PENETRATION RESISTANCE OF SOIL ON THE YEAR-LONG USING MOUNTAIN PASTURE BY THE CATTLE

PENETRAČNÝ ODPOR PÔDY NA CELOROČNE VYUŽÍVANOM HORSKOM PASIENKU HOVÄDZÍM DOBYTKOM

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ABSTRACT

In the year 2006 we investigated mechanical compaction of soil on the mountain pasture (altitude 920 m). Penetration resistance was researched on the compacted places, by cattle hoofs (breed Charolais), which were compared with unmanaged place after deforested. We investigated, that penetration resistant increasing with depth. However intensive increase of compaction was registered exclusively into certain depth. Soil compaction of unmanaged place and cutting - grazing place had high signification of lower penetration resistant (MPa) to compare with place year-long used by grazing.

KEY WORDS: penetration resistance, mountain pasture, system of breeding sucker beef

ABSTRAKT

V roku 2006 sme skúmali mechanické utlačenie pôdy na horskom pasienku (920 m n. m.). Penetračný odpor sme zisťovali na stanovištiach utlačených chodidlami hovädzieho dobytka (Charolais) a porovnávali sme ich s nevyužívanými plochami po odlesnení. Zistili sme, že penetračný odpor s hĺbkou rastie. Avšak intenzívny nárast utlačenia bol zaznamenaný iba do určitej hĺbky. Zhutnenie pôdy nevyužívanej plochy a plochy kosenej a pasenej dosahovalo vysoko preukazne nižší penetračný odpor v MPa v porovnaní s celoročne využívanou plochou pasením.

KĽÚČOVÉ SLOVÁ: penetračný odpor, horský pasienok, systém celoročného chovu hovädzieho dobytka

INTRODUCTION

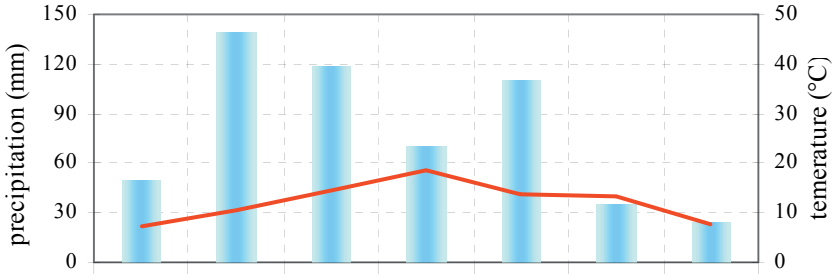
Degradation under the influence of soil compaction on the pastures is big problem in areas of Australia and adjacent islands (Australasia) [14, 12, 7], but also in other countries [4, 10]. In consequence of soil compaction occurs to the degradation of physical properties which interferes soil regimes. That's the reason why physical and mechanical properties of soil are considered for the criterions of soil compaction and their certain boundary values are taken as a borders of damaging soil compaction. There are mainly bulk density, which is increasing by compaction, porosity, aeration and porosity for water, which are decreasing with intensity of compaction [2]. Cattle trampling on the pasture increasing bulk density and penetration resistant. Poaching or pugging is related to penetration of soil surface by hoofs of grazing cattle and the result is damaged pastures. Animal trampling makes excessively compact zone in depth 0.70 – 1.05 m. Compact soil defend to drainage despite of present the big macro - pores. Soil structure and hydrologic changes caused by hoof compacting may cause severe problems in the pasture management [10]. [7] investigated that worse soil physical properties influenced to the yield production during the year. In positively relation, macro - porosity in soil depth from 0.05 m and from 0.06 do 0.10 m was demonstrated. Generally this connection is much important as relative production in spring as harvests in summer-autumn. Research of soil penetration pointed out to the different results in dry matter production. Where soil compaction was higher, the yield was higher as on less compacted soil, because harvest depend more at soil moisture. Lower soil compaction decrease the risk of low yields in second harvest. [6]. Change to soil physical properties caused by grazing and treading are likely to play only a minor role in, in comparison to hoof damage, in change of botanical composition of pasture. However, where overgrazing has occurred and the weather conditions are dry, soil physical limitations may hinder regrowth of the desired pasture species [11]. Pressures applies to the soil by grazing animals are generally of short duration, and are therefore usually associated with compaction rather than consolidation [9]. [13] found that while the contact time between hoof and ground for a walking cow was 0.75 s, pressure was applied to the ground for only about 0.6 s, but during grazing the contact time was generally longer. Pressure applies by grazing is undisturbed and occurs more slowly than for remoulded soil [5]. However, influence of compacted soil, effected by permanent grazing, can be moderated by the aeration. But, these better properties are after 40 weeks coming back to the level occurred before [3].

MATERIALS AND METHODS

Experimental areas were initiated in the spring 2006. The experiment is situated on the site Diel in district Poltár (48° 25` N, 19°34` E) with altitude 920 m. For this area is typical continental clime. Long-term mean annual precipitation is 900 mm and during the growing season (IV.– IX.) is 450 mm. Long-term mean annual temperate is 6 °C and during the growing season 13 °C. The mean number of days with snow cover is 80. The climatic conditions for growing season (Year 2006) are represented in figure 1. The soil profile is loamy-sandy in the whole depth. Dominant fraction in the soil profile is sand, it represent 66.99 % participation in the humus horizon and 63.81 % in the cambic horizon. Other soil fractions see in table 1. The experimental place was established on the deforested pasture. The

area was using in the past (circa 50 years ago) as a

Figure 1: Climatogram - Diel 2006



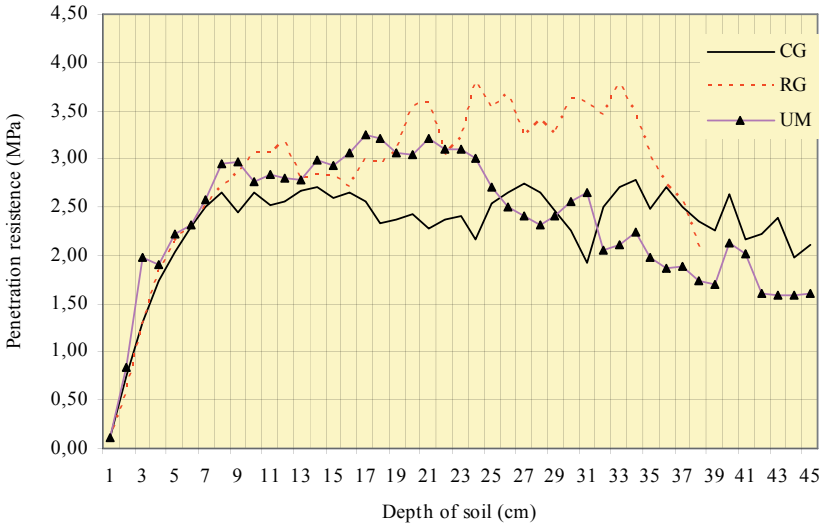
	A	M	J	J	A	S	O
precipitation	49,3	139,5	118,9	70,4	110,3	34,6	23,8
temperature	7,389	10,678	14,587	18,59	13,646	13,19	7,824

Table 1: Physical properties of soil

Soil horizon	Depth of soil (m)	% representation of soil fractions (mm)					
		> 0.25 5.fraction	0.25-0.05 4.fraction	0.05-0.01 3.fraction	0.01-0.001 2. fraction	< 0.001 1.fraction	< 0.01 1.+2. fr.
Aoq	0.00 - 0.05	55.73	11.26	19.80	11.06	2.15	13.21
Bv_1	0.50 - 0.60	48.85	14.96	19.61	10.6	5.98	16.58

Fractions : < 0,001 mm - clay, 0,001-0,01 mm - fine and medium grit, 0,01-0,05 mm - coarse grit, 0,05-0,25 mm - fine sand, > 0,25 mm - medium sand

Figure 2: The curve lines of penetration resistance on the mountain pasture



pasture. To the year 2006 was pasture overgrow by the trees and shrubs and successively was made deciduous forest with predominant of Betula pendula Roth. After restitution of the soil to the initial owners this area started to use as the silvo-pastoral system (graze cattle). In the year 2005 the deciduous forest was completely eliminate and area is used by grazing meat cattle, brad Charolais. The cattle are kept on the mountain pasture without year-long stabling and during winter are fed on the feeding places. The stocking rate is during the year in range 0.3 – 0.6 $LU.ha^{-1}$. The experimental variants (Table 2) were established randomized to the non-completely blocks with three replications after deforested. For measure of soil compaction was used digital record penetrometer P–BDH 3A made according to [1]. In the each replication was made 10 puncture by penetrometer. Parameters of machine according to norm ASAE S 313.1 (cone angle 30°, average of base-line 12.8 / 20.3 mm). Measure was made to the depth 0.45 m depends on the rocky in soil. Results are evaluated by statistical software Statistica 7.0 by Fisher test.

RESULTS

Results from measures of penetration resistance in the first year after deforested area are showed in figure 2. Measure of soil compaction was investigated, that penetration resistant with depth increasing. Penetration resistant to depth 0.09 m was intensively increasing on the all of investigated variants. On the variant RG the compaction oscillated in depth from 0.09 m to 0.33 m with the biggest penetration resistant 3.81 MPa in 0.24 m and 3.78 MPa in 0.33 m. From 0.33 m it was intensively decreasing up to value 2.08 MPa. On the year-long use place with reseeding (RG) by cattle was investigated the biggest soil compaction which was high significant in the whole scale of measured soil profile (Figure 3, Table 3). We suppose, it was affected year-long use by cattle, soil

Table 2: Variants and treatments

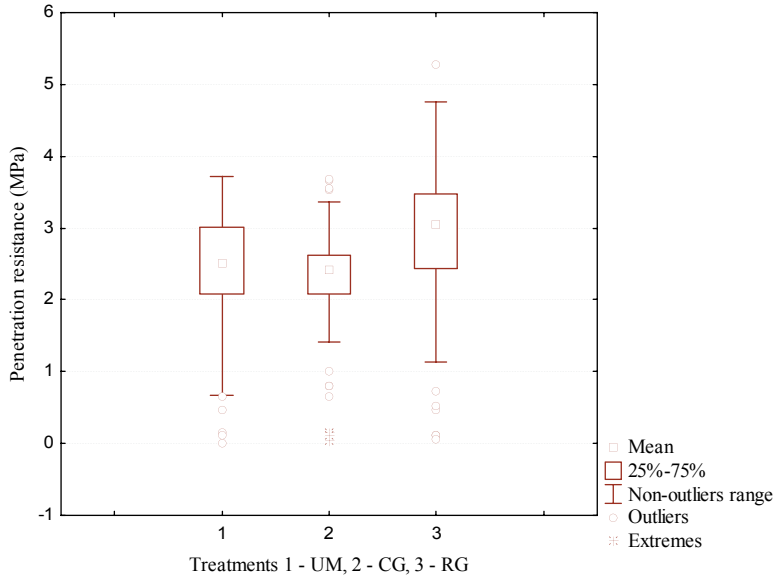
Variants	Treatments
RG	Reseeding of grass-leguminous mixture and year-round grazing by cattle Charolais. Reseeding components: *Festuca pratensis, Phleum pratense, Poa pratensis, Dactylis glomerata, Trifolium repens, Lotus corniculatus* .
CG	Grass cutting (June) and subsequent grazing by cattle Charolais (June – April)
UM	Control - unmanagement of pratotechnics during year-round

Table 3: Compresion average of soil and significant of variants

Variants	Compresion average	1	2
CG	2,31	****	
UM	2,39	****	
RG	2,87		****

****: P < 0,01, CG - cutting and grazing, UM - unmanaged, RG - reseeding and grazing

Figure 3: Penetration resistance on the mountain pasture under different treatments. Abbreviattions of reatments see Table 2.



compaction and penetration of hoofs.

On the variant CG, into depth 0.09 m, soil compaction fluctuated in range from 2.74 MPa to 1.93 MPa. From depth 0.33 m the fluctuations of resistant, affected by rocky soil in deeper layer, were recorded. The variant CG was closed to the stage of maturity at hay harvest (end of June) and cut without mechanization. Only after hay harvested came up to penetration of cattle. From the first year of research follow, that in the alternate use of pasturing (cutting and grazing) there was not markedly compaction of the soil occurred. In spite of pasture using during the winter, analysis were not significant (Table 3). In the process we have to take into the consideration that hay harvesting in experimental conditions was carrying out without mechanization. Therefore we suppose, that compaction could be affected by composite way of using. The lowest compaction was recorded on the control variant UM, from depth 0.09 m into the depth 0.23 m, where the soil compaction wasn't increasing markedly. From 0.23 m soil compaction was decreasing to the lowest value (1.62 MPa) in compare with other variants. On this variant the anthropogenic influence from deforested silvo-pastoral system wasn't occurred, therefore the lowest value of penetration resistant was recorded. Average value of compaction was similar to the variant CG (Table 3).

DISCUSSION

From reached results we can observe that the highest increase of soil compaction was achieved on the year-long pasture with reseeding (RG). The lowest soil compaction was on the control variant (UM) and on the variant with cutting and grazing (CG). The most intensive increase of compaction was found out into the depth 0,09 m. The results of soil compactions strength to the depth 0.09 m (2.44 – 2.96 MPa) are dissimilar in comparison with findings of [8]. Authors found out higher value of compaction. They assert that the highest increase was below the ground from 0.01 – 0.03 m (0.05 m). In the interval from 0.03 – 0.07 it reached balanced value and afterwards the resistance was again increased. We are supposing that this dissimilar of penetration resistance values were caused by soil moisture. In the condition of mountain pasture the most intensive compaction in depth 0.01 – 0.09 m was demonstrated. [10] supposes that the trampling of animals make overmuch compact layer in depth 0.70 – 10.5 m. On the pastures with year-long use in condition of agroenvironment with stocking rate 0.30 – 0.60 LU.ha^{-1} (150 – 300 kg.ha^{-1}) soil compaction was high significant in compare with control variant and variant with cutting – grazing was not significant. We are suppose this trend can by affected by the way of the treatment, the control variant was not grazed and not compacted by the cattle and, on the variant cutting-grazing, the time of grazing period was shorter. We agree with finds of [9], that the pressure affected by animals grazing has generally short duration. Penetration resistance in zone of the most intensive compactions (into 0.09 m) on the variant with year-long using was reached max. 3.06 MPa and on the variant cutting – grazing was reached the value max. 2.64 MPa.

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