Performance of grass mixtures with mountain brome (*Bromus marginatus* Nees ex Steud.) in Central European lowlands

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ABSTRACT

The seeding rate of 2 mil viable seeds of mountain brome cv. Tacit (28.1 kg/ha) is sufficient to establish a productive stand. The seeding amount can be decreased in the mixture with legumes. The growing in pure stand or in a simple mixture, e.g. with alfalfa, is appropriate, because of its low competitiveness. Mixtures with red clover were slightly worse, and mixtures with white clovers, resp. other grasses less suitable. The optimal cutting height of mountain brome to 5–8 cm with regard to forage yield and persistence. Although this grass does not have special demands on site, it does not tolerate long-term dampness and floods. It is mainly used as silage grass with high dry matter production potential, with forage of better-than-average nutritive value, which is kept till the stage of early flowering.

Keywords: grasses; mountain brome; grass mixtures; persistence; cutting height; seeding rate

Mountain brome (*Bromus marginatus* Nees ex Steud.) is erect, up to 1 m high short living bunchgrass, without rhizomes, botanically fitting in the frame of *Bromus* family into the section of *Ceratochloa* (DC et Beauv.) Griseb. It is a native range grass in Northern America where it appears at elevations ranging from 300 to 4000 m. It was introduced to the Czech Republic in the period between the world wars (Míka et al. 2002). Nowadays it can be found on sandy soils, on the river banks, for example, in the surroundings of the town of Veselí-upon-Lužnice, Southern Bohemia. The collection allowed breeding of a material which was registered as a cultivar Tacit in 1998.

Mountain brome cv. Tacit possesses an extraordinary yield potential (with 3–4 harvests a year, about 15 t of dry matter from a hectare), it is heading in every harvest, in the area of adaptation it persists for 3–7 years under good management (esp. it is necessary to leave somewhat higher stubble when cut, and during grazing to keep low or medium stock density). It is tolerant against drought, and it is effective in improving water infiltration, therefore it works well in the areas susceptible to erosion. The herbage matures more slowly compared to herbage of many other grasses, and even in the early athesis it shows high digestibility of organic matter (OMD) and good nutritive value (Pozdíšek et al. 2002). Cattle and horses take it in well. The ensilagebility of herbage is excellent, partly due to a higher content of water-soluble carbohydrates (WSC). But it is fairly sensitive to heavy grazing by larger animals.

Mountain brome is an excellent and reliable seed producer during more subsequent years (Míka et al. 2003). It has very good seedling vigour and it establishes itself readily if seeded in spring or in early summer. It grows well in a wide variety of soils, esp. moderately moist, well-developed, deep, medium textured soils. The principal use is as a silage grass grown in pure stand or in a simple mixture, e.g. with alfalfa or red clover (at least 70% mountain brome and at most 30% legumes). When seeded in pure stand, the recommended seeding rate in Czech conditions ranges from 30 to 50 kg/ha. Mountain brome is not competitive enough with some other grasses such as orchardgrass, ryegrasses, festulolium and it should not be combined with them. However, these recommendations are based on a short-term observation and practical experience.

The aim of this study is to evaluate more exactly the optimal seed mixture composition (species combinations, legumes compatibility, seeding rate) regarding the dry matter (DM) yield, annual yield distribution and mountain brome persistency in herbage stand under cutting regime.

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Table 1. Trial with increasing seeding rates of mountain brome; cumulative dry matter yield in t/ha (sum of 3 cuts in 3 harvest years)

Alternative No.	Number of viable seeds (in millions per hectare)	Seeding rate (kg/ha)	Cumulative dry matter-yield (mean of 2 sites) in t/ha
1	2	28.1	35.0
2	4	44.2	35.3
3	6	66.3	35.2
4	8	88.4	35.0
5	10	110.5	35.0
6	15	165.7	35.2

$LSD_{0.95}$ = 2.4, $LSD_{0.99}$ = 3.4

MATERIAL AND METHODS

In the first series, the trials were established with gradually increasing rate of sown seed of mountain brome (Table 1) to find optimal seeding rate per hectare. The dry matter yield total (sum of 3 cuts and 3 harvest years) was there the criterion of primary importance. The method of trial establishment and next management were identical to the following series.

In the second trial series, 17 mixtures (Table 2) were seeded without cover crop on 2 sites in summer 1999 according to an identical scheme. Harvest plot size was 10 m^2, 4 replications.

The site in Červený Dvůr lies at the altitude of 420 m, with average annual temperature of 7.2°C, with annual long-term precipitation average of 598 mm. The topsoil of the field is shallow, soil easily drying sandy loam on gneiss (typologically cambisoil) of low natural fertility, with pH 5.6, of

Table 2. Seed mixture composition (kg/ha)

Sown varieties	Mixture No.																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Mountain brome cv. Tacit (*Bromus marginatus*)	48	42	36	29				8							42		
Smooth bromegrass cv. Tabrom (*Bromus inermis*)							27	12.6	36								42
Italian ryegrass diploid cv. Romul (*Lolium multiflorum*)						27											
Meadow fescue cv. Otava (*Festuca pratensis*)					29					36							
Creeping red fescue cv. Tagera (*Festuca rubra* ssp. *rubra*)				10	10			8.4									
Tall fescue cv. Kora (*Festuca arundinacea*)												36					
Kentucky bluegrass cv. Slezanka (*Poa pratensis*)				5	5												
Timothy cv. Sobol (*Phleum pratense*)								8.5									
Festulolium cv. Hykor [(*Lol.mult.* x *Fest. arund.*) x *Fest. arund.*]											36			29			
Tall oatgrass cv. Median (*Arrhenatherum elatius*)													36				
Red clower diploid cv. Tábor (*Trifolium pratense*)		6	12			9	9	4.2						10			
White clower cv. Nivel (*Trifolium repens*)				5	5												
Alfalfa cv. Magda (*Medicago sativa*)															6	24	6

low natural stock of available P and Mg, medium stock of K, humus content 18.7 g/kg, and with weakly saturated sorption complex.

The site in Jevíčko lies at the altitude of 380 m, on the alluvium of the Jevíčka river in the climatic region that is mild warm, mild humid, with average annual temperature of 7.5°C, annual long-term precipitation average of 629 mm and underground water state fluctuating from 1.5 to 0.6 m. The soil type is fluvisoil, of deep topsoil with high natural fertility, with pH 7.2, rich in available P, K, Mg and humus content 3.18 g/kg and saturated sorption complex.

Prior to seeding 400 kg/ha of combined fertiliser NPK-1 (with stated content of 12% N, 19% P_2O_5, 19% K_2O) were applied. In the spring of each year 200 kg/ha were applied and another 100 kg/ha of NPK-1 were applied after first and second cuts. In the sowing year two weeding cuts were done, in the full harvest years three cuts were done.

Evaluated traits:

– dry matter yield
– area covered by mountain brome in the autumn of 3rd harvest year
– crude protein (CP) content, net energy for lactation (NEL) , organic matter digestibility (OMD), and water-soluble carbohydrates content (WSC) in dry matter

The herbage quality parameters were predicted in dried samples using NIRSystems 6500 apparatus and ISI 3.01 software. Due to statistical dependency between cuts the variance analyses were performed for each cut separately. On the contrary, the dependency among the harvest years was not statistically significant, therefore the harvest year is considered to be one of sources variability. The variance analysis was used with following factors: sites, harvest years, seed mixtures. The 3rd cut at the Jevíčko site was omitted and the remaining data was processed as incomplete series.

RESULTS

The trials on both sites could be evaluated and the results could be statistically processed. Both trials at the Jevíčko site were flooded by the Jevíčka river for 9 days in the 3rd harvest year in August before the 3rd cut. Mountain brome was most damaged by the flood, but also smooth bromegrass died out to a great extent.

Gradually increasing seeding rate in the range 2–15 mil of viable seeds per hectare did not significantly affected dry matter yield in 32 years (NS) – Table 1. However, the difference between the two sites was significant: the mean was 38.3 t/ha at Červený Dvůr and 31.9 t/ha in Jevíčko; $LSD_{0.99}$ = 6.1) and the interaction between factors seeding rate and site non-significant (NS).

In the trials with grass mixtures, pure stand of smooth bromegrass (mixture No. 9) and pure stand of alfalfa (No. 16) demonstrated one of the lowest dry matter yields in 3 years. Mountain brome in pure stand was in comparison with these slightly better in yield (NS), the mixtures with legumes (No. 8, 2, 3, and 5) were significantly better ($P_{0.95}$)

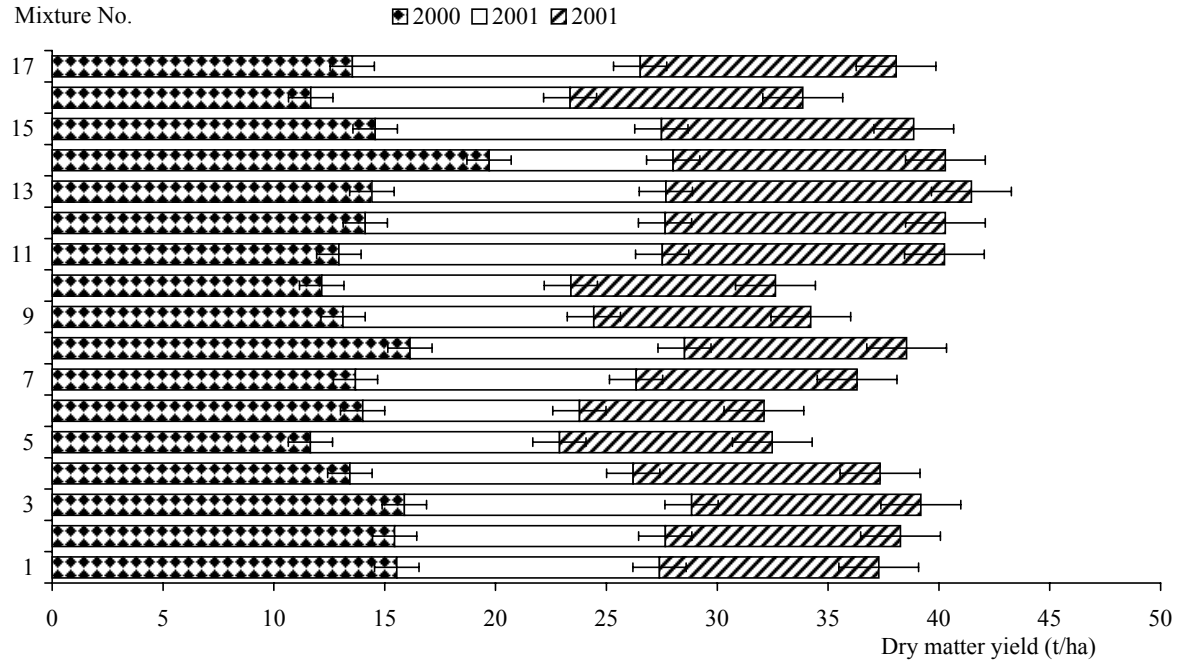

Figure 1. Dry matter yield in 1st, 2nd, and 3rd harvest year (t/ha); mean of 2 sites, error bars represent $LSD_{0.95}$

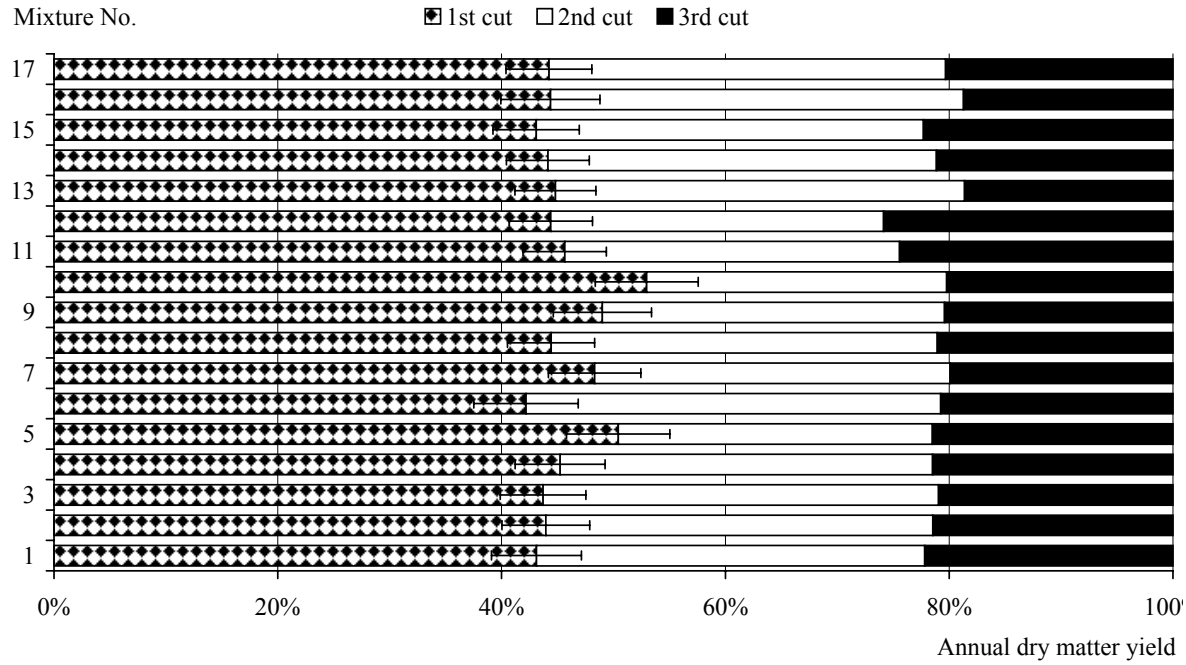

Figure 2. Annual dry matter yield distribution according to 1st, 2nd, and 3rd cut (3-years mean), error bars in first cut represent $LSD_{0.95}$

– Figure 1. The mixture of smooth bromegrass with red clover (No. 7) or with alfalfa (No. 17) was slightly worse (NS) in cumulative 3-year dry matter-yield than the pure stand (No. 2).

In annual dry matter yield distribution there is no significant difference between pure stand and mixtures of both bromegrasses (NS). The proportion of the 1st cut from annual yield makes 41–44% (Figure 2).

Herbage quality of mountain brome in the 1st cut was somewhat higher than that of smooth bromegrass (NS) both in pure stands and in grass-legume mixtures (Table 3) according to CP, NEL, OMD and WSC content. Alfalfa, as a mixture component, increased CP of herbage somewhat higher (NS) than red clover (No. 2 vs 15, resp. 7 vs 17). The same tendency was demonstrated by NEL concentration. However, presence of legumes decreased the content of WSC in forage (NS).

Mountain brome showed higher persistence at the Červený Dvůr site than at the Jevíčko site ($P_{0.99}$). At the same time its ability to cover the land slightly decreased with the decrease of its proportion in seed mixtures at the end 3rd full harvest year (NS) at the Červený Dvůr site. At the Jevíčko site it stayed almost without any changes but it was extremely low (Figure 3).

DISCUSSION

The seeding rate 28.1 kg/ha of mountain brome in pure stand was sufficient to establish successful vegetation. Unfortunately, smaller amount was not tested to say if it would be sufficient as well. In the USA the seeding rate for mountain brome cv. Bromar and Taller 11.2 kg/ha on a pure live seed (PLS) basis is recommended. The seeding rate is reduced with increasing levels of legumes in the mixture (Vogel et al. 1996), e.g. 11 kg/ha of mountain brome with 5 to 6 kg/ha Spanish sweet clover (Whyte et al. 1959).

Both trials at the Jevíčko site show that the location at the Jevíčko site is less suitable for mountain brome and also partly for smooth bromegrass as results from cumulative dry matter yield in 3 years (Table 1) and low coverage area (Figure 3). The low value of coverage was also caused by 9-day-long flooding before the 3rd cut in the 3rd harvest year, which especially mountain brome obviously does not tolerate.

Although mountain brome and smooth bromegrass are grasses with C_3-type of photosynthesis, their association ability with other grasses or legumes is quite low. Grasses with C_3-photosynthesis usually tend to grow in multivariate stands, whereas grasses with C_4-type of photosynthesis grow rather as pure stand (Gáborčík and Gáborčík 1988). The trials demonstrated that mixture of mountain brome with alfalfa (87.5 + 12.5% seed weight) was very successful in terms of dry matter yield, nutritional quality, and also persistence (Figure 1 and 3, Table 3). Red and white clovers demonstrated worse results in comparison to alfalfa at Červený Dvůr site, though red clover in pure stand does better there than alfalfa in pure stand. The growth pattern of

mountain brome with alfalfa matches better than that of red clover. Nevertheless, the decisions if alfalfa or red clover for the mixture will be chosen depends primarily on the objectives of the farmer and then on field conditions, etc.

Combination of mountain brome with other grasses does not seem to be useful according to our trials also because its lifespan gets shorter by that, especially on less suitable locations (poorly drained, too moist, with heavy soil) – Míka et al. (2003).

The competition ability of mountain brome in mixtures with legumes is poor, and the cutting date does not change it substantially (Míka et al. 2003). If cut nearly to the anthesis stage, regrowth in the first 3 weeks performs still well. Also the presence of fertile tiller commonly retards development of new tillers (Míka et al. 2002), but after the fertile tillers are removed, reinitiation of growth from vegetative tillers and from existing tiller bases starts more easily in comparison to the case of smooth bromegrass. We have not noticed that alfalfa in the 2nd or 3rd cut would prevail over mountain brome in the stand.

Also smooth bromegrass in three-cut-system is not as competitive with legumes as orchardgrass (Vogel et al. 1996) or festulolium cv. Hykor (Figure 1). If cut at the pre-elongation stage or early heading, the persistency will be better than in case of delaying the cutting date until alfalfa's optimal harvest maturity. The delay creates disadvantage for the growth of smooth bromegrass for the rest of the season, esp. in the mixture with alfalfa.

The height of cut significantly affects yield and persistence of mountain brome. Practically, in the first growth much tiller elongates but not so entirely as in case of smooth bromegrass. As the shoot apex of the former elevates only merely, obviously it is by cutting not damaged at the height of stubble 5–8 cm and no detrimental effects could be observed (Míka et al. 2003). But being cut at lower level, a restricted new shoot development results from carbohydrate depletion and removing the tillering points.

On the contrary, smooth bromegrass is much more susceptible to a low level of defoliation. Because (1) it only heads in the 1st cut, and (2) nearly every tiller elongates and elevates shoot apex at about

Table 3. Forage quality parameters in 1st cut (means of 2 sites and 3 harvest years)

Mixture No.	Forage quality parameters			
	CP (g/kg dry matter)	NEL (MJ/kg dry matter)	OMD (%)	WSC (g/kg dry matter)
1	133.6	5.81	74.9	57.8
2	139.4	5.89	75.2	57.5
3	148.1	5.92	76.0	56.5
4	146.8	5.89	76.7	52.4
5	132.7	5.85	75.2	56.7
6	140.7	6.03	75.5	75.1
7	143.4	5.86	74.1	39.7
8	126.9	5.88	74.0	54.7
9	124.3	5.88	74.7	46.4
10	126.1	5.85	73.9	58.3
11	105.3	5.61	73.1	67.8
12	112.1	5.75	74.8	69.5
13	96.1	5.79	70.7	41.0
14	119.3	5.75	74.0	59.6
15	142.4	5.94	75.5	55.9
16	167.2	6.47	74.9	37.8
17	147.1	6.10	73.2	38.7
$LSD_{0.95}$	11.2	0.34	2.7	6.4
$LSD_{0.99}$	14.8	0.45	3.6	8.5

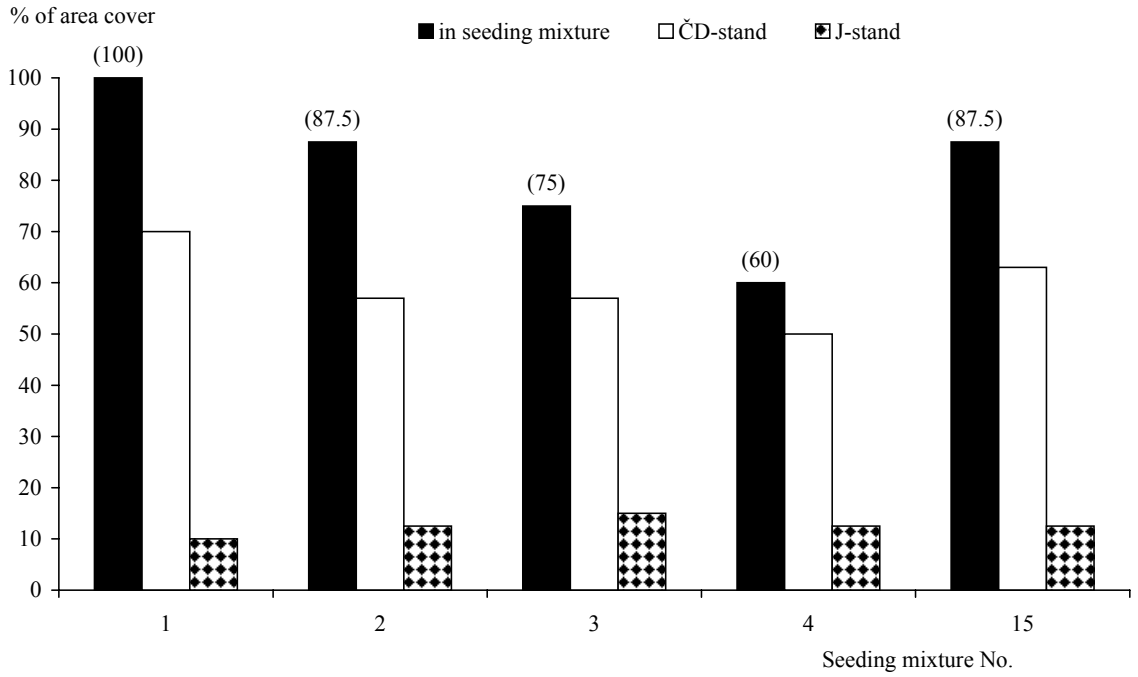

Figure 3. Area covered by mountain brome (in % of field area) in autumn of 3rd harvest year at sites Červený Dvůr (ČD) and Jevíčko (J)

the same time which makes them vulnerable to removal by mowing or close grazing (Vogel et al. 1996). Therefore the cutting height in the 1st cut should be at least 10 cm, in the 2nd cut it can be somewhat lower.

Mountain brome cv. Tacit, being developed from the strains that became naturalized to some extent to natural conditions of Southern Bohemia, tolerates rather wide range of environmental stresses, such as drought, heat, cold and low soil fertility. But the minimal levels of N, P, K are still required to optimise forage yield. Generally, the fertilization is economical as long as the cost of 1 kg of fertilizer is lower than the price of 1 kg of beef cattle at recommended N rates (Vogel et al. 1996). At the Červený Dvůr site it is up to 90 kg N (in addition of 25 kg P and 45 K) per hectare, though CP content of the herbage gets up to the dose of 180 kg N (Míka and Řehořek 2004).

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ABSTRAKT

Chování travních směsí se sveřepem horským (*Bromus marginatus* Nees ex Steud.) v nížinách a pahorkatinách střední Evropy

Výsevek 2 miliony klíčivých obilek sveřepu horského cv. Tacit (28,1 kg/ha) je dostatečný k úspěšnému založení produkčního porostu v čisté kultuře. Ve směsi s jetelovinami lze výsevek snížit. S ohledem na malou konkurenční schopnost je účelný výsev buď v čisté kultuře, nebo v kombinaci s vojtěškou. Kombinace s jetelem lučním byly poněkud horší, kombinace s jetelem plazivým, resp. s jinými travami méně vhodné. S ohledem na pícninářskou

výkonnost a vytrvalost sveřepu horského se doporučuje výška seče 5–8 cm. Třebaže není náročný na stanoviště, nesnáší dlouhodobé zamokření a záplavy. Hlavní využití nachází jako silážní tráva s vysokou produkcí sušiny, s pící nadprůměrně výživné hodnoty, kterou si udržuje až do začátku květu.

Klíčová slova: trávy; sveřep horský; travní směsi; vytrvalost; výška seče; výsevek

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