



GROWING KALE

Brassica oleracea

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Fig. 2. Kale cultivated as a common edible crop.

Kale is a leafy vegetable crop that originated from the Mediterranean or Asia Minor (Stephens, 2015). Also known as borecole, kale belongs to the same genus and species (*Brassica oleracea*) as Brussels sprout, common broccoli, cauliflower, and head cabbage, but is in the cultivar group Acephala (Fig.1). Examples of other *B. oleracea* crops that are of the cultivar group Acephala include collards and spring greens. Although kale is cultivated as a food crop (Fig 2.), some varieties are cultivated as ornamentals (Graves, 2018) as shown in Fig 3.



Fig. 3. Ornamental kale.

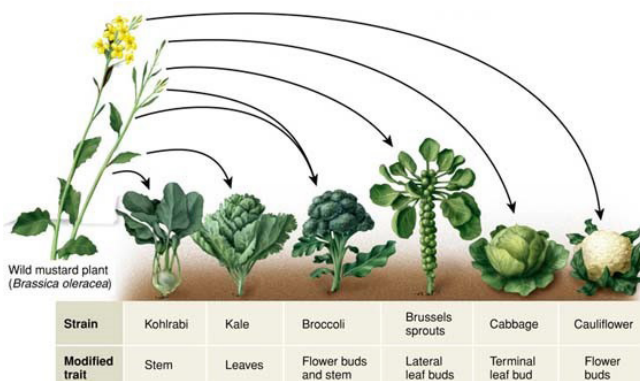


Fig. 1 - *Brassica oleracea* from its uncultivated form to several examples of cultivated forms.

Kale can be consumed as a raw vegetable, and can also be used as a cooked vegetable. On Guam, kale has become a popular vegetable for salads and fresh-blended shakes. It is rich in Vitamin A, Vitamin C, Vitamin K, Folic Acid, Calcium, and is a good source of Dietary Fiber (HealthiestFoods.com, 2015). Fig. 4 shows basic nutrition facts of raw kale as provided by the United States Department of Agriculture (USDA).

Nutrition Facts	
Serving Size: 100 g	
Amount Per Serving	
Calories 50	Calories from Fat 6
% Daily Values*	
Total Fat 0.7g	1%
Saturated Fat 0.091g	0%
Polyunsaturated Fat 0.338g	
Monounsaturated Fat 0.052g	
Cholesterol 0mg	0%
Sodium 43mg	2%
Potassium 447mg	
Total Carbohydrate 10.01g	3%
Dietary Fiber 2g	8%
Sugars -	
Protein 3.3g	
Vitamin A 308%	Vitamin C 200%
Calcium 14%	Iron 9%

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Fig. 4. Nutrition facts of raw kale.

Growing Kale

Kale can be transplanted from a seedling or direct-seeded into the ground. Seeds germinate in 4-7 days in the nursery or ground. Commercially, seedlings should be spaced 12-18 inches apart and 1.5-2.5 feet apart between rows (Cornell University, 2006).

A general fertilizer recommendation for one growing season for kale is 871-1300 lbs. of 10:10:10 (N-P2O5-K2O) per acre, or approximately 2-3 lbs. of the same nutrient ratio for every 100 sq. ft. (Masabni and Lillard, 2011).



Fig 5. Kale varieties grown in Guam Cobbly Clay Loam in Yigo, Guam on April 25 – June 7, 2018.

Irrigation of kale should consist of frequent watering. During dry periods, ensure soils are kept moist and not saturated. During extended rainfall events, watering may not be necessary until soil is nearly dried up.

Kale is a cool season crop that grows best in soil temperatures of 60-65°F (15.5-18°C). Hot weather will result in bitter kale (Wolfe, 2012). Depending on variety, kale can grow well in temperatures above 80°F (27°C), but will likely result in a bitter-tasting vegetable (Acosta, personal communication, March 30, 2018). Preferably, kale should be grown in fertile soils that consist of good drainage such as Akina Silty Clay, Guam-Saipan Complex, Guam-Yigo Complex, Pulantat Clay, and Togcha soils. Kale grows best in fertile, well-draining soils with high organic matter such as Guam-Yigo Complex, Pulantat clay, and Togcha-Akina Silty Clay soils. Fertile compost is also a good media source to grow kale. Kale prefers a media/soil pH of 6.0-7.5 (Cornell, 2006). Guam Cobbly Clay Loam, a commonly cultivated soil type of Guam, is a shallow limestone soil that is not very fertile, but with proper management, kale can be productive.

Common Pests and Diseases

Aphids (Family: Aphididae), butterfly caterpillars (Order: Lepidoptera), and whiteflies (Family: Aleyrodidae) are commonly observed insects on almost all *Brassica* species, but one of the most damaging insects is the diamondback moth (*Plutella xylostella*) (Ekman et al, 2014). Larvae of the diamondback moth feed on all parts of the plant. Registered insecticides can help control insect infestations. Planting trap crops like mustard and collards on the perimeter of fields may reduce diamondback moth larvae infestations on kale (Bamba, personal communication, March 28, 2018).

Common diseases that are problematic for *Brassica* species include fungi, particularly Black leaf rot (*Alternaria spp.*) and Black rot (*Xanthomonas campestris*). Registered fungicides can control the spread of such fungal problems associated with kale. Some prevention measures to reduce chances of diseases and avoid pesticide use include growing kale in full sunlight, avoiding long periods of soil saturation, keeping farm tools clean, and choosing disease resistant varieties if available.



Fig 6. Cabbage worm foraging on foliage of Beira variety of kale.

Plant Care

It is always good practice to consistently monitor plants for pests and diseases. If a pest or disease is unknown, collect samples if possible and submit to the University of Guam, Cooperative Extension & Outreach for correct identification and treatment recommendations.

Weeding and mulching around plants will reduce weed competition and conserve soil moisture.

It is also advisable to keep records of all field activities. Proper record-keeping will identify good practices and mistakes, along with identifying desired varieties of plants. This will also improve decision-making for future crops.

Harvest

Depending on variety, kale is generally harvested within 50–60 days after germination (Haynes et al, 2009). Baby kale varieties usually are harvested about 25 days after germination (Manning et al, 2016).

Entire kale plants are usually harvested by cutting plants just above the soil line as a one-time harvest. Kale leaves can be harvested multiple times from individual plants with the ‘cut and come again’ harvest method. This method basically consists of harvesting the outer, older leaves of the plant by cutting off leaves approximately 1 inch above the soil line. This allows the younger new leaves to grow and form new heads for multiple harvests from individual plants. The ‘cut and come again’ harvest method may be performed continuously for kale until overall plant growth declines.

Post-Harvest Handling

Like most cabbage (*Brassica*) family crops, kale should be cooled immediately after harvest and stored at 32°F (0°C) at 95–100 percent relative humidity to slow down water loss and decay (University of Maine Cooperative Extension, 2001). Avoid losing moisture in storage rooms. This will provide a longer shelf life in stores.

2018 Kale Variety Trial on Guam

There are numerous varieties of kale available on the internet from seed companies such as Baker Creek Heirloom Seed Co. (<http://www.rareseeds.com/>), Kitazawa Seed Co. (<http://www.kitazawaseed.com/>), and Johnny’s Selected Seeds (<http://www.johnnyseeds.com/>).

A variety trial was conducted at the Western Pacific Tropical Research Center, Dean’s Circle House 1, Agriculture & Life Sciences, College of Natural & Applied Sciences, University of Guam (Fig. 5). On April 25, 2018, four varieties of Kale were transplanted in Guam Cobbly Clay Loam soil, a commonly cultivated soil in northern Guam, after growing in plant trays for 22 days. The four varieties grown for the trial included Beira (F1 Hybrid), Redbor (F1 Hybrid), Scarlet, and Starbor (F1 Hybrid).



Fig 7. Beira

Hellula undalis, the cabbage worm, was observed as the major pest that attacked all kale varieties during the entire growing period in the field after transplant. In an effort to control the aggressive pest, an organic

pesticide, active ingredient *Bacillus thuringiensis v kurstaki*, was applied twice a week. The cabbage worm severely hindered the growth of approximately 17% of total plants in the field (Fig. 6). For data collection, plants that were severely damaged were not used for data recording. Representatives of each variety are shown in Figures 7, 8, 9, and 10.



Fig 8. Scarlet

Entire individual plants of all varieties that grew fair were harvested on June 7, after growing for 42 days in the field. Harvested plants were measured for fresh weight and labeled as marketable or non-marketable. Other than plants severely damaged by the cabbage worm, Beira grew more vigorously than all other varieties. Starbor and Redbor grew fairly well, while Scarlet resulted in the poorest average growth. Approximately 50% of total harvested plants combined were labeled as marketable and 50% labeled as non-marketable. The high percentage of non-marketable plants were due to cabbage worm damage to the foliage of the plants. Table 1 displays average fresh weight of the kale percent marketability of each kale variety.



Fig 9. Redbor



Fig 10. Starbor

Cultivar	Avg. weight per plant (g)	% Marketability
Scarlet	62.00	25
Beira	466.50	25
Redbor	189.75	100
Starbor	240.50	50

Table 1. Yield data of tested cultivars of Kale

Discussion

Kale is a nutritious leafy vegetable that is becoming quite popular on Guam. Kale can be consumed in many styles, cooked or raw. Locally, it is commonly used for salads and blended shakes. Although kale is a cool season crop, the recent variety trial proved that kale, depending on variety, can be productive in Guam’s tropical conditions. Common cabbage family pests like the cabbage worm will likely require intense control measures to reduce pest damage and maintain quality marketable yields. Nevertheless, kale may be a potential subsistence and commercial crop for Guam growers. Seek characteristics from seed sources that include the term ‘heat-tolerant.’

For Support

Contact the College of Natural & Applied Sciences’ Cooperative Extension & Outreach at 735-2080 for help or more information. Additional publications can be found on our website at: www.cnas-re.uog.edu under the Publications tab.

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Disclaimer

Mention of a company or organization is to provide an example and is not an endorsement or recommendation in preference to others that may also be suitable.

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