SITE PREPARATION AND AUTOMATIC MACHINE PLANTING OF CONTAINERIZED STOCK

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Abstract.--An automatic planting machine has been developed for the planting of peat pots and paperpots. Planting and site preparation are carried out simultaneously, the latter by integral hydraulically driven double-blade scarifiers. The machine automatically selects the best planting spot and adjusts row spacing to maintain the required plant density. Different types of planting machine can be produced depending on the desired scarification method and planting conditions.

Resume.--Une planteuse mécanique a été mise au point pour le plantage des pots en tourbe et des pots en papier. Le plantage et la scarification, faite par des scarificateurs hydrauliques intégraux à deux lames, se font simultanément. La machine choisit automatiquement le meilleur endroit pour le plantage et corrige l'espacement des rangées pour maintenir la densité de plantage requise. On peut fabriquer différents types de planteuses selon la méthode de scarification désirée et les conditions de plantage.

INTRODUCTION

In recent years the G.A. Serlachius Corporation has developed an automatic planting machine which combines the site preparation and planting functions into a single mobile unit (Kohonen 1981). The machine is modular, and is normally mounted on a Valmet forwarder. Although different combinations are possible, the planting machine comprises five main elements, which perform the following functions: 1. mechanical/chemical site clearance; 2. site preparation; 3. plant feeding; 4. planting; 5. herbicide application. After the planting period is finished, all components are easily removable so that the prime mover can be used for other purposes.

The five machine functions will be described separately.

1. MECHANICAL/CHEMICAL SITE CLEARANCE

A blade is attached to the front of the prime mover for mechanical clearance of slash and other debris from the planting path. The height of the blade can be varied, and it may be set to cut any residual trees. In the case of hardwoods the driver may spray herbicides from nozzles positioned inside the blade.

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2. SITE PREPARATION

In 1975, when development work on the planting machine project began, we recognized that the site preparation requirements for automatic, mechanized planting are far more stringent than those for manual planting. To insure good survival of machine-planted stock the site must be well prepared. The planting bed must be even, and must not contain any slash or air-pockets. Also, because we plant immediately after scarification, provision must be made for compressing the planting bed before planting. To fulfill these requirements we constructed hydraulically driven double-blade scarifiers, which will be described later.

The most commonly used site preparation equipment in Scandinavia today falls into one of three categories, viz.: i) spot scari-

fiers, ii) continuous scarifiers, or iii) various types of plow. The application of these three operating principles in the development of a single-unit site preparation/planting machine is discussed briefly below.

i) Spot scarifier - The first prototype planting machine used spot scarifiers, but the results were unsatisfactory. The main fault was that the scarified spot was too short for more than one planting attempt, so that on a second attempt the planting head frequently landed outside the spot. Consequently, with spot scarifiers the planting density is usually too low. The advantage of spot scarification is low cost, relative simplicity of operation and low energy requirements.

ii) Continuous scarifier - The earliest type used was a freely rotating single-blade scarifier. In difficult conditions the results were poor. In general, there were too many interruptions in the planting bed, with the result that trees were often planted into slash or unscarified spots. In the second stage of development the scarifier was kept in contact with the forest floor by hydraulic pressure. The results were better, and the equipment was further improved by powering the scarifier through the addition of a hydraulic motor. While this has improved the quality of site preparation, energy requirements have increased.

The main disadvantage of these scarifiers for single-pass site preparation and planting is that the planting bed has no opportunity to settle. Normally, in Scandinavia, site preparation is carried out in summer, allowing time for the ground to settle before planting the following spring. With simultaneous scarification and planting, provision must therefore be made to compress the planting bed before planting.

iii) Plows - In general, plows are too heavy to be combined with a planting unit. Also, the speed and capacity of the planting machine would be reduced too much.

As noted earlier, the present Serlachius planting machine incorporates hydraulically driven double-blade scarifiers. The working principle is illustrated in Figure 1. The blades are placed in front of the rear wheels of the prime-mover in such a way that the front blade removes slash while the rear blade forms the planting bed on the cleared area. The planting bed is compressed by the rear wheels of the prime-mover, and the planting heads are situated just behind the rear wheels.

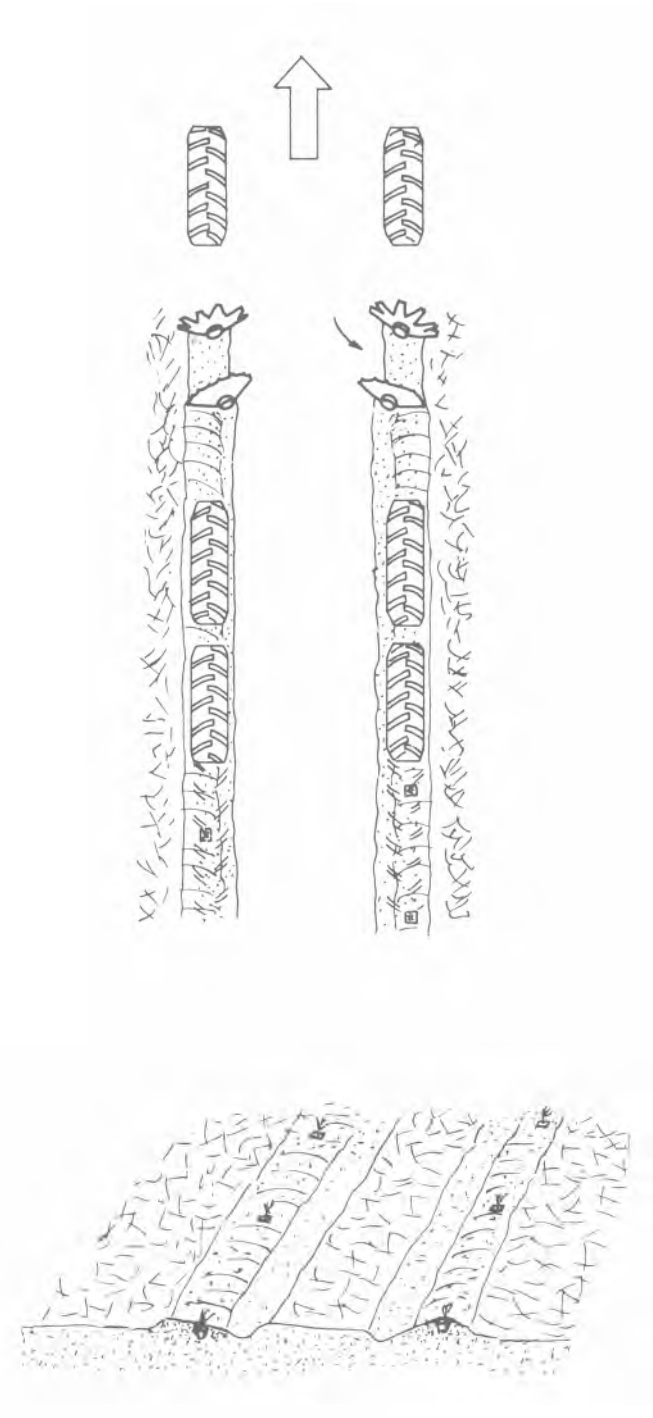

Figure 1. Working principle of double-blade scarifiers on Serlachius Planting Machine.

The scarifiers can readily roll over stumps and stones, and the driver can control the speed and direction of the blades.

Preliminary results of a study carried out by the Metsteho, the Forest Work Study Section of the Central Association of Finnish Forest Industries (Kaila 1982), show that planting beds formed in the above manner produce better planting conditions than do those formed by the regular methods. However, it must be kept in mind that such scarifiers are not intended to compete with forest plows.

This type of site preparation is expensive, but our tests have shown that the superior planting results will compensate for the extra costs. Spot scarifiers may be a viable alternative to the double-blade scarifiers for easier site conditions.

Figure 3. Serlachius Planting Machine.

3. PLANT FEEDING

A European standard-size plastic pallet (100 cm x 120 cm) is used as the basic unit for growing and transporting the containerized seedlings (Fig. 2). It is also used as the basic unit in our planting machine (Fig. 3).

Figure 2. Standard pallets used for growing, transporting and loading seedlings onto planting machine.

The feeding system is loaded with five pallets, giving a planting capacity of 2,000 peat pot seedlings. The pallet is opened automatically and the seedlings are fed to the planting heads. The empty pallets are stacked on a separate frame. About once every hour the driver must feed in a new set of five pallets. The machine can carry planting stock for up to four hours of operation.

The machine is designed to plant either peat pots or paperpots. Seedlings may be fed completely automatically, semi-automatically or manually.

4. PLANTING

The machine scarifies and plants two rows simultaneously. The planting heads (Fig. 4) remain stationary in relation to the planting spot during the actual planting cycle, while the machine continues to move forward. After the planting cycle is completed the planting heads are drawn forward to their starting position to receive a new seedling. The two planting heads operate independently, and automatically maintain the required plant density, select a suitable spot and adjust the planting depth.

When equipped with a planting spot sensor device, the planting heads are able to reject stones, stumps, slash and water as candidate planting spots. On wet sites, where the rear wheels of the prime-mover might sink, the driver can move the planting heads outside the wheel track and plant in suitable non-scarified positions.

5. HERBICIDE APPLICATION

Nozzles for applying herbicides are attached to the planting heads. They can spray so-called slow-release herbicides to enable small seedlings to be used on sites with potentially heavy weed competition. Such herbicides are inactive during the first year after site preparation, hut are released in the second year and keep out weed competition for two or three years after planting.

Figure 4. Planting head of Serlachius Planting Machine.

MACHINE CAPACITY AND APPLICATION

The production capacity of the machine varies between 1,500 and 3,000 seedlings per hour, depending upon site conditions, size of planting stock and the required planting density. The quality of planting is high, averaging 90% correctly planted seedlings.

Site restrictions on operation of the planting machine depend mainly on the ability of the prime-mover to negotiate difficult site conditions. The planting unit itself can operate under relatively difficult conditions. Depending upon the chosen combination of machine options and ground conditions, different prime-movers may be used. In Scandinavia, the forwarder is the most commonly used prime-mover.

It is very difficult to give an exact cost for the machine because, inasmuch as the design is modular, the cost will depend on the components selected.

LITERATURE CITED

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