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# LETTUCE CULTIVARS FOR LOW-TECH NON-CIRCULATING HYDROPONICS

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*Abstract.* **Winter and spring (1997) lettuce (*Lactuca sativa*) variety trials were conducted at the Horticultural Learning Center in Tavares, FL in a new low-tech hydroponic system. The system was setup in a greenhouse with open screened sides and no environmental controls. Leaf, bibb, and butterhead types were tested. Although differences in cultivars were evident, all performed well. Cultivars ranged from 6.6 to 9.4 and 4.7 to 10.5 oz per plant in the winter and spring trials respectively. 'Salina' showed excellent heat tolerance in the spring. 'Ermosa' ranked highest in overall quality in both trials. Cultivars were also ranked for bolting and bitterness. This simple non-circulating hydroponic system could be used with good results by homeowners and market gardeners to produce short season lettuce crops.**

Hydroponics, growing plants without soil, has developed since the 1600's primarily from experiments in plant nutrition. The most rapid developments have been in the 20th century (Resh, 1995). Hydroponic systems are often high tech and expensive. New passive hydroponic systems called non-circulating hydroponics and dynamic root floating technique (DRF) were developed at the Asian Vegetable Research Center in Taiwan for low-tech hydroponics in tropical agriculture (Anon., xxxx). These systems are relatively inexpensive compared to traditional hydroponics and don't require electricity.

The new systems borrowed from the methods of traditional Taiwanese farmers who grow vegetables in swampy lowland areas on raised beds, and uses the new materials currently available such as polyethylene sheeting and agricultural plastics. These systems have been further studied and refined at the University of Hawaii by B. A. Kratky and colleagues (1988, 1993, 1996). Raised field agricultural systems have been found throughout the world and may have been common in many indigenous cultures. An ongoing study by University of Florida researchers of Inca cultures in Bolivia and Peru found raised beds which "probably were developed to raise the soil above the water level so that roots did not rot in the high water table" (Anon., 1996).

Plants which would die if all their roots where suspended in non-aerated water, may survive if a portion of their root are suspended in air. The raised bed in the swampy field provided air to the roots. The principle of the passive hydroponic systems is that a portion of the root must be suspended in air or aggregate containing air (air roots) absorbing necessary oxygen. The rest of the roots are in water, absorbing nutrients and water (water roots).

Preliminary work in Florida has found certain plants more adaptable to passive hydroponics than others. This report will show that short season lettuce crops perform well under the conditions of this study. More work is needed to study the productivity of other plant varieties, temperature effects, depth of air, aggregate, or water, and the feasibility of field and greenhouse uses for passive hydroponics.

## Materials and Methods

Total of four hydroponic growth frames were constructed for this trial. Each variety of lettuce was produced in each growing frame, resulting in a total of four replications per variety. Hydroponic growing frames were constructed from the following material list.

2 - 96 inches pressure treated white pine 2 × 4
2 - 45 inches pressure treated white pine 2 × 4
1 - 96 inch × 48 inch sheet of ½ inch plywood
1 - 96 inch × 48 inch sheet of 2 inch styrofoam
1 - 120 inch × 60 inch piece of 10 mil polyethylene

The 2 × 4's were nailed together to form a 4 ft × 8 ft rectangular frame. The sheet of plywood was then nailed on to form a bottom for the frame. Each frame was then placed on the ground and leveled. The polyethylene liner was then placed into the growing frame with the outer edges folded and stapled to the top of the wood frame. Forty-five 2 inch diameter holes were cut out with a key hole saw in the sheet of styrofoam 10 inch on center.

Lettuce varieties were sown in Ω inch oasis cubes, one seed per cube and placed in flat/tray for watering until germination. Approximately eight holes where cut into the lower edge of a six oz plastic cup. A fine vermiculite was placed in the bottom of the cup, approximately 1 inch deep. The oasis cube containing the seedling was then placed in the cup and fine vermiculite was added around the cube for stabilization. Planting and harvesting dates were Jan. 10 1997 and 5 Mar. 1997 respectively for the winter trial and 1 Apr. 1997 and 21 May 1997 for the spring trial.

Each growing frame was filled with water to within approximately 1 inch from top edge. A fertilizer solution, 0.6 lb Nutri-sol 4-5-26 (4-2.2-21.6, N-P-K) plus minors Hydroponic basic mix (Part 1) and 19.5 oz of $CaNO_3$ liquid fertilizer, was dissolved in water and mixed in. Nutri-sol hydroponic basic mix is no longer available, however similar products are available (Masterblend Hydroponic Mix or Peters Hydroponic Mix). Frames were then filled to the top with water. This provided a growing solution depth of approximately 3.5 inches and a total volume of 62.72 U.S. gal.

The sheet of styrofoam was placed on the top of the frame. The plastic cup containing the lettuce seedling was than placed in the holes. The cup set approximately 1 inch into the growing solution. The plants were then allowed to grow with no additional water or fertilizer solution being used until harvest. A bitterness and quality taste test were administered using 20 participants.

Table 1. Winter lettuce yield and quality results.

| Variety | Avg Plant Wt (oz) | Quality Rating[z] | Bitterness[y] Rating |
|---|---|---|---|
| Salina | 6.6 | 4 | 3 |
| Tango | 9.4 | 2 | 4 |
| Ermosa | 8.3 | 1 | 1 |
| Optima | 8.2 | 3 | 2 |

[z]Varieties were compared for quality (texture and taste), 1 being best and 4 being the least.
[y]Varieties were compared for bitterness starting with 1 being the least and 4 being the bitterest.

Table 2. Spring lettuce yield and quality results.

| Variety | Avg Plant Wt (oz) | Quality[z] Rating | Bitterness[y] Rating | Avg No. Plants Bolting |
|---|---|---|---|---|
| Salina | 4.7 | 5 | 5 | 0.0 |
| Tango | 6.0 | 4 | 6 | 1.1 |
| Ermosa | 9.7 | 1 | 1 | 2.4 |
| Optima | 10.5 | 3 | 3 | 2.8 |
| Nancy | 7.1 | 6 | 4 | 1.5 |
| Green Ice | 7.2 | 2 | 2 | 1.9 |

[z]Varieties were compared for quality (texture and taste), 1 being best and 6 being the least.
[y]Varieties were compared for bitterness starting with 1 being the least and 6 being the bitterest.

## Results and Discussion

This non-circulating hydroponic system proved to be a relatively simple and inexpensive system. It can be used on any level area in the production of short season lettuce crops by homeowners and market gardeners. Once set up the system has little to no maintenance during crop production. Monitoring of solution is not necessary due to the short length of the crop being grown.

All lettuce varieties tested developed an extensive root system that adapted to the change in water level. Results of both winter and spring variety trials (Table 1, Table 2) ranked 'Ermosa' highest in overall quality. Environmental factors that might contribute to bitterness were not monitored. However, varieties were different when compared in taste tests at the end of the trial. 'Salina' showed the best tolerance to bolting in the spring.

The system was shown to several homeowner groups that were touring the Discovery Gardens. Response was very favorable with many expressing interest in setting up similar systems on patios. Major points of interest was that the system had no moving parts, pumps, etc. to maintain.

The potential of this and similar systems for commercial use are being evaluated. Further work is needed to study the productivity of other varieties and longer season vegetable crops. Short season lettuce crops would work well in a market garden or u-pick situations based on the results of this trial.

## Literature Cited

Anonymous. xxxx. ATTRA - Appropriate Technology Transfer for Rural Areas. Hydroponic vegetable production: Information package. Fayetteville, AR.

Anonymous. 1996. Intern. Focus. Intern. Programs for Agr. and Natural Resources, Univ. of Fla. 7(4):1-4.

Kratky, B. A., J. E. Bowen and H. Imai. 1988. Observations on a noncirculating hydroponic system for tomato production. HortScience 23(5):906-907.

Kratky, B. A. 1993. A capillary, noncirculating hydroponic method for leaf and semi-head lettuce. HortTechnology 3(2):206-207.

Kratky, B. A. 1996. Non-circulating hydroponic methods. DPL Hawaii, Hilo, HI.

Resh, H. M. 1995. Hydroponic food production. 5th ed:23-26. Woodbridge Press Pub. Co., Santa Barbara, CA.

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# YIELD RESPONSE OF HERBS TO N AND K RATES IN MULTIPLE HARVESTS ON SAND

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*Abstract.* **Italian parsley (parsley), *Petroselinum crispum*, Russian tarragon (tarragon), *Artemisia dracunculus*, sweet marjoram (marjoram), *Origanum majoranna*, and thyme, *Thymus vulgaris*, were evaluated for their yield potential in multiple harvest during fall-winter-spring (Oct.-Mar.) 1994-1995. The herbs were grown with the full-bed polyethylene mulch-seepage irrigation system at three N and K rates, 1×, 2×, and 3× (1× = 44 N and 36 K lb/acre). Phosphorous was applied at 30.5 lb P/ acre with all three N and K rates. Treatments were arranged in a randomized complete block and replicated four times. In the first three harvests, fresh weight of parsley, tarragon and thyme were similar with the 3 N and K rates. In the fourth and fifth harvests, parsley and tarragon yields increased with increasing N and K rates. Marjoram yields were best with the 2× (88 N and 72 K lb/ acre) N and K rate. Plant survival of marjoram and thyme were adversely affected by increasing soil total soluble salt (TSS) concentrations as the season progressed. Nitrogen and K rates had little or no effect on macroelement concentrations in herb shoots.**

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In the United States, herbs are the fastest growing segment of the specialty vegetables (Miller and Harper, 1990; Sit-