FOREST MANAGEMENT BUREAU RELEASED APR 06 2017 RECORDS UNIT

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MEMORANDUM

FOR : The Regional Directors
Regions 2, 3, 4A, 5, 6, 9, 12, 13, NCR & NIR

FROM : The Director

SUBJECT : **TECHNICAL BULLETIN 22-E (ADDENDUM) - CROP RECORDING FOR THE DEVELOPMENT OF PROPAGATION PROTOCOLS**

DATE : APR 05 2017

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I. This Technical Bulletin

This Technical Bulletin is to introduce some of the methods and procedures of collecting data necessary to start managing a nursery and to impress on the nursery management the importance of keeping good records right from the start. The types of records kept at a container nursery fall into two general categories: 1) financial and production records, and 2) cultural records.

II. Users of the Technical Bulletin

The users of the Technical Bulletin are the Nursery Managers, Growers, Assistant Growers and readers who will operate a seeding machine and tray topper for a mechanized nursery for native plants as well as exotic plants in the tropics.

III. Introduction

Recordkeeping is a vital component of effective and successful nursery operation and management. A common weakness to an efficient nursery operation is the lack of records about seed treatments, germination requirements, percentage of germination, plant development, and special crop needs. One of the potential benefits of good recordkeeping is the development of successful propagation protocols. A propagation protocol is a document that shows all the steps necessary to propagate a plant, from the collection of seeds to outplanting.

The most important record to keep is a daily log that tracks what happens with each crop. Eventually, protocols can be developed from these logs and tailored to the unique growing conditions of a specific nursery to allow nursery managers to more readily repeat success from year to year.

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IV. Data Collection and Analysis

A. Financial and production records

Financial records are kept to account for expenditures, to control the budget, and to provide the records necessary for improving procedures in the future.

A financial record keeping system should be designed to document three general classes of information: (1) expense data; (2) production data; and (3) unit-cost data.

The data can be recorded by individual nursery operation (such as "sowing") but can also be used to analyze other production variables such as species and container size. Information on seedling production costs should be organized to reflect different cost elements including supplies, utilities, services, and labor (Table 1). Analysis of this information can show to the nursery managers where costs are excessive and help make management decisions. Because labor is such a large component of production costs, nursery managers should collect the number of hours spent on each task along with the number of seedlings processed. This information can then be analyzed and formatted to produce tables (Table 2) that can be invaluable in making sound management decisions such as whether to invest in new labor-saving equipment.

Table 1. Production costs for two (2) different crops of container seeedling

Cost Elements	Dry Season Crop (Nov-Apr)	Rainy Season Crop (May-Oct)	Average % of Total Cost
Propagation Supplies			
Growing media			
Seed			
Fertilizer			
Pesticides			
Other Supplies			
Utilities			
Power			
Fuel			
Services and Rentals			
Labor			
Full time			
Part time			
Misc. expenses			
Total cost per 1,000 seedlings			
Total cost per crop			

Note: The list of cost elements is not limited to the above, other elements can be added.

Financial records should also include detailed production data regarding operational information such as "hours of labor spent filling containers" or "bags of fertilizer purchased" or "numbers of a certain species of tree seedlings shipped." Such production information can be helpful in many management decisions regarding materials purchasing, budgeting, or other operational, cultural, or maintenance activities. These financial data can be used to calculate unit cost (pesos per thousand seedlings) that is essential for estimating future production costs when bidding on seedling growing contracts.

Table 2. Average nursery labor requirements and cost per process

Process	Hours/1,000 seedlings	Cost per 1,000 seedlings	% of Total
Seed preparation			
Sowing			
Transplanting			
Fertilizing			
Weeding			
Watering			
Maintenance			
Grading			
Packing			
Shipping			
Total per crop			

Note: The list of processes is not limited to the above, other processes can be added.

Modern computer-based record systems make record keeping much easier, especially the sorting of the data into different categories and displays for analysis.

B. Cultural records

Cultural records are maintained to provide a plan for duplicating successful crops and give an accounting that can be used in (a) determining the cause of errors in the culture of the crop, (b) deciding on action taken on the current crop, and (c) making plans to avoid problems with future crops.

Cultural records fall into three categories: 1) growing schedules, 2) environmental conditions in the propagation area, and 3) crop development records

1. *Growing schedules.* These written plans of crop timing are essential to successful nursery management and are developed prior to sowing based on the best information and experience available. Growing schedules may be only rough outlines of dates for key cultural processes, such as sowing, thinning, and harvesting, or they can provide considerable detail on each

step of the process together with a record of actual accomplishment. The best growing schedules include a variety of operational considerations related to crop timing, culture, and growing space utilization. They should include:

a. Target specifications for the crop and the time of delivery.
b. Adequate allowance of time for seed stratification, if needed, prior to sowing and for a proper hardening period prior to shipment.
c. Placing species or container types with similar growth regimes in the same propagation environment.
d. Planning efficient use of space in the propagation environment to allow large blocks of similar trees to be sown at the same time and, if possible, placing seedlings to be removed first near the perimeter or doors for ease of handling.

Growing schedules should serve as a daily reminder to the nursery manager about the operations to be done and should, in aggregate for the various crops being grown, serve as the basis for work force and materials planning on a week-to-week basis.

Table 3. Seedling growth data can be very useful in detecting problems

Fertilizer Used	Age (weeks)	Total seedling dry weight (mg)	Shoot:root ratio	Growing media level (ppm)	Nitrogen content	Management analysis
						(Acceptable Growth)
						(Better growth)
						(Inferior growth)

2. *Environmental conditions.* This set of culture-related records contains information such as temperatures inside and outside the propagation structure, solar radiation intensity, growing medium nutrient analysis, occurrence of insect pests and disease, and other general observations. These records not only show the crop environment maintained but also will indicate various equipment failures and any involuntary deviations from the growing schedule. Abnormal crop conditions discovered later can often be related back to mechanical failures as indicated in the environmental records.

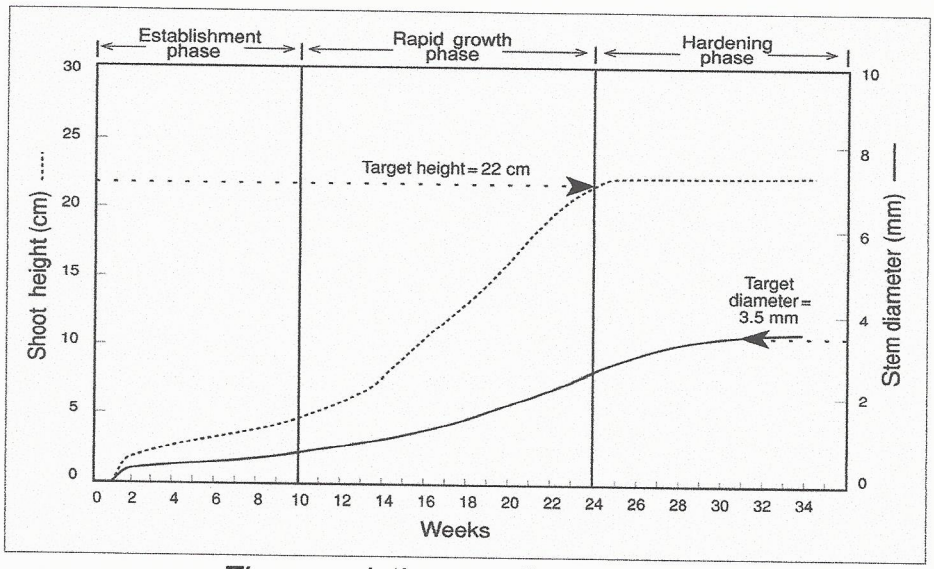
This weather information can be stored on disk and can be used to plot and analyze trends, which can help nursery managers spot problems quickly and take corrective action before serious growth loss occurs.

3. *Crop development.* All nurseries should keep some form of permanent records that monitor the growth and development of their crops over the growing season. Nursery managers should monitor significant events such as speed of germination and take periodic measurements of growth parameters including shoot height and stem diameter (caliper). Root growth is more difficult to monitor because seedlings have to be removed from the container. Although it requires destructive sampling, seedling ovendry weight is a useful index of crop development and is necessary for the calculation of shoot-to-root (S:R) ratios.

C. Data Collection and Crop Scheduling with Computers

The format for data collection and growing schedule can be as simple as a handmade chart on graph paper or as detailed as a commercial scheduling calendar. Growing schedules are easy to construct and design with modern word processing or spreadsheet computer software programs. These tables and graphs can be developed in Corel WordPerfect in a few hours using the "Table QuickCreate" feature. Microsoft Word' and other programs have similar capabilities.

During the growing season, seedling growth trends can easily be visualized by graphing shoot height and caliper over time. Although they can be plotted by hand, computers make this process easy and the information can be stored for future analysis. These growth charts are invaluable in monitoring crop development and adjusting cultural practices during the growing season. For example, if one seed lot shows slow growth compared to the target growth curve, the nitrogen fertilization rate can be increased to bring it up to expectations. On the other hand, if the seed lot shows stretching, a moderate water stress can slow down the growth. Accumulating growth records and developing charts over several crops allows the nursery manager to reasonably predict seedling growth.



The cumulative growth curve

Growth curves are the basis for refining growing schedules and predicting the time and resources necessary to produce the target seedling. The effects of unusual weather or other cultural factors on seedling quality or delivery time of a crop can also be projected.

Table 4. Target seedling specifications for reforestation sites

Species	Stocktype	Shoot Height (cm)		Stem Diameter (mm)	
		Target	Range	Target	Minimum

Towards the end of the growing season, distribution curves of height and caliper can be used to illustrate how well a particular crop meets its target specifications. Then, the grading (culling) standards can be set based on the target seedling dimensions and the ability to the crop to meet these expectations. For shoot height, the shippable seedlings are usually clustered in a normal distribution around the target specification, with the culls distributed in both tails of the curve below the minimum and above the maximum height standards

It is best to appoint one person—the crop monitor— responsible for taking all seedling development and inventory measurements. This ensures that the measurements are taken the same way each time and, because they become intimately familiar with crop development. Seedling height can easily be taken with a ruler and stem diameter with calipers, and the data recorded on prepared data forms.

FOR INFORMATION AND GUIDANCE.

NONITO M. TAMAYO, CESO IV