

TREE PLANTING MACHINE FOR OPEN PEAT LAND

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Background

The total forest area in Finland is 25 million hectares, 9.7 million of which are peat land. In 1969, about 318,000 hectares of peat land were drained for forestry by 91,000 kilometers of ditches. Some 10 percent of Finland's peat land, roughly 1. million hectares, are wet open swamplands.

The demand for raw wood by the forest industry exceeds the annual increment of the forests, making the afforestation of open swamps an important issue. Last year, approximately 20,000 hectares of open swampland were afforested. The afforested area is expected to increase rapidly in the near future. Three quarters of last year's afforestation was done by planting and one quarter by direct seeding. A shortage of labor in the planting season and the fact that labor costs are rising faster than machine costs have made it necessary to mechanize tree planting.

Among the 14 types of tree planting machines used or tested in Finland, the MARA tree planter is the only one designed for afforestation of open peat swamplands.

Specifications for the machine are given on p. 3.

Conditions

Several studies on machine planting in open swampland have been made in Finland. This report is restricted to two sites, one in Kemi at latitude 66° north and one in Ylane at latitude 61° north. In recent years, annual precipitation has been 340-570 mm. in Kemi and 440-620 mm. in Ylane. The temperature has been approximately 850 degree days in Kemi and 1,200 degree days in Ylane annually. Maximum and minimum temperatures in Kemi have been + 30

and - 43 degrees C., and in Ylane + 29 and 41 degrees C. The planting season is restricted to 3 to 4 months. Soaked ground makes walking difficult.

Methods

The usual manual planting method on pre-drained swamps is with a hoe or spade directly in the sod, in turf overturned by a hoe or by plowing. Some 30 grams of NPK or PK fertilizer is applied manually to each tree, the amount depending on the nutrition in the peat.

A problem peculiar to arctic regions is that the peat remains frozen until the middle of June when the trees have started growing: To extend the planting season, planting stock raised in Paperpot PF 408 containers has been used successfully.

Since a shallow ditch is necessary to remove excess water, a 60 to 100 hp. drawing machine has proved essential for an economic hourly operation. The machine makes a trench 50 cm. deep, 20 cm. wide at the bottom, and 50 cm. wide at the top (see diagram on p. 3), by means of a KOPO rotary trencher which is capable of cutting wood in the peat but does not work in mineral soil. In Kemi, a Bombardier tractor with hydraulic power transmission to the planter was used, and in Ylane a Ford 5,000 with a 1:24 reduction gear box and 5,5 meter long and 65 cm. wide tracks. With 85 cm. wide tracks the ground pressure is roughly 85 grams per square centimeter. Two long knives open planting trenches on both sides of the ditch at a distance of 165 cm. One operator inserts the trees into each planting trench in turn, thus planting two rows. The fertilizer is applied to each tree individually in adjustable amounts by pedals from four hoppers. The phosphate goes to the bottom of the trench and the NPK, at a distance of 25 - 30 cm. from the tree, onto the peat surface. Loaded packing wheels close the trenches.

The transport capacity of the unit depends on

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how much additional space has been made on the tractor. An entire day's load may be taken if the ground is not too wet or soaked. In practice, the planting stock was transported from the roadside to the planting site by the planting unit. Filling was then done at the end of a row in order to break the monotony of the work.

Results

The capacity of the tree planting unit varies from 800 to 1,500 meters planted per hour. Since the usual spacing in the row is 2 meters, it means one tree per meter per ditch. In practice, the output per day was 5,000 to 8,000 trees per 8-hour shift. The divisions of the working time in the two studies is given in table 1. The work at Kemi lasted 20 days with an average output of 5,438 trees per day. In Yläne, the tractor was stuck in a water hole for most of the first day.

Since the unit moves on the soft flat ground slowly and without shaking or jolting, no accidents have occurred so far. The operator is protected from flying chopped peat and wood by flaps. A roof gives protection from the rain. The soft peat makes it even safe for the operator to place his hand under the packing wheels. At Finland's arctic latitudes, snakes have constituted no danger on open swamps.

The survival of MARA machine-planted trees has usually been somewhat poorer than that of manually planted trees, but the results have been acceptable. The NPK fertilizer should probably be spread over a wider area than the present 1 square decimeter. The development and growth of the machine-planted plants have, however, been better than with manual planting. The data are given in table 2.

Discussion

The use of the MARA tree planter is restricted to peat soil, 50 cm. minimum depth, free from mineral soil and large stumps. The PTO requires a reduction gear box 1:24 on normal farm tractors which should be equipped with long, wide tracks giving a ground pressure of maximum 80 grams per square centimeter.

The machine costs of the Kemi planting were 25 Fmk (1 Fmk = 23cents in American money) per hour and for two alternating operators 32 Fmk per day. Thus the cost per thousand trees planted was 52 Fmk excluding overhead costs. For manual planting on swampland without making a ditch, the usual cost has been 40 to 60 Fmk per thousand trees and the cost for making a ditch of similar size about the same per 1,000 meters.

TABLE 1.—Divisions of working time at Kemi and Yläne

Site	Number of trees planted	Planting	Filling plant and fertilizer	Turning	Changing work site	Machine cervice	Rest	Stoppage			Extraordinary work
								Planter	Tractor	Obstacle	
percentage of work time (appr. 8 hour day)											
Kemi	108 760	70.1	9.4	5.0	1.4	0.1	2.5	1.9	4.7	3.8	1.1
Yläne a.	1 258	16.6	2.2	—	0.4	—	—	2.2	—	78.6	—
b.	6 730	71.7	8.1	3.0	2.5	—	5.7	7.2	—	1.8	—

TABLE 2.—Development and survival data for machine-planted trees

Site	Date of		Survival	Length	Increment 1970	Needle length
	planting	inventory				
			percent	cm.	cm.	mm.
Kemi	5 Sept.—9 Oct. '69	25 Sept.—2 Oct. '70	82.5	14.7	6.8	27.6
Yläne	4—5 June '69	8 Nov.—9 Dec. '70	99.5	27.5	16.7	63.7

Thus the combined costs are higher than those for machine planting.

Technical specifications for the MARA Tree Planter:

Length	2.20 m.
Width	2.45 m.
Height	2.30 m.
Weight	800 kg.
Distance between row pair	1.65 m.
Fertilizer hoppers	4x75 kg.

Manufacturer: KURPAN KONEPAJA

Loimaa
Phone 923-8618

Dealer: TYÖVÄLINE OY
Kutomontie 16-18, Helsinki 37
Phone 90-458 081 telex 12-1344



Figure 1.—This rotary trencher makes a 2 feet deep ditch to remove excess water. Two hollow knives open the planting trenches 2 feet from each side of the ditch. One oz. phosphate (33% P_2O_5) is given in the trench, and one oz. of mixture of 24% P_2O and 15% K_2O or 15% (N). 25% P_2O and 10% K_2O is given on the surface 1 foot apart from each tree.

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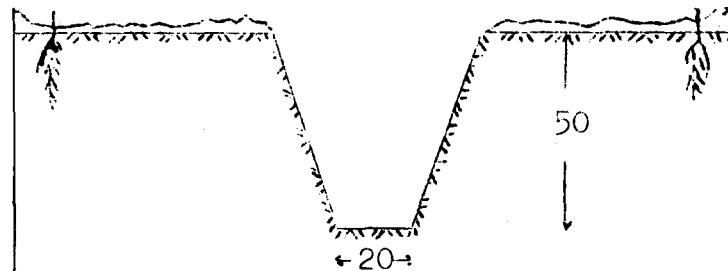
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Figure 2.—The machine operator is sitting with his legs in the ditch and inserts the trees in the two rows. Loaded packing wheels close the trenches. Long wide tracks are used on the tractor to get a ground pressure less than 1.5 lb per square inch.



Trench diagram