Establishing trampling-resistant mixed swards: a comparison of four seed mixtures

Nilsdotter-Linde N.[1], Salomon E.[2], Adolfsson N.[2] and Spörndly E.[3]
[1]Swedish University of Agricultural Sciences (SLU), Department of Crop Production Ecology, Uppsala, Sweden; [2]JTI – Swedish Institute of Agricultural and Environmental Engineering, Uppsala, Sweden; [3]SLU, Department of Animal Nutrition and Management, Uppsala, Swedden;
nilla.nilsdotter-linde@slu.se

Abstract

Increasing herd size often brings major challenges in maintaining dense swards, especially near cow houses. High-quality, trampling-resistant swards are crucial for grazing management, animal welfare and environmental protection. A field experiment initiated in July 2012 (triplicate plots) at Uppsala, Sweden, is comparing four seed mixtures with regard to establishment rate, resistance to trampling and grazing behaviour. The mixtures comprise forage and amenity cultivars of smooth meadow-grass (*Poa pratensis*) and red fescue (*Festuca rubra*), with/without inclusions of white clover (*Trifolium repens*), perennial ryegrass (*Lolium perenne*) and tall fescue (*Festuca arundinacea*). Degree of ground cover was evaluated by spatial analysis of Unmanned Aircraft System photographs (taken May, July, Sept. 2013, April 2014) and field measurements (plants m^{-2}) (August 2012, May 2013). Botanical composition was determined in May 2014. The seed mixture with tall fescue (35% cv. Borneo) established significantly more slowly than other mixtures ($P<0.05$), but by September 2013 had the highest ground cover (70%) due to a high proportion of white clover. In May 2014, all four mixtures had sufficient ground cover after winter (~86%). Next, the treatments will be intensively grazed and trampling resistance and grazing behaviour analysed.

Keywords: seed mixture, establishment, ground cover, spatial analysis, pasture

Introduction

Increasing herd size makes it difficult to maintain dense swards, especially near cow houses, where trampling-resistant swards are crucial for grazing management, animal welfare and environmental protection. In this project, the establishment rate, resistance to trampling and grazing behaviour of four seed mixtures are being compared. Sward establishment is described here. Resistance to grazing/trampling will be reported in early 2016 when two grazing seasons have been completed.

Materials and methods

Four seed mixtures were composed with the objective to find a mixture that would give a persistent sward resistant to trampling. The mixtures were sown randomly in 12 field plots (each 12×36 m^2), with three replicate blocks. Diploid perennial ryegrasses were chosen to give denser swards than tetraploids (Orr *et al.*, 2003). Two mixtures contained white clover, smooth meadow-grass and red fescue, one with perennial ryegrass (A) and the other tall fescue (B) (Table 1). Mixture C was similar to A, but without white clover. Mixture D contained similar proportions of species to C, but used amenity-type (sports turf) varieties, whereas C had forage-type varieties (Table 1). Sowing took place on 6 July 2012 in fertilised (50 kg N ha^{-1}) plots (A-D), adjoining a new ley sown in late May. Total seed rate was 30 kg ha^{-1}.

Sward establishment in each plot was assessed by two methods: (1) Counting the number of plants (grasses and clover) within a quadrat (0.5×0.5 m^2) thrown randomly 3 times per plot on two occasions (August 2012 and May 2013); and (2) determining degree of ground cover by aerial photography. Sward botanical composition was assessed in May 2014 by taking small plant samples from the corners and

Table 1. Seed mixtures used in treatments.

Species		Variety (type)	Seed mixture, %			
			A	B	C	D
Trifolium repens (L.)	White clover	Undrom (small leaves)	20	20		
Poa pratensis (L.)	Smooth meadow-grass	Kupol (forage)	35	35	44	
		Julius (amenity)				44
Festuca rubra (L.)	Red fescue	Gondolin (forage)	10	10	12	
		Cezanne (amenity)				12
Lolium perenne (L.)	Perennial ryegrass	Foxtrot (late, diploid, forage)	35		44	
		Bizet 1 (late, diploid, amenity)				44
Festuca arundinacea (Schreb.)	Tall fescue	Borneo (amenity)		35		

centre of a quadrat (0.3×0.3 m^2) thrown randomly 10 times per plot and determining dry weight (DW) of different species plot-wise. Degree of ground cover/bare soil in photographs taken by an Unmanned Aircraft System in May, July, September 2013 and April 2014 was evaluated by spatial analysis using the programme ArcGIS 10.0 (2013). The results were expressed as a percentage. All data were processed by analysis of variance in a model handling treatment and block as independent variables.

Results and discussion

Despite favourable weather conditions, with regular rain in summer 2012, sward establishment was slow. In August, there were large amounts of annual weeds, mainly common chickweed (*Stellaria media* L.) in the plots. Since the aerial photography could only evaluate ground cover, without distinguishing sown species from weeds, it was not carried out in autumn 2012. However, a count of established plants was made on 25 August (Table 2). The number of plants present had decreased by spring 2013 owing to extensive flooding of the entire study area in early spring, which killed many plants. Since the experiment comprised triplicate blocks with all treatments randomised within blocks, the effects of flooding were probably similar for all plots within blocks. However, significantly fewer plants had germinated in treatment B compared with treatments A-C in August 2012 and fewer plants were recorded in C compared with D plots in May 2013 (Table 2). Tall fescue is known to have slow establishment and an open growth pattern, while perennial ryegrass establishes rapidly and quickly provides ground cover (DairyNZ Farmfact, 2010). Statistical analysis revealed that the number of large, well-developed plants was significantly higher (P<0.01) in D plots (10) than in A-C plots.

In 2013 the plots were mowed regularly and dry weather meant that weeds were not a problem for aerial photography. The vegetation analysis based on photographs taken in May 2013 showed that the degree of ground cover was very low, on average 41% (Table 3). This was due to spring flooding. On average, 65% of the surface was covered with vegetation in July 2013, 62% in September 2013 and 86% in April 2014.

Table 2. Number of plants established (m^{-2}) for seed mixtures A-D.[1,2]

Recording occasion	Seed mixture[3]			
	A	B[1]	C	D
25 August 2012	31^{a} (2.3)	20^{b} (2.9)	29^{a} (2.3)	35^{a} (2.3)
6 May 2013	17^{ab} (2.3)	16^{ab} (2.9)	12^{b} (2.3)	20^{a} (2.3)

[1] One plot (out of three) of treatment B was deleted from the data set due to recording error.

[2] Least squares means (standard error in parenthesis), calculated separately for the two recording occasions. Values within rows with different superscript letters are significantly different (P<0.05).

[3] Seed mixtures A-D are described in Table 1.

Table 3. Degree of ground cover (%) in 2013 and spring 2014 for seed mixtures A-D.[1]

	Seed mixture[2]				SE
	A	B	C	D	
17 May 2013	41^{ab}	32^{b}	37^{ab}	47^{a}	3.1
17 July 2013	63^{b}	71^{a}	62^{b}	66^{ab}	2.2
14 September 2013	58^{b}	70^{a}	58^{b}	63^{b}	2.1
30 April 2014	83^{a}	89^{a}	87^{a}	86^{a}	2.0

[1] Least squares means and standard errors (SE), calculated separately for each assessment occasion. Values within rows with different letters are significantly different (P<0.05).
[2] Seed mixtures A-D are described in Table 1.

In May 2013, seed mixture B gave a significantly lower degree of ground cover than mixture D. At the next assessment, ground cover in B plots had strongly increased and was significantly higher than in A and C plots. In autumn 2013, mixture B covered significantly more of the surface than the other mixtures, but these differences evened out and by spring 2014 there were no significant differences between plots. The botanical analysis in spring 2014 revealed a tendency for a higher proportion of white clover in B plots than in A plots (33% vs 19%, P<0.059), most likely as a result of the late start and open sward by tall fescue giving less competition for clover at an early stage of establishment and consequently the observed higher proportion of clover in sward B compared with A. There was no difference in the proportion of ryegrass compared with tall fescue in A and B plots at the time of the botanical analysis in spring 2014. However, the proportion of wilted grasses was significantly higher in A and C plots than in B and D plots (26 and 21% vs 8 and 10%, respectively; P<0.05), probably an effect of more wilted grasses in cv. Foxtrot.

Conclusions

The seed mixture with tall fescue (35% cv. Borneo) established significantly more slowly than other mixtures (P<0.05), but by September 2013 had the highest ground cover (70%) due to a high proportion of white clover. In May 2014, all four mixtures had sufficient ground coverage after winter (~86%) which provides a basis for trampling-resistant swards.

Acknowledgements

Funding from the Swedish Farmers' Foundation for Agricultural Research is gratefully acknowledged.

References

ArcGIS (2013) How maximum likelihood works. Available at: http://tinyurl.com/36ukgab.

DairyNZ Farmfact (2010) Tall fescue establishment and management. Available at: http://tinyurl.com/mnja5cj.

Orr R.J., Cook J.E., Champion R.A., Penning P.D. and Rook A.J. (2003) Intake characteristics of perennial ryegrass varieties when grazed by sheep under continuous stocking management. *Euphytica* 134, 247-260.