

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

Brassica Basics:

Members of the Brassicaceae plant family include many crops of agronomic and horticultural importance, including canola, wasabi, broccoli, mustard greens, cabbage, rutabaga, kai-lan, and turnip. The plant family today exhibits a rich diversity of plant types resulting from direct selection for seed and vegetative tissue over thousands of years. Most of the significant horticultural Brassica crops are found within the genus *Brassica* and, more specifically, within the species *Brassica oleracea*. Common *B. oleracea* vegetable crops include kale, broccoli, cabbage, kohlrabi, collard, and cauliflower and were domesticated in the cool, moist climates of the Mediterranean basin. The ability to hybridize with both wild species and other cultivated members within the Brassica family has encouraged continued diversification of the *B. oleracea* species in modern breeding programs.

Kale/Collard Production Overview and Varietal Selection

Most of the members of the *Brassica oleracea* species are biennial and require a vernalization period to trigger reproductive development. Optimum germination temperatures occur between 20-25°C (68-77°F). Kale and collard are both hardy leafy brassica types that can be planted late into the fall; production in extremely hot environments may trigger a bolting response in some leafy *Brassica* varieties. Both crops, however, are well suited to fall plantings and can withstand heavy frosts. Some kale cultivars may even be able to overwinter for multiple harvests late into the season. Requirements for multiple-harvest kale/collard plantings have not previously been well defined for mineral soils, and few recommendations exist for entire-plant harvests.

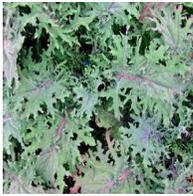


Figure 1. Organic kale plots during summer 2016 at Homer C. Thompson Research Farm in Freeville, NY.

A wide array of kale and collard cultivars are available for production (Table 1), though many open-pollinated and landrace cultivars are only available through seed saving organizations or small seed companies. International and domestic seed production issues and high demand in North America have strained available stock of hybrid (F₁) seeds. Most cultivars are available for organic production, though seed shortages, again, remain an issue for popular hybrids. Though not formally defined, leafy *B. oleracea* crops can be organized into five common market classes: collard, Siberian, red curl, Tuscan, and green curl. Unfortunately, most cultivars currently available do not have easily accessible information regarding important horticultural traits, such as disease resistance, pest resistance, yield, or plant spacing requirements.

Table 1. Representative cultivars within common kale and collard market classes. Listed cultivars do not represent all currently available material on the market and have not been extensively evaluated in NY State.

--- Market Class ---

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

National and Local Markets

Kale (*Brassica oleracea* var. *acephala* L.) and collards (*Brassica oleracea* var. *viridis*) are common leafy green vegetables whose recent rise in popularity has reinvigorated interest from both fresh and processed markets across the U.S. Kale, in particular, has emerged as one of the most important leafy green vegetables, in part because of its market versatility and status as a nutritional “powerhouse.” It is also popular as an alternative salad green, a component of health beverages, and as a processed dry vegetable in alternative chip markets.



Data from the 2012 Census of Agriculture estimates that approximately 12,542 acres of collard and 6,256 acres of kale were harvested for U.S. fresh and processed markets (USDA, 2012); the majority of production in 2012 was intended for fresh produce markets. Kale is a new, but significant, horticultural product in Northeastern direct-to-consumer and organic markets. During the 2015 fall season, between 15-20% of kale sold in New York was marked ‘local’ (USDA, 2015). In December of 2015, a stakeholder listening session focused on breeding needs for organic production identified kale as an important crop to organic growers in the northeast. Acreage dedicated to kale production nearly doubled between 2007 (57 ac.) and 2012 (104 ac.) within the state of New York alone (USDA, 2012). Collard is more commonly grown and consumed in the southern U.S., though acreage in northern regions is beginning to increase. Estimated economic impact of these two crops has not been well defined, but market trends suggest a continued rise in acreage dedicated to the production of leafy Brassica types.

Breeding Program Background



Figure 2. Sample of diversity in the Griffiths breeding program at Cornell. Promising hybrids will be trialed in 2017-2018 on-farm field trials.

The Griffiths' Lab is excited to showcase new breeding material focused on expanding the diversity of leafy Brassica vegetables to support current market expansion. Efforts to breed new leafy Brassicas began in 2008 with a focus on African kale (sukuma wiki). This effort expanded with support from the Atkinson Center for a Sustainable Future incorporating diverse materials from collection maintaining biodiversity. The diversity generated also merged plant materials from projects focused on enhanced leaf pigmentation and the SCRI-funded East Coast Broccoli project. We are now hoping to leverage stakeholder feedback to guide future development and ensure that the breeding program suits the needs of national and regional food systems.

NYFVI Grant and Consumer Research

In the coming years, the vegetable breeding program at Cornell seeks to engage downstream players in the breeding, development, and promotion of new material. New and diverse kale hybrids developed at Cornell's NYSAES have been advanced to the point of on-farm evaluation, where they can be used to generate stakeholder feedback for future breeding work and evaluated for market potential. Recently acquired funding from the USDA Specialty Crop Block Grant through New York Farm Viability Initiative (NYFVI) will allow the program to perform on-farm hybrid trials in 2017-2018, develop enterprise budgets specific to kale production, and continue breeding and evaluation of new material. Further, ongoing partnerships with the Cornell Sensory Evaluation center and the Cornell Institute for Food Systems (CIFS) have allowed the program to embark on consumer research that seeks to elucidate the methodology required to engage consumers in the plant breeding process. Preliminary research conducted in the fall of 2016 included consumer home-use tests of fresh kale products (Figure 3) and a small focus group. Ultimately this research will help the program better understand how to interact and connect with consumers. The materials developed and in advancement will provide new and diverse product options to drive enterprise, diversity, and sustainability for NY vegetable growers. We encourage you to remain engaged with the program and check back for trial updates!

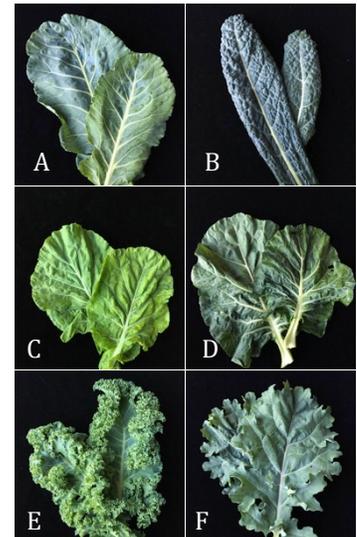


Figure 3. Six leafy Brassica types included in consumer home-use tests in the fall of 2016. A) Collard B) Tuscan/Lacinato C) Yellow Collard (breeding line) D) Portuguese Tronchuda E) Deep Curl F) Jagged.

Notes

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