INDIGENOUS SCRUBWEED CONVERSION METHODS FOR WESTLAND PLANTATION ESTABLISHMENT: PAST, PRESENT, AND FUTURE*

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ABSTRACT

A review of available information dealing with the conversion of indigenous scrubweed areas to exotic forests in Westland (and elsewhere) is given. Current site preparation regimes involve felling of residual scrubweeds, a cure spray when necessary, and then burning. After planting with radiata pine (Pinus radiata *D. Don*) *a release spray with 1.08 kg 2,4,5-T is essential where scrubweed regrowth is a problem. Where bracken* (Pteridium aquilinum *var.* esculentum) *and other fern regrowth occurs, asulam is used as a release spray, though greater emphasis is being placed on the use of hexazinone.*

In areas where a successful burn of felled material has been achieved, scrubweed regrowth is not apparent until 3 years from planting. By age 7 years, of the radiata pine crop, indigenous scrubweed offers a dense understorey and makes any silvicultural operations extremely difficult and expensive. In some areas regrowth can be so vigorous that the radiata pine crop may fail completely. Alternative land preparation options have been tested with the most successful regime tested involving felling, burning, and oversowing with maku lotus (Lotus pedunculatus *cv. 'Grasslands maku'*) *and Yorkshire fog* (Holcus lanatus) *before or immediately after planting.*

INTRODUCTION

Prior to the 1970s most Westland exotic forests were established on free-draining hill soils. Before conversion, much of this land carried heavy indigenous forest, podocarp-hardwood and podocarp-beech types. The selection of sites was influenced:

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(1) By a need for free-draining deep hill soils, often on steep dissected country (yellow-brown earths as opposed to gley podzols).
(2) By virtue of distance from major markets, the need to tend stands for higher value products, namely, veneer logs and high-grade sawlogs.

However, inherent problems in establishing and intensively managing radiata pine on such sites are the initial removal of the indigenous forest cover and the subsequent control of regrowth while the exotic crop is being established and tended.

Since about 1975 a large proportion of Westland's plantings have been on flat terrace and rolling gley podzols. In many of these situations the indigenous scrubweed problems presented by the pakihi vegetation are not so severe. Nevertheless, both drainage and the application of fertilisers are modifying these sites to the extent that scrubweeds are developing as an understory and could be a problem in establishment of a second rotation exotic crop.

PAST WORK WITH HERBICIDES

It was reported in 1962 (Beveridge and Hedderwick) that Westland was facing a major problem with indigenous scrubweed competition. The main species consisted of dense thickets of kamahi (*Weinmannia racemosa*), *Quintinia serrata* suckers, and wineberry (*Aristotelia serrata*).

Trials in the North Island (Beveridge, 1962) indicated that the most effective treatment for desiccation of standing scrub was 2,4,5-T butoxyethanol ester in oil. *Fuchsia excorticata* and wineberry appeared to be the most susceptible species and mahoe (*Melicytus ramiflorus*) the most resistant. Pelleted fenuron, broadcast or placed on a grid system through groups of dense scrub hardwoods, caused little damage to larger trees in 6 months; only mahoe was defoliated to any extent.

Comments on a trial by N.Z. Forest Products (Crowther, 1962) indicated that atlacide (59% sodium chlorate and 41% calcium chloride) was better than 2,4,5-T in water. Of interest was an attempt "to cut lines 60 cm wide through the vegetation" using a helicopter fitted with "coarse nozzles". Although this was effective, the lines proved too narrow and side growth soon closed the gaps.

Further comments by Beveridge (1962) indicated that the use of 2,4,5-T and/or 2,4-D in diesel oil was effective for indigenous scrubweed desiccation. In 1971, Beveridge and Klomp reported that on easy terrain (Mamaku Plateau) most methods of site preparation would cost at least $98/ha. On the easy terrain good planting conditions were obtained by using a tractor to pile up felled and burned vegetation. Aerial spraying with herbicides (7.17 kg 2,4,5-T in 225 litres of diesel oil/ha) quickly defoliated vegetation and was an aid to tractor clearing and drying out of large, felled material in preparation for burning. Rockell (1966) also recommended the use of 2.2 kg 2,4,5-T plus 2.2 kg 2,4-D in diesel for indigenous scrubweed desiccation. He did not recommend it for use on standing manuka (*Leptospermum scoparium*) or gorse (*Ulex europaeus*).

Further work, by Preest (1966), indicated that common indigenous hardwood weeds vary tremendously in their reaction to weedicides, from those such as wineberry and *Coprosma australis*, which proved to be very sensitive to 2,4,5-T emulsifiable ester in water, to species such as mahoe and kamahi which are very resistant to it.

Of the chemicals tested and considered suitable for conifer release few had been tested on indigenous species, and at that time there did not appear to be any superior to 2,4,5-T. Species controlled well include wineberry, *Coprosma australis, C. lucida, C. robusta, Melicytus lanceolatus* (seedlings), pate (*Schefflera digitata*), and bush lawyer (*Rubus australis*). *Fuchsia excorticata* and *Neopanax arboreum* tend to resprout after initial defoliation. Mistblower application of 0.5% or 1% 2,4,5-T emulsifiable ester in water successfully released a number of exotic and indigenous conifers from seedling and coppice regrowth of the above scrubweed species arising after tractor clearing of logged indigenous forest.

Preest (1969), claimed that 2,4,5-T and/or 2,4-D in diesel oil are the most effective spray formulations available for long-term desiccation and kill of indigenous hardwood scrub growth containing a mixture of susceptible and partially susceptible species. For rapid, even, short-term desiccation of hardwood scrub and ferns [including bracken and tree fern (*Dicksonia* spp.)] or where grasses, including toetoe (*Cortaderia fulvida*) and gahnia (*Gahnia setifolia*) form an appreciable proportion of the vegetation, a paraquat/2,4,5-T mixture was the recommended treatment, or paraquat alone where these plants on their own would constitute sufficient fuel for burning. In the past two years increased use of hexazinone and glyphosate has resulted in a better kill of ferns and grasses but are much costlier than paraquat. Hexazinone is being used as a release spray over the top of radiata pine plantings too.

FUEL AND FIRE

Some of Westland's problems reported at the 1967 Forest and Nursery Establishment Symposium (Chavasse and Weston, 1969) resulted from poor fuel preparation and poor burning, leaving a site in which access for planting and supervision was difficult. The resulting survival of planted stock was 54% on one such site.

It has been emphasised (Chavasse, 1969) that all operations such as logging, felling of residual material, and spraying should help prepare fuel for burning. Careful planning and integration of these operations are necessary to ensure that the best possible site preparation is obtained (Day, 1969). Hand methods of clearing cutover indigenous hill country were discussed by Rogers (1969). He stressed the importance of moving in as soon after logging as possible and of the need for an orderly felling pattern. All material exceeding 1 m in height should be felled and completely severed from the stump. Material should be felled and left for a curing period of up to 18 months and no less than 9 months. Ideally all southern faces should be felled first.

In 1969 a programme was initiated by the Forest Research Institute to look at better use of fire as a management tool. The primary objective of this research was to improve burning operations by providing basic data on fuel drying rates and assessing fuel/weather/site relationships. Thus several trials were laid down initially in the Bay of Plenty and latterly some in Westland indigenous cut-over sites and one at Otautau Forest in Southland. The findings of all this work were similar:

—Complete severence of all stems at felling is essential.

—Felling time between autumn and spring, 10 to 3 months prior to burning did not result in any marked differences in fuel moisture content at time of burning.

—An extra summer's drying (felled 18 months prior to burning) resulted in a greatly reduced moisture content (m.c.) of 5 and 15 cm diameter pieces of fuel at time of burning.

—The 100 g hazard stick correlated well with m.c. of litter samples.

—4-6 days without rain is sufficient to render the litter flammable; but in practice this is better related to energy input by sunshine, air temperature, and wind rather than actual days since rain.

—Moisture contents of stick fuels were more stable than m.c. for litter.

—Several studies have indicated that an uninterrupted drying period of 10 to 14 days is necessary during the burning season

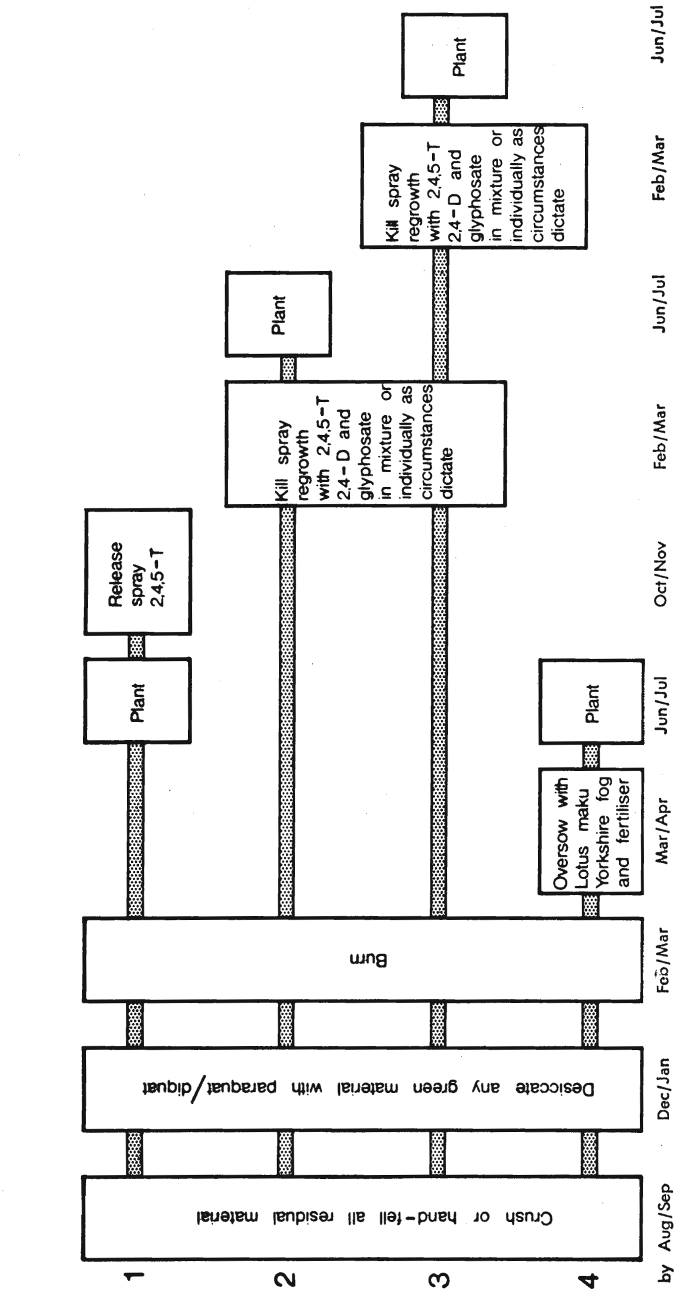

FIG. 1: *Options for conversion from indigenous scrubweeds to exotic forests.*

to bring m.c. of stick material to <20%. Once stick fuels are down to this level brief periods of light rain may not alter m.c. significantly. Once again, this shows that it is the m.c. of the ground litter (which fluctuates considerably with the weather) which determines readiness for burning.

During the 1970s more intensive lighting-up patterns evolved *e.g.*, mass ignition techniques. A significant advance was the introduction of aerial ignition devices. Nevertheless, there still exists much room for improvement in burning. For instance, more collection, interpretation, and application of on-site meteorological information to determine fuel readiness and suitability of burning conditions is needed.

CURRENT WORK

In summarising the Westland experience 1965-1975, Jackson (1976) noted that, although considerable advances had been made over that past decade, it was also evident that optimum solutions had yet to be found for conversion of indigenous scrubweed sites to exotic forests. Similar comments were made (Chavasse, 1981) when a need was expressed for improved chemical treatments for pre-burn desiccation of hardy indigenous weeds such as *Blechnum capense*, gahnia, and shrub hardwoods, and for releasing pines from hardy indigenous weeds on unburnt or poorly burnt sites.

In Southland Conservancy (Guild, 1981) indigenous cut-over areas to be converted to exotics are being intensively prepared and oversown with grass/clover mixtures soon after planting: an application of the so-called "replacement theory". In this, steps are taken to fill the vacuum created by clearing off undesirable vegetation with alternative plant material that will impede re-invasion by the initial weed species and greatly assist in reaching a certain goal, in this instance an exotic forest crop. A trial was established at Blue Spur, Kaniere Forest, near Hokitika to test this and 3 other site preparation options which are given in Fig. 1.

The first three options were applied to 0.5 ha plots and replicated 3 times in an area which had been hand-felled, tractor crushed, and burnt. Option 4 was carried out on a 2 ha block within the catchment area. The herbicide, seed, and fertiliser were all applied by helicopter.

This trial has been running for only three years, but results, so far, are very encouraging. Results were evaluated using vegetation transects to assess suppression of indigenous regrowth and are summarised in Table 1.

TABLE 1: PERCENTAGE OF SAMPLING POINTS *WITHOUT* INDIGENOUS SCRUBWEEDS.

Site preparation options	1	2	3	4
% Sites free of indigenous weeds	19	19	73	82

Analysis was carried out using a chi-square test. Options 3 and 4 resulted in a greatly reduced indigenous weed population and the differences are highly significant ($P < 0.01$) when compared with options 1 and 2. Option 4 has resulted in better ($P < 0.05$) indigenous scrubweed control than Option 3.

In Options 1, 2, and 3 problem weeds occupying the sites to a greater or lesser degree and offering competition to the planted radiata pine include *Dicksonia squarosa, Blechnum* spp., putaputaweta (*Carpodetus serratus*) wineberry, hutu (*Ascarina lucida*), pigeonwood (*Hedycarya arborea*), and kamahi.

In the oversowing option, indigenous weed control was excellent. Two plants of *Gahnia setifolia* and a few *Dicksonia squarosa* were present. The latter were present because they had not been felled initially.

An advantage of oversowing compared with two post-burn sprays is that the site can be planted in the first winter after burning, rather than two years later. In addition N is injected into the site by the maku lotus. (In our trial, more maku lotus seed and fertiliser may have been used than is really necessary and further trials need to be undertaken to establish minimum rates needed). Should maku lotus and Yorkshire fog themselves create an early establishment weed problem, this could be overcome by adjusting timing of oversowing or by using 3, 6-dichloropicolinic acid and hexazinone as a spot release treatment.

Costs of oversowing with seed and fertilisers are around $750/ha if quantities of material used were as used in this trial although the cost of the double-hit herbicide regime was slightly cheaper at $720/ha. However, the quantity of seed and fertiliser used may have been more than necessary (R. E. Fitzgerald, pers. comm.) and has the advantage in that the manager can plant the first winter after burning as well as providing a source of nutrients for optimising tree growth. The major disadvantage of the double-hit chemical regime lies in the delay of planting for 12 months coupled with the fact that the site is barren of any vegetation except for the planted crop species. Though it has not occurred yet in our trial, re-invasion by weed species is still a strong possibility as seed dispersal by birds would occur.

A REGIME FOR WIDER EVALUATION

The above results suggest that the following regime may be worth wider evaluation in Westland, and perhaps elsewhere:

1. Hand-fell residual bush (or crush if possible).
2. Desiccate spray as required.
3. Burn.
4. Oversow, either before or after planting, with 7.5 kg coated and inoculated seed of maku lotus (current cost $6.67/kg) and the following fertilisers/ha: 41.67 kg P; 520 g B; 750 g Cu; 52 g Co; 30 kg S; and 39 g Mo*. Additional fertiliser could be applied the following autumn using per ha: 15 kg P: 27.5 kg K; and 35 kg S.†
5. Plant.
6. Spot release if required.

Felling should be completed at least 8 months but no longer than 2 years before burning. Burn under the most hazardous conditions (with the provision of proper safeguards). The need for a pre-burn desiccant spray is dependent on the quantity of shrub hardwood regeneration before burning; if required, a mixture of 4 kg 2,4,5-T/4 kg 2,4-D in water with 10% v/v diesel is recommended.

Where ghania and ferns are a major component, 2-3 kg paraquat or 6 kg hexazinone could be used.

This paper seeks to draw attention to relevant past work. The above regime is not a ready-made solution to all of Westland's conversion problems but it is thought to have good potential. It is presented to promote discussion and experimentation.

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*500 kg/ha Westland Pakihi Pasture Starter (Ravensdown Fertiliser Co-op. Ltd.).

†250 kg/ha 22% Potash Sulphur Super (Ravensdown Fertiliser Co-op. Ltd.).

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