

## Produce Buyer Quality Requirements to Form an Eastern Broccoli Industry

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### Abstract

We used an online survey to examine the broccoli quality requirements of East Coast wholesale and retail buyers. Buyers exhibit strong preferences for broccoli attributes such as dark green color, small bead size, and uniform heads. Buyers demand the same high quality standards for both locally grown and West Coast–grown broccoli. Natural food resellers are more open to different product conditions in local broccoli. They could be the most approachable buyers for broccoli grown in the East Coast. These results could serve as the basis for future research regarding produce buyers’ preferences for locally grown produce.

**Keywords:** broccoli, buyer preferences, local food, logit regression

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## Introduction

Fresh broccoli is one of the major fresh vegetable crops, with a utilized production of 22 million cwt in 2016, valued at \$838 million, similar to that of cabbage (U.S. Department of Agriculture, 2017). Although broccoli consumption is widespread throughout the United States, more than 85% of production occurs in California (U.S. Department of Agriculture, 2017; Atallah, Gómez, and Björkman, 2014). According to the U.S. Department of Agriculture (2015),

The ongoing drought in California is likely to have a major impact on the State's agricultural production. Long-term moisture deficits across most of the State remain at near record levels. Because California is a major producer in the fruit, vegetable, tree nut, and dairy sectors, the drought has potential implications for U.S. supplies and prices of affected products this year and beyond.

Monterey County, which accounts for 40% of total U.S. broccoli production (Le Strange et al., 2010), has also been one of the hardest hit areas by the drought (U.S. Department of Agriculture, 2015), creating concerns about supply reliability due to unexpected production disruptions in California from droughts and floods and supply chain disruptions due to the long length of the supply chain.

To diversify broccoli supplies, the USDA funded the East Coast Broccoli Project to support the production and marketing of high-quality East Coast-grown broccoli as a supplement to West Coast supplies. The project encompasses the development of broccoli strains suitable for the East Coast climate, farmer recruitment, and infrastructure development to establish an East Coast broccoli industry (Björkman, 2011).

Strain development is fundamental to establishing the East Coast broccoli supply. Nearly all broccoli strains were developed to mature under California conditions and cannot be grown in most areas of the East Coast (Björkman, 2011). Weather conditions particular to the East Coast provide an exceptional problem for strain development: Hot, humid East Coast summers can cause structural abnormalities, including deformities that prevent the development of high-quality broccoli heads (Björkman and Pearson, 1998). Heads develop poorly when temperatures during bud development routinely exceed 30°C, causing uneven bud growth, which produces uneven head size and uneven heads (Björkman and Pearson). We tested whether buyers would accept local, East Coast broccoli varieties, which do not have the bud and head uniformity and other quality traits exhibited by California-grown broccoli.

The new, Eastern-grown strains have been tested with consumers and demonstrated potential for price premiums in the East Coast market (Fan et al., 2015). Demand for locally grown food is increasing, driven not only by rising concerns about transportation costs and sustainability (Björkman, 2011) but also by perceptions of increased freshness and other quality factors and social factors (such as helping local farmers and local communities). Research on other fruit and vegetable products has found higher consumer demand and increased WTP for local produce (Carpio and Isengildina-Massa, 2009; Meas et al., 2015; Thilmany McFadden, 2015).

Given strong consumer demand, the key to promoting Eastern broccoli lies in expanding production as well as marketing new products. Direct marketing channels, such as farmers' markets, are historically important channels for local produce, but research has shown that the growth of direct marketing channels has plateaued. Most of the sales growth of local produce is from intermediated grocery channels (Low et al., 2015; Thilmany McFadden, 2015; Richards et al., 2017). To build a scalable industry, Eastern-grown broccoli needs to go beyond direct marketing channels and approach intermediated grocery retailers, such as supermarkets (King, Gómez, and DiGiacomo, 2010). Although large supermarket distribution systems typically prefer to source from a few, large-scale suppliers to minimize cost, several national and regional supermarket chains have successfully sourced and marketed local food produced during local production seasons (King, Gómez, and DiGiacomo). Supermarkets can use local foods to create a sense of connection between consumers and local producers and build a more intimate relationship with local consumers (King, Gómez, and DiGiacomo). With expanded Eastern broccoli production and a well-coordinated regional supply chain, opportunity exists for an Eastern-broccoli industry to increase the supply to large-scale supermarkets and achieve economies of scale.

It is worth investigating preferences of produce buyers from large intermediaries, the gatekeepers to the grocery store shelves, and better understand their quality requirements for local broccoli. We conducted an online survey to shed light on produce buyers' willingness to pay a premium and their quality requirements for locally grown broccoli compared to nonlocal broccoli. We also explored buyers' most preferred product conditions for various product attributes. We explored whether certain types of buyers would have different quality standards or behaviors. Despite the small sample size, the results could be a useful basis to structure future hypotheses on produce buyers' preferences because the buyers we reached procured produce for companies representing about 50% of the grocery market on the East Coast.

## **Literature Review**

Many researchers have gauged local produce marketing success by surveying consumers. Darby et al. (2006) found that consumers were willing to pay up to \$1.17 more per carton for locally grown strawberries. Loureiro and Hine (2002) discovered that although consumers were willing to pay more for locally grown potatoes in Colorado, that premium was linked to higher product quality. In South Carolina, consumers indicated willingness to pay an average premium of 27% for produce grown in-state, despite many not being able to detect quality differences (Carpio and Isengildina-Massa, 2009). Meas et al. (2015) found that consumers in Ohio and Kentucky would pay premiums for blackberry jam identified by more specific geographical designations, such as substate regions and the Ohio Valley, indicating a preference for a clearer definition of "local" produce.

Various studies have demonstrated that consumers tend to associate "locally grown" with higher product quality and social contribution. Carpio and Isengildina-Massa (2009) found that consumers' main reason for choosing local produce was to support local farmers and the local economy. In a study by Onozaka, Nurse, and Thilmany McFadden (2010), survey participants indicated "proven health factors," "supporting local economy," "farmers receiving fair share of economic returns," and "maintaining local farmland" as the top four criteria used in their selection process. Consumers also considered locally grown produce to be superior in terms of freshness,

eating quality, food safety, and nutritional value. Darby et al. (2006) found a substantial increase in willingness to pay (WTP) for local produce among consumers because of freshness, taste, a direct connection to food sources, nutrition, food safety, and support for local businesses and the regional economy. Gracia, de Magistris, and Nayga (2012) showed that social influence factors affect WTP for local food among women.

Despite studies showing consumer preferences for locally grown produce, the few studies on buyer preferences focus on buyers at traditional wholesale firms serving institutional customers. Hughes, Crissy, and Boys (2014) showed that wholesalers serving institutional customers tended to avoid handling local food due to the additional costs involved. Rimal and Onyango (2013) found that although there was buyer interest in local food in wholesale organizations serving institutional customers, attributes such as price, freshness, quality, and availability were considered more important decision drivers. Becot et al. (2014) found that Vermont school food directors, while encouraged to buy foods locally, were often limited by their budgets and regulatory edicts barring them from using geographical preferences as part of the bidding process (Becot et al.). The study suggested that institutional buyers were unlikely to be a source of price premiums (Becot et al.). Emerging local food system wholesalers are attempting to increase supply of locally procured products to institutions, but they are still a minority (Hughes, Crissy, and Boys).

Because few researchers have investigated large-scale retailers and wholesalers selling to the retail market, buyers' preferences for local produce—broccoli in particular—from these organizations are unknown. Whether East Coast broccoli can be a viable supplement to California broccoli supplies cannot be determined. Our contribution to the literature is to fill this gap by using primary research to determine buyer preferences for locally grown broccoli and provide guidance to Eastern broccoli growers in terms of both product standard and marketing channel prioritization.

## **Data**

Primary data were collected through an online survey of major broccoli buyers in the East Coast market. The initial survey questions were developed by Phillip Coles, who has 35 years of experience in the produce industry, and Thomas Björkman, an expert in plant breeding who is developing broccoli strains for the East Coast climate. Once the survey questions were compiled, they were reviewed by two produce buyers, one from a large wholesaler and another from a regional grocery retailer. A variety of buyers from national and regional supermarket chains, supercenters, and produce wholesalers were selected and asked about their requirements, preferences, and practices related to broccoli purchases. Buyers were identified through personal contacts and social platforms such as LinkedIn® and represented roughly half the grocery retailing industry by sales (Lerman, 2014; McKitterick, 2015; SN Supermarket News, 2015). The survey was distributed to 49 buyers, of whom 27 responded (55%). The survey was conducted between November 2014 and February 2015 using Qualtrics. No remuneration was provided, and respondents could skip questions if they wished. Although this resulted in some missing values in the data, sufficient data were collected for most of the questions. Response rates were similar regardless of merchant type, size, or function (Table 1).

In the study, we defined “local” broccoli as broccoli produced in the same state as retailed. There is no universally accepted definition for “local” produce. The U.S. Congress defined local food in

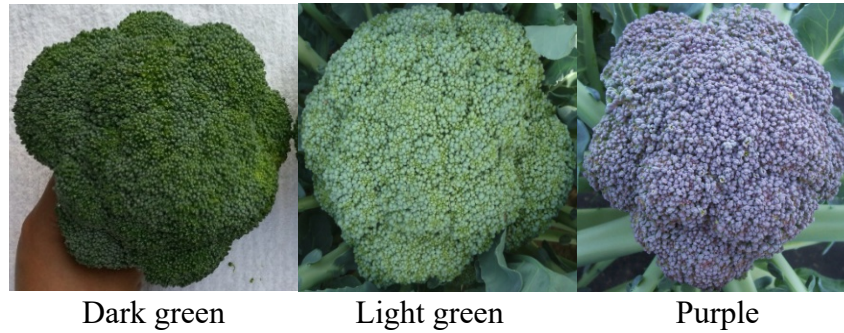
**Table 1.** Produce Merchants Who Were Sent the Survey and Those Who Responded Represented by Type, Size, and Function

	Buyers Sent the Survey		Respondents	
	No. of Buyers (N)	Response Rate (%)	No. of Buyers (N)	Percentage by Category (%)
By type				
Natural food	19	52.6	10	37.0
Conventional	30	56.7	17	63.0
By size				
Local	13	61.5	8	29.6
Regional	25	52.0	13	48.2
National	11	54.5	6	22.2
By function				
Wholesalers	14	64.3	9	33.3
Supermarkets	31	48.4	15	55.6
Supercenters	4	75.0	3	11.1
Total	49	55.1	27	100.0

the 2008 Food, Conservation, and Energy Act as “‘locally or regionally produced agricultural food product’ if the total distance traveled is less than 400 miles from its origin, or within the State in which it is produced” (Martinez et al., 2010). Meanwhile, consumers have varying opinions on what constitutes the term “local.” We chose our definition because it is part of the definition provided by the U.S. Congress, it is considered more easily definable and understood (Loureiro and Hine, 2002), and, more importantly, preliminary discussions with several buyers indicated that this was an accepted and often used definition among produce buyers.

In the first part of the survey, we asked questions regarding buyers’ purchasing practices and attitudes (e.g., whether they have procured any local produce and marketed them as “local” and whether they consider “local” to be a positive product feature that could command a higher selling price). In the second part of the survey, we asked buyers to assess local and nonlocal broccoli with respect to different product attributes based on photographs of broccoli with various product conditions. Figure 1 depicts one example for three colors of broccoli.

The pictures were shown to the buyers without any descriptive terms. After seeing the photographs, buyers decided whether the condition in each picture was “preferred,” “acceptable” or “unacceptable” under two scenarios, nonlocal and local. The assessment was repeated for six product attributes (color, bead size, head uniformity, stem length, maturity, and bead uniformity). Identical pictures were used for both nonlocal and local scenarios to discern whether buyers may be more forgiving toward locally produced broccoli in their quality requirements.

**Figure 1.** Broccoli Pictures Showing Different Colors

## Methodology

We first investigated the answers to the behavioral and attitudinal questions and cross-cut the data by merchant type, size, and functions to understand the overall situation as well as any heterogeneity across groups. Following that, we explored how different product conditions affect the probability of product acceptance or preference from a buyer's perspective. We considered six product attributes (color, bead size, head uniformity, stem length, maturity, and bead uniformity) and ran two regressions for each product attribute. Separate regressions were run for each product attribute because we had asked in the questionnaire for the assessment separately for each product attribute. There was no interaction between product attributes.

For each product attribute, we used one product condition as the outside option and looked at the change in probability of acceptance or preference given a change in product condition from the outside option. A random-effect logit model was used considering the binary nature of the dependent variables. Logistic distribution of the error terms was assumed. Individual random effect was included due to the correlation between the assessments of different product conditions from the same individual.

Mathematically, for each attribute  $i$  ( $i$  = color, bead size, head uniformity, stem length, maturity, and bead uniformity), we have:

$$(1) \quad Preferred_j = \alpha_0 + \alpha_1 Local_j + \alpha_2 Natural\_Food_j + \beta_i Value\_Attribute_i + \varepsilon_{1j},$$

$$(2) \quad Acceptable_j = \gamma_0 + \gamma_1 Local_j + \gamma_2 Natural\_Food_j + \delta_i Value\_Attribute_i + \varepsilon_{2j},$$

where subscript  $j$  refers to one assessment case regarding the product attribute. The variables *Preferred*, *Acceptable*, *Local*, and *Natural\_Food* are binary variables, which take a value of 0 or 1, and *Value\_Attribute<sub>i</sub>* is a column vector responding to product conditions. The number of elements in the vector is equal to the number of product conditions minus 1 (because one product condition was excluded as the outside option). The row corresponding to the product condition in the specific assessment case takes a value 1, and the other rows take a value of 0.  $\beta_i$  and  $\delta_i$  are row vectors of parameter estimates corresponding to the product conditions in the column vector *Value\_Attribute<sub>i</sub>*. The parameter estimates in  $\beta_i$  and  $\delta_i$  are the natural logs of the odds ratio for acceptance or preference under one product condition compared to the outside option. Based on the industry norm on product quality, we chose the least preferred product conditions as the outside

option for each product attribute. Therefore, we expect to see an increase in probability of acceptance or preference when we change from the outside option to another product condition. In other words, we expect the parameter estimates in  $\beta_i$  and  $\delta_i$  to be positive. Stata 14.2 was used to conduct the regressions. Table 2 lists the variables used in the model and their definitions.

**Table 2.** Variables and Definitions

Variables	Definition
Dependent variables (for each product attribute: maturity, bead size, head uniformity, stem length, color, bead uniformity):	
Preferred	1 if “preferred,” 0 otherwise, for each attribute $i$
Acceptable	1 if “preferred” or “acceptable,” 0 otherwise, for each attribute $i$
Independent Variables:	
Local	1 if broccoli is produced within the state where it is retailed; 0 otherwise
Natural Food	1 if buyer represents a natural food reseller; 0 otherwise
Product Attributes	
Maturity	
Optimal maturity	1 if yes, 0 otherwise
Over mature	1 if yes, 0 otherwise
Very over mature	1 if yes, 0 otherwise (excluded dummy)
Bead size	
Small	1 if bead size is small, 0 otherwise
Medium	1 if bead size is medium, 0 if otherwise
Large	1 if bead size is large, 0 if otherwise (excluded dummy)
Head uniformity	
Very uniform	1 if broccoli head is very uniform, 0 otherwise
Uniform	1 if broccoli head is uniform, 0 otherwise
Nonuniform	1 if broccoli head is not uniform, 0 otherwise (excluded dummy)
Stem length	
Flush cut stem	1 if broccoli stem is cut flush, 0 otherwise
Short stem	1 if broccoli stem is short, 0 otherwise
Medium stem	1 if broccoli stem is medium, 0 otherwise
Long stem	1 if broccoli stem is long, 0 otherwise
Extra-long stem	1 if broccoli stem is extra-long, 0 otherwise (excluded dummy)
Color	
Dark green	1 if broccoli head is dark green, 0 otherwise
Light green	1 if broccoli head is light green, 0 otherwise
Purple	1 if broccoli head is purple, 0 otherwise (excluded dummy)
Bead uniformity	
Very uniform	1 if broccoli beads are very uniform, 0 otherwise
Uniform	1 if broccoli beads are uniform, 0 otherwise
Nonuniform	1 if broccoli beads are not uniform, 0 otherwise (excluded dummy)

The dependent variable is based on the buyers' assessments of the six product attributes. The raw data—entered as “preferred,” “acceptable,” or “unacceptable”—were processed into two binary variables, *Preferred* and *Acceptable* (Table 2).

The explanatory variables on product conditions were generated by associating each photo with one descriptor; for example, in Figure 1, the three conditions are tagged as dark green, light green, or purple in color. These product descriptions entered the equation as the binary variable *Value\_Attribute<sub>i</sub>*, which takes a value of 0 or 1. One of the product conditions was excluded as the outside option.

Product origin and reseller type were also included as dummy variables. The variable *Local* was used to identify the potential difference in the quality requirements from the buyers for the local and nonlocal products. The question of interest is whether buyers have lower quality requirements for the local products. We included *Natural\_Food* to capture potential heterogeneity in quality requirements between the natural food resellers and the other conventional resellers. We focused on this specific reseller type based on our examination of the behavioral and attitudinal questions.

## Results

After exploring the answers to the behavioral and attitudinal questions, we found the majority of the buyers had procured local produce before, and almost all of them considered “local” to be a positive feature. When they procured local produce, they typically marketed it as “local.” Locally grown is marketed by providing sections devoted to “local” in the produce section, shelf talkers identifying products as local, identifying local farmers with photos and displays telling their stories. Retailers at times have special events and tastings showcasing locally grown products (Granderson, 2016). Although only 23% of buyers believed local produce could command higher selling prices, most of them nevertheless wanted to have East Coast broccoli available and would prefer East Coast broccoli, all else equal. Table 3 summarizes the statistics.

Discussions with buyers while finalizing the survey, and with contacts who helped identify buyers from smaller organizations, revealed that larger organizations, regional and national resellers with distribution centers, tended to be more interested in additional broccoli supplies in case of supply disruptions and to increase price competition. Having sources closer to individual distribution centers gives them additional supply lines and alternatives. In the event of a shortage in California, West Coast distribution centers could continue to be supplied from California and East Coast facilities could source from East Coast suppliers. This also gives greater flexibility to Midwest facilities, which could be supplied from either coast depending on conditions.

Smaller and natural food resellers have one to a few stores and do not have distribution centers. They are typically in one metropolitan area, and those in our survey are all on the East Coast. They are more interested in minimizing the distance from their sources, and therefore prefer broccoli from other regions on the East Coast to California broccoli when local broccoli is not in season. We cross-cut the data by merchant type, size, and function. We discovered that significantly more natural food resellers believed that local produce could command a higher selling price.



**Table 3.** Respondents Who Answered “Yes” to the Behavioral and Attitudinal Questions, Total and Breakdown by Merchant Type

Practices or Attitudes	Overall (%, N)	Natural Food (%, N)	Conventional (%, N)	p-Value (Fisher's Exact)
Do you procure “local” produce?	74.1	70.0	76.5	1.000
Do you consider “local” a positive marketing feature?	92.3	100.0	87.5	0.508
Do you consider “local” a feature that commands higher price?	23.1	55.6	5.9	0.010***
If you purchased local broccoli in 2013, was it marketed as local?	87.0	100.0	80.0	0.526
Do you see an advantage to East Coast broccoli being available when “local” is out of season?	88.0	90.0	86.7	1.000
Other attributes being equal, would you prefer East Coast broccoli?	79.2	100.0	68.75	0.130

Note: Single, double, and triple asterisks (\*, \*\*, \*\*\*) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively. Number of responses (*N*) varies due to missing values, percentages calculated based on available answers. The fourth question is based on the number of respondents who purchased local broccoli in 2013; two buyers who had not purchased were not included. Fisher's exact test is used for calculating *p*-values due to small sample size.

We obtained regression results on two dependent variables, *Preferred* and *Acceptable*, regarding the six product attributes.<sup>1</sup> Tables 4 and 5 illustrate the odds ratios estimated from equations (1) and (2). Table 4 signifies the likelihood that buyers prefer a product of a particular condition to the excluded option, and Table 5 indicates the odds that a buyer considers a product with that condition acceptable over the excluded condition.

In Table 4, no coefficient for local product origin is significant, indicating that buyers use the same quality standards across local and nonlocal products when selecting preferred products. Buyers from natural food sellers tend to be more tolerant of stem length, product color, and maturity. However, they are no different from buyers from conventional resellers when evaluating bead size or head uniformity. Buyers prefer a dark-green color, small bead size, uniform head, and short stem. The odds ratio for dark green is high, indicating a clear preference. No significant preference was found for product maturity.

When looking at the odds ratios for the buyers to accept a product condition, similar to the preferred case, we do not see significant coefficients for local products. Dark-green color, small bead size, uniform head, and short stem are again most likely to be accepted, but the buyers would also accept light green color, medium bead size, and flush cut stem, indicating higher tolerance. Dark green is still the most widely accepted color, followed by light green, while purple is almost

<sup>1</sup> We did not include the result on bead uniformity in the preferred case because none of the coefficients were significant.

universally unwanted, except for a few natural food store buyers. This results in extremely high odds ratios for dark green and light green colors. The coefficients for optimal maturity and over maturity are significant and close to each other, indicating similar acceptance levels for both conditions. Coefficients for head uniformity are significant in the acceptable case, showing strong preferences for very uniform and uniform head over nonuniform ones (Table 5).

**Table 4.** Regression Result on Preferred Product Conditions (Coefficients in Odds Ratios)

	(1) Preferred: Color	(2) Preferred: Bead Size	(3) Preferred: Head Uniformity	(4) Preferred: Stem Length	(5) Preferred: Maturity
Local	0.58 (0.43)	1.09 (0.51)	0.97 (0.55)	0.85 (0.31)	1.09 (0.52)
Natural food reseller	10.69* (13.97)	1.00 (0.53)	1.37 (1.17)	2.69*** (0.98)	2.81* (1.75)
Dark green	1,146.31*** (1,910.22)				
Light green	1.22 (1.20)				
Small bead size		19.19*** (15.53)			
Medium bead size		4.81* (4.00)			
Very uniform head			15.66** (18.85)		
Uniform head			29.80*** (35.71)		
Flush cut stem				1.83 (1.08)	
Short stem				3.10** (1.75)	
Medium stem				1.33 (0.82)	
Long stem				1.26 (0.77)	
Optimal maturity					1.98 (1.1)
Over mature					0.49 (0.33)
No. of obs.	132	131	118	208	130

Note: Single, double, and triple asterisks (\*, \*\*, \*\*\*) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

**Table 5.** Regression Result on Acceptable Product Conditions (Coefficients in Odds Ratios)

	(6) Acceptable: Color	(7) Acceptable: Bead Size	(8) Acceptable: Head Uniformity	(9) Acceptable: Stem Length	(10) Acceptable: Maturity	(11) Acceptable: Bead Uniformity
Local	0.27 (0.47)	0.91 (0.51)	0.98 (0.61)	1.08 (0.36)	1.19 (0.54)	0.35 (0.54)
Natural food reseller	0.85 <sup>a***</sup> (3.38)	2.93 (2.50)	12.84 (22.94)	2.29 (1.27)	1.82 (1.79)	7.89 (21.19)
Dark green ( $\times 10^{15}$ )	0.16 <sup>***</sup> (1.21)					
Light green ( $\times 10^{10}$ )	0.88 <sup>***</sup> (3.43)					
Small bead size		20.69 <sup>***</sup> (17.01)				
Medium bead size		20.20 <sup>***</sup> (16.64)				
Very uniform head			2.84 (2.17)			
Uniform head			3.89* (3.05)			
Flush cut stem				2.96** (1.53)		
Short stem				3.43** (1.81)		
Medium stem				1.53 (0.75)		
Long stem				1.56 (0.76)		
Optimal maturity					2.71* (1.54)	
Over mature					2.62* (1.48)	
Very uniform bead ( $\times 10^{20}$ )						1.71 <sup>***</sup> (8.87)
Uniform bead ( $\times 10^{10}$ )						2.89 <sup>***</sup> (8.95)
No. of obs.	132	131	118	208	130	131

Note: Single, double, and triple asterisks (\*, \*\*, \*\*\*) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

<sup>a</sup> Coefficient and standard deviation rescaled, in  $10^9$ .

Overall, there is no difference in quality requirements regardless of whether broccoli is sourced locally; all buyers have the same quality requirements for both local and nonlocal broccoli. The hypothesis that the locally grown feature would be attractive enough to compensate for lower product quality is disproven. Buyers for natural food sellers tend to be more forgiving; they accept a wider range of product conditions. Broccoli buyers seem to be most selective with color, followed by bead size, bead uniformity, and head uniformity. Given the limitation of the sample size, some of these findings might be subject to the small-sample bias. However, they could be helpful to form hypotheses for future research on produce buyers' preferences.

## **Conclusion**

In this study, we investigated fresh produce buyers' preferences regarding broccoli product attributes through a survey of buyers from major fresh produce merchants. The regressions show that they favor dark green color, uniform heads and beads, small bead size, and short stems. This result is consistent with both our expectations and industry norms for high-quality broccoli. The preference of dark green color is extremely strong, followed by small bead size and uniform heads. Results also suggest that natural food resellers tend to be more forgiving on quality. They are more willing to procure a wider range of broccoli conditions. We failed to detect any difference in quality requirements between local and nonlocal produce. Although most respondents indicated interest in local and East Coast broccoli, they demanded identical product quality, regardless of origin. The buyers would not compromise their quality standards for the additional value provided from local sourcing. Although natural food resellers are more tolerant with product maturity, color, and stem length, their modicum of forgiveness seems to be for all broccoli and is not affected by product origin.

This suggests that East Coast growers must first establish product quality competitiveness—especially regarding color, bead size, and head uniformity—to compete with the California broccoli. While these key product attributes depend a lot on the development of new varieties suitable for the region, stem length and maturity are relatively easier to manage and should be a quick win to augment product attractiveness. In particular, growers should ensure that broccoli has short stems and are not flush cut, as flush cuts are not only less desirable but also reduce product weight and thus yield. Flush cut stems, while acceptable, will lower quality and raise costs compared to short stems. For the new broccoli growers on the East Coast, natural food resellers could be a good starting point, given their more forgiving quality requirements overall. Moreover, as natural food resellers are typically smaller, growers could start with a smaller scale launch with them. As growers become more proficient and competent, able to meet the other quality parameters, they could scale up production and approach larger clients.

Given the small sample size in this study, we suggest using our findings as a directional analysis to inform future research. In addition, more research regarding retail buyers is needed to better understand this key role in the fresh produce supply chain. With a larger sample, other approaches (such as a choice experiment) could be used to better quantify the importance of different product attributes and the value of being able to meet product requirements.

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## Appendix: Broccoli Buyer Questionnaire

### 1. "Local" Broccoli Procurement:

We would like to know about your "local" broccoli procurement. In particular:

Do you procure "local" broccoli (Defined as grown in the same state as retailed)? Yes\_\_\_ No\_\_\_

If you use a different definition of "local" for marketing, what is your definition?

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Does "local" broccoli have any additional value for you:

As a marketing feature (but no effect on pricing)? Yes\_\_\_ No\_\_\_

As a feature that commands a higher selling price? Yes\_\_\_ No\_\_\_

If it commands a higher price, what was the average \$/box markup for local broccoli in the past year? \_\_\_\_\_

When local broccoli is in season, what percentage purchased in 2013 was considered local?

0 ☐ > 0-5 ☐ 5-20 ☐ 20-50 ☐ More than 50 ☐

Was it marketed as local? Yes\_\_\_ No\_\_\_

Would your organization see an advantage to East Coast Broccoli being available when "local" (As defined by state) is out of season? Yes\_\_\_ No\_\_\_

If you have bought broccoli grown in the Eastern U.S. in the past, what have you seen as specific advantages and disadvantages:

	Advantage	Disadvantage	Varies
Cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consistency of availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consistency of quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

All other attributes being equal, would you prefer to procure East Coast Broccoli? Yes\_\_\_ No\_\_\_

During 2013, approximately what percent of broccoli purchases was procured from the East Coast?

\_\_\_\_\_

Five years earlier, during 2008, approximately what percent of the broccoli purchased was procured from the East Coast? \_\_\_\_\_



## 2. Quality requirements and pricing policies:

Do you have price quality penalties and premiums? Yes\_\_\_ No\_\_\_

If you answered yes, please provide the following information:

On what parameters: \_\_\_\_\_

Are they stated in written agreements? Yes\_\_\_ No\_\_\_

Would you be willing to share a sample agreement with us? Yes\_\_\_ No\_\_\_

We would like to understand your broccoli quality requirements and whether those requirements may be different for "local" broccoli. Please indicate your quality requirements for "non-local" and "local" broccoli. In addition, please indicate whether criteria shown in each photo is a preferred or acceptable requirement, or something that normally would be rejected:

External condition:

Non-local:

Grade: Fancy ☐ #1 ☐ #2 ☐ Do not use USDA grading ☐  
Maximum % Damage tolerance: None ☐ up to 5% ☐ 5-20% ☐

Local:

Grade: Fancy ☐ #1 ☐ #2 ☐ Do not use USDA grading ☐  
Maximum % Damage tolerance: None ☐ up to 5% ☐ 5-20% ☐

Maturity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli



Non-local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Color:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli



## Non-local:

preferred ☐  
 acceptable ☐  
 unacceptable ☐

☐  
☐  
☐

☐  
☐  
☐

## Local:

preferred ☐  
 acceptable ☐  
 unacceptable ☐

☐  
☐  
☐

☐  
☐  
☐

## Bead size:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli



## Non-local:

preferred ☐  
 acceptable ☐  
 unacceptable ☐

☐  
☐  
☐

☐  
☐  
☐

## Local:

preferred ☐  
 acceptable ☐  
 unacceptable ☐

☐  
☐  
☐

☐  
☐  
☐

## Head uniformity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli



## Non-local:

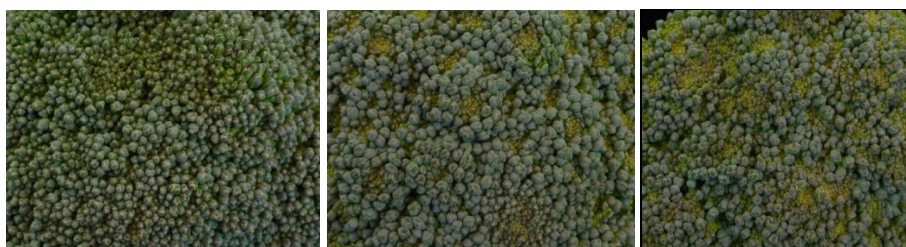
preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Bead uniformity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli



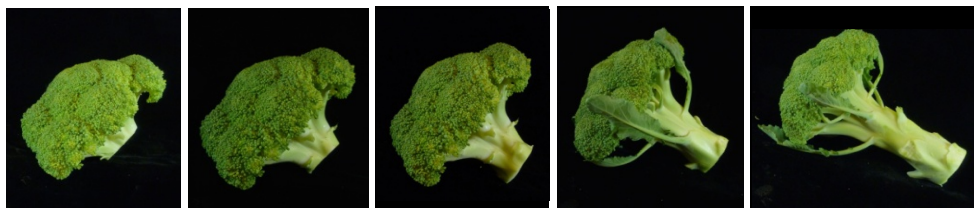
## Non-local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Stem length:



Non-local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Local:

preferred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
unacceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 3. Postharvest requirements:

We would like to know about your postharvest requirements for broccoli, including packaging, pre-cooling and storage. If you have no requirements for a particular category, please indicate 'none'.

Packaging:	Requirement	Preference	None
Outer cases: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Selling unit: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pack size: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pre-cooling:			
Ice: 1-2 pounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ice: 10-20 pounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Iceless:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Storage:			
Temperature: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shelf-life: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### 4. Seasonality, volumes, and sources:

We would like to ask you about the sources (state or region within state) and volumes of broccoli crowns over the last year (2013).

What were your total boxes of broccoli purchased in 2013? \_\_\_\_\_

Please provide information for your two main suppliers.

<i>Season</i>	<i>Supplier</i>	<i>Total volume (# of 21 lb. boxes)</i>	<i>Length of relationship?</i>	<i>Sources (country, state or region within state)</i>
Spring	1.			
	2.			
Summer	1.			
	2.			
Fall	1.			
	2.			
Winter	1.			
	2.			