

Agriculture and Environment

Influence of ecological factors on the survival of some cereal grasses cultivated in the Sakar Mountains

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Abstract. The region of the Sakar Mountains has specific soil and climatic conditions and the survival of grass species mainly providing forage for animals is often problematic. The trial was carried out with the following perennial grass species: wheatgrass, wildrye, tall fescue and red fescue. The main objective was to study directly the vegetative development of these species under the soil and climatic conditions of the Sakar Mountains, by observing their survival expressed through botanical presence in the sward, their density and degree of plant cover. The results showed that wheatgrass, wildrye and tall fescue successfully developed under the dry conditions of the Sakar Mountains. The three species had stable presence in the sward reaching 94,5 % for wheatgrass in the second year and 95,5 % and 94,2 % for wildrye and tall fescue, respectively, in the third year. Tall fescue had best adaptation to the conditions of the region. It had the highest density, a number of 1923/m² on average with 78 % plant cover.

Key words: Sakar Mountains, ecological factors, botanical composition, density, plant cover

Introduction

When establishing perennial swards, attention is mainly paid to the ecological conditions of the given region. They determine their vegetative development and productivity.

In our country there is a great diversity with regard to soil types and manifestation of climatic characteristics. Depending on species genetics and physiology, each of the plant associations has particular requirements in the process of vegetative development. This necessitates to conduct studies on adaptation of perennial grasses to different ecological regions (Katova, 2005; Mitev, 2000; Stoeva, 2001; Lingorski, 2001).

With this study we aimed at determining the effect of ecological factors on the survival of some perennial grasses, namely wheatgrass, wildrye, tall fescue and red fescue cultivated in pure stands in the Sakar Mountains conditions. The objective of this experiment was achieved by observing the manifestation of the main climatic characteristics, such as rainfall and temperature, botanical presence of species in the sward, sward density and degree of plant cover.

Material and method

The experiment was conducted in field conditions in the scientific and experimental base of N. Pushkarov Institute of Soil Science – Sofia city, near the town of Topolovgrad. It is representative of the Sakar agroecological region with its soil and

climatic characteristics. Observations were conducted with the following perennial grasses: wheatgrass (*Agropyron cristatum*, L.), wildrye (*Elymus yunceus*, Fisch.), tall fescue (*Festuca arundinaceae*, Schreb) and red fescue (*Festuca rubra*, L.). The experimental plots had a size of 20 m² (2/10 m). The soil type was greatly eroded leached cinnamonic forest soil, poor in humus (0,87) and nutrients and with highly acidic reaction (pH – 3,60 in KCl). The grasses were sown in spring, in early March, at a sowing rate according to the species requirements. Mineral fertilizing was conducted once per year in the second half of February with the fertilizer rate of N₁₂₀, P₁₂₀, K₆₀ kg/ha. Mowing was conducted at the stage of hay-cutting ripeness (earling-early flowering). The following observations were made during the three years: meteorological characteristics, such as rainfall and air temperature; botanical composition of sward expressed in percentages; sward density recorded as a number per m² and degree of plant cover in percentages. The characteristics of botanical composition and sward density were determined before mowing. The degree of plant cover was recorded immediately after mowing the experimental plots.

Results and discussion

The location of the Sakar agroecological region forms a specific microclimate of the region. The droughts in summer often lasting also in autumn are very characteristic. Winter is mild, snow cover is not thick and melts quickly under the penetrating warm

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Mediterranean streams. The period of observations is defined as dry, because in all three years the rainfall amounts were below the rate for the region (Fig. 1).

The first and third year had particularly small amounts of rainfall sums, only 432,2 mm and 415,7 mm. The second record year with 561,4 mm rainfall was a little more favourable in this respect, but again with insufficient rainfall. It is evident from the figure that in the second year the moisture supply during the growing season was the best - 419,4 mm and in the first year the rainfall during the growing season was critically scanty. Figure 1 presents also the average annual air temperature and air temperature for the growing season.

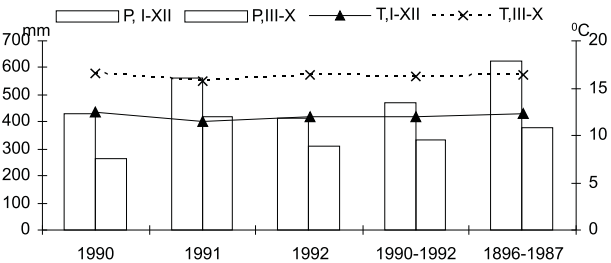


Figure 1. Rainfall sum (P,mm) and average annual air temperature (T,°C) according to years, on average for the period and for a long period of time

Differences in this indicator were found only in the second year, which had slightly lower temperatures and was outlined as a cooler year. The values of the average temperatures for the growing season in the first and third year and the average one for the period of study were very close, 16,5; 16,2 and 16,2 °C, respectively, and coincided with the average rate for the region for the growing season - 16,4 °C.

Figure 2 presents the meteorological characteristics by months and years during the period of study. In all three years at the beginning of the growing season and in April in particular, the rainfall amounts were sufficient and normal.

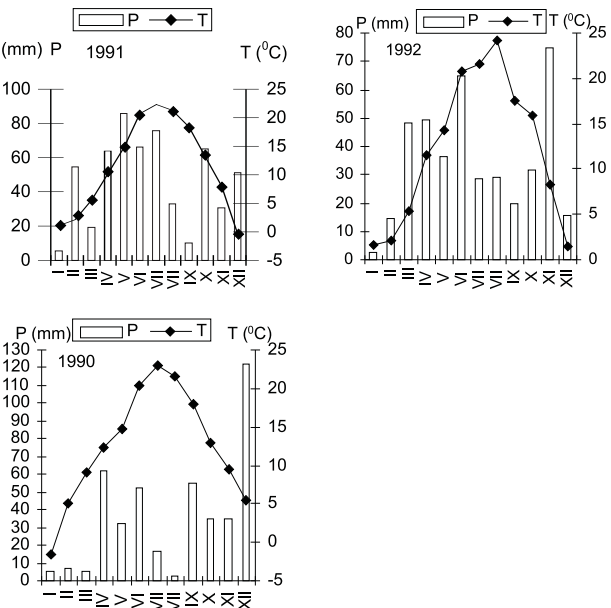


Figure 2. Rainfall sum (P,mm) and average monthly air temperature (T,°C) in the period of study by months and years

The months of May and June of the first year, May, June, July and August of the second year and June and August of the third year had good moisture. The rainfall was critically low in March, May, July and August of the first year, in March and September of the second year and insufficient in May and July of the third year. The average monthly air temperatures in February, March and July of the first year were higher than usual. In the second year the months of March and September had higher temperatures and in the third year the month of August was very hot. The average monthly temperatures in January of the first year and in December of the second year were rather low and with negative values.

As it is evident from the analysis of climatic parameters in the three years of study, the formed agrometeorological situation had a tendency to drought and the survival of plant communities was definitely difficult. Adaptation of vegetation to such conditions is a slow process and often many of them do not succeed in surviving the critical climatic situation. The botanical composition of the sward reflects the species presence in the established sward at the moment of mowing, but is formed during the growing season and directly depends on manifestation of climatic parameters. Each of the studied grass species of wheatgrass, wildrye, tall fescue and red fescue cultivated in pure stands possesses good adaptation to the environment in which it lives. In the first year tall fescue had the best participation in the sward - 87,94 % (Fig. 3). In the next years its participation increased, but it participated to the highest extent in the third year - 94,2 %. The second year of observation that had the best climatic characteristics was the year, in which the four grass species showed high participation. The third year, though with lower annual rainfall amount, provided relatively good moisture supply during the growing season. Wildrye and tall fescue reached the summit of their participation in the third year. Red fescue had the lowest participation in the sward among the studied grasses. Its survival was the best in the second year with 75,68 % and its participation decreased by over 15 % in the third year.

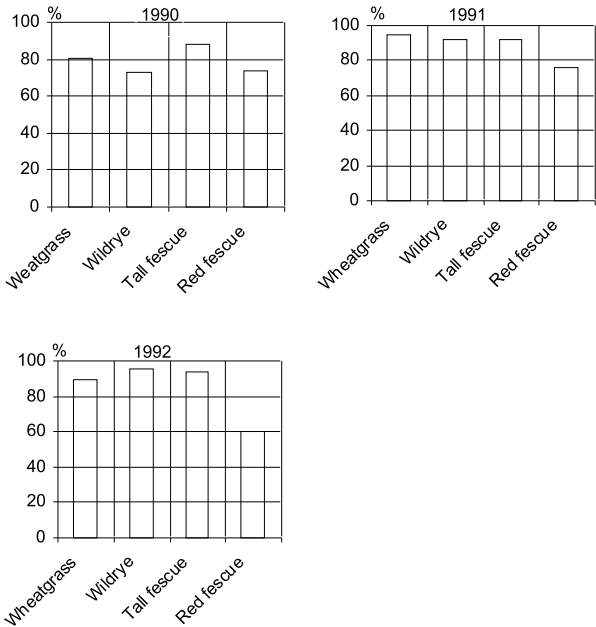


Figure 3. Percentage participation of the species by years of study

One of the important characteristics reflecting development and survival of vegetation and grass associations in particular is the sward thickness (density). Its unit of measurement (number/m²) is used to record the available shoots and branches having developed during the growing season. Density of the formed sward of the studied grass species is presented in Figure 4. The low grass density was very pronounced in the first year. Higher density was recorded only in red fescue – 1548 n/m², which was due to the fact that it is a typical pasture grass forming greater number of vegetative shoots. Wildrye had slower development in the first year and for that reason it had the smallest number of shoots – 1256 n/m². The second year was distinguished for a considerable increase of the density recorded in all studied species. The density showed greatest increase in wildrye and tall fescue – by 668 and 632 n/m², respectively. They increased their density also in the third year and it reached 2086 n/m² in wildrye and 2280 n/m² in tall fescue.

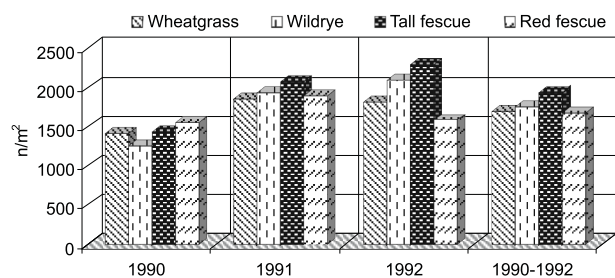


Figure 4. Species density (n/m²) by years and on average for the period of study

In the third year there was a decrease of density in the other two species, which was minimum in wheatgrass, but more considerable in red fescue, in which the number of recorded shoots was less by 300. On average for the period, tall fescue was distinguished for the best density - 1923 n/m².

A characteristic representing mainly the antierosion effect of the swards is the degree of plant cover (sod cover). The importance for its study comes from the fact that most of swards are established on inclined eroded terrains. Conclusions for antierosion importance of the different kinds of swards can be drawn from its values. The values of the degree of plant cover directly depend on vegetative development of grasses. Table 1 reflects the degree of plant cover in the different studied grasses. As for the previous characteristics, the degree of plant cover was low in the first year of study. In the second year, owing to the good vegetative development of the grasses, the plant cover increased in all studied species – by 18 % in wheatgrass; by 16 % in wildrye and tall fescue and by 14 % in red fescue. The increase of plant cover in wildrye and tall fescue continued also in the third year of study, though not so much, whereas in wheatgrass and red fescue there was a decrease of plant cover by 8 %.

Table 1. Degree of plant cover of the grass species (%) by years and on average for the period

	1990	1991	1992	Average
1.Wheatgrass	60	78	70	69.33
2.Wildrye	56	72	78	68.67
3.Tall fescue	64	80	88	77.33
4.Red fescue	64	68	60	64.00

These results were an adequate reflection of the manifestation of the climatic parameters during the years of study and the biological features of the species. The values of the plant cover of the studied grass species varied by years, but since all three years had smaller rainfall amounts, the average values for the period of study could be taken as real under conditions of drought. Among the studied grass species, tall fescue was the grass providing the best plant cover (77,33 %) on the ground surface. Wheatgrass and wildrye provided almost the same plant cover - 69,33 and 68,67 % and red fescue had the smallest plant cover – 64 %. Though possessing capacity to establish thick and strong sod, it had lower survival under the dry conditions of the Sakar Mountains.

Conclusion

Tall fescue possesses high ecological plasticity, shows good survival in dry conditions and is recommended for swards with an antierosion purpose.

Wheatgrass and wildrye have similar capacities for survival in dry conditions, but wildrye has slower development in the beginning and shows good survival in the conditions of the Sakar Mountains in the third year.

Red fescue is unsuitable for cultivation in dry conditions. It has difficult adaptation in dry conditions and shows low survival in the Sakar region.

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