Variety-trials with *Lolium multiflorum* and *Lolium x hybridum* under organic and non-organic conditions

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Abstract

Forty-five varieties of *Lolium multiflorum* L. and 24 varieties of *Lolium x hybridum* Hausskn. were examined in pure stands at three experimental sites over a three-year period. One of these sites was on an organic farm, which was managed according to the 'BIO SUISSE' guidelines. Under organic conditions nitrogen supply was low (100 kg N ha^{-1} y^{-1}) and the fertiliser was applied as strongly diluted cattle manure. At the non-organic experimental sites the moderate annual amounts of nitrogen (250 kg N ha^{-1} y^{-1}) were applied as ammonium-nitrate. At the organic site the invasion of unsown clover and forb species was not suppressed. The pure grass stands at the other sites were treated once with a herbicide against dicots. Due to the marked differences in management, the grass yield in the plots was clearly lower at the organic site. Nevertheless, there was an outstanding correspondence between the yield of the different varieties among the experimental sites. The best varieties at the non-organic sites were also the best varieties at the organic site. This suggests that the 'list of recommended varieties', based on the results of variety tests mainly conducted under non-organic conditions, is also valuable for organic farming.

Keywords: *Lolium*, manure, organic farming, Ryegrass, variety, yield

Introduction

Lolium multiflorum and *Lolium x hybridum* Hausskn. are high yielding forage grasses. Their leaf-rich yields in spring and autumn are highly valued as they contain high levels of digestible energy and sugar. During the summer the harvested plant material of *Lolium multiflorum* contains a high proportion of stems and this results in a fibre-rich forage. However, by using appropriate *Trifolium pratense* varieties, optimal grass-clover-mixtures can be created, which have a good forage-quality during the summer months.
Because of their rapid development after sowing and because the yield usually decreases markedly after the third year, *Lolium multiflorum* and *Lolium x hybridum* are used in mixtures for leys with a duration of two to three years. In Switzerland about 25,000 hectares of such grass-clover-mixtures are sown per year. Because of the high yield and the high proportion of red clover these mixtures acquire a large amount of nitrogen via symbiotic nitrogen fixation. This is an advantage for the organic farms, as they usually have a negative nitrogen balance.
Both *Lolium multiflorum* and *Lolium x hybridum* are susceptible to life threatening organisms such as *Xanthomonas graminis* and *Microdochium nivale*, which strongly reduce persistence. Thus, for a sustainable yield during the two to three year-long utilisation period, high resistances to these disease causing organisms are required.

Materials and methods

From 1997 to 1999 forty-five varieties of *Lolium multiflorum* and 24 varieties of *Lolium x hybridum* were tested in variety trials at three locations for each species. Detailed information on the experimental sites, sowing dates and number of cuts with yield dry matter

measurements is given in Table 1. Pure stands of *Lolium multiflorum* and *Lolium x hybridum* were sown at a rate of 27 kg ha^{-1} and 20 kg ha^{-1}, respectively. The plot size was 1,5 × 6,0 m. The experiment was designed as a latin square. The experimental site 'Bad Knutwil' was on an organic farm managed according to the 'BIO SUISSE' guidelines (organic). All the other experimental sites were located on conventional farms (non-organic).
At the organic site nitrogen was applied as strongly diluted cattle manure. Because the animals were held on pasture most of the time during summer, little manure was available. Thus, only 100 kg utilisable N ha^{-1} y^{-1} were applied (in unequal intervals). At the non-organic sites 250 kg N ha^{-1} y^{-1} were applied (50 kg N ha^{-1} prior to each regrowth) as ammonium-nitrate.

Table 1. Experimental sites and sowing dates of variety trials with *Lolium multiflorum* and *Lolium x hybridum* from 1997 to 1999

Site	Altitude m ASL	Sowing Date	*Lolium multiflorum*			*Lolium x hybridum*		
			replicates	number of cuts with DM measurements		replicates	number of cuts with DM measurements	
				1998	1999		1998	1999
FAL Reckenholz	440	10.04.1997	4	5	4	-	-	-
Oensingen	460	08.04.1997	4	5	4	4	5	4
Bad-Knutwil (organic)	490	17.07.1997	4	5	3	4	5	4
Ellighausen	520	09.04.1997	-	-	-	4	5	4

Results and discussion

Both *Lolium* species exhibited a lower mean annual dry matter yield at the organic site compared to the non-organic sites (Fig. 1). *Lolium multiflorum* at the organic site showed annual yields from 3,100 to 8,400 kg DM ha^{-1} y^{-1}, depending on the variety, while the annual DM yields at the non-organic sites were between 6,200 and 12,700 kg ha^{-1}. *Lolium x hybridum* showed values comparable to the values of *Lolium multiflorum*.
The marked differences between the organic and non-organic experimental sites may be caused by (i) different yield potentials of the sites due to differences in the environmental conditions (climate, soil) or by (ii) great differences in the sward management systems. For the high nitrogen-demanding pure *Lolium* stands, the level of N fertilisation at the organic site was extremely low. This favoured the invasion of unsown species. At the non-organic site, the higher level of N fertilisation and the utilisation of a herbicide led to a competitive advantage of the grasses compared to the dicots. Thus at the non-organic site, the grass DM yields presented in Figure 1 correspond to the total DM yield of the plots. The grass DM yields at the organic site had to be calculated from the total DM yield of grasses and dicots (7,900 to 12,000 kg ha^{-1} y^{-1}) multiplied by the grass proportion (16 to 78%). Based on the high total DM yields at the organic site it can be concluded that the organic site had a yield potential comparable to the other experimental sites and that the differences in grass DM yield between the organic and the non-organic sites were due to the different management.
In terms of the grass DM yield, general impression and persistence, the correspondence of the varieties between the experimental sites was found to be extremely good. Furthermore the correspondences between the organic site and the non-organic sites were no weaker than those between the non-organic sites. For the DM yield of *Lolium multiflorum* the results of the other experimental sites explained the results at the organic site by 63% (r^2=0.63), while the results of the non-organic sites Oensingen and FAL Reckenholz were explained by 67% and 49% respectively (Fig. 1). For *Lolium x hybridum*, the results of the other sites explained the DM

yield at the organic site by 51% and at the non-organic sites by 44% (Oensingen) and 35% (Ellighausen), respectively.

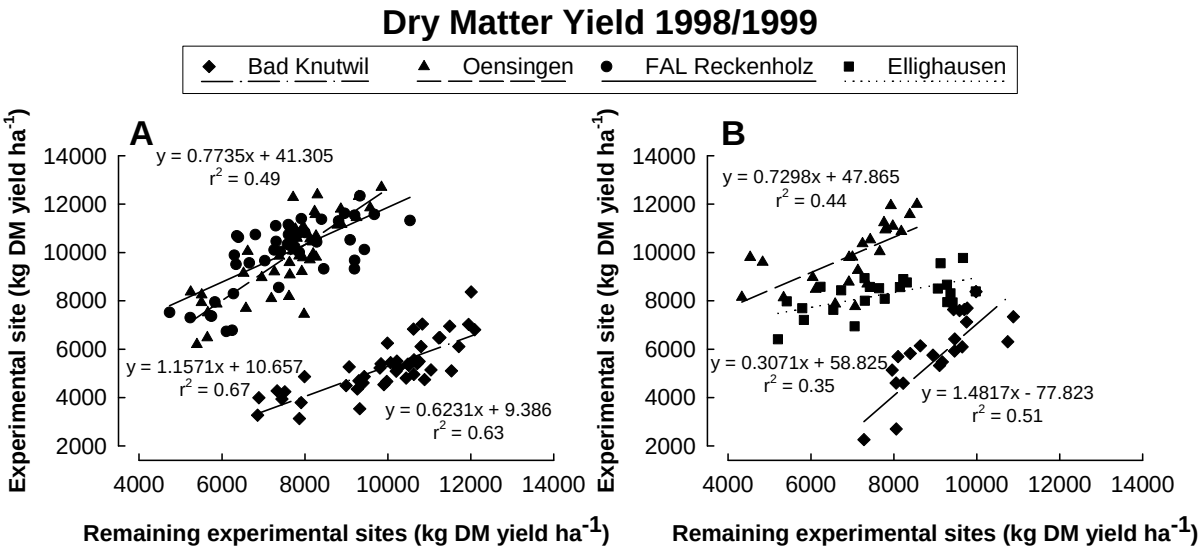

Figure 1. Correspondence of the annual dry matter yields (kg DM ha^{-1} y^{-1}) of the varieties of *Lolium multiflorum* (A) and *Lolium x hybridum* (B) at the respective experimental site with the mean of the annual dry matter yields (kg DM ha^{-1} y^{-1}) at the remaining experimental sites.

Observations of infestations caused by *Xanthomonas graminis* and *Microdochium nivale* could only be made in the pure stands at the non-organic sites (Lehmann *et al.*, 2000). In the mixtures, which resulted from the invading dicot species at the organic site, no observations of infestations were possible, due to sward structure. This emphasises the importance of pure stands in variety trials, even though, in practice, most of the varieties are used in mixtures in our country.

Leys in Switzerland are (i) mainly grass-clover mixtures and (ii) they are predominantly fertilised with manure, also on non-organic farms. Thus, the differences in growth conditions for the grasses between non-organic and organic sites are not as big as in variety trials. Because clover species in the mixture decrease the demand for fertiliser N, nitrogen-fertilisation may have a smaller effect on grass growth than in pure stands. The use of the nitrogen-demanding *Lolium multiflorum* and *Lolium x hybridum* for a comparison experiment between a low-N and a high-N system is, thus, an extreme test.

Conclusion

Based on the strong correspondence between the results of all experimental sites, it can be concluded that the 'list of recommended varieties of forage crops' (Suter *et al.*, 2002) contains the best varieties of grass species for both non-organic and organic systems. This may be especially true for clover species, which are not fertilised with nitrogen in the variety trials at all.

References

Lehmann J., Briner H.U., Schubiger F.X. and Mosimann E. (2000) Italienisches Raigras und Bastard-Raigras: Sortenversuche 97 bis 99. *Agrarforschung*, 7, 124-129.

Suter D., Briner H.U., Mosimann E. and Bertossa M. (2002) Liste der empfohlenen Sorten von Futterpflanzen. *Agrarforschung*, 9, I-XVI.