Transplant large liners to shorten crop time

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Increasing fuel cost has focused attention on improved production efficiency. For growers of finished plants, one option is to purchase larger or pre-finished liners and seedling plugs for transplant into pots and baskets. The benefit of a large or pre-finished liner is shorter time after transplant.

Liners finish quickly after transplant when they already have a large shoot and root size, are developmentally mature (grown for more weeks during the liner stage), and when early flowering of long day crops such as petunia or calibrachoa has been initiated using supplemental or daylength (photoperiod) lighting.

Rapid finishing time improves space use efficiency by allowing an additional crop turn (and extra revenue). Alternatively, heat savings result from transplanting later and opening up greenhouses during the warm months of spring. Our research aimed to measure how much time would be saved for finished plant production when transplanting large or small liners.

Research Methods

Calibrachoa 'Superbells Red' unrooted cuttings provided by InnovaPlant Costa Rica were stuck on Feb 2 2006 into Ellepot^{TM} liner cells ranging from 20 to 80 mm in diameter (144 to 10-count trays). Throughout the liner and finished plant stages, calibrachoa were grown at 72^{o}F day/67^{o}F night air temperature. Photoperiod was 16h, and 9.4 moles of PAR light per square meter per day was provided from combined sunlight and supplemental lighting from high-pressure sodium lamps at 575 foot candles in a glass greenhouse at the University of New Hampshire, Durham N.H. Liners were sprayed with Sumagic at 5 ppm three and five weeks after transplant (Feb 23 and Mar 6).

When liners were 4, 6, or 8 weeks old (Mar 2, Mar 16, or Mar 30), we transplanted these cuttings into 4.5-inch pots or 12-in hanging baskets, continuing with the same climate settings. One liner was transplanted per 4.5-in pot, using 20 to 50 mm diameter (144 to 32-count) liners. Each 12-inch hanging baskets contained 5 liners, using 20 to 80 mm (144 to 10-count) liners.

We then measured how long it took to produce a "finished" 4.5-inch pot, defined as having at least five open blooms and foliage covering at least 90% of the media surface. A "finished" 12-inch basket had at least eight stems overlapping by more than 8-in (20-cm) from the edge of the pot, and at least 50 open blooms.

Results

All liners, regardless of size, finished in 4.5-in pots about the same if they are planted early (4 weeks old), because the root zone in the liner cell was not limiting to growth. When liners were planted on Mar 2, 4 weeks after planting, the finish date in 4.5-in pots (Table 1) was similar across liner sizes.

Table 1. Effect of liner size and age on finished time in 4.5-inch pots. All unrooted cuttings were stuck into liners on the same day (Feb 2), and then were transplanted on three dates (Mar 2, Mar 16, or Mar 30). The colored cells ( ) indicate normal "transplantable" crop age for different liner sizes (4 weeks for 20 to 23-mm liners, at least 6 weeks for 25 to 40-mm liners, and at least 7 weeks for 50-mm liners).

Finish Date

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**7-Apr**	15-Apr	24-Apr
23mm (125-count)	**5-Apr**	13-Apr	23-Apr
25mm (105-count)	6-Apr	**10-Apr**	30-Apr
30mm (72-count)	5-Apr	**5-Apr**	23-Apr
40mm (50-count)	5-Apr	**4-Apr**	11-Apr
50mm (32-count)	4-Apr	3-Apr	**10-Apr**

Days from Transplanting Rooted Liner to Finished 4.5-inch Pot

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**36**	31	25
23mm (125-count)	**34**	29	25
25mm (105-count)	35	**26**	32
30mm (72-count)	35	**20**	24
40mm (50-count)	34	**19**	12
50mm (32-count)	33	18	**11**

Days from Sticking Unrooted Cutting (Feb 2) to Finished 4.5-inch Pot

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**64**	73	81
23mm (125-count)	**62**	71	81
25mm (105-count)	63	**68**	88
30mm (72-count)	63	**62**	80
40mm (50-count)	62	**61**	68
50mm (32-count)	61	60	**67**

At 6 to 8 weeks old, plants in large liners finished up to 2 weeks earlier than small liners because of root zone restrictions in small liners. When liners were transplanted at 6 or 8 weeks of age, the finish date in 4.5-in pots occurred earlier as liner size increased (Table 1). By 6 to 8 weeks of liner age, root growth in a 20 to 25 mm liner limited shoot growth during the liner stage. Small liners also dry down more quickly than large liners, resulting in air-pruning of roots. In contrast, cuttings grown in large cells have more area for root growth, and are usually grown for 6-8 weeks so that roots, shoots, and flower buds are well developed at time of transplant.

The results demonstrate that it would be better to hold plants in large liners compared with small liners to avoid root-bound liners with delayed finishing. If producing your own large liners, it also

means excessive shoot growth could be a problem during liner production, and growth retardants or other height control methods are needed.

Table 2. Effect of liner size and age on finished time in 12-inch baskets. All unrooted cuttings were stuck into liners on the same day (Feb 2), and then were transplanted on three dates (Mar 2, Mar 16, or Mar 30). The colored cells ( ) indicate normal "transplantable" crop age for different liner sizes (4 weeks for 20 to 23-mm liners, at least 6 weeks for 25 to 40-mm liners, and at least 7 weeks for 50-mm liners).

Finish Date

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**17-Apr**	27-Apr	7-May
23mm (125-count)	**13-Apr**	28-Apr	6-May
25mm (105-count)	15-Apr	**29-Apr**	9-May
30mm (72-count)	12-Apr	**24-Apr**	3-May
40mm (50-count)	12-Apr	**16-Apr**	29-Apr
50mm (32-count)	12-Apr	15-Apr	**19-Apr**
70mm (18-count)	12-Apr	12-Apr	**15-Apr**
80mm (10-count)	12-Apr	9-Apr	**15-Apr**

Days from Transplanting Rooted Liner to Finished Basket

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**46**	42	38
23mm (125-count)	**42**	44	37
25mm (105-count)	44	**44**	40
30mm (72-count)	42	**39**	35
40mm (50-count)	41	**32**	30
50mm (32-count)	41	31	**20**
70mm (18-count)	41	27	**16**
80mm (10-count)	41	24	**16**

Days from Sticking Unrooted Cutting (Feb 2) to Finished Basket

Liner Size	Transplant Date		
	2-Mar	16-Mar	30-Mar
20mm (144-count)	**74**	**84**	**94**
23mm (125-count)	**70**	**86**	**93**
25mm (105-count)	**72**	**86**	**96**
30mm (72-count)	**70**	**81**	**91**
40mm (50-count)	**69**	**74**	**86**
50mm (32-count)	**69**	**73**	**76**
70mm (18-count)	**69**	**69**	**72**
80mm (10-count)	**69**	**66**	**72**

Large (30 to 50 mm) liners that were 6 weeks old, transplanted into 4.5-in pots on Mar 16, finished around the same date as 4-week-old small (20 to 25-mm) liners planted two weeks earlier on Mar 2.

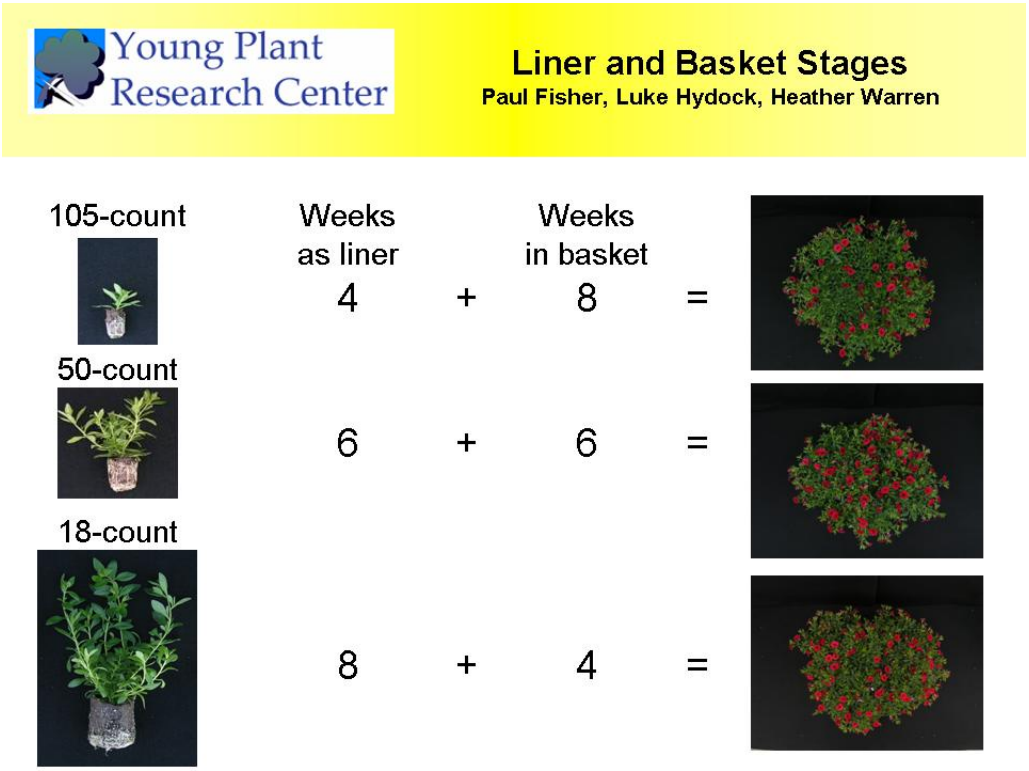
*The shortest finish time from **transplant** to finished pot (11-12 days) occurred with 40 to50-mm liners planted at 8 weeks of age (Table 1).* The minimum time from **sticking** to finished pot occurred with any liner size planted at 4 weeks, or with 30 to 50-mm liners planted at 6 weeks.

We saw similar trends with 12-in hanging baskets (Table 2) compared with our results with 4.5-in pots. *The same finished date in a hanging basket could be achieved with any liner size planted early (4 weeks old) or using a large liner planted late (6-8 weeks old).* For example, an 8-week-old 50-mm liner finished in the pot by 19-April, 20 days after transplant (Table 2). In contrast a 6-week-old 25-mm liner finished in the pot by 15-April, 44 days after transplant.

In Conclusion

Similar final finished quality could be achieved in different ways (Figure 1), using either a small liner that requires more time in the finished container, or by using a large liner that finishes rapidly. Time in the large container can be substituted with extra time in the liner stage, especially if large liners are used that do not excessively limit shoot growth. The most efficient use of space occurs by transplanting a large, pre-finished liner at 6-8 weeks of age, because there is low space requirement per cutting during the liner stage.

Figure 1. Three ways to achieve a total crop time of 12 weeks from sticking unrooted cuttings to producing a finished 12-in hanging basket (5 liners/basket). The photos of hanging baskets at right was taken 12 weeks after sticking unrooted cuttings. The three liner sizes [25-mm (105-count), 40-mm (50-count), and 70-mm (18-count)] are shown at left, at the stage when they were transplanted into hanging baskets.



In next month's Greenhouse Grower, we follow up this research with a financial analysis of the economic costs and benefits of large and small liners.

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