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Forty Years of Trying to Containerize Everything: Successes and Failures

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Abstract

There have been major advances in containers used for production of nursery stock during the past decades, particularly with the advent of plastics in the manufacturing of nursery containers. Most seedlings were being grown in seed beds in the early 1970s, with peat block and plastic bags started to make their appearance. Availability of polystyrene led to the development of Speedling® trays for vegetable seedling production. Plug trays gained popularity in forestry around the world, along with the development of mechanical transplanters. Containerization of woody crops still presents some challenges, with systems developed over the past 20 years for nursery production of grape, tea tree, cherry, and pecan, and citrus.

INTRODUCTION

During forty years of involvement in the nursery trade and before, I have endeavoured to be as innovative as possible in growing as many genera in containers as I could. During that time, there have been significant advances in the use of different materials for forming containers, rather than the recycling of kerosene drums and jam tins used when crops first came out of in-ground nurseries. Container growing has been further assisted by the availability of high-quality growing media, controlled-release fertilizers, and a better understanding of the physical properties substrates need to possess to produce high quality plants. This paper attempts to cover as many different containers that I have used or have seen being used in other nurseries, describe some of the successes we have had, and highlight some of the failures we have encountered along the way.

THE EARLY DAYS OF CONTAINER-IZATION

I remember my mother taking me to a nursery almost 70 years ago to buy bedding plants. Some were grown in-ground with the seedlings dug and wrapped in newspaper and some were grown in wooden flats. As I recall, the wooden flats had a division in the centre, used a very sandy medium, were returnable after use, and probably held about 100 seedlings.

There were also 4-gallon and 5-gallon kerosene drums in use, mainly with a heavy soil-based medium for growing citrus and some other fruit trees. Jam tins with holes punched in the bottom were quite commonplace and used for a wide range of genera. *Eucalyptus*, *Callistemon*, and other native plants were grown in metal tubes that could be unclipped and the tree extracted from them for planting, with this type of container was used extensively in the forestry and revegetation industries during the 1960s and 1970s. From this time forward, the use of plastics for container manufacture started to become commonplace and revolutionized the way we grew plants.

FROM BARE-ROOT SEEDLINGS TO THE SPEEDLING® FLAT AND BEYOND

In the early 1970s, most seedlings were being grown in seed beds, either by nurseries or individual growers of vegetables, tobacco, forestry trees, and bedding plants. Changes to this system probably started with the use of peat blocks, particularly in Europe, along with large grow blocks. Plastic grow bags also made an appearance during this time. In Australia, much of the citrus tree production was in 5-litre and 6-litre bags. Plastic grow bags are low cost and still in use today.

When polystyrene was made available for general manufacturing, it lent itself to being used for a huge range of molded products. George K. Todd, the son of an upstate New York vegetable grower who had trained as an electrical engineer, put his mind to coming up with a simpler method of growing seedlings than by using seed beds and wooden flats. He developed a 200-cell, polystyrene tray that was 76 mm deep with the same outer dimensions as traditional wooden flats and became known as the Speedling® 100A. This invention, which George Todd patented as the Todd Planter Flat and then branded the name Speedling®, revolutionized the seedling nursery industry globally. Introduced into Australia in the late 1970s by celery growers under license to Todd, growers kept the inverted pyramid shape but changed the cell numbers, depth, and outer dimensions of the tray to suit their benching that was originally set up to hold wooden flats.

In 1982, Narromine Transplants, at the time a subsidiary of Yates Seeds Ltd., entered into an arrangement with the Speedling Corporation of America (by then based in Florida) to use Speedling® flats, but with the original American sizes. This licensing arrangement also spread to South Africa and Israel around the same time. As an example of the adoption of the Speedling® concept in Australia, the entire vegetable seedling crop changed from in-ground production to containers within about an 8-year period.

Speedling Corporation went on to develop a range seedling flats of various cell sizes, including its popular 080A with 338 cells. This flat, with a tray depth of 57 mm, for the first time allowed a high density of seedlings per square metre and, consequently, a much better utilization of greenhouse space. We used this flat at Narromine Transplants to propagate a range of traditional vegetable seedlings, including processing tomatoes, but the cell size proved to be too small for the establishment of vegetable crops in harsh Australian conditions. We moved back to a 200-cell flat (but with only a 50-mm depth) and used the 080A for in-house propagation of tree seedlings that were then transferred into forestry tubes.

The 100A flat lent itself to the propagation of high-quality seedlings such as brassicas, peppers, tomatoes, tobacco, and some early work with forestry seedlings. Australian asparagus growers were keen to try growing green asparagus hybrids, such as UC157, from seed rather than using traditional crowns. The 100A flat lent itself to this but we soon realized there was a problem with the aggressive root system of this plant which penetrated the polystyrene foam flats, thus rendering both the flat and the seedling unusable. Through our Speedling nursery contacts in South Africa we were able to obtain a solution using copper oxide and water-based paint. Flats were dipped into the solution prior to use with asparagus and this stopped root penetration with a high degree of success. This dipping solution was also used with other crops that had the ability to penetrate the polystyrene, particularly *Eucalyptus*. This need disappeared once injection-moulded plastic flats became available.

From the original Todd Planter Flat, the patent of which was fiercely guarded by George Todd, there was a proliferation of other cell type flats around the world, all with different cell shapes designed to circumvent the patent. Today there are thousands of examples of cell-growing systems.

CONTAINERS IN FORESTRY

At a seedling growing refresher course around 1985, I raised the possibility of using Speedling®-type propagating flats for growing forestry seedlings and was laughed off the conference floor. Five years later we heard that the South Africans were using a 127-mm-deep polystyrene Speedling® flat to grow *Acacia* and *Eucalyptus* for the forestry industry there, so in 1992, after a visit to that country, we imported a few hundred trays to use as a trial and grew our first *Eucalyptus* seedlings for sale the following year. We had great success with this early production, but transport over large distances, coupled with the fragility of the flat in the field and the problems of handling by human transplanters, led us to look at the possibility of using a more user-friendly flat.

We also had problems with the germination of some *Eucalyptus*, such that direct-seeding into the final container was not an option without the use of hand labour to "block-up" empty cells. The Swedes had developed a 40-cell flat known as a Hiko V93 Tray with cylindrical, 93-cm^3 cells with root trainers and a tapered base. This tray was much more manageable in the field and it just happened that three trays set side-by-side were the same width as the original 100A Speedling® tray so that, with a bit of ingenuity, we were able to use our existing benching.

Our next challenge was to overcome the problems of low and intermittent germination of some of the species we were dealing with and the need to reduce hand labour. To this end we experimented with 512-cell plug flats, initially designed for the bedding plant industry, but we thought we should be able to single-seed them and eventually mechanically transplant them into the final container. Our competitors thought we were crazy and some of our clients exhibited a healthy amount of skepticism as well until we were able to prove that there was no detrimental effect on root systems. The degree of uniformity that we finished up with was exceptional. This practice is currently the norm in Australia, along with the use of mechanical transplanters being the accepted process of final transfer.

The forestry industry in Australia, South Africa, Chile, Brazil, Uruguay, and Argentina turned to the use of hybrid *Eucalyptus* for pulp production. This move required the production of these hybrids as clones via cutting production. The system of stock plant creation and maintenance, developed mainly in Brazil and South Africa, was adopted by two Australian nurseries in cooperation with one another, with Narromine Transplants being one of the participants. The process required was adapted by us using coir fibre slabs for stock plant maintenance, 512-cell plug trays for cutting propagation, and Hiko V93 flats as the final container. We have continued to use this production system for a number of other Australian native plants.

GRAPEVINES, ROOTSTOCKS, *MELLEUCA*, AND *LEPTOSPERMUM* SEEDLINGS AND CUTTINGS

During the early 2000s there was a rush to plant grapevines for wine grape production around the world, and Australia was no exception. We chose to grow our vines, both own-rooted and grafted, using waxed paper containers based on a system developed in the USA. This system required a higher price than for open-rooted vines grown in-ground. There was initial resistance to the use of the paper container, which was meant to be planted in its entirety in the vineyard. The system was clean, quick, and successful, and it appealed to customers that were in a hurry to plant and could afford the additional price. We have more recently grown a series of cherry rootstocks from cuttings in a paper container system.

Propagation of *Melaleuca alternifolia* for the production of tea tree oil is a challenge. Seed cannot be sown directly in the field and plant populations in production plantations require around 30,000 seedlings per acre. We have successfully propagated this crop by suspending seed (typically 14,000 seeds per gram) in a gel and sowing the seed in small clumps into seedling flats. Currently, we are also propagating a range of *Leptospermum* species for honey production and clones of selected *Melaleuca alternifolia* from cuttings using 512-cell plug trays and Hiko V93 flats as the final containers.

CHERRIES, CITRUS, AND PECANS

Several years ago, we were approached to grow cherries in a container size of 0.93 litres. We had never attempted any fruit tree work previously and started off growing rootstocks in coir bags for cutting production. Cuttings were stuck into a 240-cell tray, grown under mist, and then transplanted into the final containers. The trees grew well but there was a great deal of grower resistance to such small plants. Most growers were used to open root whips and after one season they reverted to open-root plants. We continue to produce citrus with the rootstock seedlings grown in Hiko V93 flats and then transferred to a 3.3-litre air-pruning container for budding and growing-on. This container grows excellent trees and there has been no buyer resistance with these plants.

During the past two years, we have been attempting to grow pecans, *Carya illinoinensis*, in containers. Traditionally grown in-ground from seedling rootstocks and usually patch-budded, we were approached by Australia's biggest grower to attempt containerization. We started with 0.93-litre containers planted with a seedling rootstock grown in V93 Hiko flats during summer and then grafted using terminal side and top wedge grafts during late winter; it was a dismal failure. We grew-on the failed grafts and patch-budded in late January using new wood, but with only limited success.

I had a conversation with another IPPS member about our problems, he told me that he had tried using the callus system that we used for grapevine propagation, but with containerized pecan seedling rootstocks that were bare-rooted, bench grafted, put through a callus box system, and then grown-on in a larger container. We tried this with a large number of rootstocks and had varying success, sometimes up to 93% but in general 40% to 60% strike rates. We initially used a

3.7-litre round container used mainly for citrus, but this was mistake as pecans have very strong, fast growing root systems and we experienced root curling at the base of the container. We now use our 3.3-litre air-pruner citrus container for pecans which allows a much more acceptable root system to develop.

We are still struggling to increase our grafting take rate and, in the coming season, will be more selective with grafting wood, seedling readiness, and general post-callusing handling in the nursery. One of the main problems we think pecans have in the nursery is that there are no clonal rootstocks available and seedling rootstocks are quite variable in height and vigour, leading to grafting and budding failures.

We will continue to try adapting as many plants as we can to container production.