Progress in Forest Nursery Practice©

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Methods from yesteryear are outlined, the big changes brought about by hydraulic and power-take-off (PTO)-equipped tractors, the weed control possible with mineral oils, the triazines, and more recent herbicides. The change from densely sown seedbeds to precision-spaced seeds, the mechanical methods for controlling root growth and hardening stock ready for planting. The old "puddling" technique has been replaced with fast transfer of stock to the forest in designer planting systems.

INTRODUCTION

Following World War 1, forestry plantings expanded rapidly in the United Kingdom and later in New Zealand with an emphasis on fast growing exotic conifers. For forest nurseries, sandy soils were preferred for ease of working, quick drainage after wet weather, good root development, and easier lifting in wet winter conditions.

TRADITIONAL METHODS

Ground preparation was done by horse and manpower. Seed was broadcast by hand on beds and covered with soil taken from the alleyways between the beds. This created slightly raised beds which aided drainage and lessened the risk of root diseases. Stocking densities were generally high to minimise weeding. With a soil cover, damping off caused losses as seedlings emerged and hand weeding was an essential and regular task throughout the growing season. In late winter seedlings were spade lifted, roots trimmed, and seedlings packed in boxes for transplanting, to grow sturdy during a 2nd year in the nursery. A taut wire marked out the transplant line, a hand dug trench prepared for the seedlings, which were placed against the wall of the trench and soil replaced. Alternatively a shortened bricklayers' trowel was used to put seedlings into the soil. Human feet shuffling astride the line of seedlings firmed the soil. Weeding was again the summer job, helped by hoeing between the transplant lines. Root development was good and spade wrenching not necessary for many species, but common practise with 2-year *Pinus radiata* and *Cupressus macrocarpa* in New Zealand.

Pinus radiata was often grown as a 1-year crop before planting in the forest and sowings were often in drills using Planet Junior sowers. Seedlings were undercut manually by spade in March when autumn rains commenced, the severing of the tap root encouraging side root growth and slowed down top shoot growth. Kainui Forest, 40 km south of Nelson, was planted between 1923 and 1926 with unwrenched seedings in July and August using a pick in hard gravely clay bound soils. The shape of the pick matched the shape of the long tap root and very good results were achieved. This forest is now on its third rotation.

THE MECHANICAL REVOLUTION

In the last 50 years considerable changes have occurred to reduce manpower requirements in forest nurseries. The Ferguson tractor with hydraulics for rear mounted implements and splined power take-off (PTO) for moving-part implements, such as rotary hoes and spray pumps, revolutionised forest-nursery techniques. Mechanisation of ploughing, cultivating, ridging for raised beds on heavier soils, top dressing, and undercutting/wrenching with a sharp rigid blade under the seedbed, led to much innovation and locally made implements to suit local conditions.

On heavier soils in the cooler parts of the South Island the problem of soil caking hard and limiting the emergence of crop seedlings was remedied by the use of pea gravel as a seed cover, gravity spread from a hopper behind a tractor. In Nelson bright sunshine scorched the emerging seedlings when pea-metal cover was used, but pine sawdust proved effective over seed in V-shaped drills with quicker more even germination and no damping-off losses.

THE CHEMICAL REVOLUTION

In the mid 1950s aromatic mineral oils were proving effective in keeping carrot crops free of weeds and trials in conifer nurseries showed that 18% aromatic mineral oil killed most weeds and did not harm pines. This really did revolutionise weed control. Best applied in the cool of the evening or early morning by tractor mounted boom sprayer, seedling weeds wilted and died within a few hours. The stronger 21% aromatic mineral oil was used prior to emergence of the pine seedlings killing all seedling weeds and damaging perennial weeds, ensuring a weed free period before the next germination of weeds. This weed free period was vital for other conifers which became tolerant to 18% aromatic mineral oil only after several weeks following emergence. One unrecognised benefit of the aromatics spray regime was the absence of onion thrip and its damaging effect in later years on the terminal growth of *P. radiata* seedlings.

The introduction of the triazine herbicides and their ability to give several months of weed-free conditions when applied to bare soil before weed germination, led to the use of propazine over conifer species and simazine over some broadleaf species.

Aromatic oils were phased out as oil prices soared. Nurserymen were puzzled by the increasing problem of rosette heads in *P. radiata* seedlings and it took some time to recognise that onion thrip was the culprit, necessitating to this day a fortnightly insecticide spray to control it.

A diquat or paraquat combination became the pre-emergent herbicide killing all weed seedlings before the sown crop emerged, but there have been human toxicity problems, leading to its replacement by hopefully safer glyphosate.

STOCKING DENSITY REVOLUTION

Crops which needed a 2-year nursery period before planting in the forest had traditionally been densely sown for a year and then lined out in transplant lines for a further year with increased room to develop. Trials showed that sowing at much lower densities and undercutting the seedbed in the first autumn could produce quality 2nd year plants without the expense of lifting and lining out. Additional nursery area was required, but with good weed control available this was not a problem.

Douglas fir (*Pseudotsuga menziesii*) is now mainly produced as a 2/0 seedling spending 2 years in the same seedbed. To meet the demands for accurately spaced seedlings, precision vacuum drills were designed in New Zealand to drill and sow accurately across and along the seedbed. Plump well-balanced seedlings survive better in the forest and grow quicker in the 1st year compared to thinner planting stock.

Controlling root growth is important with wider spaced plants and this is achieved in two ways. Sharp vertical rolling discs on a steerage tool frame attached to the 3-point linkage of a tractor enable side roots to be cut between the drills. The need for accurate shallow undercutting across the width of the seedbed led to the development of the reciprocating root pruner where a sharp thin high tensile steel blade passes under the seedbed at 10-cm depth reciprocating on a short stroke at high speed. For *P. radiata* this first undercutting is done in February/March when the seedlings are 15 to 20 cm in height. This is followed in the autumn by several time-spaced passes with a rigid wrenching blade tilted slightly to aerate the soil, encourage root proliferation, and discourage further height growth, hardening off the seedlings for their move to the forest planting site.

HANDLING REVOLUTION

To maintain the roots in a moist condition during transit, the old method was to "puddle" the roots in a slurry of clay and often bundles of trees were heeled-in at the planting site to await planting. Current practice demands careful, quick handling at the nursery, short transport time, and prompt planting by contract planting gangs. Trees are mechanically loosened to minimise fine root loss when trees are pulled, the few rejects are culled, good plants counted and boxed in waxed or plastic boxes designed to fit into a light metal frame carried around the planter's waist.

In low humidity climates the roots are dipped or sprayed with water as they are packed. Clay slurries are no longer used. Polythene liners are used inside the boxes to maintain moisture around the plants when cold storage or long distance travel is necessary.

To meet the size requirements of fitting tree seedlings into a standard DL55 box, topping is often required and this needs to be done with thin sharp blades on a tractor mounted rotary or finger mower several weeks before lifting, to allow the wound to heal and buds to develop for the spring flush. Topping has no permanent adverse effect, within a year of transplanting *P. radiata* and *P. menziesii* form a single dominant leader. Mechanical seedling lifters have been designed and tried, but they lie abandoned. Manual dexterity and adaptability remain paramount.