Yellow bristle grass presence in two key New Zealand dairy regions: trends in pasture infestations and roadside spread

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Summary Yellow bristle grass (*Setaria pumila* (Poir.) Roem. & Schult.) is a summer-active C_4 annual species prevalent in dairy pastures in the upper North Island of New Zealand. It provides poor quality forage and plants may be avoided by grazing livestock once seedheads emerge. There are also concerns that the bristles can penetrate the mouth parts of grazing livestock and cause harm. Two surveys were undertaken to monitor its spread; the first monitored trends in bristle grass ground cover in an infested dairy region and the second monitored its spread along roadsides in a region recently invaded. In the first instance, 39 dairy pastures were monitored once each summer in the Waikato region over seven years (2008−2014). Yellow bristle grass presence remained below 12% of total ground cover, although there were increases in its cover in the years following the 2008 drought. Monthly assessments from January to April of seedhead presence before and after grazing in three of the surveyed pastures showed that YBG was grazed throughout the season, regardless of seedhead presence. In the second survey, rural roadsides in the Taranaki region were monitored once annually in February for bristle grass presence over two years (2013−2014). In February 2013, yellow bristle grass was prevalent along the roadsides that were major access routes within the region, with some infestations noted on less frequently used (minor) roads, particularly where minor roads intersected with the major roads. In the following summer (February 2014), the distribution was similar, with some outlying patches no longer present (most likely due to local council control measures), with some spread along roads near major towns.

Keywords Summer-active grass, C_4 species, roadside weeds, weed invasion, dairy pastures.

INTRODUCTION

Yellow bristle grass (YBG) is a prevalent C_4 annual grass weed in dairy pastures in the upper North Island of New Zealand (James *et al*. 2009, Tozer *et al*. 2012). Dairy farmers in the North Island are concerned about its spread and potential to reduce milk production, given its low nutritive value over much of its growing season (Sultan *et al*. 2007) and possible avoidance of seedheads by grazing livestock, resulting in lower pasture utilisation. Additionally, farmers and regional councils are concerned about its spread into other regions that are similar in climate to the upper North Island or otherwise climatically suitable for YBG (Lamoureaux and Bourdôt 2013).

Due to these concerns, a pasture monitoring programme was initiated to determine the extent of its presence in the Waikato region, in the upper North Island of New Zealand, where the weed has become established. Farmers, who formed an action group to combat the weed, think that it has been present in Waikato for at least a decade (YBG Action Group, pers. comm.) Additional data were collected from three of these surveyed pastures to determine if cattle graze YBG plants with seedheads. A roadside survey was also undertaken over two summers in Taranaki, on the lower West Coast on the North Island. Based on communications with the regional council and rural professionals and our own observations, its presence in Taranaki pastures appears to be limited to northern Taranaki. However, farmers are concerned that invasion of southern Taranaki pastures may be facilitated by YBG spread along roadsides. The aim of both surveys was to monitor the spread of the weed. It was hypothesised that YBG would increase over time, both in terms of ground cover in the pasture and presence along roadsides.

MATERIALS AND METHODS

Pasture survey A survey of 39 pastures, on twelve dairy farms in central Waikato, was undertaken each February (late summer) over a seven year period, from 2008–2014. In each pasture, ground cover of perennial ryegrass (*Lolium perenne* L.), clover species (*Trifolium* spp.), YBG, summer grass (*Digitaria sanguinalis* L. Scop) and broadleaf weeds (e.g. *Rumex* spp., *Ranunculus* spp.) was visually estimated in four randomly positioned 2 × 2 m quadrats. Assessments were made by the same operator on all occasions.

Data were analysed in GenStat using Restricted Maximum Likelihood analysis (REML), fitting farms and paddocks within farm as random effects. Changes

in botanical composition between 2008 and 2014 were tested with a repeated measures REML analysis.

Evidence of grazing In three of the surveyed dairy pastures, YBG defoliation was monitored between January and April, pre- and post-grazing. Prior to grazing, the reproductive state of YBG was noted (vegetative vs. seedhead visible) in 150, 30 × 30 cm randomly positioned quadrats in each pasture, all of which contained YBG. If YBG was absent from a quadrat, the quadrat was randomly repositioned until YBG was present. The same procedure was undertaken within 48 hours after grazing and evidence of YBG defoliation noted.

Roadside survey To monitor YBG presence, the same 570 kilometres of Taranaki roadsides were surveyed in March (early autumn) 2013, and March 2014. An observer documented the presence of patches of YBG using a GPS device while being driven at a speed of approximately 50 km h^{-1} (except for on the busiest major roads). This included two roads that circumnavigated the region, as well as minor, intersecting roads that began near sea-level and ended at an altitude of up to 1100 m a.s.l. Spot checks were randomly made to verify that YBG was being correctly identified (i.e. by stopping the car to observe patches more closely).

RESULTS

Pasture survey There was a decline in ryegrass (*Lolium* spp.) cover, and an increase in the cover of YBG, summer grass and broadleaf weeds after the 2008 drought ($P < 0.001$), when only 97 mm of rain was recorded from December–February (Table 1). From 2009 until 2011, ryegrass cover averaged 39% but increased by 10% to an average of 49% between 2012 and 2014. Clover cover also increased after the 2008 drought from 7% to 24% in 2010 (a wet summer), and thereafter fluctuated.

Yellow bristle grass cover remained at high levels from 2009 until 2012 (averaging 12%) and declined to intermediate levels in 2013 and 2014 (averaging 8%). The drop in YBG cover in 2013 and 2014 corresponded with summer droughts in both years. Summer grass cover fluctuated (from 4% in 2013 to 16% in 2009 after the most severe drought). Broadleaf weed cover increased from 4% in 2008 to 12% in 2010 and thereafter declined, to 4% cover in 2014. There was considerable variation in YBG cover between paddocks within a year and also between paddocks across years. Over the 6-year period, YBG presence in quadrats ranged from 46% to 72% of quadrats and was detected in 68% to 89% of pastures. It is possible that YBG was not detected in pastures where only small patches were present.

Evidence of grazing In January, when the first assessment of YBG defoliation was made in each of the three pastures, two-thirds of plants had seedheads present and 66% of patches showed evidence of defoliation (Table 2). By the next assessment in February and thereafter, all plants had seedheads present, with most plants producing a seedhead on each tiller. Yellow bristle grass was grazed throughout the growing season, even when all plants had seedheads present (February–March: 80–93% of patches grazed, Table 2).

Table 1. Botanical composition of 39 Waikato dairy pastures assessed each February, expressed as percentage ground cover, and the percentage of quadrats and percentage of pastures in which yellow bristle grass was present.

Component	2008	2009	2010	2011	2012	2013	2014	LSD[1]
Ground cover (%)								
Ryegrass	56	42	36	39	48	50	49	7.3
Clover	7	11	24	16	22	5	13	5.2
YBG[2]	4	12	11	12	12	7	9	4.0
Summer grass	5	16	9	12	5	4	8	4.6
Broadleaf weeds	4	9	12	11	5	4	4	3.8
Proportion of total quadrats/pastures containing YBG (%)								
Quadrats	46	69	64	72	70	63	53	–
Pastures	72	89	75	82	83	74	68	–
Rainfall (mm)[3]	97	310	277	334	376	151	135	–

[1] LSD: least significant difference ($P < 0.001$); [2] YBG: Yellow bristle grass; [3] Summer rainfall (December–February).

Table 2. Percentage of yellow bristle grass patches grazed. Data are based on assessments of 150 quadrats in each of three Waikato pastures.

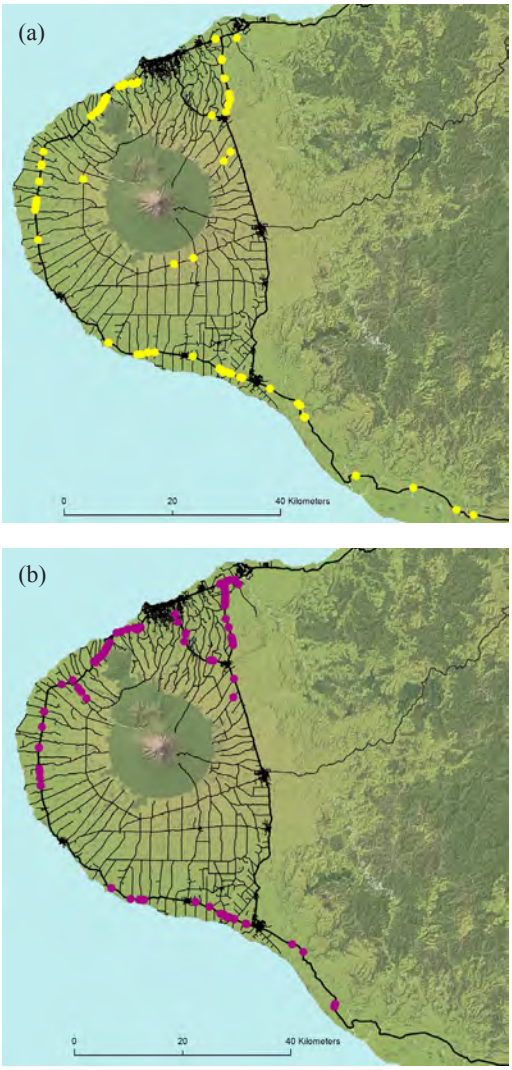
Month	Patches grazed (%)[1]
January[2]	66
February[3]	93
March[3]	80
April[3]	44

[1] Data averaged over three pastures for three consecutive grazings; [2] Two-thirds of plants had seedheads visible; [3] All plants had seedheads visible.

There was little evidence of trampling or of avoidance of YBG except for the April assessment when YBG had senesced and only 44% of patches showed evidence of grazing – on earlier occasions patches were nearly always grazed close to the ground.

Roadside survey Yellow bristle grass was prevalent along the peripheral state highways that circumnavigated the Taranaki region and particularly near the largest town (New Plymouth) in 2013 and 2014 (Figures 1a, b and c). There were only a few patches observed on inland roads in both years, other than in the north of Taranaki, near the largest town and also several outlying patches to the west and south in 2013.

There was an increase in YBG prevalence near the largest town (from 2013 to 2014) but a reduction in prevalence in inland areas, with the absence in 2014 of three outlying populations that had been present in 2013.



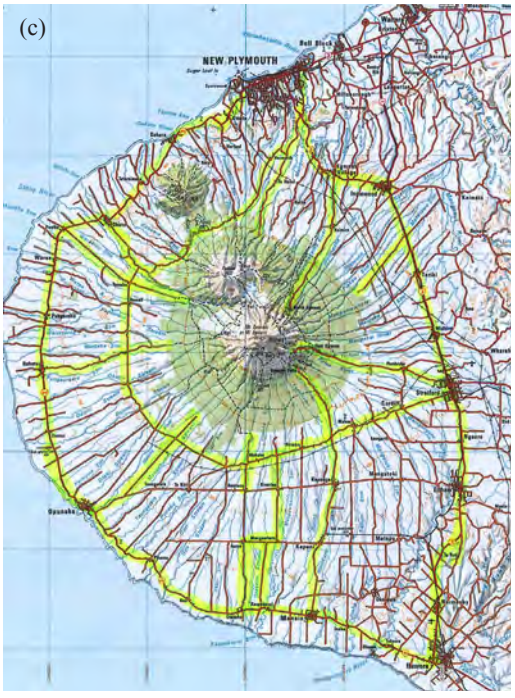


Figure 1. Presence of yellow bristle grass patches on roadsides in Taranaki in the North Island of New Zealand during (a) March 2013 and (b) March 2014. (c) Roadsides surveyed are highlighted.

DISCUSSION

In Waikato dairy pastures, YBG has remained at similar levels over the last six years, other than the year after the severe drought in 2008 when the incidence of YBG increased. Greater fluctuation has occurred in summer grass presence, which is another annual C_4 species. Yellow bristle grass is more erect than summer grass and has larger seeds (Edgar and Connor 2000). It is possibly more competitive than summer grass, which may explain why YBG cover has fluctuated less.

This study provides evidence, based on three pastures in farms heavily infested with YBG, that lactating dairy cattle will readily defoliate the grass, with and without seedheads. This grazing to low residuals is believed to make the application of a herbicide less effective as there is insufficient plant material after grazing to absorb the herbicide. This is consistent with another study in which large 2 x 2 m patches were also readily defoliated (Tozer and Cameron 2009). Although this appears to conflict with reports of grazing avoidance of YBG once seedheads have emerged (James *et al*. 2009), grazing preference is complex and depends on many factors, which can vary over time and between pastures (Baumont 1996). Avoidance of seedheads may be an issue on some occasions, but not others.

A range of options have been developed to control the spread of YBG (James 2013). The herbicide fenoxaprop, for the selective control of summer-active grasses in pastures, was registered in 2013. While trials have demonstrated efficacy (James *et al*. 2013), it was only applied to two pastures in this survey. There were insufficient data to assess if it has been effective in reducing the content of YBG and other C_4 species (e.g., summer grass) in the year after its application. On-going data collection will enable us to assess its effectiveness in the future. The lack of herbicide use is consistent with verbal communications with the 12 farmers involved in the pasture survey, which revealed that while three farmers were actively trying to control YBG, most were 'just living with it'.

In the Taranaki region, where YBG is a relatively new weed incursion, there was evidence of control measures being used along roadsides. The patch distribution on the roads surveyed remained similar in 2013 and 2014 in most cases. The increase in patch presence in northern Taranaki, where traffic is heavier, demonstrates how roads provide a corridor for this weed. Local councils are likely to be proactive in controlling weeds around marker posts and along busier roadsides. Chemical or other control measures could create bare ground on the roadsides in which YBG could establish. Additionally, seeds may become attached to mowers and other vehicles which facilitate YBG spread. Livestock grazing of infested roadsides may also facilitate YBG spread as seed can survive passage through cattle and germinate in dung (James 2013). In contrast, we observed that the minor, less busy roads normally had grassy, rather than bare, roadside verges which would make it more difficult for YBG to establish.

The absence of some of the outlying inland patches in 2014 was most likely explained by active council intervention in managing YBG (Taranaki Regional Council, pers. comm.). The 2013 YBG distribution map presented here was used by the council to assist in locating and controlling YBG. The activities of the council were also apparent by the number of roadside patches to which herbicide had been applied and by the wide-spread use of roadside mowing. A reduction of patch sizes, although not quantified in this survey, was noted in some of the southern populations. Based on visual observations, these reductions were most likely due to the herbicide applications and mowing of roadsides.

In conclusion, once established within pastures in a region, it appears that YBG is there to stay. Based on data collected over these six years, it is likely to remain a small component of the sward on a regional scale, although it may dominate some paddocks. In combination with other summer-active grasses, this is likely to lead to a loss in production as the total C_4 component may exceed 20% of ground cover, thereby contributing a significant proportion of low quality feed in some years.

While it is acknowledged that avoidance may be an issue, data collected here indicates that it is grazed. Therefore its poor nutritive value (as noted previously) would be the major cause of livestock production loss over the summer months. In Taranaki where YBG is a recent weed incursion, spread is occurring along roadsides, particularly on busier roads, although council interventions can be successful in removing outlying populations and limiting its spread.

ACKNOWLEDGMENTS

Thanks are due to Mike Dodd and Trevor James for valuable comments on the manuscript and Josef Beautrais for provision of Figures 1a and b.

Funding for the survey work came from the Beating Weeds II project, an MBIE-funded programme (C09X0905) sub-contracted to AgResearch from Landcare Research.

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