

treatments. Under competitive vegetation situations, e.g. culling in forests using picloram at 0.25%, stump height (up to basal diameter height) is not critical. In non-competitive situations, it is desirable to cut the stump as near to the ground as possible.

#### Injection Technique

Injection, using a water-soluble formulation (Tordon 105), offers a proven technique for regrowth control. Number and distribution of suitable injection sites to allow application of the chemical are important considerations.

#### MECHANIZATION

A complete programme will involve the consideration and integration of ground and aerial application techniques. Equipped helicopters, applying invert emulsions or thickened sprays, are a valuable tool in inaccessible terrain.

#### THE ROLE OF HERBICIDES IN ASSISTING ESTABLISHMENT OF PINUS RADIATA IN NEW ZEALAND

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More than 50,000 acres of *Pinus radiata* are now planted annually in New Zealand. Grass, scrub weeds and/or bracken fern seriously interfere with survival and growth rate of the young trees on most sites. Hand release of pines is only possible to a limited extent, and is especially difficult in more remote, large planting blocks. The present trials using selective chemical sprays for tree release were developed in two stages:

1. Herbicide screening tests to determine tolerance of young pine trees in relation to stage of growth.
2. Field trials to assess herbicidal activity against a range of weeds and selectivity towards pine transplants.

In both the screening and field site trials (1/0 seedlings) planted during winter were broadcast sprayed at two stages.

1. Late winter - dormant prior to 'flushing'.
2. Late spring - during 'flushing'.

Over a 6 month trial period visual assessments were made of weed control by estimating reduction in ground cover and height of weeds, together with visual assessment of tree vigour, survival count and height measurement of the pines.

Two types of herbicidal treatments were applied in both trial types:

## RESULTS

### 1. Grass release herbicides

- (i) The most selective broadcast treatment for release of first year transplant *Pinus radiata* from pasture grass cover has been a mixture of atrazine 4 lb plus amitrole T 2 lb.
- (ii) Where grass growth is rank or *Cortedaria* spp. and sedges are present, improved knockdown and residual control is achieved with 2,2-DPA added to atrazine/ amitrole (up to 2.5 + 4/1.25 lb respectively). Because of the lower selectivity of 2,2-DPA towards pines, this mixture is safer as a directed application around the tree or as a pre-plant broadcast treatment. Aerial application of the 2,2-DPA mixture has resulted in needle burn, reduced initial tree vigour and some loss of height increment.
- (iii) Winter-early spring treatments applied up to 6 weeks after planting before trees begin to 'flush' and when competing grass regrowth has strongly commenced, result in more complete weed control and offer higher tree tolerance than late spring treatments. The mulch of dead grass cover probably aids continued effectiveness and moisture conservation through the summer.
- (iv) Mixtures of amitrole T or 2,2-DPA/amitrole with 'Tandex' were tested. Although grass knockdown and residual control, especially of *Paspalum dilatatum* and *Paspalum distichum* was markedly improved, pine tolerance was considered insufficient to tandex mixtures.

### 2. Broadleaf weed and brush weed herbicides

- (i) Although well tolerated by pines even during the spring 'flushing' stage, broadcast sprays of the amine salt of 2,4,-5-T were considerably less effective herbicidally than the standard 2,4,5-T ester treatment of 1 lb.
- (ii) Mixtures of picloram + 2,4,5-T at 1 + 4 oz. per acre

as the amine salt or ester have proved very effective for the control of annual thistles which prolifically over-top pine transplants on fire cleared sites in the first year following burning. Pine transplants at the early spring growth stage tolerated without loss of vigour picloram/2,4,5-T mixtures up to 2 + 8 oz per acre in aerial treatments. As with 2,4,5-T, second year trees show a much lower tolerance margin to these mixtures.

- (iii) Brush weeds such as broom (*Cytisus scoparius*), gorse (*Ulex europaeus*) and the native tutu (*Coriaria* spp.) can be adequately suppressed for pine release by picloram/2,4,5-T (up to 2 + 8 oz per acre) if treated in mid-spring when the weeds are growing actively and before the pines recover from transplant shock.
- (iv) Strong pine tree vigour and adequate nutrition increase the apparent tolerance to picloram/2,4/5-T treatments as vigorous terminal growth leads to recovery from temporary herbicidal suppression.
- (v) Pine tolerance during the early to mid-summer 'rest' period needs more detailed study because brush weeds are then still in a susceptible active growth stage. The practical levels of pine tolerance to brush herbicides during the second winter dormancy period also warrants investigation. The control of bracken (*Pteridium esculentum*) and pine release from its regrowth remains a major unresolved problem in New Zealand forestry.