
Respondents	283	289	258

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A6: Ordered probit parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork
NPMA Member	-0.449*** (3.02)	-0.144 (1.01)	-0.125 (0.85)
Experience	0.0026 (0.44)	-0.0020 (0.34)	0.0081 (1.35)
11 to 50 Employees	0.077 (0.24)	-0.249 (0.80)	0.748** (2.41)
51 to 100 Employees	-0.135 (0.30)	-0.348 (0.84)	0.360 (0.83)
More than 100 Employees	0.025 (0.06)	-0.583 (1.45)	0.419 (1.01)
\$1 to \$5 Million Sales	0.038 (0.12)	-0.058 (0.19)	-1.049*** (3.40)
More Than \$5 Million Sales	-0.172 (0.41)	0.177 (0.45)	-0.601 (1.49)
Business Health	-0.007 (0.08)	0.111 (1.30)	-0.031 (0.35)
Environment Health	0.073 (0.77)	-0.192** (2.06)	-0.143 (1.50)
Human Health	-0.120 (1.13)	0.007 (0.07)	-0.039 (0.37)
μ_1^k	-2.38*** (8.47)	-2.41*** (9.19)	-2.17*** (8.07)
μ_2^k	-2.12*** (8.28)	-1.76*** (7.86)	-1.74*** (7.52)
μ_3^k	-1.60*** (7.01)	-1.11*** (5.34)	0.52** (2.48)
μ_4^k	-0.02 (0.09)	0.22 (1.11)	1.39*** (6.26)
Respondents	272	260	279

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A6 (continued): Ordered probit parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork
NPMA Member	0.273** (2.02)	0.101 (0.74)	0.235* (1.76)
Experience	0.0153*** (2.78)	-0.0025 (0.46)	0.0114** (2.15)
11 to 50 Employees	0.530* (1.77)	-0.029 (0.10)	-0.129 (0.46)
51 to 100 Employees	0.371 (0.89)	0.229 (0.58)	-0.274 (0.66)
More than 100 Employees	0.655 (1.62)	0.244 (0.64)	-0.273 (0.67)
\$1 to \$5 Million Sales	-0.438 (1.49)	-0.087 (0.31)	-0.016 (0.06)
More Than \$5 Million Sales	-0.831** (2.10)	-0.305 (0.82)	-0.105 (0.26)
Business Health	0.092 (1.14)	0.102 (1.28)	0.163** (2.01)
Environment Health	-0.114 (1.32)	-0.039 (0.45)	-0.011 (0.13)
Human Health	-0.168* (1.76)	-0.040 (0.44)	-0.342*** (3.63)
μ_1^k	-0.26 (1.40)	-1.95*** (8.41)	-0.57*** (3.02)
μ_2^k	0.77*** (3.96)	-1.62*** (7.67)	0.14 (0.74)
μ_3^k	1.22*** (6.08)	-0.46** (2.41)	0.48** (2.55)
μ_4^k	1.66*** (7.99)	0.83*** (4.21)	1.38*** (6.89)
Respondents	276	285	277

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A6 (continued): Ordered probit parameter estimates (*t*-statistic) for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork
NPMA Member	0.204 (1.52)	0.320** (2.42)	-0.254* (1.82)
Experience	0.0133** (2.46)	0.0048 (0.90)	0.0061 (1.10)
11 to 50 Employees	0.425 (1.51)	0.154 (0.56)	0.218 (0.73)
51 to 100 Employees	0.032 (0.08)	0.003 (0.01)	-0.057 (0.14)
More than 100 Employees	0.439 (1.15)	0.358 (0.96)	0.137 (0.33)
\$1 to \$5 Million Sales	-0.486* (1.75)	-0.112 (0.42)	-0.269 (0.93)
More Than \$5 Million Sales	-0.765** (2.05)	-0.489 (1.35)	-0.291 (0.73)
Business Health	0.140* (1.74)	0.165** (2.12)	0.103 (1.24)
Environment Health	-0.023 (0.27)	-0.042 (0.51)	0.052 (0.59)
Human Health	-0.222** (2.33)	-0.106 (1.24)	-0.095 (1.01)
μ_1^k	-0.41** (2.18)	-0.64*** (3.43)	-2.01*** (8.35)
μ_2^k	0.40** (2.11)	0.15 (0.83)	-1.24*** (6.13)
μ_3^k	0.67*** (3.52)	0.91*** (4.79)	-0.01 (0.04)
μ_4^k	1.36*** (6.88)	1.43*** (7.22)	1.04*** (5.04)
Respondents	283	289	258

*** Statistically significant at one percent.

** Statistically significant at five percent.

* Statistically significant at ten percent.

Table A7: Ordered probit error correlation estimates [90 percent confidence intervals] for impacts of lost access to pyrethroid insecticides

	Cost of Insecticide Products	Application Frequency	Record Keeping and Other Paperwork	Customer Satisfaction and Retention	Training and Management Requirement	Ability to Manage Insect Resistance	Ability to Control Invasive Pests	Ability to Practice Integrated Pest Management
Application Frequency	0.334 [0.183, 0.471]							
Record Keeping and Other Paperwork	0.436 [0.283, 0.567]	0.317 [0.172, 0.448]						
Customer Satisfaction and Retention	0.064 [-0.092, 0.217]	0.112 [-0.036, 0.254]	0.147 [0.000, 0.288]					
Training and Management Requirement	0.559 [0.435, 0.662]	0.503 [0.384, 0.606]	0.488 [0.362, 0.597]	0.056 [-0.086, 0.195]				
Ability to Manage Insect Resistance	0.230 [0.079, 0.372]	0.237 [0.092, 0.373]	0.290 [0.148, 0.420]	0.626 [0.528, 0.707]	0.175 [0.034, 0.308]			
Ability to Control Invasive Pests	0.117 [-0.036, 0.264]	0.214 [0.070, 0.350]	0.331 [0.191, 0.458]	0.679 [0.591, 0.750]	0.232 [0.093, 0.362]	0.820 [0.762, 0.865]		
Ability to Practice Integrated Pest Management	0.084 [-0.070, 0.233]	0.187 [0.046, 0.321]	0.191 [0.047, 0.327]	0.666 [0.579, 0.738]	0.166 [0.029, 0.297]	0.726 [0.649, 0.788]	0.622 [0.529, 0.701]	
Health and Safety Risks to You and Your Customers	0.486 [0.352, 0.601]	0.433 [0.302, 0.549]	0.461 [0.327, 0.576]	0.241 [0.098, 0.374]	0.537 [0.425, 0.632]	0.400 [0.269, 0.516]	0.349 [0.212, 0.471]	0.278 [0.142, 0.403]

Survey Instruments

National Association of Landscape Professionals

The Value of Pyrethroids

Please Tell Us About Yourself

1: Which describes your role in the landscape industry? (Check All That Apply)

1. I am a business owner
2. I am a business manager
3. I am a trained and certified pesticide applicator
4. Other, please specify _____

2: How long have you been working in or otherwise been involved in the landscape industry?

Years

Please Tell Us How Your Business Manages Pests

3: We know that in your business you have to manage a number of different insect pests. How important are each of these factors in choosing how to accomplish this task? (Please check one for each reason)

[Randomize]	Not at All Important 1	Not too Important 2	Somewhat Important 3	Very Important 4
A. Insecticide Cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Broad spectrum of insects controlled in a single application	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Product Efficacy including speed of knockdown and control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Long lasting control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Pollinator safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Time and labor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G. Convenience & ease of use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H. Safety to applicator (e.g., personal protective equipment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I. Safety to customer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
J. Unique control of a pest or pest spectrum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
K. Management of resistant pests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
L. Insecticide being a Restricted Use Product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
M Safety to Non-Target Insects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
N. Flexibility in application method	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4: Which of the following classes of insecticides did your company use in the past year? (Check All That Apply)

1. Organophosphates (e.g., Dylox, Acephate)
2. Pyrethroids (e.g., Talstar, Triple Crown)
3. Neonicotinoids (e.g., Merit, Safari, Arena)
4. Fipronil (e.g., TopChoice)
5. 25b (e.g., Botanigard)
6. Other, please specify _____
99. Do Not Know

Impacts of Pyrethroid Loss

The next five questions ask you to think about what would happen if pyrethroid insecticides were no longer available. Telling us how you would respond to this hypothetical situation will give us a better understanding of the value that these insecticide products provide to your company and your customers.

5: Listed below are some of the major pests you may have been asked to manage in the past year. Please put a check by each pest where you employed a pyrethroid within the past year for control.

1. Emerald ash borer or other tree and shrub borers
2. Clearwing (ash, peach, dogwood) and flat head (birch, apple)
3. Scales, armored and soft
4. Grubs, adults (Japanese beetle), larvae on turf (Japanese beetle, white grubs)
5. Chinch bugs (lawn)
6. Spider mites
7. Leafminers (boxwood, birch), aphids, psyllid (boxwood)
8. Sawflies (evergreens)
9. Gypsy moth
10. Web-making caterpillars (Eastern tent, fall webworm) bagworms.
11. None of these

6: If pyrethroids were no longer available, to what extent do you feel acceptable alternative management options are available for your major pest issues? (Please check one)

1. There are no acceptable alternatives to pyrethroid insecticides.
2. There are not enough acceptable alternatives to pyrethroid insecticides.
3. There are some acceptable alternatives available to pyrethroid insecticides.
4. There are many acceptable alternatives available to pyrethroid insecticides.

7: Please give us your best estimate for how the loss of pyrethroids would impact your business in each of the following areas. (Please check one for each potential impact)

[Randomize]	Significant Increase 1	Increase 2	No Change 3	Decrease 4	Significant Decrease 5	Don't Know 99
A. Cost of insecticide products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Application frequency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Record keeping and other paperwork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Customer satisfaction and retention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Training and management requirements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Ability to manage insect resistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G. Ability to control invasive pests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H. Ability to practice Integrated Pest Management (IPM)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I. Health and safety risks to you and your customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8: In your own words, how would the loss of pyrethroids impact your business?

9: In your own words, how would the loss of pyrethroids AND neonicotinoids impact your business?

Your Company

The final six questions are about the company where you work. The answers to these questions will allow us to group responses by business features providing a better understanding of your responses.

10: Which of the following best represents the primary specialty of the company where you work? *(Please check the single most important segment even though your business may engage in more than one segment listed)*

1. Lawn care
2. Landscape design and installation
3. Landscape maintenance
4. Tree care
5. Irrigation and water management
6. Interior plantscaping

11: What type of customer does your company service? *(Please check all that apply)*

1. Residential
2. Commercial
3. Other, please specify... _____

12: Which of the following best describes the type of company where you work *(Please Check One)*

1. My company operates from a single location
2. My company operates from a single location
3. My company operates many locations across multiple states

13: Please estimate the number of full-time, year-round employees at your company *(Please check one)*

1. Zero
2. 1-10
3. 11-50
4. 51-100
5. More than 100

14: Which of the following product forms have you used in the past year?

(Please check all that apply)

1. Liquid sprays
2. Baits
3. Granules
4. Dusts
5. Impregnated fertilizers
6. Aerosols

15: Please give us your best estimate of your business' gross sales for 2015

(Please check one)

1. Less than \$250,000
2. \$250,000 or more, but less than \$500,000
3. \$500,000 or more, but less than \$1 million
4. \$1 million or more, but less than \$5 million
5. \$5 million or more

Thank you for your time on helping us understand your position on this important issue to your industry.

National Pest Management Association

On behalf of the Pyrethroid Working Group

The Value of Pyrethroids

Please Tell Us About Yourself

1: Which describes your role in the pest management industry? *(Check all that apply)*

1. I am a business owner
2. I am a business manager
3. I apply pesticides
4. Other, please specify _____

2: How long have you been working in or otherwise been involved in the pest management industry?

Years

Please Tell Us How Your Business Manages Pests

3: We know that in your business you have to manage a number of different insect pests. How important are each of these factors in choosing how to accomplish this task? (Please check one for each reason)

	Not at All Important 1	Not too Important 2	Somewhat Important 3	Very Important 4
A. Insecticide Cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Broad spectrum of insects controlled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Ability to control insects with a single application	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Product Efficacy including speed of knockdown and control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Convenience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Pollinator safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G. Time and labor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H. Long lasting control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I. Safety to applicator (e.g., personal protective equipment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
J. Safety to customer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
K. Consistent control of a pest	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
L. Management of resistant pests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
M. Insecticide being a Restricted Use Product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
N. Safety to Non-Target Insects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
O. Flexibility in application method	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4: Which of the following classes of insecticides did your company use in the past year? (Please check all that apply)

1. Organophosphates (e.g., Nuvan Prostrips, Orthene PCO)
2. Pyrethroids (e.g., Talstar, Demand, Suspend)
3. Neonicotinoids (e.g., Temprid, Alpine, Premise)
4. Fipronil (e.g., Termidor, Taurus)
5. 25b (e.g., Essentria, Cimexa, Mother Earth)
6. Other, please specify _____
99. Do Not Know

Impacts of Pyrethroid Loss

The next five questions ask you to think about what would happen if pyrethroid insecticides were no longer available. Telling us how you would respond to this hypothetical situation will give us a better understanding of the value that these insecticide products provide to your company and your customers.

5: Listed below are some of the major pests you may have been asked to manage in the past year. Please put a check by each pest where you employed a pyrethroid within the past year for control.

1. Cockroaches
2. Ants
3. Bed bugs
4. Mosquitoes
5. Flies
6. Termites (including pre-treats)
7. Occasional pest invaders
8. Plant pests
9. Turf pests
10. None of these

6: If pyrethroids were no longer available, to what extent do you feel acceptable alternative management options are available for your major pest issues? (Please check one)

1. There are no acceptable alternatives to pyrethroid insecticides.
2. There are not enough acceptable alternatives to pyrethroid insecticides.
3. There are some acceptable alternatives available to pyrethroid insecticides.
4. There are many acceptable alternatives available to pyrethroid insecticides.

7: Please give us your best estimate for how the loss of pyrethroids would impact your business in each of the following areas. (Please check one for each potential impact)

	Significant Increase 1	Increase 2	No Change 3	Decrease 4	Significant Decrease 5	Don't Know 99
A. Cost of insecticide products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Application frequency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Record keeping and other paperwork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Customer satisfaction and retention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Training and management requirements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Ability to manage insect resistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G. Ability to control invasive pests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H. Ability to practice Integrated Pest Management (IPM)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I. Health and safety risks to you and your customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8: In your own words, how would the loss of pyrethroids impact your business?

9: In your own words, how would the loss of pyrethroids AND neonicotinoids impact your business?

The final six questions are about the company where you work. The answers to these questions will allow us to group responses by business features providing a better understanding of your responses.

Your Company

10: Which of the following best represents the primary specialty of the company where you work? *(Please check the single most important segment even though your business may engage in more than one segment listed.)*

1. General Pest Exterior
2. Interior Pest Control
3. Mosquito Barrier
4. Termite including pre-treats
5. Lawn Care
6. Fumigation

11: What type of customer does your company service? (Please check all that apply)

1. Residential
2. Commercial
3. Food Handling Establishments
4. Other (Please specify) _____

12: Which of the following best describes the type of company where you work.

(Please check one)

1. My company operates from a single location
2. My company operates multiple locations in a region
3. My company operates many locations across multiple states

13: Please estimate the number of full-time, year-around employees at your company.

(Please check one)

1. Zero
2. 1-10
3. 11-50
4. 51-100
5. More than 100

14. Which of the following product formulations have you used in the past year?

(Please check all that apply)

1. Liquid Sprays
2. Baits
3. Granules
4. Dusts
5. Aerosols

15: Please give us your best estimate of your business' gross sales for 2015. (Please check one)

1. Less than \$250,000
2. \$250,000 or more, but less than \$500,000
3. \$500,000 or more, but less than \$1 million
4. \$1 million or more, but less than \$5 million
5. \$5 million or more

Thank you for your time on helping us understand your position on this important issue to your industry.