THE PROPAGATION UNIT: LAYOUT AND EQUIPMENT TO AID HANDLING

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Abstract. The significant role of labour costs in the propagating unit are discussed, and the main demands on labour are identified. The scope of the materials handling problem in the unit are then investigated. Equipment and equipment design factors are then described for: (a) permanent or semi-permanent structures, (b) handling machinery, and (c) handling smaller units. Existing layouts and their particular problems are described and, finally, general guidelines for the design of new units are laid down.

Labour costs represent the biggest single item of expenditure for all general nurserymen; it seems highly unlikely this situation will change in the forseeable future. No area in the nursery has a greater labour input that the propagation unit. Most propagation departments have a higher proportion of skilled to unskilled staff than any other sector of the company. The problems of reducing labour input by mechanisation are greater in the propagation unit than any other.

DEMANDS ON LABOUR

Most units place demands on labour in three main ways:

(a) Manipulative manual skills which notably include the craftsman operations, such as bench grafting, preparing and inserting cuttings, etc. In many units this probably accounts for the largest single labour input.

(b) Maintenance operations such as watering, shading, etc. often involving measurement and human judgment as well as manual labour. Probably least demanding in labour in most units.

(c) Materials handling — this accounts for a significant proportion of the total labour content in the unit and covers all forms of handling from movement of the individual cuttings to bulk handling of cutting trays, etc.

MATERIALS HANDLING /SCOPE OF THE PROBLEM

The most complex nursery propagation units carry out propagation by seed, cuttings and grafting. In these are found diverse handling problems.

Seed — Large quantities of seed, perhaps several hundredweight, may be involved, some of it perishable, some requiring specialised treatments. The seed may arrive in small or large quantities, usually over an extended period of time.

Cuttings — Many of the large units in Great Britain and Ireland may be handling in excess of one million cuttings annually. For much of the year cuttings are highly perishable, and frequently timing of various operations, notably collection, is thought to be critical. The importance of timing can result in severe labour peaks at certain periods and this, in turn, can often lead to a failure to obtain material at the optimum stage for rooting. Handling of the individual cuttings during preparation, treatment, and insertion needs to be especially well planned or labour output can be very poor.

Grafting — Scion handling is very similar to that of cuttings. The understock which is normally pot-grown can represent a very difficult handling problem, particularly if 'drying off' of the stocks is the normal pre-grafting routine. Two individual transportation handlings of the pot grown understock can account for 22% of the total time taken in bench grafting.

Seed and cutting containers and associated media normally represent the bulk of all materials to be handled in the propagation unit. The weight of material involved can be enormous. A single 100 ft. × 40 ft. propagating house when housing filled cutting boxes may represent the movement of 30-40 tons of material. When it is realised that each complete crop represents a double handling of this weight and that the house could hold four or five crops per year, a potential handling in weight alone could amount to 400 tons of compost. In commercial practice, with losses due to access paths and a three-crop turn round, a figure of 200 tons of material or 1 cwt. per sq. ft. per year is more realistic.

EQUIPMENT AND ASPECTS OF EQUIPMENT DESIGN WHICH MAY AID HANDLING PROCEDURES

(a) **Permanent or semi-permanent structures.** Permanent structures should always be built as large as possible and in design be as simple as possible. Structural members (walls, etc.) should be designed to last 50 years.

(i) *Propagation house.* A large single span structure with a completely clear floor space and all other fittings, mist lines, ventilator arms, etc. fitted well above head height (preferably 8 ft. or more) is advisable. If bottom heat is required this should be built into the floor, selecting a system which is likely to last indefinitely (i.e. polythene heating pipes and warm water). Ideally the whole of the floor space should be capable of being heated and misted so that maximum utilisation of floor area is possible.

(ii) *Working Shed.* Efficient heating, good light provided by numerous transparent roof lights supplemented by fluorescent lighting is essential. Plenty of ventilation should be provided; this can be ensured by large sliding doors to eaves height on at least three of the walls. Clear unimpeded floor space is, of course, essential.

(iii) *Cold Store.* For technical reasons the jacketed store is ideal. Few companies can justify the cost of this for propagation requirements only, and a cheaper direct cold store is therefore a good alternative. Under direct store

individual wrapping of separate batches is essential to prevent dessication of the material, but this is often a convenient means of separating varieties of numbered batches. The value of the cold store as an aid to the short and medium term storage of propagating material has been undeservedly neglected. Intelligent use of the store can help greatly in reducing labour peaks, can reduce losses in productive time due to adverse weather conditions, and can improve utilisation of handling machinery by enabling bulking up of small individual batches, and can aid in many other ways, many still to be discovered.

(b) **Handling Machinery.** This falls into two major groups, propelled and non-propelled equipment. Propelled machines may have their own power source or be manually propelled. There is an enormous and bewildering range of equipment concerned with handling in all the possible categories and it is obviously impossible to attempt to cover it all. To keep informed of latest developments in this sphere, propagation managers may be advised to take one or more of the specialists' magazines on the subject, which are often available free of charge.

(i) *Fork lift and pallet systems.* These systems, for so long the mainstay of materials handling in industry, are slowly becoming accepted as part of normal equipment in the British nursery industry.

Fork lifts may be attached to conventional tractors, and in modern units designed with mechanical handling in mind the robustness, power and weight of the tractor may commend this system. In general, the poor manoeuverability and bulk of the tractor makes it unsuitable for use in the propagation unit. By utilising the smaller dimensions and greater maneuverability of the vineyard versions of some popular tractor models the disadvantages noted may be to some extent offset. Tractors have the advantage over most fork lifts that lifting forks may often be fitted to the front and rear of the machine, thus doubling the carrying capacity and making them most suitable for horizontal travel over some distance.

There are literally hundreds of different versions of fork lift trucks available. The choice of model will depend on numerous factors, but it is unlikely that most requirements cannot be met in at least one model. In our own case we have selected a fairly compact maneuverable cross country truck capable of lifting one ton to 9 ft high.

For handling pallet loads of filled cutting boxes inside the restricted space of the propagating house we use a hand pallet truck. This has proved to be extremely maneuverable, and does not put the structure in so much jeopardy due to accidental ramming of main structural members.

(ii) *The pallet.* If numerous types of fork lift are available, even more types of pallet can be obtained. Pallets to hold almost every conceivable type of material have been designed and manufactured. In the propagating unit the most important design is almost certainly the multi-tier pallet. These can be manufactured from a range of materials, but box section steel is to be recommended. The number of tiers can be varied by making them removable, and clearances can be changed by sliding the individual shelves into variously spaced side supports. It is quite feasible by using the multi-tier pallet to pack lorry-sized loads into a compact space which can become a highly maneuverable mobile unit.

Pallet bins can be used to speed up the handling of large quantities of loose material such as rooting media or potting compost. We have in mind to ask our supplier to produce rooting media in paper lined pallet bins

loaned to him by ourselves. We expect great labour savings over our present system of hand shovelling and wheel barrow handling.

(iii) *Tractor/trailer systems.* These can occasionally have an application, but normally the unit must have been designed with the system in mind as 'trains' comprising a tractor pulling a string of trailers is lacking in manuverability. The system is seen at its best where very large volumes and weights of material are to be moved in a linear set up, notably on the growing beds in the container unit of Darby Bros. A further refinement seen at Darby Bros. is the use of the Jack Tug which enables individual trailer loads to be detached and maneuvered separately from the main batch.

(c) **Handling smaller units.** These are normally containers of some sort for the handling of relatively small batches of seed, cuttings or scions.

Polythene bags — These are ideal where the material being handled has no need to be orientated, either because it requires subsequent sorting, or because it grows satisfactorily regardless of orientation, e.g. seed.

Once sorting and preparation of material has occurred the maintenance of correct orientation can result in great savings in subsequent handlings. We always stack prepared cuttings or scions carefully so that their bases are all level and facing one way in a plastic tray. Usually each tray contains a specific number of items. The tray is then taken to the rooting area for cutting insertion or, more commonly, placed inside a polythene bag which wrapped around to prevent moisture loss, the whole then being put into the cold store. Batches of cuttings are stored at 36-38°F for a convenient time (up to 3 weeks) prior to insertion. This system ensures that labour planning and utilisation can be best achieved. The handling of small lots by small teams of people or individuals can result in serious inefficiencies.

PROPAGATION UNIT LAYOUT

Unfortunately, this aspect is nearly always an 'after the event situation', in that many of the main characteristics of the unit have been built in, and therefore are fixed. Old units usually suffer from paths which are too narrow for access by self propelled vehicles. The site may not be level and working surfaces poor. It may be possible to purchase a quite small, cross country fork lift which may overcome the problems just mentioned, as in our own case. Such machines are not cheap, but it is false economy to consider the purchase of a mini-type tractor with a fork lift 'tacked on'.

Another alternative in the above example might be to concrete paths which are too narrow for all but hand trucks, and use a hand pallet truck in conjunction with a pallet handling system. The use of this type of arrangement has advantages over the use of hand-pulled barrows. Any developments made for the hand pallet system may at some later date be converted to a fully mechanised handling system if the opportunity for re-building occurs.

In many of the older units the engine-powered flat-bedded truck with a small carrying capacity in relation to its cost is the traditional system of materials handling. Replacement of this system by a multi-tier and bin pallet system could be well justified on reduced running costs, even if paths would need to be levelled and concreted to enable small battery-powered fork lifts to operate.

If a completely new unit is to be designed, then every opportunity exists for efficient materials handling to be designed into the system. Avoid gimmickry, keep the layout very simple for maximum long term flexibility; avoid committing yourself to a particular and specialised handling system, and allow copious access to all the major components of the unit.

Take plenty of advice from materials handling specialists, and try to see as many other well designed units as possible before finally deciding on your layout.