Feed-out losses of whole-crop cereal silage

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Abstract

The utilisation of whole-crop cereal silage, when fed on pasture, is an unknown factor when assessing the economics of whole-crop cereal silage in dairy farming systems. This study aimed to document the utilisation of whole-crop cereal silage and compare it to the utilisation of pasture silage fed under the same conditions. Data was collected from nine whole-crop cereal and two pasture silage feeding events during the autumn and spring of 2004. The concentration of silage fed in spring (3.04 kg (dry matter) DM/m) was lower ($P<0.001$) than that fed in autumn (4.59 kg DM/m). Residual silage left after feeding (kg/m fed) was not significantly affected by season or silage type. When expressed as a percentage of that fed, utilisation was lower for whole-crop cereal silage (80.6%) than for pasture silage (90.4%; $P<0.032$). However, when silage utilisation (g/kg DM fed) and the amount fed (kg DM) were compared, the utilisation of the silage was positively related to the amount fed ($r^2 = 0.44$; $P<0.001$) with utilisation of over 90% being achieved when more than 4 kg DM/m was fed (measured in 38% of the feeding events).

Keywords: dairy cows, pasture, silage, utilisation, whole-crop cereal

Introduction

Whole-crop cereal silage use has risen from very little in 1998 to an estimated 15000-18000 ha sown in 2004 (Stevens *et al.* 2005). Technical issues such as agronomic practice, weed control and harvest conditions have been addressed through experience and technical support packages (Stevens *et al.* 2005). However, one area of concern that has remained is that of utilisation of the crop during feeding out.

Feeding of both pasture and whole-crop cereal silages overseas is usually in troughs in feedlot situations. In New Zealand silage is usually fed on pasture as a relatively small part of the diet. Whole-crop cereal silages are fed both in spring and autumn as a supplement to lactating dairy cows, predominantly in the South Island where maize silage production is limited. Silage utilisation is a term that often refers to the metabolic efficiency of silage once consumed by the animal, as indicated by reviews by Steen (2000) and Charmley (2001). The utilisation of silage fed on pasture, or the feeding wastage has received little attention.

This study aimed to quantify the DM losses of whole-crop cereal silage and pasture silage during feeding to dairy cows in the paddock. Feeding out in both autumn and spring was done to estimate the influence of soil conditions on wastage.

Materials and methods

Data from nine whole-crop cereal and two pasture silage feeding events was collected during the autumn and spring of 2004. Whole-crop silages included seven Triticale events and two wheat events. All silages were precision chopped at 25 to 50 mm.

Four sheets of 1 by 2 m were laid on the ground in the line of the silage feed-out wagon with 1m between them. A spray painted line denoted the ends of each sheet. To minimise any effect on feeding behaviour due to colour or smell, the spray paint was applied as a line starting between 1 and 2 m away from fed out material.

Normal feeding out occurred as per farm preference using feed-out wagons towed behind a tractor. Pasture silage was fed along a fence line while the whole crop cereal silage was fed in the middle of the paddock, often stretching 300-400 m.

Silage on each sheet was weighed to determine fresh weight of silage fed/linear metre. Silage was sampled for DM content and then replaced in the feeding line at a density representative of the original silage feeding. Samples were also checked for stones and this was noted. Cows were then allowed access to the silage as part of their normal feeding regime.

The silage residual after grazing was sampled the following day by removing a turf 20 cm wide to a depth of 2 cm extending across the width covered by silage left behind at approximately 0.5 m from the end of each sheet. The 1 m zone allowed for no "disturbance" of the fed out material for residual sampling. The silage remaining in the turf was removed using a small rake and weighed. A sub-sample was taken and washed before drying and weighing. The visual grain and fibre components were dissected, dried and weighed for one Triticale whole-crop cereal silage during spring (n=3). The amount of grain left after feeding of that silage was measured during two feeding events (n=8).

On occasions where cows had excreted over the sample area either no transect was taken or the sample was taken at a non-contaminated point within the 1 m zone between the original sheet placement areas.

Table 1 Utilisation of pasture and whole-crop cereal silage when fed on pasture.

	Season			Silage type		
	Autumn		Spring	Pasture		Whole-crop
Amount fed (kg DM/m)	4.59		3.04	4.10		3.52
SED		0.453			0.549	
Prob		<0.001			0.284	
Residual (kg DM/m)	0.47		0.44	0.35		0.55
SED		0.094			0.114	
Prob		0.764			0.081	
Utilisation (% of fed)	89.7		82.3	91.4		80.6
SED		4.16			5.03	
Prob		0.076			0.032	

Data was analysed statistically by residual maximum likelihood (Patterson & Thompson 1971) with the random effects given by measurement date and fixed effects by season and silage type. Predicted means are presented. Relationships between the amount of whole-crop cereal silage fed and subsequent utilisation were derived using non-linear regression analysis, fitting an exponential function.

Results

Rainfall during April was 22% (or 16 mm) above average while temperatures were 1°C below average. Rainfall during September was also above average by 51% (or 34 mm) while again temperatures were below average by 0.9°C. Allocation of pasture in both periods was based more on minimising soil damage than maximising pasture utilisation or intake. Therefore the amount of pasture fed to cows was, at times, limited and the cows were more dependent on a forage supplement. Utilisation of silages fed on the ground was also influenced by the adverse soil conditions.

The concentration of pasture silage fed (kg DM/m) was not significantly greater than the amount of whole-crop cereal silage fed (P=0.284; Table 1). The concentration (kg DM/m) of silage fed in spring was lower than that fed in autumn (P<0.001; Table 1). There was no interaction between the type of silage and the season for concentration of silage fed.

The amount of silage left after feeding, when expressed as kg DM/m (Table 1), was not significantly different for silage type (P = 0.081) or for season of feeding (P = 0.764). No interaction was detected.

When expressed as a percentage of the amount of silage fed (Table 1) the utilisation of silage was lower when feeding whole-crop cereal silage than pasture silage (P = 0.032). Utilisation in autumn was not significantly higher than utilisation in spring (P = 0.076).

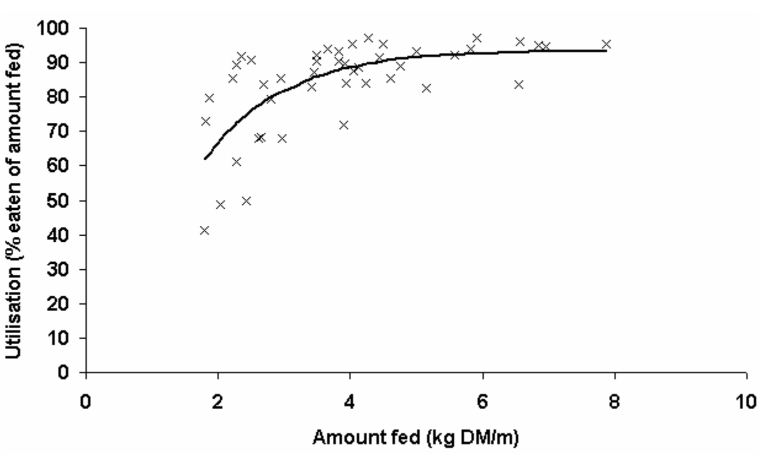
Utilisation of the silage fed (g DM eaten/ kg DM fed) was compared with the amount fed (Figure 1) and all silages and seasons exhibited the same trends. Utilisation of the silage was positively related to the amount fed, or density of the crop on the ground by the exponential model:

Utilisation (g/kgDM fed) = 936 – 1434*($0.432^{\text{kgDM fed}}$) (r^2=0.44; P<0.001).

Another factor involved in the utilisation of silage was contamination by stones. Five samples containing 8% stones by dry weight were collected during autumn. The average wastage was 38% (SE = 5.6) even though the density of crop fed out was high at 5.2 kg DM/m.

The amount of grain in the silage samples was tested during spring. Samples from the silage stack at feeding found that visual grain made up 21% (SE = 1.61) of the dry weight of the silage. Grain found in the silage residual in the paddock was 14.2% (SE = 5.98) by dry weight.

Figure 1 A relationship between the amount of silage fed and the utilisation by the grazing dairy cow.



Discussion

Wastage of silage fed on pasture, or conversely the utilisation of that silage, has been largely ignored by research in NZ. Barry *et al.* (1980) noted that losses of silage DM during feeding out are highly variable without further defining the extent of the problem. International feeding systems tend to use self-feed bunkers or feed troughs and therefore utilisation issues revolve around potential soil contamination at making and secondary fermentation after the stack is re-opened (Steen 2000; Charmley 2001).

The weather conditions during feeding were similar in both spring and autumn as cool, wet weather was prevalent. This was reflected in relatively similar amounts left behind in both seasons. Greater variability was noted in late-October due to an increasing availability of pasture.

Of note was the relatively small difference between the amounts of pasture and whole-crop silage that were left unutilised, even though the pasture silage was fed by the fence under a wire to prevent trampling. This suggests that trampling is a minor cause of loss under the conditions tested here. Losses are more likely to have been due to the inability of the cow to eat any more silage off the ground, as is implied by the lack of difference in the amount of silage left uneaten on the ground. More pasture silage feeding events need to be measured to verify the results shown here, as only two pasture silage feeding events were measured.

The most important finding is that the utilisation of the whole-crop cereal silages was related to the density or concentration of the silage on the ground. The relationship in Figure 1 suggests that the utilisation of silage when fed on pasture increases as the amount or concentration of silage (kg DM/m) increases. This is of particular importance for whole-crop silage for two reasons. The first is a relatively low bulk density of the silage once removed from the silage pit. This contrasts with a higher bulk density of pasture silage. Though the bulk density of silages has not been measured, farmers do note a difference in the relative amounts that silage wagons can hold, with whole-crop cereal silage being lighter. Farmers need to feed out a greater bulk per m of whole-crop silage than pasture silage to reach the same weight of dry matter. Secondly, a higher feeding density of whole-crop cereal silage fed will minimise the loss of free grain to the ground.

The low grain loss of 14.2% was surprising. However, the amount of grain recovered from the silage samples before feeding was also low. This may be due to grain loss at harvest although Redman & Knight (1992) estimated that this figure may only be 6 to 10% of the grain dry weight with direct harvesting. A second factor may be the maceration of grain during harvest, resulting in grains in the cheesy dough stage being indistinguishable after ensiling. The dissected fibre in the crop was estimated by NIR to have a metabolisable energy concentration of 10.7 MJ/kg. This would be considered very high for what should be the stem of the crop. Therefore it suggests that some grain content may have been associated with this fraction even though it was not visible.

The presence of stones in a silage crop was a major cause of rejection or low utilisation where they were noted. This indicates that care is required in the growing, harvesting and feeding out of a crop, as the introduction of stones and soil at any time will affect its utilisation.

Conclusions

The results showed that wastage was no bigger issue in whole-crop cereal silage than in pasture silage. However, the estimation of the amount being fed was a problem for the farmers. The bulky nature of whole-crop cereal silage was deceiving and hence whole-crop cereal silage was being fed out at a lower density of DM than pasture silage, leading to higher wastage in the field. Increasing the feeding density would reduce the wastage seen in whole-crop cereal silage feeding to levels similar to that seen in pasture silage.

To increase paddock utilisation of whole-crop cereal silage to over 90% of that fed, then farmers should aim for a feed-out rate of over 4 kg DM/linear m (as measured in 38% of the feeding events).

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