SITE PREPARATION FOR AFFORESTATION

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Summary

In production forests, control of weeds during establishment and early development stages is as important as it is in other crops. The aim is to eliminate unwanted vegetation—grass, bracken fern (*Pteridium aquilinum* var. *esculentum*), gorse (*Ulex europaeus*), scrub, and scattered bush—during site preparation. This is usually done by burning, but planned clearance cannot always be completed under favourable conditions. Chemical weed-killers are being used to “condition” vegetation for burning and also to deal with regrowth after unsatisfactory site preparation. There is considerable scope for development of techniques and materials which will enable chemicals to be used more as a management tool than as a late defence against weeds that threaten to suppress tree growth or hinder silvicultural treatments.

THE OBJECT of this paper is to describe site preparation requirements for effective forest establishment, how present chemicals can aid preparation, and the limitations of these materials. Past practices are reviewed briefly and an outline is given of difficulties in the management of production forests arising from inadequate site preparation.

BURNING

In New Zealand, fire has been the main tool for preparing land for tree planting. The objectives are to reduce all dense scrub and slash to a state and proportion that allow men to plant, and to kill (or markedly reduce the vigour of) any non-timber species—weeds in this context—so that competition with growth of the forest crop is minimal. For many years, forests were planted on reverted farm land or land that had been covered with light scrub (especially manuka (*Leptospermum scoparium*), bracken fern (*Pteridium aquilinum* var. *esculentum*) and introduced weeds. Most of this vegetation was easily burnt, though difficulty was experienced on certain aspects and sites without preliminary felling. Various practices were developed to help burn the more fire-resistant types of cover. These included felling fire-start lines, felling all the overwood, and (more recently) mechanical crushing using tractor blades or towed chopping rollers. Often, difficult areas were by-passed, leaving pockets of unproductive scrub in the planted forest.

For large afforestation programmes, sufficient land has to be held in a state where vegetation is ready to burn in preparation for planting as planned. Planting must be done in stages to build up the orderly sequence of age-classes essential for proper management and harvesting in production forests. Progressive planting must be done so that further burning of unplanted areas can proceed without risk to planted areas, which in the early stages of development are particularly susceptible to damage.

Good planning and preparation for burning, a bold approach to the lighting of preparatory burns, and favourable conditions for burning, can produce excellent planting conditions. Costs are often as low as a few pence an acre, especially for large burns.

In 1964, the Forest Service tried to burn 32,200 acres in preparation for planting; it achieved 28,000 acres. In 1965, 27,000 acres were attempted and 23,000 acres were achieved. In one area, a 2,000-acre burn cost 8.7d. per acre; in another, a 50-acre burn cost £8 2s. 10d. per acre. Costs per acre for protective firebreaks and labour are often much higher when small areas are being burnt, mainly because the same preparation and suppression organization is required whether the burn is large or small. Burning sometimes fails, partly or completely, to meet the objectives already outlined, especially on sites adjacent to existing forest. On these, expensive fire-break safeguards have to be established and fires lit when conditions are "safe", which means they are *not* favourable for effective clearing.

Management of a growing forest and the quality of the material produced are affected by the efficiency of land preparation. Ideally, the forest area should be fully stocked at establishment so that trees grow evenly with no gaps and little variation in tree size or form, both of which are influenced considerably by competition from nearby trees. Difficult planting, such as among a tangle of unburnt scrub or slash, or in dense swards of grass, leads directly to variable, or locally inadequate, stocking. Gaps have to be filled (an operation known as "blanking") the year after planting—an extra cost; or more difficult and costly cultural work is required during the crop's formative years. Hence, clean land is a *sine qua non* in efficient afforestation.

As development of land-using industries—the so-called primary production aspect of our economy—continues, land for afforestation becomes more difficult to obtain in face of agricultural expansion. This forces afforestation activities on to more distant, usually difficult to prepare land, or on to locally available areas (in terms of marketing of forest produce) which previously had been bypassed because of some unattractive feature, often difficulty in preparation and establishment of an exotic crop.

MECHANICAL CLEARING

On easy slopes on country that is not too broken, mechanical clearing is another generally applicable technique for removing scrub growth and reducing competition from weeds. Costs for this method, as with burning, give a yardstick against which alternatives can be measured. The objectives in mechanical clearing can be to eliminate competing weeds or to prepare them for easy effective burning. Generally slopes need to be of less than 20°; the practical limit is usually considered to be 15°.

Simple ploughing-in of a dense grass/light weed complex may give all the preparation needed. At the other extreme are: (1) The chopping up of heavy growth of old gorse or light second-growth indigenous scrub with giant discs or chopping rollers, or crushing. (2) All the post-logging or harvesting techniques, commonly carried out by felling gangs and associated powerful mechanical equipment—multiple tractor ball and chain, winching, and other gear designed to apply mechanical power to smash and windrow dense vegetation.

Generally, mechanical clearing techniques are well understood, and the combination of methods giving the best return for money spent can be found simply by trial and error.

Gorse (*Ulex europaeus*) can usually be controlled for about £10 per acre by two double discings and a final harrowing with stump-jumpers to give a reasonably level surface. Although this cultivation is more expensive than normal preparation, such as simple fire-breaking and burning, it ensures control, not merely temporary suppression, of gorse. Ploughing is cheaper for a single pass where only tree lines are opened up, but costs increase if drainage or other physical conditions of the soil have to be improved.

Heavy scrub and second growth, with or without remnant unmerchantable hardwoods, contain such a variability and complexity of types that it is pointless to generalize about costs, except that to date costs higher than £25 per acre have not normally been accepted. A more general yardstick for complete and acceptable preparation would be £10 to £15.

One point needs to be emphasized: with mechanical clearing there is little operational difficulty; machines work and the job gets done. Clearing programmes can be adhered to and, except for delay due to unseasonable weather during normal burning periods, planting progresses as scheduled. Preparation is not complicated by the variables of seasonal differences and responses to chemicals; the availability of aircraft; and the wide range of susceptibility of weeds affected by such aspects as botanic composition, soil variation, and variability in skill of application.

PLACE OF CHEMICAL METHODS

An understanding of this background is essential in discussing the use of chemicals in forestry. Reference will be made here mainly to pre-planting preparation, but there is growing awareness that chemicals could be used to release young trees from weeds. The weed problems at both these stages are closely related, because the need to release trees is directly connected with inability to eliminate weeds before planting.

Chemicals offer a reasonably effective means of dealing with vegetation on steep, non-tractor slopes, except, as noted above, where the alternative of total felling is possible, either in conjunction with logging or where labour and skills are at hand. Chemical methods can be used both for preparation and releasing, but are likely to be more practicable for the latter because of labour costs.

In certain circumstances, individual treatment of competing plants might be practicable, but generally the widest use will be found for chemicals where they can be applied by air or by mist drifting techniques, where plant reaction follows uptake of chemicals through foliage and/or roots:

- (1) Where vegetation is relatively short (second-growth up to 20 ft) but is dense and impedes access for planting, chemical desiccation will help to produce a hot, consuming fire.
- (2) Where there is a closed canopy of high scrub or forest too dense for exotic plants to grow through, but with open conditions beneath (such as where animals have eaten out the understorey) chemicals could be used to kill the overwood and allow light to penetrate. Important principles are:
 - (a) The cost must be acceptable.
 - (b) Techniques must be simple — reduced to a standard drill or drills.

- (c) Chemicals must be effective on a wide range of vegetation and reliable under certain recognizable conditions. Alternatively, a chemical must be specific and positive in use — *e.g.*, an efficient bracken fern killer, especially for releasing trees, would be welcomed.
- (d) The materials must be acceptable for health and safety reasons — *e.g.*, aerial application of inorganic arsenic compounds, which are promising technically, is prohibited in most areas.
- (e) Diluents used need to be safe, cheap, and readily available.
- (f) Highly active chemicals suitable for low volume application would be preferable, on cost grounds. Penetration into lower canopies or tiers is desirable.
- (g) Residual toxicities must be low.
- (h) Translocation and “kill” properties are preferable to a quick “scorch” with rapid leaf fall, because there is less chance of second growth.

There are special conditions for releasing trees once they are established, but many of the problems encountered in post-planting phases would be better solved by more efficient preparatory work. Releasing should preferably be averted by use of more specific or powerful chemicals against weeds at the preparation stage, when application would not be restricted by considerations such as minimal doses or awkward timing because of the presence of a tree crop.

More precise knowledge is needed about the use of particular chemicals for certain types of work — *e.g.*, only 2,4-D is apparently effective against very young stages of wineberry (*Aristotelia* sp.), but the butyl ester of 2,4,5-T (1 lb in 10 gal of water per acre) readily kills older stages. Many operational details have to be worked out and knowledge is still limited on:

- (a) Timing of applications according to vegetational development stages.
- (b) Use of multiple applications and mixtures.
- (c) When to burn in relation to time since spraying and in advance of planting.

An example will be given of improvement in technique in dealing with gorse, not to record that it is the last word in control, but to indicate how, almost accidentally, refinements develop.

Many must have seen a rather patchy crop of pines appearing through gorse, commonly when it is 6 to 12 ft high; usually the gorse has had little difficulty in re-establishing a dense cover. At some stage before the pines broke through the gorse, forest managers would have waited anxiously for the outcome, and often belatedly would have attempted to “give the gorse a knock”, with varying results. Sometimes the pines are so suppressed and protected that a virtual kill spray can be applied with only slight risk of trees being distorted by chemical damage. But even if this treatment releases the trees, the gorse continues to grow.

If the gorse is dense, management costs for the developing forest go up at an alarming rate. Pruning costs, which should be about £5 to £8 per acre for each of two lifts, often treble and the quality of

work, and subsequently of the timber recovered, suffer. Line cutting to give access for pruners costs from £4 10s. to £11 16s. per acre; low pruning from £6 10s. to £16 5s. per acre; and second pruning, to a height of 20 ft, another £8 to £12. As initial establishment would have cost about £2 per acre for preparation (burning, but no other control practice), and £12 for planting, the total cost under these conditions would be about £45 per acre. This does not include provision for blanking, release cutting, or spraying, an average figure for which would be about £8 per acre.

The improved technique for dealing with the situation outlined was as follows:

- (a) Dense gorse was sprayed with 2,4,5-T in November, 1962. This cost £4 10s. per acre.
- (b) Burning was not done until April, 1964, 16 months later.
- (c) Planting was not done that winter and the regrowth of gorse was sprayed in November, 1964, at a cost of £4 per acre.
- (d) Planting in July, 1965, over the mostly dead, 1 ft-high gorse was relatively easy.
- (e) Release spraying was done in November, 1965, costing £1 15s. per acre.

Today there is little evidence of suppression by gorse, and a fully stocked stand is developing normally, and at completion of the second pruning lift the total cost per acre should not exceed £28.

Clearly much more needs to be known about the use of different chemicals for a wide variety of conditions and operations. New chemicals may be discovered and refinements may be made in formulations and additives, but in the main there are enough chemicals to give reliable results if they are used with maximum efficiency. Too often, the required conditions for, and limitations of, weedkillers are not well enough understood locally; the greatest need at present is for intelligently conducted trials to prove the best methods for field use of materials. Growth-regulating chemicals have made many contributions to agriculture and forestry since 2,4-D was developed 20 years ago. They can be expected to contribute more in future, as weedicides become tools of management and are not regarded, as they are so often today, as a defence measure.