Hybrid ryegrass can improve the botanical quality of multi species mixtures for leys

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Abstract

Perennial ryegrass (*Lolium perenne* L.) is a highly valuable species in mixtures for leys. However, under mowing it is soon replaced by companion grasses. In a three-year experiment, the effect of a partial replacement of perennial ryegrass by hybrid ryegrass (*Lolium* × *hybridum* Hausskn.) of the 'perennial' phenotype on ryegrass content was examined. Botanical composition and dry matter yield of four mixtures consisting of either pure perennial ryegrass or perennial and hybrid ryegrass of the 'perennial' phenotype, cocksfoot (*Dactylis glomerata* L.), meadow fescue *(Festuca pratensis* Hudson.), timothy (*Phleum pratense* L.), red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.) were assessed after the 1st and the 2nd winter. Adding hybrid ryegrass increased total ryegrass content 1.47 fold to 46% throughout the experiment. At the same time, hybrid ryegrass reduced the non-ryegrasses by about 30%. While hybrid ryegrass reduced clover content after the 1st winter by 33%, it did not affect the clover content after the second one. Dry matter yield was unaffected by hybrid ryegrass, neither in the first cuts after winter nor on an annual basis. Adding hybrid ryegrass of the 'perennial' phenotype may improve botanical quality of multi species mixtures with perennial ryegrass for three-year leys.

Keywords: grass-clover mixtures, leys, hybrid-ryegrass, *Lolium* × *hybridum* Hausskn., species proportion, botanical quality

Introduction

Perennial ryegrass (*Lolium perenne* L.) is a versatile forage species used in multi species mixtures for leys. In Swiss 'Standard Mixtures' for three-year leys for good conditions, perennial ryegrass is the basis for high yields of high-quality forage (Suter *et al.*, 2021). However, under mowing, it will be eventually replaced by the more persistent grass species that should help to maintain productivity of the mixture in the second main utilisation year (Nyfeler *et al.*, 2009; Suter *et al.*, 2012). Since forage quality of other grasses is lower than of perennial ryegrass (Davies and Morgan, 1982; Frame, 1991; Turner *et al.*, 2006), the replacement should happen as late as possible. This is partially achieved by the use of early varieties of perennial ryegrass with a good persistence (Suter *et al.*, 2012). However, further improvement is required to meet the needs of modern forage production. New varieties of the more competitive hybrid ryegrass (*Lolium x hybridum* Hausskn.) of the 'perennial' phenotype (Nay *et al.*, 2022) might help to maintain a high proportion of ryegrasses. Thus, a field experiment was established to examine the potential for improvement of botanical composition of the most important grass-clover mixture for three-year leys in Switzerland.

Materials and methods

Four mixtures were sown in the field at Ellighausen, Switzerland (47°36'41.3'N, 9°08'34.6'E; 520 m a.s.l.) in a randomised complete block design with four blocks in April 2016. All mixtures contained early perennial ryegrass, cocksfoot (*Dactylis glomerata* L.), meadow fescue (*Festuca pratensis* Hudson), red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.). Two mixtures contained one of two varieties of late perennial ryegrass while to the other two mixtures contained one of two varieties of hybrid ryegrass of the 'perennial' phenotype instead (Table 1). Prior to sowing and in spring the experiment was fertilized with 40 kg P ha^{-1} and 240 kg K ha^{-1}. Each of the 5 annual growth cycles received 25 kg N ha^{-1} in the form of ammonium nitrate. At harvest of the spring-growths of 2017 and

Table 1. Seed rates (kg ha^{-1}) of four experimental grass-clover mixtures containing one of two varieties of either late perennial ryegrass (LP) or of hybrid ryegrass of the 'perennial' phenotype (LH).

	LP		LH	
Species / cultivar	**LP1**	**LP2**	**LH1**	**LH2**
Red clover cv. *Global*	2.0	2.0	2.0	2.0
White clover, medium leaved cv. *Hebe*	1.5	1.5	1.5	1.5
White clover, large leaved cv. *Bombus*	2.5	2.5	2.5	2.5
Cocksfoot, early cv. *Beluga*	5.5	5.5	5.5	5.5
Meadow fescue cv. *Préval*	12.0	12.0	12.0	12.0
Timothy cv. *Rasant*	2.5	2.5	2.5	2.5
Perennial ryegrass, early cv. *Lacerta*	3.0	3.0	3.0	3.0
Perennial ryegrass, late cv. *Calibra*	4.0			
Perennial ryegrass, late cv. *Soraya*		4.0		
Hybrid ryegrass, 'perennial' phenotype cv. *Palio*			4.0	
Hybrid ryegrass, 'perennial' phenotype cv. *Palmata*				4.0
Total	33.0	33.0	33.0	33.0

2018, botanical composition was analysed. DMY of both the two spring growths and the annual totals of 2017 and 2018 were recorded. All statistical analyses were performed with the statistical software R's 'aov'-function (R Core Team, 2021).

Results and discussion

Even though ryegrass content in all mixtures decreased as expected (Suter *et al.*, 2012) between the two analysed harvests from 44 to 33% (P<0.05), the mixtures containing hybrid ryegrass exhibited a 1.47 fold total ryegrass content (46%) throughout the experiment, compared to the mixtures without hybrid ryegrass (P<0.01), irrespective of the varieties used (Figure 1). At the same time, hybrid ryegrass reduced the content of non-ryegrasses by about 30% from 23 to 16% (P<0.05). This may have a positive effect on forage quality (Davies and Morgan, 1982; Frame, 1991; Turner *et al.*, 2006).

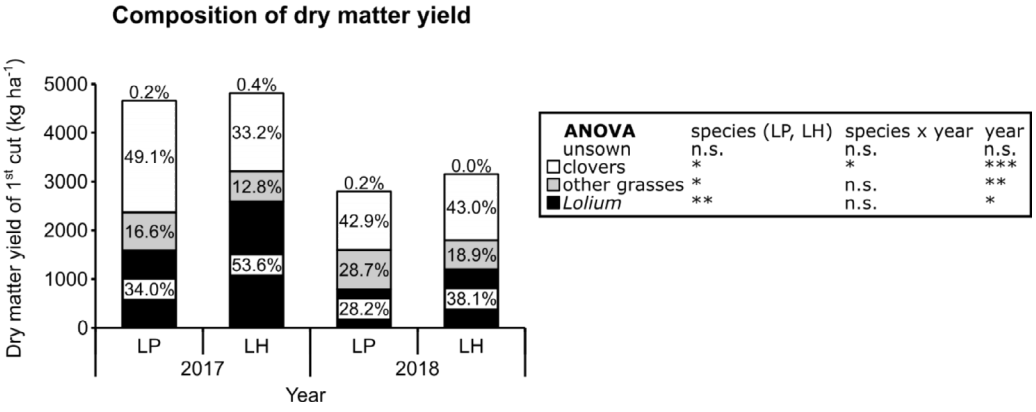

Figure 1. Dry matter yield and yield composition of the spring cuts of two consecutive years of grass-clover mixtures with red clover, white clover, meadow fescue and cocksfoot containing either *Lolium perenne* (LP) alone or *Lolium perenne* and *Lolium* × *Hybridum* (LH). Analysis of variance (ANOVA) for effects of species (LP, LH), year and species × year on yield composition: n.s. = not significant, * P<0.05, ** P<0.01 and *** P<0.001.

While hybrid ryegrass reduced clover content (mainly white clover, data not shown) after the 1st winter by 33% ($P<0.05$), it did not affect the clover content after the 2nd winter (interaction species [LP, LH] × year: $P<0.05$), showing that its higher proportion after the 2nd winter was due to a hybrid ryegrass induced reduction of non-ryegrasses. The fact that the increase of the proportion of ryegrasses was mainly due to a shift within the grass fraction shows that it may be possible to increase the quality of the mixture while maintaining the positive effects of the legumes on yield and forage quality (Nyfeler *et al.*, 2009) as well as on symbiotic N_2 fixation and the whole plant production system (Nyfeler *et al.*, 2011).

Dry matter yield, which decreased from 12,573 kg ha^{-1} in the 1st year to 7,213 kg ha^{-1} in the 2nd year (data not shown), was only affected by the year ($P<0.001$). The same picture (year: $P<0.001$) could be observed with the yield of the first cuts after winter, which decreased from 4,750 kg ha^{-1} in the first year to 2,979 kg ha^{-1} in the 2nd year (Figure 1). This shows that the benefit of adding hybrid ryegrass lies in an improvement of botanical quality rather than in an increase in yield.

Conclusions

Hybrid ryegrass of the 'perennial' phenotype has the potential to increase the content of ryegrasses in the yield also after the 2nd winter. Thus, replacing at least a part of perennial ryegrass in the seed mixture with hybrid ryegrass of the 'perennial' phenotype may improve botanical quality of multi species mixtures for three-year leys.

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