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***Invited presentation at the 2018 Southern Agricultural
Economics Association Annual Meeting, February 2-6, 2018,
Jacksonville, Florida***

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Consumers' Willingness to Pay for Hydroponic Lettuce: A Non- hypothetical Choice Experiment

Daniel N. Gilmour¹ - *gilmourd@uark.edu*

Rodolfo M. Nayga, Jr.¹ - *rnayga@uark.edu*

Claudia Bazzani² - *claudia.bazzani@univr.it*

Heather Price¹ - *haprice@uark.edu*

February 6, 2018

1. Agricultural Economics and Agribusiness, University of Arkansas

2. Department of Business Administration, University of Verona

What is Hydroponic Lettuce?

“Lettuce is typically grown in soil using **traditional** farming practices. A different method involves growing plants in water instead of soil. This method, referred to as **hydroponic**, raises plants in water with added mineral nutrients.” – Wording from our survey



Hydroponic Crops in the Marketplace

- An important market
 - In 2014, total value of the US lettuce crop = \$2.41 billion^{1,2}
 - Total value of indoor lettuce crop = \$55.5 million³ (2%)
 - 70% of indoor crop was grown hydroponically³
- Based on improved plastics, LED lighting, and plant science⁴
- In November 2017, the USDA approved organic certification for hydroponics following controversy and years of unclear guidelines.⁵

1. National Agricultural Statistics Service. (2015). Crop Values: 2014 Summary. *Crop Values: 2014 Summary*, (February), <http://usda.mannlib.cornell.edu/usda/current/CropV>. Retrieved from http://usda.mannlib.cornell.edu/usda/current/CropValuSu/CropValuSu-02-24-2015_correction.pdf
2. Includes leaf, head, and romaine lettuce production
3. USDA NASS. (Dec. 2015). *2012 Census of Agriculture: Census of Horticultural Specialties (2014)*. Retrieved from https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Census_of_Horticulture_Specialties/HORTIC.pdf
4. Resh, H. M. (2001). *Hydroponic Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower* (6th Editio). Santa Barbara, CA: Woodbridge Press Publishing Company.
5. Dewey, C. (2017). Pioneers of organic farming are threatening to leave the program they helped create. *Washington Post*. Retrieved from <https://www.washingtonpost.com/news/wonk/wp/2017/11/02/pioneers-of-organic-farming-are-threatening-to-leave-the-program-they-helped-create>

Research Objectives

- Purpose of the study
 - To investigate possible value-added labeling for hydroponic lettuce.
- Research Questions
 - Are consumers willing to pay more for hydroponic lettuce?
 - How does hydroponic willingness to pay (WTP) compare with organic?
 - Will information about hydroponic benefits affect WTP?


Field Experiment

- Survey location
 - Regional supermarket in Fayetteville, Arkansas
 - 6 days (Wednesday - Monday) in May 2017
 - Participants received \$5 credit to be used for any item in the store.
 - 215 participants






Choice Experiment Design

- Attributes
 - Growing Method
 - Traditional
 - Hydroponic
 - Organic Certification
 - (Blank)
 - USDA Organic
 - Price
 - \$1, \$2, \$3, or \$4
- Bayesian Choice Design (Ngene)
 - 3 alternatives per choice set
 - 8 choice sets per individual

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Please click on the product option you prefer to buy.

 Traditionally Grown	 Hydroponically Grown 	Neither of these
\$2.00	\$3.00	
Option A	Option B	Option C
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Non-hypothetical for Incentive Compatibility

- One choice set randomly selected as “binding” at the conclusion of the survey, and participants had to purchase their selected product at the price indicated
- No deception: All listed products were available
- Example:
 - Participant chose alternative A in choice set 8, so they pay \$2 to buy a traditionally grown lettuce.



Information Treatments

Group	# of responses	Info about Organic certification	Info about Hydroponics	Benefits of Hydroponics
Control	54	Yes	No	
Environment	54	Yes	Yes	Reduces water, land, and fertilizer use
Clean	54	Yes	Yes	Reduces pesticide use and contact with soil
Local	53	Yes	Yes	Reduces nutrient loss from transit time in harsh climates

Results Outline

- Demographic Balance Across Treatments
- Consumer Attitudes
 - Perception of Hydroponic “Naturalness”
 - Overall Consumer Attitudes Towards Hydroponics
- Willingness to Pay
 - Hydroponic vs. Organic

Balance Across Treatment Groups: Demographics

Group	Control	Environment	Clean	Local	Chi-Square
Female	54%	61%	54%	66%	p = 0.49
4y College	70%	72%	65%	64%	p = 0.76
White	83%	89%	96%	87%	p = 0.18
Income > \$80K	46%	43%	48%	49%	p = 0.91
Children at home	22%	26%	24%	26%	p = 0.96

Information Improved Perception of Hydroponic “Naturalness

“On a scale from 1 to 5 where 1 means unnatural and 5 means natural, how would you rate the "naturalness" of lettuce grown using each of these growing methods?

	Control	Environment	Clean	Local
Conventional Traditional				
Average Rating	3.15	3.17	3.15	3.19
Conventional Hydroponics				
Average Rating	2.67	3.11	2.74	3.04
2-tailed T test	p = 0.02	p = 0.80	p = 0.09	p = 0.54

Information Improved Overall Consumer Attitudes Towards Hydroponics

“Would you want your child to eat hydroponic lettuce as part of their lunch at school?”

	Control	Environment	Clean	Local
Average Rating ¹	3.33	3.69	3.67	3.83
2-tailed T test		p = 0.07	p = 0.05	p < 0.01

“Do you think that food grown hydroponically should be allowed to use the organic label?”

	Control	Environment	Clean	Local
Average Rating ¹	3.63	3.96	4.07	4.08
2-tailed T test		p = 0.06	p = 0.01	p = 0.01

1. 5-point Likert scales between strongly disagree/definitely not and strongly agree/definitely yes

Analysis of Choice Data

- Random Parameters Logit with Error Components in Willingness to Pay Space
 - n = individual
 - j = alternative
 - t = question

$$U_{njt} = \theta_{njt} (ASC - PRICE_{njt} + \omega_{1n} Hydroponic_{njt} + \omega_{2n} Organic_{njt} + \eta_{njt}) + \varepsilon_{njt}$$

- Baseline product: conventional, traditionally grown lettuce
- Estimated using functions from the “gmnl” package in R

Information Increased marginal WTP for Hydroponics

	Control	Environment	Clean	Local
Hydroponic	-\$1.47	\$0.20	-\$0.56	-\$0.69
Control vs. Treatment Group 2-tailed T-tests ¹		p < 0.01	p < 0.01	p < 0.01
Organic	\$1.13	\$1.50	\$1.65	\$1.69
Control vs. Treatment Group 2-tailed T-tests		p = 0.70	p = 0.16	p = 0.03

1. T-tests between individual marginal WTP values in each group.

2. Interaction effects for organic + hydroponic was excluded from models since the interaction was insignificant for all treatment groups in the original MNL models.

Conclusions

- The organic label is currently more important than hydroponic labels
- Information seems to improve attitudes toward hydroponics and increase WTP
- While a hydroponic label may cause a consumer discount at this point in time, more marketing and consumer familiarity with hydroponic benefits would likely increase willingness to pay.

