SURFACE PLANTING SYSTEMS

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Abstract.--The history of surface planting methods in Sweden, and the development of the Peat-Pillow concept, are reviewed and discussed, together with the problems which research attempts to address.

Résumé.--On fait l'historique des méthodes de plantation en surface en Suède. On analyse et on discute de ces méthodes, de la progression de l'idée de la motte de tourbe, et des problèmes que la recherche essaie de résoudre.

INTRODUCTION

In Sweden considerable effort is being made to solve some of the problems involved in the mechanization of reforestation. This effort should be viewed against a background of increasing costs for manual reforestation activities and a reduction in the permanent labor force available for planting.

Up to now, "deep" planting with either bare-root or containerized seedlings has been the principal means of artificial regeneration. In the planting operation, this involves placing the seedling roots in a hole dug into the ground. One of the reasons for developing other planting principles is that, with mechanized deep planting, it is difficult to achieve a suitable environment for the plant.

In recent years, a new planting principle has attracted great interest in Swedish forestry circles because of its strong potential for mechanization. This is known as surface planting and involves a specially designed container with the seedling being placed directly on the prepared ground surface. From a technical point of view, surface planting has several advantages over deep planting (e.g., it is easier and faster). Biologically there is a good possibility of obtaining rapid establishment with this method, as the roots of the plant start growing in the warm top layer of the soil.

The first step toward mechanization of surface planting involves a machine which scarifies the planting patch and delivers a container to each patch. At the present time, the choice of planting point and exact positioning of the container within a scarified patch is done manually from the ground. With completely mechanized planting, the choice of planting position and adjustment of the container will be made from the machine.

THE PEAT PILLOW: AN APPLICATION OF THE SURFACE PLANTING METHOD

The Peat-Pillow is the first example of a containerized planting system developed on the principle of surface planting, and is almost ready for operational use (Fig. 1). The pillow concept had already been tried in the late 1960s as a method for direct sowing (Remröd 1971), but met with little success. The Peat Pillow discussed here is essentially the same, but with it the seedlings are grown in the nursery before being planted in the forest. It consists of a block of compressed peat, enclosed in an envelope of black polyethylene (7 x 7 cm) which holds the peat together and restricts moisture loss in the nursery and field. A hole 5 cm in diameter in the polyethylene at the bottom of the

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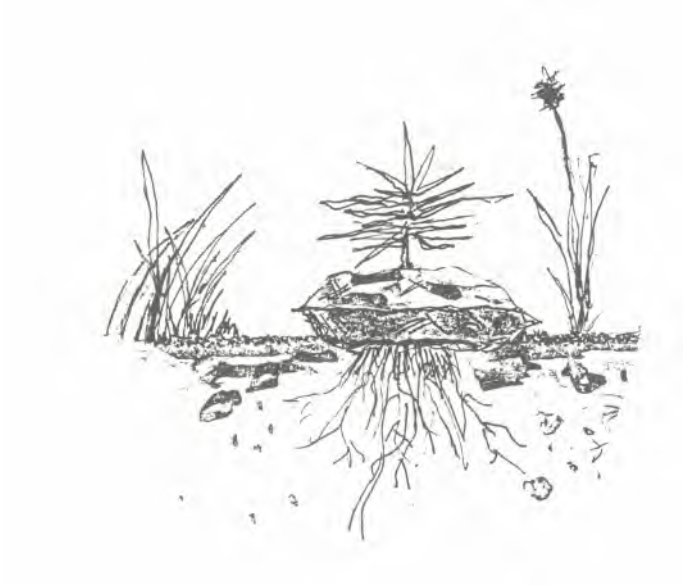

Figure 1. The Peat-Pillow planted on the surface.

pillow allows seedling roots to grow down into the soil after outplanting.

In the nursery, seedlings are grown outdoors on frames which permit air-root pruning. The Peat-Pillow is relatively space-demanding in the nursery in comparison with other container planting systems (about 180 seedlings/m^2); however, greenhouse facilities are not needed.

The Peat-Pillow is placed directly on scarified ground for surface planting. Equipment for manual planting has been developed and the further development of a partially or completely mechanized system for distributing and positioning the Peat-Pillow is well advanced (Lindstrom and Hakansson 1980).

CURRENT RESEARCH

Research into the use of surface planting is being carried out both at the Logging Research Foundation and at the Swedish University of Agricultural Sciences in Garpenberg. At the latter, two projects are under way, one concerned with basic surface planting principles and the other a biological follow-up of Peat-Pillow plantations (Lilliehbök and Nyström 1981). Current investigations in the first project are described briefly below.

After an introductory phase, the project has concentrated on the resolution of a number of key biological and technical problems. The purpose is to increase our knowledge of the surface planting technique and to develop broad guidelines for developing future systems. The experimental studies are directly concerned with the establishment phase for surface planted seedlings, which may be divided into three distinct stages (Fig. 2), viz.:

1. Seedling roots have not yet established themselves in the surface soil.
2. Seedling roots are becoming established in the surface soil.
3. Seedling roots are fully established in the surface soil, and the tree is large enough to depend upon its root system for support and stability.

Stage 1--Roots Still in Container

During this first stage the seedling may be subjected to a great deal of stress. This stress places heavy demands on the container and the method of planting:

Figure 2. The three periods of the establishment phase.

- The container should restrict drying of the substrate, both from the top and from the bottom. The study emphasis is on the design of the container and protection against evaporation.

- The container should be designed and planted so that good hydraulic conductivity is established between the ground surface and the container substrate. This study focuses on the criteria for establishing such moisture conditions.

- The container should be sufficiently stable that, until seedling roots are fully established, it will not be overturned by wind, etc. Here we are concerned with the relationship between container size, seedling characteristics and the tendency for the Peat-Pillow to overturn (Hogberg and Lindström 1980). This involves artificial methods for stabilizing the continer (e.g., pins), and the identification and assessment of site factors which may contribute to the overturning of seedling and container.

- The container should protect against injuries from insects. This study investigates the possibility of combining container design with a protective function, especially against the pine weevil *(Hylobius abietus* L.) (Lindström and Mattson 1980).

Stage 2--Root Establishment

In this stage, seedling roots penetrate into the surface soil, from which they obtain water and nutrients. The fact that roots grow into the soil signifies that the seedling is becoming stabilized on the scarified patch, and the risk of seedling dehydration diminishes as the roots become established.

During this second stage the principal requirement is that the container should allow good root penetration. The aim of the studies is to obtain knowledge of the effects of root penetration on the stability and water supply of the plant (Hogberg 1981).

Stage 3--Roots Established

In the third stage, the seedling is often so large that it is exposed to the destabilizing effects of wind and snow. The larger the seedling the greater are the demands placed on the stabilizing function of the root system. Also during this stage, the protective function of the container (restricting drying of the substrate and protecting against insects) decreases in importance as the seedling roots become firmly established in the soil.

The main requirement of the container during this third period is that its design should not lead to root deformations which might cause stability problems for the tree. An unsuitable container design and/or improper growing conditions may initiate root deformations in the nursery. This study therefore focuses on the relationship between container design, nursery methods and planting techniques on the one hand and root development and seedling stability on the other.

CONCLUSION

Knowledge in the area of surface planting is at present limited. A number of fundamental technical and biological studies must be undertaken before we can define the potential value and limitations of surface planting. The knowledge acquired will lay the foundation for technical development in this field.

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