Economics of direct transplant versus liners, and unrooted versus callused cuttings

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Growers are looking for new ways to save on labor and production costs. With options including direct sticking (transplant), callused cuttings, unrooted cuttings (URCs), and liners of different sizes, the decision on the most profitable starting plant material to use in different situations can be a challenge.

At the University of Florida, we are running production trials and developing costing models to compare URCs, callused cuttings, or liners. In the last article, we presented results from experiments run over two years:

(1) **To produce a rooted liner (Figure 1)** from a callus cutting reduced production time by an average of 1 week compared with a URC, and reduced shrinkage from an average of 1% to 5%.
(2) **To produce a finished flowering pot (Figure 2)** direct transplant of a URC into the final container had too high of a shrinkage rate and production time. Direct transplant of callused cuttings required an average of 29 days more than transplanting a rooted liner to produce a shippable flowering container, with 0% compared with 1 % shrinkage.

In this article, we discuss how to calculate the economic effect of these options on cost and profitability.

Figure 1: A rooted liner can be produced from callused or unrooted cuttings (URC).

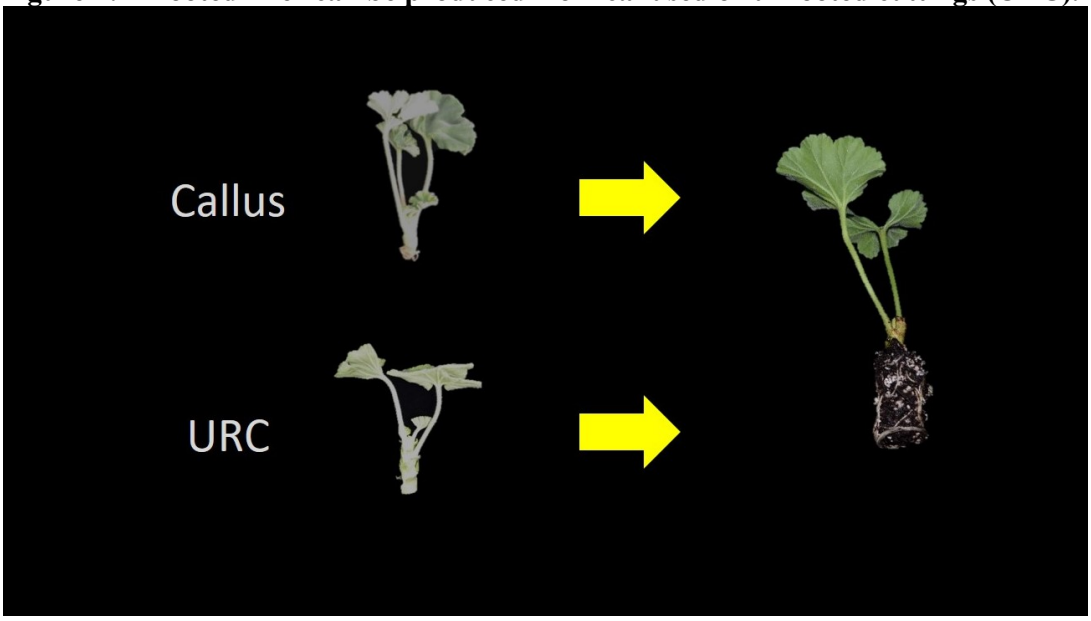
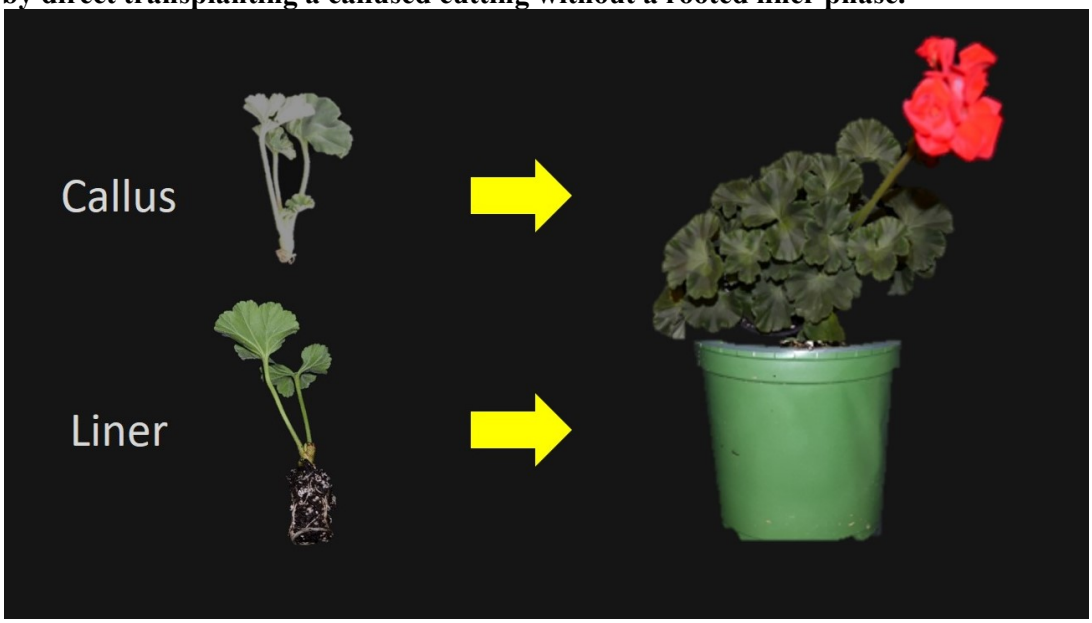


Figure 2: Finished plant material can be grown by transplanting a rooted liner, or by direct transplanting a callused cutting without a rooted liner phase.



(1) Producing a rooted liner from a callused or unrooted cutting

When deciding whether to produce a rooted liner tray from callused versus unrooted cuttings, three variables help when making the decision of which plant material to choose:

1. The increased cost of callused cuttings vs URCs.
2. The number of days to obtain a rooted liner. The longer the days, the higher the space utilization. If square foot week (sfw) is used to allocate overhead, this cost will be increased.
3. Reduction in shrinkage (crop losses). Shrinkage will impact direct costs related to transplanting such as cost per cutting, container, growing media and labor to transplant.

Taking these considerations into account, in order to break-even the extra cost of the callused cutting has to be covered by the reduction in shrinkage and/or the reduction in propagation time. To obtain an accurate estimate, it is necessary to calculate a detailed enterprise budget for the varieties we want to analyze.

Table 1 shows a simplified budget for producing a tray of rooted liners. Values for production time and shrinkage are based on the average of 16 crops of 4 species (bracteantha, osteospermum, scaevola, and zonal geranium) grown over two years. In this example, the callused cuttings are assumed to cost $0.10 more than URC on average, and callused cuttings finish one week earlier than URC and have 3.9% less shrinkage. As with any budget, the results completely depend on the assumptions but the analysis is intended to provide a framework for your own calculations.

Table 1. Cost and benefit analysis to produce a rooted liner when using callused or unrooted cuttings assuming a difference in shrinkage of 3.9% and a saving in time of one week, with a $0.10 higher cost for the callused cutting compared with a URC.

Crop name	URC	Callused cutting	Difference callused minus URC	Notes
Container width (inches)	11	11		
Container length (inches)	22	22		
Container area (square feet)	1.7	1.7		
Plants per container	102	102		
Cost per cutting	***$0.34***	***$0.44***	***$0.10***	Average cutting cost for plants supplied in our trials
Cost of cuttings (per container)	$34.68	$44.88	$10.20	
Weeks to produce a rooted liner	***5.0***	***4.0***	***-1.0***	Average difference in time with callused in our trials
Total area-time (square foot weeks)	8.4	6.7	-1.7	Production time x area per container
Overhead cost per square foot week	$0.60	$0.60		Varies by business
Overhead cost (per container)	$5.04	$4.03	-$1.01	Reduction in overhead because of shorter production time with callused versus URC
Other direct costs per container (container, growing media and labor to transplant)	$3.98	$3.98		Costs obtained from grower interviews
Total costs before shrinkage (Overhead + other direct costs + cuttings)	$43.70	$52.89		
Shrinkage (S, in %)	***4.54%***	***0.67%***	***-3.87%***	Average shrinkage with callused versus URC in our trials
Additional cost of shrinkage	$2.08	$0.36	-$1.72	Cost of shrinkage = S/(100%-S)*production cost
Total cost after shrinkage (per container)	$45.78	$53.25	$7.47	
Sales price per rooted liner	$0.57	$0.57		Prices obtained from grower interview
Sales price (per container)	$58.14	$58.14		
Net revenue (per container)	***$12.36***	***$4.89***	***-$7.47***	
Net revenue per square foot week	$1.47	$0.73		

With this set of assumptions:

- The higher cost for callused cuttings increases the total plant material cost by $10.20 per 102-count tray.
- The shorter production time by one week reduces the overhead cost by $1.01 assuming the overhead cost per square foot week is $0.60.
- The 3.9% less shrinkage from callused cuttings saves $1.72 in cost.
- Overall, the net revenue was higher with URC compared with callused cuttings by $7.47 per tray.
- The net revenue per unit of space and time (square foot week) was also highest with URC which is important during the peak production season when the goal is to generate revenue in a way that is very efficient in space and time use.

Producing a rooted liner tray from URC would be more profitable with this set of values. However, using a callused cutting would be favored if:

- Shrinkage with URC is higher. For example, if shrinkage was 18% then the cost would break even using callused cuttings at $0.10 extra.
- With a lower cost per callused cutting compared with URC. Varying only price in Table 1, callused cuttings would need to only cost $0.03 more than URC to break even.
- The production time is much shorter with callused cuttings. Production time would need to be very short – only 2 weeks – for callused cuttings to break even.

(2). To produce a finished flowering pot from a rooted liner or a callused cutting

To produce a finished flowering plant, we need to consider higher shrinkage and longer production time when using a callused cutting but a lower plant material cost compared with rooted liners. The average values from our trials are summarized in Table 2. With these assumptions:

- Callused cuttings were $0.13 less expensive than rooted liners.
- The longer production time by three weeks increased the overhead cost by $0.45.
- The 0.5% higher shrinkage from callused cuttings increased cost by only $0.01. Shrinkage was low for both plant types, however at a commercial scale there is probably less risk of quality issues from rooted liners than callused cuttings because rooted liners have developed passed the sensitive initial rooting phase.
- Overall, the net revenue was higher with rooted liner compared with callused cuttings by $0.33 per pot.
- The net revenue per unit of space and time (square foot week) was also highest with rooted liner.

Producing a finished flowering pot from a rooted liner would be more profitable with this set of values. However, using a callused cutting would be favored if:

- There was a high price difference – rooted cuttings were much higher than a callused cutting.

- The callused cuttings required only 1 more week of production time compared with the rooted liner.
- The overhead cost per square foot week is very low. This may be the case during the off-season when space and time are not limiting. In that situation, the low direct cost of a callused cutting means the gross margin (sales minus direct costs) favors a callused cutting. This is the situation in the summer when many growers directly transplant poinsettia or chrysanthemum cuttings into the finished pot rather than using more expensive rooted liner starting plants.

CONCLUSIONS

Overall, we conclude that the main situation where it is profitable to use a callused cutting to produce a rooted liner tray is when there is high shrinkage from URCs. Some plant varieties do not ship well from the cutting supplier to the propagation greenhouse. For a plant variety that has low rooting percentage, it could be more efficient for the offshore supplier to grade out weaker cuttings that do not produce callus and thereby increase rooting percentage at the propagation greenhouse. If the propagation greenhouse has limited mist space, liner trays with callused cuttings could be more quickly moved to a lower-cost finishing zone than URCs.

For producing flowering potted plants, it depends on the season and grower objectives when deciding between callused cuttings and rooted liners. During the peak season when short crop times is critical to maximize return per square foot week, rooted liners will often be favored. In the off-peak period when space and time are not limiting, the lower material price of callused cuttings is favored.

An important analysis we have not included here is the comparison between direct transplant of callused cuttings versus starting your own rooted liners from URCs and then transplanting into the finished pot. Direct transplant can reduce labor and material costs by eliminating the rooted liner step. However, you need to carefully budget out the costs of both liner and finished plant steps, and carefully cost out processes such as transplanting, grading, and transporting.

The example budgets presented are only one set of assumptions intended to illustrate the factors that should be considered when choosing your starting plant material. We encourage you to run your own analysis. For more information and training, we recommend our Costing and Profitability course available at hort.ifas.ufl.edu/training.

ACKNOWLEDGEMENTS

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Table 2. Cost and benefit analysis to produce a finished 4-in container when using rooted liners or callused cuttings assuming a difference in shrinkage of 0.5%, 3 weeks longer production time, and $0.13 lower cost for the callused cutting compared with a rooted liner.

Crop name	Rooted liner	Callused cutting	Difference callused minus rooted liner	Notes
Container width (inches)	6	6		
Container length (inches)	6	6		
Container area (square feet)	0.25	0.25		
Plants per container	1	1		
Cost per cutting	***$0.57***	***$0.44***	***-$0.13***	Average callused cutting cost for plants supplied in our trials, and example liner cost from grower interviews
Cost of cuttings (per container)	$0.57	$0.44	-$0.13	
Weeks to produce a finished pot	***5.0***	***8.0***	***3.0***	Average difference in time with liners and callused cuttings in our trials
Total area-time (square foot weeks)	1.3	2.0	0.8	Production time x area per container
Overhead cost per square foot week	$0.60	$0.60		Varies by business
Overhead cost (per container)	$0.75	$1.20	$0.45	Reduction in overhead because of shorter production time with liner versus callused
Other direct costs per container (container, growing media and labor to transplant)	$0.25	$0.25		Costs obtained from grower interviews
Total costs before shrinkage (Overhead + other direct costs + cuttings)	$1.57	$1.89		
Shrinkage (S, in %)	***0.0%***	***0.5%***	***0.5%***	Average shrinkage with liner versus callused in our trials
Additional cost of shrinkage	$0.00	$0.01	$0.01	Cost of shrinkage = S/(100%-S)*production cost
Total cost after shrinkage (per container)	$1.57	$1.90	$0.33	
Sales price (per container)	$1.92	$1.92		Average wholesale price from USDA survey 2015
Net revenue (per container)	***$0.35***	***$0.02***	***-$0.33***	
Net revenue per square foot week	$0.28	$0.01		