

MECHANIZATION OF NURSERY AND ESTABLISHMENT

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INTRODUCTION

This paper describes some aspects of mechanization within the forest development activities of A.P.M. Forests Proprietary Ltd.— a subsidiary of Australian Paper Manufacturers Ltd., in Gippsland, Victoria.

Large-scale planting commenced in 1950, and by 1966 a total of 46,500 net acres of pine, principally *Pinus radiata*, and 2,700 acres of eucalypt plantation had been established.

The current annual planting is 4,000 acres of pine and 1,000 acres of eucalypt, distributed over a number of tree farms within about 60 miles of A.P.M.'s pulp and paper mill at Maryvale, about 95 miles east of Melbourne.

Planting sites cover a wide range of soil types. The establishment techniques used in high rainfall steep terrain areas, which occur mainly in the Strzelecki Ranges, are quite different from those used in the undulating, moderate to low rainfall areas which comprise about two-thirds of the company land holdings in Gippsland.

NURSERY MECHANIZATION

Prior to 1961, pine seedlings were raised in two separate nurseries, at Mirboo North, adjacent to the high rainfall areas, and at Longford, in the geographic centre of the lower rainfall areas.

Nursery technique then comprised soil preparation by ploughing and harrowing; sowing with hand-operated "Planet Junior" seeding machines; application of pre- and post-emergence weedicides (white spirit) with knapsack pressure sprays; root pruning by spade and manual lifting, sorting and bundling of seedlings.

In 1962, one central nursery was established at Longford to raise 2,500,000 pine seedlings per annum, using a high degree of mechanization. The 5.3 acre site, comprising well-drained light sandy loam, was designed to suit the use of an International AM7 "Farmall" tractor to which is attached a range of mid-mounted, linkage-mounted and trailed implements for soil preparation, sowing, spraying, root wrenching, lifting, sorting and bundling. A full account of methods and implements used in this nursery has been given by Hill (1962).

Since 1962, the nursery area has been extended to 20 acres and output progressively increased to about 4,500,000 seedlings per annum. Labour productivity and costs of production are given in Table 1.

A new nursery site, suitable for raising 5,000,000 seedlings per annum, is now being developed at Longford, and some modifications are being made to technique and equipment. This new nursery

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TABLE 1: PINE SEEDLING PRODUCTION 1959 TO 1966

	1959-60	1960-1	1961-2	1962-3	1963-4	1964-5	1965-6
Seedlings in millions	1.21	1.74	2.20	2.56	4.45	4.64	4.35
Man-hours per 1,000 seedlings							
Sowing and tending	1.64	0.99	0.66	0.61	0.34	0.46	0.51
Lifting	1.00	1.47	0.75	0.59	0.44	0.39	0.46
Total man-hours per 1,000	2.64	2.46	1.41	1.20	0.78	0.85	0.97
Prime cost \$ per 1,000	4.08	2.98	2.46	2.14	1.50	*1.58	*1.74

* The rise in man-hours and prime cost per 1,000 seedlings after 1963-4 resulted from drought which increased watering and fertilizer requirements.

comprises three sections, which will be worked on a three-year rotation with intermediate cropping and fallowing. Each section is 50 chains in length and 3 chains in width to allow long runs with nursery equipment (seeding, spraying, root-wrenching, lifting, etc.).

Nursery beds are approximately five feet in width, permitting ten rows of seedlings five inches apart. Of the implements and methods described by Hill (1962), soil preparation will now be carried out using a 60 in. cut rotary hoe followed by rolling, seed sowing will be carried out with a 10 unit machine made up of two banks of five seeders (in place of the single-bank six unit machine), and an additional five nozzles have been added to the boom spray to suit the new row spacing. The wire root pruner, wedge lifting tool and mobile sorting and bundling table remain unaltered.

One full-time nurseryman using existing equipment, and supplemented by extra labour working part-time during seasonal lifting, sorting and bundling peaks, will be employed.

PLANTATION ESTABLISHMENT

The primary aim of a plantation establishment project is to produce a profitable crop. Rising labour costs, shorter working hours and improved working conditions make it imperative that labour productivity be raised in all phases of the project from establishment to harvesting. Many more employment opportunities are now available in decentralized secondary industries in Gippsland and labour for forest work is in short supply. Increased mechanization of forest work has become essential to combat the influences of increasing cost and decreasing availability of labour.

Close attention has been given to mechanizing site preparation as this operation affects the cost and quality of many subsequent

operations and will determine to some extent the success of future mechanization, particularly in harvesting.

Moderate Terrain

Preparation and planting techniques on moderate terrain have undergone little change, with the exception that clearing efficiency greatly increased following the introduction of "power shift" tractors. The sequence of operations on this class of country is as follows.

Clearing and Heaping. Clearing is generally done by chaining with a pair of Caterpillar D9 power shift tractors, equipped with tree pushers to handle oversize trees. The chained material is then roughly heaped into windrows 5 chains apart. Final heaping is completed with D7E tractors fitted with 16 ft width rake blades.

Soil Preparation. After the firebreak system has been laid out and road alignments roughly formed, the planting area is ploughed using a pair of "Shearer Majestic" stump jump ploughs pulled in tandem by a D6 tractor. Recently a "Connor-Shea Giant" disc cultivating plough, pulled by a D7 tractor, has been introduced. A good deep tilth has been achieved with this unit, at production rates up to 25% greater than with the Shearer ploughs. On poorly drained or shallow soil sites, ploughing is followed by ridging using a pair of "Rome" disc ridgers, toolbar-mounted on a D6 tractor.

Planting. During the autumn months, windrowed material is burnt and vermin eradicated by aerial baiting with diced carrots and 1080 poison. Planting commences in early June and is carried out with "Lowther" tree planting machines drawn in pairs behind a D6 crawler tractor. With a three-man crew comprising tractor operator and two planting machine operators, a daily output of 18 net acres planted is regularly achieved (16,000 seedlings approximately).

On soil types where experimental work has shown response to superphosphate, the fertilizer was, until recently, applied to each seedling at time of planting from a hopper mounted on the planting machines. Hand application of fertilizer around the base of the seedling several weeks after planting (that is, during spring or early summer) has been found to produce a better growth response and this method of fertilizing is now standard practice on these phosphate-deficient soils.

Tending. Considerable importance is attached to the maintenance of young plantations in a scrub-free condition. Experimental work has shown increased growth of *P. radiata* where scrub competition has been eliminated. Time studies have shown a marked increase in the cost of tree marking and utilization of first thinnings where scrub has persisted to form a physical barrier and access and vision are limited. Scrub growth is removed by heavy-duty rotary slashers drawn by small crawler tractors (John Deere 1010 and I.H.C. 500 class) operating between the rows. With the exception of scrub control in windrows, hand slashing has been eliminated.

Production rates achieved in the conversion of low quality eucalypt forest to plantation are set out below.

Clearing & rough heaping (D9's)	....	....	1.50 acres/machine-hour
Raking (D7's)	....	....	2.50 acres/machine-hour
Ridging (D6's)	....	....	3.70 acres/machine-hour
Machine planting three-man crew (D6 and 2 Lowthers)	....	....	2.40 acres/machine-hour
Equivalent per man-hour	....	....	0.80 acres/man-hour
Hand planting on comparable site	....	....	0.25 acres/man-hour
Machine slashing (3 yr stand)	....	....	1.00 acres/machine-hour
Hand slashing (on comparable area)	....	....	0.10 acres/man-hour

Steep Terrain

Plantation establishment in the Strzelecki Ranges south of Traralgon commenced on a small scale in 1959. During the first three years, pine planting was confined to the more moderate slopes, mainly on neglected farmland which carried grass, bracken and light scrub. Under these conditions it was possible to combine the operations of clearing and soil preparation by fitting a pair of rippers to the D7 tractor blade and working on the contour.

However, this method was limited to slopes up to 15°, representing a relatively small percentage of the planting area. An efficient method for clearing slopes over 15° and up to 30° had to be devised for economic establishment. These areas are of high rainfalls and high site quality and are located within 25 miles of the Maryvale Mill. The more sheltered parts are suitable for plantation-grown mountain ash (*E. regnans*) and parts of the remainder for *P. radiata*.

Vegetation varies from scattered eucalypts and *Acacia* spp. to bracken and scrub. Techniques that have been developed for plantation establishment on these sites are described by Mann (1967). The main alternatives examined were:

- (1) Hand-clearing of planting lines followed by pit planting. Labour productivity was low and the cost high.
- (2) Chemical spraying of scrub, followed by burning. This method is inefficient at present, as some scrub species are resistant to hormone sprays. Even given a satisfactory scrub kill and follow-up burn, the standing stems present a barrier to planting crews and planting rates are significantly below those achieved on similar sites that have been mechanically cleared.
- (3) Chainsaw felling of heavy timber, followed by broadcast burning and pit planting. This method has proved satisfactory on selected sites, generally where well grown acacias and scattered eucalypts predominate.
- (4) Mechanical clearing followed by broadcast burning and pit planting.

The last method involves the construction of tractor trails or "benches" at about two chain intervals on a gradual slope across the contour. The intervening scrub is cleared with a ship's anchor chain pulled by two D7E tractors operating on adjoining benches. Both tractors are radio equipped for safe operation and the tractor

operators communicate by a system of signals. An offsider is employed felling trees that cannot be pulled over.

Clearing is carried out during early summer and the flattened scrub is allowed to dry for several weeks and then broadcast burnt. Where slopes permit, the soil is ripped but generally these sites must be pit planted. Ripping is done with a D6 tractor equipped with a hydraulic tilt blade and rear-mounted rippers which may be quickly adjusted to give row spacings of 10 ft, 8 ft 6 in., and 7 ft. The tilt blade allows it to be used for side cutting, which increases ripping production on side slopes. Row spacing is varied to obtain optimum stocking at minimum planting cost.

Benching is expensive, but it does provide a measure of erosion control, improves access, and reduces the cost of planting, tending and ultimately of harvesting.

Production rates achieved in the conversion to pine plantation of dense dogwood scrubland, having slopes of up to 30°, are set out below.

Clearing, benching, chaining, 25° to 30° slopes (D7)	....	....	....	....	....	0.50 acres/machine-hour
Ripping slopes up to 20° (D6)	....	....	....	....	....	1.33 acres/machine-hour
Planting 7 ft×7 ft spacing:						
Ripped lines	....	....	....	....	....	1.3 to 2.0 acres/man-day
Pit planting	....	....	....	....	....	0.45 to 0.9 acres/man-day

Additional costs are incurred for broadcast burning, seedling stock and its distribution, aerial baiting of vermin, and overheads. In the case quoted, total afforestation cost including overheads is \$60 per acre.

CONCLUSION

Increased mechanization is contributing to a steady increase in labour productivity, work safety, and establishment quality. Further advances are expected from continued research and development, work study, method improvement and new equipment.

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