of burns in cut-over native bush and other similar areas should be routine practice and adequate stocks of seed should be held for that purpose.

In conclusion, it may be reiterated that there is no difficulty in growing valuable stands of eucalypts in New Zealand provided good seed is selected and the species are correctly sited.

Summary

Eucalyptus species selected as the most suitable for forestry purposes in New Zealand are classified according to their climatic requirements. Their growth characteristics and utilisation properties are discussed and a technique of nursery treatment for planting with open-rooted stock is described in detail. Suggestions are made for the wider use of eucalypts in New Zealand silviculture.

THINNING BY POISONING *

By J. G. GROOME

1. Introduction

Overdue thinning of even-aged stands, in which natural suppression has been negligible, will always present an embarrassing problem where a market for such thinnings is not available. The difficulty of obtaining labour and finance for the execution of operations which are not immediately profitable is too well known to all to require further stress here. Yet those who have been faced with the utilisation of such stands will sympathise with the forester when he seeks to improve them, even though the sympathy may seldom be provided in the form of men and money. The case for thinning to waste of large areas of our slower-growing exotic stands has been admirably presented by D. Kennedy (1) and this paper seeks to present a method for carrying out such thinning when costs must be held to a low figure.

The elimination of unwanted stems by poisoning has been the subject of extensive overseas research although most of this work has been directed against useless hardwood species growing in pine stands. The poisons used are arsenic, hormones and "ammate" (ammonium sulphamate), and these are now known as silvicides, a term analogous to weedicides in agriculture. The only available account of poisoning coniferous stems is that given by Pearson (2) in which he describes the successful use of sodium arsenite on ponder-
osa pine. Previous investigations in New Zealand have been limited to simple girdling with disappointing results. Trials with the poisons listed in Table 1 were carried out at Karioi Forest during 1951 and 1952 in a twenty-three-year-old stand of *Pinus murayana* which still carried 590 live trees per acre. Thus mortality in the 680 trees per acre originally planted had been slight and as the average height of the survivors exceeded 60 feet, the relief of the stand was as urgent as it was difficult. Thinning by normal means was attempted but proved so costly that it is doubtful whether the improvement to the stand was economically justifiable, even if labour had been available.

### TABLE 1
Methods used to kill standing trees.

<table>
<thead>
<tr>
<th>Poison used</th>
<th>Method of application</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Girdling only</td>
<td>(a) $\frac{1}{2}$ lb./1 gal. water/1 lb. flour</td>
</tr>
<tr>
<td>2. Sodium arsenite</td>
<td>Paste on exposed surfaces</td>
<td>(b) $1\frac{3}{4}$ lb./1 gal. water $\frac{1}{2}$ lb. flour</td>
</tr>
<tr>
<td>3. 2, 4-D</td>
<td>Solution in frill cuts</td>
<td>(c) 1 lb/1 gal. water 1 lb. flour</td>
</tr>
<tr>
<td>4. ACP-977</td>
<td>Solution with oil carrier in frill cuts</td>
<td>$\frac{1}{2}$ pint/4 gals. water</td>
</tr>
<tr>
<td>(2,4-D/2, 4,5-T)</td>
<td></td>
<td>$\frac{1}{4}$ pint/2 gals. water</td>
</tr>
<tr>
<td>5. Ammate crystals</td>
<td>Placed in notch cuts</td>
<td>1 gal. Diesel Oil</td>
</tr>
<tr>
<td>6. Ammate solution</td>
<td>Solution in frill cuts</td>
<td>1 tablespoon per notch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) 2lb./1 gal. water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) 4lb./1 gal. water</td>
</tr>
</tbody>
</table>

2. Results

Complete removal of a strip of bark and cambium, or girdling, is a slow and often ineffective method of killing most evergreens, and the trees so treated in this investigation were still growing vigorously eighteen months later.

The introduction of hormone solution to the sapstream by means of frill cuts has also given negative results to date. However, further trials with ACP-977 seem warranted as evergreens have been killed in American experiments when this poison was used with an oil carrier.

“Ammate”, which is widely used on hardwoods in America, has been effective in killing the trees within one year of treatment, when applied in the crystalline form. When used as a solution however, the trees have remained unaffected, although the negative result may have been due to the method of application rather than the chemical solution. “Ammate” crystals have proved to be the most satisfactory poison used to date, giving complete kills, being cheap and safe in application and requiring no preparation or equipment other than an axe and tablespoon. Unfortunately, it is available at a high cost only from America and even experimental supplies are difficult to obtain in this country at the present time.

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Sodium arsenite has also given satisfactory results, the death of the tree occurring within three weeks. This chemical being a deadly poison is dangerous to use and requires a certain amount of preparation before application, but has the advantage of being available in quantity at a low cost. Experimental work has shown that the poison is effective if applied to a number of blazes varying with the diameter of the tree, thus avoiding complete ring-barking. This method was used over 50 acres of the stand and after some initial difficulties in mixing had been overcome required less than one man/day per acre to carry out a 45 per cent thinning, i.e., the treatment of 260 undesirable and competing trees per acre. Counts made a year later have revealed that only a 50% average kill has been obtained the failures being attributable to lack of attention to the following points:

(1.) The poison must be applied as soon as possible (preferably the same day as the blazes are made).

(2). Poisoning should not be carried out in wet weather, the rain running down the stems and removing or diluting the poison.

(3). Blazes should not be placed more than six inches apart.

(4). The poison appears to be effective during the growing season only and the operation should be carried out either just before or during this period (the above stand was treated in February).

3. Preparation and application of sodium arsenite.

Sodium arsenite is received as a powder and in order to prepare it in a paste form the following method is recommended:

(1). Prepare a very stiff concentrated paste by boiling the water and the flour.

(2). Prepare a solution, as concentrated as possible, of sodium arsenite in the warm-to-hot water, but do not boil. That is, boil the water first and during the subsequent cooling period (when no water vapour is being given off) add the sodium arsenite.

(3). The flour-water paste can be thinned out to the required consistency by dilution with the sodium arsenite solution. Both solutions should be warm on mixing and the flour-water solution preferably hot.

A concentration of 1/3 lb. of poison to every gallon of water has been found to be effective. The paste is applied with a wide painter's brush.

Boiling sodium arsenite can cause volatilisation of white arsenic resulting in severe headaches and worse effects, and should be avoided. Additional precautions should be taken when mixing and applying the poison and workers must wear overalls, gloves and a face shield. The poison should be stored in a locked building and treated areas indicated with suitable notices. In cases of poisoning an emetic
should immediately be used and followed by an antidote of sodium thiosulphate in water (hypo solution). The emetic should then be repeated and followed with two tablespoons of Epsom salts in water.

4. Effect of treatment

Trees killed by this method had lost all their needles and the bark hung loosely within nine months. Certain bracket fungi and surface moulds have since appeared on the cut surfaces. Pearson (2) reports that "poisoned trees rot with astonishing rapidity, even those of 30 inches d.b.h. going down within 10 years". The tree is moribund for a short time only and thus the period during which it is susceptible to insect attack is reduced to a minimum. The rotted trees are incorporated in the duff on the forest floor gradually without producing the impenetrable mass of slash which follows any normal thinning operation.

The reader will no doubt have already mentally listed several apparent objections to this unorthodox but effective method of thinning. Allow me to anticipate these objections and attempt to allay any fears for the future of stands treated in such a manner. Firstly the question of secondary poisoning or translocation of portion of the poison through root grafts to the untreated trees. Pearson (2) states that this may occur if the poison is applied too lavishy. Stoate (4) records that a side effect of arsenic was observed when poisoning had been carried out over a large area of pines infested with the Western Australian "Christmas tree". As the parasitic "Christmas Tree" fixes itself by haustoria to the roots of the pines the translocation of the poison is probably to be expected. However, no ill effects have been observed on untreated trees during the present investigation, and these would reasonably be expected to be manifest soon after the poison was applied. Secondly, the possibility of the poison being toxic to decay organisms is discounted by Pearson (2) who contends that it speeds up rather than retards the process of decay. This is an important point in favour of its use in localities where natural slash decay is slow. Finally, there are many who will object to large numbers of dead standing trees in the forest even for a short period and they will contend that the dead trees are undesirable from both the aesthetic and fire-protection viewpoints. However, would anyone claim that the stands which require this type of thinning are not already highly susceptible to fire? Furthermore the aim of the forester is to put the maximum amount of increment on the most desirable stems and if he sacrifices a little of the beauty of the forest in achieving that aim he should be consoled by the fact that the ultimate harvesting of the stand will have been considerably facilitated.

Summary

Methods for eliminating unwanted trees in dense stands by the introduction of silvicides to the sapstream are explained and results
discussed. The use of sodium arsenite over a large area is described. Possible disadvantages of the method are elaborated and a case for carrying out this type of thinning in preference to leaving the stand unintended is put forward.

References


ONE-MAN CHAIN SAWs

By J. L. HARRISON-SMITH

Chain saws are here to stay, there is no doubt about that, and more and more people will be using them as their value as time savers is better appreciated. Having had some experience with several makes of one-man saws over the past 2½ years, the writer puts forward these notes in the hope that they may help others both in the selection and operation of machines to suit their particular needs.

Types

One-man saws may be divided into two distinct types, those in which the whole saw is turned on its side when it is used for felling and those in which the cutter-bar only is turned while the engine remains upright.

The former includes the English Danarm and Liner, the Norwegian Jo-Bu and several American makes such as the Disston, Homelite, Reed-Prentice, McCulloch and Woods Boss. The layout makes for strength and rigidity and one would also expect it to allow the building of a lighter saw for a given power. Actually this does not seem to work out in practice for most of the makes mentioned are substantially heavier than many of the other type. It ought also to facilitate cheaper construction but there again some saws so made cost a good deal more than swivel-bladed makes of similar cylinder capacity.