EFFECT OF LOW RATES OF TETRAPION ON SERRATED TUSSOCK

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Summary. The rate of tetrapion recommended for commercial application to serrated tussock (*Nassella trichotoma*) is 1.5 kg ha^{-1}, but promising results have been recorded with lower rates than this when the herbicide was applied close to flowering. Thus an experiment was set down to compare the effect of tetrapion at 0.375, 0.75 and 1.125 kg ha^{-1} when applied at flowering (mid to late spring) and at various intervals after flowering (early and late summer; early and late winter).

Nineteen to 28 months later there was no difference between any time of application at the 0.75 and 1.125 kg ha^{-1} rates; all treatments gave from 96 to 100% kill. At the 0.375 kg ha^{-1} rate, the effectiveness of tetrapion applied in early summer was better ($P < 0.05$) than when applied in early spring and early and late winter.

These results indicate that tetrapion is most effective in killing serrated tussock when applied after flowering (summer) when food reserves and vegetative buds are at a minimum.

INTRODUCTION

Serrated tussock, a serious weed of pastures, infests 680 000 ha of New South Wales (Campbell 1977) and smaller areas in New Zealand and South Africa. Improved pastures used to control the weed are established on non-arable land by aerial application of herbicide, seed and fertilizer (Campbell 1977). In late 1979, tetrapion was registered for use on serrated tussock (Campbell *et al.* 1979) at a recommended rate of 1.5 kg ha^{-1}. However, in an experiment in 1976 (Campbell *et al.* 1979), serrated tussock was susceptible to lower rates applied in late spring while it was flowering. Thus an experiment was established to compare the effects of three low rates of tetrapion when applied close to flowering and at various periods thereafter.

MATERIALS AND METHODS

Site. The site was 32 km south of Bathurst at an altitude of 1000 m. The soil was derived from basalt and had a large component of rocks. The area was heavily infested with serrated tussock.

Treatments. Three rates of tetrapion were applied on six occasions between November 1978 and August 1979 (Table 1). There were four replicates with an unsprayed control plot in each. Plot size was 16 m^2. The herbicides were applied with a hand-held pneumatic sprayer in a volume of 937 L ha^{-1}.

Measurements. The percentage kill of serrated tussock was recorded in February 1981, 19 to 28 months after treatment.

Table 1. Condition of serrated tussock at spraying.

Time of application	Vigour of growth	Stage of growth
Mid spring (Nov. 6 1978)	Vigorous	Inflorescence just appearing with a few purple glumes.
Late spring (Nov. 28 1978)	Vigorous	Inflorescence fully emerged from sheath with all glumes purple; anthesis just finished.
Early summer (Dec. 19 1978)	Moderate	Inflorescence elongating and growing over the top of the leaves; seeds ripening. Most herbicide would be retained on the inflorescences.
Late summer (Feb. 15 1979)	Restricted by dry conditions.	75% of inflorescences dispersed from the tussocks.
Early winter (June 15 1979)	Restricted by cold.	Vegetative.
Late winter (Aug. 23 1979)	Restricted by cold.	Vegetative.

RESULTS

There was no difference in effect of tetrapion between any time of application at the 0.75 and 1.125 kg ha^{-1} rates, both of which gave between 96% and 100% kill of serrated tussock (Table 2). At the 0.375 kg ha^{-1} rate, the only commercially acceptable results ($>$ 90% kill) were achieved by spraying in early and late summer; there was a notable depression in effectiveness of tetrapion in late winter.

Table 2. The effect of three rates of tetrapion on percentage kill of serrated tussock.

Time of application	Kill of serrated tussock (%)		
	Tetrapion rate (kg ha^{-1})		
	0.375	0.75	1.125
Mid spring (Nov. 6 1978)	76 d[1]	98 ab	100
Late spring (Nov. 28 1978)	85 cd	99 ab	100
Early summer (Dec. 19 1978)	95 abc	99 a	100
Late summer (Feb. 15 1979)	91 bcd	99 a	100
Early winter (June 15 1979)	79 d	98 ab	100
Late winter (Aug. 23 1979)	33 e	96 abc	100

[1] Values not followed by the same letter differ (P = 0.05); analysis based on the angular transformation.

DISCUSSION

Results of this experiment showed that serrated tussock can be killed with lower rates of tetrapion than the 1.5 kg ha^{-1} currently recommended (Campbell 1980). Tetrapion at rates of 0.75 and 1.125 kg ha^{-1} was effective at all times of application indicating that neither climatic conditions nor growth cycle influenced the effect of these rates. Although tetrapion was not applied in autumn, results from the late summer and early winter applications indicate that spraying in autumn would probably be as effective as spraying in other seasons.

Differences between application times at the low rate of tetrapion indicate that either climatic conditions or growth stage of serrated tussock influence herbicide effectiveness. The low rate of tetrapion was more effective when applied in summer in the post-flowering stage than in late winter when serrated tussock was in the vegetative stage. Whyte *et al.* (1959) stated that the period of reproduction, from elongation of the inflorescence to the ripening of the seed, is the critical period in the life cycle of a perennial grass; food reserves and vegetative buds that can form new tissue are at a minimum. If tetrapion is concentrated in regions of active growth and food storage, as is the similar herbicide 2,2-DPA (Crafts and Foy 1959), then concentration of tetrapion in the vegetative buds and other meristematic tissue would be greater and more toxic in the post-flowering stage than at other growth stages.

Tetrapion was effective when applied in the post-flowering stage despite dry conditions after spraying (27 mm in eight weeks). This contrasts with barnyard grass (*Echinochloa crusgalli*) and Johnson grass (*Sorghum halepense*) which are more easily killed when they are growing vigorously (Warren 1954; Leasure 1963). It indicates that the stage in the life cycle at which tetrapion is applied to serrated tussock is more important than favourable conditions for growth.

Dry conditions after spraying could also restrict the distribution of tetrapion to the plant roots. Tetrapion enters the plant mainly through the roots (I.C.I., personal communication, 1979). Although it was dry after the early summer 1978 application, the 21 mm of rain received in the four days after spraying was sufficient to ensure the effectiveness of tetrapion despite the serrated tussock being covered with a dense layer of inflorescences.

Soil type can influence the effectiveness of tetrapion in killing serrated tussock. Under the same environmental conditions, tetrapion was less effective when applied to tussock on a rocky basalt soil than when applied to tussock on a basalt soil with few rocks (Campbell *et al.* 1979). Practical experience indicates that tetrapion is more effective in killing serrated tussock on soils derived from slate, shale or granite than on soils derived from basalt. As this experiment was conducted on rocky basalt soil, the rates of tetrapion that were effective in killing serrated tussock should be effective on all other major soil types.

Method of application can influence the rate of tetrapion necessary to kill serrated tussock. Drift of aerially applied tetrapion can reduce the actual rate of tetrapion received by serrated tussock (Yates *et al.* 1974). Thus higher rates of tetrapion should be used for aerial application than for ground application unless conditions are optimal.

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