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DURABILITY OF ARTIFICIAL SWARD WITH THE PARTICIPATION OF RED FESCUE SITUATED ALONG THE SLOPES OF THE CENTRAL BALKAN MOUNTAIN VI. STATE OF MIXED SWARD OF RED FESCUE, KENTUCKY BLUEGRASS AND BIRDSFOOT TREFOIL

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Abstract*.* The state of mixed swards of red fescue, Kentucky bluegrass and birdsfoot trefoil was studied, situated along the slopes of the Central Balkan Mountain, during the period of 1st to the 13th year of their creation. At a high degree of soil gleying, (at) the low part of slope, the dry matter yields were within the limits of 2.8 t/ha^{-1} (1997, south–easterly exposure) up to 10.66 t/ha^{-1} (1999, north–easterly exposure). At a low degree of soil gleying, (and) high part of the slope, the dry matter yields were within the limits of 2.34 t/ha^{-1} (1994, westerly exposure) up to 14.34 t/ha^{-1} (1995, east exposure). The most prominent in productive terms for period of study are variants at the east and south–easterly exposure, slightly gleyed soil. The participation of the sown species in the total forage yield is variable quantity. They reach (at their most) up to 96% in 1998, north exposure, slightly gleyed soils an up to 97% in 2000, north–east exposure, highly gleyed soils. Their share was small in 2004 (44%) and in 2006 (42%) on a westerly slope, highly eroded soils.

Key words: red fescue, Kentucky bluegrass, birdsfoot trefoil, Balkan Mountain, slopes.

Introduction

The grass areas cover an important share in the agricultural economics [FRANK *et al.*, 1998]. It is necessary to point out, that in the selection of components, for the creation of a meadow sward, it should be paid attention not only to the productivity and respectively the economics, but also to its influence over the environment, for example [KANNEGANTI *et al.*, 1998].

In the previous study [MITEV *et al.*, 1992] a number of positive results have been determined in the growing of mixed sward of red fescue, Kentucky bluegrass and birdsfoot trefoil of local origin, which are a subject of patent work.

We share the view of some authors that the combination of certain species could ensure priority of the mixed swards through better use of the resources of the environment [TURKINGTON *et al.*, 1987; SANDERSON *et al.*, 2001].

The combination of components in the swards, as well as the determining of their number should be a result from their behaviour in the conditions of the habitat.

In their increase from 2 to 3 in numbers, the agressiveness in the system rose fourfold [MITEV and PETROV, 1999].

It is considered that the species diversity allows to overcome the unfavourable influences of environment easier [IVES *et al.*, 2001], as a result of the mutual assistance [CALLAWAY, 1998].

In physiological and phenological aspect that allows more efficient use of the available resources [HECTOR, 1998].

The use of swards give opportunity to cross traditional boundaries in generally accepted concepts about agriculture, ecology, conservation and management of the earth, which include sustainable development, decrease in use of pesticides and artificial fertilizers, soil protection *etc*. [WATKINSON *et al.*, 2001; KRUEGER *et al.*, 2002].

The aim of the study was to establish the durability of a mixed sward consisting of red fescue, Kentucky bluegrass and birdsfoot trefoil with a local origin during the period of the 1st to the

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13th years of its creation along the slopes of the Central Balkan Mountain.

Materials and methods

The conditions of creation and conducting of the experiment were described in the methodical part of a previous publication [MITEV and BELPERCHINOV, 2000].

The main feature in it is the spreading of swards of red fescue, Kentucky bluegrass and birdsfoot trefoil along the foothill slopes at a different disposure against the four cardinal points under correspondent soil differences, sun shining *etc*.

The variants are given under the enclosed tables.

Data are processed by a statistical softwear Stratgraphics Plus v.2.1.

The soils of high degree of gleying (A) are characterised by pH (KCl) 3.9–4.0 exchangeable cations in 100 g soil, Al–1.3 –1.6; Mn–0.6–1.3; Ca+Mg–3.6–4.5.

Those of low degree of gleying (B) are characterised by pH (KCl) 4.7 exchangeable cations in 100 g soil, Al–0.6–1; Mn–0.3–0.8; Ca+Mg–9.1–11.1.

After the autumn ploughing in depth of 18–20 sm and the following pre–sowing procedures, 800 germinating seeds were sown at 1m^2 of local populations of red fescue, Kentucky bluegrass and birdsfoot trefoil in equal proportions.

Each of the above mentioned species participate with 1/3 of its sowing rate for creation of independent swards.

The experiment was set in 1994. It was laid out in 4 replications, by the block method, with a size of the experimental plot of 4 m^2.

It was fertilized by P–0.08 t/ha^{-1} every second year, reckoned from 1995. It was supplied by N–0.08 t/ha^{-1} annually, reckoned from 1995.

The dry matter yields were studied, as well as the botanical composition of swards.

They were cut at the phase of beginning of flowering of legumes and ear formation/heading of grasses.

The comparison was made according to controls that were chosen conventionally.

At regular intervals a part of the data were published concerning the behaviour of the described swards [MITEV *et al.*, 2006; MITEV and GORANOVA, 2008], as they followed a certain sequence, tendency and logics of discussion, which are different from the present.

The average amount of precipitation for a period of 35 years (1965–2000) was 737.3 mm. closer to them were these in 1994, 1995, 1998. In 1996, 1997, 1999, 2001, 2003 the precipitation was less in comparison with the average for the region.

In 2002, 2004, 2006 it was greater.

Particularly significant were the differences in 2000, when precipitation was almost the half in comparison with the average for the region.

In 2005 it was almost twice as high.

The average annual temperature (1965–1994) for region was +9.7C, and for the vegetation period March–October +13.6C.

It was lower in 1996, 1997, 2000, and higher in the rest years.

Results and discussion

At a high degree of soil gleying, low part of the slope, the dry matter yields were within the limits from 2.8 t/ha^{-1} (1997, south–easterly exposure) to 10.66 t/ha^{-1} (1999, north–easterly exposure) (Table 1).

At a low degree of soil gleying, high part of the slope, the dry matter yields were within the limits from 2.34 t/ha^{-1} (1994, west exposure) to 14.34 t/ha^{-1} (1995 easterly exposure).

The most prominent in productive terms for the period of the study were the variants at east and south–east exposure, slightly gleyed soils.

In a mixed sward of red fescue and Kentucky bluegrass [NAYDENOVA and MITEV, 2008] the productivity was the highest on an east slope, with a low degree of gleying.

In the present discussion it is determined for south–east exposure with a low degree of gleying.

At that exposure the years (1994; 1995; 1997; 1999; 2002; 2004; 2006) with yields over the conventionally accepted limit of 1.0 t/ha^{-1} dry matter and those

close to it, were the most among all other grass combinations, which are a subject of a more comprehensive scheme of study [MITEV and BELPERCHINOV, 2000].

Table 1.

Dry matter yield in t/ha^{-1} of mixed sward from red fescue, Kentucky bluegrass and birdsfoot trefoil

Var*	Harvest year													
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Average for the period
	Low part of the slope, high degree of soil gleying													
A_1 (к)	0	9.25 A	4.46 B	3,21 C	4.22 B	6.36 B	3.42 A	3.10 B	6.42 B	3.41 A	6.53 A	6.25 A	6.31 A	5.2450 B
A_2	0	6.38 B	4.22 B	2,80 C	4.82 B	6.92 B	3.24 A	3.41 B	7.21 B	3.11 A	6.99 A	6.90 A	6.05 A	5.1708 B
A_3	2,88	4.49 B	9.07 A	7,21 A	7.21 A	10.6 6A	4.82 A	7.07 A	10.1 0A	4.49 A	–	–	–	6.8000 A
	High part of the slope, low degree of soil gleying													
B_1 (к)	7,98 b	14.34 a	5.74 b	9.30 b	6.77 a	8.88 b	4.08 a	7.14 a	8.40 b	5.46 a	10.8 5a	6.78 b	9.68 b	8.1077 a
B_2	9,08 a	11.90 b	6.69 b	12.6 4a	7.58 a	12.5 8a	4.62 a	7.59 a	10.4 1a	5.32 a	9.09 b	7.22 a	11.2 2a	8.185 a
B_3	2,34 d	7.88 c	4.54 c	7.31 c	7.92 a	9.00 b	3.54 b	3.58 b	6.77 c	4.57 a	7.11 c	6.37 b	5.58 c	5.8854 c
B_4	3,79 d	7.34 c	5.35 b	6.12 c	5.39	8.12 b	2.97 b	4.64 b	7.08 c	3.15 b	7.07 c	5.88 c	6.12 c	5.6169 c
B_5	4,57 c	10.24 b	7.60 a	7.00 c	7.33 a	7.68 b	4.73 a	7.36 a	8.53 b	4.92 a	7.14 c	8.00 a	–	7.917 b

*Statistical analysis of variance (ANOVA), a multiple comparison of mean values through the smallest statistically proven differences (LSD 0.05). Data are processed by a statistical softwear Stratgraphics Plus v.2.1.

*A1 East exposure with a high degree of soil gleying (Control of A variants)
A2 South–east exposure with a high degree of soil gleying
A3 North–east exposure with a high degree of soil gleying
B1 East exposure with a low degree of soil gleying (Control of B variants)
B2 South–east exposure with a low degree of soil gleying
B3 West exposure with a low degree of soil gleying
B4 West exposure with a low degree of soil gleying (highly eroded soils)
B5 North exposure with a low degree of soil gleying

That behaviour should not be related only with precipitation, neither with the total amount of nutrients. In a series of the conducted researches for region [TOTEV, 1985; MIHOVSKY, 1992] was recorded a high productivity of swards in the second or third year, with subsequent degradation, which required ploughing in the third or fourth year since creation of the swards. On a slope at south–easterly exposure with heavily gleyed soils highest productivity was recorded in 2002 (9th vegetation). During last three year period (2004–2006), productivity of that variant was higher than that in previous periods.

In a previous publication was presented thesis that each 'structural unit' (..., species, population, variety...) probably has a specific energy configuration and represents a specific 'projection in Time', which in a peculiar way includes in cycle of Nature. In this situation, use of environmental factors is strictly individual, and a part of them remains conditionally not mastered forever. The access to them from part of plant material, sustainability of development of swards, and so on differ [MITEV, 2004; MITEV and NAYDENOVA, 2012].

In this case it is not difficult to assume that components in a sward interact on "time level", creating peculiar "energy–informational systems" with their corresponding durability [MITEV and NAYDENOVA, unpublished]. The botanical composition of swards manifests sustainability of their development (Table 2). The participation of the sown species in total forage yield is a variable quantity. They reached up to 96% in 1998, north exposure, slightly gleyed soils and up to 97% in 2000, north–easterly exposure and highly gleyed soils. Their share in initial and final period of study usually is smaller: 29%, north exposure, low degree of soil gleying, 1994; 36% west exposure, highly eroded soils, 1994; 42%, west exposure, highly eroded soils, 2006.

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Table 2.

Botanical Composition of Swards in %, I cutting

Var*	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		2005		2006	
	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds	sown species	weeds
A_1(к)			73	27	95	5	89	11	92	8	94	6	96	4	91	9	88	12	89	11	73	27	72	28	88	12
A_2			69	31	89	11	86	14	90	10	94	6	96	4	87	13	92	8	58	42	72	28	87	13	64	36
A_3	41	59	77	23	95	5	90	10	94	6	88	13	97	3	86	14	84	16	61	39						
B_1(к)	46	54	93	7	57	43	94	6	93	7	94	6	88	12	89	11	43	57	94	6	94	6	78	22	71	29
B_2	38	62	86	14	83	17	91	9	88	12	60	40	81	19	88	12	84	16	89	11	83	17	81	19	86	14
B_3	67	33	89	11	91	9	92	8	93	7	67	33	75	25	80	20	90	10	85	15	64	36	84	16	81	19
B_4	36	64	86	14	67	33	88	12	86	14	75	25	84	16	68	32	69	31	86	14	44	56	91	9	42	58
B_5	29	71	58	42	95	5	89	11	96	4	92	8	94	6	95	5	92	8	82	18	88	12	51	44		

*A1 East exposure with a high degree of soil gleying (Control of A variants)
A2 South–east exposure with a high degree of soil gleying
A3 North–east exposure with a high degree of soil gleying
B1 East exposure with a low degree of soil gleying (Control of B variants)
B2 South–east exposure with a low degree of soil gleying
B3 West exposure with a low degree of soil gleying
B4 West exposure with a low degree of soil gleying (highly eroded soils)
B5 North exposure with a low degree of soil gleying

The red fescue is a predominant species in the swards. The limitation of the table does not allow showing the specific data according to the type of species. In previous publications has been mentioned that the participation of red fescue reached up to 84% in 2004, north exposure, slightly gleyed soils [MITEV *et al*., 2006]. It had 89% from the total yields at north–easterly exposure, highly gleyed soils, in 1998 [BELPERCHINOV and MITEV, 2004].

The presence of weeds was higher in low level of soil gleying, at a high part of the slope. It is considered that the poorer soils create conditions for increase in the species diversity [SANDERSON *et al*., 2004].

The contradiction with the results of the mentioned author could be due to difference in the geographical conditions [PEETERS and JENSSENS, 1998] or to the peculiarities of the species composition of the discussed plant communities.

The presence of weeds shows the level of balance in the system. It should be noted that they are not the classical weed species, but such that are characteristic for the neighbouring natural swards, which belong to that category that is composed of different fodder grasses.

Galium sp., broadleaf plantain (*Plantago major*) and narrowleaf plantain (*Plantago lanceolata*) *etc*. are herbs and when they are used they have a positive influence over the animal organism, respectively over the human one.

The mentioned species, as well as the self–sown other meadow grasses, with a local origin such as white and hybrid clover, *Lathyrus* sp. *etc*, display the level of balance in the system, as well as the change in the balance. The specificity of the interrelation among productivity and the category of the so called weeds impose a careful analysis according to the type of swards, as well as continuation of the experiment in the future.

Conclusion

The durability was studied of mixed swards consisting of red fescue, Kentucky bluegrass and birdsfoot trefoil situated along the slopes of the Central Balkan Mountain in period from the 1st to the 13th year of their establishment.

At a high degree of soil gleying, low part of the slope, the dry matter yields were within the limits from 2,8 t/ha^{-1} (1997, south–easterly exposure) to 10.66 t/ha^{-1} (1999, north–easterly exposure).

At a low degree of soil gleying, high part of the slope, the dry matter yields were within the limits from 2.34 t/ha^{-1} (1994, west exposure) to 14.34 t/ha^{-1} (1995 easterly exposure). The most prominent in productive terms for the period of the study were the variants at east and south–east exposure, slightly gleyed soils.

The participation of the sown species in the total forage yield is a variable quantity. They reached up to 96% in 1998, north exposure, slightly gleyed soils and up to 97% in 2000, north–easterly exposure and highly gleyed soils. The grass components, and especially red fescue, are predominant in the swards.

The presence of self–sown other meadow grasses of local origin was determined, such as white clover, hybrid clover, *Lathyrus* sp. *etc*. Weed infestation, in view of the durability of swards (1st–13th year since their establishment) has been slight.

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