MECHANICAL AIDS TO PLANT PROPAGATION

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Recently I have heard prominent Australian nursery operators remark that plant propagation is labour intensive and mechanisation of propagation is not possible. Such a point of view misrepresents the role that mechanisation can play in the propagation of plants and demonstrates a misunderstanding of the role of the plant propagator.

Much of the routine work of plant propagation is repetitive and predictable and can be carried out by relatively unskilled nursery personnel. Many of the routine operations involved in plant propagation can be performed easily by mechanical aids. The role of the plant propagator is becoming increasingly advisory and supervisory in the selection of propagation techniques, appropriate materials, facilities and equipment.

The objective of mechanisation is to increase the efficiency of the operation by improving the efficiency of staff and by making their job easier (3). Rarely does the introduction of machinery eliminate manpower; the integration of man and machine achieves the best results (3). A study to demonstrate the most efficient method of operation of a potting machine established that maximum output was achieved with a labour force of seven (2).

In order to understand the role which mechanisation can play it is necessary to examine the complete production system. A nursery production system is a sequential series of operations which lead to the production of a finished plant product (1). Most complete production systems consist of four distinct stages:

(i) Propagation stage

(ii) Transplant or tube stage

(iii) Growing-on stage

(iv) Marketing stage

A detailed analysis of the operations involved in each stage and the sequence in which they are carried out can identify repetition and pinpoint areas where efficiency of production can be improved. A very comprehensive review of the development of a systems approach to nursery production has been produced by Verma (3) in which systems analysis using a computer simulation model is advocated.

It may not be practical in a small nursery situation to go that far in operational analysis but the preparation of a simple operational flow chart will enable each stage in the overall system to be examined separately to determine where improvements can be made (1).

Table 1. Operational Flow Chart — Propagation by Seed (1).

Propagation Stage
Mixing of propagation media
Transport of media to steriliser
Sterilising/pasteurising of media
Filling of propagation containers
Bulk sowing of seeds
Covering of seeds
Transport to propagation facility

The sequence of operations outlined in Table 1 illustrates that in the propagation of plants by seed all of the operations can be accomplished with mechanical assistance.

Media Mixing. A wide range of media mixing equipment is available to suit the volume requirements of most nurseries. Two basic principles of ingredient mixing are used:

(1) Agitation of ingredients in a rotating drum, a system based on the equipment used in concrete mixing.

(2) Paddle or ribbon mixing in a static chamber, as used in the mixing of stock feeds.

Transport of Media to Steriliser. The discharge of mixed media from the mixer and its transport to the steriliser (or directly to the container filling area if sterilising is not done) can be accomplished with the use of mobile trolleys or belt conveyors. It is desirable to eliminate any unnecessary handling of mixed media and a number of innovations can help to achieve this; e.g. it is possible to use many rotary mixers as a pasteurisation chamber, or to utilize the transport trolley as the pasteurisation chamber.

The use of belt conveyors is becoming increasingly common in nurseries for the transport of media to the work areas and their use can contribute greatly to improvements in efficiency.

Filling of Propagation Containers. The filling of propagation trays or community pots can be quite simply carried out using belt conveyors and overhead hoppers. More sophisticated equipment involves the incorporation of devices which meter media quantities to discharge precise amounts into each container, vibrate the filled containers to settle the medium and level the surface uniformly. Attachments can be obtained for many potting machines to enable tray filling to be carried out efficiently.

Bulk Sowing of Seeds. A wide range of mechanised seed sowing equipment is available to enable more accurate placement of seeds during the sowing process. Not only is the efficiency of seed sowing improved but the transplanting stage of seedling production may be eliminated resulting in a significant cost saving.

Vacuum seeding equipment is the most widely used method of mechanical seed sowing but pneumatic equipment, although much more expensive, is becoming more common in Australian nurseries. Small seeds or seeds of an irregular shape can be pelleted to improve the efficiency of mechanical sowing. The techniques of pre-germination of seeds prior to sowing allow greater uniformity of production and provide the nurseryman with more accurate control of quality.

Covering of Seeds. Hoppers and belt conveyors can also be used very successfully for placing a layer of covering material on top of sown seeds. The incorporation of photocells and vibrator plates enable the covering to be applied quickly and evenly with no spillage or waste.

Transport of Propagation Containers. A wide range of manual and mechanised trolleys are used for the movement of plants within the nursery with a high level of efficiency. However, even the best trolleys still require a considerable labour input in loading and unloading.

Palletisation of plant material at the propagation stage and for growing-on of plants substantially reduces the labour inputs of loading and unloading. Redesign of pallet handling equipment is necessary in order to improve the utilisation of nursery growing space.

The use of mobile or travelling benches will provide an even higher level of efficiency in the movement of plants within the nursery. The containers are placed directly onto the travelling benches at the propagation stage and thereafter no manual handling of individual containers is necessary. The travelling bench allows a moving production line concept to be introduced to the nursery. Newly propagated plants enter through one end of the production facility and emerge through the other end when ready for sale.

Travelling benches can also facilitate conditioning or hardening off of plants within the nursery without the need for manual movement of individual plants. This is particularly valuable in the production of seedling crops such as vegetables which are destined for field planting. The benches filled with

plants are wheeled or rolled outside during the daytime to be hardened off in full sun but they can be easily and quickly returned to the protected growing environment in the event of unfavourable weather conditions.

SUMMARY

The examples of mechanisation used in this paper relate primarily to aids used in the sequence of production operations involved in the large scale production of plants by seed. An analysis of the production systems used in the propagation of plants by cuttings or other vegetative propagation techniques would reveal similar opportunities for the use of mechanical aids.

The decision to incorporate mechanical equipment in the nursery must take into account the scale of operations of the nursery. Large scale output of a limited range of plants lends itself better to mechanisation than the small nursery with wide diversity of production.

As cost pressures continue to increase manpower productivity becomes of increasing importance to the nursery operator and the incorporation of mechanical aids will do much to increase that productivity.

LITERATURE CITED

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