# Sweet success? Managing yellow bristle grass (*Setaria pumila*) with grazing attractants in dairy pastures

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## Abstract

Yellow bristle grass (YBG) is a summer-active grass weed which is rapidly spreading in dairy pastures in the North Island. Different grazing attractants were applied to Waikato dairy pastures at the end of January and February. Cows responded to attractants containing molasses (foliar applied or pellets), but not to coarse agricultural salt or sugar. There was less pasture dry matter, less YBG cover and more bare ground in the pellets treatment. There was also less pasture dry matter, more bare ground and fewer YBG tillers with seedheads in the foliar applied molasses treatment. By April, ryegrass and other species had filled bare areas and YBG cover was least in the pellets treatment. These preliminary results suggest that pellets may provide a cost-effective and easy to apply tool which can reduce seed-producing YBG plants. Care needs to be taken that YBG seeds are not spread via dung into clean paddocks and further measurements will be required to validate its long-term effectiveness.

**Keywords:** *Setaria pumila*, yellow bristle grass, grazing attractants, molasses, salt, sugar

## Introduction

Farmers have observed that yellow bristle grass (*Setaria pumila*, YBG) has become more prevalent in central North Island dairy pastures over the last decade and this causes them concern. YBG, a weedy, summer-active grass, competes with ryegrass and other sown pasture species and reduces pasture productivity. Milk production may also be reduced when cattle are fed mainly on hay containing a high proportion of YBG (Fava *et al*. 2000). In addition, its seed production is prolific, and seeds can survive in the soil for a few years, providing a source of re-infestation (Masin *et al*. 2006). Developing control strategies which reduce or prevent seed production should therefore assist in the long-term control of YBG.

Grazing attractants such as salt and molasses have been used successfully to increase grazing intensity on patches of under-utilised and less palatable forage (Bailey & Welling 1999; Gillespie *et al*. 2006). Stock ingest salt directly in soil, as well as preferentially selecting plants with higher sodium contents from areas to which salt has been applied (Anderson *et al*. 2008). Sodium concentrations are low in many inland soils, including Waikato, which can lead to livestock production losses (O'Connor *et al*. 2000). Molasses has similarly been used as a grazing attractant, alone or in combination with urea or salt (Anderson 2004; Humphrey 1956; Willoughby & Axelsen 1960). Sugar and molasses have also been used to increase pasture utilisation on rotationally grazed dairy farms. The application of either attractant, but particularly molasses, to areas where dung was deposited 3-4 weeks previously, increased consumption of dung-affected pasture (Marten & Donker 1964).

Our aim was to compare the effects of the grazing attractants – agricultural salt, molasses and sugar – on YBG content and seedhead production in rotationally grazed Waikato dairy pastures. The key hypothesis tested is that application of grazing attractants after YBG seedhead emergence increases grazing pressure, thereby reducing its production of mature seedheads.

## Methods

### Experimental site

Experimental plots were established in a run-out 1.55 ha dryland dairy paddock, sown with ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*), near Paterangi, Waikato. The site was chosen for its high and relatively even cover of YBG. The soil was a volcanic ash (pH 5.9; Olsen P, 41 µg P/ml soil; Ca, 9 MAF QT units; K, 9 MAF QT units; S, 24 ppm sulphate sulphur; Mg, 27 MAF QT units and Na, 6 MAF QT units, in January 2009).

Summer rainfall (Dec 2008 – Feb 2009, 310 mm) was above the long-term average (Dec–Feb, 1975–2004, 259 mm). The experimental paddock was grazed for one day on 30 January 2009, 28 February 2009 and 19 April 2009 by Friesian mid-lactation dairy cattle. The paddock was stocked with 120 cattle, which equated to 3.1 cows/ha, as part of a rotation on the dairy-farm. Average total pasture dry matter pre- and post-grazing was 3005 and 2134 kg DM/ha, respectively, for the first grazing, and 3561 and 2184 kg DM/ha, respectively, for the second.

### Treatments

The treatment layout was a randomised split-plot design

**Table 1** Dates on which treatments were applied, the paddock was grazed and pasture measurements were taken.

| Application | Date of application and pre-grazing measurements | Paddock grazed | Post-grazing measurements | Final assessment |
|---|---|---|---|---|
| First | 29 January | 30 January | 1 February | 1 April |
| Second | 27 February | 28 February | 1 March | 1 April |

with 4 blocks. Grazing attractants were each randomly assigned to a 2 x 4 m plot; a randomly chosen half of each plot received the first application on 29 January 2009 and the remainder on 27 February 2009 (Table 1).

Grazing attractant treatments were pellets containing molasses and other ingredients, molasses + water, refined white sugar + water, coarse agricultural salt and the control (no attractant or water). They were applied to the split-plot 1 day before grazing. Application rates and treatment costs are shown in Table 2. There was no rainfall between attractant application and grazing on either application date. Two application dates were included to determine if results were repeatable as YBG growth stage changed. Approximately two thirds of YBG tillers had seedheads at the first grazing, but all tillers had seedheads at the second grazing.

Pellets were specially formulated for this experiment, and contained maize, wheat bran pollard, dried distillers grains and solubles, lime, molasses (5%), salt and flavouring. Protein, metabolisable energy, neutral detergent fibre, starch and crude fibre comprised 16, 12, 28, 22 and 10%, respectively. The pellet application rate was chosen such that a light scattering of pellets was clearly visible on the pasture surface; no published literature was available regarding application rates for pellets. Pellets and salt were broadcast onto plots by hand. Water was added to the sugar or molasses to make up a total volume of 5 L, which was applied using a watering can with a shower nozzle. Application rates of salt, sugar solution and molasses solution were similar to those of Gillespie *et al*. (2006) and Marten & Donker (1964). Cattle had not been exposed to any of the supplements previously.

**Table 2** Rates and costs of application for pellets containing molasses and other ingredients, molasses applied with water (Molasses), refined white sugar applied with water, and coarse agricultural salt.

| Treatment | Rate (kg/ha) | Cost[1] ($/ha) | Rate (g/m$^2$) | Cost (cents/m$^2$) |
|---|---|---|---|---|
| Pellets | 200 | 100.00 | 20 | 1 .0 |
| Molasses | 9.3 | 31.62 | 0.9 | 0.5 |
| Sugar | 450 | 746.10 | 45 | 0.8 |
| Salt | 100 | 45.96 | 10 | 0.5 |

[1]Costs were obtained 5 June 2009 from RD1 for molasses, sugar and salt and from Seales Limited, Morrinsville, for pellets.

**Botanical composition (visual assessment)**

Botanical composition of pasture covers, total pasture dry matter and YBG standing height and panicle presence were estimated pre- and post-grazing in the split-plots. Pre-grazing measurements were completed before applying the grazing attractants. A final assessment was also undertaken on 1 April, 8 weeks after the first and 4 weeks after the second application (Table 1). This final assessment enabled residual effects of treatments on YBG to be detected and occurred before the paddock was grazed again in mid-April. All assessments were made by the same trained operator.

Percent cover of YBG, ryegrass (*Lolium perenne*), white clover (*Trifolium repens*), broadleaved weeds, other annual grasses (summer grass (*Digitaria sanguinalis*), smooth witchgrass (*Panicum dichotomiflorum*)) and the proportion of bare ground were visually estimated. A calibrated, rising plate meter was used to estimate pasture dry matter based on 25 readings per plot. The standing height (i.e. vertical height from the seedhead tip directly to the ground) of 30 randomly selected YBG tillers and the presence of YBG seedheads on these tillers were recorded for each plot.

**YBG nutritional quality and sodium concentrations**

YBG tissue samples were collected on January 29 from the first application control and salt plots and on April 1 from the first application salt plots and second application control, salt and both molasses plots. Samples (5 snip samples cut to ground level in each plot) were collected from each plot, bulked for each treatment and oven-dried at 80°C for 24 h. Nutritional value of YBG in the molasses treatments was determined using Near Infrared Spectroscopy (NIRS)(FeedTECH, AgResearch). Sodium concentrations in YBG from the salt-treated plots was measured by Sodium Plasma Emission Spectrometry.

**Statistical analysis**

ANOVA of visual botanical cover (not dry matter) was undertaken on pre- and post-grazing data, as well as data from the final assessment. ANOVA was also undertaken on the reduction (pre-grazing minus post-grazing), and the percent reduction (i.e. the reduction expressed as a proportion of the original amount present before grazing (pre minus post)/pre *100), of all variables. Finally, an ANOVA was done on the reduction in YBG

**Table 3** Percent reduction, caused by grazing, in pasture dry matter, YBG standing tiller height, proportion of tillers with YBG seedheads and YBG percent cover for molasses + water (Molasses), pellets containing molasses and other ingredients, coarse agricultural salt and sugar + water, averaged over both application dates.

| | Grazing attractant | | | | | |
|---|---|---|---|---|---|---|
| | Control | Molasses | Pellets | Salt | Sugar | LSD |
| Pasture DM | 27.2 | 37.7 | 40.3 | 29.9 | 26.3 | 4.94 |
| YBG height | 60.4 | 70.9 | 66.4 | 52.1 | 54.2 | 18.08 |
| YBG seedheads | 20.8 | 48.5 | 37.8 | 18.3 | 21.3 | 20.25 |
| %YBG | -0.3 | 17.1 | 33.1 | 15.0 | -8.6 | 27.11 |

content between the date of treatment application (29 January or 27 February) and final measurement (April) for all variables. We present percent reductions for changes in pasture dry matter, botanical cover, YBG tiller height and the proportion of tillers with seedheads, as forage available differed between the two applications; this approach allows us to standardise all data. Data transformation was not required to normalise the variance for the results presented. Analyses were undertaken in GenStat 10.2 (VSN International Ltd., Oxford).

## Results

### Botanical composition of cover pre- and post-grazing

The cover of YBG (53%), ryegrass (28%), broadleaved weeds (14%), other summer annual grasses (3%) and the proportion of bare ground (1%) did not vary between split-plots before grazing attractants were applied (averages of both application dates). However, the percent cover of white clover was greater in the pellets treatment than in other treatments before both application dates ($P<0.05$), although white clover in all treatments remained below 3.5% and averaged 2%.

Molasses was the most effective grazing attractant (Table 3). Removal of pasture dry matter (percent reduction) in both the molasses solution and pellets treatments was greater than in all other treatments ($P<0.001$). Total pasture dry matter dropped from approximately 3290 to 1980 kg DM/ha in the pellets treatment and from 3410 to 1990 kg DM/ha in the molasses solution treatment (pre- and post-grazing, averages of both application dates). In addition, percent reduction in YBG height was greater in the molasses solution than salt treatment ($P<0.05$), although there was no difference between the molasses treatments and control treatment. This corresponded to a reduction in height from approximately 23 to 6 cm in the molasses solution treatment. Similarly, there was a greater reduction in the proportion of tillers with seedheads in the molasses solution treatment than in the control, salt and sugar treatments ($P<0.05$). Finally, the percent reduction in YBG cover was greater in pellets than in the control and sugar treatment ($P<0.05$). This corresponded to a reduction in YBG cover from approximately 53 to 34% in the pellets treatment (pre minus post-grazing, averages of both application dates). There was no interaction between grazing attractant and application date, for any of these measurements.

The proportion of bare ground post-grazing was also greater in the pellets (42%) and molasses solution (34%) than in control (12%), salt (20%) and sugar (16%) treatments (averages of both application dates, $P<0.001$).

### Botanical composition of cover at the final assessment

YBG percent cover was least in the pellets treatment (13%, $P<0.05$) and there was no difference in percent cover of YBG between the control (25%), molasses solution (26%), salt (30%) or sugar (30%) treatments (averages of both application dates). There was no grazing attractant or application date treatment effect on the proportion of bare ground, ryegrass, white clover or broadleaved weed cover (Table 4), pasture dry matter (1846 kg DM/ha) or YBG standing tiller height (20 cm, averages of all treatments). All YBG tillers had seedheads during the final assessment. The percent reduction in YBG cover from the date of application to April 1 was greater for the pellets treatment (79%) than for all other treatments, including the control (54%, $P<0.05$, averages of both application dates).

### Plant nutritional quality and sodium levels

YBG provided poor quality forage. It had a high dry matter content (95%), moderate crude protein (14%) and ash (10%), high levels of acid detergent fibre (37%) and neutral detergent fibre (65%), moderate levels of soluble sugar (8%), low organic matter digestibility (59%) and low metabolisable energy (9 MJ ME/kg DM, values averaged over all treatments tested).

Sodium levels in YBG plants were extremely low before salt application at the end of January (<0.01% of DM). When assessed in April 2009, sodium levels had

**Table 4** Botanical composition of the pasture cover (%) at the time of the first (29 January) and second (27 February) application and on 1 April, averaged over grazing attractant treatments.

| Date | YBG | Ryegrass | White clover | Broadleaved weeds | Other summer annual grasses | Bare ground |
|---|---|---|---|---|---|---|
| First application | | | | | | |
| Pre-grazing | 59 | 25 | 2 | 13 | 0 | 2 |
| April 1 | 27 | 43 | 4 | 19 | <1 | 7 |
| Second application | | | | | | |
| Pre-grazing | 47 | 31 | 2 | 14 | 6 | 0.2 |
| April 1 | 23 | 43 | 6 | 17 | <1 | 11 |

increased to 0.06% and 0.05% of DM, 1 and 2 months, respectively, after salt application. However, these salt levels are still considered to be low.

## Discussion

There was strong preference shown by dairy cattle for molasses treated areas. The farmer observed that cattle rapidly found and grazed these areas and there were clear visual differences between molasses and non-molasses treatments within the first hour of morning grazing. These visual observations were supported by significant reductions in pasture dry matter, YBG height, YBG cover and the proportion of YBG tillers with seedheads in the molasses treatments. Further, at the end of the experiment, the effect of pellets (containing molasses and other ingredients) was still evident, as demonstrated by the low cover of YBG in the pellets treatment (13%). This lower cover also meant lower YBG seedhead production per plot, as all YBG tillers had seedheads at this final assessment.

While there was little difference immediately after grazing between applying molasses with water or pellets containing molasses, pellets had a more sustained effect. It is possible that the other ingredients in the pellets attracted cattle, leading to more persistent searching for the pellets (farmer observation) on the ground and increasing trampling, uprooting and mortality of YBG plants. In contrast, in foliar-applied molasses plots, molasses was on upper leaves and more easily removed; cattle did not need to search for the molasses on the soil surface. Molasses application by pellets also provides a much simpler application method than for the liquid molasses and is still cost effective (1 cent/$m^2$). Application of pellets so as to achieve a light scattering that is clearly visible is a simple rule of thumb with which pellets can be applied. A further advantage of pellets over a foliar application is the superior ability of pellets to withstand rainfall, a frequent occurrence in Waikato. In contrast, the foliar applied molasses may rapidly wash off leaves.

While results are promising, the percentage reduction in YBG cover and seedheads achieved by molasses application may be insufficient to cause a decline over time in the number of YBG plants, although it is just as effective as a single herbicide application (James & Rahman 2009). Longer-term studies will be required to validate the effectiveness of pellets in reducing YBG ingress. Also, seeds may spread to clean paddocks as they can survive passage through grazing livestock and germinate in dung (T.K. James pers. comm.). This may be a danger for several days after seedheads are ingested. For example, it takes 3 days for most seeds of giant ratstail (*Sporobolus pyramidalis*) to pass through the digestive system of cattle and Bray *et al*. (1998) found 79% of seeds in the dung were viable. Repeat applications of molasses may also be required, as YBG can rapidly produce new tillers and seedheads between grazings, as occurred in this experiment.

The use of grazing attractants to control patches of YBG may be an option for organic farmers or those who choose not to use chemical options. However, to date, there are no effective herbicide control methods specific for YBG (James & Rahman 2009) and pellets may be useful when applied in conjunction with other control options. Some farmers are resorting to hand-grubbing and physically removing patches of YBG. Others have burnt large patches of YBG, but this also removes desirable species.

While sodium levels in YBG tissue increased in response to salt application (from 0.01 % to 0.05 % DM), there was no detectable influence of salt on YBG cover or height. This is in contrast to a South Island high country pasture study, where salt has been successfully used as a grazing attractant (Gillespie *et al*. 2006). In Waikato, salt may be washed through the soil profile more rapidly given the high rainfall, and dense, vigorous pastures may make it more difficult for dairy cows to locate salt on the soil surface.

Sugar did not appear to limit the proportion of YBG tillers with seedheads, as it had little effect on YBG height and pasture DM, and was the most costly option. Sugar application also appeared to increase YBG cover. Visual observations indicated that much trampling of sugar treated plots occurred. It is possible that trampled YBG plants covered other vegetation, leading to an apparent increase in YBG cover. A simple measurement of tiller length (from its base to the seedhead tip) rather than the standing height (vertical distance from the tip to the ground) would help to ascertain this. Regardless of the reason for this apparent effect, all measurements indicate that sugar was of no apparent benefit.

In summary, the pellets containing molasses and other ingredients show some promise in providing a cost-effective tool that can be used in conjunction with other practices to reduce YBG cover and potential seedhead production in dairy pastures. However, care needs to be taken so that ingested seeds are not spread by dung into YBG-free paddocks, and additional measurements are needed in the summer following application to validate its long-term effectiveness.

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