

Lettuce, Herbs, and Strawberries: Alternative Crops for Greenhouses and Small Farms.

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Abstract: An indoor test plot using a 21' x 95' greenhouse with double poly roof, insect screened sides, roof vents, side curtains, and horizontal air flow contained 1500 Verti-Gro pots, 0.11 cubic feet/pot, stacked 10 pots high. They were filled with 85% perlite and 15% coarse perlite or coconut fiber as a growing media. Sierra type lettuce, spacing 11.3 sq. ft./vertical stack or 3-plants/sq. ft. An outdoor area of 15' x 50' covered with black polypropylene ground cover, Verti-Gro expanded polystyrene (EPS) pots stacked 5 high on 42" spacing, staggered and anchored into the ground with 5' x 3/4" pipe on a rotating swivel, filled with 85% perlite and 15% coconut fiber or screened cypress mulch. The strawberry variety used was Sweet Charlie. Comparisons were made on several different varieties of lettuce, herbs, spinach and strawberries in vertical towers.

Key Words: Hydroponic, Ebb and Flood, NFT, Vertical Towers, Lettuce, Herbs, Spinach, Strawberries, Greenhouses, Expanded polystyrene, EPS.

Introduction:

In most countries where greenhouse hydroponic vegetable crops are grown the number one crop is tomatoes, followed by European cucumbers, peppers, lettuce, herbs, and strawberries. Other crops such as spinach, edible flowers and a few other specialty crops that are suitable for controlled environment agriculture are also grown. Market factors, climate, the type of greenhouse, fuel cost and other factors may indicate that consideration be given to alternative crops in lieu of, or in addition to, tomatoes and cucumbers. In order to evaluate the profitability of these alternative crops one must consider the growing system as well as the greenhouse design.

Results and Discussion:

Strawberries and certain varieties of lettuce and herbs are high-density crops and considered high cash value crops, outdoors, in tunnels or in greenhouses. The determining factors for profitability includes:

Capital cost per plant space

Productivity per unit area

Operating cost per pound or per unit

The four types of systems that have been used to grow lettuce, herbs and strawberries in greenhouses are:

Nutrient Film Technology (NFT)

Ebb and Flood

Floating Beds

Vertical Towers

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NFT has been the most frequently used system in the past decade. Various types of ebb and flood systems have also been used as well as floating bed systems. None of these systems have taken over the market. The main reason is the cost of these systems and the maintenance involved on a per crop basis.

Capital cost and life expectancy of a growing system is the key factor in return on investment. Since none of the previous lettuce systems or herb growing systems have shown a continuous high return on investment they have not been used extensively in the U.S.

Production in these systems has remained fairly constant and no new methods or varieties have increased production significantly. However, the cost of these systems has continued to rise.

There have been no major breakthroughs in disease control, harvesting techniques, or labor savings in recent years and the production and production cost has not changed significantly. There are only a few basic ways to improve production in the above systems and these include:

Planting larger seedlings

Selection of varieties

Harvesting smaller heads (lettuce)

The quality of produce from these systems has been excellent as long as the spacing is not too close and the environment has been controlled. Root and leaf diseases have been major problems in re-circulating hydroponic lettuce and herb systems whether NFT, ebb and flood or floating beds. Maintenance on these three systems is high and one of the major concerns is the constant cleaning of the trays and tanks or beds.

The cost of production is high and the market must be good. In these systems the lettuce varieties include mostly Bibb types such as Ostinata, Salina, and Rex. Leaf lettuce, Romaine (or Cos) lettuce, spinach, herbs and strawberries have not been profitable in these systems. The production cost versus investment cost has not been favorable in most areas of the U.S. Sierra leaf lettuce has been successful in Florida under high light and high heat conditions. Little Caesar Romaine lettuce has been successful during the cooler months. Spinach varieties such as Space, Tyee and Bloomsdale have been grown successfully in many areas but with limited production. In all areas the variety must be tested to fit the climate conditions and market conditions.

There are some advantages of re-circulating systems that use no growing media. There is no replacement cost for media and the plants can be sold as live plants with live roots. Growing on a flat plane allows for optimum light levels, at least to the top of the plants. However, packaging live plants with bare roots is more costly than packing cut leaves or cut whole plants. The extra price might be justifiable in some markets. Clean lettuce, herbs and spinach with a good shelf life will bring a premium in the market as long as it is attractively packaged.

Spacing is critical when using these types of systems so that diseases can be controlled with good air circulation and minimal pesticide usage. The most common spacing for lettuce is 8" x 8" or 2.5 plants per square foot. After deducting aisle space and end space the plant density is approximately 2-2.25 plants per square foot. The spacing is a direct relationship to the size of plant grown and the harvest stage. The average production time for lettuce is four weeks from transplant to harvest or six weeks from seed to harvest.

The capital cost of these systems are all about the same and range from \$4.00-\$6.00 per square foot. Assuming a medium range of cost and using 10,000 square feet as a model the cost of the systems is \$50,000. With 22,500 plants in 10,000 square feet the capital cost is \$2.25 per plant space for lettuce, herbs and spinach. This high cost has kept these types of systems at a very slow growth pace in the greenhouse industry. In fact, many have not survived even though they produced excellent products.

Until recently no major breakthroughs in capital cost have been reached. A few years ago Verti-Gro increased it's research on lettuce, herbs, spinach, and strawberries. With the help of growers and researchers, such as the U. of Florida AREC at Live Oak, FL, improvements in production have been realized in many leafy type crops in vertical towers. With the development of the rotating tower the production and quality has risen while costs have decreased. Light consistency and ease of planting and harvesting have been improved by easily rotating the stacks on a weekly basis. The average plant density in a Verti-Gro system is three plants per square foot with no plants touching each other if harvested at a reasonable stage.

The costs per 10,000 square feet is only \$15,000 and this includes the growing media and labor to install the system. In 10,000 square feet there are 30,000 plants so the costs per plant space is only \$0.50 versus \$2.25 on other systems. This is less than twenty five percent of the cost of other systems. The greenhouse space is also reduced by twenty five percent. Maintenance is low and the system is guaranteed for five years. The vertical system can be re-circulating or drip for the same price. Assuming a reasonable cost of approximately \$10.00 per square foot for the greenhouse the savings on the greenhouse cost is approximately \$25,000. These are important numbers to consider when planning on growing lettuce, spinach, or herbs in greenhouses.

Although strawberries have not been grown in the other systems the cost comparison is the same at approximately \$0.50 per plant. One acre of strawberries in the field is approximately 17,000 plants and every year it costs \$.25 per plant to get the field prepared and planted. In the greenhouse in vertical towers the cost is about \$.15 per plant. Lower initial investment cost and lower cost of production year after year is the key to profitability in strawberries. "U-Pick" operations will have a higher profit margin than selling through the normal marketing channels where special packaging and cooling is required.

High density cropping, if done properly, can reduce operating costs significantly. On a per plant basis energy, water, fertilizer, pest and disease control, land costs, and the like can all be reduced. If artificial lighting is to be feasible high density cropping is essential.

In the past six months Verti-Gro has successfully tested an outdoor vertical growing system for strawberries in Florida. Using a five pot high stack or 3 1/2' x 3 1/2' spacing the plant density on strawberries (or any other small plant) is two plants per square foot or 87,000 plants per acre. The total cost of the system, including ground cover, pipe, irrigation, rotating stacks, growing media and labor to install is approximately \$1.00 per square foot or \$40,000 per acre. As compared to the standard outdoor strawberry density per acre the initial cost is \$8,000 per acre for 17,000 plants. This, however, is a one-time cost.

Conclusion:

It is essential to evaluate the cost, maintenance, life expectancy, operating cost, projected production and the growing systems of the above alternative crops. The high cost of NFT, ebb and flood, and floating bed systems have deterred many growers. Production varies considerably from variety to variety and particularly from climate to climate. The size or weight of a lettuce head is the determining factor in production. One grown may harvest in three weeks where another may harvest in five weeks. Alternative drops do not fit into the same greenhouse floor plan as tomatoes, cucumbers or peppers. These are tall crops normally grown in peat or cocofiber bags, rockwool slabs or perlite bags. Leafy crops are not profitable in these tips of systems due to inefficient use of space.

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Note: Even though this article was written and published in 1999 the numbers and comparisons are still quite accurate. However, if you are planning growing lettuce and herbs you should do an up-to-date comparison on all the systems.

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