Mendel University in Brno

Faculty of Forestry and Wood Technology

Department of Geology and Soil Science

FOREST SOILS AND CLIMATIC PARAMETERS: THE INTERRELATIONSHIP BETWEEN CLIMATIC FEATURES AND CHOSEN SOIL PROPERTIES FROM THE VIEWPOINT OF CHANGES OF AIR TEMPERATURES AND PRECIPITATIONS

DIPLOMA THESIS

2015/2016

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Guides to writing a thesis:

1. Till beginning of spring 2015, to get familiar with scientific literature dealing with the interrelationships among plants, soil organic matter content and pH degree. The references are to be focused on forestry priorities reinforcing forest management ones.
2. Till spring 2015, to select study plots reinforcing Masaryk Forest Krtiny. For the study plot selection, put the stress on mesoclimatical parameters e where both temperatures and precipitations differs (the coldest plot, the wettest plot, the dryiest plot, the warmest plot at Masaryk Forest Krtiny).
3. Since spring 2015, laboratory analyses following soil sampling will be practised. The following soil properties will be determined:
   1. minimal air capacity
   2 maximal capillar water capacity
   3. pH at H20
   4. pH at 0.01 mol.l/1CaCl2
4. Till the end of 2015, to take part in field work on the study plots chosen where particular plant sociological features wíll be determined.
5. To summarise the results and discuss them from the viewpoint of forest management.

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Declaration

I hereby declare that I compiled the diploma thesis on the topic of ***„Forest soils and climatic parameters: the interrelationship between climatic features and chosen soil properties from the viewpoint of changes of air temperatures and precipitations"*** *by myself and have stated all sources used. I agree to my thesis being published in accordance with §47(b) of the Act No. 111/1998 Coll. on Higher Education Institutions including amendments to some other acts and in compliance with Mendel University Chancellor's decree on publishing final theses. I am fully aware that my thesis is subject to Act no. 121/2000 Coll., The Copyrights Act and that the Mendel University in Brno has the right to enter into licence agreements for use of this work as school work in accordance with §60 section 1 of the Copyrights Act. I hereby agree to obtain a written statement from the University that any license agreement with a third party on the use of copyright does not contravene the rightful interests of the University prior to executing any such agreement, and agrees to disburse any compensation for costs incurred in association with the thesis compilation in compliance with the due calculation.*

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Bc. Lukáš Karas

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Author: Bc. Lukáš Karas

Title: Forest soils and climatic parameters: the interrelationship between climatic features and chosen soil properties from the viewpoint of changes of air temperatures and precipitations

Abstract: This diploma thesis is dealing with interrelationship between chosen soil properties and air temperature and precipitation. Five study plots, located in Training Forest Enterprise Masaryk Forest Křtiny, were sampled during vegetation period and subsequently laboratory analysed for actual soil reaction, potential soil reaction, maximal capillary water capacity and minimal air capacity. From those five study plots were chosen four climatically different (the warmest, the coldest, the wettest and the driest) study plots based on climatic data. The goal of this study is a determination of climate impact on selected soil properties.

Keywords: actual soil reaction, air temperature, cambisols, luvisols, maximal capillary water capacity, minimal air capacity, potential soil reaction, precipitation, stagnosols

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Název: Lesní půdy a klimatické vlastnosti: vzájemný vztah mezi klimatickými faktory a vybranými půdními vlastnostmi z hlediska změny teplot vzduchu a srážek

Abstrakt: Tato diplomová práce se zabývá vzájemnými vztahy mezi vybranými půdními vlastnostmi a teplotou vzduchu a srážkami. Pět lokalit na Školním lesním podniku Masarykův Les Křtiny bylo vybráno, vzorkováno a následně laboratorně analyzováno na půdní reakci aktivní, půdní reakci potencionální, maximální kapilární kapacitu a minimální vzdušnou kapacitu v průběhu celého vegetačního období. Z těch pěti lokalit se vybraly čtyři klimaticky odlišně lokality (nejteplejší, nejstudenější, nejvlhčí a nejsušší) na základě klimatických dat. Cílem této práce je posouzení vlivu klimatu na vybrané půdní vlastnosti.

Klíčová slova: kambisoly, luvisoly, maximální kapilární vodní kapacita, minimální vzdušná kapacita, půdní reakce aktivní, půdní reakce potencionální, srážky, stagnosoly, teplota vzduchu

Contents

List of abbreviations

A_{MKK}	Minimal air capacity
CHMI	Czech Hydrometeorological Institute
ČHMÚ	Czech Hydrometeorological Institute (Český hydrometeorologický ústav)
FAO	Food and Agriculture Organization
FVT	Forest vegetation tier
GIS	Geographic Information System
GPS	Global Positioning System
IPCCV	Intergovernmental Panel on Climate Change
IUSS	International Union of Soil Sciences
m a.s.l.	Metres above sea level
pH/H_2O	Actual soil reaction
pH/KCl	Potential soil reaction
s. r. o.	Private Limited Company (Společnost s ručením omezeným)
TA ČR	Technologic Agency of the Czech Republic (Technologická agentura České republiky)
TFE	Training Forest Enterprise Masaryk Forest Křtiny
TKSP ČR	Czech Taxonomic Soil Classification (Taxonomický klasifikační systém půd ČR)
Θ_{MKK}	Maximal capillary water capacity

1. INTRODUCTION

Soil is an important part of forest ecosystems and is considered as a relatively stable component. Physical properties such as porosity, permeability, etc. are affected with difficulty. Other properties are more easily influenceable (Klimo et al., 2002). This study deals with interactions between selected soil properties – physical parameters of Maximal capillary water capacity and minimal air capacity, and chemical properties actual soil reaction and potential soil reaction, and influence of climate conditions, namely temperature and precipitation.

This diploma thesis was conducted as a part of the project of TA ČR *Contactless monitoring and spatio-temporally modelling variability of selected different soil characteristics*. Five climatically diverse study plot were monthly sampled from March to November and according to climatic data were chosen four study plots – the warmest, the coldest, the driest and the wettest. These study plots are situated in the territory of Training Forest Enterprise Masaryk Forest Křtiny of Mendel University in Brno. This diploma thesis is focused on determination of climate impact on selected soil properties mentioned above.

2. AIM OF WORK

The aim of this diploma thesis is a complex study of the interaction between chosen soil properties, namely actual soil reaction, potential soil reaction, maximal capillary water capacity, and minimal air capacity, on selected climatically different study plots, and climatic features – temperature and precipitation.

3. LITERATURE REVIEW

3.1. Training Forest Enterprise Masaryk Forest Křtiny (TFE)

Training Forest Enterprise Masaryk Forest Křtiny as a part of Mendel University in Brno provides an area of about 10,200 hectares for practical training of students and create conditions for dealing with educational and research projects (Matějík, 2009).

Forests of School Enterprise consists of a continuous complex following the northern edge of the city of Brno. Forest stands are at an altitude range from 210 to 575 metres above the sea level. The average annual temperature is 7.5° C, average annual rainfall 610 mm, in the growing season only 360 mm (Matějík, 2009).

Geological bedrock in the western part of the enterprise is granodiorite, in the middle part it is Devonian limestone and in the eastern part Culm offal. Terrain is very jagged, with deep valleys of river Svitava and Křtinský brook with numerous side valleys and glens. Mixed stands dominates with 48 % of conifers and 52 % of broadleaf species. The main tree species are spruce, pine, larch, beech and oak (Matějík, 2009).

3.2. Technology Agency of the Czech Republic

Technology Agency of the Czech Republic (Technologická agentura České republiky) – TA ČR is a state unit and budget chapter administrator. TA ČR prepares and manages grant programs of state aid in order to encourage the interconnection between research organizations of applied research and experimental development and innovation activities of companies and government. The main goal of TA ČR is to support the emergence of highly competitive economic environment based on knowledge and innovation in which research and development, enterprises and government effectively co-operate (TAČR - Technologická agentura ČR 2016).

3.3. Climate changes in Europe

According to many studies which are examining the impacts of global warming on terrestrial ecosystems there is consistent pattern of change. Across the northern hemisphere the response to warming by phenological change is well documented (McCarthy et al., 2001; Sparks and Menzel, 2002; Walter et al., 2002; Parmesan and

Yohe, 2003; Root et al., 2003). According to the Christensen et al. (2007) the temperature in the northern temperate Europe may increase by 1.5-2.5 °C over the next few decades due to global warming.

Changes in climate likely play an important role in increased risk of floods (Kundzewitz, 2005). According to IPCC (2001) a statistically significant increase in global land precipitation in the 20th century has been noted. Extremes in precipitation increase flood risk. Christensen and Christensen (2003) stated that the average summer precipitation had decreased and that the consequent events of summer drought may be simultaneously accompanied by short but potentially devastating heavy precipitation (Casty et al., 2005; Beniston et al., 2011) events resulting in flash floods, higher risk of soil erosion, more frequent overflow of storm drainage facilities, and higher risk of landslides in unstable area (Bollschweiler and Stoffer, 2010). As for the mountainous area, for the climate in the Alps from the late 19th century to the end of the 20th century was spotted an increase of the mean annual temperatures by about 2 °C (Beniston, 2006; Auer et al., 2007; Solomon et al., 2007).

According to Gobiet et al. (2014) it is assessed that levels of atmospheric CO_2 will rise and it will increase global temperature by 0.25 °C per decade throughout the current century. Increased CO_2 levels can affect plants in two ways. Firstly, the plant is affected directly by the CO_2 in the atmosphere. It is a primary source of carbon for plants. Increased level of CO_2 in the atmosphere stimulates photosynthesis. Simultaneously the stomata are partially closed and the transpiration intensity is reduced leading to the improved water use efficiency (Žalud and Dubrovský, 2002). Results in controlled environment indicates that the growth of the crops should increase by about 14 ± 11 % for C4 plants at doubled atmospheric CO_2 (Dhakhwa et al., 1997). The second effect of higher level of CO_2 is the weather change due to CO_2 increase (referred as *indirect effect* or *weather effect*) (Žalud and Dubrovský, 2002).

3.4. Soil types

Three Reference Soil Groups of soil were researched – Cambisols, Luvisols, and Stagnosols. Both Cambisols and Luvisols are prevailing and the most widespread in Central Europe (Jones et al., 2005) and also in temperate deciduous forests. This biome is characterized by humid and temperate climate (udic moisture and mesic soil temperature regimes). Litter produced by plants is rich in nitrogen and cations and poor in lignin. The rate of organic matter decomposition is higher than in the boreal forest (Certini and Scalenghe, 2012).

3.4.1. Cambisols

Cambisols can be found in wide variety of environments around the world and under many types of vegetation covers (Jones et al., 2005), they cover about 1.5 billion ha worldwide, mostly in temperate and boreal regions which were influenced by glaciation during the Pleistocene (Driessen, 2001). In Europe they are very common, covering approximately 12 % of Europe's area (Jones et al., 2005). They are the most widespread Reference Soil Groups in Central Europe (IUSS Working Group, 2006), especially in less favoured mountain areas (Hejcman and Kunzová, 2010).

Soil type which was studied belongs according to Czech Taxonomic Soil Classification to brown soils. This soil type is distributed in wide range of climatic and vegetative conditions, mostly in vegetative tiers 2-8 under the original broadleaved and mixed forests (Němeček, 2001). Nowadays brown soils form approximately 40 % of agricultural land (Královec, 2003). According to Jandák (2006), this soil type is the most distributed soil type of the Czech Republic with 45 % of agricultural land fund and 68 % of forest land fund.

Parent material are materials with medium or fine texture derived from a wide range of rocks predominantly in alluvial, colluvial or aeolian deposits (Driessen, 2001). Cambisols are soils that are developed only moderately, on account of rejuvenation of the soil material or because of their young pedogenetic age, they are young soils (Jones et al., 2005), in transitional stage of development from young soil to mature soil. In areas with low temperatures, low precipitation, impended drainage, highly calcareous or with parent material resistant to weathering the cambic horizon may be quite stable. Typical is horizon differentiation, which is evident from changes in structure, colour or carbonate content. These soils have either cambic horizon, mollic horizon with low base saturation or andic, vertic, plinthic, petroplinthic, salic or sulphuric horizon (Driessen, 2001).

According to Driessen (2001) the Eutric Cambisols are one of the most productive soils of the temperate zone, and are agriculturally frequently used in Europe, primarily in loess areas (Jones et al., 2005). Alluvial plains in dry zone often with irrigation are used for production of food and oil crops, whilst undulated and hilly (mainly colluvial) terrain is managed as a grazing land or to produce annual and perennial crops. As for the highland, Cambisols on steep slopes are better kept under forest cover (Driessen, 2001). Cambisols with higher portion of stones are used for forestry. Also less fertile Cambisols in Central and Northern Europe are better for forestry, however, this soils can be together with irrigation and fertilization used for farming (Blume et al., 2015).

3.4.2. Luvisols

Luvisols in general occur on well-drained landscapes. They extend over 500-600 million ha worldwide, mostly in temperate regions (IUSS Working Group, 2014). Luvisols cover approximately 6 % of the Europe and can be found from the Mediterranean Sea to Denmark and Estonia in the north (Jones et al., 2006). They are common in flat or slightly sloping land in cool temperate regions and warm regions with distinct dry and wet seasons (for example Mediterranean) (IUSS Working Group, 2014).

Luvisols are characteristic soil of forested regions (McGregor, 1984), and are considered to be together with chernozems and phaeozems the most naturally fertile soils in Central Europe. Luvisols occur on 10.5 % of the territory of the Czech Republic, and usually are in the transition zone between Chernozems in the lowlands and Cambisols in altitudes higher than 350 m above sea level on geological substrates of lower quality (Kozák et al., 2003; Kozák, 2010).

According to Czech Taxonomic Soil Classification there was one type of Luvisols that was studied: brown soils (*hnědozem*). Brown soils were formed primarily on flat or undulated loess under the original oakwood or hornbeam oakwood in the 1st and 2nd (or 3rd) vegetation tier (Němeček, 2001). This soil type comprise of agricultural land fund and 5 % of forest land fund (Jandák, 2006).

Parent material is a wide variety of unconsolidated materials (for example glacial till, aeolian, alluvial, and colluvial deposits (IUSS Working Group, 2014). According to FAO (1998) Luvisols are characteristic by having an argic horizon. Luvisols contain more clay in the subsoil than in the topsoil, as a result of pedogenetic processes (particularly clay migration) which leads to an argic subsoil horizon. They also have high-activity clays in the argic horizon and a high base saturation in the 50-100 cm depth (IUSS Working Group, 2014).

Most Luvisols are fertile and convenient for agricultural uses. Luvisols with a high content of silt are susceptible to structure deterioration when tilled with heavy machinery or when wet. Also Luvisols on steep slopes are threatened by erosion (IUSS Working Group, 2014).

3.4.3. Stagnosols

Reference Soil Group Stagnosols covers 150-200 million ha across the world. it is mainly distributed in humid to perhumid temperate parts of Central and Western Europe, North America, south-eastern Australia, and Argentina, where are associated with Luvisols or silty or clayey Cambisols and Umbrisols. They can be found also in perhumid subtropical region, with Acrisols and Planosols. (IUSS Working Group, 2014).

They are usually in depressions where is water pooling during wet periods or in level to slightly sloping landscape (Chesworth, 2008). In Germany, they occur in level loess and calcareous glacial till landscapes with more than 700 mm of annual precipitation, on slopes with Haplic Luvisols or in depressions with Gleysols (Blume et al., 2015).

In Czech Taxonomic Soil Classification Stagnosols belongs to soil type *pseudogleje*. This soil type is characterized by distinct mottling of redoximorphic diagnostic horizon. It is found in plain landscapes of humid areas in vegetation tiers 2-7 (Němeček, 2001), with 7 % of agricultural land fund and 5 % of forest land fund (Jandák, 2006).

Parent material is a wide variety of unconsolidated material, glacial till, loamy aeolian, alluvial and colluvial deposits or physically weathered silt stone. Stagnosols are soils influenced by perched water table, they are periodically wet and mottled in the topsoil and subsoil, and can be concreted or bleached (Osman, 2013). Mottling and bleached horizon can be up to 50 % of the 50 cm mineral soil surface volume (Chesworth, 2008).

Agricultural use of Stagnosols is limited by oxygen deficiency due to stagnant water (Osman, 2012). Soils are too wet during wet season, but on the contrary in dry season they can be too dry for cultivation of crops (IUSS Working Group, 2014). Pipes of ditch drainage is not suitable because it can cause lack of water during dry season. Better option of improvement is cultivation of deep-rooting crops or ploughless cultivation. On the contrary, Stagnosols are good soils for pasturing or for forest sites (Blume et al., 2015).

3.5. Soil properties

3.5.1. Soil reaction

The soil reaction is basic physico-chemical property of forest soils. It is defined by the ratio between the concentration of hydronium and hydroxyl ions in soil suspension. This ratio is expressed as a hydrogen exponent, pH (Rejšek, 1999). Soil reaction express the degree of acidity or alkalinity of the soil (Vavříček and Kučera, 2015).

The soil reaction is an important nature indicator of the soil stand and important plant growth indicator. Its character is rather unstable and dynamic due to very quickly changing values (Dykyjová, 1989). The H^+ ions concentration is influenced by many factors, mainly by organic (humic) and mineral acid content, $CaCO_3$, Na_2CO_3, or by saturation of the sorption complex (Pelíšek, 1966).

The soil reaction directly affects chemical, biological and many physical soil properties, it has influence on formation, accumulation and mobilization of toxic substances in the soil, furthermore, influences the nutrient accessibility, humus quality and soil structure (Čurlík et al., 2003). It also influences the soil development, weathering of soil-forming minerals, or translocation of products of hydrolysis (Ledvina et al., 2000). It is important in forestry when using physiologically acid fertilizers (e.g. KCl). After fertilization, K^+ cation binds to the sorption complex, H^+ ions are released and soil solution is acidificated (Vavříček and Kučera, 2015)

There are two forms of soil reaction – actual soil reaction (pH/H_2O) and potential soil reaction (pH/KCl). Actual soil reaction is determined by suspension of soil sample and water. Only free ions of the soil solution which are not fixed on soil colloids of the sorption complex are released. Potential soil reaction is measured in the solution of salt (0.01M $CaCl_2$ or 1M KCl). Cation released after the dissociation displaces hydrogen ions bounded in the sorption complex. Slightly dissociated compounds (humic compounds of organic acids and clay minerals) exchange their cations in sorption bond for cations of neutral salts (Vavříček and Kučera, 2015).

Values of the net charge of the colloid system are gained by comparing the values of actual and potential soil reaction. Values of pH in actual soil reaction are higher than values of pH of potential soil reaction, usually about 0.3-1 pH level (Vavříček and Kučera, 2015).

According to Rejšek (1999), very strongly acidic reaction is at pH/KCl at values below 3.0 and at pH/H_2O at values below 3.5. Strongly acidic reaction is at pH/KCl in the range from 3.0 to 4.0 and at pH/H_2O in range 3.5-4.4, medium acidic reaction at pH/KCl is in the range 4.1-5.0 and at pH/H_2O in the range 4.5-5.5. Values in range 5.1-6.0 in case of potential reaction indicate moderate acidic reaction. The same reaction is at pH/H_2O at values from 5.6 to 6.5. Values in the range 6.1-7.0 at pH/KCl and 6.6-7.2 say that the soil reaction is neutral. Values higher than 7.0 (in case of pH/KCl) and higher than 7.2 (pH/H_2O) signify moderately alkaline soil reaction.

Świtoniak et al. (2016) were studying soil reaction in Luvisols. They chose 4 study plot, 2 sampling spots in each study plot, in Bachotek, Gaj, Wąbrzeźno and Unisław in Kuyavian-Pomeranian Voivodeship in northern Poland. Study plot in Bachotek is covered with mixed forest with dominating tree species *Pinus sylvestris*. Study plots in Gaj, Wąbrzeźno and Unisław are in arable land.

Holzwarth et al. (2011) were researching potential soil reaction. Study plots were chosen in mature deciduous forest in Hainich National Park in Thuringia, Germany. Soil type at the study plots is Luvisol.

3.5.2. Maximal capillary water capacity

Pavel et al. (1984) says that maximal capillary water capacity is an ability of the soil to retain water for the plant’s needs. Němeček (2011) adds, that it is a hydrolimit, which defines the ability of the soil to retain the maximum amount of water in capillary pores. Dykojová (1989) says, that this quantity describes the best the ability of the soil to retain water for plants. According to Vavříček and Kučera (2015) maximal capillary water capacity indicates maximal saturation of capillary and semi-capillary pores, in this case, at this level of saturation are only coarse pores waterless. Špička (1964) says, that to increase Θ_{MKK} it is expedient to increase fertilization and increase proportion of manure and organic matter in soil. Maximal capillary water capacity is measured in percentage

Cultivated moderately heavy soils have value of Θ_{MKK} in the range from 30 to 40 %. Soils with low Θ_{MKK} have low retention capacity, that means in case of high precipitation is water soaking to subsoil and light soils losses nutrients and in case of heavy soils water runs off the cultivated area (Javůrek et al., 2010).

Vavříček and Kučera (2015) state that sandy soils have value of Θ_{MKK} from 10 to 17 %, loams with stand with mixture soils 18-28 %, sandy loams soils 25-30 %, loamy soils 30-35 %, clay-loam soils 35-40 %, and clay soils 40-45 %.

In case of forest soils, capacity to retain water is assessed as follows: if values of maximal capillary water capacity are less than 5 %, it means, that the soil has very low water-bearing capacity. Values in range from 5 to 10 % say that the soil has low water-bearing capacity, 10-30 % indicate water-bearing soil, 30-50 % strong water-bearing capacity and more than 50 % show soil with very strong water-bearing capacity. Extreme values (less than 5 %, more than 50 %) indicate low fertility soils (Rejšek, 1999).

Vopravil et al. (2014) were dealing with maximal capillary water capacity of Stagnosols with forest cover and in arable land. Study plot was near Krymlov, in Central Bohemian region. Four sampling spots were under forest cover, with dominating *Picea abies*, other tree species were *Pinus sylvestris*, *Betula verrucosa* and Pse*udotsuga menziesii*, another sampling spot was in arable land.

3.5.3. Minimal air capacity

Minimal air capacity informs about the amount of air in the soil at the time when all the capillary pores are filled with water (Rejšek, 1999). A_{MKK} indicates the proportion of non-capillary pores in soil, which can be filled with water (Jandák et al., 2010). It is determined as a difference between porosity and maximal capillary water capacity in percentage (Rejšek, 1999).

Excessively high maximal air capacity leads to too high activity of aerobic organisms and humus mineralization (Jandák et al., 2010). Furthermore, because of high level of minimal air capacity aerated layer is heating up more and soil losses moisture (Vavříček and Kučera, 2015). On the contrary in case of low A_{MKK} air exchange is slowing down and soil microorganism development is inhibiting. A_{MKK} value is constantly changing together with soil moisture (Jandák et al., 2010).

In case of crops, the optimum for demanding crops is about 15 %, for less demanding crops around 10 %. Critical values for all crops is less than 10 %. At this critical level are soils susceptible to waterlogging have poor water permeability (Javůrek, 2010). The same situation happens with A_{MKK} less than 5 % in case of grassland and forest soils (Jandák et al., 2010; Vavříček and Kučera, 2015).

Minimal air capacity less than 5 % in forest soils indicates very low A_{MKK} and non - aerated soil horizon. Values 5-10 % indicate low A_{MKK} and soil horizon is poorly aerated, 10-20 % means medium A_{MKK} and moderately aerated soil horizon. High minimal air capacity is for values 20-40 % and soil horizon is strongly aerated. Very strongly aerated soil horizon and very high minimal air capacity is in case of values higher than 40 % (Rejšek, 1999). Value 8 % of A_{MKK} can be considered as a limit value, upper tolerable value is more than 20 %. Values higher than 25 % are considered as risk values (Vavříček and Kučera, 2015).

Vopravil et al. (2014) were studying minimal air capacity as well. Details are described in chapter 3.6.2.

4. METHODOLOGY

4.1. Material

4.1.1. Localities

4.1.1.1. Study plot 1 – Bukovinka

4.1.1.1.1. General characteristics

Stand: 193B5 / 193B905

Forest vegetation zone: Beech with oak (3 FVT)

Forest site: 3H1 – *Querceto-Fagetum illimerosum trophicum with Oxalis acetosella,* and *Carex pilosa*; 3S7 – *Querceto-Fagetum mesotrophicum* with *Carex pilosa*

Altitude: 520 m above sea level

Potential drought hazard: small

GPS: 49.3018289N, 16.7983258E

4.1.1.1.2. Pedological characteristics

Pedological map: see fig. 50 in appendix

4.1.1.1.2.1. Soil profile "Agriculture area"

WRB: Gleyic Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Gleyic brown soil (Němeček, 2011)

Soil Taxonomy: Alfisols udalf (Soil survey staff, 2014)

Gleyic Luvisol on decalcified loess loam with noticeable rounded boulders of greywacke (typical for region of Drahanský culm.

Humus form: turfy moder

Soil profile: see fig. 47 in appendix

Fig. 1 Study plot 1 – Bukovinka (Mapy.cz, 2016a)

Table 1 Soil profile description of study plot 1, agriculture area

Horizon	Depth	Description
Fz	0-2	incoherent, loose humus pulp with soil fauna extrements
Hh	02.III	compact, very dark and partial humus mull
Ad	03.IX	5YR 4.5/1, light humic horizon highly conditioned by grassland, utterly incoherent, sandy loam
(Ev)	IX.27	10YR 7/3, indications of foliate structure, with equally dispersed base rock skeleton
Btg	27-55	7YR 6/4, signs of gleyfication, with equally dispersed base rock skeleton, coherent, cloddy
C	55→	10YR 7/6, with noticeable greywacke boulders of various dimensions, with signs of tightness

4.1.1.1.2.2. Soil profile “Forest stand”

WRB: Dystric Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Dystric luvisol (Němeček, 2011)

Soil Taxonomy: Alfisols udalfs (Soil survey staff, 2014)

Dystric Luvisol on decalcified loess loam with noticeable, rounded boulders of greywacke (typical for region of Drahanský culm).

Humus form: typical moder

Soil profile: see fig. 47 in appendix

Table 2 Soil profile description of study plot 1, forest stand

Horizon	Depth	Description
L	0-2	mixed forest litterfall, older litterfall with signs of decomposition, discolored
Fz	02.IV	humus pulp, loose
Hh	04.V	nonstructural humus mull
Ah	V.14	7.5 YR 3/1, malleable, easily friable, humic
(Ev1)	14-26	10YR 7/3, dark, friable, mildly disrupting, elastic, nonaggregate
(Ev2)	26-33	2.5Y 8/2, loose, sandy loam, nonaggregate, very easily disrupting, slightly moist
Btg	33-60	matrix 10YR 6/4 with distinctive signs of gleyfication of rusty colour, nonfriable, sticky
C	60→	7.5 YR 7/4, cohesive, viscous, non-compact, equally mildly moist

4.1.1.2. Study plot 2a – Proklest

4.1.1.2.1. General characteristics

Stand: 184D9a / 184D102

Forest vegetation zone: Beech (4 FVT)

Forest site: Beech (4 FVT)

Altitude: 550 m above sea level

Potential drought hazard: small

GPS: 49.3162386N, 16.7725872E

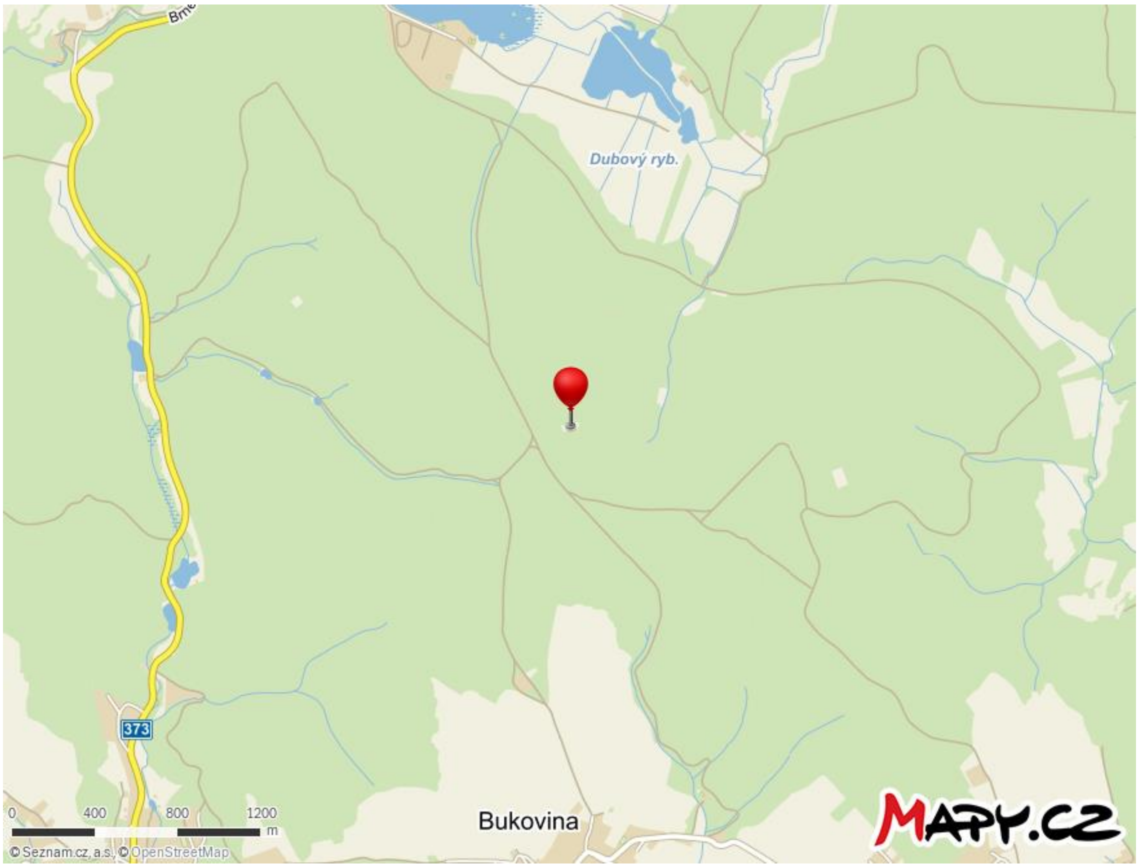


Fig. 2 Study plot 2a – Proklest (Mapy.cz, 2016b)

4.1.1.2.2. Pedological characteristics

Pedological map: see fig. 51 in appendix

4.1.1.2.2.1. Soil profile "Agriculture area"

WRB: Haplic Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Luvic brown soil (Němeček, 2011)

Soil Taxonomy: Alfisols udalfs (Soil survey staff, 2014)

Haplic Luvisol on decalcified loess soil without capping humus

Soil profile: see fig. 47 in appendix

Table 3 Soil profile description of study plot 2a, agriculture area

Horizon	Depth	Description
Ap	0-28	10YR 3/1, colourly strongly separated, distinctively friable, moderately moist, slightly disrupting
(Ev)	28-55	2Y 7/4, slightly skeletal, loamy sand, crumb structure, loose, appearance of red spots on weathered skeleton over 10 mm
Bt	55→	10YR 7/6, slightly gravel, very mildly flattened, freshly moist, non-compact

4.1.1.2.2.2. Soil profile "Forest stand"

WRB: Dystic Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Dystric luvisol (Němeček, 2011)

Soil Taxonomy: Alfisols udalfs (Soil survey staff, 2014)

Dystic Luvisol on decalcified loess soil with ongoing illimerisation,

Humus form: moric moder

Soil profile: see fig. 47 in appendix

Table 4 Soil profile description of study plot 2a, forest stand

Horizon	Depth	Description
L	0-2	
Fm	02.V	
Hh	05.VI	very dark humic mull, sticky, compact
Ah	06.X	2.5YR 3/1, distinctively dark coloured, insignificantly crumbled, freshly moist, loose
(Ev1)	X.26	10YR 7/3, occurrence of red spots on weathered skeleton over 10 mm
(Ev2)	26-50	2.5Y 8/2, brighter, presence of red spots on weathered skeleton over 10 mm
Bt	50→	2.5Y 5.5/6, loamy, mildly skeletal, slightly matted down, with signs of compactness

4.1.1.3. Study plot 2b – Chochola

4.1.1.3.1. General characteristics

Stand: 180A7 / 180B102

Forest vegetation zone: 4S1 –*Fagetum mesotrophicum* with *Oxalis acetosella*; 4A2 – *Tilieto-Fagetum acerosum lapidosum* with *Melica uniflora*

Forest site: Beech (4 FVT)

Altitude: 520 m above sea level

Potential drought hazard: small

GPS: 49.3327903N, 16.7560433E

Fig. 3 Study plot 2b – Chochola (Mapy.cz, 2016c)

4.1.1.3.2. Pedological characteristics

Pedological map: see fig. 52 in appendix

4.1.1.3.2.1. Soil profile "permanent grass cover"

WRB: Haplic Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Luvic brown soil (Němeček, 2011)

Soil Taxonomy: Alfisols udalfs (Soil survey staff, 2014)

Haplic Luvisol on decalcified loess soil with ongoing illimerisation.

Humus form: typical moder

Soil profile: see fig. 48 in appendix

Table 5 Soil profile description of study plot 2b, permanent grass cover

Horizon	Depth	Description
L	0-1	
Fa+(Hh)	01.III	
Ad	III.14	2.5 Y 4/1, humic, not muddy, very easily friable
(Ev)	14-35	10YR 7/2, direct and clearly visible boundary to Bt, mildly lightered, slightly disrupting, malleable
Bt	35-55	10YR 6/4, lumpy, non-compact, freshly moist, lumps are easily crushed
C	55-70	2.5Y 7/6, friable
C/D	70→	loess loam with large fragments of fine-grained greywacke, rarely in size of angular blocks

4.1.1.3.2.2. Soil profile "Forest stand"

WRB: Dystic Luvisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Dystric luvisol (Němeček, 2011)

Soil Taxonomy: Alfisols udalfs (Soil survey staff, 2014)

Dystic Luvisol on decalcified loess soil with ongoing illimerisation

Humus form: typical moder

Soil profile: see fig. 48 in appendix

Table 6 Soil profile description of study plot 2b, forest stand

Horizon	Depth	Description
L	0-1	
Fm	01.III	
Hh	03.IV	
Ah	04.IX	2.5 Y 4/1, friable, slightly moist, humic
(Ev)	IX.40	2.5Y 8/2, horizon more distinctively colourly different – albic, evident boundary to Bt, signs of tabular to platelet structure
Bt	40-60	10YR 6/4, cloddish and difficult to crumble, with tendency to stiffness
C	60→	2.5Y 6/6, dusty

4.1.1.4. Study plot 3 – Rudice

4.1.1.4.1. General characteristics

Stand: 173A6, 173A3 / 173A904

Forest vegetation zone: Beech with oak (3 FVT)

Forest site: 3W1- *Querceto-Fagetum calcarium*

Altitude: 500 m above sea level

Potential drought hazard: high

GPS: 49.3262808N, 16.7282075E

4.1.1.4.2. Pedological characteristics

Pedological map: see fig. 53 in appendix

4.1.1.4.2.1. Soil profile "Agriculture area"

WRB: Haplic Stagnosol (World reference base for soil resources 2014, 2015)

TKSP ČR: Luvic pseudogley (Němeček, 2011)

Soil Taxonomy: Aquic haplustalf (Soil survey staff, 2014)

Haplic Stagnosol on decalcified loess soil with distinctive ferrans in eluvial horizon

Humus form: turfy moder

Soil profile: see fig. 48 in appendix

Fig. 4 Study plot 3 – Rudice (Mapy.cz, 2016d)

Table 7 Soil profile description of study plot 3, agriculture area

Horizon	Depth	Description
F	0-4	
H	04.V	
Ad	V.15	7.5YR 3/1, gray-black, loamy sand
En	15-35	5YR 7/2, noticeable ferrans, sandy loam
Bmt	35-65	5YR 7/8, redoximorfic characters with prevailing rust colour and gray tonguing, possible influence of laterally migrating water
BCg	65→	no signs of whitening, 7.5YR 7/8

4.1.1.4.2.2. Soil profile "Forest stand"

WRB: Haplic Stagnosol (World reference base for soil resources 2014, 2015)

TKSP ČR: Luvic pseudogley (Němeček, 2011)

Soil Taxonomy: Aquic haplustalf (Soil survey staff, 2014)

Haplic Stagnosol on decalcified loess soil with a distinctive rusty marbling

Humus form: typical moder

Soil profile: see fig. 48 in appendix

Table 8 Soil profile description of study plot 3, forest stand

Horizon	Depth	Description
L	0-1	mixed forest litterfall, high proportion of nondecomposed beech litterfall
Fz	01.III	noticeable pulp with a significant portion of soil fauna
Hh	03.IV	locally various in content and quality humic mull
Ah1	04.X	10YR 2/1, intensively humic, black
Ah2	X.20	5YR 5/1, humic, irregular (pocket-shaped) border from the bottom
En	20-33	5YR 8/2, sandy to sandy loam, absenting ferrans probably caused by lateral water
Bmt	33-65	2.5YR 7/8, particularly noticeable rusty colour with whited tonguing, looses colour going to the bottom, grain size is not heavy, distinctively separated from En
BCg	65→	7.5YR 7/8, pedogenically layered decalcified loess loam with signs of gleyification

4.1.1.5. Study plot 4 – Křtiny

4.1.1.5.1. General characteristics

Stand: 205B17/9

Forest vegetation zone: Oak with beech (2 FVT)

Forest site: 2B2 - *Fageto-Quercetum eutrophicum* with *Melica uniflora*; 2S2 - *Fageto-Quercetum mesotrophicum* with *Luzula nemorosa* and *Carex digitata*

Altitude: 460-470 m above sea level

Potential drought hazard: high

GPS: 49.2948289N, 16.7503464E

Fig. 5 Study plot 4 – Křtiny (Mapy.cz, 2016e)

4.1.1.5.2. Pedological characteristics

Pedological map: see fig. 54 in appendix

4.1.1.5.2.1. Soil profile "Agriculture area"

WRB: Skeletic Cambisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Distric cambisol (Němeček, 2011)

Soil Taxonomy: Inceptisols (Soil survey staff, 2014)

Skeletic Cambisol on strongly skeletal weathered clay slate of Drahany culm.

Humus form: turfy moder

Soil profile: see fig. 49 in appendix

Table 9 Soil profile description of study plot 4, agriculture area

Horizon	Depth	Description
F + (H)	0-2	cut meadow; intermittent discontinuous mull with soil fauna excrements
Ad	II.17	10YR 6/1, humic, turfy, with signs of cohesion
Bv	17-40	7YR 7/3, cohesive, hard-friable
Cr	40→	numerous fragments of lower carboniferous clay shales

4.1.1.5.2.2. Soil profile “Forest stand”

WRB: Skeletic Cambisol (World reference base for soil resources 2014, 2015)

TKSP ČR: Distric cambisol (Němeček, 2011)

Soil Taxonomy: Inceptisols (Soil survey staff, 2014)

Skeletic Cambisol skeletic on strongly skeletal weathered clay slate of Drahany culm.

Humus form: typical moder

Soil profile: see fig. 49 in appendix

Table 10 Soil profile description of study plot 4, forest stand

Horizon	Depth	Description
L	0-2	
Fa	02.III	humic pulp horizon with signs of life activities of typical forest soil fungi and soil fauna
Hh	03.IV	humic mull horizon, dark, compact, not matted down
Ah	IV.13	10YR 5/1, humic forest, incoherent, disintegrating agregates
Bv	13-50	7YR 7/4, higher dust content, lumpy
Cr	50→	10YR 5/2 together with fragments of lower carboniferous clay shales

4.1.2. Climatic and spatial information

Table 11 Climatic and spatial information

Study plot	Average annual temperature*	Total rainfall ½ 2- ½ 11/2015*	Study plot evaluation	Altitude	GPS position
1 - Bukovinka	8.16 °C	430 mm	the wettest	520 m a.s.l.	49.3018289N, 16.7983258E
2a - Proklest	8 °C	414.2 mm	the coldest	550 m a.s.l.	49.3162386N, 16.7725872E
3 - Rudice	8.39 °C	393.8 mm	the driest	500 m a.s.l.	49.3262808N, 16.7282075E
4 - Křtiny	8.8 °C	411.4 mm	the warmest	460 m a.s.l.	49.2948289N, 16.7503464E

* ČHMÚ, 2016

4.2. Methods

4.2.1. The fieldwork methods

Soil samples were extracted from each locality from March to November around 15th of each month. There were 13 sampling spots on each locality; 6 spots on managed meadow (or agriculture area), 6 spots in the forest and 1 spot in ecotone. Numbering starts at the ecotone and is labelled as E1 (E as ecotone), then continues to both directions on meadow and forests where each sampling spot is 3 metres from the previous (as seen on the picture below). Forests spots are labelled as L (as "Les" – forest) and managed meadow as Z (as "Zemědělská plocha" – agricultural area); at the forests are sampling spots L2 to L6 and on the meadow are sampling spots Z8 to Z12.

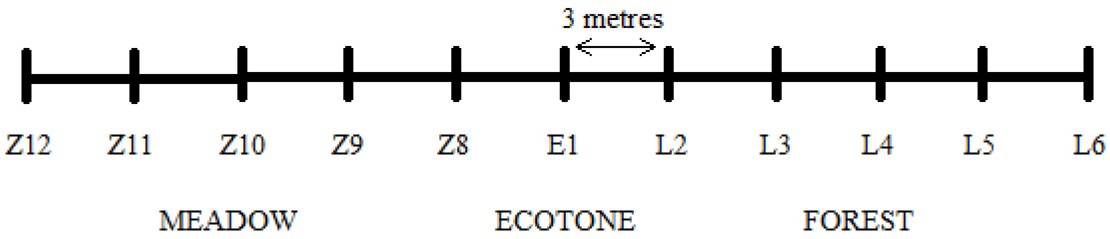


Fig. 6 Scheme of distribution of sampling spots

As mentioned above the fieldwork took place each month from March to November always around 15th of each month. From each sampling spot were taken 2 samples, one from the depth of 5 cm and one from 40 cm. Samples were put into plastic bags, labelled with the code of locality, sampling spot and depth (for example 1-E1-5) and the date of the sampling.

From each sampling spot was taken also soil sample in Kopecky's soil sample ring of 100 cubic centimetre of capacity from the depth of 5 cm. Each ring was provided with number which was recorded together with the code of the sampling spot.

Fig. 7 Fieldwork – sampling of Kopecky's soil sample ring (left), (Luterová, 2015c)

Fig. 8 Sample preparation – homogenized soil samples after drying (right), (Luterová, 2015b)

4.2.2. Sample preparation

Before analyses samples were homogenized in the sieve with 2 mm mesh and stored in the refrigerator at 5 °C to keep their original moisture.

After that samples were processed according to constant sample weight detected by drying analysis (Rejšek, 1999). From each sample around 20-30 g of the soil sample was taken, put into the paper bag, labelled with the number according to conversion table and weighed. After that paper bags were put into the convection dryer in 105 °C for 4 hours. After drying samples were weighed again.

4.2.3. The laboratory methods

4.2.3.1. Actual soil reaction and potential soil reaction

Soil reaction was analysed according to the ISO/DIS 10390 (1992) methodology with minor modifications.-

Working procedure

For each sample 5 g of soil sample was taken twice and put into two 25 ml flasks, one for actual and one for potential soil reaction. Each flask was labelled with soil sample number and either with "H" (for actual soil reaction) or "K" (for potential soil reaction).

Consequently 12.5 ml of distilled water was added into the flask labelled with letter "H". Flask was later capped and put into the shaker for 30 minutes. After 24 hours the content of the flask was poured into smaller beaker and pH value was measured with combined electrode of pH-meter. Value was after stabilization recorded with the accuracy of two decimals.


Fig. 9 Soil reaction – Flasks with soil samples in the shaker (left), (Karas, 2015a)

Fig. 10 Soil reaction – Combined electrode pH meter (right), (Karas, 2015a)

For potential soil reaction was used the flask with label with letter “K” where 12.5 ml of 1 $mol.l^{-1}$ KCl was added. Flask was capped and put into the shaker for 30 minutes. After 24 hours the suspension was poured into smaller beaker and pH value was measured with combined electrode of pH-meter. Value was recorded after the stabilization with the accuracy of two decimals.

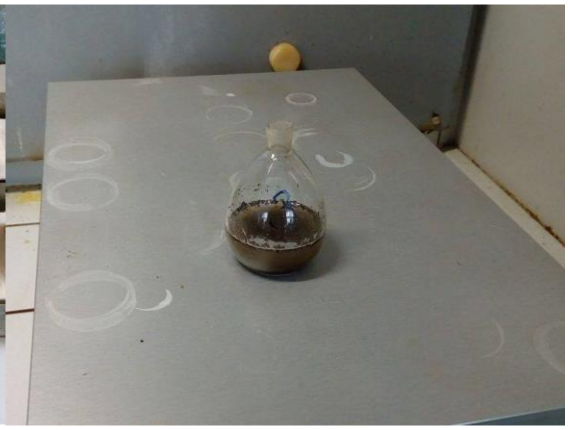



Fig. 11 Maximal capillary water capacity - Kopecky’s soil sample ring saturating (left) (Karas, 2015b)

Fig. 12 (right) – Minimal air capacity – pycnometer with soil sample and water (Karas, 2015c)

4.2.3.2. Maximal capillary water capacity

In this analysis was used method according to Novák (1932) with minor modifications.

Working procedure

Properly taken soil sample in Kopecky's soil sample ring was opened and carefully put onto filter paper. Ring was put together with the filter paper onto the pad in a metal bath filled with water. The ring was covered with round convex clock glass to prevent water evaporation. The sample was left to absorb water for 24 hour to full saturation. After the saturation was ring together with filter paper and clock glass put on three sheets of filter paper and left to suck out the water for 2 hours. After 2 hours the ring was together with filter paper and clock glass weighed.

After that the ring with filter paper was placed in a convection drier and was dried to a constant weight in 105 °C for about 12 hour. After drying the ring with filter paper was weighed again. Subsequently the soil sample was pulled out from the sample ring which was cleaned and weighed. Soil sample was later used to measure the minimal air capacity.

Calculation

$$\Theta_{MKK} = \frac{m_{MKK} - m_d}{V} * 100$$

Θ_{MKK} – maximal capillary water capacity (%)
m_{MKK} – weight of artificially saturated sample after 2 hours of sucking out water (g)
m_d – weight of the sample dried to the constant moisture (g)
V – sample volume in Kopecky's soil sample ring (cm^3)

4.2.3.3. Minimal air capacity

In this analysis were used following methods (Rejšek, 1999) with minor modifications:

- Bulk density
- Specific weight
- Porosity
- Minimal air capacity

Working procedure

For the analyses were used soil samples from the Kopecky's soil sample ring after they were used for maximal capillary water capacity. Samples were dried to constant weight.

Thoroughly cleaned and numbered Gay-Lussac's pycnometer was weighed. After that it was filled with distilled water to the brim, capped with the cap so water squirted through the capillary, dried and weighed. Pycnometer was later emptied, dried, than approximately 10 g of weighed soil sample was added. In the next step water was added into pycnometer so the water level slightly surpassed soil sample level.

In the next step pycnometer was put on electric hotplate and the content of pycnometer was brought to boil and boiled for several minutes. Meanwhile it was necessary to stir the content several times and to pay attention so that the content did not spill. After the boiling the pycnometer was cooled to room temperature and filled with distilled water, capped and weighed.

Calculation

Bulk density

$$\rho_d = \frac{c - a}{V}$$

ρ_d – bulk density (g.cm^3)
c – weight of Kopecky's soil sample ring with lids and soil sample dried to constant weight (g)
a – weight of Kopecky's soil sample ring with lids (g)
V – volume of the Kopecky's soil sample ring (cm^3)

Specific weight

$$\rho_s = \frac{m_1}{(m_1 + m_2) - m_3}$$

ρ_s – specific weight (g.cm^3)
m_1 – weight of soil sample dried to constant weight (g)
m_2 – weight of pycnometer with distilled water (g)
m_3 – weight of pycnometer with the sample after boiling and distilled water (g)

Porosity

$$P = \frac{\rho_s - \rho_d}{\rho_s} * 100$$

P – porosity (%)

ρ_s – specific weight (g.cm^3)

ρ_d – bulk density (g.cm^3)

Minimal air capacity

$$A_{MKK} = P - \Theta_{MKK}$$

A_{MKK} – minimal air capacity (%)

P – porosity (%)

Θ_{MKK} – maximal capillary water capacity (%)

4.2.4. Climatic data acquisition

Two basic climatic features were acquired – average monthly temperature and accumulated monthly rainfall. These data were obtained from Czech Hydrometeorological Institute and from meteorological station situated in Olomučany sawmill and Dyk nurseries near Křtiny. Values of average annual temperature were obtained and values of accumulated monthly rainfall were gathered from CHMI.

4.2.5. Data analysis

Data from laboratory analysis were analysed in R Studio (R Core Team, 2016) and mean values and standard deviation was obtained.

Four study plots were chosen – the warmest, the coldest, the wettest and the driest on the basis of comparison of values of average annual temperature and accumulated monthly rainfall. After that line charts were created for each analysis and each study plot with all the values of laboratory analyses from March to November, along with the mean values for each sampling spot and the trend line. The results were obtained based on the evaluation and comparison of the charts.

5. RESULTS

5.1. Statistical analysis

Study plot 1 – Bukovinka

Study plot 1 had values of actual soil reaction in 5 cm in range from 3.18 to 5.52. The lowest pH was measured at sampling spot L5 in September, the highest at sampling spot Z8 in September (table 17 in appendix). Average value from agriculture land is 4.84 and from forest cover is 3.72. (table 12). Actual soil reaction in 40 cm was in range from 3.25 to 5.40. The lowest pH was in L3 in September and the highest in Z10 in April. Average value in agriculture land was 4.52 and in forest cover 4.12 (table 12).

Potential soil reaction in 5 cm study plot 1 had range of pH values from 2.78 to 4.44. The lowest was in L6 in July and the highest 4.44 in November (table 22 in appendix). Average value from agriculture land was 3.81 and from forest cover 3.17. (table 12). In case of potential soil reaction in 40 cm the values were in range from 2.70 to 4.15 with the lowest value in Z11 from November and the highest value 4.15 from Z9 in March (table 22 in appendix). Average pH value from agriculture land was 3.46 and from forest cover 3.32 (table 12).

Maximal capillary water capacity in study plot 1 had values from 28.83 (Z10 in May) to 67.81 (L3 in August) (table 27 in appendix). Average value from agriculture land was 37.96 and from forest cover was 44.79 (table 12). In case of minimal air capacity, the range of values was from –34.24 to 34.24. The lowest value was in L3 in August (-3.81) and the highest in E in May (34.24) (table 32 in appendix). Average value from agriculture land was 9.47 and from forest cover 18.46 (table 12).

As can be seen in fig. 13, actual soil reaction in both depths and potential soil reaction in 5 cm had similar development, higher in agriculture land and lower in forest cover. As for potential soil reaction in 40 cm, there is not visible trend, average values are between pH lever 3 to 3.5. In fig. 14 is chart of average values of maximal capillary water capacity and minimal air capacity. Both analyses has similar ascending trend.

Table 12 Results from laboratory analyses with mean values for each sampling spot for the entire period and with standard deviation (R Core Team, 2016)

Sample	pH/H20 in 5 cm	pH/H20 in 40 cm	pH/KCl in 5 cm
1 - Z12	4.85 ± 0.34	4.39 ± 0.4	3.79 ± 0.34
1 - Z11	4.8 ± 0.31	4.5 ± 0.47	3.77 ± 0.21
1 - Z10	4.78 ± 0.4	4.68 ± 0.49	3.77 ± 0.26
1 - Z9	4.84 ± 0.23	4.55 ± 0.34	3.77 ± 0.2
1 - Z8	4.92 ± 0.36	4.47 ± 0.39	3.97 ± 0.31
Mean value of Z	4.84	4.52	3.81
1 - E	4.24 ± 0.48	4.07 ± 0.34	3.46 ± 0.35
1 - L2	3.77 ± 0.26	4 ± 0.24	3.24 ± 0.17
1 - L3	3.71 ± 0.18	4.02 ± 0.38	3.14 ± 0.14
1 - L4	3.72 ± 0.31	4.18 ± 0.34	3.19 ± 0.29
1 - L5	3.62 ± 0.32	4.18 ± 0.43	3.09 ± 0.21
1 - L6	3.76 ± 0.23	4.22 ± 0.24	3.17 ± 0.2
Mean value of L	3.72	4.12	3.17
Sample	**pH/KCl in 40 cm**	**MKK**	**AMKK**
1 - Z12	3.28 ± 0.25	35.37 ± 2.72	10.95 ± 7.34
1 - Z11	3.34 ± 0.35	38.36 ± 4.6	6.87 ± 5.83
1 - Z10	3.55 ± 0.37	37.9 ± 5.01*	7.9 ± 6.04*
1 - Z9	3.58 ± 0.34	40.11 ± 5.05	6.98 ± 3.81
1 - Z8	3.53 ± 0.29	38.05 ± 3.12	14.64 ± 8.67
Mean value of Z	3.46	37.96	9.47
1 - E	3.4 ± 0.22	43.45 ± 5.47	17.95 ± 9.78
1 - L2	3.27 ± 0.19	44.78 ± 9.24	16.58 ± 8.47
1 - L3	3.34 ± 0.19	47.49 ± 10.98	16.21 ± 8.49
1 - L4	3.29 ± 0.24	41.36 ± 8.22	22.38 ± 9.84
1 - L5	3.36 ± 0.21	45.02 ± 8.8	20.55 ± 8.42
1 - L6	3.34 ± 0.22	45.31 ± 9.32	16.57 ± 9
Mean value of L	3.32	44.79	18.46

* 1-2 values are missing in a dataset

Study plot 2a – Proklest

As for the study plot 2a, actual soil reaction in 5 cm was in range from 3.16 (L6 in September) to 5,26 (Z10 in November) (table 18 in appendix). Average value from agriculture land was 4.53 and from forest cover 3.79 (table 13). At the depth of 40 cm the range of values was 3.54-5.65 with the lowest in L4 in August and highest in Z11 in November. Average values were 4.49 in agriculture land and 4.11 under forest cover (table 13).

Potential soil reaction in 5 cm had range from 2.61 (L6 in July) to 4.04 (Z11 in August) (table 23 in appendix). Average value from agriculture land was 3.55 and 3.09 under forest cover (Table 13). At the depth of 40 cm, the range was 2.75-4.90. The lowest pH level was measured in Z9 in July and the highest in Z11 in November (table 23 in appendix). Average values from agriculture land was 3.48 and from forest cover 3.33 (table 13)

Concerning maximal capillary water capacity, the range was from 21.41 (Z10 in April) to 55.35 (L4 in November) in study plot 2a (table 28 in appendix). Average values were 36.36 and 39.57 from agricultural area and forest. As for minimal air capacity, the range was from -4.53 (Z11 in November) to 55.35 (L2 in August) (table 33 in appendix). Average value from agricultural land was 5.36 and from forest 13.37 (table 13).

Both soil reactions in both depths were similar trend, slightly descending from agriculture land to forest cover (fig. 15). In the fig. 16, the curves of ΘMKK and AMKK has ascending trend, lower values in agricultural land and higher values in forest cover.

Table 13 Results from laboratory analyses with mean values for each sampling spot for the entire period and with standard deviation (R Core Team, 2016)

Sample	pH/H20 in 5 cm	pH/H20 in 40 cm	pH/KCl in 5 cm
2a- Z12	4.5 ± 0.3	4.5 ± 0.49	3.53 ± 0.17
2a- Z11	4.66 ± 0.33	4.62 ± 0.54	3.58 ± 0.26
2a- Z10	4.56 ± 0.36	4.39 ± 0.26	3.6 ± 0.23
2a- Z9	4.54 ± 0.35	4.43 ± 0.33	3.65 ± 0.19
2a- Z8	4.37 ± 0.46	4.52 ± 0.47	3.41 ± 0.24
Mean value of Z	4.53	4.49	3.55
2a- E	3.84 ± 0.39	4.29 ± 0.3	3.21 ± 0.33
2a- L2	3.86 ± 0.41	4.29 ± 0.33	3.14 ± 0.27
2a- L3	3.79 ± 0.27	3.98 ± 0.34	3.13 ± 0.21
2a- L4	3.8 ± 0.3	4.09 ± 0.36	3.08 ± 0.15
2a- L5	3.84 ± 0.59	4.06 ± 0.37	3.1 ± 0.23
2a- L6	3.68 ± 0.43	4.12 ± 0.37	3 ± 0.23
Mean value of L	3.79	4.11	3.09
Sample	**pH/KCl in 40 cm**	**MKK**	**AMKK**
2a- Z12	3.44 ± 0.21	35.2 ± 2.88*	5.87 ± 5.53*
2a- Z11	3.66 ± 0.51	35.65 ± 3.01	4.87 ± 4.51
2a- Z10	3.39 ± 0.24	33.82 ± 4.89	2.36 ± 4.52
2a- Z9	3.42 ± 0.33	36.07 ± 1.33	4.2 ± 2.7
2a- Z8	3.48 ± 0.11	40.58 ± 4.58	9.48 ± 8.63
Mean value of Z	3.48	36.26	5.36
2a- E	3.39 ± 0.19	42.77 ± 7.52*	11.53 ± 6.53*
2a- L2	3.38 ± 0.2	39.94 ± 6.85	15.83 ± 7.36
2a- L3	3.31 ± 0.17	39.22 ± 4.77	11.77 ± 7.95
2a- L4	3.36 ± 0.2	39.36 ± 7.37	14.2 ± 4.49
2a- L5	3.3 ± 0.16	40.96 ± 7.85	10.13 ± 9.95
2a- L6	3.29 ± 0.18	38.35 ± 6.76	14.92 ± 5.84
Mean value of L	3.33	39.57	13.37

* 1-2 values are missing in a dataset

Study plot 2b – Chochola

Actual soil reaction in 5 cm was in range from 3.48 (L3 in June) to 7.85 (Z9 in March) (table 19 in appendix). Average values were 6.43 in agricultural land and 4.77 under forest cover (table 14). In the depth 40 cm, the lower value was 3.45 (L3 in September) and the highest value 6.76 (Z8 in April) (table 24 in appendix). Average value for agricultural land was 4.83 and in forest cover 4.25 (table 14).

Potential soil reaction in 5 cm was in range from 2.95 (L3 in August) to 7.03 (Z9 in March) (table 24 in appendix). The average values from agricultural land and forest cover were 5.57 and 4.01 (table 14). In case of potential soil reaction in 40 cm, the range was from 2.89 (L3 in July) to 6.53 (Z9 in March). Average value in agricultural land was 3.73 and in forest cover 3.51 (table 13).

Concerning maximal capillary water capacity, the range was from 24.43 (E in October) to 60.68 (L4 in October). The average values for agricultural land and forest cover were 42.27 and 42.65 (table 13). The lowest value of minimal air capacity was -2.64 (Z10 in June), the highest value was 35.95 (L6 in October). The average value in agricultural land was 7.25 and under forest cover was 14.76 (table 14).

The highest pH values were in agricultural land in case of actual soil reaction in 5 cm, in the range from 6 to 7. Both pH/H_2O and pH/KCl in 5 cm had similar trend, slightly ascending from Z15 to L2, then rapidly descending to L3 and up to L6 slightly ascending. Concerning soil reactions in 40 cm, levels of pH were higher in agricultural land than in soil under forest cover (fig. 17), In case of Θ_{MKK}, the average values were similar. The trend of minimal air capacity was ascending (fig. 18).

Table 14 Results from laboratory analyses with mean values for each sampling spot for the entire period and with standard (R Core Team, 2016)

Sample	pH/H20 in 5 cm	pH/H20 in 40 cm	pH/KCl in 5 cm
2b- Z12	5.89 ± 0.41	4.53 ± 0.4	4.86 ± 0.31
2b- Z11	6.57 ± 0.47	5.03 ± 0.85	5.68 ± 0.53
2b- Z10	6.38 ± 0.36	4.63 ± 0.57	5.72 ± 0.35
2b- Z9	6.72 ± 0.89	5.14 ± 0.97	5.74 ± 1.04
2b- Z8	6.59 ± 0.49	4.83 ± 0.91	5.86 ± 0.68
Mean value of Z	6.43	4.83	5.57
2b- E	6.53 ± 0.41	4.63 ± 0.52	5.89 ± 0.7
2b- L2	6.86 ± 0.33	4.71 ± 0.78	6.35 ± 0.4
2b- L3	4.2 ± 0.53	3.9 ± 0.35	3.48 ± 0.4
2b- L4	4.32 ± 0.57	4.2 ± 0.37	3.49 ± 0.31
2b- L5	4.23 ± 0.28	4.09 ± 0.29	3.33 ± 0.2
2b- L6	4.22 ± 0.24	4.33 ± 0.74	3.38 ± 0.13
Mean value of L	4.77	4.25	4.01
Sample	**pH/KCl in 40 cm**	**MKK**	**AMKK**
2b- Z12	3.43 ± 0.27	46.81 ± 2.96	7.82 ± 5.27
2b- Z11	3.8 ± 0.72	41.22 ± 6.06	6.66 ± 8.48
2b- Z10	3.44 ± 0.37	39.89 ± 4.9	5.51 ± 7.02
2b- Z9	4.16 ± 1.19	39.36 ± 6.6	6.53 ± 4.49
2b- Z8	3.8 ± 0.85	44.09 ± 2.84	9.73 ± 5.49
Mean value of Z	3.73	42.27	7.25
2b- E	3.63 ± 0.47	39.54 ± 9.81*	13.93 ± 6.56*
2b- L2	3.85 ± 0.91	41.79 ± 6.97	12.62 ± 6.48
2b- L3	3.33 ± 0.28	43.62 ± 8.18	16.28 ± 7.27
2b- L4	3.37 ± 0.25	43.67 ± 9.76	16.23 ± 7.26
2b- L5	3.43 ± 0.22	43.8 ± 7.76	13.86 ± 6.16
2b- L6	3.55 ± 0.6	40.38 ± 7.55*	14.81 ± 12.08*
Mean value of L	3.51	42.65	14.76

* 1-2 values are missing in a dataset

Study plot 3 – Rudice

As for the study plot 3, the actual soil reaction in 5 cm varied from 3.46 (L5 in June) to 6.59 (Z11 in October) (table 20 in appendix). The average value in agricultural land was 5.79, however 4.16 in forest cover (table 15). In 40 cm, the range was from 3.43 (L5 in June) to 6.52 (Z9 in October) (table 20 in appendix). Average values from agricultural land and forest cover were 5.87 and 4.01 respectively (table 15).

Potential soil reaction in 5 cm was in range from 2.68 (E in April) to 5.44 (L6 in July) (table 25 in appendix). Average values were 4.84 for agricultural land and 3.41 for forest cover (table 15). The lowest measured value was 2.80 in L4 in July and the highest was 5.68 in Z8 in June (table 25 in appendix). The average value for agricultural land was 4.86 and for forest cover was 3.34 (table 15).

Maximal capillary water capacity differed from 27.74 in L6 in March to 67.53 in L3 in August (table 30 in appendix). Average value for agricultural land was 47.89 and for forest cover 48.74 (table 15). Concerning minimal air capacity, the measured values were from -3.76 (Z10 in June) to 31.48 (L3 in October) (table 35 in appendix). Average value for agricultural land was 4.36 and for forest cover 15.88 (table 15).

Both soil reaction in both depths have similar trend, slightly ascending to the ecotone, then rapidly descending to L2 and then slightly descending to L6 (fig. 19). In case of maximal capillary water capacity, the curve of average values is almost parallel to axis x, only with peak in L4. Minimal air capacity has ascending trend, but average values of individual sampling spots are fluctuating (fig. 20).

Table 15 Results from laboratory analyses with mean values for each sampling spot for the entire period and with standard deviation (R Core Team, 2016)

Sample	**pH/H20 in 5 cm**	**pH/H20 in 40 cm**	**pH/KCl in 5 cm**
3 - Z12	5.78 ± 0.34	5.7 ± 0.36	4.82 ± 0.32
3 - Z11	5.94 ± 0.4	5.73 ± 0.38	4.87 ± 0.22
3 - Z10	5.68 ± 0.57	5.98 ± 0.11	4.77 ± 0.54
3 - Z9	5.81 ± 0.39	5.99 ± 0.33	4.93 ± 0.27
3 - Z8	5.75 ± 0.31	5.94 ± 0.34	4.82 ± 0.31
Mean value of Z	5.79	5.87	4.84
3- L2	4.49 ± 0.37	4.25 ± 0.4	3.77 ± 0.44
3 - E	5.92 ± 0.58	5.53 ± 0.4	4.9 ± 0.48
3 - L3	4.58 ± 0.73	4.1 ± 0.42	3.8 ± 0.35
3 - L4	4.09 ± 0.38	3.99 ± 0.36	3.34 ± 0.29
3 - L5	3.88 ± 0.34	3.76 ± 0.28	3.12 ± 0.28
3 - L6	3.74 ± 0.2	3.96 ± 0.25	3.04 ± 0.18
Mean value of L	4.16	4.01	3.41
Sample	**pH/KCl in 40 cm**	**MKK**	**AMKK**
3 - Z12	4.68 ± 0.39	48.75 ± 4.08	2.32 ± 3.34
3 - Z11	4.81 ± 0.25	45.97 ± 3.4	9.42 ± 7.95
3 - Z10	4.85 ± 0.31	47.92 ± 3.55	1.82 ± 3.88
3 - Z9	4.86 ± 0.42	48.27 ± 4.14	4.74 ± 7.65
3 - Z8	5.1 ± 0.28	48.55 ± 2.6	3.51 ± 4.27
Mean value of Z	4.86	47.892	4.36
3- L2	3.45 ± 0.21	47.17 ± 8.89	12.85 ± 10.47
3 - E	4.48 ± 0.51	47.98 ± 2.93	7.81 ± 5.47
3 - L3	3.35 ± 0.28	47.88 ± 11.5	18.36 ± 11.23
3 - L4	3.33 ± 0.23	55.11 ± 8.92*	13.69 ± 5.84*
3 - L5	3.33 ± 0.11	49.64 ± 9.51	15.37 ± 4.71
3 - L6	3.26 ± 0.18	43.89 ± 13.61*	19.15 ± 7.56*
Mean value of L	3.34	48.74	15.88

* 1-2 values are missing in a dataset

Study plot 4 – Křtiny

Actual soil reaction in 5 cm varied from 3.80 (L6 in September) to 6.72 (L6 in March) (table 21 in appendix). The average value from agricultural land was 5.89 and under forest cover 5.87 (table 16). In case of depth of 40 cm, the range was 4.40-6.53. The lowest value was in L4 in July and the highest in Z10 in July (table 21 in appendix). Average values from agricultural land and from soil under forest cover were 5.51 and 5.50 respectively (table 16).

As for potential soil reaction, values of pH in 5 cm varied from 3.17 (L6 in July) to 6.21 (L6 in April). The average value in agricultural land was 4.91 and in soil under forest cover was 4.96 (table 16). Values ranged between 3.16 (L4 in July) and 6.19 (L6 in April) in 40 cm (table 26 in appendix). Average values for agricultural land and forest cover were 4.42 and 4.47 respectively (table 16).

Maximal capillary water capacity varied from 22.96 (L5 in May) to 54.57 (L5 in November) (table 31 in appendix). The average value in agricultural land was 36.66 and in soil under forest cover was 36.12 (table 16). As for minimal air capacity, the values were in range from -4.64 (E in June) to 32.38 (L5 in November) (table 36 in appendix). Average values were 12.22 for agricultural land and 19.08 for soil under forest cover (table 16).

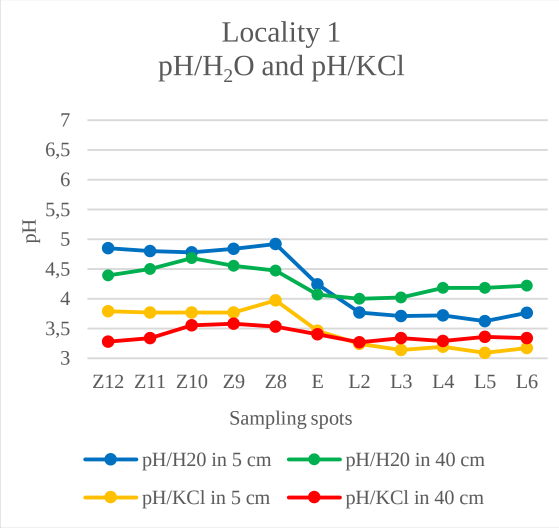
Both soil reaction in both depths have similar slightly descending trend with minor fluctuations in soil under forest cover (fig. 21). In case of Θ_{MKK}, the curve is slightly descending down to L2, then ascending up to L6.Opossite trend can be seen in minimal air capacity. Curve is ascending up to L2, then going down to L6 (fig. 22).

Table 16 Results from laboratory analyses with mean values for each sampling spot for the entire period and with standard deviation (R Core Team, 2016)

Sample	pH/H20 in 5 cm	pH/H20 in 40 cm	pH/KCl in 5 cm
4 - Z12	6.03 ± 0.47	5.7 ± 0.4	5.14 ± 0.27
4 - Z11	6.07 ± 0.26	5.82 ± 0.25	5.11 ± 0.29
4 - Z10	5.92 ± 0.31	5.6 ± 0.49	4.99 ± 0.3
4 - Z9	5.73 ± 0.5	5.08 ± 0.43	4.66 ± 0.34
4 - Z8	5.7 ± 0.52	5.36 ± 0.44	4.66 ± 0.32
Mean value of Z	5.89	5.51	4.91
4 - E	5.53 ± 0.21	5.34 ± 0.25	4.51 ± 0.33
4 - L2	6.11 ± 0.3	5.54 ± 0.29	5.08 ± 0.44
4 - L3	6.02 ± 0.37	5.72 ± 0.24	5.1 ± 0.5
4 - L4	5.81 ± 0.42	5.15 ± 0.46	4.96 ± 0.38
4 - L5	5.79 ± 0.17	5.47 ± 0.35	4.85 ± 0.44
4 - L6	5.61 ± 0.98	5.64 ± 0.52	4.83 ± 1.24
Mean value of L	5.87	5.50	4.96
Sample	**pH/KCl in 40 cm**	**MKK**	**AMKK**
4 - Z12	4.62 ± 0.22	37.94 ± 5.49	9.79 ± 6.65
4 - Z11	4.8 ± 0.34	37.68 ± 4.41	11.55 ± 4.75
4 - Z10	4.34 ± 0.29	35.48 ± 4.28	11.06 ± 7.77
4 - Z9	4.04 ± 0.27	35.94 ± 4.79	15.15 ± 6.49
4 - Z8	4.29 ± 0.33	36.25 ± 3.08	13.57 ± 3.4
Mean value of Z	4.42	36.66	12.22
4 - E	4.17 ± 0.18	29.93 ± 3.31	18.93 ± 9.41
4 - L2	4.5 ± 0.57	28.98 ± 3.93*	21.31 ± 4.55*
4 - L3	4.74 ± 0.47	34.22 ± 4.11*	19.45 ± 5.94*
4 - L4	4.05 ± 0.56	36.72 ± 4.59*	19.54 ± 5.91*
4 - L5	4.35 ± 0.42	38.57 ± 10.57*	17.31 ± 9.76*
4 - L6	4.71 ± 0.63	42.13 ± 6.63*	17.8 ± 8.94*
Mean value of L	4.47	36.12	19.08

* 1-2 values are missing in a dataset

Study plot 1



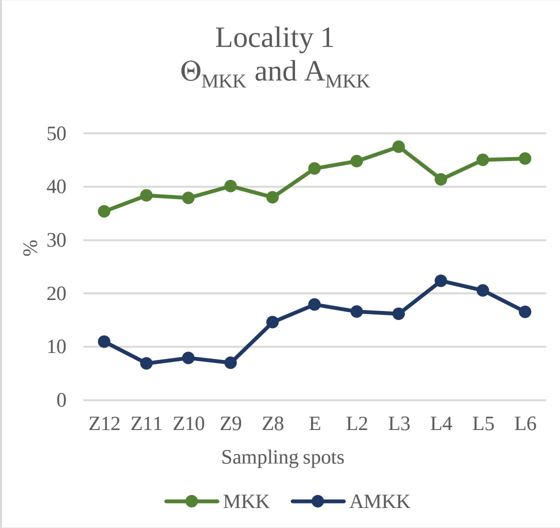
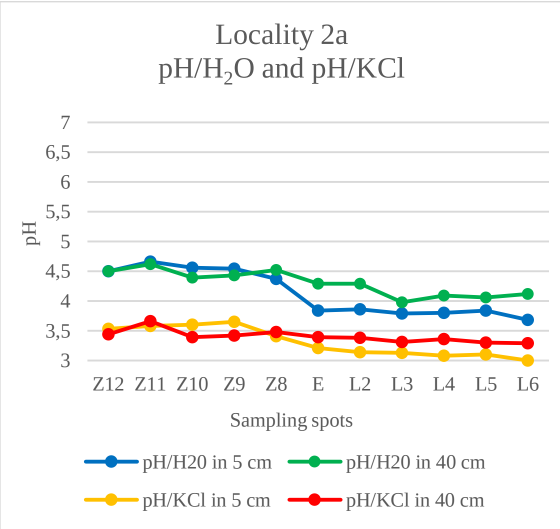


Fig. 13 Mean values of actual soil reaction from 5 and 40 cm of depth and potential soil reaction from 5 and 40 cm of depth from study plot 1 (left)

Fig. 14 Mean values of maximal capillary water capacity and minimal air capacity from study plot 1 (right)

Study plot 2a



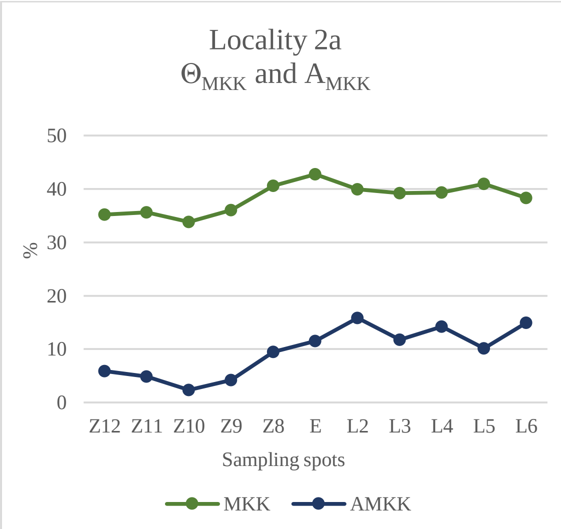
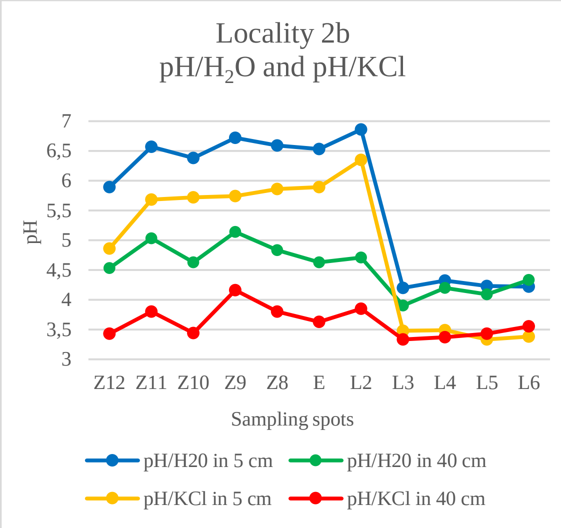


Fig. 15 Mean values of actual soil reaction from 5 and 40 cm of depth and potential soil reaction from 5 and 40 cm of depth from study plot 2a (left)

Fig. 16 Mean values of maximal capillary water capacity and minimal air capacity from study plot 2a (right)

Study plot 2b



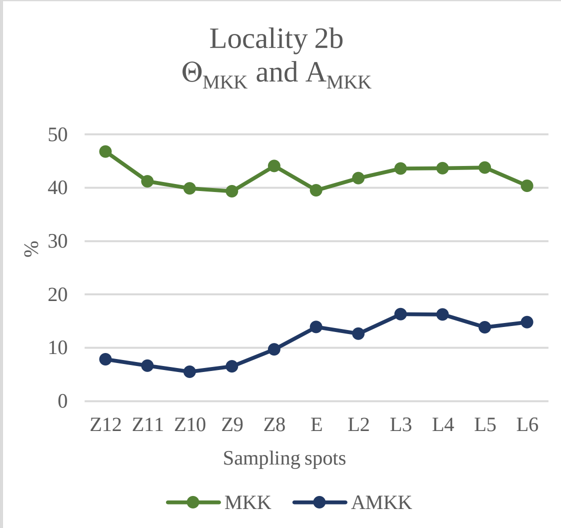
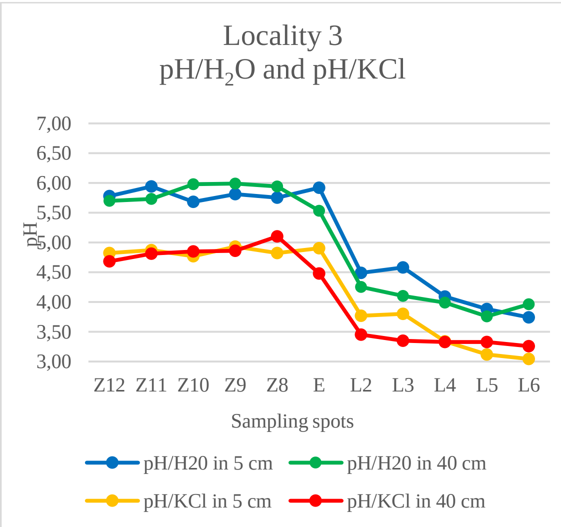


Fig. 17 Mean values of actual soil reaction from 5 and 40 cm of depth and potential soil reaction from 5 and 40 cm of depth from study plot 2b (left)

Fig. 18 Mean values of maximal capillary water capacity and minimal air capacity from study plot 2b (right)

Study plot 3



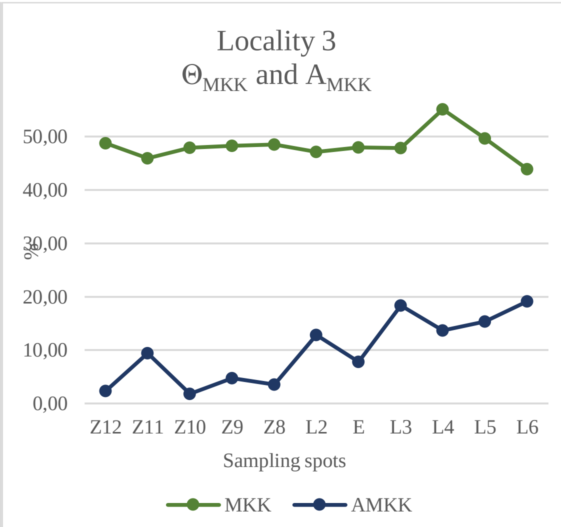
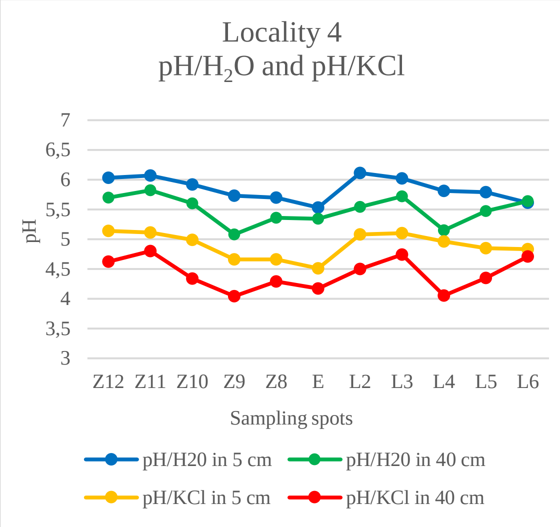


Fig. 19 Mean values of actual soil reaction from 5 and 40 cm of depth and potential soil reaction from 5 and 40 cm of depth from study plot 3 (left)

Fig. 20 Mean values of maximal capillary water capacity and minimal air capacity from study plot 3 (right)

Study plot 4



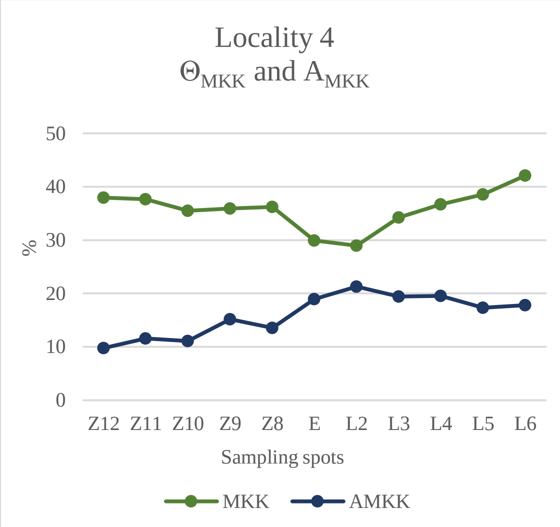


Fig. 21 Mean values of actual soil reaction from 5 and 40 cm of depth and potential soil reaction from 5 and 40 cm of depth from study plot 4 (left)

Fig. 22 Mean values of maximal capillary water capacity and minimal air capacity from study plot 4 (right)

5.2. Seasonal dynamics of soil properties

5.2.1. Actual soil reaction in 5 cm

In case of actual soil reaction in 5 cm of depth, the smallest seasonal fluctuations were in study plot 1 (fig. 23), wettest study plot. On the contrary, significant differences within vegetation period can be seen in the driest study plot (4) (fig 25).

As can be seen in fig. 25, the biggest difference between agricultural land and forest cover was in study plot 3. On the contrary, study plot 4 had very small differences between agricultural land and soil under forest cover in case of actual soil reaction in 5 cm (fig. 46). All study plots had descending trend values going from agricultural land to forest cover (figures 23-26).

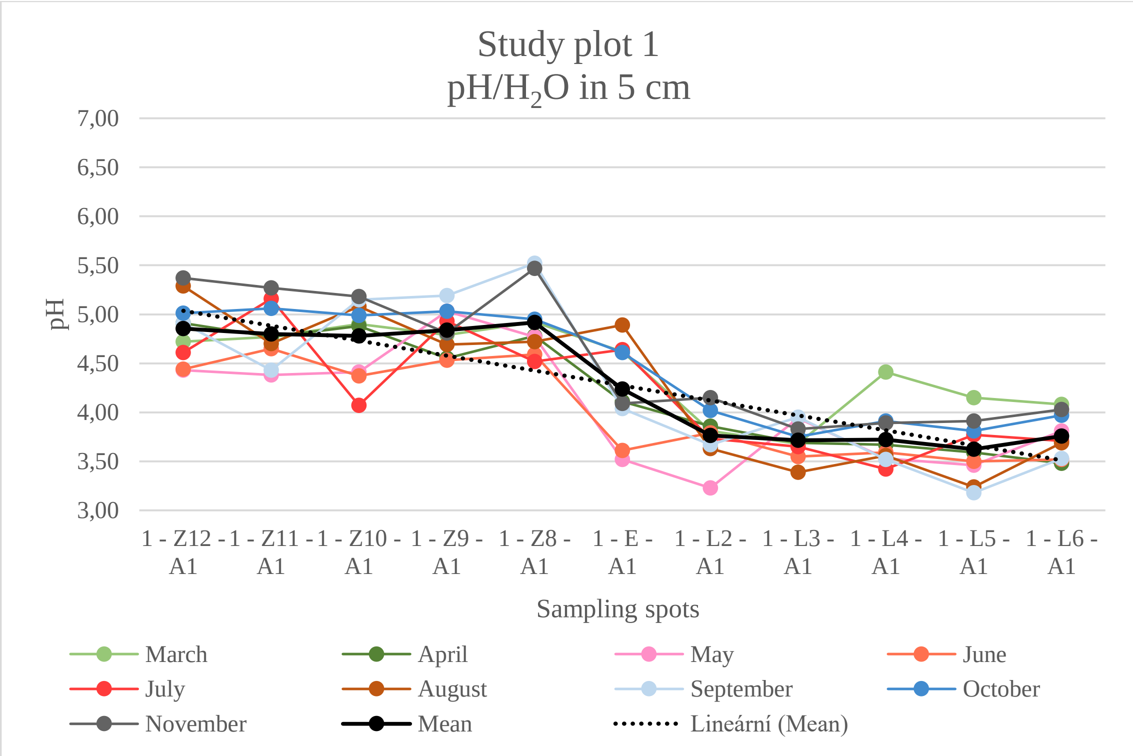


Fig. 23 Chart of monthly values with mean values and exponential trendline of the wettest study plot

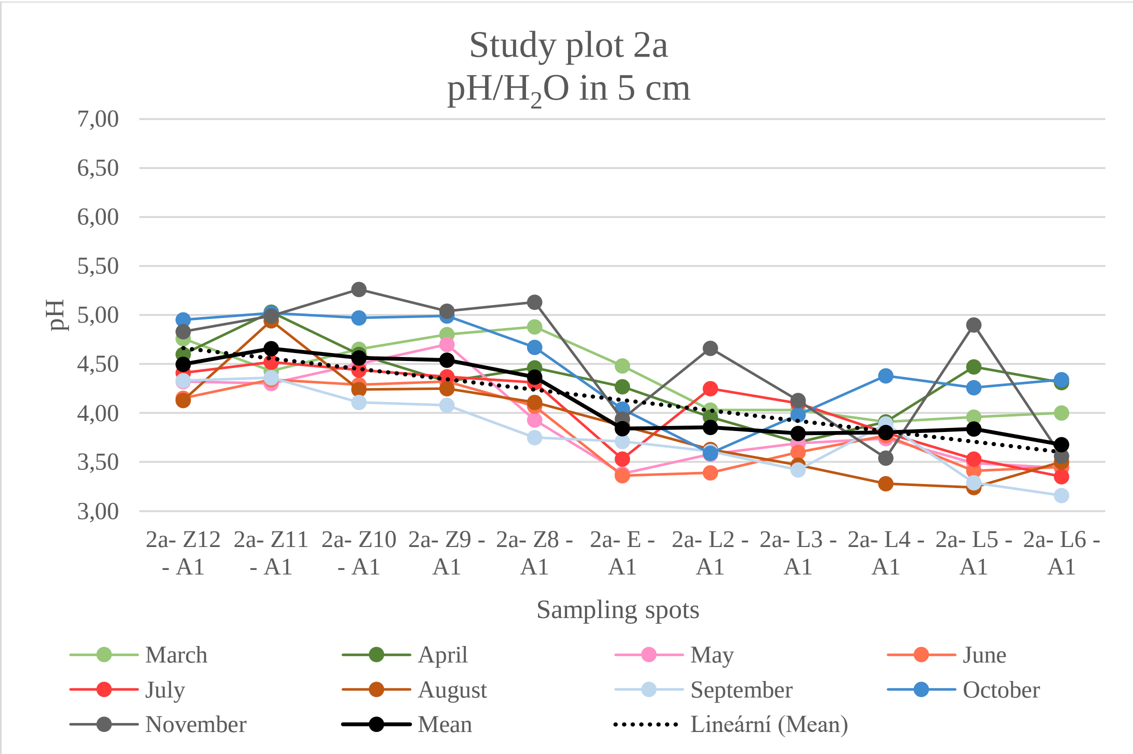


Fig. 24 Chart of monthly values with mean values and exponential trendline of the coldest study plot

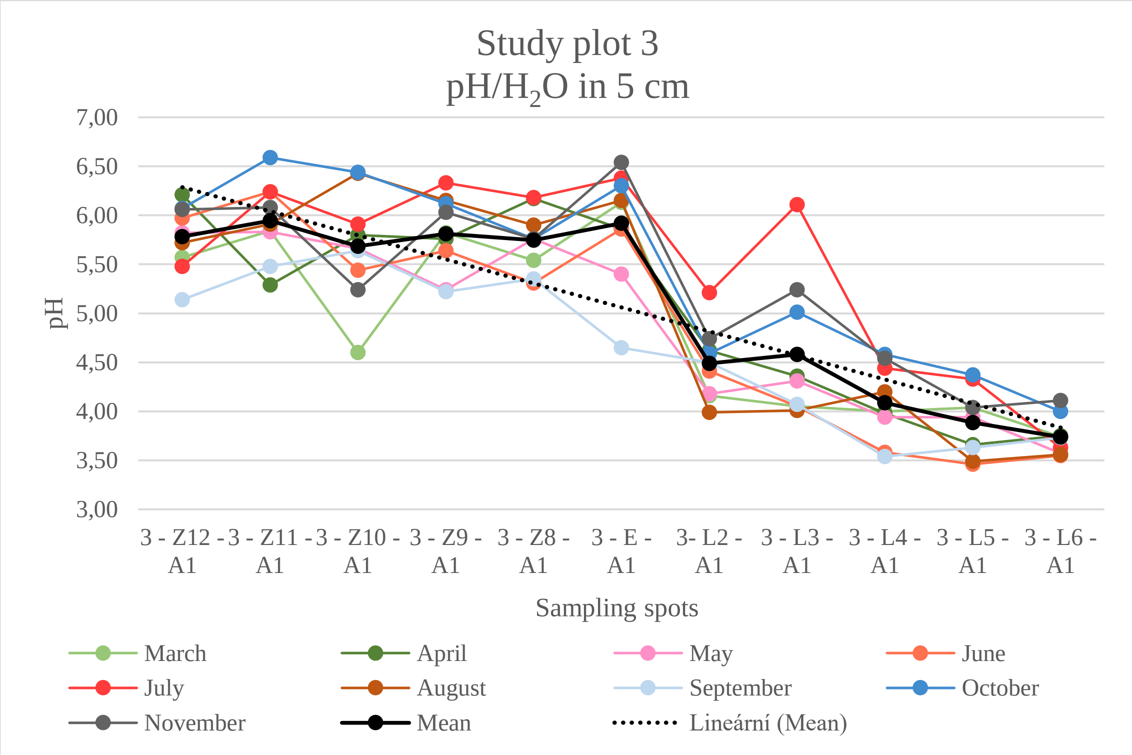


Fig. 25 Chart of monthly values with mean values and exponential trendline of the driest study plot

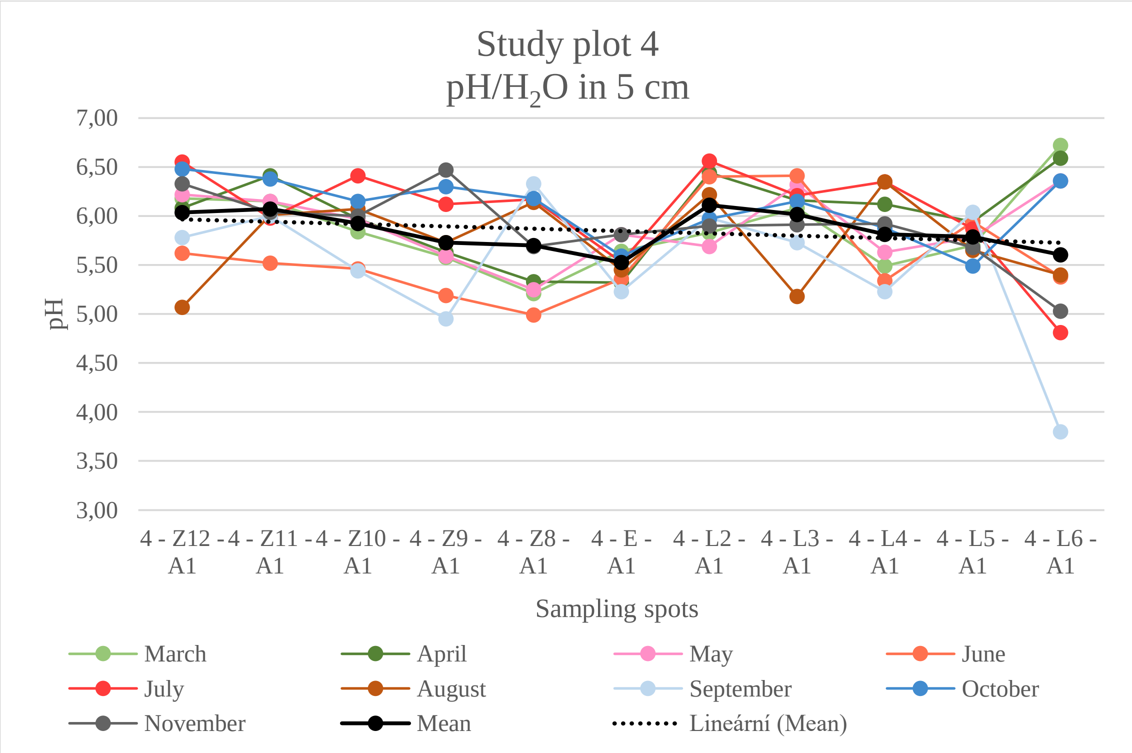


Fig. 26 Chart of monthly values with mean values and exponential trendline of the warmest study plot

5.2.2. Actual soil reaction in 40 cm

As can be seen, the least influence of climate on actual soil reaction in 40 was in study plot 2a (the coldest) (fig. 28). The strongest influence was in the warmest plot (study plot 4) (fig. 30).

Again, the biggest differences in values of pH between agricultural land and forest cover were in study plot 3 (fig. 29). Study plot 4 shown minor differences between those two different land uses. All four study plots shown descending trend from agricultural land to forest cover (figures 27-30)

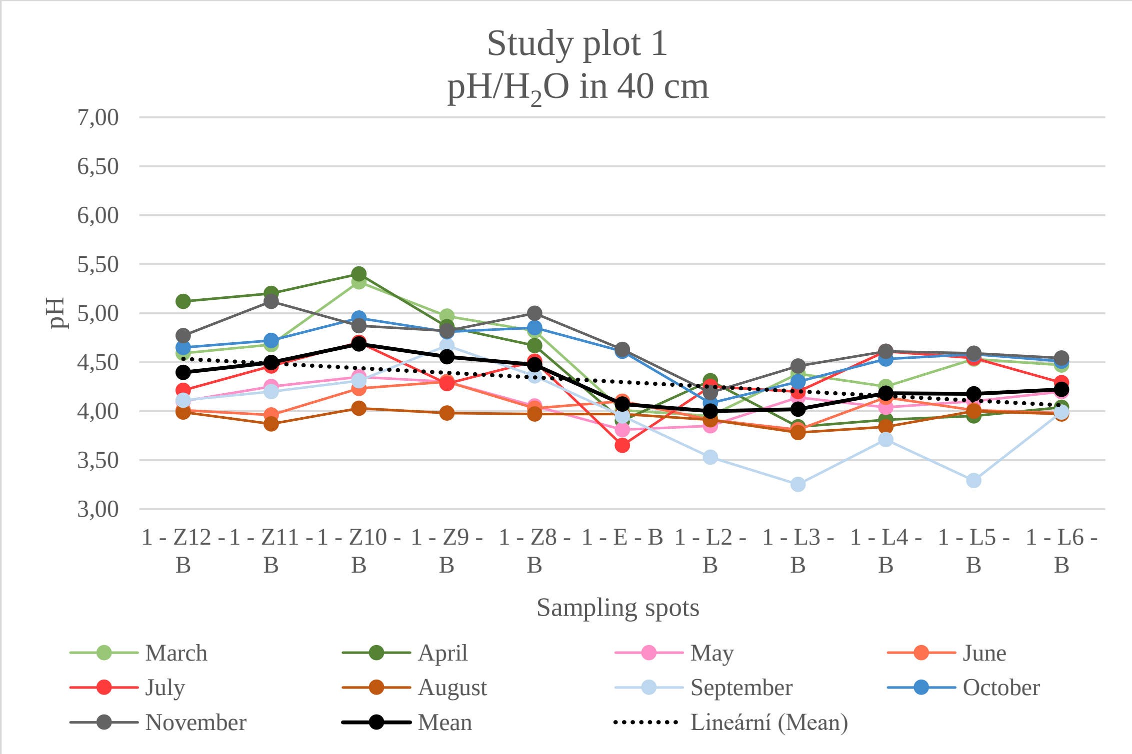


Fig. 27 Chart of monthly values with mean values and exponential trendline of the wettest study plot

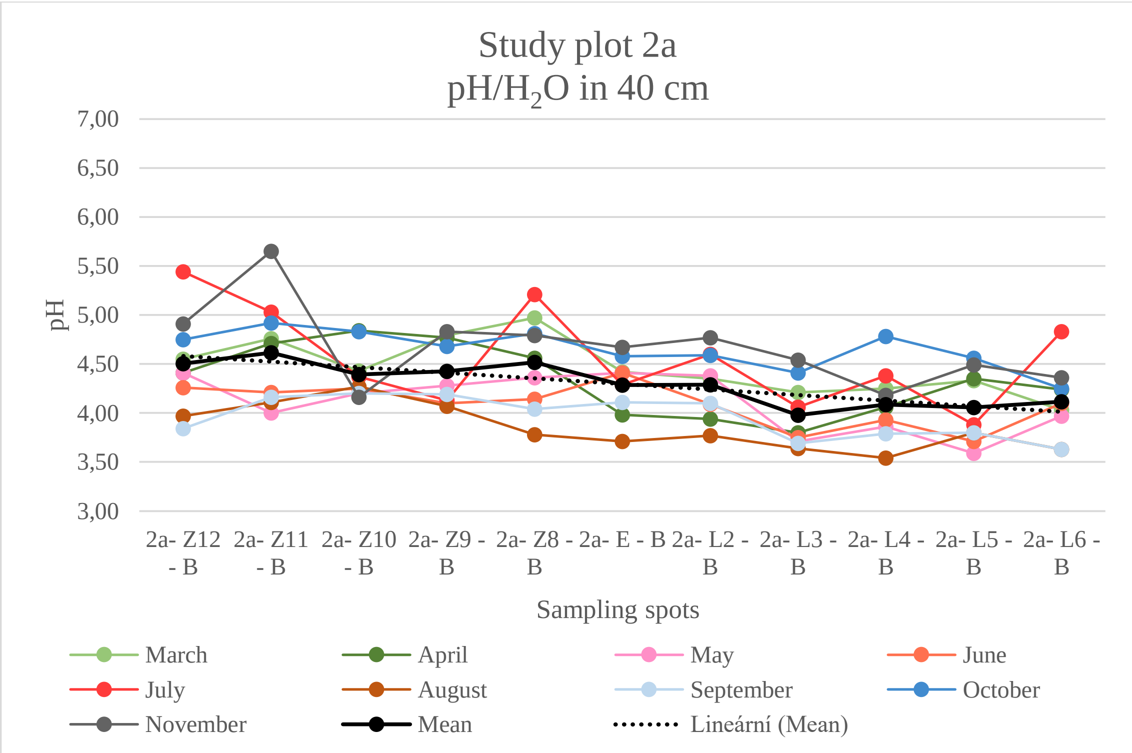


Fig. 28 Chart of monthly values with mean values and exponential trendline of the coldest study plot

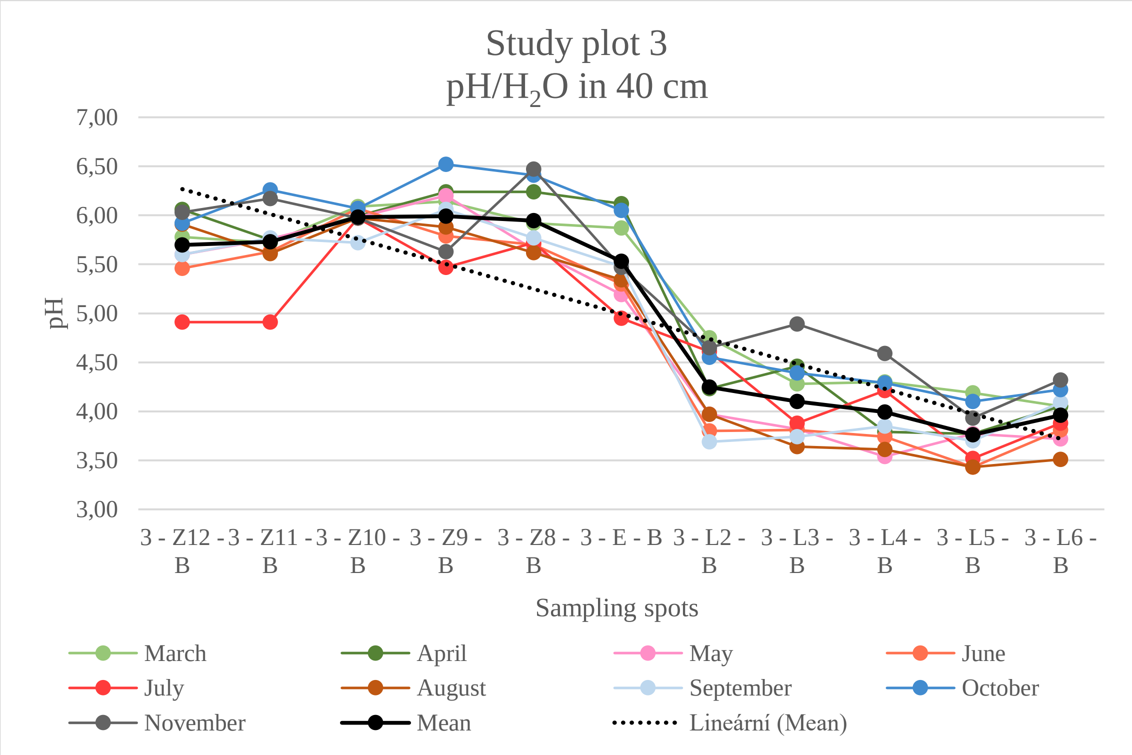


Fig. 29 Chart of monthly values with mean values and exponential trendline of the driest study plot

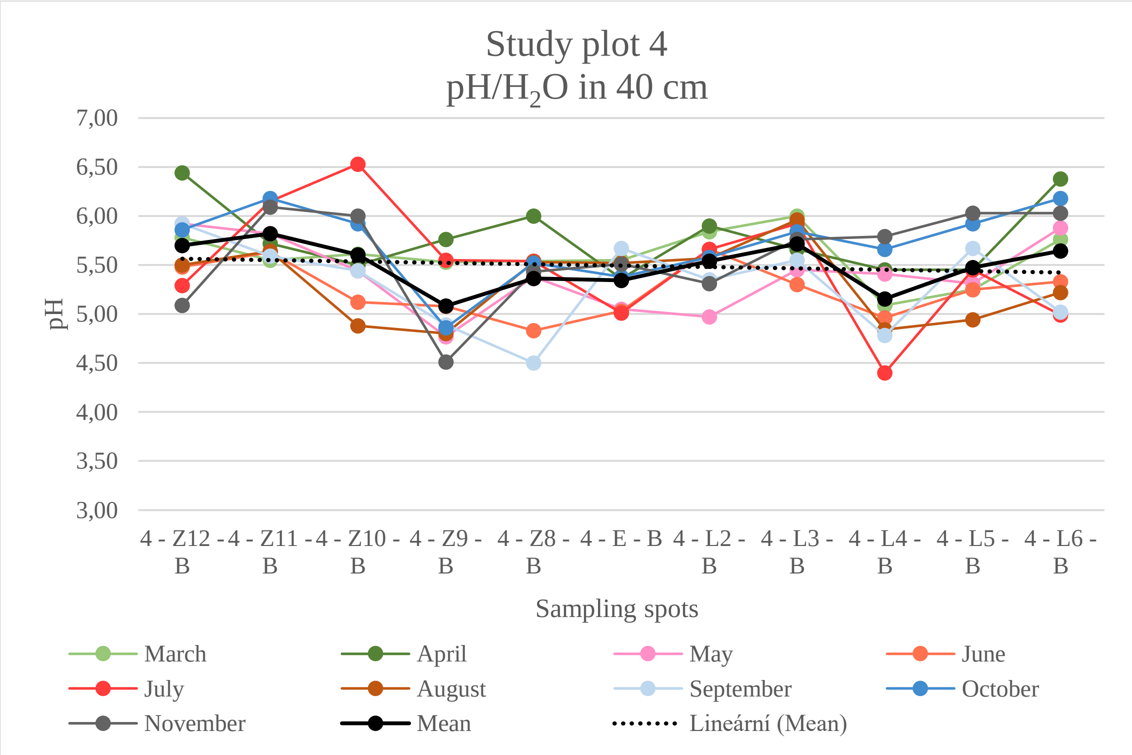


Fig. 30 Chart of monthly values with mean values and exponential trendline of the warmest study plot

5.2.3. Potential soil reaction in 5 cm

Charts show similar behaviour as in case of actual soil reaction. And both study plots 2a and 3 had similar behaviour. On the contrary, the biggest fluctuation were in study plot 4 (figures 31-34).

All study plots shown descending trend (figures 31-34). As in case of actual soil reaction, study plot 3 had big differences between values of pH in agricultural area and in soil under forest cover (fig. 33). Trend of study plot 4 is very slightly descending, but values of pH are in a smaller range in agricultural land. On the contrary, values of pH in forest cover are in a bigger range (fig. 34).

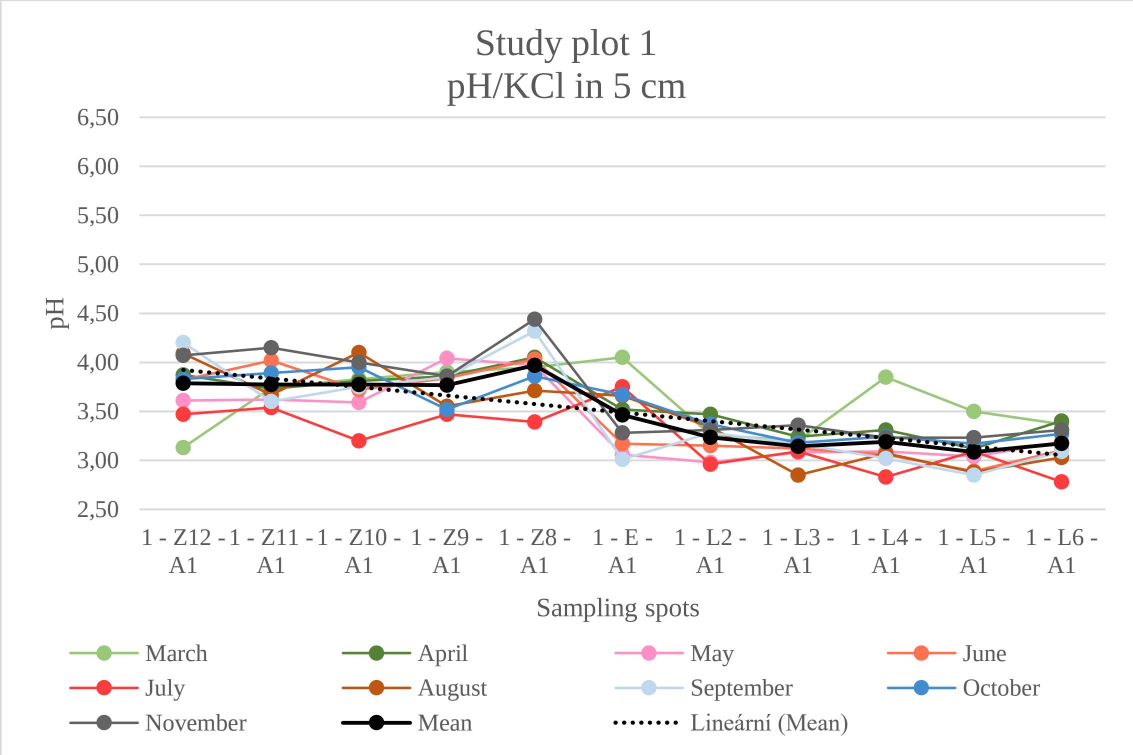


Fig. 31 Chart of monthly values with mean values and exponential trendline of the wettest study plot

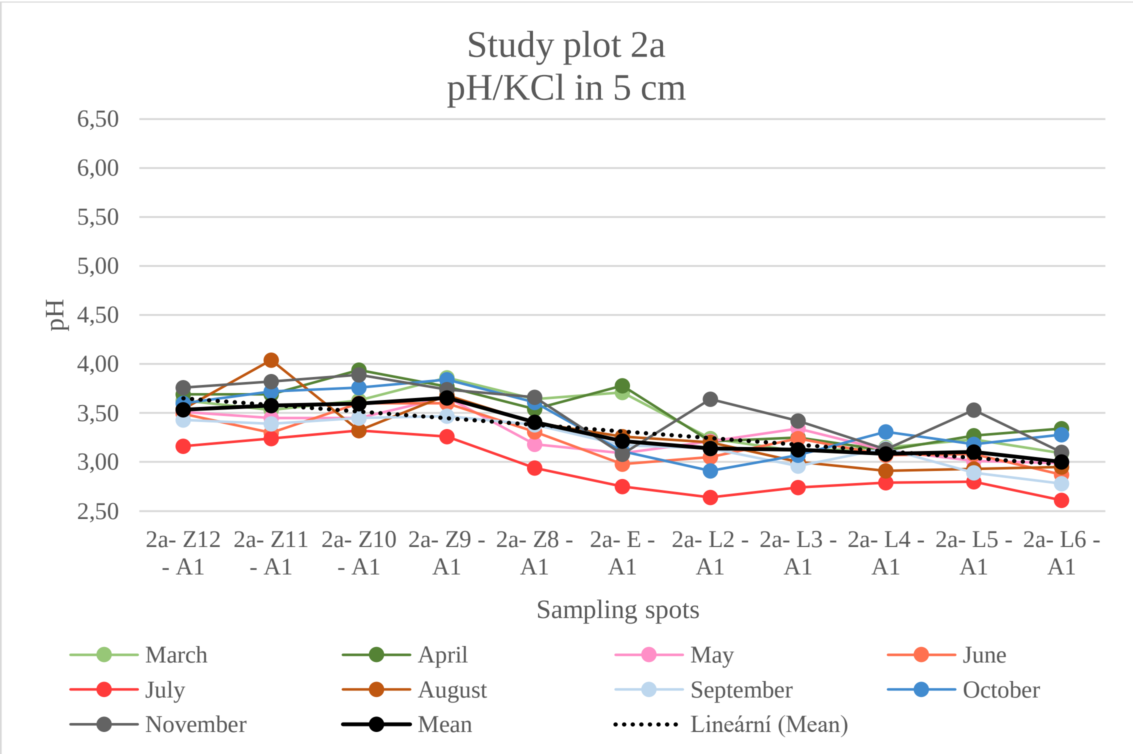


Fig. 32 Chart of monthly values with mean values and exponential trendline of the coldest study plot

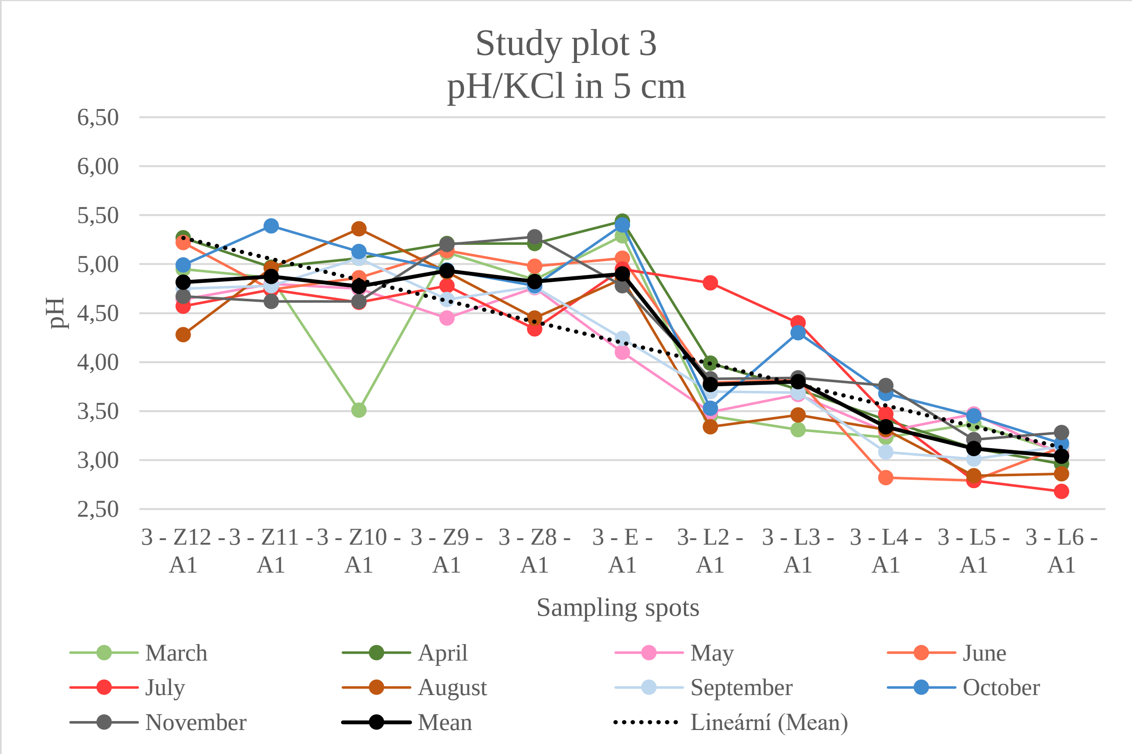


Fig. 33 Chart of monthly values with mean values and exponential trendline of the driest study plot

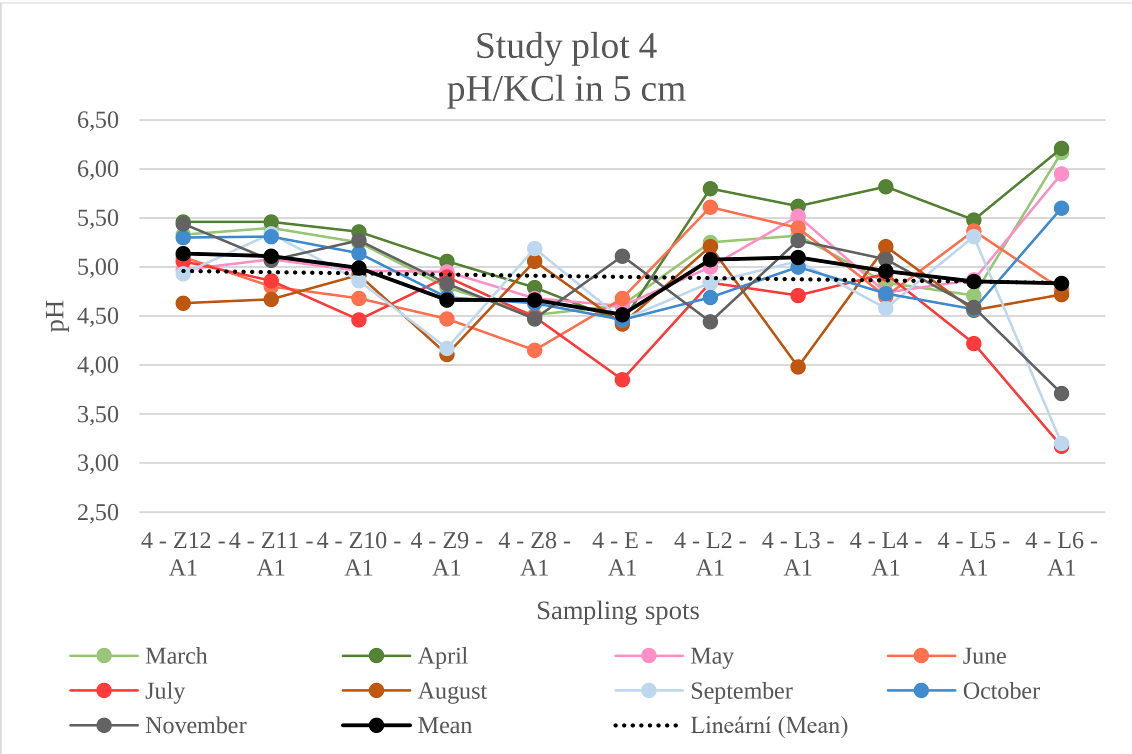


Fig. 34 Chart of monthly values with mean values and exponential trendline of the warmest study plot

5.2.4. Potential soil reaction in 40 cm

The biggest dependence on seasonal dynamics in in study plot 4, the warmest (fig. 38).

All study plots had descending trend, but only study plot 3 had major differences between agriculture land and forest cover (fig. 55). Study plots 1 and 2a had almost the same values at both sides, but in case of agricultural land the values were in bigger range (figures 35 and 36). Study plot 4 had a big range of pH values in soil under forest cover (fig. 38).

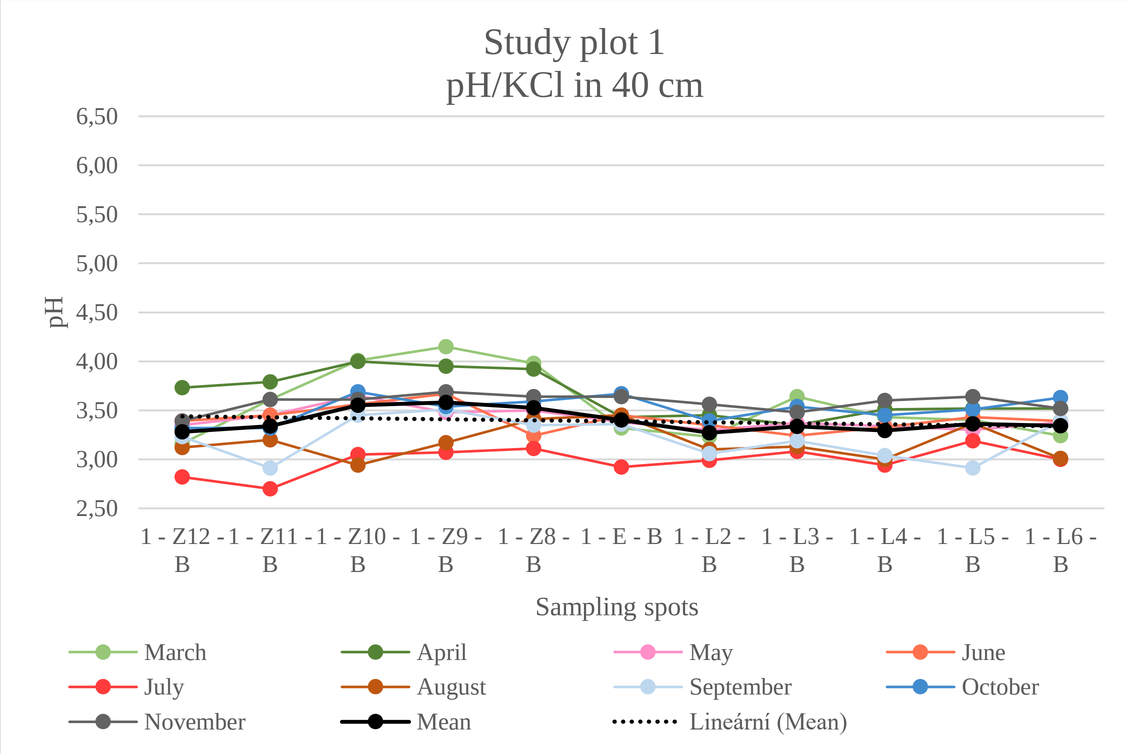


Fig. 35 Chart of monthly values with mean values and exponential trendline of the wettest study plot

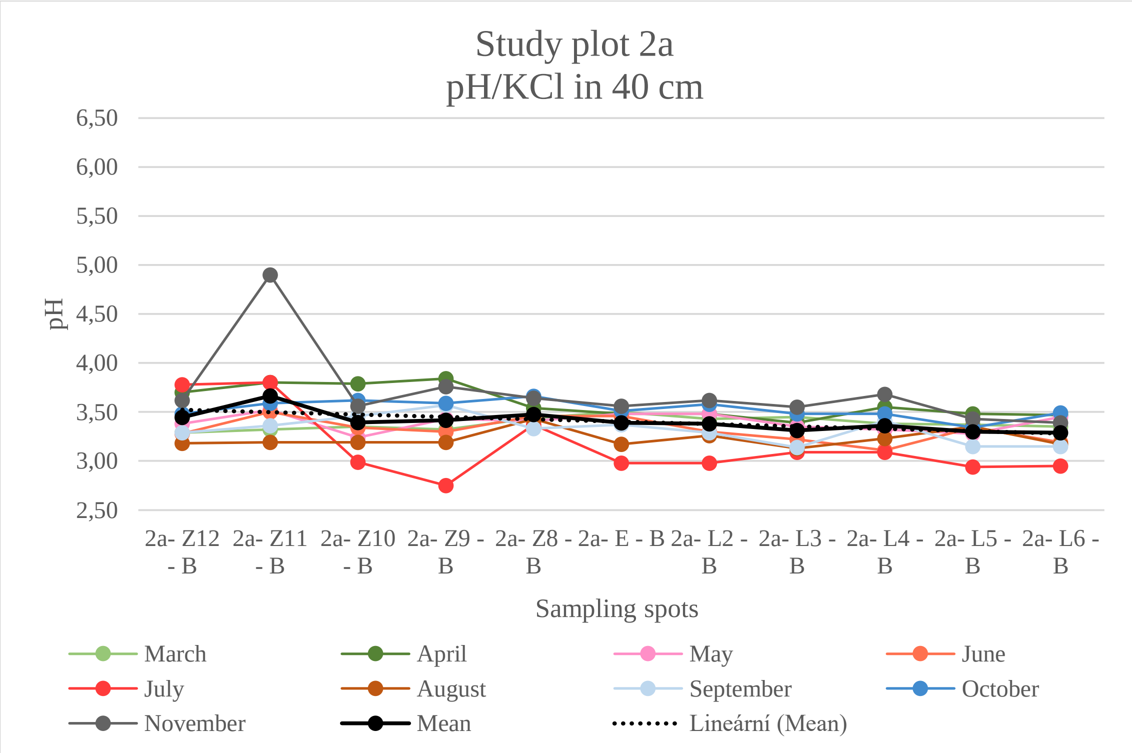


Fig. 36 Chart of monthly values with mean values and exponential trendline of the coldest study plot

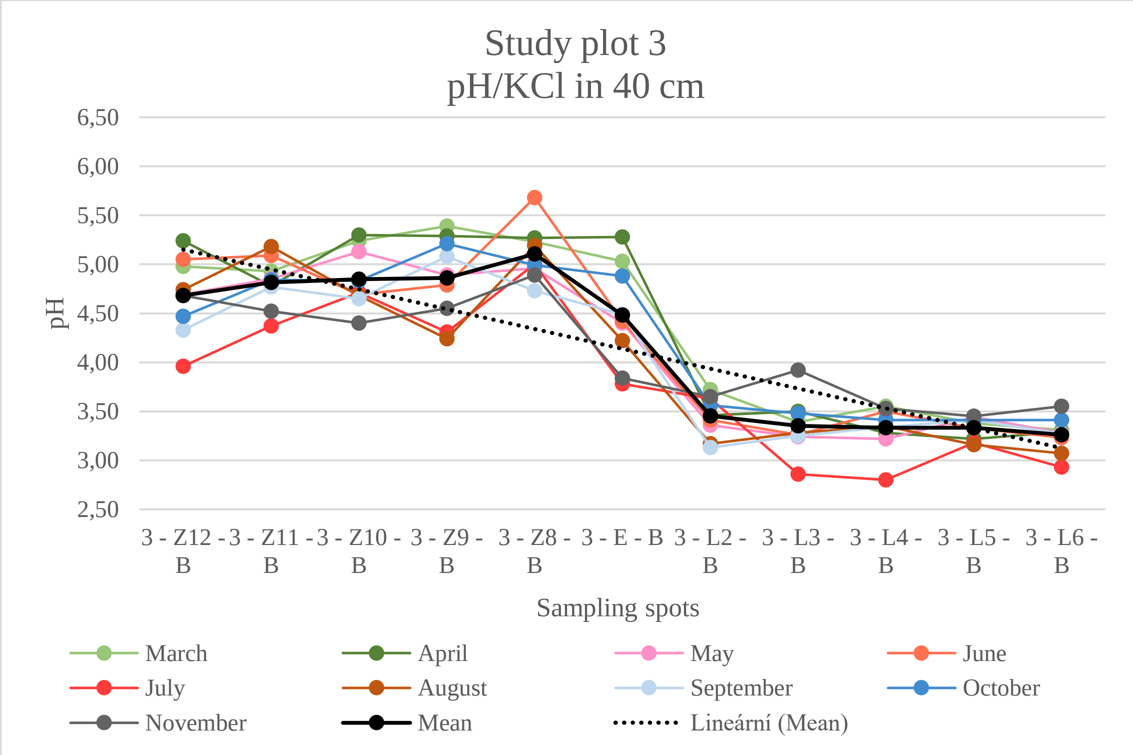


Fig. 37 Chart of monthly values with mean values and exponential trendline of the driest study plot

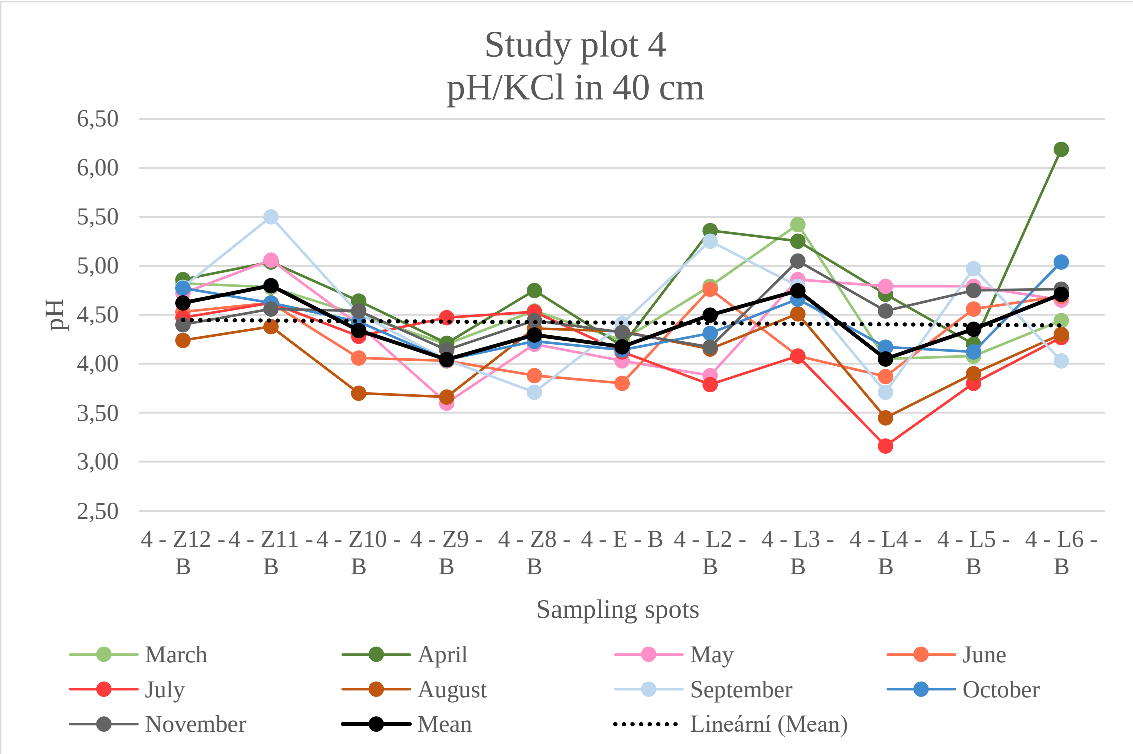


Fig. 38 Chart of monthly values with mean values and exponential trendline of the warmest study plot

5.2.5. Maximal capillary water capacity

The slightest influence of seasonal dynamics was in study plot 4 (fig. 42). It is also evident, that soil under forest cover are more dependent on climate that soils of agriculture land (figures 39-42).

All study plots had ascending trend (figures 39-42). Study plots 1, 2a and 3 had big range of values in soil under forest cover.

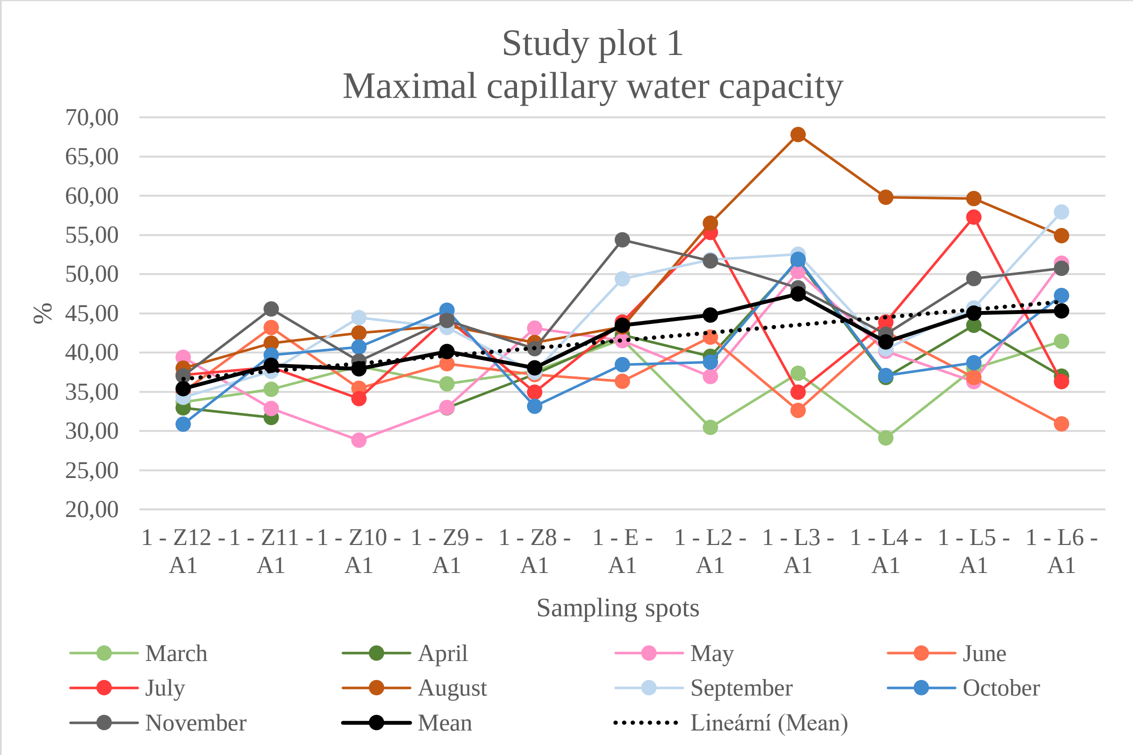


Fig. 39 Chart of monthly values with mean values and exponential trendline of the wettest study plot

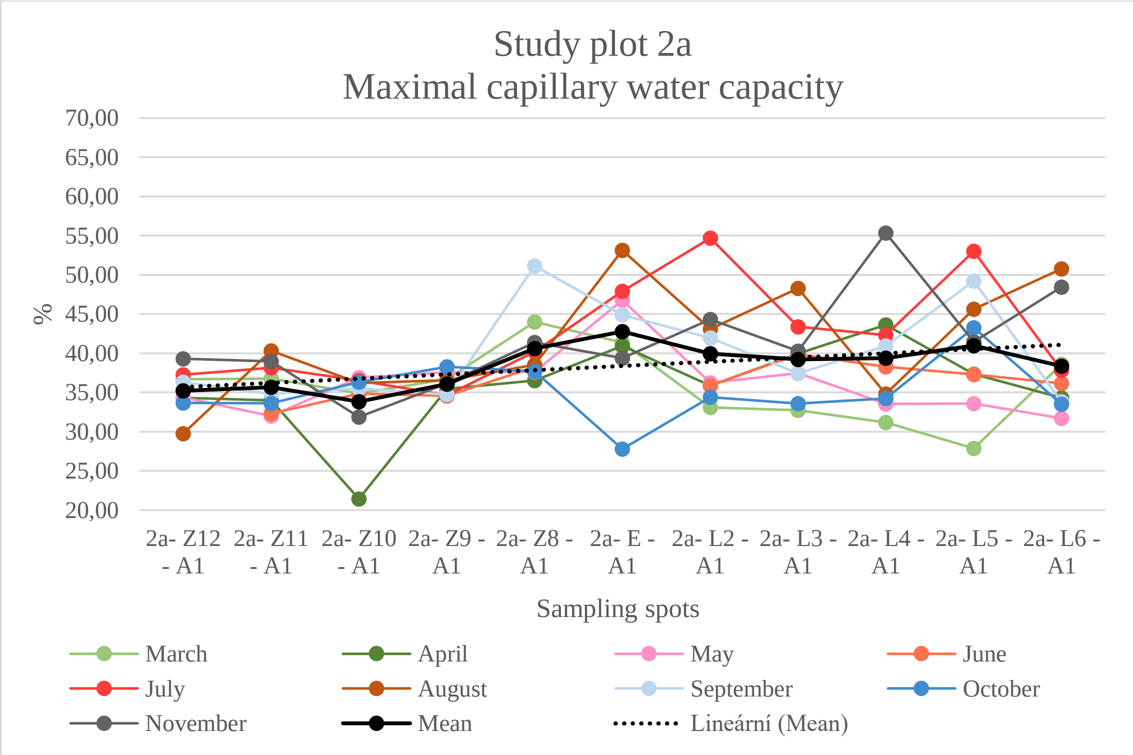


Fig. 40 Chart of monthly values with mean values and exponential trendline of the coldest study plot

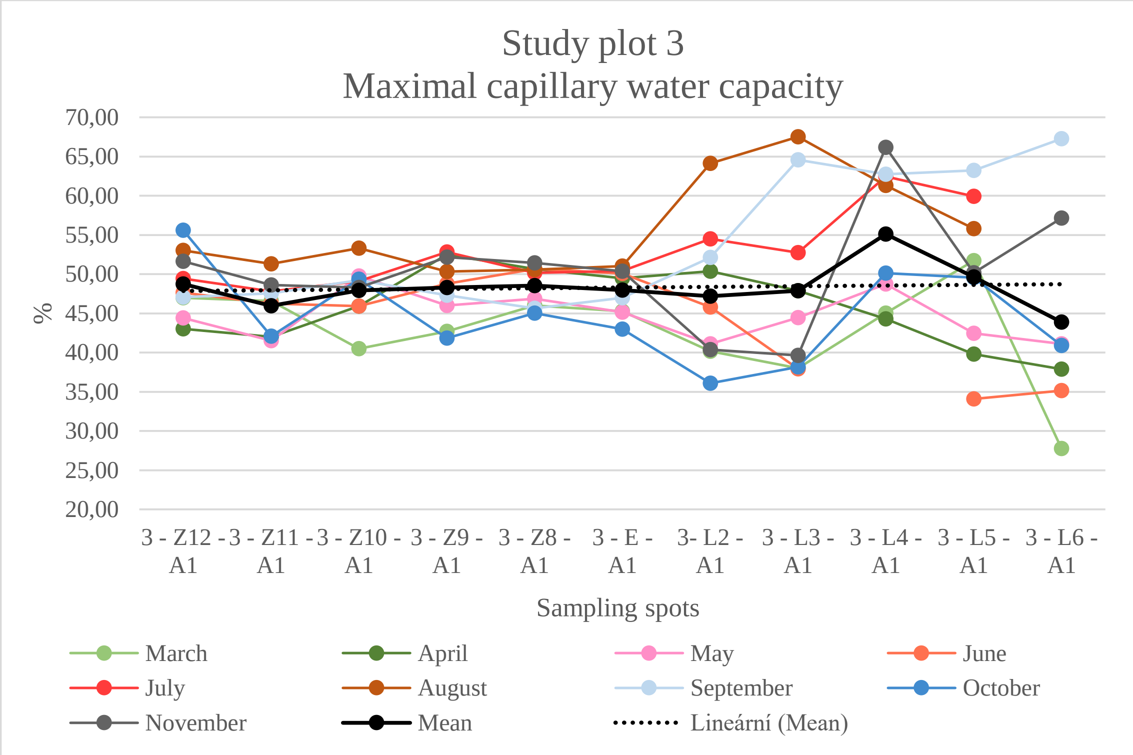


Fig. 41 Chart of monthly values with mean values and exponential trendline of the driest study plot

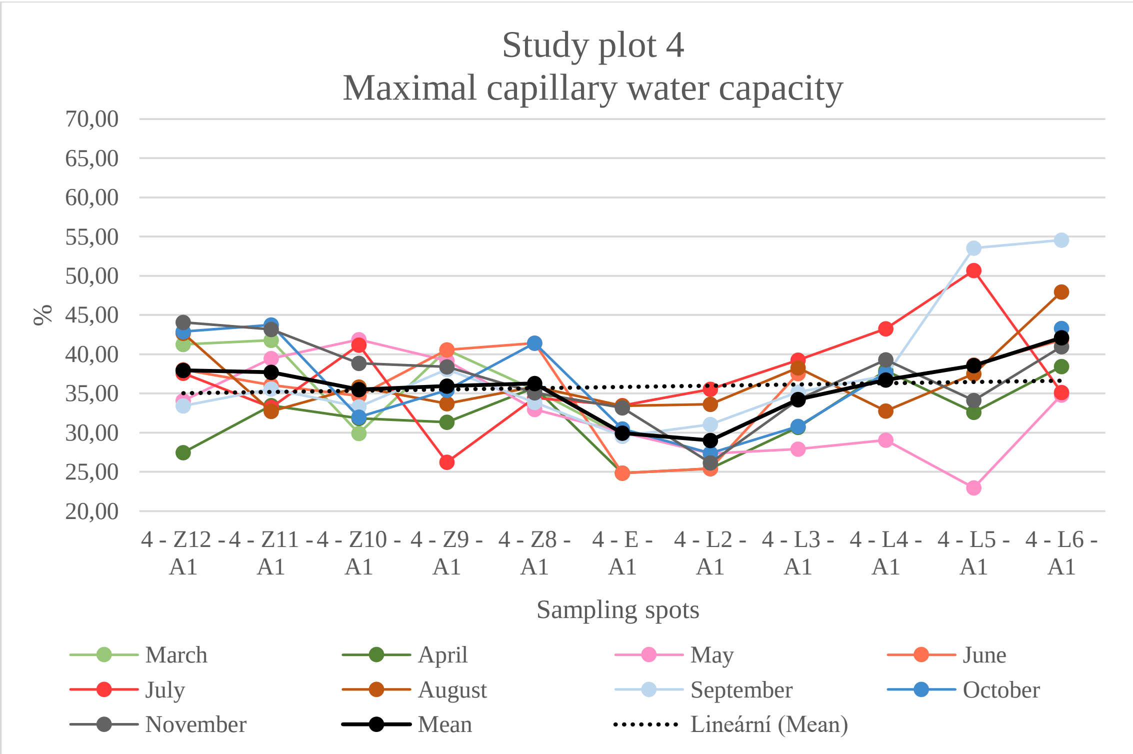


Fig. 42 Chart of monthly values with mean values and exponential trendline of the warmest study plot

5.2.6. Minimal air capacity

The smallest influence of climate is in the study plot 4 (fig. 46).

All study plots had ascending trend (figures 43-46).

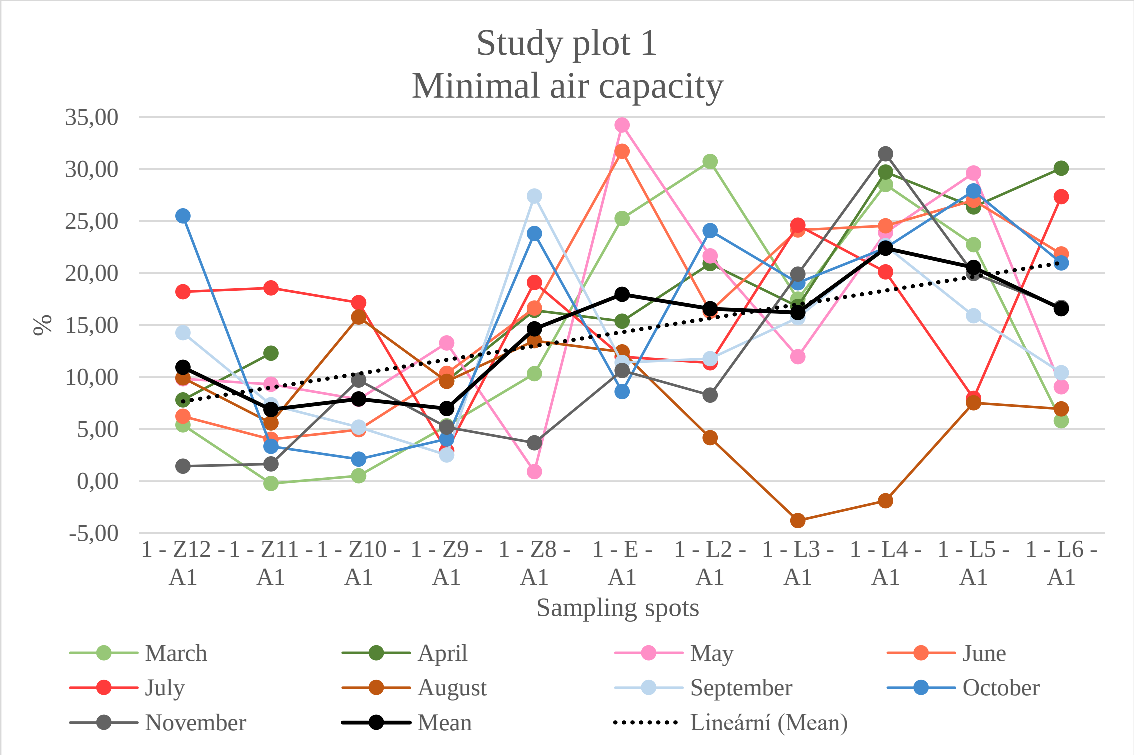


Fig. 43 Chart of monthly values with mean values and exponential trendline of the wettest study plot

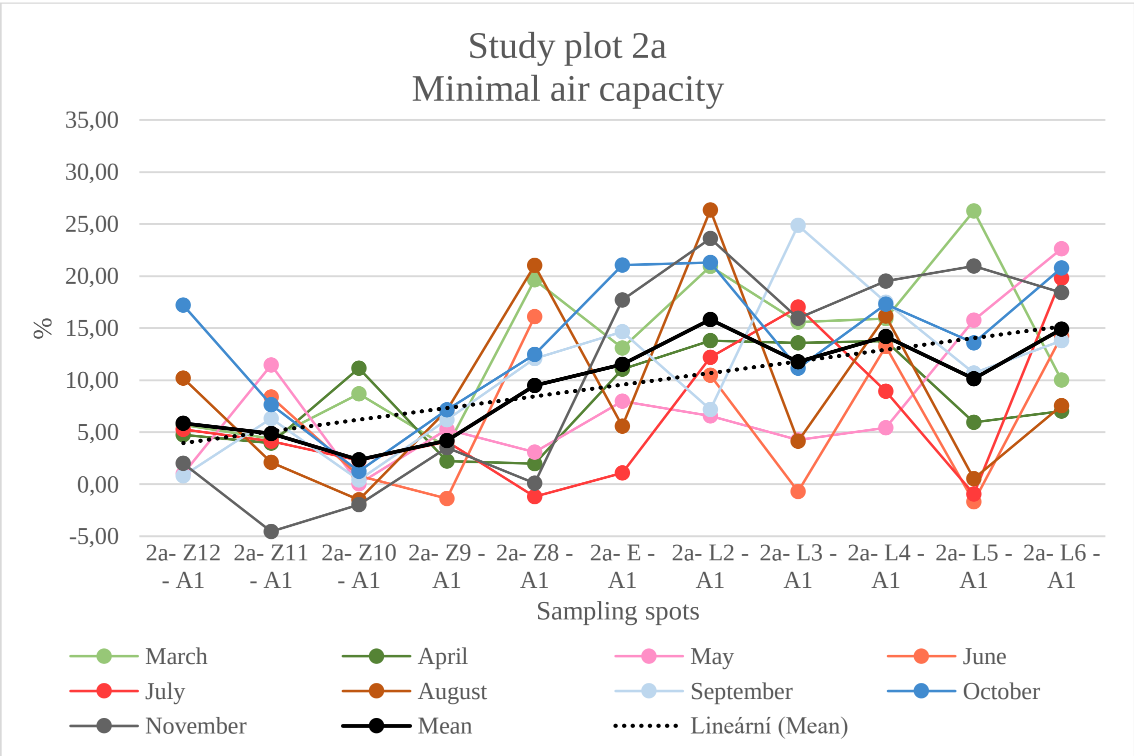


Fig. 44 Chart of monthly values with mean values and exponential trendline of the coldest study plot

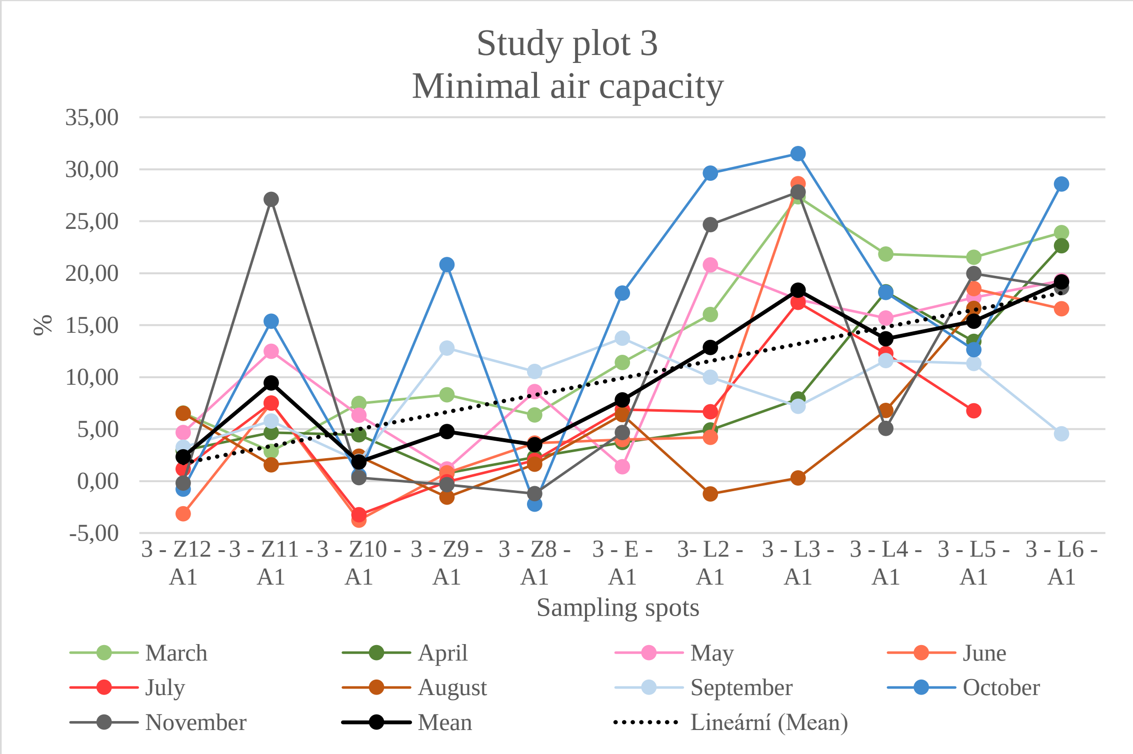


Fig. 45 Chart of monthly values with mean values and exponential trendline of the driest study plot

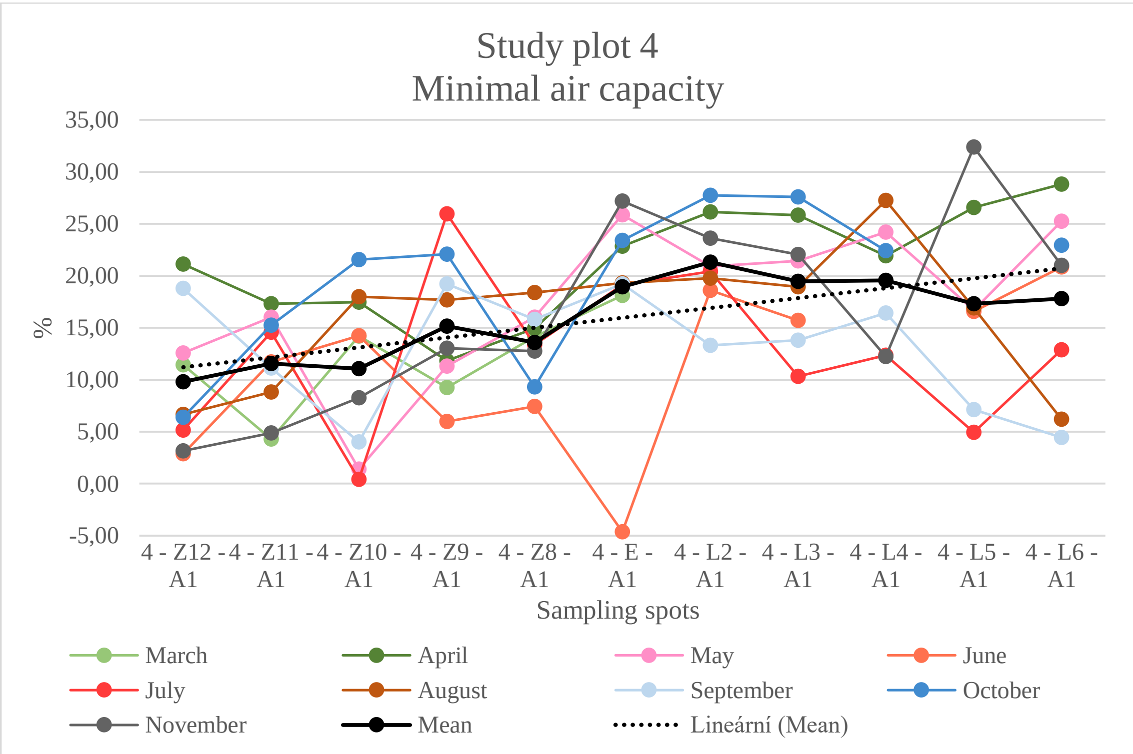


Fig. 46 Chart of monthly values with mean values and exponential trendline of the warmest study plot

6. DISCUSSION

In this chapter results from laboratory analyses of soil properties in relation with stand properties and climate are compared with results of other authors. Chapter is divided according to analyses, that were done, and Reference Soil Groups.

Świtoniak et al. (2016) found out that in case of study plot Bachotek, which is under forest cover, actual soil reaction in 5 cm in both sampling spots was strongly acidic (pH 4.3 and 4.4). Our data from study plots 1 and 2a under forest cover shows the same acidic reaction (strongly acidic with average values 3.72 and 3.79). Reference Soil Group in study plot 2b is Luvisols as well, but the actual soil reaction in 5 cm under forest cover was medium acidic (average value was 4.77). As for actual soil reaction in 40 cm, in the same study plot Bachotek, Świtoniak et al. (2016) discovered, that actual soil reaction was neutral in 1st sampling spot and medium acidic in the 2nd sampling spot (pH 6.9 and 5.2). The results of actual soil reaction in 40 cm in this thesis indicates, that study plots 1, 2a and 2b had strongly acidic reaction (average pH values 4.12, 4.11 and 4.25).

Potential soil reaction was examined in study of Świtoniak et al. (2016) as well. In the study plot Bachotek, potential soil reaction in 5 cm was strongly acidic (pH 3.6 and 3.8) in both sampling spots. Results in this study were the same – all three study plots with Reference Soil Group Luvisols – study plots 1, 2a and 2b, had strongly acidic soil reaction (average pH values 3.17, 3.09 and 4.01). But in case of potential soil reaction in 40 cm, results differs. Study of Świtoniak et al. (2016) shown, that the soil reaction was moderate acidic (pH 5.2) in one sampling spot and medium acidic (pH 4.2) in second sampling spot. Soil reaction of study plots 1, 2a and 2b was again strongly acidic (average pH values 3.32, 3.33 and 3.51).

Świtoniak et al. (2016) had 3 study plots in agricultural land, each of them with 2 sampling spots with arable lands. The first one, study plot in Gaj, had actual soil reaction medium acidic and moderate acidic in 5 cm (5.3 and 6.1), and neutral in 40 cm (6.9 and 6.8). As for Wąbrzeźno, actual soil reaction in 5 cm was medium acidic and moderate acidic (5.0 and 5.7). Actual soil reaction in 40 cm was medium acidic and neutral (5.5 and 7.2). In Unisław was discovered that pH/H_2O in 5 cm was moderate acidic and moderate alkaline (6.0 and 7.6), and in 40 cm neutral and moderate alkaline (6.9 and 8.2). Actual soil reaction of study plot 1 in 5 cm was medium acidic (4.84) and in 40 cm medium acidic as well (4.52). Study plot 2a shown the same soil reaction in 5 cm, medium acidic (4.53), but strongly acidic reaction in 40 cm (4.49). Actual soil reaction of study plot 2b in 5 cm was moderate acidic (6.43) and in 40 cm medium acidic (4.83).

In case of potential reaction in 5 cm, first sampling spot in Gaj had the same soil reaction (4.4), second sampling spot had medium acidic reaction (4.7). Wąbrzeźno had strongly acidic and medium acidic reaction (3.9 and 4.6). Unisław shown moderate acidic and neutral soil reaction in 5 cm (5.1 and 6.7). Potential soil reaction in 40 cm differed from actual soil reaction in 40 cm only in second sampling spot in Gaj, where the reaction was medium acidic (5.0), in Wąbrzeźno's second spot with moderate acidic soil reaction (5.7), and in Unisław in first sampling spot with moderate soil reaction (5.7). Potential soil reaction of study plots 1, 2a and 2b in both 5 and 40 cm was strongly acidic, only in study plot 2b in 5 cm was moderate acidic.

Holzwarth et al. (2011) found out, that concerning potential soil reaction measured in depth 0-10 cm in Luvisols in mixed forest, medium acidic (4.8) soil reaction and strongly acidic (3.5) soil reaction was observed. In contrast, study plots 1, 2a and 2b, which are also on Luvisols, had strongly acidic potential soil reaction in 5 cm (average pH levels 3.17, 3.09 and 4.01).

Vopravil et al. (2014) found out, that concerning maximal capillary water capacity, Stagnosols had strong water-bearing capacity (35.66 %) in arable land. The same Θ_{MKK} was in case of study plot 3 from this thesis with value 47.89 %. Soils under forest cover in study plot in Krymlov had two values of strong (33.17 %, 32.75 %) and two values of normal (25.80 %, 29.98 %) water-bearing capacity. In this study, Θ_{MKK} of study plot 3 in agricultural area had strong water-bearing capacity (47.89 %).

In case of minimal air capacity, Vopravil et al. (2014) discovered, that soil horizon in arable land was poorly aerated (8.23 %). On the contrary, soil horizon of study plot 3 in arable land was non-aerated (4.36 %). Three sampling spots of Vopravil's (2014) study had strongly aerated horizons (23.46 %, 29.36 %, 24.72 %) and one moderately aerated horizon (19.41 %). Stagnosol of study plot 3 in forest had moderately aerated horizon (15.88 %).

Both soil reactions were measured at the depth of 5 cm and 40 cm. Soil reaction can be evaluated separately by depths. For the depth of 5 cm (organo-mineral superficial humic horizon) in the case of actual soil reaction in the transect of 15 m in the forest cover and

15 m in permanent grass cover, the smallest seasonal fluctuations are in the wettest study plot (see fig. 23). On the contrary, the driest locality shows significant differences within the vegetation period for the actual soil reaction in the given depth (fig. 25). In case of detailed evaluation of the character of fluctuations among individual months in the driest study plot it is clear, that despite the fact, that the fluctuations are the biggest among those four climatically different study plots, they are lawful. On the other hand, the warmest study plot is characterized by fluctuations of hardly identifiable rules (fig. 26). That means, if we assess the climate impact on forest soils by actual soil reaction in A horizon, we can generalize that actual soil reaction will develop according to the theoretically discovered rules in forest stands with higher annual precipitation, while in forest stands with higher average annual temperature will occur fluctuations which may be difficult to generalize.

For the same depth (organo-mineral superficial humic horizon) together with potential soil reaction is evident similar character of evaluation as for actual soil reaction. I.e., that behaviour of this important physically-chemical parameter of forest stands in localities with high rainfall is very close to the behaviour of this parameter in localities with low average temperature (figures 27-30).

For forest soil's A horizons and for climatically different study plots, this study provides a conclusion that if forest soil in wet and cold localities is assessed, then actual and potential soil reaction in A horizon can be derived for the whole vegetation period according to the theoretical assumptions given on the one hand by the behaviour of soil reaction and on the other by soil process of the evaluated forest stand (figures 23, 24, 31, and 32). In case of localities with warm and dry conditions, this theoretical assumption does not need to apply (figures 33 and 34). There is apparent influence of seasonal dynamics (i.e. of individual months) so strong that it overlays importance of forest soil as such. In general it means that the influence of climate on soil reaction value in forest soil's A horizons is the strongest in dry and warm conditions.

For the depth of 40 cm (subsurface mineral horizon) and actual soil reaction, the least impact of seasonal dynamics is more in the coldest study plot than in the wettest study plot (figures 27 and 28). The strongest influence in the same depth for actual soil reaction is in the warmest study plot (fig. 30).

It is very interesting to compare the homogeneity behaviour in case of potential soil reaction in the same depth in the coldest and wettest study plot in the forest to the fluctuations in permanent grass cover in the same mesoclimate (figures 35 and 36). Again, the most distinct dependence on seasonal dynamics in case of potential soil reaction and 40 cm of depth is in the warmest study plot (fig. 38). From the forestry point of view, it is important to appraise the strong influence of a seasonal dynamics on the soil in the permanent grass cover and incomparably homogeneous behaviour of potential soil reaction in the driest study plot in the forest stand. Generally speaking, mineral B horizon shows a similar pattern as A horizon and at the same time higher diversity of forest soil than in case of permanent grass cover soil.

There are two possible conclusions. Firstly, there is a strong influence of forest cover on the A horizon, whilst permanent grass cover contributes far less significantly on the A horizon soil reaction from the seasonal dynamics point of view. Even though in case of the warmest and driest study plot, where the impact of climate is the strongest (see above), this conclusion does not apply. Secondly, for B horizons it is probably a natural behaviour of forest soil development, which because of centuries lasting forest management, stabilises the soil reaction far more than the fast transport processes within deforested agricultural land reaching the depth of 40 cm. Exception is the hottest study plot, where is the strongest climate impact on the soil property dynamics.

Both physical parameters (parameter of hydric soil regime and parameter of aeration soil regime) were measured at the depth of 5 cm.

Maximal capillary water capacity was evidently depended on the land use. Under the forest cover it was far more dependent on climate than in soils with permanent grass cover. Therefore it is evident that in general the transpiration stream of the trees significantly modifies the hydric soil regime of forest soil. If four climatically different study plots are compared, in case of forest soil the slightest climate influence over the year to maximal capillary water capacity is in the warmest study plot (fig. 42). I.e. at high evaporation (undoubtedly combined with a high suction for tree transpiration) there are generally similar conditions within soil body throughout the year regarding maximal capillary water capacity. If there is no occurrence of high evaporation and transpiration, the influence of climate on maximal capillary water capacity of forest soil is clearly evident. This, however, does not apply for permanent grass cover. In this case, regardless of the mesoclimate, seasonal dynamics does not manifest itself as much as under the forest cover.

The result of this study is relatively clear regarding minimal air capacity in the A horizon. Regardless of the differences between forest soil and soils under permanent grass cover, and above all (concerning the goals of this study) regardless of individual study plots with different climate, the climate impact on minimal air capacity is generally determinative. This fact is understandable in forest soils, where it is evident that when the maximal capillary water capacity varies, the minimal air capacity fluctuates. In this case there is also a slightly lower climate impact on forest soil in the warmest study plot (fig. 46). It is also interesting to analyse the cause of strong climate influence on minimal air capacity of soils of permanent grass cover, whilst the influence of climate on maximal capillary water capacity in the same study plots does not manifest itself distinctively (figures 43-46).

7. CONCLUSION

This study deals with the interaction between chosen measurable forest soil properties and the fundamental differences in the process of basic climatic features with the goal of possible proposals for pan-European context of forest management.

In the territory of Training Forest Enterprise Masaryk Forest Křtiny was chosen the warmest (study plot 4 – Křtiny), the coldest (study plot 2a – Proklest), the wettest (study plot 1 – Bukovinka), and the driest (study plot 3 – Rudice) study plot. These study plots were systematically sampled during the vegetation period and subsequently analysed in laboratory. Following analyses were conducted: actual soil reaction, potential soil reaction, maximal capillary water capacity, and minimal air capacity. Given research was conducted as a part of the project of Technology Agency of the Czech Republic "*Contactless monitoring and spatio-temporally modelling variability of selected different soil characteristics*", number TA04020888, with the cooperation with Palacký University in Olomouc.

Actual soil reaction and potential soil reaction were measured at depth of 5 and 40 cm. The smallest seasonal fluctuation was discovered in wettest study plot (study plot 1 – Bukovinka) and the biggest differences were in the driest locality (study plot 3 – Rudice) at the depth 5 cm. The warmest study plot shown the biggest fluctuations among individual months. Actual soil reaction in A horizon will develop according to theoretically discovered rules in forest stands with higher annual precipitation, whilst fluctuations that might be difficult to generalize will appear in forest stands with higher annual temperature. In case of potential soil reaction its behaviour in localities with high rainfall is very similar to the behaviour in localities with low average temperature.

Actual and potential soil reaction can be derived for the whole vegetation period according to theoretical assumption in wet and cold conditions. This conclusion does not apply for dry and warm conditions. The strongest influence of climate on soil reaction in A horizon is in forest stands with dry and warm conditions.

In case of actual soil reaction in 40 cm, the strongest influence was in the warmest study plot (Křtiny), and the smallest impact in the coldest study plot (Proklest). The biggest dependence on seasonal dynamics is in the warmest study plot (Křtiny) in case of potential soil reaction in 40 cm. Both soil reaction in 40 cm shows a similar pattern as in

A horizon and also shows higher diversity of forest soils than in permanent grass cover soils.

Both maximal capillary water capacity and minimal air capacity were measured at the depth of 5 cm. The smallest influence was in the warmest plot (Křtiny). The influence of climate on maximal capillary water capacity in forest stands is clearly evident in case of lower evaporation and transpiration. On the contrary, this does not apply for permanent grass cover, where seasonal dynamics does not manifest itself as much as under the forest cover. The influence of climate on minimal air capacity regardless the differences between forest and permanent grass cover is clearly determinative. In case of the warmest study plot (Křtiny), there is slightly lower climate impact on minimal air capacity.

8. SUMMARY

Daná práce se zabývá interakcí mezi vybranými měřitelnými vlastnostmi lesních půd a základními rozdíly v chodu základních klimatických prvků a to s cílem možných návrhů pro celoevropský kontext lesního hospodářství.

Na území školního lesního podniku byla vybrána nejteplejší (Křtiny), nejstudenější (proklest), nejvlhčí (Bukovinka) a nejsušší (Rudice) lokalita, které byly systematicky vzorkovány v průběhu celého vegetačního období a následně laboratorně analyzovány pro hodnoty půdní reakce aktivní, půdní reakce potencionální výměnní, maximální kapilární vodní kapacity, minimální vzdušné kapacity. Daný výzkum probíhal jako součást projektu TAČR „Bezkontaktní monitorování a časoprostorové modelování variability vybraných diferenciačních vlastností půdy“, číslo TA04020888, a to ve spolupráci s Univerzitou Palackého v Olomouci.

Půdní reakce aktivní a půdní reakce potenciální byly měřeny v hloubkách 5 a 10 cm. V rámci půdní reakce aktivní v 5 cm bylo zjištěno, že nejmenší výkyvy jsou na nejvlhčí lokalitě, naopak největší výkyvy jsou na lokalitě nejsušší. Pro stejnou hloubku a půdní reakci potenciální výměnnou lze vidět podobný charakter jako u půdní reakce aktivní. Vliv klimatu na půdní reakci je nejsilnější u půd v suchých a teplých podmínkách.

Pro hloubku 40 cm a půdní reakci aktivní je nejmenší vliv sezónní dynamiky na lokalitu nejstudenější. Naopak, největší vliv má na lokalitě nejteplejší. V případě stejné hloubky a půdní reakce potencionální největší závislost na sezónní dynamice ukázala nejteplejší lokalita. Pro obě půdní reakce platí podobná zákonitost jako v A horizontu, přičemž je v této hloubce větší rozdílnost mezi lesní půdou a půdou trvalého travního porostu.

Fyzikální vlastnosti maximální kapilární kapacita a minimální vzdušná kapacita byly měřeny v hloubce 5 cm. Nejmenší vliv klimatu byl zjištěn na nejteplejší lokalitě. Není-li vysoký výpar a vysoká transpirace, pak se klima na maximální kapilární kapacitě lesní půdy výrazně projeví. V případě travního porostu to neplatí, zde se sezónní dynamika neprojevuje tak výrazně. U minimální vzdušně kapacity je výsledek poměrně jednoznačný, bez ohledu na rozdíly mezi lesní půdou a půdou travních porostů a bez ohledu na rozdílné klima lokalit, je vliv klimatu na minimální vzdušnou kapacitu obecně rozhodující.

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9.4. List of tables

9.5. List of figures

10. APPENDIX

10.1.1. Soil probes

Fig. 47 Soil probes: A - study plot 1 Bukovinka, agriculture area; B - study plot 1 Bukovinka, forest stand; C - study plot 2a Proklest, agriculture area; D - study plot 2a Proklest, forest stand (Vranová, 2016a)

Fig. 48 Soil probes: A - study plot 2b Chochola, permanent grass cover; B - study plot 2b Chochola, forest stand; C - study plot Rudice, agriculture area; D - study plot Rudice, forest stand (Vranová, 2016c)

Fig. 49 Soil probes: A - Study plot Křtiny, agriculture area; B - study plot Křtiny, forest stand (Vranová, 2016b)

10.2. Pedological maps of study plots

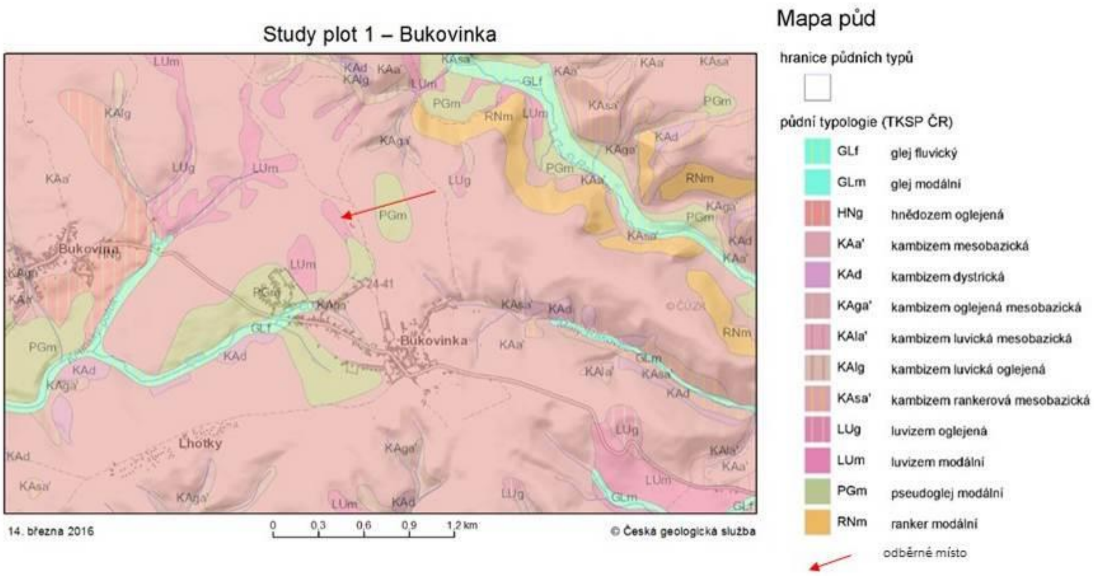

Fig. 50 Pedological map of study plot 1 (Česká geologická služba, 2016a)

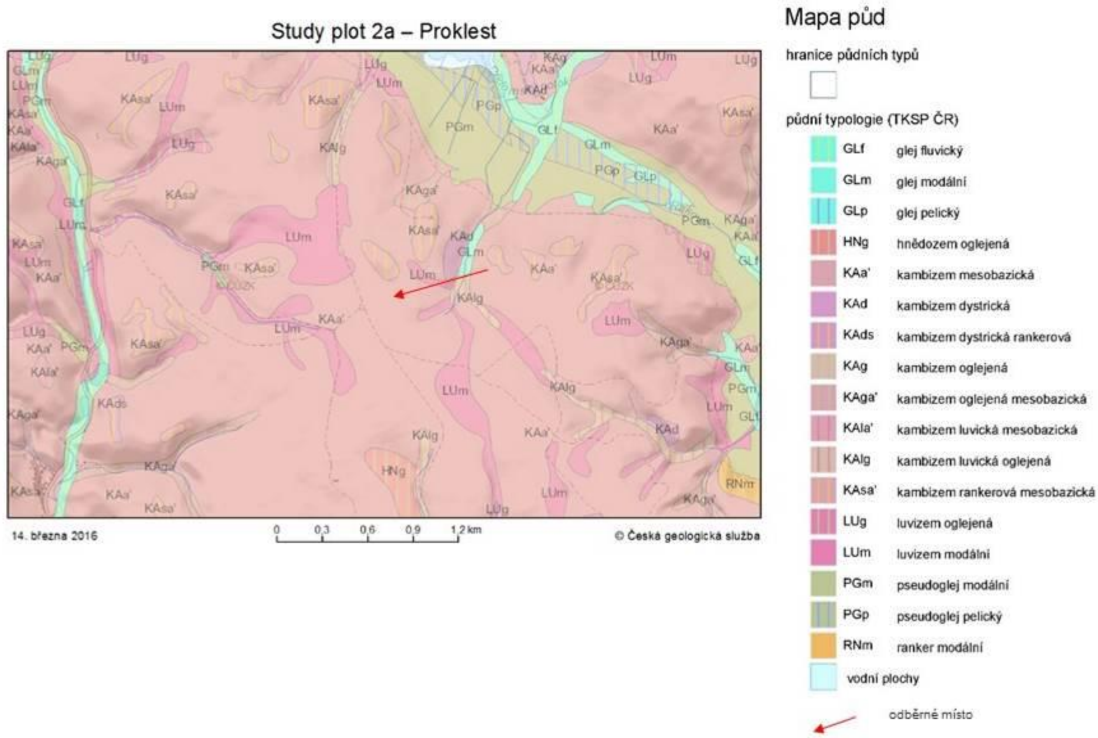

Fig. 51 Pedological map of study plot 2a (Česká geologická služba, 2016b)

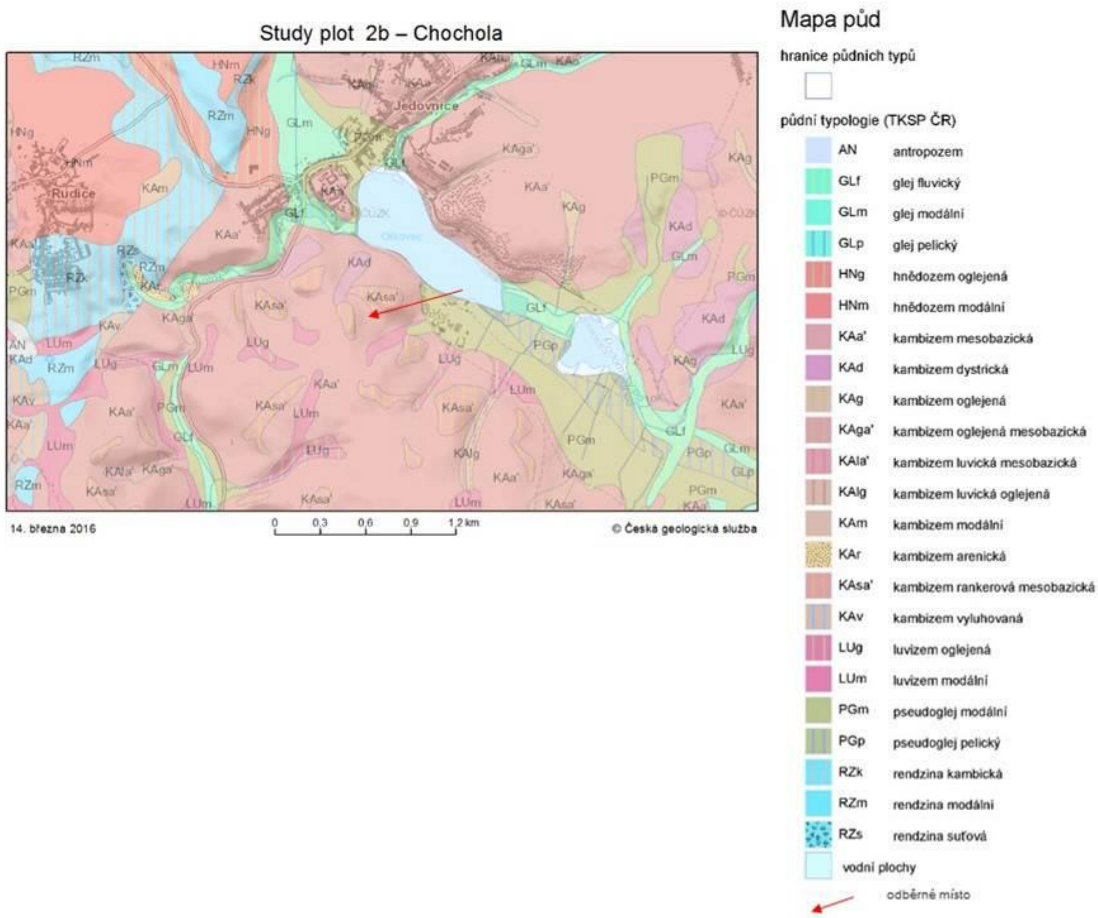

Fig. 52 Pedological map of study plot 2b (Česká geologická služba, 2016c)

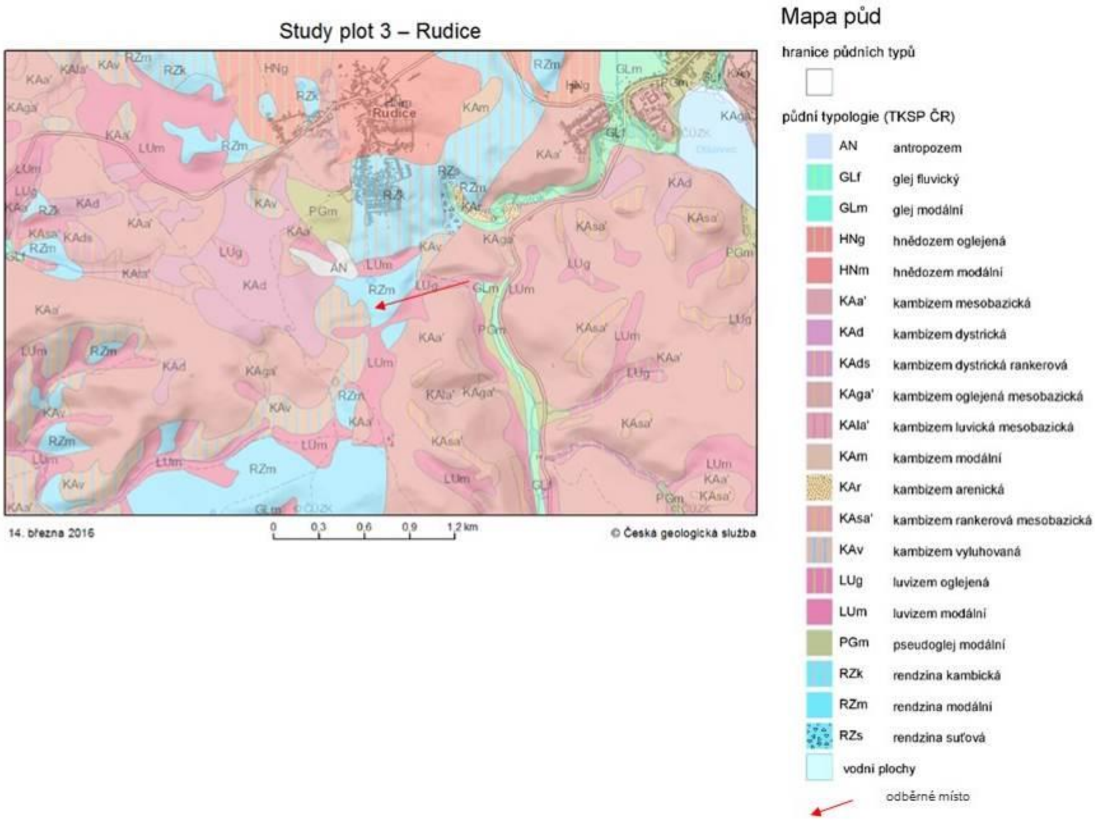

Fig. 53 Pedological map of study plot 3 (Česká geologická služba, 2016d)

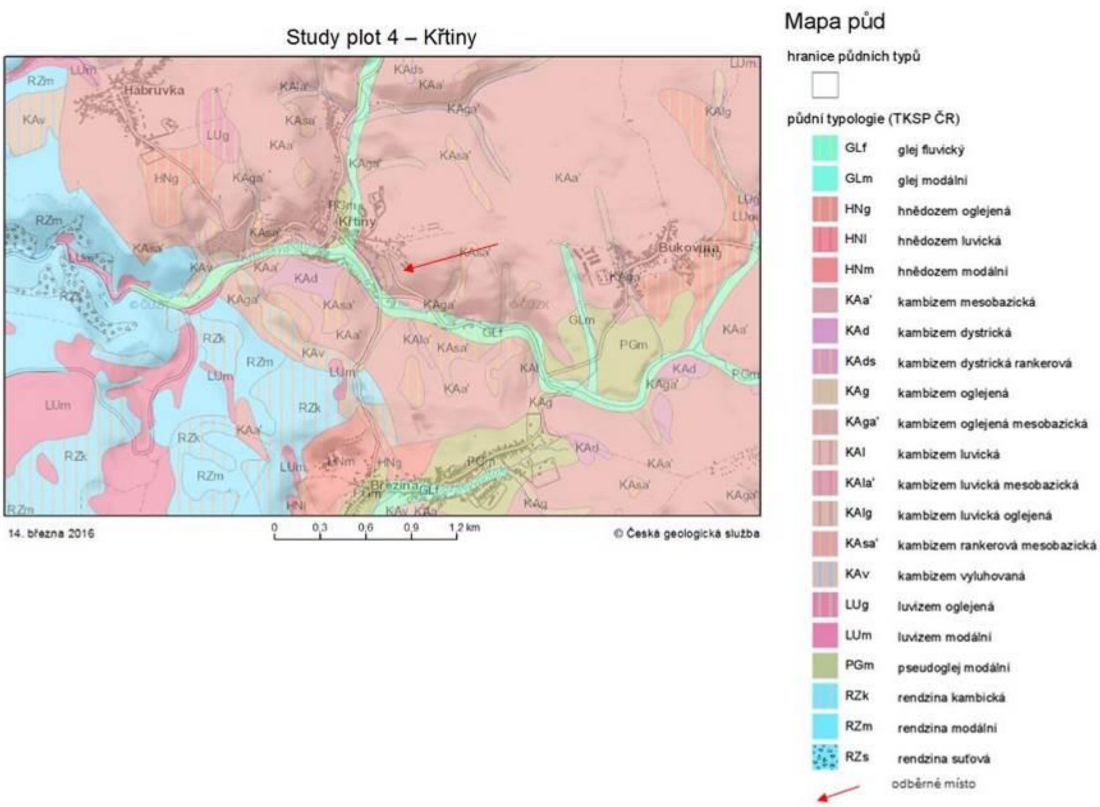

Fig. 54 Pedological map of study plot 4 (Česká geologická služba, 2016e)

10.3. Data

10.3.1. Actual spoil reaction

Table 17 Actual soil reaction, study plot 1

Study plot 1 Bukovinka	Actual soil reaction pH/ H_2O								
Sample	March	April	May	June	July	August	September	October	November
1 - E - A1	4.62	4.11	3.52	3.61	4.64	4.89	4.04	4.61	4.09
1 - E - B	4.01	3.90	3.81	4.10	3.65	3.97	3.95	4.61	4.63
1 - L2 - A1	3.81	3.86	3.23	3.79	3.73	3.63	3.67	4.02	4.15
1 - L2 - B	3.95	4.31	3.85	3.91	4.25	3.91	3.53	4.08	4.19
1 - L3 - A1	3.68	3.69	3.94	3.55	3.65	3.39	3.95	3.75	3.83
1 - L3 - B	4.38	3.84	4.14	3.81	4.20	3.78	3.25	4.30	4.46
1 - L4 - A1	4.41	3.67	3.53	3.59	3.42	3.56	3.52	3.91	3.89
1 - L4 - B	4.25	3.91	4.04	4.14	4.61	3.84	3.71	4.53	4.61
1 - L5 - A1	4.15	3.59	3.46	3.50	3.77	3.24	3.18	3.81	3.91
1 - L5 - B	4.53	3.95	4.10	4.01	4.54	4.00	3.29	4.58	4.59
1 - L6 - A1	4.08	3.48	3.81	3.52	3.71	3.69	3.53	3.97	4.03
1 - L6 - B	4.47	4.04	4.20	3.98	4.29	3.97	3.99	4.51	4.54
1 - Z8 - A1	4.92	4.78	4.77	4.59	4.52	4.72	5.52	4.95	5.47
1 - Z8 - B	4.82	4.67	4.05	4.03	4.51	3.97	4.36	4.85	5.00
1 - Z9 - A1	4.79	4.55	5.03	4.53	4.93	4.69	5.19	5.03	4.81
1 - Z9 - B	4.97	4.86	4.30	4.30	4.28	3.98	4.67	4.81	4.82
1 - Z10 - A1	4.90	4.88	4.41	4.37	4.07	5.08	5.15	4.99	5.18
1 - Z10 - B	5.32	5.40	4.35	4.23	4.70	4.03	4.31	4.95	4.87
1 - Z11 - A1	4.77	4.77	4.38	4.65	5.16	4.70	4.43	5.06	5.27
1 - Z11 - B	4.68	5.20	4.25	3.96	4.46	3.87	4.20	4.72	5.12
1 - Z12 - A1	4.72	4.91	4.43	4.44	4.61	5.29	4.91	5.01	5.37
1 - Z12 - B	4.59	5.12	4.10	4.01	4.21	3.99	4.11	4.65	4.77

Table 18 Actual soil reaction, study plot 2a

Study plot 2a Proklest	Actual soil reaction pH/ H_2O								
Sample	March	April	May	June	July	August	September	October	November
2a- E - A1	4.48	4.27	3.38	3.36	3.53	3.87	3.71	4.04	3.94
2a- E - B	4.42	3.98	4.41	4.41	4.29	3.71	4.11	4.58	4.67
2a- L2 - A1	4.03	3.96	3.58	3.39	4.25	3.63	3.61	3.59	4.66
2a- L2 - B	4.35	3.94	4.38	4.09	4.60	3.77	4.10	4.59	4.77
2a- L3 - A1	4.03	3.70	3.69	3.60	4.10	3.47	3.42	3.98	4.13
2a- L3 - B	4.21	3.80	3.71	3.75	4.06	3.64	3.69	4.41	4.54
2a- L4 - A1	3.91	3.91	3.74	3.77	3.80	3.28	3.89	4.38	3.54
2a- L4 - B	4.25	4.06	3.86	3.93	4.38	3.54	3.79	4.78	4.18
2a- L5 - A1	3.96	4.47	3.49	3.41	3.53	3.24	3.29	4.26	4.90
2a- L5 - B	4.33	4.35	3.59	3.71	3.88	3.80	3.80	4.56	4.49
2a- L6 - A1	4.00	4.31	3.44	3.45	3.35	3.50	3.16	4.34	3.56
2a- L6 - B	4.03	4.24	3.97	4.10	4.83	3.63	3.63	4.25	4.36
2a- Z8 - A1	4.88	4.46	3.93	4.07	4.31	4.11	3.75	4.67	5.13
2a- Z8 - B	4.97	4.56	4.36	4.14	5.21	3.78	4.04	4.81	4.79
2a- Z9 - A1	4.80	4.32	4.70	4.32	4.37	4.25	4.08	4.99	5.04
2a- Z9 - B	4.79	4.77	4.28	4.10	4.13	4.07	4.19	4.68	4.83
2a- Z10 - A1	4.65	4.60	4.50	4.29	4.44	4.24	4.11	4.97	5.26
2a- Z10 - B	4.43	4.84	4.20	4.25	4.37	4.27	4.20	4.83	4.16
2a- Z11 - A1	4.43	5.03	4.30	4.34	4.52	4.94	4.36	5.02	4.99
2a- Z11 - B	4.76	4.71	4.00	4.21	5.03	4.11	4.16	4.92	5.65
2a- Z12 - A1	4.76	4.60	4.32	4.15	4.41	4.13	4.33	4.95	4.83
2a- Z12 - B	4.55	4.41	4.41	4.26	5.44	3.97	3.84	4.75	4.91

Table 19 Actual soil reaction, study plot 2b

Study plot 2b Chochola	Actual soil reaction pH/ H_2O								
Sample	March	April	May	June	July	August	September	October	November
2b- E - A1	6.27	6.41	6.63	6.90	5.96	6.25	6.72	7.33	6.29
2b- E - B	4.26	5.26	5.27	4.20	4.56	4.33	3.87	5.19	4.72
2b- L2 - A1	7.25	6.82	6.77	6.90	6.67	6.36	6.54	7.36	7.08
2b- L2 - B	4.84	6.63	4.17	4.12	4.48	4.33	4.22	4.95	4.62
2b- L3 - A1	4.16	5.10	3.85	3.48	4.42	3.52	4.23	4.40	4.68
2b- L3 - B	4.61	3.87	3.80	3.66	3.78	3.66	3.45	4.25	4.02
2b- L4 - A1	4.44	4.15	4.24	3.80	5.53	3.74	3.82	4.84	4.31
2b- L4 - B	4.33	4.12	4.05	4.11	4.65	3.74	3.64	4.72	4.47
2b- L5 - A1	4.15	4.04	3.83	3.88	4.59	4.31	4.25	4.41	4.62
2b- L5 - B	4.29	4.16	4.11	3.80	3.74	3.74	3.99	4.52	4.42
2b- L6 - A1	4.28	4.11	4.13	3.89	4.33	4.03	4.06	4.60	4.54
2b- L6 - B	4.10	4.19	4.01	4.01	3.92	3.83	4.13	4.57	6.21
2b- Z8 - A1	6.77	6.71	6.67	6.69	5.68	5.97	6.53	7.21	7.12
2b- Z8 - B	5.87	6.76	4.31	4.34	4.18	4.02	4.48	4.64	4.89
2b- Z9 - A1	7.85	7.37	6.25	4.90	6.23	6.39	6.85	7.54	7.08
2b- Z9 - B	6.29	6.69	4.20	4.22	4.76	3.97	4.80	5.65	5.65
2b- Z10 - A1	6.63	6.53	6.27	6.03	5.96	6.36	6.58	7.07	6.01
2b- Z10 - B	5.25	5.58	4.24	4.18	4.60	3.88	4.14	4.93	4.88
2b- Z11 - A1	5.79	7.14	6.87	6.13	6.35	6.20	6.67	6.88	7.08
2b- Z11 - B	4.33	6.12	6.35	4.03	4.64	4.03	5.05	5.16	5.53
2b- Z12 - A1	5.75	5.70	5.99	5.02	5.91	6.08	5.80	6.47	6.30
2b- Z12 - B	4.43	4.41	4.53	4.11	4.88	3.90	4.44	5.08	5.01

Table 20 Actual soil reaction, study plot 3

Study plot 3 Rudice	Actual soil reaction pH/ H_2O								
Sample	March	April	May	June	July	August	September	October	November
3 - E - A1	6.13	5.86	5.40	5.86	6.38	6.15	4.65	6.30	6.54
3 - E - B	5.87	6.12	5.19	5.30	4.95	5.34	5.48	6.05	5.47
3- L2 - A1	4.16	4.62	4.18	4.41	5.21	3.99	4.50	4.59	4.74
3 - L2 - B	4.75	4.23	3.97	3.80	4.61	3.97	3.69	4.55	4.65
3 - L3 - A1	4.05	4.36	4.31	4.05	6.11	4.01	4.07	5.01	5.24
3 - L3 - B	4.28	4.46	3.82	3.81	3.88	3.64	3.74	4.39	4.89
3 - L4 - A1	4.00	3.98	3.94	3.58	4.44	4.20	3.54	4.58	4.54
3 - L4 - B	4.30	3.79	3.54	3.74	4.21	3.61	3.85	4.29	4.59
3 - L5 - A1	4.04	3.66	3.94	3.46	4.33	3.49	3.63	4.37	4.04
3 - L5 - B	4.19	3.77	3.77	3.43	3.52	3.43	3.70	4.10	3.93
3 - L6 - A1	3.74	3.75	3.57	3.55	3.63	3.56	3.73	4.00	4.11
3 - L6 - B	4.05	4.05	3.72	3.81	3.88	3.51	4.09	4.22	4.32
3 - Z8 - A1	5.54	6.17	5.76	5.31	6.18	5.90	5.35	5.76	5.76
3 - Z8 - B	5.92	6.24	5.65	5.70	5.72	5.62	5.77	6.41	6.47
3 - Z9 - A1	5.82	5.76	5.24	5.64	6.33	6.15	5.22	6.12	6.03
3 - Z9 - B	6.14	6.24	6.20	5.79	5.47	5.88	6.06	6.52	5.63
3 - Z10 - A1	4.60	5.80	5.66	5.44	5.91	6.43	5.64	6.44	5.24
3 - Z10 - B	6.09	5.99	5.98	6.07	5.97	5.97	5.72	6.07	5.97
3 - Z11 - A1	5.84	5.29	5.83	6.24	6.24	5.91	5.48	6.59	6.08
3 - Z11 - B	5.72	5.75	5.76	5.63	4.91	5.61	5.77	6.26	6.17
3 - Z12 - A1	5.57	6.21	5.82	5.97	5.48	5.72	5.14	6.07	6.06
3 - Z12 - B	5.78	6.06	5.60	5.46	4.91	5.91	5.60	5.92	6.03

Table 21 Actual soil reaction, study plot 4

Study plot 4 Křtiny	Actual soil reaction pH/ H_2O								
Sample	March	April	May	June	July	August	September	October	November
4 - E - A1	5.64	5.32	5.81	5.36	5.53	5.45	5.23	5.59	5.81
4 - E - B	5.55	5.36	5.05	5.03	5.01	5.52	5.67	5.38	5.51
4 - L2 - A1	5.83	6.44	5.69	6.40	6.56	6.22	5.98	5.97	5.90
4 - L2 - B	5.84	5.90	4.97	5.66	5.66	5.57	5.35	5.58	5.31
4 - L3 - A1	6.08	6.16	6.32	6.41	6.21	5.18	5.73	6.15	5.91
4 - L3 - B	6.00	5.66	5.45	5.30	5.92	5.96	5.55	5.84	5.76
4 - L4 - A1	5.49	6.12	5.63	5.34	6.35	6.35	5.23	5.88	5.92
4 - L4 - B	5.09	5.45	5.41	4.96	4.40	4.84	4.78	5.66	5.79
4 - L5 - A1	5.70	5.94	5.78	5.94	5.87	5.65	6.04	5.49	5.68
4 - L5 - B	5.25	5.45	5.31	5.25	5.45	4.94	5.67	5.92	6.03
4 - L6 - A1	6.72	6.59	6.36	5.38	4.81	5.40	3.80	6.36	5.03
4 - L6 - B	5.76	6.38	5.88	5.33	4.99	5.22	5.02	6.18	6.03
4 - Z8 - A1	5.21	5.33	5.25	4.99	6.17	6.14	6.33	6.18	5.69
4 - Z8 - B	5.54	6.00	5.38	4.83	5.54	5.53	4.50	5.52	5.43
4 - Z9 - A1	5.58	5.63	5.59	5.19	6.12	5.73	4.95	6.30	6.47
4 - Z9 - B	5.53	5.76	4.77	5.08	5.55	4.80	4.89	4.86	4.51
4 - Z10 - A1	5.84	5.97	5.97	5.46	6.41	6.07	5.44	6.15	6.00
4 - Z10 - B	5.61	5.50	5.44	5.12	6.53	4.88	5.44	5.92	6.00
4 - Z11 - A1	6.15	6.41	6.15	5.52	5.98	6.01	6.00	6.38	6.04
4 - Z11 - B	5.55	5.72	5.82	5.63	6.15	5.64	5.59	6.18	6.09
4 - Z12 - A1	6.18	6.08	6.22	5.62	6.55	5.07	5.78	6.48	6.33
4 - Z12 - B	5.78	6.44	5.92	5.48	5.29	5.50	5.92	5.86	5.09

10.3.2. Potential soil reaction

Table 22 Potential soil reaction, study plot 1

Study plot 1 Bukovinka	Potential soil reaction pH/KCl								
Sample	March	April	May	June	July	August	September	October	November
1 - E - A1	4.05	3.52	3.06	3.17	3.75	3.66	3.01	3.67	3.28
1 - E - B	3.32	3.43	3.38	3.45	2.92	3.45	3.36	3.67	3.64
1 - L2 - A1	3.26	3.47	2.98	3.15	2.96	3.34	3.28	3.37	3.31
1 - L2 - B	3.23	3.45	3.30	3.35	2.99	3.10	3.06	3.39	3.56
1 - L3 - A1	3.20	3.24	3.08	3.12	3.09	2.85	3.17	3.18	3.36
1 - L3 - B	3.64	3.35	3.37	3.24	3.08	3.13	3.19	3.54	3.48
1 - L4 - A1	3.85	3.31	3.09	3.06	2.83	3.07	3.02	3.24	3.23
1 - L4 - B	3.43	3.51	3.34	3.33	2.94	3.00	3.04	3.45	3.60
1 - L5 - A1	3.50	3.12	3.04	2.89	3.09	2.88	2.85	3.17	3.23
1 - L5 - B	3.40	3.52	3.30	3.43	3.19	3.37	2.91	3.51	3.64
1 - L6 - A1	3.37	3.40	3.19	3.10	2.78	3.03	3.09	3.27	3.31
1 - L6 - B	3.24	3.52	3.38	3.39	3.00	3.01	3.39	3.63	3.52
1 - Z8 - A1	3.95	4.05	3.97	4.03	3.39	3.71	4.32	3.86	4.44
1 - Z8 - B	3.98	3.92	3.50	3.24	3.11	3.41	3.35	3.59	3.64
1 - Z9 - A1	3.90	3.86	4.04	3.84	3.47	3.55	3.85	3.52	3.86
1 - Z9 - B	4.15	3.95	3.48	3.67	3.07	3.17	3.51	3.54	3.69
1 - Z10 - A1	3.83	3.81	3.59	3.72	3.20	4.10	3.75	3.95	4.00
1 - Z10 - B	4.01	4.00	3.65	3.56	3.05	2.94	3.45	3.69	3.61
1 - Z11 - A1	3.74	3.73	3.62	4.02	3.54	3.67	3.60	3.89	4.15
1 - Z11 - B	3.61	3.79	3.45	3.45	2.70	3.20	2.91	3.32	3.61
1 - Z12 - A1	3.13	3.87	3.61	3.82	3.47	4.09	4.20	3.83	4.07
1 - Z12 - B	3.16	3.73	3.35	3.39	2.82	3.12	3.23	3.32	3.39

Table 23 Potential soil reaction, study plot 2a

Study plot 2a Proklest	Potential soil reaction pH/KCl								
Sample	March	April	May	June	July	August	September	October	November
2a- E - A1	3.71	3.78	3.09	2.98	2.75	3.26	3.17	3.11	3.08
2a- E - B	3.50	3.48	3.48	3.46	2.98	3.17	3.37	3.51	3.56
2a- L2 - A1	3.24	3.21	3.21	3.05	2.64	3.20	3.14	2.91	3.64
2a- L2 - B	3.43	3.48	3.48	3.30	2.98	3.26	3.29	3.58	3.62
2a- L3 - A1	3.11	3.25	3.34	3.24	2.74	3.00	2.96	3.07	3.42
2a- L3 - B	3.45	3.39	3.35	3.22	3.09	3.13	3.14	3.48	3.55
2a- L4 - A1	3.15	3.12	3.12	3.07	2.79	2.91	3.14	3.31	3.13
2a- L4 - B	3.38	3.55	3.32	3.11	3.09	3.23	3.41	3.48	3.68
2a- L5 - A1	3.23	3.27	3.01	3.08	2.80	2.93	2.89	3.18	3.53
2a- L5 - B	3.37	3.48	3.28	3.34	2.94	3.35	3.15	3.34	3.43
2a- L6 - A1	3.09	3.34	2.99	2.87	2.61	2.95	2.78	3.28	3.10
2a- L6 - B	3.35	3.47	3.45	3.19	2.95	3.17	3.15	3.49	3.39
2a- Z8 - A1	3.64	3.54	3.18	3.31	2.94	3.40	3.38	3.61	3.66
2a- Z8 - B	3.44	3.54	3.41	3.46	3.37	3.43	3.33	3.66	3.64
2a- Z9 - A1	3.86	3.77	3.66	3.60	3.26	3.68	3.47	3.84	3.74
2a- Z9 - B	3.32	3.84	3.43	3.30	2.75	3.19	3.57	3.59	3.76
2a- Z10 - A1	3.63	3.94	3.45	3.60	3.32	3.32	3.45	3.76	3.89
2a- Z10 - B	3.35	3.79	3.24	3.34	2.99	3.19	3.46	3.62	3.56
2a- Z11 - A1	3.53	3.69	3.45	3.30	3.24	4.04	3.39	3.72	3.82
2a- Z11 - B	3.32	3.80	3.52	3.50	3.80	3.19	3.36	3.59	4.90
2a- Z12 - A1	3.63	3.69	3.51	3.49	3.16	3.54	3.43	3.60	3.76
2a- Z12 - B	3.29	3.70	3.38	3.28	3.78	3.18	3.29	3.48	3.62

Table 24 Potential soil reaction, study plot 2b

Study plot 2b Chochola	Potential soil reaction pH/KCl								
Sample	March	April	May	June	July	August	September	October	November
2b- E - A1	5.65	5.53	6.11	6.76	5.21	4.71	6.35	6.81	5.89
2b- E - B	3.38	4.37	4.25	3.29	3.05	3.41	3.28	3.98	3.67
2b- L2 - A1	6.78	6.62	6.50	6.43	6.36	5.59	6.10	6.81	5.97
2b- L2 - B	3.84	6.21	3.48	3.29	3.40	3.68	3.32	3.71	3.69
2b- L3 - A1	3.48	4.19	3.20	3.04	3.37	2.95	3.83	3.48	3.77
2b- L3 - B	3.81	3.36	3.32	3.26	2.89	3.12	3.10	3.56	3.58
2b- L4 - A1	3.63	3.52	3.46	3.33	4.16	3.12	3.17	3.68	3.38
2b- L4 - B	3.41	3.37	3.38	3.25	2.94	3.27	3.24	3.62	3.81
2b- L5 - A1	3.49	3.29	3.13	3.12	3.03	3.41	3.49	3.41	3.61
2b- L5 - B	3.29	3.55	3.47	3.42	3.07	3.13	3.59	3.64	3.67
2b- L6 - A1	3.43	3.46	3.40	3.45	3.14	3.23	3.35	3.55	3.44
2b- L6 - B	3.22	3.66	3.53	3.37	3.06	3.16	3.36	3.57	5.06
2b- Z8 - A1	6.30	6.29	6.21	5.67	4.61	4.86	6.07	6.49	6.22
2b- Z8 - B	4.66	5.69	3.57	3.26	2.90	3.48	3.55	3.47	3.60
2b- Z9 - A1	7.03	6.66	5.33	3.87	4.86	5.03	6.32	6.65	5.87
2b- Z9 - B	5.18	6.53	3.55	3.23	3.00	3.17	3.55	5.04	4.20
2b- Z10 - A1	6.05	6.15	5.55	5.49	5.11	5.62	5.98	6.04	5.46
2b- Z10 - B	3.92	3.90	3.33	2.92	3.03	3.25	3.24	3.67	3.66
2b- Z11 - A1	5.03	6.13	6.16	6.02	4.75	5.35	5.86	6.22	5.61
2b- Z11 - B	3.13	4.86	4.97	3.36	3.10	3.20	3.88	3.62	4.06
2b- Z12 - A1	4.82	5.17	5.01	4.35	4.62	4.65	5.24	5.21	4.69
2b- Z12 - B	3.13	3.69	3.61	3.33	3.01	3.27	3.40	3.75	3.67

Table 25 Potential soil reaction, study plot 3

Study plot 3 Rudice	Potential soil reaction pH/KCl								
Sample	March	April	May	June	July	August	September	October	November
3 - E - A1	5.29	5.44	4.10	5.06	4.95	4.85	4.24	5.40	4.78
3 - E - B	5.03	5.28	4.40	4.42	3.78	4.22	4.49	4.88	3.84
3- L2 - A1	3.45	3.99	3.49	3.79	4.81	3.34	3.70	3.53	3.83
3 - L2 - B	3.72	3.46	3.36	3.41	3.63	3.17	3.13	3.56	3.65
3 - L3 - A1	3.31	3.72	3.67	3.82	4.40	3.46	3.69	4.30	3.84
3 - L3 - B	3.39	3.50	3.24	3.26	2.86	3.28	3.25	3.48	3.92
3 - L4 - A1	3.23	3.41	3.29	2.82	3.47	3.31	3.08	3.68	3.76
3 - L4 - B	3.55	3.28	3.22	3.50	2.80	3.35	3.34	3.41	3.53
3 - L5 - A1	3.37	3.12	3.47	2.79	2.79	2.84	3.01	3.45	3.21
3 - L5 - B	3.38	3.22	3.44	3.33	3.18	3.16	3.41	3.41	3.45
3 - L6 - A1	3.08	2.96	3.06	3.13	2.68	2.86	3.14	3.17	3.28
3 - L6 - B	3.31	3.29	3.28	3.23	2.93	3.07	3.27	3.41	3.55
3 - Z8 - A1	4.84	5.21	4.76	4.98	4.34	4.45	4.77	4.78	5.28
3 - Z8 - B	5.23	5.27	4.96	5.68	5.00	5.19	4.73	4.99	4.89
3 - Z9 - A1	5.12	5.21	4.45	5.14	4.78	4.92	4.64	4.94	5.20
3 - Z9 - B	5.39	5.29	4.89	4.79	4.31	4.24	5.08	5.21	4.55
3 - Z10 - A1	3.51	5.06	4.75	4.86	4.61	5.36	5.06	5.13	4.62
3 - Z10 - B	5.24	5.30	5.13	4.69	4.71	4.68	4.65	4.83	4.40
3 - Z11 - A1	4.86	4.97	4.80	4.74	4.74	4.96	4.78	5.39	4.62
3 - Z11 - B	4.93	4.78	4.85	5.09	4.37	5.18	4.77	4.84	4.52
3 - Z12 - A1	4.95	5.27	4.64	5.22	4.57	4.28	4.75	4.99	4.67
3 - Z12 - B	4.98	5.24	4.69	5.05	3.96	4.74	4.33	4.47	4.68

Table 26 Potential soil reaction, study plot 4

Study plot 4 Křtiny					Potential soil reaction pH/KCl				
Sample	March	April	May	June	July	August	September	October	November
4 - E - A1	4.61	4.44	4.60	4.68	3.85	4.42	4.46	4.46	5.11
4 - E - B	4.24	4.18	4.03	3.80	4.12	4.33	4.41	4.14	4.32
4 - L2 - A1	5.25	5.80	5.00	5.61	4.84	5.21	4.84	4.69	4.44
4 - L2 - B	4.79	5.36	3.88	4.76	3.79	4.15	5.25	4.31	4.17
4 - L3 - A1	5.32	5.62	5.52	5.40	4.71	3.98	5.06	5.00	5.27
4 - L3 - B	5.42	5.25	4.86	4.08	4.08	4.51	4.79	4.66	5.05
4 - L4 - A1	4.84	5.82	4.74	4.70	4.93	5.21	4.58	4.73	5.08
4 - L4 - B	4.05	4.71	4.79	3.87	3.16	3.45	3.71	4.17	4.54
4 - L5 - A1	4.71	5.48	4.87	5.37	4.22	4.56	5.31	4.57	4.59
4 - L5 - B	4.08	4.20	4.79	4.56	3.80	3.90	4.97	4.12	4.75
4 - L6 - A1	6.17	6.21	5.95	4.77	3.17	4.72	3.20	5.60	3.71
4 - L6 - B	4.44	6.19	4.65	4.69	4.27	4.30	4.03	5.04	4.76
4 - Z8 - A1	4.51	4.79	4.68	4.15	4.49	5.06	5.19	4.63	4.47
4 - Z8 - B	4.54	4.75	4.20	3.88	4.53	4.36	3.71	4.23	4.44
4 - Z9 - A1	4.79	5.06	4.95	4.47	4.90	4.11	4.17	4.69	4.83
4 - Z9 - B	4.20	4.21	3.60	4.03	4.47	3.66	4.04	4.04	4.14
4 - Z10 - A1	5.25	5.36	4.96	4.68	4.46	4.92	4.86	5.14	5.27
4 - Z10 - B	4.50	4.64	4.40	4.06	4.28	3.70	4.51	4.43	4.54
4 - Z11 - A1	5.40	5.46	5.08	4.80	4.86	4.67	5.34	5.31	5.07
4 - Z11 - B	4.78	5.04	5.06	4.62	4.62	4.38	5.50	4.62	4.56
4 - Z12 - A1	5.33	5.46	4.97	5.10	5.06	4.63	4.93	5.30	5.44
4 - Z12 - B	4.82	4.86	4.72	4.53	4.47	4.24	4.78	4.77	4.40

10.3.3. Maximal capillary water capacity

Table 27 Maximal capillary water capacity, study plot 1

Study plot 1 Bukovinka	Maximal capillary water capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
1 - E - A1	41.68	42.24	41.50	36.31	43.89	43.25	49.40	38.43	54.38
1 - L2 - A1	30.46	39.53	36.95	41.97	55.31	56.48	51.84	38.78	51.66
1 - L3 - A1	37.33	51.69	50.33	32.63	34.95	67.81	52.52	51.86	48.26
1 - L4 - A1	29.10	36.81	40.15	42.67	43.88	59.80	40.46	37.05	42.31
1 - L5 - A1	37.94	43.49	36.27	36.82	57.26	59.63	45.68	38.69	49.42
1 - L6 - A1	41.44	36.97	51.39	30.90	36.27	54.90	57.91	47.26	50.73
1 - Z8 - A1	37.65	37.23	43.12	37.20	34.93	41.26	37.48	33.14	40.48
1 - Z9 - A1	36.00	32.93	32.99	38.59	44.38	43.45	43.19	45.40	44.07
1 - Z10 - A1	38.24		28.83	35.45	34.12	42.51	44.45	40.71	38.89
1 - Z11 - A1	35.32	31.72	32.87	43.18	38.11	41.20	37.61	39.66	45.57
1 - Z12 - A1	33.67	32.95	39.40	35.00	37.14	38.00	34.29	30.87	37.03

Table 28 Maximal capillary water capacity, study plot 2a

Study plot 2a Proklest	Maximal capillary water capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
2a- E - A1	41.37	40.92	46.78		47.92	53.12	44.90	27.79	39.36
2a- L2 - A1	33.09	35.88	36.23	35.88	54.69	43.08	41.93	34.39	44.33
2a- L3 - A1	32.71	39.95	37.46	39.87	43.38	48.29	37.42	33.59	40.27
2a- L4 - A1	31.16	43.60	33.53	38.28	42.33	34.81	40.93	34.24	55.35
2a- L5 - A1	27.86	37.35	33.57	37.29	53.02	45.62	49.20	43.23	41.46
2a- L6 - A1	38.60	34.33	31.69	36.16	37.83	50.76	33.83	33.49	48.45
2a- Z8 - A1	44.00	36.50	37.60	38.21	40.19	38.50	51.13	37.68	41.38
2a- Z9 - A1	36.68	35.44	37.56	34.55	34.65	36.56	34.72	38.27	36.16
2a- Z10 - A1	34.87	21.41	36.88	34.86	36.50	36.20	35.54	36.31	31.85
2a- Z11 - A1	36.78	33.97	32.00	32.31	38.14	40.32	34.80	33.60	38.95
2a- Z12 - A1	36.69	34.33	34.36		37.24	29.73	36.30	33.66	39.30

Table 29 Maximal capillary water capacity, study plot 2b

Study plot 2b Chochola	Maximal capillary water capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
2b- E - A1	40.95	47.21	37.27	27.86	50.69		37.64	24.43	50.26
2b- L2 - A1	31.86	36.55	39.63	46.39	49.66	37.47	52.86	44.83	36.87
2b- L3 - A1	30.81	42.87	42.47	40.87	50.43	45.87	59.90	37.04	42.34
2b- L4 - A1	33.28	31.94	50.82	44.26	50.03	49.02	35.21	60.68	37.80
2b- L5 - A1	40.55	38.10	37.88	40.56	55.56	39.87	58.88	41.09	41.67
2b- L6 - A1	37.01	36.26	37.59		39.74	47.26	55.74	31.95	37.50
2b- Z8 - A1	40.56	44.59	42.33	45.49	42.60	41.96	49.62	42.83	46.87
2b- Z9 - A1	30.24	31.65	42.20	31.65	48.94	42.51	41.99	40.33	44.77
2b- Z10 - A1	34.26	39.85	40.90	39.85	45.29	48.83	39.97	33.94	36.08
2b- Z11 - A1	30.88	38.46	45.43	47.51	42.12	43.25	37.70	35.73	49.87
2b- Z12 - A1	42.04	46.98	44.77	46.92	48.73	49.98	43.14	48.21	50.53

Table 30 Maximal capillary water capacity, study plot 3

Study plot 3 Rudice	Maximal capillary water capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
3 - E - A1	45.28	49.46	45.14	50.08	50.42	51.04	47.00	43.00	50.38
3- L2 - A1	40.15	50.38	41.09	45.78	54.48	64.11	52.13	36.07	40.37
3 - L3 - A1	38.00	47.89	44.47	37.93	52.75	67.53	64.57	38.18	39.64
3 - L4 - A1	45.01	44.29	48.74		62.47	61.30	62.72	50.14	66.18
3 - L5 - A1	51.73	39.79	42.46	34.10	59.93	55.79	63.22	49.54	50.17
3 - L6 - A1	27.74	37.89	41.11	35.16			67.27	40.90	57.13
3 - Z8 - A1	45.99	50.64	46.86	50.64	50.18	50.57	45.62	45.03	51.44
3 - Z9 - A1	42.70	52.50	46.01	48.77	52.80	50.33	47.32	41.82	52.18
3 - Z10 - A1	40.48	45.92	49.74	45.92	49.11	53.30	49.24	49.33	48.27
3 - Z11 - A1	46.56	42.00	41.50	46.26	47.78	51.31	47.57	42.10	48.62
3 - Z12 - A1	46.97	43.01	44.40	47.65	49.42	53.04	47.06	55.59	51.64

Table 31 Maximal capillary water capacity, study plot 4

Study plot 4 Křtiny	Maximal capillary water capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
4 - E - A1	29.57	24.83	30.02	24.83	33.45	33.43	29.55	30.48	33.17
4 - L2 - A1		25.40	27.32	25.40	35.55	33.63	31.05	27.38	26.15
4 - L3 - A1		30.67	27.91	37.55	39.26	38.28	35.17	30.78	34.17
4 - L4 - A1		37.90	29.05		43.23	32.74	37.25	37.60	39.30
4 - L5 - A1		32.61	22.96	38.62	50.67	37.50	53.53		34.10
4 - L6 - A1		38.44	34.80	41.83	35.13	47.96	54.57	43.31	40.97
4 - Z8 - A1	35.47	35.72	32.95	41.42	34.43	35.87	33.88	41.43	35.10
4 - Z9 - A1	40.56	31.35	39.16	40.55	26.24	33.70	38.06	35.43	38.38
4 - Z10 - A1	29.90	31.82	41.85	34.68	41.16	35.81	33.30	31.97	38.84
4 - Z11 - A1	41.76	33.46	39.47	36.05	33.20	32.73	35.56	43.73	43.15
4 - Z12 - A1	41.27	27.47	34.08	38.03	37.58	42.69	33.41	42.89	44.06

10.3.4. Minimal air capacity

Table 32 Minimal air capacity, study plot 1

Study plot 1 Bukovinka	Minimal air capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
1 - E - A1	25.25	15.37	34.24	31.70	11.94	12.42	11.39	8.60	10.64
1 - L2 - A1	30.73	20.92	21.66	16.31	11.36	4.16	11.78	24.06	8.27
1 - L3 - A1	17.50	16.78	11.97	24.15	24.61	-3.81	15.69	19.08	19.88
1 - L4 - A1	28.51	29.70	23.89	24.55	20.11	-1.88	22.64	22.41	31.47
1 - L5 - A1	22.73	26.36	29.61	27.01	7.95	7.51	15.88	27.91	19.97
1 - L6 - A1	5.80	30.07	9.05	21.84	27.33	6.94	10.42	20.98	16.68
1 - Z8 - A1	10.33	16.41	0.91	16.62	19.08	13.50	27.39	23.82	3.69
1 - Z9 - A1	5.32	9.64	13.27	10.37	2.91	9.60	2.51	4.03	5.18
1 - Z10 - A1	0.52		7.85	4.94	17.16	15.77	5.17	2.10	9.71
1 - Z11 - A1	-0.23	12.28	9.32	4.01	18.56	5.58	7.34	3.35	1.65
1 - Z12 - A1	5.39	7.81	9.83	6.23	18.20	9.92	14.25	25.49	1.44

Table 33 Minimal air capacity, study plot 2a

Study plot 2a Proklest	Minimal air capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
2a- E - A1	13.10	11.06	7.97		1.09	5.58	14.67	21.06	17.71
2a- L2 - A1	20.95	13.79	6.57	10.48	12.21	26.36	7.19	21.29	23.61
2a- L3 - A1	15.58	13.60	4.26	-0.70	17.03	4.14	24.87	11.17	15.94
2a- L4 - A1	15.92	13.77	5.43	13.24	8.93	16.16	17.50	17.31	19.51
2a- L5 - A1	26.27	5.96	15.76	-1.67	-0.93	0.55	10.69	13.57	20.97
2a- L6 - A1	10.01	7.03	22.64	14.22	19.79	7.55	13.79	20.79	18.42
2a- Z8 - A1	19.64	1.98	3.09	16.12	-1.19	21.04	12.09	12.47	0.11
2a- Z9 - A1	3.57	2.22	5.28	-1.38	4.10	7.12	6.20	7.15	3.52
2a- Z10 - A1	8.70	11.14	0.05	0.83	2.29	-1.50	0.43	1.24	-1.96
2a- Z11 - A1	4.39	3.96	11.45	8.37	4.15	2.10	6.33	7.65	-4.53
2a- Z12 - A1	5.72	4.74	0.99		5.27	10.19	0.80	17.23	2.01

Table 34 Minimal air capacity, study plot 2b

Study plot 2b Chochola				Minimal air capacity [%]					
Sample	March	April	May	June	July	August	September	October	November
2b- E - A1	19.16	18.70	7.51	13.19	6.39		8.68	25.04	12.79
2b- L2 - A1	14.03	13.91	8.16	2.78	6.55	21.50	8.85	20.67	17.14
2b- L3 - A1	20.76	23.47	22.22	20.32	1.04	12.74	11.99	21.23	12.79
2b- L4 - A1	16.89	24.09	13.70	20.74	8.90	11.38	15.96	5.92	28.45
2b- L5 - A1	7.36	13.95	15.03	14.91	8.58	16.99	4.73	24.58	18.63
2b- L6 - A1	12.55	9.60	18.06		19.28	-2.34	2.48	35.95	22.88
2b- Z8 - A1	3.75	6.36	15.37	7.59	5.28	20.62	9.17	12.76	6.68
2b- Z9 - A1	10.28	9.82	1.32	8.93	7.58	2.76	11.39	8.03	-1.36
2b- Z10 - A1	3.14	2.04	7.48	-2.64	5.67	3.64	2.73	22.66	4.83
2b- Z11 - A1	4.32	5.08	6.78	5.22	5.69	-1.72	5.10	28.17	1.30
2b- Z12 - A1	1.38	3.07	15.95	5.69	9.55	9.46	11.40	1.12	12.77

Table 35 Minimal air capacity, study plot 3

Study plot 3 Rudice	Minimal air capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
3 - E - A1	11.41	3.72	1.38	3.98	6.89	6.38	13.75	18.08	4.66
3- L2 - A1	16.03	4.92	20.80	4.21	6.65	-1.24	9.99	29.61	24.65
3 - L3 - A1	27.33	7.90	17.47	28.61	17.20	0.28	7.20	31.48	27.80
3 - L4 - A1	21.82	18.20	15.68		12.26	6.78	11.58	18.14	5.05
3 - L5 - A1	21.51	13.42	17.66	18.50	6.74	16.59	11.32	12.62	19.95
3 - L6 - A1	23.88	22.62	19.27	16.58			4.55	28.56	18.61
3 - Z8 - A1	6.34	2.28	8.60	3.64	1.99	1.61	10.54	-2.22	-1.23
3 - Z9 - A1	8.30	0.76	1.16	0.80	-0.07	-1.54	12.77	20.82	-0.34
3 - Z10 - A1	7.47	4.45	6.33	-3.76	-3.25	2.39	1.90	0.55	0.33
3 - Z11 - A1	2.86	4.66	12.47	7.48	7.49	1.56	5.77	15.36	27.10
3 - Z12 - A1	6.53	2.94	4.66	-3.15	1.14	6.51	3.25	-0.78	-0.20

Table 36 Minimal air capacity, study plot 4

Study plot 4 Křtiny	Minimal air capacity [%]								
Sample	March	April	May	June	July	August	September	October	November
4 - E - A1	18.10	22.84	25.85	-4.64	19.11	19.31	19.22	23.40	27.19
4 - L2 - A1		26.15	20.90	18.59	20.42	19.77	13.31	27.74	23.63
4 - L3 - A1		25.83	21.43	15.70	10.32	18.94	13.79	27.57	22.04
4 - L4 - A1		21.91	24.21		12.36	27.25	16.42	22.42	12.23
4 - L5 - A1		26.58	16.70	16.56	4.93	16.92	7.11		32.38
4 - L6 - A1		28.83	25.25	20.85	12.89	6.21	4.45	22.95	21.01
4 - Z8 - A1	14.13	14.93	16.01	7.44	13.37	18.39	15.79	9.31	12.76
4 - Z9 - A1	9.25	11.83	11.31	5.98	25.95	17.69	19.21	22.08	13.02
4 - Z10 - A1	14.21	17.47	1.40	14.24	0.42	17.97	4.01	21.56	8.25
4 - Z11 - A1	4.29	17.31	16.02	11.70	14.58	8.82	11.11	15.26	4.89
4 - Z12 - A1	11.43	21.11	12.57	2.89	5.15	6.67	18.79	6.39	3.15