SELECTIVE CHEMICAL CONTROL OF YELLOW BRISTLE GRASS (*SETARIA PUMILA*) IN PASTURE

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ABSTRACT

Yellow bristle grass (*Setaria pumila*) is a summer-growing annual grass currently expanding in distribution throughout pastures in Waikato. Readily grazed in its early vegetative growth stage, it is avoided by animals when the seed heads appear as barbed bristles lead to animal health problems, particularly around the mouth. Three field trials were conducted with several herbicides for control of yellow bristle grass. Since yellow bristle grass germinates over an extended period from November to February, the best control that could be achieved from a single herbicide application was 70% by 2,2-DPA alone or in combination with either TCA or carbetamide, applied in December. MSMA was more effective on larger plants. Ethofumesate treatment resulted in poor control of yellow bristle grass and severe damage to white clover (*Trifolium repens*). All herbicides evaluated resulted in variable levels of damage to perennial ryegrass (*Lolium perenne*).

Keywords: yellow bristle grass, *Setaria pumila*, herbicide, grass weed, pasture weed.

INTRODUCTION

Yellow bristle grass (*Setaria pumila*) is an upright annual that grows 25–45 cm high. It normally germinates from mid November to February when soil temperatures are greater than 20°C in the surface layer from which the seed germinates (Steinmaus et al. 2000). As it has a C₄ photosynthetic pathway it can quickly outgrow perennial ryegrass (*Lolium perenne*) during the warm summer months and form a major component of the pasture sward (Dekker 2003). However, it has poor nutritive values and although readily grazed in its vegetative state, it is frequently avoided by stock once the seed heads emerge. The latter appears to be a learned response and is probably due to irritation of the oral regions by the minute barbs on the bristles of the seed head (Fava et al. 2000). Despite this it is still acknowledged as an important forage grass in climates with low rainfall such as northern Australia, northern Africa and parts of eastern Europe (Panday & Singh 1992).

Farmers in Waikato have become alarmed in recent years at the rapid spread of this weed and its detrimental effect on farm production (James 2008). As an annual plant entirely dependent on seed to maintain its life cycle, the long term solution to managing this weed will most likely be found in more competitive pastures and minimising its germination or incursion by better farm practices that do not open up the pastures at critical times. However, there are situations for which the use of an herbicide is the best option. These situations could include: eradication of new and small incursions; extending the life of a sward to better fit pasture renovation schedules; and controlling it in locations where it is otherwise difficult to manage – such as farm raceways, fence lines, road sides, etc. It is difficult to selectively remove a targeted grass from among other grass plants, particularly during spring or summer when most grasses are actively growing. Herbicides are mostly used to control winter growing annual grasses, e.g. barley grass (*Critiesion*

sp.) and annual poa (*Poa annua*), in perennial ryegrass swards, and this is traditionally carried out in winter when the perennial ryegrass is not actively growing.

The trials reported here investigated several herbicides for selectivity and efficacy in controlling yellow bristle grass in perennial ryegrass swards.

MATERIALS AND METHODS

Three trials were conducted at two sites on farms at Paterangi near Hamilton. All trials were in old, established pasture with reduced perennial ryegrass content and increased amounts of annual grasses and other weeds.

Trial 1 (in 2006/07) evaluated four herbicides (rates and application dates in Table 1). Individual plot size was 3 m × 10 m and there were four replications with all herbicides and application times fully randomised within each replicate. The herbicides tested were ethofumesate (Expo), 2,2-DPA (Dalapon), 2,2-DPA + TCA (Teedal) and MSMA (Pasma). The herbicides were applied by CO₂ powered backpack sprayer with a 3 m boom fitted with four TeeJet 11003 flat fan nozzles to apply 200 litres/ha at 200 kPa. The application on 13 November had an air temperature of 22°C and soil temperature of 19.3°C. The pasture had been grazed 8 days previously and the yellow bristle grass plants were small with 1–4 leaves and they had not tillered. The application on 13 December had an air temperature of 21°C and soil temperature of 21.7°C. The sward was more patchy than the previous application as it had been lightly grazed. Yellow bristle grass plants had 1–3 tillers and were up to 100 mm tall although some had been grazed to 25 mm. The application on 16 January had an air temperature of 20°C and soil temperature of 21.6°C. The pasture was very patchy with some clumps of yellow bristle grass at the early seed head stage and up to 200 mm tall, while other plants were still in the vegetative stage (2–3 leaves) having only recently germinated. Assessments of yellow bristle grass control and damage to perennial ryegrass and white clover (*Trifolium repens*) were made by two observers on 13 December 2006 and on 16 January, 21 February and 27 March 2007 by estimating the vigour and density of the species compared to the untreated controls.

Trial 2 (2008/09) evaluated the same four herbicides as well as a newly formulated mixture of 2,2-DPA and carbetamide (Table 3). Individual plots were 3 m × 8 m, four replications per treatment, all fully randomised as before. Application on 3 December 2008 had an air temperature of 24–25°C and soil temperature of 21.2°C. The plots were about 20% bare ground, with 1–5% white clover. The perennial ryegrass was about 100–150 mm high and the yellow bristle grass had 2–3 leaves. There was also summer grass in the plots and these plants had 2–5 leaves.

Trial 3 (2008/09) was at the same site as Trial 2, with the same treatments except that 2,2-DPA + TCA was omitted. Individual plots were 3 m × 6 m, four replications per treatment, all fully randomised as before. The application on 23 December 2008 had an air temperature of 19°C and soil temperature of 20.1°C. The plots had been grazed a week previously and the grass cover was short. The yellow bristle grass plants mostly had 3–5 tillers by this time.

Assessments in both Trials 2 and 3 were visual estimation by two observers of damage to perennial ryegrass only, as no clover was present, together with total counts of yellow bristle grass seed heads. In the untreated plots, seed head counts per plot were estimated by counting a half or quarter of the plot area, depending on the density in each plot.

Data from all trials were subjected to ANOVA to separate treatment means and the LSD calculated. Seed head counts were log₁₀ transformed prior to analysis to reduce heterogeneity of variance but the untransformed means are presented in the tables along with letter indicating significant differences ($P < 0.05$) as determined for the means of the transformed data.

RESULTS AND DISCUSSION

Control of yellow bristle grass in Trial 1 varied between the different application times (Table 1). Three treatments, 2,2-DPA, 2,2-DPA + TCA and MSMA, all gave about 50% control while ethofumesate only resulted in 25% control with the early application on 15 November. The main reason for the reduced level of control at later dates was the

subsequent germination of yellow bristle grass after the herbicide treatments were applied. Treatments applied on 13 December resulted in a higher level of control than those applied either earlier or later, except for MSMA. At this time both 2,2-DPA and 2,2-DPA + TCA gave about 70% control. Again the main reason for incomplete control was continued germination over the summer months. The generally poor level of control from the late application on 16 January was due to some of the larger plants not being killed by the treatments, although MSMA appeared to be more effective at controlling the larger plants and this efficacy was sustained through to the final assessment in autumn.

TABLE 1: Score of yellow bristle grass control (0–100) by herbicides applied at different times in Trial 1.

Treatment	Application date	Rate (kg ai/ha)	Yellow bristle grass control ¹			
			13/12/06	16/1/07	21/2/07	27/4/07
Untreated		-	0	0	0	0
Ethofumesate	15/11/06	2.0	25	23	16	0
2,2-DPA ²	15/11/06	1.5	50	53	26	15
2,2-DPA + TCA	15/11/06	0.8 + 4.4	48	45	44	43
MSMA	15/11/06	6.6	58	25	20	0
Ethofumesate	13/12/06	2.0	-	40	25	15
2,2-DPA	13/12/06	1.5	-	70	55	53
2,2-DPA + TCA	13/12/06	0.8 + 4.4	-	68	48	55
MSMA	13/12/06	6.6	-	38	25	0
Ethofumesate	16/1/07	2.0	-	-	18	0
2,2-DPA	16/1/07	1.5	-	-	26	0
2,2-DPA + TCA	16/1/07	0.8 + 4.4	-	-	31	15
MSMA	16/1/07	6.6	-	-	50	55
LSD (P=0.05)			18.8	17.8	9.6	22.5

¹0 = no effect, 100 = no yellow bristle grass.

All the herbicides tested in Trial 1 also damaged the pasture. Most damage to the perennial ryegrass occurred after the 13 December application (Table 2), which unfortunately also appears to be the optimal time for control of yellow bristle grass. At this time the peak damage to perennial ryegrass was estimated to be about 40% for the two 2,2-DPA treatments. Most of the treated plots recovered fully by the time of the last assessment although the level of damage from the first two 2,2-DPA + TCA applications (15 November and 13 December) remained high for a longer time than the 16 January treatment. However, the pasture at this site was old with only a weak perennial ryegrass component, which could have been a contributing factor to the high level of damage.

White clover generally sustained less damage from the herbicides than perennial ryegrass in Trial 1 (data not presented). No clover damage was observed in any of the 2,2-DPA or 2,2-DPA + TCA treatments while MSMA caused only 10–20% damage to white clover, which soon recovered. Ethofumesate resulted in 60–80% reduction in white clover with no sign of recovery by the end of the trial.

Treatments in Trials 2 and 3 were applied around the optimum application time established from Trial 1. The 2,2-DPA + carbetamide treatment was added as this formulation is soon due to replace the 2,2-DPA + TCA herbicide. Results from these

TABLE 2: Score of damage to perennial ryegrass (0–100) by herbicides applied at different times in Trial 1.

Treatment	Application date	Rate (kg ai/ha)	Perennial ryegrass damage ¹			
			13.12.06	16.1.07	21.2.07	27.4.07
Untreated		-	0	0	0	0
Ethofumesate	15/11/06	2.0	13	13	5	0
2,2-DPA	15/11/06	1.5	18	28	8	0
2,2-DPA + TCA	15/11/06	0.8 + 4.4	20	15	5	0
MSMA	15/11/06	6.6	10	8	0	0
Ethofumesate	13/12/06	2.0	-	30	5	0
2,2-DPA	13/12/06	1.5	-	38	18	0
2,2-DPA + TCA	13/12/06	0.8 + 4.4	-	38	15	0
MSMA	13/12/06	6.6	-	18	3	0
Ethofumesate	16/1/07	2.0	-	-	13	0
2,2-DPA	16/1/07	1.5	-	-	20	0
2,2-DPA + TCA	16/1/07	0.8 + 4.4	-	-	20	0
MSMA	16/1/07	6.6	-	-	10	0
LSD (P=0.05)			18.7	20.4	8.4	-

¹0 = no damage, 100 = no perennial ryegrass.

two trials closely support the findings of Trial 1. The 2,2-DPA treatments, including 2,2-DPA + carbetamide, were again among the best treatments, with those applied earlier (Trial 2, Table 3) being slightly more effective than those applied later (Trial 3, Table 3). Again, ethofumesate was less effective on yellow bristle grass than the other treatments and MSMA performed well, particularly at the later treatment date of 23 December (Trial 3, Table 3). Although the yellow bristle grass plants were damaged by the herbicides and reduced in size compared to those in the untreated plots, they still managed to produce high numbers of seed heads.

Damage to perennial ryegrass from the herbicides was also observed in these two trials, although due to the variation in quality of the old pasture at these sites, the differences were generally not significant (data not presented). Overall, damage was less in Trial 2 than in Trial 3, with the exception of the MSMA treatment, which caused more damage in Trial 2. There was insufficient white clover to reliably assess for damage to this species in these two trials.

None of the herbicides evaluated here offered a 'one-shot' solution for control of yellow bristle grass in pasture and those that offered some degree of control did so at the cost of some pasture damage. The weediness of many annual species is strongly related to their ability to produce large quantities of seed, especially when under stress (Pheloung 2001). Data presented here on number of yellow bristle grass seed heads demonstrate how well equipped yellow bristle grass plants are for producing seed. To achieve eradication of an annual species, the reproductive cycle must be broken. The results from the present trials show that although the herbicide treatments significantly reduced plant vigour and delayed the emergence of seed heads, they appear to have had little impact in terms of breaking the reproductive cycle. To achieve better control of this weed and reduce seed production, repeat applications of the herbicide will be required, which could result in severe levels of pasture damage.

TABLE 3: Number of yellow bristle grass seed heads per m² after different herbicide treatments were applied on 3 and 23 December for Trials 2 and 3 respectively.

Treatment	Rate (kg ai/ha)	Trial 2			Trial 3		
		23.12.08	9.1.09	2.2.09	9.1.09	2.2.09	6.3.09
Untreated	-	1.6 a ¹	7.7 a	26.6 a	3.8 a	14.4 a	15.0 b
Ethofumesate	2.0	0.5 b	4.1 a	21.1 ab	3.1 a	21.9 a	42.3 a
2,2-DPA	1.5	0.4 b	0.7 b	7.3 c	0.1 bc	2.1 b	18.3 b
2,2-DPA + TCA	0.8 + 4.4	0.5 b	0.4 bc	7.9 c	-	-	-
MSMA	6.6	0.4 c	0.2 bc	12.0 bc	0 c	0.1 c	1.8 c
2,2-DPA + carbetamide	1.1 + 1.1	0.4 b	0.3 bc	9.7 bc	0.3 b	3.8 b	14.7 b

¹Numbers in each column followed by the same letter are not significantly different (P<0.05).

Therefore, control of yellow bristle grass with herbicides can be recommended only to control new and small infestations or to reduce seed production in old pastures. Ultimately good suppression of this weed is likely to be achieved through better farm and pasture management and pasture renovation (Tozer et al. 2008). Yellow bristle grass seed can survive passage through ruminants and in effluent ponds (T.K. James, unpubl. data), therefore improved, whole farm management would be required to minimise the reintroduction of this weed to renovated or weed free pastures. The use of break crops to minimise the quantity of yellow bristle grass seed in the soil and thus reduce reinfestation from the seed bank prior to pasture renewal is currently being evaluated.

The present study has shown that yellow bristle grass was difficult to control from a single application of herbicide. The best results, with a maximum of 70% control, were obtained from 2,2-DPA alone or in combination with either TCA or carbetamide applied in December. MSMA was more effective on larger plants later in the season. All treatments resulted in some pasture damage. Repeat applications through the season may provide better control of this weed.

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