Comparative Consumer Perspectives on Eco-friendly and Insect Management Practices on Floriculture Crops

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SUMMARY. **Declining bee populations has garnered media attention, which has pressured plant retailers to ask or demand the reduction or elimination of neonicotinoid insecticide use in greenhouse production. This study investigated consumer perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices. Data from an online study were collected from 1555 Americans in May 2015. Over half (55%), nearly half (48.2%), and more than 30% of the participants felt that "bees are not harmed," "better for the environment," or "plants that attract bees," respectively, was a characteristic of bee-friendly insect management practices. The latter group erroneously confused bee-friendly insect management practices with plants that are a potential food source for bees. When asked to rate various insect management plant production practices on a five-point Likert scale, consumer mean scores were positive (defined here as 3.5 to 5.0) for "plants grown using bee-friendly insect management practices," "plants grown using insect management strategies that are safe for pollinators," "plants grown using best insect management practices to protect pollinators," and "plants grown using insect management practices that leaves no insecticide residue on the plant." Plant species accounted for 31.6% of the decision to purchase the plant, followed by price (25.1%), insect management strategy (23.3%), and eco-friendly practices (20.1%) that was similar to prior published findings. Analyses showed that plants labeled as "grown using bee-friendly insect management practices" were worth $0.26, $0.26, $0.89, and $1.15 more than plants labeled as "grown in a sustainably produced potting soil/mix," "grown using recycled/recaptured water," "grown using protective neonicotinoid insecticides," and "grown using traditional insect management practices," respectively. In addition, plants labeled as "grown using best insect management practices to protect pollinators" were worth $0.10, $0.10, $0.73, and $0.99 more than plants labeled as "grown in a sustainably produced potting soil/mix," "grown using recycled/recaptured water," "grown using protective neonicotinoid insecticides," and "grown using traditional insect management practices," respectively. Thus, selected insect management strategies were valued more, on average, than eco-friendly production practices.**

Honeybee (*Apis mellifera*), bumblebee (*Bombus* sp.), and other solitary bee populations have declined dramatically in the last 50 years from a combination of factors including: habitat loss, dietary stresses, climate change, pesticide exposures, and exposure to mites, parasites, and pathogens including varroa mite (*Varroa destructor*) and nosema disease (*Nosema ceranae*) (Doublet et al., 2015; Goulson et al., 2015). Recently, neonicotinoid insecticides, a class of insecticides that act as neurotoxins to control a wide variety of crop pests, were shown to be a contributing factor to bee decline (Doublet et al., 2015; Goulson, 2013; Goulson et al., 2015; Pisa et al., 2015). As a result of emerging scientific evidence and social and political pressures, retailers are asking or demanding that plant producers reduce or eliminate the use of neonicotinoid insecticides in ornamental plant production. According to a nationwide study performed by Wollaeger et al. (2015), despite increasing media information on bee decline, the majority of American consumers did not understand what neonicotinoid insecticides were and discounted plants labeled as "neonicotinoid-free." Furthermore, when ornamental plants were labeled with insect management methods, consumers valued those methods as much or more than plant price and as much or less than plant species. Labeling plants as "bee-friendly" produced a greater perceived economic value compared with plants labeled with "neonicotinoid-free," "grown with use of beneficial insects" or "grown with traditional insect management" (Wollaeger et al., 2015).

Research showed that some consumers have a greater willingness to pay for some insect management practices including those that are pesticide-free, grown with biological control, or biorational spray programs (Grygorczyk et al., 2014; Jetter and Paine, 2004; Olson et al., 1995; Wollaeger et al., 2015). In addition, some consumers are willing to pay a premium for plants grown with environmentally friendly practices. For example, consumers were willing to pay a premium for containers with a smaller rather than larger carbon footprint (Yue et al., 2010). In another study, consumers were reportedly more interested in purchasing plants that were produced using energy-saving production techniques than those labeled sustainably grown or grown with water-saving practices (Behe et al., 2013). The container type (compostable, conventional, plantable, or recyclable) and production practice (conventional, energy-saving, sustainable, or water-saving) were similarly important to consumers.

In the present study, our goal was to develop a more holistic consumer perspective to better understand consumer perceptions and willingness to pay a price premium for floriculture crops grown using different pest management practices (grown using bee-friendly insect management practices, best insect management practices to protect pollinators, protective neonicotinoid insecticides, or traditional insect management practices) and eco-friendly production practices (grown in a container made from recycled materials, in a sustainably produced potting soil/mix, using recycled/recaptured water, or using traditional plant production methods). The combination

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of these two attributes represents a broader and, perhaps, more realistic set of attributes consumers might encounter and evaluate when purchasing plants. We investigated consumer's perception of, and preferences for, plants grown with these insect management and eco-friendly production methods. We explored the importance of pest management practices relative to eco-friendly production practices, plant species, and price in consumer's purchasing decisions.

Materials and methods

Survey development. An Internet survey was developed in Qualtrics (Provo, UT) and was administered from 11 to 13 May 2015. Potential survey respondents were contacted from a pool maintained by Global Market Insite Institute (GMI; Bellevue, WA) and invited to participate in the survey. Respondents were paid in points to redeem prizes through GMI. Both the firm and their panel have been used to recruit subjects for prior online studies involving horticultural products (Behe et al., 2010, 2013; Getter and Behe, 2013; Wollaeger et al., 2015).

The survey collected data from consumers who had made a live plant purchase in the past 12 months. The survey aimed to collect at least 1500 responses distributed across the continental United States. In compliance with federal law, no participants under the age of 18 were invited to participate and the survey protocol and instrument were approved by the university's institutional review board (IRB) for research involving human subjects (IRB no. x14-323e). The survey included multiple-choice (single and multiple answer) and rating (using a five- or seven-point Likert scale) question types. With the exception of an initial consent-to-participate question and a question to determine if the participant had purchased a live plant within the last 12 months, all respondents had the option to not respond to any subsequent questions. Questions were grouped into five categories: likelihood-to-buy, characteristics and connotations of insect management practices, importance of plant attributes in purchasing decisions, and demographic characteristics of the respondents.

Each likelihood-to-buy question was framed by showing subjects a picture of a floriculture product in a 4-inch (10.2 cm) container with text of the price, description of the greenhouse pest management production practices, and description of the greenhouse eco-friendly production practices (Table 1). The participant was then asked "How likely would you be to purchase this plant?" and asked to respond with a whole unit on the Likert scale of 1 (very unlikely) to 5 (very likely). The second set of questions (characteristics and connotations of insect management practices) asked "Which of the following do you consider to be characteristic of plants that are grown using" either "bee-friendly insect management practices," "traditional insect management practices," "best insect management practices to protect pollinators," or "protective neonicotinoid insecticides? (Choose all that apply)." Participants could respond with any of the 34 response options, including "I do not know." These four phrases describing insect management practices were developed by the researchers in response to the results reported in Wollaeger et al. (2015) and to one commercially available tag in the 2015 season that stated, "This plant is protected from problematic aphids, whiteflies, beetles, mealy bugs, and other unwanted pests by neonicotinoids." One question also evaluated the connotations associated with labeling plants with their insect management practices. Participants were asked to rank on a scale of 1 (means something very negative) to 5 (means something very positive) seven pest management labeling wording. The third block of questions (importance of plant attributes in purchasing decisions) asked the participant what characteristics are important to them when purchasing an ornamental live plant. The final block of questions asked about the respondents' demographic information including age, gender, ethnicity, marital status, education, and household income.

Conjoint development. Conjoint analysis was used to understand the implicit effects of plant attributes on consumer product choice decisions and is not uncommon in consumer horticulture research (Behe et al., 2005a, 2005b, 2013; Hall et al., 2010; Wollaeger et al., 2015; Zagaden et al., 2008). This statistical method determines preferences of participants for hypothetical products about a given set of attributes and was used here on the likelihood-to-buy questions (Kuhfeld, 2010). Conjoint analysis defines overall preference for a particular product, in this case ornamental plants with varying price points, insect management strategies, and eco-friendly production methods, as the sum of the part-worths (also termed utilities) for each factor level (Hartigan, 1975; van Gaasbeek and Bouwman, 1991). In other words, the part-worth utility shows the relative value of one level of an attribute to another, whereas the relative importance shows the importance among attributes.

Table 1. The likelihood to purchase attributes (species, price, insect management strategy, and eco-friendly production method) with their respective levels for an Internet survey querying consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices.

Attribute	Levels
Species	Moss rose, verbena, salvia, marigold
Price for a 4-inch (10.2 cm) pot	\$1.99, \$2.49, \$2.99, \$3.49
Insect management	Grown using bee-friendly insect management practices, best insect management practices to protect pollinators, protective neonicotinoid insecticides, or traditional insect management practices
Eco-friendly practice	Grown in a container made from recycled materials, in a sustainably produced potting soil/mix, using recycled/recaptured water, or using traditional plant production methods

The likelihood-to-buy questions framed in a conjoint design were developed to assess consumer response to four attributes: species, price, insect management strategy, and eco-friendly production practices. We used four different plant species in each category, with four prices, four insect management strategies (without definition or explanation), and four eco-friendly production practices [also without definition or explanation (Table 1)].

Although all 256 permutations of attributes could have been presented to respondents, we developed a fractional factorial conjoint design of 16 combinations of hypothetical ornamental plant products for the survey to reduce time investment (Chrzan and Orme, 2000) and respondent fatigue. Fractional factorial design improves experiment efficiency by using only a fraction of the attribute combinations in experiments while retaining the ability to assess all attributes in the complete design. The images for the conjoint questions were shown to the participants before asking them any other questions (Fig. 1). Species included in this study were chosen based on widely known and commonly available plants in the floriculture industry. Although these species and cultivars may not be the best food source for bees and other pollinators, they are economically important to plant producers. In addition, commercial growers may be treating these species with neonicotinoid or other classes of insecticides during plant production, which may leave residue in the flower's pollen depending on application rate and timing. The images shown in the survey were taken by the researchers or colleagues and used with their permission. Price points were chosen based on the national market price of similar products in different types of retail outlets in 2014. Insect management strategies and eco-friendly production practices were based on the researcher's observations of potential new marketing terminology.

DATA ANALYSIS. Conjoint analysis was conducted in SAS (version 9.3; SAS Institute, Cary, NC) using PROC TRANSREG. Means of coefficients and relative importance across respondents were analyzed in PROC GLM for significant differences between attributes using Tukey's honestly significant test with $P = 0.05$ as a maximum value of significance. Frequency data were analyzed for differences using Wilcoxon–Mann–Whitney (PROC

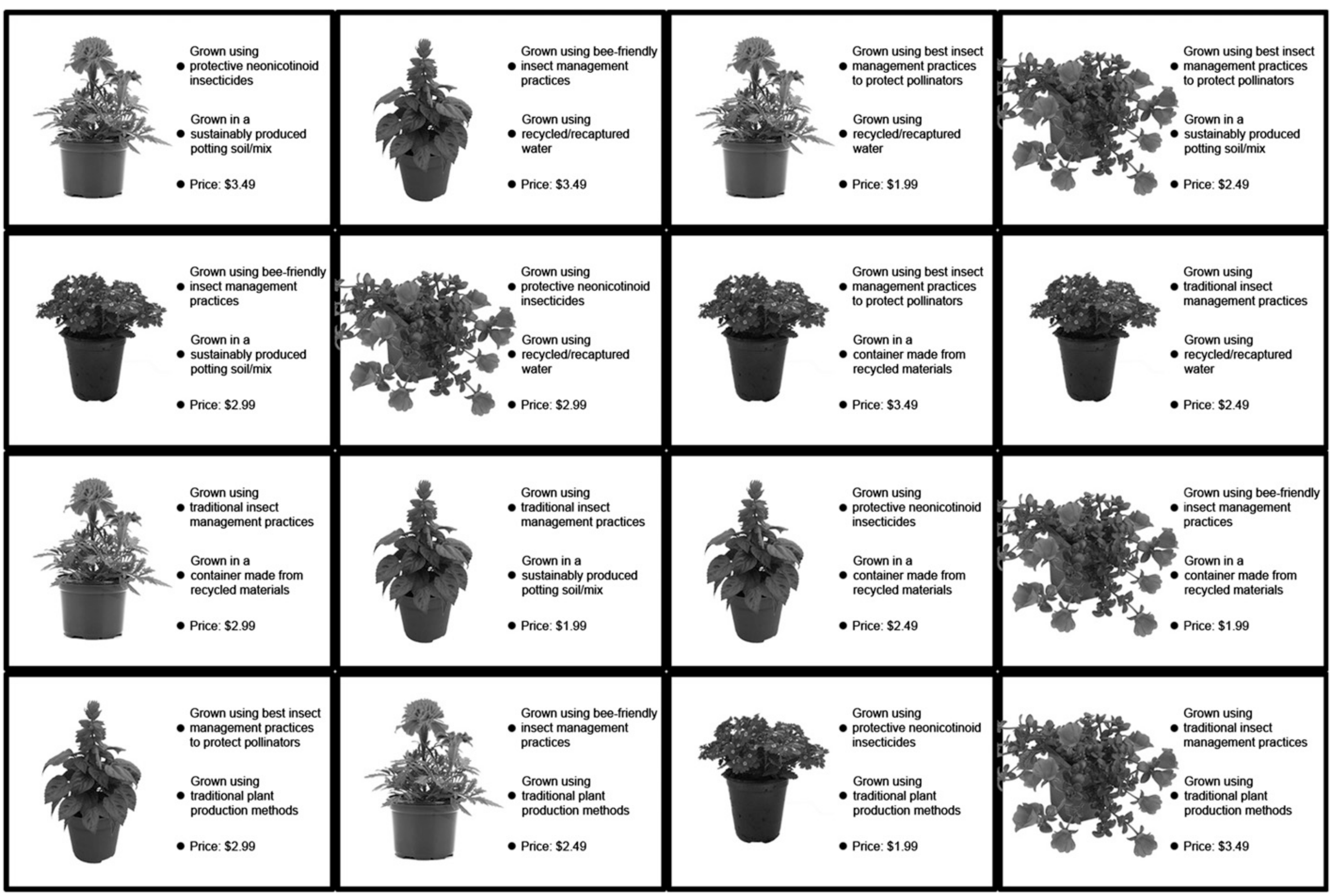

Fig. 1. Conjoint pictures shown to respondents in order from left to right, top to bottom in an Internet survey that queried consumers (who had purchased live plants in the past 12 months) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555). Respondents were shown each picture individually in order and asked to rate each picture on a scale of 1 (very unlikely) to 5 (very likely) in terms of how likely they would be to purchase this flowering ornamental plant in a 4-inch (10.2 cm) pot intended for use in the landscape at the given price and production method.

NPAR1WAY). Likert scale questions were analyzed for differences using PROC GLM and comparisons were performed using least square means with $P = 0.05$ as a maximum value of significance.

Results and discussion

DEMOGRAPHICS. A total of 1555 consumers completed the survey (Table 2). The average age of consumers at the time of the survey was 49.4 years old, and gender distribution was roughly half female and half male. Nearly two-thirds (64.6%) of participants had some college, an associate's degree, or a bachelor's degree. More than half (54.1%) resided in suburban areas and about half (53.7%) had a household income of $20,000 to $79,999 in 2014. Every state was represented (data not shown).

CHARACTERISTICS OF INSECT MANAGEMENT PRACTICES. Over half (55%) and nearly half (48.2%) of the participants felt that "bees are not harmed" or "better for the environment," respectively, was a characteristic of bee-friendly insect management practices (Table 3). More than 30% also felt that "environmentally friendly," "use of products without bee toxicity," "safer for humans," and "plants that attract bees" were additional characteristics. The latter characteristic ("plants that attract bees") indicated a continued confusion about the plant production practice vs. the plant itself (as a pollinator food source) as the term was also associated with bee-friendly in Wollaeger et al. (2015). About half (50.9%) and roughly one-third (33.8%) of participants characterized traditional insect management practices as "pesticides are used" and "insecticides are used," respectively. About two-fifths (41.3%) of participants characterized best insect management practices to protect pollinators as "bees are not harmed," whereas more than 30% of participants agreed that "better for the environment," "use of products without bee toxicity," and "environmentally friendly" also characterized this practice. Almost half (44.8%) of the participants answered "I do not know" when asked to characterize insect management practices that use protective neonicotinoid insecticides. The broad demographic based represented by respondents in this study and its consistency with previous findings (Wollaeger et al., 2015) indicates that the lack of understanding surrounding the word "neonicotinoid" is not associated with a particular demographic segment and may be extrapolated to all American consumers.

When asked to rate various insect management plant production practices on a scale of 1 (means something very negative) to 5 (means something very positive), consumer mean scores were positive (defined here as 3.5 to 5.0) for "plants grown using bee-friendly insect management practices," "plants grown using insect management strategies that are safe for pollinators," "plants grown using best insect management practices to protect pollinators," and "plants grown using insect management practices that leaves no insecticide residue on the plant" (Table 4). All other production practices were neutral in meaning (defined here as 2.5 to 3.5).

IMPORTANCE OF PLANT ATTRIBUTES IN PURCHASING DECISIONS. Consumers ranked "the flowering plant has no plant damage" as the most important attribute [on a 7-point Likert scale of 1 (not at all important) to 7 (very important)]

Table 2. Demographical characteristics of participants in the Internet survey that queried consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555).

Demographic	Mean no. or frequency
Adults in household [no. (SE)]	1.5 (0.03)
Children in household [no. (SE)]	0.7 (0.03)
Age at the time of survey [years (SE)]	49.4 (0.43)
Gender [no. (%)]	
Female	788 (50.5)
Male	771 (49.5)
Ethnicity [no. (%)]	
African American	75 (4.6)
Asian	59 (3.6)
Hispanic	103 (6.4)
Native American	29 (1.8)
Pacific Islander	0 (0.0)
White/Caucasian	1,345 (82.9)
Other	11 (0.7)
Education [no. (%)]	
Less than high school	14 (0.9)
High school/GED[z]	249 (16)
Some college	341 (21.9)
2-year college degree	164 (10.5)
4-year college degree	501 (32.2)
Master's degree	204 (13.1)
Professional degree (JD, MD)[z]	58 (3.7)
Doctoral degree	25 (1.6)
Area [no. (%)]	
Metropolitan region	376 (24.8)
Rural region	319 (21.1)
Suburban region	818 (54.1)
Income [no. (%)]	
Less than $19,999	105 (6.8)
$20,000–$39,999	300 (19.4)
$40,000–$59,999	270 (17.4)
$60,000–$79,999	262 (16.9)
$80,000–$99,999	202 (13.0)
$100,000–$119,999	160 (10.3)
$120,000–$139,999	76 (4.9)
$140,000–$159,999	69 (4.5)
$160,000–$179,999	25 (1.6)
$180,000–$199,999	30 (1.9)
$200,000 or more	51 (3.3)

[z]GED = General Educational Development certification, JD = Juris Doctorate, MD = Doctor of Medicine.

Table 3. The number and percentage of Internet survey participants who chose each trait in response to the question "Which of the following do you consider to be characteristic of plants that are grown using (one of the four pest management practices)? Choose all that apply." The Internet survey queried consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555). Traits are presented here in alphabetical order, but were presented to participants randomly.

	Pest management practice [no. (%)]			
Trait	Bee-friendly insect management practices	Traditional insect management practices	Best insect management practices to protect pollinators	Protective neonicotinoid insecticides
A healthy appearing plant	309 (19.9)	218 (14)	321 (20.6)	154 (9.9)
Bees are not harmed	855 (55)	155 (10)	642 (41.3)	178 (11.4)
Better for the environment	749 (48.2)	171 (11)	591 (38)	222 (14.3)
Environmentally friendly	608 (39.1)	182 (11.7)	486 (31.3)	187 (12)
Expensive	121 (7.8)	69 (4.4)	130 (8.4)	91 (5.9)
Has no insects on the plant	128 (8.2)	284 (18.3)	197 (12.7)	121 (7.8)
Hazardous for humans	51 (3.3)	228 (14.7)	43 (2.8)	95 (6.1)
Higher price	251 (16.1)	116 (7.5)	216 (13.9)	128 (8.2)
I do not know	172 (11.1)	218 (14)	292 (18.8)	697 (44.8)
Inexpensive	115 (7.4)	150 (9.6)	70 (4.5)	51 (3.3)
Insecticides are not used	262 (16.8)	38 (2.4)	173 (11.1)	46 (3)
Insecticides are used	59 (3.8)	526 (33.8)	84 (5.4)	145 (9.3)
Less pesticide residue on flowers and leaves	366 (23.5)	126 (8.1)	363 (23.3)	135 (8.7)
Lower price	123 (7.9)	209 (13.4)	86 (5.5)	99 (6.4)
Marketing gimmick	101 (6.5)	85 (5.5)	91 (5.9)	77 (5)
No pesticide residue on flowers and leaves	260 (16.7)	50 (3.2)	220 (14.1)	63 (4.1)
No synthetic pesticide used	224 (14.4)	54 (3.5)	216 (13.9)	59 (3.8)
Not environmentally friendly	47 (3)	359 (23.1)	57 (3.7)	102 (6.6)
Pesticide residue on flowers and leaves	65 (4.2)	364 (23.4)	72 (4.6)	111 (7.1)
Pesticides are not used	411 (26.4)	120 (7.7)	308 (19.8)	111 (7.1)
Pesticides are used	139 (8.9)	792 (50.9)	125 (8)	200 (12.9)
Plants not attractive to bees	77 (5)	99 (6.4)	69 (4.4)	65 (4.2)
Plants that attract bees	488 (31.4)	138 (8.9)	320 (20.6)	122 (7.8)
Pollinators are harmed	64 (4.1)	248 (15.9)	72 (4.6)	112 (7.2)
Safer for humans	511 (32.9)	163 (10.5)	450 (28.9)	216 (13.9)
Some other characteristic not listed	30 (1.9)	23 (1.5)	16 (1)	22 (1.4)
Use of biopesticides	116 (7.5)	173 (11.1)	152 (9.8)	138 (8.9)
Use of natural pesticides	293 (18.8)	161 (10.4)	332 (21.4)	142 (9.1)
Use of natural products	463 (29.8)	164 (10.5)	418 (26.9)	180 (11.6)
Use of products that are toxic to bees	57 (3.7)	301 (19.4)	67 (4.3)	120 (7.7)
Use of products without bee toxicity	605 (38.9)	121 (7.8)	498 (32)	133 (8.6)
Use of synthetic pesticides	61 (3.9)	319 (20.5)	73 (4.7)	142 (9.1)
Worse for the environment	33 (2.1)	315 (20.3)	38 (2.4)	95 (6.1)

when considering a plant purchase (Table 5). This is consistent with previous reports (Wollaeger et al., 2015). Participants ranked the next five attributes as equally important and included a plant that was grown in a way to protect pollinators with as little pesticides as possible that left no pesticide residue on the leaves or flowers, but also had no insects on the plant. These results are consistent with popularly held belief that customers perceive that any presence of insects, beneficial or not, reduces the quality of plants (Marsh and Gallardo, 2009).

The next most important characteristic was a low price, which was equally as important as plants grown in a sustainably produced potting soil mix as well as plants grown in a container made of recycled materials (Table 5). Price was more important than plants that were produced using bee-friendly practices or grown with recycled/recaptured water. Plants that were grown with no neonicotinoid products were rated second to last, which is probably a reflection on consumers lack of understanding of the word "neonicotinoid" (Wollaeger et al., 2015). Traditional insect management practices were the least desired attribute of any presented.

CONJOINT ANALYSIS. Unlike the stated preferences for characteristics and attributes of plants in other questions, conjoint analysis extracts the relative importance of each attribute and level from the implied preference.

Table 4. **Mean score of Internet survey participants answer to the question "On a scale of 1 (means something very negative) to 5 (means something very positive), how would you label the meaning of the following plant production practices?" The Internet survey queried consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555).**

Plant production practice	Score [mean (SE)]
Plants grown using bee-friendly insect management practices	4.18 (0.02) a[z]
Plants grown using insect management strategies that are safe for pollinators	4.14 (0.02) ab
Plants grown using best insect management practices to protect pollinators	4.06 (0.021) b
Plants grown using insect management practices that leaves no insecticide residue on the plant	3.95 (0.021) c
Plants grown using protective neonicotinoid insecticides	3.31 (0.024) d
Plants grown using neonicotinoid insecticides	3.18 (0.025) e
Plants grown using traditional insect management practices	3.13 (0.027) e

[z]Means within a column followed by the same lowercase letter are not different by Tukey's honestly significant difference ($P \leq 0.05$).

Table 5. **Mean response of Internet survey participants to the question "In thinking about your choices to buy flowering plants, how important are each of these to your purchase decision (1 = not at all important, 7 = very important)?" The Internet survey queried consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555).**

Characteristic	Response [mean (SE)]
The flowering plant has no plant damage	5.89 (0.032) a[z]
The plant was grown in a way that protected pollinators	5.46 (0.04) b
The flowering plant was grown using as little pesticides as possible	5.4 (0.04) b
The flowering plant has no insects on it	5.34 (0.042) bc
The flowering plant has no pesticide residue on the leaves or flowers	5.34 (0.04) bc
The plant was grown in an environmentally friendly manner	5.32 (0.041) bc
Insects harmful to the plant were controlled by using beneficial insects	5.2 (0.039) cd
The plant has a low price	5.16 (0.038) cde
The plant was grown in a sustainably produced potting soil/mix	5.02 (0.04) def
The plant was grown in containers made of recycled materials	4.97 (0.043) ef
The plant was produced using bee-friendly practices	4.88 (0.046) f
Recycled/recaptured water was used to grow the plant	4.82 (0.046) fg
No neonicotinoid products were used to grow the plant	4.65 (0.045) g
The plant was grown with traditional insect management strategies	4.21 (0.045) h

[z]Means within a column followed by the same lowercase letter are not different by Tukey's honestly significant difference ($P \leq 0.05$).

The relative importance and part-worth utility for each attribute (price, species, insect management practice, and eco-friendly production practice) in the conjoint study is shown in Table 6. The part-worth utility was used to examine the order of importance of these factors to the respondents within the survey. Plant species accounted for 31.6% of the decision to purchase the plant, followed by price (25.1%), insect management strategy (23.3%), and eco-friendly practices (20.1%). This is similar to findings in Canada that showed consumers valued price (22% to 29% relative importance) over pest management practices (22% to 25% relative importance) for greenhouse-grown mums [*Dendranthema* × *grandiflorum* (Grygorczyk et al., 2014)]. This finding was contrary to other research that showed that price was equally as important as species and insect management production practice for 4-inch outdoor ornamental bedding plants (Wollaeger et al., 2015). This present study, however, did demonstrate that the insect management strategy was indeed more important to consumers in the purchase decision compared with the selected eco-friendly production practices.

When considering all levels of each attribute, lower prices were preferred to higher prices. Although this may seem intuitive, this indicates the use of logic or rational reasoning by subjects when coming to a conclusion about their willingness to purchase the plants shown in the images. Among the four insect management strategies, the "traditional" insect control method was least preferred (had a lower part-worth score), whereas the term "bee-friendly" was the most preferred (had a higher part-worth utility score) and was more valuable to survey participants than "grown using best management practices to protect pollinators" and "grown using protective neonicotinoid insecticides." These results are consistent with those reported in Wollaeger et al. (2015) where consumers were willing to pay the most for "bee friendly" and the least for "traditional" insect management practices. Of the eco-friendly plant production practices, grown using recycled/recaptured water, as well as grown in a sustainable potting mix were equally preferred over plants grown in pots made from recycled materials. "Traditional" eco-friendly production methods were least preferred.

To put these results into a monetary context, the difference between the lowest and the highest price 4-inch pot was \$1.50 and the price utility difference was 0.495 [the minimum of the price utilities (–0.221) subtracted from the maximum of the price utilities (0.274)]. Therefore, the change in the part-worth means score was worth \$3.03 (\$1.50/0.495). We can conclude that plants labeled as "grown using bee-friendly insect management practices" are worth \$0.26, \$0.26, \$0.89, and \$1.15 more than plants labeled as "grown in a sustainably produced potting soil/mix," "grown using recycled/recaptured water," "grown using protective neonicotinoid insecticides," and "grown using traditional insect management practices,"

Table 6. Mean part-worth and relative importance scores for a conjoint analysis (price, species, insect management practices, and eco-friendly production practices) from an Internet survey that queried consumers (who had purchased live plants in the past 12 mo.) perspectives on eco-friendly ornamental plant production practices in combination with a variety of insect management practices (*n* = 1555).

Attribute	Part-worth scores[z] [mean (SE)]	Relative importance scores[y] [mean (SE)]
Price		25.09 (0.421) b[x]
$1.99	0.274 (0.0111) a[x]	
$2.49	0.002 (0.0071) de	
$2.99	–0.057 (0.0072) fg	
$3.49	–0.221 (0.0108) h	
Species		31.57 (0.580) a
Marigold	–0.050 (0.014) ef	
Moss rose	0.00 (0.0143) d	
Salvia	–0.069 (0.012) fg	
Verbena	0.115 (0.0125) c	
Insect management strategy		23.26 (0.446) c
Grown using traditional insect management practices	–0.200 (0.0119) h	
Grown using bee-friendly insect management practices	0.181 (0.0105) b	
Grown using best insect management practices to protect pollinators	0.128 (0.0098) c	
Grown using protective neonicotinoid insecticides	–0.112 (0.0116) g	
Eco-friendly practices		20.08 (0.304) d
Grown in a container made from recycled materials	–0.020 (0.0073) def	
Grown in a sustainably produced potting soil/mix	0.094 (0.0077) c	
Grown using recycled/recaptured water	0.095 (0.0084) c	
Grown using traditional plant production methods	–0.170 (0.0103) h	

[z]Part-worth scores having a positive and a negative value indicate consumers had a positive or negative preference for the indicated trait, respectively. Larger absolute values indicate a stronger preference than smaller absolute values.
[y]Relative importance scores having larger values indicate consumers placed a higher value on that attribute than those attributes with lower scores.
[x]Means within a column followed by the same lowercase letter are not different by Tukey's honestly significant difference ($P \leq 0.05$).

respectively. This perceived price premium of $1.15 for "bee friendly" plants compared with "traditionally grown" plants was similar to the previously reported $0.96 price premium (Wollaeger et al., 2015). In addition, plants labeled as "grown using best insect management practices to protect pollinators" are worth $0.10, $0.10, $0.73, and $0.99 more than plants labeled as "grown in a sustainably produced potting soil/mix," "grown using recycled/recaptured water," "grown using protective neonicotinoid insecticides," and "grown using traditional insect management practices," respectively.

Among the plant species, verbena (*Verbena* ×*hybrida*) was preferred more than moss rose (*Portulaca grandiflora*), whereas marigold (*Tagetes erecta*) and salvia (*Salvia splendens*) were equally preferred the least. The response of participants to preferring marigolds least is interesting in that the U.S. Department of Agriculture (USDA) tracks sales of the largest segments of floriculture products and marigolds are one of those segments having sold 3.6 million flats and 10.4 million potted plants in 2014 (USDA, 2015).

Conclusions

Consumers evaluate many factors when buying plants. Among those factors are the insect management practices and environmental impact of plant production, if advertised by the retailer. When asked pointedly, consumers want perfect plants ("The flowering plant has no plant damage" mean = 5.89) at the lowest possible price (lowest price had the highest mean part-worth score in the conjoint analysis). Saliency refers to a topic or concept that is "at the top of mind" and perhaps one reason for the higher mean relative importance of insect management strategy over eco-friendly production practices (lowest relative importance) was the considerable publicity on the topic of bees and bee health. Plant species continues to be the key driver of the purchase decision, whereas price and other attributes are of lesser relative importance. Consumers' knowledge of "bee friendly" production practices continues to be inaccurate as evidenced by the high percentage of subjects agreeing that that specific production practice makes plants more attractive to bees. Media may be drawing attention to the use of neonicotinoid insecticides but our data shows that the publicity has not been successful in educating the general public with scientifically accurate information on the definition of "bee friendly" insect management practices. The need for sensitivity to the environment appears to be less an issue with consumers than insect management practices as evidenced by the lower relative importance of eco-friendly practices compared with insect management strategies. Therefore, growers and retailers who educate their customers and promote their current practices may elevate the perceived value of these more sustainable production methods.

Also, the study sought to integrate a more holistic set of attributes with the inclusion of eco-friendly practices. We observed that, with the addition of those practices, the relative importance of price was less than in Wollaeger et al. (2015). The complexity of plant attributes challenges researchers to make the choices of extrinsic characteristics as broad and as realistic as possible. However, no singular consumer study presents the definitive case for what consumers actually see in the marketplace. Researchers should continue to provide multiple attributes in studies evaluating willingness to pay for products to capture a more complete perspective.

No study is without its limitations. Here, the online sample and survey methods in general are not considered by all to be accurate reflections of consumer behavior, while there is some evidence to support the notion that survey research is reflective of actual consumer behavior (Yue et al., 2010). Another limitation of the study may be that our recruited subjects were responding to selected stimuli and may not have responded in an identical manner had other plants, production methods, definitions, or explanations been provided. We do believe, however, that the data support our conclusions.

Finally, the authors recommend the honest and ethical use of the term "bee friendly practices" in labeling. Although consumers are neither accurate nor unanimous in their interpretation of this phrase, the data suggest it is helpful (and potentially more profitable) for plant marketers to use the phrase in the identification of plant production practices that may cause little to no harm to bee populations (given the current level of understanding about pest management strategies and tools). Future marketing efforts made by companies who use the phrase may also help to educate the public at large about the meaning of "bee friendly" and the details that might be of interest to some customers. This information might be made available on a website or other locale where interested persons might develop a more accurate perception of "bee friendly" pest management tools and practices.

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