NURSERY SYSTEMS

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A system is defined as "a regularly interacting or interdependent group of items forming a unified whole." Certainly any nursery fits this definition. It is sometimes more accurate to say that the nursery system through the interaction and interdependence of its components provides a source of consternation to the manager and others who may be dependent upon it. This we strive to make the exception rather than the rule.

1/ Panel presentation. Papers of panel participants are included.

Differences in basic nursery systems result from:

1. Differing species.
2. Differing seedling sizes.
3. Differing soil types.
4. Differences in facilities.
5. Differences in climate.
6. Differing preferences for methods and equipment.
7. Tradition.

The first five are valid criteria for selection and matching of components into a nursery system. Preferences and tradition are questionable criteria for component selection.

My objective this morning is to look at some nursery component interaction and illustrate the interdependence and the necessity for matching the components in a nursery system. With a little luck it may help you to recognize a logjam or a deadfall before you reach it in your nursery system.

Historically, nurseries required high labor inputs to keep things functioning smoothly. From bed layout through weed control to the harvesting phase a pair of hands performed most of the operations. As long as labor was available in quantity, at relatively low cost, we felt little pressure to apply the technological advances developed in other industry. Recently most of us have experienced shortages of manpower and rising costs. This has provided the impetus for innovation and mechanization of many nursery operations.

The major components of the nursery system, as I see them, are production, processing, and marketing. Production includes seed sowing and care. Processing includes harvesting, transportation, packaging and warehousing. Marketing includes delivery systems involving transportation and warehousing,

The nursery superintendent can be likened to the general manager of a manufacturing company, in the respect that he is responsible for all three phases of the system. He wears three hats, that of Production Superintendent, Processing Plant Manager, and Director of Marketing. He also is Director of Research and Development since he is responsible for innovations and improvements to all three systems so that his costs remain competitive and the quality of his product remains high or is continually improved. This latter responsibility may be the most troublesome, since a change in one part of the system effects all the succeeding operations to some degree. It is this R&D responsibility I would like

to emphasize this morning, beginning with production.

Decisions regarding sowing effect subsequent operations. The first decision might be drill versus broadcast methods of sowing. There are definite advantages to both methods. Broadcast sowing is said to foster better root development and minimize weed control problems. Better control of seedling depth may be possible with broadcast sowing.

Drill sowing is reputed to be a cheaper method since seed placement and cover are regulated in one operation. Some between the drill row operations are possible in drill sown beds if spacing is wide enough. Examples of this are the basket-type mechanical weeders used in certain nurseries. Lateral root pruning is possible with this method. But perhaps most important, mechanical harvesting with the devices currently in the development, testing, or operational phase is possible with drill sowing. In so far as the physiological or morphological development of the seedling is concerned, the sowing method probably has little effect on the end product. The decision you make with regard **to sowing** method only becomes important when other components of the nursery system are considered.

Regardless of the sowing method, seedbed densities are the single most important factor governing the quality of the stock produced and succeeding operations. Quality control is more properly a function of the production component of the nursery system. Too often we relegate this important function to the processing component of the system. The grading room floor is not the place for quality control.

Within narrow limits, in the range of 25-35 seedlings per square foot, little quality difference may be experienced. However, densities varying above or below this range often have a striking impact on morphological development.

Higher densities result in more time expended in grading to a fixed standard and more nursery area required to produce a given quantity of premium seedlings. Nursery care is affected by the sowing system selected and bed densities achieved. Mulching, fertilization, shading (if practiced), weed control, insect and disease control are all effected either quantitatively or qualitatively by the sowing system or the results obtained with the system.

Leaving the production component of the nursery system, the next component is that of processing. This includes harvesting the seedlings from the field, transporting them to the packaging area, and accomplishing the job of packaging and storage for further shipment. Of these harvesting is perhaps the only one that has retained it's basic character since the beginning of nursery history.

Sure, some changes have been made in equipment configuration, power source, and containers used in the field but the two-hand-method of manual removal of seedlings from the nursery bed has remained the primary lifting procedure. The speed that a man could pull trees governed the output of the nursery. This has been unchanged except by the introduction of more hands into the system. Harvesting has controlled the transportation requirements, the grading and packaging speed, and the distribution rate to the field planters.

It seems that now we are on the threshold of truly mechanical harvesting with the several lifter developments that you will hear about later. However, mechanized harvesting will not be the panacea that we are seeking if it is introduced into existing nurseries with the same system components we are currently using.

A good sized lifting crew can pull 400,000 seedlings in a day; it requires 20 to 35 people to grade and package this quantity depending on the system in use and the intensity of grading, which again is primarily dependent upon the seedling density at which they grow.

Mechanized harvesting offers the opportunity to move two to four times this quantity within the same time frame. Assume for a moment that you have one of these expensive harvesting devices in your nursery, with the capacity to double, triple, or perhaps quadruple your daily harvesting output. Would your present transportation system, grading and packaging system, and distribution system allow you to operate such a machine at full capacity? *My* guess is that most of us would answer "no."

Let me suggest that successful mechanical harvesting rather than solving all of our seedling handling problems simply transfers the burden to subsequent operations. The greatest gain that accompanies mechanical harvesting is that of flexibility. It may not be necessary to operate the harvester at peak capacity. You can slow it down or only operate it on a part time basis, but I feel this decision should be based on the field planting demands for trees and not our ability to handle the output of a harvester.

A harvester is only the first step in streamlining our nursery operations to produce, process, and market seedlings more efficiently. Most of our field handling system needs a major overhaul. The small rigid container system in use for field to processing point transport may not accommodate the output of these harvesters.

Consider some hypothetical figures for a moment. At a speed of 20 feet per minute your transport system will need to accommodate 144,000 seedlings per hour. With a container capacity of 2,000,

the minimum requirement is 72 containers per hour. On a daily basis when recycling is on the basis of 200 containers, or a packaging output of 400,000 seedlings per day, the transport system must make available 376 containers per day.

However, the disparity between the harvesting component and the packaging component causes increasing container demand. Some 304 containers remain in the storage system containing the unprocessed trees. If you were a manager in a system of this sort, you have four alternatives.

1. Stop the harvesting operation.

2. Introduce more containers and more storage capacity into the system.

3. Increase the packaging capability which in turn will place additional demands upon the marketing or storage component of the system.

4. Combinations of these alternatives.

A solution to the transport and container problem may be in field packaging behind the harvester and accomplishing the harvesting and packaging in the field without the discontinuity we currently experience in these components. With this solution, the grading and counting operation might be obsolete as we know it and in some cases practice it. Quality control would be moved to the production component of the system where it can be accomplished through precision sawing and programmed growth. Quantity control might be through improved inventory accuracy and the use of ADP for rapid inventory processing as it is in some nurseries at present. Bed density may be controlled by implanting seed of known germinative capacity into a narrow plastic tape that dis-integrates in the soil. Seed sowing may become a simple matter of unrolling a tape on the soil and ccvering it. This method is being used to some extent in agriculture and experimentation with tree seed is in progress at an Oregon state nursery.

In summary, differences in nursery systems result from:

1. Differing species.

2. Differing seedling sizes.

3. Different soil types,

4. Different facilities.

5. Different climate.

6. Different preferences for methods and equipment.

7. Tradition.

In selecting and matching components, preferences and tradition are questionable criteria for component selection.

Because nurseries do not represent great market potential the manager is unable to select from devices developed specifically for his industry. He must make his selection of compatible components from the wide array developed for other applications or by his colleagues.

This task is certainly formidable since field trials of equipment are not often available to aid in his selection. Because of this, each nursery system is the product of the manager's ability to cut fit, borrow, and develop the various components to satisfy the biologic, edaphic, and budgetary constraints imposed upon him from above and below. This is not a one shot program in a nursery, some of us may tend to rest on our oars feeling smug that we are ahead of the industry with our advanced techniques. When we resume the rowing we may find we are several lengths behind in a relatively short period of time. Over the past 15 years, I have been priviledged to visit one nursery in the Southeast three times during the shipping season. On the first visit the grading and packaging operation required large amounts of hard labor to count, grade, and package the stock. On my most recent visit, a small crew was packaging on a weight basis without intensive grading. This manager has successfully moved the quality control in his operation from the processing component to the production part of the system where it can be more economically accomplished. As a nursery manager you soon note that "good advice often interferes with your plans" and that it is available from so many sources, at least that has been my experience.

The nursery system is a blend of the seedlings biological requirements and the nursery manager's experience. The biological requirements of our crop are pretty well known and usually fulfilled, but we always need more experience and good advice. You will receive some of both here. Because of the differences in nursery systems it will be necessary for you to sort out the ideas you can use and fit them to the pecularities of your nursery system.