

Primary production of the association *Festuca pratensis* – *Trifolium elegans* on the northern slopes of Mt Lyulin

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Received: December 12, 2005 > Accepted: May 15, 2006

Abstract: The results of a phytocoenological investigation and structure of primary biological productivity in the association *Festuca pratensis* – *Trifolium elegans* are reported in the paper. The total amount of the primary biological production (green phytomass + dry mass) is 4.47 t/ha. The green phytomass of the Gramineous group amounts to 2.90 t/ha, of which the green phytomass of *F. pratensis* constitutes 50.4%. The green phytomass of the Leguminous group amounts to 1.06 t/ha, in which the green phytomass of *T. elegans* accounts for 74.5%.

Key words: formations, phytocoenoses, phytomass, primary production

Introduction

Investigations into the structure and dynamics of the primary biological production of basic natural grassy communities constitute an important part of the study of the biological turnover of substances and soil-formation processes in the natural ecosystems and their rational use, prognostication and protection. Over the last decades such investigations have acquired an increasingly complex character in Bulgaria and have involved the efforts of specialists from various institutes and departments (Kočev & Nicolov 1976; Meshinev 1977; Bondev & al. 1985; Totev & al. 1986; Kurkin 1986; 1996; Georgiev 1987; Ilin 1988; Snakin & al. 1991; Shishov & al. 1991; Grishkan 1995; Gorchakovski & Abramchuk 1996; Delipavlov & Angelov 2000; etc.).

Material and methods

Meadow communities (ecosystems) dominated by fescue grass (*Festuca pratensis* L.) are relatively widely spread in the flatlands and moderately humid foremountainous regions of the country. Besides as main dominant in the grassy communities, fescue grass participates also as co-dominant with other mesophytic species in the group of Gramineous and Leguminous grasses. According to Yakimova & al. (1977), meadow coenoses with participation of *F. pratensis* rate among the best, owing to their high yields and excellent fodder properties.

The investigations were carried out on the northern slopes of Mt Lyulin, at the bottom of a typical mountain water catchment. The explored catena was of a semimountainous type and was situated at the

foot of Mt Lyulin, in the altitude belt of 700–900 m. Its territory had a complex configuration, with un-homogeneous and contrasting, highly rugged mesorelief. The soils were of the leached smolnitza type, with various degree of accumulated organic substances. Climatically, the region belongs to the climatic zone of the Sofia Plain which falls into the European Continental (Temperate) Climatic Area (Velev 1997). The average annual temperature amplitudes varied within the range of 23 °C to 16 °C, with a maximum in August and a minimum in January. Annual precipitations were close to the average values for the country.

The study of the structure of primary biological production was carried out according to the method of Mordcovich & al. (1985), Florova & Polushkin (1986), Ilin (1988), and Snakin & al. (1991). The plant samples were collected (in the period of maximum productivity of the dominants) late in June and early in July, in 1998 and 1999, from the model plot of the association. The working pads measured 50/50 cm (0.25 m²) at $n = 7$. Under laboratory conditions, all fractions of the plant samples were dried at 85 °C in the course of 48 hours and weighed up to 0.1 g. The obtained results were reduced to absolute dry mass. Abundance was judged by the five-point scale of Hult, with Arabic numerals, and occurrence was rated on the five-point scale of Raunkier, with Roman numerals (Shenikov 1964). No studies of the structure of primary biological production of the association *Festuca pratensis*–*Trifolium elegans* have been so far carried out in Bulgaria. The climagrams for 1998–1999 were plotted on the basis of the averaged data for the towns of Bankya and Bozhourishte.

Results and discussion

The association *Festuca pratensis* – *Trifolium elegans* was situated in the accumulating part of a second-order catena on the northern slopes of Mt Lyulin (above Gradoman village, Sofia district). The applied mode of utilisation was hay mowing. Thirty-three higher plants participated in the composition of the model plot. The total projection cover was close to 100%. Besides the dominant Gramineous and Leguminous species, some Mixoherbosa species were found in greater abundance and occurrence (Table 1). The vertical structure of the community had two distinctly differentiated floors. The horizontal structure was homogeneous.

Table 1. Phytocoenological characteristics of the association *Festuca pratensis*–*Trifolium elegans*.

Species	Abundance	Occurrence
Gramineous		
<i>Festuca pratensis</i>	3–4	IV–V
<i>Alopecurus arundinaceus</i>	+	
<i>A. pratensis</i>	1	I–II
<i>Arrhenatherum elatius</i>	1	I–II
<i>Bromus commutatus</i>	1	I
<i>Dactylis glomerata</i>	+	
<i>Festuca valesiaca</i>	1 (2)	I–II
<i>Phleum pratense</i>	1	I
<i>Poa pratensis</i>	1	I–II
Cyperaceous		
<i>Carex distans</i>	1	I
Leguminous		
<i>Trifolium elegans</i>	2–(4)	III–IV
<i>Lathyrus nissolla</i>	+	
<i>L. pratensis</i>	1	I
<i>Lotus tenuis</i>	1	I
<i>Trifolium campestre</i>	1(2)	I–II
<i>T. repens</i>	1	I
<i>Vicia grandiflora</i>	1–2	I–II
<i>V. hirsuta</i>	1	I
Mixoherbosa		
<i>Achillea millefolium</i>	1	I
<i>Alyssum alyssoides</i>	1	I
<i>Centaurea</i> sp.	+	
<i>Convolvulus arvensis</i>	1–2	I–II
<i>Crepis biennis</i>	+	
<i>Daucus guttatus</i>	1	I
<i>Galium verum</i>	1(2)	I–II
<i>Hypericum perforatum</i>	+	
<i>Plantago lanceolata</i>	1	I–II
<i>Potentilla reptans</i>	1	I–II
<i>Ranunculus repens</i>	1	I
<i>Rhinanthus rumelicus</i>	1	I
<i>Rumex acetosella</i>	+	
<i>Sanguisorba minor</i>	1	I
<i>Taraxacum officinale</i>	1	I

The obtained results on the structure of primary biological production have shown that it was very unevenly distributed between the agrobiological groups of main dominant and co-dominant (Table 2). The total aboveground primary production (green phytomass + dry mass) in the association *Festuca pratensis* – *Trifolium elegans* amounted to 4.47 t/ha (averagely for the two years of study). The green phytomass consti-

tuted the main amounts. The experimental results related to the structure have shown that the green phytomass of the Gramineous (Table 2) claimed the greatest amounts. Its relative share accounted for over two-thirds (69.05 %), respectively, of the total quantities of the green phytomass (Gramineous + Cyperaceous + Leguminous + Mixoherbosa). Over half of the total green phytomass of that group was supplied by *F. pratensis* (157.36 g/m² in 1998 and 140.68 g/m² in 1999), which accounts for 33.33 % of the total primary production of the association (averagely for the two years of study).

Second came the green phytomass of the Leguminous group: 25.24% and 23.71 %, respectively, of the total green phytomass and the total (summary) production (Table 2). *T. elegans* has played a major part in the formation of the green phytomass in that group during the two years of research. The green phytomass of *T. elegans* accounted for approximately two-thirds of the green phytomass of the Leguminous (77.7 % in 1998 and 71.9 % in 1999). A comparative analysis of these results has shown that in the second year of study there was a slight (quantitative and relative) increase in the green phytomass in that group. The increase of the green phytomass of the main co-dominant, *T. elegans*, however, was the greatest, at approximately the same relative participation of the green phytomass in the Gramineous group (68.7 % in 1998 and 60.9 % in 1999). One of the main reasons for the greatest (quantitative and relative) participation of the green phytomass of the Leguminous group and,

respectively, of *T. elegans*, were the considerably higher average monthly precipitations during the vegetation period of 1999 and the status of the association *Festuca pratensis* – *Trifolium elegans* in the accumulation part of the catene (Figs 1, 2). The relative increase of the green phytomass in the Leguminous group in 1999 amounted to 13 %.

The green phytomass of the Mixoherbosa group ranked third (Table 2). The relative decrease of the amount of green phytomass from that group took place mainly at the expense of the increasing green phytomass of the Leguminous group. These trends are interesting from a practical viewpoint. An improvement of the hydrothermal conditions (mainly an increase in precipitation) has increased the amount of green phytomass in the Leguminous group. The dry mass has shown the lowest absolute and relative values during both years of research. Its relative share varied about 4–6 % of the total (summary) aboveground production.

The total amount of the aboveground primary biological production in the association *Festuca pratensis* – *Trifolium elegans* on the northern slopes of Mt Lyulin was close to the average parameters of the aboveground production in the grassland ecosystems in temperate latitudes (Bazilevich & al. 1986) and nearly equalled the literary data on primary biological production of meadow (grassy) ecosystems in the Russian Plain (Ilin 1988).

Our results obtained on the structure of the aboveground primary biological production in the investigated association are very close and similar in comparison to

Table 2. Primary biological production in the association *Festuca pratensis*–*Trifolium elegans*.

Phytomass Fraction	1998				1999				(1998–1999)/2		
	g/0.25 m ²		g/m ²	%	g/0.25 m ²		g/m ²	%	t/ha	% from	% from
	X	± SD			X	± SD				gr. phytom.	total phytom.
I. Gramineous	79.60	11.77	318.40	68.66	65.46	13.57	261.84	60.85	2.90	69.05	64.87
a/ <i>Festuca pratensis</i>	39.34	7.86	157.36	33.93	35.17	6.67	140.68	32.69	1.49	35.56	33.33
b/ Other gramineous	40.26	3.91	161.04	34.73	30.29	3.44	121.16	28.16	1.41	33.57	31.54
II. Cyperaceous	1.40	0.55	5.60	1.21	–	–	–	–	0.03	0.72	0.67
III. Leguminous	20.49	6.90	81.96	17.67	32.61	8.67	130.44	30.31	1.06	25.24	23.71
a/ <i>Trifolium elegans</i>	15.93	4.86	63.72	13.74	23.46	4.31	93.84	21.81	0.79	18.80	17.67
b/ Other leguminous	–4.56	2.04	18.24	3.98	9.15	2.18	36.60	8.50	0.27	6.43	6.04
IV. Mixoherbosa	6.53	1.97	26.12	5.63	3.60	1.14	14.4	3.35	0.20	4.78	4.47
V. Total green phytomass	108.02	21.19	432.08	93.18	101.68	3.50	406.72	94.51	4.20	100.00	93.74
VI. Dry mass	7.91	0.84	31.64	6.82	5.90	0.57	23.60	5.48	0.28	–	6.26
Total phytomass	115.93	22.03	463.72	100	107.58	4.07	430.22	100	4.47	–	100

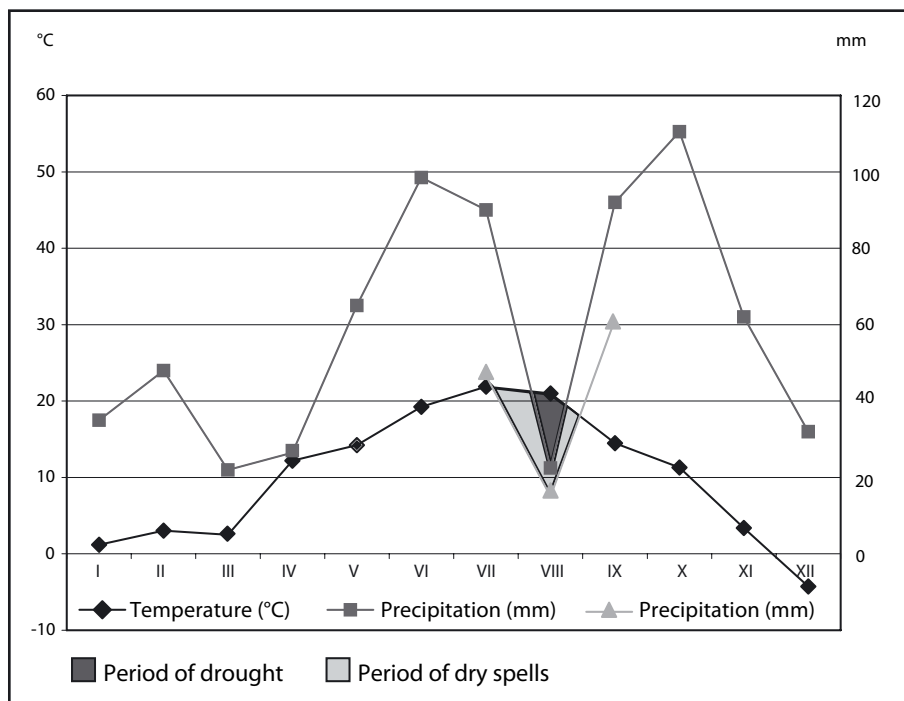


Fig. 1. A climagram for 1998 (after Walter 1955).

the known kindred literary data in Bulgaria on mono- and polydominant herbaceous communities dominated by *F. pratensis* and other mesophylous herbaceous species of the Gramineous group (Yakimova & al. 1977; Apostolova 1991; Kočev & Tzerovska 1994; etc.). There are differences chiefly in the relative correlations between the various groups (Gramineous, Leguminous, dominant, co-dominant, etc.), depending on the type of dominance of the plant communities and the physico-geographical conditions of the region.

The results obtained in the association *Festuca pratensis* – *Trifolium elegans* give rise to several practical conclusions and recommendations. Late June and early July suit best (optimally) for mowing the aboveground phytomass, when its amounts show the highest values and the best fodder properties.

Conclusion

The total amount of primary biological production (green phytomass + dry mass) in the association *Festuca pratensis* – *Trifolium elegans* has amounted to 4.47 t/ha (averagely for the two years of study). It was very unevenly distributed between the agribiological groups, dominant and co-dominant. The green phytomass of the Gramineous group has registered the highest amounts (2.90 t/ha) during the two years of study, followed by the green phytomass of the Leguminous group (1.06 t/ha).

The amount of green phytomass of *F. pratensis* accounted for 33.3% of the primary biological production of the association and for 51.4% of the green phytomass of the Gramineous. The amounts of the green phytomass of *T. elegans* were over two-thirds (74.53%) of the total green phytomass of the Leguminous and approximately one-fifth (17.67%) of the total primary production of the association (averagely for the two years of study). Most suitable (optimum) time for hay mowing of the aboveground phytomass is late June and early July, when it shows the highest quantity values and the best fodder properties.

Acknowledgements. This paper is a contribution to Project B-712 supported by the National Science Fund, Ministry of Education and Science, R Bulgaria.

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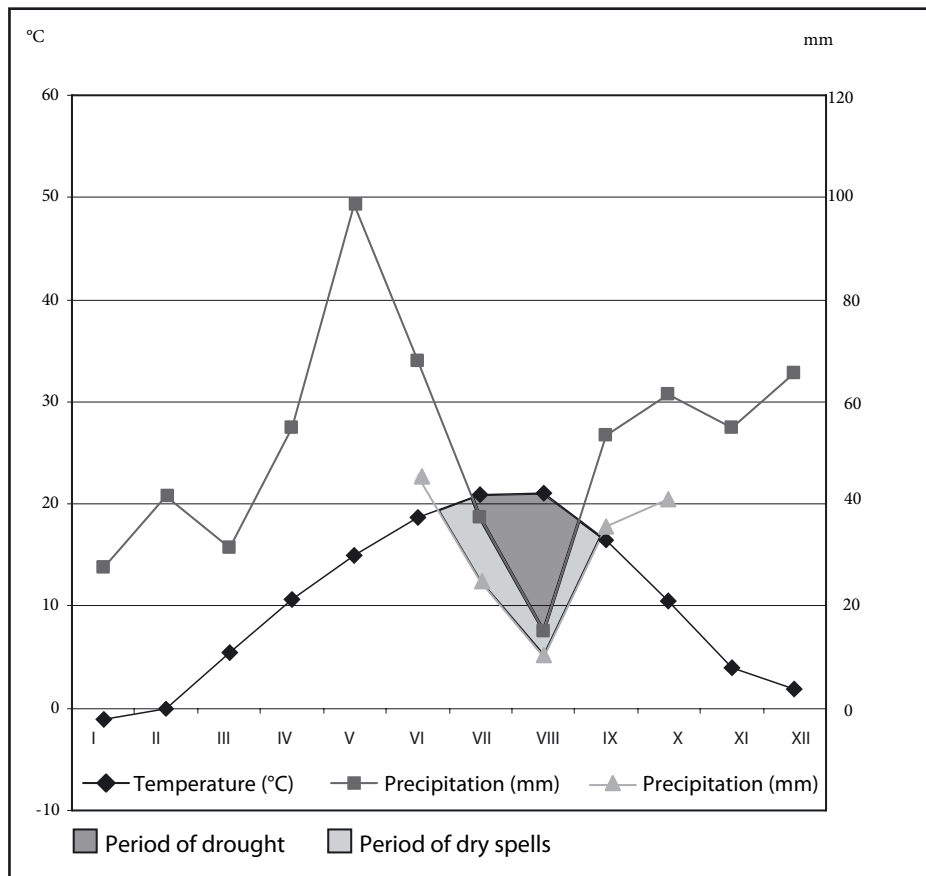


Fig. 2. A climagram for 1999 (after Walter 1955).

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