CELL-RAISED TRANSPLANTS—VEGETABLES AND NURSERY STOCK

D. O. CLIFFE

Australian Plantation Industries Pty. Limited
Munros Wharf Road
Wyrallah, N.S.W. 2480

The concept of cell-raised transplants was first conceived in the United States. Mr. George Todd, in conjunction with personnel of Cornell University, using expanded polystyrene (EPS) as their medium, designed and manufactured what we now know as the Speedling® seedling flat.

This flat made its debut in 1978 and consisted of 200 cells of an inverted pyramid shape approximately 75 mm deep with a 25 mm opening.

Since that original concept, the name Speedling® has become synonomous with vegetable seedling raising in most of the developed countries of the world.

Whilst the nursery industry and, in particular, the conservative farming community, were slow to accept the principle of cell-raised plants it is now apparent, particularly in the U.S.A., that the system is well entrenched. Adaptations of the principle continue to be presented to the market in myriad form.

As what now seems to be a logical progression from the original concept of cell-grown vegetable transplants, there has been a gradual use of cells for the propagation of nursery stock. More recently, direct plantings from cells to the field have been made with tree and fodder crops.

THE PRINCIPLE

Transplant propagating flats were traditionally of wooden construction, usually filled with soil or loam. When plants were ready for transplanting, the root mass had to be separated often causing considerable damage and subsequent mortality or poor growth in the field.

The cell concept sought to individualize each plant, lessen the possibility of root damage and subsequently transplant shock, giving each plant the opportunity to perform as well as its neighbour during propagation.

The choice of the inverted pyramid structure came after considerable mathematical calculations and from nursery and field observations. It proved to be a resounding success. (G. Todd, Pers. Comm).

The inverted pyramid was given a small hole at the base of the structure and the entire flat, because of the rigidity provided by EPS, was supported on rails in the nursery so that air could pass underneath, thus pruning roots as they pushed through the opening.

It quickly became apparent that traditional housing and methods of supplying nutrient to the plants were inadequate; as a result, new low cost greenhouses with travelling irrigators and nutrient programmes to match, were evolved.

PROGRESSION OF THE CONCEPT

By the mid-1970's the techniques for successful propagation of cell transplants, particularly in regard to vegetable crops, were well in place.

By the early 1980's cells were being used for the raising of nursery stock such as trees, flowers, and shrubs from seed, cutting propagation of carnation in Israel and for the transfer of tissue-cultured material.

More recently, in Australia, tree and fodder shrub species propagated via the cell principle have been directly transplanted in the field.

Such a progression is desirable from an economic viewpoint, particularly in regard to reafforestation, fodder provision, shelter, and soil erosion control.

However, it should be realized that not all species adapt well to the treatment and that environmental and soil conditions play a large role in successful establishment.

PROPAGATION OF TREE AND SHRUB SPECIES

Flat selection: EPS is economical and easily handled in the nursery; however it has some drawbacks due to its insulating properties and the fact that it is a relatively soft product.

Some species, particularly *Asparagus, Acacia, Eucalyptus* and *Brachychiton* to name a few, will penetrate the sides of cells with their vigorous root system. In some instances therefore, rigid plastic flats may be of assistance in reducing the problem, as long as adequate bench support is provided.

Recently a new product, Styrodip®, has come on the market. Claims are made that when EPS flats are treated with this material, much of the root penetration and subsequent damage problems during extraction are eliminated.

Cell size has been shown to be significant in relation to establishment and maturity. Weston and Zandastra (1) and Dufault and Waters (2) found that a larger initial root system, which promotes increased uptake of water and nutrients and undergoes greater new root initiation, may account for earlier maturity of plants grown in larger cells.

Most success has been gained by using a cell with a volume of 22 ml particularly with the deep rooting species. A 16 ml cell has also been used with limited success in field transplanting but for the purposes of nursery stock production has proved adequate.

Media: The success of cell type seedling propagation owes much to the use of a simple medium formulated on a 1:1 basis from peat and vermiculite. However, due to economic constraints, much work has been carried out on alternative sources of materials for this purpose.

Experience with *Melaleuca alternifolia* grown in 1:1:1:1 pine bark, sand, loam, and peat has shown that considerable root distortion resulted if particle sizes were too large. This condition caused slow establishment and eventual retardation of the plant in the field.

Both vermiculite and peat have good water and nutrient holding capacity and provided a horticultural grade of vermiculite is used, an air-filled porosity of 10 to 15% can be expected. This range is considered to be ideal for seedling raising mixes, (3). Polystyrene beads can also be added but should not constitute more than 10% of the mix.

Fertilizer: Peat is an acid material and requires the addition of neutralizing agents in the form of dolomite lime. If African vermiculite is used, however, some correction should be made for the fact that it usually has a pH of about 8.

Best results have been obtained with a pH of the media around 6.4. Further additions of superphosphate, iron, sulphate, trace elements, and usually a wetting agent, will give a balanced medium.

Sowing seeds of some Australian native species has proven extremely difficult. With *Melaleuca alternifolia,* seed counts often reach 55,000 per gram. *Atriplex nummularia* (old man salt bush), on the other hand, weighs only 30 seeds per gram.

Various methods can be used from vacuum seeders to gel type solutions but in most cases there will be some need of hand thinning after emergence.

The cell system of propagation has required the formulation of foliar feeding programmes adapted to environment, species, cell volume, and media (Thomas, Pers. Comm).

It has been found that the principles of nutrient application applied to cell-grown vegetable transplants, can be adapted to other plants. However, the frequency of application must be modified, according to species and weather conditions.

The growing period in cells for most vegetables varies from 25 to 70 days. With other species it can be much longer, for example, atriplex—150 days, and most eucalypts, 80 to 100 days.

The basis of most successful nutrient programmes for cell-type propagation involves the injection of fertilizer into the irrigation water which is then applied to the cells via travelling irrigators. These "background" type nutrient programmes usually consist of a solution made from calcium and potassium nitrate and, depending on water supply, may carry other chemicals such as chlorine.

In conjunction with the "background" programme, applications of soluble fertilizer are made via the irrigators at varying predetermined periods. Usually the soluble is a complete type, incorporating trace elements.

With cell propagation, many minor deficiencies can be encountered and constantly need correction. Iron is an example, particularly in winter when the plant's ability to take up this element can be severely affected.

Field Transplanting of Tree and Shrub Species: It is imperative that adequate soil preparation be undertaken prior to transplanting. Usually, the area to be planted should be left fallow for at least 12 months and during that period, ripped to a depth of 45 to 50 cm.

Immediately prior to planting, the use of a small rotary hoe will eliminate large clods and provide a flat, fine tilled surface for a transplanting machine.

Many different types of transplanting machinery are available. From an economic and practical viewpoint, the model 3000 Mechanical Transplanter with water injection and ground drive mechanism has been found to be most suitable.

The most successful plantings from cells, which have grown on to maturity, were carried out in the Southern Tablelands of S.E. Australia during spring (Walker Pers. Comm) and on the western slopes and plains of New South Wales during early autumn.

In all cases, water injection mechanisms were used in association with the transplanters and in the case of the southern areas, absorbant gels were added to the injection water at the rate of 1 gram per litre. Each plant received 400 to 500 mls of solution as it was placed in the ground.

CONCLUSIONS

There seems little doubt that the concept of direct transplanting from cell containers to the field, can be a worthwhile proposition, that is provided the necessary criteria of soil preparation and correct propagation of the material to be transplanted are followed.

Established stands of Australian native species for windbreaks, shelter, and particularly fodder vindicate the concept.

Considerable work is needed however, in determining correct growing times in cells, particularly for larger species. Preliminary evidence suggests that this timing can critically influence the eventual performance of the plant in the field.

LITERATURE CITED

1. Weston and Zandastra, 1983. Larger, earlier yields, *American Vegetable Grower*, December 1983.

2. Dufault and Waters, 1985. Container size influences broccoli and cauliflower transplant growth but not yield. *HortScience* 20(4):682–684.
3. Handreck and Black, 1984. Growing Media for Ornamental Plants and Turf, New South Wales University Press.

CULTIVATION OF AUSTRALIAN PLANTS—200 YEARS OF PROGRESS

GREG LAMONT[1]

New South Wales Department of Agriculture
P.O. Box 581
Gosford, N.S.W., 2250

The beauty and horticultural value of the Australian flora was first recognized by Joseph Banks (1743–1820), the botanist who accompanied Lieutenant James Cook on his voyage of circumnavigation of the world in 1768–1771. Banks and his assistants shipped large collections of seeds, living plants in tubs, and dried specimens to England. Many, of course, failed to survive but a surprising number did.

Banks, on his return to England became Director of the Royal Botanic Gardens at Kew and continued his efforts to introduce Australian plants, particularly with the assistance of collectors. A greenhouse known as the Botany Bay House was built to accommodate the living collections. Collectors such as Caley, the superintendent of the new Botanic Gardens at Parramatta gathered plants from the western parts of the Cumberland Plain and the Blue Mountains. Other notable collectors included Brown, Cunningham, and von Mueller in the east of Australia and Baxter, Drummond, and Molloy in the west. Wealthy noblemen and women often owned extensive collections of exotic plants, cultivating them in greenhouses because of the extreme English winter climate. Experienced horticulturists were in strong demand. Gardening journals such as Curtis's Botanical Magazine, first issued in 1787, recorded the early cultivation of Australian plants together with superb colour prints. The catalogues of several large English nurseries listed interesting selections of Australian plants, many of which are now lost. In 1870 James Veitch and Sons of Chelsea, offered various-sized *Blandfordia cunninghamii* for prices in the range 3s 6d to 31s 6d. In 1886 the list of William Bull, also of Chelsea, included *Davidsonia pruriens, Elaeocarpus angustifolius* [syn. *E. grandis*], and a double-flowered *Epacris* sp.

Australian plants also found their way into private collections

[1] Senior Research Horticulturist