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MECHANICAL HANDLING OF PROPAGATION BENCHES

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The purpose of this paper is to introduce the initial physical developments of a system in which I have been interested for several years. The developments discussed arise from the aim, which may be broken into three parts;

1. To re-think the basic approach to the volume production nursery and to develop an integrated nursery system with stock control which economically enables increased production volume and efficiency.

2. To design a system around the plant's growth requirements of moisture, light, temperature, humidity, and nutrition.

3. To develop mechanical systems and aids on a universal or multi-purpose basis, especially in the early stages of propagation — by seed, cuttings, or tissue culture — from small parent stock to 100 mm and 125 mm pot production.

A basic design criterion was adopted with regard to the species most likely to be grown, (indoor and outdoor container foliage plants), available energy sources, local engineering fa-

cilities, and expertise and basic cost comparison of alternative systems.

A pallet handling system was selected and its eight components are described below:

1. **The Pallet Basket.** The Australian standard pallet size of 1.18 metre was chosen as it is in wide use in transport, warehouses, and allied trades. It may be handled manually by two staff persons, or mechanically by a "pallet jack" fork lift, or by a specialised carrier.

The pallet is lightweight, rigid, and compact in storage, being constructed of 5 mm gauge galvanised steel mesh turned up at the sides and with 75 mm angle-iron legs welded on.

2. **Styrene Nursery Box.** Overseas experience confirms energy saving and other benefits from the use of styrene boxes on trays, so a container was designed which fits exactly 6 per pallet, and formed in styrene.

It has conical internal depressions serving each of the 308 holes in its base. Each hole runs to the peak of concave channels formed in the underside of the base to permit unblockable drainage and to channel rising heat which may enter into the box contents via the holes.

The upper edges of the box have male locating lugs with corresponding female recesses to enable stable stacking in either direction. Further, a special collar may be inserted to produce a despatch carton.

The box may be used for all stages of propagation, young growing-on, or mother stock, as well as for despatch.

3. **Heating System.** Offpeak, electrically-heated, stored hot water was installed using radiator pipes to circulate the water. Sensors and proportioning valves maintain the desired heating at the benches. Each bench may be isolated from the system.

4. **Greenhouse Structure and Ventilation.** This consists of a 2,000 square metre concrete-floored, aluminium framed structure clad with corrugated fibreglass, formed of five gable roof bays, each eight metres wide with a 2 metre automatic ridge vent system and 2 metre wide door at each end of each bay.

5. **Attached Workshed.** This houses the heating system, support equipment, and general storage. It is centrally located to enable minimum average distance of plant travel. It is spacious enough to enable access of large nursery equipment, has extensive bench area and machinery location for convenient flow of plants and media for propagation, potting, and despatch activities.

6. **Resultant Patented Bench System (P.F. 2662).** Dual level system with steel frame central support raised above the floor on legs attached to the outer end of the lower bench frame.

The levels are 1 metre apart and have radiator pipes attached on both levels. On these pallet legs rest when placed on the bench by a special handling device. This runs down the aisles between each set of benches on guide rails.

7. **Pallet Carrier.** Designed specifically for this function, it may be described as having a stable base on wheels, plus a revolving mast with motorised lift of articulated fork arms. These enable it to locate and pick up the 1.18 metre pallet in a bench row and carry it in an aisle width of 0.68 metres.

The pallet may be run out to the propagating or potting bench, despatch bench, or simply transferred to a trailer or adjoining shadehouse floor where the legs of the pallet elevate the crop above the floor.

8. **Bench Capacity.** Each 1.18 metre length or "module" of bench holds 4 pallets each with 6 styrene nursery boxes. Each module holds 48 plastic propagation trays, or over 2300 50mm conventional tubes (or 42's), or approximately 140 10-cm pots, or approximately 80 12.5-cm. pots. This system gives a bench to floor area cover in excess of 150%.

It should be noted that the only manual phase is the lifting of a styrene nursery box of cuttings onto the pallet, or the location of pots or blanket propagation material such as rockwool matting onto the pallet. The pallet is then carried and located on the bench, or brought from the bench to the work area to have cuttings removed, or be treated as required.

A boom spray, self-propelled by its own water pressure, is under investigation to run along each aisle, watering or spraying both levels and both sides simultaneously. At present we hand water with great success, watering the upper level first, then returning along the lower level. Contamination and overwatering of the lower level are the chief fears of onlooking nurserymen and I was concerned by their consistent comment.

Happily, to date, we have had no clear evidence of these problems. In fact, I am becoming aware of an increasing amount of double-layering in nurseries, not to mention overhead baskets.

Factors which I believe aid our success include:

1. Very good air flow at all points in the system under, through, and above the benches.
2. Open freely-draining, well-aerated medium which does not exaggerate potential overwetting.

3. Watering heavily and as seldom as possible.
4. Maintaining moderate humidity levels.
5. Locating crops according to growth factor needs, such as high or low light.

Note also that a level or a bench may be "Tented Off" for specialised microclimatic control such as fog propagation.

Another common comment was our light source at the lower level, not exactly overhead. Our experience is again good with most species which we have placed on the lower level, including *Kentia* palms, *Calathea*, *Spathiphyllum*, *Peperomia*, *Dieffenbachia*, *Philodendron*, *Laccospadix*, *Aglaonema*, etc. Species which do show directional reaction are mainly those which have "spaced internodal trunks" such as *Aralia* and *Schefflera*, and climbing species.

Some benefits not anticipated include slightly spaced internode lengths on *Syngonium* and other "tightly node spaced" species, facilitating my style of cutting supply. This is to take early smallish, main-growth cuttings, resulting in a bushy yet compact young plant for growing on. This spacing makes the taking of cuttings so much easier and therefore quicker, which in turn is more economical.

By this practical illustration of my approach to the aims stated, I hope I have at least suggested to you that alternative approaches to nursery production can be taken. If, in time, an integrated nursery system evolves using standard sizes to facilitate production processes, quality, and systems handling, including despatch, then I believe the nursery industry will be poised to take a great step forward.

Finally, I must stress the versatility of this system which enables the enterprise to discover a market need and quickly adapt the growing or production facility to enable supply of that line, thus the nursery will be better equipped all around to go into the more competitive years ahead.

SOME PROBLEMS IN SEED RAISING

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As propagators, we find at some time we must produce some plants by sexual propagation. The old cry can be heard that seed lines are easy to grow. I often wonder how many good propagators have lost a batch of seed or have failed to germinate them. When this happens a good propagator will look to find out where he has gone wrong. Seed propagation is