SURVIVAL AND GROWTH OF 1/0 RADIATA PINE SEEDLINGS

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SYNOPSIS

The implications of planting stock quality in survival have long been recognized. This trial, initially intended to quantify the relationship, goes a step further in the establishment phase and emphasizes the longer term advantages of initially superior stock. Stem diameter is shown to be a valuable measure of stock quality in terms of both survival and growth for the three years following planting. Planting stock of an initially superior stem diameter class is seen to show almost twice the height growth of that in the poorer class.

DETAILS OF THE TRIAL

Graded 1/0 radiata pine seedlings from Milton Nursery were planted at Naseby, Berwick, and Otago Coast Forests in Southland in winter 1966. The purpose of the trial was an attempt to quantify what was meant by "good" and "poor" planting stock. Trees were selected at random from nursery beds and graded first by length of shoot (less than or more than 8 in.); secondly, by roots ("good" or "poor"); and thirdly by the diameter of the stem one inch above the root collar. Judgement on roots was by eye, but those classifying the seedlings had previously been engaged in quantitative measurements of root:shoot ratios. To check on accuracy, ten sample seedlings were taken from each class and their root-shoot ratios were measured by green weight. The mean ratio for those with roots classified as "good" was 1.7:1; for those classified as having "poor" roots the mean ratio was 1.1:1.

This method of sorting gave 14 classes. Thirty trees of each class were planted 1 ft apart at all three forests.

OBSERVATIONS AND RESULTS

Survival

At Berwick and Otago Coast differences in survival were, apart from the poorest grade, negligible, but at Naseby, where conditions are more severe, there is a marked trend of improving survival percentages from the poorest to the best grade. The irregular results for Naseby for January 1968 are due partly to animal damage. Details are given in Table 1.

Height Growth

Shoot extension was measured in March 1967, January 1968 and October 1969. Figures for Naseby are unreliable due to animal damage; therefore Table 2 is confined to measurements at Berwick and Otago Coast.

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Results for Berwick and Otago Coast have been amalgamated in Fig. 1, which shows height growth related only to stem diameter, without considering original shoot length or quality of roots. This shows that at each measurement the growth of trees with stem diameter class of 5 mm or more is approaching twice the growth of trees with stem class of 2 mm. This would appear to indicate that the most important criterion for estimating quality of trees from Milton would be stem diameter, and this in turn is related to density in seedbeds. At Milton a density of not more than 10,000 seed-

TABLE 1: PERCENTAGE SURVIVAL

Seedling Grade Shoot (*in.*)	Root	Stem Diam. Class* (*mm*)	*Survival, March 1967* % Berwick	Otago	Naseby	*Survival, January 1968* % Berwick	Otago	Naseby
< 8	poor	2	100	86	57	90	73	30
		3	100	93	83	100	90	67
		4	100	93	93	100	90	93
	good	2	100	100	68	93	100	3
		3	100	97	93	100	87	73
		4	100	100	74	100	100	40
		5	100	90	87	97	80	67
> 8	poor	3	100	100	87	93	97	50
		4	100	87	97	97	80	83
		5	100	100	90	97	100	77
	good	3	100	100	90	97	97	38
		4	100	93	100	100	93	97
		5	100	100	100	100	100	97
		6	100	97	100	100	97	97

*Steam diameter classes measured from *x*.6 mm to *y*.5 mm.

TABLE 2: HEIGHT GROWTH

Seedling Grade Shoot (*in.*)	Root	Stem Diam. Class (*mm*)	*Shoot Extension to Mar. 1967 (in.)* Berwick	Otago	*Shoot Extension to Jan. 1968 (in.)* Berwick	Otago	*Mean Height to Oct. 1969 (ft in.)* Berwick	Otago
< 8	poor	2	1.5	2.0	1.2	4.5	1 8	4 8
		3	2.5	2.0	3.5	5.5	2 10	5 1
		4	3.0	2.0	6.1	5.1	3 9	5 10
	good	2	1.5	2.5	3.4	6.3	2 6	5 7
		3	2.5	2.0	4.8	5.8	3 0	5 10
		4	2.5	3.0	7.0	7.3	4 4	6 7
		5	4.0	4.5	7.7	6.5	4 0	6 6
> 8	poor	3	1.5	1.5	5.3	4.3	3 2	5 7
		4	1.5	2.5	6.5	5.0	4 2	6 1
		5	2.0	2.5	4.8	6.6	3 1	7 0
	good	3	2.0	2.0	4.9	7.4	3 5	5 4
		4	2.0	2.0	6.1	6.0	3 11	6 3
		5	2.5	2.0	10.3	5.8	5 0	6 8
		6	2.5	3.0	8.2	7.5	4 7	7 4

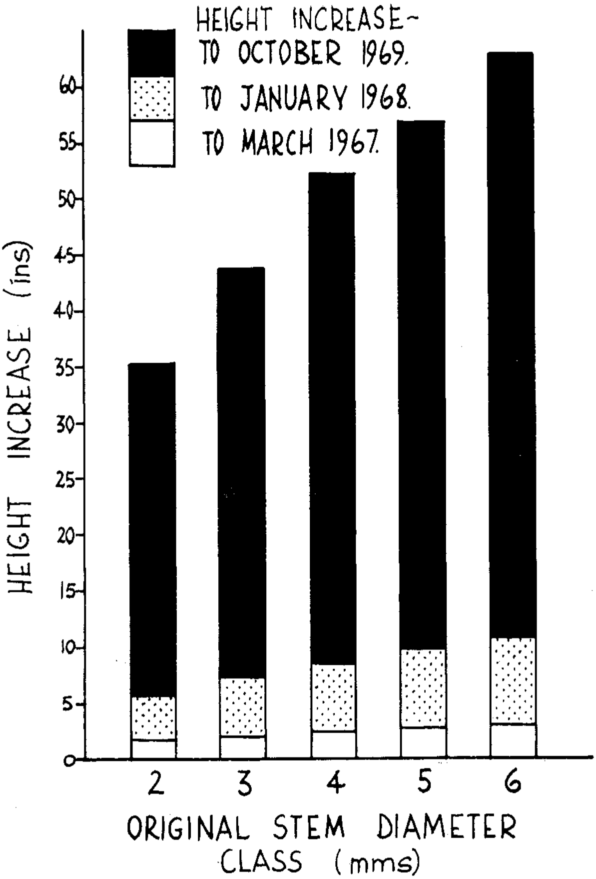

FIG. 1: *Height increment in relation to initial stem diameter class. (An initial mean height of 8 in. is assumed.)*

lings per 100 yards of bed is aimed for, stock showing little quality improvement below this density (Prior, 1968).

Stem Diameter Growth

In October 1969 all stem diameters three inches above ground level were measured. As with height, this also was closely related to stem diameter at the time of planting. Mean figures for Berwick and Otago Coast combined are:

Original Stem Diameter Class (mm)	*Stem Diameter in October 1969 (in.)*
2	0.69
3	0.88
4	1.06
5	1.15
6	1.32

DISCUSSION

This trial was on a very small scale and results can only be indicative. However, the trends established, in relation to the factors studied, are sufficiently clear to indicate certain desirable seedling characteristics. Although the tree stocks used were a fair sample of those normally used for planting in Southland and Otago, they received more care in handling and planting than would be the case with normal planting gangs. Thus, figures for survival are better than would normally be expected. Survival on the best sites (Berwick and Otago Coast) is in all cases high, but on the harder site at Naseby there is a clear indication that the poorer trees are less able to establish themselves than those of better quality. If survival percentage is based on initial stem diameter, and all three forests are combined (omitting survival of 3% for one Naseby sample with 2 mm stem diameter), survivals are as follows:

Initial Stem Diameter Class (mm)	*Survival % in January 1968*
2	77
3	82
4	89
5	90
6	98

It is apparent, from the figures in Table 1, that the effect of "good" and "poor" roots is not particularly important. However, a second observation is that most mortality, on all sites, has occurred in the second year after planting. This was unexpected, and further study of mortality in the second (and possibly the third) year after planting seems desirable.

Shoot extension is considerably greater in the second season than in the first. In the final height measurement of October 1969, the differences are further extended so that the better classes reflect almost twice the height of the poorer classes. At all stages height differences are reflected in diameter differences.

An attempt was made to rank the importance of stock quality factors. Although on the basis of this trial no great precision could be expected, and although it seems likely that all factors studied have some importance, the most obvious trends are based on stem diameter at time of planting. The advantages of an initially tall plant, able to cope wtih competing vegetation, are usually recognized; and it has long been the custom to regard a high root:shoot ratio as a measure of quality. Thus, on the basis of this trial a "good" tree would be one with a top of at least 8 in., a relatively high root:shoot ratio, and a stem diameter, one inch above the root collar, of 4 mm or better.

While survival may be acceptable regardless of stock quality, on favourable sites and in normal planting years, the long run advantages of superior stock, giving better survival and greater initial height growth, are clear. The initial variations found in nursery stock can result from a number of factors — genetic quality, density in seedbeds, time of seedling emergence in relation to competing neighbours, and so on. It might be expected that such small variations would tend to even out as the planted stand grows. However, the trial indicates that initial variations lead to increasing, not decreasing, variability over the first three seasons of growth. It could thus be surmised that final expression of dominance results from the initial quality of the individual tree (provided that competition from other vegetation does not delay growth of some trees). In any case, more rapid growth in the first and second year after planting is highly desirable, in order to reduce or eliminate costly releasing operations. On this basis also, therefore, the planting of superior quality tree stocks is most desirable. On harsher sites, as at Naseby, the importance of high quality is even more marked.

REFERENCE

Prior, K. W., 1968. *In* Chavasse, C. G. R.; Weston, G. C. Forest nursery and establishment practice in New Zealand. *For. Res. Inst. Symposium No. 9.*