

Kale for Emerging Markets

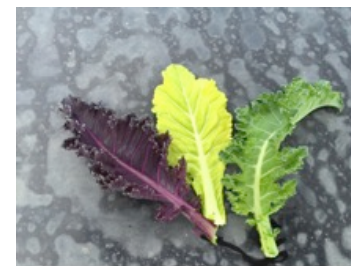
Breeding for diverse quality traits in kale (*Brassica oleracea* var. *acephala*) for emerging Northeast markets

Presented by: Hannah Swegarden, PhD Student, Cornell University, NYSAES



Current Breeding Program

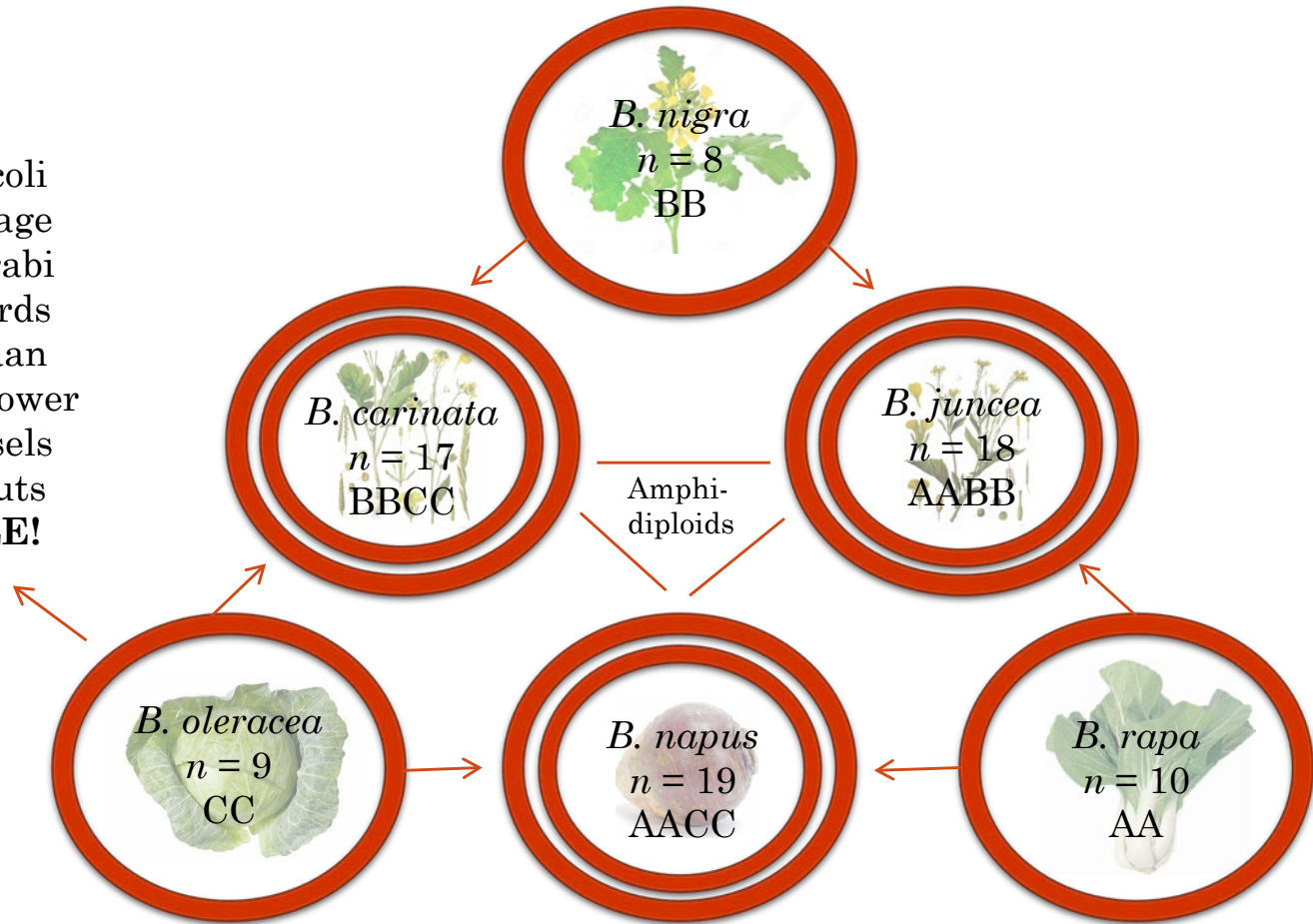
- NYSAES Vegetable Breeding Program:
 - Dr. Phillip Griffiths ('Griff')
 - Crop Specialties:
 - Cole Crops
 - Snap/Dry Beans
 - Small-Fruited Tomatoes
- Recent Focus on Leafy Brassicas
 - Increased Pigmentation
 - Novel Leaf Shapes
- Kale breeding material predates kale "craze"
 - **~2000:** Diverse Collard Collections from SE U.S.
 - **2009:** Grant from Atkinson Center for a Sustainable Future
 - **2015:** Novel Test Hybrids (F₁) Show Potential



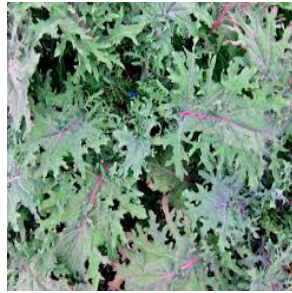
Brassica Relationships



Broccoli
Cabbage
Kohlrabi
Collards
Kailaan
Cauliflower
Brussels
Sprouts
KALE!



Market Classes and Cultivars



Siberian



Red Curl



Tuscan



Green Curl



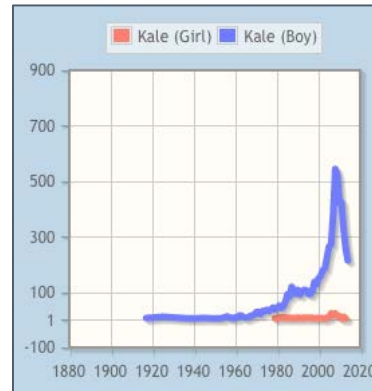
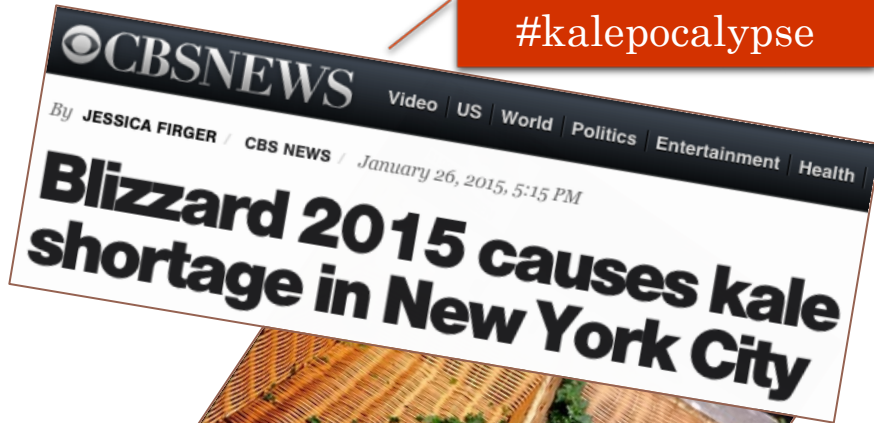
Collard

Fizz	Redbor F ₁	Black Magic	Ribor F ₁	Top Bunch F ₁
Dwarf Siberian	Scarlet	Nero di Toscano	Winterbor F ₁	Champion
Gulag Stars	Baltic Red	Dinosaur	Vates Kale	Georgia Collards
True Siberian	Roulette	Cavolo Lacinato	Pentland Brig	Green Glaze
			Meadowlark	Evenstar

Now Trending: #kale

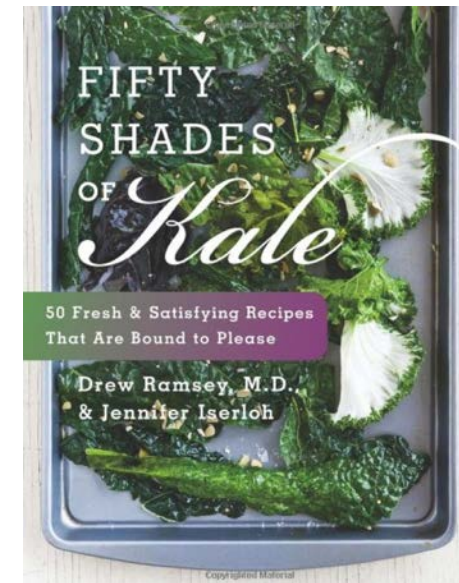
Rhythm® Superfoods Closes \$3 Million Funding Round With Lead Investment From General Mills
Superfood Snack Brand Closes Momentous Round of Funding, With Food Giant as Lead Investor

#kalepocalypse



Babies Named "Kale"
= 514 (Male)
= < 5 (Female)

Foodie's Delight...



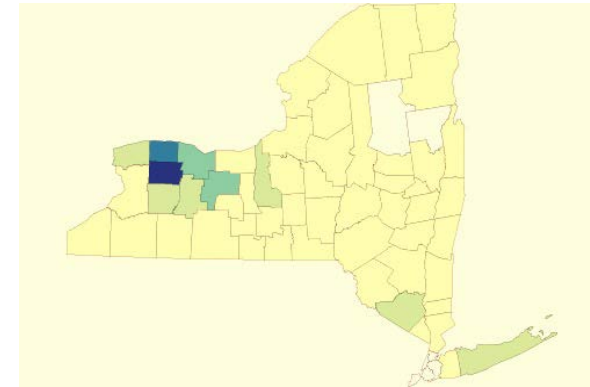
Chick-fil-A says goodbye to coleslaw, hello to kale

USA TODAY NETWORK Kristen B. Reed, WXIA-TV, Atlanta 3:45 p.m. EST January 7, 2016

(ssa.gov, 2015; Mintel, 2016)

Kale Production Stats

- Nationwide fresh and processed markets (2012):
 - 6,256 harvested acres of kale
 - 12,542 harvested acres of collard
- Kale acreage doubled between 2007 and 2012
 - 57 ac. → 104 ac.
- Significant product in NE direct-to-consumer and organic markets
 - Fall 2015: 15-20% of kale sold in NY marked 'local'
 - December 2015: organic stakeholder listening session



Primary Vegetable Production Acreage in NY

VEGETABLE GROWERS NEWS
JUN 18, 2015
More growers riding the kale production
bandwagon

(USDA, 2015; Hultengren et al., 2016; USDA, 2012)

Developing Novel Plant Traits

Existing Plant Morphologies



Novel Plant Morphologies



Integrated Approach to Plant Breeding

- First “Cornell Kale Day” in August 2016
- NYC chef’s demonstration in September 2016



- Greenmarket/GrowNYC partnerships
- Outreach and feedback from seed industry partners
- Recently acquired USDA Specialty Crop Block Grant funding through NYFVI:
 - On-farm trialing of new hybrids in 2017-2018
 - Detailed production surveys and enterprise budgets

Consumers + Plant Breeding

The plant breeding pipeline does not typically involve direct interaction with consumers...

- Consumer information is viewed as irrelevant and/or subject to volatility?
- Consumers don't know what they want?
- Interaction is viewed as too time consuming for plant breeders?
- Language/translation barriers inhibit direct interaction?
- Lack of established methodology?



Preliminary Studies

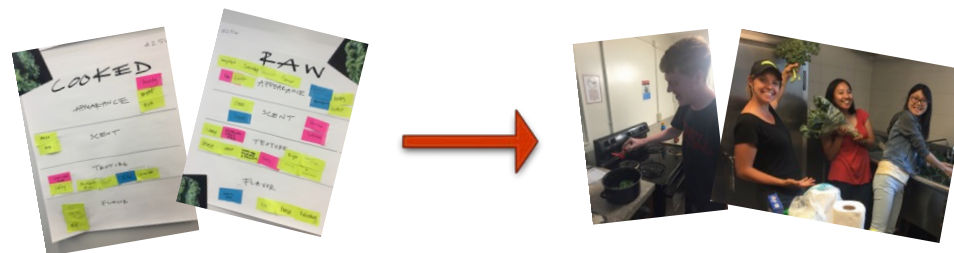
- So *how* do we begin to connect consumers and plant breeders?
 - Reframe plant breeding as a product development pipeline
 - Explore sensory analysis and consumer research tactics
 - Perform case study using an established plant breeding program
- Primary objectives of the preliminary analysis:
 - Understand importance of different plant traits through consumer lens
 - Understand consumer information that is feasible/applicable to breeding
- Methodology: Qualitative Multivariate Analysis (QMA)



Qualitative Multivariate Analysis (QMA)

Employed an **eight-step product development tool**, as a potential means of elucidating consumer feedback, values, and trait hierarchy in kale.

- Step 1 • Establish Study Objectives
- Step 2 • Identify Product Set
- Step 3 • Home-Use Tests (HUT)
- Step 4 • Capture Consumer Language (Facilitated Focus Group)
- Step 5 • Build Value Diagram
- Step 6 • “Love-It” or “Hate It” (Asks the Why?)
- Step 7 • Napping Exercise (Preference Mapping)
- Step 8 • Kano Diagram (Must-Have vs. Driver vs. Delighter)



QMA Overview

- Kale (*Brassica oleracea* var. *acephala*) selected as case study:
 - Diversity in leaf shape/size currently available on the market (product category)
 - Current popularity in Western markets ensures consumer familiarity
 - Availability of a plant breeding program at Cornell University!
- Fourteen participants given samples for in-home use tests



'Top Bunch'
#378



Tuscan Kale
#842



'P13-2'
#476



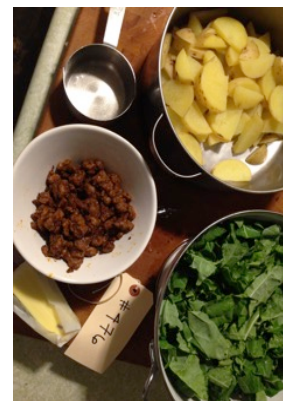
'Fizz'
#543



'Winterbor'
#256



'Beira'
#921



"Flat"
"Bright"
"Scalloped"



"Huge"
"Aromatic"
"Springy"



"Slightly wilted"
"Smooth leaves"
"Deep green"



QMA Overview Cont.

- Focus group conducted in Sensory Evaluation Center in Sept. 2016



- Built value diagram and performed perceptual mapping
- Results still need to be validated by larger population



Classic “Iconic” KALE: curly edges and all




	Raw		Cooked	
Texture	<ul style="list-style-type: none"> Crisp Springy Structural integrity Dense/full Rigid ribs (difficult to mince, de-vein, leads to waste) Rough leaves Chewy 	<ul style="list-style-type: none"> Got mushy after sitting in a dressing Soft Delicate Bright Crunchy Not wilted Substantial/satisfying (fills big volume) Sharp edges/corners 	<ul style="list-style-type: none"> When minced, thickened well but was somewhat difficult to homogenize After baking: soft, crunchy Firm texture (even after adding broth) 	<ul style="list-style-type: none"> Long cook time Lofty Perfectly even Smooth Frilly Crunch Soft/easy to chew
Appearance	<ul style="list-style-type: none"> Nice color, bouncy Curly, frilly, extremely curly, decorative, art-nouveau Hydrated appearance Fresh Wavy edges Saturated color Voluminous 	<ul style="list-style-type: none"> Pale Pretty Stereotypical, “Grocery store kale” Puffy clouds of kale goodness Deep saturated green color (in a smoothie) 	<ul style="list-style-type: none"> Muddy looking/muddy green Not beautiful, wanted something darker and greener Bright Fun Pretty-additional charm due to curls 	<ul style="list-style-type: none"> Nice pop of green, an accessory to the dish
Flavor	<ul style="list-style-type: none"> Not much Kale! Fresh Refreshing Green Not as bitter as would have liked 		<ul style="list-style-type: none"> Good kale/Nice flavor Not too overwhelming or sulfurous Mild (even coconut oil masks it) A bit of cabbage flavor 	<ul style="list-style-type: none"> Curls caught a lot of broth (more flavorful) Nutty Slight bitter
Scent	<ul style="list-style-type: none"> Fresh aroma Clean Green 	<ul style="list-style-type: none"> Smelled bad during blending Terrible Sulfurous 	<ul style="list-style-type: none"> Fresh Mild 	

MORE
Important



LESS
Important

	Cooked (sautéed, baked, in stew/soup, other)		Raw (salad, smoothie)	
	Most Preferred	Least Preferred	Most Preferred	Least Preferred
Appearance	 <p><i>Retained Shape</i></p>	 <p><i>Color Change to Brown</i></p>	 <p><i>"Iconic" Kale</i></p>	 <p><i>Cheap/Less Nutritious</i></p>
Texture	 <p><i>Not Chewy</i></p>	 <p><i>Mucilaginous/Slimy</i></p>	 <p><i>Crisp</i></p>	 <p><i>Fibrous/Rubbery</i></p>
Flavor	 <p><i>Cabbage Flavor</i></p>	 <p><i>Bitter</i></p>	 <p><i>Mild/Mellow</i></p>	 <p><i>Pungent</i></p>
Scent	 <p><i>Mild/No Smell</i></p>	 <p><i>Slightly More Sulfurous</i></p>	 <p><i>Fresh/No Smell</i></p>	 <p><i>Indistinguishable Smell</i></p>

Value Diagram

Value	Descriptors
Sensory Attributes	
<i>Flavor</i>	robust/pungent/strong, spectrum of flavor intensity, sulfurous, bitter, grassy, natural
<i>Texture</i>	tender, touch, fibrous, rubbery, mucilaginous, rigid/hard vs. soft, crunchy, flaccid, stringy
<i>Color</i>	vibrant or dark green, red/purple pigments, retention after cooking, aversion to yellow type, pigmented types considered “decorative”
<i>Scent/Aroma</i>	fresh, absent, mild, hint of iconic “sulfur” smell when cooked
Appearance/Recognition	muscular vs. graceful, leaf margin (flat vs. curly), undamaged leaf surface, kale vs. not kale, retains identity when prepared
Shelf-Life	durability, hardy, keeps in refrigerator for days, distinct from other leafy greens, bagged salads vs. whole leaves
Health and Well-Being	nutritious, gardening, organic, diet, lifestyle supplement, virtuousness, convenience

What is important for kale?

Most Important Traits

Least Important Traits



Storability/Freshness



Texture



Appearance



Scent/Aroma



Leaf Size



Color

Future Directions

- Next steps for consumer sensory research program:
 - Conduct larger validation (Kano Satisfaction) survey
 - *If funding allows...*
 - Establish a kale descriptive panel
 - Validate research with larger group of consumers
- Engage/support diversified funding
 - Growers, producers, and processors
 - Drive longevity of new breeding lines in markets
- Continued dialogue across food system

CIFS CORNELL INSTITUTE FOR FOOD SYSTEMS PRESENTS

"One kale, Two kale, Green kale, Purple kale..."

Be FIRST to find out! Consider sponsoring this Research!

CIF S-IPP member sponsorship: \$2,500
Non-CIF S-IPP member sponsorship: \$5,000

Deep Cur, Smooth Green, Tuscan Lacinato, Purple Perchata, Smooth Purple, Jolly Edge, Ergo Green, Coco Purple

EXCLUSIVE RESEARCH SPONSOR BENEFITS:

- Early access to the results
- Exclusive access to mid-program progress report (webinars)
- Market development
- Impact on the direction of the breeding program
- Free one-hour research consult on unrelated project with Sensory Evaluation Center staff
- Free guided tour of Stocking Hall

Organic Kale Consumer & Sensory Research Program

1. Qualitative Consumer Research (PWT + F&G)
September-December 2018
• Consumer kale lexicon
• Perceptual product maps
• Aesthetic attribute importance hierarchy
• Emotional laddering

2. Kale Consumer Survey
December 2018
• Validate kale aesthetic attribute hierarchy
• Understand current consumer habits and attitudes

3. Kale Descriptive Panel
September-December 2017/2018
• Sensory profile of each kale variety tested
• Overlay with consumer liking data (after consumer tested step 4)

4. Kale Consumer Test
Fall 2017 or 2018
• Validate research results with consumers

About the Research Team

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THANK YOU!