

# Are consumers knowledgeable about neonicotinoid insecticides and pollinator-friendly plants?<sup>1</sup>

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## Introduction

Use of neonicotinoid insecticides in the US ornamental horticulture industry continues to capture attention due to potential health risks to pollinator insects. Neonicotinoids are the most widely used class of insecticides in agricultural production (Jeschke et al. 2011). Even though neonicotinoids are primarily used in food crops, the use of neonicotinoids in the ornamental horticulture industry and the potential impacts on pollinators are not negligible. According to Douglas and Tooker (2015), from 1996 to 2011, 93% of neonicotinoid active ingredients were sold for crop-use products (e.g., agronomic pesticides, seed treatments, etc.) while the remainder were sold for turf/ornamental (4%), household pesticide control (1.4%), and lawn/garden use (1.2%).

The use of neonicotinoids in ornamental horticulture is important given the plethora of household landscapes that can impact pollinator health and serve as pollinator habitat. Specifically, 90 million US households (78% of all US households) have yards, landscapes, or gardens (Kiesling and Manning 2010). Homeowners' management approaches to these landscapes may be influenced by their knowledge and attitudes toward neonicotinoids. However, the general public's exposure to neonicotinoid insecticide information is relatively limited despite the increased attention to neonicotinoids' effect on pollinators in regulatory and academic arenas (Rihn and Khachatryan 2016; Wollaeger et al. 2015). There is currently a lack of research providing a comprehensive evaluation of consumers' knowledge about neonicotinoids and pollinator plants, as well as their overall interest in enhancing pollinators' health and the use of neonicotinoids. This report summarizes a survey that addressed these topics. The survey is a part of a larger research project aimed at incorporating pollinator conservation into the ornamental horticulture industry's sustainability initiatives.

This report is relevant for green industry stakeholders (i.e., growers, marketers, retailers, Extension agents, researchers) involved with production, promotion, and communication strategies. Additionally, the contents could be of interest to firms shifting toward more sustainable

production options with which end consumers may or may not be familiar. Knowing how consumers' perceived and actual knowledge impacts their behavior can aid firms as they make production and labeling decisions toward neonicotinoid insecticides.

## Materials and Methods

Online and in-person surveys were conducted to collect information from a national sample and a Florida sample. In contrast to existing studies using self-reported (subjective) information only, this study incorporated quiz questions to test participants' objective knowledge about pollinator-attractive plants.<sup>1</sup> One hundred and forty-one central Florida participants were recruited for the in-person survey, and 1,680 participants completed the national online survey. In both surveys, participants indicated if they had heard about neonicotinoid insecticides (yes/no), followed by how knowledgeable they were about neonicotinoid insecticides on a 1–7 rating scale (1 indicating not at all knowledgeable, 4 neither knowledgeable nor not knowledgeable, and 7 extremely knowledgeable). Participants also indicated their knowledge about pollinator-attractive plants on the same 7-point rating scale. Four quiz questions were used to measure participants' objective knowledge about pollinator-attractive plants. In each quiz question, participants were provided two plant names supplemented with images of the plants and asked to select the one that was pollinator attractive (Appendix). Lastly, participants indicated their involvement in pollinator-conservation activities by selecting from a pre-defined list of actions beneficial to pollinator health those actions they were currently taking. The list included: a) plant selection to feed adults, b) plant selection to feed larvae/young, c) decrease or do not use pesticides, d) add features to aid pollinator insects (brush piles, water sources), e) source plants locally, f) primarily buy native plants, g) primarily buy plants that are labeled as helpful to pollinators, and h) primarily buy flowering plants.

<sup>1</sup> Quiz questions to test participants' real knowledge of neonicotinoids were not incorporated based on considerations that the general public's (self-reported) awareness about neonicotinoids is about 24% (Rihn and

Khachatryan 2016). We believe a quiz question in this situation might not reveal useful information because the majority of the participants would be guessing on the answers or simply skipping the question, likely due to low familiarity.

## Results

Participants' socio-demographic information is summarized in Table 1. While the online sample has a relatively balanced male-to-female gender ratio, the in-person Florida sample has more females with only 26% male participants. In general, participants in the in-person survey are slightly older, more educated, and have higher household incomes (Table 1). Even though the samples were drawn from two different populations (Florida and national), we find participants' knowledge about neonicotinoids and their knowledge about pollinator plants are fairly consistent. As shown in Figure 1, in both samples, about 27% of the participants had heard about neonicotinoid insecticides while the majority (more than 70%) had not, indicating roughly a three percentage points increase since 2016 in comparison to the 24% estimated by Rihn and Khachatryan (2016). Less than 20% of the participants viewed themselves as knowledgeable about neonicotinoids by selecting 5 or higher on the 7-point rating scale (Figure 2), and none of the participants in the in-person survey perceived themselves as extremely knowledgeable (by selecting 7) about neonicotinoids. Meanwhile, more than two thirds of the survey participants in both samples selected a value of 1–3 on the rating scale, meaning they were not knowledgeable about neonicotinoids.

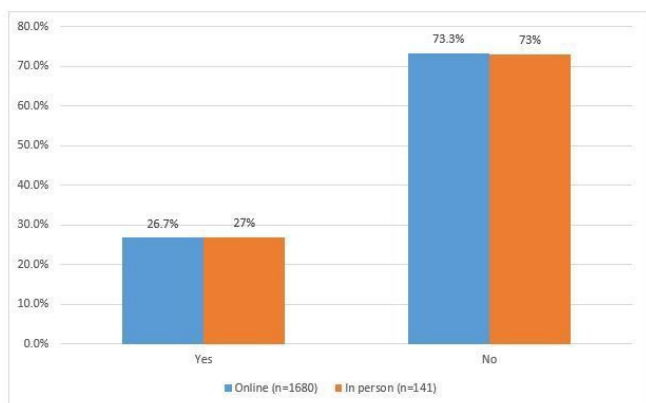


Figure 1. Percentage of participants who have heard of neonicotinoid insecticides.

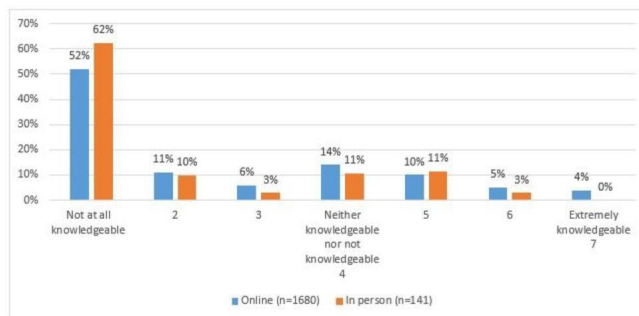


Figure 2. Subjective knowledge about neonicotinoid insecticides.

With regard to knowledge about pollinator plants, 47.5% of the online survey participants and 54% of the in-person survey participants were knowledgeable about pollinator-attractive plants by selecting a 5, 6, or 7 on the rating scale. Less than 30% of the participants (26% of the online sample and 29% of the in-person survey sample) were not knowledgeable about pollinator plants. While subjective knowledge is a strong predictor of attitudes, existing studies show people tend to be poor judges of how much they actually know, meaning additional knowledge tests may improve accuracy (Alba and Hutchinson 2000; Fernbach et al. 2019). The quiz question results revealed this gap. Only 5% of the online survey participants and 4% of the in-person survey participants correctly identified the pollinator-attractive plants in all four quiz questions (Figure 4). In-person participants performed slightly better than the online participants. Thirty percent of the in-person participants correctly answered three of the quiz questions while only 16% of the online participants correctly answered three of the quiz questions.

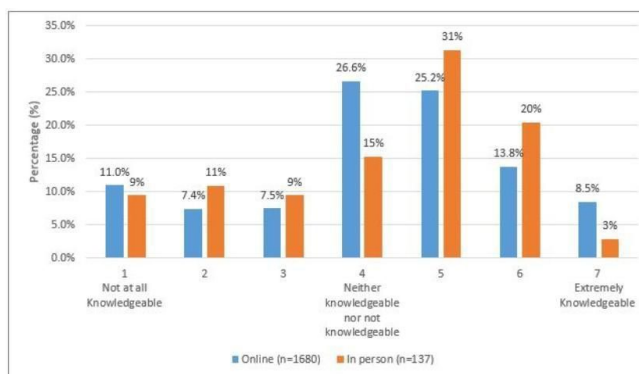


Figure 3. Subjective knowledge about pollinator-attractive plants.

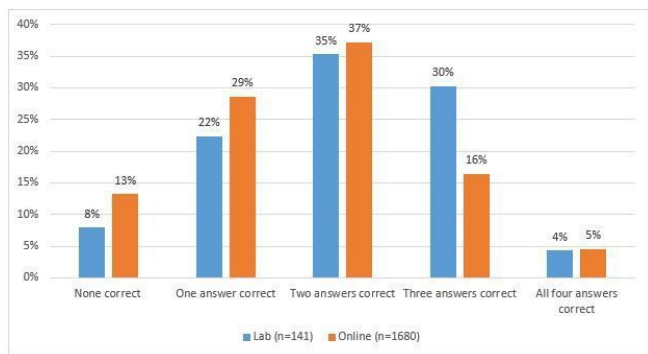


Figure 4. Objective knowledge about pollinator-attractive plants.

Regarding involvement in actions to enhance pollinator health, none of the activities were selected more predominantly than the others (Figure 5). But more participants indicated that they chose to decrease or not use pesticides (19% of the online and 18% of the in-person sample), and primarily buy flowering plants (18% of the online and 15% of the in-person sample) to improve pollinator health.

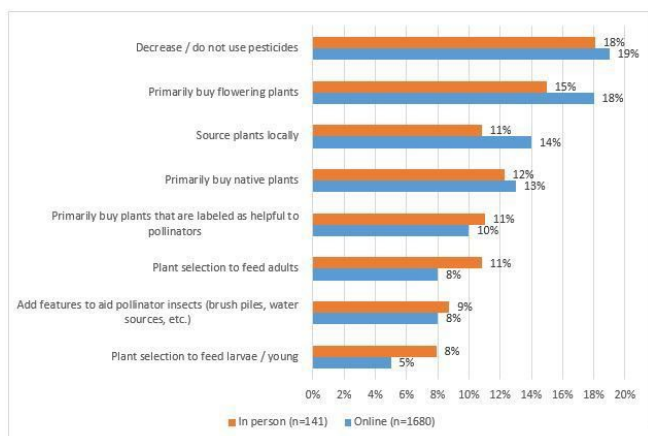


Figure 5. Involvement in pollinator-conservation activities.

## Conclusion

While the potential consequences of neonicotinoid insecticides continue to attract researchers' and policy makers' attention, and mass media coverage of neonicotinoids increases, our consumer survey results suggest that general public awareness and knowledge about neonicotinoids remain low. There is only a slight increase of three percentage points from 24% to 27% since 2016. Based on the knowledge gap between subjective and objective knowledge (i.e., personal opinions vs. perspectives based in facts such as quiz questions) about pollinator-attractive plants identified in this study, we guess that the objective knowledge about neonicotinoids could be even lower if consumers tend to overstate their level of knowledge. On the other hand, even though consumers are involved in an array of activities that could contribute to improvements to pollinator health, we

observe an emerging trend of more people pursuing a "greener" gardening approach by decreasing or not using pesticides. Results of this survey can be used by policy makers to educate consumers and local communities by developing new educational programming and curricula that support and enhance overall knowledge of pollinator-attractive plants and pollinator health, with potential for urban gardens to act as an extensive network of pollinator-friendly habitats. As consumer knowledge increases, potential demand for pollinator-friendly plants may create positive feedback to growers in the ornamental horticultural industry to evaluate their existing pest-management practices and identify feasible alternative options.

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## Appendix

Quiz question example that tested consumers' objective knowledge about pollinator-attractive plants.

Below are the images of two annual bedding plants. Please choose the one that you think is pollinator/bee attractive (Please select one).



Figure 6. Sweet alyssums.

Credit: Magdevski/iStock/Getty Images Plus



Figure 7. Geraniums.

Credit: emer1940/iStock/Getty Images Plus

- Sweet alyssums
- Geraniums
- I don't know

Table 1. Participants' sociodemographic characteristics.

Variables	Online	In-person
Number of participants	1680	141
Male	42%	26%
Age (mean)	52	55
Ethnicity		
White/Caucasian	87%	85%
African American	5.1%	5.8%
Hispanic	2.8%	4.3%
Asian	2.8%	1.4%
Native American	0.9%	0.0%
Pacific Islander	0.2%	0.7%
Other	1.4%	2.9%
Household income (median)	\$40,000–59,999	\$60,000–79,999
Household size (mean)	2.7	2.7
Education level		
HS+	99%	100%
Bachelor's degree+	42%	51%
Plant purchase behavior		
Number of visits (mean)	6	8
Amount spent per visit (mean)	\$68	\$33

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