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EVALUATION OF ASPARAGUS AS A NEW CROP FOR HAWAII

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SUMMARY

Asparagus (*Asparagus officinalis* L.) is a perennial vegetable that shows promise as a new crop for diversification of Hawaiian agriculture. It has many advantages and a ready local market as well as potential as an export crop. It is a low maintenance crop requiring only irrigation, fertilizer, and timely pesticide applications. Asparagus is resistant to nematodes that are limiting to many vegetable crops in tropical environments. It is also quite resistant to most diseases and other pests. Once established, the field will remain in production for 15 or more years without replanting. In Hawaii, a crop can be harvested every six months and the harvest dates can be scheduled at any time of year or staggered year round on a farm. It is also tolerant of brackish water.

Asparagus was grown for three years on the Hawaii Agriculture Research Center Kunia farm and is being grown on a Waialua farm as a Sustainable Agriculture Research and Education (SARE) project. The purpose of these projects was to determine cultivation practices and to control weeds, pests and diseases with a minimum of pesticide use. The use of polyethylene mulch at planting prevented significant weed until the ferns were big enough to shade out further weed infestations. The highest yielding cultivars were Apollo and Atlas, developed in California. The sustainability of asparagus farming, profitability and potential market development will be studied in future projects.

INTRODUCTION

Asparagus is a perennial vegetable crop that has potential in Hawaii to fill a growing local market and eventually the export market. With the increasing diversification of Hawaii's agricultural products, asparagus shows promise as a new commercial crop for local farmers. A study was undertaken by Hawaii Agriculture Research Center (HARC) at its Kunia farm to investigate the yield potential and adaptability of several New Jersey asparagus varieties under Hawaiian growing conditions. The HARC study was supported

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by Grove Farm, Hawaiian Earth Products, and Diamondhead Papaya Co. A second trial was installed in cooperation with a local grower with funding from the Sustainable Agriculture Research and Education (SARE) program. The objectives of the SARE trial were to determine the best growing practices, the most suitable varieties, the sustainability of the crop in terms of disease and pest control and continued harvesting for a number of years. The information gained in these trials will be available to Hawaiian growers who are interested in new diversified crops.

Asparagus has a number of advantages. It produces an extensive root system that continues to produce shoots for many years. The expected production life of a field is 15 to 20 years. Once established, the plants are resistant to nematodes. The root mass and thick ferns keep weeds from becoming a problem. Some of the commercial cultivars are male hybrids that do not produce female flowers and thus do not expend energy on fruit production. During the continued years of production the crop does not require any replanting or plowing and it is a low maintenance, sustainable crop. Most areas in Hawaii require irrigation and fertilizer both of which can be applied through a drip irrigation system. Although asparagus is considered a temperate crop, it has proven to be well adapted to a year-round growing season. Hawaii has a unique advantage over other production areas in that respect. It appears so far that two harvests per year are possible. Harvesting can be scheduled at any time of year and can be staggered to allow harvesting over a long period on one farm so that the market can be steadily supplied. Harvests can be scheduled during times when there is a low supply of asparagus on the world market and the price is high. In addition, it is tolerant of somewhat saline conditions and can be grown with slightly brackish water.

Until recently, nearly 100% of the asparagus consumed in Hawaii was imported, mainly from California and Mexico. Due in part to the information generated in these trials, the acreage planted in asparagus is increasing in Hawaii. Many local consumers and retailers have expressed their preference for fresh, locally grown spears over imported asparagus. In addition to supplying local needs, a potential export market exists in Japan which could be supplied from Hawaii during summer and fall months when Japanese and mainland USA production is lowest.

MATERIALS AND METHODS

A project was established at the HARC farm at Kunia on Oahu. The objectives were to determine appropriate cultivars for Hawaii and to evaluate each cropping system for yield performance and possible application to Hawaii's growing conditions. The trial was installed as a randomized complete block with four replications for the main cultivars and two replications for observational cultivars. Plots were further divided into subtreatments of one row for the four month cycle and one row for the mother stalk system. All plots were double rows. The main cultivar plots were 20 feet long and the observational variety plots were 10 feet long. Rows were five feet apart within plots and 10 feet apart between plots. Seedlings were transplanted four inches apart within rows.

The asparagus cultivars planted were all male hybrids from New Jersey (Jersey Asparagus Farms, Inc., 105 Porchtown Rd. Pittsgrove, NJ 08318). The four main cultivars in the trial were: Jersey Giant, Jersey Knight, Jersey Prince, and Jersey King.

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The observational cultivars were Jersey Gem, Jersey Jewel, NJ 880, and Jersey General. Seeds were planted in 72 cell Speedling trays on July 22, 1994 and transplanted into the field on October 27, 1994. Transplants were planted into the bottom of 6-inch-deep furrows which were then gradually filled in with bagasse mulch. Weed control was with Treflan 4E at 2 pt./A as a preemergent with compost and hand weeding. Sevin 80S at 1.5#/A was applied on April 24, 1995 for thrips and cutworms.

Fertilizer rate and schedule
first year

<u>Rate</u>	<u>Greenhouse</u>	<u>Field</u>
75#/A	16-15-15 on 8/12/94	16-15-15 on 10/27/94
75#/A		16-15-15 on 11/28/94
75#/A		10-30-10 on 12/22/94
75#/A		16-15-15 on 2/13/95
75#/A		10-30-10 on 3/14/95
75#/A		16-15-15 on 4/26/95
500#/A		16-15-15 on 8/28/95
	each subsequent crop cycle	
150#/A		10-30-10 after harvest
500#/A		16-15-15 during fern growth

After nearly one year of growth, irrigation was stopped to induce dormancy. One month later, the dried ferns were cut and removed. Fertilizer was applied and irrigation restored at this time. During the first harvest, September 4 - 12, 1995, spears were harvested daily. After harvest, the trial was divided to accommodate two different harvesting regime subplots that were randomly located within each plot. The clear cut method required the removal of the ferns and subsequent harvesting of spears for approximately 30 days. The mother plant system required the removal of all ferns except three ferns per crown which were maintained throughout an eight-month continuous harvesting period. Subsequently there were three more harvests during the project: January 1996, August 1996, March 1997.

A second asparagus project was installed under the SARE program on the farm of Milton Agader, in Waialua on Oahu. This project had as its objectives to use the information acquired in the first project to determine whether these asparagus cultivars and practices would be applicable to real farming conditions in Hawaii and would be an acceptable and profitable crop for Hawaii growers. The information from the SARE project has been made available to growers through media events and a field day.

Seeds for this project were started in seedling trays in commercial potting soil on 8/16/96 and transplanted into the field on 11/1/96. The plot layout was a randomized complete block with 12 replications per cultivar. The cultivar plots were divided into 3 subplots each of two different fertilizer rates and with fresh water and brackish water irrigation. Planting was in four 10 ft rows per plot at 5 ft spacing. Data was taken from one row of each plot and the rest of the crop was harvested by Mr. Agader. The rows were covered with polyethylene mulch with a single drip irrigation line per row. The total test area was one half acre. There were eight asparagus cultivars in the project including the three best New Jersey varieties from the first project: Jersey Gem, Jersey Giant, and Jersey Giant. In addition, there were five California cultivars: Atlas, Apollo, UC 157, Grande, and

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Purple Passion. The California cultivars were obtained from Brian Bensen, 2815 Anza Ave. Davis, CA 95616.

Irrigation water was applied for 14 hours every other day. Weed control was not necessary because the polyethylene mulch kept weeds in check until the ferns closed in. There have so far not been any insect problems requiring insecticide treatment. During the first year, Dithane DF was applied to control an outbreak of *Cercospora* blight. The fungicide was applied at 2 lb/A of product for four sprays at weekly intervals. During the second crop year there has not been any need for disease treatment. Fertilizer was applied through drip irrigation as 11-37-0 and liquid urea. A side dressing was applied by hand to give the high fertilizer treatment rate during the first crop cycle. The results showed that the higher fertilizer rate made no difference to yield so this was discontinued during the second year. Total phosphorus to the test in 1997 was 81 lb/A. Total potassium was 94 lb/A. Total low nitrogen rate was 80 lb/A and high rate was 240 lb/A. In order to produce brackish water conditions during the test, dissolved salt was applied in the irrigation water on half of the test area. No salt was applied during the first year, but during the second crop cycle, Mr. Agader applied a small amount; less than the 1200 ppm NaCl per month that was originally planned.

The first harvest took place in December 1997, one year after planting. Irrigation was stopped and ferns cut back. A one-month dry period is recommended before the start of harvest to induce dormancy, but rains occurred and new spears began to appear as soon as the ferns were cut so harvest began immediately. After harvest, the ferns were allowed to regrow for six months. The water was stopped on July 1, 1998 and ferns were cut and removed one month later. As soon as water and fertilizer were again applied, the spears began to grow and the second harvest continued from 8/10/98 to 8/30/98. Both harvests in the Waialua project were carried out by the clear cut method.

RESULTS

The results of the first harvest, one year after planting, for the Kunia project are presented in Table 1. Harvest results were taken as number and weight of medium size (3/8-5/8 in diam.) and jumbo size (>5/8 in diam.) spears. There were differences in total weight of marketable spears among the asparagus cultivars, but the differences were not significant. There were, however, significant differences in weight of jumbo size spears. Use of bagasse compost in the trial gave significant yield increase over no compost.

The highest total marketable spear-yielding asparagus variety in this project was Jersey General with an average yield of 7575 lb/A for the total of the last three harvests. As shown in Table 2, the percent marketable spears declined from 84% in harvest two to 46% in harvest four while the total gross value of marketable spears increased from the second to third harvest but declined in the fourth harvest. It appears that yields plateaued at the fourth harvest under the conditions of this trial. The mother plant system of management produced more marketable spear numbers per acre than the clear cut method. However, the total weight of marketable spears did not differ, since the mother plant system produced twice as many culls as the clear cut method. In addition, the mother plant system incurred higher labor costs. On the basis of these results, the three

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New Jersey cultivars selected for the SARE project in Waialua were Jersey General, Jersey Gem, and Jersey Giant.

Two harvests have so far been carried out in the SARE Waialua project. The results of the first trial are shown in Table 3 as average weight per plot in ounces of spears of three different sizes: small (1/4-3/8 in diam.), medium (3/8 - 5/8 in diam.), and jumbo (>5/8 in diam.). Spears less than 1/4 in diam. were discarded as culls. The first harvest was small in total weight of spears harvested and lasted only 8 days. The results serve to illustrate cultivar differences.

The second Waialua harvest took place in August, 1998 and had a longer harvest period and higher yields than the first harvest. Results are presented in Table 3. Cultivar performance was similar for both harvests with the two California cultivars, Apollo and Atlas, out yielding the others in total weight, weight and number of medium and jumbo spears. Jersey Gem and Jersey Giant produced more small size spears which are preferred by restaurants. Since asparagus is sold by weight, a higher price for small spears still may not be as profitable as greater total yield.

As mentioned above, the planned amount of salt was not applied to the project area and the exact amount is not known. The results (Table 5) show a significant increase in yield with salt which may be explained in that the salt had no measurable negative effect while the additional nutrients in the sea salt benefited the asparagus somewhat. The estimated total weight of marketable spears sizes small, medium and large from the second Waialua project harvest was 2895 lb/A. This estimate was based on daily harvesting for 21 days which was the harvest schedule for the test area outside of the data plots.

CONCLUSIONS

In Hawaii, asparagus can be harvested after one year when started as transplanted seedlings compared to two to three years in temperate climates. The percent marketable spears (medium and jumbo sizes) of the highest yielding cultivar in the Kunia project, Jersey General, averaged 77% over harvests 2 through 4. Spear yields of all varieties steadily increased from harvest one through harvest three, then declined in harvest four. The marketable spear ratio declined from 84% in harvest two to 46% in harvest four over the same time period. This suggests the possibility of inhibited crown productivity due to a lack of dormancy, a lack of adaptation of Jersey cultivars to tropical environments, or inadequate nutrition for optimum production during the course of the study.

In the Waialua project, the three California cultivars, Apollo, Atlas, and UC 157 gave the greatest yield weight overall. This may indicate better adaptation of California cultivars to Hawaiian growing conditions. The Waialua project has now had two harvests with the second out yielding the first. After the first year of fern growth, the harvests are planned to continue every six months. It remains to be seen whether this harvest schedule may be maintained over several years without declining yields. In the Waialua project, small size spears (1/4 - 3/8 in diam.) were included as marketable. If sold separately to hotels and restaurants, the small spears will receive a higher price. The New Jersey variety Jersey Giant had the greatest yield in small spears. Small spears contributed from 12.8%

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(Purple Passion) to 31.3% (Jersey Giant) of the total harvest weight in the second harvest. The highest yielding Apollo had 19.8% small spears by weight.

Composting gave a yield increase over no compost. Slightly brackish conditions had no negative effect on yield. The clear cut method of harvesting was seen to be advantageous because of its lower labor costs although yields of both harvest methods were similar. Asparagus proved to be a low maintenance crop once established. Fertilization and irrigation are necessary, but weed control is minimal and very few disease, insect or nematode problems were encountered. In Hawaii, the ability to schedule harvests at any time of year when prices are high is a great advantage to growers. Acreage of asparagus is increasing in Hawaii and time will tell whether the crop will find local and export markets and become a significant part of Hawaii's diversified agriculture production.

Table 1. HARC Kunia farm trial. Yield of asparagus (lb/A) after one year. Spears harvested daily, September 4 - 12, 1995.

<u>cultivar</u>	<u>medium</u> ¹	<u>jumbo</u>	<u>total marketable weight</u>
Jersey Knight	747.1 a	624.5	1,371.5
Jersey Prince	765.6 a	450.3	1,215.9
Jersey King	829.3 a	381.2	1,210.5
Jersey General	936.5 ab	752.0	1,688.5
Jersey Jewel	952.9 ab	214.0	1,166.9
Jersey Gem	1,031.8 ab	882.6	1,914.4
Jersey Giant	1,059.1 ab	485.1	1,544.2
NJ 880	1,279.6 b	528.2	1,807.8
		ns	ns

¹ Means in the same column followed by the same letter are not significantly different by Duncan's Multiple Range Test, P = 0.05.

ns = not significant. Although the numerical differences appear large, there were only 2-4 reps and the differences are not statistically significant.

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Table 2. HARC Kunia farm trial. Total yields for three clear cut harvests (lb/A).

<u>cultivar</u>	<u>medium</u>	<u>jumbo</u>	<u>total marketable weight</u>
Jersey Giant	3545	1772	5317
Jersey Prince	2701	1466	4167
Jersey King	3172	1275	4448
Jersey Knight	2827	1158	3984
Jersey General	3954	3621	7575
NJ 880	3570	2173	5744
Jersey Gem	3981	2121	6101
Jersey Jewel	3352	1048	4400

Total marketable weights for each harvest (average of all cultivars).

	<u>harvest 2</u>	<u>harvest 3</u>	<u>harvest 4</u>
<u>total marketable weight</u>	1878	2086	1254
<u>total weight including culls</u>	2233	3276	2723

Table 3. SARE asparagus project first harvest December 15 - 22, 1997. Results shown as average weight of spears in pounds per acre in three size categories.

<u>cultivar</u>	<u>small</u> ¹	<u>cultivar</u>	<u>medium</u>
Purple Passion	110 a	Jersey Gem	105 a
Jersey General	180 b	Jersey General	120 a
Grande	250 cd	Purple Passion	120 a
Apollo	265 cd	Grande	160 a
Jersey Gem	265 cd	Jersey Giant	165 a
Atlas	275 cd	UC 157	240 b
UC 157	300 cd	Atlas	245 b
Jersey Giant	330 d	Apollo	260 b
<u>cultivar</u>	<u>jumbo</u>	<u>cultivar</u>	<u>total, all sizes</u>
Jersey Gem	15 a	Jersey General	315 a
Jersey General	20 a	Purple Passion	315 a
Jersey Giant	25 a	Jersey Gem	385 ab
Purple Passion	90 ab	Grande	505 abc
Grande	100 ab	Jersey Giant	525 bc
UC 157	125 ab	UC 157	665 cd
Atlas	190 b	Atlas	715 d
Apollo	225 b	Apollo	750 d

¹ Means in the same column followed by the same letter are not significantly different by Duncan's Multiple Range test, P = 0.05.

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Table 4. SARE asparagus project second harvest August 11-28, 1998. Results shown as average weight of spears in pounds per acre in three size categories.

<u>cultivar</u>	<u>small</u> ¹	<u>cultivar</u>	<u>medium</u>
Purple Passion	215 a	Purple Passion	730 a
Jersey General	450 b	Jersey General	835 ab
Grande	450 b	Jersey Gem	1015 bc
Atlas	460 bc	Grande	1075 bcd
Apollo	540 bcd	UC 157	1210 cd
UC 157	595 cd	Jersey Giant	1220 cd
Jersey Gem	600 cd	Atlas	1280 d
Jersey Giant	650 d	Apollo	1320 d

<u>cultivar</u>	<u>jumbo</u>	<u>cultivar</u>	<u>total, all sizes</u>
Jersey Gem	200 a	Jersey General	1575 a
Jersey Giant	210 ab	Purple Passion	1675 ab
Jersey General	280 ab	Jersey Gem	1800 abc
UC 157	415 abc	Grande	1975 abcd
Grande	450 bc	Jersey Giant	2080 bcd
Atlas	600 cd	UC 157	2225 cd
Purple Passion	725 de	Atlas	2340 de
Apollo	865 e	Apollo	2725 e

¹ Means in the same column followed by the same letter are not significantly different by the Least Significant Difference (LSD) test, P = 0.05.

Table 5. Salt water vs. fresh water. Analysis of average weight in ounces and spear number per plot for all varieties and all sizes.

<u>water</u>	<u>number</u> ¹	<u>weight</u>
salt	85.2 a	44.1 a
fresh	76.1 b	38.2 b

¹ Means in the same column followed by the same letter are not significantly different by the Least Significant Difference (LSD) test, P = 0.05.