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Consumers' Valuation of Disease-Resistant Nursery Stock: A Case Study of Dogwoods

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This article summarizes a study of consumers' willingness to pay (WTP), in urban areas in Tennessee, Mississippi, and Michigan, for a powdery mildew resistant dogwood tree. Powdery mildew is a disease affecting flowering dogwoods that can limit growth, detract from the appearance, and may cause plant decline and death. Study objectives were to provide information about consumers' WTP and to identify potential marketing strategies for the introduction of the disease-resistant tree. On average, survey respondents indicated they are willing to pay a \$13.35 premium for a flowering dogwood tree which is resistant to powdery mildew. Regression results led to inferences that the presence of dogwoods in a respondent's yard, presence of dogwoods infected with powdery mildew in a yard, landscape expenditures, presence of flower beds, landscape satisfaction, criteria for selecting plants and trees, retail outlets where respondents shop for landscape materials, geographic location, and income had significant effects on the WTP. Marketing implications include the need to provide information at the point of sale, to place the trees near flowering plants at outlets, and to interact with shoppers to determine characteristics of their yards.

Key Words: contingent valuation, disease resistance, dogwood, marketing, maximum likelihood, nursery, powdery mildew

Flowering dogwoods are popular ornamental trees in American landscapes. Home-owners, new home builders, and professional landscapers have found this tree desirable due to its bright spring flowers and fall foliage. U.S. wholesale sales of flowering deciduous trees in 1998 were over \$293 million, with dogwood sales accounting for more than \$24 million of this total (U.S. Department of Agriculture, 2001).

Powdery mildew (*Microsphaera pulchra*) is a fungal disease affecting flowering dogwoods (*Cornus florida*). Symptoms include disfigured leaves, stunted plant growth, limited flowering, and dead branches. Ultimately, powdery mildew can cause plant health decline and death. An infected tree is also more likely to develop insect, pest, and drought stress problems. Powdery mildew is difficult to control. Prevention and cure require repeated fungicide applications to maintain disease-free plants (Windham and Witte, 1998).

The disease increases growing and marketing costs for flowering dogwood nursery stock producers and distributors. Additional costs are primarily due to the increased number of fungicide applications and the loss of trees. Based on 1984 data (the most recent available), the estimated cost of pest and disease control during production of one acre of dogwoods was \$290 over a three-year period (Badenhop, Witte, and Glasgow, 1985). For 2000, this cost estimate rose to \$1,075 per acre, with the increase largely due to powdery mildew (Trigano, 2001).

The demand for flowering dogwoods is adversely affected by powdery mildew. As awareness of the disease increases, landscape architects and designers are apt to substitute other ornamental trees, such as the redbud, in place of a susceptible flowering dogwood which may contract powdery mildew. Homeowners seeking to add new flowering trees or replace diseased dogwoods are likely to choose substitute ornamental trees as well. Controlling for powdery mildew requires applications of fungicides which increase the total cost of purchasing and owning a flowering dogwood.

Three new dogwood varieties that are resistant to powdery mildew have recently been identified. The feasibility of introducing these resistant trees depends to a large extent on consumer acceptance. Since the patented trees are not commercially available, and growers require some indication of the demand before they are likely to produce the trees, estimates are needed of the value consumers place on the disease-free trees.

This article describes a study of consumers' willingness to pay (WTP), in urban areas in Tennessee, Mississippi, and Michigan, for a powdery mildew resistant tree. The objectives of the study were to: (a) estimate WTP for the new tree; (b) estimate WTP as a function of a homeowner's landscape characteristics, knowledge of tree and shrub pest and disease problems, and socioeconomic measures; and (c) develop marketing implications based on these estimates.

Methodology

Willingness to Pay

It was assumed the consumer would derive more utility from and spend less maintaining the resistant tree, and therefore would be willing to pay more for the tree. There has been much debate in the literature as to how a survey should ask the WTP question (e.g., Bishop and Heberlein, 1990; Whittington et al., 1990; Mitchell and Carson, 1989; Rowe, Schulze, and Breffle, 1996).

In a bidding game, a price, called a bid, is given, and the respondent is asked if he or she would pay more or less than this price. This question can be followed either with an inquiry as to how much more or less the respondent is willing to pay, or with subsequent bids. An alternative is the bidding card method in which prices for similar goods or services are placed on the card for reference points. A problem arises, however, when there is price variation among retailers, making it difficult to create a single reference price setting. Both methods may cause a starting-point bias (Bishop and Heberlein, 1990).

Strategic bias occurs when a respondent, in an attempt to increase the likelihood that a good will be brought to market, will overstate his or her WTP (e.g., Whittington et al., 1990; Mitchell and Carson, 1989). With respect to dogwoods and powdery mildew, there is little for the individual to gain from acting strategically, and no one individual could influence the survey, just as a single individual cannot influence the market.

Range bias is likely to occur when the payment card range is either too large or too small. The respondents might not find their actual WTP within the specified range if it is too small, thus affecting the WTP mean and standard deviation (Rowe, Schulze, and Breffle, 1996, p. 181). Examining the distribution of WTP could reveal these biases. There may be a problem if the upper or lower tails contain a large number of observations or if there is a tendency for respondents to pick the middle value (a centering bias).

A respondent's WTP also could be affected by substitutes and complements (Cummings, Ganderton, and McGuckin, 1994; Hoehn, 1991; Hoehn and Loomis, 1993; Kahneman and Knetsch, 1992). To the extent they are systematically omitted from the decision-making process, estimates of the WTP would be biased.

Informational Display Materials

An informational display was designed for use in a booth at home and garden shows. The objective of the display was to inform some visitors, and remind others, of the powdery mildew problem. A brief, nontechnical explanation of the disease, presented in large, easy-to-read text, helped visitors understand the powdery mildew problem quickly. Pictures in the display booth served as visual aids to depict the effects of powdery mildew. These included a large flowering dogwood in full bloom, a close-up of healthy dogwood leaves, and a close-up of diseased flowering dogwood leaves. The display materials were intended to enable people to identify powdery mildew on their own flowering dogwoods. Master Gardeners¹ or State Extension personnel were available at the booth to answer questions.

After viewing the information materials presented, visitors were asked to fill out a questionnaire and drop it in a box beside the display. The four specific home and garden shows comprising our survey sites were selected for several reasons: (a) availability of booth space, (b) geographic dispersion, and (c) availability of local staff to conduct the survey.

The Questionnaire

The questionnaire consisted of three parts: (a) a WTP setting; (b) landscape questions, which gathered data on the type of yard, landscape elements present in the yard, and respondent's awareness and knowledge about tree and shrub diseases and pests;

¹ Master Gardeners are volunteers who have taken part in Extension Service horticulture training—i.e., 35 hours of horticulture Extension instruction (e.g., refer to Sams, 1997).

and (c) demographic questions which elicited socioeconomic data about the respondents.²

A statement to create the WTP setting was placed at the top of the questionnaire. The respondent was asked to assume that his or her favorite retailer was selling dogwood trees of uniform size in a standard five-gallon container; the trunks were one inch in diameter, and the tree height was five feet.

The first question asked the respondent how much *more* he or she was willing to pay for an identical dogwood tree, except this tree was resistant to powdery mildew. The respondent was then provided a range of values, starting at \$0 and ending at \$30, increasing by \$1 increments with \$5 multiples noted below the number line. Although not stated in the survey, the range was based on an expected price of a nonresistant dogwood tree being between \$50 and \$100, depending on the type of retailer. In this way the range was designed to cover the likely range of responses (Cameron and Hupert, 1989). In addition, the range adopted for the survey was designed to cover any additional production-related costs, such as learning how to work with a new variety, providing a return to the Experiment Station that developed the trees, and the administrative cost of a certification program.

The use of a range, as opposed to specific reference and alternative prices, was to minimize two possible biases: a starting-point bias (e.g., Bishop and Heberlein, 1990) and a range bias (e.g., Rowe, Schulze, and Breffle, 1996). A substitution bias (Cummings, Ganderton, and McGuckin, 1994; Hoehn, 1991; Hoehn and Loomis, 1993; Kahneman and Knetsch, 1992) was not considered to be a factor because alternative landscape trees were promoted where the sampling took place.

In the second section of the questionnaire, most questions prompted the respondent to check items from a list or to rank items in a list. These items were designed to identify the characteristics of the respondent's landscape, expenditures on landscaping, knowledge of landscaping, criteria for selecting trees and shrubs, where landscape stock was purchased, opinions about quality of plants purchased, and opinions about pesticide use.

The socioeconomic measures which were gathered reflected trade-offs among the length of the questionnaire, time required for completion, and a desire to obtain data on both landscape and respondent characteristics. An additional consideration was an interest in avoiding too few observations in some response categories by trying to elicit too much detail from a limited sample. The socioeconomic information gathered included home ownership, age, gender, and income before taxes.

Modeling the WTP

The additional price a respondent is willing to pay for a powdery mildew resistant flowering dogwood is the dependent variable which is considered to be a function of measures associated with responses to other questions in the survey. WTP is

² A copy of the questionnaire is available from the authors upon request.

assumed to be normally distributed. The limited payment range of \$0 to \$30 represents a double-censored variable. A reported WTP of an additional \$30 for the resistant tree could mean one of two things: the respondent was willing to pay a premium of exactly \$30, or he or she would pay more than \$30. In contrast, a reported WTP of \$0 could mean the respondent was not willing to pay a premium in this situation, he or she would never pay more in any situation, or the person would pay less to compensate for the risk that the new variety could develop other problems.

Results

A total of 610 questionnaires (147 from Knoxville, Tennessee; 269 from Nashville, Tennessee; 132 from Detroit, Michigan; and 62 from Jackson, Mississippi) were completed in the spring of 2000. The Master Gardeners staffing the booths at the four home and garden shows did not report any data on the number of people asked to complete a questionnaire; therefore, the actual response rate is unknown. Descriptions of the data and univariate and pairwise tests of independence among responses to the questions are available elsewhere (for this information, refer to Klingeman et al., 2001).

The emphasis of the discussion below is to examine characteristics of the respondents, landscape characteristics, and awareness and knowledge of disease and pest problems. Missing responses to some of the questions by some respondents resulted in a reduction in sample size to 472 observations for the regression analysis.

Descriptive Statistics

Descriptive characteristics of the survey respondents are reported in table 1. These characteristics are typical of individuals expected to attend home and garden shows, and are similar to those found in other surveys of landscape plant buyers (e.g., Safley, Wohlgenant, and Rezitis, 2000; Barton et al., 1998; Hudson et al., 1997; Hardy et al., 2000). Almost all of those surveyed were homeowners, with the percentage of respondents who owned their own homes ranging from 92% in Knoxville to 98% in Jackson.

The typical respondent had a higher income than the median income for the population of the respective state. The median incomes in the four samples were \$60,500 for Knoxville, \$67,250 for Nashville, \$69,750 for Detroit, and \$63,750 for Jackson. In contrast, the median 1999 incomes in Tennessee, Michigan, and Mississippi were \$36,536, \$46,238, and \$32,450, respectively (U.S. Bureau of the Census, 2000). Given the costs of owner-occupied housing, the prevalence of higher income respondents was not unexpected.

Respondents were generally older than the corresponding census population. The median ages of respondents in the four samples were 50.7, 49.8, 53.2, and 51.1 for Knoxville, Nashville, Detroit, and Jackson, respectively, versus median population ages for the metropolitan statistical areas (MSAs) of 37.3 in the Knoxville MSA, 34.5 in the Nashville MSA, 35.5 in the Detroit MSA, and 33 in the Jackson MSA.

Table 1. Descriptive Characteristics of Survey Respondents Attending Four Home and Garden Shows in 2000

Characteristic	Knoxville, Tennessee	Nashville, Tennessee	Detroit, Michigan	Jackson, Mississippi
Number of respondents	147	269	132	62
Home ownership (%)	92	95	94	98
Median income of respondents	\$60,500	\$67,250	\$69,750	\$63,750
Median income for state ^a	\$36,536	\$36,536	\$46,238	\$32,450
Median age of respondents (years)	50.7	49.8	53.2	51.1
Median age for MSA (years) ^b	37.3	34.5	35.5	33.0
Has existing dogwood in landscape (%)	86	80	47	72
Powdery mildew present in landscape (%)	16	29	7	16
Average annual landscape expenditures ^c	\$886	\$1,058	\$973	\$552

^aSource: U.S. Bureau of the Census (2000), "Median Household Income by State: 1994 to 1999."

^bSource: U.S. Bureau of the Census (2001a,b,c), "Profiles of General Demographic Characteristics: Census of Population and Housing" for Michigan, Mississippi, and Tennessee, respectively.

^cAmong respondents who reported they had landscape expenditures during 1999.

(U.S. Bureau of the Census, 2001a,b,c). An older age distribution for the sample versus the population is consistent with the need to accumulate sufficient savings to at least make the down payment on a housing unit.

The majority of respondents in the three southern areas already had dogwoods in their landscapes (86% in Knoxville, 80% in Nashville, and 72% in Jackson). In Detroit, 47% of respondents indicated the presence of dogwoods in their landscapes. This pattern seems reasonable because dogwoods are more suited to warmer climates.

At least 63% of the respondents in each city revealed they had some pest or disease problems with the dogwoods in their landscapes. The presence of powdery mildew was reported by 16% of Knoxville respondents, 29% in Nashville, 7% in Detroit, and 16% in Jackson. Their differences are statistically significant (Klingeman et al., 2001). The low occurrence of powdery mildew in Detroit is likely a result of that city's colder climate, since powdery mildew survives better in warmer climates (Windham, 2001).

Respondents were asked to estimate their annual expenditures in 11 yard-related categories. These were summed by respondent to obtain an estimate of a household's overall landscape expenditures. As observed from table 1, the average annual expenditure per yard ranged from a low of \$552 in Jackson to a high of \$1,058 in Nashville.

A variety of other factors may have influenced WTP for powdery mildew resistant dogwoods. The type of outlet where a respondent purchased trees could be related to WTP. With respect to dogwoods, other components of the consumer's price are transportation costs and time involved in shopping, acquiring information, and caring for the tree. Consequently, market price variation across outlets is consistent with differences in consumers' WTP for resistant trees.

Table 2. Survey of Respondents Attending Four Home and Garden Shows in 2000: Reasons Given for Selecting Trees for Landscape Use (percent)

Selection Factor	Knoxville (n = 147)	Nashville (n = 269)	Detroit (n = 132)	Jackson (n = 62)	Combined (n = 610)
Size/shape ^a	51	48	61	40	51
Ease of maintenance	47	43	44	42	45
Attracts birds/animals	37	31	38	32	34
Flower color	30	35	32	37	33
Flowering season	35	31	32	35	32
Disease resistance	20	22	24	23	22

^aThe size/shape selection factor was significantly different across cities at the 0.5 level ($P^2 = 8.67$).

Independent garden centers, retail chains, nurseries, and mail order businesses were the retail outlets used most frequently by respondents in all four cities. Some people (Knoxville 16%, Nashville 24%, Detroit 33%, and Jackson 13%) stated they purchased landscape plants from farm markets or truck stands. Respondents typically reported that the quality of landscape plants purchased was good, regardless of the type of retail outlet.

Over half of the respondents (Knoxville 54%, Nashville 58%, Detroit 64%, and Jackson 50%) had annual flower beds in their landscapes. Asked if they were content with their landscapes, the percentages of survey participants affirming satisfaction were Knoxville 32%, Nashville 41%, Detroit 52%, and Jackson 43%.

Respondents were asked to indicate why they chose landscape trees (table 2). Of particular interest to this study was disease resistance, which was cited as important by 22% of all respondents. The top five reasons for selecting trees were reported as size/shape (51%), ease of maintenance (45%), attracts birds/animals (34%), flower color (33%), and flowering season (32%).

Willingness to Pay

The goal of estimating the regression equation was to identify determinants of respondents' WTP more for the resistant flowering dogwood. Figure 1 shows the distribution of WTP, the dependent variable, by percentage of respondents. Only eight respondents indicated they would not pay more for the resistant tree. Forty-five respondents (7%) did not answer the WTP question. Less than 10% (56 respondents) indicated they would pay \$30 or more for the resistant tree.

Nonresponses to the WTP question were treated as responses of \$0 in order to avoid a bias (Edwards and Anderson, 1987; Wang, 1997). The assumption is that a nonresponse reflects one of three possibilities. First, the respondent considered the problem to be unimportant. Second, the two trees in question were so similar that the respondent could not determine a WTP, which is the same as a WTP of \$0. Third, the individual may have felt a discount was needed in order to purchase a new variety.

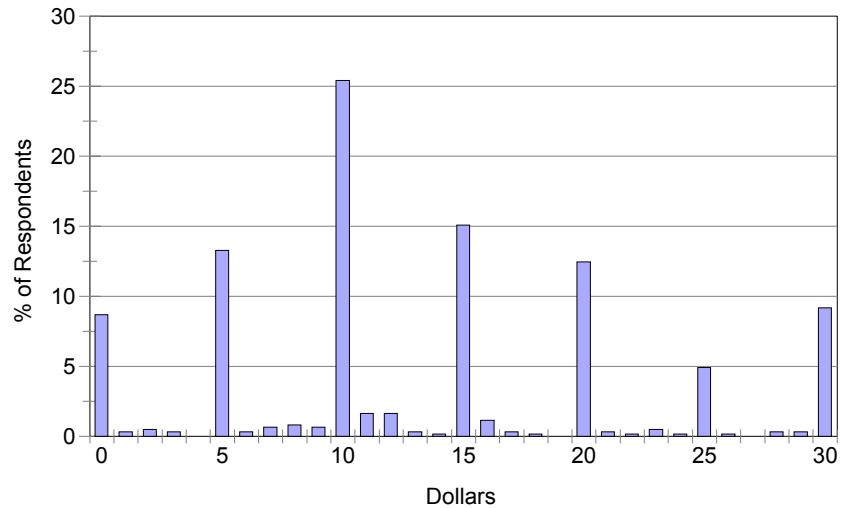


Figure 1. Survey respondents attending four home and garden shows in 2000: Distribution of respondents' WTP

There was a tendency for responses to cluster in multiples of five dollars. The clustering of responses in \$5 increments may reflect two possibilities. First, these amounts were shown on the number line. Second, many respondents may have been more comfortable making decisions in \$5 multiples. The mean and standard deviation were \$13.35 and \$8.43, respectively, while the most common response was \$10. Respondents could only indicate WTP amounts in integers. However, the dependent variable was considered to be continuous because, if the resistant flowering dogwood was available on the market, it would not have to be priced in dollar increments.

The WTP analysis shows some tendency for the WTP amount to be normally distributed with respect to the \$5 increments, as reflected in the symmetric and unimodal distribution shown in figure 1. Furthermore, the tails do not contain large proportions of the responses, suggesting the range used was appropriate. A centering bias does not appear to be present, because the mean is below \$15.³

Estimation and Final Regression Model

Estimation focused on finding the best overall fit (the greatest maximum likelihood). Often, when estimating an equation, it is important to determine marginal effects of each variable when all others are held constant. Because only one variable in the model is not binary (landscape expenditure), marginal effects are not presented. In addition, the marginal effect of any one variable is dependent upon the relative level of the other variables, and thus comparison is difficult.

³ The truncation at \$0 and \$30 precluded testing for normality.

The binary coding of most of the independent variables suggested that multicollinearity would be a problem if a regression was estimated using all of the independent variables. Consequently, a sequential approach was taken. Initially, regressions of the WTP on each individual variable were estimated. Variables having insignificant coefficients were not considered in subsequent estimations. Regressions of combinations of significant independent variables from the simple regressions were estimated. Equations were compared on the basis of their log-likelihood values, with the objective of finding the set of variables that generated the largest log-likelihood value.

Table 3 provides the set of variables used in the final regression. The equation which generated the highest log likelihood is detailed in table 4. The computed P^2 (75.524) leads to the inference of a significant overall fit.

The presence of a dogwood in the landscape significantly decreased the WTP. This finding suggests that consumers who already own a dogwood tree were not likely to purchase another, and were therefore unwilling to express a higher value for a disease-resistant tree. However, if the dogwood had powdery mildew, then the respondent was willing to pay more for the resistant tree.

The dollar amount spent on landscaping, as expected, had a significant positive effect on the WTP.

The presence of annual flower beds in the landscape had a significant positive coefficient. This could be interpreted as a reflection of the tastes and preferences of the respondents. Flowering dogwoods are most noteworthy for their spring blooming season. Respondents who placed a high value on flower beds were likely to have appreciated a dogwood in full bloom, thus explaining the positive coefficient. The respondents who were content with their landscapes were willing to pay significantly less for the resistant tree.

Among reasons given by respondents for selecting landscape trees, two were statistically significant: disease resistance and fruit. As shown in table 4, disease resistance had a significant positive coefficient. People who were concerned about disease resistance were willing to pay more. Respondents who were interested in fruit trees were willing to pay less for the resistant tree.

The questionnaire contained a list of eight sales outlets, and respondents were asked to check those they used to purchase landscape plants. These outlet categories were denoted as follows: retail chain, landscaper/contractor, farm market/truck stand, independent/specialty garden center, mail order catalog, grocery, direct from nursery, and other. Responses were coded to indicate whether the respective outlet was used (0 = not used, 1 = used). Each was included in the initial regressions, and only the farm market/truck stand outlet was found to be significant. Therefore, this coefficient is interpreted versus all other outlets. Farm markets/truck stands are generally less expensive, and thus the WTP a premium for disease resistance was lower.

The city in which the survey was conducted had a significant effect on the WTP. Nashville, Knoxville, and Detroit all had positive effects on the WTP versus Jackson residents. The inference is that respondents in Jackson were less likely to pay more for the resistant tree.

Table 3. Survey Respondents Attending Four Home and Garden Shows in 2000: Characteristics of Variables Used in Maximum-Likelihood Estimation

Variable	Measurement Unit	Mean
WTP for resistant dogwood	Dollars (\$)	\$13.35
Presence of dogwood in landscape	Binary: 0 = No, 1 = Yes	0.74
Presence of powdery mildew in dogwoods	Binary: 0 = No, 1 = Yes	0.20
Sum of annual landscape expenditures	Dollars (\$)	\$803.36
Presence of annual flower bed in landscape	Binary: 0 = No, 1 = Yes	0.57
Satisfied with landscape	Binary: 0 = No, 1 = Yes	0.41
Select landscape trees based on disease resistance	Binary: 0 = No, 1 = Yes	0.22
Select landscape trees based on fruit	Binary: 0 = No, 1 = Yes	0.10
Shop for landscape plants, shrubs, and trees from farm market/truck stand	Binary: 0 = No, 1 = Yes	0.23
Knoxville, Tennessee	Binary: 0 = No, 1 = Yes	0.24
Nashville, Tennessee	Binary: 0 = No, 1 = Yes	0.44
Detroit, Michigan	Binary: 0 = No, 1 = Yes	0.22
Annual household income of \$125,000 or more	Binary: 0 = No, 1 = Yes	0.10

Table 4. Survey Respondents Attending Four Home and Garden Shows in 2000: Estimated Regression Equation

Variable	Coefficient*	Std. Error
Constant	10.5909	1.6569
Presence of dogwood in landscape	! 2.7932	1.0366
Presence of powdery mildew in dogwoods	2.2491	1.0763
Sum of annual landscape expenditures	0.0007	0.0002
Presence of annual flower bed in landscape	2.6291	0.8512
Satisfied with landscape	! 2.7693	0.8603
Select landscape trees based on disease resistance	3.9121	1.0051
Select landscape trees based on fruit	! 2.7873	1.3031
Shop for landscape plants, shrubs, and trees from farm market/truck stand	! 2.4420	0.9771
Knoxville, Tennessee	4.1079	1.6369
Nashville, Tennessee	3.0298	1.5186
Detroit, Michigan	3.9564	1.9631
Annual household income of \$125,000 or more	2.9654	1.4121
Log Likelihood = ! 1,521.753		
P ² = 75.524*		
Sample size = 472		

*All coefficients are statistically significant at the .05 level.

Six income categories were provided in the questionnaire: less than \$25,000, \$25,000–\$49,999, \$50,000–\$74,999, \$75,000–\$99,999, \$100,000–\$124,999, and \$125,000 or more. The lowest (<\$25,000) was the omitted income category in the initial regressions. All income categories had insignificant coefficients, except for the highest (\$125,000 or more). If the respondent had a household income of more than \$125,000 a year, then he or she would be more likely to pay more for the resistant tree versus respondents in the other income categories. This result, combined with the significant farm market/truck stand coefficient, reveals that consumers' WTP for the resistant dogwood changes with the market price—i.e., the demand curve for the resistant tree lies above the one for the traditional dogwood, but they are not parallel.

Marketing Implications

Results suggest that, when compared to an identical flowering dogwood tree, consumers were willing to pay on average \$13.35 more for a flowering dogwood tree which is resistant to powdery mildew. The most frequently circled price premium was \$10. A WTP response in the context of this study represents an upper bound on the premium because: (a) no payment occurred, (b) respondents were drawn from people attending home and garden shows, and (c) information about the disease was presented to survey participants prior to completing the questionnaire. This premium represents a valuation at the end of the distribution channel. Therefore, it cannot be added at each stage. It must be shared, resulting in a total from the nursery to the consumer of \$13.35 or less.

The significance of the farm market/truck stand coefficient suggests the WTP varies. To the extent this type of outlet is patronized by lower income consumers, the results also suggest lower income consumers have lower WTP. However, a separate chi-squared analysis led to the inference that the income category of the respondent was independent of each outlet type, with the exception of landscaper/contractor, where higher income respondents tended to use this outlet. This outlet venue was insignificant in the regressions, however.

Nurseries, wholesalers, and retailers can use these results in developing marketing plans. Among the considerations are the specific points noted below.

- People who attend home and garden shows are likely to be representative of the target market of flowering dogwood purchasers. These individuals were older, in higher income brackets than the population as a whole, and interested in their yards. Whether homeowners who have dogwoods in their landscapes may be willing to pay more for a resistant tree depends on whether their current yard trees have the disease and whether they are satisfied with their landscapes. Individuals who spent more on landscaping were willing to pay more for a resistant dogwood. Based on these factors, a helpful marketing strategy for retailers would be to instruct employees to get to know their customers and their spending patterns, and target these customers when marketing resistant flowering dogwoods. Promotional materials (e.g., direct mail,

newspaper inserts) should be focused on explanations of the disease and easy ways for people to recognize the problem in dogwoods in their landscapes. The distributional emphasis of the materials should be primarily in higher income neighborhoods.

- Several location-related factors emerged in the survey results. Based on the relationship between perennial flower beds and increased WTP, retailers could place resistant flowering dogwood displays near perennial flower displays. Survey respondents who selected landscape trees based on disease resistance were willing to pay more for a resistant flowering dogwood. An implication is that information about powdery mildew and the resistant tree should be provided at the point of sale. This display should consist of pictures and nontechnical explanations, much like the display materials used in conjunction with the survey described here.
- Consumers who are in the market for fruit trees are willing to pay less for a resistant flowering dogwood tree. This relationship is consistent with the possibility of substituting another type of flowering tree. This finding suggests care must be taken in the pricing of the resistant tree. The price should reflect consumers' valuation of powdery mildew, but not be so high as to cause substitution of other flowering trees.
- People are willing to pay a smaller premium when purchasing disease-resistant flowering dogwoods from farm markets and truck stands. The lower price, however, does not necessarily mean these retailers should avoid stocking disease-resistant flowering dogwoods. There are at least three reasons for the lower WTP. First, these outlets may have a lower price level in general, and therefore WTP a premium for a disease-resistant tree may be less. Second, this type of retail outlet may attract buyers who pay lower purchase prices but are willing to pay higher opportunity costs, such as travel cost to the point of sale and tree maintenance. Third, consumers may feel there is more risk when buying from this type of retailer.
- The premium that respondents were willing to pay varied by city. Respondents in Nashville, Knoxville, and Detroit indicated they were willing to pay more for a disease-resistant tree than those in Jackson, Mississippi. This finding could be the result of a lower price level, and does not mean retailers in Jackson should avoid resistant flowering dogwood stock.
- Finally, the patented flowering dogwood trees may be more expensive to source for nurseries. But, in addition to a higher WTP at retail, there may be reductions in nursery production costs. Nursery growers producing resistant flowering dogwoods may be able to reduce the investment in both chemicals and labor to control powdery mildew.

References

- Badenhop, M. B., W. T. Witte, and T. E. Glasgow. (1985). "Production systems and costs for producing balled and burlapped trees of dogwood cultivars." Bulletin No. 637, Tennessee Agricultural Experiment Station, University of Tennessee, Knoxville.
- Barton, S. S., J. R. Brooker, C. R. Hall, and S. C. Turner. (1998, June). "Review of customer preference research in the nursery and landscape industry." *Journal of Environmental Horticulture* 16(2), 118–124.
- Bishop, R. C., and T. A. Heberlein. (1990). "The contingent valuation method." In R. L. Johnson and G. V. Johnson (eds.), *Economic Valuation of Natural Resources: Issues, Theory, and Applications* (pp. 81–104). Boulder, CO: Westview Press.
- Cameron, T. A., and D. D. Huppert. (1989). "OLS versus ML estimation of non-market resource values with payment card interval data." *Journal of Environmental Economics and Management* 17, 230–246.
- Cummings, R. G., P. T. Ganderton, and T. McGuckin. (1994, May). "Substitution effects in CVM values." *American Journal of Agricultural Economics* 76, 205–214.
- Edwards, S. F., and G. D. Anderson. (1987, May). "Overlooked biases in contingent valuation surveys: Some considerations." *Land Economics* 63(2), 168–178.
- Hardy, J., B. K. Behe, S. S. Barton, T. J. Page, R. E. Schutzki, K. Muzii, R. T. Fernandez, M. T. Haque, J. Brooker, C. R. Hall, R. Hinson, P. Knight, R. McNiel, D. B. Rowe, and C. Safley. (2000, December). "Consumer preferences for plant size, type of plant material, and design sophistication in residential landscaping." *Journal of Environmental Horticulture* 18(4), 224–230.
- Hoehn, J. P. (1991, May). "Valuing the multidimensional impacts of environmental policy: Theory and methods." *American Journal of Agricultural Economics* 73, 289–299.
- Hoehn, J. P., and J. B. Loomis. (1993). "Substitution effects in the valuation of multiple environmental programs." *Journal of Environmental Economics and Management* 25, 56–75.
- Hudson, J. T., B. K. Behe, H. G. Ponder, and W. E. Barrick. (1997, March). "Consumer perceptions and expectations of garden center product and service quality." *Journal of Environmental Horticulture* 15(1), 12–15.
- Kahneman, D., and J. L. Knetsch. (1992). "Valuing public goods: The purchase of moral satisfaction." *Journal of Environmental Economics and Management* 22, 57–70.
- Klingeman, W. E., J. R. Brooker, D. B. Eastwood, B. K. Behe, J. R. Riley, and P. Knight. (2001, November). "Consumer perceptions of landscape characteristics, disease and pest problems, and the value of powdery mildew resistant dogwoods." Research Series Report No. 07-01, Department of Agricultural Economics, University of Tennessee, Knoxville.
- Mitchell, R. C., and R. T. Carson. (1989). "Measurement bias." In *Using Surveys to Value Public Goods: The Contingent Valuation Method* (pp. 231–259). Washington, DC: Resources for the Future.
- Rowe, R. D., W. D. Schulze, and W. S. Breffle. (1996). "A test for payment card biases." *Journal of Environmental Economics and Management* 31, 178–185.
- Safley C. D., M. K. Wohlgenant, and A. N. Rezitis. (2000, January). "Economic and socioeconomic factors affecting consumer purchases of fall nursery products." ARE Report No. 19, NCCES/NCAN/NCDACS, North Carolina State University, Raleigh.

- Sams, D. (1997, February). "Introduction." In *Tennessee Master Gardener Handbook*. Pub. No. PB-1578, Agricultural Extension Service, University of Tennessee, Knoxville.
- Trigano, R. N. (2001). Professor, Entomology and Plant Pathology, University of Tennessee, Knoxville. Unpublished data, per acre cost of pest and disease control for dogwoods.
- U.S. Bureau of the Census. (2000). "Median household income by state: 1984 to 1999." Online. Available at <http://www.census.gov/hhes/income/histinc/h08.html>. [Accessed June 21, 2001.]
- . (2001a, May). "Profiles of general demographic characteristics: 2000 Census of Population and Housing, Michigan." 2kh26.pdf. Online. Available at <http://www.census.gov/prod/cen2000/index.html>.
- . (2001b, May). "Profiles of general demographic characteristics: 2000 Census of Population and Housing, Mississippi." 2kh28.pdf. Online. Available at <http://www.census.gov/prod/cen2000/index.html>.
- . (2001c, May). "Profiles of general demographic characteristics: 2000 Census of Population and Housing, Tennessee." 2kh47.pdf. Online. Available at <http://www.census.gov/prod/cen2000/index.html>.
- U.S. Department of Agriculture. (2001). *1998 Census of Horticultural Specialties*. USDA, Washington, DC.
- Wang, H. H. (1997). "Treatment of 'don't-know' responses in contingent valuation surveys: A random valuation model." *Journal of Environmental Economics and Management* 32, 219–232.
- Whittington, D., J. Brisco, X. Mu, and W. Barron. (1990, January). "Estimating the willingness to pay for water services in developing countries: A case study of the use of contingent valuation surveys in southern Haiti." *Economic Development and Cultural Change* 38, 293–311.
- Windham, M. T. (2001, October 17). Professor, Entomology and Plant Pathology, University of Tennessee, Knoxville. Personal communication regarding powdery mildew and climate.
- Windham, M. T., and W. T. Witte. (1998, September). "Naturally occurring resistance to powdery mildew in seedlings of *Cornus florida*." *Journal of Environmental Horticulture* 16(3), 173–175.