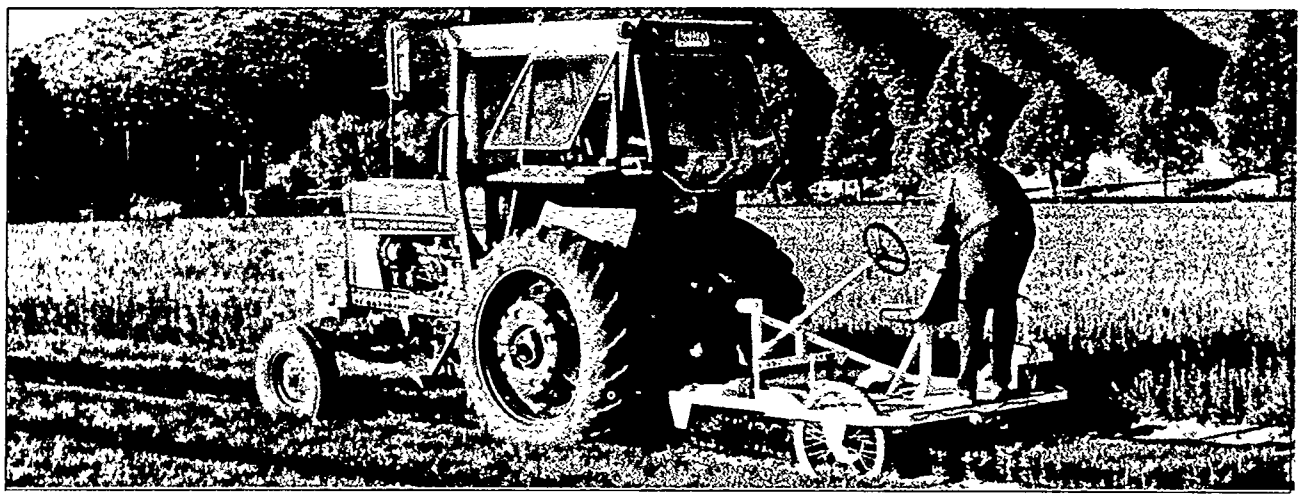
6.0 Inventory and Quality Monitoring



Each year nurseries conduct one or more inventories of the seedling crop using standard sampling procedures. Seedling inventories are used to:

- Determine the sowing efficiency for each seed lot and species to calculate the sowing rate for future crops.

- Calculate the number of seedlings in each age class to help plan for staffing and supply needs.

- Estimate the number of seedlings that will meet grading standards. These statistics not only help the nursery manager project seedling sales and establish prices, but also can be used to develop better cull factors for each species and seedlot to better manage future crops.

- Survey the amount and extent of damage by pests or abiotic injury. These unanticipated events can seriously affect seedling survival and growth rates, and estimates of damage are needed to adjust the standard inventories.

The purpose of the inventory will determine its timing. Sowing checks are usually done as soon as the germinants have emerged and become established in the seedbed, although earlier checks may be needed as problems are observed. Some nurseries perform only one inventory per year to predict the number of shippable seedlings, usually after the seedlings have stopped height growth and set buds. Pest surveys are done whenever serious damage is observed.

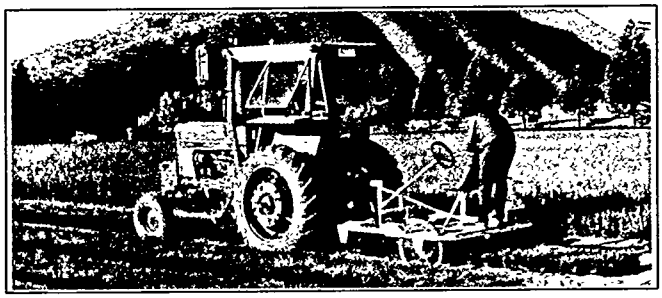
Common inventory terms include:

Gross — the overall number of seedlings per seedlot.

Net (shippable) — estimated number of seedlings which will meet morphological standards of height, caliper, root volume, etc.

Cull — the difference between the gross and net inventories, i.e., the number of seedlings that will be discarded (culled) for size or quality purposes, usually expressed in percent.

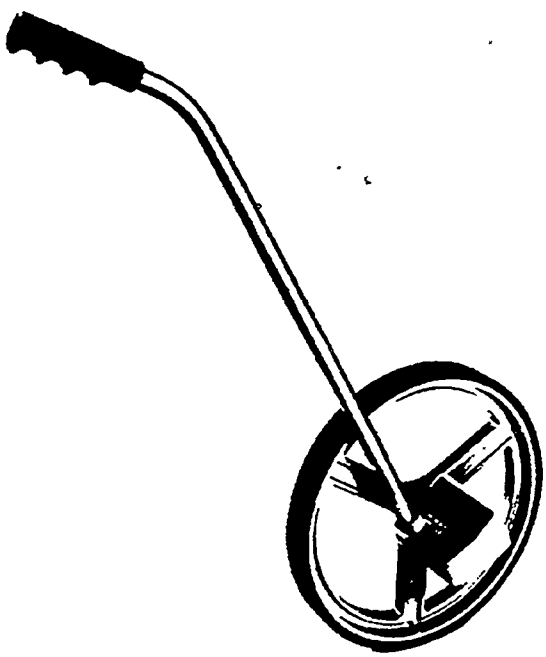
6.1 Measuring Seedbeds



Many nursery cultural operations require an accurate knowledge of the area that is sown with each particular seedlot. The correct application of fertilizers, herbicides, fungicides are all contingent upon knowing the amount of area to be covered. Seedbeds are measured in a number of ways. Some nurseries use ordinary tape measures or land-measuring wheels to determine the actual sown area of seedbed. Others use more sophisticated electronic measurement instruments. The choice of method will depend on the cost and the amount of precision and accuracy desired.

Land-Measuring Wheels

These wheels are used to determine distances, area, and acreages. They consist of a wheel mounted on a light frame. A meter records each revolution of the wheel.



Land-Measuring Wheels:

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Edwards Equipment Co., Inc.
4312 Main St.
Yakima, WA 98903
(509) 248-1770

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

General Supply Corp.
P.O. Box 9347
303 Commerce Pk. Dr.
Jackson, MS 39286-9347
(601) 981-3382

Nasco
901 Janesville Ave.
Ft. Atkinson, WI 58538
(414) 563-2446

Redington Counters, Inc.
P.O. Box 608
130 Addison Rd.
Windsor, CT 06095
(203) 688-6205

Trumeter Co., Inc.
38-40 W 32nd St.
New York, NY 10001
(212) 564-0666

Electronic Distance Meters

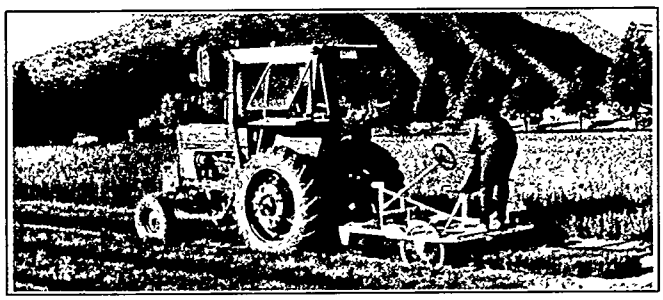
These devices, known as EDMs, measure distance only. They can be used alone or mounted on a transit or theodolite. An infrared beam and a prism are used to measure distance and some models have built-in calculators. The cost of the various models will vary with the accuracy range. Ultrasonic measuring instruments that can measure up to 250 feet are also available for short distance measurement and are inexpensive.

Electronic Distance Meters:

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
Jackson, MS 39284-8397
(800) 647-5368

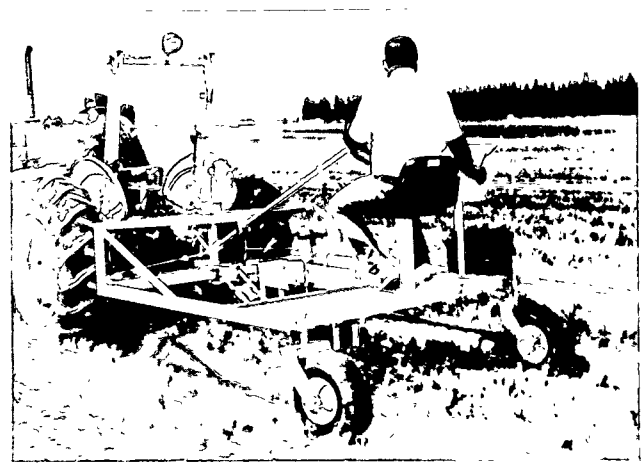
6.2 Inventory Equipment



Typical seedbed inventory equipment consists of a rectangular metal sampling frame that is slightly longer than the distance across the seedbed and either 6 inches or 1 foot in width. These sampling frames are usually fabricated at the nursery. The sampling position within the seedbed is determined with a measuring tape and the inventory information is recorded on a clipboard or entered into an electronic data recorder. The use of an electronic data recorder greatly reduces or eliminates data entry time into a PC or mainframe computer. The drawback of some data recorders is the small viewing screen, which hinders the review of previously entered data.

MTDC Seedling Counter

The MTDC counter consists of transmitter and receiver circuitry housed in sealed aluminum enclosures and mounted on skids, a magnetic pickup for determining distance traveled, a stem diameter reference, and a computer for data storage and retrieval that interfaces with a personal computer and provides a permanent data base. These components are transported on a steel frame that attaches to a tractor with a category II three-point hitch.

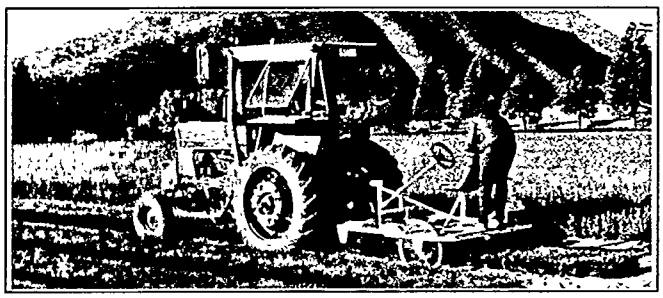


The counter's optoelectronic detector uses an invisible infrared light beam to detect and count seedlings. A transmitter emits a beam of light across and through the seedling row to a receiver. The beam shape—a vertical plane of light makes it possible to distinguish seedling stems from branches.

Drawings, an operating manual, and a video, *The Seedling Counter*, are available on request from:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900

6.3 Data Processsing

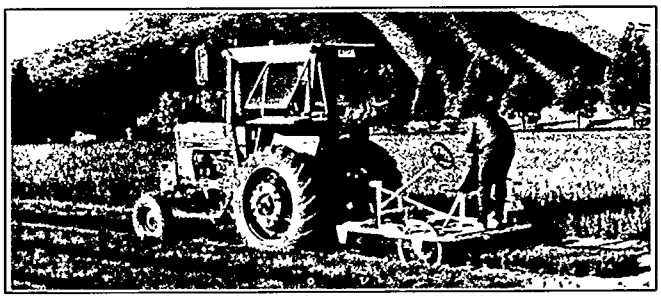


Use of computers to calculate nursery inventories has greatly facilitated this time-consuming project. Personal desk and laptop computers as well as mainframe systems are used. Most nurseries develop their own software for inventories. Field use of hand-held and laptop computers for information storage is common. Processing and data manipulation is usually accomplished on PC's and main-frame systems in the office. Local computer stores and software consultants can provide the necessary assistance.

Data Recorders and computers are available from common computer outlets and:

Omnidata International
P.O. Box 448
Logan, UT 84321
(801) 753-7760

6.4 Measuring Seedling Quality



The "quality" of tree seedlings depends on how the stock will be used. For most forestry and conservation purposes, seedling quality is defined as outplanting performance on a specific site — both initial survival and subsequent growth. Currently, there is no single test or procedure that totally predicts seedling outplanting performance, but seedling quality tests can be divided into two categories:

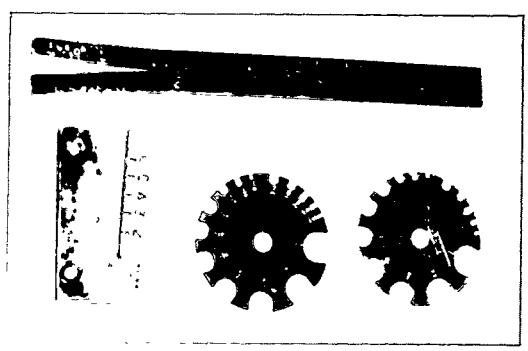
***Morphology Tests**—Tree seedlings have traditionally been evaluated by morphological characteristics such as shoot height, stem caliper, and dry weight. Chemical tests of mineral nutrient and carbohydrate status also fall into this category and are sometimes used to help measure seedling quality.*

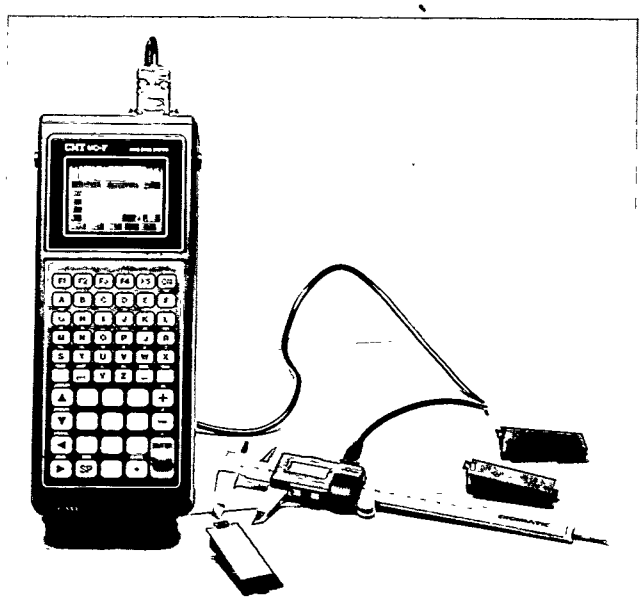
***Physiology Tests**—In recent years, a number of seedling quality tests that actually measure seedling performance under specific environmental conditions have to been developed. Root Growth Capacity (RGC) tests measure the ability of seedlings to regenerate new roots when grown under ideal growth conditions. Cold hardness tests involve placing seedlings in a cold chamber at a range of freezing temperatures and measuring the actual damage to foliage, buds, and stem tissue.*

Although some larger nurseries are equipped to do these tests on-site, others use the services of private testing laboratories. By having an independent laboratory perform the test, both the nursery and the customer are assured of receiving an unbiased, objective evaluation of the condition of the seedlings.

Stem Caliper Measurement Devices

Devices to quickly gauge the stem diameter of seedlings are used both in the field for inventory and also in the packing shed. They range from circular gauges to "V"-shaped home-made devices to electronically record micrometers. Stem caliper can be obtained by using various devices.





Chase Tree Gauge:

A.M. Leonard
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Electronic Caliper:

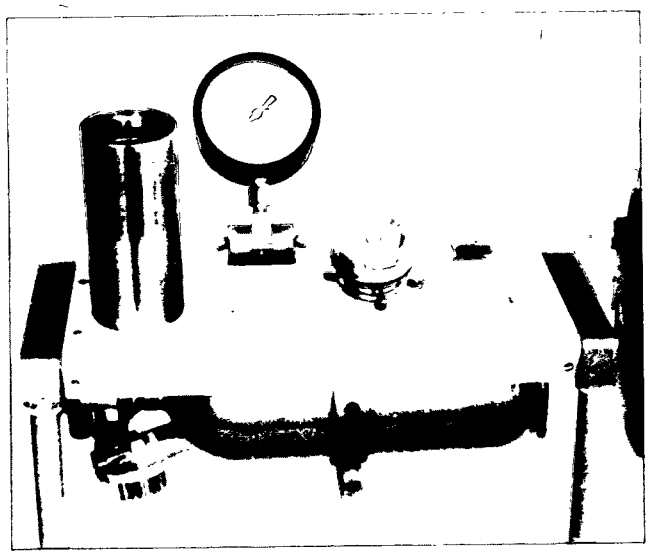
Corvallis Microtech., Inc.
413 SW Jefferson Ave.
Corvallis, OR 97333
(503) 752-5456

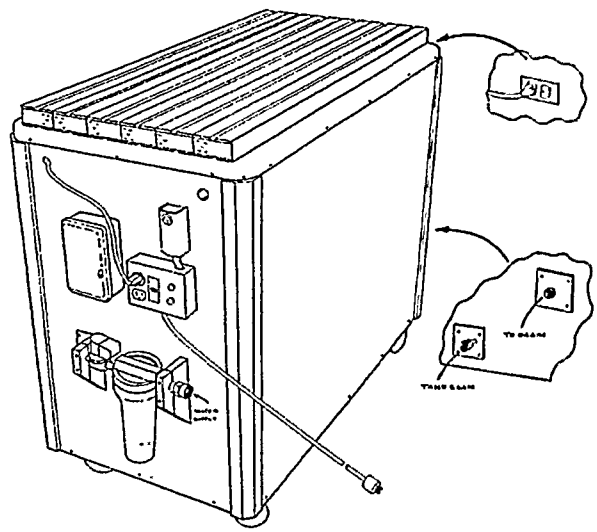
PMS (Plant Moisture Stress) Test Devices

Plant moisture stress (PMS) is a measure of the internal water content of plants. While nurseries now have the capabilities to measure the amount of water (osmotic) stress seedlings are exhibiting at any point in time, this measure is not truly an accurate assessment of seedling quality. It is an indicator of the amount of water stress the seedling is exhibiting at the moment the test is performed and is useful for scheduling irrigation as well as checking PMS levels during lifting, grading, packing, storing, transporting, and outplanting operations.

Drawings of a Root Growth testing chamber are available from MTDC upon request:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900





Moisture Stress Equipment:

PMS Instrument, Co.
2750 NW Royal Oaks Dr.
Corvallis, OR 97330
(503) 752-7926

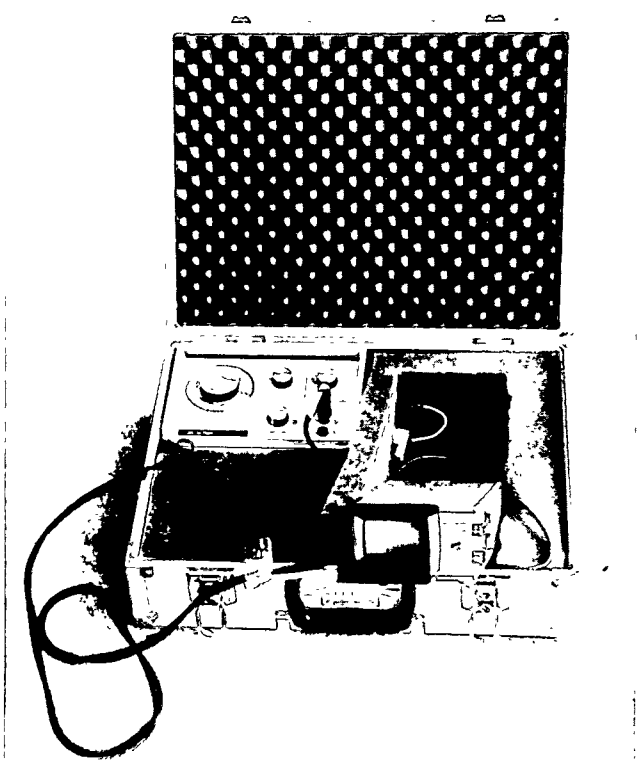
Testing Facilities:	**Foliar Testing:**
International Paper Co. Seedling Testing Service 34937 Tennessee Rd. Lebanon, OR 97355	Century West P.O. Box 1174 Bend, OR 97709 (503) 382-6432
Weyerhaeuser Research Center Seedling Testing Lab 505 N. Pearl St. Centralia, WA 98531	Soil/Plant Testing Lab Strand Ag. Hall Oregon State University Corvallis, OR 97331 (503) 737-2187

Dormancy Testers

Shock is one of the primary problems in transplanting nursery stock. It is generally believed that the best time to transplant is during dormancy.

Tests show if the plants are dormant. Forest Service nurseries at Lucky Peak and Coeur d'Alene test their plants with an electronic apparatus that consists of an oscilloscope, a square-wave generator, and a electrode. The operator inserts the electrode into the seedling's stem. The amplitude of the wave produced on the oscilloscope indicates the seedling's state of dormancy.

For more information on performing this test, see *Portable Oscilloscope Technique for Detecting Dormancy in Nursery Stock*, 1975, Technical Report INT-26, available from the USDA Forest Service Intermountain Forest and Range Experiment Station, 324 25th Street, Ogden, UT 84401.



Oscilloscope:	**Wave Generator:**
Tektonix, Inc. Time Square Park 300 W Mercer Way Sallt Lake City, UT 84115 (801) 486-1091	Wavetek P.O. Box 85265 9045 Balboa Ave. San Diego, CA 92128 (619) 279-2200