NOTES

TOLERANCE OF *PINUS RADIATA* TO GRASS COMPETITION

A. E. BEVERIDGE and B. K. KLOMP*

Recent trial plantings of radiata pine, on farmland in central North Island and on sites invaded by grasses after clearing of woody vegetation on the Mamaku Plateau, have drawn attention to the ability of seedlings to compete with certain grasses, provided that high quality planting stock is used. In most of these trials the planting stock has consisted of autumn-sown 1½/0 seedlings from the Forest Research Institute nursery, conditioned for planting by repeated wrenchings as described by van Dorsser and Rook (1972). These seedlings have been 35-55 cm high at planting and sufficiently sturdy to withstand the collapse of rank grass in the first year after planting. Further specifications for good quality 1½/0 seedling stock include a height/diameter ratio of 50:1 to 60:1 and a dry weight root/shoot ratio of 1:4 or better (pers. comm., J. C. van Dorsser) Such planting stock has also shown a high tolerance to root competition by grass, particularly on the Mamaku Plateau with its cool, moist climate.

The age of the planting stock is probably of less importance than its sturdiness and conditioning. Thus, well-conditioned 1/0 or 2/0 stock might perform equally well on some sites and comparative trials are required on hard sites, particularly where seedlings are subject to grass competition and damage by browsing animals. Trials on site preparation and establishment have been carried out on the Mamaku Plateau over a period of seven years, using blocks of 2 to 5 ha. Results from only two of the more recent trials are given in this note, to show the performance of well-conditioned planting stock when seedlings have suffered no check from browsing animals, *Dothistroma pini* needle blight, or excessive compaction of the soil. In other trials 1½/0 seedlings averaging only 25 cm in height have shown good growth and survival on well-burnt sites previously occupied by logged indigenous forest. For planting on pasture, or on sites where tall-growing weeds are expected, larger planting stock has been preferred.

In large-scale operations it may be difficult to match the quality of planting stock or the standard of handling achieved in trials but the object of this note is to suggest that more attention should be given to the production of high quality planting stock and to care in planting. In many parts of the country small planting stock is used, even on difficult sites, so that planting is a cheap and rapid operation, but expensive

*Scientist and Technical Officer, Forest Research Institute, Rotorua.

releasing may have to be carried out and the quality of the crop may be reduced. The alternative procedure of using larger, better quality planting stock and a slower planting rate with a consequent reduction in, or elimination of, releasing costs should be considered.

Examples are given below of performance of radiata pine on farm pasture and on a site cleared of indigenous forest and rapidly invaded by grass.

On the Mamaku Plateau radiata pine seedlings planted on farmland have survived equally well in grass allowed to grow rank and in spots where grass has been killed by chemicals (Table 1).

TABLE 1: SURVIVAL AND GROWTH OF RADIATA PINE PLANTED IN A 5 ha FARM PADDOCK*, MAMAKU

Treatment	% Survival after 10 months	Initial Height (cm)	Height after 1 yr (cm)
1. Spot sprayed† before planting	98	51	76
2. Spot sprayed after planting (using inverted cone)	90	51	71
3. No chemical release	99	51	71

*At planting the close-cropped sward consisted predominantly of ryegrass (*Lolium perenne*) and clovers with patches of Yorkshire fog (*Holcus lanatus*) and other grasses. As the sward became rank much of the ryegrass declined and by autumn the composition was estimated to be:

Yorkshire fog — 50%
Ryegrass — 20%
Clovers — 10%
Browntop (*Agrostis tenuis*) — 10%
Cocksfoot (*Dactylis glomerata*) and timothy (*Phleum pratense*) — 10%

†Spots approximately 1 m in diameter were sprayed with a paraquat/simazine mixture applied at the rate of 1 kg paraquat plus 7 kg simazine in 600 litres water per sprayed hectare. Each spot received 40 ml of spray. With a tree espacement of 1.8 × 3.6 m, approximately 12% of the planted area is treated and the subsidised retail price of chemicals amounts to $6.70 per planted ha. Trees were planted in August, four weeks after Treatment 1 and three weeks before Treatment 2.

Similar tolerance to grass competition has been shown by seedlings planted in newly-sown ryegrass and clover on a site cleared of indigenous forest by felling and burning (FRI, 1971). Unsown, cleared and burnt sites at Mamaku were rapidly invaded by Yorkshire fog. When radiata pine was planted after crushing and burning of a 2 ha block of logged indigenous forest near Mamaku, survival was 94% after one year and 86% after two years. Mean height at planting was 46 cm and mean height growth was 20 cm for the first year and 53 cm for the second year. Yorkshire fog germinated on the site in

the autumn before planting so that the young trees were in competition with dense grass.

Growth rates of these two stands are not outstanding for radiata pine but are good for hard sites at an altitude of 550 m a.s.l. on silty, easily compacted soils. No seedlings have been suppressed by grass in either stand and similar results have been obtained in other trials where this study, well-grown planting stock has been used. There has been no need to release such seedlings on sites invaded by grasses, thistles or fireweeds and they have not been damaged to any significant extent by opossums, rabbits or hares. These animals may remove the leader tips of newly-planted seedlings but recovery from this type of damage is good.

When good standards of site preparation, tree handling and planting have been achieved on cleared sites, the major cause of seedling mortality has been attack by *Armillaria*. On the 2 ha block referred to above, an assessment of all seedlings at three-month intervals showed that 82% of seedlings recorded as dead or moribund within 21 months of planting were infected by *Armillaria*.

Where small 1/0 stock has been used elsewhere on an operational scale after clearing and burning logged indigenous forest, it has sometimes been found necessary to release newly-planted seedlings from grass and Scotch thistle (*Cirsium vulgare*) by separate aerial sprayings. If planting stock is both small and soft it is also prone to animal damage, leading to smothering by grass. The use of larger seedlings is an insurance against failure of aerial spraying and measures to control browsing animals. The total cost of these measures may amount to $70/ha so the extra cost of raising and planting the larger and sturdier 1½/0 stock should be well worth while.

Estimated costs of using the two types of planting stock to plant 1500 seedlings/ha on a cleared and burnt site are as follows:

	1/0	*1½/0*
Cost of plants	$16.50	$24
Cost of planting	$30	$45
Total cost	$46.50	$69

Early growth rates show that use of the well-conditioned 1½/0 planting will shorten the rotation by one year. The value of this reduction in the rotation is estimated to be $35/ha (R. L. Knowles, pers. comm.) thus compensating for the greater cost of using the larger seedlings. In the first year after planting, these larger seedlings are less damaged by browsing animals than are the 1/0 seedlings and are quicker to recover from removal of the terminal buds. In the second year the leaders of 1½/0 seedlings will often be out of browsing range whilst smaller seedlings may continue to be hedged.

The measures taken to control grass and browsing animals when 1/0 seedlings are planted are not always fully effective so that on the more difficult sites, at least, there will usually be some mortality in addition to that caused by *Armillaria*.

When grazing is practicable, grass may be regarded and managed as an asset rather than a liability, to the extent that,

should wild grasses not naturally invade the site after the clearing burn, better pasture grasses can be sown with the object of grazing in the plantation throughout most of the rotation. Such grazing may be done on a short rotation sawlog regime with wide spacing and early pruning and thinning (Knowles, 1972). In this situation the use of sturdy planting stock has many advantages (Beveridge and Klomp, 1972).

Although the tolerance of radiata pine to grass has been illustrated in trials at Mamaku, with a well distributed annual rainfall of 2000 to 2500 mm, there has been supporting evidence from other regions where radiata pine has been planted in pasture — *e.g.*, at the Whatawhata Hill Country Research Station, Matahina and Reporoa. While chemical control of grass will continue to have a useful application in many situations, it is suggested that more attention should be given to the production of well-grown 1½/0 or 2/0 seedlings for planting on sites where weed competition and animal damage are likely to be troublesome.

REFERENCES

Beveridge, A. E.; Klomp, B. K., 1972: *Graing before Planting and in Young Plantations.* Paper presented to For. Res. Inst., Symp. No. 14, Animals in Forests, unpublished.

Forest Research Institute, 1971: *N.Z. For. Serv., For. Res. Inst. Ann. Rep., 1971:* 40-1.

Knowles, R. L., 1972: Farming with forestry: multiple land use. *Farm For., 14* (3): 61-70.

van Dorsser, J. C.; Rook, D. A., 1972: Conditioning of radiata pine seedlings by undercutting and wrenching: description of methods, equipment and seedling response. *N.Z. Jl For., 17* (1): 61-73.