PROTECTED CULTURE OF STRAWBERRY AS A METHYL BROMIDE ALTERNATIVE: CULTIVAR TRIAL

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Greenhouse production of strawberry using soilless culture can be considered as a valid alternative to field production using methyl bromide. Several growers in Florida are considering this transition as the method offers advantages in addition to avoiding soil fumigation. Strawberries in protected culture are grown in troughs, and plant densities can be increased up to 5 times leading to higher yields. The fruit is protected from soil and rain splash and the humidity is lower; fungal disease incidence, particularly botrytis and anthracnose, is decreased so fruit quality is enhanced. The area of greenhouse strawberry production in Europe is 17,280 acres; Japan is 6,800 acres and S. Korea has18, 750 acres.

The Protected Agriculture Project (PAP) at the University of Florida was established in 1999 as a demonstration project. Research is conducted on crop production inside high-roofed plastic greenhouses with passive venting and insect screens. These greenhouses are commercially produced and are relatively economical ($2-$4 ft^{-2}). Greenhouse production systems from other locations are adapted to function effectively under Florida conditions and systems have been developed for growing strawberries without pesticides in soil-less culture.

Method: Most US strawberry (*Fragaria* x *ananassa* Dutch) cultivars are bred for field production, and very limited information about their performance under protected cultivation is available. Seven strawberry cultivars were grown to evaluate their fruit yield, quality potential and susceptibility to powdery mildew and aphid infestation. Standard production systems developed at the PAP were used for this cultivar trial. The strawberry cultivars tested were 'Strawberry Festival', 'Earlibrite', 'Carmine', FL-97-39, 'Treasure', 'Sweet Charlie', and 'Camarosa'. Conditioned plug plants were transplanted into pine bark (1in sieved) contained within 'Hanging Bed-Pack®' troughs The troughs were suspended from 1.8 m above the ground and spaced 50 cm apart. Plants were irrigated with nutrients 8 to 10 times daily with a drip tape. Treatments were arranged using a randomized complete block design with nine plants per plot at a density of 22 plants.m^{-2} (2.2 plants.ft^{-2}). No fungicides or insecticides were used. Bumble bees (*Bombus terrestris* L.) (Koppert Biological Systems Inc., Romulus, MI) were used to pollination. Insect pests that occurred on the strawberries were controlled by the release of biological control agents; the predatory mite *Neoseiulus californicus*

McGregor for the two-spotted spider mite (*Tetranichus urticae* Koch.), and *Aphidius colemani* Viereck for cotton aphids (*Aphis gossypii* Glover).

Results and Discussion: Fruit were harvested 21 times from 25 Nov 2002 to 26 Mar 2003, and the first eleven harvests until 27 Jan were considered "early". FL97-39 performed best with both the highest early ant total marketable yield it was followed by 'Carmine', 'Camarosa' and 'Treasure', which were not significantly different during the early harvest (Tables 1 and 2). Sweet Charlie performed most poorly under greenhouse conditions. The average fruit weight of FL97-39 was significantly greater than all other cultivars during the early season.

The major problems in greenhouse production are insect pests and powdery mildew. The aphid population peaked on the strawberry plants in December and was worse on the cultivars 'Sweet Charlie' and 'Carmine', after this time the populations declined as a result of biological control (Table 3). Powdery mildew infests the leaves, pedicels, flowers and fruits. and there were differences in susceptibility between the different cultivars, with FL97-39 and Earlibrite being the most susceptible (Table 4).

Total yields attained over the season varied between a high of 8445 12-lb flats.acre^{-1} for FL97-39 and a low of 5317 12-lb flats.acre^{-1} for Sweet Charlie. This compares to a ten-year average yield for field-produced strawberries of 2,392 12-lb flats.acre^{-1}. The winter of 2002-2003 was a very cold one with temperatures recorded below 0^{o}C on 36 days, there was an estimated loss of 15% for field produced strawberries. The lowest temperatures recorded in the unheated greenhouse were 4.5^{o}C. Although growth of strawberries slows at this temperature strawberry production can continue, without the losses experienced in field grown crops.

Advantages of Protected Culture of Strawberry.

- Soil fumigation in not required.
- Yields per acre up to five times greater than field grown
- Quality of fruit is increased
- Grey mold and anthracnose are not a significant problem
- Fruit can be produced and marketed as pesticide-free.
- Harvest efficiency can be improved by 25-30%
- Production is increased during the early season.

Disadvantages

- Start-up costs for greenhouse production can be high.
- Grower knowledge deficit. Growers are skilled at highly intensive field production; they must adapt their skills for greenhouse production.

Greenhouse production of strawberry is a serious alternative to field production with methyl bromide.

References available at: **http://www.hos.ufl.edu/ProtectedAg**

Table 1. Early (Nov 25, 2002 – Jan 27, 2003) yield of seven strawberry cultivars grown under protected culture at the UF Protected Agriculture Project.

	EARLY MARKETABLE YIELD				
Cultivar	Average fruit weigh	No. of fruit per plant	Marketable Yield	Marketable Yield	Marketable Yield
	(g.fruit^{-1})	(no.plant^{-1})	(%)	(g.plant^{-1})	(12-lb flats.acre^{-1})
FL 97-39	23.1 a	10.7 ab	96.6 a	247.9 a	4048 a
Carmine	18.0 cd	12.4 a	91.2 b	227.8 ab	3720 ab
Camarosa	18.3 cd	10.1 ab	93.2 ab	184.5 abc	3013 abc
Treasure	21.0 b	8.5 ab	97.4 a	180.1 abc	2941 abc
Earlibrite	19.0 bc	7.8 b	91.2 b	147.9 bc	2415 bc
Sweet Charlie	17.1 cd	8.5 ab	80.5 c	143.9 bc	2350 bc
Strawberry Festival	16.2 d	7.3 b	82.4 c	118.3 c	1932 c
R-square	0.84	0.46	0.89	0.56	0.56

Means followed by the same letter within each column are not significantly different according to Duncan's multiple range test, P=0.05.

Table 2. Total (Nov 25, 2002 – Mar 26, 2003) yield of seven strawberry cultivars grown under protected culture at the UF Protected Agriculture Project.

	TOTAL MARKETABLE YIELD				
Cultivar	Average fruit weigh	No. of fruit per plant	Marketable Yield	Marketable Yield	Marketable Yield
	(g.fruit^{-1})	(no.plant^{-1})	(%)	(g.plant^{-1})	(12-lb flats.acre^{-1}
FL 97-39	21.5 a	24.0 ab	89.8 ab	517.2 a	8445 a
Carmine	18.6 bc	26.2 a	89.3 ab	488.5 a	7977 a
Strawberry Festival	19.7 b	22.2 abc	89.9 ab	438.3 ab	7157 ab
Treasure	21.8 a	19.4 bc	94.3 a	423.4 ab	6913 ab
Earlibrite	22.5 a	18.0 c	88.9 ab	404.5 ab	6605 ab
Camarosa	19.2 b	18.0 c	83.7 bc	344.3 b	5622 b
Sweet Charlie	17.6 c	18.4 c	80.6 c	325.6 b	5317 b
R-square	0.86	0.62	0.68	0.63	0.63

Means followed by the same letter within each column are not significantly different according to Duncan's multiple range test, P=0.05.

Figure 3. Monthly changes in aphid (*Aphis gossypii*) infestation for seven strawberry cultivars grown under protected culture during 2002-03.

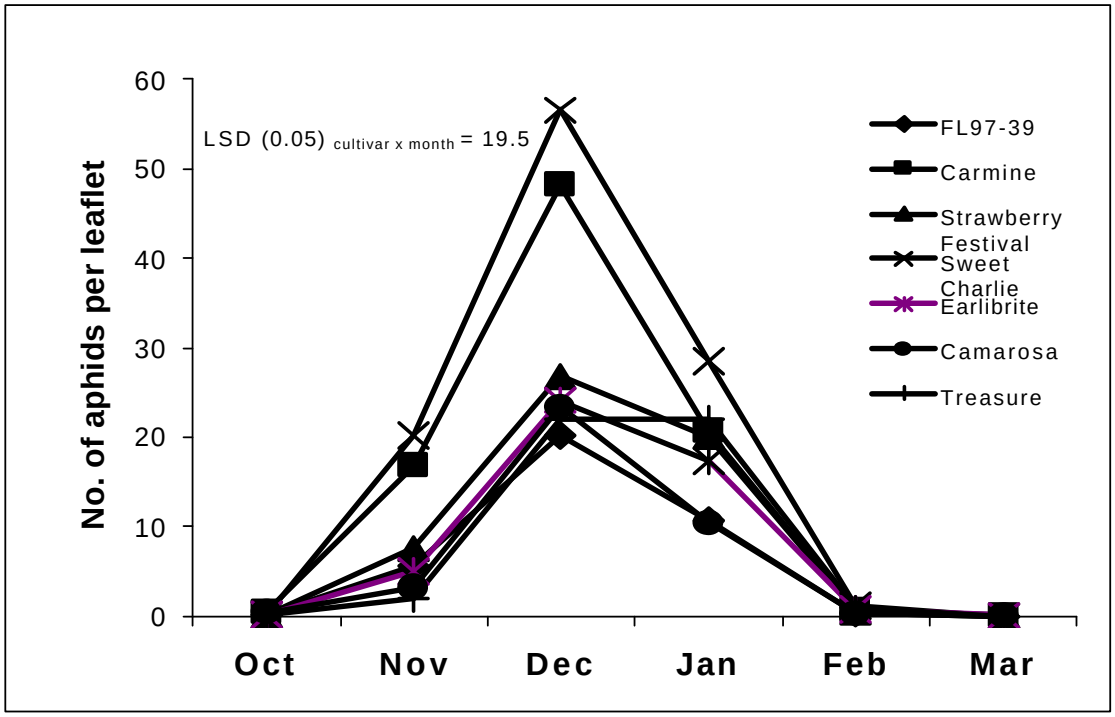

Figure 4. Susceptibility to powdery mildew (*Sphaerotheca macularis*) for seven strawberry cultivars grown under protected culture during Fall 2002-03.