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How Growers' Values Affect Decisions in Choosing Strawberry Cultivars in the USA: A Higher-Order Construct PLS-SEM Approach

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ABSTRACT

The United States of America (US) is the world's second-leading producer of strawberries. In the US, several cultivars of strawberries exist, and, among other factors, breeders consider their growers' environmental conditions and market targets when breeding. Growers often have the possibility of choosing a cultivar in which they obtain the most value. Growers' decisions regarding cultivars are influenced by perceived value. This study is the first to treat the concept of domain-specific innovativeness (DSI) as a higher-order construct and combine it with consumer perceived value (PV) to analyze which of the selected PVs – functional (PFV), social (PSV), conditional (PCV), and aesthetic (PAV) – directly affect or mediate growers' decision to choose a variety to grow (DCVG). The proposed research model was evaluated using the disjoint two-stage approach of the partial least squares structural equation model (PLS-SEM). The data analysis of 216 growers from the measurement model revealed that the model had good reliability and validity. In the analysis of the structural model, the total effect, seven direct and two indirect effects supported the hypotheses. Two direct effects and two indirect effects did not support the hypotheses. PFV and PSV mediate the effect of DSI and DCGV. The outcomes of this study significantly enhance our understanding of how diverse perceived values influence the decision-making behavior of strawberry growers in the US concerning the selection of cultivars. Furthermore, this study provides insights for strawberry breeders and nurseries by encouraging innovative approaches in the development of cultivars and the formulation of effective marketing strategies.

KEYWORDS
Strawberry; growers; perceived value; cultivars; PLS-SEM

Introduction

Consumption of strawberries in the United States (US) has increased significantly from 2 pounds per capita in 1980 to 8 pounds in 2013 (U.S. Department of Agriculture USDA, 2014). The consumption and production of fresh or processed strawberries is expected to increase as a result of increased awareness of the health and economic benefits associated with strawberry fruit and crop (Basu, et al. 2014; Malone, et al. 2014; Samtani, et al. 2019; USDA, 2017; USDA-ERS, 2023). There are some challenges to strawberry cultivation such as poor cultivar resilience to diseases and climate change, poor-tasting fruits, short shelf-life, and high percentage of nonmarketable produce, all of which adversely affect revenues of strawberry growers (Husaini and Neri, 2016). Plant breeders have developed hundreds of strawberry cultivars that meet grower and consumer preferences. This has helped to overcome many of the challenges and enhanced production across the US (Varman, 2025).

Several studies have compared the performance of different cultivars of strawberries in various parts of the US and under various conditions (Gu, et al. 2017; Liu et al., 2024; Santos et al., 2009). The

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results of these studies show the dynamic nature of cultivars in the strawberry industry and ongoing shifts in cultivar preferences by growers (López-Aranda, et al. 2011). These shifts suggest that growers are seeking some desired yield characteristics that can best satisfy their market targets, ensure consumer loyalty, and gain a competitive advantage (López-Aranda, et al. 2011). Many prior studies have concentrated on consumers' perceptions and expectations of strawberry cultivars (Bhat et al., 2015; Lewers et al., 2020; Porter, et al. 2023; Predieri, et al. 2021) with little being known about the perceptions and expectations growers have of cultivars they grow (Li, et al. 2020). However, unlike the final consumers, strawberry growers are the ones knowledgeable of cultivars and make decisions of cultivars at their disposal to grow. When growers are deciding on cultivars to grow, the perceived value (PV) for these cultivars play an important role, because PV is essential in achieving; competitive advantage (Kurt Christensen, 2010; Parasuraman, 1997), PV is a significant factor in strategic management (Nguyen and Leblanc, 2001; Woodruff, 1997), it plays a critical role in driving consumer satisfaction, loyalty, and behavioral intentions, ultimately influencing business profitability (Keshavarz and Jamshidi, 2018; Reichheld et al., 2000; Sharma and Klein, 2020; Woo and Kim, 2019). Specifically, this paper aims to address the research question: *What perceived values affect US growers when deciding to choose cultivars of strawberries to grow?*

The means-end chain theory holds that consumer behavior is value-driven, so PVs ultimately influence consumers' choice patterns (Gutman, 1997). Consumers prefer to purchase goods that are perceived to have the highest value (Parment, et al. 2021). Only a few academic works have successfully integrated domain-specific innovativeness (DSI) into the theoretical structure of consumers' perceived value (Jiang, et al. 2022). DSI captures an individual's tendency to learn about (information-possessing innovativeness (IPI)) and adopt new products (product-possessing innovativeness (PPI)) within a specific area of interest. By integrating DSI in the study's model, this study assessed growers' openness to learning and adopting cultivars (Chauhan, et al. 2019; Goldsmith and Hofacker, 1991; Varma Citrin, et al. 2000). In this study the researchers defined DSI as a higher-order construct (HOC) (Becker, et al. 2012) made up of two subdimensions (Jeong, et al. 2017) – IPI and PPI – using a Reflective-Formative Model (Becker, et al. 2012). Woodruff (1997) defined PV as a multidimensional concept reflecting how consumers evaluate products based on their ability to meet personal goals in use situations. While PV has been measured both as a unidimensional and multidimensional construct (Monroe, 2012; Sánchez-Fernández and Iniesta-Bonillo, 2007), this paper focused on its multidimensional nature, particularly in relation to specific perceived value types (Chahal and Kumari, 2012; Holbrook, 1999; Sheth, et al. 1991). Given the context of strawberry cultivars, the study emphasized four relevant dimensions: perceived *functional (PFV), aesthetic (PAV), social (PAV), and conditional (PCV)* values, excluding epistemic and emotional values due to overlap with other constructs.

There is a knowledge gap in studying the value behaviors of US strawberry growers when choosing cultivars to grow. This study aimed to lessen that gap by examining the specific objectives; a) identifying growers' key perceived value dimensions b) analyzing the direct, indirect and mediating relationships between DSI, growers' PV of cultivars, and their decision to choose to grow a variety (DCGV) and c) providing strategic recommendations.

DSI plays a significant role in shaping consumers' perceptions of the functional value (i.e., the monetary and performance) of products or services (GSI Commerce, 2009). Therefore, the researchers conjectured the hypothesis: ***H1****: DSI has a positive effect on PFV*. Consumers' appreciation of visual aesthetics differs based on their preferences, and those familiar with innovation in a specific domain are more open to novel design elements like shape, color, and size (Bloch, et al. 2003). The researchers thus posited the hypothesis: ***H2****: DSI has a positive effect on PAV*. Individuals with high product-possessing innovativeness often make purchasing decisions to enhance their social image and influence how others perceive them (Carver and Scheier, 1981). Therefore, the researchers hypothesized that ***H3****: DSI has a positive effect on PSV*. PCV refers to the value of a product that becomes noticeable only under specific conditions (Sheth, 1974), such as climate, location, or a managerial skill set. The researchers suggested that growers with higher DSI are better able to recognize and evaluate these situational benefits. Therefore, the hypothesis posited was: ***H4***: *DSI has a positive effect on PCV*.

Indeed, the functionality, reliability, and cost efficiency of the product have come to be of primary importance in the decision to use an innovation. Therefore, the researchers formulated the hypothesis: ***H5***: *PFV has a positive effect on DCGV*. The aesthetic value and distinctiveness of visual design in terms of size, shape, color etc, influence consumers' adoption and purchase decisions (Bloch et al., 2003; Kim, et al. 2021). Innovation diffusion theory highlights that individuals often adopt new products to boost their social status, with social value playing a key role in shaping acceptance behavior. Therefore, the researchers hypothesized that ***H7***: *PSV has a positive effect on DCGV*. Conditional value often depends on the prevailing situations such as the managerial skills of the growers, climate or production season, and level of capital and labor resources of the growers, among others. Growers' anticipation of these situations affects the cultivars they grow. Therefore, the researchers advanced the hypothesis: ***H8***: *PCV has a positive effect on DCGV*. The idea of domain-specific consumer innovativeness is commonly utilized in diffusion theory to explain why and how people in a given social system accept and spread new products (Jiang, et al. 2022). Consequently, the researchers formulated the hypothesis: ***H9***: *DSI has a positive effect on DCGV*.

Generally, high and positive PV contributes to the decision to adopt new products (Khoi et al., 2018). Hence, the researchers hypothesized the following: ***H9a***: *PFV mediates the effect of DSI on the DCGV;* ***H9b***: *PAV mediates the effect of DSI on the DCGV;* ***H9c***: *PSV mediates the effect of DSI on the DCGV;* and ***H9d***: *PCV mediates the effect of DSI on the DCGV*.

This study developed theoretical and conceptual frameworks, and formulated hypotheses based on existing literature. It adapted a measurement instrument from prior studies to collect primary cross-sectional data from US strawberry growers. Using a quantitative approach, it assessed the measurement and structural reliability and validity of the model. The analysis of results provided insights into the behavior of US growers in selecting strawberry cultivars.

The Figure 1 below is the conceptual framework for this study.

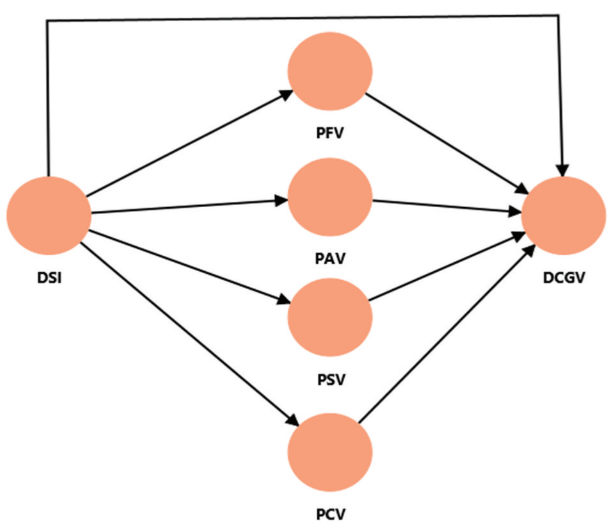

Figure 1. Conceptual research model of domain-specific innovativeness (DSI), Perceived values (PV) and decision to choose to grow a variety (DCGV) of strawberry by growers in the US. Where the PV comprises of the following PCV (Perceived Conditional Value), PAV (Perceived Aesthetic Value), PSV (Perceived Social Value) and PFV (Perceived Functional Value).

Materials and methods

Questionnaire design

The questionnaire was designed with two sections. The first section collected data for demographic information of the growers (see Table 2). In the second section, to measure the latent variables and test the relationships among them as proposed in the research model, 26 questions measuring observable indicators were developed for the latent constructs. The survey questionnaire was prepared using Google Forms and made available for completion online to members of strawberry growers' associations in the US between May 5, 2023, to July 14, 2023. These questions were adapted or guided from previous studies (see Table 1). The seven-point Likert scale was adopted to rate each item. Studies show that 5- to 7-point Likert scales optimize reliability and validity, while finer scales offer no added benefit (Dawes, 2008). A 7-point Likert scale was used because it enhances survey reliability by offering more response options, allowing participants to express their views more accurately and aligning better with objective reality. It also provides deeper insights into participants' reasoning and motivations (Joshi et al., 2015). At the end of the data collection, a draw was conducted and three growers each won a package for participating.

Data collection and analysis

A simple random sampling technique from the association members was used to collect the data. To ensure the accuracy and reliability of the dataset, redundant and inconsistent responses were identified by filtering out key variables such as e-mail addresses, farm names, and zip codes. To further validate the data, an online verification of the farm names and area codes were carried out to confirm that the farms existed and were located within the US. In cases where ambiguities or uncertainties arose, the respondents were contacted via e-mail for clarification. Observations that failed to meet these validation criteria were systematically removed from the dataset. This rigorous approach ensured the integrity of the final data used for analysis. After cleaning the dataset, the researcher arrived at 216 observations for further analysis. Soper (2022) provided a simple online method for calculating sample size appropriate for PLS-SEM. This can be accessed via website[1] interaction. Using Soper's (2022) calculation, the minimum sample size for model structure was 89 which is below the sample size used in this study. This approach is deemed superior to other online sample size calculators (Memon et al., 2020).

The researchers applied partial least squares structural equation modeling (PLS-SEM). PLS-SEM's flexibility in handling small samples, complex models, and minimal distributional assumptions, coupled with its focus on prediction and causal explanations, made it an ideal choice for this study (Hair et al., 2012). The statistical package used in analyzing the dataset was SmartPLS 4.0.9.8.[2] DSI was modeled as an HOC based on its two dimensions (IPI and PPI). Following the recommendation of Becker et al. (2023) to reduce bias, enhance predictive power and avoid multicollinearity issue, the researchers applied the disjoint two-stage approach, which used the latent variable scores of IPI and PPI generated in the lower-order construct (LOC) or Stage_1 as inputs for the model computation in the HOC or Stage_2. In this approach, it was recommended that both the reliability and discriminant validity of the LOC and HOC are evaluated. However, only the structural measurement of HOC was relevant for analysis. As recommended by Hair et al. (2022), this study used several statistical tests and criteria to assess the measurement and structural models. At the measurement model stage, the goal was to ensure construct validity and reliability therefore the following key criteria were evaluated; composite reliability and convergent validity and discriminant validity tests (Sarstedt, et al. 2021). Using the latent variable scores from the first stage, the structural model was tested for hypothesis testing, mediation analysis, model fit, and

[1]https://www.danielsoper.com/statcalc/calculator.aspx?id=89 (last accessed 27th March 2025)
[2]SmartPLS is headquartered in Germany. Version used for the research was (SmartPLS 4.0.9.8).

Table 1. Measurement instrument adapted and modified from prior studies to measure Perceived Values (PV), Information-Possessing Innovativeness (IPI), Product-Possessing Innovativeness (PPI) and Decision to Choose to Grow Variety (DCGV).

Variable	Item	Source
Information-Possessing Innovativeness (IPI)		
IPI_1	I actively seek information about varieties from diverse sources.	Modified based on: Jiang et al. (2022); Jeong et al. (2017); Goldsmith and Foxall (2003).
IPI_2	I am generally more sensitive to information about varieties than other growers.	
IPI_3	I usually spend more time searching for information on varieties than other growers.	
Product-Possessing Innovativeness (PPI)		
PPI_1	I generally have more strawberry varieties growing on my farm than other growers I know.	Modified based on: Jiang et al. (2022); Jeong et al. (2017); Goldsmith and Foxall (2003).
PPI_2	I generally tend to purchase the latest strawberry varieties.	
PPI_3	I tend to buy new strawberry varieties earlier than my peers.	
Perceived Functional Value (PFV)		
PFV_1	I like strawberry varieties based on their cost-effectiveness.	Modified based on Sweeney and Soutar (2001); Sheth et al. (1991).
PFV_2	I like strawberry varieties based on their resilience to diseases.	
PFV_3	I like strawberry varieties based on their quantity of yield.	
PFV_4	I like strawberry varieties based on their resilience to pests.	
PFV_5	I like strawberry varieties based on their ability to perform consistently.	
PFV_6	I like strawberry varieties based on their consistent quality flavor.	
Decision to Choose to Grow Variety (DCGV)		
DCGV_1	If I am the sole decision maker, I wish to use new strawberry varieties.	Modified based on Agarwal and Karahanna (2000).
DCGV_2	If I can afford it, I will grow every variety that is conducive to my location.	
DCGV_3	I feel positive about buying and using new strawberry varieties.	
Perceived Social Value (PSV)		
PSV_1	I believe growing this strawberry variety enhances my status, brand, and recognition among other growers.	Modified based on Jeong et al. (2017); Venkatesh et al. (2003).
PSV_2	People whose viewpoints I respect want me to grow this strawberry variety.	
PSV_3	Growing this strawberry variety would make people think positively of me.	
Perceived Aesthetic Value (PAV)		
PAV_1	I find the appearance of the strawberry variety in terms of color visually appealing.	Modified based on Lavie and Tractinsky (2004); Chahal and Kumari (2012)
PAV_2	I find the appearance of the strawberry variety in terms of size visually appealing.	
PAV_3	To what extent does the visual appeal of the variety resonate with your personal aesthetic preferences?	
Perceived Conditional Value (PCV)		
PCV_1	I value the location conduciveness of the strawberry variety that makes growing it possible.	Created for this study but guided by Pihlström and Brush (2008)
PCV_2	I value that the growing system available to me makes it possible to grow this variety.	
PCV_3	I value that the capital resources available to me make it possible to grow this variety.	
PCV_4	I value that the managerial skills I use make it possible to grow this variety.	
PCV_5	I value that the climate available to me makes it possible to grow this variety.	

Source: Adapted from previous literature sources.

predictive relevance. The following key criteria were evaluated; collinearity assessment, path coefficients, significance testing, explanatory and predictive analysis (Becker et al., 2023). All assumptions of the measurement and structural models were met. Generally, the control variables; farm size, type of farm ownership, educational level, main role, and main target market did not affect the model.

Table 2. Descriptive statistics of the 216 strawberry growers in the US who responded to the survey questionnaire ($N = 216$).

Demographic Profile	Categories	Frequency per category	Relative frequency per category (%)
Sex	Male	129	59.72
	Female	87	40.28
Age	≤20	30	13.89
	21 to 30	25	11.57
	31 to 40	53	24.54
	41 to 50	69	31.94
	51 to 60	14	6.48
	61 to 70	18	8.33
	71≥	7	3.24
Educational Level	Below high school	6	2.78
	High school	26	12.04
	Undergraduate	129	59.72
	Masters	39	18.06
	Ph.D.	16	7.41
Farm ownership	State	11	5.09
	Universities	25	11.57
	Private individuals	89	41.2
	*Uni.-Private partnership	44	20.37
	*Uni.-State partnership	32	14.81
	State-Private partnership	15	6.94
Employee size	0 to 9 employees	25	11.57
	10 to 49 employees	97	44.91
	50 to 249 employees	58	26.85
	250 employees and over	36	16.67
Main target market	Industrial processing	73	33.8
	U-pick & farm markets	38	17.59
	Groceries & supermarkets	60	27.78
	Restaurants	15	6.94
	Export	30	13.89

Source: Developed by the researcher from the survey.
*Uni. = University.

Results

Distribution of survey responses

As shown in Figure 2, the highest number of responses of strawberry growers (56) came from California, which is identified in red. As the number of responses decreases, the identifying color scheme ranges from deep blue, to light blue, and to gray. Florida, Oregon, Washington, North Carolina, Virginia, New York, and Pennsylvania each provided from 10 to 20 responses. The remaining states provided 1 to 10 responses. In summary, at least one response came from 31 states out of the 50 states in the US. This represents approximately 62% of responses across the US. Approximately 26% of the responses came from California.

Descriptive statistics

The descriptive statistics of the study in Table 2 showed that the sample consisted of 129 males (59.7%) and 87 females (40.3%) involved in US strawberry production. Over 31.9% were aged 41 to 50 years, and 59.7% hold undergraduate degrees. Most respondents (60.7%) were managers. Privately owned farms made 41.2%, and 44.9% of farms have 10 to 49 employees, classifying them as small and medium-sized enterprises. The primary target market was industry processing, supplied by 33.8% of growers.

Composite reliability and convergent validity

Items were deemed to have convergent validity if the values for composite reliability (CR), average variance extracted (AVE), and outer loadings met or exceeded thresholds of 0.7, 0.5, and 0.7,

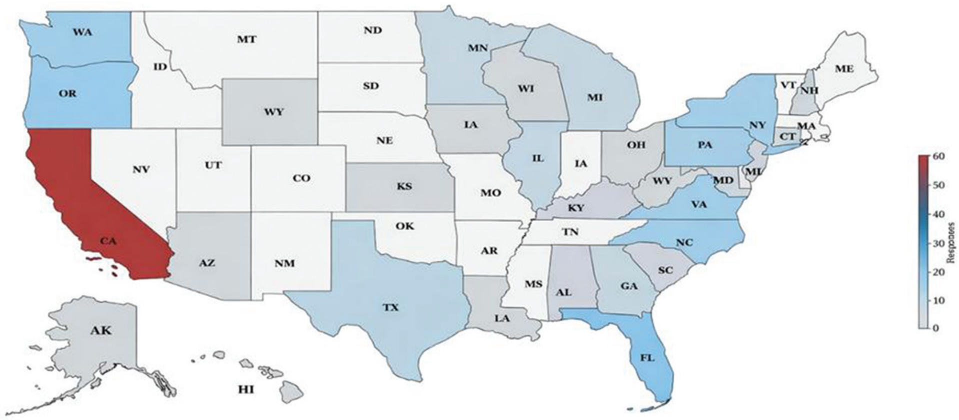

Figure 2. Distribution of survey responses from 216 strawberry growers across the USA.

Table 3. Composite reliability (cr) and convergent validity of the lower order construct and the higher-order construct to examine reliable, coherent and meaningful representations of latent constructs.

Lower Order Construct or Stage_ 1					Higher Order Construct or Stage_2			
Items	Outer loadings	Cronbach's alpha	CR (rho_a)	AVE	Variable	Cronbach's alpha	CR (rho_a)	AVE
DCGV_1	0.804	0.753	0.754	0.668	DCGV	0.753	0.754	0.668
DCGV_2	0.827							
DCGV_3	0.821							
IPI_1	0.809	0.765	0.782	0.680				
IPI_2	0.772							
IPI_3	0.888							
PAV_1	0.856	0.806	0.813	0.720	PAV	0.806	0.813	0.720
PAV_2	0.838							
PAV_3	0.852							
PCV_1	0.786	0.828	0.839	0.585	PCV	0.828	0.839	0.585
PCV_2	0.805							
PCV_3	0.719							
PCV_4	0.741							
PCV_5	0.770							
PFV_1	0.763	0.867	0.875	0.601	PFV	0.867	0.875	0.601
PFV_2	0.697							
PFV_3	0.833							
PFV_4	0.737							
PFV_5	0.781							
PFV_6	0.833							
PPI_1	0.717	0.716	0.737	0.637				
PPI_2	0.826							
PPI_3	0.844							
PSV_1	0.808	0.806	0.812	0.721	PSV	0.806	0.811	0.721
PSV_2	0.839							
PSV_3	0.899							

*DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value; PPI = Product-Possessing Innovativeness; IPI = Information-Possessing Innovativeness; AVE = Average Variance Extracted.

respectively (Hair et al., 2012). From Table 3, the measurement items for each construct were considered to exhibit adequate internal consistency reliability (Bagozzi et al., 1991) both at the LOC and HOC levels.

Discriminant validity

The Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT) are employed to determine the discriminant validity of the model. These criteria help assess the distinctiveness of each construct, ensuring that it is not highly correlated with other constructs (Henseler et al., 2015). In Tables 4 and 5, the researchers examined the discriminant validity of the LOC and HOC, respectively, using the Fornell-Larcker criterion. As proposed by Fornell and Larcker (1981), the criterion suggests that for a construct to be considered reliable, the square root of its AVE should exceed the correlation values with other constructs within the same row and column. These conditions were met in Tables 4 and 5.

The exact threshold level of the HTMT was debatable, but it was agreed that a lower HTMT ratio indicates better discriminant validity. Some authors suggest a threshold of 0.85 (Clark and Watson, 2016; Kline, 2011), whereas others propose a value of 0.90 (Gold et al., 2001; Teo et al., 2008). From Table 6, PPI <->PFV and PPI <->IPI in LOC or stage_1 slightly exceeded the threshold; however, from Table 4, it can be concluded that discriminant validity was established.

Collinearity assessment and effect size (F2)

Collinearity occurs when two or more indicators are highly correlated. It is an issue because it increases standard errors. To assess collinearity, the variance inflation factor (VIF) of the structural model is applied. From Table 7, VIF < 5 means that there is no level of collinearity among the constructs of the structural model. Effect size (f^2) is a numerical measure that quantifies the size of the difference between two groups or the strength of the relationship between variables (Cohen, 1988). For the effect size (f^2) of the hypothesis, there are three different effect values: small (greater than 0.02), medium (greater than 0.15), and large (greater than 0.35) (Chin, 1998; Hair et al., 2012). It is shown from Table 7 that there were large effect size of *DSI->PFV, DSI->PAV, DSI->PSV*, and *DSI->PCV*. There were small effect sizes of the following: *DSI->DCGV, PAV->DCGV, PFV->DCGV*, and *PSV->DCGV*. The effect size of *PCV->DCGV* was below 0.02 and can be described as negligible.

Table 4. Measuring discriminant validity of the lower order construct (LOC) using the Fornell-Larcker criterion.

Discriminant Validity of LOC_Fornell Larcker_LOC_Stage 1							
	DCGV	IPI	PAV	PCV	PFV	PPI	PSV
DCGV*	**0.818**						
IPI	0.672	**0.825**					
PAV	0.646	0.509	**0.848**				
PCV	0.620	0.535	0.730	**0.765**			
PFV	0.716	0.668	0.668	0.719	**0.775**		
PPI	0.661	0.669	0.646	0.583	0.733	**0.798**	
PSV	0.630	0.504	0.614	0.586	0.660	0.636	**0.849**

*DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value; PPI = Product-Possessing Innovativeness; IPI = Information-Possessing Innovativeness.

Table 5. Measuring discriminant validity of the higherorder construct (HOC) using the Fornell-Larcker criterion.

Discriminant Validity of HOC_Fornell Larcker_Stage 2					
	DCGV	PAV	PCV	PFV	PSV
DCGV*	**0.817**				
PAV	0.647	**0.848**			
PCV	0.620	0.730	**0.765**		
PFV	0.716	0.668	0.719	**0.776**	
PSV	0.631	0.614	0.586	0.660	**0.849**

*DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value.

Table 6. Measuring discriminant validity using the Heterotrait-monotrait ratio (HTMT) of lower order construct (LOC) and higher-order construct (HOC).

Paths	LOC or Stage _1 (HTMT)	HOC or Stage_2 (HTMT)
IPI <->DCGV*	0.872	
PAV <->DCGV	0.816	0.816
PAV <->IPI	0.638	
PCV <->DCGV	0.739	0.739
PCV <->IPI	0.630	
PCV <->PAV	0.879	0.879
PFV <->DCGV	0.869	0.869
PFV <->IPI	0.801	
PFV <->PAV	0.795	0.795
PFV <->PCV	0.796	0.796
PPI <->DCGV	0.892	
PPI <->IPI	0.906	
PPI <->PAV	0.838	
PPI <->PCV	0.714	
PPI <->PFV	0.910	
PSV <->DCGV	0.799	0.799
PSV <->IPI	0.639	
PSV <->PAV	0.759	0.759
PSV <->PCV	0.686	0.686
PSV <->PFV	0.793	0.793
PSV <->PPI	0.824	

*DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value; PPI = Product-Possessing Innovativeness; IPI = Information-Possessing Innovativeness; Paths = refers to the hypothesized directional relationships between constructs in the model.

Significance and relevance of the HOC model

After resampling the data 10,000 times using bootstrapping (Hair et al., 2023), the statistical significance of each path coefficient was evaluated at a significance level (α) of 0.05 or a confidence level of 95%. Table 7 and Figure 3 present the results of the direct, indirect, and total effects analysis. Table 7 shows that seven direct effects are significant (H1, H2, H3, H4, H5, H7, H9) and support their hypotheses, while two are nonsignificant (H6, H8) and do not support their hypotheses. The most positive significant effect was DSI on PFV ($t = 21.845$, $p = .000$), followed by DSI on PAV ($t = 14.985$, $p = .000$), DSI on PCV ($t = 14.634$, $p = .000$), DSI on PSV ($t = 13.554$, $p = .000$), PFV on DCGV ($t = 2.507$, $p = .012$), and PSV on DCGV ($t = 2.095$, $p = .036$). Overall, DCGV was significantly impacted by DSI, PFV, and PSV, whereas PAV and PCV were insignificant on DCGV. The total effect of DSI on DCGV was positive and significant ($t = 18.310$, $p = .000$). Additionally, the indirect effects DSI->PFV->DCGV (O = 0.177, $t = 2.478$, $p = .013$) and DSI->PSV->DCGV (O = 0.095, $t = 2.067$, $p = .039$) were significant, while DSI->PAV->DCGV and DSI->PCV->DCGV were not significant.

Explanation of the HOC research model

The Figure 3 represents a diagram of the PLS-SEM higher-order construct developed from this study. The blue circles indicate latent constructs, while the yellow-highlighted labels represent observed variables. Path coefficients (numbers along arrows) indicate the strength and direction of relationships between constructs, with p-values in parentheses reflecting statistical significance. Factor loadings, shown near observed variables, indicate how well each indicator represents the latent variable. Significance is typically assessed at a threshold of $p < .05$.

Table 7. Direct, Specific Indirect and Total effects in the higher-order construct (HOC) model.

Direct Effect of HOC								
Hypothesis	Original sample (O)	Sample mean[3] (M)	Standard deviation (STDEV)	T statistics	*p*-values	VIF	f2	Supported
DSI ->DCGV (H9)*	0.310	0.310	0.085	3.665	0.000	2.795	0.091	Yes
DSI ->PAV (H2)	0.648	0.649	0.043	14.985	0.000	1.000	0.726	Yes
DSI ->PCV (H4)	0.614	0.618	0.042	14.634	0.000	1.000	0.606	Yes
DSI ->PFV (H1)	0.771	0.772	0.035	21.845	0.000	1.000	1.465	Yes
DSI ->PSV (H3)	0.640	0.639	0.047	13.554	0.000	1.000	0.693	Yes
PAV ->DCGV (H6)	0.153	0.150	0.087	1.761	0.078*	2.606	0.024	No
PCV ->DCGV (H8)	0.067	0.074	0.083	0.806	0.420	2.717	0.004	No
PFV ->DCGV (H5)	0.230	0.227	0.092	2.507	0.012	3.420	0.041	Yes
PSV ->DCGV (H7)	0.148	0.147	0.071	2.095	0.036	2.058	0.028	Yes
Specific Indirect Effect of HOC								
Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	*p*-values			Supported
DSI ->PAV ->DCGV	0.099	0.097	0.056	1.771	0.077*			No
DSI ->PCV ->DCGV	0.041	0.047	0.052	0.787	0.432			No
DSI ->PFV ->DCGV	0.177	0.175	0.071	2.478	0.013			Yes
DSI ->PSV ->DCGV	0.095	0.094	0.046	2.067	0.039			Yes
Total Effect of HOC								
Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	P values			Supported
DSI ->DCGV	0.722	0.723	0.039	18.310	0.000			Yes

Note: *Significant at 10% level.
*Domain-Specific Innovativeness = DSI; DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value.

Mediation analysis

To conduct the mediation analysis, the *p*-values, t-tests, and confidence intervals of the specific indirect effect, direct effect, and total effect are considered together (Sarstedt et al., 2021) and evaluated at a significance level (α) of 0.05. From Table 8, *H9a* and *H9c* support the hypothesis that PFV and PSV mediate the effect of DSI on DCGV, respectively. The mediation effect for both is partial. However, *H9b* and *H9d* do not support the hypothesis that PAV and PCV mediate the effect of DSI on DCGV, respectively.

Explanatory and predictive powers of the model

R-squared measures a model's explanatory power, representing the variance in endogenous constructs explained by all linked exogenous constructs. According to Hair et al. (2023), an R-squared value of 0.25 indicates weak explanatory power, 0.50 is moderate, and 0.75 is substantial. Table 9 shows that DCGV and PFV have moderate explanatory power, with 61.3% and 59.2% of their variance explained by their exogenous variables, respectively. PAV, PCV, and PSV have weak but approaching moderate explanatory power, with 41.8%, 37.4%, and 40.7% of their variance explained by their exogenous variables. respectively.Table 9 also shows the latent variable (LV) prediction of DCGV, PFV, PAV, PSV, and PCV. They have a Q2 value greater than 0 indicating that the model has predictive relevance, but the predictive performance might be moderate or less accurate as Q2 approaches 0.Table 9 also shows the Root Mean Square Error (RMSE) and the Mean Absolute Error (MAE). RMSE is the standard deviation of the residuals (prediction errors). Like RMSE, MEA is used to evaluate the

[3]Sample Mean (M) is the mean of the path coefficients obtained from the bootstrapping procedure. Original Sample (O) represents the path coefficient obtained from the PLS-SEM algorithm using the original dataset. If Original Sample and Sample Mean are close, the bootstrapping results are stable, indicating a reliable path coefficient.

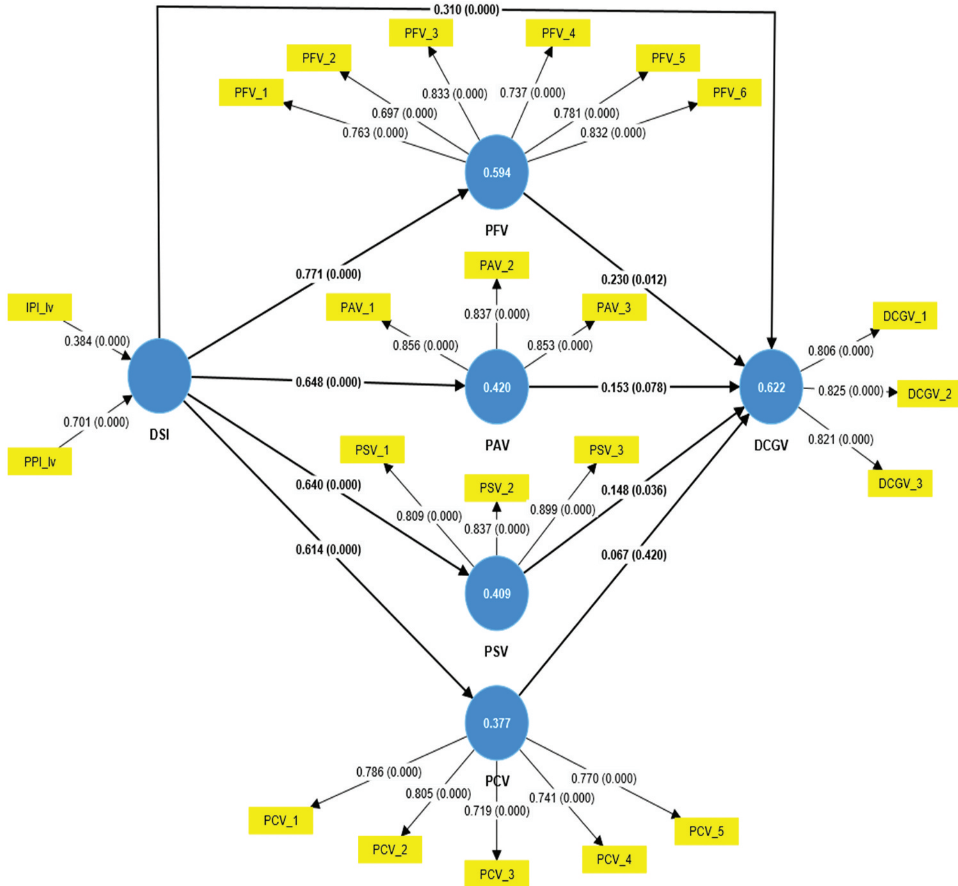

Figure 3. Research model of higher-order construct showing the relationship and strengths of latent constructs and observable variables. Where PCV (Perceived Conditional Value), PAV (Perceived Aesthetic Value), PSV (Perceived Social Value), PFV (Perceived Functional Value), DCGV (Decision to Choose to Grow a Variety) and each with their respectively numbered observed variables/indicators such as PCV_1, PAV_2, DCGV_3 etc., DSI (Domain-Specific Innovativeness), PPI_lv= Product-Possessing Innovativeness latent variable scores from the lower order construct, and IPI_lv= Information-Possessing Innovativeness latent variable scores from the lower order construct. *Significance Level (α)=0.05; blue circles indicate latent constructs; yellow boxes are the numbered indicators or observed variables of their respective latent construct; r-squared are values in blue circles; *p*-values are in parenthesis; path coefficients are values across bold arrows; factor loadings are values across faint arrows shown near observed variables.

accuracy of a model, but MEA is simpler and less sensitive to large errors. Low RMSE and MAE values that approach zero imply more accurate predictions.

Discussion, theoretical and practical contributions

This study investigated the behavior of US strawberry growers in selecting cultivars conducive to their locations. Through the analysis of the conceptualized model, the study confirmed some hypotheses and rejected others. Direct effect analysis reveals that DSI significantly influences the functional, aesthetic, social, and conditional values of the chosen cultivars. Similar conclusions were drawn by Jeong et al. (2017) and Truong (2013), indicating that consumer innovativeness positively affects perceived value. Contrary to previous findings by Pihlström and Brush (2008), this study found that Perceived Conditional Value (PCV) has an non-significant direct effect on cultivar selection. This might be because although PCV can influence decisions under certain conditions, its impact is limited if other dimensions like aesthetics, quality, yield, and social imagery do not meet growers' expectations. Interestingly, perceived aesthetic value was weakly non-significant at a 5% significance level but

Table 8. Mediation results of the Perceived values (PVs) between domain-specific innovativeness (DSI) and decision to choose to grow variety (DCGV).

Path	Original Sample	T-statistics	*p*-value	Final Decision
Mediation of PFV*				Partial Mediation. The hypothesis is supported
(DSI ->PFV ->DCGV)				
DSI ->PFV	0.771	21.845	0.000	
PFV ->DCGV	0.230	2.507	0.012	
DSI ->PFV ->DCGV (Indirect effect)	0.177	2.478	0.013	
DSI ->DCGV (Total effect)	0.722	18.310	0.000	
Mediation of PAV				No mediation. The hypothesis is not supported.
(DSI ->PAV ->DCGV)				
DSI ->PAV	0.648	14.985	0.000	
PAV ->DCGV	0.153	1.761	0.078*	
DSI ->PAV ->DCGV (Indirect effect)	0.099	1.771	0.077*	
DSI->DCGV (Total effect)	0.722	18.310	0.000	
Mediation of PSV				Partial Mediation. The hypothesis is supported
(DSI ->PSV ->DCGV)				
DSI ->PSV	0.640	13.554	0.000	
PSV ->DCGV	0.148	2.095	0.036	
DSI ->PSV ->DCGV (Indirect effect)	0.095	2.067	0.039	
DSI ->DCGV (Total effect)	0.722	18.310	0.000	
Mediation of PCV				No mediation. The hypothesis is not supported.
(DSI ->PCV ->DCGV)				
DSI ->PCV	0.614	14.634	0.000	
PCV ->DCGV	0.067	0.806	0.420	
DSI ->PCV ->DCGV (Indirect effect)	0.041	0.787	0.432	
DSI ->DCGV (Total effect)	0.722	18.310	0.000	

Note: *Significant at 10% level.
*PFV = Perceived Functional Value; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; Paths = refers to the hypothesized directional relationships between constructs in the model.

Table 9. Explanatory power (R^2) and predictive powers (Q^2 predict, RMSE and MAE) of the hoc.

Variable	R-square	R-square adjusted	Q^2 predict	RMSE	MAE
DCGV*	0.622	0.613	0.514	0.703	0.547
PAV	0.420	0.418	0.411	0.775	0.609
PCV	0.377	0.374	0.364	0.806	0.619
PFV	0.594	0.592	0.587	0.650	0.476
PSV	0.409	0.407	0.400	0.782	0.642

*DCGV = Decision to Choose to Grow Variety; PCV = Perceived Conditional Value; PAV = Perceived Aesthetic Value; PSV = Perceived Social Value; PFV = Perceived Functional Value; RMSE = Root Mean Square Error; MAE = Mean Absolute Error.

is significant at a 10% level. Other studies (Fan et al., 2021; Schwieterman et al., 2014) highlighted that sweetness, flavor, intensity, and texture are crucial for consumer preference in fresh markets. However, this study acknowledges that over a quarter of the growers target the processing industry, with almost half being small farms prioritizing functional qualities, particularly yield. Guthman and Zurawski (2020) noted that most strawberry growers prioritize yield despite its entanglement with other qualities like size, flavor, and disease resistance. They also emphasized that the drive for higher yields, influenced by factors such as buyer-grower contracts and rising land values, create a collective action problem for many growers. The total effect analysis indicates that DSI positively impacts growers' DCGV, consistent with findings in other fields such as presented in Okoroji et al. (2021), in their study of the factors affecting the adoption of mobile applications by farmers. Their results show that information/awareness and intention to use positively affected the actual use of mobile applications. This study also supports that the decision to choose strawberry cultivars is influenced by PFV and PSV, which mediate between DSI and DCGV. However, PAV and PCV do not mediate this relationship, although PAV shows mediation at a 10% significance level. This research underscores that while functional and social values are critical in cultivar selection, aesthetic and conditional values play a nuanced role. The study's findings highlight the complex interplay of various factors influencing growers' decisions, aligning with broader agricultural trends and challenges.

This research expands on the theory of innovation diffusion in the agricultural sector by examining the mediating role of perceived value (PV) in strawberry growers' decision-making processes. While previous studies (e.g., Araujo et al., 2016) have explored innovation diffusion, this study uniquely integrates the theory of consumption value, or PV, with the DSI framework. This integration has been scarcely addressed in the literature, with only a few examples such as Jiang et al. (2022) and Jeong et al. (2017), who studied car safety seats and wearable technology, respectively. In this study, DSI is conceptualized as a HOC within the strawberry industry. The research model, adapted from Jeong et al. (2017) and Jiang et al. (2022), was modified to a HOC to capture the complex relationships influencing growers' choices. Previous studies have combined the theory of consumer value with other theories to create comprehensive methods for understanding consumer values, such as Dhir et al. (2020) with flow theory and the theory of planned behavior, and Carlson et al. (2019) with service-dominant logic. The theoretical contributions of this research confirm and diverge from prior studies, significantly enhancing our understanding of the diverse perceived values influencing US strawberry growers' decisions regarding cultivar selection. The findings align with Jiang et al. (2022), indicating that increased consumer value assessments correlate with a higher willingness to pay. The practical implication of this study will shape breeders and nurseries strategic positioning of production and marketing activities to meet growers' vital perceived values. This novel research can also provide a useful framework for the anticipation of growers' acceptance of current and emerging strawberry varieties. Strategic measures, such as comprehensive customer surveys, product upgrades, effective communication, and emphasis on product uniqueness by breeders, nurseries, and retailers, can positively influence growers' cultivar choices. The implications of this study extend beyond strawberry cultivation, suggesting that this theoretical framework may be applied to other industries to explore and generalize the findings.

Conclusion

Research on strawberry growers in the US has largely overlooked the impact of growers' characteristics, such as perceived functional, social, conditional, and aesthetic values, on their choice intentions. This study bridges the gap between the strawberry industry and product marketing research. It offers significant theoretical, methodological, and contextual contributions to the field. Despite its strengths, the study faced limitations, primarily concerning sample size. Although PLS-SEM is suitable for smaller samples, a larger response rate of at least a thousand would have been preferable to enhance statistical robustness and generalizability. Additionally, the study's reliance on self-reported data from growers introduces potential biases, such as memory recall inaccuracies and social desirability effects. Future research should consider incorporating external validation measures, such as observational data or third-party assessments, to improve construct validity.

Looking ahead, several avenues for future research can further develop and extend these findings. First, studies should explore the role of behavioral, psychological, and physical factors alongside perceived values to create a more holistic model of growers' decision-making processes. Incorporating factors such as risk perception, sustainability concerns, and technological adoption could refine the predictive power of the model.

Second, expanding the study beyond the US to other major strawberry-producing countries such as Spain, Mexico, and China would help validate the findings across different cultural, economic, and regulatory contexts. Cross-country comparative studies could reveal regional variations in growers' decision-making patterns, enhancing the model's applicability on a global scale.

Third, longitudinal research designs could provide deeper insights into how growers' preferences and perceptions evolve over time, especially in response to market shifts, environmental changes, and technological advancements. Future studies could also investigate the influence of policy interventions and industry incentives on growers' choices, offering practical insights for policymakers and stakeholders in the agricultural sector.

By addressing these future research directions, scholars can build upon the current study to develop a more comprehensive understanding of growers' decision-making processes, ultimately supporting more effective marketing strategies and policy frameworks in the strawberry industry.

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Author contributions

CRediT: Gabriel Yeboah: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing; Jayesh Samtani: Investigation, Project administration, Supervision, Resources, Writing-review and editing; Giovanni Marin: Supervision.

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Data availability statement

Data used in this study is readily available in a Dropbox file upon request.

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