Risk Preferences in Tree Purchases under Pest Threat:
Case of Flatheaded Borer Damage

Benjamin Campbell   Samyam Shrestha

Abstract

This study explores factors associated with consumers' risk attitudes toward purchasing trees under pest threat, focusing on flatheaded borers, significant wood-boring pests of ornamental and orchard trees in the United States. Using a nationally representative online survey, respondents reported the maximum acceptable probability of pest damage they would tolerate when purchasing trees across different severity levels. Based on these responses, we use cluster analysis to group individuals into three risk types: risk averse, risk neutral, and risk takers. We then estimate a multinomial logit model to examine the sociodemographic and experiential determinants of membership in each risk group. Results show that risk aversion is more common among older respondents, racial minorities, and those without ties to agriculture, while risk-taking attitude is associated with larger household size, and certain regional locations. These findings offer insights into how diverse consumer segments perceive pest-related risk and can inform marketing, extension, and outreach strategies in the nursery and landscape industries.

Keywords: Risk preferences, consumer behavior, tree purchasing, pest risk, flatheaded borers, cluster analysis

JEL codes: D12, D81, Q10

1. Introduction

Flatheaded borers are wood-boring beetles that attack economically important trees, including both established and newly transplanted landscape specimens, nursery-grown commercial trees, fruit-producing shrubs and trees, and silvicultural trees grown for timber and nut production. Some species, such as the flatheaded apple tree borer (*Chrysobothris femorata*), are widely distributed across the United States, while others, including the Pacific flatheaded borer (*Chrysobothris mali*) and the goldspotted oak borer (*Agrilus auroguttatus*), are more regionally concentrated in the western United States.

These pests rank among the most significant concerns in managed tree systems due to both the severity of damage and the difficulty of detection and control. Over the past decade, flatheaded borers have become increasingly problematic across nurseries, urban landscapes, and fruit and nut production systems. Their attacks can cause severe physical symptoms, including trunk scarring, bark splitting and shedding, sap leakage, crown dieback, and tree death. Even when trees survive an infestation, damage may reduce marketability in nurseries, lower yields in orchards, and increase vulnerability to future stressors like drought or trunk failure.

The economic stakes are considerable: in nursery systems alone, trunk scarring, canopy dieback, or bark splitting caused by borer infestations can significantly reduce tree market value or make them unsuitable for sale. For example, even mild damage to tree trunks may disqualify plants from retail markets or lead to costly reclassification to lower-value grades (Purcell and Ling, 2019). In fruit and nut orchards, persistent infestations may reduce yields, stunt growth, and shorten orchard lifespans, further increasing production costs and replanting frequency. These economic pressures underscore the importance of understanding consumer sensitivity to pest threats, particularly when planting decisions involve visible or structural damage risk.

While most existing research on flatheaded borers has focused on their biology, spread, and control (Coleman and Seybold, 2011; Coleman et al., 2011; Seybold and Coleman, 2015), relatively little is known about how consumers, particularly non-specialist buyers of trees for residential or landscaping purposes, respond to the threat of pest infestation. Understanding consumer responses is particularly important for nurseries, landscapers, and policymakers, as public demand can shift based on perceived risks even in the absence of observable pest symptoms. Tree buyers, ranging from municipalities to individual homeowners, are often faced with limited information about pest risks and little guidance on how to weigh potential damage when making purchasing decisions. Understanding how consumers navigate this uncertainty is critical, particularly as biosecurity threats and climate stressors intersect to increased vulnerability across managed landscapes.

This paper examines how risk perceptions influence consumer decisions to purchase trees under pest threat. Using a nationally representative online survey, we asked respondents whether they would find it acceptable to purchase trees under varying levels of pest damage severity. Based on their responses, we classify individuals into three behavioral risk types, and examine the sociodemographic and experiential factors associated with membership in each group.

Our results show that respondents' willingness to purchase trees under pest risk varies with demographic and experiential characteristics. Using cluster analysis, we identify three distinct consumer types, including risk averse, risk neutral, and risk takers, based on how they respond to varying probabilities of flatheaded borer damage. We find that risk aversion is more common among older respondents, racial minorities, and those without ties to agriculture, while risk tolerance is associated with higher educational attainment, more children in the household, and residence in New England. These findings contribute to the growing literature on consumer behavior under biological risk by providing new evidence that pest-related purchasing decisions are shaped by broader sociodemographic and experiential differences. The results have important implications for nursery marketing, extension programs, and risk communication strategies aimed at diverse consumer segments.

Our study contributes to a growing literature on behavioral responses to biosecurity and pest threats (Finnoff et al., 2007; Epanchin-Niell & Wilen, 2012), as well as research on consumer decision-making in horticultural and landscape contexts (Tourte and Gaskell, 2004; Yue & Behe, 2008; Hall et al., 2010; Boumaza et al., 2010; Yue et al., 2011; Bradley et al., 2017). It also connects to broader work in environmental and agricultural economics that explores how individual risk preferences shape willingness to accept uncertain outcomes (Gupta et al., 2004; Lusk and Coble, 2005; Barhal et al., 2014; Bocquého et al., 2014; Gong et al., 2016; Cerroni, 2020). By focusing on consumer behavior under pest-related uncertainty, this study provides insight into the types of individuals who are more or less sensitive to biological risks, and the factors that predict such variation.

We begin by providing background on flatheaded borers. We then present a simple theoretical framework for tree purchase decisions under pest risk. We then describe the survey design, and the construction of risk behavior clusters based on respondents' purchasing decisions. Finally, we use multinomial logit regression to examine how demographic and perceptual variables explain cluster membership, and discuss the implications of our findings for nursery marketing, pest communication strategies, and consumer education.

2. Flatheaded Borers

Flatheaded borers (Coleoptera: Buprestidae) represent a major group of wood- and phloem-boring beetles that pose significant risks to both natural forests and managed landscapes across the United States. Larval tunneling through the phloem and outer xylem impairs water and nutrient transport, resulting in canopy decline, sap leakage, and eventual tree death (Coleman et al., 2011; Seybold and Coleman, 2015). Although historically considered secondary pests primarily affecting stressed trees, recent outbreaks have shown that some flatheaded borer species can act as primary drivers of mortality in otherwise healthy hosts (Coleman et al., 2011).

One notable example is the goldspotted oak borer (Agrilus auroguttatus), an indigenous insect from southeastern Arizona and northern Mexico that became invasive in southern California following its introduction around 2004 (Seybold & Coleman, 2015). Since then, the beetle has killed tens of thousands of coast live oak, California black oak, and canyon live oak, reshaping oak woodland ecosystems over thousands of hectares (Coleman et al., 2011).

Flatheaded borers present significant management challenges due to their cryptic life history. Once larvae are established beneath the bark, chemical control options become largely ineffective (Potter & Redmond, 2013). Consequently, current management strategies emphasize preventive approaches, such as maintaining tree health through proper irrigation, minimizing mechanical injury, and in high-value settings, applying systemic insecticides prior to infestation (Potter and Redmond, 2013). However, the use of chemical treatments raises concerns about costs, environmental impact, and public acceptance, particularly in urban environments.

Their Infestations can result in significant economic losses. In nursery production, even minor trunk defects caused by borer feeding can disqualify trees from commercial sale or force their reclassification into lower-value grades (Potter and Redmond, 2013). In forests and rural landscapes, mortality of mature oaks not only reduces timber and aesthetic values but also threatens associated ecosystem services, such as wildlife habitat provision and soil stability (Seybold and Coleman, 2015). Moreover, the loss of canopy cover can increase susceptibility to secondary disturbances, including wildfire and windthrow.

Despite their growing impact, flatheaded borers have received less public attention than invasive pests like the emerald ash borer. Nevertheless, their expanding range and the scale of tree mortality observed in affected areas underscore the urgency of continued monitoring, public education, and development of integrated management strategies tailored to vulnerable tree species and landscapes (Coleman et al., 2011; Seybold & Coleman, 2015).

3. Theoretical Framework of Tree Purchase under Varying Probability of Pest Damage

Consumers differ in their willingness to purchase trees that may experience pest damage. These differences can stem from individual characteristics such as demographics, knowledge and experience of trees and pests, or risk preferences. We capture this heterogeneity in a simple model of consumer decision-making under uncertainty.

Assume that a tree is being sold at price P, and the tree provides value V to the consumer if it remains healthy, representing the perceived benefit or satisfaction from owning an undamaged tree. If the tree suffers pest damage, the utility drops to $V - \delta_s$, where δ_s is the loss in value from pest damage of severity level $s \in \{L, M, H\}$. The probability that the tree will suffer damage is denoted $p \in (0,1)$.

Let each individual i evaluate the expected utility of purchasing the tree as:

$$EU_i = (1 - p) . u(V) + p . u(V - \delta_s)$$

We assume that utility is increasing and concave such that $u' > 0$ and $u'' < 0$, reflecting risk aversion. We assume a constant relative risk aversion (CRRA) utility function, such as $u(c) = \frac{c^{1-r}}{1-r}$, where $r > 0$ is the coefficient of relative risk aversion. This form implies that individuals differ in their willingness to accept uncertain outcomes based on the curvature of their utility.

We assume that the utility of spending the price P on alternative goods is $u(P)$, and the tree is purchased if the expected utility from owning the tree is at least as large as this. In other words, the individual purchases the tree if:

$$EU_i \geq u(P)$$

To bring individual heterogeneity to the forefront, let us rewrite the purchase condition as:

$$(1 - p) . u(V) + p . u(V - \delta_s) \geq u(P)$$

This inequality describes the condition under which an individual chooses to purchase the tree: the expected utility of owning the tree must be at least as great as the utility of spending the same amount on alternatives. If this condition holds, the individual purchases the tree; otherwise, they do not.

Now we introduce a person-specific parameter θ_i, representing individual i's tolerance for pest-related damage risk. This parameter could reflect a mix of preferences and observable traits. We model the utility from purchasing as:

$$U_i = \theta_i . [(1 - p) . (V - P) + p . (V - \delta_s - P)] + \varepsilon_i$$

where, θ_i captures how strongly the individual values tree ownership net of cost, adjusting for damage risk. The term ε_i is the reflect unobserved heterogeneity in preferences, idiosyncratic error, or context-specific shocks to utility. Higher θ_i indicates higher risk tolerance or valuation of the tree, even under pest threat. This leads to a probabilistic choice rule:

$$\Pr(Buy_{is}) = \Pr(U_i \geq 0) = F(\theta_i, p, \delta_s, P)$$

We do not observe θ_i directly, but each respondent in our survey is presented with a series of hypothetical tree-purchasing scenarios that vary by pest damage severity and infestation probability. These choice tasks allow us to observe how willingness to purchase changes across pest risk or damage conditions. In our empirical strategy explained below, we classify individuals into three risk types based on their purchase decisions across pest risk scenarios: risk-averse (those

who purchase trees only under low pest probability or mild damage), risk-neutral (those who purchase under moderate risk conditions), and risk-taker (those willing to purchase even when pest risk is high).

4. Data and Methods

To better understand the role of risk attitudes in tree purchases under pest threat, a nationally representative online survey was conducted in December 2022. The survey included a dedicated section on flatheaded borers, focusing on respondents' knowledge, perceptions, and management preferences.

Specifically, the questionnaire assessed familiarity with flatheaded borers and their symptoms, personal experience with infested trees, pest management practices, and confidence in maintaining landscape plants. It also captured respondents' willingness to purchase trees under varying levels of pest risk, perceived severity of damage, and preferences for alternative landscaping options.

To elicit risk preferences, respondents were presented with hypothetical tree-purchasing scenarios involving different levels of damage severities, categorized as low, moderate, or major. For each scenario, they indicated the highest probability of damage under which they would find acceptable to still consider purchasing the tree, using a scale from 0 to 100. On this scale, 0 indicated that the respondent would find the purchase completely unacceptable under the given pest risk, while 100 indicated that they would find it completely acceptable. The survey also collected standard demographic information and data on household plant-buying behaviors, yard ownership, and decision-making roles related to landscaping and plant care.

After excluding respondents with missing values for key variables in our analysis, the final sample comprised 498 observations. The survey's demographic composition mirrored the U.S. Census estimates for demographic characteristics like median age, education, median household income, and gender. With respect to the representativeness of the sample, female respondents constituted nearly 54% of the survey sample, closely matching the national ratio of 52% (U.S. Census Bureau, 2019b) (Table 1). The median household income of the sample was $62,500 which is similar to the U.S. Census estimate of $62,843 (U.S. Census Bureau, 2019b).

The average age of the respondents was approximately 55 years which is slightly higher than U.S. Census estimates of 38 years of age for the overall U.S. population and slightly lower than the average age of U.S. residents above 18 years of age, the age group that comprises our sample (U.S. Census Bureau, 2019a). The sample average age is conditional on a potential respondent being above 18 years of age. Furthermore, 23% were Gen Z (born after 1996), 13% percent were Millennials (born between 1981 and 1995), 19% percent were Gen X (born between 1965 and 1980), 37% percent were Baby Boomers (born between 1946 and 1964), and 6% percent were from the Silent Generation (born in 1945 or earlier). Geographic state delineation are based on

Bureau of Economic Analysis definitions (Abadi, 2018). The racial composition, education levels, and geographical representation of the sample were also similar to U.S. Census estimates.

To analyze respondents' behavior, we first group individuals into distinct and cohesive categories using cluster analysis, followed by multinomial logit regression to examine the factors influencing cluster membership. Cluster analysis aims to categorize individuals such that the differences within each cluster are minimized while the differences between clusters are maximized (Disdier and van Tongeren, 2010). In our case, where the data are continuous, we use Euclidean distance as the measure of dissimilarity between respondents. Cluster analysis based on Euclidean distance is widely used in agricultural economics, including applications related to food security (Diaz-Bonilla et al., 2000), the identification of countries' negotiation partners in international trade (Bjornskov and Lind, 2002; Costantini et al., 2007), and consumer preferences for product attributes (Campbell et al., 2013), among other topics.

For cluster analysis, we grouped respondents with similar ratings on the survey question, "what is the maximum probability you would find acceptable to purchase a tree that could develop [given level of] flatheaded borer damage?" across the three levels: little, mild, and major. The most common method for identifying the number of clusters involves using a predefined algorithm (e.g., Ward's linkage) to cluster similar individuals and then applying a statistical test (e.g., pseudo-J, pseudo-T-square) to determine the optimal number of segments (Campbell et al., 2013). Ward's linkage was used to cluster the respondents and the Calinski and Harabasz (1974) stopping rule was used to find the optimal number of clusters based on k-means clustering, which, for our sample, is determined to be three. After determining the optimal number of clusters, we used a multinomial logit model to identify which sociodemographic variables may increase/decrease the probability of being in a particular cluster. The multinomial logit model (Greene, 2003) is specified as follows:

$$Prob(Cluster_i = j) = \frac{e^{\beta'_j X_i}}{\sum_{k=1}^{K-1} e^{\beta'_k X_i}}$$

where $Prob(Cluster i = j)$ represents the probability that respondent i belongs to cluster j, K is the total number of clusters, and X_i is a vector of sociodemographic characteristics of individual i. The parameter β is a vector of coefficients that represent log-odds and can be cumbersome to interpret, so we present marginal effects at the sample mean to obtain more meaningful results. For continuous variables, marginal effects provide the change in the probability of being in a specific cluster due to a one-unit change in an explanatory variable. For categorical variables, they represent the change in the probability of being in a specific cluster when the variable changes from the reference category to the category of interest. This approach offers clearer insights into the determinants of cluster membership for both types of variables.

Results

We first present the descriptive statistics on the survey respondents' perceptions on their maximum probability they would find acceptable to purchase a tree that could develop flatheaded borer damage. Table 2 displays statistics for responses to this survey question.

For each damage level scenario, the respondents were asked to rate out of 0-100 on how much they would find it acceptable to purchase the tree. On this scale, 0 indicated that the respondent would find the purchase completely unacceptable under the given pest risk, while 100 indicated that they would find it completely acceptable. This question was asked for three levels of pest probabilities: little, mild, and major. We refer to the respondents' value as probability of purchase.

Table 2 shows that when a tree could develop little level of flatheaded borer, the average probability the respondents find it acceptable to purchase the tree was 23.447 out of 100. Similarly, for trees with a chance of developing mild and major flatheaded borer damage, the probabilities were 12.297 and 0 respectively. All respondents reported that they would not find it acceptable to purchase tree with a chance of developing major levels of the damage.

Cluster Membership

Based on Ward's linkage to cluster the respondents and the Calinski and Harabasz (1974) stopping rule to find the optimal number of clusters based on k-means clustering, we created three clusters categorizing our sample respondents based on their acceptability to purchase a tree that could develop varying levels of flatheaded borer damage: little, mild, and major. The resulting three clusters are highlighted below with their average acceptability scores shown in Table 3.

Cluster 1: This is our largest cluster consisting of 269 respondents (54% of the sample) and the most risk averse group among the three clusters, with acceptability of purchase tree with little damage being 1.315, with mild damage being 0.821, and major damage being 0. We label this cluster the "risk-averse" group.

Cluster 2: This is the smallest cluster comprising 100 respondents (20% of the sample). Cluster 2 had the acceptability of purchase tree with little damage being 22.070, with mild damage being 19, and major damage being 0. We label this cluster the "risk neutral" group.

Cluster 3: This cluster includes 129 respondents (26% of the sample) and the most taking group among the three clusters, with acceptability of purchase tree with little damage being 70.666, with mild damage being 31.031, and major damage being 0. We label this cluster the "risk-takers" group.

Cluster-level Demographic Profiles

Table 4 presents the sociodemographic characteristics of respondents across the three risk clusters: risk averse, risk neutral, and risk takers. A few key patterns emerge. The risk averse group has the

lowest average household income at \$60,065, while risk takers report the highest at \$71,318. Despite differences in income, the average age is similar across clusters, with risk neutrals slightly older on average (51.5 years), compared to risk adverse (49.5 years) and risk takers (48.7 years).

Among risk takers, 25.5% are Gen Z, the highest Gen Z share across the three groups, while 40.3% are Baby Boomers. In contrast, the risk neutral group has the highest proportion of Baby Boomers (42%), whereas the risk averse group has the lowest (34.9%). In terms of race and ethnicity, the risk averse group is comparatively more racially diverse, with 71% White and 18.2% African American respondents. By contrast, the risk neutral group is the most predominantly White (79%), and least likely to identify as a race other than White or African American.

Regarding education, a larger share of risk takers have higher levels of educational attainment. 13.1% hold a degree higher than a bachelor's, compared to just 8.5% in the risk averse group. Similarly, only 34.8% of risk takers have high school or less education, compared to 46% of risk averse individuals.

Geographic patterns are relatively consistent across clusters, with the Southeast being the most common region for all groups. In terms of residence, metro dwellers are least represented in the risk neutral group (12%) and most represented among risk takers (20.1%).

Household structures differ modestly, with risk neutral and risk takers having more children and adults on average in the household than risk averse individuals. Political affiliation is fairly balanced across clusters, though risk takers are somewhat more likely to identify as Republican (34.1%).

Finally, the risk averse group has the weakest agricultural ties: 71% report no personal or familial connection to farming or agriculture, compared to 51% of risk neutrals and 55.8% of risk takers. Despite this, a high percentage of all three groups report being the primary shopper for food, each at around 90%.

Multinomial Logit Regression Results

Risk Averse: Several factors are associated with a higher likelihood of being in the risk averse group. Compared to Millennials, individuals from Gen X and the Silent Generation are 15.4 and 20.1 percentage points more likely, respectively, to be in the risk-averse group. Race also plays a role: Black respondents are 12.3 percentage points more likely to be in this group than White respondents, while those identifying as another race are 16.5 percentage points more likely. Respondents with more children in the household are significantly less likely to be risk averse: each additional child is associated with a 10.6 percentage point decrease in the probability of being in this group and each additional member in the household is associated with a 4 percentage point decrease in the probability. A higher number of adults in the household and having grandparents or parents who grew up or worked on a farm are also associated with a lower likelihood of being risk averse. Compared to those without any personal or familial connection to agriculture, those

whose grandparents or parents worked or grew on farm were 14.5 percentage points less likely to be a member of the risk-averse group.

Risk Neutral: Respondents in this group are less likely to be from other race compared to White respondents, by 10.8 percentage points. They are also less likely to be from the Rocky Mountains or New England compared with the Southeast, by 12.4 and 11.9 percentage points respectively. Additionally, having more children in the household is positively associated with being risk neutral. Each additional child increases the likelihood of being in this group by 5.1 percentage points. Primary shoppers of plants are 9 percentage points more likely to be risk neutral than those who are not. Finally, respondents whose parents or grandparents grew up or worked on farms are also more likely to be in this group (7.8 percentage points), compared to those without any personal or familial connection to agriculture.

Risk Takers: Results show that Gen Z individuals are more likely to be a member of the risk-takers group. Compared to Gen Z, Gen X individuals are 9.6 percentage points less likely to be in the risk taker group, and Silent Generation respondents are 17 percentage points less likely. Black respondents are 8.5 percentage points less likely to be risk takers than Whites, although the coefficient is not statistically different from zero at 90 percent significance level. Individuals with higher than bachelor's degrees are 14.9 percentage points more likely to be risk takers than those with only a high school education or less, although the coefficient is again not statistically significant. Household structure also matters; having more children or adults is positively associated with being a risk taker. Having one additional child is associated with a 5.5 percentage points lower probability of being in a risk taker cluster. None of the other variables explain the cluster membership.

Across all three clusters, political affiliation and being the primary shopper of food were not statistically significant predictors. These findings suggest that age, race, education, region, and household composition play a more prominent role in explaining individuals' risk preferences than political beliefs or consumer roles.

Conclusion

This study examines how consumers' risk preferences influence their acceptance to purchase trees under varying levels of pest threat, focusing on damage caused by flatheaded borers. Using a nationally representative survey, we elicited respondents' tolerance for pest-related risk and grouped individuals into three distinct behavioral types: risk averse, risk neutral, and risk takers, based on their responses to hypothetical infestation scenarios. Cluster analysis and multinomial logit regression results highlight that risk attitudes toward pest-damaged trees are systematically associated with demographic and experiential characteristics.

Our findings show that risk aversion is more prevalent among older individuals, racial minorities, and those without personal or familial ties to agriculture. In contrast, individuals from Gen Z

generation and those from larger household size are more likely to exhibit risk-taking behavior. Regional patterns also emerge, with residents of New England more likely to display risk-tolerant purchasing behavior.

These results offer important implications for the nursery and landscape industries. As pest threats become more prevalent and public awareness grows, understanding the heterogeneity in consumer risk tolerance can help guide marketing strategies, outreach programs, and pest management communication. Tailored messaging that addresses specific concerns of risk-averse consumers, such as emphasizing pest management practices or guarantees of tree health, may help maintain demand even when pest risks are prominent.

In addition, this study contributes to the broader literature on consumer behavior under biological and environmental risk. Future research could build on this work by experimentally testing how different information treatments, such as pest resistance labeling or warranty programs, influence risk perceptions and tree purchasing behavior under biological uncertainty.

Table 1. Sociodemographic characteristics of the survey respondents

Variable	Mean	Std. Dev.
Sociodemographic characteristics		
Female (%)	0.538	0.499
Median Household income	62,500	-
Median Age (years)	55	-
Age Generation		
Gen Z	0.232	0.423
Millennial	0.130	0.337
Gen X	0.196	0.397
Baby Boomer	0.377	0.485
Silent Generation	0.062	0.241
Race		
Caucasian	0.740	0.438
African American	0.164	0.371
Other race	0.034	0.181
Education		
High school or less	0.419	0.494
Some college	0.295	0.456
Bachelor's degree	0.186	0.390
Higher than bachelor's degree	0.098	0.298
Geographical Region		
Southeast	0.313	0.464
Southwest	0.110	0.313
Far West	0.148	0.356
Great Lakes	0.150	0.358
Plains	0.060	0.238
Rocky Mountains	0.018	0.133
Mideast	0.160	0.367
New England	0.038	0.191
Residence		
Metro	0.164	0.371
Suburban	0.564	0.496

Rural	0.271	0.444

Household characteristics

No. of children in the household	0.325	0.778
No. of adults in the household	2.132	1.072

Political beliefs

Republican	0.289	0.453
Democrat	0.327	0.469
Independent	0.307	0.461
Libertarian	0.012	0.109
Other political views	0.064	0.245

Relation to farm work

Grand/Parents grew up or worked on farm	0.317	0.465
Grew up or worked on farm	0.094	0.292
Work/ed in ag (non-farm)	0.074	0.262
No relation to ag/farming	0.630	0.483
Primary shopper of food/plants		
Primary food shopper	0.911	0.284
Primary plant shopper	0.712	0.452

Notes: Household income is in 2022 US Dollars. Southwest includes AZ, NM, OK, and TX. Far West includes AK, CA, HI, NV, OR, and WA. Great Lakes include IL, IN, MI, OH, and WI. Plains include MN, MO, ND, NE, IA, KS, and SD. Rocky Mountains include CO, ID, MT, UT, and WY. Mideast includes DC, DE, MD, NJ, NY, and PA. New England includes CT, MA, ME, NH, RI, and VT. Southeast includes AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV. Standard deviations are in parentheses.

Table 2. Perceptions on undocumented workers in agriculture

Variable	Mean	Std. Dev.	Min	Max
Little	23.447	31.015	0	100
Mild	12.297	19.470	0	100
Major	0	0	0	0
N	498			

Notes: The statistics are for the responses to the survey question, "What is the maximum probability you would find acceptable to purchase a tree that could develop [the following levels of] flatheaded borer damage?"

Table 3. What is the maximum probability you would find acceptable to purchase a tree that could develop [the following levels of] flatheaded borer damage?

Potential damage level	Clusters		
	Risk averse (N=269)	Risk neutral (N=100)	Risk takers (N=129)
Little	1.315***	22.070	70.666***
	(2.968)	(9.498)	(19.207)
Mild	0.821***	19.000	31.031***
	(2.406)	(18.991)	(22.700)
Major	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)

Notes: This table presents the mean values of responses to the survey question, "What is the maximum probability you would find acceptable to purchase a tree that could develop [the following levels of] flatheaded borer damage?" The means for all clusters are compared with those for the cluster "risk neutral," which consists of respondents who are, on average, the most risk neutral. Standard deviations are in parentheses. *p < 0.1, ** p < 0.05, *** p < 0.01.

Table 4. Sociodemographic characteristics of the survey respondents

Variable	Risk Averse (N=269)		Risk Neutral (N=100)		Risk Takers (N=129)	
	Mean	SD	Mean	SD	Mean	SD
Sociodemographic characteristics						
Female (%)	0.576	0.495	0.540	0.500	0.457	0.500
Household income ($)	60,065	54,668	69,000	46,820	71,318	53,134
Average age (years)	49.524	19.806	51.450	20.582	48.658	19.812
Gen Z	0.226	0.419	0.220	0.416	0.255	0.438
Millennial	0.137	0.345	0.120	0.326	0.124	0.330
Gen X	0.211	0.409	0.180	0.386	0.178	0.384
Baby Boomer	0.349	0.477	0.420	0.496	0.403	0.492
Silent Generation	0.074	0.262	0.060	0.238	0.038	0.193
Race and ethnicity						
White	0.710	0.454	0.790	0.409	0.767	0.424
African American	0.182	0.386	0.150	0.358	0.139	0.347
Other race	0.107	0.310	0.060	0.238	0.093	0.291
Education						
High school or less	0.460	0.499	0.400	0.492	0.348	0.478
Some college	0.278	0.449	0.300	0.460	0.325	0.470
Bachelor's degree	0.174	0.380	0.210	0.409	0.193	0.396
Higher than bachelor's degree	0.085	0.280	0.090	0.287	0.131	0.339
Geographical region						
Southeast	0.301	0.459	0.360	0.482	0.302	0.461
Southwest	0.115	0.319	0.100	0.301	0.108	0.312
Far West	0.152	0.360	0.160	0.368	0.131	0.339
Great Lakes	0.171	0.377	0.140	0.348	0.116	0.321
Plains	0.048	0.214	0.090	0.287	0.062	0.242
Rocky Mountains	0.018	0.135	0.010	0.100	0.023	0.151
Mideast	0.159	0.367	0.120	0.326	0.193	0.396
New England	0.033	0.180	0.020	0.140	0.062	0.242
Residence						
Metro	0.163	0.370	0.120	0.326	0.201	0.402
Suburban	0.568	0.496	0.560	0.498	0.558	0.498
Rural	0.267	0.443	0.320	0.468	0.240	0.428
Household Characteristics						
No. of children in the household	0.230	0.657	0.440	0.856	0.434	0.917
No. of adults in the household	2.089	1.099	2.120	1.066	2.232	1.019
Political beliefs						
Democrat	0.327	0.327	0.330	0.472	0.325	0.470
Republican	0.267	0.267	0.280	0.451	0.341	0.475
Independent	0.327	0.327	0.320	0.468	0.255	0.438
Libertarian	0.007	0.007	0.010	0.100	0.023	0.151
Other	0.070	0.070	0.060	0.238	0.054	0.227
Relation to farm work						
Grand/Parents grew in farms	0.252	0.435	0.420	0.496	0.372	0.485
Grew up or worked in farm	0.078	0.268	0.120	0.326	0.108	0.312
Work/ed in ag (non-farm)	0.063	0.243	0.100	0.301	0.077	0.268
No relation to ag/farming	0.710	0.454	0.510	0.502	0.558	0.498
Primary shopper of food/plants						
Primary shopper of food	0.899	0.301	0.940	0.238	0.914	0.280
Primary shopper of plants	0.676	0.468	0.810	0.394	0.713	0.454

Notes: Household income is in 2022 US Dollars. Southwest includes AZ, NM, OK, and TX. Far West includes AK, CA, HI, NV, OR, and WA. Great Lakes include IL, IN, MI, OH, and WI. Plains include MN, MO, ND, NE, IA, KS, and SD. Rocky Mountains include CO, ID, MT, UT, and WY. Mideast includes DC, DE, MD, NJ, NY, and PA. New England includes CT, MA, ME, NH, RI, and VT. Southeast includes AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV. Political beliefs come from the survey question, "How liberal/conservative are you on the following topics?" and range from 0 (strong liberal) to 100 (strong conservative). Standard deviations are in parentheses.

Table 5. Sociodemographic determinants of the respondents' membership in the clusters

	(1)		(2)		(3)	
	Risk Averse		Risk Neutral		Risk Takers	
	ME	SE	ME	SE	ME	SE
Female	0.079	(0.051)	-0.004	(0.407)	-0.075	(0.045)
Household income	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Millennial	0.102	(0.081)	-0.037	(0.608)	-0.065	(0.065)
Gen X	0.154**	(0.075)	-0.057	(0.052)	-0.096*	(0.058)
Baby Boomer	0.063	(0.073)	-0.010	(0.053)	-0.052	(0.060)
Silent Generation	0.201**	(0.101)	-0.030	(0.084)	-0.170**	(0.057)
Black	0.123*	(0.068)	-0.037	(0.051)	-0.085	(0.053)
Other Race	0.165**	(0.080)	-0.108***	(0.043)	-0.056	(0.068)
Some college	-0.069	(0.060)	-0.006	(0.043)	0.075	(0.056)
Bachelor's degree	-0.073	(0.072)	0.019	(0.057)	0.053	(0.067)
Higher than bachelor's degree	-0.124	(0.093)	-0.024	(0.063)	0.149	(0.095)
Southwest	0.053	(0.080)	-0.038	(0.056)	-0.015	(0.068)
Far West	0.027	(0.071)	0.002	(0.055)	-0.029	(0.065)
Great Lakes	0.112	(0.077)	-0.043	(0.051)	-0.069	(0.060)
Plains	-0.133	(0.109)	0.076	(0.095)	0.056	(0.100)
Rocky Mountains	0.096	(0.182)	-0.124*	(0.071)	0.027	(0.171)
Mideast	-0.009	(0.073)	-0.060	(0.049)	0.070	(0.066)
New England	-0.084	(0.140)	-0.119*	(0.062)	0.203	(0.136)
No. of kids in the household	-0.106***	(0.037)	0.051**	(0.022)	0.055*	(0.289)
No. of adults in the household	-0.040*	(0.023)	0.0153	(0.020)	0.025	(0.020)
Suburb	0.006	(0.070)	0.059	(0.053)	-0.065	(0.057)
Rural	-0.030	(0.084)	0.115	(0.077)	-0.085	(0.059)
Republican	0.012	(0.064)	-0.044	(0.045)	0.031	(0.056)
Politically Independent	0.081	(0.062)	-0.016	(0.046)	-0.065	(0.051)
Libertarian	-0.149	(0.197)	-0.061	(0.134)	0.211	(0.186)
Politically Other	0.059	(0.097)	-0.026	(0.072)	-0.032	(0.083)
Grand/Parents grew/worked on farm	-0.145**	(0.054)	0.078*	(0.044)	0.067	(0.050)
Grew up or worked on farm	-0.017	(0.091)	-0.022	(0.059)	0.039	(0.082)
Work/ed in ag (non-farm)	0.027	(0.098)	0.003	(0.069)	-0.030	(0.081)
Primary shopper of food	-0.049	(0.098)	0.022	(0.083)	0.026	(0.081)
Primary shopper of plants	-0.089	(0.060)	0.090*	(0.047)	-0.001	(0.053)
N			496			
Log pseudolikelihood			-462.503			
Wald Chi-square			74.060			
Pseudo R-square			0.073			

Notes: The table shows marginal effects of the covariates on the probability of being a certain cluster type (1-5) using multinomial logistic regression model. The category of reference is the Gen Z for generations, the Southeast for regions, white for race, female for sex, high school or less for education, urban for location, and no relationship with farming or agriculture for relationship with farming or agriculture. Political beliefs come from the survey question, "How liberal/conservative are you on the following topics?" and range from 0 (strong liberal) to 100 (strong conservative). Robust standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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