Lysimeter researches in peduncled oak forest of Northwest Croatia

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Abstract

The following deposited matters were monitored: Cl^-, SO_4^{2-}-S, NH_4^+-N, NO_3^--N, Na^+, K^+, Ca^{2+}, Mg^{2+}. Sampling is performed by means of funnels (througfal) with openings minimum of 314 cm², and the amount of precipitation is measured in rain gauges with a surface opening of 60 cm². Rain gauges and funnels are placed diagonally by 6-9 items, each on 30x30 m plot. On a control plot, where the impact of vegetation is excluded, funnels (bulks) and rain gauges were placed in a random order or circularly. Plastic zero tension lysimeters are placed in the soil at the depth of 10 cm or beneath the humus layer and in mineral part of soil (100 cm). They collect the seepage liquid in the soil. Sampling is carried out once a month. According to the obtained data of monitoring, our forest and soil absorb more deposited particles (wet and dry sedimentation) in comparison to control samples in the open area.

Introduction

Peduncled Oak and Common Hornbeam forest community (*Carpino-betuli Quercetum roboris*, Anic 1956/emed. Rauš 1969) is characterized by wide ecological amplitude. It is also manifested in diverse and common low growth layer. It occurs in a range among 110 and 120 meters above sea level. The soils in this class are characterized by additional moisturizing; periodical or permanent. This group, according to studies in EGT II-G-10 up to now, includes; pseudogley level terrain (dystric, eutric, gleyic Planosol and stagnic, gleyic Albeluvisol), pseudogley gley (molic, dystric Gleysol), eugley (molic, endogleyic Gleysol) with hypogley sub-type, and humo-fluvisol (molic, eutric Fluvisol). Some types of automorphic soil class occur in places: luvisol, pseudogleyic (gleyic, distric Luvisol), and in some localities eutric cambisol pseudogleyic (eutric, gleyic Cambisol). This part of Croatia, according to pedological studies so far, differs in type and share of the main type, or main types of soil, with regard to parental substrate and some chemical and physical properties.

Research methods

Cations and anions (K^+, Na^+, Ca^{2+}, Mg^{2+}, NH_4^+, Cl^-, NO_3^-, SO_4^{2-}) and the amount of percolate was carried out at 6 experimental plots. The first group of instruments consists of zero tension lysimeters that collect seepage water in the soil profile. There is three lysimeters on every plot installed at a depth of 10 cm, i.e. beneath the humus layer, and lysimeter at a depth of 100 cm, i.e. in the mineral part of soil. Lysimeters installed in a hole on vertical wall of soil pit. After installation the soil pit is pack into and covered with humus layer and leaves. Two years after lysimeters are ready for sampling percolated liquid and analyses in laboratory. The second group of measuring instruments consists of plastic rain gauges and plastic funnels for measuring and collecting the amount of precipitation. All instruments are washed out before installation on plots by 10% nitrogen acid and also several times by redistilled water. Liquid sampling was carried out once or, if required, several times. Samples were taken in rinsed plastic reagents bottles with double lids and sent to laboratory for analysis the same day or frozen for analyses. Acidity and conductivity of liquids were measured directly on the field, immediately after sampling.

Chemical composition of liquids was determined in the State Weather Institute. Ions of : Cl^-, SO_4^{2-}-S, NH_4^+-N, NO_3^--N, Na^+, K^+, Ca^{2+}, Mg^{2+}. Analytical methods which are usually used for the determination of small quantities of matter in water and precipitation were used. Methods are described in WMO (1974), Standard Methods (1975), MOHLER et al. (1975).

Results and discussion

In the lysimeters at a depth of 100 cm pH liquid values range moistly from 6,10 to 7,10. In lysimeters at depth of 10 cm under the humus horizon values were lower and ranged from 5,47 to 6,35 pH. Average amount of cations and anions on six plots in lysimeter liquids are slightly increased than samples from control rain gauges. Peduncled Oak and Common Hornbeam Community in the northwest Croatia absorb more sediment particles (wet and dry sedimentation) compared to the control samples on the open area. That influences on the forest soils and soil solution in forest soils.

These results are in concord with researches of BRETCHEL, 1989; VAN BREMEEN et al., 1984; BALÁZS et al., 1992 who established a major role of forest cover and the fact that the total of deposited matter is always higher under the forest cover than on control locations. Similar results were obtained by KREJCI and VRBEK, 1995; VRBEK, 1992, 1993, 2002 by measuring digging through in forest of peduncled oak and common hornbeam on the territory of the river Cesma in three age classes. It is known that due to leaching of deposited matter, increased deposition of sulphur and other elements occurs more in the forest than in the open area. The surplus of nitrogen is a bigger danger for forest ecosystems than sulphur. Nitrogen influences the soil acidification and, most significantly, leads to misbalance in nutrition and weakens tree resistance to the impact of unfavourable abiotic factors (drought, low temperatures and wind) and biotic factors (plant diseases and insects).

Conclusions

There is an increased input of deposited matter into our forest ecosystems in all sites of monitoring. On control locations

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Table 1: **Average amount of cations and anions yearly (tree plots on each type of soil); (KŠ = Thrufall in forest, KO = Bulk control, L10 = Lysimeter beneath the humus layer, L100 = Lysimeter in mineral part of soil)**

Planosol	K^+	Na^+	Ca^{2+}	Mg^{2+}	NH_4^+-N	Cl^-	NO_3^--N	SO_4^{2-}-S	HCO^{3-}	H^+
					mgL^{-1}					
KŠ	8,36	0,42	4,24	1,64	0,89	2,35	3,58	2,03	0,280	0,0041
KO	0,47	0,31	1,26	0,27	0,17	0,94	1,48	1,03	0,150	0,0043
L_{100}	1,20	5,22	17,69	7,04	0,07	3,91	2,56	12,68	0,280	0,0022
L_{10}	1,65	0,95	3,34	2,53	0,09	1,97	3,61	3,03	0,050	0,0152
Albeluvisol	K^+	Na^+	Ca^{2+}	Mg^{2+}	NH_4^+-N	Cl^-	NO_3^--N	SO_4^{2-}-S	HCO^{3-}	H^+
					mgL-1					
KŠ	4,66	0,29	1,68	0,63	0,96	1,40	2,73	0,95	0,089	0,0061
KO	0,28	0,26	2,17	0,26	0,26	0,90	1,17	0,60	0,092	0,0064
L_{100}	0,16	10,35	1,85	1,81	0,05	3,01	1,65	2,29	0,131	0,0044
L_{10}	0,71	1,35	2,09	1,52	0,04	2,41	0,01	2,02	0,127	0,0117
Fluvisol	K^+	Na^+	Ca^{2+}	Mg^{2+}	NH_4^+-N	Cl^-	NO_3^--N	SO_4^{2-}-S	HCO^{3-}	H^+
					mgL-1					
KŠ	17,13	0,97	5,09	1,41	1,63	2,51	3,96	1,74	0,143	0,0089
KO	1,21	0,30	1,76	0,35	0,14	0,99	2,33	1,06	0,138	0,0026
L_{100}	1,25	0,67	65,05	7,65	0,62	1,94	3,31	0,84	0,435	0,0617
L_{10}	1,99	0,80	7,51	3,38	0,09	1,95	5,87	5,88	0,117	0,0064

(KO), where impact of vegetation is excluded, these amounts are always lower.

Most SO_4-S entered the lysimeters at a depth of 10 cm in Fluvisols increase, and the greatest amount was in Planosols. Increase in sculpture was also found in the lysimeters at a depth of 100 cm.

Increase in NO_3-N was highest in the lysimeters at a depth of 10 cm in the Planosol and Fluvisol. A slightly smaller increase was found in the lysimeters and samples under the tree crowns (thrufall).

The highest increase in the sodium content was determined in the Planosol and Albeluvisol in lysimeters at a depth of 100 cm.

There was on average most potassium in lysimeters at a depth of 10 cm in Planosols, somewhat less in Fluvisols and Albeluvisols. There was most potassium in Fluvisols at the control site, followed by the samples under the tree crowns.

Most magnesium content was found in Planosols in lysimeters at a depth of 100 cm, followed by those at 10 cm depth. A somewhat smaller increase was found in the Albeluvisols, while in area of Fluvisols an increase was registered at the control site in the forest.

Monitoring by this method should be extended to other important forest communities in Croatia, in order to achieve better insight into the influence of forest ground cover vegetation on dry and wet depositioning.

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