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Morning: Lectures related to soil degradation

1) Soil degradation and soil compaction (Reintam)

In the 1st Mrs. Reintam's lecture she was talking about a lot of different types of degradation of the soil, among others, soil compaction. In this (2nd) lecture she enlarged this type of soil degradation.

In different types of ecosystems soil compaction can be detected, but mainly it is problem of cultivated soil.

The very 1st problem discussed was how to detect soil compaction. It can be done during wet period of the year by equipment, which is based on measuring of water potential. It can be done in this way because soil compaction has several effects on the soil: a) it create a crust on the top of the soil, so it is much harder for water to penetrate the soil (a lot of water flow down the field), so there is less water in the soil --> higher water potential. b) There is also in the soil smaller ratio big pores: small pores (it changes soil texture), so there isn't enough space for water and in addition the water is held in the soil stronger --> higher water potential. Of course, there is also higher bulk density in compacted soil.

There was some interesting information about fertilizers. The research compared degree of soil compaction (in the scale 1 --> 6) against fertilization. They found out, that fertilization has no effect on plant production in heavily compacted soil (5, 6) compared to less compacted soil (1 - 4).

So, what to do with soil compaction?

- using organic fertilizers
- decrease frequency of crossing through the field - multifunctional tractors
- growing intercrop-plants
- deeprooted plants
- ...

2) Effects of soil degradation on soil organisms (Wanner)

In the beginning of the lesson Mr. Wanner mentioned, that (briefly): a) Primary and secondary succession of soil organisms is not as predictable as plant succession, b) disturbance increases biodiversity because of reduction of dominant species, c) there are in succession two important theories: Intermediate disturbance hypothesis (some disturbance fosters biodiversity since there is no competitive exclusion) and Metapopulation theory (several populations from different habitats are combined to a network).

Than he was also speaking about 3 main topics - post mining areas, military training areas, and tightly connected to these areas, prescribed burning. In **post mining areas** biodiversity and dynamics in soil was quite high 10 years after the mining had been finished. Many protozoa (e.g., testate amoebae) are found there. This is important because these two

organismic groups are linked to soil formation and soil fertility. They are also rapidly growing and they react to different conditions --> = bioindicators. **Military training areas** were in the past periodically damaged and left to free succession. So there are in these areas very rich habitats, we can observe free succession and find a lot of protected species. Fires were in the past normal part of "habitat (nature) management", but nowadays they are usually not tolerated. So, in Germany **prescribed burning** is applied only on small areas and permission from government is required. Wanner et al. found in their research, that (briefly): a) quality and size of fire is the most important factor, b) there is in the soil among soil microfauna no succession (with respect to a temporal replacement of species).

Break: 12:00 -13:00

Afternoon: Seminars related to soil degradation

1st seminar talk by Kadri Krebstein and Diego Sanchez de Cima

Organic farming and soil degradation

(Presentation was based on the paper: Soil Organic matter and biological soil quality indicators after 21 years of organic and conventional farming, written by Andreas Fließbach, Hans-Rudolf Oberholzer, Lucie Gunst, Paul Mäder)

What is organic farming?

- crop rotation, livestock and green manure, species resistant to diseases and adapted to local conditions
- strict limits on chemical pesticides and synthetic fertilizers
- raising livestock in free-range providing them with organic feed

Bio-Dynamic organic farming

- practice where soil, plants and animals are considered as a whole, constituting a self-sustaining system

  Alternative variant where:

  - chemical fertilizers are totally replaced by microbial nutrient givers such as bacteria, algae, fungi

  - composting, green manuring, crop rotations

Ways of soil degradation

Soil degradation: “loss of soil productivity and losses in soil quality due to human activity”

- decrease of organic matter and biodiversity

- compaction
- erosion
- soil sealing
- salinization
- pollution
- flooding
- desertification

The experiment

based on 4 farming systems + control (nonfert):

- bio-dynamic composted: farmyard composted manure + slurry
- bio-organic rotted: farmyard manure + slurry
- conventional stacked: farmyard manure + slurry
- mineral: conventional without manure
- all under crop rotation during 3 different periods for 21 years and 2 fertilization intensities (reduced and normal)

Results

Organic Carbon and total nitrogen:

- decreasing with time for all the systems
- bigger decrease in organic carbon in the unfertilized control plots
- higher losses of organic carbon in systems without manure
- higher values of nitrogen for bio-dynamic composted plots

Soil acidity (pH):

- In the beginning non significant differences among treatments pH = 6.31
- 2^{nd} period: non-significant differences (pH>0.5) in pH but higher pH values for bio-dynamic composted plots
- 3^{rd} period: mineral plots present the bigger decrease in pH

Conclusions

- Soil organic matter positive affected by manure amendment

- Biological parameters of soil quality were enhanced in organic farming systems, presenting better results for bio-dynamic composted plots
- Microbial activity were enhanced in organic treatments

2nd seminar talk by Lisa Männer and Martin Seifert

Influence of soil quality on the growth of *Folsomia candida* (Willem) (Collembola)

(Presentation was based on the paper from Satoshi Kaneda, Nobuhiro Kaneko)

Short description of collembola:

length: 0,1-17mm

habitat: litter of soil layer

food: bacteria, pollen, dead plant material, soil minerals, algae

Hypothesis:

- Increased growth with higher microbial biomass
- Examination of the relationship between collembolan growth and soil quality indicators

Experiment 1: “mixed soil experiment”

Overlaying organic layer of forest soil removed (depth 5 cm)

Suspensions: mix soil and sand

- 25% sand, rest soil
- 50% sand, rest soil
- 100% soil

Experiment 2: “natural soil experiment”

Overlaying organic layer of forest soil removed (depth 5 cm)

Soils collected from 7 sites

Conclusions

Collembolan growth clearly influenced by soil quality, but response different between experiment 1 and 2.

The hypothesis was refuted by the experiment 2.

Growth rate lower at sites were microbial biomass was higher and fungi dominated the soil.

3rd seminar talk by Wanda Engelschall and Stefanie Batke

“Hot spots” on a new soil surface – How do testate amoeba settle down?

(Presentation was based on the paper from Manfred Wanner, Michael Elmer)

Short description of testate amoeba:

habitat: in soils, leaf litter, peat bogs, near/in fresh water

heterotrophic organisms

build up quickly biomass

Is there a successful colonization process?

- Colonization after circa 8 months
- >90% uncovered, sandy substrate
- testate amoeba: only few species with low density

covered vs. uncovered patches

covered: higher density of micro-fauna, different taxa and 10 times higher abundances of testate amoeba

Conclusions

- Small-scaled colonization patterns are linked to small vegetation patches
- No obviously influence by any large-scaled environmental gradients
- Main factor: presence of organic matter
- Role of substrate moisture unclear

4th seminar talk by Regina Kunkel and Mascha Wolf

Species diversity and metal accumulation in oribatid mites (Acari, Orbatida) of forests affected by a metallurgical plant

(Presentation was based on a paper from Andrei S. Zaitsev, Nico M. van Straalen)

This paper is about the metal accumulation in oribatid mites. Oribatid mites are very numerous in soils and play an important role in detrital food web. The scientist hypothesized that community structure and diversity of oribatid mites is linked to metal pollution. With respect to this, the potential of the mites for bioindication for heavy metal pollution was evaluated. They observed seasonal differences in species appearance and density as well as influences of landscape. The accumulation of metals was very high in mites, though the differences between individuals were extremely high. Zinc accumulation was linked to feeding type, so species feeding only on fungi accumulated Zn more than other species.

In fact, the most polluted site had the highest species richness and density although it was the most polluted site. That leads to the conclusion that metal contamination may not be the leading factor for oribatid species density and diversity. There is some potential for bioindication, but not with respect to heavy metals.