A REVIEW OF CHEMICAL CONTROL OF BRACKEN AND GORSE FOR FOREST ESTABLISHMENT

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Summary

Asulam, dicamba, karbutilate, picloram, and 4-CPA in liquid form can give temporary control of bracken (*Pteridium aquilinum* var. *esculentum*) if applied at the correct time in relation to frond development. Trials indicate that granular formulations (chlor-thiamid, dichlobenil, and sodium chlorate/borate) applied dry after burning may be more effective. With gorse (*Ulex europaeus*) multiple treatments applied to regrowth in autumn after burning, and again the following year, eliminate stools and seedlings. 2,4,5-T+paraquat and 2,4,5-T+picloram, both followed by 2,4,5-T alone, gave the best results.

INTRODUCTION

BRACKEN (*Pteridium aquilinum* var. *esculentum*) and gorse (*Ulex europaeus*) are economically the most important weeds competing with tree seedlings during forest establishment (Chavassee and Fitzpatrick, 1973). Each presents different control problems. Bracken restrained for 1 to 3 years normally gives no further problem. On tractorable land discing or ripping can provide control. On steeper country bracken is burnt late in the summer but, following planting, slasher-releasing may be required. This is costly and an alternative is desirable.

Controlling gorse is harder since seed can live in the soil for 50 years. During establishment gorse can be controlled by chopping and uprooting stools with super-giant discs, but some stools survive and regeneration after cultivation competes with trees. On steep country burning gives only temporary control. In either case trees need releasing, usually with low rates of esters of 2,4,5-T (1 kg/ha) in 100 to 200 litres/ha water to retard gorse sufficiently for trees to establish. Better control, or eradication, is needed.

BRACKEN CONTROL

Knowles (1970) reviewed control methods. Davenhill (1970) discussed herbicides found promising overseas, and results of trials at the Forest Research Institute, Rotorua. Further trials have been undertaken since 1970. In the following notes *typicum* means European bracken; *esculentum* is the New Zealand variety.

(a) Bracken control by liquid formulations

Amitrole-T: Erskine (1968) reported a 75% reduction of *typicum* after applying 8 to 9 kg/ha. Some effect lasted up to 8 years. Volger (1964) confirmed Erskine's finding that time of application, when fronds are

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fully expanded but soft, was critical. Early Forest Research Institute (FRI) trials on *esculentum*, applying 2.2, 4.5 and 9.0 kg/ha to fully expanded soft fronds, gave only slight temporary scorching. Similar results were obtained in 1971 with amitrole-T at 9.0 and 13.0 kg/ha, plus 2,4,5-T at 4.0 kg/ha.

Asulam: Wasmuth (1973) reports 12-month control of *esculentum* with asulam applied to fully expanded soft fronds. Application to expanding fronds causes necrosis, but long term growth is unaffected. When applied to unfurling fronds in FRI trials, at rates up to 18 kg/ha, reactions of individual fronds varied. Again, time of application is critical (Veerasekaran and Kirkwood, 1972).

Dicamba: Mitchell (1968) applied dicamba as a salt and reported 14 months control of *typicum* and some residual effect at 9 kg/ha. Aldhous (1964), Hodgson and Donaldson (1966), and Brown (1968) had good results for 1 or 2 years at rates from 2 to 7 kg/ha, but Nolle (1966) had no success at rates up to 3.3 kg/ha. Erskine (1968) and Mitchell (1968) obtained longer lasting results by pre-emergence application. In early FRI trials dicamba ester applied to fully expanded soft fronds at 2.2, 4.5, and 9.0 kg/ha gave only slight scorching. In 1971, 4.0 kg/ha applied to fronds in the crozier stage gave severe distortion and necrosis, but growth 12 months later was unaffected. Dicamba amine at 4.5 kg/ha had similar, but less severe, effects.

Glyphosate: In FRI trials, summer applications of 8.0 kg/ha to fully expanded fronds gave severe browning off but regrowth seemed unaffected. When applied to expanding fronds, following a February burn, almost total kill resulted.

Karbutilate: Trials in Waikato and the Bay of Plenty showed that 4.0 and 8.0 kg/ha applied in both spring and autumn to fully expanded fronds gave total kill and complete control for up to 18 months (A. C. Mackay, pers. comm.). Early FRI results were inconclusive as fronds in the crozier stage were treated, but later trials are confirming Mackay's results.

Picloram: Picloram in liquid form applied to various frond stages at rates from 1.0 to 4.5 kg/ha gave good control of *typicum* for up to 2 years, sometimes with further residual effects (Nolle, 1966; Hodgson and Donaldson, 1966; Harranger *et al.*, 1967; Mitchell, 1968). At FRI, the amine salt applied to expanded soft fronds of *esculentum* at rates from 4.5 to 9.0 kg/ha gave slight distortion and browning of fronds, with no lasting effect.

4-CPA: Erskine (1968) reported control of *typicum* with 8 to 11 kg/ha. Timing was critical, and control was generally short term. Matthews (1962) and Mason (1962) had early promising results on *esculentum*, and in early FRI trials 4-CPA at 4.5 and 9.0 kg/ha gave reasonable temporary control; 12 months later new growth was unaffected.

Typicum and *esculentum* seem to react differently to the same chemicals. Also, time of application in relation to frond condition and growth stage is critical; *esculentum* fronds generally emerge over several weeks and are thus in different stages at any one time. In addition, picloram (Preest 1966), karbutilate and, to a lesser extent, dicamba (Brown, 1968) can have deleterious residual effects on tree seedlings planted following treatment.

Although some liquid formulations are promising for *esculentum* control, alternative methods in forestry are desirable, and FRI trials have concentrated on granular herbicides. The effects of repeated applications of liquid formulations are, however, also being examined.

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(b) Bracken control by granular herbicides

Chlorthiamid and dichlobenil: Application must be in cool weather to reduce volatilisation. Bracken is cut or burnt in spring or autumn. The herbicides should then be applied as fronds are appearing at the soil surface. Rates of 11 to 13 kg/ha gave 100% control for the following year. Inconsistent results may be due to too early application, and also to litter on the soil surface. Both herbicides control other herbaceous weeds and so could have more use than the chemicals discussed below.

Karbutilate: Pellets containing this herbicide applied at 15 kg/ha killed virtually all emerged fronds of *esculentum*. Complete suppression, though slow to appear, lasts for at least 15 months.

Picloram: Control of *typicum* for 2 years or more is obtained with 1.0 to 4.5 kg/ha, especially when applied before frond emergence (Nolle, 1966; Hodgson and Donaldson, 1966; Aldhous, 1967; Harranger *et al.*, 1967; Erskine, 1968; Mitchell, 1968; Martin, 1968). Rohrig and Rozsnyay (1961) found, however, that sometimes 12 kg/ha gave lasting control while 22 kg/ha was ineffective. In early FRI trials 2.2, 4.5, and 9.0 kg/ha applied in December distorted and reduced frond growth of *esculentum*, but only the highest rate reduced cover. The effects lasted only 1 year.

Sodium chlorate/borate: 3-year trials showed that sodium chlorate formulations containing borate as a fire retardant, applied dry at rates of 180 to 360 kg/ha a few days after burn-off, give excellent 2-year control of *esculentum*. As with other granular herbicides, the effect is confined precisely to the area of application; with small plots, reinvasion from margins occurs in the second year, indicating that the chemical is not translocated within the rhizomes.

Residual effects of karbutilate and picloram may make subsequent tree planting hazardous. Radiata pine (*Pinus radiata* D. Don) can, however, be planted (at least on pumice soil) shortly after treatment with sodium chlorate, chlorthiamid, and dichlobenil at the rates described, without being affected, although 6 to 8 weeks' delay is recommended.

GORSE CONTROL

This problem weed should be removed before, rather than after, planting, because more techniques and herbicides can be used. Land clearing regimes may include machines, herbicides, and fire. Blading is possible on steeper country, removing cover and some topsoil, but this is unsuitable where it can cause soil loss. Other methods can only temporarily check gorse and some forms of machine preparation, especially super-giant discing, can cause problems in planting and establishment. A method to virtually eliminate gorse is necessary, and herbicides are expected to play the major role.

In 1970 it was decided to try multiple herbicide applications (Chavasse and Davenhill, 1973). The original plan was: burn in late summer; first herbicide treatment in autumn; second treatment in the following summer; plant trees in the following winter; third (releasing) treatment, if necessary, in spring/summer.

An initial hot burn was undertaken in February 1970. Herbicides were applied in late April before severe frosts, when coppice shoots were 8 to 15 cm high and there were abundant cotyledonary seedlings; there was

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little growth of other plants. Treatments were mixtures of the butyl ester 2,4,5-T with (individually) paraquat, ammonium sulphate (AMS), sodium chlorate, methylarsinic acid, and picloram at various rates, all applied in 220 litres of water/ha.

Trials were assessed in September. All plots had a few seedlings, and some regrowth from stools. Areas treated with 2,4,5-T (4 kg/ha) + paraquat (1.12 kg/ha), and with 2,4,5-T+picloram (4:1 ratio) at 2.25 kg/ha had least regrowth.

The second application was in March 1971, using a repeat of the original mixtures, or various rates of 2,4,5-T in water or diesel oil. The second assessment was in October. There was again some sprouting in plots treated with 2,4,5-T+AMS, sodium chlorate, and methylarsinic acid, but none on plots treated originally with 2,4,5-T+paraquat and 2,4,5-T+picloram. On these also, there was little seedling growth. The control plots contained impenetrable gorse up to 2 m high.

Inspection in March 1973 confirmed little growth on the treated plots. The planned third releasing application was not required.

CONCLUSION

While it cannot be claimed that totally effective operational methods for controlling bracken and gorse have been devised, trial results are promising. If equipment can be improved so that granular herbicides can be aerially applied, they could become the most important materials for bracken control. For gorse, the multiple treatment technique appears promising.

A greater problem may be a combination of the two, since mixtures of gorse and bracken are being more frequently found in afforestation areas.

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