What is a Soil Management Plan, and why would you want one?

Next to water, soil is the most important resource of a bareroot nursery, and must be properly managed if the nursery is to be successful. Soil quality is not fixed, but instead, soil is living and constantly changing. Even the most productive nursery soil can be ruined by improper cultural practices. Seedling harvesting is particularly harmful. Bareroot seedlings differ from most other crops in that the entire plant, including the roots, is removed and so little organic matter is returned to the soil. Due to the necessity of having to lift bareroot seedlings during the dormant winter period when the weather is often wet, soil structure can be seriously damaged within a relatively few years (Figure L).

Figure L. Seedling harvesting during wet winter weather can seriously damage soil productivity

Many soil problems can be avoided by careful nursery site selection, but economic and political considerations often outweigh biological factors when a new nursery is established. Few nursery managers have had the luxury of participating in the selection of their nursery site, and so must manage their soil in the best way that they can. Frequently, new nursery managers find that they have inherited a worn-out soil that must be coaxed back into full productivity.

Bareroot seedling production is a complex interplay between the physical, chemical, and biological properties of the soil, and the cultural operations used at the nursery. Cultural practices, such as fertilization and irrigation, must be properly scheduled and executed to complement the unique characteristics of individual nursery soils. For example, even moderately saline or alkaline water can severely reduce soil productivity if irrigation is improperly applied

and corrective soil amendments are not used. Soil microorganisms, both beneficial mycorrhizal fungi and root rot pathogens, are also affected by soil characteristics and nursery cultural practices.

Steps in Developing a Soil Management Plan

Soil management must be approached in a **planned, systematic** manner. Because of the complex nature of a productive nursery soil, a series of spontaneous, unrelated cultural treatments will not produce the desired result. Soils are unique - there are no two nurseries that will have exactly the same soil conditions. For this reason, each nursery should attempt to develop a written soil management plan that considers the special nature of their nursery soils. Because of differences in economics and management objectives, the exact size and complexity of the plan will vary with the size and resources of the nursery.

A typical nursery soil management plan consists of four sequential processes:

1. *Mapping nursery soils - an* accurate soil survey is the foundation of a functional soil management plan but I have found that many nurseries do not have an up-to-date soil map.

2. *Analyzing soil survey results* - the results from the soil survey must be interpreted and correlated to seedling growth.

3. *Assessing soil production potential* - soil survey results must be integrated with operational realities.

4. *Implementing and updating the plan* - soil management is a continuing process, and so the plan will need to be periodically adjusted to reflect changing soil conditions or production goals.

Let's look at the first step: Mapping nursery soils

Obtain general soil survey information about your nursery - One of the best sources of soils information is the USDA-Soil Conservation Service (SCS), which conducts largescale soil surveys across the nation. Packets containing maps and descriptions of the major soil types occurring around the nursery are available by county from the local SCS office. Although the information from these surveys is too general to use for the Soil Management Plan, they will give a good idea of the soil types and conditions that may be encountered during the intensive nursery soil survey.

Make an accurate, up-to-date nursery map -One of the easiest ways to produce a map is to obtain a recent aerial photograph of your nursery from the local USDA - Agricultural Stabilization and Conservation Service (ASCS), SCS, or County Extension office. Enlargements of the aerial photos can be obtained from the master files in the Salt Lake City Office of the ASCS. A working map can be produced by outlining the boundaries of the nursery, and then enlarging or reducing it on a copying machine (Figure M). The scale of the map can be determined by measuring the distance between two easily recognizable landmarks on the ground, and comparing that distance to the map distance.

Establish nursery management units - A management unit, often called a **"block",** is the smallest area that can be managed for a particular crop. Blocks are usually controlled by roads, irrigation lines, windbreaks, or other features of natural topography. For example, the nursery blocks at the Colorado State Forest Nursery in Ft. Collins are determined by the location of the surrounding windbreaks (Figure M). The nursery blocks will delineate the sampling populations for the soil survey, and should be identified with a number or letter to aid the sampling process. The intensive field analysis and soil samples for testing will be collected within the boundaries of these blocks.

Determine soil survey sampling criteria -Before the survey can begin, it is necessary to identify the physical, chemical, and biological conditions **("limiting factors")** that affect seedling growth at your nursery. Some of these are standard for most forest and conservation nurseries, but others will be unique to specific sites. Note that these sampling criteria are different from those used in standard SCS surveys. Some typical examples include:

Physical Factors

* Depth of arable soil (Figure N)
* Soil texture
* Soil structure
* Compaction layers

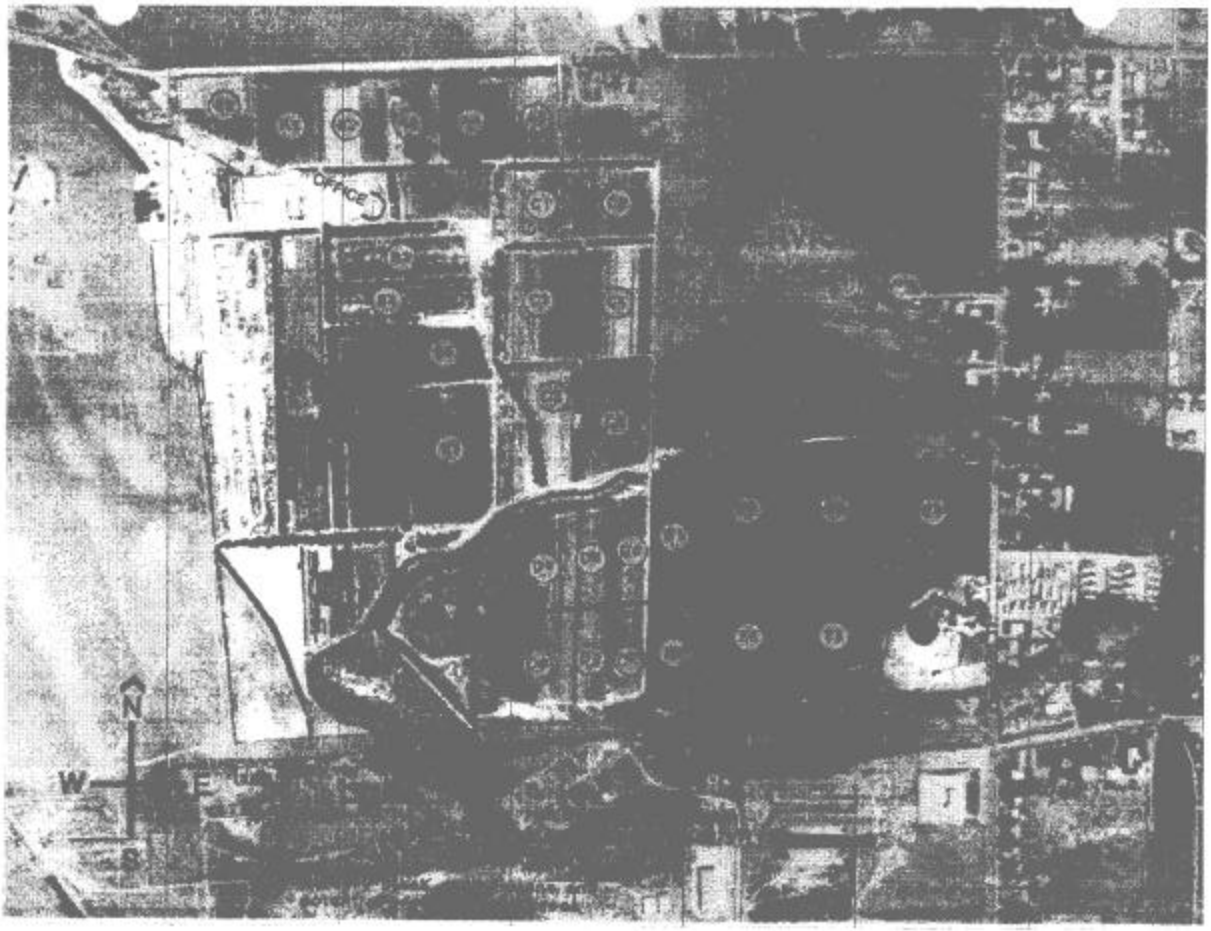

Figure M. Maps for soil surveys can be made from aerial photos and the nursery blocks can be superimposed.

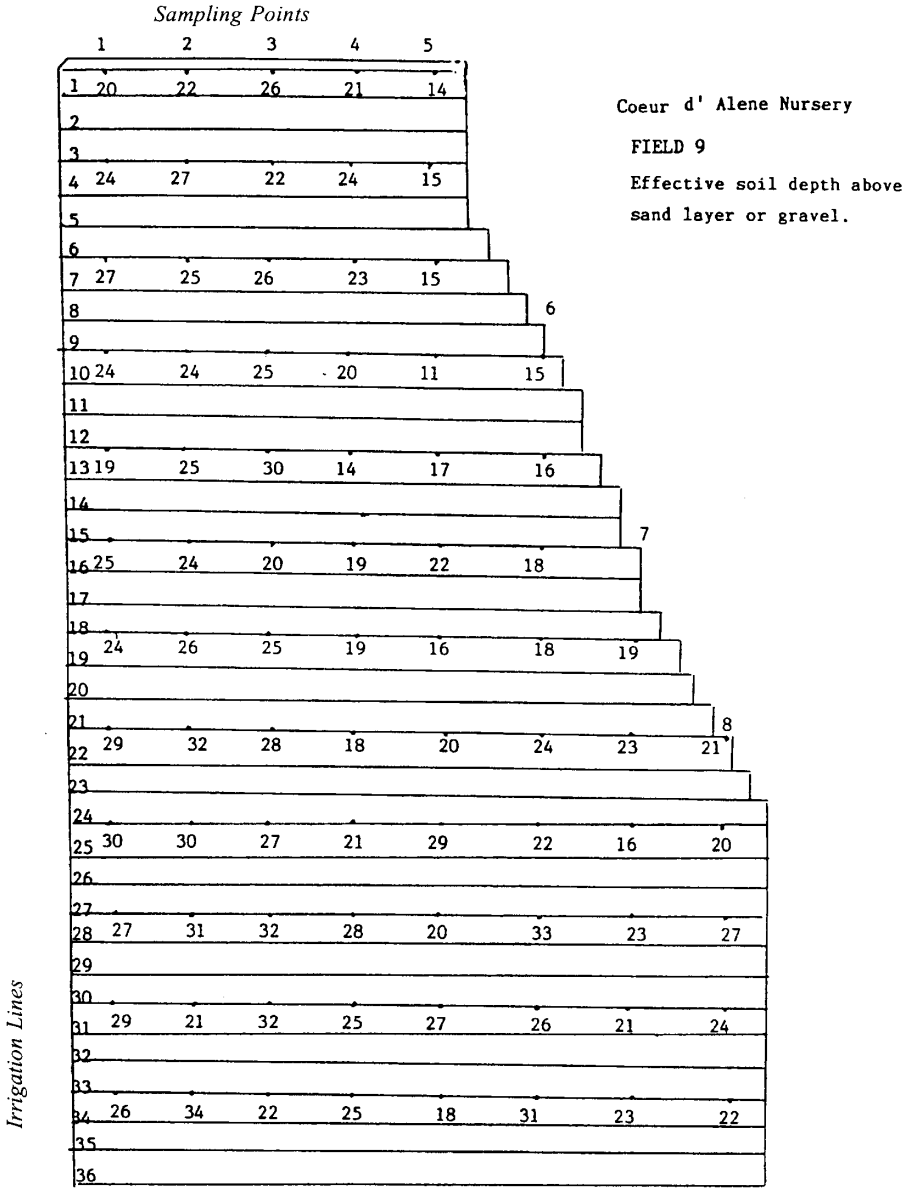

Figure N. The soil sampling grid at Coeur d' Alene nursery was oriented around the irrigation system.

Chemical Factors

* Soil reaction (pH)
* Electrical conductivity
* Aluminum saturation

% Calcium carbonate

Biological Factors

* High populations of soil pathogens
* Proper mycorrhizal fungi
* Stubborn weeds

Some of these factors (depth, texture) can be obtained by an on-site soil survey, and others (chemical content, pathogen populations) must be determined through soil testing.

Lay out a sampling grid for the survey -Although the sampling locations should not be biased, it is best to use a regularly-spaced pattern that will insure that they cover the entire nursery block. This insures that variations in soil conditions are adequately represented in the sample. Each sampling point can be identified by block and sampling point number from the grid. Referencing the grid to the irrigation lines is a good idea, so that the sampling points can be relocated easily. The number of samples that are needed within each block is primarily a function of soil variation, time, and economics. For example, a sampling grid at 100 ft. X 100 ft. intervals has been used at Forest Service nurseries, which amounts to about 9 sample points per acre (Figure N). Nurseries that are lucky enough to have large areas of uniform soil can get by with fewer samples; in that case, the sampling grid could be expanded to 200 ft. X 200 ft., or about 4 sample points per acre.

The Soil Management Plan will be only as good as the data gathered during the survey, but the time to do the sampling and the cost of laboratory soil analysis are always limiting. It may be most economical to survey only a few blocks of the nursery at a time; this can often be accomplished during the rest year of the rotation. In this way, the entire nursery can be surveyed in a few years and the cost of the laboratory analysis can be spread out.

After you have constructed your soil map and have decided on a sampling design, you are ready to begin the soil survey itself. The next article in this series, Conducting the Soil Survey, will be presented in the July, 1995 Issue of FNN.

Sources:

Landis, T.D.; Boyer, D.S. What is a soil management plan and why would you want one? Escanaba, MI: Northeastern Area Nurseryman's Conference and Nursery Soil Workshop; 1992 July 29-30. Portland, OR: USDA Forest Service, Cooperative Forestry. 12 p.

Meinert, D.; Viele, D.; Knoernschild, T.; Moore, M. 1994. Soil management plan for the G.O. White State Forest Nursery. In: Landis, T.D. tech. coord. Proceedings: Northeastern and Intermountain Forest and Conservation Nursery Associations. 1993 August 2-5; St. Louis, MO. General Technical Report RM-243. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station: 9-18.