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## *Evaluation of Two Soilless Growing Media and Three Fertilizer Programs in Outdoor Bag Culture for Strawberry in North Florida 98-06*

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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 in vegetable crops during 1995-96 (Anon, 1997). Essentially all strawberries in Florida are grown using plastic 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, primarily for control of diseases, weed, and nematodes. The potential loss of the major fumigant, methyl bromide, after the year 2000, 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 Bradford County, but are generally grown for local direct sales. Approximately 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 perlite bags could be a possible alternative system. Currently the greenhouse vegetable industry in Florida is using a perlite bag culture system (Hochmuth and Hochmuth, 1996). Much of this system can be

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successfully adopted for outdoor hydroponic strawberry production (Hochmuth and Crocker, 1997).

Small bag culture production areas can be established using a standard hydroponic fertigation system with two concentrated fertilizer stocks and proportioners. A possible alternative fertilizer program may be the utilization of controlled-release fertilizers in the bag. This fertilizer would be placed directly in the media immediately after planting. Irrigation water only could then be supplied via microirrigation without the expense of the fertilizer proportioner system.

This trial was conducted to evaluate strawberry production in bag culture by comparing two soilless growing media, perlite, and a peat mix. In addition, three fertilizer programs were compared, one was a typical hydroponic fertigation program and two were controlled-release fertilizer programs.

## **Materials and Methods**

A trial was conducted in the 1997-98 season at the North Florida Research and Education Center - Suwannee Valley near Live Oak, FL to evaluate strawberry production using two soilless growing media and three fertilizer programs in bag culture. The two media compared were perlite and a peat mix. The peat mix was Scott's Growing Medium 560 with coir. Scott's Growing Medium 560 with coir is made of the following ingredients: composted pine bark 35-45%, processed coconut coir pith 20-30%, Canadian sphagnum peat moss 10-20%, processed bark ash 5-15%, horticultural perlite 5-15%, and a proprietary nutrient charge. The media treatments were placed in layflat bags approximately three feet long and ten inches in diameter. Bags were placed end-to-end on a level area of soil covered with black polypropylene ground cover. Bags were arranged in pairs of rows with five feet between the centers of each pair to facilitate spraying with a tractor-mounted sprayer. Plots were arranged in a randomized split block design with four replications. Main plots were the two media treatments and the subplots were the three fertilizer treatments.

The three fertilizer treatments included two controlled-release fertilizer materials and one hydroponic nutrient fertigation program. The two controlled-release fertilizer treatments were applied once at the beginning of the season, immediately after planting. Each controlled-release fertilizer treatment was applied at the rate of 26 grams per plant. The application was made by opening a space in the media three inches deep and one inch from the plant, and pouring 26 grams of fertilizer per plant in the hole created. The hole was then pressed closed. The irrigation emitter for each plant was placed immediately over the fertilized area. The two-controlled release fertilizer treatments were: 1. Osmocote Plus TM 15-9-11 with micronutrients and a

timed release 12-14 months and 2. Osmocote Plus™ 16-8-12 with micronutrients and a timed release of 8-9 months (Table 1).

Plug plants of the strawberry cultivar 'Camarosa' were planted into all production bags on October 6, 1997 (Grubach, 1997). Six plants per bag were planted in a staggered pattern. Irrigation during the season was supplied via half-inch polyethylene tubing laid in the center of each pair of rows. Six plants were planted in each bag and an irrigation emitter was placed at each plant (Hochmuth and Hochmuth, 1996). Emitters were Chapin's "Tickle Stik" with a .05 inch inside diameter leader. A standard hydroponic bag culture fertigation system with two injectors and nutrient stock tank system was used for delivery of water and nutrients for the fertigation treatments (Hochmuth, 1992). Two stock tanks of concentrated nutrient solution were mixed as needed according the University of Florida recommendations for hydroponic tomato (Hochmuth, 1990). This complete nutrient solution delivered a final nutrient concentration containing 150 ppm N, 50 ppm P, 200 ppm K, 90 ppm Ca, 40 ppm Mg, and 55 ppm S. Micronutrient delivery was 2.8 ppm Fe, 0.2 ppm Cu, 0.8 ppm Mn, 0.3 ppm Zn, 0.7 ppm B, and 0.05 ppm Mo (Table 2). A maximum of six irrigation events per day during daylight hours were determined by time with an irrigation controller. The same irrigation timing and delivery system was used for both controlled-release fertilizer treatments, however, water only was delivered to those bags.

Disease, insect, and mite populations were managed through integrated pest management scouting and control measures (Hochmuth and Maynard, 1996). Protection from frost and freezing temperatures was provided by application of Agryl™ polypropylene floating row cover (2.0 ounce per square yard). The cover was held up and away from the plants by using wire hoops anchored in the ground. The wire hoops formed an arch over the bags of strawberry plants. The row cover protected blooms and fruit when ambient temperatures reached as low as 24°F. Fruits were harvested and weighed from 12 December 1997 to 15 May 1998. In addition, plant petiole samples were collected periodically during the season. The petiole sap was expressed from the petiole and analyzed for N and K concentrations using Cardy ion selective electrodes (Hochmuth, 1994). All harvest data were subjected to analysis of variance procedures.

## **Results and Discussion**

Fruit yields in both media and all three nutrient program treatments were similar at just under one pound per plant (Table 3). Comparison of strawberry yield in perlite and peat mix treatments showed no significant difference in total, early, or any monthly yields. Early yield (December and January) was nearly identical at about 0.17 lbs per plant in both media treatments. Production during March and April was high and

represented over half of the total seasonal yield. Total yields in perlite at 0.88 lbs per plant and peat mix at 0.97 lbs per plant were not significantly different.

Fertigation treatments were all similar in terms of strawberry fruit yields during the entire season. Osmocote 15-9-11, Osmocote 16-8-12, and the fertigation treatment all resulted in total yields between 0.90 and 0.94 lbs per plant. Likewise, no significant differences in any monthly yield were detected among the three fertilizer treatments.

Petiole-sap nitrogen and potassium levels were similar between perlite and peat mix when the same fertilizer treatment was used. Sap levels of nitrate-N and K with Osmocote decreased significantly at the end of the season in comparison to the fertigation program. The late season decrease did not result in a significant decrease in yield; however, the nitrate-N and K deficiency in the leaves was observable only during late April and May. The fertigation program maintained very high levels of sap nitrate-N and K during the entire season. Research on field-grown strawberry plant petiole sap indicates nitrogen levels should be 600-800 ppm nitrate-N in the early fruiting season and level off to 200-500 ppm nitrate-N in mid and late season (Hochmuth, 1994). The fertigation program seemed to maintain these levels throughout the season. However, the two controlled-release fertilizer treatments seemed to be on or below the minimum level at times, especially during the last month. Osmocote Plus 15-9-11 (12-14 months) seemed to maintain higher nitrogen levels in the petiole sap than Osmocote Plus 16-8-12 (8-9 months). This was most apparent in the perlite media plots.

Plant sap petiole potassium levels in strawberry are recommended to be maintained at 2500-3500 ppm K in the early fruiting season and 1500-2500 ppm K in the mid and late season (Hochmuth, 1994). The fertigation program seemed to maintain these levels throughout the season. The high levels of over 3000 ppm K at the end of the season in the peat treatments occurred during a period when a very light fruit load was on the plants due to high temperatures. The two controlled-release fertilizer treatments were similar to each other in both perlite and peat mix treatments. The K level was generally in the range of 1000-1500 ppm and may be at or just below the recommended level.

This study shows excellent strawberry yield can be obtained using these hydroponic bag culture techniques. Perlite and the peat mix performed equally well and either will make a good media for bag culture of strawberry. The at-planting Osmocote fertilizer treatments performed as well as the daily fertigation program. This result is encouraging for those interested in small production areas because the expensive injector system would not be necessary. The rate of this trial was 26 grams per plant and even though no yield differences were detected in this trial, an increased amount or a mid season side-dress application may be preferred. Further refinement of the amount and timing of the controlled-release fertilizer applications is worthy of testing before large scale adoption.

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**Table 1.** Fertilizer analysis of two controlled-release fertilizer materials used in soilless bag culture of strawberry in Live Oak, FL.

Nutrient	Osmocote Plus™ 15-9-11	Osmocote Plus™ 16-8-12
	(%)	(%)
N	15	16
P <sub>2</sub> O <sub>5</sub>	9	8
K <sub>2</sub> O	11	12
Mg	1.2	1.2
S	2.3	2.4
B	0.02	0.02
Cu	0.05	0.05
Fe	0.50	0.50
Mn	0.07	0.07
Mo	0.02	0.02
Zn	0.17	0.17
Release Time	12 - 14 Months	8 - 9 Months

**Table 2.** Nutrient content of the fertigation solution treatment delivered to bag culture strawberry production in Live Oak, FL.

Nutrient	Delivered Concentration (ppm)
N	150
P	50
K	200
Ca	135 <sup>z</sup>
Mg	50 <sup>y</sup>
S	60
Fe	2.8
Cu	0.2
Mn	0.8
Zn	0.3
B	0.7
Mo	0.05

<sup>z</sup> In addition to 135 ppm Ca supplied from the nutrient stock, 72 ppm Ca is contained in the raw water.

<sup>y</sup> In addition to 50 ppm Mg supplied from the nutrient stock, 10 ppm Mg is contained in the raw water.

**Table 3.** Evaluation of two soilless media and three nutrient programs in the production of 'Camarosa' strawberry in Live Oak, FL.

	Yield (lbs per plant)							
	Total Yield	Early Yield	Dec	Jan	Feb	Mar	Apr	May
<b>Media</b>								
Perlite	0.88	0.18	0.01	0.17	0.18	0.27	0.20	0.05
Peat Mix	0.97	0.17	0.00	0.17	0.18	0.35	0.21	0.06
	NS	NS	NS	NS	NS	NS	NS	NS
<b>Fertigation Program</b>								
Osmocote 15-9-11	0.94	0.16	0.01	0.16	0.20	0.31	0.22	0.05
Osmocote 16-8-12	0.94	0.17	0.00	0.17	0.20	0.33	0.17	0.07
Fertigation	0.90	0.18	0.01	0.17	0.14	0.29	0.23	0.06
	NS	NS	NS	NS	NS	NS	NS	NS

## Industry Cooperators

Airlite (perlite)  
 3505 65th Street, Vero Beach, FL 32967  
 (407) 562-3518  
 Chapin Watermatics, Inc. (irrigation emitters)  
 PO Box 490, Watertown, NY 13601  
 (315) 782-1170

The Scott's Company (media & fertilizer)  
 14111 Scottslawn Road, Marysville, OH 43041  
 1-800-492-8255  
 We Gro-Rite Inc. (strawberry plants)  
 1482 Fairview Road, Andrews, NC 28901-9731  
 (704) 321-4371