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PLANTLET SIZE AFFECTS GROWTH AND DEVELOPMENT OF STRAWBERRY PLUG TRANSPLANTS

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Abstract. **An experiment was conducted to determine what effect plantlet size has on the growth and development of strawberry (*Fragaria* ×*ananassa* Duch.) plug transplants. 'Sweet Charlie' plantlets from 2 and 4 mm diameter stolons, and with zero, one, or two fully expanded leaves, were selected and grouped into a factorial set of treatments. These plantlets were first rooted in 18.8 cm^3 cells and then moved to 110 cm^3 cells. After a growth period of 6 weeks, the plants were placed in a growth chamber for 2 weeks under conditions conducive to flower bud initiation. The plants were then transplanted into a greenhouse hydroponic gutter system. Root, crown, and flower data suggest that two-leaf plantlets can produce field-ready transplants quicker than zero or one-leaf plantlets, and that plantlets from large diameter stolons should be used to produce early fruiting transplants.**

Commercial strawberry cultivars are vegetatively propagated because their seeds are not true to type. The standard strawberry transplant used in Florida and other major winter production areas of the world is produced by planting a field nursery in the spring. The nursery plants produce daughter plants on stolons in response to long daylengths and high temperatures. In the early fall the daughter plants are dug, soil is removed from the roots, and the plants are held in cold

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storage until they are planted in a fruit production field. This type of transplant often varies in size, and is prone to being damaged during the digging process. An alternative production system has been developed that uses strawberry mother plants in elevated horizontal gutters to produce daughter plantlets on hanging stolons (Bish et al., 2001). Strings of plantlets are removed from the mother plants and the plantlets are separated from each other before being rooted in transplant trays (under intermittent mist) and grown as containerized transplants.

Containerized transplants are not subject to digging damage. However, variability in plant size can occur. This variability has important implications for early season fruit yield. Albregts (1968) and Hochmuth et al. (2001) both found that large-crowned transplants produced higher early season yield than small-crowned transplants. The objective of the research described in this paper was to determine the influence of plantlet size on the growth and development of plug transplants.

Materials and Methods

'Sweet Charlie' micropropagated plants (from Nourse Farms, Inc., South Deerfield, Mass.) were planted in a horizontal gutter system that was developed at the University of Florida for strawberry plantlet production (Bish et al., 2001). The system was constructed in a glass greenhouse at the University of Florida, Gainesville, Fla. Air temperature within the greenhouse was maintained at 32 °C day/25 °C night. Shade cloth (30% shade) was used to give a light intensity of 700 $\mu mol \cdot m^{-2} \cdot s^{-1}$ during full sun. The photoperiod was extended to 16 h with high-pressure sodium halide lamps (150 $\mu mol \cdot m^{-2} \cdot s^{-1}$).

On 28 Mar. 1997 plantlets from 2 and 4 mm diameter stolons, and with zero, one, or two fully expanded leaves, were selected and grouped into a factorial set of treatments. Three replications of 20 plantlets each were used per treatment. Plantlets were rooted under mist irrigation (12 s of mist every 6 min) for 1 week in 18.8 cm^3 cell trays (Speedling Todd 100 flats; Speedling, Inc., Sun City, Fla.). The rooting medium consisted of a 4:1 (v/v) vermiculite:perlite mix (Verlite Co., Tampa, Fla.; Airlite Processing Corp., Vero Beach, Fla.). After the plantlets had been in the 18.8 cm^3 cell trays for 2 weeks, they were transplanted into 110 cm^3 cell trays.

The trays were placed on a capillary mat that was covered with perforated (5000 holes$\cdot m^{-2}$) black plastic (0.05 mm) (Vatex F/M, OS Plastics, Inc., Norcross, Ga.). Two drip irrigation tubes (30.5 cm emitter spacing with 62 $mL \cdot min^{-1} \cdot emitter^{-1}$ at 55×10^3 pa; Netafim; Orlando, Fla.) were placed underneath the capillary mat and above a white on black plastic film (.03 mm thickness) on greenhouse benches. Plants were fertigated for 10 min, three times a day (Bish et al., 2001).

After 6 weeks in the greenhouse, the transplants were placed into growth chambers (one chamber for each replication) under conditions conducive to flower bud initiation. These conditions consisted of a 25 °C day/15 °C night temperature regime, 80% relative humidity, and a 12-h photoperiod (supplied with sixteen, 160-watt fluorescent bulbs and eight, 54-watt incandescent bulbs (410 $\mu mol \cdot m^{-2} \cdot s^{-1}$). After 2 weeks in the growth chambers, the transplants were returned to the greenhouse and planted into white plastic gutters (10 cm width by 10 cm depth).

The following dependent variables were measured: root dry weight at 0, 1, and 2 weeks (after initiation of the experiment on 28 Mar.); crown diameter at 0 and 8 weeks; and flower number at 12 weeks. Dry weights were obtained after roots were dried at 70 °C for 72 h in a forced-air oven. Data were analyzed by analysis of variance.

Results and Discussion

Leaf number, but not stolon diameter, significantly affected root dry weight (Table 1). Two-leaf plantlets had greater root dry weight at 0, 1, and 2 weeks than one-leaf plantlets, and one-leaf plantlets had greater root dry weight at these sampling times than zero-leaf plantlets. The roots of one- and two-leaf plantlets had lower growth rates than the roots of zero-leaf plantlets during the second week (Table 1). This can be explained by the fact that once the container volume is filled with roots, further root growth is inhibited. These results suggest that two-leaf plantlets can produce field-ready transplants quicker than zero or one-leaf plantlets.

There was a significant interaction of stolon size and leaf number on initial crown diameter (Table 2). Plantlets from 4-mm diameter stolons had larger initial crown diameters than plantlets from 2-mm diameter stolons. And two-leaf plantlets had larger crown diameters than one- or zero-leaf plantlets, but the effect of leaf number was more pronounced in plantlets from 4-mm diameter stolons than in plantlets from 2-mm diameter stolons. Crown diameter after 8 weeks was greater among plantlets from 4-mm diameter stolons than from 2-mm diameter stolons, but was not affected by leaf number (Table 3).

Table 1. Strawberry root dry weight as influenced by plantlet leaf number and stolon diameter.[z]

	Root dry weight			Root growth	
No. of expanded leaves	0 week	1 week	2 week	0-1 week	1-2 weeks
		(mg)		(mg dry weight)	
0	1.1 c[y]	30.0 c	63.5 c	28.9 c	33.5 a
1	5.5 b	57.9 b	67.1 b	52.4 a	9.2 b
2	23.0 a	67.0 a	72.9 a	44.0 b	5.9 b
ANOVA *P* values					
Leaf no. (L)	0.0001	0.0001	0.0001	0.0001	0.0001
Stolon diameter (S)	0.8040	0.5263	0.2704	0.8329	0.2273
L × S	0.9624	0.0848	0.8925	0.1748	0.1843

[z]Only values for significant main effects are presented.
[y]Mean separation within columns by LSD at $P \leq 0.05$.

Table 2. Strawberry crown diameter (0 weeks) as influenced by stolon diameter and plantlet leaf number.[z]

Stolon diam (mm)	No. of expanded leaves	Crown diam (mm)
2	0	2.1 f[y]
	1	2.7 e
	2	3.1 d
4	0	5.1 c
	1	6.1 b
	2	8.1 a
ANOVA *P* values		
Stolon diameter (S)		0.0001
Leaf no. (L)		0.0001
S × L		0.0001

[z]Only values for significant main effects are presented.
[y]Mean separation within columns by LSD at $P \leq 0.05$.

Table 3. Strawberry crown diameter (8 weeks) and flower number as influenced by stolon diameter and plantlet leaf number.[z]

Stolon diam (mm)	Crown diam (mm)	No. of flowers
2	5.9 b[y]	1.3 b
4	10.3 a	8.0 a
ANOVA *P* value		
Stolon diameter (S)	0.0001	0.0001
Leaf no. (L)	0.1402	0.5305
S × L	0.3603	0.9314

[z]Only values for significant main effects are presented.
[y]Mean separation within columns by LSD at $P \leq 0.05$.

Flower number was also affected by stolon diameter but not leaf number (Table 3). Plantlets from 4-mm diameter stolons produced significantly more flowers than plantlets from 2-mm diameter stolons. These results suggest that plantlets from large diameter stolons should be used to produce early fruiting daughter plants.

Transplant performance needs to be evaluated under commercial field and greenhouse or plastic tunnel conditions, but it appears that high quality plugs, with well developed root systems and high early season flowering potential, can be produced by careful selection of plantlets.

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