

Leafy Crop Variety Trials

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Cultivar trials were conducted to evaluate leafy crop varieties for field production at low (70 ft) and high (800 ft) elevation, and for non-circulating hydroponics production at low elevations. The results of these trials are preliminary. Normally variety trials should be replicated over several years and locations before recommendations can be made by CTAHR extension. Growers interested in promising varieties should thus evaluate them first in small plots to evaluate adaptability to their farm's particular environmental conditions.

Experimental Site Descriptions

UH Poamoho Experiment Station.

870 ft elevation;
45 inches median annual rainfall.
Wahiawa silt clay (Tropeptic Eutruxox);

The Poamoho experimental farm is located on soil which has a mineralogical composition of kaolinitic clay and iron oxides and an organic matter content of approx. 2%. The red soil is derived from basalt that is kaolinitic with oxides of iron and manganese.

UH Waimanalo Experiment Station

Mean Annual Temperature: 75 F (24.6C), monthly range 70-80F (22-27C)
Mean annual rainfall 55 in (1380 mm). Annual Range= 500-1800 mm
Soil type- Vertic Haplustolls, derived from lava and coral
pH about 6.5, good base status, low organic matter
Typical soil fertility in these plots is organic matter content of 1.12%, pH= 5.6, and soil nutrient levels (in ppm) of P= 52, K=480, Ca= 2600, and Mg= 800.

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Yields of several lettuce varieties grown at the UH Poamoho Experiment Station, Jan-March 1999

Cultivar	Type	Average wt. (gr/plant)	Average weight (oz/plant)	Yield (lb/100 ft)	Yield (lb/Acre)
Short Guzmaine*	Romaine	796	28.1	176.6	38,319
Floricos*	Romaine	730	25.8	175.5	38,080
Floridade	Romaine	703	24.8	160.9	34,922
Valmaine*	Romaine	615	21.7	159.0	33,631
70096	Romaine	561	19.8	135.6	29,421
70180	Romaine	537	19.0	123.7	26,837
Everglades	Butterhead	358	12.6	118.4	25,689
B-1239-3	Butterhead	225	7.9	78.9	17,126
Dark Green Btn*	Boston	423	14.9	49.6	10,763
B1192	Boston	330	11.7	93.2	20,236
Floribib	Boston	273	9.6	72.7	15,787
Manoa*	semi-head	234	8.2	60.2	13,060
				51.6	11,194

* Standard varieties (old or new). Paris Island (California, Hawaii, other places); Dark Green Boston (California, NY, other places); Short Guzmaine (hydroponics, Big Island); Manoa (Hawaii); Floricos (Florida); Valmaine (old std., Hawaii, Florida, California, NY, etc.)

Note: Lettuce was sown on January 13, 1999 on 50 ft plots. Plants were thinned about 2 weeks after planting to obtain a distance of 1 ft between plants. The field was sprinkler irrigated as needed, normally 2x per week. On March 10, a five foot section was harvested from each plot and the weight of 5 plants was recorded individually.

Yield data: Overall all varieties showed a uniform growth and marketability of harvested plots was nearly 100%. Yields per acre were calculated based on an estimated population of 21,700 plants per acre (assuming a spacing of 2 ft between rows and

Leafy Crop Variety Trial

UH Poamoho Experiment Station, Jan. to March, 1998
Hector Valenzuela, Ted Goo and Susan M. Migita
University of Hawaii at Manoa, CTAHR

Six Leafy crop varieties were evaluated for their marketable yield at the UH Poamoho Experiment Station. The crops were direct-seeded on Jan. 24th, and harvested on Mar. 11th. The plants were grown on 15-ft plots per treatment (variety), with 5 replications per treatment. At harvest each individual head was weighed. The crop was sprinkler irrigated as needed. Leafhoppers were a problem during the early growth stages but the plants in general outgrew this pest damage. The Red Leaf Mustard variety has been evaluated in Poamoho (800 ft elevation) and at the Waimanalo Experiment Station (low elevation) and performed well at both sites. It is an attractive and pungent leafy crop, but is susceptible to white rust. Green Boy pak choy has also performed well on trials conducted both in Poamoho and at Waimanalo, had attractive heads and had a very uniform growth. The spinach varieties are slow to establish and performed best at the high elevation (Poamoho) site. Because of its slow establishment, weedy fields should be avoided when growing direct-seeded spinach.

Green Seoul Chinese cabbage (loose head)- HungNong
Red Leaf Mustard- HungNong
White Pak Choy- HungNong
Green Boy Pak Choy- Hungnong
Seed (compare to Mei Qing Choi)
Summer Focus spinach- Takii
Super Alrite Spinach- Takii

Hungnong Vegetable Seeds
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Table L-1. Marketable yield of several leafy crop varieties grown at the UH Poamoho Experiment Station, Jan. to March, 1999.

Cultivar	Type	Head wt (grams)	Head wt (lbs)	Yield (lb/100 ft)	Yield (lb/Acre)
Green Soul	Ch. cabbage	874a	1.93a	385.4a	83623.5a
Green Boy	Pak choy	441b	0.97b	194.4b	
42194.4b					
White pkchoy	Pak choy	311c	0.69c	137.1c	29756.2c
Red mustard	Mustard	327c	0.72c	144.2c	31287.0c
Summer Alrite	Spinach	318c	0.70c	140.2c	30425.9c
Summer focus	Spinach	191d	0.42d	84.2d	
18274.7d					

Note: Yields per 100 ft and per acre were estimated based on a plant population of 43,400 plants per acre (2 ft between rows and 6 inches between plants in the row). Numbers followed by the same letter within each column are not statistically different according to Duncan's New multiple test range at a 95% confidence interval (P<0.05).

Leafy Crop Cultivar Trial Waimanalo, Winter 1996

Hector Valenzuela and Christine Crosby

Univ. Hawaii at Manoa, CTAHR, Dept. of Horticulture

Location: UHM Waimanalo Experiment Station, 70 ft elevation

Direct Seeded Dec. 12, 1996

Harvested Feb. 6, 20 & 21, 1997

Spacing 4-6 inches between plants

4 rows per bed, under drip irrigation

Each variety was grown on a 45-50 ft long bed, with 4 rows per bed.

Growing conditions were extremely wet, with extensive crop losses reported island-wide.

Several spinach (horenso) varieties were grown in this observational trial but did not perform well at this low-elevation site.

Variety	Yield per bed (lb/50 ft)	Yield per Acre (lb/Acre)
Green pak choy (Marutane)	77.5 lbs	9,140 lbs
White pak choy (Marutane)	130 lbs	15,005 lbs
Green Soul Chinese cabbage (Hun)	119.5 lbs	14,093 lbs
Red leaf mustard (Hungnong)	58.5 lbs	6,752 lbs

Cultivar descriptions

Green pak choy: has soft and thick petioles which are green as contrast to most other white-petiole cultivars. It can be grown from late spring to late fall. It is known for its pleasant flavor when cooked with meat and other vegetables. Maturity 30-40 days.

Green Soul Chinese cabbage: A semi-head type Chinese cabbage. Vigorous grower with yellowish green narrow leaves and pleasant flavor. Popular in fresh market for short term Kimchee making.

Red leaf mustard: A colorful, attractive and tasty variety that has performed well on several trials at Waimanalo and in Poamoho (800 ft elevation).

White pakchoy: The leaf is round, dark green and waxy. The fleshy petiole is pure white and very delicious. The plant can be available almost any time during the various growth stages. Maturity 30-40 days.

Marutane Leafy Green Variety Trial at Poamoho, Jan-March 1995
Hector Valenzuela

A leafy green variety trial consisting of Japanese varieties (Marutane Seed) was conducted at the UH Poamoho Experiment Research Station from Jan. to March '95. Plots were 10 feet long and were replicated twice. Spacing was 1 ft between plants in the row and 2 ft between rows for an approximate population of 21,700 plants per acre. Seeds were sowed on 19 Jan. and harvested on 22 March. Results are shown on Table LF-1.

Varietal Description

Asia: leaf pointed type; smooth and medium dark green colored; seed shape= prickly seeded; bolting medium; summer to autumn sowing; spring sowing possible in cooler areas. tolerant against downy mildew.

Culture: hybrid between oriental and European type; spring or summer to winter harvest; early maturity; leaf is a pointed oriental type; smooth and dark colored; seed shape is rounded; bolting is medium; mid summer growing is not recommended due to risk of bolting; it can be harvested before bolting. resistance to downy mildew r-1 and r-2.

Green Page: leaf slightly pointed.

Green Pak Choy: maturity 30-40 d; green

Mustard Komatsuna Green: maturity about 20-30 days; all season type; glossy dark green color; excellent for oriental cooking.

Shirona: maturity about 20-30 days; all season type; white petiole with bright medium green leaf; use for cooking and pickling.

Tairyoku: hybrid between oriental and European type; fall to winter harvest; maturity is early; plant upright; leaf slightly pointed; thick smooth and dark green colored; rounded seed; bolting is medium; upright; resistance to downy mildew r-1 and r-2.

Vivace: maturity early; plant semi upright; leaf slightly pointed; smooth and very dark green colored; seed round shaped; bolting is slow; excellent uniformity and quick growing. resistance to downy mildew r-1, r-2, and r-3.

White Pak Choy: maturity 30-40 d; white petiole; same culture as green pak choy.

Seed Source:
 Marutane Co. Ltd.
 C.P.O. Box 65
 Kyoto 600 Japan

Acknowledgements: Thank-you to: Marutane for providing seed samples, to Richard Nakano and the staff at Poamoho for field preparation, plot maintenance, and data gathering, and to Cerruti Hooks for data collection and analysis.

Table LF-1. Yield of Spinach and leafy green varieties, Poamoho, Spring 1995.

Cultivar	Type	Marketable wt. (lb/Acre)	Total wt. (lb/Acre)	Grade A (percent)	Grade B (percent)	Culls (percent)
Shirona Green	Mustard green	23,827	23,924	38	47	14
Komatsuna Green	Mustard green	6,423	6,553	48	45	6
Green Pak Choy	Pak choy	20,788	21,016	43	26	30
White Pak Choy	Pak choy	20,376	20,994	29	30	55
Culture Spinach	Spinach	6,900	6944	88	11	0
Green Page	Spinach	4,774	4806	50	0	50
Vivace Spinach	Spinach	380	434	0	38	61
Asia	Spinach	770	922	0	46	54
Tairyoku	Spinach	337	412	0	35	64

**Red Leafy lettuce cultivar Evaluation in a Greenhouse
Non-circulating Hydroponics System, March to April, 1998
Ted Goo and Hector Valenzuela
Univ. Hawaii at Manoa, CTAHR, Horticulture Dept.**

This low-elevation cultivar trial was conducted at the UHM Magoon greenhouse in Manoa Valley, Oahu, HI. The purpose of the trial was to evaluate the suitability of selected specialty red leafy lettuce cultivars for production in a non-circulating hydroponics system. A green Boston type was included for comparison. The experimental protocol, including the hydroponics system and the crop nutrition was conducted as described by Riede and Valenzuela (1996). The crop was sowed in 72-cell Speedling trays on March 3, 1998, and transplanted into forestry tubes on April 3. Six plants from each variety were grown in a 13 x 27 x 11-inch "fishing" styrofoam box with 2-4 replications (boxes) per variety. The crop was harvested on April 31 and individual head weight, diameter, and height were determined. Because specialty lettuces are a high value crop, crop quality, taste, and appearance are more important than head weight. The quality and appearance of all the varieties evaluated was excellent. Optima is a nice large dark green Boston type, and Merlot is a nice dark red leafy type.

Table RL-1. Marketable yield and dimensions of several leafy lettuce varieties grown under a non-circulating hydroponics system, Manoa Valley, March to April 1998 (harvested 28 days after transplanting).

Cultivar	Type	Source	Diameter (inches)	Height (in)	Weight (grams)	Weight (ounces)
Optima	Boston (Green)	Johnny's	11.6a	7.1b	181a	6.4a
Cocarde	Red leaf	Johnny's	10.5bc	8.5a	157a	5.5a
Carrona	Red butterhead	Johnny's	11.0ab	6.0c	117b	4.1b
Sangria	Boston, red	Johnny's	10.0c	5.7c	99b	3.4b
Merlot	Dark Red Leaf	Cooke's	8.8d	6.1c	49c	1.7c
Lollo Rosa	Red Loose Leaf	Cooke's	7.2e	5.5c	53c	1.9c

Note: Numbers followed by the same letter within each column are not statistically different according to Duncan's New multiple test range at a 95% confidence interval (P<0.05).

Catalog Cultivar Descriptions

- Cocarde- (Johnny's) 49 days. A "giant red Oakleaf" type. The large, heavy, upright trumpet-shaped heads are made of delicate, lobed, dark green leaves with a rusty red overlay. Slow bolting.
- Lollo Rossa- (Cook's)- One of the most deeply curled of the looseleaf lettuces; pale frosty green interior with beautiful rose coloring at the leaf margins. Heat-tolerant.
- Merlot- (Cook's)- Deep burgundy colored. Loose leaf, slow bolting, and ideally suited for cut-and-come again mesclun culture.
- Optima (Johnny's)- 52 days. A big dark green Boston. A dark green Nancy type. Thick leaves. Larger, heavier, and more resistant to tipburn and bottom rot than the old Tania or Dark Green Boston varieties. Good taste.
- Sangria (Johnny's)- 49 days. Fancy red butterhead. Medium size head of wavy leaves prominently tinted with a warm, rosy red color. Mild taste. Slow to bolt and tipburn. Developed by Vilmorin in France.

Acknowledgements: Thank-you to Craig Okazaki for help with experimental setup and maintenance of the seedlings and hydroponics system and to Christine Crosby for help in data collection. Thank-you to Johnny's and to Cook's garden for providing seed samples.

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Lettuce Cultivar Evaluation in a Greenhouse

Non-circulating Hydroponics system.

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Introduction. The non-circulating hydroponics system for lettuce production developed by Dr. Bernard Kratky of the University of Hawaii at Manoa is gaining popularity locally. It is a relatively simple system that has been successfully used by gardeners and several commercial growers to produce organically-grown leafy lettuce. Dr. Kratky in collaboration with the UH-Manoa Innovation Center has patented and produced a home version of this system which will be featured at the Hawaii New Product Show at the Neil Blaisdell Center on May 16-18, 1996. Proceeds from the sale will benefit the University of Hawaii and the Horticulture Graduate Student Organization. Standard semi-head cultivars used for hydroponic production in Kauai and Hawaii include *Ostinata*, *Salina*, and *Green Mignonette*. Leafy types used in hydroponics include *Red Sails* and *Green Ice*.

Evaluation of Lettuce cultivars for non-circulating hydroponics.

The cultivar trial was conducted at the UHM Magoon greenhouse in Manoa Valley, Oahu, HI. The purpose of the trial was to evaluate the suitability of different leafy and semi-head lettuce cultivars for production in a non-circulating hydroponic system. The eight cultivars evaluated are described in Table Let-1..

The non-circulating hydroponics system used is a variant of the patented home version developed by Dr. Kratky. Sixteen styrofoam boxes with covers (known in the ornamental fish trade as a 'tall fish box' (dimensions 13"x27"x11", Pacific Allied Corp., Kapolei, HI)) were lined with 2-layers of 6 mil black plastic. Six uniformly spaced holes were drilled through the styrofoam cover of each box using a 1 3/4" diameter hole-saw bit. The inner side of the cover was lined with a single layer of black plastic to prevent solar radiation penetration into the box which would promote algae growth in the hydroponic solution. Each box was filled with 9.5 gallons of water containing 22 g soluble calcium nitrate fertilizer, 11 g epsom salt and 22 g of PHT 8-15-36 with soluble hydroponic fertilizer micronutrients (Plant Health Technologies, Boise, ID.) The initial total dissolved salts concentration was 1.7 mS. As a general guide nutrient concentrations for hydroponic lettuce nutrient solutions are, in ppm: N, 150; P, 50; K, 200; S, 45; Cl, 35; Ca, 175; Mg, 45; Mn, 0.5; Cu, 0.1; Zn, 0.3; B, 0.5; Mo, 0.1; and Fe, 3; at a solution conductivity of about 2 dS/m.

Six pencil size holes were drilled into SC-10 Super Cell tree tubes (Steuwe and Sons, Corvallis, OR.) and the tubes were filled with a pre-dampened Premier Pro-mix BX (Premier Brands, Red Hill, PA), a commercially available peat-pearlite medium. The tubes were seeded on March 5, 1996 and placed under a misting system (5 sec mist per 15 min) to promote uniform seed germination. The seedlings were transferred to the hydroponic system on March 15 and harvested on April 15. No further care or attention was given to the plants during the growing period. Maximum day-time temperatures ranged from 80-90°F in the greenhouse.

The trial consisted of 8 cultivars, three blocks and three plants per block. After harvest the cultivars were evaluated for yield, taste and visual appearance. Visual appearance and taste were evaluated by a taste panel made up of by four horticulture department members.

Yield data are presented in Table Let-2. *Oakleaf*, a green oak-shaped leaf variety and *Vulcan*, a newly introduced red-leaf lettuce produced the largest heads and appear to be suited for production in non-circulating hydroponics. *Anuenue*, a cross between *Manoa* (*Green mignonette*) and *Great Lakes*, produced large heads but developed severe marginal necrosis. *Centennial* produced moderate sized semi-headed lettuce. *Black seeded Simpson* a leafy green lettuce bolted early. It's newer version *Simpson Elite* showed no signs of premature bolting, however, it produced relatively small heads. *New Red Fire* produced small to moderate heads with very crinkled red-leaves. *Red salad bowl* produced small heads of charming red oak-shaped leaves. Note that yields would have likely been higher under cooler growing conditions if the plants had been grown during the winter or at higher elevations.

Gourmet material? The taste panel preferred the mild and pleasant taste of both *Vulcan* and *Red Salad Bowl*. *Anuenue* and *Centennial* were both found to be slightly bitter, whereas *Oakleaf*, *New Red Fire* and *Simpson Elite* had a slight, but tolerable "grassy" taste.

The panel agreed that *Oakleaf* and *Simpson Elite* would be fine for the home garden or in salad mixes, but probably wouldn't be marketable in Hawaii as a "stand alone" due to it's light green leaf color. *New Red Fire* also would be appropriate for the home hydroponic garden, but it may not gain commercial acceptance due to its very crinkled leaf texture which made it to look "dry" and to "lack luster." *Vulcan* had nicely convoluted-, tender-, and crisp-looking red-margined leaves and *Red Salad Bowl* had nice colored and oak-shaped leaves- traits which could make these varieties marketable as gourmet products.

Conclusions. Both *Vulcan* and *Red Salad Bowl* had very good visual appearance, a mild pleasant taste and may have potential for commercial production in non-circulating hydroponic systems. Note that the varieties grown in this trial may perform differently under cooler growing conditions and that the quality may be affected by modified nutritional regimes and hydroponic systems. For this reason, hydroponic and greenhouse growers are encouraged to continually experiment with new varieties during the different growing seasons, and to fine-tune the nutritional regimes for their favorite varieties.

Table Let-1. Description of lettuce cultivars evaluated for non-circulating hydroponics.

Cultivar	Seed Source	Description
Anuenue	Univ of Hawaii/ Johnny's seed	Compact semi-head lettuce. Bright glossy green leaves. Heat-resistant.
Black-seeded Simpson Centennial	Johnny's Seed Johnny's	Open head light green crinkled leaves. Semi-head. Large outer green leaves and smaller leaves forming a compact head. Slow bolting and lettuce mosaic virus tolerant.
New Red Fire	Johnny's	Open head, dark red margins over light green background. The leaf texture is crinkled. Slow to bolt.
Oakleaf Red Salad Bowl	Johnny's Johnny's	Light green oak-shaped leaves. heat and bolting resistant. Red oak-shaped leaf lettuce. Heat tolerant and bolt resistant All America Winner.
Simpson Elite	Johnny's	Open head light green crinkled leaves. Slower bolting compared to Black-seeded Simpson.
Vulcan	Johnny's	Open head, red margins over light green background. Slightly ruffled leaf texture. Slow to tipburn.

Table Let-2: Mean yield for lettuce cultivars grown in a non-circulating hydroponic system (harvested 30 days after transplanting).

Cultivar	Yield \pm SE (grams per plant)	Yield (oz/plant)	Potential production (lbs/1000 sq. ft)
Royal Oak	184 \pm 3 a	6.5	998
Vulcan	125 \pm 3 abc	4.4	678
Anuenue	123 \pm 9 abc	4.3	667
Centennial	123 \pm 1 abc	4.3	667
Black-seeded Simpson	120 \pm 1 bc	4.2	651
New Red Fire	119 \pm 1 bc	4.3	645
Red Salad Bowl	84 \pm 1 c	3.0	455
Simpson Elite	84 \pm 2 c	3.0	455

*Mean Separation performed by Duncan's Multiple Range mean separation test

Note: The goal of hydroponic lettuce production is to produce 9 crops per year with an average yield of 300 grams/sq. ft./crop.

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