DEVELOPMENT OF SELECTED PROPERTIES OF ARABLE SOILS TYPE CHERNOZEM

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ABSTRACT

The aim of this work is to assess the development of selected soil characteristics over time. In the research were taken in the fields of southern Moravia, valuated as chernozem soil type, soil samples from the topsoil layer. It was selected twenty sites, with chernozem soil type. There were taken intact and bulk soil samples from the topsoil layer. The results were then compared with potential properties referred in literary sources, the results of a comprehensive survey of soil (the KPP, completed in 1963) and available results of agrochemical tests the Central Institute for Supervising and Testing in Agriculture (the UKZUZ). In this article the results of content of phosphorus, potassium, calcium, magnesium, $CaCO_3$, soil organic matter and its quality and exchangeable pH are compared.

The results of our analyzes and comparisons with historical data do not indicate significant trends of changes in nutrient content (which are depend mainly on fertilizing), organic matter and its quality or pH. However, there has been a dramatic increase of $CaCO_3$ content in the topsoil layer, which is under natural conditions often decalcified. Such an increase in carbonates (about 5%) can, according to literary sources, attributed to erosion - narrowing of the topsoil layer and the gradual approximation to loess – parent material rich in carbonates.

Key words: pH, agriculture, nutrients, carbonates, humus, soil developing

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INTRODUCTION

Agricultural activity is and still long time will be an indispensable source of livelihood for the whole civilized society. Success of the agriculture depends on many factors and among the most important and irreplaceable so far is undoubtedly soil. The quantity and quality determine the ability to produce agricultural crops, cultivation intensity and last but not least, the reciprocal ecological environment in your area and globally as well.

During the investigation we were watched basic properties of soils, which are among our most fertile – chernozems of southern Moravia. It was selected twenty sites with soil type chernozem on loess, where they were taken loose and undisturbed soil samples from the topsoil layer. The results were evaluated as a soil fertile features and then compared with prospective properties referred in literary sources, the results of a comprehensive survey of soil (the KPP) completed in 1963 and available results of agrochemical tests of the Central Control and Testing Institute of Agriculture (abbr. ÚKZÚZ). In this article are compared results of certain nutrients level (Mehlich III method) – phosphorus, potassium, calcium and magnesium; content of carbonates, soil organic matter (quantity and quality) and exchangeable pH.

MATERIAL AND METHODS

Exchangeable pH was measured after removing the skeleton of the soil and mixing the sample with a solution of $CaCl_2$. Exchangeable soil reaction is given by hydrogen ions in soil solution and also by that is sorbed to soil colloids and may in certain conditions be released into the soil solution and thereby increases the active soil acidity. It expresses the content of hydrogen ions located in the soil solution and hydrogen ions are displaced into solution by the action of the sorption complex solution of neutral salts. Determined in 0,01 M $CaCl_2$ extract. Calcium ions (Ca^{2+}) are in excess, so they replace H + ions sorbed on the colloidal complex, they will go into solution and the total activity measure as potentiometric pH in $CaCl_2$ (Škarpa, 2010).

The content of oxidized carbon (with subsequent calculation of the content of soil organic matter) in the soil samples was determined by a oxidimetry method, thus in wet way, by Walkley-Black method, modif. by Smith-Pelíšek. Organic carbon humic substances are oxidized by chromo-sulfuric mixture at an elevated temperature of 120 ° C and by a redox titration Mohr's salt it will establish unreacted residue sulfuric mixture (Jandák, 2003).

Carbonate $CaCO_3$ content in the soil was determined by the method according to Janek in Janek's limemeter. Principle of this method is as follows: carbonates in soil decompose hydrochloric acid (10% HCl diluted 1:3 with distilled water), and during this reaction increase a gas - carbon dioxide. It is moving in the closed system on the water level, allowing volumetrically subtracted directly from the lines the percent of carbonate content (Jandák et al., 2003).

Determination of the amount of available nutrients phosphorus, potassium, calcium and magnesium were performed by the method Mehlich III.

RESULT AND DISCUSSION

Expression results in graphs, analyzed and compared with the KPP and agrochemical tests UKZUZ and tabular evaluation.

Phosphorus

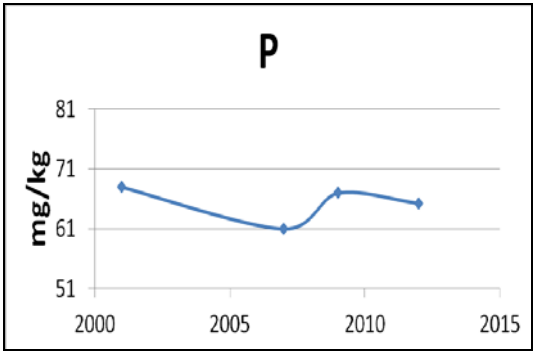

Fig. 1: Development of available phosphorus in the time.

Evaluation	**P** mg/kg
Low	below 50
Satisfactory	**51 - 80**
Good	81 - 115
High	115 - 185
Very high	over 185

Tab. 1: evaluation of phosphorus analysis (richter a Hlušek, 2003).

Potassium

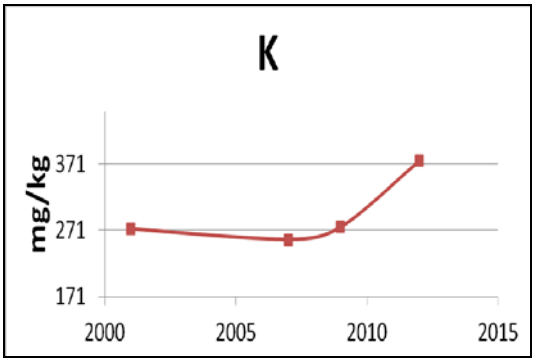

Fig. 2: Development of available potassium in the time.

Evaluation	**K** mg/kg
Low	below 105
Satisfactory	106 - 170
Good	**171 - 310**
High	**311 - 420**
Very high	over 420

Tab. 2: Evaluation of potassium analysis (richter a hlušek, 2003).

Calcium

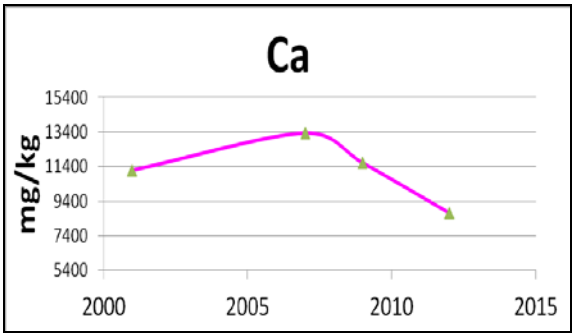

Fig. 3: Development of available calcium in the time. analysis (Škarpa, 2010).

Evaluation	**Ca** mg/kg
Low	below 1100
Satisfactory	1001-2000
Good	2001-3300
High	3301-5400
Very high	**over 5400**

Tab. 3: Evaluation of calcium

Magnesium

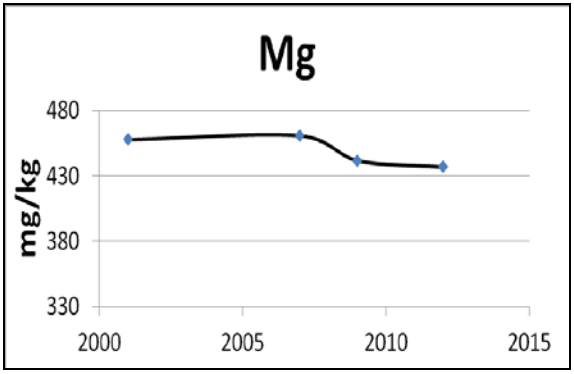

Fig. 4: Development of available magnesium in the time.

Evaluation	**Mg** mg/kg
Low	below 105
Satisfactory	106 - 160
Good	161 - 265
High	266 - 330
Very high	**over 330**

Tab. 4: Evaluation of calcium analysis (Richter a Hlušek, 2003).

Exchangeable pH

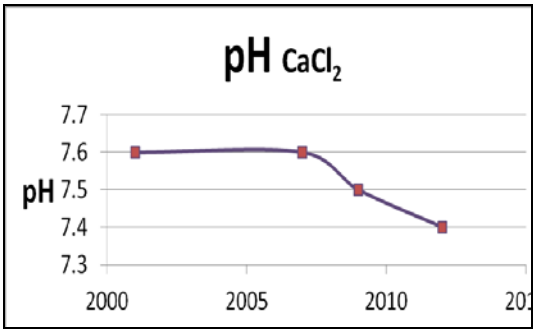

Fig. 5: pH Development of pH in the time.

Exchangeable **pH**	**Evaluation**
below 4,5	Extremely acidic
4,6 - 5,0	Very acidic
5,1 - 5,5	Acidic
5,6 - 6,5	Lightly acidic
6,6 - 7,2	Neutral
7,3 - 7,7	**Alkaline**
over 7,7	Very alkaline

Tab. 5: Evaluation of exchangeable pH analysis (Škarpa, 2010).

Soil organic matter

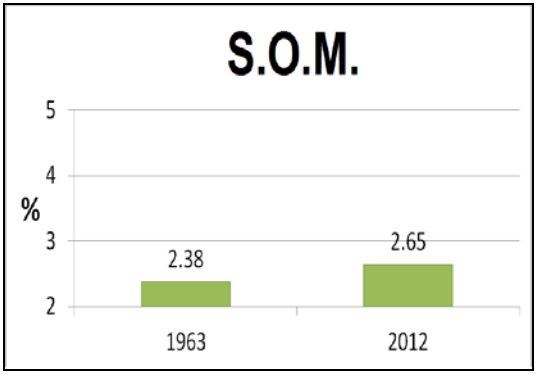

Fig. 6: Development of S.O.M. in the time (HA:FA for year 2012 = 1,23)

Evaluation of soils	Content of **humus**
Humusless	0
Low humic	below 2
Moderate humic	**2.5**
Strongly humic	over 5

Tab. 6 Evaluation of humus content (Jandak, 2004).

Carbonates

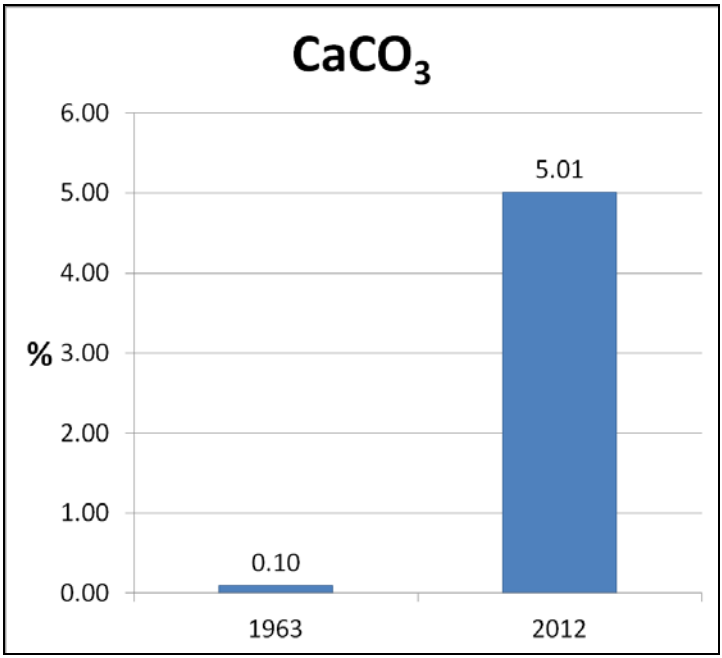

Fig. 7: Content of carbonates about the year 1963 and today (results of KPP finished in 1963 and ours)

The results of analysis of available nutrients in the soil - K, P, Mg and Ca are moving in satisfactory values - magnesium and calcium have been presented in the range of representation "very high" potassium fluctuates between "good" to "high", only phosphorus is in values "satisfactory". The relatively low content of mobile phosphorus in such otherwise well-fertilized soil related to the contrary, a very high content of calcium carbonate CaCO3 extension. In an alkaline environment with follows powerful representation of this element easily immobilized to insoluble forms, is unavailable (or very difficult) for plants and are also largely reflected in the analysis of available nutrients Mehlich III (Ann et al, 1999).

Levels for oxidizable carbon, or humus - more specifically soil organic matter, correspond to the farmed soils on chernozems - content lower than original / potential (Nemecek, 1990), but still in a satisfactory range of "moderate humus" soils. Compared with the results of KPP even suggest an increase about 0,3 % in last 50 years. But it is not important, or even a statistically significant increase. Moreover, the quality of humus measured by the ratio humic acid/fulvic acids (HA:FA) is 1.28 - which is below the minimum threshold of 1.5, in chernozems moreover originally reported in the range of 2-3 (Nemecek, 1990).

Exchangeable pH has been present almost in all observed sites in the alkaline range of the scale, a decrease of 0.2 pH level is visible in the graph is thus not statistically significant. In addition, the decrease in pH did not correlate with long-term increase in carbonate content in the topsoil.

Perhaps the most interesting comparison in this work is a comparison of carbonate content in the topsoil today and during KPP about 50 years ago. Here we see growth from 0.1 to 5%. Carbonates are often contrast in surface horizons typically leached, a carbonate-free, especially by acidification of fertilizers or precipitation (particularly in the past moreover by its acidity). The opposite trend - the growing amount of carbonates in the topsoil is perhaps on one hand of the many positive reasons, however, on the other hand the it points to a much more serious problem of most of agricultural soils in the Czech Republic - soil erosion. Once the soil loss will exceed its genesis, occurs reducing soil profile and surface horizons (topsoil) will begin both physically and consequently in its properties closer to parenting material. In our case, we're talking about loess - calcareous material rich in carbon. After a sufficient amount of erosion of fertile topsoil will begin stripping the subsurface horizons, all of which have not been washed carbonates and which have subsequently picking up loess by a plowing (Sobocká 2003 Fulajtár 1999). We can also see the erosion and loess "leaking" to the surface on satellite images and often looking at the agricultural landscape after harvest on the spot.

It can be therefore concluded that arable chernozem around the site Hustopece are well supplied with nutrients (from industrial fertilizers), have an alkaline pH and contain the expected amount of organic matter. But it stands to that with the increasing erosion of the soil will be decreasing topsoil horizon and humus in it. One such extreme case has been observed during the sampling. But in that case we can't call this soil type already chernozem. Human activity transforms it to a less fertile soil type – regosol. And such soils will not be able to compare even with the current chernozems in any way and do not provide the conditions for the growth of plants and thus also the current crop farmers working on them.

CONCLUSIONS

The content of available nutrients in the soil indicates significant deficiencies due to plant nutrition. The concentration of essential nutrients is usually observed moving in tabular premium values, only the phosphorus within the last 13 years under ranges from "satisfactory". The content of soil organic matter corresponds with the land use on chernozems, but the quality of humus is under the minimum level.

Noteworthy is abnormally high content of carbonates $CaCO_3$ (which are usually in the topsoil layer extracted) and related "very high" content of calcium. This, at first glance, positive fact is caused by the serious problem of agricultural land – soil erosion. By the intensive erosion of surface layers and washing the topsoil horizon away in long term the parent material, rich in carbonates, closer to the surface. At some sites was even only the loess with twenty centimeters topsoil layer over it with a sharp transition. Soil erosion is also well visible on satellite images.

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