

## Pre-publication version

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# Automating a propagation nursery

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In previous IPPS presentations, I have focused on roots in containers and how plants are not designed to grow good roots in containers. At the time, there was a lot of misinformation about containers and the containers that were available varied wildly in their quality. Fortunately, there are now good containers available that can produce a more natural root structure.

Containers that can produce a more natural root structure use a variety of different methods to manipulate roots, but I favor “air pruning” techniques. With air pruning, roots are forced to grow out of apertures in the wall of the container, where the relatively dry air kills the root tip and allows for secondary roots to develop. This has been done at the base of the propagation cell by many containers for years; however, if this can also happen along the sides of the container, then you can develop a large quantity of young, vigorous roots along the interior walls of the container. A “normal” container with no apertures creates a small number of roots that typically circle around the base of the container. Air pruning containers have now been available for some 20 years, with a bigger variety available every year. They have had good adoption in propagation sectors such as forestry, fruit trees, and even vegetables.

The woody ornamental sector stands out as not having adopted these air pruning containers. Why is this? I would think that having great roots that produce plants quicker would be of interest to the woody ornamental sector and trays are now practical, so they fit into current set-ups. There is, however, a third factor that is required to create good uptake is the economic incentive. It is clear there is not enough economic incentive currently.

Anything that saves labor would be a major help in bringing about these economic incentives. Another speaker stated he believes as much as 50% of gross sales income is spent on labor; this is a staggering proportion. Labor savings are available for our industry in the form of making people more efficient centrally or using machines to automate tasks. This requires a “headhouse” to which plants are brought and where most of the staff and machines are based. This requires an efficient, internal transport system which is currently only possible on new, purpose-built nurseries.

These purpose-built, automated nurseries are now even located in many places where labor cost is still relatively low and availability is high. For example, in Uruguay there have been two big automated eucalyptus nurseries built recently. We would normally expect such nurseries to be somewhere like The Netherlands, but clearly other people believe investing in the future to save in areas such as labor costs is correct.

I believe that having a headhouse with automation is possible at most current nurseries. However, the limiting factor is the cost of moving plants to the headhouse on what may be a regular basis. I believe there is a way to do this efficiently, which requires the combination of a fork system and a tray with legs. Figure 1 shows a typical fork system. Figure 2 shows a homemade fork system that has been used for this purpose for about 20 years in California. Figure 3 shows a schematic for the trays that will work with these forks and Figure 4 shows a typical nursery layout as currently adopted, i.e., one where labor moves to the jobs. Figure 5 shows a typical nursery workstation that is uncomfortable, inefficient, difficult to manage, and can lead to injury, especially due to all the bending down required. Beyond the costs involved, it is of concern that people still want to do jobs in this manner. Figure 6 shows my suggested system in which staff are based in the headhouse, which is

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comfortable, efficient, safe, easy to manage, and a better working environment. Plants are brought to the headhouse by forks. If work is done manually in the headhouse, then big savings can be attained. In addition, machines can be introduced here, reducing labor costs even more.



Figure 1. A typical fork system being used to move plants in a nursery.



Figure 2. A homemade fork system that has been used to move plants at a nursery in California for about 20 years.

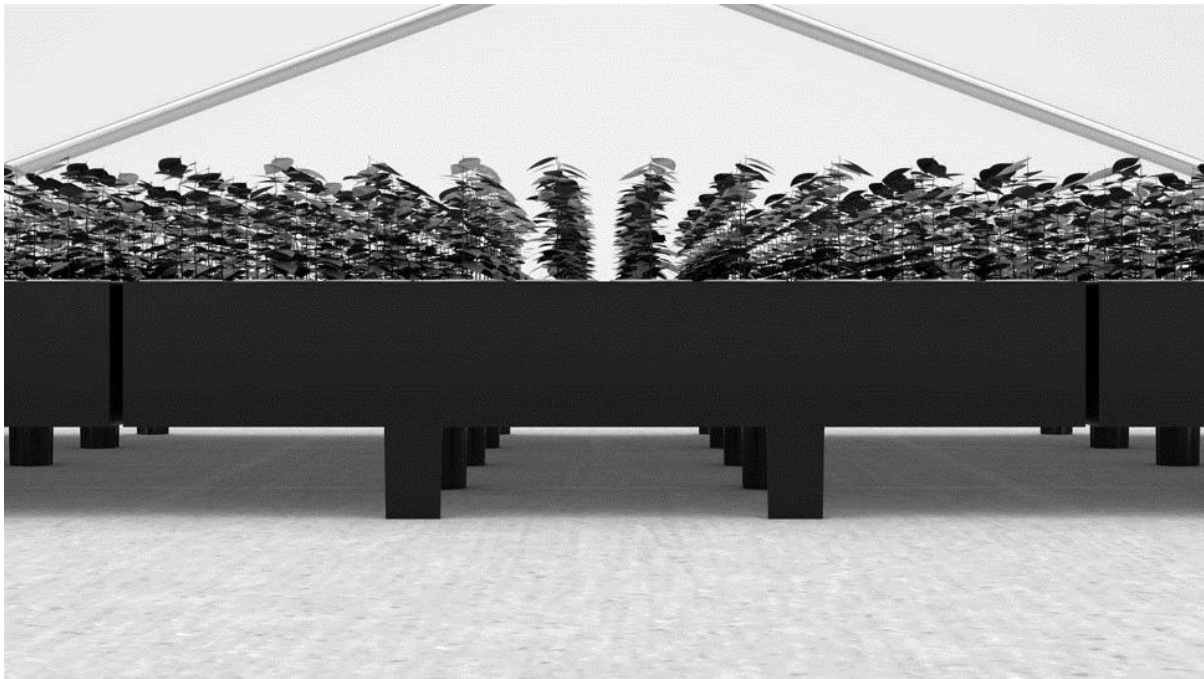


Figure 3. Schematic of trays with legs that will work with a fork system.

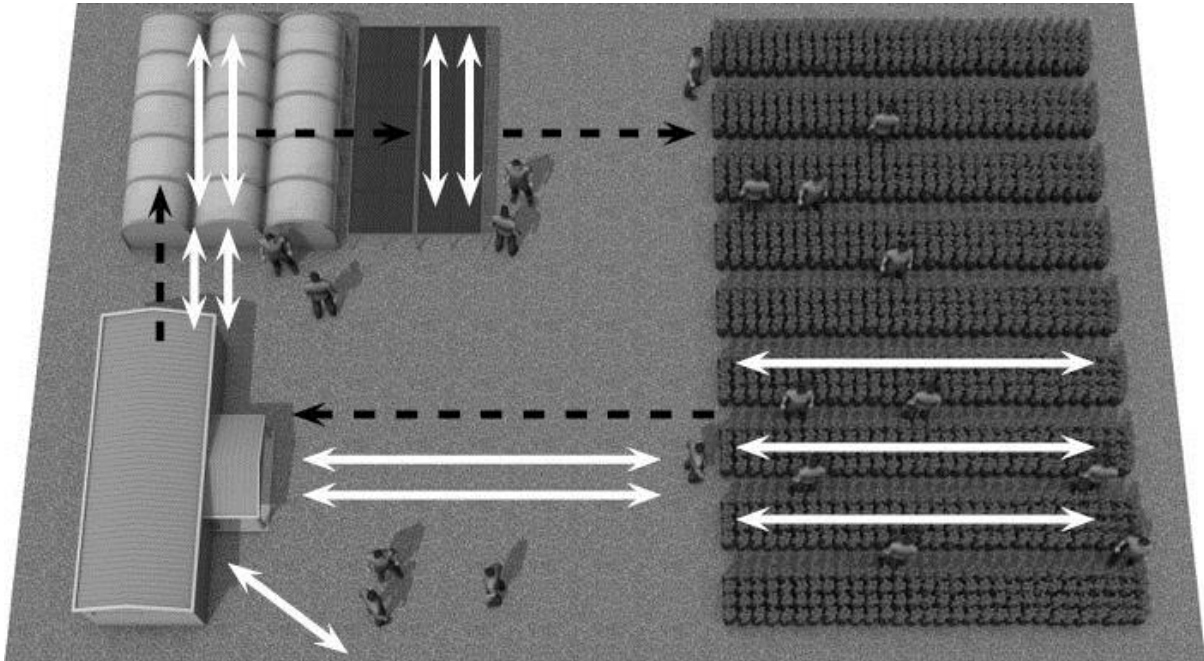


Figure 4. A typical nursery layout, i.e., a nursery in which labor moves to the jobs that need to be performed.



Figure 5. A typical workstation that is uncomfortable, inefficient, difficult to manage, and can lead to injury (due to the repeated bending required).

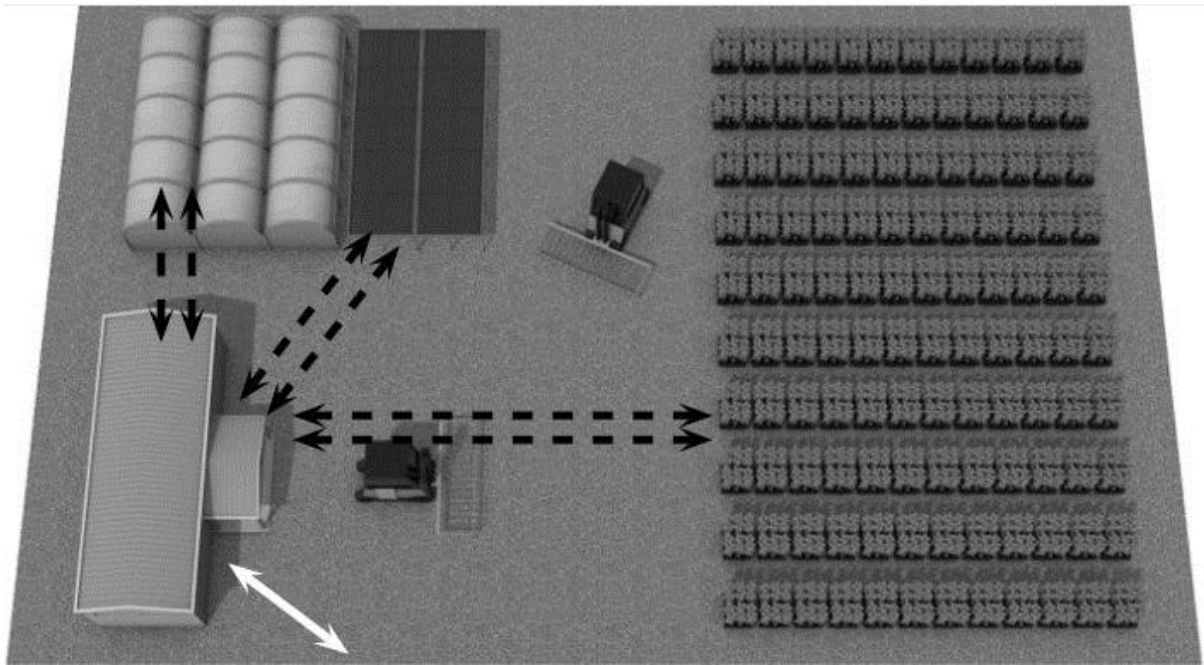


Figure 6. A suggested system in which nursery production staff are based in a headhouse, which is comfortable, efficient, safe, easy to manage, and a better working environment.

I estimate 50% of labor costs could be saved. So, if labor is 50% of gross sales and your nursery turnover is, for example, \$4 million, then you could save \$1 million per year by using a headhouse and automation. These are ballpark estimates, but the potential is huge. Even with investment in trays with legs, forklifts, and mechanization for the headhouse, the return on investment should be very quick. This would result in not only better profits, but better cash flow and happier staff doing more enjoyable jobs, and thus a better long-term future for the business in all respects.

My interest here is a great root system, and trays with legs can also be great air pruning trays. When the cells are elevated to allow for fork access, this also allows air to flow around the cells for air pruning. The only downside here is that, if you use under-floor heating, the heating system will be less efficient with this type of tray, but this is a small disadvantage in the big picture.

One other factor that needs consideration is the type of media to use for both mechanization and air pruning. The first choice to be made is use of loose fill or stabilized medium. The latter was developed mainly to create better roots or to work better with mechanization as you can lift plants while they are very young, lift cells with no plant in them at all, and handle trays with big and small plants in them. Also, since the whole plug is bound (including the top half), a stabilized plug maintains its integrity and shape. Figure 7 shows a stabilized plug that remains intact; a similar plug containing loose fill medium could collapse upon extraction, with dire effects on the potting machine's performance. Machines like uniformity. Figure 7 also shows that you can still get bad roots in a stabilized medium, so you do need to also use the right "air pruning" tray.



Figure 7. Plugs containing stabilized medium easily remain intact upon extraction.

I feel that stabilized media is the right way to go, although there is a massive assortment available, each with their niche market. My first distinction is whether the stabilized media can be made on site or must be bought in. Buying in means you cannot use your own soil as easily, and there is lead time, freight cost, inventory factor, and so on. Making stabilized media on-site means the units are fresh and you know what's in them. Table 1 shows some brands which are available, split into these two categories, plus a third category for media that can be bought in or made on-site. As far as I know, Ellepots are the only option here which make them very flexible.

Table 1. Some brands of stabilized media plugs made on-site and/or off-site (purchased).		
Made On-site	Made Off-site	Made On-site and Off-site
Ellepot Jiffy Some glue plugs	Ellepot Preforma Q Plug Fertiss FlexiPlugs Grodan Oasis Horticubes	Ellepot

One final point on stabilized media to consider is the amount of air flow around the plug. Some plugs are made in the tray and touch the walls, whereas others are placed into the tray after manufacture. With the latter, there is a gap between plug and cell walls that is great for air flow. Good air flow means air pruning of roots plus great aeration and drainage – a big advantage. Again, a good example here is the Ellepot, which is my choice in stabilized media.

To conclude, I believe that a tray with legs containing stabilized media plugs and moved around the nursery by forks to allow for mechanization in a headhouse, where the majority of staff and machinery are based, is a great way to significantly reduce labor costs on current nurseries, plus create jobs that people like.

Information on mechanization from multiple sources is listed by category on our website ([www.propstek.com](http://www.propstek.com)), along with suppliers of forks. We have also created several videos of machines we think will work well in a headhouse, plus more details on the concepts discussed above. We very much welcome feedback on this idea in order to help make this a reality for our industry and try to help with the labor challenges we all face.

## QUESTIONS

Douglas Justice: Have you seen air pruning used in pot-in-pot systems?

John Cooley: I have not, but air pruning, by definition, requires movement of air around the pot, which you do not tend to have with a pot-in-pot system.

Chris Murphey: Have you had success with large nurseries considering the system and putting together some numbers?

John Cooley: My position has been that air pruning is needed to produce a good quality root system. We have been doing trials with nurseries for the past 20 years. It seems that woody plant nurseries are not as receptive to the air-pruning containers. This is the first time that I have put my thoughts together on adding other ideas to the mix, and labor savings is clearly the best economic incentive for making changes to production systems.

Adrian Reimer: Is anyone using the trays with legs with a forklift now?

John Cooley: Quite a few nurseries in Europe are using forklifts, but I have not seen forklifts used to move trays in North America, probably because most trays here do not have legs. So, it is a question of asking the suppliers to carry such products. I see no reason it should not work and could be a good idea for the future.