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The Development and Demonstration of an Outdoor Hydroponic Specialty Crop Production System for North Florida 99-12

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Abstract: Small farmers throughout North Florida continue to seek information on high value specialty crops. A greenhouse hydroponic vegetable industry has been present in this region for over 10 years. As the population of the region continues to increase, demand for local production of high value crops such as strawberry also increases. Research at the University of Florida, North Florida Research and Education Center - Suwannee Valley was conducted to develop and demonstrate an outdoor soilless production system. This system utilizes the technology for soilless bag culture currently used by greenhouse tomato growers and frost protection via polypropylene row covers as used by field strawberry growers in North Florida. Harvest of fresh strawberries throughout the winter is possible in North Florida with the use of row covers. Soilless culture provides an opportunity for many small producers to intensively produce strawberries outdoors without the high initial investment of mulching and fumigation equipment.

Keywords: small farms, perlite, bag culture, drip irrigation, row covers.

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Introduction

Strawberry is a major crop produced in Florida on 6,000 acres annually. The strawberry crop is valued at slightly over 100 million dollars, behind only tomato, pepper, and potato during 1995-96 (Anon., 1997). Essentially all strawberries in Florida are grown using full-bed polyethylene mulch culture in fields. Most fields are planted each year with little opportunity for crop rotation. This production system requires soil fumigation each year prior to application of new mulch. Fumigation is used primarily for control of diseases, weeds, and nematodes. The potential loss of the major soil fumigant, methyl bromide, after the year 2005 has created a need to search for alternative fumigants or production systems. Some strawberry production in Europe is being done with soilless bag culture outdoors on raised beds. In addition, vertical hydroponic production systems have become available and are being used commercially in the U. S. (Carpenter, 1997; Garner, 1998).

Most of the large commercial strawberry acreage for shipping is located in central Florida near Plant City and Dover. Strawberries are also produced in many other areas of Florida, including a concentration in Bradford County, but are generally grown there for local direct sales. Over 80% of the farms in North Florida are small farms and many are operated by part-time farmers. Without mulching and fumigation equipment, many growers are not able to grow strawberries in the current field plasticulture system.

An outdoor hydroponic system using soilless bag culture could be a possible alternative. Currently the greenhouse vegetable industry in Florida is using a perlite bag culture system (Hochmuth and Hochmuth, 1996). Much of this system can be successfully adapted to outdoor hydroponic strawberry production (Hochmuth and Crocker, 1997).

Traditionally, strawberry fields in Florida have been established annually using bare-rooted plants. Recently, plug (container-grown) plants have become available as an alternative. Plug plants do not require the large quantities of overhead irrigation during the planting and establishing period (Grubich, 1997). The plug plants could be well suited for planting into bag culture systems.

Project Objective

Several trials were conducted at the North Florida Research and Education Center - Suwannee Valley from 1996 to 1998 to evaluate various components of a hydroponic production system for strawberry. These trials included the evaluation of bag culture, media, container-grown plug plants, controlled release fertilizer, drip irrigation, and strawberry cultivars. The objective of this project was to develop and demonstrate soilless systems for outdoor strawberry production that could be adopted on a garden or larger commercial scale.

Results and Discussion

The initial trial in the 1996-97 season evaluated three medias used in lay-flat bag culture systems and also compared production of three popular strawberry cultivars (Hochmuth and Crocker, 1997). The three medias were perlite, peat mix, and wood fibers. The three cultivars were, "Camarosa", "Chandler", and "Sweet Charlie". Each media performed equally well at about 1.0 lbs per plant using "Sweet Charlie" as the cultivar. "Camarosa" and "Chandler" produced about 1.6 lbs per plant.

This result was very encouraging since the yields were approximately twice the yields of the same cultivars grown in the traditional field production system.

The 1997-98 season trials were conducted to further evaluate specific components of the system. Container-grown plug plants were compared to bare-root transplants in one study. Two controlled-release fertilizers were compared to the standard hydroponic nutrient solution program in two medias.

Container-grown plug transplants gave higher early season yield than bare-root transplants (Hochmuth et al., 1998a). Early yield was considered for all harvests in December and January. Early yield for plug transplants was 0.2 lbs per plant and 0.04 lbs per plant for bare-root transplants. Total seasonal yield was similar for both transplant types at about 1.0 lbs per plant.

In the 1997-98 season media and fertilizer study, equal strawberry yields were again found using two soilless medias (Hochmuth et al., 1998b). Perlite and peat-lite mix both performed very well using either the standard hydroponic nutrient solution (Hochmuth, 1992) or two different controlled-release fertilizer programs. The two controlled-release Osmocote Plus™ fertilizer programs were equal in strawberry production to the standard hydroponic nutrient solution program at near 1.0 lbs per plant. The two Osmocote Plus™ fertilizers were 15-9-11 (12-14 month release) and 16-8-12 (8-9 month release).

All trials reported here used an irrigation system made of poly hose and Chapin's Trickle Stik™ emitters. One emitter was placed at each plant in all studies reported. Polypropylene row covers were also used during each frost or freeze event.

These trials were observed by hundreds of people visiting the North Florida REC - Suwannee Valley over the two seasons. Visitors were participating in field days, tours, Master Gardener trainings and other events. Interest in this project was high for both gardeners and commercial growers. The gardener was especially interested in the controlled-release fertilizer programs because they could not justify the expense of the standard two or three proportioner system used in most hydroponic systems. One Master Gardener in Suwannee County taught gardeners how to implement this system using controlled-release fertilizer and helped implement this on five gardens in the 1998-99 season.

One commercial grower became a cooperator to provide a site for a pilot program for this project during the 1998-99 season. The site was a unique utilization of an abandoned poultry house structure. The roof was removed but the sidewalls and curtains were utilized. Old manure was removed from the floor and a bedding of wood chips was placed under a polypropylene weed barrier. The nutrient delivery system was a standard hydroponic fertilizer program with two proportioners typically used in Florida (Hochmuth, 1990). A dilute fertilizer solution was delivered at each irrigation. The irrigation delivery system was Chapin's drip tape with emitter every four inches. One drip tape line was manually fed through each row of bags. The drip tape was fed through the bag, but on top of the perlite media. The grower production site was 33 x 300 ft and included 5,000 strawberry plants of "Camarosa", 500 plants of "Chandler", and 500 plants of "Sweet Charlie". Harvest began in December of 1998 and fruit was sold at a community farmers market. Frost protection was implemented using polypropylene row cover at each freeze event by pulling the cover over lines of small cable placed two feet above several rows.

A part of the production area was dedicated to onions, lettuce, and specialty greens in the same growing season as the strawberry. After the strawberry crop was terminated, okra was seeded directly into the same production bags. The okra was harvested from July through October.

The expenses and income summary for this project is provided on Table 1. Total variable costs were $6,780 and the annual depreciation and interest of the fixed cost was $665. The total cash income for the strawberry and other crops was $9,700 leaving a net profit of $2,255 for this one-quarter acre project.

Conclusions

This project has been successful in developing and demonstrating plasticulture technologies for gardeners and commercial growers to produce high quality strawberries. As the population continues to grow in North Florida, demand increases for locally grown fresh fruits and vegetables. Utilizing this type of system is popular for the small farmers and gardeners of the region, especially where production space or farm equipment is limited. Soil-borne diseases and nematodes are persistent problems in Florida and many of these growers do not have access to mulching and fumigation equipment. The ability to grow more than one crop (double crop) in the same bag has a

great economic benefit. This practice brings two challenges, however, keeping the irrigation system clean and free of clogging, and protecting the polyethylene bags from premature degradation due to intense UV exposure.

The products grown in this system may have value added characteristics that can be marketed. Leafy green vegetables, for instance, are free of any sand or dirt and should be sold for a higher price than the field-grown competition. This outdoor soilless culture system appears to be quite successful for gardeners or small farmers who want to intensively produce strawberries or other high value crops for their own use or for sale.

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Table 1. Estimated Expenses and Income for Hydroponic Strawberry and Specialty Crop Project at Sonny Andrews, Brooker, FL

Variable Costs

Expense Items		Cost
Perlite media	$	900
Grow bags and ties		300
Drip tape		180
Fertilizer		600
Strawberry plug plant, vegetable plug transplants, seed		900
Pest control program		180
Packing and containers		600
Labor (filling growing bags, planting, picking, and packing for strawberry & vege)		3,000
Electricity		120
Total Variable Costs	**$**	**6,780**

Fixed Costs

Expense Items		Total Costs
Row cover (2 oz/yd² 36 x 300) including cable, posts, connector, etc. for cover	$	500
Black polypropylene ground cover and anchoring pins		300
Fertilizer proportioners		450
Irrigation set-up (filter, solenoids, lay-flat bags, flush caps, misc. PVC parts)		400
Backpack sprayer		500
Irrigation controller		120
Refrigeration		500
Total Fixed Costs	**$**	**2,770**

Income

Strawberry		Income
5,000 lbs of Camarosa fruit sold at an average of $1.00 per lb	$	5,000
Total Income on Strawberry Crop	**$**	**5,000**
Other Crops		
Okra	$	2,700
Lettuce & Specialty Leafy Greens		1,000
Onions		1,000
Total Income for Other Crops	**$**	**4,700**
Total Income for all Crops	**$**	**9,700**

Summary

Costs		
Variable	$	6,780
Fixed Costs Depreciation and Interest (at 5 years)		665
Total Costs		7,445
Income		9,700
Total Profit	**$**	**2,255**