

PERMANENCE OF SOWN SWARD SITUATED ALONG THE SLOPES OF THE CENTRAL BALKAN MOUNTAIN

D. Mitev¹, G. Naydenova²

¹Research Institute of Mountain Stockbreeding and Agriculture,
5600 Troyan, 281 Vasil Levski Str. Bulgaria,

²Experimental Station of Soybean, 5200 Pavlikeni 61 Ruski Str. Bulgaria

Corresponding author: dimitarmtv@mail.bg

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Abstract: The state of mixed swards of red fescue, Kentucky bluegrass and bird's foot trefoil was studied. The experiment was situated along the slopes of the Central Balkan Mountain, during the period of the 1st to the 13th year of their creation. At a high degree of soil gleying, the low part of the slope, the dry matter yields were within the limits of 2.8 t/ha (1997, south-eastern exposure) up to 10.66 t/ha (1999, north-eastern exposure). At a low degree of soil gleying, high part of the slope, the dry matter yields were within the limits of 2.34 t/ha (1994, western exposure) up to 14.34 t/ha (1995, east exposure). The most prominent in productive terms for the period of the study are the variants at the east and south-eastern 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 and up to 97% in 2000, north-east exposure, highly gleyed soils. Their share was small in 2004 (44%) and in 2006 (42%) on a western slope, highly eroded soils.

Key words: red fescue, Kentucky bluegrass, bird's foot trefoil, Balkan Mountain, slopes

Introduction

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 bird's foot 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 (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. When the number of components was increased from 2 to 3, the aggressiveness in the system raised fourfold (Mitev and Petrov, 1999).

The aim of the study was to estimate the permanence of a mixed sward consisting of red fescue, Kentucky bluegrass and bird's foot trefoil with a local origin during the thirteen years period, 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 bird's foot trefoil along the foothill slopes at a different disposure against the four cardinal points under correspondent soil differences, insolation etc. The variants are given under the enclosed tables. Data were processed by statistical software Stratgraphics Plus v.2.1, with analysis of variance (ANOVA) and multiple comparison of mean values through the smallest statistically proven differences (LSD 0.05).

The dry matter yield and botanical composition of swards were studied.

In relation to soil, the region belongs to the foothill subzone of Northern Bulgaria forest-steppe zone, about which is typical the significant presence of pseudopodzolic soils. Pseudopodzolic horizon (A_1 ; A_2) has a thickness of 30 – 40 cm and it is saturated abundantly by gleyic spots and iron-manganese concretions. Illuvial horizon (B_1 ; B_2 ; B_3) has a thickness of 80 – 100 cm and it is abundantly saturated at the top with light grey and rusty gleyic spots. Brown and brown-yellowish tones are predominant in the lower parts (*Palaveev and Totev, 1983*).

The soils of high degree of gleying (A) were characterized by pH_(KCl) 3.9–4.0; exchangeable cations in meqv/100 g soil, Al 1.3–1.6, Mn 0.6–1.3, Ca and Mg 3.6–4.5. The soils with low degree of gleying (B) were characterised by pH (KCl) 4.7; exchangeable cations in meqv/100 g soil, Al 0.6–1, Mn 0.3–0.8, Ca and Mg 9.1–11.1.

The experiment was established in 1994 in a randomized complete block design with four replicates, and a plot size of 4 m². After the autumn ploughing in depth of 18–20 cm and the following pre-sowing procedures, 800 germinating seeds were sown at 1m² of local populations of red fescue, Kentucky bluegrass and bird's foot trefoil in equal proportions. Each of the above mentioned species participate with 1/3 of its sowing rate for creation of independent swards. Sward was fertilized with N (80 kg/ha) annually and with P (80 kg/ha) every second year, starting from 1995. The dry matter yields were studied in the following way: green mass samples were dried at 105°C till a permanent weight was reached. The dry matter yield was recalculated on the base of the determined percentage proportion. The botanical composition of swards was determined in the following way: four plant samples were taken from random places in the diagonals of the plots from each variant, for each replication of the experiment, till the weight of the pattern of

two kilograms was reached. The botanical composition of swards was determined in this sample. The swards were cut at the phase of beginning of flowering of legume. Variants A₁ and B₁ were accepted as a control, which was conventionally chosen (*Iglovikov et al., 1971*). The average amount of precipitation for a period of 35 years (1965-2000) was 737.3 mm. It was closer to that 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 the 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 the region was 9.7°C, and for the vegetation period March-October 13.6°C. 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 (1997, south-eastern exposure) to 10.66 t/ha (1999, north-eastern exposure) (Table 1).

Table 1 Dry matter yield in t/ha of mixed sward from red fescue, Kentucky bluegrass and bird's foot trefoil

Harvest year	Low part of the slope, high degree of soil gleying			High part of the slope, low degree of soil gleying				
	Variant							
	A ₁ (k)	A ₂	A ₃	B ₁ (k)	B ₂	B ₃	B ₄	B ₅
1994	-	-	2.88	7.98b	9.08a	2.34d	3.79d	4.57c
1995	9.25A	6.38B	4.49B	14.34a	11.90b	7.88c	7.34c	10.24b
1996	4.46B	4.22B	9.07A	5.74b	6.69b	4.54c	5.35b	7.60a
1997	3.21C	2.80C	7.21A	9.30b	12.64a	7.31c	6.12c	7.00c
1998	4.22B	4.82B	7.21A	6.77a	7.58a	7.92a	5.39b	7.33a
1999	6.36B	6.92B	10.66A	8.88b	12.58a	9.00b	8.12b	7.68b
2000	3.42A	3.24A	4.82A	4.08a	4.62a	3.54b	2.97b	4.73a
2001	3.10B	3.41B	7.07A	7.14a	7.59a	3.58b	4.64b	7.36a
2002	6.42B	7.21B	10.10A	8.40b	10.41a	6.77c	7.08c	8.53b
2003	3.41A	3.11A	4.49A	5.46a	5.32a	4.57a	3.15b	4.92a
2004	6.53A	6.99A	-	10.85a	9.09b	7.11c	7.07c	7.14c
2005	6.25A	6.90A	-	6.78b	7.22a	6.37b	5.88c	8.00a
2006	6.31A	6.05A	-	9.68b	11.22a	5.58c	6.12c	-
Average for the period	5.24B	5.17B	6.80A	8.10a	8.18a	5.88c	5.61c	7.91b

The same letters - are not significantly different at the 0.05 probability levels; A1 East exposure (Control of A); A2 South-east exposure; A3 North-east exposure; B1 East exposure (Control of B);

B2 South-east exposure.; B3 West exposure.; B4 West exposure (highly eroded soils); B5 North exposure.

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

On a slope at south-eastern exposure with heavily gleyed soils the highest productivity was recorded in 2002 (9th vegetation). During the last three year period (2004-2006), the productivity of that variant was higher than that in the previous periods. In a previous publication was presented the thesis that each 'structural unit' (...species, population, variety, ...) probably has a specific energy configuration where a proper energy balance is achieved, which allows the formation of a specific "projection in Time" (including permanence in ontogenetic and phylogenetic aspect), which in a peculiar way is included in the cycle of nature. In this situation, the use of the environmental factors is strictly individual, and a part of them remains conditionally not mastered for ever. The access to them from the part of the plant material, the sustainability of the development of the swards, and so on differ (Mitev, 2004; Mitev and Naydenova 2012). In this case it is not difficult to assume that the 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 the swards manifests the sustainability of their development (Table 2).

The participation of the sown species in the total forage yield is a variable. They reached up to 96% in 1998, north exposure, slightly gleyed soils and up to 97% in 2000, north-eastern exposure, highly gleyed soils. Their share in the initial and final period of the 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. The red fescue is a predominant species in the swards. 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-eastern 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 should be noticed that the species, included here, are not *Setaria viridis* (L.) P.B., *Setaria glauca* P.B., *Agropyrum repens* (Scop.) etc. We found the presence *Galium aparine* (L.), *Galium tricornis* (With), the broadleaf plantain (*Plantago major* L.), narrowleaf plantain (*Plantago lanceolata* L.) etc., which are characteristic for the neighbouring natural swards. These species are herbs that have a positive influence over the animal organism, respectively over the human one.

Table 2 Botanical Composition of swards in %, I cutting

Year		Variant							
		A ₁ (k)	A ₂	A ₃	B ₁ (k)	B ₂	B ₃	B ₄	B ₅
1994	sown species	0	0	41	46	38	67	36	29
	weeds	0	0	59	54	62	33	64	71
1995	sown species	73	69	77	93	86	89	86	58
	weeds	27	31	23	7	14	11	14	42
1996	sown species	95	89	95	57	83	91	67	95
	weeds	5	11	5	43	17	9	33	5
1997	sown species	89	86	90	94	91	92	88	89
	weeds	11	14	10	6	9	8	12	11
1998	sown species	92	90	94	93	88	93	86	96
	weeds	8	10	6	7	12	7	14	4
1999	sown species	94	94	88	94	60	67	75	92
	weeds	6	6	13	6	40	33	25	8
2000	sown species	96	96	97	88	81	75	84	94
	weeds	4	4	3	12	19	25	16	6
2001	sown species	91	87	86	89	88	80	68	95
	weeds	9	13	14	11	12	20	32	5
2002	sown species	88	92	84	43	84	90	69	92
	weeds	12	8	16	57	16	10	31	8
2003	sown species	89	58	61	94	89	85	86	82
	weeds	11	42	39	6	11	15	14	18
2004	sown species	73	72	-	94	83	64	44	88
	weeds	27	28	-	6	17	36	56	12
2005	sown species	72	87	-	78	81	84	91	51
	weeds	28	13	-	22	19	16	9	44
2006	sown species	88	64	-	71	86	81	42	-
	weeds	12	36	-	29	14	19	58	-

A1 East exposure with a high degree of soil gleying (Control of A); A2 South-east exposure with a high deg. of soil gley.; A3 North-east exposure with a high deg. of soil gley.; B1 East exposure with a low deg. of soil gley. (Control of B); B2 South-east exposure with a low deg. of soil gley.; B3 West exposure with a low deg. of soil gley.; B4 West exposure with a low deg. of soil gley. (highly eroded soils); B5 North exposure with a low deg. of soil gley.

The mentioned species, as well as the other self-sown meadow grasses and legumes, with a local origin such as white and hybrid clover, 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 opportunity for prolonged use of artificial meadow wards has been found in the slopes of the Central Balkan Mountain.

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 (1997, south-eastern exposure) to 10.66 t/ha (1999, north-eastern 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 (1994, west exposure) to 14.34 t/ha (1995 eastern 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-eastern exposure, highly gleyed soils. The grass components, and especially red fescue, are predominant in the swards. The presence of self-sown other legumes of local origin was determined, such as white clover, hybrid clover, etc.

Weed infestation, in view of the durability of swards (1st - 13th year since their establishment) has been slight.

Postojanost sejanih travnjaka koji se nalaze na padinama duž padina centralnih Balkanskih planina

D. Mitev, G. Naydenova

Rezime

Stanje mešovitih travnjaka crvenog vijuka, livadarke i žutog zvezdana je analizirano u ovoj studiji. Eksperiment je smešten duž padina Centralnog Balkanskog planinskog venca, u periodu od 1. do 13. godine njihovog postojanja.

Na izrazito glejnim zemljištima, na nižim delovima padina, prinosi suve materije bili su u granicama 2,8 t/ha (1997, jugoistočni izloženosti) do 10,66 t/ha (1999, severno-istočni izloženosti).

Na slabo glejnim zemljištima, na višim delovima padina, prinosi suve materije bili su u granicama 2,34 t/ha (1994, zapadne ekspozicije) do 14,34 t/ha (1995, istočne ekspozicije). Najistaknutiji u proizvodnim uslovima za period istraživanja su varijante na istoku i jugo-istoku, na blago glejnom zemljištu.

Učešće posejanih vrsta u ukupnom prinosu travnjaka je promenljivo. Dostiže 96% u 1998, na severnim ekspozicijama i blago glejnim zemljištima i do 97% u 2000. godini na severno-istočnim ekspozicijama i visoko glejnim zemljištima. Njihov udeo je bio mali u 2004. (44%) i 2006. godini (42%) na zapadnoj padini, gde su veoma erodirana zemljišta.

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