

leaf area indicate that maximum leaf area in an unmolested stand occurs in the autumn whilst it is minimal in the spring. O'Brien (1963) has reported that most frond and rhizome apices are formed over the winter months May to September.

The density of fronds was found to vary from region to region and from spring to autumn in Victoria. Over 38 sites in Gippsland the average number per  $m^2$  was 15.75 in spring and 21.80 in autumn. In the north east over 23 sites, the averages were 22.27 and 47.54 per  $m^2$  and in the western districts over 9 sites, they were 12.36 and 26.85 per  $m^2$  respectively. It is reasonable to suggest that the leaf area is equally as variable and may influence the reliability of herbicide performance.

In view of the aforementioned it is apparent that the best time to apply a herbicide is in the late autumn, mid April-early June, as at this time photosynthetic area is maximal, frond numbers are maximal and the production of rhizome and frond apices is about to commence. This theory has proved correct for asulam, which only proves reliable if applied in late autumn. It is suggested that should slashing be contemplated once per annum, most benefit would be gained by treatment in late autumn. If two slashings per annum are contemplated then they should be completed in January and again in late autumn.

#### THE EFFECT OF ASULAM ON BRACKEN WITH PARTICULAR EMPHASIS ON RHIZOME MORPHOLOGY AND SUBSEQUENT PASTURE DEVELOPMENT

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#### INTRODUCTION

Bracken (*Pteridium esculentum*) is commonly associated with unproductive carpet grass (*Axonopus affinis*) -based pasture on the North Coast of New South Wales (Auld 1971). In non-arable areas control of bracken by chemical treatment may be worthwhile if the productivity of the associated pasture can be increased. Desirable pasture species such as paspalum (*Paspalum dilatatum*), Kikuyu (*Pennisetum clandestinum*) and white clover (*Trifolium*

*repens*) are often present in carpet grass-bracken areas and could be encouraged by management and fertilizer application if the bracken canopy were removed. Trials were commenced in 1971 to determine the effectiveness of asulam for bracken control.

#### FROND REGENERATION

In frost-free areas bracken fronds emerge and survive throughout the year, the peak emergence of fronds occurring during spring. The population is thus dominated by young immature fronds in spring-summer and by mature fronds in autumn-winter. Asulam failed to reduce frond numbers when applied in summer to a bracken population dominated by immature fronds.

Autumn application of asulam at 4 to 8 kg a.i. ha<sup>-1</sup> in 1973 resulted in reduction of frond numbers by 86% after 6 months and by 79% after 2 years. In 1974 these rates reduced frond numbers by 71% after 6 months and by 50% after 1 year. The presence of more immature fronds at the time of application in 1974 than in 1973 further emphasizes the importance of frond maturity at application time (Veerasekaran and Kirkwood 1972).

#### RHIZOME MORPHOLOGY

Morphological features of the rhizome of interest in relation to herbicide resistance in local bracken were as follows. There were 0.71 fronds, 0.46 frond buds and 6.5 rhizome apices per metre of rhizome. Eighty nine per cent of rhizome apices were dormant, and of these the largest group (63%) were buds at the base of dead fronds. Seventy eight per cent of dormant buds occurred on shoots without a current season frond.

Examination of the rhizomes of treated and untreated plants showed that asulam killed all actively growing rhizome apices and frond buds acropetal to treated fronds. Fronds arising after treatment with asulam tended to be smaller, with a higher proportion arising from dormant rhizome apices and frond base buds on older parts of the rhizome. Thus, in addition to a reduction of buds and apices the morphological age of the plant was increased (Watt 1943).

#### CONCLUSIONS

Although asulam significantly weakens the plant by reducing the size of fronds, and the number of fronds, frond buds and rhizome apices, the potential for regeneration from dormant apices and frond base buds is large. It is essential therefore that following treatment a new ecological balance be established by fertilizer application, seeding and grazing management to prevent bracken from regaining dominance. Asulam can contribute