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Root system examinations on the forests of the Hungarian mountain-ranges of medium height

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Key words: beech forest, soil, root system, rhizosphere animals, *Fagus sylvatica.*

Introduction

Root system of the zonal forest associations at different base rock terrritories of North-Hungary (Bükk and Mátra mountains) has been investigated since 1990 with support of the Hungarian Scientific Research Found (OTKA).

The examined plant communities and stands are the next (Fig. 1.):

I. *Aceri tatarico-Quercetum:* Kerecsend, Bükk mountains (1)
II. *Quercetum petraeae-cerris:* Síkfőkút, Bükk mountains (2) Bátor, Bükk mountains (3)
III. *Mellitio-Fagetum:* Tamáskút, Bükk mountains (4) Galyatető, Mátra mountains (5)

The investigations have covered the structure of the root system of trees, the detailed analysis of the soils and the investigations of the living creatures of the rhizosphere.

In this paper the data of the roots from beech forest *(Mellitio-Fagetum)* are published (Bükk mountains and Mátra mountains).

Methods

In order to determine the main physical-chemical features of soils were samples of disturbed structure were examined, they were 10 cm from each other and the depth was 1 m. From these samples the Arany restriction values, the sizes of fragments, the total nitrogen, organic material and carbon content, the absorptive phosporus and potassium content were calculated. During the determination of organic material we used the Tyurin method, while the phosphorus-potassium content was determined with ammonium-lactate method. The rest of the investigations happened according to standard.

The roots of the trees were digged (KÁRÁSZ, I. 1984) up with the method of gradual digging and washing with strong water-spout (two trees in each sample areas). The fixation of the physiognomic structure was done by taking pictures and making rhizograms (vertical and horizontal). In order to determine the quantitative data and the r/s quotient we measured the total weight which was divided into the parts above soil level and parts under it. The further examination of the roots were made by diameter categories (mass, volume and length determination).

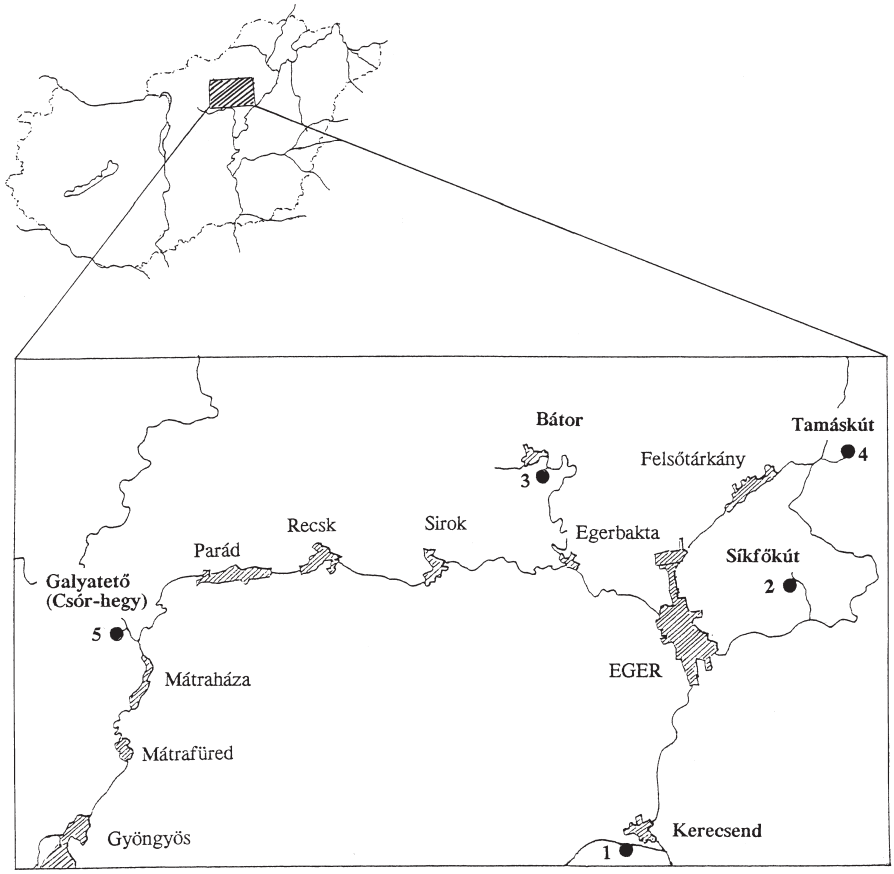

Fig. 1. Map of the sample areas

The most important data of the beech sample trees are below (Table 1):

Sample area	Sample number	Age (year)	Trunk diameter in chest height (cm)	Height (m)
Bükk mountains:	1	95	37,6	27,6
Tamáskút (On limestone bed-rocks)	2	96	32,0	25,2
Mátra mountains:	1	86	44,9	29,5
Galyatető (On andezite bed-rocks)	2	80	41,1	31,0

The analysis of the living creatures of the root system were carried out with the generally used microbiological method Most – Probable-Number-Analysis MPN (ROWE, R.–TODD, R.–WAIDE, J. 1977). We have analysed the quantity of the aerobe bacteria, the number of

fungi, algae and actinomyces and the bacteria feeding on monoplasts were also examined. With the help of flotation method we have studied the distribution of the Nematoda at different depths of the soil.

Results

On the basis of the examinations of the soils of *Mellitio-Fagetum* community are brown forest soil:

– the areas of Tamáskút, in the Bükk mountains are dissected by dolomite, and near Galyatető in the Mátra mountains they are dissected by andezite rocks.

According to the water pH measurements they are moderately acid and according to KCl measurements they are strongly acid soils. Big deviations can be found only on some levels (Fig. 2/a–b). The hydrolytic acid values (Y_1) (Fig. 2/c) which shows negative correlation with pH are extreme in many cases. Condsidering the average (Table 2.)

Table 2. Averaged data of investigated soil samples

	K_A	pH(H_2O)	pH(KCl)	Y_1	$CaCO_3$ (%)	Soluble N-content (ppm)	Organic matter content (%)	AL-soluble P_2O_5 (ppm)	AL-soluble K_2O (ppm)
Tamáskút	37,53	5,42	4,34	15,61	0	1520	2,24	95,4	108,1
Galyatető	43,17	5,4	4,4	14,55	0	720	1,05	9,9	203,6

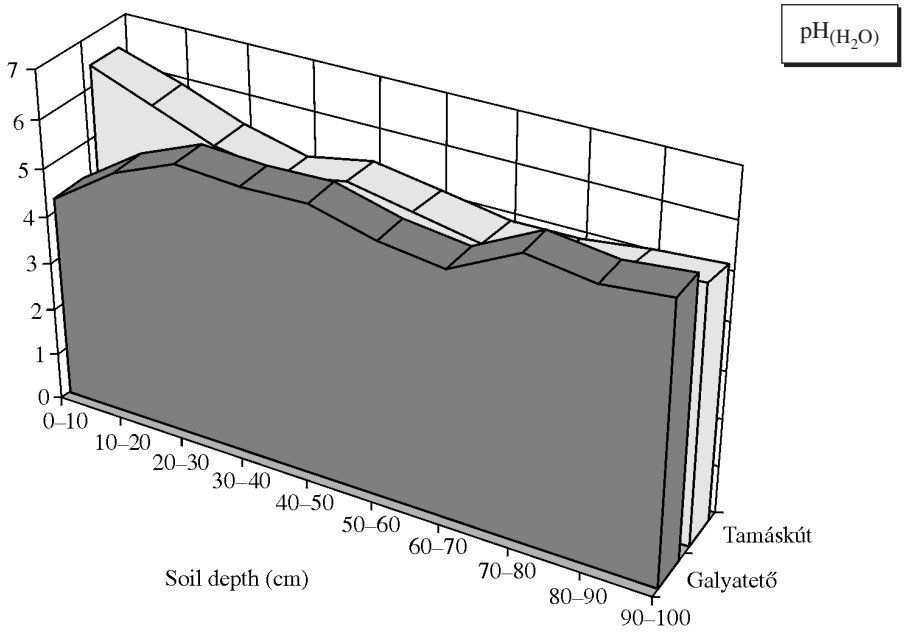

Fig. 2/a

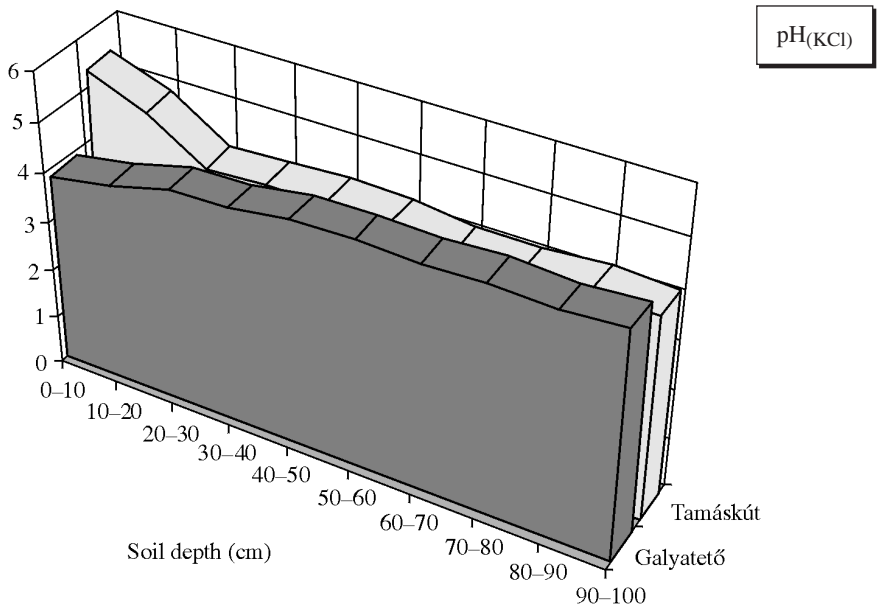

Fig. 2/b

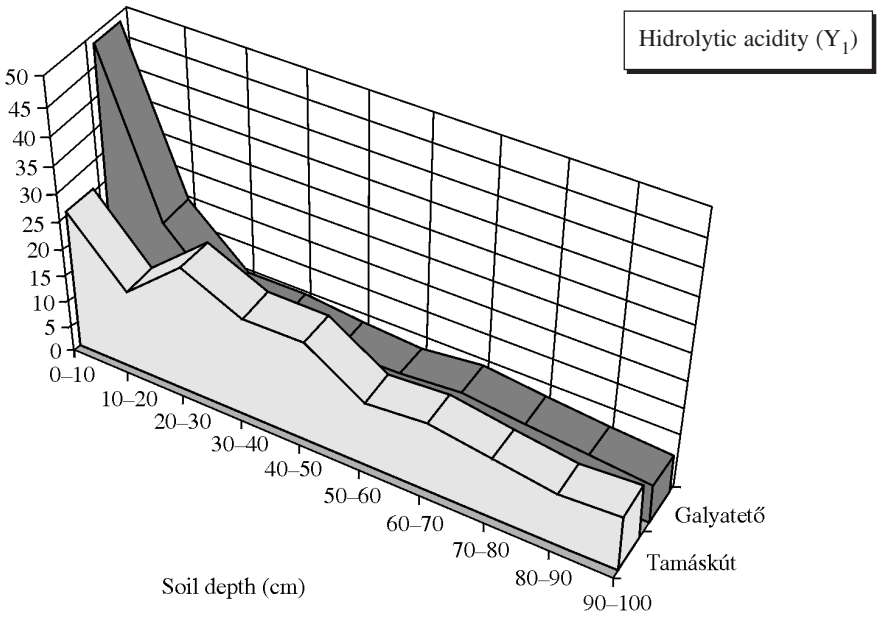

Fig. 2/c

we can also see the growth of the acidity of soils which shows similar results as the comparing examinations in the same areas taken in different seasons (KOVÁCS, M. 1975; BERKI, I.–HOLES, 1988). The N-content and organic material don't show correlation in each cases (HINRICH, L. et al 1985). The organic material was weak and quite weak

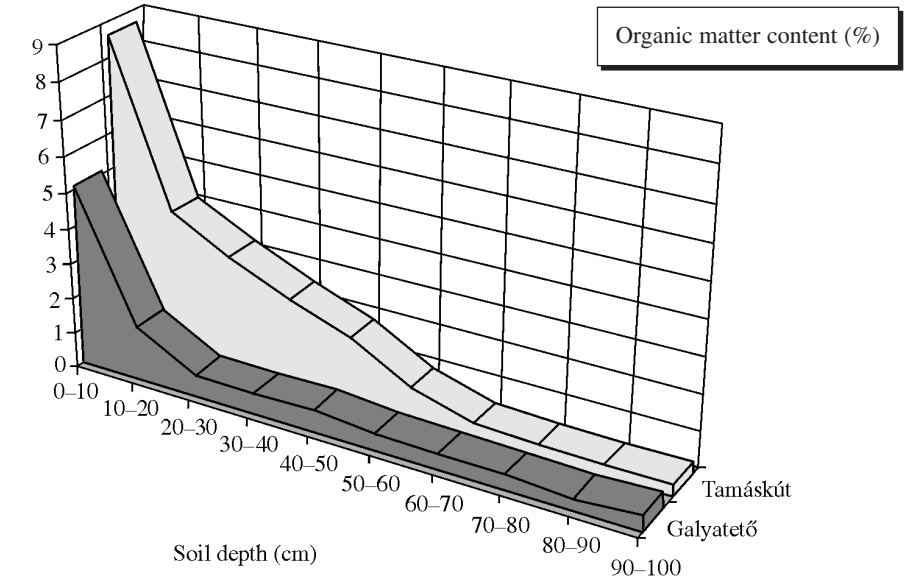

Fig. 2/d

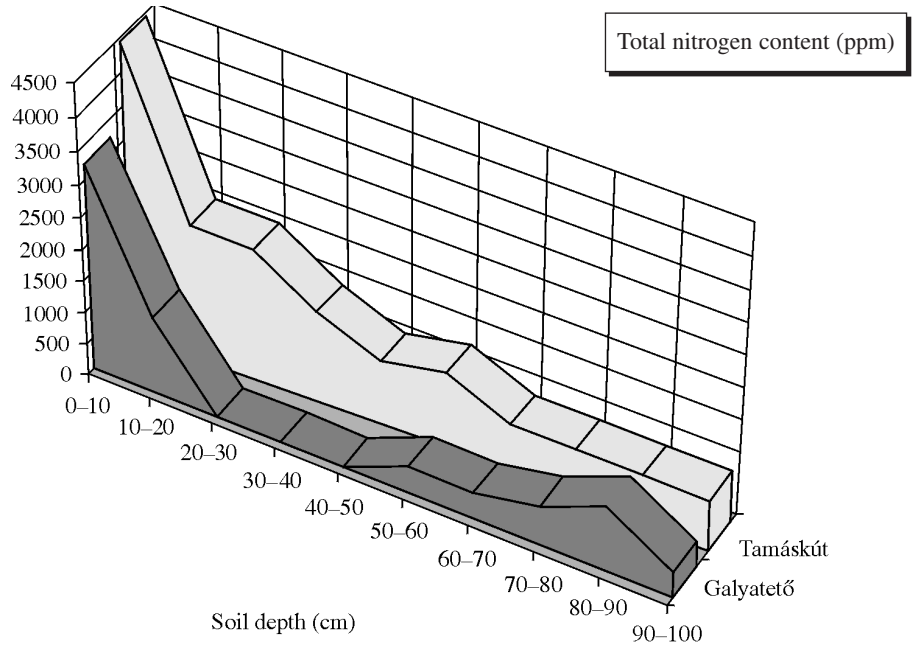

Fig. 2/e

50 cm deep in Tamáskút Bükk mountains, from 20 cm deep in Galyatető Mátra mountains (Fig. 2/d). There were no measurable N-content in the areas of Galyatető down in 20–50 cm deep (Fig. 2/e). The absorptive phosphorus content don't reach the minimum level in most cases. The results of Tamáskút are medium level. Galyatető is weakly pro-

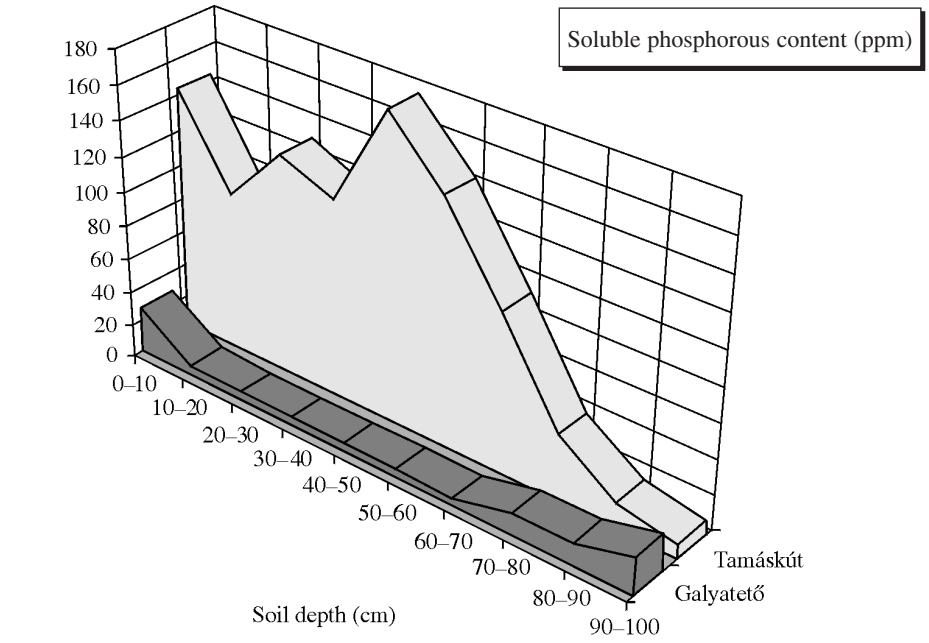
Soluble phosphorous content (ppm)
180
160
140
120
100
80
60
40
20
0
0–10
10–20
20–30
30–40
40–50
50–60
60–70
70–80
80–90
90–100
Soil depth (cm)
Tamáskút
Galyatető

Fig. 2/f

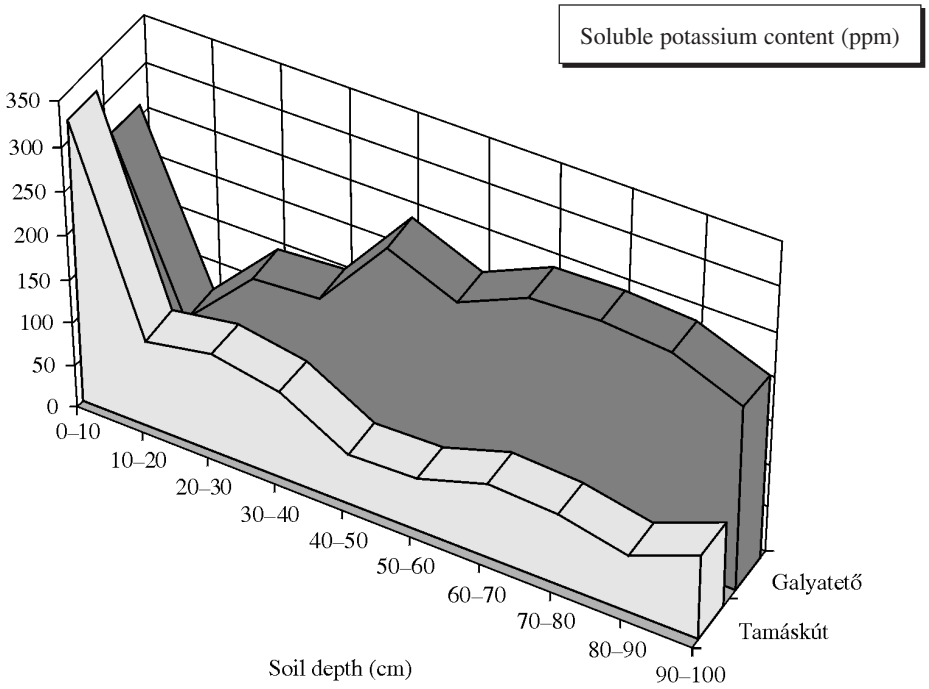
Soluble potassium content (ppm)
350
300
250
200
150
100
50
0
0–10
10–20
20–30
30–40
40–50
50–60
60–70
70–80
80–90
90–100
Soil depth (cm)
Galyatető
Tamáskút

Fig. 2/g

vided (Fig. 2/f). The K-content is good only in the areas of Galyatető, the soils of the other community is average (Fig. 2/g).

The root system of beech trees *(Fagus sylvatica)* andezite bed-rocks in Mátra mountains, shows a plated shape. There uptake zone (the 2/3 part of thin roots) is formed 2–3 m from the trunk and it is in 30–70 m deep (Fig. 3/a). The roots form special disk shaped formulas and these parts sit on the bigger or smaller rocks which can be found in the soil. The thick roots serving as sustainers are settled radially and they have more or less the same length. There are no typical main root in these root systems. The horizontal distribution is usually 3–3,5 m and the maximal penetration is 70–90 cm (Fig. 3/b).

On limestone (Bükk mountains) the beech trees have mainly heart shaped root systems just like it is written in literature (KÖSTHLER, J. N. et al. 1968, MAYER, A. 1958). The roots form a smooth network in the soil and their horizontal expansion is similar to those of the trees living on andezite, but their vertical expansion is bigger (160–180 cm).

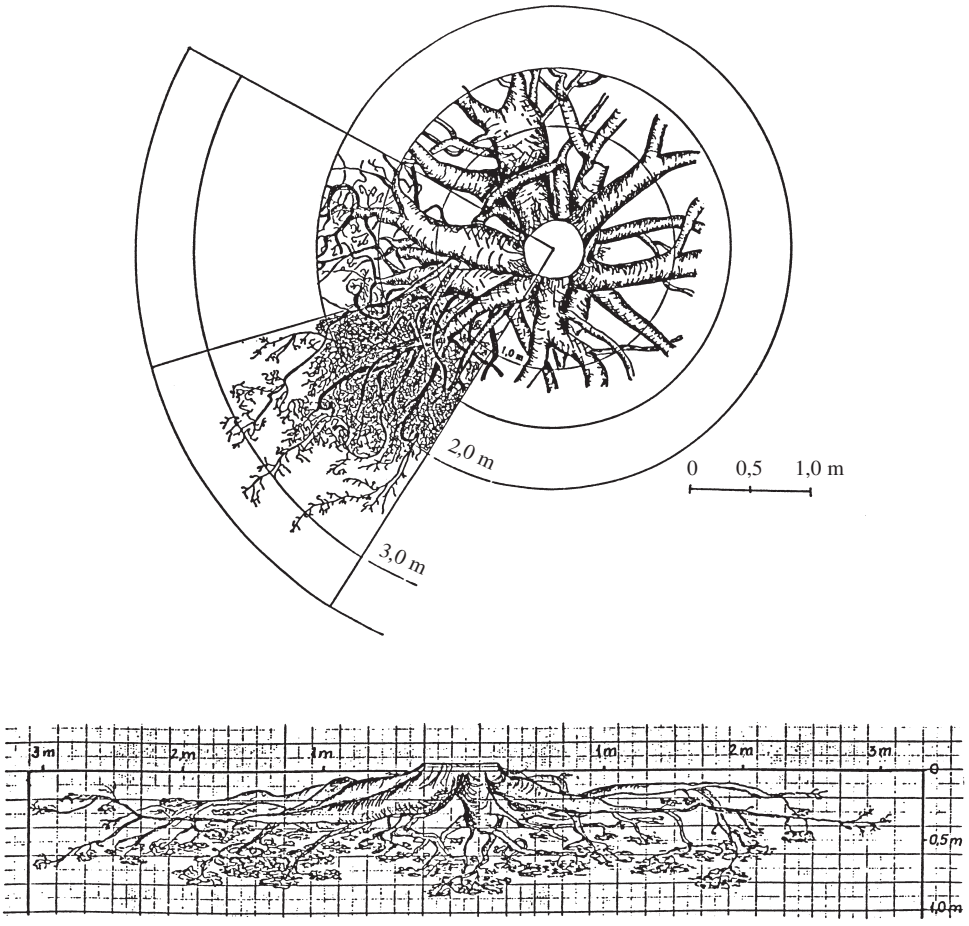

Fig. 3. The horizontal (3/a) and vertical (3/b) structure of the beech tree (Mátra mountains, Hungary, 86 years old)

The deviation in root systems of the beech individuals living on different bed-rocks can be found in the difference of soil structures and in the thickness of the soils. At the examined four sample trees the average rate of the roots from the total mass of the plant is 19,6% an the average r/s quotient is 0,24.

The tendency of the quantity of microflora, microfauna and Nematoda of the soils of the sampling territories have been analysed within the frame of a preliminary report. According to the results of the examinations it can be proved that the changes of the above mentioned elements in the soils of the examined territories are shows appreciable correspondence.

Fig. 4. shows the mean value of the data which were measured in different depths, correlating animals and soil types.

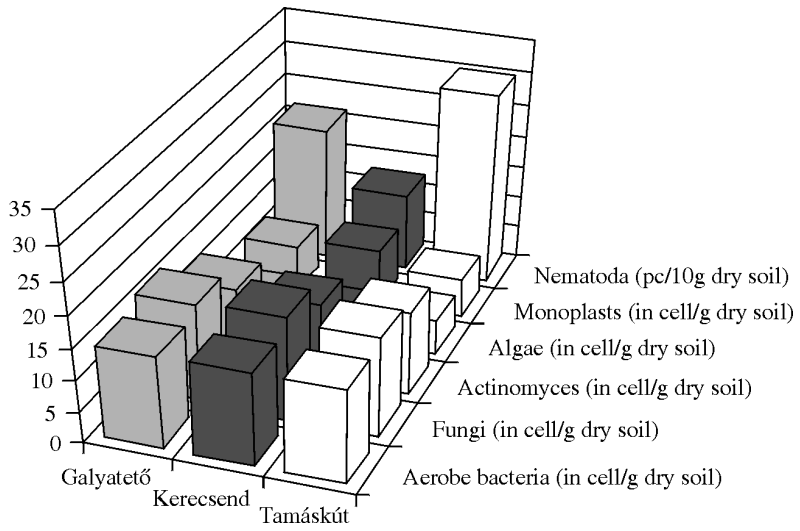

Figure 4. Tendency of the composition of microflora, microfauna and Nematoda correlating with the examined soil-type

Taking the physical and chemical characteristic features of the examined soils for our basis, we can state that there is no any significant difference between the examined soil types. It is why the soil-dwelling animals shows similarity.

There were no significant differences in the case of the quantity of aerob bacteria, fungi, actynomycetes, algae, and monoplasts, but the occurrence of Nematoda have been relatively higher at Tamáskút.

Discussion

The root system of the different beech forest attends are highly modified by the thickness of the soil, the base rock, and the physical and chemical features of the soil. In the case of the beeches there is inverse proportion between the distribution of the root system and the thickness of the soil. The disc shaped root system is the most frequent. The root system of

the individuals is generally separated from each other, but in the case of the 70–90 years old stands substantial root competition have not been observed.

Acknowledgement

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