Amaranth as a Climate-Resilient, Nutrient-Dense, Culturally-Preferred Crop to be Integrated in New Jersey Agriculture

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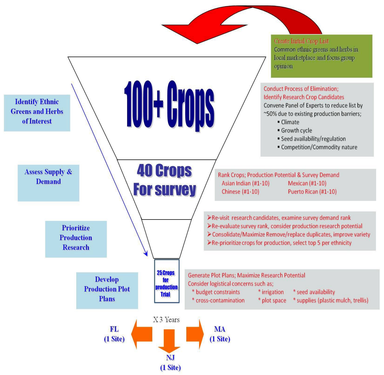
Abstract

Demand for culturally preferred leafy greens in the US is rising rapidly due to the increased awareness among cultural groups about their culinary heritage and the desire for diverse and healthy diets.[1] This demand is heightened when considering the disproportional effects of food insecurity on minoritized ethnic populations.[2] Leafy green amaranth (*Amaranthus spp.*) is a crop of economic and nutritional importance among ethnic minority communities within the Northeastern United States and around the world. Consumer surveys along the Eastern U.S. targeted amaranth as a top 10 desired leafy green among Asian Indian, Chinese, and Mexican consumers, though it has limited market availability in the U.S.[3] It is a heat-loving and drought-tolerant crop that exhibits a strong resiliency to climate change and abiotic stress and has the potential to supplement locally grown spinach in summer months, due to its similar flavor and nutrient density.[4,5] Its production is limited by a lack of consistent germplasm, standardized growing practices, and ultimately a lack of mainstream consumer awareness of this promising crop. As New Jersey experiences increased average temperatures throughout the summer, it is important to identify climate-resilient crops that can thrive in these new conditions.[6] Our research aims to address the importance of adjusting New Jersey agricultural products to reflect its rapidly changing climate and diversifying population.

Consumer Preference Surveys



Survey Methods

- Online focus group bulletin board sessions with representative members of Chinese, Indian, Mexican and Puerto Rican communities along the US East Coast were used to compile an initial list of culturally preferred leafy greens and herbs.
- A panel of marketing, crop specialists and field/extension faculty reviewed the list and removed greens with production barriers that could limit marketability.
- Voluntary participants who self-identified as Asian Indian (n=277), Chinese (n=276), Mexican (n=288) and Puerto Rican (n=232) and were the primary food shoppers of their household were randomly selected along the US East Coast to participate in phone surveys.
- Surveys were offered in English, Mandarin, Cantonese, Hindi, and Spanish. Questions included frequency, proximity, purchase locations, quantity, price and expenditures of culturally-preferred leafy greens and herbs.

(a)

Crops	Asian Indian					
	Respondents Purchase Behavior					
	Regular		Seasonal		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Purslane/Veradolga	17	6.14%	18	6.50%	35	12.64%
Nightshade	15	5.42%	35	12.64%	50	18.05%
Fenugreek	110	39.71%	90	32.49%	200	72.20%
Indian Sorrel Spinach	107	38.63%	56	20.22%	163	58.84%
Indian Sorrel	8	2.89%	11	3.97%	19	6.86%
Malabar Spinach	15	5.42%	31	11.19%	46	16.61%
Radish Greens	106	38.27%	99	35.74%	205	74.01%
★ Amaranth (Purple)	16	5.78%	13	4.69%	29	10.47%
★ Amaranth (green)	28	10.11%	32	11.55%	60	21.66%
Turmeric	133	48.01%	70	25.27%	203	73.29%

Note: Percentage calculated based on total 277 respondents and the total below 100% indicates non response

(b)

Crops	Chinese					
	Respondents Purchase Behavior					
	Regular		Seasonal		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Shanghai bok choy	198	72%	40	14%	238	86%
Chinese broccoli	151	55%	48	17%	199	72%
Chives & Flowers	66	24%	42	15%	108	39%
Garland Chrysanthemum	30	11%	55	20%	85	31%
Lycium Leaf	10	4%	10	4%	20	7%
Malabar Spinach	39	14%	17	6%	56	20%
Potherb Mustard	29	11%	18	7%	47	17%
Spinach	152	55%	48	17%	200	72%
Sugar Pea tops/bean	76	28%	38	14%	114	41%
★ Yen choy (Amaranth)	51	18%	27	10%	78	28%

Note: Percentage calculated based on total 276 respondents and the total below 100% indicates non response

(c)

Crops	Mexican					
	Respondents Purchase Behavior					
	Regular		Seasonal		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
★ Amaranth	18	6%	16	6%	34	12%
Chard	41	15%	63	23%	104	37%
Lambsquarter	36	13%	49	18%	85	30%
Epazote	71	25%	52	19%	123	44%
Lemon Verbena	14	5%	7	3%	21	8%
Lipia	36	13%	29	10%	65	23%
Papalo	25	9%	35	13%	60	21%
Purslane/Verdolaga	65	23%	68	24%	133	48%
Roselle	84	30%	59	21%	143	51%
Vine Vegetables	84	30%	10	4%	94	34%

Note: Percentage calculated based on total 280 respondents and the total below 100% indicates non response

Table 1: Top 10 purchased culturally preferred leafy greens in Asian Indian (a), Chinese (b), and Mexican (c) consumer groups based on 2011 survey data along the Eastern United States. Amaranth was selected as a top 10 green within all three communities.

Global Germplasm Evaluation for Yield and Nutrient Density

Two consecutive variety trials were performed in 2021 and 2022 at NJAES Rutgers Horticulture Farm 3 to evaluate a global collection of germplasm, coming from the UDA-GRIN, the World Vegetable Center, American commercial sources, and Rutgers breeding lines. There were 7 species within the *Amaranthus* genus represented. Year 1 consisted of 97 unique lines. Yield-related traits were evaluated 6 weeks after transplanting, including flowering time, plant height, stem diameter, leaf area, petiole length, whole plant fresh, and dry weight. Dried samples were then saved for nutritional analysis: specifically total antioxidants, provitamin A, chlorophylls A and B, and total polyphenols. Based on this data, 38 lines of amaranth were advanced to year two of the study, again collecting yield-related data and using dried samples for mineral analysis. Four Rutgers lines have been selected for continued breeding based on these variety trials, along with cultural preferences of leaf shape and color.

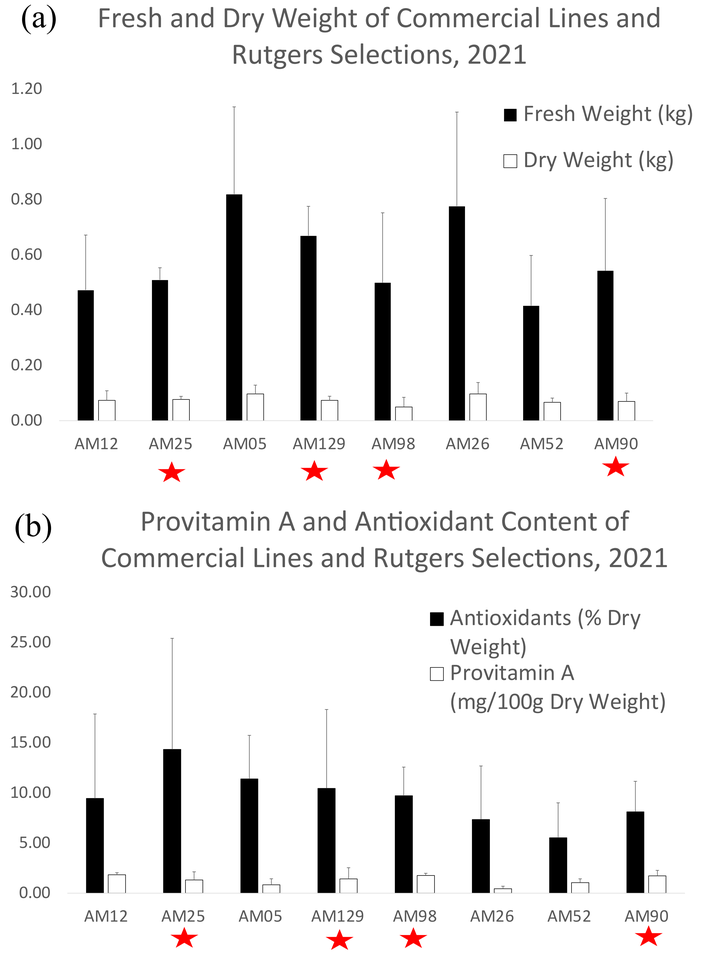


Figure 1: Rutgers breeding lines are compared with commercial varieties for fresh and dry weight (a) and antioxidant content and total Provitamin A (b). Rutgers advanced genetic selections are indicated with a red star.

Figure 2: Rutgers advanced genetic selections highlighted in figure 1, based on cultural preferences, yield, and nutritional data.

Amaranth as a Climate-Resilient Crop

Our research uses a market-driven approach to identify culturally relevant produce options that are lacking in consistent production strategies, with the purpose of increasing the accessibility and affordability of such key foods in migrant diets. The initial evaluation of global germplasm allows us to select for climate-resilient traits, like heat and drought tolerance, as these issues are driving New Jersey farmers to adjust their production methods. New Jersey agriculture relies on high-value specialty crops that do not require a lot of land and cater to the state's diverse population. Amaranth is a key food in diets around the entire world. It is incredibly resilient to drought and heat stress, which makes it an ideal leafy green in summer months, during which most greens cannot grow. Its neutral to slightly bitter flavor is comparable to that of spinach, and it holds many of the same nutritional properties. By connecting with growers and consumers from South Asian, East Asian, African Diaspora, and Latin communities, we are working towards breeding strong climate-resilient varieties that are suitable to New Jersey's climate, high in nutritional value, and representative of the cultural expectations of this crop.

Citations

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Acknowledgments

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