Water retention assessment in traditional agricultural landscape
(case study Liptovská Teplička, Slovakia)

Marta Dobrovodská, Veronika Piscová, Pavol Kenderessy

Institute of Landscape Ecology of SAS, Slovakia

METHOD

I. THEORY

Plant roots play a vital role in the supply of water for plant growth. Knowledge about the amount of active, living roots in the soils of different stands/sites in the same depth provide data for comparing stands of various ecological conditions from the point of view of their water retention ability. We have decided to assess water retention using methods of studying root mass – dry weight (g) taken in depth 0 -6 cm within sample sites of different ecological conditions in traditional agricultural landscape. We have studied the correlation of root mass and selected site factors - independent variables: geological pad, slope gradient, forms of anthropogenic relief (FAR), FAR rock content, FAR orientation along contour/fall lines. FAR lenght and hight, land use, position on the FAR.

II. SAMPLE SITES SELECTION

1.LOCALITIES – 14 in total

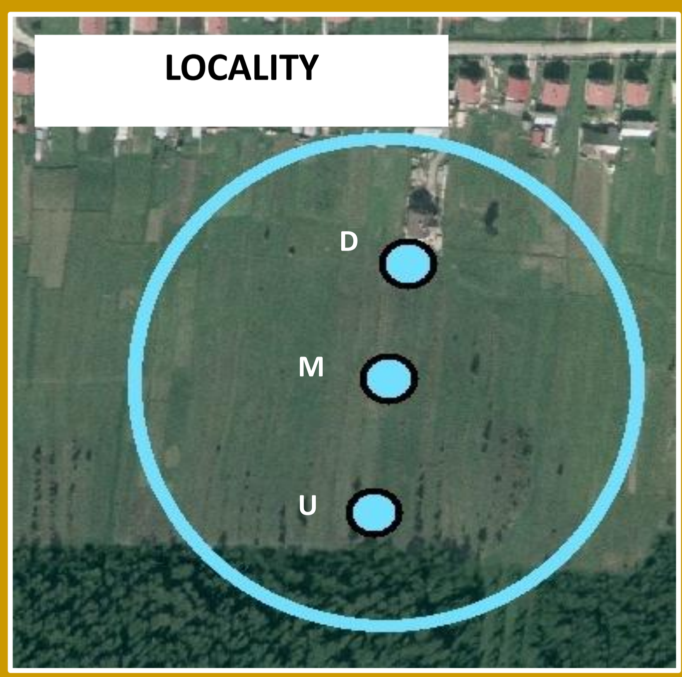
- a random samling according to FAR type variability, geology, land use, FAR topography

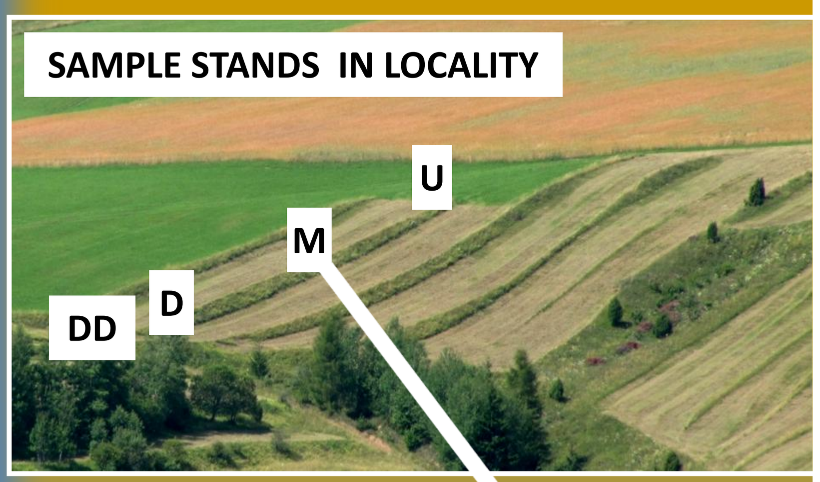
2. SAMPLE STANDS

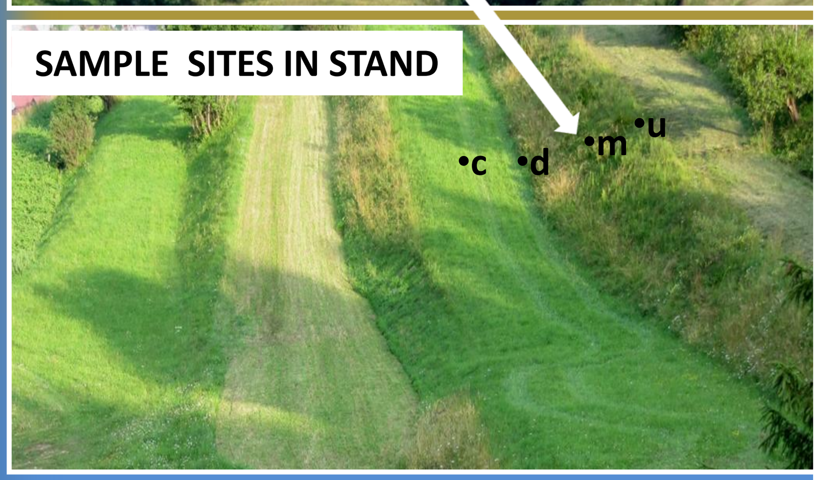
- upper sample stand – U
- middle sample stand – M
- down sample stand – D
- down sample stand outside FAR - DD

3. SAMPLE SITES - 41 IN TOTAL

- upper sample site – u
- middle sample site – m
- down sample site – d
- central productive plot site – c







III. FIELD WORK

- GPS location of sample site
- assesment of the FAR properties (lenght, hight skeleton content)
- root sampling

IV. LABORATORY WORK

- washing process

- sample material separation

- oven drying
- weighting dry root mass

V. STATISTICAL EVALUATION

We have used simple bivariation analysis to assess the impact of independent variables on factor of water retention. According to these results the best water retention is associated mainly to following variables:

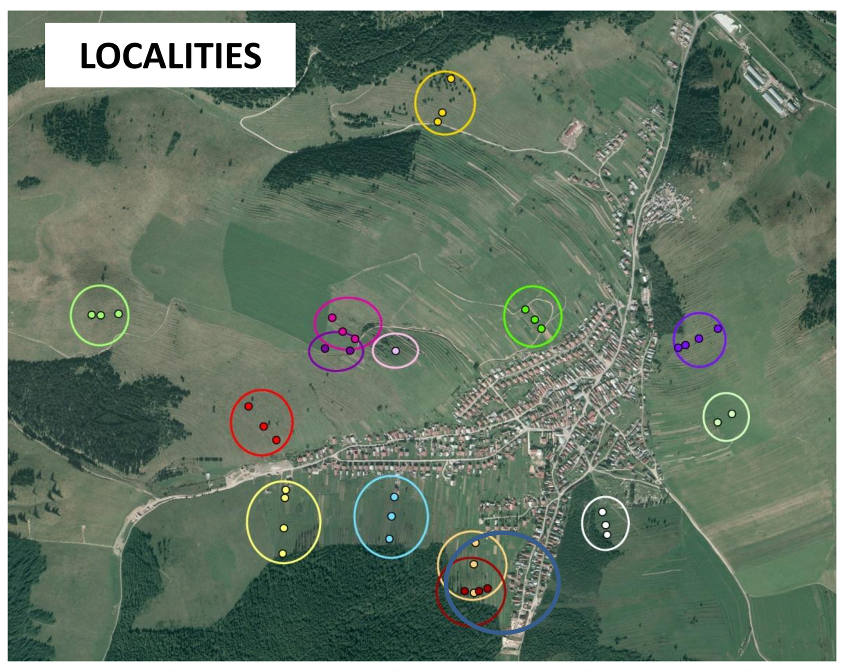
- Geology – Ramsau dolomites
- Slope gradient - 3˚ - 7˚
- Forms of anthropogenic relief – terrace –mound
- FAR orientation along contour/fall lines - bias course
- Position on the FAR - down FAR sample site, central productive plot site
- Land use - regular mown and grazed grassland and regular mown grassland

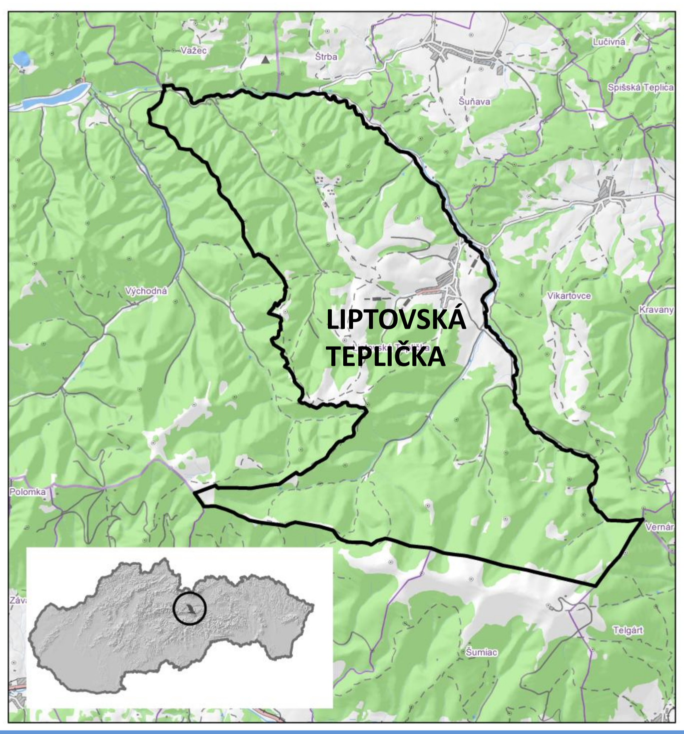
Furthermore the factors as FAR lenght and hight were correlated with factor of water retention using Spearman's correlation with r < ± 0,5. Based on this, FAR length and hight have a little effect on variability of water retention values.

VI. FUTURE TRENDS

According the presented results we are planning to place the dataloggers in order to record soil moisture correlated with precipitation data measured at local meteorological station.

Liptovská Teplička originated in 1634 by goral *Sholtise* colonisation with *Walachian* rights. By the beginning of the 20th century, the agricultural land had been divided into many small parcels belonging to individual owners. Due to this fact, and the presence of steep slopes and high soil skeleton content, the agricultural landscape consisted of many elongated parcels with balks - forms of anthropogenic relief **(FAR)** as mounds, heaps and terraces. The establishment of a cooperative farm and collectivization of the agriculture, starting in 1975 affected only a part of the territory of the village. Nevertheless, it caused the mass abandonment of arable land by self-employed farmers and led to huge self-grassing of non-recultivated areas, although with preservation of the balks. Despite the significant decline in agricultural use, tens of kilometres of FAR have been preserved.





The FAR were characterized as relief forms created by conscious and spontaneous agricultural activity of man, using traditional agricultural equipments and technologies in order to increase the productivity of landscape, with regard to the character of natural environment and the degree of economic and cultural-social development of local inhabitants. The balks have been divided into two basic genetic groups according Ružičková, Dobrovodská, Valachovič, 1999 and Špulerová et. al, 2014:

a) forms, which are result of the improvement of relief-soil quality, mostly further on directly cultivated

They have been created in the course of long-term land cultivation of arable fields on steep slopes that resulted in parallel **terrace plateaus (P)** - productive plots, of some meters width and grassy slopes **terrace slopes (T)** - balks. They can be long several hundred of meters, high since tens of centimeters up to few meters. The running of terraces can be oriented along the slope´s declivity, along contour lines or in diagonal direction toward contour lines. Terrace slopes are composed of soil with different proportion of skeleton depending on type of soil and sub-soil layer. Proportion of skeleton on terrace slopes was increased also by farmers who accumulated here the stones removed from neighboring productive plots.

b) forms, which are result of the soil- skeleton removing, mostly further on directly not cultivated

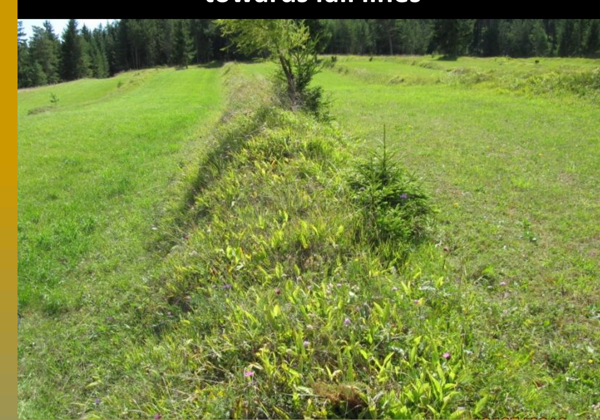
Solitary heaps were formed from the stones removed during annual ploughing and deposited to one place within a field or along its edge. They are concave stone features of elliptical to irregular radial pattern that was conditioned by cultivation of arable land along solitary heaps usually situated in the centre of the plots. Soil content is dependent on distribution of rocks, biomass decomposition, erosion and other processes. **Mounds (M)** have been created gradually by merging of heaps. They create linear concave stone features, characterized by different skeleton and soil content.

c) forms, which are result of the two given methods of soil cultivation. The third group is represented by **slope mounds (SM).** They occure in terraced areas, where stones from soil were removed during yearly ploughing and thus heaped on the slope of the terrace. Its surface is irregular, sometimes there is possible to identify separate heaps. There are also FARs which have created also as combination of both practices - we call them **terrace-mound (TM)**.

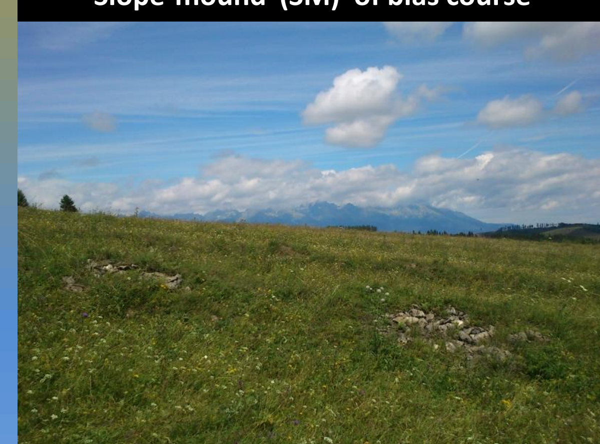
Terraced area (T, P) with FAR oriented along contour lines

Mounds (M) with orientation towards fall lines

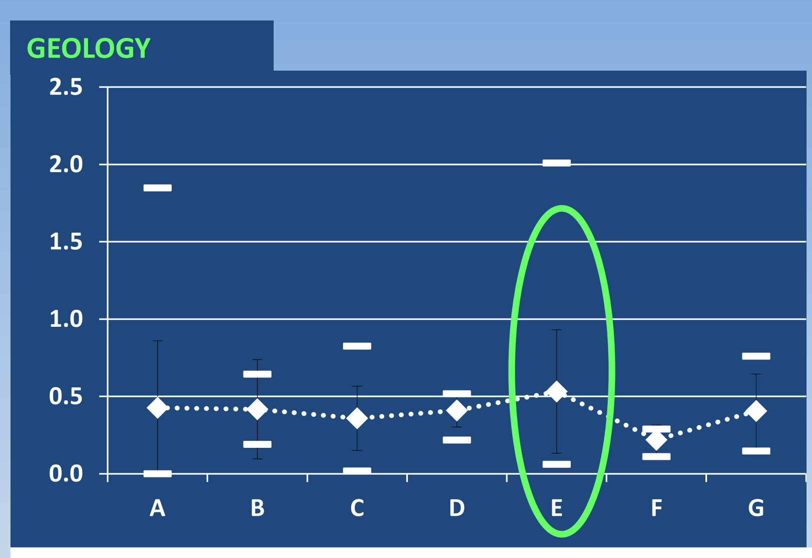
Terrace-mound (TM) with orientation towards fall lines



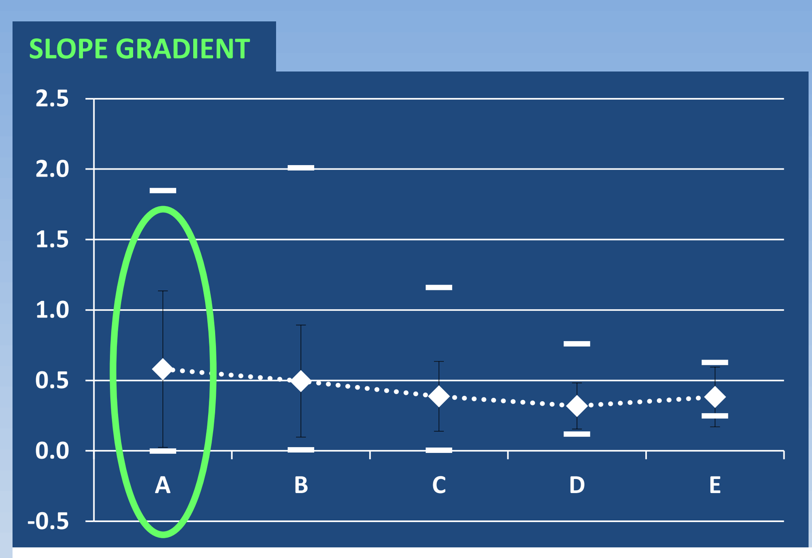
Slope-mound (SM) of bias course



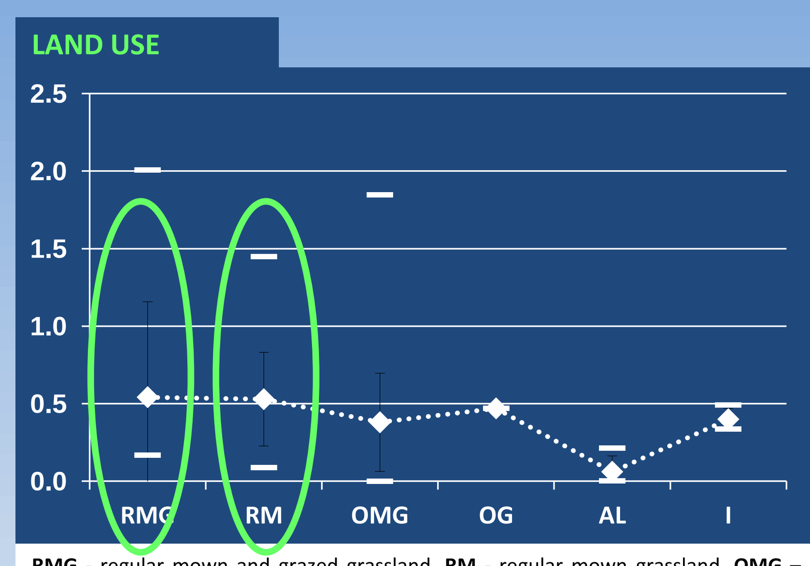
PRELIMINARY RESULTS



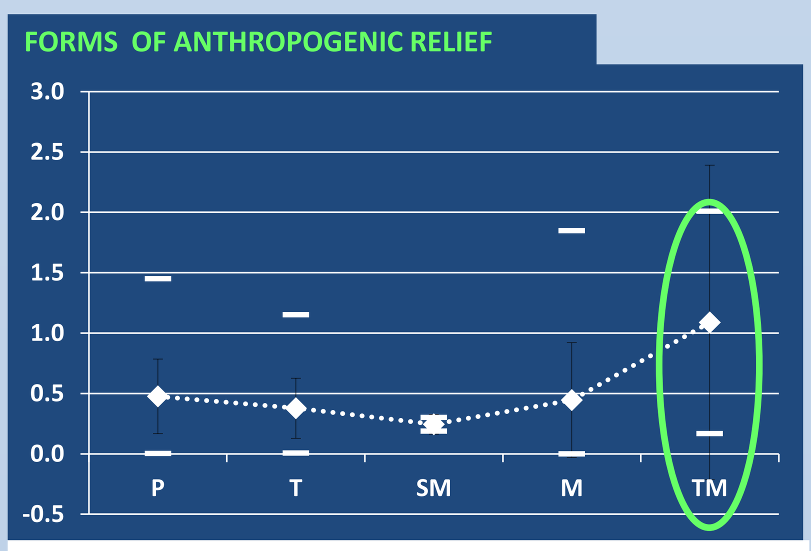
A – deluvial deposits under clay shales, crinoid limestones and ramsau dolomites, **B** - calcareous clay, calpionel limestones, **C** - shales, crinoid limestones, **D** – clay shales with sandstones and dolomites, **E** – ramsau dolomites, **F** - bright-grey, conglomerates, colour sandstones, siltstones, shales, **G** – grey conglomerates, sandstones, dacites and their vulcanoclastics



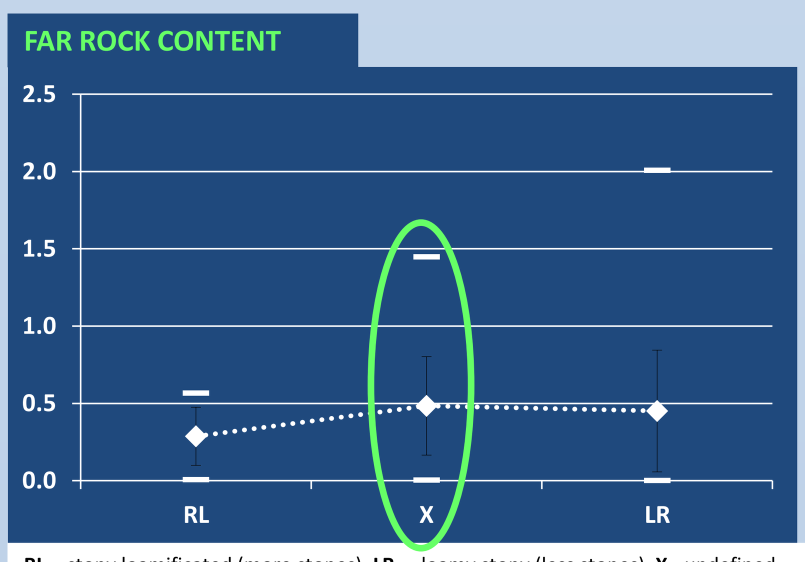
A - 3˚ - 7˚, **B** - 8˚ - 12˚, **C** - 13˚ - 17˚, **D** - 18˚ - 25˚, **E** - 26˚ and more



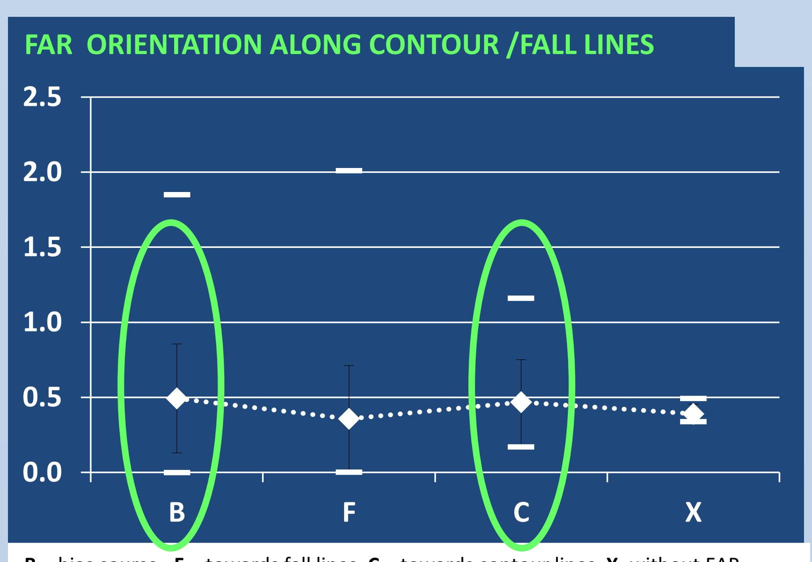
RMG - regular mown and grazed grassland, **RM** - regular mown grassland, **OMG** – occasionally mown and grazed grassland, **OG** –occasionally grazed grassland **AL** – arable land, **I** - intensive grassland



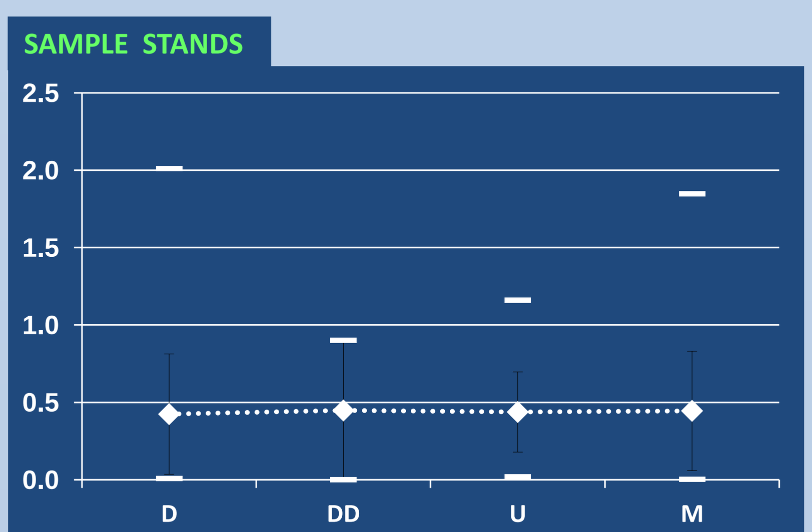
P – terrace plateau, **T** – terrace slope, **SM –** slope mound, **M** – mound, **TM** – terrace-mound



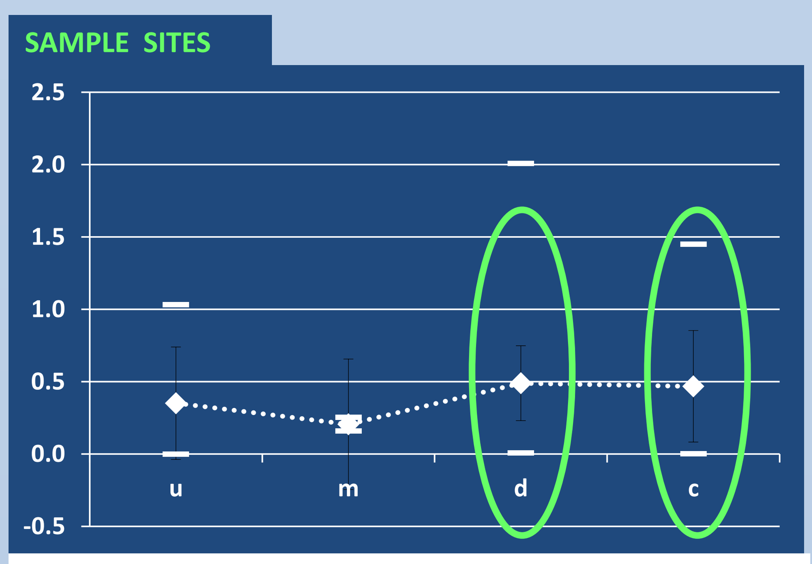
RL - stony loamificated (more stones), **LR** - loamy stony (less stones), **X -** undefined



B - bias course , **F** - towards fall lines, **C –** towards contour lines, **X-** without FAR



D - down sample stand, **DD** - down sample stand outside FAR, **M** - middle sample stand, **U** - upper sample stand



u upper FAR sample site, **m** – middle FAR sample site, **d** - down FAR sample site, **c -** central productive plot site

This research was conducted within the grant project of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences No.2/0158/14 "Diverse of agricultural landscape and its ecosystem services".