MACHINE PLANTING IN TARAWAREA FOREST

E. MANKTELOW*

INTRODUCTION

Of all industries, forestry has probably been one of the slowest to become mechanized and, even now, the process is far from complete. Since the last World War, however, much specialized equipment has been developed for forestry use, and there is little doubt that during the next two decades even greater strides will be made in this direction.

Such equipment developed especially for forest use includes tree-planting machines. This short article deals with the use and limitations of these machines and considers some of their possible developments. It is based on experience gained in operating crank-axle Lowther planting machines in Taranwera Forest since planting commenced in 1962. As these machines could be more widely used in the establishment of exotic forests in New Zealand, a record of experiences with machine-planting in Taranwera Forest may be of interest to other forest owners.

MULTIPLE UNITS AND SOME EARLY DIFFICULTIES

During the past five planting seasons, an area of approximately 4,000 acres has been established in *P*inus *r*adiata or Douglas fir on the river flats or flat gully bottoms of the Taranwera Valley.

From the outset it was intended to plant all topographically suitable areas with heavy-duty crank-axle Lowther planting machines. To this end, an HD16 crawler tractor was fitted with a drawbar having three ball-and-socket trailer hitches spaced at seven foot centres along the bar. The power take-off from the machine was coupled to a hydraulic pump which supplied hydraulic power for lifting and lowering the planting machines. The pipelines leading from the pump to the planters were either galvanized iron or aero-quip flexible hosing and couplings. The planting machines themselves were modified from their hand-operated hydraulic system to the powered one on the tractor; and the plant containers and foot boxes on the machines were enlarged to enable them to carry more trees.

During the first planting season, difficulties were experienced with the aero-quip couplings becoming damaged when small pieces of scoria cut the neoprene seals. This in turn led to burst hose-lines. These couplings were removed and replaced with standard gland nuts. The ball-and-socket hitches also gave trouble when the unit was travelling over undulating ground, as the uneven surface caused the planting machines to become unhitched, which once again burst the flexible, hydraulic hose-lines. Safety chains were fitted to all machines; and later the trailer-type coupling was replaced with a fully universal, pin-and-tongue type coupling. The triple unit itself proved to be clumsy, with the outside machines running wide of the towing unit and at the end of a long drawbar which tended to oscillate up and down when the tractor moved.

* Forest Ranger, Tasman Pulp and Paper Co. Ltd., Kawerau.
over slight transverse irregularities on the ground. This had a tendency to either lift the planting unit out of the ground, or bury it too deeply. For the second planting season, the drawbar was shortened to haul only two planting machines and the hydraulic pump and drawbar were fitted to an HD11 tractor. The planting machines, when hauled by this smaller tractor, planted along the crushed tracks of the tractor. This prevented the oscillations mentioned above and generally proved to be more satisfactory and versatile than the larger and more clumsy triple unit.

The soil of this area comprises 24 to 36 in. of black basaltic lapilli, which were deposited 80 years ago during the eruption of Mt. Tarawera. The lapilli overly volcanic ash of older showers. Part of the river flats had been grassed and had been used as a sheep run. This use had considerably compacted the scoria into a tough, abrasive covering which would have been very difficult to hand-plant.

When the units tackled the compacted grass area, tremendous wear took place on the planting shoes, the shoe points and the large disc coulters of the planting machines. This wear had not been anticipated and spare parts had not been ordered with the machines. Since this experience, spare plough points, disc coulters and a complete spare planting shoe have been held in readiness as replacements, together with flexible hose-lines and spare wheels, should breakages or punctures occur. During the first planting season, it was also found that the canopies on the planting machines were inadequate to protect the operators from rain, or the tree seedlings from drying winds. These, too, have been extended both forwards and downwards to give the required protection.

**TREE SUPPLY AND GANG ORGANIZATION**

Because of the ability of the Lowther planters to plant large numbers of trees in a short period of time, some difficulty was experienced in handling plant which had come to the planting site tied in bundles and puddled. The bundles had to be opened and the tree seedlings placed into metal containers, which were then fitted into the tree bins of the planting machines. This operation, together with the heeling-in of the tree stock at the planting site, caused much unnecessary work and needless handling of the tree stock. To avoid this, cardboard containers which fitted the Lowther tree bins were filled in the nursery. The cartons proved unsatisfactory in wet conditions and were replaced with multiwall paper sacks, opened lengthways, stiffened with battens and covered with polythene. These bags, filled with 500 open-rooted seedlings at the nursery, eliminated the need for puddling, for heeling-in at the nursery and at the forest, and for containerization at the planting site. This not only reduced costs but, because it reduced the handling of the tree stock, also gave improved survival of the tree seedlings.

With both the double and triple units, when planting irregular flat areas the machines followed the periphery of these flats, working inward in irregular, concentric circles. This removed the necessity of turning the planting units around at the end of each planting run, if the flats had been planted in parallel, straight
rows. This also meant that the machines were planting continuously which, although desirable from a cost angle, becomes monotonous for the operators. To secure maximum performance from planting units and operators, it has been found necessary to provide an additional man for each unit's crew. This extra man allows the planter operators to be "spelled", breaking the monotony of the job. When not machine-planting, the extra man helps unload tree supplies at the site, tidies up poorly planted trees, and blanks any areas missed because of the rough terrain or the heavy vegetative cover.

With two Lowthers hauled by the HD11, the third planter has been alternatively used as a spare pool machine or operated as a single unit, being hauled either by a TD6 crawler tractor, or a Fordson Power Major rubber-tyred tractor fitted with dual rear wheels. With the single unit, the tractor driver and the planting machine operator alternate with each other to break the monotony of planting.

In both cases it has proved very easy to put the machine planting on a bonus incentive method of payment. However, experience has shown the need to have more than one bonus base, to cope with varying ground conditions. In good going on clean ground, it is possible to sustain a planting rate of 12,000 trees per machine-day of 8 hours. On one 400 acre flat, in 1966, the double unit averaged 25,000 trees per day for the entire area.
As each season has gone by, the knowledge gained by the previous season's work has enabled the scope of the planting machines to be extended.

During the first year difficulty was experienced in tackling areas of heavy burnt manuka, since many of the remaining sticks could not be cut by the disc coulters of the planting machines. This was overcome to some extent by adjusting the coulters to ride almost touching the planting shoes, giving the coulter blades a type of scissors effect. Even so, operators' knuckles were barked by sticks coming through at them, and the planting was continually slowed up in order to clear rubbish from the planting machines. With the double unit, the situation was improved by the crushing action of the tractor's tracks.

An attempt was made to extend the width of the tractor blade to cover the two trailing machines. However, difficulty was experienced in spilling the debris off the end of the angled blade, so that every now and again the tractor driver would have to lift his blade, leaving a mound of material in the path of the planting machines. The planting shoe then had to be lifted from the ground to climb over this heap of unplantable debris. Last year the problem was finally solved by designing and building a V or snow-plough blade which automatically cleared the debris into two small windrows, lying just wider than the width of the two Lowthers. This double unit fitted with the snow-plough blade averaged the 25,000 trees per day mentioned previously.

At the end of the planting season, the same unit was taken into 50 acres of hill country, covered with hardwood scrub growing

Fig. 2: The HD11 with snow-plough blade.
on slopes up to 30°. It successfully cleared and planted these slopes in one operation. The method of planting used was to walk the unit up a spur and then swing off it and plant down the slope, returning along the bottom of the spur and then repeating this process. Obviously, because the machines were planting only half the time, output dropped. However, the cost of line-cutting such areas, which could not be burnt, would have been greater than the cost of planting by this method. Further, since the snow-plough blade completely scalped the area clean of vegetation, release cutting was not necessary the following year as would have been the case if the area had been line-cut. For successful establishment, such slopes require to be regular, free from rocky outcrops and climbable by the unit when not planting.

**SUMMARY OF ADVANTAGES AND LIMITATIONS OF MACHINE PLANTING**

(1) Because the Lowther cultivates as it plants, survival of machine-planted stock has been superior to that of hand-planted areas—i.e., survival percentages of Tarawera Forest have never been below 90%.
(2) The regularity of the row width of machine-planted areas enables these sites to be mechanically release-cut using rotary mowers between the rows.

(3) The ability of the machines to handle large quantities of trees in short periods of time, even during wet weather, means that a large labour force is not required and that planting can be carried out during the optimum period of the planting season.

(4) By bringing planting machines into an area, one also brings in a source of power. Thus other operations may be carried out for very little extra cost at the time of planting—i.e., the use of the snow-plough blade for clearing. Further uses for this power source might be the automatic fertilizing of planted trees or the control of ground vegetation by sprays fitted to the planting machines.

(5) Basically, however, these machines are limited to flat or easily undulating country with vegetative cover no heavier than young, dense stands of manuka or similar vegetation.

FUTURE DEVELOPMENTS

To extend machine-planting to its limits, it would seem that the Lowther planters will have to be redesigned to be carried rather than trailed by the tractor hauling them. In other words, their development must parallel that of many agricultural implements which are no longer trailed but are carried on a three-point hydraulic linkage. If this is done, and at the same time some method can be evolved to place the Lowther operator on the tractor (where he could plant more safely), then it should be possible to machine-plant any area that a crawler tractor can move over. Such a unit would need to be fitted with a V-blade. In the future, it may be possible to dispense with the planter operator altogether and have a mechanical device feeding trees into the ground.

If traction is poor or the machines are expected to travel over rough terrain and clear the ground as they go, the hauling unit for a single planting machine would have to be an HD6 or TD9 class of tractor. For the same conditions, a D6 or an HD11 would be required to haul the double unit. For ideal going—old farm paddocks for example—a heavy-duty farm tractor or a TD6 has adequate power for hauling a single planting machine, while an HD6 or TD9 should be capable of pulling two machines.

Planting costs have not been mentioned here because, with varying hire rates of machinery within different forest organizations, they mean very little. However, costs can easily be derived from the average performance per single planting machine which, in reasonable conditions, will plant 10,000 trees per eight-hour day, at 900 trees per acre. Tree supplies must be well organized and spare parts for the planting machines or hauling units must be readily available in cases of breakdown. Obviously, this performance will be reduced as ground conditions deteriorate.

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