The difference the grain size distribution forehead vineyard terraces of South Moravia with respect to ground cover vegetation cover

JANA SIMECKOVA, ANNA HAMMEROVA, BEATA HRABOVSKA
Department of Agrochemistry, Soil Science, Microbiology and Plant Nutrition
Mendel University in Brno
Zemedelska 1, 613 00 Brno
CZECH REPUBLIC

xsimecko@node.mendelu.cz

Abstract: Soil is an intricate system. Different characteristics are used to his. One of them belong grain size distribution. The soil texture affects many other physical, physicochemical and biological properties.The paper deals with grain size distribution of forehead terraces with respect to ground cover vegetation cover. We have distinguished the place – bare, grass and shrubs. For comparison was used pipetting method and of determining soil texture by Novak (grouped according to particles smaller than 0.01 mm).
The laboratory results show that most of the monitoring locations and places are soil class sand loamy. The results were statistically processed. These results suggest that not only the grain size distribution of individual places vary but also vary also grain size distribution one location to different places (bare, grass, shrubs). The places bare and shrubs are in terms of the grain size distribution statistically proven different.

Key-Words: soil class, terrace

Introduction

One of the physical properties of the soil is the soil texture. The texture is formed by mechanical particles of mineral origin. [1] Elementary particles are grouped according size into grain size fractions. Quantitative representation of individual fractions in soil is referred to as soil texture. Quantitative representation fractions are given in weight percent. [2]

The soil is divided into two fractions: skeleton and fine earth. In the soil is monitored primarily fine earth because is a principal component of soil. Particle size affects many other physical and physical-chemical properties. We can talk about porosity, air and maximum water capacity, soil permeability to water and air, adhesion, plasticity, soil sorption, soil temperature, and others. According soil grain size determines the possible use of the land or the method of processing and reclamation of land. From this standpoint belongs soil granularity to the basic characteristics of the soil. [2] The soil texture affects the biological properties of the soil also. The size of microbial activity depends on the grain size distribution. [3]
Impact the texture to the other processes in the soil is also dealing some scientific work. An example can be the contribution that dealt with aspects influencing the yield of sugarcane. There was an association between the occurrence amount eldana larvae and soil texture. The authors explain the clay content. If the soil contains little clay, the plant can suffer from water stress and it affects the presence of N in the stem of sugarcane. Higher incidence of N in aboveground plant parts makes it easier to attack eldana larvae. [4]

It has been detected differences in the intensity of the assault soybean cyst nematode [5] or *Renynchulus reniformis* [6].

Soil texture can also affect the release into the atmosphere of certain substances applied to the land for the protection of plants against pests. Certain textures are able to retain substances in the soil longer, which allows extending the time for contact with the pests. [7]

The authors Sağlam and Dengiz [8] dealt the difference of soil organic matter, water stable aggregates, hydraulic conductivity, bulk density of different soil classes and different land use. There were statistically significant differences between soil type and soil organic matter content, hydraulic conductivity and water stable aggregates. However, different with volume weight was not found. The authors based their results argue that soils with higher content clay particles are better able to treat the water and make better use of nutrients.

Material and Methods

This article analyzes the grain size distribution of terraces. It is at a location Morkuvky, Mutenice, Nemcicky, Velka Slunecna by Dolni Dunajovice. All sites are located on the vineyard terraces.

Terraces generally originated mainly in the last century. It was combined with the state agricultural policy of the former regime. There was a demand for the used of all locations that are suitable thanks the climate. Thus began to build terraces on slopes with too large longitudinal slope. The total area of the terraces in the Czech Republic is 3 899.76 hectares. It is located in the district of Brno-venkov, Breclav, Hodonin, Melnik, Uherské Hradiste, Vyskov and Znojmo. Of the total area of terraces is 1 390.79 hectares used for the cultivation of the vine. [9]

Terrace consists of two parts - the production area and forehead terrace, which has just cope longitudinal slope. Forehead terraces are now developing succession; they are left without human intervention. It creates conditions for the growth of rare plants. Because the forehead terraces are without human intervention, there is a good opportunity for the life of various animal species. We assume that the soil texture could affect on what species the sites will be found. In this paper, we focus only on the analysis of particle-size distribution of each of these locations.

At each location were identified three sites with respect to ground cover vegetation cover. At each location had to find place bare - with ground cover up to 40 %, grass - with ground cover above 40 % without greater representation of trees or shrubs, shrubs - sufficient coverage consisting of shrubs or trees.

Loose samples for grain size distribution analysis were collected from the surface layer approximately the middle of the slope, where it was placed pitfall traps for insects.

Loose samples were dried under applicable methodology. Grain size distribution analysis was performed using the pipette method. The method consists in that it is based on values of the specific weight of each sample is determined sedimentation time, which is different for each particle density determined tabulating. Creates a water suspension and identified by sedimentation times specific weights for each fraction is performed pipetting. Pipetted amount in a weighing bottle is deferred on the hotplate, where there is evaporation of excess water. After evaporation, the sample is inserted into an oven set at 105°C. After drying, the sample weight is weighed weighing dish. [10]

Using this method we gain weight value of the fraction and using Excel we gain weight percentages of each fraction in the sample. Based on these values, we are able to determine the soil class.

In this work, we used to label size fraction classification by Kopecky and to determine the class of soil samples used Novak classification that soil types classified by content loam particles (<0.01 mm).

This article also contains the statistical data processing. We focused on comparing the content loam particles. Each other was compared all the bare places, place grass or shrubs too. In addition it was compared the contents loam particles at various places each location.

In statistics, ANOVA was used when the data were normally distributed. In the event, that data was not normally distributed used the Kruskal-Wallis one-way analysis of variance. For tests, in which appeared statistically significant difference was performed subsequent analysis using the appropriate post-hoc tests for determining the values between which the difference is statistically significant.

Results and Discussion

As stated above, the grain size distribution is of the basic characteristics of the soil. If we know the grain size distribution of the soil, we can estimate other soil properties. The representation of the different grain size fraction directly influences other soil properties.

For locations described in this article were found differences in soil class, not only between locations but also between different places of one location. Overview of soil class by location and place is in Table 1.

Table 1 Overview of soil class by location and place

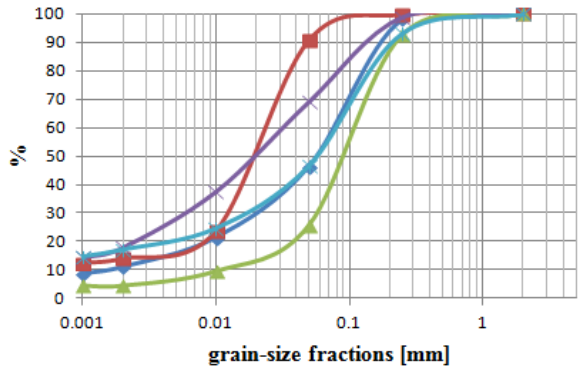
LOCATION/PLACE	BARE	GRASS	SHRUBS
MORKUVKY	sand loamy	sand loamy	sand loamy
MUTENICE	sand loamy	sand loamy	clay loam
NEMCICKY	sand	loamy sand	sand loamy
TESANY	loam	clay loam	clay loam
VELKA SLUNECNA	sand loamy	sand loamy	loam

The predominant soil class is sandy loam soil class and the total of 8 places. This soil class contains loam particles (particles smaller than 0.01 mm)

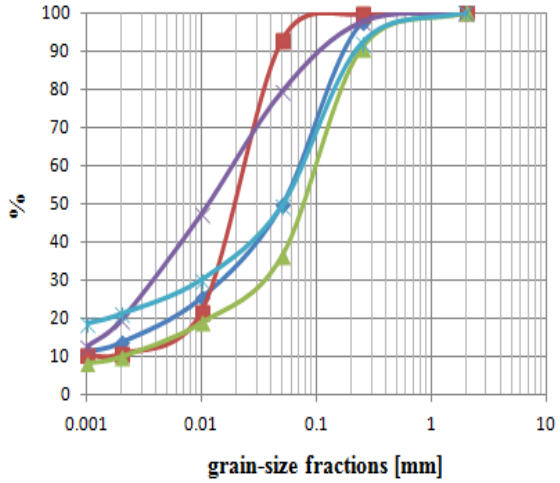
between 20-30 %. This soil class has compliant porosity, permeability and air capacity. [2]
Second soil class was clay loam. It was on three monitored places. Content loam particles are 45-60 %. These soils have a high sorption and retention capacity. [3]

Fig. 1 Particle-size distribution curve for locations

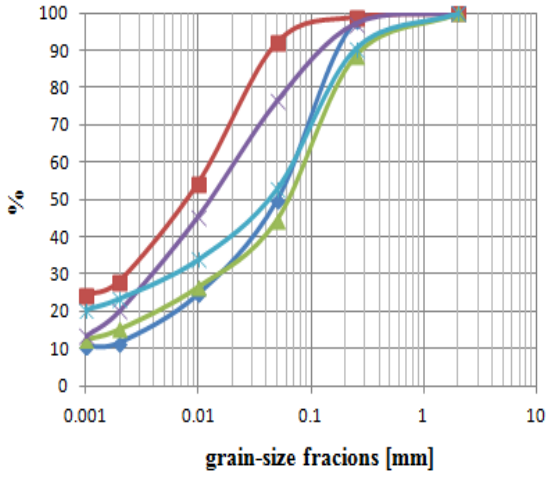
a) bare



b) grass



c) shrubs



Legend:

Morkuvky
Mutenice
Nemcicky
Tesany
Velka Slunecna

Soil class loam was at the two places only. They contain 30-45 % loam particles. And the one place is sandy soil class and one is loamy sand. Sandy soil type contains 0-10 % loam particles and loamy 10-20 %.

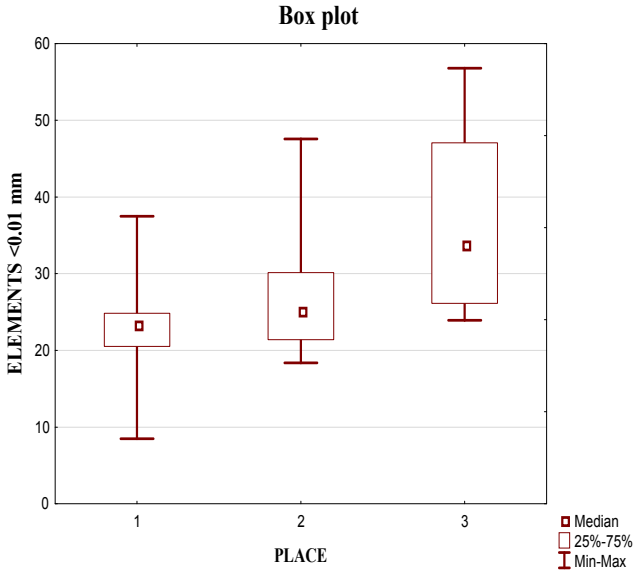
The statistics shows that the locations are different in various places in terms of soil class. For the places bare is statistically significant difference for all places, exceptions are locations Mutenice with Velka Slunecna. In place of grass was statistically significant difference at all locations. In place of shrubs was no statistically significant difference to demonstrate only between the locations Morkuvky - Nemcicky.

Table 2 Kruskal-Walis one-way analysis of varaiance all locations between places

	Kruskal-Wallis one way analysis of variance: p = .0029		
	1	2	3
<0.01 mm	R:15.733	R:21.367	R:31.990
1		0.720427	**0.00225**
2	0.720427		0.0842
3	**0.00225**	0.0842	

Legend: 1 – bare; 2 – grass; 3 – shrubs

Fig. 2 Box plot all locations between places



Legend: 1 – bare; 2 – grass; 3 – shrubs

In addition to the differences between the locations by places were also found statistically significant differences between places in different locations. A statistically significant difference between all places has been found in locations Nechvalin and Velka Slunecna. For locations Nikolcice and Morkuvky was statistically significantly difference bare place from grass and shrubs. U Mutenice again statistically significantly difference place bare of bushes and grass.

For statistical comparison of all places divided by points with a statistically significant difference was found only between the place bare and shrubs.

Conclusion

The laboratory results show that the grain size distribution of the vineyard terraces is different. The predominant soil class of the monitored locations is soil class sandy loam.

With statistics showed that content loam particles which are used to determine the soil class, significantly different from each other. This difference was found between both locations categorized by the places, but is also found in the statistics of individual places at one location or all locations statistical comparison between them. From this we can derive that there is a possible influence of soil class on the present animal species in the case that some species prefers a certain soil composition.

Acknowledgement

The research was funded by IGA AF MENDELU TP 7/2014

References:

[1] Rehák Š, Janský L, *Fyzika pôdy I: základné fyzikálne vlastnosti pôdy*, 1. ed. Bratislava: Univerzita Komenského, 2000, 105 pp, ISBN 80-223-1544-3.

[2] Fulajtár E sen, *Fyzikálně vlastnosti pôd*j, Bratislava: Výskumný ústav pôdoznalectva a ochrany pôd, 2006, 141 s, ISBN 80-89128-20-3

[3] Fulajtár E, *Fyzikálne vlastnosti pôd Slovenska, ich úprava a využitie*, 1. ed., Bratislava: Veda, 1986, 155 pp.

[4] Rhodes R, Miles N, Keeping MG, *Crop nutrition and soil textural effects on eldana damage in sugarcane,* 86th Annual Congress of the South African Sugar Technologists' Association (SASTA 2013), Durban, South Africa, 6-8 August 2013 2014 pp. 121-136, also available from: http://cabdirect.org/abstracts/20143179956.html?resultNumber=2&q=title%3A%28%22soil+texture%22%29.

[5] Pérez-Hernández O, Giesler LJ, Quantitative relationship of soil texture with the observed population density reduction of Heterodera glycines after annual corn rotation in Nebraska, *Journal of Nematology*, Vol. 46, No.2, 2014, pp. 90-100, also available from: http://cabdirect.org/abstracts/20143257795.html?resultNumber=3&q=title%3A%28%22soil+texture%22%29

[6] Moore SR, Lawrence KS, The effect of soil texture and irrigation on *Rotylenchulus reniformis* and cotton, *Journal of Nematology*, Vol. 45, No.2, 2013, pp. 99-105, also available from: http://cabdirect.org/abstracts/20133377415.html?resultNumber=0&q=title%3A%28The+Effect+of+Soil+Texture+AND+Irrigation+on+Rotylenchulus%29

[7] Simpson CR, Nelson SD, Ajva HA, *Impact of soil texture and organic matter content on mitc volatilization from soil columns,* Proceedings of the 19th World Congress of Soil Science: Soil solutions for a changing world, Brisbane, Australia, 1-6 August 2010, Symposium 4.1.2 Management and protection of receiving environments 2010 pp. 64-67, also available from: http://www.cabi.org/cabdirect/FullTextPDF/2011/20113345997.pdf

[8] Sağlam M, Dengiz O, Influence of selected land use types and soil texture interactions on some soil physical characteristics in an alluvial land, *International Journal of Agronomy and Plant Production*, Vol. 3, No. 11, 2012, pp. 508-513, also available from: http://www.cabi.org/cabdirect/FullTextPDF/2012/20123393238.pdf

[9] Hošková M, *Zemní terasy a možnosti jejich rekultivace a revitalizace,* in Sborník konference JUNIORSTAV 2007, Brno: CERM, 2007, pp. 222-222, ISBN: 978-80-214-3337- 3, also available from: http://www.fce.vutbr.cz/veda/JUNIORSTAV2007/pdf/Sekce_3/Hoskova_Veronika_CL.pdf

[10] Zbíral J, Honsa I, Malý S, Váňa M, *Analýza půd*. 3. edit., přeprac. a rozš. Brno: Ústřední kontrolní a zkušební ústav zemědělský, 2010-2011, 290 pp, ISBN 978-80-7401-0