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Transpiration intensity in submediterranean species *Trifolium patens* from three meadow associations of mountain Radocelo (Serbia)

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Summary - The submediterranean species *Trifolium patens* Schreb. is known as a very good quality forage crop, spread in various types of valley and hilly meadows in Serbia. As transpiration intensity may indicate different ways of water balance mechanisms in plants, the diurnal changes of transpiration have been determined in this species grown in three meadow associations at Rudnjanska upland and mountain Radocelo: ass. *Danthonietum calycinae*, *Agrostietum vulgarae* and *Koelerietum montanae*. Transpiration curves in *Trifolium patens* have indicated the moderately stabile water regime of this species, where water restriction was partly endogenously regulated during the hottest period of day in ass. *Danthonietum calycinae*. The highest values of transpiration intensity have been recorded in ass. *Koelerietum montanae*, which mostly develops on shallow, poor and dry soil. Generally, transpiration intensity was clearly dependent on environment, i.e. microclimatic factors. A significant ecological plasticity of *T. patens* regarding its water regime in natural habitat conditions, could be important for breeding purposes, by collecting populations with most favorable water regime.

Key-words: microclimate, *Trifolium patens*, transpiration, meadows

Résumé - *L'espèce sub-méditerranéenne* Trifolium patens *est une excellente plante fourragère qui se développe bien dans les vallées et collines de Serbie. L'intensité diurne de transpiration a été mesurée dans 3 prairies de Rudnjanska et Radocelo comme un indicateur de l'état hydrique de la plante. Les courbes de transpiration ont montré que* Trifolium patens *présente un régime hydrique relativement stable quand le déficit hydrique est régulé de façon endogène par l'association du* Danthonietum calycinae. *L'intensité maximale de transpiration a été enregistrée dans le* Koelerietum montanae *qui se développe sur des sols pauvres, secs et peu profonds.* Trifolium patens *présente donc une bonne plasticité vis à vis des conditions écologiques et pourrait donc être une source intéressante de génotype à collecter pour sélectionner des cultivars adaptés à différents régimes hydriques.*

Mots-clès: *microclimat,* Trifolium patens, *transpiration, prairie*

Introduction

Ecophysiological investigations of plants under natural habitat conditions lead to the better understanding of adaptation mechanisms in plants, as well as, the ecological plasticity and ecological amplitude in regard to environmental influences. Water regime is very reliable indicator of an adaptation level of plant to the habitat, as it is strongly influenced by physical factors of environment and at the same time, endogenously regulated by different mechanisms at all stages of the plant body organization. Water balance can be computed directly from quantitative determinations of water uptake and transpiration (Etherington, 1976).

Transpiration is determined by the physical conditions affecting evaporation only as long as the degree of opening of the stomata does not change, i.e., as long as the stomata remain open to a fixed degree or remain firmly closed (Larcher, 1983).

Water balance determination in plants from different habitats allows creating a strategy for further selection program and breeding, because certain ecotypes and populations may exhibit favorable properties, as better adapted ones.

The submediterranean species *Trifolium patens* may be qualified as a good quality forage crop (Klapp, 1971). This species enters the characteristic type of the meadow Class: *Molinio-Arrhenatheretea* Tuxen 1957 (Kojic *et al.*, 1994). Numerous and different populations of *Trifolium patens* may be found in several types of meadow communities, that are spread along the valley, submediterranean and hilly regions in Serbia, widely differing in moisture degree (Misic and Lakusic, 1990).

The present investigation study deals with determination of water regime characteristics in *Trifolium patens* from three different plant communities, developed at the same climatic conditions. The properties of water regime in *T. patens* have been described by measurements of diurnal transpiration intensity with simultaneous recording of the microclimate parameters in each community.

Materials and methods

Three widespread meadow communities (ass. *Danthonietum calycinae, Agrostietum vulgarae* and *Koelerietum montanae*) from hilly part of Serbia have been chosen to estimate the water regime in *Trifolium patens*, a species well represented in each meadow community.

The region investigated, with significant presence of these communities, was Rudnjanska upland, situated between mountain Radocelo in the north, and the farthest north east part of the mountain Golija in the south. All of three mentioned plant communities belong to the Alliance *Chrysopogoni-Danthonietum calycinae* Kojic 1957, the Order *Festucetalia valesiacae* Br.-Bl. et Tx. and Class *Festuco-Brometea* Br.-Bl. et Tx.

The measurements of transpiration intensity, as well as the microclimate, were undertaken for the purpose of an estimation of water regime features in *Trifolium patens*, during the summer period in 1996. The values of transpiration intensity were obtained by the method of fast leaves cutting (Stocker, 1929), being expressed in mg/g/min (mg of transpired water per g of fresh leaf mass per minute). Diurnal transpiration intensity has been measured from 9 a.m. till 7 p.m., every two hours. At the same time, some external factors were recorded, such as: soil temperature (at depth of 30 cm, 10 cm and at the ground level - 0 cm), air temperature (at different height of: 100 cm, 50 cm and 20 cm), light intensity (at ground level - 0 cm, at the vegetation level and above the vegetation level) and relative air humidity (at 20 cm and 100 cm).

Results and discussion

The microclimatic parameters in three investigated associations have shown moderately expressed diurnal changes (Tab. 1). However, according to the comparative analysis of diurnal microclimatic changes in each community, the most favorable thermic regime was shown by the community *Agrostietum vulgarae*, while the highest soil temperatures were determined in ass. *Koelerietum montanae*, possibly, because of soil characteristics, which has been warmed up more intensively.

Values of diurnal relative humidity were lowest in ass. *Koelerietum montanae*, that could be related with its poorest vegetation cover. The highest light intensity was determined at 11 a.m. in ass. *Danthonietum calycinae*, while in the other two communities the daily maximum of solar radiation was at 1 p.m.. All slight differences regarding the diurnal microclimatic changes for each term of measurement, external factor or community, reflect narrow specific features of certain habitat, although vegetation was developed under the same general climatic conditions.

Tab. 1. The microclimatic parameters in three meadow communities: 1 - *Danthonietum calycinae*; 2 - *Agrostietum vulgarae*; 3 - *Koelerietum montanae*

Time (h)		9			11			13	
Air and soil temperature (°C)	1	2	3	1	2	3	1	2	3
100 cm	19.1	19.8	17.9	19.3	21.6	19.0	20.0	22.3	19.4
50 cm	19.7	20.7	18.6	21.0	23.4	19.8	20.9	22.7	20.4
20 cm	20.3	21.8	19.1	21.5	26.6	20.2	22.7	23.8	21.0
0 cm	15.4	19.4	18.4	16.0	23.2	20.0	17.0	22.4	20.8
-10 cm	15.9	15.8	16.1	16.6	16.8	17.6	17.6	18.0	19.0
-30 cm	16.2	16.5	16.0	16.3	16.5	16.1	16.3	16.5	16.1
Light intensity (lux)	1	2	3	1	2	3	1	2	3
0 cm	280	490	440	550	610	600	600	580	520
Vegetation level	250	530	480	680	660	670	730	600	670
Above the vegetation level	300	670	670	720	690	670	750	630	700
Relative humidity (%)	1	2	3	1	2	3	1	2	3
20 cm	62	70	60	53	68	88	56	60	63
100 cm	76	67	53	72	65	75	70	56	58
Time (h)		15			17			19	
Air and soil temperature (°C)	1	2	3	1	2	3	1	2	3
100 cm	20.4	22.7	19.2	21.1	21.0	18.9	16.3	16.2	15.8
50 cm	21.1	23.5	19.4	20.8	21.4	18.9	16.4	15.7	15.5
20 cm	22.1	25.8	19.8	21.3	23.3	18.8	16.2	14.6	15.4
0 cm	19.0	21.7	19.6	18.2	17.3	18.4	14.1	12.7	15.0
-10 cm	18.9	18.7	20.0	19.5	18.7	20.5	19.1	18.4	19.5
-30 cm	16.2	16.4	16.0	16.6	16.3	16.2	16.2	16.3	16.0
Light intensity (lux)	1	2	3	1	2	3	1	2	3
0 cm	550	410	530	310	230	160	40	21	24
Vegetation level	650	490	570	410	290	320	60	27	79
Above the vegetation level	680	600	660	580	500	550	100	34	210
Relative humidity (%)	1	2	3	1	2	3	1	2	3
20 cm	54	48	63	55	47	58	71	79	70
100 cm	49	41	59	52	45	48	63	65	66

Thus, the differences in transpiration curves in *Trifolium patens* from three meadow communities, could be explained, among other, as a consequence of the specific habitat influence.

Diurnal transpiration intensity in *T. patens* from three meadow communities developed on Radocelo, showed that highest daily values (66.7 mg/g/min) and maximal difference between highest and lowest transpiration, were recorded in community *Koelerietum montanae*. Similar transpiration curves, with two high values (at 11 AM and 5 PM) and one restriction of transpiration at 3 PM have been noticed for ass. *Agrostietum vulgarae* and *Koelerietum montanae* (Fig. 1). Stomatal closure at 11 AM was obtained in *T. patens* grown in ass. *Danthonietum calycinae*. All data in regard to the diurnal transpiration in *T. patens* from three different meadow communities illustrate a movable, moderately stable water regime of this species, where water loss closely parallels the diurnal fluctuations of solar radiation income, but contemporarily emphasize an endogenous water regime regulation. This type of transpiration is known for many herbaceous plants, in which the guard cells responding to even small water saturation deficits, temporarily restrict transpiration (Larcher, 1983).

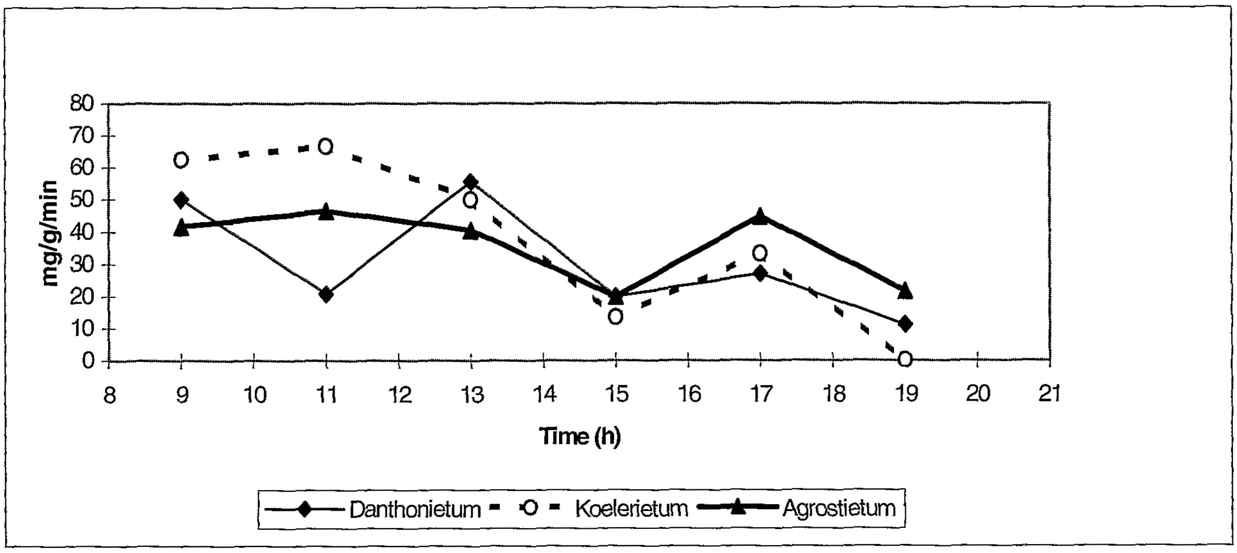

Fig. 1. Diurnal changes of traspiration in *Trifolium patens* from three meadow communities.

Conclusion

Water regime in *Trifolium patens* could be characterized as a moderately stable one, where restriction of transpiration was noticed in certain part of day, depending on internal balance between uptake and loss of water. Although transpiration was highly correlated with external factors, there have been expressed certain differences in water balance regulation, illustrating specific influences by different habitats. In our opinion, *T. patens* could be important as a forage crop, because the ecological plasticity of different ecotypes or populations may allow its further selection.

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