

## Hawai'i Cooperative Extension Service

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# Zucchini Elite

Summer/Fall Zucchini cultivar Trials conducted in Poamoho (870 ft elevation) and Kunia (250ft) in Central Oahu, and Kamuela (2,400 ft), Hawaii

*Hector Valenzuela, John McHugh, C.R. Hooks, and Stacy Riede*

## Introduction

Zucchini is a popular but relatively minor vegetable crop in Hawaii. Area under production in the state was 90 Acres in 1994 up from 50 in 1990 but down from 115 in 1993. Farm-gate value of production was \$376,000 in 1994, down from \$437,000 in 1993. Average state-wide yields, as reported by the DOA, were 8,900 lbs/Acre in 1994. Important production bottlenecks include the melon fly, viruses, the silverleaf whitefly, aphids, and other cucurbit insects, nematodes, and diseases. Overall Hawaii growers produce 32% of the zucchini consumed locally. The total volume consumed in Hawaii in 1994 was about 2.5 million pounds, compared to less than 0.5 million in 1970. In Kula, Maui, traditionally a strong zucchini crop production area, Dr. John Cho (UH Plant Pathology) and Robin Shimabuku (UH Cooperative Extension, Maui) introduced a successful viral cross-protection technology for management of the Zucchini Yellow Mosaic Virus. Through a monitoring program they implemented, inoculation efficiency, as performed by growers, increased to over 90% and the cross-protection technology has now been adopted by over 90% of the growers in Kula.

Variety trials were conducted in Poamoho and Kunia on Oahu and Kamuela on Hawaii during the Summer and summer/fall to evaluate new zucchini varieties that may replace standard varieties such as 'Ambassador'. Cultivars evaluated ranged from dark green to yellow, to white, and even included some odd-colored and shaped summer squashes in order to determine the potential productivity and local adaptability of "standard" zucchini varieties, as well as of those that may have potential for specialty markets. All crops were grown in bare-ground, with sweet corn borders as trap crops for the melon fly, and all, except the one in Kamuela, were drip irrigated. All trials were conducted during the warmest and driest part of the year (July-Sept.) which is conducive of rapid crop growth, but is also a part of the year often correlated with highest arthropod pest and viral disease infestation.

## Experiment 1. Poamoho summer 1994

A trial was conducted in the summer 1994 to evaluate the growth of 7 zucchini varieties at the University of Hawaii Poamoho Experiment Station in Oahu. The station is located at 870 ft elevation and has 45 inches mean annual rainfall. The red Wahiawa silt clay soil is derived from basalt that is kaolinitic with oxides of iron and manganese with pH of 5-6.5 and organic matter content of 2%. The crop was direct seeded on July 13, 1994. Standard protocols were followed for commercial zucchini production. The fruit was first picked on August 15th, and was thereafter picked 10 times for four weeks. The plants were spaced 5 feet between hills and 6 feet between rows. The field was thinned to two plants per hill. The crop was bordered by several sweet corn rows and several malathion baited lures were placed in the plots for melon fly control. The varieties were monitored and rated based on their susceptibility (as determined by observed visual "silver leaf" symptoms) to the silverleaf whitefly. Some viral symptoms developed late in the crop growth cycle and had no apparent effect on final yields.

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### Experiment 2. Poamoho fall 1995

A second trial was conducted at the UH Poamoho station in the fall 1995 to evaluate the growth of 40 zucchini varieties. For the trial 20 varieties were first planted, followed by a second planting of 20 other varieties about 20 days later. Because of this arrangement the first 20 varieties were exposed to little whitefly and viral disease pressure. However the second planting had high incidence of Papaya Ringspot Virus (Watermelon Mosaic Virus I). For this reason yield comparisons can't be made between varieties grown in the first planting to those in the second planting. However, trial results show the degree of yield loss that can be obtained from viral diseases when following zucchini plantings with zucchini in neighboring fields. Other cultural practices were conducted as described in the Poamoho 1994 trial section below.

Planting dates= Aug. 1, 1995 (first planting) and Aug. 22 (second planting).

Spacing- 3 feet between hills in the row and 5 feet between rows (8,680 linear ft/Acre, 2,893 hills/Acre).

Treatments- single replication plots, 6 hills per plot.

First planting- Harvested 12 times from Sept. 4 to Oct. 16, 1995.

2nd planting- Harvested 6 times from Oct. 2 to 19, 1995.

Viral diseases for 2nd planting- Papaya Ringspot Virus (Watermelon Mosaic I) was detected through ELISA test method by the UH-Ag. Diagnostic Service Ctr.

### Experiment 3. Kunia summer/fall 1995

A cooperative trial was conducted by Dr. John McHugh at the HARC Kunia substation to evaluate 60 zucchini varieties under Central Oahu Growing Conditions. The Kunia Station is located at 250 ft elevation, has an average annual rainfall of 29 inches, and has average temperatures from May through October of 88/77F (daytime/nighttime). Because of the very early and high silverleaf whitefly infestations, this trial was ideal for variety evaluation under stressful growing conditions. However, it wasn't possible to develop a useful visual index of silverleaf damage among the different varieties because almost all varieties showed symptoms on 100% of the foliage.

*First planting (40 varieties).*

Direct seeded on July 20.

Spacing- 3 feet between hills in the row and 5 feet between rows (8,680 linear ft/Acre, 2,893 hills/Acre).

Treatments- single replication plots, 6 hills per plot.

Harvest. Harvested 12 times from Aug. 25 to Sept. 20, 1995.

*Second planting on July 27 (20 varieties).*

For this second planting the earliest variety was picked 11 times, the second earlier set was picked 10 times, and the last set was picked 8 times. Harvest period was from 28 Aug. to 20 Sept. 'Prelude' was first harvested on 28 Aug. 'President', 'Seneca-Willhite', 'Dixie', and 'Seneca-Twilley' were all first harvested on 30 Aug. All others were first picked on 4 Sept.

### Experiment 4. Kamuela fall 1995

A trial was conducted at the UH Lalamilo Experiment Station to evaluate the growth of 12 zucchini varieties. The station is located at >2,400 ft elevation, has a median annual rainfall of 30-43 inches with a mean temperature range of 60-73F. The Waimea silt loam (Typic Eutrandsols, medial, isothermic) reddish prairie soil has an organic matter content of 8-9% and is excellent for vegetable production. Previous soil samples showed a pH of 5.9-6.3 and soil nutrient levels of 25 lb/acre phosphorus (very low), 80 lbs/acre potassium (low), 4000 lbs/acre Calcium (moderate), and 500 lbs/acre Magnesium (low). Fertilizer applications were made to complement the native soil fertility. The soils are originated from Volcanic ash and have high infiltration rates, with a minimum level of 1.5 inch per hour, and the crops are normally sprinkler irrigated. In addition to the sprinkler irrigation, this was the only location where the crop was transplanted.

Seed was sowed on Aug. 29, 1995 into 72-cell Speedling trays and transplanted into the field on Sept. 15, 1995.

Spacing was conducted as is local practice, to minimize wind damage- Individual non-replicated plots consisted of 12 plants on double staggered rows with plants spaced 3 ft in the row and five foot centers between beds (8,680 linear ft/Acre, 5,786 hills/Acre).

Harvested daily (32 times) from Oct. 16 to Nov. 17, 1995.

Table Te-1. Yield distribution and mean fruit size of zucchini squash, West Tennessee Expt. Station, 1993.

Cultivar	Midseason &			Fruit size (lb)
	Early yield (lb/acre)	Late yield (lb/acre)	Total yield (lb/acre)	
Zucchini Elite	4000a	12600a	16600a	0.63a
Consul	3300ab	8600ab	11900ab	0.67a
Seneca Zucchini	4200a	5800bc	10000b	0.64a
Zuchitong	2600ab	7000b	9600b	0.73a
Congress	2900a	6300bc	9200b	0.75a
Golden Zucchini	2800ab	6200bc	9000b	0.67a
Seasons	1400b	7100b	8500b	0.74a
Classic	3000ab	5200bc	8200b	0.74a
Spineless Beauty	2800ab	3900bc	6700bc	0.75a
Verdemax	2400ab	4000bc	6400bc	0.63a
Barq	3100ab	3200bc	6300bc	0.63a
Suzini	1000b	900c	1900c	0.72a

Early fruit harvest- 6/9 to 6/21. Means followed by the same letter are not significantly different, Duncan's Multiple Range Test, 5% level. [Mullins, C.A., D.L. Coffey, J.E. Wyatt, D.E. Deyton, and C.E. Sams. 1994. Fruit and Vegetable Research. Tennessee Farm and Home Sci. No. 172, Fall:38-43.]

Table Po-1. Zucchini cultivar yields in Poamoho Station, summer 1994.

Cultivar & (seed source)	Mark. yield (lb/100 ft) (lbs)	Mkt. Yield (lb/Acre) (lbs) <sup>Z</sup>	Fruit No. per Acre	Marketable/ Total Fruit Weight (%)	Grade A Percent by weight <sup>Y</sup>	Grade B Percent by weight <sup>Y</sup>	Whitefly damage index (1 low: 5 high)
Giada (Nunhems)	216a <sup>X</sup>	31,262a	34,262a	50	37a	12a	3.4bc
Ambassador (Peto)	173ab	25,144ab	28,384ab	48	31ab	17a	3.3b
Botna (Nuhmems)	173ab	25,134ab	28,766ab	46	30ab	16a	4.9d
Elite (Harris)	166ab	24,044ab	27,046ab	45	26abc	19a	3.7bc
Midnight (Harris)	115bc	16,657bc	20,452bc	38	23bc	15a	4.1c
Commander (Peto)	113bc	16,422bc	18,628c	36	17c	19a	2.2a
Elira (Nunhems)	102c	14,760c	17,456c	39	22bc	17a	3.4bc

<sup>Z</sup> Yields based on density of about 3,000 hills per acre (spacing of 3 by 3 ft).

<sup>Y</sup> Percent Grade A and B fruit is based on percent out of total fruit weight produced per plant including culls and jumbos. Jumbo fruit yields were similar to marketable yields and were not included as marketable fruit. The large number of jumbos was due to the infrequent harvesting (2-3 times per week instead of daily as is done in commercial operations).

<sup>X</sup> Numbers followed by the same letter within each column are not significantly different according to Duncan's New multiple range test (P<0.05).

Table Po-2. Marketable yields of zucchini varieties grown in Poamoho, fall 1995

Cultivar	Mkt. Yield (lb/A)	Mkt. Yield (lb/100ft)	Grade A by weight (%)	Grade B by weight (%)	Fruit No. (No./A)	Whitefly Damage (1 low: 5 high)
<b>First Planting (Harvested 12 times)</b>						
Tigress	34,695	398	43	51	43,560	1.0
Spineless Beau.	24,112	277	37	53	29,524	1.7
Black Jack	22,358	256	35	61	25,168	2.3
Aztec	21,824	250	35	52	30,976	0.2
Noblesse	21,131	242	53	44	21,780	0
Raven	20,778	238	38	54	29,040	1.0
Botna	20,386	233	36	58	25,168	4.0
Giada	17,433	200	32	54	13,552	1.5
ZS-7	16,520	189	34	54	24,200	0.2
Black Zucc	15,154	173	18	68	18,870	0.2
Ambassador	14,897	171	55	40	23,716	2.2
Senator	14,896	171	30	63	19,360	2.7
Elite	14,588	167	30	54	19,360	3.0
Freedom II	14,309	137	47	24	34,364	0.5
Verdemax	14,098	162	52	35	21,780	0.8
Consul	14,066	161	8	70	9,680	3.3
Envoy	12,667	174	40	52	16,940	4.2
Storr's Green	12,618	145	38	54	16,456	NA
Gold Rush	11,387	130	49	43	18,876	3.0
Midnight	6,723	77	17	33	8,712	4.2

continues...

## RESOURCES

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*Asparagus Production Video.* A video of Scott and Sam Walker's (Jersey Asparagus) presentation given earlier this year at the UH Pearl City Facility. Copies are available, on loan, from your local Vegetable Crops County Extension Agent.

Table Po-2, continues.

Cultivar	Mkt. Yield (lb/A)	Mkt. Yield (lb/100ft)	Grade A by weight (%)	Grade B by weight (%)	Fruit No. (No./A)	Whitefly Damage (1 low: 5 high)
<b>Second Planting (6 harvests)</b>						
Senator	10,448	98	29	70	4,356	NA
President	9,595	75	42	51	12,100	1.0
Embassy	9,412	129	35	64	11,616	0
Sunex	8,367	98	33	52	11,616	1.0
Green Whoop II	7,032	35	65	28	9,680	1.2
Courgette	6,232	57	26	45	9,680	0
Richgreen	5,688	105	19	69	6,776	0
Spineless ZS4	5,506	63	32	41	6,292	0
Cocozelle	5,058	58	12	67	7260	0
Seasons	4,973	95	15	69	13,552	0.8
Zucc Select	4,739	64	20	71	6,292	1.7
Golden Dawn	4,119	57	24	75	6,776	0.3
Burpee Hybrid	4,023	46	27	68	7,744	0.8
Green Magic	3,575	41	29	65	4,356	0
Roly	3,020	35	0	58	7,260	0.3
Eminent	2,348	27	22	20	6,776	2.8
Fordhook	2,091	24	9	0	2,420	0
Golden Zucc	1,227	31	52	48	1,936	0.3
Condor	768	9	0	28	1,936	0
Gray's	330	4	0	0	968	NA

Table Po-3. Early Zucchini yields (first 3 harvests) in Poamoho Trials, 1st planting.

Cultivar	Marketable wt.	Jumbos	Off-grade (lbs/Acre)	Culls	Total weight
Spineless B.	3,880	1,140	480	360	6,253
Tigress	3,770	6,590	140	100	11,312
Raven	3,320	2,500	520	400	7,193
Noblesse	3,160	1,180	480	0	5,144
Aztec	2,660	3,590	380	140	7,225
Elite	2,100	2,760	200	330	5,752
Gold Rush	1,980	540	260	0	2,796
Botna	1,960	4,460	400	460	7,769
Black Jack	1,580	3,640	0	450	6,051
Verdemax	1,460	1,280	420	760	4,183
ZS-7	1,020	760	340	500	2,796
Storr's Gr.	930	1,620	440	480	3,703
Senator	740	2,320	360	380	4,055
Ambassador	700	1,020	130	0	1,974
Freedom	520	840	1060	800	3,436
Giada	380	720	120	0	811
Black Zucc.	280	1,320	580	800	3,180
Midnight	0	0	0	760	811
Consul	0	0	0	520	554

Table Ku-1. Marketable yields of zucchini varieties grown in Kunia, fall 1995.

Cultivar	Mkt. Yield (lb/A)	Mkt. Yield (lb/100ft)	Grade A (%)	Grade B (%)	Fruit No. (No./A)	Early Yields (lb/A)
Spineless B. <sup>Z</sup>	25,288	290	46	54	43,560	7,831
Storr's Green	23,154	266	37	63	39,688	6,807
Milano <sup>Z</sup>	21,649	248	49	51	32,428	4,993
Black Jack <sup>Z</sup>	21,618	248	27	72	26,620	2,592
Tigress	17,520	201	50	50	33,390	3,969
Elite	16,464	189	46	53	42,108	7,682
Green Whop	15,674	180	46	53	33,880	5,537
Noblesse	15,429	177	25	74	26,136	6,231
Spineless B.-S <sup>Z</sup>	15,173	174	57	42	27,104	
ZS-7	15,023	172	41	59	26,620	3,841
Burpee Hyb	14,895	171	54	46	31,944	6,295
Aztec	14,628	168	49	51	28,556	4,865
Embassy	14,308	164	37	62	23,232	3,393
Gold Dawn II	13,615	156	44	56	18,876	2,422
Green Magic	12,750	146	34	65	NA	3,574
President	12,313	141	50	50	28,556	4,086
Fordhook	12,057	138	15	84	6,776	149
Ambassador	11,545	132	16	84	29,524	2,725
Giada	11,363	130	42	57	18,876	2,176
Sunex <sup>Z</sup>	10,958	126	39	61	20,328	
Black Zucc	10,755	123	24	75	14,036	1,632
Senator	10,616	121	48	51	22,264	3,521
Chefini	10,339	119	47	53	17,424	2,998
Seneca Milano	10,072	116	53	47	21,780	4,993
Botra	9,304	107	12	87	23,232	1,307
Midnight	9,005	103	37	63	17,908	2,358
Gray Zucc <sup>Z</sup>	8,760	100	48	51	12,584	1,067
Select	8,568	98	25	74	21,780	2,304
Verdemax	8,173	94	37	63	18,876	2,507
Gray Zucc	7,831	89	54	46	19,360	1,067
Seasons	7,565	87	34	65	15,972	2,080
Condor	7,387	85	33	67	17,908	2,187
Prelude II <sup>Z</sup>	7,373	84	94	5	18,392	907
Envoy	6,860	79	37	63	17,808	2,176
President <sup>Z</sup>	6,807	78	55	45	15,004	491
Seneca-W <sup>Z</sup>	6,508	75	34	66	14,520	1,941
Cocozelle	6,156	71	23	76	7,744	
Gold Finger <sup>Z</sup>	6,156	71	45	54	11,616	
Senator <sup>Z</sup>	5,164	59	70	30	9,680	245
Super Select	4,140	47	14	86	7,260	2,390
Richgreen	3,883	44	27	73	11,616	1,600
Zuc Green <sup>Z</sup>	3,499	40	65	35	4,840	
Eminent <sup>Z</sup>	3,201	37	33	67	7,260	
Seneca	3,094	35	36	64	9,680	
Gold Rush <sup>Z</sup>	2,571	29	0	100	4,356	
Roly Poly	2,518	29	80	20	14,036	1,024
Consul	2,496	28	14	85	7,260	1,238
Commander <sup>Z</sup>	2,112	24	31	69	4,840	
Raven	1,888	22	26	74	13,068	1,216
Corsair <sup>Z</sup>	1,707	19	56	43	2,420	
Seneca-T <sup>Z</sup>	1,536	18	29	71	4,356	1,941
Gold Rush-S	1,301	15	0	100	2,420	213
Dixie <sup>Z</sup>	1,067	12	60	40	9,196	267
Burpee Gold	896	10	24	76	1,936	
Freedom II	661	7	54	45	6,292	299
Tay Belle <sup>Z</sup>	597	7	100	0	7,260	

<sup>Z</sup> Second planting picked only 11 times (Prelude), 10 times (President, Seneca, and Dixie), and 8 times (all others in this set).

Table La-1. Zucchini cultivar trials at the UH Lalamilo Experiment Station, Kamuela, summer/fall 1995.

Cultivar	Marketable (lb/A)	Grade A (lb/100ft)	Grade A (%)	Off-Grade (%)	Culls (%)	Fruit No. (No./A)
Ambassador.	24,655	274	96	3.5	0.0	46,464
Tigress	26,020	270	88	9.9	1.6	45,980
Envoy	22,729	258	96	1.5	2.6	45,012
Raven	21,935	239	93	5.4	1.1	42,102
Senator	19,689	227	100	0	0.0	38,239
Verdemax	20,134	212	91	8.6	0.0	35,816
Midnight	19,176	210	94	5.1	1.2	33,880
Black Zucc	18,286	209	99	1.0	0.0	34,364
Consul	18,131	201	87	3.6	9.4	37,268
Freedom II	16,892	173	89	11.0	0	65,340
Unknown-1	12,390	143	100	0.0	0.0	25,652
Black Jack	12,332	130	91	8.9	0	22,264
Aztec	10,600	122	100	0.0	0.0	28,556
Unknown-4	9,690	84	74	24.6	1.4	14,520

Yields based on 5,786 plants per acre.

100 ft row yields based on double rows per bed with 3 ft between plants.

Lower plant stands obtained due to rainfall and storms early in the season with Aztec (66% plant stand) and with Midnight (33%).

## Results

**Poamoho Summer 1994.** Trial results are shown in Table Po-1. 'Giada', a white fruited variety had the greatest yields producing over 34 tons per acre. Other top yielders were 'Ambassador' which is the standard green zucchini variety in Hawaii, 'Botna', and 'Elite'. The top yielders had greater fruit quality with approximately 50% of fruit produced graded as marketable, and with 30-37% of all fruit produced classified as Grade A. About 50% of the fruit produced for all varieties was graded as jumbos (graded here as unmarketable). Due to labor limitations we only harvested 2-3 times per week, instead of daily pickings as is done commercially, which resulted in the large incidence of jumbos. 'Commander' showed the least incidence of silverleaf whitefly with below moderate damage levels. The other varieties showed intermediate damage levels, while 'Botna' had the highest damage ratings, among all varieties tested. The whitefly was not a significant problem in this trial, but information on tolerance to whitefly feeding may be important for cultivar selection in locations where high whitefly numbers are expected. Similar observations were made in trials conducted in Waianae in which 'Classic' showed the least symptoms, 'Ambassador' was intermediate and 'Spineless' zucchini showed the most damage from whitefly feeding (unpublished data).

### Poamoho fall 1995

**Marketable Yields.** The top yielding varieties from the first planting were 'Tigress' and 'Spineless Beauty' (Table Po-2). Other varieties with marketable yields above 20,000 lb/Acre included 'Black Jack', 'Aztec', 'Noblesse', 'Raven', and 'Botna'. The top yielders for Grade A fruit were Tigress (14,918 lb/Acre), Noblesse (11,199 lb/Acre), Spineless Beauty (8,921 lb/Acre) and 'Ambassador' (8,193 lb/Acre).

### Poamoho, cont.

Other varieties with high grade A yields (7-8,000 lb/Acre) included in descending order: 'Raven', 'Black Jack', 'Aztec', 'Botna', and 'Verdemax'. The high yielding varieties for the second planting (7-10,500 lbs marketable weight/Acre) were, in descending order: 'Senator', 'President', 'Embassy', 'Sunex', and 'Green Whooper II'.

**Early Yields.** Highest early marketable yields (2-3,900 lbs/Acre obtained from the first three harvests) were obtained with 'Spineless Beauty', 'Tigress', 'Raven', 'Noblesse', 'Aztec', and 'Elite' (Table Po-3). Early marketable yields for 'Ambassador', a standard variety, were 700 lb/Acre.

**Silverleaf whitefly damage.** Among the higher yielding varieties for the first planting, those with the lowest index (< 1) of Silverleaf whitefly damage were 'Aztec', 'Black Jack', 'Freedom II', and 'Verdemax'. Most varieties grown in the second planting had low incidence of silverleaf whitefly damage but high mosaic virus pressure.

### Kunia fall 1995

**Marketable Yields.** All varieties in this trial were exposed to high silverleaf whitefly pressure beginning at the seedling state, despite standard pesticide applications- which explain for the relatively lower yields obtained compared to other trials. The highest yielding varieties in Kunia (>20,000 lbs/Acre marketable yields) were 'Spineless Beauty', 'Storr's Green', 'Milano', and 'Black Jack'. Mid-yielding varieties (15-20,000 lbs/Acre) were in descending order 'Tigress', 'Elite', 'Green Whopper', 'Noblesse', and 'ZS-7'. The highest Grade A yields were obtained with 'Spineless Beauty' (11,632 lbs/Acre), and Milano (10,608 lbs/Acre). High Grade A yields (7-9,000 lbs/Acre) were also obtained, in descending order, with 'Tigress', 'Storr's Green', 'Burpee Hybrid', 'Elite', 'Green Whooper II', and 'Aztec'. High early marketable yields (above 4,800 lbs/Acre in the first three pickings) were obtained, in descending order, with 'Spineless Beauty', 'Elite', 'Storr's Green', 'Burpee Hybrid', 'Noblesse', 'Green Whopper', 'Milano', and 'Aztec'.

## Kamuela Summer/Fall 1995

Daily harvests in this trial resulted in yields with the highest Grade A percentages. Plant stands, however, were affected early on by several strong winds and rains, reducing potential yields significantly. The greatest marketable yields were obtained by 'Tigress' and 'Ambassador'. Marketable yields above 19,000 lbs/Acre were also obtained by 'Envoy', 'Raven', 'Senator', 'Verdemax', and 'Midnight'. Among these top yielders, the highest Grade A fruit percentage was obtained with 'Senator', 'Ambassador', and 'Envoy'.

### Work from other areas:

**Florida:** Top yielders (10 harvests) from a Spring trial in Sanford were 'Spineless Beauty', 'Elite', 'Sunre 9718', 'Eminent', and 'Sunex 9715'. Greatest early yields (3 harvests) were obtained by 'Elite', 'Spineless Beauty', and 'Sunre 9718' (Sunseeds). Total yields ranged from 36 to 42,000 lb/Acre, and early yields from 18 to 22,000 lbs/Acre (D. Maynard, Univ. FL. Circ S-392).

**Louisiana:** Trials were conducted at different spacings and at different planting dates. Varieties with the higher mean marketable yields of over 38,000 lb/Acre (12 harvests) over the 5 planting dates (from April to June) included: 'Classic', 'Senator', 'Corsair', 'Elite', 'Jade', 'Onyx', and 'Tastelini' (Mulkey, W.A. and T.P. Talbot. Louisiana Agr. Vol 36, No. 1 pg. 17-19).

**Tennessee:** Greatest total yields in a summer trial (Table Te-1) were obtained by 'Elite', 'Consul', and 'Seneca Zucchini'. Greatest early yields were obtained by 'Seneca Zucchini', 'Elite', and 'Congress' (Mullins et al., 1994).

## Conclusions

### Marketable Yields

The following varieties were among the highest yielding varieties in more than one location: 'Tigress', 'Spineless Beauty', 'Ambassador', 'Elite', 'Botna', 'Green Whopper', 'Noblesse', 'Black Jack', and 'Senator'. In Florida trials high yields have also been obtained with 'Spineless Beauty', 'Ambassador', and 'Elite'. In Louisiana high yields were also obtained with 'Senator', and 'Elite'. 'Elite' also performed well in Tennessee trials.

### Grade A Fruit

The following varieties had the highest Grade A fruit yields in more than one location: 'Ambassador', 'Tigress', 'Spineless Beauty', 'Aztec', and 'Botna'.

### Early yields

High early yields were obtained in more than one location with 'Spineless Beauty', 'Noblesse', 'Aztec', and 'Elite'. High early yields were also reported with 'Elite' in Florida and Tennessee trials.

### Overall

Varieties with an overall top performance in terms of yield and fruit quality were: 'Spineless Beauty', 'Ambassador', 'Tigress', 'Elite', 'Botna', 'Nobless', and 'Aztec' (yellow zucchini). Final variety selection will be based on disease resistance (some varieties such as 'Tigress' have mosaic virus resistance or tolerance), quality characteristics (such as skin color), earliness, and adaptability to your growing location. It is recommended that growers evaluate new varieties on a small-scale first, before increasing the acreage significantly. Zucchini does well at high elevations such as Kula and Kamuela (see Table LA-1) during the summer months, but additional trials are warranted at these higher elevations.

## Variety Descriptions

### Green Zucchini

- Ambassador (PetoSeed/Twilley). Fruit has a medium green, waxy exterior. Open plant habit. Fruit is 7-8 in long, cylindrical and smooth, plant type is compact bush, open habit with easy picking.
- Aristocrat (Liberty). Widely adapted with smooth, slender, glossy dark green fruit. Open bush.
- Black Beauty -Black Zucchini (Willhite/Sun). Bush type. Long, straight, slender with slight ridges, black-green color. Flesh greenish white firm.
- Black Jack (Stokes). Standard dark green type with little flecking.
- Black Zucchini (See Black Beauty).
- Botna (Nunhems). F1 hybrid. Vigorous growth. Single stem without laterals, long, slender, cylindrical fruits, medium green, glossy fruit color, flecked with light green. Fruit easy to pick, suitable for field or greenhouse production.
- Burpee Hybrid (Burpee). Excellent flavor, hybrid vigor. Medium-green, tendered shinned fruits on compact, bush-like plants.
- Chefini (PetoSeed). Glossy, medium dark green cylindrical fruit. Vigorous plant provides good cover.
- Cocozelle (Johnny's) Authentic Italian strain. Long, slender cylindrical zucchini is dark green overlaid with lighter green stripes.
- Commander (PetoSeed). Dark green fruit with fine speckles, refined blossom end, open plant type, early maturity.
- Condor (Johnny's). Glossy deep green zucchini.
- Consul (Asgrow). Medium/dark green early, high-quality.
- Corsair (Asgrow). Very dark green, cylindrical.
- Elira (Nunhems). F1 hybrid. Medium vigorous plant growth, open plant habit. Medium long, cylindrical fruits. Dark green, glossy skin.
- Elite (See Zucchini Elite, Harris Moran). Hybrid. Earlier than other varieties. A lustrous sheen to fruit color adds attractiveness to the fruit. Fruit color is medium green, shape is long, nearly cylindrical.
- Embassy (PetoSeed). Medium green, cylindrical strong open plant with few spines.
- Eminent (Sun). Glossy medium green, slightly flecked, stress tolerant.
- Envoy (Sun). Medium to dark green, cylindrical, slightly flecked, darker fruit than Storr's Green.
- Fordhook (Burpee). A vigorous bush-type plant with heavy yields.
- Giada (Nunhems). F1 hybrid, vigorous plant growth, open plant habit. Medium early harvests, medium long, global/cylindrical fruit shape, light green to white colored fruits.
- Green Magic II (Park). Space saving compact bush zucchini. Bears solid dark green fruits.
- Green Whopper II (Park). Straight, dark green fruits.
- Grey Zucchini (Willhite). Summer squash for garden or shipping. Straight, smooth, mottled, medium green with gray.
- Greyzini (Stokes). Light medium green, slightly tapered.





# Lettuce Cultivar Evaluation in a Greenhouse Non-circulating Hydroponics system

Stacy A. Riede and Hector R. Valenzuela

**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 pesticide-free 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 Made in Hawaii Festival at the Neil Blaisdell Center on May 17-19, 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*.

## Materials and Methods

The cultivar trial was conducted at the low-elevation 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.

**System set-up.** 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 1/2" 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 to deter 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 mS.

**Growing the seedlings in "forestry tubes."** 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 80-90F in the greenhouse.

The trial consisted of 8 cultivars, three replicates and three plants per replicate. 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.

**Yields.** 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 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 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 appear "dry" and "lack luster." *Vulcan* had nicely convoluted-, tender-, and crisp-looking red-margined leaves and *Red Salad Bowl* had nice colored, 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 quality may be affected by modifying 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
<i>Anuenue</i>	UHM/ Johnny's seed	Compact semi-head lettuce. Bright glossy green leaves. Heat-resistant.
<i>Black-seeded Simpson</i>	Johnny's Seed	Open head light green crinkled leaves.
<i>Centennial</i>	Johnny's	Semi-head. Large outer green leaves and smaller leaves forming a compact head. Slow bolting and lettuce mosaic virus tolerant.
<i>New Red Fire</i>	Johnny's	Open head, dark red margins over light green background. The leaf texture is crinkled. Slow to bolt.
<i>Oakleaf</i>	Johnny's	Light green oak-shaped leaves. Heat and bolt resistant.
<i>Red Salad Bowl</i>	Johnny's	Red oak-shaped leaf lettuce. Heat tolerant and bolt resistant All America Winner.
<i>Simpson Elite</i>	Johnny's	Open head light-green crinkled leaves. Slower bolting compared to Black-seeded Simpson.
<i>Vulcan</i>	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 of bench space)
<i>Royal Oak</i>	184 $\pm$ 3 a	6.5	998
<i>Vulcan</i>	125 $\pm$ 3 abc	4.4	678
<i>Anuenue</i>	123 $\pm$ 9 abc	4.3	667
<i>Centennial</i>	123 $\pm$ 1 abc	4.3	667
<i>Black-seeded Simpson</i>	120 $\pm$ 1 bc	4.2	651
<i>New Red Fire</i>	119 $\pm$ 1 bc	4.3	645
<i>Red Salad Bowl</i>	84 $\pm$ 1 c	3.0	455
<i>Simpson Elite</i>	84 $\pm$ 2 c	3.0	455

Johnny's Selected Seeds  
 Foss Hill Rd.  
 Albion, Maine 04910  
 207-437-4395  
 fax 800-437-4290  
 e-mail: jsscomm@mint.net

\*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 (about 660 lb/1000 sq ft of bench space).

**Acknowledgements:** Thank-you to Johnny Seeds for providing seed samples, to the industry collaborators for supplying materials for the hydroponic system (see Materials and Methods section), to Dr. B. Kratky for generously providing ongoing technical advise, to Craig Okasaki, Manager UH Magoon Facility, for help in establishing and maintaining the hydroponic set-up, to Natalie Nagai for setting up the taste-panel and help in quality analysis, and to Pat Yahata for her comments and participation in the taste-panel.

## Survey of Nematodes at Watershed, Waimanalo Reservoir, and Waimanalo Farms

*Randy Hamasaki*

CTAHR Plant Pathologist Dr. Donald Schmitt, presented an informational meeting on "Nematodes in Irrigation Water" at the UHM Waimanalo Experiment Station on April 10, 1996. The study by investigators F. Zhang and D.P. Schmitt involved comprehensive nematode samplings: 1) at the watershed in the Maunawili mountain area; 2) within the 60 million gallon Waimanalo reservoir; 3) at outlets of the reservoir; 4) and among 40 species of plants at 18 Waimanalo farms which were using both city and irrigation water. The economically important species of root-knot, lesion, and reniform nematodes were detected at both watershed and farm sites. These nematodes occurred in very low numbers and in low frequency at the watershed. In contrast, high numbers and a high frequency of these plant-parasitic nematodes were found at the farms. No plant parasites were detected within the reservoir. One to two plant-parasitic nematodes were detected from the outlets after a heavy rain. The population of nematodes was no different (P=0.05) from the soil samples on crops irrigated by city water vs. irrigation system water. No burrowing nematodes were detected at the watershed, reservoirs or outlets.

**Conclusion:** Nematodes from the Maunawili mountain are not likely to worsen the existing nematode problem at farms. Nematode problems occurring at the farms are not related to the use of water from the Waimanalo Irrigation System. These findings are applicable only to the Waimanalo Irrigation System. D. Schmitt mentioned that Waimanalo Irrigation System users who wish to be extra cautious could cease irrigation water use for about 24 hours after a high rainfall event such as a flash flood occurring at the watershed area.

## UPCOMING EVENTS

Made in Hawaii Festival, 17-19 May, 1996, Neal Blaisdell Exhibition Hall. Program includes: Food sampling, Selling to the Public, Aloha Friday and Fashion Show, Fresh Produce and Exotic plants, and much more. For info contact Carol Pregill, Hawaii's Food Industry Assoc. at 808-533-1292, Fax. 808-599-2626.

Technologies for Agriculture Workshop, 14 May 1996, 8:30 AM- 1 PM, Outrigger Prince Kuhio Hotel. An informational workshop sponsored by the UHM Office of Tech. Transfer and Economic Development and CTAHR, on commercially applicable technologies and technical assistance available to the ag industry from the USDA-ARS, the Jet Propulsion Lab., and the University of Hawaii. RSVP at 808-539-3823.

CTAHR-UHM Food Irradiation Workshops, May-June 1996. One day workshops offered in Honolulu 22 May; Lihue 28 May; Hilo 6 June; and Kahului 13 June. Workshops will provide information on irradiation technology as a food-preservation technology. Send registration to Dr. James H. Moy, Dept. of Food Sci., 1920 Edmonson Rd., Honolulu, HI 96822, Tel. 808-956-3853; jmoy@hawaii.edu.

8th Annual Pacific Islands Taro Festival. 29 June, 1996, 9 AM- 4 PM. Windward Community College Campus, Kaneohe. For info call 808-235-7433.

12th Annual Hawaii State Horticulture Show. 21-22 June, 1996. Edith Kanaka'ole Tennis Stadium in Hilo.

### Yellow Summer Squash in Miss:

#### Summer yellow squash varieties for Mississippi

*Dr. Rick Snyder, MSU*

The highest yielding variety was 'Smoothie' (average of 6 lbs marketable fruit per plant and 3 marketable fruit per plant), a straightneck type from Abbott & Cobb. This hybrid is very early, and produces bright yellow, very smooth skinned fruit. For the semi-crookneck types, 'Medallion' had the highest yield, followed by 'Superset', 'Goldie', and 'Sundance'. 'Medallion' is a bright yellow hybrid from Abbott & Cobb. This variety, new in 1991, has a vigorous open bush type plant. 'Superset' you may remember is a PYG type (precocious yellow gene) of squash. The PYGs possess a gene that keeps the fruit yellow even when infected with watermelon mosaic virus (WMV). This virus typically makes infected fruit turn green- either in stripes, blotches, or in entirety. One possible disadvantage is that the peduncle (fruit stem) is also yellow in color. WMV is especially prevalent in late spring and summer plantings of yellow squash, so this variety should be considered for these later plantings. 'Dixie', the most widely grown yellow squash variety in Mississippi, ranked 8th out of 10 varieties in yield (R.G. Snyder, 1994, Summer squash varieties for Mississippi, Vegetable Press, MSU, Vol 94, No. 6, June 24, 1994).

#### Notice to our readers:

The UHM-CTAHR Vegetable Crops Update Newsletter is now sent statewide to commercial vegetable growers, replacing Newsletters previously published individually by UH County Extension Agents in Oahu, Big Island, and Maui. The goal is to consolidate CTAHR's technology dissemination activities that address both industry-wide as well as more localized topics of interest. We welcome your ongoing input and comments which help us to put out an extension newsletter that better meets your informational needs. Please keep in touch with your cards, faxes, e-mail, and telephone calls.

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Dwight Sato, CES Hilo  
Tel. 808-959-9155, Fax. 808-959-3101

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Randy Hamasaki, CES Oahu  
Tel. 808-247-0421, Fax 808-247-1912

---

Alton Arakaki, CES Molokai  
Tel. 808-567-6833, Fax. 808-567-6818

---

Robin Shimabuku, CES Maui  
Tel. 808-244-3242, Fax 808-244-7089

---

Hector Valenzuela  
Vegetable Crops Asst. Extension Specialist  
Tel. 808-956-7903, Fax. 808-956-3894, hector@hawaii.edu

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The pesticide information provided here should be used only as a guide. This is not a recommendation; consult an expert. Before purchasing a pesticide, the user should carefully read the entire label to determine if the pesticide is appropriate (legal) for the particular use. Labels frequently change without notice.

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