

## **Progress Report to Southern Region Small Fruit Consortium**

**Title:** Evaluation of Cultivars, Plug Establishment Date, and Plant Spacing on Greenhouse Strawberry Production

**SRSFC Project** 2008-08

**Proposal type:** Research

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**Objectives:**

- 1) To evaluate strawberry cultivars for fall and winter greenhouse production.
- 2) To evaluate timing of plug plant establishment on fall protected-culture production.
- 3) To evaluate spacing of potted strawberry plants in greenhouse production.

**Justification:**

There is demand for year-round supply of fresh strawberries in the U.S. Strawberries are currently shipped into the mid-south states during the off-season. Strawberries are typically produced from late April until late June in the mid-south. However, the highest strawberry prices occur during the fall in November and December. Research by Dr. Takeda (2005) showed that July-plugged plants had the potential to produce a significant crop from October to December in the mid-Atlantic coast region by using a protective high tunnel production system. He reports that "Income from fall and spring strawberry production (double cropping) can help to raise farm profitability."

More strawberry cultivars need to be evaluated for off-season production. 'Albion' is a new day-neutral cultivar from UC-Davis (2006) that has quickly gained popularity in California. 'Strawberry Festival' (2000) and 'Carmine' (2001) are two short-day cultivars released by the Univ. of Florida that fruit early in the spring. 'Camarosa' (1993) is a short-day cultivar from UC Davis that was described by the California Strawberry Commission as having good early production potential and accounted for approximately 1/3 of Californian's production in 2008. 'Ventana' (2002) is a newer short-day cultivar from UC Davis that the commission described as producing fruit earlier in the season than 'Camarosa', and with excellent fruit quality.

If strawberries are grown in containers in greenhouse production, then research is needed to determine what size of containers are needed.

## Methodologies:

*Experiment 1.* Runner tips were collected by Dr. Takeda from ‘Albion’, ‘Camarosa’, ‘Carmine’, ‘Strawberry Festival’, and ‘Ventana’ on 1 July, 15 July or 31 July and established as plug plants. In mid-September, the plug plants were transferred to one gallon size pots containing 50% Promix and 50% perlite. An experiment was established with the 15 randomized treatments and eight replications in a heated 96 ft by 30 ft polyethylene-covered greenhouse at the East Tennessee Research and Education Center, Knoxville. The pots were placed on greenhouse benches in trays that kept pots spaced 12 inch (center-to-center) in double rows. Each experimental unit contained 6 plants, thus there were 48 plants of each treatment in the experiment. Plants were fertigated with nutrient solutions containing Hydro-Gardens strawberry formula 8-12-32, magnesium sulfate and calcium nitrate.

The greenhouse was treated twice with insect bombs prior to planting. During the trial, insects and mites were controlled with the following biologicals: the predatory mite *Phytoseiulus persimilis* to control two spotted mites, the parasitic wasp *Encarsia formosa* to control white flies, and the predator mite *Amblyseius cucumeris* to control thrips. Bumblebees were used for pollination. Yield data was collected and observations made from establishment until mid April.

*Experiment 2.* Plug plants of ‘Strawberry Festival’ were purchased and established in 4 ¾ in, 5 ½ in, 6 in, 6 ¾ in, 7 ½ in, or 8 ¼ in diameter pots on 13 Sept. An experiment was established in the above greenhouse with the plants in six pot sizes, 12 plants per experimental unit, and four replications. The pots were arranged in trays such that the plants were 12 inches apart (center-to-center) in double rows 6 inches apart. Similar cultural procedures were preformed as in Experiment 1.

## Results:

*Experiment 1.* The first bloom was observed 4 Oct., 2007 on ‘Albion’ and ‘Camarosa’ and on 9 Oct. on ‘Carmine’, ‘Strawberry Festival’, and ‘Ventana’. The first bloom of ‘Albion’ occurred 4 Oct. regardless of plug date. Fruit were harvested approximately twice per week until 21 April 2008. The first fruit harvest of ‘Albion’, ‘Carmine’, and ‘Camarosa’ occurred on 4 Nov. and the other cultivars 3 days later. ‘Carmine’ yielded the most fruit (105 g/plant) during November and December although yields of all cultivars were relatively low in the fall. The greenhouse heaters malfunctioned for four days in mid-November while the outside temperatures reached the mid 20s F. We assume the inside temperatures were almost as low. Researchers observed reduced bumblebee activity and blackened tissue in the crowns during that time. They also observed in mid-January that the number of flowers were relatively low. Thrip populations also increased in January, causing extensive damage to flowers. Yields in February were less than 1/3 of those in December or January. Plants propagated 1 July yielded only 4% more fruit before January than those propagated 15 July, but approximately 75% more than those propagated 31 July. ‘Ventana’ yielded the most fruit for the entire harvest period (1.4 lb/plant) with 90% occurring after 1 Jan. ‘Carmine’ and ‘Camarosa’ yielded about 20% and 10%, respectively, of their fruit before 1 January but produced similar amounts for the entire harvest period (~1.2 lb/plant). ‘Albion’ and ‘Strawberry Festival’ were relatively productive in November and December, producing 18% to 21% of their total yield, but less productive than other cultivars after 1 Jan. ‘Ventana’ was the most productive

cultivar overall, had very good quality, but needed to be propagated by 1 July to improve early yields.

The two-spotted mite was initially the most difficult pest to control, but high populations of *P. persimilis* eventually controlled the pest. Minor outbreaks of whiteflies and were controlled with *Encarsia Formosa*. *Amblyseius cucumeris* were introduced several times starting in mid January to control thrips. Thrip populations declined but damage to flowers was still evident in March. More research is needed on biological control of thrips. One hive of bumblebees was efficient at pollinating a house of strawberries for about six weeks.

*Experiment 2:* The ‘Strawberry Festival’ plants were extensively infected with anthracnose (*Colletotrichum*) and the data were unreliable.

**Conclusions:** Our trials have showed that yields of 0.5 lb/plant by 1 Jan. and 2.0 lb/plant by mid-April could be achieved in the greenhouse even though factors have limited production each year. ‘Ventana’ was the most productive cultivar with very good quality. ‘Carmine’ also had good quality but had a smaller berry. ‘Strawberry Festival’ had good quality berries but the lowest yields. ‘Albion’ and ‘Camarosa’ had uneven ripening on the fruit surface.

**Impact Statement:**

Several cultivars have been identified as suitable for greenhouse off-season production. ‘Carmine’ and ‘Ventana’ had good quality fruit and ‘Ventana’ was the most productive cultivar in the trials.

Bumblebees can be used to pollinate strawberries in a greenhouse. Their use necessitates careful use of pesticides. Biological predators have provided adequate control of the two-spotted mite, aphids and white flies. However, damage from thrips has been more difficult to control thus far.