PROBLEMS AND TECHNIQUES IN RAISING 1/0 PINUS RADIATA STOCK IN MILTON NURSERY

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The decision to grow radiata at Milton, for planting as 1/0, was made at conservancy level in 1959. This of course was agreed on in view of a known rapidly rising programme and a forecast of land shortage by 1963. To allow for planned green cropping and arrest the deterioration of the site, a proportion of radiata stocks was sown broadcast to be raised as plantable 1/0 and all equipment was redesigned to conform to a reduced bed alley-way of 20 inches instead of the previous 36 inches. At this time it was emphasized that one-third of the nursery area should always be out of tree production and green-cropped to improve structure and fertility. The drop in fertility was due to many years of fallowing with no planned organic build-up of the soil, and ineffective drainage. This deterioration was not evident while production was low but with the rapid increase to full production, coupled with the poor growing seasons of the past few years, this defect has become more evident with, in addition, a rising pH.

To alleviate the problems in the early 1960s, nursery soil management was concentrated on providing better drainage, a strict rotation with green cropping, and lowering of the pH. This included tile and mole draining of the old site at Milton as well as the new extension when it became available.

It was of interest to note that the radiata 1/0 crop in 1963, following tile and mole drainage in the old nursery, was vigorous and healthy and of good colour only over the narrow strip overlying the tile drain, indicating good drainage over this disturbed tile trench and probably higher soil temperatures owing to a lower water-table.

The Milton soil is a shallow, heavy, silt loam overlying dense clay. It has a blocky structure, low porosity and poor aeration. In such a soil, waterlogging occurs even in only moderate rainfall and surface drainage is slow. All outflow enters the Milton Borough stormwater drainage system from the old nursery and the system is unable to cope with heavy rain. The new extension is a little better, with out-flow entering the Salmond Creek, but even so surface water still has to seep to mole drain levels and this is a slow process. It is doubtful if mole drains are very effective under these conditions of impeded flow.

The choice of oats (variety Black Supreme) for a green crop, on experience to date, has proved to be a good one, but the inability to keep to a strict rotation with at least one-third green crop is frustrating. On the heavy soils of Milton, a

rotation with up to 50% in green crop would be desirable. It has been possible, however, to keep the old nursery site out of production for three years with continuous green cropping, resowing with *P. radiata* in 1968. A marked improvement is evident in soil handling, texture and vigour of crop. However, it must be pointed out that this period also coincided with a low winter rainfall. This must have some bearing on the results to date.

With the old nursery out of production for three years, the newly acquired site (1964) has been in full production with very little green crop. Although this land has been in pasture and farmed for 80 years, deterioration is noticeable after only four years’ production.

An average pH of 6 in the early 1960s has steadily been reduced to approximately 5.5 today, some of the blocks of higher pH by direct sulphur application at 5 cwt per acre. All fertilizers are sulphur-based.

**PRODUCTION TECHNIQUES**

The output of all species from Milton Nursery in 1958 was 800,000. This figure has increased annually to nearly 9 million in 1969. The first 1/0 *P. radiata* for planting were lifted in 1960; the trees were very small and averaged four to six inches. The total number of *P. radiata* 1/0 plantable in 1969 is 5½ million, with sizes varying from 6 to 12 inches.

It has been the practice to sow as early as possible in the spring to get a long growing season, essential in any soil south of latitude 46 degrees. Beds are fertilized on Forest Research Institute advice following soil sampling. Hitherto fertilizers have been applied during preparation of beds, but current trend is toward summer topdressing. It is a feature of Milton that as summer advances all 1/0 *P. radiata* show an increasing loss of colour. Most noticeable is the deficiency symptom of potash, burnt yellow needle tops. Normal practice of topdressing in early March with potash at 1 cwt per acre tends to rectify this. Some magnesium deficiency can also show up at this time, again not difficult to correct with magnesium sulphate at ½ cwt per acre. Even so, a general overall loss of colour (that is, uniform pale green foliage) remains.

Density of sowing in 1/0 *P. radiata* beds is approximately 100 per square yard of drills. A lower density would be desirable in the Milton soil, but the ideal could be an uneconomic proposition.

Excellent weed control is now possible in 1/0 *P. radiata* beds, with a single spray before emergence of paraquat at 2½ pints per acre, plus Gesamil at 1 lb active ingredient per acre, all in 60 gal of water. This maintains a comparatively weed-free surface well into summer, with minimal hand-weeding. There is, however, the disadvantage that inter-row cultivation cannot be carried out without breaking the Gesamil seal, and topdressings of fertilizers have to await rainfall for penetration. Weed growth, however, would be very heavy without the use of a weed seed germination inhibitor (Gesamil).
Root pruning with the Marsh reciprocating blade is done only when seedlings have attained minimum acceptable height growth of six inches or more, usually late in March. Local trials in 1964 with beds wrenched progressively from mid-summer onwards showed clearly that all growth ceases after root pruning; a repeat of this trial by the Forest Research Institute in 1968 gave identical results. It will be seen that, in order to achieve height growth, wrenching must be delayed; but a delayed wrench restricts the time available for root development as well as coinciding with cooling-off in the soil, thus reducing natural hardening-off of shoots and further root growth. It is significant that, whether wrenched early or late, roots are at approximately the same stage of development in April. These roots are fair for plant height and some further growth may occur before lifting. Indications are that the soil has already cooled sufficiently by early February to prevent root stimulation following wrenching.

A prominent side-effect in all the wrenching trials, irrespective of date, was a rapid loss of colour within a week or so of wrenching. No other 1/0 crops lose colour at any stage, except the known autumn tints that develop in *P. nigra* and *P. contorta*. These crops do not receive topdressing and are not normally wrenched until early winter or early spring, after growth has ceased and shoots hardened or before spring movement. 2/0 crops do not lose colour after wrenching with the exception of *P. radiata* to a minor degree, probably because of its gross feeding habit. Height growth does not cease after wrenching 2/0 crops owing to their deeper rooting system and larger amount of root fibre in contact with the soil. In addition, 2/0 crops already have a reasonable root system when wrenching commences in the summer of the second year.

**DISCUSSION**

In the southern half of the South Island, soils cool rapidly after February and do not provide sufficient warmth to promote recovery after wrenching or pruning. 1/0 *P. radiata* roots are small at this stage and in contact with only the top three or four inches of soil, after wrenching. While the Marsh pruner has a beneficial effect on older, deeper rooted crops, with its tendency to shatter compacted soils, it is probable that a rigid bandsaw type of blade such as used in the Blair Athol wrencher would be most suitable for 1/0 radiata where undue disturbance is not required. Such a machine might allow much earlier pruning without undue check of growth. Warm soils appear to be essential for late summer root development. Such conditions are rare in Southland and may only occur on average one year in five.

The majority of all soil problems at Milton Nursery are associated with, or aggravated by, the impeded drainage of an unsuitable soil type. These problems include low soil temperatures, frost lift and high water-tables. Under such conditions, radiata 1/0 seedlings are affected at various stages of development and handling, and production of a balanced uniform tree is most difficult.
There is a tendency for better survival rates in forest plantings after mid-winter compared with late autumn. The trees that overwinter in the nursery acquire a natural hardening. Stock planted in late autumn is also more susceptible to possible mishandling between lifting, despatch and forest, especially where prolonged transit is necessary and extended heeling-in occurs on forests before planting. This factor is largely eliminated now that multi-walled paper bags are in use, and no heeling-in on forests is necessary. A much better survival rate is now being achieved.

Finally, 1/0 radiata are suitable for reasonably clean sites only, and failure of such plants in heavy cutover or weed can be expected even with top quality stock. The biggest contributing factor in poor survival is the plant's inability to sustain active growth and gradual hardening-off after wrenching, in any but warm soil conditions. These conditions are rare in coastal Otago.