Progress Report to Southern Region Small Fruit Consortium

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

SRSFC Project 2007-11

Project 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. Research is being conducted to extend the production period to earlier in the spring by use of tunnels (Kadir, 2006). 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."

Methodologies:

Experiment 1. Runner tips were collected by Dr. Takeda from five cultivars ('Camarosa', 'Carmine', 'Chandler' and 'Ventana' (short-day strawberries), and 'Evie-2' (everbearing strawberry) in early July and in early August. Runner tips were also collected from 'Raritan', 'Noreaster' and 'Darselect' in July and also established as plug plants. In mid September, the plug plants were transferred to 6 inch x 4.5 inch round pots (87 inch^3) containing 50% Promix and 50% perlite. An experiment was established with the 13 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) within-row and in double rows 6 inches apart. Each experimental unit contained 6 plants, thus there were 48 plants of each treatment in the experiment. In mid October, plug plants of 'Sweet Charlie' and 'Strawberry Festival' were purchased and planted in pots in the planned locations 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 predator mite *Neoseiulus cucumberis* to control thrips and the parasitic wasps *Encarsia formosa* and *Eretmocerus eremicus* to control white flies. Bumblebees were used for pollination. Yield data was collected and observations made from establishment until mid April.

Experiment 2. Plug plants of 'Carmine', 'Camerosa', 'Chandler' and 'Sweet Charlie' were purchased and established in 87 inch^3 pots in mid-October. An experiment was established in the above greenhouse with the four cultivars with 6 or 12 inches (center-to-center) in-row spacing in double rows 6 inches apart. Four replications of the treatments were arranged in a randomized complete block design. Similar cultural procedures and data collection were preformed as in Experiment 1.

Results:

Experiment 1. The first harvest was collected on 13 November and harvest continued until 13 April. For the November-December period, 'Carmine' (July tip-cutting) had the highest yield (0.5 lb/plant). Plants from July tip cuttings of 'Camarosa', 'Evie-2', and 'Ventana' had approximately 0.4 lb/plant). Yields of 'Raritan', 'Noreaster', and 'Darselect' were less than 0.2 lb/plant. Yields of the five cultivars propagated in July had approximately 35 percent more yield than the same cultivars propagated in August. An initial delay of supplying pollinators and inadequate regulation of daytime high temperatures probably reduced yields during the November-December period.

'Evie-2', 'Carmine', and 'Camarosa' yielded approximately 2 lb/plant for the entire harvest period. Fruit of 'Evie-2' were relatively large but had unacceptable flavor, and ripened unevenly. 'Carmine' and 'Camarosa' had acceptable flavor and fruit size. 'Ventana' plants yielded slightly less fruit but had the best fruit quality throughout the trial. 'Raritan', 'Noreaster', and 'Darselect' yielded less than 1 lb/plant and had the smallest berries and less desirable fruit quality. Yields of 'Sweet Charlie' and 'Strawberry Festival' could not be compared statistically to the other cultivars because of the difference in planting dates. 'Strawberry Festival' fruit were flavorful and relatively large fruit and yielded 55% more than 'Sweet Charlie'. 'Sweet Charlie' plants seemed to have more pollination problems and suffered much more wilt late in the season than other cultivars. Again, a delay in supplying adequate numbers of pollinators at various times probably reduced overall yields.

The two-spotted mite was the most common and difficult pest to control, but initial high populations of *P. persimilis* eventually controlled the pest. *P. persimilis* populations were released at least every two weeks to control mites. Minor outbreaks of whiteflies were controlled with the parasitic wasps.

Experiment 2: 'Camerosa', 'Chandler' and 'Sweet Charlie' plants yielded less than 55% as much fruit per plant at the 6 inch in-row-spacing as plants grown at the 12 inch spacing during November and December harvest period. Only 'Carmine' had relatively high yields at the 6 inch spacing (89% yield of plants at the 12 inch spacing), thus may be better adapted for higher planting densities in a greenhouse. 'Sweet Charlie' plants had very low yields compared to 'Camerosa', 'Carmine' and 'Chandler'.

Conclusions:
Our trial 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 several factors limited production. Several cultivars were deemed unacceptable because of low yields or fruit size ('Raritan', 'Noreaster', and 'Darselect') or for poor fruit quality ('Evie-2'). 'Carmine' and 'Camerosa' yielded 1.9 lb/plant and had acceptable fruit quality. 'Ventana' yielded approximately 1.7 lb/plant with the highest quality fruit.

The insect and mite pests were almost entirely controlled with biologicals, thus demonstrating that strawberries can be produced with little or no need for insecticides/miticides. If using bumblebees for pollination, then the use of any pesticides may harm the bees. Fungicides such as Nova were sprayed a couple of times to control *Botryris.* A major part of the costs of using predators for insect/mite control in a single greenhouse was the shipping costs. Growers may need to grow greenhouse strawberries on a larger production scale, join with other growers to share shipping costs or find ways to keep predators reproducing in the houses in order to improve the economics of using biologicals for control and pollination.

Impact Statement:
Several cultivars were identified that are promising for fall and winter greenhouse. July tip-cutting plug plants yielded more than those started in August. Bumblebees can be used to pollinate strawberries throughout the winter. Their use necessitates the concern for pesticides. Biologicals were successfully used to control the mite and white fly populations.

Publications:
None, one in preparation.

Literature Cited:
Kadir, S., E. Carey, and S. Ennahli. 2006. Influence of High Tunnel and Field Conditions on Strawberry Growth and Development. HortScience 41:329-335.

Takeda, F. 2005. Propagation methods for producing strawberry plants for fall cropping in the mid-Atlantic coast region. Annual Cumberland Shenandoah Fruit Workers Conference. pp 133-135.