

# Forage quality screening of *Lolium multiflorum* Lam. cultivars appropriate for high carbohydrate rations

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## Abstract

High merit cows (>10.000 l cow<sup>-1</sup> year<sup>-1</sup>) are usually fed rations high in carbohydrates and low in fibre. In these diets the percentage of silage made from permanent grasslands is low, due to their limited energy contents. As a consequence, adding straw to high carbohydrate mixed rations is a common practice to ensure effective fibre for proper rumen function. However, low digestibility fibres negatively affect feed intake, especially when ruminal distention dominates control of feed intake around peak lactation. Therefore, an alternative diet, high in digestible fibre, seems an option to break the cycle of structural and energetic demands on the roughage. We examined a range of Italian ryegrass cultivars to obtain information about quality characteristics and variations which may be helpful for advisers asking for forages appropriate for high output systems. Samples from three cuts of a field trial with 22 *Lolium multiflorum* cultivars and candivars were analysed by near infrared reflectance spectroscopy for quality traits including acid detergent fibre (ADF), neutral detergent fibre (NDF), enzyme insolubility and water soluble carbohydrates. We considered NDF-ADF differences as most suited for assessing applicability in high carbohydrate rations. Based on these criteria we find significant varietal differences exist in *Lolium multiflorum*.

**Keywords:** Italian ryegrass, forage quality, hemicelluloses, high merit diets

## Introduction

The abolition of the milk quota system in 2015 will further add to the economic pressure on European milk producers (Oudendag *et al.*, 2014). Degression of the unit costs of milk production by increasing the milk yield per cow is regarded as the main adaptive strategy of farmers to meet the challenges of fluctuating market prices. High-merit cows (>10.000 l cow<sup>-1</sup> year<sup>-1</sup>) are usually fed with rations high in carbohydrates and low in fibre. The percentages of silages made from permanent grasslands in these diets are low due to their limited energy contents. As a consequence, adding straw to high carbohydrate mixed rations is a common practice to ensure effective fibre for proper rumen function. However, low digestible fibre negatively affects feed intake, especially when ruminal distention dominates control of feed intake around peak lactation (Allen and Piantoni, 2014). Therefore, an alternative diet, high in digestible fibre, seems an option to break the cycle of structural and energetic demands on the roughage. We consider that Italian ryegrass (*Lolium multiflorum* Lam.) has the best potential among temperate forage grasses to provide sufficient fibre while also maintaining high energy contents. In this investigation, we analysed the extent and variability of forage quality traits, focussing on fibre characteristics among varieties of *L. multiflorum*.

## Materials and methods

We established a field experiment with 22 cultivars of Italian ryegrass, in a randomised block design with four replicates on a sandy loam soil near Rostock (northeast Germany). Field plots (12 m<sup>2</sup>) were sown in August 2008 and harvested five times in the following main harvesting years 2009 and 2010, using a Haldrup forage harvester at a cutting height of 6 cm. Fresh weights were measured and dry matter yields were calculated after drying a 500 g subsample in a draught oven at 60 °C to constant weight.

After grinding to 1mm particle size, samples of the first two growths were analysed by near infrared reflectance spectroscopy for quality traits including acid detergent fibre (ADF), neutral detergent fibre (NDF), enzyme insolubility (EULOS) and water soluble carbohydrates (WSC). We used the VDLUFA-freshgrass-calibration, which was adjusted for the effects of the harvest year on the base of reference analysis. Quality traits were analysed by analysis of variance (ANOVA) for varietal impacts.

## Results and discussion

The influence of variety on quality traits characterising a good usability in high-merit rations is given in Table 1. Thus the crude fibre contents show considerable differences due to ryegrass variety at the first cut after establishment. This effect decreases with increasing sward development, indicating differences in sward and tiller structure due to variations in the rate of establishment and tiller development. Field observations support this interpretation. In contrast to strategies that focus on maximisation of energy content in high-merit rations, higher fibre contents can be tolerated as long as the fibre quality remains at a high level. High fibre quality is characterized by low lignin contents and high concentrations of hemicelluloses in the forage cell walls.

Table 1. Results of the analysis of variance (ANOVA, *P*-values), means and standard deviations of the means (in brackets) for some selected quality traits from different cuts.<sup>1,2</sup>

	CF (g kg <sup>-1</sup> DM)	HC (g kg <sup>-1</sup> DM)	HC/CF-ratio	WSC (g kg <sup>-1</sup> DM)	EULOS (g kg <sup>-1</sup> DM)
1 <sup>st</sup> cut 2009	219.3 (14.5) ***	154.9 (23.1) n.s.	70.5 (8.53) n.s.	263.8 (15.7) n.s.	187.6 (24.45) *
1 <sup>st</sup> cut 2010	275.6 (31.8) **	203.0 (18.6) *	74.1 (6.60) n.s.	113.2 (26.7) n.s.	265.3 (36.33) *
2 <sup>nd</sup> cut 2010	283.6 (16.1) n.s.	181.0 (15.7) **	63.8 (4.43) *	170.1 (18.9) *	259.3 (23.62) n.s.

<sup>1</sup> CF = crude fibre; HC = hemicelluloses; WSC = water soluble carbohydrates; EULOS = enzyme insolubility; DM = dry matter.

<sup>2</sup> Effects of variety: ns = not significant; \* *P*<0.05, \*\* *P*<0.01, \*\*\* *P*<0.001.

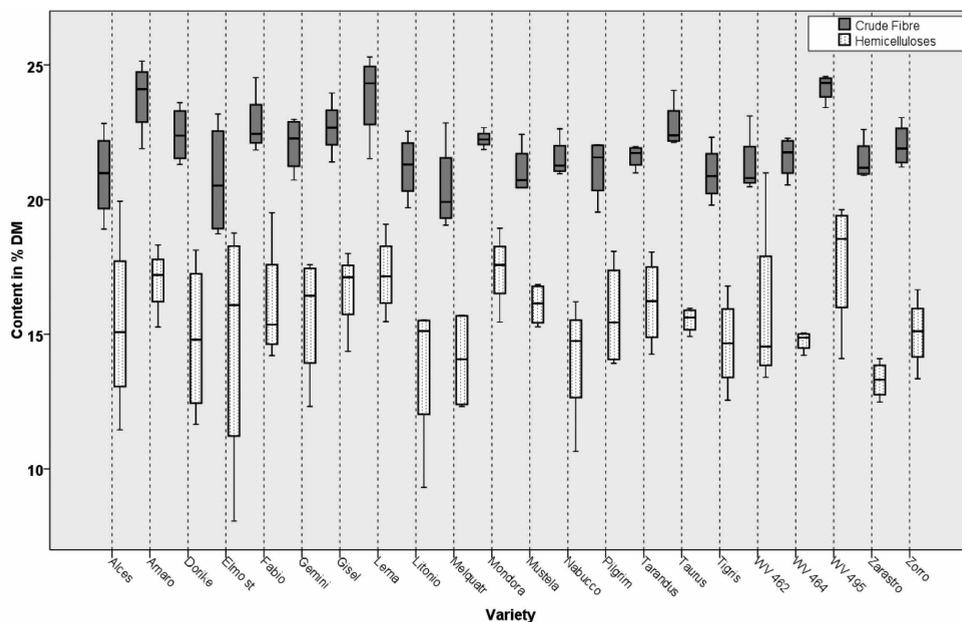


Figure 1. Crude fibre content and corresponding content of hemicelluloses of different varieties of *Lolium multiflorum* at the first cut of the first main harvest year. Boxplot: boundaries = Tukey's hinges, median = line inside the box, box length = interquartile range.

We found significant differences in the contents of hemicelluloses in two of three analysed cuts (Table 1). No single variety pattern could be seen, and even in the first cut no general effect of variety on this trait was detected (Figure 1). For example, cv. Zarastro showed lower hemicelluloses but higher sugar contents than did cv. Alces, with higher but more varying concentrations in the NDF-ADF difference at comparable levels of crude fibre.

## Conclusions

Italian ryegrass cultivars could demonstrate their superior forage quality and suitability for feeding to high-merit cows. However, the forage quality pattern among the range of Italian ryegrass varieties may be quite different and can be modified further by cutting regime. For high-merit cow rations with an overload of highly degradable carbohydrates the fibre content and fibre quality become more important than the high energy contents arising from fructan accumulation in the stems. In the future, a different focus on quality breeding goals according to specific cropping and feeding strategies will be necessary.

## References

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