

## Alternatives to Loose-fill Media for Improved Plug Handling

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### Summary

We specialize in the propagation of woody ornamentals, and our primary focus is rooting cuttings quickly and uniformly. However, many factors contribute to uneven rooting and finishing, and liners always need to be graded prior to shipping. In general, rooted crops finish unevenly over the course of weeks, and it may be necessary to go through a crop several times to fill orders. Grading can also damage the plants. In many instances, extracting a plant prematurely will destroy the root system or harm it to the point that it will never be salable. This paper reports

alternatives to loose-fill media in plug trays that could improve the handling process and shorten the production cycle. There were twelve plant species that were rooted as liners using five different media systems: LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon. Our best liner production system was the GC: Loose-fill (30% Peat, 55% composted fines, 10% perlite, 5% vermiculite, amendments) + Growcoon liner holder.

## INTRODUCTION

There are several alternatives to traditional loose-fill media in plug trays. One option is growing in individual cups. Companies such as Jiffy and Oasis offer alternative products including Jiffy Pots, Jiffy Pellets, Grow Blocks, Preforma, Fertiss, Rootcubes, and Terra Plug. Growcoon is a European-designed cutting and seed plug holder that fits into the cells of the plug tray. It is comprised of a biodegradable material and is designed to support and protect the rootball of a young plant. The Ellepot is another option that has been discussed in at least two other IPPS papers (Billingsley 2003 and Andrzejewski 2003).

This paper will compare the Preforma plugs, Ellepots, and Growcoons liner systems to our normal loose-fill media.

## MATERIALS AND METHODS

### Plant species and auxin treatment

*Abelia* x *grandiflora* ‘Kaleidoscope’ PP16,988 – 1000 ppm K-IBA

*Aucuba japonica* ‘Rozannie’ – 1500 ppm K-IBA

Rhododendron ‘Roblez’ PP28,279 Encore® Azalea Fire® - 1500 ppm K-IBA

*Clethra alnifolia* ‘Hummingbird’ – 1000 ppm K-IBA

*Distylium* ‘PIIDIST-V’ PP27,631 First Editions® Cinnamon Girl® *Distylium* – 4000 ppm K-IBA

*Hydrangea macrophylla* ‘Nikko Blue’ – 1000 ppm K-IBA

*Hypericum frondosum* ‘Sunburst’ – 1500 ppm K-IBA

*Ilex verticillata* ‘Red Sprite’ – 1500 ppm K-IBA

*Illicium floridanum* ‘Florida Sunshine’ – 1500 ppm K-IBA

*Lagerstroemia* x ‘Sioux’ – 1000 ppm K-IBA

*Ligustrum sinense* ‘Sunshine’ PP20,379 ‘Sunshine’ Ligustrum – 1000 ppm K-IBA

*Loropetalum chinense* var. *rubrum* ‘PIILC-I’ PP25,534 First Editions® Crimson Fire™ – 1500 ppm K-IBA

### Trial mixes

We already understood the production advantages, disadvantages, and handling benefits of Preforma, Ellepots, and Growcoon plug systems. Our goal was to better quantify the differences in time to ship for our loose-fill, the Preforma, Ellepot, and Growcoon. In order to ship, the plug needed to be fully extractable with the rootball holding together well enough to be handled without falling apart. For loose-fill plugs, this entails complete rooting. For the Preforma, Ellepots, and Grocoon, this entails that several roots should be visible on the outside of the plug. The following liner production products were used:

**LF:** Loose-fill (MM 865: 30% Peat, 55% composted fines, 10% perlite, 5% vermiculite, amendments).

**GC:** Loose-fill (MM 865 above) + Growcoon (013-H72).

**GB:** Bark fill (80% fines, 20% compost, amendments) + **Growcoon** (013-H72).

**EP:** Ellepot (50mm x 50mm GROW Mix: 60% Peat, 30% fine perlite, 10% coir).

**PF:** Preforma plug (coir and peat w/ binder polymer).

The trial began on 20 May 2022 with the preparation of the trays. Cuttings were stuck on 23 May 2022. We used the TO Plastics PL-36-Star plug tray, which is our standard plug tray. Sampling of plugs began on 24 June 2022 and continued bi-weekly through the end of the trial. The last sample date was 3 October 2022. Rooting and extractability of the intact rooted plug were noted, and suitability for shipping was also measured.

### Propagation

Most of the varieties we produce root easily, and our practices are typical of most liner propagation nurseries. Rooting percentages range from 70% to 90% for most crops. Rooting times vary by crop and season, from summer crapemyrtles rooted in 5-6 weeks and winter conifers requiring up to 5 months. About half of our production is in plug trays, which will be the focus of this paper.

### Production

Once the cuttings have rooted, they are removed from the propagation houses and grown off in production areas. The production goal is to finish the crop as a fully rooted-out liner – as quickly and uniformly as possible so orders can be shipped to customers.

### Grading

A plug's readiness is largely determined by its root system. If the plug cannot be extracted from the tray and handled without falling apart, it is not shippable. Grading is a challenge for two main reasons. *First*, plants do not finish uniformly, so it can be difficult to match crops with orders. A large order may need to be delayed until enough plants are rooted out, or the customer may decide to take fewer plants

than ordered. If a crop scheduled for late in the year cannot be shipped because it has not finished, it could be spring of the following year before it is ready. *Second*, processing a crop too soon will often result in the loss of many of those plants. Extracting a plug liner before it has completely rooted will result in damage that prevents further root growth into the media (**Fig. 1**).



**Figure 1.** Extracting a liner before it has completely rooted to the bottom of plug results in damage that prevents further root penetration into the media.

Other issues also affect grading. Even species that are typically aggressive rooters in spring and fall may not fill out the bottom of the plug if conditions are adverse due to heat, moisture, or media compaction stresses. Other plants will push new roots to the side of the tray, hit the wall, and go straight down to bottom of the plug tray instead of filling out the media evenly (**Fig. 2**). The result is a cylinder of media inside the roots that will fall away when the plug is extracted. Some plants send roots straight down, leaving a low shoulder at the point of root initiation that allows the top of the plug to fall away (**Fig. 3**).



**Figure 2.** Roots can grow along the plug side walls, but fail to fill out the center of the plug.



**Figure 3.** The plug media is not held together when roots grow to the bottom, but do not fill out the top and sides of the plug.

## RESULTS

At week five, rooting evaluations were initiated and subsequently made every other week until the end of the trial. Figures 8-19 illustrate rooting of the 12 plant species, including the date of the photo, in the five different plug media systems: LF: Loose-fill media, GC: Loose-fill + Growcoon,

EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon.

### Rooting

In general, all of the plants rooted with greater success in the GC (Loose-fill + Growcoon) treatment (**Tables 1 and 2**).

**Table 1.** Summary of results by five plug media systems measured across twelve plant species.

	LF: Loose-fill	GC: Loose-fill, plus Growcoon	GB: Bark fill plus Growcoon	EP: Ellepot	PF: Preforma plug
Rooted	72%	98%	77%	71%	69%
Shippable	73%	98%	88%	77%	82%
Weeks to Extract	12.1	8.3	8.6	9.1	10.5
Weeks to Ship	15.7	10.4	12.1	13.9	14.5
Weeks < LF	---	5.3	3.6	1.8	1.2
Faster production turnover than LF	---	34%	23%	12%	8%
Salable Plants	53%	96%	68%	55%	57%

This is not surprising since the GC trial used our loose-fill media in a propagation zone that was being used to root cuttings stuck in loose-fill media. Had the EP: Ellepot, PF: Preforma plug, or GB: Bark fill + Growcoon trials been propagated in

zones dedicated to those media, rooting results would likely have been similar, based on previous production experience. One surprise was how well the GC rooted. A rooting percentage of 90% would have been expected. The extra care that went

into planning and observing the trial may account for increased rooting. The other surprise was the unexpectedly low rooting percentage of LF: Loose-fill media treatment. There was essentially no difference between GC and LF, and the Growcoon itself did not seem to offer any advantage beyond holding the rootball together. It

may be that the process of sampling was destructive on plants in the LF group. With GC, if the roots had reached the Growcoon sleeve, the plant extracted easily. With LF, attempts at extraction prior to full rooting would have been detrimental. This reinforces our experience grading liner crops in loose-fill media.

**Table 2.** Weeks to ship and percent improvement of other plug systems compared to LF: loose-fill by plant species.

	LF: Loose-fill	GC: Loose-fill, plus Growcoon		GB: Bark fill, plus Growcoon		EP: Ellepot		PF: Preforma plug	
	Weeks	Weeks	%	Weeks	%	Weeks	%	Weeks	%
<i>Abelia x grandiflora</i> ‘Kaleidoscope’	19	9	53%	11	42%	11	42%	11	42%
<i>Aucuba japonica</i> ‘Rozannie’	13	9	31%	11	15%	11	15%	11	15%
Rhododendron ‘Roblez’	19	11	42%	17	11%	19	0%	19	0%
<i>Clethra alnifolia</i> ‘Hummingbird’	15	11	27%	11	27%	13	13%	11	27%
<i>Distylium</i>	19	15	21%	15	21%	17	11%	23	-21%
<i>Hydrangea macrophylla</i> ‘Nikko Blue’	11	7	36%	9	18%	11	0%	11	0%
<i>Hypericum frondosum</i> ‘Sunburst’	15	9	40%	15	0%	11	27%	11	27%
<i>Ilex verticillata</i> ‘Red Sprite’	19	11	42%	11	42%	15	21%	19	0%
<i>Illicium floridanum</i> ‘Florida Sunshine’	19	11	42%	11	42%	19	0%	19	0%
<i>Lagerstroemia</i> x ‘Sioux’	11	9	18%	9	18%	9	18%	9	18%
<i>Ligustrum sinense</i> ‘Sunshine’	9	7	22%	7	22%	7	22%	7	22%
<i>Loropetalum chinense</i> var. <i>rubrum</i>	19	15	21%	17	11%	23	-21%	23	-21%
Average	15.7	10.4	34%	12.1	23%	13.9	12%	14.5	8%

## Extraction

It would have been difficult to quantify extraction without destroying plants, particularly LF plants. Therefore, weeks to extraction should be taken as estimates based on experience with the plants and the media. In general, GC and GB were the first to be extractable, followed a week later by EP, and 2-3 weeks later by PF (Tables 1 and 2). LF lagged behind by nearly a month. These results are reflected in the shippability of rooted liners. As with rooting, there is the caveat that these plants were not optimally grown for either GB, EP, or PF, and altering production practices in favor of those groups would likely have produced different results.

## Shippability

This was the main factor on trial. On average, GC plants were shippable almost 2 weeks before GB, 3-4 weeks before EP and PF, and over 5 weeks before LF. Again, production practices that favor EP and PF over GC would likely have produced different results. However, this was what we wanted to trial – what performed best under our current growing practices compared to our current standard LF mix.

## Breakdown by species

In general, the faster the plant rooted, the smaller the media effect - versus a greater media effect when the liners rooted slower. The notable exception was *Abelia x grandiflora* ‘Kaleidoscope’ PP16,988, which has a fine root system that roots out poorly into our LF media. Both *Loropetalum chinense* var. *rubrum* ‘PIILC-I’ PP25,534 First Editions® Crimson Fire™ and *Distylium* ‘PIIDIST-V’ PP27,631 First Editions® Cinnamon Girl® *Distylium* were surprises as well. Experience predicted that both of these slow rooters

should have gained more than 4 weeks in a GC over LF, but that did not occur. A possible explanation was that while slow rooters, once they begin to root out - they do so quickly.

## DISCUSSION

### Performa plugs

*Abelia x grandiflora* ‘Kaleidoscope’ roots nearly 100% with very fine roots in loose-fill media. However, the crop takes weeks to get ready after propagation, and we still lose many liners during the grading process (Fig. 4).



**Figure 4.** *Abelia x grandiflora* ‘Kaleidoscope’ PP16,988 - in a loose-fill plug is difficult to grade and is not shippable.

A Performa plug offered us an expensive option compared to the loose-fill plugs; but by saving two more plants per tray, we make-up the cost-differential (Fig. 5). ‘Kaleidoscope’ stuck in Performa plugs rooted faster than loose-fill cuttings, and they were ready to ship within a month after removal from propagation. With rooting percentages close to 100%, they were all ready at the same time – and our cull rate went from 80% to less than



5%. We were also able to grade entire crops quickly.



**Figure 5.** *Abelia x grandiflora* 'Kaleidoscope' PP16,988 - in a Preforma plug grades easily and ships well.

The Preforma plug was easy to use, clean, pest free, and improved grading of rooted liners. Pre-filled trays come on pal-

lets that can be stored for months and easily placed by a greenhouse when needed. There were also drawbacks. First, the media has a bulk density of over 900 (kg/m<sup>3</sup>), which is twice as dense as the mixes we normally use, so watering was a challenge. The other drawback was the inability to customize. We incorporate fertilizer and bifenthrin insecticide into our loose-fill mix, which is not possible with Preforma. Dedicated irrigation zones along with additional bifenthrin and fertilizer applications corrected these issues.

### Ellepot

Ellepot offered an improvement over the Preforma plugs because they were significantly cheaper, and its mix was more comparable to what we use. However, the mix we purchased is much finer than our loose-fill, in addition to being compressed, it tends to stay wetter than our typical plug - so over-watering was still an issue (Figs. 6 and 7).



**Figure 6.** Poor rooting occurs when Ellepots (1<sup>st</sup> and 3<sup>rd</sup> plugs) and Preforma plugs (2<sup>nd</sup> and 4<sup>th</sup> plugs) are over-irrigated.



**Figure 7.** Poor rooting of HYNB: *Hydrangea macrophylla* ‘Nikko Blue’ in Ellepot (Left) and Preforma plugs (Right) when over-irrigated.

Other mixes are available, including a high-porosity blend, that might be more comparable to our loose-fill. Like Preforma, it comes in clean, pre-loaded trays that are weed free and easy to handle. Although it comes with a starter charge, it cannot be customized to the degree that our loose-fill is, and it has the same drawback of not having bifenthrin in the media. Purchase of an Ellepot machine would allow the use of a custom loose-fill blend and mitigate these shortcomings.

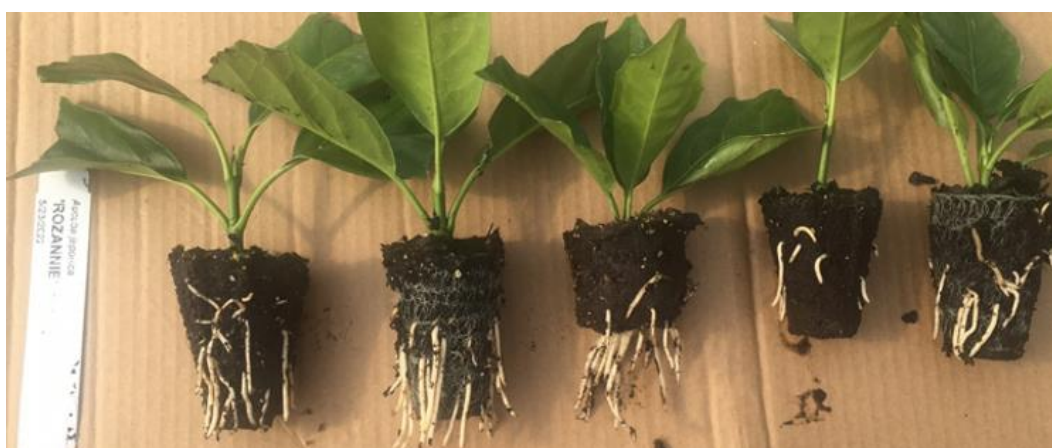
### **Growcoon**

The Growcoon is basically a small, biodegradable sleeve or liner that fits inside each plug. Loose-fill media is then added. These are very inexpensive. Any loose-fill media can be used. The drawback is that each sleeve must be placed in each plug; however, it is still a much cheaper option than either Preforma or Ellepot. There are also automation options to facilitate placing the sleeves in the trays.





**Figure 8.** *Abelia x grandiflora* 'Kaleidoscope' PP16,988 rooting in plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 11 July 2022.



**Figure 9.** *Aucuba japonica* 'Rozannie' rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 25 July 2022.



**Figure 10.** *Rhododendron* 'Roblez' PP28,279 Encore® Azalea Fire® rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 20 July 2022.



**Figure 11.** *Clethra alnifolia* ‘Hummingbird’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 11 July 2022.



**Figure 12.** *Distylium* ‘PIIDIST-V’ PP27,631 First Editions® Cinnamon Girl® rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 20 September 2022.



**Figure 13.** *Hydrangea macrophylla* ‘Nikko Blue’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 11 July 2022.





**Figure 14.** *Hypericum frondosum* ‘Sunburst’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 6 June 2022.



**Figure 15.** *Ilex verticillata* ‘Red Sprite’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 20 September 2022.



**Figure 16.** *Illicium floridanum* ‘Florida Sunshine’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 20 September 2022.



**Figure 17.** *Lagerstroemia* x ‘Sioux’ rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 11 July 2022.



**Figure 18.** *Ligustrum sinense* ‘Sunshine’ PP20,379 ‘Sunshine’ Ligustrum rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). Rooting date was 11 July 2022.



**Figure 19.** *Loropetalum chinense* var. rubrum ‘PIILC-I’ PP25,534 First Editions® Crimson Fire™ Fringe Flower rooting plugs with LF: Loose-fill media, GC: Loose-fill + Growcoon, EP: Ellepot, PF: Preforma plugs, and GB: Bark fill + Growcoon (from left to right). The roots are difficult to see because they are red-purple and do not stand out against the media. Rooting date was 5 October 2022.

## LITERATURE CITED

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