Competitiveness, Yield and Forage Quality of Soft and rough-Leafed Varieties of Tall Fescue (Festuca arundinacea Schreb.) in a Mountain Environment.

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Introduction

Tall fescue would be a desirable component of seed mixtures for permanent, intensively farmed meadows in mountain regions subjected to summer dry periods, such as it is the case of some areas of South Tyrol, as it is one of the few species well adapted to such conditions. However, there are two issues to be clarified, in order to allow for the development of such a seed mixture. Firstly, this species is known to be poorly competitive in the early phase because of slow establishment (Badoux, 1971). This may lead to an unsatisfactory share in mixed lawns and varieties with good competitiveness should be chosen. Secondly, under dry climate conditions tall fescue can become dominant in mixed plant stands. In pure plant stands there is indeed concern that the rapid deterioration of forage quality with increasing developmental stage may result in a poor intake of this forage when fed to dairy cows (Paoletti et al. 1998). For this reasons, a 5-year field experiment was conducted in a mountain environment to evaluate several tall fescue varieties for competitiveness, yield and forage quality.

Material and methods

The field trial was established on the 4th of April 2005 at the experimental farm Mair am Hof in Dietenheim (920 m a.s.l., Bruneck, South Tyrol, Italy). The soil had a pH of 6.3, a humus content of 51 g/kg, a P-content of 122 mg/kg and a K-content of 373 mg/kg. The mean yearly temperature and precipitation sum in the quinquennium 2005-2009 were on average 7.7 °C and 856 mm respectively. Five soft-leafed varieties (Barcel, Bariane, Barolex, Belfine, Molva) were compared to four rough-leafed varieties (Astico, Fawn, Hykor, Kora). Hykor, although registered as a tall fescue variety, is actually a festulolium (*Festuca pratensis* x *Lolium multiflorum*). The plots were mechanically sown with a plot seeder trm 2200 Plotmatic (Wintersteiger, Ried, A) at a seed rate of 40 kg/ha. The trial design was a Latin rectangle with three replications and a plot size of 6.4 x 4 m. In the first year, only cleaning cuts were made. Starting with the second growing season, the trial was harvested 4 times per year, following a harvest plan (22nd of May, 4th of July, 21st of August, 2nd of October). Adjustments of the harvest date were allowed up to 12 days in accordance with the weather conditions and with the management of the experimental farm. The trial was fertilised after each cut with about 20 m³/ha of 2:1-water-diluted slurry. Before each harvest date, the yield share of tall fescue was assessed in each plot. a 1.35 m-wide strip was harvested in the middle of the plot along its longest side and the fresh yield weighed with a field scale. a 500 g-mixed sample was used to determine water content after drying at 60°C for at least 4 days. a grass sample of 200 to 250 g fresh weight, containing tall fescue only, was obtained in the field trough manual separation from other species and used for forage quality analyses. Forage quality was determined from 2006 to 2008 according to Van Soest (Naumann et al., 1997). Digestibility in 2007 and 2008 was measured *in vitro* for the first cut and on a mixed sample of the following three cuts according to Tilley und Terry (1963). The tall fescue-net yield was calculated for each cut by multiplying the tall fescue share by the DM-yield of the mixed plant stand. Year summary variables were calculated for all traits but the digestible organic matter (DOM) as weighted means with respect to the tall fescue-net yield. Statistical analysis of data was performed with a mixed model taking into account the variety and design factors (lines and columns) as fixed

and the year as a repeated factor. The second order-interactions of the year with variety and design factors were included in the model. For the statistical analysis of DOM, the interaction cut*year was included as a repeated factor in the model, as well as the cut, the year and their interactions (up to the third order) with the other factors. Prior to analysis, data were checked for normality of residuals and homogeneity of variances. Post hoc comparisons were performed by LSD test. a probability of $P < 0.05$ was regarded as significant.

Results and discussion

All traits but DOM were significantly affected by both the variety and the year. Interactions between them were detected for tall fescue net DM-yield and crude protein. DOM was affected by variety, cut and by the interaction of cut and year. Results depending on the factor variety are shown and discussed.

Although pure sown, the vegetation of all plots quickly developed to mixed lawns, mainly due to the germination and establishment of legumes and forbs from the soil seed bank. The mean share of tall fescue decreased on average from 51% in 2006 to 35% in 2009, showing that other species rather tall fescue were advantaged by the given climatic conditions. Such conditions, not particularly dry in summer, provide valuable information about the competitiveness of tall fescue. The tall fescue-share was higher for rough-leafed than for soft-leafed varieties, with Barolex and Molva exhibiting intermediate features (Tab. 1). a similar pattern was observed for the tall fescue-net yield. The varieties showed in this respect a large variation, with Kora, the most productive variety yielding one third more than the least productive (Bariane). On the whole, rough-leafed varieties showed better competitiveness than soft-leafed varieties. In accordance with our findings, a lower competitiveness of Molva, Belfine and Barolex in comparison to Kora was reported by Suter et al. (2009). However, this is probably also caused by a different earliness of the varieties. As a matter of fact, among the investigated varieties, the rough-leafed have an earlier development than the soft-leafed, as shown by our observation in the field and by phenological surveys on these varieties reported by other authors (Jöggi et al., 1981; Paoletti et al., 1998; Suter et al., 2003; Suter et al. 2009). Concerning forage quality, higher crude protein content was found for soft-leafed varieties, while NDF and ADF were found in higher amount among rough-leafed varieties. Also these findings are in accordance with the expectations due to the different earliness of soft and rough-leafed varieties.

Table 1: Yield share, net tall fescue-yield and forage quality of the investigated varieties. ADF values were log-transformed for analysis; back-transformed means are shown. Means without common letters are significantly different.

Variety	Leaf type	Tall fescue-yield share [%]	Tall fescue-net DM-Yield [t/ha/year]	Crude Protein [g/kg]	NDF [g/kg]	ADF [g/kg]	ADL [g/kg]	DOM [g/kg DM]
Kora	rough	51.4 ^{A}	6.0 ^{A}	142 ^{CD}	592 ^{AB}	336 ^{AB}	50 ^{C}	641 ^{A}
Hykor	rough	51.1 ^{A}	5.8 ^{AB}	138 ^{DE}	591 ^{ABC}	339 ^{A}	53 ^{BC}	636 ^{A}
Fawn	rough	46.6 ^{AB}	5.9 ^{AB}	132 ^{E}	601 ^{A}	342 ^{A}	56 ^{BC}	601 ^{C}
Astico	rough	45.6 ^{AB}	5.7 ^{AB}	137 ^{DE}	592 ^{AB}	341 ^{A}	52 ^{C}	634 ^{AB}
Barolex	soft	44.3 ^{ABC}	4.7 ^{ABC}	154 ^{B}	573 ^{DE}	322 ^{D}	55 ^{BC}	636 ^{A}
Molva	soft	43.6 ^{ABC}	4.6 ^{BC}	149 ^{BC}	583 ^{BCD}	326 ^{CD}	51 ^{C}	616 ^{BC}
Belfine	soft	38.9 ^{BC}	4.2 ^{C}	153 ^{B}	578 ^{CDE}	331 ^{BC}	64 ^{AB}	625 ^{AB}
Barcel	soft	38.2 ^{BC}	4.3 ^{C}	153 ^{B}	573 ^{DE}	326 ^{CD}	51 ^{C}	628 ^{AB}
Bariane	soft	36.0 ^{C}	3.8 ^{C}	164 ^{A}	567 ^{E}	319 ^{D}	71 ^{A}	617 ^{BC}

On the contrary, the lignin content (ADL) was not found to be consistent with the leaf type. The highest value was observed for Bariane, which is reported to be very late in the development and exhibited in our experiment the lowest values of the NDF and ADF. On the opposite, the lowest lignin content was found for Kora, which had high values of NDF and ADF. Also the *in vitro*-digestibility varied depending on variety and was not consistently related

to leaf softness, with the highest values being found for the rough-leafed varieties Kora and Hykor and for the soft-leafed variety Barolex.

Conclusions

The choice of suitable varieties of tall fescue for a seed mixture for permanent, polyphyte meadows should take both competitiveness and quality traits into account. While competitiveness, protein content, NDF and ADL seems to be strongly related to the leaf type and to earliness, lignin content and digestibility seem to rather depend on the single variety. Kora among the rough-leafed and Barolex among the soft-leafed varieties can be considered a good compromise between competitiveness and forage quality. Further research should be devoted to the optimisation of such a seed mixture.

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