The effect of Glyphosate on Whitegrass (*Cortaderia pilosa*)

R.P. Thompson

Department of Primary Industries Water and Environment, Scottsdale Tasmania.

ABSTRACT

Increased productivity from sheep and beef enterprises in the Falkland Islands is largely dependent upon improving feed quality and quantity. The key to achieving this is to replace the low quality natural vegetation dominated by whitegrass, *(Cortaderis pilosa*) with improved pasture species. This paper examines the ability of the herbicide glyphosate to control whitegrass and concludes this chemical may have a role in pasture improvement programs in the Islands.

KEY WORDS

Whitegrass, *Cortaderia pilosa,* glyphosate, Falkland Islands, pasture establishment.

INTRODUCTION

Increased production from grazing animals in the Falkland Islands is largely dependent upon improving the quantity and quality of nutrients available to them. The native vegetation is largely grassland dominated by *Cortaderia pilosa* (whitegrass) which has low nutritive value.

The most practical means of improving the nutrition of grazing livestock is by replacing the native vegetation with improved pasture species. Traditionally this has been done by conventional cultivation, usually with rotovators, followed by burning. Such a procedure is expensive both in terms of energy and labour and often results in very poorly compacted seedbeds and thus low seedling germination and survival. There is also the risk of long burning fires in the peat profile resulting in sterile clay pans and erosion. Consequently, only a relatively small area of improved pasture exists on the Islands.

In an effort to minimise energy and labour inputs into pasture improvement and reduce the risk of erosion the role of herbicides in controlling whitegrass was investigated. This paper reports results of experiments designed to test the effectiveness of glyphosate to control whitegrass. No previous experimental work with herbicides to control endemic species has been conducted in the Falkland Islands.

MATERIALS AND METHODS

An area dominated by whitegrass was selected and plots 2.8m by 100m established. Glyphosate (480 g/l) was selected as a herbicide most likely to be effective on this vegetation because of experience reported elsewhere (Davenhill 1988 and Duckett 1989**).** The herbicide was applied in combination with a surfactant (galacetic) at the rate of 100 ml/ha. Application was in mid spring or early summer using an all terrain vehicle (ATV) fitted with either a Lemken sprayer or wick wiper. Treatments in all experiments were replicated three times.

Three experiments were conducted.

Experiment 1

Natural vegetation to which glyphosate was applied at the rate of 0, 0.96, 1.92, 2.88, 3.84 grams per hectare, corresponding to 0, 2, 4, 6, 8 litres per hectare of the commercial formulation Roundup^{R} using a boom spray delivering the spray mix at the rate of 220 l/ha.

Experiment 2

Natural and regrowth vegetation following burning or flail mowing to which glyphosate (diluted 1:2 with water) was applied by a rope wick wiper in either single or double wiping applications. Each of the seven wiper application settings was used on both vegetation states.

Experiment 3

Natural vegetation which had been burnt in early spring and allowed to regrow prior to application of glyphosate in early summer using the same rates and methods as in experiment 1.

Experiment 1 was assessed using the number of whitegrass seed heads as an indicator of herbicide effect during the first summer. A year following herbicide application all experiments were assessed using percentage green leaves present on the target species as an indicator of herbicide effect. Both these measurements were done using twenty, quarter square meter quadrats per plot. Data was analysed using analysis of variance following log transformation of percentages.

RESULTS

Experiment 1

All rates of applied glyphosate reduced the number of flower heads produced by whitegrass (Table 1).

Whitegrass leaf chlorosis was evident about a month after application of the herbicide but necrosis occurred slowly over the following year. All rates of applied glyphosate reduced the number of green whitegrass leaves present a year after the application (table 2).

Table 1. Effect of glyphosate on whitegrass seed head production.

Roundup^{R} (l/ha)	Mean flower heads (No./m^2)
0	113.6^{a}
2	21.6^{b}
4	16.8^{b}
6	3.9^{b}
8	1.9^{b} .

Significant difference ($p<0.01$) denoted by different superscripts.

Picture 1. Whitegrass seed heads from untreated plots on the left.

Table 2 Effect of glyphosate on green leaves of whitegrass one year after application.

Roundup^R (l/ha)	Mean % Green Leaves Whitegrass
0	54.5^a
2	40.7^b
4	15.8^c
6	9.0^d
8	8.0^d

Significant difference ($p<0.05$) denoted by different superscripts.

Experiment 2

Wick wiping glyphosate onto whitegrass was an effective means of applying the chemical as indicated by Table 3. The response to flail mowing and double wick wiping was statistically variable but both practices tended to have a similar effect of increasing the effectiveness of the herbicide (Table 3).

Table 3. Effect of wick wiping glyphosate on % green leaves of whitegrass regrowth one year after application.

Mean % Whitegrass leaves green

wiper setting	flail mowed		not flail mowed	
	single wipe	double wipe	single wipe	double wipe
Not wiped	73.6a	73.6a	57.3ab	57.3ab
1	19.2defg	23.0defghi	15.5defgh	13.0defghi
2	56.7abc	19.5defghij	43.5bc	8.0defghij
3	9.0efghij	16.5defghij	22.0cd	17.0defg
4	19.5def	7.0ijkl	2.0jkl	7.0defghij
5	17.0fghij	0.5kl	16de	0.5kl
6	4.5ijkl	0.5kl	12de	2.0jkl
7	6.5ghijk	0l	5.5ijkl	4.5hijk

Significant difference ($p<0.05$) denoted by different superscripts

Experiment 3

Applying glyphosate to green whitegrass regrowth following burning showed a similar rate effect as achieved by applying the herbicide to unburned swards (Table 4). The magnitude of each rate effect was increased by burning.

Table 4 Effect of glyphosate on % green leaves of whitegrass regrowth one year after application

Roundup^{R} (l/ha)	Mean % Whitegrass leaves green
0	69.0^{a}
2	22.3^{b}
4	2.75^{c}
6	2.0^{cd}
8	0.33^{d}

Significant difference ($p<0.05$) denoted by different superscripts.

DISCUSSION

Glyphosate is clearly toxic to whitegrass but effectiveness is increased when applied to fresh regrowth created by burning. Application of the herbicide to post burning regrowth whitegrass leaves results in adequate control being achieved by the rate of 4 l/ha. The reason for this is possibly two fold. Firstly, burning removes all the dead whitegrass leaves thus preventing them from shading living leaves from the herbicide application which effectively reduces the rate of herbicide applied to living plant tissue. Secondly, recovering from burning probably places the plant under stress making it more susceptible to herbicides. Unfortunately herbicide was not applied to unburnt whitegrass at the same time as it was to the regrowth following burning thus a time of application response might have been missed.

Application of glyphosate by wick wiping was also an effective means of controlling whitegrass, with the added advantage of the process being reasonably insensitive to wind at the time of application. Wick wiping the target plants in two directions 180? apart appeared to increase the efficacy of the herbicide, again probably by increasing the surface area of green leaf to which the herbicide was applied.

Considerable within treatment variation was apparent with the wick wiping probably because of the variable micro relief of the area, which makes maintaining an even application rate difficult.

The visual effects of chlorosis and necrosis due to herbicide application were slow to appear with whitegrass. This may be because the plant is naturally slow growing in the Falkland's environment.

It is apparent from these results that increasing the exposure of green whitegrass tissue to glyphosate improves control and probably reduces the rate of herbicide required. Fire and flail mowing are obviously effective means of achieving this but perhaps a similar result could be achieved by increasing the application pressure or by the inclusion of spraying oils and other wetting agents. This should be the subject of further investigations.

Herbicides such as glyphosate probably have a place along with conventional seedbed preparation in pasture improvement endeavours in the Falkland Islands because large areas can be treated quickly and relatively cheaply. Lax whitegrass areas characterised by plants assuming a more prostrate habit with the absence of small tussock hillocks (or bogs as they are known locally) are probably ideal for herbicide application followed by burning and direct drilling. Alternatively, these areas could be burnt in one spring, herbicide applied in the following summer and direct drilled in the following spring. The dead whitegrass leaves would provide a mulch and thus protection for the emerging seedlings both from environmental factors (wind and soil erosion) and geese predation. Because whitegrass is a poor seed producer (McAdam 1992) there is little likelihood of the whitegrass community quickly regenerating from seed or such seedlings providing competition of a magnitude detrimental to seedlings of introduced species. Regrowth following herbicide treatment was only observed in areas where ideal penetration of the herbicide did not occur. Given that such areas are likely to be small and that whitegrass grows slowly this is unlikely to be a significant problem.

Areas of bog whitegrass characterised by numerous small hillocks could be controlled by herbicide application but the area would need to be slashed or mulched prior to burning so as to remove the hillocks. These hillocks are essentially ‘dry islands’ of fibrous organic material, which does not burn well in situ, and if seed is planted into them the chances of survival are small due to the risk of desiccation. Mechanical removal of the hillocks followed by burning does provide some control of the native species but experience to date suggests that such treatments are not sufficient to completely eliminate the native whitegrass.

Herbicides may play a role in pasture establishment in the Falklands but the ability to establish pastures following herbicide treatment must be assessed and compared to that achieved by conventional cultivation and combinations of herbicides and cultivation methods.

ACKNOWLEDGMENT

The technical and intellectual assistance given by Sean Miller in the design and conduct of these experiments is gratefully acknowledged.

REFERENCES

1. Davenhill N.A. 1988. Herbicides for Pampas Grass Control Proc. **41st,** N.Z. Weed and pest Control Conf.

2. Duckett T. 1989. Managing Tasmania's Pampas Grass Problem: A Strategy for Control Tasforests September

3. McAdam J.H. 1992. Whitegrass Proceedings of 1st International Symposium, The Queens University of Belfast ISBN:-0 85389 454X