University of West –Hungary
Forestry Faculty

Theses of the doctor's dissertation

Impacts of liming on the Oribatida fauna in the soil of a beech forest /Acari: Oribatida/

Mrs Szemerey Tamásné

Sopron

2004

Doctor's School: School for Forest- and Game Management Sciences designated to Roth Gyula

Branch of Science: Sciences for Forest and Game Management

Program: Ecology and diversity of forest ecosystems

Supervisor: dr. h. c. Dr. Szodfridt István, professor emeritus

Introduction and target of the research

60 % of the Hungarian forests are on acid soils. These acid soils developed from parent rocks of acid or from those of basic reaction. The latter was transformed into acid reaction due to leaching processes.
Nowadays the acid precipitations, acid atmospheric deposits and not correct tree species choice resulting in unmixed coniferous stands have increased the degree of acidification in the soil of our forests.
Liming seems to be a good measure to stop the unfavourable processes in the extremely acid forest soils. This technique has not been yet into the Hungarian forestry practice, so we have not got experiences on its long-term effects.
The author investigated the impact of liming on the Oribatida fauna, witch is an important component of soil biology. The investigations were carried out in a beech stand of acid soil.

The author set the following research targets:

- Description of the Oribatida fauna with its species composition and quantitative data by soil samples taken in experiment plots;
- Analysis of the fauna (newly detected and rare species);
- Has the liming any impact on the species composition of the fauna investigated by the author;
- Are there any changes in their population after liming (abundance investigations);
- Are there any changes in their dominance relations in the limed plots;

- Are there any changes in the species composition of Oribatida fauna of the limed plots (diversity and similarity tests);

- Are there any strict indicator species in the community witch maybe well pronounced and quickly react to the physical and chemical changes caused by liming, be they either positive or negative;

- What is the permanence of the liming effect, how long can it be detected by measurements;

- What is the length of time during witch the Oribatida population or its dominant species are able to get regenerated, if the impact is unfavourable.

Methods applied

Site surveying was carried out with routine soil investigations on an experiment area chosen by the author (Brennberg, sub compartment: 171G, age of the forest: 31 years, stand-forming species: beech, climate: Beech, genetic soil type: acidic non-podzolised brown forest soil).

Based on preliminary investigations the following treatment variants were applied: liming with 10t/ha dosing, liming with 20t/ha dosing, untreated control plot. Plot size: 25*25 metres. Liming material: limestone dust of Fertőrákos.
Soil samples (500cm^3) for Oribatida fauna investigations were taken in the 1st, 2nd, 7th and 12th year after liming. Mites were gained with a paper funnel constructed by Balogh J. – Loksa I., the counting of collected specimens and their identification was made under binocular selecting and scanning microscopes.
Abundance of collected species (A) was also determined for the characterization of Oribatida populations meaning the

average number of individuals in a soil sample of 500 cm^3 and in addition the dominance (D) was expressed in % of the relative abundance and the frequency (F) in % of their occurrence. Statistical evaluation of abundance was made by Mann-Whitney test.
Comparison of Oribatida fauna in the control and limed plots was made with diversity indices – ratio of species number/number of individuals, Shannon diversity index, Simpson diversity index and Rényi-diversity. For the statistical estimation of Shannon diversity index jackknife method was applied.
Similarity between control and limed plots was settled by Sörensen index and cluster analysis for its completion.

Scientific results (Theses)

1. We found 90 Oribatida species representing 36 families and 64 genera in the soil samples (including their litter-cover). It was altogether 83239 individuals that were counted and identified by the author.

Of the 90 species there were two (*Masthermannia mamilláris* (Berlese, 1904) and *Eupelops subuliger* (Berlese, 1916) that were new for the Hungarian fauna. There were also some species that were rare in Hungary, such as *Cultroribula juncta* (Michael, 1885), *Berniniella sigma* (Strenzke, 1951), *Carabodes reticulatus* Berlese, 1913 and *Eporibatula rauschenensis* (Sellnick, 1908).

2. There cannot be found any information on research of this kind in the Hungarian literature. According to the estimations of Schmidt (1988) a considerable part of the forested lands of

acid soils (0,9 million hectare) may need liming. The soils biologic consequences of such activity on Oribatida fauna –an important component of soil biology- can be prognosticate by the results of our research.

3. The most peculiar symptom of liming was the reduction of the individual number of Oribatida mites. At the start of liming experiment the soil pH slightly increased but in the later years it has got even higher. Simultaneously with this the number of Oribatida decreased in the upper 8 cm soil layer of the plots limed.
This difference has become stable even in the later years and become significant in spring and late in autumn 7 years after the initiation of the experiments. The effect of liming with higher dose was unfavourable, while it was mild when low dose was applied. There was only one case (June 1988), when significant difference was found in the individual number of the two plots limed.

4. The experiments proved, that the effect of liming is long-term as the individual numbers of Oribatida mites were different in the control plot and the two treated ones over 12 years after liming.
It is advisable to repeat the sampling in certain time intervals.

5. Population dynamics can be determined by the sampling carried out (from March to December) the in the 7th year after liming. The individual numbers performed a spring-early summer maximum and then this numbers were the lowest on the dry hot summer while the absolute maximum was attained in the cooler more moist autumn months.

6. 7 years after liming there was no close correlation between soil pH and individual number of Oribatida mites. The data verify only a tendency between the two factors, namely the individual number of Oribatida is decreasing with increasing pH.

7. There were no or very small changes in the dominance structure of Oribatida fauna after the liming, species number did not consequently change. Up to the summer of the first and second year after the liming the species number was highest if the treatment was done with higher dose, but in the control plot the autumn was the time of their maximum. Though the control plot showed in several cases higher species richness compared to the limed plots, in spite of this it cannot be stated with certainty that the species number was reduced by liming. Changes in species richness did not follow the tendencies in population dynamics during the year. No connection was found between the degree of liming and species number.

8. The Oribatida populations contained usually 7-12 dominant or subdominant species on the area, they were giving the 75-85 % of all samples. Simultaneously the occurrence of sporadic species was in general high, but their appearance was uncertain.

30-55% of the total population was *Chamobates voigsti* (Oudemans, 1902). Liming had an instant decreasing effect on the individual number of *C. voigsti*. 7 years after liming treatments with small lime-dose showed significant difference from control only in autumn, while bigger dose all the year round.

Subdominant species on control and treated plots were mostly the same (*Medioppia subpectinata*, (Oudemans, 1900),

Quadroppia quadricarinata (Michael, 1885), *Eupelos plicatus* (C. L. Koch, 1835), *Belba sp1*., but their proportion was differing from each other. Individuals of *Suctobelba,* és *Suctobelbella* genera were represented mostly with high number.

In the liming variant of 20 t/ha the *C. voigsti* was driven back and its place taken over by *M. subpectinata* and *Q. quadricarinata* 12 years after the begin of the experiments. On the control plot there was a new element among the dominant species, that is *Microppia minus* (Strenzke, 1952), witch is known as an obligate acidophilus species. Samples were taken only once in this year, so it was unlike the previous years not enough to draw any conclusions.

9. There were two species the preference of witch for certain pH was consequent.
Haplozetes vindobonenzis (Wilmann, 1935) was found in general with the highest individual number in the plot treated with 10 t/ha limes. The optimal pH province for it may be that between neutral and acidic ones.
Tectocepheus sarekensis Trägardh, 1910 occurred with significantly higher individual number on the plot of bigger lime dose than in the control one or on that treated with less lime.

10. There was no species found that was regularly present in the control plot and disappeared after liming. The occurrence of species of low frequency and little individual number can be taken as accidental (e. g. *Licneremaeus licnophorus* (Michael, 1882), *Trichoribates trimaculatus*, (C. L. Koch, 1835), etc.).

There were some species like *Adamaeus onustus* (C. L. Koch, 1841) wich were subdominant elements in both the

control and limed plots at the start of liming, but their individual number decreased everywhere by 1998.

11. As for the diversity investigations the least diversity was found in the control plot. Species composition was more similar in the control plot and in that of higher lime dose than in the two limed plots. Sörensen similarity indices were mostly higher meaning that the species spectrum in control and limed plots were not different.

12. The author and her collaborators have concluded from the experiment that the liming had a favourable effect on the soil condition.

-pH increased to 7,5 (20 t/ha) and 6,9 (10 t/ha) respectively, while the characteristic pH in the control plot amounted to 4,7-4,8.

-The hydrolytic acidity was zero in the topsoil of treated plots and in their humus layer, while in the control plot it was 30-40.

-The variant 20 t/ha lime performed better results than the one of 10 t/ha.

- The effect of lime doses was provable to a soil depth of 10-15 cm.

-Base saturation in the layer A_{00}-10 cm increased on a remarkable way in the treated plots against the control plot.

-There was no significant difference in the development of C/N ratio on the control plot and treated plots, it was 40-50 in the organic layer while 20 in the mineral one, witch is optimal in forest soils.

14. Considering the favourable changes in the soil (physical and chemical features) and the reduced number of Oribatida

species and individuals, responsible for the decomposition of organic materials, the liming as a way of amelioration can be recommended only for very acid soils.

.

List of publications in connection with the research subject

Publications:

Szemerey, R., (1990): Influence of Nutrient Recharges on Oribatid Mites (Acari: Oribatei). Agrokémia és Talajtan. 39 (3-4). 561-564.

Szemerey T.né**,** Traser Gy.(1994): The impact of liming on the soil fauna. Erdészeti Lapok. CXXIX. évf. 3.szám. 75-76.

László R. – Szemerey T-né – Traser Gy. (2003): Effects of various soil cultivation methods in forests on the mesofauna in NW-Hungary
Леса евразии – Белые ночи,
III. Международная конференция молодых ученых, Материалы,
Издательство МГУЛ, Москва, p. 103-105.

Book- chapters:

Szontagh, R. : Acari: Mites. In Tóth, J. (edit) (1999): Forestry entomology. Publishing House: Agroinform, Budapest, 440-444.

Research reports:

Bidló A.-Jakab J. -Kovács G.-né dr. -Kovács G.-Szemerey T.-né-dr. Varjú P. (1987-1991): In vivo investigations of the biogeochemical cycle of the most important nutrients in Scotch pine stands. Erdészeti és Faipari Egyetem, Termőhelyismerettani Tanszék, Kutatási jelentés, Sopron

Szemerey T.-né (1987-1991): The effect of nutrient supply on a few elements of mesofauna. Erdészeti és Faipari Egyetem, Termőhelyismerettani Tanszék, Kutatási jelentés, Sopron

Bidló A.-Jakab J. -Kovács G.-né dr. -Kovács G.-Szemerey T.-né-dr. Varjú P. (1987-1990): Survey of nutrient and water cycle in forest ecosystems in the function of environmental factors (biologic activity of basic and reference areas, mineralization, humification, comparing investigations). Erdészeti és Faipari Egyetem, Termőhelyismerettani Tanszék, Kutatási jelentés, Sopron.

Szemerey T.né (1993): Impact of liming on a few elements of mesofauna. (Attached to the research on Possibilities and Necessity of physical and chemical improvement of

acid forest soils (led by P. Bellér) Erdészeti és Faipari Egyetem, Termőhelyismerettani Tanszék, Kutatási jelentés, Sopron.

Szemerey T.né (2000): Impact of liming on a few elements of mesofauna. (Attached to the research on Possibilities and Necessity of physical and chemical improvement of acid forest soils (led by P. Bellér) Erdészeti és Faipari Egyetem, Termőhelyismerettani Tanszék, Kutatási jelentés, Sopron, 95-131.

Bidló, A., Heil, B., Kovács, G., Kovács, R., Szemereyné, R., (2003): Chemical amelioration of very acid forest sites, complex survey of its forestry use. FVM research report

Lectures:

Szemerey, R.:Influence of Nutrient Recharges on Oribatid Mites. (előadás angol nyelven), 10th International Symposium on Soil Biology, Keszthely, 1989.

Bidló A.-Jakab J. -Kovács G.-né dr. -Kovács G.-Szemerey T.-né-dr. Varjú P.: Biological Activity in the Litter and Surface Soil Layers under Scots pine Forest Stands. Nyíregyháza , 1991.

Szemerey T.né: Investigations on Oribatid fauna in a beech forest after liming in a neighbourhood of Sopron . EFE, Tudományos Ülésszak, Sopron, 1993.

Szemerey T.né-dr. Kovács G.: Soil biological relations in afforested lands. Introduction of a new technique for the recharge of soil nutrients. Székesfehérvár, 1999.

Szemerey T.né: Impact of liming of acid forest soils on the Oribatida fauna in soils. NYME EEK Tudományos Ülésszak Fehér Dániel tiszteletére, Sopron, 2000.

Szemerey Tamásné, Dr. Kovács Gábor, Dr. Bidló András (2003): Impact of forest soils on the Oribatida fauna. (Acari : Oribatida)

6th, Congress for Ecology, Gödöllő

Poszter

László R., **Szemerey T.-né**, Traser Gy. (2003): Effect of soil tillage on the mesofauna in cseri soils.

6th, Congress for Ecology, Gödöllő

Internetes publikáció

László R.- **Szemerey T-né,** Traser Gy. (2003): Effects of various soil cultivation methods in forests on the mesofauna in NW-Hungary

http://www.

bioscience.ru./Conference/EAForest2003/Sections/s3.htm