EXTENDING FLUPROPANATE USE – SPOT APPLICATION ON PERENNIAL MISSION AND GAMBA GRASS

Wayne Vogler, Emma Carlos and Kelsey Hosking
Biosecurity Queensland, Department of Agriculture and Fisheries, Tropical Weeds Research Centre, P.O Box 187 Charters Towers, Queensland 4820, Australia.

ABSTRACT

Perennial mission grass (*Cenchrus polystachios*) and gamba grass (*Andropogon gayanus*) are two highly invasive grasses present in north Queensland. Currently, herbicide control options for these species are limited to non-selective herbicides such as glyphosate that result in significant off-target damage. In this study, field trials were conducted to investigate the efficacy of spot applications of flupropanate (liquid and granular) into the tussock as a selective herbicide option for these grasses. Australian Pesticides and Veterinary Medicines Authority (APVMA) approval will be sought for the use of: 4.5 g/tussock of GP Flupropanate and 0.6 ml/tussock of Tussock™ for perennial mission grass control; and 9 g/tussock of GP Flupropanate and 1.2 ml/tussock of Tussock™ for gamba grass control. These rates were selected as the most efficacious, although efficacy was not significantly higher than lower rates, it is expected that these rates will be more effective under marginal conditions. In summary, spot application of flupropanate is an effective and practical method for controlling these invasive grasses with particular application in areas such as revegetation sites, sites in the early stages of invasion with limited or scattered infestations and sites where the northern wet season can limit access for high-volume herbicide application.

Keywords: Flupropanate, perennial mission grass, gamba grass, spot application.

INTRODUCTION

Perennial mission grass (*Cenchrus polystachios*) and gamba grass (*Andropogon gayanus*) are two highly invasive grasses present in north Queensland. Perennial mission grass remains undeclared in Queensland though in the Northern Territory it is a Class B and Class C weed under the *Weeds Management Act 2001*. Gamba grass is listed as category 3 restricted matter under the *Biosecurity Act 2014* in Queensland and recognised as a Weed of National Significance in Australia. Each of these grasses compete strongly with native pasture and their high biomass can fuel intense bushfires that damage ecosystems and threaten the safety of people and property (Department of Agriculture and Fisheries, Biosecurity Queensland 2016, Northern Territory Government of Australia 2017). Despite the significant negative impacts of these grasses, herbicide control options are limited. Most registered herbicides are non-selective, such as glyphosate, and can cause non-target damage, or mortality, to surrounding desirable species. This can reduce competition for invasive species and leave areas open to further invasion. With this in mind, a selective herbicide could greatly improve management of these invasive grasses. Flupropanate is a selective, soil-active, residual herbicide that requires rainfall to enter the soil and be absorbed through the root system of plants. A single application has the potential to control mature plants and germinating seedlings, although effectiveness and timeframes will vary depending on soil type and rainfall. The effect of flupropanate on perennial mission and gamba grass is not known, although anecdotes suggest that it may be useful for their control. This trial investigated whether individual perennial mission and gamba grass tussocks could be effectively controlled with a single spot application of liquid or granular flupropanate.

METHODS

The herbicides Tussock™ (745 g/L flupropanate) and GP Flupropanate (86.9 g/kg flupropanate) were used for all liquid and granular flupropanate treatments respectively. All trials were established in October 2013 using a completely randomised block design. Experimental units comprised 4 m x 4 m plots, with each treatment replicated four times.

Perennial mission grass

The trial site (16°57'53.42"S, 145°24'33.43"E°) was located within a grassy woodland where patches of perennial mission grass had established. Plots contained an average of 15 perennial mission grass plants, with mean basal diameters of 15.8 cm. Tussock™ and GP Flupropanate were tested at 0.3, 0.6 and 1.2 ml/tussock; and 2.25, 4.5 and 9.0 g/tussock respectively for efficacy against a control (no flupropanate). The respective rates of each formulation contained the same amount of active ingredient. Measured doses of Tussock™ and GP Flupropanate were applied to the centre of all tussocks in each plot. Tussock™ treatments were applied with a N.J. Phillips® 5 ml Tree Injector as a single 4 ml shot of herbicide/water solution per tussock while GP Flupropanate treatments were hand applied.

Herbicide efficacy was assessed at 106 and 183 days after treatment (DAT) by rating each tussock as alive or dead. Mortality (%) was analysed, and this was calculated as the number of dead tussocks over the total number of treated tussocks. The impact of herbicide treatments on adjacent non-target grasses and broadleaf plants was assessed by measuring the distance (cm) between treated tussocks and the nearest non-target grass and broadleaf plant that was alive. At 183 DAT, the total number of stems with emerged seed heads was counted in each plot.

Gamba grass

The trial site (16°58'58.28"S, 145°15'49.53"E°) was located on cleared agricultural land dominated by gamba grass. Plots contained an average of 30 gamba grass plants, with mean basal diameters of 12.9 cm. Prior to the commencement of the trial, cattle had grazed the site, making tussocks accessible and easily treated on an individual basis. Cattle were excluded for the duration of the trial. Tussock™ and GP Flupropanate were tested using the application rates and methodology used for perennial mission grass (see above).

Herbicide efficacy was assessed at 133 and 182 DAT by rating each tussock as alive or dead. However, as there had been significant gamba grass recruitment, gamba grass tussocks that were ≤5 cm in size were considered to have been recruited from seed since treatment application and were not included in the efficacy assessments. Mortality (%) was analysed, and this was calculated as the number of dead tussocks over the total number of treated tussocks. At 182 DAT, the total number of gamba grass stems with emerged seed heads was counted in each plot. Tussocks that were ≤5 cm were also counted in each plot to assess lateral movement and residual effects of the herbicide on 'new plants'.

Statistical analyses

Randomised complete block ANOVAs ($p<0.05$) were used to assess treatment effects. Where required, data was transformed ($\log_{10} + 0.1$) to meet ANOVA assumptions. Means or back-transformation of the geometric means are presented. Treatment means were separated according to Fisher's Protected LSD ($p<0.05$).

RESULTS

Perennial mission grass

Mortality of perennial mission grass tussocks 106 DAT was significantly different between treatments ($p<0.001$), with nil mortality in controls and the highest and middle herbicide rates having similarly high mortality (Table 1). There was an increase in mortality over time and by 183 DAT, mortality of tussocks remained significantly different between treatments ($p<0.001$). While the highest GP Flupropanate treatment (9.0 g) resulted in the greatest mortality of mission grass, at 183 DAT it was not significantly higher than any other herbicide treatment, except the 2.25 g GP Flupropanate treatment. Stems with emerged seed heads in the control plots averaged 22.6 at 183 DAT which was significantly higher than all herbicide treatments (Table 1) ($p<0.001$). There was little impact on non-target species at 106 DAT with no significant difference ($p>0.05$) between the control and herbicide treatments in the average distance from a treated tussock to the nearest live non-target grass or broadleaf plant, which averaged 9.19 cm.

Table 1. Mean tussock mortality and number of stems with emerged seed heads per plot. Means within columns followed by the same letter are not significantly different ($p>0.05$).

Treatment	Rate	Tussock mortality 106 DAT (%)	Tussock mortality 183 DAT (%)	Number of stems with emerged seed heads per plot 183 DAT
Control	NA	0.0 d	13.6 c	22.6 a
Tussock™	0.3 ml	45.6 bc	83.9 ab	3.6 b
Tussock™	0.6 ml	77.7 a	90.9 a	0.9 b
Tussock™	1.2 ml	89.8 a	87.9 ab	1.0 b
GP Flupropanate	2.25 g	36.6 c	65.7 b	5.0 b
GP Flupropanate	4.5 g	68.5 ab	87.5 ab	0.9 b
GP Flupropanate	9.0 g	78.0 a	97.3 a	4.8 b

Gamba grass

There was a significant treatment effect on mortality of gamba grass tussocks 133 DAT ($p<0.05$). In control plots, all initial plants remained alive, compared to the herbicide treatments where >60% mortality was recorded (Table 2). The two highest rates of GP Flupropanate had significantly higher tussock mortality than the lowest Tussock™ rate, while tussock mortality was not significantly different between all other treatments (Table 2). There was a significant difference in the number of new plants (<5 cm in size) between treatments ($p<0.05$), with the Tussock™ treatments generally having fewer new plants compared to the GP Flupropanate treatments and controls (Table Table 2). There was on average 42.8 stems with emerged seed heads in the highest GP Flupropanate treatment at 182 DAT which was significantly fewer ($p<0.05$) than in all other treatments (Table 2).

Table 2. Mean tussock mortality, number of new plants and number of stems with emerged seed heads per plot. Means or back transformations of geometric means (*) within columns followed by the same letter are not significantly different ($p<0.05$).

Treatment	Rate	Tussock mortality 133 DAT (%)	Number of new plants per plot 133 DAT	Number of stems with emerged seed heads* per plot 182 DAT
Control	NA	0.0 a	8.3 b	215.0 a
Tussock™	0.3 ml	61.1 b	5.8 ab	164.3 a
Tussock™	0.6 ml	67.3 bc	1.3 a	107.5 a
Tussock™	1.2 ml	78.6 bc	6.5 ab	147.0 a
GP Flupropanate	2.25 g	83.0 bc	10.5 b	301.8 a
GP Flupropanate	4.5 g	88.7 c	9.8 b	280.8 a
GP Flupropanate	9.0 g	92.0 c	10.8 b	42.8 b

DISCUSSION

Spot application of at least one rate of each herbicide was effective for controlling perennial mission and gamba grass tussocks, although gamba grass generally required higher rates to achieve satisfactory mortality. Even then, mortality averaged less than 80% using Tussock™ which is towards the lower range for acceptable herbicide efficacy. Lateral movement of herbicides from treated tussocks appeared negligible, with no impact on adjacent plants. Emergence of new gamba grass plants also suggested no residual impact on areas surrounding tussocks. Follow up treatment will be essential to control emerging seedlings.

While not practical on a large scale or for dense monocultures, spot application of flupropanate products has a place in control of perennial mission and gamba grass. The high-concentration low-volume method of applying Tussock™ provides a treatment option for hard to access areas where using heavy spray equipment is impractical. GP Flupropanate offers the opportunity to immediately treat tussocks encountered by chance as its granular formulation is easily portable and does not require mixing or dilution. All flupropanate products are soil-active and require rainfall to enter the soil and be absorbed through the root system of plants. These products can be applied during the dry season and become active in the wet season, allowing control when access to apply herbicides is restricted by weather and road conditions.

Given its advantages, the potential to extend this method to other invasive grasses such as African fountain (*Cenchrus setaceus*), giant rat's tail (*Sporobolus pyramidalis* and *S. natalensis*) and Guinea grass (*Megathyrsus maximus var maximus*) warrants investigation.

Spot application of flupropanate provides an effective and practical method for controlling both perennial mission and gamba grass in areas such as revegetation sites, sites in the early stages of invasion with limited or scattered infestations and sites where the northern wet season can limit access for herbicide application. A minor use permit application will be submitted to the Australian Pesticides and Veterinary Medicines Authority (APVMA) to extend the control options available to land managers for these invasive grasses.

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REFERENCES

Department of Agriculture and Fisheries, Biosecurity Queensland (2016) 'Gamba grass, *Andropogon gayanus*'. https://www.daf.qld.gov.au/__data/assets/pdf_file/0011/67466/IPA-Gamba-Grass-PP147.pdf. (Queensland Government, Brisbane).

Northern Territory Government of Australia (2017) 'Mission grass'. https://nt.gov.au/environment/weeds/list-of-declared-weeds-in-the-nt/mission-grass. (Northern Territory Government of Australia, Darwin).