Greater Appeal of Native Plants for Environmentally Conscious Consumers[1]

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Abstract

Native plants are increasingly of interest to growers, wholesalers, and retailers as they seek to expand sales in this important plant category. A recent online survey of 2,066 Americans showed that while many consumers were interested in, and had made a purchase of, a native plant in the past 12 months, more than half believed they were either slightly or not at all knowledgeable about native plants. People who use more environmentally conscious gardening behaviors (e.g., composting, recycling containers, rain barrels, organic practices, pollinator friendly plants, plants requiring less irrigation) are more likely to view native plants as important in their gardens and landscapes. Three segments based on perceived importance of native plants were compared and marketing implications are discussed.

Index words: *Euonymus alatus* Thunb, gardening, *Lythrum salicaria* L, organic, ordered probit, recycled containers, residential landscape, *Rhamnus cathartica* L.

Significance to the Horticulture Industry

Native plants are one category that would benefit from improved marketing and communications to stimulate consumer demand. Marketers realize that not all markets are homogeneous and dividing a marketing into segments enables savvy marketers to capitalize on the attitudes, preferences, perceptions, and behaviors common within individual market segments. In the present study, researchers identified three consumer segments regarding their perceived importance of native plants: Native plant champions segment (50% of the market) believes native plants are very or extremely important; Pro-native plant segment (33% of the market) perceives them as moderately important; and Ambivalent segment (17% of the market) who believe native plants are not or only slightly important. While results showed that there were multiple differences regarding pro-environmental behavior, few differences were identified regarding demographic characteristics. Key behavioral differences in this study were the use of rain barrels, composting, and recycling gardening plastics. Marketers should consider adding native plant messages (e.g., benefits) near the areas where these products are merchandised to attract consumers to the available plants.

Introduction

Incorporating native plants into residential and commercial landscapes could provide significant environmental benefits (Rodriguez et al. 2017, Shaw et al. 2017, Van Heezik et al. 2020). If properly managed and planted, gardens and landscapes could serve as "wildlife corridors" in urban areas (Rudd et al. 2002), which could aid ecological health, biodiversity, and wildlife habitat (Breuste 2004, Goddard et al. 2010, Grimm et al. 2008, Raymond et al. 2019). This is only feasible if native plants are perceived as aesthetically, ecologically, and economically valuable to the marketplace.

Currently, native species are underrepresented in the landscape and garden center industry. In developed countries, residential landscapes are predominately non-native species (Burghardt, Tallamy, and Shriver 2009), which have often been deliberately introduced (Mack and Erneberg 2002). In the U.S., most introduced plants are for ornamental purposes (Randall and Marinelli 1996). A major concern with introduced plants is their potential invasiveness (e.g., purple loosestrife (*Lythrum salicaria* L.); burning bush (*Euonymus alatus* Thunb.); buckthorn (*Rhamnus cathartica* L.) (Gagliardi and Brand 2007, Yue et al. 2011, 2012). Incorporating more native plants into landscapes through increased marketplace acceptance may aid in minimizing introductions of non-native species that may have negative environmental consequences (such as invasiveness).

Several studies addressed supply chain issues and industry challenges related to native plant production and marketing (Brzuszek and Harkess 2009, Kauth and Perez 2011, Phondani et al. 2016, White et al. 2018). In 2017, 841 garden centers sold native plants in the U.S., with only 26% of 25,000 native vascular plants being commercially available (White et al. 2018). Brzuszek and Harkess (2009) surveyed southeastern nurseries (n=125) and determined that 20% of the nurseries sold native plants and approximately 50% did not label their plants as native or not native. Barriers to native plant production include low demand, low propagation (seeds, etc.) supply, limited availability of desirable species, and low education among customer groups (Brzuszek and Harkess 2009, Kauth and Perez 2011). Additionally, commercial production of native plants often depends upon plant characteristics, conservation status, distribution, and taxonomy (Phondani et al. 2016, White et al. 2018). Often, native plant

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availability is region and species dependent. For instance, in 2005, 11% of plant sales in Florida were native species (Norcini 2006). More recently, in 2017 in the Midwest, nearly 74% of 1,000 prairie grass species were commercially available (White et al. 2018). A better understanding of the market for native plants is imperative given that demand is expected to increase (Kauth and Perez 2011). Wilde et al. (2015) highlight that market feasibility studies are necessary and that there is a need for educational information, increased demand, and regional collaborations to promote native plants.

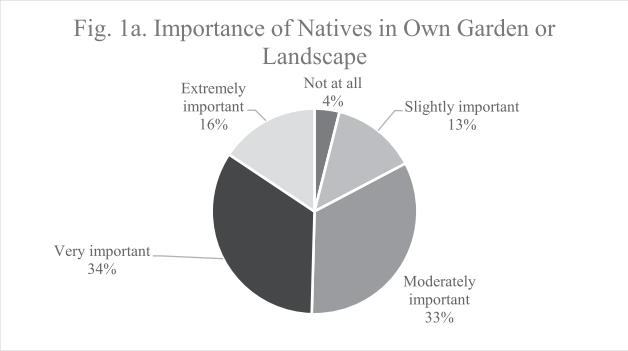
Consumer perception studies on native plants have addressed the relationship between social norms, aesthetic considerations, and pro-environmental behavior and native plant preferences (Gillis and Swim 2020, Rodriguez et al. 2017, Shaw et al. 2017, Van Heezik et al. 2020). Social norms impact acceptance of native landscapes where people assume their neighbors prefer turf grass lawns to native plantings (Peterson et al. 2012). This can deter homeowners from planting natives or result in natives being planted in less prevalent locations than the front yard, such as a side yard or back yard (Gillis and Swim 2020). Part of this perception may be related to aesthetic characteristics. Beck et al. (2002) found that native plants were not considered as aesthetically pleasing as other options and that there was a strong need for natives to imitate traditional definitions of aesthetically pleasing landscape plants. However, other studies determined that consumers view native plants as aesthetically appealing (Shaw et al. 2017, Gillis and Swim 2020). In turn, consumers' positive perceptions of native plants' beauty positively impact their intent to purchase native plants (Gillis and Swim 2020). Regarding pro-environmental behavior, several studies have established a positive correlation between environmental knowledge and purchase likelihood for native plants (Narem et al. 2018) or positive perceptions of native plants (Shaw et al. 2017).

A clear understanding of what appeals to consumers regarding attributes of native and non-native plants as well as learning the characteristics and habits of consumers who are likely or less likely to buy native plants will help garden centers position native plants favorably in the marketplace, thus increasing their purchase and benefitting the environment. Thus, our objectives of this research were to:

1. Identify the importance of native plants in landscapes and gardens to U.S. consumers, and
2. Assess the relationship between the importance of native plants and gardening practices used by U.S. consumers.

Materials and Methods

To address the research objectives, an online survey was administered in September 2022 using an online panel provider (Qualtrics, Provo, UT). An online panel provider is a firm that provides different panel(s) for studies. The panels are screened to insure they are real participants and data that is collected is cleaned to make sure responses are complete and valid. The survey consisted of several question blocks addressing perceptions and interest in native plants. The questions included the consent form, screening questions, knowledge of native plants, plant purchasing behavior (e.g., annual spending, retail location), gardening practices, importance of native plants, perceptions of native plants, and demographic characteristics.



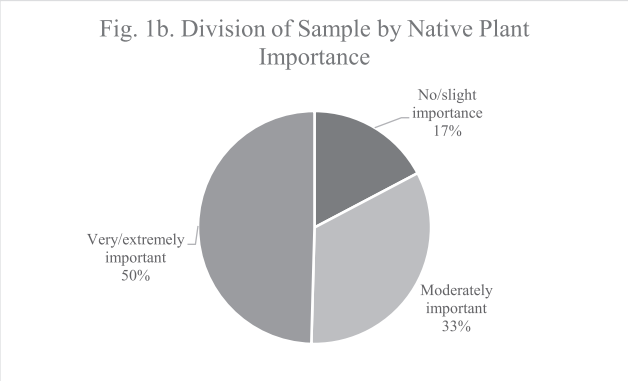


Fig. 1. U.S. consumers' perceived importance of incorporating native plants into their own gardens and landscapes from an online survey conducted in 2022 (n=2,066).

Prior to participation, participants were screened to insure they were 18 years or older, lived in a residence where they could landscape (i.e., own a single unit dwelling (e.g., house) or mobile home), and are the primary gardening or plant purchaser in their household. A total of 2,066 U.S. people qualified, passed the validation questions, and completed the survey. All study procedures were approved by the University of Tennessee's IRB (UTK IRB-22-06847-XM).

For the analysis, the importance of native plants, gardening practices, and demographic questions were used. To measure the importance of native plants, participants were asked "how important it is to you that native plants are incorporated into your own gardens and landscapes?". Their responses were measured using a 5-point Likert scale where 1 indicated not at all important and 5 indicated extremely important. The mean value was 3.440 (SD=1.031) with half of the sample (50%) indicating that incorporating native plants into their gardens and landscapes was extremely or very important, 33 percent indicated moderately important, 13 percent slightly important, and 4 percent not at all important (Fig. 1a). For additional analysis, participants were categorized into three groups, where group 1 included people who answered extremely or very important (Likert scale values 4 or 5), group 2 included people who selected moderately impor-

tant (3), and group 3 consisted of people who indicated slightly or no importance (a value of 1 or 2) (Fig. 1b). Categorizing respondents into these three groups provides clear-cut comparisons between those perceiving the importance of native plants differently.

Econometric analysis. Additional econometric analysis was used to assess the relationship between participants' interest in native plants, their gardening practices, and demographic characteristics. The three categories of participants level of interest in native plants was used as the dependent variable. Given the ordered nature of the dependent variable (i.e., group 1=extremely/very important, group 2=moderaterly important, and group 3=slightly/not important), an ordered probit model and marginal effects were used. The ordered probit is an appropriate framework to model ordinal survey respondents where the observed dependent variable has an ordinal scale (Greene 2003).

The ordered probit is based on a latent continuous variable y^* underlying the ordinal responses observed. Let y^* represent the latent dependent variable (i.e., the three categories grouping respondents based on the importance placed in native plants in one's garden or landscape) (Cameron and Tribedi 2009, Long and Freese 2006). The latent variable is a linear combination of observables X and a disturbance term ε that has a normal distribution. Letting $i = 1, 2, \ldots, n$ index the category of respondents, and for the case in which there are three ordered categories (i.e., $y_i[1, 2, 3]$):

$$y_i^* = x_i^{'}\beta + \varepsilon_i \tag{1}$$

in which y_i^* is the unobserved latent variable and y_i is the observed ordinal variable

$$y_i = 1 \; if \; y_i^* \leq 0$$

$$y_i = 2 \; if \; 0 < y_i^* \leq \mu_1$$

$$y_i = 3 \; if \; \mu_1 < y_i^*$$

such that μ_1 and β are unknown parameters to be estimated. We then have the following probabilities:

$$\Pr(y_i = 1|X_i = x) = \Phi(-X_i\beta)$$

$$\Pr(y_i = 2|X_i = x) = \Phi(\mu_1 - X_i\beta) - \Phi(-X_i\beta)$$

$$\Pr(y_i = 3|X_i = x) = 1 - \Phi(\mu_1 - X_i\beta)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function.

Eq (2) illustrates the model specification in the ordered probit regression. The ordered probit assessed the importance respondents placed on incorporating native plants into their own gardens and landscapes. The dependent variable y_i^* takes the value of $y = 1$ if respondent answered incorporating native plants into their own gardens and landscapes is extremely or very important, $y = 2$ if respondent answered incorporating native plants into their own gardens and landscapes is moderately important, and $y = 3$ if respondent answered incorporating native plants into their own gardens and landscapes is slightly or not important.

$$\begin{aligned}\Pr(Y_i = 1|X_i = x) &= \Phi(X_i\beta) \\ &= \Phi(\beta_0 + \beta_1 compost + \beta_2 growown \\ &\quad + \beta_3 nativessp + \beta_4 organic \\ &\quad + \beta_5 lessfert + \beta_6 lesswater \\ &\quad + \beta_7 recycle + \beta_8 pollinator \\ &\quad + \beta_9 rainwater + \beta_{10} orgplant \\ &\quad + \beta_{11} soilamend + \beta_{11}\end{aligned} \tag{2}$$

Where X_i is a vector of the participant *i's* characteristics (e.g., socio-demographics), and $\beta = (\beta_0, \beta_1, \beta_2, \beta_3', \beta_4', \beta_5', \beta_6', \beta_7', \beta_8', \beta_9', \beta_{10}', \beta_{11}')'$ is a vector of unknown constants. The variable *compost* represents participants agreement with using compost in their gardens. The *nativessp* variable represents their agreement with using native species. The *organic* variable is their agreement with using organic practices. The *lessfert* variable captures their agreement with planting varieties that require less fertilizer and pesticides in their gardens. The *lesswater* variable captures their agreement with using varieties that require less water. The *recycle* variable is their recycling of gardening packaging. The *pollinator* is their use of pollinator friendly plants. The *rainwater* variable is their use of rainwater barrles or collectors. The *orgplant* is purchasing organically grown plants. The *soilamend* variable captures their use of soil amendments. The β is a vector of coefficients associated with the independent variables included in x_i.

To determine participants' current gardening practices, they were provided 11 gardening practices statements and asked to indicate if the statements reflected their gardening practices using a 7-point Likert scale (1=not at all like me; 7=exactly like me). The statements were generated based on observed practices used by consumers, promoted through Extension or other educational sources, options available at garden centers, and from existing literature (Kiesling and Manning 2010, Thomas et al. 2020). The gardening practices statements included composting on property and using the compost in the garden, growing own food, using native plant species in the garden, using organic gardening practices (e.g., organic plants, organic fertilizers, organic soil amendments), using plant varieties that require less fertilizer or pesticides, using plant varieties that require less water, recycling gardening packaging, using pollinator friendly plants, using rainwater barrels or collectors, purchasing plants that are organically grown, and using soil amendments to improve soil health. The statements were presented to participants in a random order to prevent order bias. The mean rating for each statement was generated for each category of native plants importance, and group significance was estimated using ANOVA and Tukey's honest significance test. Analyses were conducted using Stata statistical software (release 17, StataCorp, College Station, TX).

Table 1. Mean and standard deviation of demographic characteristics of 2,066 U.S. consumers from a 2022 online survey addressing perceptions of native plants.[z]

		Overall		Group 1 – Ambivalent		Group 2 – Pro-native		Group 3 – Native Plant Champions	
		(N=2,066)		(n=357)		(n=685)		(n=1,024)	
Variable [z]	*Definition*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age	Age in years.	57.1	14.6	55.3 a	14.4	58.3 b	14.8	57.0 ab	14.4
Female	1=female; 0=otherwise	0.77	0.42	0.80	0.40	0.77	0.42	0.75	0.43
White	1=white; 0=otherwise	0.92	0.28	0.93	0.26	0.92	0.27	0.91	0.29
Black	1=black; 0=otherwise	0.03	0.16	0.03	0.17	0.02	0.14	0.03	0.17
Hispanic	1=Hispanic; 0=otherwise	0.04	0.20	0.04	0.19	0.04	0.20	0.04	0.21
Ethnicother	1=other ethnicity; 0=otherwise	0.04	0.19	0.03	0.16	0.04	0.19	0.04	0.19
Bseduplus	1=bachelor's degree or higher; 0=less than a bachelor's degree	0.46	0.50	0.43	0.50	0.44	0.50	0.48	0.50
Rural	1=live in rural area; 0=otherwise	0.42	0.49	0.46	0.50	0.41	0.49	0.41	0.49
Suburb	1=live in suburban area; 0=otherwise	0.45	0.50	0.42	0.50	0.46	0.50	0.44	0.50
Urban	1=live in urban area; 0=otherwise	0.13	0.34	0.12	0.32	0.12	0.33	0.15	0.36
Northeast	1=live in Northeast; 0=otherwise	0.20	0.40	0.21	0.41	0.18	0.39	0.20	0.40
Midwest	1=live in Midwest; 0=otherwise	0.20	0.40	0.28 a	0.45	0.22 b	0.41	0.17 b	0.38
Southwest	1=live in Southwest; 0=otherwise	0.20	0.40	0.13 a	0.34	0.19 b	0.39	0.23 b	0.42
Northwest	1=live in Northwest; 0=otherwise	0.20	0.40	0.21	0.41	0.20	0.40	0.19	0.40
South	1=live in South; 0=otherwise	0.20	0.40	0.17	0.37	0.22	0.41	0.21	0.41

[z]Anova and Tukey's honest significance test were used to test significance between groups. Different letters indicate significance at the 5% level.

Results and Discussion

There were 2,066 complete and useful responses. Table 1 shows the demographic characteristics of the sample. Average age was 57.1 years old with a range from 18 to 89 years old. About three quarters of our sample were female and 23.2% were male (0.1% preferred not to say or indicated non-binary). Over half (54.3%) had education equivalent to at least two years of college; 22.8% had a four-year college degree. Almost all (92%) were Caucasian, 4% were Hispanic, 3% Black, 2% Asian, and the remainder indicated another ethnic background or preferred not to say. Households averaged 1.9 adults and 1.4 children per household. Average 2021 household income was $74,730 with median household income in the $60,000 to $69,999 category. More participants were from suburban regions (44.7%) than rural (29.2%), urban (13.4%), or small towns (12.7%).

We asked study participants how important native plants are in their garden and landscape (Fig. 1a and 1b). We combined the "not at all" important segment with the "slightly important" segment and, separately, combined "extremely important" and "very important" to create three actionable market segments with greater balance among the three (as opposed to five).

We then examined the demographic characteristics of the three groups (Table 1) and found only three demographic differences. First, the Ambivalents (Group 1) were the smallest segment relative to the other two and were three years younger than the Pro-Natives ($P<0.01$; Group 2) but the Native Plant Champions (Group 3) were similar in age to both groups (Ambivalent $P=0.128$; Pro-native $P=0.165$). Champions (Group 3) and Pro-Natives (Group 2) were less likely to live in the Midwest ($P<0.01$and $P<0.1$, respectively) or Southwest ($P<0.01$and $P<0.05$, respectively), but there were no other geographical differences. There were no differences in ethnic heritage or area of residence (i.e., urban, rural, suburban, or small town).

When we compared the three groups on their average responses to the 11 gardening-related behavioral statements, we found clear differences between the groups (Table 2). For all the statements, the Champions (Group 3) had a significantly higher mean score (or greater level of agreement) on each statement compared to the Pro-Native group (Group 2). The Pro-Native group (Group 2) scored significantly higher, on average, for each statement compared to the Ambivalent group (Group 1).

Results from the ordered probit model are shown in Table 3 (log likelihood = -1716.9731, LR Chi^2 +769.48, $P<0.01$, Pseudo $R^2=0.1831$). The ordered probit model results further refined the behavioral statements that would lead to an increased probability of consumers being in each cluster. From greatest impact to least, the statements that produced the greatest probability of perceiving native plants as important were "I use native plant species in my garden," "I use pollinator friendly plants (e.g., plants that attract bees, hummingbirds, or butterflies)," "I use plant varieties that require less water," "I use organic gardening practices (e.g., using organic plants and organic fertilizers and/or soil amendments)," "I compost on my property and use the compost in my garden (e.g., garden waste, leaves, cuttings, or other household waste)," "I recycle gardening packaging (e.g., cardboard, plastics, plant containers, kitchen waste, etc.)," and "I use a rainwater barrel or collector." Each of these actions contributed positively to an increased probability of placing high importance in incorporating native plants in gardens and landscapes relative to participants perceiving native plants as not important. Four statements did not vary in significance and included "I grow some of my own food," "I use plant varieties that require less fertilizer or pesticides," "I purchase plants that are organically grown," and "I use soil amendments to improve soil health."

Table 2. Mean and standard deviation of response to 11 statements regarding pro-environmental gardening behaviors.[z]

	Overall		Group 1 – Ambivalent		Group 2 – Pro-native		Group 3 – Native Plant Champions	
	(n=2,066)		(n=357)		(n=685)		(n=1,024)	
Statement [zy]	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
I use a rainwater barrel or collector.	3.09	2.34	2.36 a	2.08	2.75 b	2.19	3.57 c	2.42
I compost on my property and use the compost in my garden (e.g., garden waste, leaves, cuttings, or other household waste).	3.75	2.39	2.78 a	2.21	3.41 b	2.29	4.32 c	2.36
I purchase plants that are organically grown.	4.09	1.94	3.20 a	1.91	3.87 b	1.84	4.54 c	1.89
I use organic gardening practices (e.g., using organic plants and organic fertilizers and/or soil amendments).	4.21	2.00	3.17 a	1.88	3.89 b	1.94	4.79 c	1.88
I grow some of my own food.	4.69	2.26	3.99 a	2.36	4.56 b	2.23	5.03 c	2.17
I use plant varieties that require less water.	4.99	1.67	4.24 a	1.82	4.71 b	1.59	5.43 c	1.52
I use soil amendments to improve soil health.	5.07	1.82	4.28 a	2.02	5.00 b	1.71	5.39 c	1.74
I use native plant species in my garden.	5.24	1.61	3.95 a	2.00	4.82 b	1.41	5.96 c	1.15
I use plant varieties that require less fertilizer or pesticides.	5.36	1.59	4.63 a	1.86	5.17 b	1.49	5.75 c	1.43
I use pollinator friendly plants (e.g., plants that attract bees, hummingbirds, or butterflies).	5.49	1.58	4.54 a	1.82	5.27 b	1.51	5.97 c	1.33
I recycle gardening packaging (e.g., cardboard, plastics, plant containers, kitchen waste, etc.)	5.56	1.92	4.83 a	2.23	5.36 b	1.92	5.94 c	1.69

[z]Participants indicated how well the statements described their gardening practices using a 7-point Likert scale where 1=not at all like me to 7=exactly like me.

[y]Anova and Tukey's honest significance test were used to test significance between groups. Different letters indicate significance at the 5% level.

Table 3. Marginal effect estimates from an ordered probit model assessing the relationship between U.S. consumers' environmentally friendly gardening practices, demographics, and perceived importance of native plants (n=2,066).[z]

	Group 1			Group 2			Group 3		
	Ambivalent (n=357)			Pro-native (n=685)			Native Plant Champions (n=1,024)		
Statement [z]	*dy/dx*	*SE*	*P-value*	*dy/dx*	*SE*	*P-value*	*dy/dx*	*SE*	*P-value*
I compost on my property and use the compost in my garden (e.g., garden waste, leaves, cuttings, or other household waste).	**-0.60**	**0.30**	**0.02**	**-0.70**	**0.30**	**0.02**	**1.30**	**0.60**	**0.02**
I grow some of my own food.	-0.20	0.30	0.40	-0.20	0.30	0.40	0.50	0.50	0.40
I use native plant species in my garden.	**-5.40**	**0.40**	**0.00**	**-5.70**	**0.50**	**0.00**	**11.20**	**0.80**	**0.00**
I use organic gardening practices (e.g., using organic plants and organic fertilizers and/or soil amendments).	**-1.10**	**0.30**	**0.00**	**-1.10**	**0.40**	**0.00**	**2.20**	**0.70**	**0.00**
I use plant varieties that require less fertilizer or pesticides.	-0.60	0.40	0.10	-0.70	0.40	0.10	1.30	0.80	0.09
I use plant varieties that require less water.	**-1.30**	**0.40**	**0.00**	**-1.30**	**0.40**	**0.00**	**2.60**	**0.70**	**0.00**
I recycle gardening packaging (e.g., cardboard, plastics, plant containers, kitchen waste, etc.)	**-0.60**	**0.30**	**0.03**	**-0.70**	**0.30**	**0.03**	**1.30**	**0.60**	**0.03**
I use pollinator friendly plants (e.g., plants that attract bees, hummingbirds, or butterflies).	**-2.50**	**0.40**	**0.00**	**-2.60**	**0.40**	**0.00**	**5.10**	**0.70**	**0.00**
I use a rainwater barrel or collector.	**-0.50**	**0.30**	**0.04**	**-0.60**	**0.30**	**0.04**	**1.10**	**0.50**	**0.04**
I purchase plants that are organically grown.	-0.30	0.30	0.42	-0.30	0.40	0.42	0.60	0.70	0.42
I use soil amendments to improve soil health.	-0.60	0.30	0.07	-0.60	0.30	0.07	1.20	0.60	0.07
Demographic characteristic									
Age	-0.10	0.00	0.08	-0.10	0.00	0.08	0.10	0.10	0.08
Female	0.40	1.30	0.73	0.50	1.40	0.73	-0.90	2.70	0.73
White	-0.20	1.90	0.94	-0.20	2.10	0.94	0.30	4.00	0.94
Bseduplus	-0.50	1.10	0.63	-0.50	1.10	0.63	1.10	2.20	0.63
Urban	-3.20	1.70	0.06	-3.40	1.80	0.07	6.60	3.50	0.06
Suburb	-0.90	1.20	0.47	-0.90	1.20	0.47	1.80	2.40	0.47
Northeast [y]	1.30	1.70	0.43	1.40	1.80	0.43	-2.70	3.50	0.43
Midwest [y]	**4.40**	**1.60**	**0.01**	**4.60**	**1.70**	**0.01**	**-9.00**	**3.40**	0.01
Southwest [y]	-2.90	1.70	0.08	-3.10	1.80	0.09	6.00	3.50	0.08
Northwest [y]	2.50	1.70	0.14	2.70	1.80	0.14	-5.20	3.50	0.14

[z]Bold font indicates significance at the 5% level.

[y]South was the base for the regional comparison.

The largest factor impacting the probability of being part of the Native Plant Champion cluster were using native species in their garden when compared to participants not using native species in their gardens. To illustrate, using native plants species in their garden increased the probability to be a Native Plant Champion by 11.20% ($P<0.05$) relative to their counterparts. The other top factors increasing the probability of cluster membership for Native Plant Champions are using pollinator friendly plants (5.10%; $P<0.05$) and using plant varieties that require less water (2.60%; $P<0.05$), relative to people not using these practices. Homeowners reporting to use organic gardening practices were 2.20% more likely to be Native Plant Champions ($P<0.05$) than people not using organic gardening practices. Homeowners that compost and use compost in their garden were 1.30% more likely to be part of the Native Plant Champions ($P<0.05$) than people who do not compost. Other factors increasing the probability to be Native Plant Champions were recycling gardening packaging (1.30%; $P<0.05$) and using a rainwater barrel or collector (1.10%; $P<0.05$) than people who do not use these practices. As shown in Table 3, these factors decrease the probability to be part of the Ambivalent and Pro-native clusters.

The only demographic characteristic which influenced the probability of buying a native plant was living in the Midwest. Midwestern homeowners were 4.40% more likely to be Ambivalent ($P<0.05$), 4.60% more likely to be Pro-Native ($P<0.05$), and 9% less likely to be Native Plant Champions ($P<0.05$) relative to participants residing in the South.

Results from the ordered probit model and marginal effects reinforce the finding that demographic characteristics are not driving interest in native plants as much as pro-environmental values. This is surprising, given the region-specific nature of native plants, one would expect some regional differences (Gillis and Swim 2020, Norcini 2006). But it is good news for marketers in that messaging does not need to vary by the demographics of the population being served by online retailers or brick-and-mortar stores. Instead, use of promotional messaging that aligns with current gardening practices and reinforces the benefits of native plants may encourage purchase and use in residential landscapes. Since composting, recycling plastics, and the use of rain barrels are some of the key gardening-related behavioral differences encouraging native plant purchases, it makes sense to construct native plant displays near the merchandising of these products (rain barrels and composting bins). Similar messaging might be added in areas where non-plastic containers are used (e.g., biodegradable containers) or when used plastics are being recycled. Use of organic gardening practices also improves the probability of native plants being important. Incorporating organic gardening options (e.g., fertilizers, soil amendments) with native plant displays or near native plant displays may leverage this positive relationship and increase consideration of native plants by gardeners. Additionally, seeking plant varieties that benefit pollinators and use less water positively impacted the importance of native plants. Both of these ecological benefits have been associated with native plants (Vickers 2006, Zaninotto, Thebault, and Dajoz 2022) meaning highlighting this information at the point of sale may be another means of encouraging native plant purchases.

Literature Cited

Beck, T.B., J.E. Heimlich, and M.F. Quigley. 2002. Gardeners' perceptions of the aesthetics, manageability, and sustainability of residential landscapes. Applied Environ. Educ. and Comm. 1:163–172.

Breuste, J.H. 2004. Decision making, planning and coverage for the conservation of indigenous vegetation within urban development. Landscape and Urban Planning. 68:439–452.

Brzuszek, R.F. and R.L. Harkess. 2009. Green industry survey of native plant marketing in the southeastern United States. HortTechnology 19:168–172.

Burghardt, K.T., D.W. Tallamy, and W. Shriver. 2009. Impact of native plants on bird and butterfly biodiversity in suburban landscapes. Conservation Biology, 23: 219–224.

Cameron, A.C. and P.K. Trivedi. 2009. Microeconometrics Using Stata. A Stata Press Publication, StataCorp LP, College Station, TX. p. 512.

Gagliardi, J.A. and M.H. Brand. 2007. Connecticut nursery and landscape industry preferences for solutions to the sale and use of invasive plants. HortTechnology 17:39–45.

Gillis, A.J. and J.K. Swim. 2020. Adding native plants to home landscapes: The roles of attitudes, social norms, and situational strengths. J. Environ. Psych. 72:101519.

Goddard, M.A., A.J. Dougill, and T.G. Benton. 2010. Scaling up from gardens: Biodiversity conservation in urban environments. Trends in Ecology and Evol. 25:90–98.

Greene, W.H. 2003. Econometric Analysis. Pearson Education, Upper Saddle River, NJ.p. 736-738.

Grimm, N.B., S.H. Faeth, N.E. Golubiewski, C.L. Redman, J. Wu, X. Bai, and J.M. Briggs. 2008. Global change and the ecology of cities. Science 319:756–760.

Kauth, P.J. and H.E. Perez. 2011. Industry survey of the native wildflower market in Florida. HortTechnology 21:779–788.

Kiesling, F.M. and C.M. Manning. 2010. How green is your thumb? Environmental gardening identify and ecological gardening practices. J. Environ. Psych. 30:315–327.

Long, J.S. and J. Freese. 2006. Regression Models for Categorical Dependent Variables Using Stata (2nd ed.). A Stata Press Publication, StataCorp LP, College Station, TX. p.183-186.

Mack, R.N. and M. Erneberg. 2002. The United States naturalized flora: Largely the product of deliberate introductions. Annals Missouri Botanical Garden 89:176–189.

Narem, D.M., M.H. Meyer, C. Yue, and N. Roth. 2018. Point of sale displays influence consumer decisions to purchase native grasses. HortTechnology 28: 748–754.

Norcini, J. 2006. Native plants: An overview. Department of Environmental Horticulture, FL Coop. Ext. IFAS Pub., University of Florida, Gainesville, FL.

Phondani, P.C., A. Bhatt, E. Elsarrag, Y.M. Alhorr, and A. El-Keblawy. 2016. Criteria and indicator approach of global sustainability assessment system for sustainable landscaping using native plants in Qatar. Ecological Indicators 69:381–389.

Randall, J.M. and J. Marinelli. 1996. Invasive plants: Weeds of the global garden. Brooklyn Botanic Garden, Brooklyn, NY. 111 p.

Raymond, C.M., A.P. Diduck, A. Buijs, M. Boerchers, and R. Moquin. 2019. Exploring the co-benefits (and costs) of home gardening for biodiversity conservation. Local Environ. 24:258–273.

Rodriguez, S.L., M. N. Peterson, and C.J. Moorman. 2017. Does education influence wildlife friendly landscaping preferences. Urban Ecosystems 20:489–496.

Rudd, H., J. Vala, and V. Schaefer. 2002. Importance of backyard habitat in a comprehensive biodiversity conservation strategy: A connectivity analysis of urban green spaces. Restoration Ecology 10:368–375.

Shaw, A., K.K. Miller, and G. Wescott. 2017. Australian native gardens: Is there scope for a community shift? Landscape and Urban Planning 157: 322–330.

Thomas, M., K. Jensent, M. Velandia, C. Clark, B. English, D. Lambert, and F. Walker. 2020. Outdoor home gardener preferences for environmental attributes in gardening supplies and use of ecofriendly gardening practices. HortTechnology 30:552–563.

Van Heezik, Y., C. Freeman, K. Davidson, and B. Lewis. 2020. Uptake and engagement of activities to promote native species in private gardens. Environ. Mgmt. 66:42–55.

Vickers, A. 2006. New directions in lawn and landscape water conservation. Amer. Water Works Assoc. 98:56–156.

White, A., J.B. Fant, K. Havens, M. Skinner, and A.T. Kramer. 2018. Restoring species diversity: Assessing capacity in the U.S. native plant industry. Restoration Ecology 26:605–611.

Wilde, H.D., J.K.G. Kamal, and G. Colson. 2015. State of the science and challenges of breeding landscape plants with ecological function. Hort. Res. 2:14069.

Yue, C., T. Hurley, and N.O. Anderson. 2012. Heterogeneous consumer preferences for native and invasive plants: Evidence from experimental auctions. HortScience 47:1091–1095.

Yue, C., T.M. Hurley, and N. Anderson. 2011. Do native and invasive labels affect consumer willingness to pay for plants? Evidence from experimental auctions. Agric. Econ. 42:195–205.

Zaninotto, V., E. Thebault, and I. Dajoz. 2022. Native and exotic plants play different roles in urban pollination networks across seasons. Res. Square, https://doi.org/10.21203/rs.3.rs-1418244/v1. Accessed June 1, 2022.