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# DEVELOPING A SYSTEM TO PRODUCE ORGANIC PLUG TRANSPLANTS FOR ORGANIC STRAWBERRY PRODUCTION

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*Abstract.* **The USDA National Organic Standards require growers to use organically grown transplants for growing strawberries as an annual crop. However, organically grown strawberry plug transplants are not presently available in the U.S. or Canada. A study was conducted during fall 2002-03 wherein three types of plug mixes and fertilizers were evaluated for organic plug transplant production. Runner tips of 'Camarosa' strawberry were obtained from a nursery in North Carolina and planted in propagation trays. Our research demonstrated that good quality organic plug transplants can be produced under low-cost polyhouses by using organic plug mixes and organic fertilizers. Plants grown in a plug mix containing ¼ in screened pinebark and worm castings (1:1 v/v) needed to be irrigated more frequently as compared to those grown in plug mixes that contained untreated peat moss, coarse perlite, and medium vermiculite (2:1:1 v/v). Both Fertrell Super-N (4-2-4) and Fish-O-Mega (4-2-2) produced healthy transplants when used alone, but caused 'leaf burn' when used together. Therefore, when used in combination, the concentrations of Fertrell Super-N and Fish-O-Mega may need to be reduced in order to avoid leaf burn. The cultivar used in this study ('Camarosa') is highly susceptible to anthracnose fruit rot disease which was a severe problem during the unusually wet and cold fall of 2002-03. Regardless of the type of plug mix or fertilizer used, the non-marketable yields were greater than the marketable yields since many fruits that would have otherwise been marketable were rendered unfit for the market due to the severe outbreak of anthracnose fruit rot disease. Therefore, selecting cultivars that are resistant to anthracnose fruit rot will be necessary for organic strawberry cultivation in Florida. Disinfection of the runner tips prior to plug production by dipping in dilute solutions of Oxidate® or Chlorox® bleach may help reduce the incidence of this disease, and may ultimately result in improved yields.**

In the Southern region of the U.S., strawberries are grown as an annual crop. Most of the production is done in Florida (6,900 acres) and North Carolina (1,800 acres), and small scale farmers in many other states grow strawberries as a cash crop for direct marketing. Even though strawberries are one of the most popular fruits in the United States, they are listed among the ten foods most to be avoided due to high pesticide residues (Ames and Born, 2000). Methyl bromide, which is a class I ozone depleting substance and will be phased out by Jan. 2005, is used as a soil-fumigant in 90% of the total strawberry acreage in Florida (ERS/USDA, 1999). Consumer awareness about the advantages of pesticide-free, organically grown produce is increasing and many consumers are willing to pay a premium price for organically grown strawberries (Pritts and Kovach, 2000). Organic strawberry production without methyl bromide can be an economically viable alternative for strawberry growers who wish to adopt an alternative method of strawberry production in the post-methyl bromide era.

Most organic strawberry growers have been using plug transplants produced in North Carolina or Nova Scotia, Canada that are not grown organically. The stock plants used in the production of these plug transplants are fumigated with methyl bromide and, the stock plants as well as the plug transplants are sprayed with synthetic pesticides. Presently, there are no wholesale transplant producers in the U.S. or Canada who can supply organically grown strawberry transplants. However, since October 2002, when the USDA National Organic Standards took effect, organic growers who grow strawberries as an annual crop are prohibited from using plugs that have been obtained from stock plants treated with prohibited materials like methyl bromide and other synthetic pesticides.

The main objective of the present work was to develop a system to grow organic strawberry plug transplants using low-cost polyhouse structures, locally available organic plug mixes, and organic fertilizers.

## Materials and Methods

### *Organic Strawberry Plug Transplant Production*

The suitability of various organic plug mixes and fertilizers, and two kinds of polyhouse structures was evaluated for strawberry plug transplant production.

*(i) Treatments.* Three kinds of plug mixes (Organic mix 1, Organic mix 2, and Fafard 3-B; Table 1) and three kinds of fertilizers [Fertrell Super-N 4-2-4 (organic), Bioflora Fish-O-Mega (organic) and a complete nutrient solution (not labelled organic); Table 2] were evaluated for plug transplant production (Table 3). One set of plugs was grown in a low-cost PVC polyhouse constructed at Rosie's Organic farm (Gainesville, Fla.) and, another set of plugs with identical treatments was grown in a commercial polyhouse located at the Horticulture Research Unit, University of Florida (Gainesville, Fla.).

*(ii) Polyhouses.*

(a) Low-cost PVC polyhouse:

The total cost of this 200 ft² polyhouse was approximately $375 (Table 4). The structure was constructed on-site by using PVC pipes (schedule 40), untreated wood, polyethylene

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Table 1. Plug mixes.

| Plug mix | Contents | Price (per 2.8 cu. ft bag) |
|---|---|---|
| FAFARD 3-B | 45% peat moss<br>25% processed bark<br>10% medium grade vermiculite<br>20% horticultural perlite proprietary starter nutrient charge & wetting agent. | $7.25 |
| Organic Mix 1 | 50% untreated peat moss<br>25% coarse perlite<br>25% medium grade vermiculite no starter nutrients, no pH stabilizers, no surfactants. | $4.54 |
| Organic Mix 2 | 50% of ¼" sieved pinebark<br>50% of worm castings no starter nutrients, no pH stabilizers, no surfactants.<br>*Includes price of pinebark only. Worm castings cost $3.81 for a 15 lb bag.<br>Cost of worm castings is not included in the price assuming that it will be produced on-site. | $0.33* |

sheets, bird-netting, weed-barrier cloth, and aluminum grippers (Figs. 1 and 2). This structure can be easily built on the farm by two persons in two days. The dimensions can be changed as needed. PVC pipes generally last for 7-8 years and polyethylene sheets need to be changed after 3-4 years. Since there are no electrical components in this structure, energy input is practically nil and maintenance is very easy and does not need special skills. PVC Polyhouse specifications:

| | |
|---|---|
| Usable space: | 170 ft$^2$ (80 50-cell trays—4,000 transplants) |
| Walkway: | 30 ft$^2$ (3.5 ft × 20 ft) |
| Floor: | Landscape fabric as weed barrier. |
| Base frame: | 20 ft × 10 ft frame made with 4 in × 4 in untreated lumber. |
| Columns: | 1in PVC pipe, 6 ft high at wall and 8 ft high at peak. |
| Column supports: | Rebars (2 ft long) were drilled into the lumber at four corners and along all four sides at 5 ft intervals. |
| Arches and cross members: | ¾ in PVC pipe. |
| Coverings: | Top: Polyethylene sheeting (200 microns) and shade net (50%)<br>Sides: Bird netting attached directly to PVC with aluminium gripper and wiggle wire |

(b) Commercial single-bay polyhouse:

This was a 2940 ft$^2$ single-bay polyhouse with double polyethylene roof which is available commercially and manufactured by Atlas Greenhouse Systems Inc., Alapaha, Ga. The total height of the polyhouse was 12 ft. The air movement inside the polyhouse was facilitated by opening or closing the 4 ft high side-curtains and 3.3 ft high roof-vent, and by operating HAF electric fans.

*(iii) Plug production methodology.* Daughter plants (also called runner-tips) of the cultivar 'Camarosa' were shipped in from Cashiers, N.C. They cost about $85 per 1000. Daughter plants that had 2-3 fully expanded leaves were selected for plug production. The daughter plants were dipped for 30 s in a dilute solution (1:150) of Oxidate™ which is a broad spectrum bactericide/fungicide. On 8 July 2002, the daughter plants were planted in 40-cell-pack trays (2 in diameter × 2.7 in deep, Tray Masters of Florida, Sydney, Fla.) which were filled with three different plug mixes. Before planting, the plug mix in the trays was wetted completely with water. Newly planted daughter plants were protected from direct sunlight by covering them with a 50% shade-net. Mist (10 s mist at 15 min intervals from 7.00 AM to 7.00 PM) was necessary to increase the humidity and prevent the leaves from wilting. The plants were covered with shade-net and the mist was operated for a period of two weeks after planting (Bish et al., 1997). The mist program described above is suitable for hot Florida summers, and the frequency and duration of the mist program should be set according to local climatic conditions. The daughter plants usually root within 3-4 d after planting. Once the roots were well-established (about 12 d after planting) the shade-net was removed and the mist was turned off. The plugs were supplied with the specified fertilizer treatments 14 d after planting. The plugs were grown in two kinds of polyhouses from 26 July to 21 Sept.

*(iv) Biological pest management.* Two-spotted spider mites (*Tetranichus urticae*) and aphids (*Aphis gossypii*) were the two main arthropod pests during transplant production. Approximately 2000 predatory mites (*Neosiulus californicus*, Biotactics Inc., Perris, Calif.) were released for controlling two-spotted spider mites. About 200 ladybug larvae (*Coleomegilla maculata*) and 200 nymphs of the big-eyed bug (*Geocoris punctipes*) (Entomos LLC, Gainesville, Fla.) were released in the strawberry plants for controlling aphids. Chemical pesticides were not used.

Table 2. Fertilizers.

i) Fertrell Super-N (4-2-4):

Incorporated with the plug mix at the rate of 20 lb per cubic yard.
Price = $16 per 50 lb bag.[z]

ii) Bioflora Fish-O-Mega (4-2-2):

Applied as a liquid fertilizer through overhead irrigation (1:20 dilution).
Price = $5.83 per gallon.[y]

iii) Complete Nutrient Solution (Not labelled as organic):

Contains: N: 60 ppm, P: 50 ppm, K: 65 ppm, Ca: 70 ppm, Mg: 40 ppm, S: 56 ppm
Fe: 2.8 ppm, B: 0.6 ppm, Mn: 0.4 ppm, Cu: 0.1 ppm, Zn: 0.2 ppm, Mo: 0.03 ppm in final (diluted) solution.
Price = less than $0.01 per gallon (final dilution).

[z]Fertrell Super-N (4-2-4); Fertrell, Box 265, Bainbridge, PA 17502, www.bioflora.com.
[y]Bioflora Fish-O-Mega (4-2-2); Global Organics LLC, 16121 W. Eddie Albert Way, Goodyear, AZ 85338, www.fertrell.com.

Table 3. Treatments for plug transplant production.

| Trt. No. | Plug mix | Fertilizer program |
|---|---|---|
| 1 | Fafard 3-B | Overhead irrigation with complete nutrient solution (Control) |
| 2 | Organic Mix 1 | Fertrell Super-N (4-2-4) incorporated with plug mix, overhead irrigation with water. |
| 3 | Organic Mix 1 | Fertrell Super-N (4-2-4) incorporated with plug mix, overhead irrigation with Bioflora Fish-O-Mega (4-2-2). |
| 4 | Organic Mix 1 | Overhead irrigation with complete nutrient solution |
| 5 | Organic Mix 1 | Overhead irrigation with Bioflora Fish-O-Mega (4-2-2). |
| 6 | Organic Mix 2 | Fertrell Super-N (4-2-4) incorporated with plug mix, overhead irrigation with water. |
| 7 | Organic Mix 2 | Fertrell Super-N (4-2-4) incorporated with plug mix, overhead irrigation with Bioflora Fish-O-Mega (4-2-2). |
| 8 | Organic Mix 2 | Overhead irrigation with complete nutrient solution |
| 9 | Organic Mix 2 | Overhead irrigation with Fish-O-Mega (4-2-2). |

Note: Ingredients of individual plug mixes and fertilizers are presented in Table 1 and Table 2.
The above mentioned treatments were replicated four times under two types of polyhouses.

*(v) Conditioning plugs for enhancing early fruit production.* Early productivity in strawberry is associated with various factors such as cultivar, transplant type (plugs or bare-root transplants), transplant source (geographical location), and conditioning (chilling) of transplants before planting (Durner and Poling, 1998; Strik and Proctor, 1988). Flowering in most strawberry cultivars is triggered by short day-lengths and cool temperature. However, if plants are exposed to excessive amount of chilling, plants can become vegetative and fruiting may be delayed (Heide, 1976), probably due to a reduction in starch content in the crown and roots (Lieten et al., 1995). Generally, plug transplants are conditioned by subjecting them to cool temperatures ranging from 50 °F to 57 °F along with a shortened photoperiod of 8 to 10 h. Also, temperature and photoperiod interact with each other. At temperatures higher than 59 °F, a photoperiod of 10 h or less is necessary for flowering. At temperatures lower than 59 °F, flowering can occur regardless of the photoperiod (Durner and Poling, 1986). For this project, plug transplants were conditioned by subjecting them to a short photoperiod (9 h day length) and cool temperatures (50 °F night/68 °F day) for three weeks (21 Sept. to 11 Oct.).

*(vi) Data collection.* The percentage of plug transplant survival was calculated by counting the number of plug plants that had survived at the end of the plug production cycle. Plug transplants were visually evaluated for vigor, color, and root growth, and the crown diameter was measured with a Vernier calliper (Manostat, Switzerland).

*Organic Strawberry Fruit Production*

*Transplanting and cultural practices.* Organically grown strawberry plug transplants were planted at an existing organic farm for evaluating their yield potential. One month before planting, chicken manure was incorporated in the field (4 tons/acre). Beds (2.5 ft width, 1.5 ft walkway) were covered with black polyethylene mulch. On 12 Oct. 2002, conditioned strawberry plug plants were transplanted at Rosie's Organic Farm (Gainesville, Fla.) using a tractor-driven transplanter which could punch holes and deliver water to the newly planted plugs simultaneously. Since plug transplants establish very quickly, overhead irrigation was not necessary. After transplanting, strawberry plants were not provided with any additional organic manure or fertilizer until the end of the

Table 4. Cost of PVC polyhouse built at Rosie's Organic Farm (Gainesville, FL).

| Sr. No. | Material | Qty | Rate ($) | Cost ($) |
|---|---|---|---|---|
| 1 | ¾" Sch.40 PVC pipe | 250 ft | 0.21 | 51.75 |
| 2 | ¾" Tees | 20 | 0.26 | 5.20 |
| 3 | ¾" 45 deg | 10 | 0.46 | 4.60 |
| 4 | 1 × ¾" Tees | 10 | 0.54 | 5.40 |
| 5 | 1" Cross | 8 | 2.19 | 17.52 |
| 6 | 1 × ¾" bushing | 10 | 0.34 | 3.40 |
| 7 | 1" Sch.40 PVC pipe | 40 ft | 0.30 | 11.92 |
| 8 | Cement & cleaner for PVC | 1 | 5.00 | 5.00 |
| 9 | Untreated Wood (4" × 4") | 60 ft | 0.85 | 51.00 |
| 10 | Aluminum gripper | 60 ft | 0.80 | 48.00 |
| 11 | Aluminum wiggle wire | 60 ft | 0.25 | 15.00 |
| 12 | ¾" Polypipe | 50 ft | 0.07 | 3.25 |
| 13 | Foggers | 10 | 3.50 | 35.00 |
| 14 | Plastic | 258 sq. ft. | 0.14 | 36.00 |
| 15 | Shadenet (51%) | 258 sq. ft. | 0.10 | 25.80 |
| 16 | Weed barrier | 300 sq. ft. | 0.06 | 18.00 |
| 17 | Wooden Bench | 130 sq. ft. | 0.30 | 39.00 |
| | TOTAL COST (200 sq. ft.) | | | 375.84 |
| | Cost per sq. ft. | | | 1.88 |

Note: Labor = 2 man-days (16 hrs) not included in cost of polyhouse.


Fig. 1. Structural components of low-cost PVC polyhouse.

harvest, and were drip-irrigated with water only on days when there was no precipitation. Small weeds were removed with a wheel-hoe and larger weeds were removed by roto-tiller.

Biological control agents such as predatory mites (*Neosiulus californicus*) were released for controlling two-spotted spider mites. There was a large natural population of big-eyed bugs (*Geocoris punctipes*) and ladybug beetles (*Coleomegilla maculata*) in the field, therefore augmentative releases of these biological control agents were not necessary. Chemical pesticides were not used throughout the season.

*Data collection.* Fruit with 80% red color development were harvested six times from 15 Dec. to 12 Mar. 2002. Fruit weighing more than 0.4 oz which were not deformed or diseased were considered marketable. Fruit weighing less than 0.4 oz or which were deformed or diseased were considered non-marketable. For each plot, number of fruit and fruit weight were recorded for marketable and non-marketable fruit yield and quality. Yield per plant was determined by pooling harvests from individual plants in each plot and dividing by the number of plants (10 plants per plot).

## Results and Discussion

### *Strawberry Plug Transplant Production*

Type of plug mix did not have any substantial effect on the percentage of plant survival at the end of the plug production experiment (Table 5). However, type of fertilizer had a considerable effect on percentage of plant survival, wherein plug plants that were provided with a complete nutrient solution (CNS) had a higher percentage of survival (82.4%) as compared to those provided with Fish-O-Mega (81.7%), Fertrell Super-N (77.5%), or Fertrell Super-N+Fish-O-Mega (72.7%). The quality (vigor, color, root growth, average crown diameter) of plugs produced in Organic Mix 1 and 2 were comparable to those produced in Fafard 3-B (control). However, Organic Mix 2, which contained ¼ in sieved pine bark had to be irrigated more frequently as compared to the other two plug mixes. Either of the two organic plug mixes would be ap-


Fig. 2. Low-cost PVC polyhouse built at Rosie's Organic Farm, Gainesville, FL.

Table 5. Effect of three types of plug mixes and three types of fertilizers on growth of plug transplants grown in two different polyhouse structures in Gainesville, FL during summer 2002.

| | | Plug transplant quality | | | | |
|---|---|---|---|---|---|---|
| Trt. No. | Treatment description | Survival % | Vigor | Color | Root growth | Avg. crown dia. (in) |
| | Plugs produced in low-cost PVC polyhouse | | | | | |
| 1 | Fafard 3-B + Complete nutrient solution (CNS) | 81.0 | 2 | 2 | 1 | 0.31 |
| 2 | Organic Mix 1 + Fertrell (4-2-4) | 76.7 | 2 | 3 | 1 | 0.30 |
| 3 | Organic Mix 1 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 72.4 | 1 | 1* | 1 | 0.32 |
| 4 | Organic Mix 1 + Complete nutrient solution (CNS) | 81.7 | 2 | 3 | 1 | 0.28 |
| 5 | Organic Mix 1 + Fish-O-Mega (4-2-2) | 78.3 | 1 | 1 | 1 | 0.33 |
| 6 | Organic Mix 2+ Fertrell (4-2-4) | 76.7 | 2 | 2 | 1 | 0.27 |
| 7 | Organic Mix 2 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 74.5 | 1 | 1* | 2 | 0.26 |
| 8 | Organic Mix 2 + Complete nutrient solution (CNS) | 83.3 | 1 | 2 | 2 | 0.27 |
| 9 | Organic Mix 2 + Fish-O-Mega (4-2-2) | 83.3 | 2 | 1 | 2 | 0.26 |
| | Plugs produced in commercial polyhouse | | | | | |
| 10 | Fafard 3-B + Complete nutrient solution (CNS) | 85.0 | 2 | 2 | 1 | 0.26 |
| 11 | Organic Mix 1 + Fertrell (4-2-4) | 73.3 | 1 | 2 | 1 | 0.26 |
| 12 | Organic Mix 1 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 74.0 | 1 | 1* | 1 | 0.27 |
| 13 | Organic Mix 1 + Complete nutrient solution (CNS) | 80.0 | 1 | 2 | 1 | 0.26 |
| 14 | Organic Mix 1 + Fish-O-Mega (4-2-2) | 83.3 | 2 | 1 | 1 | 0.25 |
| 15 | Organic Mix 2+ Fertrell (4-2-4) | 83.3 | 2 | 3 | 1 | 0.25 |
| 16 | Organic Mix 2 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 70.0 | 3 | 1* | 2 | 0.25 |
| 17 | Organic Mix 2 + Complete nutrient solution (CNS) | 83.3 | 2 | 2 | 2 | 0.25 |
| 18 | Organic Mix 2 + Fish-O-Mega (4-2-2) | 81.7 | 3 | 1 | 2 | 0.26 |

*Leaf scorching was observed.
Rating scale for plug transplants:

| Vigor & Root Growth: | Color of leaves: |
|---|---|
| 1 Excellent | 1 Dark green |
| 2 Good | 2 Light green |
| 3 Fair | 3 Very light green |
| 4 Not good | 4 Yellow |

propriate for plug production provided care is taken to irrigate the plug mix containing pine bark more frequently. Fertrell Super-N, Fish-O-Mega, or CNS when used alone produced healthy transplants but the combined use of Fertrell Super-N and Fish-O-Mega caused 'leaf burn' symptoms. Therefore, when used in combination, the concentrations of Fertrell Super-N and Fish-O-Mega may need to be reduced in order to avoid leaf burn. The average crown diameter of plug transplants ranged between 0.25 in to 0.33 in, which was approximately 0.08-0.16 in smaller compared to commercially available plug transplants. Since there were no apparent differences in the quality of transplants produced in the two types of polyhouses, a low-cost PVC polyhouses could provide an economical alternative for plug production on a small-scale.

### *Organic Strawberry Fruit Production*

Strawberry plug transplants were planted at Rosie's Organic Farm (Gainesville, Fla.) and fruit were harvested six times from 12 Oct. to 12 Mar. The fall 2002 season (1 Oct. 2002 to 31 Mar. 2003) witnessed heavy rainfall with 52 rain days and a total precipitation of 28.5 inches, which was more than twice the amount of rain during 2001-02 and 2003-04 seasons (Fig. 3). The heavy rain was also accompanied by a severe Florida winter with a total of 562 h below 40 °F as compared to 383 h in 2001-02 and only 74 h in 2003-04 (Fig. 4). Strawberry plants were covered with a polyethylene sheet when temperatures dropped below 32 °F on 40 occasions during the entire season. The heavy rainfall and prolonged low temperatures during fall 2002-03 were highly conducive for the proliferation of anthracnose fruit rot caused by *Colletotrichum acutatum.*

'Camarosa' is known to be highly susceptible to anthracnose fruit rot, and in conventional strawberry production,

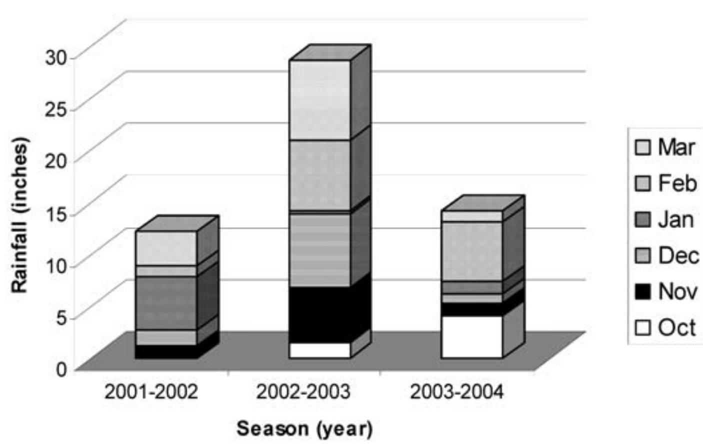


Fig. 3. Monthly rainfall in Alachua County (Florida Automated Weather Network).

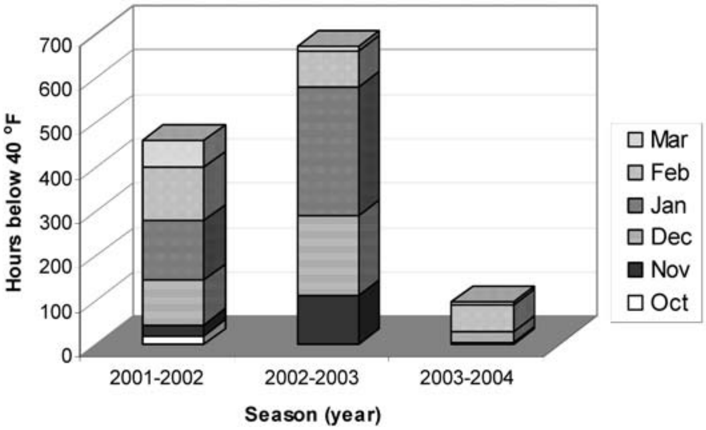


Fig. 4. Hours below 40 °F in Alachua County (Florida Automated Weather Network).

this disease can be controlled by spraying Quadris® (azoxystrobin). However, in the present experiment, the plants were not sprayed with any chemical. The unusually wet winter during fall 2002-03, which favored anthracnose fruit rot, and the high susceptibility of 'Camarosa' to this disease resulted in a severe reduction in fruit yield. Marketable fruit yield ranged between 0.9 oz to 2.4 oz per plant, and non-marketable fruit yield ranged between 3.9 oz to 5 oz per plant (Table 6). For all treatments, non-marketable yields were greater than marketable yields due to a severe outbreak of anthracnose fruit rot disease. Therefore, selecting a cultivar that is resistant to anthracnose fruit rot will be necessary for organic strawberry cultivation in Florida.

'Sweet Charlie' is one such cultivar which is known to be resistant to anthracnose fruit rot. Although this Florida cultivar was once widely grown throughout the state, it has lost its importance due to its soft fruit which makes it difficult for shipping over long distances. However, since most organically grown strawberries are sold locally at farmers markets, the short shelf life of 'Sweet Charlie' should not pose any problem and it could be an ideal cultivar for organic production. Observations from strawberry plots at Rosie's organic farm during the fall 2003-04 season indicated that 'Strawberry Festival' also seems to be well suited for organic production under Florida conditions. Although this cultivar has firm fruit, it is known to be moderately susceptible to anthracnose fruit rot. Regardless of the cultivar used, disinfection of the runner tips prior to plug production by dipping in dilute solutions of Oxidate® or Chlorox® bleach may help reduce the incidence of this disease, and may ultimately result in improved yields.

Daughter plants used in this study were not produced from organically grown stock plants since they were not available at the time. To produce organic plugs, the stock plants need to be grown organically for one year if strawberries are grown as a perennial crop. Producers could grow their own stock plants organically and harvest about 8-10 daughter plants from each stock plant. Stock plants can produce 5-6 runners, each bearing multiple daughter plants. Usually, the first two daughter plants on each runner are used for making plug transplants. On the other hand, if the grower can document to the satisfaction of a USDA accredited certifying agency that organic strawberry daughter plants are not commercially available, then non-organic transplants, including those treated post-harvest with prohibited substances may be allowed. For more details, please refer to the final recommendations of the National Organic Standards Board.

Table 6. Marketable and non-marketable fruit yield from organically grown 'Camarosa' strawberry plants. (Gainesville, FL - Fall 2002-03).

| | | Marketable yield[z] | | | Non-marketable yield[y] | | |
|---|---|---|---|---|---|---|---|
| Trt. No. | Treatment description | No. of fruit (no./plant$^{-1}$) | Fruit yield (oz/plant$^{-1}$) | Avg. fruit wt. (oz/fruit$^{-1}$) | No. of fruit (no./plant$^{-1}$) | Fruit yield (oz/plant$^{-1}$) | Avg. fruit wt. (oz/fruit$^{-1}$) |
| | Plugs produced in low-cost PVC polyhouse | | | | | | |
| 1 | Fafard 3-B + Complete nutrient solution (CNS) | 2.7 | 1.5 | 0.55 | 9.6 | 4.1 | 0.43 |
| 2 | Organic Mix 1 + Fertrell (4-2-4) | 3.4 | 1.9 | 0.57 | 12.3 | 5.0 | 0.41 |
| 3 | Organic Mix 1 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 4.2 | 2.3 | 0.54 | 10.1 | 3.5 | 0.35 |
| 4 | Organic Mix 1 + Complete nutrient solution (CNS) | 3.8 | 2.2 | 0.58 | 11.6 | 4.6 | 0.40 |
| 5 | Organic Mix 1 + Fish-O-Mega (4-2-2) | 2.8 | 1.6 | 0.57 | 10.7 | 5.0 | 0.46 |
| 6 | Organic Mix 2+ Fertrell (4-2-4) | 2.7 | 1.2 | 0.46 | 10.5 | 4.4 | 0.42 |
| 7 | Organic Mix 2 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 2.5 | 1.7 | 0.68 | 10.3 | 4.1 | 0.40 |
| 8 | Organic Mix 2 + Complete nutrient solution (CNS) | 3.6 | 2.0 | 0.57 | 11.1 | 4.7 | 0.43 |
| 9 | Organic Mix 2 + Fish-O-Mega (4-2-2) | 3.4 | 2.4 | 0.70 | 10.7 | 4.3 | 0.40 |
| | Plugs produced in commercial polyhouse | | | | | | |
| 10 | Fafard 3-B + Complete nutrient solution (CNS) | 2.7 | 1.6 | 0.58 | 10.7 | 4.0 | 0.37 |
| 11 | Organic Mix 1 + Fertrell (4-2-4) | 3.1 | 1.7 | 0.56 | 10.4 | 3.9 | 0.38 |
| 12 | Organic Mix 1 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 3.2 | 2.3 | 0.73 | 9.6 | 4.0 | 0.42 |
| 13 | Organic Mix 1 + Complete nutrient solution (CNS) | 2.3 | 1.7 | 0.75 | 10.3 | 4.3 | 0.43 |
| 14 | Organic Mix 1 + Fish-O-Mega (4-2-2) | 3.2 | 1.9 | 0.60 | 10.8 | 4.5 | 0.42 |
| 15 | Organic Mix 2+ Fertrell (4-2-4) | 1.8 | 1.2 | 0.67 | 9.7 | 4.0 | 0.42 |
| 16 | Organic Mix 2 + Fertrell (4-2-4) + Fish-O-Mega (4-2-2) | 1.5 | 0.8 | 0.57 | 10.8 | 4.4 | 0.41 |
| 17 | Organic Mix 2 + Complete nutrient solution (CNS) | 2.6 | 2.0 | 0.79 | 7.8 | 4.1 | 0.53 |
| 18 | Organic Mix 2 + Fish-O-Mega (4-2-2) | 3.8 | 2.0 | 0.54 | 10.1 | 4.7 | 0.47 |

[z]Fruit weighing more than 0.35 oz, not diseased or deformed.
[y]Fruit showing symptoms of anthracnose fruit rot or weighing less than 0.35 oz.
Note: Figures presented are average values from four replications of 10 plants each.

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