Regime and dynamics of soil moisture in forest ecosystems of Záhorská lowland

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ABSTRACT: The paper describes the regime and dynamics of the soil moisture content of sandy soils in Záhorská lowland during different growing seasons. Research plots are situated near Kamenný mlyn, approximately 3 km from Plavecký Štvrtok and 8 km southward from the town of Malacky. Changes in the soil moisture content are described by soil moisture constants (MCC, PDA, WP) and its relation to atmospheric precipitation and to the character of undergrowth is shown. The low water-holding capacity of sandy soils and their high drainage together with dense root system do not allow the sufficient saturation of soil during the growing season. The low wilting point value (2%) leads to the consumption of all available water in the soil. The most frequent is the semiarid interval of soil moisture (PDA –WP) with reduced availability of water to plants (> pF 3.1). The arid interval (< WP) occurrence on hot summer days results in a decrease in transpiration and assimilation intensity of plants, their physiological weakening and premature fall of assimilation organs.

Keywords: soil moisture; soil moisture constants; available water; evapotranspiration

The Záhorská lowland belongs to the most threatened areas of Slovakia. The worsened health condition of Záhorská lowland forests can be explained first of all by depleted soils poor in minerals, coarse parental substrate of windblown sands and by minimum water-holding capacity. In this issue Šály (1996) drew attention to the problem of pine stands. Nutrient deficiency and worsened water conditions of soils threat about 50 thousand hectares of these forest stands in the Záhorská lowland.

Besides the site conditions the health condition of Záhorská lowland forests is threatened by air pollution especially from remote sources and by improper forest management (vast afforestation, use of unsuitable tree provenances, humus and nutrient loss, etc.). Significant is the worsened soil water regime by lowering the groundwater table due to drainage (amelioration measures, sand exploitation) leading to the root hydrotropism. Nowadays it can be described as a result of long-lasting dry days.

Site characteristics

Research plots in the Záhorská lowland were established in the orographic part of the Malacky zone. They represent the most important and the most typical orographic parts of the lowland from forestry as well as site aspects. Research plots are situated near Kamenný mlyn, approximately 3 km from Plavecký Štvrtok and 8 km southward from the town of Malacky.

The local air temperature, precipitation and air movement conditions are influenced by the Malé Karpaty (Small Carpathians) mountain range. As for the air movement, NW and SW winds prevail. Average annual air temperatures are 9°C or 15–16°C during the growing season. The absolute minimum value of air temperature ranges from –17 to –25°C (Malacky), the highest ones exceed 35°C (July and August). Average soil temperatures in the upper layer of the soil profile vary from 17 to 22°C,

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at the depth of 50 cm from 17.5 to 18°C (Intribus et al. 1995).

Yearly precipitation total in the area of Malacky and Kamenný mlyn is 600 mm, in summer it varies from 350 to 400 mm (Table 1).

According to the GGMS model (Brázdil 1991; Kolektív 1992) a gradual increase of precipitation in winter and its decrease in summer are characteristic in the area of Záhorie. Ten-year precipitation observations (1986–1995) show that summer has the lowest precipitation sums (Table 2) with above-average air temperature (average air temperature higher by 2.1°C).

Geological conditions are formed by windblown sands. In the area of Kamenný mlyn it is Pontian motley clay with gravel and sand. According to the texture analysis (Bublinec 1968) sands belong to texture variety II (Pelíšek 1963) that has the highest content of grains of 0.25–0.50 mm in size. Texture fractions from 0.1 to 0.25 mm as well as from 0.50 to 1.0 mm in size are admixed.

Main hydrophysical characteristics of the soil are presented in Table 3.

Research plots belong to the typological unit of *Pineto-Quercetum* (Bublinec 1974).

Oak stand (oak 10, hornbeam+) density is $0.8^{0.8}$, canopy 100^{85}, age 80–90 years, in the undergrowth oak is present (10–15%) with hornbeam (up to 5%), furthermore pine and blackthorn.

Pine stand (pine 9–10, oak + – 1) density is $0.8^{0.70}$, canopy 85^{70}, with good growth. Herbaceous vegetation is present in the undergrowth.

The areas are similar as for their phytocoenological characteristics. The oak stand has a richer herb layer (60%) and in the pine stand grass dominates (50–80%) with high coverage of moss (*Leucobryum glaucum*).

RESEARCH METHODOLOGY

Research on water regime and forest soil moisture dynamics was carried out on model plots of Záhorská lowland (Kamenný mlyn). Soil moisture was observed in 10-days intervals using the gravimetrical method. Soil samples were taken with soil bore to the depth of 100 cm of the soil profile from each 10 cm layer in 3–5 replications or as a mixture of soil from 5 different places. Soil samples were dried at 105°C and soil moisture content was expressed in weight % or volume %.

Table 1. Climatic characteristics

Station	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	Year	GS*
Air temperature (°C)														
Malacky	4.6	0.4	–1.7	0.2	4.1	9.5	14.2	17.8	19.2	18.5	14.9	9.4	9.3	15.7
Kuchyňa	4.5	0.3	–1.8	0.0	4.1	9.1	14.8	17.6	19.0	18.4	14.7	9.5	9.1	15.5
Precipitation (mm)														
Malacky	50	41	32	32	35	46	65	72	83	67	50	49	622	383
Kuchyňa	56	46	39	42	40	53	63	99	96	68	41	50	694	421

*growing season

Table 2. Deviations from precipitation average values at Malacky (mm)

Hydrological year	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	Year	GS*
1901–1970	50	41	32	32	35	46	65	72	83	67	50	49	622	383
1985–1986	64	12	2	21	–19	–12	–21	33	–33	–9	–7	–24	7	–49
1986–1987	–17	–12	47	8	–13	–29	34	26	–18	–19	14	–29	–8	8
1987–1988	–1	12	–9	51	35	–32	–28	–11	–56	1	24	–38	–52	–102
1988–1989	–24	2	–18	–15	–20	16	14	–24	14	19	6	–22	–52	45
1989–1990	–30	–22	–22	23	–7	16	–31	–8	–34	–49	25	–12	–151	–51
1990–1991	3	10	–25	–19	4	–17	32	–2	–25	–38	–20	–32	–129	–70
1991–1992	38	19	–13	–10	40	–15	–42	64	–56	–59	–11	5	–40	–119
1992–1993	3	14	–9	44	1	–35	–18	0	29	32	–19	6	48	–11
1993–1994	–18	61	0	–13	–2	31	5	–27	–55	–27	–20	13	–52	–93
1994–1995	–9	5	40	0	20	13	2	65	–63	–25	97	–39	106	89

*growing season

Table 3. Hydrophysical characteristics of the soil in Kamenný mlyn

Stand	Oak stand				Pine stand			
Soil depth (cm)	5–10	20–30	40–50	110–120	5–10	20–30	40–50	110–120
Fraction I	3.5	3.1	2.2	0.5	4.6	3.0	2.1	0.0
Fraction II	6.1	1.9	1.7	0.1	6.5	2.5	1.9	0.1
Fraction III	2.2	3.0	2.7	1.9	2.3	5.6	3.2	2.2
Fraction IV	88.2	92.0	93.4	97.5	86.6	88.9	92.8	97.6
Bulk density (g/cm^3)	2.60	2.66	2.64	2.68	2.59	2.67	2.62	2.64
Weight volume (g/cm^3)	1.17	1.50	1.55	1.60	1.10	1.58	1.57	1.63
Porosity (%)	55.1	42.8	43.3	40.4	57.5	40.8	40.7	38.1
MCC[1] (%)	25.3	30.9	30.8	24.0	21.9	26.0	26.4	27.5
WP[2] (%)	3.3	2.4	2.2	1.3	3.3	2.5	2.5	1.1
MAC[3] (%)	29.8	11.9	12.5	16.4	35.6	14.8	14.3	10.9

[1]maximum capillary capacity, [2]wilting point, [3]maximum air capacity

These hydrophysical characteristics were determined: maximum capillary capacity (MCC) according to Novák (in Klika et al. 1954), minimum water capacity (MWC) according to Dolgov (1948) in natural conditions using the method of determination of field water capacity (FWC), point of limited availability (PLA), wilting point (WP) according to Drbal (1965), and maximum hygroscopicity (MH) according to Mitscherlich in Beutelspacher's modification.

Soil texture was determined according to Kopecký (in Hraško et al. 1962) and bulk density by a pycnometric method. Weight volume was calculated.

Climatic characteristics were obtained from observation stations placed on the research plots or from meteorological stations of the Slovak Hydrometeorological Institute in Bratislava.

Forest stand precipitation was collected in zinc-coated troughs with the collecting area of 2,000 cm^2,

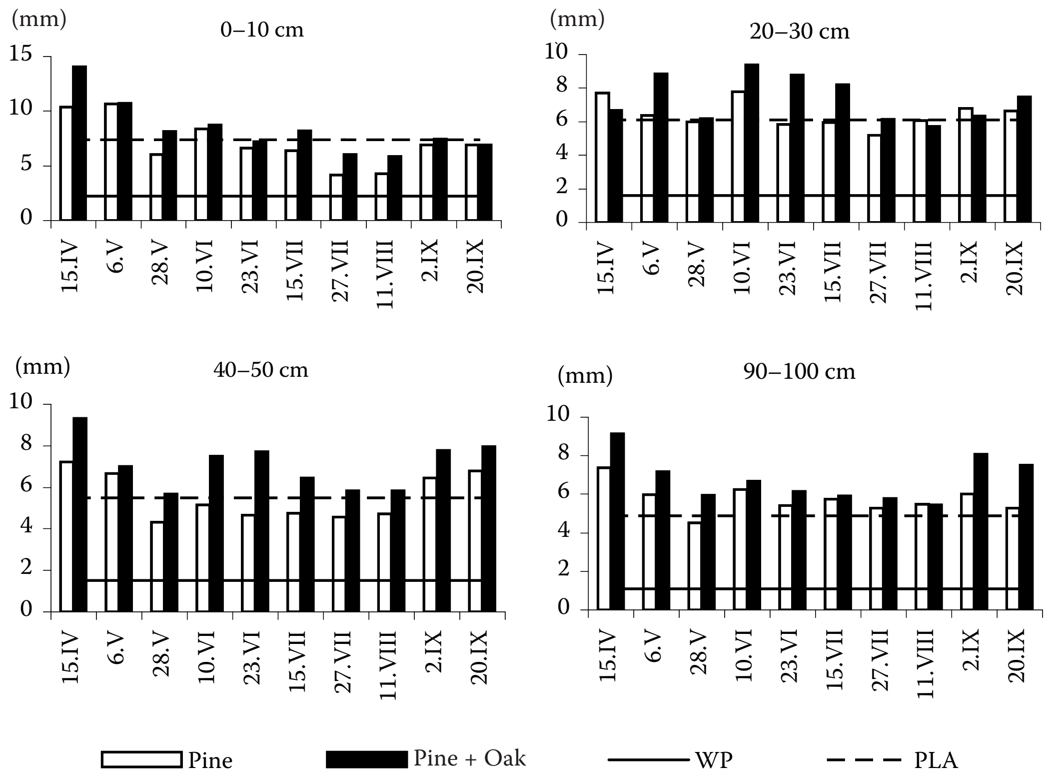

Fig. 1. Water supply (mm) in the soil layer 0–10, 20–30, 40–50, and 90–100 cm during the growing season 1995 (Borský Mikuláš)

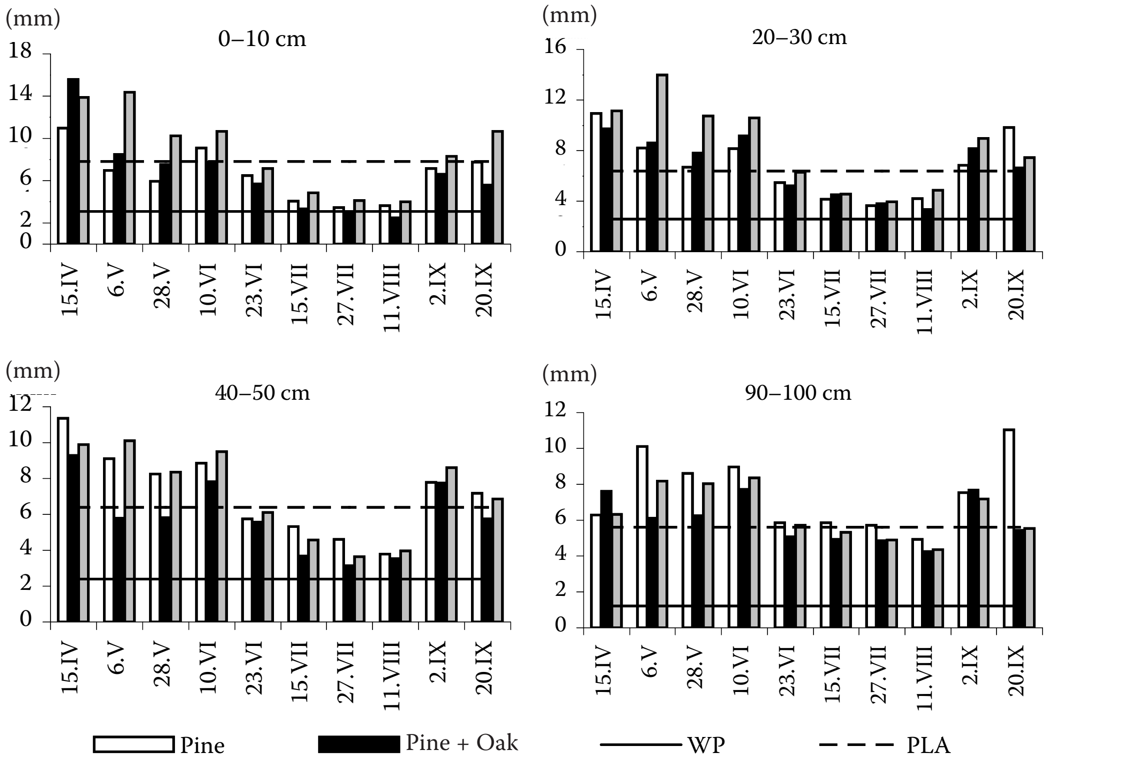

Fig. 2. Water supply (mm) in the soil layer 0–10, 20–30, 40–50, and 90–100 cm during the growing season 1995 (Kamenný mlyn)

in 5 replications. These troughs were installed in a cross-like design.

The stemflow was measured using a lead conduit installed along the circumference of the tree stem.

Precipitation penetrating through the herbaceous cover was recorded in lysimeters installed at the soil depth of 20, 50 and 100 cm. The collecting area of lysimeters was 343 cm^2.

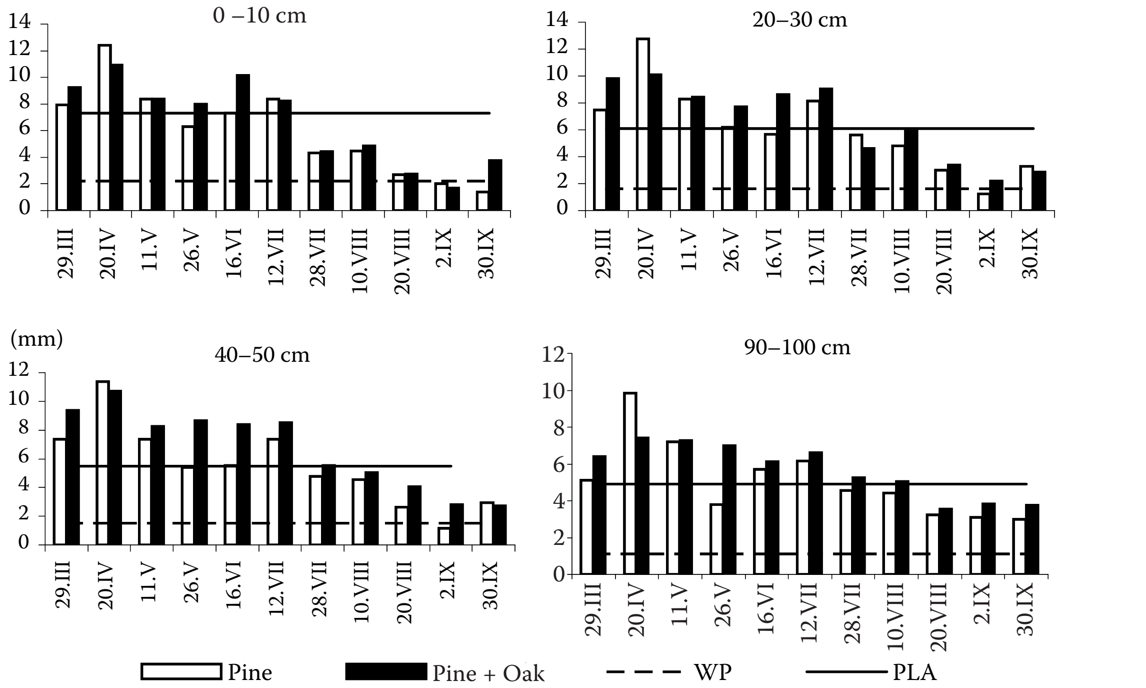

Fig. 3. Water supply (mm) in the soil layer 0–10, 20–30, 40–50, and 90–100 cm during the growing season 2000 (Borský Mikuláš)

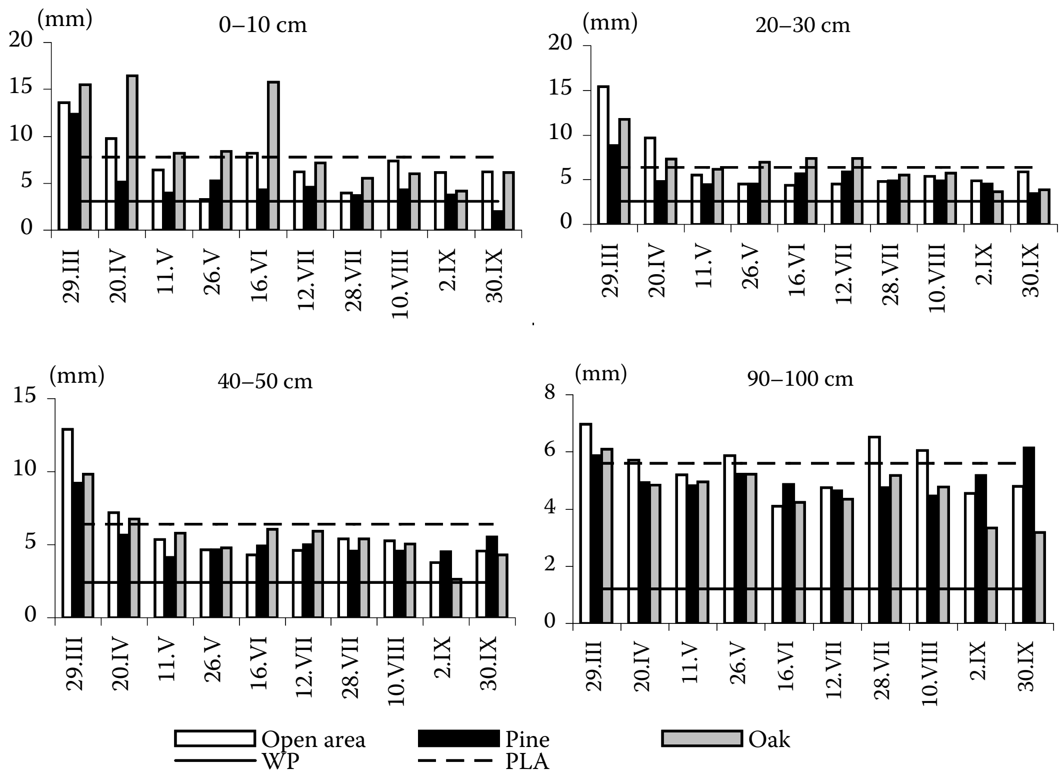

Fig. 4. Water supply (mm) in the soil layer 0–10, 20–30, 40–50, and 90–100 cm during the growing season 2000 (Kamenný mlyn)

Water consumption for evapotranspiration was calculated from the difference between the initial and end water supply in the soil taking into account other parameters of water balance (water infiltration into the soil, surface runoff, interception).

Water amount available to plants was calculated as the difference between the actual soil water amount and the non-available water value. The limit between the physiologically available water and non-available water was the wilting point (WP).

Regime of soil water and supply of available water

Maximum water content in the physiological profile of the soil was observed at the turn of winter and spring. The most favourable soil water conditions were in the upper layers of the soil profile. A higher content of water in the soil was observed due to snow melting and melting of the frozen layer of the soil. In such cases the soil water content varies between the soil moisture constants of maximum capillary capacity (MCC) and wilting point (WP). This water content represents mainly capillary easily available water for plants (pF approx. 2.5).

Water regime analyses show that in dry winter and during the winter season with average precipitation the soil water availability decreases (pF < 3.1).

Soil water amounts at different depths of the soil profile depending on precipitation activity are presented in Figs. 1 to 4.

Individual growing seasons can be characterised as follows:

The growing season 1995 was characterised by average precipitation activity (502 mm = 131.1%), with average temperature of 16.9°C (higher in comparison with long-term average by 1.2°C). Higher air temperatures were recorded in April (10.9°C), July (23.5°C), and August (19.8°C). Above-average precipitation totals were recorded in June (137 mm = 190.3%) and September (147 mm = 294%). Below-average precipitation was observed in July (20 mm = 29.8%). Especially unfavourable was a dry period in July when the consumption of water for evapotranspiration was high. The average daily water loss was higher than 5 mm, being a very high water consumption according to Mráz (1973).

Soil water data from the growing season 1995 show the highest variability in the upper and middle layers of the soil profile. The beginning of the growing season was favourable, the soil water in the whole physiological profile of the soil varied between the soil moisture constants of MCC and PLA. Continuous supply of water to plants was ensured by the presence of capillary water.

The following period of the growing season was characterised by soil water between the soil moisture constants of MCC and WP with the presence of capillary water in the range of pF between 2.0 and 4.8.

Soil water content in Borský Mikuláš site (Fig. 1) shows its relatively small changes in the whole physiological soil profile. The vegetation had a sufficient supply of available water in the whole growing season. Available water on research plots at Kamenný mlyn (Fig. 2) showed a good supply until the end of June. An intensive decrease in soil water (pF = > 4.0) was recorded in July especially in the upper and middle layers of the soil profile (0–50 cm). In the deeper layers of the soil soil water did not decrease below pF = 4.18 owing to the capillary action from groundwater, not even during dry and warm July and August.

As for the precipitation during the growing season 2000, 269 mm was recorded (70.2% of the long-term average). In the first half of this growing season below-average precipitation activity was recorded (71.6 mm = 39.1%), in the second half average precipitation sums were observed (197.1 mm = 98.5%).

The beginning of the growing season can be characterised as favourable as for the soil water conditions with the presence of capillary water available to plants.

The soil profile on the research plots of Borský Mikuláš (Fig. 3) was saturated with water between the soil moisture constants of MCC and PLA by the end of the first ten days of July. A decrease in soil water was characteristic of the following period (in spite of favourable precipitation conditions) with decreased availability of water to plants (pF < 3.5). Due to the longer lasting dry period from the first ten days of August to the end of the first ten days of September (23 mm on the open area, 8.9 mm in the mixed forest, 10.4 mm in the pine forest) the soil profile was dried to the greatest extent. In the upper and middle layers of the soil profile soil water decreased below the critical value of the WP soil moisture constant and in the deepest observed layers below the limit of 50% MCC.

Changes in soil water on the research plot Kamenný mlyn (Fig. 4), compared to the research plots at Borský Mikuláš, show that the interval with available soil water for plants was shorter. In the upper half of the physiological soil profile soil water varied between the soil moisture constants of PLA and WP (semiarid interval) since April. For the open areas short periods with higher amount of soil water were recorded only after abundant precipitation activity. As for the water amount in the forest soil, its balanced dynamics was recorded. In the pine stand the water amount near the WP soil moisture constant was observed.

Water amount during the growing season represented the category of capillary water with pF value ranging between 2.4 and 4.18. During the dry period available water in the upper 0–10 cm layer of the soil profile was almost all used up. In the soil under the oak stand physiologically bound water was recorded and in the pine stand physiologically non-available water.

Three classes of soil water were observed during the analysed growing seasons. The semihumid interval was characteristic of the beginning of the growing season (soil water amount between the soil moisture constants of MCC and PLA). Dominant was the semiarid interval (soil water amount between the soil moisture constants of PLA and WP). The arid interval (< WP) was also recorded in the upper layers of the soil profile during summer, characterised by the insufficient supply of water to plants (pF = 4.18).

DISCUSSION

The reality in the widest sense of interaction and physics is represented within a delineated spatial unit of the *atmosphere – vegetation cover – aeration zone – ground water* chain by water transport processes (Šútor, Štekauerová 2000). Infiltration as the initial component and evapotranspiration as the final component of water balance in the process of the water regime of soils are determined by the hydrophysical characteristics of soil (soil moisture retention line, hydraulic conductivity of soil, porosity, bulk density, weight volume) as well as by the transforming influence of the most important parameters of forest stand (tree species, stocking, canopy, phenophase, etc.) in the forest ecosystems.

Approximately one half of sandy soils (consisting mostly of minerals) is composed of pores filled with water and air. Soil texture and structure determine the soil capacity to hold water. Water movement in the soil is influenced by inhomogeneities such as interaggregate pores or micropores of biological origin. Namely we speak of so called preferred soil water movement that increases the infiltration rate on the one hand and on the other hand it decreases or prevents the surface runoff (Novák 1978; Pichler 2003).

Changes in the soil water of sandy soils with reference to the same parental substrate depend on the climatic conditions, especially on precipitation amount and its time distribution as well as on the character of vegetation cover. Minimal differences between parallel sites (pine, oak and pine + oak stands) can be observed mostly at the beginning of the growing season. Higher but statistically insignificant values of soil water in the oak stand can be explained by lower interception of snow precipitation, low grass and moss undergrowth, and by a more favourable humus form (Bublinec 1974) and partially by water consumption for winter transpiration (Voronkov 1973; Střelcová 2000).

Low water-holding capacity, high torridity and relatively dense and well-proportioned net of active roots reaching to the depth of 60 cm prevent the high water saturation of soil during the growing season. Soil can dry off also due to a decrease in the groundwater table to the capillary inactive bottom of the soil profile. Such a condition accompanied by a potential precipitation deficit can result in transition to hydropedological cycles with capillary strongly bound water and its decreased availability to plants (pF 3.1–4.18).

The soil environment with water supply between the soil moisture constants of MCC and WP and with a very low value of the WP soil moisture constant (approx. 2%) enables to use water during the prevailing part of the vegetation period and in its full measure. The soil was maximally drained during summer after longer lasting dry periods. Upper and middle layers of the soil profile (0–30 cm) were affected to the greatest extent. On extreme dry and warm days the water supply can decrease to the area of capillary strongly bound water or unavailable to plants (pF < 4.18).

The insufficient soil water supply results in frequent dying off of roots on the one hand and on the other hand in an increased amount of active roots in deeper and cooler layers of the soil profile with physiologically available water.

It can be stated on the basis of the changes in soil water dynamics that sandy soils belong to the well drained type of soils considering the existence and duration of hydropedological cycles with a very low or insufficient supply of available water and unfavourable hydrophysical characteristics. High temperatures (> 40°C) and high water consumption of water for evapotranspiration significantly influence the water supply decrease also in deeper soil horizons in spite of sufficient precipitation totals. Development, growth and survival of pine seedlings during dry days of the vegetation season can be explained by specific microclimatic and hydric conditions that develop in the upper layers of the soil profile. Radiation in early mornings results in increased condensation of water vapour in the upper layers of the soil and above the soil surface. Thus both evaporation and the water deficit decrease.

Moistness, duration of moistness and soil water stratification analyses (Kutílek 1971) show that the prevailing interval of soil water during the vegetation season is a semiarid interval with intermediately and strongly bound capillary water with decreased availability between pF 3.1 and 4.18. The arid interval of soil water (< WP) can be observed especially in summer after a longer lasting dry period. It usually reaches only the upper layers of the physiological soil profile (0 to 20 cm). The results of the forest soil water research show that a water decrease below the critical value of WP can be observed also in other soils in an increased measure, especially in the soils of lowlands and uplands of Slovakia (Fulajtár 1986; Gregor 1999; Soroková 2001; Tužinský, Soroková 2001).

CONCLUSION

For the study of water balance and mutual relations between soil water changes and vegetation cover characteristics it is important to know natural relations of the hydrological processes creating the water regime of the soil. Constant water changes in the forest soils are dependent on meteorological factors as well as on relief, hydrophysical characteristics of the soil and runoff relations. Especially important is the transformation influence of the forest, namely its complex influence on individual components of the water balance (interception, desuction, infiltration, surface runoff, transpiration).

During the hydrological year (with rotation of dry and wet periods) certain hydropedological cycles can be observed with the highest variability in the soil water changes during the growing season.

An unfavourable water regime, especially in the upper layers of the soil profile can develop especially due to the less developed humus horizon, small water-holding capacity and worsened retention ability of sandy soils. Vegetation under such conditions is insufficiently supplied with water and it is threatened by the physiological weakening that during the longer lasting dry periods can become a limiting factor of its further existence.

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Režim a dynamika vlhkosti pôdy v lesných ekosystémoch Záhorskej nížiny

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ABSTRAKT: Predmetom príspevku je režim a dynamika vlhkosti pôdy v piesočnatých pôdach Záhoria, v zrážkovo rozdielnych vegetačných obdobiach. Výskumné plochy sa nachádzajú pri Kamennom mlyne, asi 3 km od Plaveckého Štvrtka a 8 km na juh od Malaciek. Zmeny vlhkosti pôdy sú vyjadrené prostredníctvom hydrolimitov (MKK, BZD a BV) vo vzťahu k atmosférickým zrážkam a charakteru rastlinného krytu. Nízka vododržnosť a veľká vysýchavosť pieskov a hustá a rovnomerná sieť aktívnych koreňov vo fyziologickom profile pôdy nedovoľujú vyššie nasýtenie pôdy vo vegetačnom období. Veľmi nízka hodnota BV (okolo 2 %) podmieňuje využívanie takmer všetkej prítomnej vody v pôde. Najčastejšie sa vyskytujúci vlhkostný stav v semiaridnom intervale (BZD–BV) znamená vo vzťahu k vegetácii prítomnosť väčšinou kapilárne ťažko pohyblivú vodu so zníženou prístupnosťou pre rastliny (> pF 3,1). Výskyt aridného intervalu (< BV) v letných mesiacoch, po dlhšie trvajúcich suchých dňoch, sa na vegetácii prejavuje znížením transpirácie a asimilácie, jej fyziologickým oslabením a predčasným opadom fyziologicky oslabených asimilačných orgánov.

Kľúčové slová: vlhkosť pôdy; hydrolimity; využiteľná voda; evapotranspirácia

Záhorská nížina patrí medzi najviac ohrozené oblasti Slovenska. Zhoršený zdravotný stav lesov Záhoria možno odôvodniť v prvom rade výskytom minerálne veľmi chudobných až jalových a zrnitostne ľahkých pôdotvorných substrátov z viatych pieskov a ich minimálnou vododržnosťou.

Okrem stanovištných podmienok je zdravotný stav lesov Záhorskej nížiny ohrozený aj vplyvom imisií, predovšetkým z diaľkového prenosu, nesprávnym obhospodarovaním lesov (rozsiahle odlesňovanie, zakladanie porastov použitím nevhodných proveniencií drevín, strata humusu a minerálnych živín a pod.). Za zvlášť významný sa považuje zhoršený vodný režim znížením hladiny podzemnej vody v dôsledku odvodňovania (melioračné opatrenia, ťažba piesku a štrkopiesku), čím dochádza k zmene hydrotropizmu koreňov.

Zmeny vlhkosti pôdy piesočnatých pôd sú vzhľadom na rovnaké vlastnosti pôdotvorného materiálu závislé od klimatických pomerov, osobitne množstva a časového rozloženia zrážok a charakteru rastlinného krytu. Minimálne rozdiely medzi paralelnými plochami (bo, db a db + bo porast) sú na začiatku vegetačného obdobia. Vyššie, ale štatisticky nepreukazné hodnoty vlhkosti pôdy v dubovom poraste možno odôvodniť nižšou intercepciou snehových zrážok, menším zastúpením trávnej a machovej vegetácie a priaznivejšou humusovou formou povrchovej vrstvy pôdy a čiastočne aj spotrebou vody na zimnú transpiráciu. Nízka vododržnosť, veľká vysýchavosť a pomerne hustá a rovnomerná sieť aktívnych koreňov, ktoré zasahujú do hĺbky okolo 60 cm, nedovoľuje väčšie nasýtenie pôdy vodou vo vegetačnom období. K vysušeniu pôdy prispieva okrem už uvedeného poklesu hladiny podzemnej vody do kapilárne neaktívnych spodín aj častý deficit zrážok, čo ešte viac zrýchľuje prechod do hydropedologických cyklov s kapilárne ťažko pohyblivou vodou a jej zníženou prístupnosťou pre rastliny (pF 3,1–4,18).

Výskumné plochy sú na Záhorskej nížine situované v orografickej časti malackého pásma. Reprezentujú lesnícky i stanovištne najdôležitejšie a najtypickejšie orografické časti nížiny. Nachádzajú sa pri Kamennom mlyne, asi 3 km od Plaveckého Štvrtka a 8 km na juh od Malaciek a v oblasti pri Borskom Mikuláši.

Maximálne množstvo vody vo fyziologickom profile pôdy sa vyskytuje v období na rozhraní zimných a jarných mesiacov. Výraznejšie zvlhčenie pôdy je spojené predovšetkým s vplyvom rozmŕzajúcej povrchovej vrstvy pôdy a vody z topiaceho sa snehu. V takomto prípade sa vlhkosť pôdy pohybuje v rozmedzí existenčného intervalu vlhkosti pôdy (MKK–BV) a stav vody predstavuje kapilárne pohyblivú a pre rastliny ľahko prístupnú vodu (pF okolo 2,5).

V suchom, ale aj normálne zrážkovo zabezpečenom zimnom období môže dôjsť k situácii, kedy množstvo pôdnej vody nezasahuje do oblasti kapilárne pohyblivej a ľahko prístupnej vody a vlhkostný stav je charakterizovaný množstvom vody, kedy sa jej pohyblivosť a prístupnosť pre rastliny znižuje (pF < 3,1).

K najväčším vlhkostným zmenám dochádza v povrchových a stredných vrstvách pôdy. Vstup do vegetačného obdobia je väčšinou priaznivý, v celom fyziologickom profile sa na všetkých plochách pohybuje vlhkosť pôdy v rozmedzí hydrolimitov MKK a BZD. Plynulé zásobovanie rastlín vodou zabezpečuje kapilárne pohyblivá, ľahko prístupná voda.

Pôdne prostredie so zásobou vody v prevažne existenčnom intervale vlhkosti (MKK–BV) a veľmi nízkou hodnotou hydrolimitu bodu vädnutia (okolo 2 %) umožňuje využívať pôdnu vodu väčšiu časť vegetačného obdobia a takmer v plnom rozsahu. K maximálnemu vysušeniu dochádza v letných mesiacoch po dlhšie trvajúcich suchých obdobiach. Zasiahnuté sú najmä povrchové a stredné vrstvy pôdy (0–30 cm). V extrémne suchých a teplých dňoch môže zásoba vody klesnúť až do oblasti kapilárne nepohyblivej a pre rastliny ťažko prístupnej až neprístupnej vody (pF < 4,18). Z nedostatočnej zásoby využiteľnej vody vyplýva aj častý výskyt odumretých sacích korienkov a naopak zvýšené množstvo aktívnych koreňov v hlbších, chladnejších vrstvách pôdy s fyziologicky prístupnou vodou.

Na základe dynamiky zmien pôdnej vody môžeme konštatovať, že piesočnaté pôdy vzhľadom na existenciu a dĺžku hydropedologických cyklov s veľmi nízkou, resp. nedostatočnou zásobou využiteľnej vody a nepriaznivé hydrofyzikálne vlastnosti patria medzi vysýchavé pôdy. Vysoké teploty (> 40 °C) aj v prípade vyšších úhrnov zrážok sa vzhľadom na vysokú spotrebu vody na evapotranspiráciu podieľajú významnou mierou na znížení zásob vody aj v spodných horizontoch. Vývoj, rast a prežitie borovicových sadeníc v suchých dňoch vegetačného obdobia možno odôvodniť špecifickými mikroklimatickými a hydrickými podmienkami, ktoré sa vytvárajú v povrchových vrstvách pôdy. Pri vyžarovaní počas radiácie dochádza v ranných hodinách v povrchových vrstvách pôdy a v tesnej blízkosti nad povrchom pôdy k zvýšenej kondenzácii vodných pár, čím sa znižuje evaporácia a zároveň aj vodný deficit.

Z analýzy prevlhčenia, dĺžky prevlhčenia a stratifikácie vlhkosti pôdy prostredníctvom hydrolimitov vyplýva, že prevládajúcim intervalom vlhkosti pôdy vo vegetačnom období je semiaridný interval, s kapilárne stredne až ťažko pohyblivou vodou, so zníženou prístupnosťou až ťažko prístupnou pre rastliny (pF 3,1–4,18). Aridný interval (< BV), ktorý nemá dlhšie trvanie, sa vytvára v letných mesiacoch, po dlhšie trvajúcom suchom období a zasahuje spravidla len povrchové vrstvy fyziologického profilu pôdy (0–20 cm). Z doteraz dosiahnutých výsledkov výskumu vodného režimu lesných pôd vyplýva, že k poklesu vody pod kritickú hodnotu BV dochádza aj v iných pôdach, v najväčšej miere v nížinných a pahorkatinných oblastiach Slovenska.

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