



OCCURRENCE OF BASIC PHENOLOGICAL PHASES FOR SEVERAL SPECIES OF WHEATGRASSES AT THE HIGH-MOUNTAIN CLEAN OF TREES AREA OF THE CENTRAL BALKAN NATIONAL PARK

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Abstract: We specified the moments of occurrence of basic phases in growth of four species of wheatgrasses – *Agrostis capillaries* L., *Festuca rubra* L., *Larchenfeldia flexuosa* (L.) Schur. and *Nardus stricta* L. on territory of the “Central Balkans” National Park. We drew a phonological spectrum of the plants depending on the particular climate. We fixed the optimum period for starting and ending grazing cycle on the studied territory.

Key words: phenology, ecology, wheatgrasses, Gramineae, *Agrostis capillaris* L., *Festuca rubra* L., *Lerchenfeldia flexuosa* (L.) Schur., *Nardus stricta* L., biological characteristics.

INTRODUCTION

The high-mountain clean of trees area of the Central Balkans National Park is a huge source for the region’s dimensions of forage resources such as natural meadows and grazing grounds. The efficient using of these resources is a problem that should be solved, because their state up to now is utterly unsatisfactory (MESHINEV ETC., 2000; VELCHEV, 2002;). What caused this is mostly the ongoing unregulated grazing for decades. (CHERNYAVSKI & VEZEV, 1953; TOTEV, 1973).

According to a number of authors like NAJDENOV & VAKNOV (1955), TOTEV *et al.* (1970) starting and finishing the grazing should take into consideration the phenology of worth fodder wheatgrasses.

The already carried out phytocenological descriptions of the plant communities within the region (KOHEV, 1967, MESHINEV *et al.*, 2000;) define *Agrostis capillaris* L., *Festuca rubra* L., *Lerchenfeldia flexuosa* (L.) Schur. and *Nardus stricta* L., as some of most wildy used wheat species in the natural perennial meadow. This is provoking the purpose of the present study to be: defining the moments of occurrence

of the basic phenological phases of those four species on part of the high-mountain clear of trees area of the Central Balkans National Park.

MATERIALS AND METHODS

Studying the basic moments of seasonal growth of *A. capillaris*, *F. rubra*, *L. flexuosa* and *N. stricta* was carried out on a part of the territory of the „Central Balkans” National park – the area called Beklemeto. The studies were located on three marked grounds sized 20 m² with northern, crest and southern exposure. The grounds are in an area actively visited by grazing herds. We carried out several observations and gathered material for specifying the moments of occurrence of the basic phenophases for the four wheatgrasses on the studied territory for the period 2006 – 2008 within an interval of 10-15 days. The moments of occurrence of phenophases were specified in accordance with METHODOLOGY (1981) and the following phenophases have been reported: I. Growing up; II. Tillering; III. 5-8 cm. the height of vegetative mass; IV. Making a broom (forming ears); V. Efflorescence; VI. Ripeness. For every phenophase we specified beginning and mass occurrence.

Biometrical data for each species is made average for the three-year period of studying. The mathematical analysis used is Descriptive statistics. We calculated an accuracy index (Sx%).

RESULTS AND DISCUSSION

We did not observe growth of vegetative parts of the plants because of long hold of snow cover and low temperatures until the beginning of April. The earliest growing up was reported for the *F. rubra* and *N. stricta* in 2007 and 2008 on the grounds with southern exposure – the end of March. In 2006 due to low temperatures, we registered beginning of growing up 7 to 10 days later.

It was *L. flexuosa* that entered this phase the slowest compared to the other four studied species, especially in 2006 when the plants on the crest ground started growing not until the third week of April. (Fig. 1).

The beginning of tillering in 2006-2007 was reported between 20 – 30th of April for the *F. rubra* and *N. stricta* on the ground with southern exposure. The beginning of this phase for the *L. flexuosa* and *A. capillaris* is 5 to 7 days later; the plants from crest parts enter the phase slowest – 1-5th of May. Because of the comparatively high temperatures in the winter months of 2008 and quick warming in April (average temperature of the air 11.4°C), tillering started at about 7 – 10 days earlier (10 -25.04.2007).

N. stricta makes the largest number of vegetative tillers, and *F. rubra* is specified as the plant with the smallest number of tillers.

Table 1. Biometrical data for the species

Indicator \ Species	<i>Agrostis capillaris</i> L.	<i>Lerchenfeldia flexuosa</i> (L.) Schur.	<i>Festuca rubra</i> L.	<i>Nardus stricta</i> L.
	%XS	%XS	%XS	%XS
	min ($\bar{x} \pm Sx$) max			
Width of the leaves	2(2.91±0.11)4	–	2(3.55±0.14)5	–
Length of the joint leaves	7(8.66±0.24)10.7	4(10.8±0.47)16.2	12(20.35±1.01)37	8.9(14.18±0.57)20
Length of the stem leaves	3.7(6.32±0.23)9.7	5.5(7.8±0.31)11.6	5.5(8.3±0.29)11	3.2(4.56±0.13)5.8
Number of nodes	3(3.7±0.1)5	2(3±0.02)4	3(3.5±0.06)4	–
Length of the central internode	3.9(5.52±0.15)7.2	8(9.6±0.16)11.5	13(15±0.18)17	–
Length of the last internode	7(11.15±0.34)14.1	21(26.3±0.36)31.3	28.6(34.1±0.61)42.5	–
Height of the stem	20(34.4±1.27)50	20(41.9±1.76)60	20(±3.01)110	10(23±1.1)35
Length of ear (broom)	4.2(7.38±0.26)10.4	6.6(8.92±0.18)11.9	7(11.1±0.33)14	3(6±0.25)9
	3.7	–	–	–
	2.7	4.3	4.9	4
	3.6	3.9	3.4	2.8
	2.7	0.6	1.7	–
	2.7	1.6	1.2	–
	3	1.1	1.7	–
	3.6	4.2	4.9	3.1
	3.5	2	2.9	4.1

Despite the fact that in 2007 compared to 2008 plants enter the phase of tillering a week later, they reach the necessary height of grass for the beginning of pasture which is 5 – 8 cm. according to TOTEV *et al.* (1986) and it starts almost at the same time during the two years (beginning of May). The reason for it was the higher temperatures and comparatively larger amount of rain in May 2007. For the studied region this moment is registered the earliest for the *F. rubra* on the southern and northern grounds-during the last week of April 2007 and 2008. In 2006 a delay for about a week is registered. Compared to the other four species of wheatgrass, *L. flexuosa* has the latest growth to the necessary height in 2007 and 10 to 20th of May 2008 and in 2006 hardly at about 25th of May.

The ground biomass grew intensively up to forming ears (making a broom). The average number of nodes, formed by *F. rubra* is 4 at average length of the second internode 15.6 cm. *A. capillaris* forms from 3 to 5 nodes with average length of internode 5.4 cm., for *L. flexuosa* these figures are average 3 nodes and average length of the central internode of 11.4 cm. (Table 1).

The leaf surface and root system of the four species reach their maximum size. For the *F. rubra* the joint leaves are with average length of 20.3 cm. and stem ones-8.4 cm. For *A. capillaris* these figures are respectively 8.6 cm and 6.4 cm., for *L. flexuosa* – 10.7 cm. and 7.7 cm. and for *N. stricta* the length of joint leaves reaches 20 cm. and stem up to 6 cm. Reported average width of the leaves for *F. rubra* is from 0.2 to 0.5 cm. and for *A. capillaris* from 0.2 to 0.4 cm. and for *L. flexuosa* and *N. stricta* it does not exceed 0.1 cm.

Appearing of the ear (the broom) in 2006 occurs at about the middle of June in 2007, the end of May, the beginning of June and in 2008 it was reported in the first week of June. *L. flexuosa* enters the phase of making a broom latest with at about 5 to 10 days after the other three species. The longest phase 8 – 10 days is reported for this same plant while for the rest wheatgrasses the continuance is from 3 to 5 days. At that phase gradual lengthening of the last internode can be observed, as well as final formation of the ears (the broom). *A. capillaris* and *L. flexuosa* form the greatest number of generative stems. Despite the fact that *N. stricta* forms largest number of tillers, the percentage of generative stems for it is lowest.

Efflorescence for the four species wheatgrasses at the high-mountain clear of trees area of the pass Troyan-Karnare is reported to be at about 5 – 20th of June for 2006 and 2008 at an average temperature of air respectively (18.2 and 18.8°C). Because of considerably higher temperatures at the time of vegetation in 2007 the occurrence of the phase is earlier – 1 – 10th of June. Delay of efflorescence is reported again for *L. flexuosa* and especially for plants occupying the crest parts. The beginning of the phase for them was noted in the first ten days of July for 2006 and 2008, and at about 10 days earlier for 2007. Because of greater number of vegetative stems, formed at different time, *A. capillaris* is characterized efflorescence – until the

Temperature and precipitation in the territory of Beklemeto for the period 2006 - 2008.

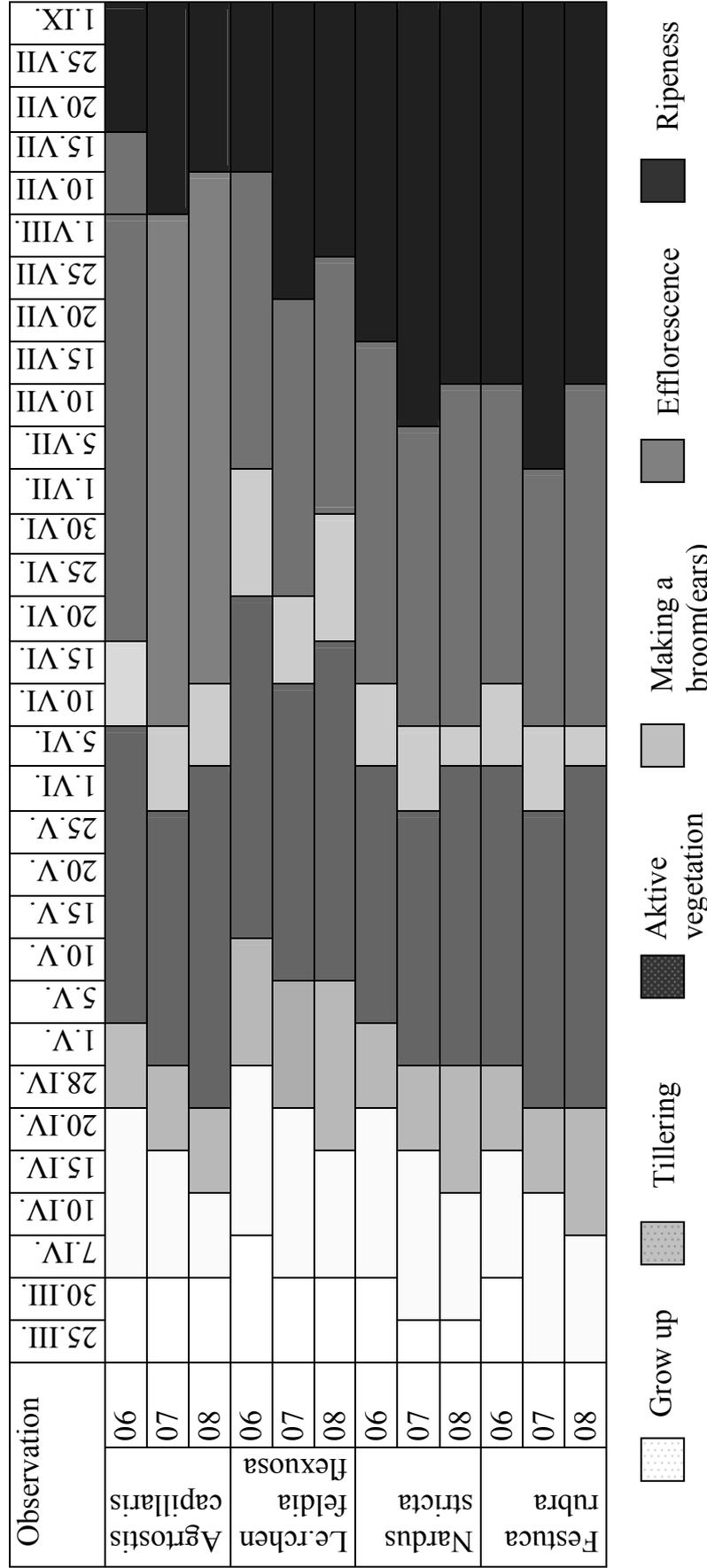
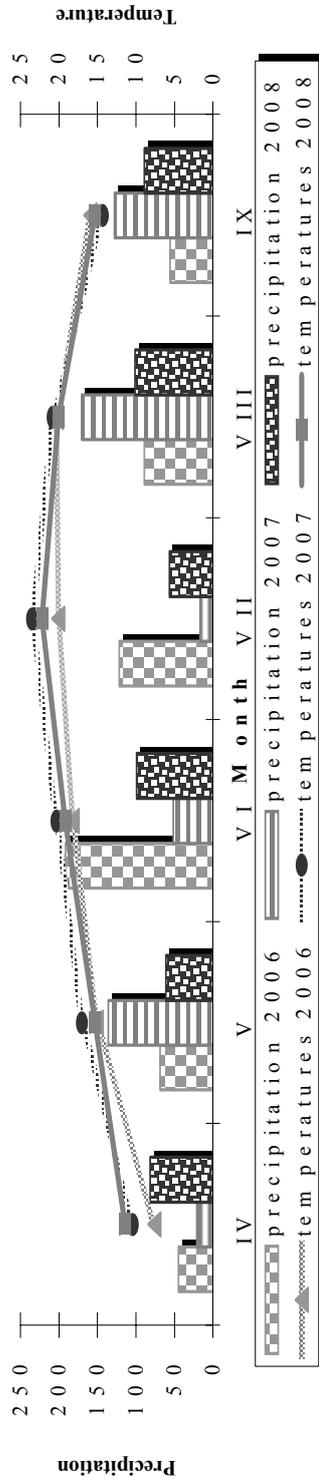


Fig.1. Phenological spectrum of species

middle of August *F. rubra* and *N. stricta* was reported at the second and third week of July and for *L. flexuosa* in the middle of August. It got ahead with at about 7 to 10 days.

The average length of the last internode for the *A. capillaris* is 11.5 cm., the height of stem reaches 20 – 50 cm. These figures for the *L. flexuosa* are respectively 26.2 cm. and 20 – 60 cm. *F. rubra* is the plant with the longest last internode – 33.8 cm. and height of stem reaching 110 cm. *N. stricta* does not form nodes on the stem, so just the general height of stem is reported – from 10 to 35 cm. (Table 1). At the end of efflorescence, the length of broom reaches its maximum, which for *A. capillaris* it is average 7.3 cm., for *L. flexuosa* – 8.9 cm., for *F. rubra* – 10.5 cm. and for *N. stricta* the ear reaches the average figure of 6.3 cm.

It is difficult to report the moments of beginning of forming and ripening of corn for the meadow perennial wheatgrasses because passing through the phase of efflorescence is a long and not a simultaneous process. At about the third week of July forming of corn is reported for the *F. rubra* and *N. stricta*, as well as for some single plants from *A. capillaris*. For the last of the species mass entering the phase is reported at about 1 – 20th of August.

CONCLUSIONS

We observed the beginning of growth of grass in the studied region after permanent lasting of air temperatures over 10°C. We recorded active tillering at the end of April, the first half of May when it is the most favourable period for starting pasture. Too early or too late (after 25th of May) beginning of grazing has a negative effect over the growth of species.

Seasonal growth of wheatgrasses directly depends on climatic and soil conditions in the studied region. It is proved by the fact that because of considerably higher temperatures and greater amounts of rain in 2007, the occurrence of forming ears and efflorescence of the four species happened 5 to 10 days earlier.

Considering all observations that have been done one can notice clear phenophase occurrence in advance for the plants, growing on the southern slope despite the conditions of the respective year. This phase in advance is especially clear in the starting phases of plants growth suggesting initial coming of herds to southern exposure terrains.

Ceasing pasturing cycle should be done 15 – 20 days before the cold weather commence in order grasses to be able to store enough nourishing substances. After the conditions of Central Balkans National Park, this period is approximately up to the middle-end of October.

REFERENCES

CHERNYAVSKI P., VEZEV L. 1953. To the Characteristics of Pastures in the Mountain Zone of the Ribaritsa Region. – Sci. Work. Centr. Sci. Res. Inst. of Forestry, 1: 171-234.

KOCHEV HR. 1967. Frutescent and Herbaceous Vegetation of the High-Mountain Region Troyan Stara Planina. – Bull.Inst. Bot., Sofia, XVII: 5-30.

MESHINEV T., I. APOSTOLOVA, E. KACHAUNOVA, V. VELCEV, A. POPOV. 2000. Flora and plant communities. – In: Meshinev T., A. Popov (Eds.): High mountain treeless zone of the Central Balkan national park. Biological diversity and problems of its conservation. Sofia, BSBCP, pp. 1-350.

METHODOLOGY OF DEDUCING COMPETITIVE SELECTION EXPERIMENTS OF FIELD CROPS. 1981. National Agency for Admitting Students, DCK, Sofia, 113 p.

NAYDENOV I., I. VANKOV. 1955. Meadows and Pastures. Zemizdat, Sofia, 192 p.

TOTEV T. 1973. Researches on Improvement and Usage of High-mountain Pastures from the Type *Nardus Stricta* L. in the Region of Central Stara Planina. Plovdiv, PhD Thesis, 250 p.

TOTEV T., S. DIMOV, I GERGOV., P. DONCHEV. 1970. Models of Improvement and Usage of Meadows and Pastures in the Mountain Regions. In: Spasov Ts., P. Donchev (Eds): Jubilee Collection of Academic Works. Academy of Agricultural Sciences. Control of All-dangerous Resources-Troyan. Zemizdat, Sofia, pp. 354-365.

TOTEV T., K. KOEV, V. LINGORSKI, K. MARINOV, I. GEORGIEV. 1986. Condition and Opportunities for More Effective Usage of Natural Meadows, Pastures and Pasture Complexes. In: Tanov A. (Eds.): Using the Resources in the Mountain and Semimountain Regions for Production of Agricultural Produce, Zemizdat, Sofia, pp. 79-98

VELCHEV B. 2002. Types of vegetation. In Geography of Bulgaria. Physical geography. Social and economic geography – BAS, Sofia: 324 – 331.

**НАСТЪПВАНЕ НА ОСНОВНИТЕ ФЕНОЛОГИЧНИ ФАЗИ
ПРИ НЯКОЛКО ВИДА ЖИТНИ ТРЕВИ
ВЪВ ВИСОКОПЛАНИНСКАТА БЕЗЛЕСНА ЗОНА
НА НАЦИОНАЛЕН ПАРК „ЦЕНТРАЛЕН БАЛКАН“**

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Определени са моментите на настъпване на основните фази в развитието на четири вида житни треви – *Agrostis capillaris*, *Festuca rubra*, *Lerchenfeldia flexuosa* и *Nardus stricta* върху част от територията на Национален парк «Централен Балкан». Съставен е фенологичен спектър на растенията в зависимост от конкретните климатични условия. Фиксиран е най-благоприятният период за започване и приключване на пасищния цикъл върху изследваната територия.