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ARTICLE

Unlocking consumer preferences: Estimating the willingness to pay for integrated pest management practices

R. Karina Gallardo[1] | **Xueying Ma**[2] | **Suzette P. Galinato**[3] | **Tobin Northfield**[4]

[1]School of Economic Sciences. Puyallup Research and Extension Center, Puyallup, Washington, USA

[2]Fay W. Boozman College of Public Health. University of Arkansas for Medical Sciences, Little Rock, Arkansas, USA

[3]Agriculture and Natural Resources Program Unit. Washington State University Extension, Pullman, Washington, USA

[4]Department of Entomology, Tree Fruit Research and Extension Center. Washington State University, Wenatchee, Washington, USA

Correspondence

R. Karina Gallardo, School of Economic Sciences. Puyallup Research and Extension Center. Washington State University. 2606 West Pioneer, Puyallup, WA 98371, USA.
Email: karina_gallardo@wsu.edu

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Abstract

Pesticides boost agricultural yields but bring environmental and climate concerns, driving a cycle of increased use. Integrated Pest Management (IPM) aims to lower pesticide reliance, yet it may impact ecosystems. This study examines consumer willingness to pay (WTP) for IPM-labeled fruits and the role of climate awareness. A survey of blueberry and cherry buyers shows the highest WTP for biocontrol over other IPM methods. After a climate intervention, WTP increased for all labels. Latent class analysis reveals three groups: pro-biocontrol, price-conscious, and pro-gene editing. These insights guide marketing, policymaking, and education on IPM's benefits and climate impact mitigation.

KEYWORDS

biocontrol, climate change, gene editing of insects, integrated pest management

JEL CLASSIFICATION

D12, M31, Q13

1 | INTRODUCTION

Pesticides are extensively used in modern agriculture, serving as a cost-effective and efficient approach to reduce yield losses (controlling plant weeds, insects, and diseases), boosting agricultural productivity, and improving the economic feasibility of farming (Bourguet and Guillemaud 2016; Fernandez-Cornejo 2014; Sharma et al. 2019; Gallardo 2024). The benefits of pesticides for humans

rely on helping control insect pests that decimate crops, transmit diseases for plants, animals, and humans. Scientists estimate that without pesticide use, fruit production would drop considerably (Lamichhane 2017).

However, there are growing concerns about the negative impacts of sole reliance on pesticide. Abundant literature documents the disruptive consequences of pesticide use to society (Bourguet and Guillemaud 2016; Sheahan et al. 2017), human health (Baldi et al. 2014; Bassil et al. 2007; Eddleston et al. 2002; Fantke et al. 2012; Hedlund et al. 2020; Hernández et al. 2013; Kim et al. 2017; Robinson et al. 2020) and the ecosystem, including pollution of water, soil, and the atmosphere along with declines in biodiversity (Mahmood et al. 2016; Sharma et al. 2019; Tudi et al. 2021).

Given society's[1] goal to maintain agricultural production and reduce sole reliance on chemicals, a comprehensive approach to pest management is essential. Since its introduction in the 1950s, Integrated Pest Management (IPM) has become a widely adopted model for crop protection. IPM is a strategy that combines various pest control techniques to minimize pest populations and reduce reliance on pesticides, balancing economic, health, and environmental concerns (Gott and Coyle 2019; U.N. Food and Agriculture Organization 2020). By integrating various pest control strategies, IPM minimizes reliance on chemical pesticides, thereby promoting a healthier environment and more sustainable agricultural practices (U.S. Environmental Protection Agency 2024).

The objective of this study is to estimate survey respondents' willingness to pay (WTP) for food labels that indicate the application of IPM-related practices[2] (i.e., biocontrol, gene editing of insect pests, and postharvest irradiation), and focuses on fresh blueberries and sweet cherries. Fresh fruits are chosen because they are often consumed raw, leading to the public perception that these products might increase the risk of retaining pesticide residues compared to other foods that are cooked before consumption or that are processed (van Doorn and Verhoef 2011). In addition, we seek to explore whether consumption motives influence consumer perceptions of production methods (van Doorn and Verhoef 2011). To this end, we include two fruits with different consumption profiles: blueberries, which are associated with year-round healthy lifestyles (Ma et al. 2024b), and cherries, which are linked to seasonal consumption and indulgence or flavor orientation (Zheng et al. 2016).

A second objective is to investigate how increased climate change awareness impacts consumer perceptions of IPM practices, addressing the significant and cyclical link between pesticide use and climate change. Pesticides, primarily derived from fossil fuels, contribute to climate change throughout their entire lifecycle, including production, transportation, use, and disposal. Many pesticides also contribute to ground-level ozone, a potent greenhouse gas, and some, like sulfuryl fluoride, are extremely potent greenhouse gases themselves. Climate change, in turn, exacerbates the need for pesticides. Rising temperatures, heat stress, and altered rainfall patterns reduce crop resilience, making them more susceptible to pests. Warmer conditions may also boost insect populations, while weeds become more resilient. These factors lead to increased pesticide use and faster pesticide degradation, creating a feedback loop that intensifies both pesticide reliance and climate change. Further, some IPM approaches, such as biocontrol, are particularly susceptible to environmental fluctuations, creating the need to evaluate IPM efficacy and adapt the strategies in response to climate change (Gvozdenac et al. 2022; Pesticide Action Network North America 2023).

[1]Society encompasses consumers, government entities, farmers, environmental organizations, and so on.

[2]Integrated Pest Management (IPM) is a comprehensive approach that integrates various practices to reduce pest abundances to tolerable levels. IPM is a flexible approach to pest management, and its practical application can depend on a range of factors, such as the type of vegetation surrounding the particular farm that can serve as a source of pests or beneficial insects, the economic value and pest susceptibility of the cultivar being grown, the environmental conditions of the farm, and so on. It is a state of flexibility and variability from farm to farm. As such, we evaluate the components that make up the IPM approach than to evaluate it as a whole.

1.1 | Background

The four IPM practices—biocontrol, gene editing of insect pests, and postharvest irradiation—have advanced applications in controlling the pest spotted-wing drosophila (*Drosophila suzukii*), a threat to blueberries and sweet cherries (Tait et al. 2021). Despite their promise, these practices pose risks of unintended consequences that may potentially lead to public rejection. For instance, biological control, which uses natural enemies like predators and parasitoids, is generally considered environmentally friendly (Barratt et al. 2018). However, introducing these natural enemies to control invasive pests can lead to unintended ecological consequences.

Genetic manipulation of insect pests, such as applications of CRISPR-Cas9[3] could include sterile insect techniques and development of transgenic strains to suppress populations (Tait et al. 2021; Li et al. 2021). These methods may raise concerns about ecological consequences, ethical considerations, unintended effects on nontarget species, and the long-term impacts on biodiversity (Patrão Neves and Druml 2017). Despite evidence confirming the safety of postharvest practices like irradiation to salvage crops with low levels of infestation (Tait et al. 2021), consumer resistance persists. While some studies indicate improved acceptance with more information, many still view irradiation as harmful and perceive its benefits as unknown (Castell-Perez and Moreira 2021).

Public rejection of agricultural production methods frequently arises from concerns about ecological impacts, human health, safety, ethical considerations, limited knowledge (Koch et al. 2017), or decline of public interest in science (Deguine et al. 2021). To address these issues, effective communication strategies are essential to enhance the public's understanding of organic, conventional, or sustainably produced foods, while also influencing policy and regulatory decisions to ensure food safety (Petzoldt 1998; Dara 2019).

Our contribution explores how consumers' perceptions change with increased awareness of climate change's impact on agricultural production. This study benefits producers, policymakers, and environmental organizations by providing targeted communication strategies and insights into consumer awareness and perceptions influencing sustainable agricultural practices. It also offers valuable data on consumer behavior related to agricultural practices and climate change.

2 | LITERATURE REVIEW

This study adds to the literature centering on consumers' WTP for IPM practices, especially applied to fresh produce. Research dating from the 1990s indicates little public knowledge about IPM methods, but once informed, studies revealed a generalized acceptance of produce that used IPM (Hollingsworth et al. 1993; Underhill 1993; Anderson et al. 1996; Govindasamy et al. 2001). Of note here, is that these studies explained IPM as a combination of cultural practices leading to a sustainable use of chemicals. The present study adds to the research on consumers' WTP for IPM by incorporating contemporary practices that were not previously explored in earlier studies.

Literature on the public acceptance of genetic manipulation to improve agricultural crops is vast. The consensus is that consumers are averse to genetically engineered crops, and this aversion is deterring further applications and the potential benefits these applications could convey (Frewer 2003; Bawa and Anilakumar 2013; Barrows et al. 2014; Lusk et al. 2014; Voytas and Gao 2014; Qaim 2020; Watanabe et al. 2020; Alston and Pardey 2021; Anders et al. 2021; Uddin et al. 2022). Research centering on consumers' perceptions of gene editing, a form of genetic engineering, particularly the applications of CRISPR-Cas9 in food production, suggests that the aversion towards gene editing is less pronounced compared to the aversion towards genetic

[3]Genetically engineering is the broad term used to describe any form of gene manipulation in living organisms. This includes both gene editing and genetic modification. Genetic modification involves altering the genome by incorporating DNA sequences from different species, while gene editing focuses on making precise changes to the existing genome without introducing foreign DNA (Entine et al. 2021).

engineering in general, particularly genetic modification (Nagamangala Kanchiswamy et al. 2015; Shew et al. 2018; Yang and Hobbs 2020; Muringai et al. 2020; McFadden et al. 2021; Marette et al. 2021; Hu et al. 2022; Uddin et al. 2022; Ma et al. 2024a). This study contributes to a broader understanding of consumer perceptions regarding the application of gene editing in agricultural production. Particularly, it focuses on the indirect use for genetic manipulation of insect pests, thereby reducing the reliance on chemical applications, and distinguishing from direct applications of gene editing for improving plant varieties.

Studies focusing on the WTP for foods using some form of insect pest genetic manipulation as a pest control practice are less abundant. The motivation of our study is directly aligned with Jones and Brown (2023), who investigated consumers' preferences for control methods for spotted-wing drosophila in fresh-market blueberries and Asian citrus psyllid in orange juice. They found that approximately one-fourth of the survey sample (27% in blueberries and 25% in orange juice) expressed disutility towards CRISPR-Cas9 applications for insect pest control. This suggests that most respondents indicated some level of acceptance towards these methods (Jones and Brown 2023). Literature on the use of irradiation as a postharvest alternative to control pests in storage in fresh fruits is also limited. One study found that, in general, consumers are more receptive of irradiation compared to sole reliance on postharvest chemical applications on fresh apples in storage (Murray et al. 2024). This study adds to the findings of previous studies in that consumers are generally more accepting of otherwise controversial technologies, such as gene editing or irradiation, when their use is associated with a reduced reliance on chemical applications.

The present study also adds to the literature centering on consumers' WTP for reductions in pesticide exposure as we estimate the WTP for products with labels indicating alternative insect control methods, thereby suggesting less reliance on chemical applications. Previous research consistently finds that consumers are willing to pay a premium for foods with fewer pesticide applications (Misra et al., 1991; Florax, 2005; Bernard and Bernard, 2010; Bazoche et al., 2013; Nitzko et al., 2024). On this, researchers noted that effectively communicating pesticide reduction through food labels, in places like the European Union, is difficult due to the abundance of labels, which could be confusing to the consumer (Bazoche et al. 2013).

This study is indirectly related to the literature on WTP for ecolabels. These are labels that indicate that the food producer or processor has used environmentally friendly practices, including sustainable use of resources and reduced chemical inputs (Gorton et al. 2021). IPM practices such as biocontrol combined with applications of environmentally friendly chemicals could be comparable to ecolabels, specifically from the less-pesticide use perspective, as in the case of applications to fresh apples (Loureiro et al. 2001; Loureiro et al. 2002; Marette et al. 2012) and reduced chemical residues in fruits and vegetables (Moon et al. 2002). Consistently, these studies found that consumers surveyed—regardless of the perspective being analyzed—are willing to pay a premium for ecolabeled food products.

This study is indirectly related to research on consumers' preferences for organic foods. Although regulations do not approve the use of genetic manipulation or irradiation in products labeled as organic, non-synthetic pesticides, in some instances, combined with some form of biocontrol method, can be labeled as organic. It is well documented that consumers' decisions to purchase organic are driven by various motivations, and one of them, is the reduced chemical applications (Anstine 2007; Zhang et al. 2008; Dettmann and Dimitri 2010; Aertsens et al. 2011; Dimitri and Dettmann 2012; Bazoche et al. 2013; Koch et al. 2017; McFadden and Huffman 2017). The WTP for organic products due to reduced chemical exposure is particularly pronounced when consumers are presented with fruits and vegetables, compared to other types of food products (Zhang et al. 2008; Lin et al. 2009; Dettmann and Dimitri 2010; Juhl et al. 2017; Uddin and Gallardo 2021).

3 | METHODS

3.1 | Data collection

The data were collected via an online survey administered by the Qualtrics Research Services™ consumer research panel.[4] We asked Qualtrics to gather participants over 18 years of age through random selection, to match the demographic profile of gender, age, and income as closely as possible to the general population in the United States. The data collection took place in February of 2024.

Qualtrics™ surveyed a total of 1597 respondents nationwide for the survey focused on fresh blueberries, while 1578 respondents were surveyed for fresh sweet cherries, making a total of 3175 respondents. The screening criteria for the respondents included individuals who have consumed fresh blueberries and sweet cherries in the past 6 months and overseeing grocery shopping in the household. This is because literature suggests that knowledge and experience with the product are necessary to mimic a real-life purchasing situation as closely as possible to provide accurate and unbiased estimates (Louviere 2006). The Institutional Review Board approved the survey (Not shown for review–IRB–20253-002).

3.2 | Experimental design

We chose discrete choice experiments (DCE) over other methods because it aligns with Lancaster's demand theory (Lancaster 1966) and enables simultaneous examination of multiple attributes in a controlled setting. Although fresh blueberries and sweet cherries are familiar to U.S. consumers, IPM logos are absent in food labels, in general. DCE also offers more observations from fewer respondents and better simulates real choice environments, reducing hypothetical bias (Louviere et al. 2000). To ensure clarity for all respondents participating in the DCE, detailed explanations of each IPM approach were provided. These explanations drew from the expertise of one of our coauthors, an entomologist.

The study employs a within-subjects design, where each participant answered six DCE questions. Next, a graphical representation of the impact of climate change on agricultural production methods was presented. Subsequently, the same six DCE questions were then presented again. In total each participant responded to 12 DCE questions. We acknowledge that using a within-subjects design involves trade-offs. This method improves internal validity by controlling for individual-level heterogeneity compared to a between-subjects design (Murray et al., 2024). Nonetheless, it may raise anchoring effects, since participants completed the same choice experiment twice, as well as potential experimenter demand effects after viewing the climate change graphic (Charness et al., 2012). We address these concerns through an ex-post assessment of the potential influence of the within-subject design on the results, discussed in the results section of this paper. Appendix A shows an example of the discrete choice question. Appendix B presents the graphical information of the climate change that underscores the implications of pest and disease resurgence, while also highlighting alternative practices such as gene editing of pests and postharvest irradiation; informing that these measures aim to reduce reliance on chemical applications and enhance the efficacy of biocontrol methods.

[4]Under our contract with Qualtrics, the deliverable is a pre-agreed number of completed surveys, and the guarantee that streamliners and bots are eliminated. Recruitment efforts, compensation to participants, and details regarding individuals initially contacted but who did not complete the survey are not included in the deliverable. The survey included screening questions at the beginning of the questionnaire and two attention checks to guarantee the control of unwanted survey takers/behavior. The number of individuals in the Qualtrics consumer research panel is large enough that we requested Qualtrics survey quotas based on income, age, and geographical distribution to be as close as possible to the U.S. population.

Each scenario offered two options (A and B) and an opt-out choice. Each option presented a photo of the fruit in a clamshell with a label consisting of a graphic logo representing the IPM practice (hereafter logo), along with a one-sentence statement explaining the logo's meaning, and a price. The four IPM-related logos used are presented in Table 1. The selection of these IPM approaches is based on prior research into novel approaches in IPM practices for controlling spot wing drosophila, a widespread pest affecting blueberries and sweet cherries (Tait et al. 2021). The price levels used come from the weekly advertised fruit retail prices (U.S. Department of Agriculture 2024).

We generated a D-optimal experimental design—for both blueberries and sweet cherries—based on the multinomial logit model and using zero prior parameter values in NGENE version 1.2. The DCEs consisted of 36 choice scenarios divided into six blocks of six choice scenarios each with a D-error of 0.019. To address potential hypothetical bias in DCE, we used two effective approaches: a cheap talk script (Champ et al. 2009) before the scenarios, and a certainty scale (1–10) after each scenario to measure respondent confidence (Hensher et al. 2012). The average certainty score was 7.96 for the blueberry survey and 8.02 for the cherry survey.

3.3 | Empirical methodology

This study uses the theory of demand to suggest that the satisfaction from consuming a good comes from its attributes rather than the good itself. As such, we estimate consumer preferences for fruits with various IPM logos using random utility theory. The utility function is represented by,

$$U_{njt} = \beta_n \boldsymbol{x_{njt}} + \varepsilon_{njt} \tag{1}$$

where U_{njt} is the utility derived by individual n when choosing alternative j in choice scenario t; x_{njt} is a vector of observed attributes (i.e., logos denoting: reliance on chemicals, use of biocontrol, use of gene editing to control insect pests, use of irradiation in postharvest; and the price attribute); β_n is a vector of parameters to be estimated; and ε_{njt} is an unobserved error term that is assumed to be identically and independently distributed (Train 2009).

This study applies the WTP space estimation by using the Generalized Multinomial Logit Model (GMNL) that allows for scale heterogeneity, that is, $\beta_n = \sigma_n\beta + [\gamma + (1 - \gamma)\sigma_n]\eta_n$ (Fiebig et al. 2010). The GMNL model incorporates consumers' preference heterogeneity as follows,

$$U_{njt} = [\sigma_n\beta + \gamma\eta_n + (1 - \gamma)\sigma_n\eta_n]x_{njt} + \varepsilon_{njt} \tag{2}$$

where σ_n is the individual-specific scale of the idiosyncratic error term that represents the scale heterogeneity, following a log normal distribution with mean $\bar{\sigma}$ and standard deviation τ. η_n is the vector of individual specific taste that represents the individual's residual preference heterogeneity, γ is a parameter between 0 and 1 that controls how the variance of residual taste heterogeneity η_n varies with the scale heterogeneity σ_n. We used the GMNL-II[5] model expressed as,

[5]The GMNL model is classified based on the values the parameter γ takes. If $\gamma = 1$, the standard deviation of the residual taste heterogeneity is independent of the scale, and we get the GMNL Type I or GMNL-I. If $\gamma = 0$, we get the GMNL Type II or GMNL-II, where the standard deviation of the residual taste heterogeneity is proportional to the scale. We estimated both specifications and opted for presenting the results from the GMNL-II model given the superior goodness-of-fit statistics based on the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and log likelihood function values.

TABLE 1 IPM logos and prices used in the discrete choice scenarios for blueberries and sweet cherries.

Blueberries				
IPM logo				
	Nonorganic blueberries have likely been treated with chemicals to control the damaging pests	Use of other living organisms to control the damaging pests	Use gene editing to alter the genetic makeup of the damaging pests to control them	Use of irradiation to control the damaging pests
Price ($/12-oz)	3.39	4.39	5.39	
Sweet cherries				
IPM logo				
	Nonorganic sweet cherries have likely been treated with chemicals to control the damaging pests	Use of other living organisms to control the damaging pests	Use gene editing to alter the genetic makeup of the damaging pests to control them	Use of irradiation to control the damaging pests
Price ($/lb)	3.29	4.29	5.29	

$$U_{njt} = \beta_{nj} ASC_{nj} + \sigma_n (-Price_{njt} + \beta_{ch,n} Chemical_{njt} + \beta_{bc,n} Biocontrol_{njt} + \beta_{gen,n} Gene\_edit_{njt} + \beta_{irr,n} Irradiation_{njt} + \boldsymbol{L\eta_n}) + \varepsilon_{njt}, \quad (3)$$

where β_{nj} is the alternative-specific constant parameter estimate, ASC_{nj} denotes the opt-out option.[6] $Price_{njt}$ is a continuous variable with three values from the experimental design, the coefficient is normalized to 1 to enable direct interpretation of the coefficients of other non-price attributes as WTP estimates. The coefficients for the non-price attributes include $\beta_{ch,n}$, $\beta_{bc,n}$, $\beta_{gen,n}$, $\beta_{irr,n}$. The following binary variables indicate the IPM logos: $Chemical_{njt}$, $Biocontrol_{njt}$, $Gene\_edit_{njt}$, and $Irradiation_{njt}$. In the regression, chemical was omitted and is considered as the baseline for comparison. $\boldsymbol{\eta_n}$ is the residual taste heterogeneity that follows a standard normal distribution, and $\boldsymbol{L}$ is the lower triangular matrix of the Cholesky decomposition (Luckstead et al. 2022). All models were estimated using the "gmnl" package in R 4.0.5 (Sarrias and Daziano 2017).

To mitigate potential hypothetical bias, we asked respondents to rate their level of certainty for each discrete choice question on a 0–10 scale, with 0 indicating extreme uncertainty and 10 indicating extreme certainty. The self-reported response certainty was incorporated in the estimation of parameters, specifically in the scale parameter σ_n for each individual, following Kunwar et al. (2020):

$$\sigma_n = \exp(\delta certain_n + \tau v_n), \quad (4)$$

where δ is the parameter of the observed heterogeneity in the scale term, τ is the coefficient on the unobserved scale heterogeneity, $v_n \sim N(0,1)$, and $certain_n$ is an indicator variable equal to 1 if individual n's certainty scale is greater or equal to 7 and 0 otherwise. In our study, we employed a certainty scale threshold of 7 to align with the threshold levels used in prior research[7] (Champ et al. 2009). We compared two model specifications: one where the scale parameter varied with respondents' stated level of certainty and one where it did not. We found that including the certainty scale improved the model's goodness-of-fit.

3.4 | Latent class model

A latent class analysis was conducted to explore the factors contributing to variability in WTP for different IPM logos, considering only the observations corresponding to before the information intervention. This model identifies unobservable characteristics through class membership variables[8] including respondents' socioeconomic traits, preferences for fruit features, and knowledge of IPM and climate change. The analyses reveal distinct segments or latent classes within the sample, where preferences vary across classes but are consistent within each class. The mathematical formulation of the latent class model can be found in Greene and Hensher (2003).

This study employs the methodology proposed by Nylund-Gibson and Choi (2018) to identify the optimal number of classes. The authors contend that beyond employing goodness-of-fit measures such as AIC, BIC, and likelihood, additional criteria should be considered to identify the most suitable number of classes. These criteria encompass a balanced distribution of respondents across segments, interpretability of results, and the marginal benefits of incorporating additional segments

[6]Note that the ASC can enter the equation in two forms, either scaled or unscaled. In this study, we opted for unscaled ASCs following previous studies Balogh et al. (2016).

[7]In our sample, 80.03% of responses in the blueberry and 81.16% in the sweet cherry survey have a certainty level above 7. There were no observations discarded based on the certainty score.

[8]These variables were selected by running three ordinary least square regressions having the WTP for each logo as dependent variables and all responses to questions asked in the survey as independent variables. The variables selected were those that remained statistically significant across all three regressions. Variables are described in Tables 2 and 4.

or classes. Consequently, while the goodness-of-fit measures favors the use of four classes, the three-class model exhibits a more equitable distribution of respondents across segments and enhanced interpretability. The latent class models were estimated in R 4.0.5 using the package "gmnl" developed by Sarrias and Daziano (2017).

4 | RESULTS

4.1 | Sociodemographic results

Both blueberry and cherry respondent samples have a slightly higher proportion of females compared to the national average, as presented in Table 2. Compared to the national average, respondents in our sample, are more likely to come from larger families and have a larger proportion of survey respondents born in or before 1981. Respondents in both samples have less proportion of households earning $75,000 or more, and a higher likelihood of having at least one child under 18. Education attained and employment status in our sample is comparable with the national average; however, the white ethnic group is represented in larger proportions. The geographical distribution in both samples closely mirrors national averages. Additionally, our respondents show a tendency towards liberal and democratic views.

4.2 | Respondents' characteristics on food consumption and IPM/climate change perceptions

Results in Table 3 show that 64% of the respondents to the blueberry survey ($N = 1,597$) stated they consume blueberries more often than 2–3 times per week, whereas 37% of respondents to the cherry survey ($N = 1578$) indicated this consumption frequency, when cherries are in season. Both groups place high importance on taste (84% for blueberries, 85% for cherries), appearance (69% for blueberries, 70% for cherries), and storage properties (63% for blueberries, 62% for cherries). Price is also important for both (70% for blueberries, 71% for cherries). Healthiness is considered more important by blueberry consumers (70%) compared to sweet cherry consumers (59%). This result coincides with Ma et al. (2024b), who found that a label emphasizing the health aspects of blueberries is important to survey respondents. Eco-friendliness, local sourcing, and organic are moderately valued by both groups, with blueberry consumers generally placing slightly higher importance on these features. Other factors like fair labor, fair trade, climate change mitigation practices, and country of origin are less emphasized but show a similar level of importance across both groups.

Only 16%–18% of respondents demonstrated moderate knowledge of IPM by correctly identifying at least two out of four key IPM-related statements. Additionally, fewer than 20% of respondents believe that IPM contributes to climate change mitigation. In terms of climate change knowledge, fewer than one in five respondents feel confident in their knowledge or ability to evaluate the climate impacts of products and services. An even smaller proportion—about 11%–12%—believe others view them as experts in this area.

Both groups largely believe that their own dietary choices have minimal impact on climate change, while acknowledging that others' choices have a slightly larger effect. A small proportion in both samples (17%–15%) believe that there is not much they can do about climate change. They are equally likely to buy foods with climate change mitigation labels if available. Both groups are moderately concerned that climate change will increase insect pests and diseases, with similar views on the effectiveness of alternative pest control practices. They also expect that climate change mitigation in agriculture might raise food prices.

TABLE 2 Sociodemographics of respondents in both surveys: blueberry and sweet cherry.

		Blueberry $N = 1597$	Cherry $N = 1578$	American Community Survey 2023[1]
Female	1 if female	0.64	0.63	0.51
Family size	1 if family members ≥ 3	0.55	0.55	0.37
Age ≥43	1 if born in or before 1981	0.43	0.44	0.33[2]
Income	1 if household income ≥75,000/year	0.46	0.45	0.48
Children presence	1 if number of children > 0	0.42	0.43	0.28
Education	1 if attained bachelor or post-graduate	0.47	0.48	0.50
Employed	1 if employed	0.59	0.60	0.61[3]
White	1 if white	0.71	0.69	0.61
Northeast	1 if Northeast	0.17	0.17	0.17[4]
South	1 if South	0.39	0.39	0.39[4]
West	1 if West	0.24	0.24	0.24[4]
Liberal	1 if slightly/extremely liberal	0.32	0.32	
Conservative	1 if slightly/extremely conservative	0.29	0.27	
Democratic	1 if democratic	0.38	0.39	
Republican	1 if republican	0.28	0.27	

[1]Source: U.S. Census Bureau https://www.census.gov/programs-surveys/acs/data.html.
[2]The comparison group in the American Community Survey is 20 to 44 years old.
[3]The employment statistic in the American Community Survey considers 16 years and older.
[4]Source: https://www.census.gov/popclock/data_tables.php?component=growth.

Recycling (59%–61%), food waste reduction (50%–51%), and owning energy efficiency house appliances (44%–45%) are the most commonly reported climate-friendly behaviors. In contrast, fewer respondents report owning electric or hybrid vehicles (13%–15%) and composting (25%–27%), suggesting lower adoption of these practices. A majority of respondents support policies promoting renewable energy and funding research for climate adaptation, with 48%–56% expressing support. However, support for taxing gasoline and nonrenewable energy use is notably lower, at only 29%–31%.

4.3 | WTP results

Table 4 presents the WTP results for blueberries and cherries labeled with different IPM logos. To assess the potential effects of the within-subjects design on the estimated results, we assigned a numerical identifier to each choice task, included as the variable *Scenario order* in the data set. We then interacted this variable with each of the attribute variables in choice experiment—*Biocontrol*, *Gene editing* (insect pests), and *Postharvest irradiation*—to test for possible anchoring effects or experimenter demand influences. Statistically significant interaction terms would suggest that *Scenario ordering* affected utility estimates, potentially influencing the WTP results. Regression

TABLE 3 Survey respondents' perceptions on motives for purchase, IPM, and climate change.

Issue		Percent of respondents	
		Blueberry $N = 1597$	S. cherry $N = 1578$
Frequent consumer	1 if once a day/several times a day/4–6 times per week/ 2–3 times a week	0.64	0.37
Importance of blueberry/sweet cherry features			
Taste	1 if important/extremely important - Taste and texture	0.84	0.85
Appearance	1 if important/extremely important - Appearance	0.69	0.70
Storage properties	1 if important/extremely important - Favorable storage	0.63	0.62
Price	1 if important/extremely important - Price	0.70	0.71
Health	1 if important/extremely important - Health	0.70	0.59
Ecofriendly	1 if important/extremely important - Eco-friendly	0.44	0.42
Local	1 if important/extremely important - Local	0.44	0.41
Organic	1 if important/extremely important - Organic	0.43	0.41
Fair labor	1 if important/extremely important - Fair Labor	0.40	0.39
Fair trade	1 if important/extremely important - Fair trade	0.39	0.36
Clim. ch. mitigation	1 if important/extremely important – Clim. ch. mitigation	0.36	0.35
Country of origin	1 if important/extremely important - Country of origin	0.34	0.35
Knowledge of IPM			
IPM knowledgeable	1 if correct ≥2 out of 4 following statements: Agree/strongly agree "IPM overlaps with organic" Strongly disagree/disagree "organic do not use any chemicals" Agree/strongly agree "organic do not use synthetic chemicals but others are allowed" Strongly disagree/disagree "organic mitigates climate change"	0.16	0.18
IPM mitigates climate change	Agree/strongly agree "IPM mitigates climate change"	0.19	0.19
Knowledge of climate change			
I know about climate change	1 if agree/strongly agree - compared to an average person, I know a lot about the climate effects and products and services	0.17	0.16
Climate change evaluation	1 if agree/strongly agree - I know how to evaluate the climate=friendliness of products and services	0.18	0.16
Climate change expert	1 if agree/strongly agree - people who know me consider me as an expert in the field of climate effects of products and services	0.11	0.12

(Continues)

TABLE 3 (Continued)

Issue		Percent of respondents Blueberry $N = 1597$	S. cherry $N = 1578$
Climate change and food consumption perceptions			
Own dietary choices	1 if agree/strongly agree - My dietary choices have no impact on climate change	0.20	0.22
Others dietary	1 if agree/strongly agree - Others' dietary choices have an impact on climate change	0.28	0.25
Not much I can do about climate change	1 if agree/strongly agree - There is not much I can do about climate change	0.17	0.15
Foods labeled climate change friendly	1 if agree/strongly agree - If available, I will always buy foods with labels indicating climate-change mitigation practices	0.23	0.23
Climate change increase pest recurrence	1 if agree/strongly agree - Climate change will increase the recurrence of insect pests and diseases	0.29	0.26
Alternative pest control	1 if agree/strongly agree - Alternative pest control practices in agriculture will mitigate climate change	0.21	0.20
Climate change and food prices	1 if agree/strongly agree - The adoption of climate change mitigation practices in agriculture will increase food prices	0.33	0.34
Household practices to mitigate climate change			
Efficient appliances	1 if agree/strongly agree - I own household appliances with high energy efficiency	0.44	0.45
Electric/hybrid car	1 if agree/strongly agree - I own an electric or hybrid car	0.13	0.15
Recycle	1 if agree/strongly agree - I recycle as much as I can	0.61	0.59
Food waste reduction	1 if agree/strongly agree - I follow strategies to reduce food waste	0.50	0.51
Compost	1 if agree/strongly agree - I compost food scraps and nonedible parts of foods to reduce landfill waste	0.25	0.27
Support to policies to mitigate climate change			
Promote	1 if support/strongly support - Policy incentives to promote renewable energy sources	0.56	0.52
Tax	1 if support/strongly support - policies taxing gasoline and nonrenewable energy use	0.31	0.29
Research	1 if support/strongly support - policies oriented to support research for solutions towards adapting current	0.52	0.48

results, presented in Appendix C, show that none of the interaction terms were statistically significant in the blueberry sample, suggesting that the within-subjects design did not influence respondents' choices. In contrast, for the sweet cherry sample, the interaction between *Biocontrol* and *Scenario order* was negative and statistically significant, indicating a decline in WTP for the

TABLE 4 GMNL-II parameter estimates for IPM logos in blueberries and sweet cherries.

	Blueberry			Sweet cherry		
	Before	After	After versus before intervention t-stat	Before	After	After versus before intervention t-stat
Mean WTP						
Biocontrol	3.21***	3.40***	0.58	2.71***	3.24***	1.56*
	(0.11)	(0.11)		(0.09)	(0.11)	
Gene editing of insect pests	1.21***	1.65***	4.96***	1.02***	1.59***	6.32***
	(0.11)	(0.11)		(0.10)	(0.11)	
Postharvest irradiation	1.10***	1.38***	1.46*	1.09***	1.55***	3.01**
	(0.11)	(0.12)		(0.09)	(0.11)	
Opt-out	−4.07***	−4.65***		−4.68***	−4.36***	
	(0.12)	(0.14)		(0.13)	(0.14)	
Standard deviation						
Biocontrol	5.27***	5.73***		5.25***	6.13***	
	(0.24)	(0.25)		(0.21)	(0.26)	
Gene editing of insect pests	3.03***	2.85***		2.62***	2.85***	
	(0.17)	(0.17)		(0.16)	(0.17)	
Postharvest irradiation	3.59***	4.02***		2.87***	4.01***	
	(0.19)	(0.21)		(0.15)	(0.20)	
Opt-out	1.73***	2.19***		1.56***	2.09***	
	(0.11)	(0.13)		(0.12)	(0.13)	
Scale heterog.	0.62***	0.82***		0.60***	0.73***	
	(0.03)	(0.03)		(0.03)	(0.03)	
Certain	−0.01	0.29***		0.11***	0.14***	
	(0.03)	(0.03)		(0.03)	(0.03)	
N of obs.	9582	9582		9468	9468	
Loglikelihood	−7882.28	−7485.15		−7616.53	−7392.98	
AIC	15796.56	15002.30		15265.06	14817.95	
BIC	15911.24	15116.98		15379.55	14932.44	

Note: H_0: WTP(after) ≤ WTP(before); H_1: WTP(after) > WTP(before).

*, **, *** denotes statistically significance at the 10%, 5%, and 1% levels.

biocontrol label over the sequence of choice tasks. This finding suggests that scenario ordering affected responses in the sweet cherry sample, specifically by reducing WTP for the biocontrol label as respondents advanced through the survey.

Across both fruits, respondents indicated the highest WTP for those labeled with the biocontrol logo, followed by gene editing of insect pests and irradiation, all preferred over chemical pest control. Before the climate change information is presented, WTP for irradiated cherries is higher

than for cherries produced using gene-edited insects; however, this relationship reverses after the information is provided. We did not find any significant disparity between the WTP for blueberries and cherries, suggesting no effect of consumption motives for these two fruits.

Our results are aligned with previous studies' findings indicating acceptance of produce that used IPM over reliance on chemicals only (Hollingsworth et al. 1993; Underhill 1993; Anderson et al. 1996; Govindasamy et al. 2001). Given the preference of alternative IPM-related practices over reliance on chemical applications, our study findings are aligned with those indicating consumers' WTP price premiums for foods with fewer pesticide applications (Misra et al. 1991; Moon et al. 2002; Florax 2005; Bernard and Bernard 2010; Bazoche et al. 2013; Nitzko et al. 2024). IPM-related practices are consistent with the message conveyed by ecolabels; to this extent, our results also concur with consumers' WTP premiums for fruit using these labels (Loureiro et al. 2001; Loureiro et al. 2002; Marette et al. 2012). Similarly, our findings align with prior research showing that consumers are willing to pay price premiums for organic produce when their primary motivation to consume organic is the reduced chemical applications (Anstine 2007; Zhang et al. 2008; Dettmann and Dimitri 2010; Aertsens et al. 2011; Dimitri and Dettmann 2012; Bazoche et al. 2013; Koch et al. 2017; McFadden and Huffman 2017).

Our findings coincide with the more recent study by Jones and Brown (2023), who found that respondents generally do not reject the use of gene drives to control insect pests in fresh blueberries and oranges for juice. Results also concur with studies signaling consumers' acceptance of post-harvest irradiation to fresh fruits, compared to reliance on chemical applications (Murray et al. 2024).

Following the climate change information intervention, WTP increased for both blueberries and cherries produced using biocontrol, gene editing of insect pests, and irradiation. The only exception was blueberries with biocontrol, for which the change in WTP before and after the intervention, was not statistically significant. The negative coefficient for the opt-out option indicates that consumers derived greater utility from selecting one of the labeled fruit alternatives compared to choosing "none."

All standard deviation coefficient estimates are statistically significant, indicating heterogeneity in the responses. After the information intervention, the standard deviation magnitudes are consistently higher than before, except for the blueberries treated using gene-edited insect pests. The scale heterogeneity is larger after the intervention compared to before, suggesting greater individual heterogeneity in responses. The certainty parameter is positive and statistically significant, indicating that those who are more certain about their responses derived greater utility from choosing blueberries or sweet cherries with the logos presented in this study.

4.4 | Heterogeneity in responses

As shown in Table 5, the latent class analyses identified three different respondent groups, with the number of individuals in each, varying by fruit: pro-biocontrol (12.65% for blueberry, 18.26% for cherries), price-conscious (57.24% for blueberry, 50.05% for cherries), and pro-gene editing (30.11% for blueberry and 31.69% for cherries). Pro-biocontrol groups favor biocontrol strongly, with mixed views on gene editing and irradiation. Price-conscious groups show high price sensitivity and limited support for gene editing. Pro-gene editing groups prioritize gene editing, with lower price sensitivity and moderate views on other methods.

We treated pro-biocontrol as the base. Compared to it, pro-gene editing respondents for both fruits are more often male, in smaller households (<3 members), and with children. Prior research suggests men are more accepting of IPM (Govindasamy et al. 2001). No conclusive patterns emerged regarding age, education, employment, or ethnicity. Pro-gene editing respondents are more likely to identify politically. For blueberries, they include more liberals and conservatives, with

TABLE 5 Latent class parameter estimates and ANOVA of membership variables to measure heterogeneity in the willingness to pay for different IPM logos.

	Blueberries			Sweet cherries		
	Pro-biocontrol	Price conscious	Pro-gene editing	Pro-biocontrol	Price conscious	Pro-gene editing
Variable	**12.65%**	**57.24%**	**30.11%**	**18.26%**	**50.05%**	**31.69%**
Price	−0.26***	−1.30***	−0.09**	−0.32***	−1.46***	−0.17***
	(0.09)	(0.08)	(0.04)	(0.07)	(0.06)	(0.04)
Biocontrol	3.79***	0.37***	1.67***	4.04***	−0.04	1.68***
	(0.24)	(0.11)	(0.12)	(0.19)	(0.10)	(0.09)
Gene editing of insect pests	−0.65**	−0.56***	1.69***	1.14***	−0.87***	1.48***
	(0.28)	(0.12)	(0.13)	(0.18)	(0.10)	(0.09)
Postharvest irradiation	0.42**	0.28**	0.69***	0.97***	0.07	0.85***
	(0.21)	(0.12)	(0.11)	(0.18)	(0.10)	(0.09)
Sociodemographics						
Female	-	−0.42***	−0.31***	-	−0.49***	−0.44***
		(0.08)	(0.07)		(0.07)	(0.08)
Family size ≥ 3	-	−0.37***	−0.30***	-	−0.42***	−0.51***
		(0.09)	(0.09)		(0.09)	(0.09)
Born in or before 1981	-	0.40***	0.18**	-	0.31***	−0.26***
		(0.08)	(0.08)		(0.08)	(0.08)
Income ≥$75,000/year	-	−0.14*	−0.11	-	−0.33***	−0.07
		(0.08)	(0.08)		(0.08)	(0.08)
Children presence	-	−0.11	0.29***	-	0.26***	0.60***
		(0.09)	(0.09)		(0.09)	(0.09)
Education ≥ bachelor degree	-	−0.09	0.20***	-	−0.16**	0.12
		(0.08)	(0.08)		(0.08)	(0.08)
Employed	-	0.40***	0.32***	-	−0.01	0.01
		(0.07)	(0.07)		(0.07)	(0.07)
White	-	−0.30***	−0.57***	-	0.11	0.11
		(0.08)	(0.08)		(0.08)	(0.08)
Northeast	-	−0.92***	−0.72***	-	−0.27**	−0.21*
		(0.11)	(0.11)		(0.11)	(0.12)
South	-	−0.71***	−0.32**	-	−0.16*	0.25***
		(0.10)	(0.10)		(0.09)	(0.09)
West	-	−0.53***	−0.57***	-	−0.04	−0.18*
		(0.11)	(0.11)		(0.10)	(0.11)

(Continues)

TABLE 5 (Continued)

	Blueberries			Sweet cherries		
	Pro-biocontrol	Price conscious	Pro-gene editing	Pro-biocontrol	Price conscious	Pro-gene editing
Variable	**12.65%**	**57.24%**	**30.11%**	**18.26%**	**50.05%**	**31.69%**
Liberal	-	0.22**	0.21**	-	0.17*	0.05
		(0.10)	(0.09)		(0.09)	(0.10)
Conservative	-	−0.06	0.29***	-	−0.35***	−0.26**
		(0.10)	(0.10)		(0.10)	(0.11)
Democratic	-	0.73***	0.47***	-	0.08	0.55***
		(0.10)	(0.09)		(0.09)	(0.09)
Republican	-	0.68***	0.22**	-	0.38***	0.49***
		(0.10)	(0.10)		(0.10)	(0.11)
Frequent consumer	-	−0.12*	0.12	-	0.03	0.03
		(0.07)	(0.07)		(0.07)	(0.07)
Importance of blueberry/sweet cherry features						
Taste	-	−0.11	−0.20*	-	−0.63***	−0.96***
		(0.11)	(0.11)		(0.12)	(0.12)
Appearance	-	0.56***	0.26***	-	0.15*	0.26***
		(0.08)	(0.08)		(0.08)	(0.09)
Storage properties	-	0.05	0.29***	-	0.35***	0.24***
		(0.08)	(0.08)		(0.08)	(0.08)
Price	-	0.83***	−0.08	-	1.01***	0.10
		(0.08)	(0.07)		(0.08)	(0.08)
Health	-	−0.64***	−0.13	-	0.04	0.16*
		(0.09)	(0.09)		(0.08)	(0.09)
Ecofriendly	-	0.39***	0.47***	-	0.01	0.18*
		(0.11)	(0.10)		(0.11)	(0.11)
Local	-	−0.66***	−0.12	-	−0.45***	−0.18*
		(0.09)	(0.08)		(0.09)	(0.09)
Organic	-	−1.58***	−0.61***	-	−1.44***	−0.63***
		(0.08)	(0.08)		(0.08)	(0.08)
Fair labor	-	0.00	−0.41***	-	−0.27***	0.03
		(0.10)	(0.09)		(0.10)	(0.10)
Fair trade	-	0.35***	0.43***	-	0.23**	0.27**
		(0.11)	(0.10)		(0.11)	(0.11)

TABLE 5 (Continued)

	Blueberries			Sweet cherries		
	Pro-biocontrol	Price conscious	Pro-gene editing	Pro-biocontrol	Price conscious	Pro-gene editing
Variable	**12.65%**	**57.24%**	**30.11%**	**18.26%**	**50.05%**	**31.69%**
Climate change mitigation friendly	-	−0.68***	−0.55***	-	−0.36***	−0.25**
		(0.11)	(0.10)		(0.11)	(0.11)
Country of origin	-	0.11	0.06	-	−0.15*	−0.01
		(0.09)	(0.08)		(0.08)	(0.08)
Knowledge of IPM						
Know IPM	-	−0.02	−0.26**	-	0.08	0.00
		(0.11)	(0.10)		(0.10)	(0.10)
IPM mitigates climate change	-	0.51***	0.43***	-	0.75***	0.80***
		(0.11)	(0.10)		(0.11)	(0.11)
Knowledge of climate change						
I know a lot about climate change	-	0.50***	0.24*	-	0.50***	0.34**
		(0.15)	(0.14)		(0.14)	(0.14)
I know how to evaluate the climate friendliness of products and services	-	0.36**	0.13	-	0.12	−0.36***
		(0.15)	(0.13)		(0.15)	(0.13)
Others consider me climate change expert	-	0.76***	0.91***	-	0.99***	1.40***
		(0.18)	(0.18)		(0.18)	(0.17)
Climate change and food consumption perceptions						
Own dietary choices don't impact on climate change	-	−0.23**	0.14	-	−0.36***	−0.40***
		(0.10)	(0.10)		(0.10)	(0.10)
Others dietary choices impact climate change	-	−0.21**	−0.30***	-	0.17*	0.14
		(0.09)	(0.09)		(0.09)	(0.09)
Not much I can do about climate change	-	0.64***	0.32***	-	0.42***	0.39***
		(0.12)	(0.12)		(0.12)	(0.12)
Buy foods labeled climate change friendly	-	0.02	0.58***	-	−0.10	0.18*
		(0.11)	(0.10)		(0.11)	(0.10)
Climate change increase insect pests and diseases recurrence	-	−0.07	0.02	-	0.24**	0.59***
		(0.10)	(0.09)		(0.09)	(0.09)
Alternative pest control practices in agriculture mitigate climate change	-	−0.05	−0.14	-	−0.55***	−0.64***
		(0.11)	(0.10)		(0.11)	(0.11)
Climate change mitigation practices in agriculture increase food prices	-	0.22***	0.34***	-	0.17**	0.23***
		(0.08)	(0.08)		(0.08)	(0.08)

(Continues)

TABLE 5 (Continued)

	Blueberries			Sweet cherries		
	Pro-biocontrol	Price conscious	Pro-gene editing	Pro-biocontrol	Price conscious	Pro-gene editing
Variable	**12.65%**	**57.24%**	**30.11%**	**18.26%**	**50.05%**	**31.69%**
Household practices to mitigate climate change						
I use efficient appliances	-	0.35***	0.02	-	0.18**	−0.00
		(0.08)	(0.07)		(0.07)	(0.08)
I use electric/hybrid car	-	0.30**	0.32***	-	0.18	0.35***
		(0.12)	(0.11)		(0.11)	(0.11)
I recycle	-	−0.03	0.10	-	0.04	0.08
		(0.08)	(0.08)		(0.08)	(0.08)
I practice food waste reduction	-	−0.31***	−0.30***	-	−0.20**	−0.13
		(0.08)	(0.08)		(0.08)	(0.08)
I compost	-	−0.12	−0.21**	-	−0.12	−0.25***
		(0.09)	(0.08)		(0.08)	(0.09)
Support to policies to mitigate climate change						
Policies promoting renewable energy sources	-	−0.44***	−0.19**	-	−0.02	−0.10
		(0.10)	(0.09)		(0.09)	(0.09)
Policies taxing gasoline and nonrenewable energy use	-	−0.36***	−0.26***	-	0.14	0.30***
		(0.09)	(0.09)		(0.09)	(0.09)
Policies oriented to support research for solutions towards adapting current agricultural practices	-	0.29***	0.45***	-	−0.23**	−0.16*
		(0.10)	(0.09)		(0.09)	(0.10)
Constant	-	1.51***	0.87***	-	1.01***	0.55***
		(0.17)	(0.17)		(0.17)	(0.17)
Loglikelihood	−8133.92			−7804.62		
AIC	16,493.84			15,835.24		
BIC	17,303.78			16,643.83		
N of obs.	9582			9468		

Note: *, **, *** denotes statistically significance at the 10%, 5%, and 1% levels.

greater Democratic affiliation. For cherries, they are less conservative, with a narrower Democrat–Republican gap.

Relative to pro-biocontrol, pro-gene editing respondents prioritize appearance and storage but not taste. They value eco-friendliness and fair trade, but not organic labels, and show a lower likelihood of buying fruit with climate change mitigation labels. Regarding IPM knowledge, they are more likely to agree that IPM mitigates climate change. However, only for blueberries, the pro-gene editing group appears to be less knowledgeable of IPM compared to the pro-biocontrol.

In relation to climate change and food consumption perceptions, for both fruits, the pro-gene editing compared to the pro-biocontrol, is more likely to agree that there is not much they can do about climate change, to buy climate-friendly labeled foods, and to believe that implementing climate change mitigation practices will increase the price of foods. Other aspects of climate change and food consumption perceptions are mixed.

About household practices to mitigate climate change, in both fruits, the pro-gene editing group compared to the pro-biocontrol more likely to own electric/hybrid cars but less likely to compost food. In terms of support for policies to mitigate climate change, for blueberries, the pro-gene editing compared to the pro-biocontrol show less support for policies promoting renewable resources and taxing gasoline and nonrenewable energy use, but express greater support for research aimed at adapting current agricultural practices. Conversely, for cherries, the pro-gene editing shows more support to taxing gasoline and nonrenewable energy use, but less support towards research.

In sum, latent class analysis identified three consumer segments—pro-biocontrol, price-conscious, and pro-gene editing—varying by fruit and preferences. Pro-gene editing respondents prioritize appearance, gene editing, and political identity, show mixed climate views, favor eco-labels but not organic, and are more likely to own electric cars. Their policy support differs by fruit type.

5 | CONCLUSIONS

Pesticides boost agricultural productivity but raise concerns about health, the environment, and climate change, creating a feedback loop that increases their use. IPM aims to reduce reliance on pesticides but may have unintended ecological impacts. This study assesses consumer WTP for IPM-labeled fruits and explores how climate change awareness affects perceptions of IPM. This study reports on a nationwide survey of blueberry and sweet cherry consumers, revealing a preference for biocontrol, irradiation, and gene editing of insect pests over chemical pesticides, with the highest WTP for biocontrol. After an information intervention consisting of disclosing climate change effects on agricultural practices, the WTP for all IPM logos increase, as does the variability in the estimates. A latent class analysis reveals three respondent groups for blueberries and cherries: pro-biocontrol (strongly favor biocontrol), price-conscious (sensitive to price and less favorable to gene editing), and pro-gene editing (in favor of gene editing, with less sensitivity to price). From a sociodemographic view, pro-gene editing individuals tend to be males, and have a smaller household and a higher proportion of households with children. Also, this group is likely to buy fruit with climate change mitigation labels. They believe IPM mitigates climate change but are less knowledgeable about IPM. Their support for climate change mitigation policies varies—they have less support for renewable energy policies and taxing nonrenewable energy, but more support for research of solutions in blueberry production.

Understanding consumer WTP for IPM-labeled fruits allows stakeholders to refine practices and marketing strategies by effectively communicating the benefits of IPM and climate change mitigation through targeted logos. Policymakers can leverage insights on climate change awareness and consumer perceptions to shape sustainable agricultural policies and incentives. Environmental advocates can raise awareness about the impacts of pesticides to encourage IPM adoption. Finally, educating consumers—via the use of logos—on the benefits of various pest management strategies and their climate impact can enhance their confidence in the quality and safety of fresh fruits.

This study has three limitations; one is its hypothetical nature. To address this, we applied two widely accepted methods in the agricultural economics literature: cheap talk and certainty scale. Since IPM logos for fresh fruits do not exist currently in the market, non-hypothetical approaches are not feasible. Further, we agree with Jones and Brown (2023) that ex-ante evaluations, which use hypothetical situations, provide more valuable insights for policymaking compared to ex post analyses. The second limitation is that our sample of respondents exhibited a slightly higher affinity

for liberal views, which are typically more receptive to climate change information. Consequently, our findings on the effects of climate change information on the WTP for IPM-related practices shall be applicable to this specific population. Third, we acknowledge that within-subjects designs involve inherent trade-offs. While this approach helps control for individual-level heterogeneity, it may also introduce anchoring effects—given that respondents completed the same choice experiment twice—and potential experimenter demand effects following exposure to the climate change graphic. To evaluate these concerns, we conducted additional analyses assessing the influence of the choice scenario order on WTP estimates. Results indicated no significant effect for the blueberry sample and a decline in WTP for the biocontrol label in the sweet cherry sample. The latter suggest no evidence of a systematic bias introduced by the within-subjects design.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Xueying Ma https://orcid.org/0000-0001-9346-9980

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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