

Production Aspects of Mini-Plug Transplants

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Abstract.--The MINI-PLUG transplant system allows the production of high quality Douglas fir transplants within a period of one or one and a half years. This patented system *which* was originally developed for the vegetable industry has been adapted for forestry by Weyerhaeuser Company under an exclusive use agreement from Grower's Transplanting, Inc. Along with reduced production time, this system offers substantial labor savings through the use of a highly automated transplanting machine. The paper describes the production aspects of this system.

INTRODUCTION

In 1983 Weyerhaeuser Company of Tacoma, Washington teamed up with Grower's Transplanting, Inc. (GTI) of Salinas, California to adapt GTI's automatic vegetable transplanting system to the production of forest seedlings. Our vision at that time was to be able to produce a Douglas fir seedling capable of high survival rates within one growing season and do this at a cost which would be competitive with other classes of seedlings. This paper describes our progress to date relative to the production aspects of this new type of seedling. Field performance results which have been highly satisfactory are reported by Tanaka elsewhere in these proceedings (Tanaka, 1988). Weyerhaeuser Company currently holds exclusive rights to use this patented system in all forestry applications.

GREENHOUSE PHASE

The MINI-PLUG™ production cycle utilizes both the controlled greenhouse environment and the natural climate of the bareroot nursery to produce a vigorous, hardy transplant in one year. Figure 1 outlines several growth cycles for MINI-PLUG' transplants. Seedlings for the standard cycle are sown into the greenhouse in January and

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transplanted into the nursery in May of the same year. These seedlings will be ready for lifting the following winter. A second cycle which produces a MINI-PLUG transplant in 1.5 years can be initiated by sowing during early summer and transplanting in the fall. Combining the winter sow and summer sow cycles gives the greenhouse the opportunity for double cropping.

Producing a high percentage of fully rooted seedlings is a primary focus during the greenhouse phase of MINI-PLUG production. It is important that the root matrix of the seedlings hold their integrity during the transplant process because the plugs are punched out the bottom of the growing tray by a spear shaped probe. To allow the plants to be set directly into the ground, the tray is specially designed with an open bottom. The tray is also designed to serve as a magazine for the plugs so that a whole tray of plants is loaded at a time (Branch 1986).

The 26.5 inch by 6.75 inch tray has 256 cells which are approximately 1 cubic inch per cell. Because of this relatively small volume, it is important to fully fill each cell with growing medium so that no air pockets exist. To accomplish this goal, we designed and modified a tray filler which fills the cells in a stepwise fashion. Empty trays are placed on a conveyor holding a series of three bins containing peat. As the trays pass underneath each bin a layer of peat drops into the trays. Immediately following each bin, a specially designed packing wheel with cogs rotate into the cells compressing the peat as the tray passes underneath. One wheel is necessary for each row of cells. The progressive sequence of filling and compressing results in a uniformly filled tray which will enable the development of a fully extractable root system.

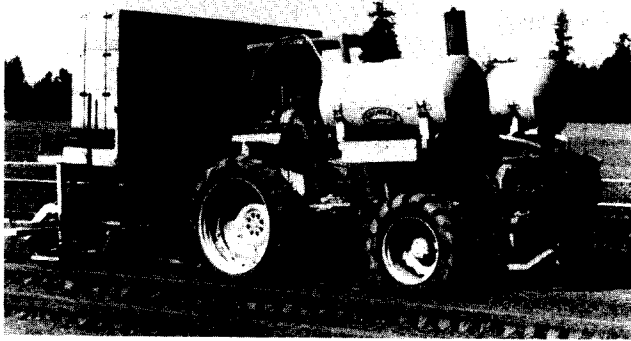


Figure 2.--MINI-PLUG™ tranplanter and tractor.

Precise adjustment of the planter mechanism to the surface of the transplant beds is required as the MINI-PLUG™ starters are only about 1 inch in length. To accomplish this, hydraulic cylinders were installed in the link arms of the three point hitch to provide side to side adjustment and a hydraulic cylinder was mounted on the ski frame at the rear to give fore and aft trim. The controls for this bed trim system are mounted at the rear of the transplanter to allow quick and precise adjustment by the machine operator. In contrast, most transplanter are manually adjusted or hydraulically adjusted by the tractor operator, who is in a poor position to judge bed conditions and planting quality.

During transplanting, water can be injected into each furrow just prior to the planting of the MINI-PLUG™ starter cells. The water system consists of twin two hundred gallon water tanks mounted on the tractor and a hydraulically driven tube pump located on the transplanter. The quantity of water flowing into the furrows is

adjusted depending on soil moisture and weather conditions. This water system eliminates the need for immediate irrigation to reduce transplanting shock. Thus, soil preparation and transplanting activities are not interrupted by irrigation.

Once transplanted in the bareroot nursery, the MINI-PLUG™ transplants are culturally treated similar to other transplant crops. These seedlings are lifted and shipped to the field after one growing season in the bareroot nursery. Upon lifting, these seedlings exhibit a dense mop-like root system having a profusion of lateral roots. Though somewhat more compact than other seedlings, MINI-PLUG™ transplants have an excellent shoot to root ratio (table 1).

SUMMARY

MINI-PLUG™ transplants have excellent shoot to root ratios, which result in high survival and growth rates. In the field high outplanting production rates are possible because of their compact size and mop-like root system. The MINI-PLUG™ transplant system requires a shorter production cycle (1-1.5 years) than other transplant stock types (2-3 years). A higher level of growing space utilization can be achieved as less space is required in both the greenhouse (2218 starters/sq meter) and the nursery (113 transplants/sq meter) than other transplant stock types. Because of the short greenhouse growth cycle more than one crop per year may be grown in the greenhouse. The MINI-PLUG™ transplanting system is highly automated with the capability of transplanting 40,000 MINI-PLUG™ starters per hour. Transplant shock is reduced because the MINI-PLUG™ starters are provided with in-furrow watering as part of the transplanting process. Transplanting costs are less as a result of a lower labor requirement; and total seedling costs per thousand can be further reduced by the increased stocking level in the nursery beds.

Table 1.-- Morphological comparison of different stock types from 1988 tests.

<u>Stock Type</u>	<u>Height (cm)</u>	<u>Caliper (mm)</u>	<u>Shoot/Root Ratio (Dry Weight)</u>
¹ MPT-S	20.6	4.3	1.67
² MPT-F	47.0	7.6	
2+0	37.0	5.4	2.94
1+1	52.2	6.9	2.86
2+1	51.9	7.4	2.33

¹MPT-S Spring Transplanted Mini-Plug™ Transplant

²MPT-F Fall Transplanted Mini-Plug™ Transplant

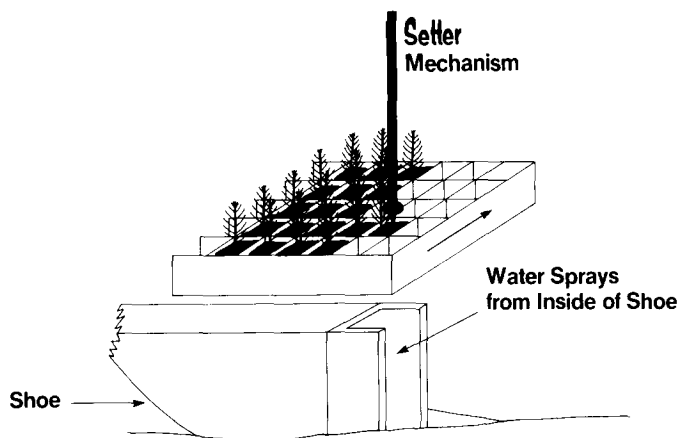


Figure 3.--Tray has just indexed to position new starter cell under setter mechanism.

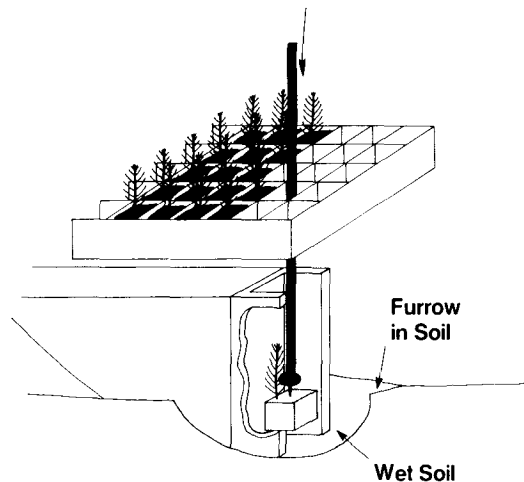


Figure 4.--Spear extends into starter cell to hold it vertical while cell is pushed through tray into furrow behind shoe.

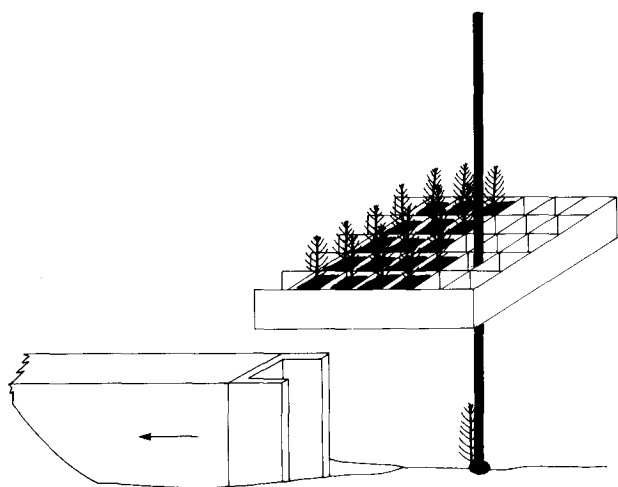


Figure 5.--Spear holds starter cell upright as shoe moves forward and soil closes around cell.

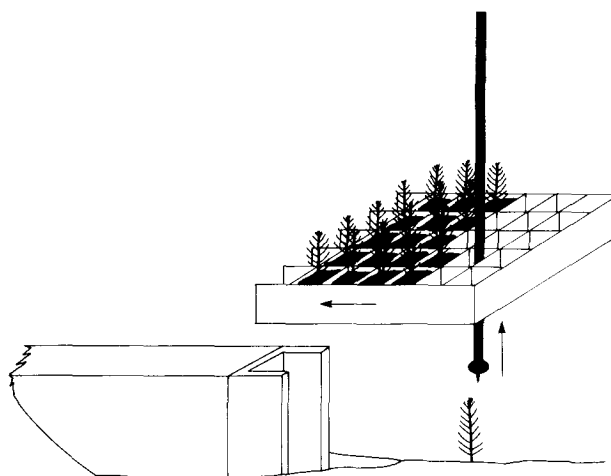


Figure 6.--Mini-Plug™ starter has been planted, spear retracts and setter mechanism returns to position over the shoe for the next cycle.

LITERATURE CITED

Branch, Gregory. 1986. A Commercially Successful Automatic Transplanter. Presentation at the 1986 Summer Meeting American Society of Agricultural Engineers. Paper no. 86-1020.

Branch, Gregory L. 1987. Pneumatic cylinders drive plant-setting mechanisms. *Agricultural Engineering* 68(4):16-17.

Tanaka, Y., B. Carrier, A. Dobkowski, P. Figueroa, R. Meade. 1988. Field performance of MINI-PLUG™ transplants. Paper presented at the joint meeting Western Nursery Council and Forest Nursery Association of British Columbia, Vernon, B.C. Canada, August 9-11, 1988.