Effects of wiping herbicides on serrated tussock (*Nassella trichotoma* (Nees) Arech.) and African lovegrass (*Eragrostis curvula* (Shrad.) Nees)

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Summary

Flupropanate (Frenock®) and glyphosate were applied to serrated tussock (*Nassella trichotoma* (Nees) Arech.) by wiping at Tuena and Dalgety, New South Wales and flupropanate was applied to African lovegrass (*Eragrostis curvula* (Shrad.) Nees) by wiping at Dalgety in September 1995. Flupropanate was also applied to serrated tussock at Tuena by spraying. The rates applied by wiping were 1:10, 1:20 and 1:40 (herbicide:water) and were applied in one or two passes. The rates used for spraying flupropanate were 0.75 to 1.5 kg a.i. ha^{-1}. Flupropanate applied by wiping killed from 99 to 100% of mature serrated tussocks in Experiment 3, near Dalgety, from the lowest rate (1:40, wiped once) to the highest (1:10, wiped twice). In Experiment 4, near Dalgety, the variation in percentage kill from lowest rate to highest was 70–99%. At Tuena the effects were inferior to those at Dalgety with variation from 40 to 92% kill for the lowest and highest rate respectively. The main reasons for the inferior result at Tuena were smaller plots, smaller tussocks and a faster speed of application. Flupropanate killed or damaged small unwiped serrated tussock, African lovegrass, cocksfoot, phalaris, and native grass plants near the base of mature tussocks. It appeared that flupropanate wiped onto leaves was washed to the soil by rain where it spread and affected grasses in close proximity to tussock bases. At Tuena, flupropanate applied as a spray on the same day as wiping gave 88–100% kills of serrated tussock from 0.75 to 1.5 kg a.i. ha^{-1}. As the highest rate of glyphosate, 1:10, wiped twice, resulted in only 33% kill of serrated tussock at Tuena, higher rates will be necessary to obtain commercially acceptable results using this herbicide. Wiping as a method of herbicide application needs testing over large areas in the field to develop a reliable practical technique as free as possible from the variables inherent in the process.

Introduction

Applying herbicides to weeds in a heavily grazed pasture by wiping has the potential to kill the ungrazed, unpalatable weed without damaging the palatable pasture. This could result in selective removal of the weed using less herbicide than applied in overall spraying, involving less labour than used in spot spraying and with less financial expenditure than in either spot or overall spraying. Serrated tussock (*Nassella trichotoma* (Nees) Arech.) and African lovegrass (*Eragrostis curvula* (Schrad.) Nees) are unpalatable grass weeds that remain ungrazed in heavily grazed pastures. Both weeds grow to 40 cm high which would allow the wiper to apply herbicides to them without contacting the pasture. The herbicides used to control these weeds, flupropanate and glyphosate (Campbell and Gilmour 1979, Campbell *et al.* 1979, 1985, 1987a) have been applied by aerial, boom and spot-spraying techniques (Campbell 1985, Campbell *et al.* 1987b) but not by wiping. Therefore experiments were conducted near Tuena and Dalgety, New South Wales to test the effectiveness of applying the herbicides to the weeds by wiping.

Material and methods

Five experiments were set down, four by wiping and one by spraying herbicides on the two perennial grass weeds. All sites were heavily infested and had soil derived from granite. Wiping was carried out with a Rotowiper® in one or two passes (opposite directions) at rates (herbicide : water) of 1:10 to 1:40. A non-ionic surfactant was added to the glyphosate mixture at 0.05% but not to flupropanate. The width of the Rotowiper was 1.8 m and the height of wiping was 10–20 cm above the ground. The roller applying the herbicide rotated in the opposite direction to the wheels on the Rotowiper. Rates of herbicides were applied from the lowest first to the highest last. After each flupropanate or glyphosate treatment the wiper was wiped dry on waste areas and was washed clean between the flupropanate and glyphosate treatments. In any one treatment the amount of herbicide mixture applied to the wiper was managed by the driver of the three-wheeled motorbike towing the wiper (Figure 1). The aim was to keep the roller moist using a hand-held electric pump. Indication that the roller was at the optimum moisture content was given by the herbicide mixture producing fine bubbles on the carpet of the wiper. Variation in wetness occurred due to the experience of the driver, the density of the weeds and the speed of the motorbike. The speed recommended for unhindered wiping, 8–10 km h^{-1}, was not achieved, it varied with the topography of the plots and the driver. Different drivers were employed at Tuena and Dalgety.

In the spray experiment flupropanate was applied with a hand-held pneumatic sprayer in 500 L ha^{-1} water to 5 × 4 m plots.

Treatments in each experiment were arranged in randomized blocks with three replications. Plots in the wiping experiments were 20 × 1.8 m at Tuena and 60 × 1.8 m at Dalgety. Measurements of herbicide effect were made at Tuena on 10 February 1997 and at Dalgety on 28 November 1996 by visual assessment of percentage kill of mature tussocks. Results were analysed by analysis of variance.

Experiment 1

Twelve treatments (Table 1) were applied near Tuena on 4 September 1995 by wiping serrated tussock with flupropanate or glyphosate. The mature serrated tussocks were 15–25 cm high with dead centres and green leaves growing from the margins. The remnants of the associated improved pasture consisting of phalaris (*Phalaris aquatica* L.), subterranean clover (*Trifolium subterraneum* L.) and annual naturalized weeds were heavily grazed by sheep. Rain (15 mm) started six hours after applying glyphosate. Immature tussocks were 2–10 cm high.

Experiment 2

Five rates of flupropanate (Table 1) were applied near Tuena on 4 September 1995 by spraying serrated tussock. The tussocks and associated pasture were similar to that in Experiment 1.

Experiment 3

Eight treatments (Table 1) were applied near Dalgety on 5 September 1995 by wiping serrated tussock with flupropanate or glyphosate. The mature tussocks were 30–40 cm high and contained 33% dead leaves. Small tussocks and grazed native pasture were not wiped because they were less than 10 cm high. Rain (0.6 mm) fell one hour after applying glyphosate.

Experiment 4

Four treatments (Table 1) were applied near Dalgety on 7 September 1995 by wiping serrated tussock in a cocksfoot (*Dactylis glomerata* L) pasture with flupropanate. The cocksfoot was grazed and therefore not contacted by the wiper.

Experiment 5

Four treatments (Table 1) were applied near Dalgety on 7 September 1995 by wiping a dense infestation of African lovegrass with flupropanate. The mature lovegrass was 30–40 cm high with little associated pasture.

Results and discussion

Wiping serrated tussock with flupropanate was more effective at Dalgety than at Tuena (Table 1). Only the 1:10 and 1:20 rates applied in two passes gave commercially acceptable results at Tuena, whereas all flupropanate treatments, except the 1:40, wiped once in Experiment 4, were successful at Dalgety (Table 1). The different effects of fluproponate at the two locations could have been due to a combination of different plot sizes, tussock heights and drivers. Plots at Tuena may have been too short (20 m) to allow the roller sufficient time to become fully charged to deliver the full rate of herbicide to the short tussocks (15–25 cm high). As treatments were applied by wiping to the three replications in order 1, 2 and 3 with the one mixture, lower percentage kills were recorded on replications 1 and 2 (56%, meaned for the six flupropanate treatments) than on replication 3 (85%). It appeared the wiper needed up to 40 m of wiping before applying the full rate of herbicide to the short tussocks. The recommendation of setting the height of the Rotowiper so that two thirds of the weed was wiped was not possible at Tuena.

At Dalgety, plots were 60 m long and the serrated tussock taller (30–40 cm) than at Tuena and thus the full rate was applied soon after the start of wiping. In addition, the wiper was driven more slowly at Dalgety than at Tuena which provided better wiper contact with the tussocks earlier in each treatment. Finally, as different drivers were used at the two sites different amounts of herbicide could have been applied early in each treatment via the hand-held pump.

At Tuena, applying flupropanate by spraying gave higher percentage kills of serrated tussock than the best wiping treatments, even when compared to the results on replication 3 (65, 92 and 97% kills for 1:40, 1:20 and 1:10 respectively, meaned for one and two passes). The higher kills from wiping on replication 3 were equivalent to spray rates of between 0.93 and 1.12 kg a.i. ha^{-1} flupropanate. No assessment of the rate of herbicide applied ha^{-1} in the wiping treatments was attempted.

The most efficient treatment for killing mature African lovegrass at Dalgety was the 1:20 rate of flupropanate wiped once (Table 1). The African lovegrass treated was a dense infestation which allowed good contact between roller and weed. Higher rates of flupropanate or the same rate (1:20) applied in two passes may be necessary to kill scattered plants where contact may not be as effective.

In each experiment small plants of serrated tussock and African lovegrass and grazed phalaris, cocksfoot and native grasses not in the vicinity of wiped mature plants, were not affected by flupropanate. However, weed seedlings and useful grasses close to the base of mature tussocks were affected by flupropanate. It appeared flupropanate wiped on the leaves of mature tussocks was washed by rain to the tussock bases where it spread in the soil and affected grasses in close

Table 1. Effect of applying herbicides by wiping and spraying on percentage kill of mature serrated tussock and African lovegrass on the southern tablelands of New South Wales , measured 15–18 months after herbicide application.

Herbicide	Rate (Herbicide: water)	Number of passes	Kill of mature plants (%)			
			Serrated tussock			African lovegrass
			Tuena Exp. 1	Dalgety Exp. 3	Dalgety Exp. 4	Dalgety Exp. 5
			Wiping			
Flupropanate (75% a.i.)	1:10	2	92 a[A]	100 a	–	–
	1:20	2	92 a	100 a	99 a	99 a
	1:40	2	40 b	99 a	97 a	95 a
	1:10	1	60 b	100 a	–	–
	1:20	1	60 b	99 a	95 a	99 a
	1:40	1	50 b	99 a	70 b	90 b
Glyphosate (36% a.i.)	1:10	2	33 a	–	–	–
	1:20	2	9 ab	10	–	–
	1:40	2	2 b	–	–	–
	1:10	1	14 ab	–	–	–
	1:20	1	2 b	5	–	–
	1:40	1	0 b	–	–	–
			Spraying			
			Exp. 2			
Flupropanate (kg a.i. ha^{-1}) (75% a.i.)	1.50		100 a	–	–	–
	1.31		100 a	–	–	–
	1.12		98 ab	–	–	–
	0.93		90 bc	–	–	–
	0.75		88 c	–	–	–
	0.00		0 d	–	–	–

[A] Values, for each herbicide, in columns not followed by a common letter differ significantly at $P<0.05$.

Figure 1. Motor bike towing the 1.8 m wide wiper when wiping serrated tussock near Tuena on 4 September 1995.

proximity (0–5 cm). Where tussocks occurred in dense patches, death of weed seedlings at their bases was almost complete and the useful grasses were severely affected. Therefore it is important to establish the minimum rate of flupropanate necessary to kill the target weed from an economic stand point as well as to get maximum selectivity.

Glyphosate applied by wiping was ineffective in killing serrated tussock which substantiates previous results in New South Wales where high rates (5 kg a.i. ha^{-1}) of glyphosate are needed to kill the weed by spraying (Campbell and Gilmour 1979). Although rain was recorded after both glyphosate wipings, the six hour rain-free period at Tuena is the recommended minimum period for the herbicide to express optimum effects. Rates of glyphosate higher than 1:10 will be necessary if wiping is to be effective on serrated tussock. A general recommendation of 1:2 is given for the control of 'many annual and perennial weeds' (Anon. 1997).

Rotowiping with flupropanate could be effective in selectively removing mature serrated tussock and African lovegrass from improved pastures with minor damage to useful plants in close proximity to the bases of tussocks. Use of the Rotowiper will be restricted by rocks, stumps, sticks, undulations and the slope of the pasture to be treated. In our experiments the wiper was 1.8 m wide, but wider wipers are available which would improve the speed and economy of treatment. Also, there are a number of more complex wipers available which could improve the effectiveness of herbicide application. For example, the rotary wick wiper (Weedbug®), applies herbicides through rotating polyurethane discs that are adjusted for height by a pneumatic three-point linkage system (McCallum 1997).

As most small plants and seedling weeds will not be affected by wiping with flupropanate, a heavily grazed pasture with mainly mature weeds would be the most appropriate to treat by wiping. If wiping can be done quickly and cheaply, treatment once or twice each year could kill succeeding generations of weeds as they mature. Therefore it would not be essential to kill the smaller plants in the first wiping but to wipe them with flupropanate as they reach wipeable height and well before they produce seeds. Glyphosate could be added to flupropanate when wiping close to flowering to prevent seedhead production (Campbell 1995).

Conclusions

These experiments show that applying herbicides by wiping could have a place in the selective removal of serrated tussock, African lovegrass and other unpalatable weeds from palatable pasture species. However it will be necessary to test wiping on a paddock scale in different locations in New South Wales to formulate a practical and economic technique that will eliminate some of the variables inherent in the wiping process associated with speed and height of application, rate of herbicide, weed density and repetitive treatment.

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References

Anon. (1997). 'Profitable pastures', 15 pp. (Monsanto Australia, Melbourne).

Campbell, M.H. (1985). Serrated tussock control. NSW Agriculture Agfact P7.6.30, 4 pp.

Campbell, M.H. (1995). Use of glyphosate and paraquat to stop seedhead production of serrated tussock (*Nassella trichotoma*). Proceedings 10th Conference Grassland Society of New South Wales, Armidale, pp. 107-8.

Campbell, M.H., Dellow, J.J., Keys, M.J. and Gilmour, A.R. (1985). Use of herbicides for selective removal of *Eragrostis curvula* (Schrad.) Nees from a *Phalaris aquatica* pasture. *Australian Journal of Experimental Agriculture* 25, 666-72.

Campbell, M.H. and Gilmour, A.R. (1979). Effect of time and rate of application of herbicides on serrated tussock (*Nassella trichotoma*) and improved pasture species. 1. Glyphosate and 2,2-DPA. *Australian Journal of Experimental Agricultural and Animal Husbandry* 19, 472-5.

Campbell, M.H., Gilmour, A.R. and Vere, D.T. (1979). Effect of time and rate of application of herbicides on serrated tussock (*Nassella trichotoma*) and improved pasture species. 2. Tetrapion. *Australian Journal of Experimental Agriculture and Animal Husbandry* 19, 476-80.

Campbell, M.H., Kemp, H.W., Murison, R.D., Dellow, J.J. and Ridings, H. (1987a). Use of herbicides for selective removal of *Eragrostis curvula* (Schrad.) Nees from a *Pennisetum clandestinum* pasture. *Australian Journal of Experimental Agriculture* 27, 359-65.

Campbell, M.H., Kemp, H.W., Murison, R.D., Keys, M.J., Dellow, J.J. and Gilmour, A.R. (1987b). African lovegrass control. NSW Agriculture Agfact P7.6.37, pp 6.

McCallum, C. (1997). Parramatta grass control by selective application of glyphosate using the Weedbug® system. Newsletter, of the Weed Society of New South Wales 9, 6-7.