Universität für Bodenkultur Wien

Department für Wald- und Bodenwissenschaften

1. Student Conference

Department of Forest and Soil Sciences, 2016

Book of Abstracts

24. May 2016

The student conference comprises the BOKU courses (2016S)

Bachelorseminar 910110,

Masterseminar 910301, and

Dissertantenseminar 910400

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Please be aware that slight modification of the program are possible. Please pay attention to the latest versions of the program (BOKU learn, Department homepage) and the bulletin board at the day of conference.

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Program overview

The meeting will take at May 24th, 2016 at the **Schwackhöfer-Haus** ("Glass building"), Peter-Jordan-Straße 82, 1190 Vienna – Ground floor (Erdgeschoss / Aula). Oral presentations will start at 9 am without delay.

The **conference desk** is open from 8 am, please do not hesitate to ask if you have any **questions**.

All **students** are kindly asked to **sign** the *attendance sheets* for the Bachelor, Master- and PhD students' seminars at the conference desk.

For **oral contributions**, all presenters are kindly asked to up-load their presentations to the provided computers (Windows 7, PowerPoint or pdf only) by USB, not less than <u>15 min</u> <u>before</u> the start of the <u>session</u>. Please note that students' oral presentations are 12 min long PLUS 3 min for questions. Please keep the time limits!

Please place your **posters** (A1-A0, portrait format) at the latest during the first coffee break at the board with the *corresponding number* (above your abstract, this book). Overall, please stay next to you poster during the poster session (12.50-14.10 pm) if questions arise. There will be poster awards, separately for Bachelor students and Master/PhD students!! Scientists (>Doctorate) at the Department please pick up the ballot paper for voting at the conference desk and return them until 3 pm. Please join the award ceremony (16.15 pm).

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9.00-9:30	**David Johnson**	**KEYNOTE** - Mycorrhizal fungi: Drivers of ecosystem processes and multitrophic interactions.
9.30-9.45	**Klaus Dolschak**	Modeling the sulfur biogeochemistry of beech stands of the Vienna Woods.
9.45-10.00	**Dessie Assefa**	Variability in fine root morphology, biochemistry, and litter quality indices of ten tropical tree species.
10.00-10.15	**Norbu Wangdi**	Understanding the consequences of climate change in remote mountain regions: a roof experiment to simulate monsoon failure in the Himalayas.
10.15-10.30	**Mathias Mayer**	Soil carbon dynamics after forest disturbance by wind.

Session ends at 10.40 sharp. Have a coffee break.

Session 2 – Forest Growth and Silviculture (9.00-10.40 o'clock, Seminar room SCHW-SR 09)

Conveners: <u>Prof. Dr. H. Hasenauer</u>, <u>Prof. Dr. A. Nothdurft</u>

Time

9.00-9.15	**Franziskus Seilern-Aspang**	Ein konkurrenzbasiertes Verteilungsfortschreibungsmodell für die Waldentwicklungsprognose in einer Eichen-Mittelwald-Betriebsklasse.
9.15-9.30	**Philipp Skalka**	Modeling of basal area increment for thinned forest stands at the districts of the forestry company "Gutsverwaltung Eberstein".
9.30-9.45	**Hans-Peter Jauk**	The comparison of the „Schweizer Methode" and the „Winkelzählprobe" at the forest inventory of the forest management Eberstein in Carinthia.
9.45-10.00	**Josef Petzlberger**	Reforestation and protection efficiency after windthrow on protection forest sites in the Zederhaustal. - *Cancelled* -
10.00-10.15	**Lukas Kofler**	Vergleich der Waldbehandlung zwischen Nord- und Südtirol anhand ausgewählter Beispiele.
10.15-10.30	**Katharina Albrich**	Simulating the effect of climate change and forest management in a mountain forest landscape.

Session ends at 10.40 sharp. Have a coffee break.

Session 3 – Soil Research (11.10-12.50 o'clock, Seminar room SCHW-SR 06)

Convener: Prof. Dr. S. Zechmeister-Boltenstern

Time

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11.40-11.55	**Christoph Höfer**	Gel for simultaneous cationic solute and pH imaging in rhizosphere soil.
11.55-12.10	**Olivier Duboc**	Phosphorus in soils and fertilisers: resource use efficiency through recycling and improved laboratory tests.
12.10-12.25	**Melanie Dober**	Soil microbial toxicity assessment of a copper-based fungicide in two contrasting soils.
12.25-12.40	**Jasmin Schomakers**	Landslide impact on carbon storage in a tropical forest ecosystem.

Session ends at 12.50 sharp. Please visit the Poster session and have some lunch.

Session 4 – Forest Engineering (11.10-12.50 o'clock, Seminar room SCHW-SR 09)

Convener: Prof. Dr. K. Stampfer

Time

11.10-11.25	**Karl Stampfer**	**KEYNOTE** - Knowledge and technologies for effective wood procurement (Tech4Effect).
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11.40-11.55	**Maximilian Kastner**	Assistance winch cable tension during ground based mechanized CTL-harvesting in steep terrain.
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12.10-12.25	**Christoph Huber**	Evaluation of a modified centrifugal spreader to apply nutrient-rich fine fractions from woodchips as a fertilizer to cutover areas in steep terrain.

Session ends at 12.50 sharp. Please visit the Poster session and have some lunch.

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Convener: <u>Prof. Dr. A. Schopf</u>

Time

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15.05-15.20	**Peter Zelinka**	Overwintering behavior and survival of the spruce web-spinning Sawfly, *Cephalcia abietis*, from an outbreak area in the northern Waldviertel, lower Austria.
15.20-15.35	**Chimi Tshering**	Comparative studies on the preference of the East Himalayan bark beetle *Ips schmutzenhoferi* (Col., Scolytinae) for Misteltoe-infected and non-infected Blue Pine (*Pinus wallichiana*) and Spruce trees (*Picea spinulosa*) in the coniferous forests of Western Bhutan.
15.35-15.50	**Veronika Neidel**	Transmission of the microsporidium *Nosema lymantriae* via feces in the host insect *Lymantria dispar* and how it is affected by simulated rain.

Session ends at 16.00 sharp. Please visit the poster award ceremony at 16.15.

Oral presentations – Abstracts

Session 1 – Forest Ecology

Oral presentation - Session 1

KEYNOTE: Mycorrhizal fungi: Drivers of ecosystem processes and multitrophic interactions

David Johnson

Institute of Biological and Environmental Sciences, University of Aberdeen, UK

Abstract

Mycorrhizal fungi form symbioses with the roots of most land plants on Earth, and are thought to have facilitated the movement of plants from aquatic to terrestrial environments 450M years ago Yet, we are only recently beginning to appreciate their key roles in regulating ecosystem processes, shaping plant communities and affecting multi-trophic interactions. Here I will discuss using examples from my own research how mycorrhizal fungi affect how carbon, nitrogen and phosphorus are cycled in soil, and interactions with above and below ground organisms. I will also argue for a better understanding of how diversity in its broadest sense can affect these processes, and stress the need to consider mycorrhizal plants and fungi in parallel to advance our ability to predict how ecosystems will respond to perturbations.

Modeling the sulfur biogeochemistry of beech stands of the Vienna Woods

Klaus Dolschak, Torsten W. Berger

Institute of Forest Ecology, BOKU

Abstract

Forest ecosystems in Central Europe have received high loads of atmospheric sulfur (S) during the last century. Several reasons led to a drastic decrease of deposition starting in the 1980s. Recent studies report only a weak response of the catchment S output to decreased atmospheric deposition. This discrepancy of S input and seepage S load is generally assigned to a net S release from the soil.

In this work we set up and apply a dynamical balance model which aims to identify the key mechanisms controlling the soil S budget. The model comprises a hydrological component controlling fluxes of solute SO_4. A sulfur dynamics module covers soil chemical processes as well as biotic S transformations.

We adjusted the model to 2 beech stands in the Vienna Woods which were intensively monitored for 2 years. The model succeeds to reproduce the current soil S pool, as well as an observed time series of SO_4 concentration in soil solution, allowing an assignation of fluctuations of solute sulfate to actual biogeochemical processes.

The model identifies the microbial interplay of S immobilization and mineralization as a major driver of the short time dynamics of solute SO_4 in the soil. A net S release, responsible for the observed output surplus, seems to be caused by the mineralization of more stable organic sulfur, originating from plant biomass. The model depicts the monitored forest stands as a sink for atmospheric sulfur during the era of elevated SO_2 emission. In the late 1980s the system shifts from sink to source for the first time. Under current legislation emission the system approaches a new steady state (I=O), which is not reached entirely within the timeframe of the simulation (1700-2200).

Variability in fine root morphology, biochemistry, and litter quality indices of ten tropical tree species

Dessie Assefa, Douglas L. Godbold, Boris Rewald

Institute of Forest Ecology, BOKU

Abstract

Although fine roots of trees are major carbon flows into the soil, little is known about their morphological indices in relation to their chemical composition. The aim of this study was to test whether root traits varied with species and correlate with biochemistry via proxy carbon fractionations and their response to carbon costs to build dense root systems. Root morphological indices (using digital image analysis with WinRHIZO software), series of digestions for root chemistry, litter quality indices, carbon cost during biomass production, were investigated on fine roots of ten tropical tree and shrub species collected in northern highland of Ethiopia. Fast growing species exhibited higher specific root length (SRL) and specific root area (SRA) but lower root tissue density (RTD) than slow growing species. All species were characterized by high values of acid insoluble fractions (AIF). The carbon content, AIF, and lignocellulose index were higher for slow growing species. RTD showed a strong positive correlation with AIF and C content. The cost to construct a gram of root biomass and the amount of CO_2 released during biomass production were higher in slow growing species. Despite differences in morphological traits and chemical composition between species, AIF, RTD, and C cost to fine roots are highly correlated irrespective of species.

Understanding the consequences of climate change in remote mountain regions: a roof experiment to simulate monsoon failure in the Himalayas

Norbu Wangdi[1], Andreas Schindlbacher[2], Robert Jandl[2], Klaus Katzensteiner[1], Andras Darabant[1], Iftekhar U. Ahmed[1], Georg Gratzer[1]

[1]Institute of Forest Ecology, BOKU
[2]Department of Forest Ecology, Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW)

Abstract

The Indian summer monsoon is a tipping element in the world's climate. A sixth of the World's population depends on its precipitation. The Himalayas are predicted to experience more than three times the mean global rise in temperature, as well as erratic rainfall patterns and an increased likelihood for total monsoon failures, so called mega-droughts. While many ecosystem manipulation experiments aiming at understanding the effects of altered precipitation, temperature and CO_2 levels have been conducted in North America and Europe, such experiments are scarce in Asia. So far, the effects of altered precipitation on ecosystems in the Himalayas have not been characterized experimentally.

Thus, to fill this gap, we are simulating late onset of the monsoon precipitation as well as total monsoon failures in a multi-year drought stress experiment in Bhutan. With these experiments, we hope to understand how altered monsoon precipitation alters ecosystem productivity, dynamics and ecosystem C fluxes. Our main objective is to characterize the ecosystem responses to drought in cool-temperate conifer and broadleaved forests along an altitudinal gradient in the Bhutan Himalayas. Our specific questions are: (1) do the roofs successfully exclude throughfall, (2) what is the rate of annual CO_2 efflux from the typical temperate cool conifer and the temperate warm broadleaved forests sites in a monsoon climate and (3) what is the effect of roofing on CO_2 efflux. The results from the study show that the roof structures are effective and the TFE approach could be used as a tool to understand the ecological effects under future climatic changes and for characterizing specific-ecosystem-environment responses in the Himalayan region. The annual soil CO_2 efflux estimates were 13.08 ± 2.9 and 14.0 ± 3.6 ton C ha^{-1} from the conifer and the broadleaved stands, respectively. The reduction in throughfall by the roofs decreased soil CO_2 efflux rates.

Soil carbon dynamics after forest disturbance by wind

Mathias Mayer[1], Bradley Matthews[1], Andreas Schindlbacher[2], Hans Göransson[1], Boris Rewald[1], Douglas L. Godbold[1] and Klaus Katzensteiner[1]

[1]Institute of Forest Ecology, BOKU
[2]Federal Research and Training Centre for Forests, Natural Hazards and Landscape, BFW

Abstract

Natural forest disturbance plays a major role in the global carbon (C) cycle; the effects of forest windthrow on soil C processes are however poorly documented. Since disturbance events by wind are predicted to increase under a changing climate, a detailed understanding of particular effects on the soil C dynamics of forest ecosystems is of major importance. In this study the temporal dynamics of soil carbon dioxide (CO_2) efflux (F_s) and soil organic C (SOC) stocks were investigated along a windthrow chronosequence in the Austrian Alps. Soil CO_2 efflux was measured from 2009 to 2012 in undisturbed control stands and adjacent windthrow areas that differed in time since disturbance. In comparison to the control stands, differences in F_s for the initial six years after windthrow were not significant, but significantly higher F_s rates were detected between nine to twelve years after windthrow. As soil temperature significantly increased following disturbance (~ 5°C), 20 to 36% of F_s at the windthrow areas was solely attributed to warmer soil conditions. An increase in grass vegetation and a consequent increase in autotrophic respiration was assumed to contribute to a higher F_s in the later period post-windthrow. However, a root-exclusion experiment at the younger windthrow sites revealed that about 80 to 90% of F_s originated from heterotrophic respiration. It could be shown that a decrease in autotrophic respiration after windthrow was in fact offset by a temperature-related increase in heterotrophic respiration, suggesting a large loss of SOC to the atmosphere. In accordance, a significant decline in SOC stocks could be observed in year six after windthrow. It therefore seems that an accelerated heterotrophic respiration promotes a decrease in SOC stocks following forest windthrow. Structural equation modelling was used to determine the abiotic and biotic factors that drive F_s and their interrelation.

Oral presentation - Session 2

Ein konkurrenzbasiertes Verteilungsfortschreibungsmodell für die Waldentwicklungsprognose in einer Eichen-Mittelwald-Betriebsklasse

Franziskus Seilern-Aspang, Arne Nothdurft, Otto Eckmüllner

Institut für Waldwachstum

Abstract

In der Arbeit soll ein eichenreicher Mittelwald in Ostösterreich mittels Inventurverfahren beschrieben werden und aus den Kennzahlen ein nachhaltiger Hiebsatz über einen Vergleich zwischen aktueller und gewünschter Durchmesserverteilung hergeleitet werden. Dazu soll der künftige Vorrat und die künftige Durchmesserverteilung aus der aktuellen Situation unter Annahme unterschiedlicher Nutzungsszenarien hergeleitet werden, wobei Lichtwuchseffekte nach Kronenfreistellung berücksichtigt werden sollen.

Über die mit Eichen Mittelwald bestockte Fläche werden etwa 100 gleichmäßig verteilte Stichprobenpunkte gelegt, auf denen Winkelzählproben nach Bitterlich gemacht werden, weiters werden beim Zentralstamm, beim 2. dicksten und 2. dünnsten Stamm Durchmesser und Baumhöhen gemessen und der Zuwachs gebohrt. Zur Verbesserung der Modelle für das zukünftige Durchmesserwachstum wird der Konkurrenzindex (CI) ermittelt. Dazu werden an einem Drittel der Punkte die Kronen der drei Bäume mit ermittelten Durchmesserwachstum sowie deren Bedränger abgelotet, um den Konkurrenzindex herzuleiten.

Zur Beurteilung der Qualität der Verjüngung (unter der Kluppschwelle von 10cm) wird die Anzahl jugendlicher Eichenkernwüchse ('Laßreitl') aufgenommen.

Modeling of basal area increment for thinned forest stands at the districts of the forestry company "Gutsverwaltung Eberstein"

Philipp Skalka, Arne Nothdurft, Otto Eckmüllner

Institute of Forest Growth

Abstract

This master thesis aims at showing the development of accrescence of forest stands in a larger Carinthian forestry called 'Gutsverwaltung Eberstein'. The basic data were collected in samples of permanent observation plots. With the tree data an individual tree-based stand growth model was used for testing the hypotheses. The best option for a simulation model was to work with the basal area increment for individual trees. The basal area increment model has been developed for the main Austrian tree species. This model is based on data from the Austrian National Forest Inventory. Since 1970, at the Carinthian Forest Company the forest inventory of trees is being re-measured all ten to fifteen years, in order to get a 10 (15)-year basal area increment of all sampled trees.

For the analysis, geographical information about the region is not needed, also age and site index are intentionally not used in order to ensure generality for the sum of possible stand conditions.

Relevant parameters for the basal area increment model are competition factor; as a consequence, the Crown Competition Factor (CCF) and the Basal Area of Larger trees (BAL) were used. Basal Area of Larger trees is a tree-specific measurement of competition that does not require spatial information and that provides a better competition measurement than the Crown Competition Factor. When comparing the measurement results of the BAL to those of the CCF, the measurement results of the Crown Competition Factor have shown a minor improvement.

Another important variable, which is required for the growth model, is the topographic factor, which includes the elevation, the exposition and the site angle of the sample plots. This factor shows the influence of the topography in basal area growth of trees.

The analysis of basal area increment and the forest site parameters will be statistically calculated with a multiple regression and may show either a significant or non-significant relationship between the basal area growth of sample trees, the influence of competition of neighboured trees and the site conditions.

The comparison of the „Schweizer Methode" and the „Winkelzählprobe"

at the forest inventory of the forest management Eberstein in Carinthia.

Hans-Peter Jauk, Otto Eckmüllner, Arne Nothdurft

Institute of Forest Growth

Abstract

For the forest inventory of the forest management Eberstein, two different types of admission processes have been used for the data recording. On one hand the "Schweizer Methode", which was already used for the forest institution in the past, and on the other hand a new admission process, the "Winkelzählprobe".

The "Winkelzählprobe" was established in 1939 and is nowadays one of the most applied forest institution admission processes in the 21. century. In contrast to the common admission process stands the "Schweizer Methode", which is based on a state gathering and showing specific alterations of the wood stock.

During the "Winkelzählprobe" the diameter at breast height and the specific height of the "Mittelstamm" was recorded. In contrast the "Schweizer Methode" requires also the diameters at breast height and the diameter which was measured at a height about seven meters. But that specific diameter is called "D07"and the height was only measured at trees which stand within a certain radius.

The focus of the master thesis is the comparison of the two admission processes to demonstrate possible differences between the two methods in relation to the computation of the stock and thus the calculation of the cut rate. Based on the recorded data, the calculation of the stock and the cut rate and a pairwise comparison it should be possible to prove if there exists the opportunity to adapt the "Winkelzählprobe" as the new admission process or if the analysis of the recorded data demonstrate a gap between the two admission processes which is impossible to neglect.

Furthermore the thesis will focus on the practice relevant factors like the duration of the entire forest institution and the suitability of the two methods in sophisticated terrain will be part of the entire verification.

Reforestation and protection efficiency after windthrow on protection forest sites in the Zederhaustal - *CANCELLED* -

Josef Petzlberger, Rupert Seidl

Institute of Silviculture, BOKU

Abstract

Austrian forests are frequently damaged by climatically induced extreme events, especially by winter storms, foehn and thunderstorms. It seems that the number of such extreme events increase under continued climatic change. Extreme storm and foehn events cause regular large-scale deforestation in Austrian protection forests. In November 2002 the foehn storm "Uschi" and a following bark beetle attack leaded to deforestation of forest stands which protect settlements and infrastructure in the Zederhaustal against avalanches and rock fall. This master thesis aims to analyze the condition of forest regeneration as well as positive and negative influences on the success of arising rejuvenation on windthrow areas 14 years after the blowdown. Furthermore, this thesis evaluates the present protection fulfillment degree of the blown areas and estimates the period required till protective function is completely given. Sample plots based on the Game Influential Monitoring (WEM) will be implemented on blown sites to collect data with respect to number, height, distribution and damages of the regeneration. Additionally, sample plots in adult stands beside the blown sites will be implemented to issue a chronosequence. The chronosequence should represent the growth process of respective species on the study site in order that periods of required diameter- and height increase can be estimated. Results of monitored sample plots will be compared with a Digital Surface Model (DOM) of the the study site to identity gaps without forest regeneration which endanger the protection fulfillment. Outcomes should reveal positive and negative developments of forest regeneration in connection with an as quickly as possible restoration of the protection fulfillment on windthrow areas in the Zederhaustal.

Vergleich der Waldbehandlung zwischen Nord- und Südtirol anhand ausgewählter Beispiele

Lukas Kofler, Harald Vacik

Institute of Silviculture, BOKU

Kurzfassung

Ziel dieser Arbeit ist es, Unterschiede in der Bergwaldbewirtschaftung zwischen Nord und Südtirol anhand ausgewählter Parameter aufzuzeigen, und mögliche Gründe dafür zu identifizieren. Konkret werden die Daten aus der Stichprobeninventur zur Waldtypisierung beider Länder verwendet, um die Nutzungsart und Nutzungsintensität zu untersuchen.

Im Rahmen der Waldtypisierung wurden die Waldflächen in beiden Ländern nach Waldgruppen und Waldtypen unterteilt. Die Unterschiede sollen anhand der Waldgruppe der submontanen Fichtenwälder und der Waldgruppe der Fichten- Tannenwälder analysiert werden. In diesen beiden Waldgruppen ist aufgrund des vorhanden Datenmaterials und der Nutzungsaktivitäten am ehesten mit Unterschiede zu rechnen. Es wurden vor allem die Parameter h/d Wert, BHD- Spreitung, Baumhöhe, Baumartenanteile und Wuchsklassenverteilung durch Mittelwertvergleiche untersucht.

Die Ergebnisse zeigen, dass es durchwegs Unterschiede in der Waldbehandlung zwischen Nord und Südtirol gibt. In Südtirol ist der Anteil ungleichartiger Bestände erheblich größer als in Nordtirol. Die Nutzungsintensität ist dagegen in Nordtirol größer. Die verglichenen Strukturparameter weisen darauf hin, dass die Wälder in Nordtirol im Allgemeinen besser gepflegt sind als in Südtirol. Der Stabilität ist dort höher und die Überschirmung weniger dicht. Weiters fällt auf, dass in Südtirol Unterständer in älteren Beständen fehlen. Der Anteil von Mischbaumarten ist dagegen in Südtirol höher. Es ist mehr Tanne und mehr Lärche vorhanden.

Viele dieser Unterschiede lassen sich - zumindest zum Teil - auf die unterschiedlichen gesetzlichen Rahmenbedingungen sowie auf unterschiedliche Waldbaustrategien in der Vergangenheit zurückzuführen.

Simulating the effect of climate change and forest management in a mountain forest landscape

Katharina Albrich, Werner Rammer, Dominik Thom, Rupert Seidl

Institute of Silviculture, BOKU

Abstract

Forest ecosystems in mountain regions provide a variety of ecosystem services, often on the same area. In Austria, forests are therefore already explicitly managed for multifunctionality. Under changing environmental conditions (changing climate and disturbance regimes) the ability of forests to provide these ecosystem services is expected to change.

The objective of this thesis is to analyze the role of forest management in such a changing environment and how well different management strategies are able to maintain the multifunctionality of mountain forests as well as to incorporate upcoming needs from society, such as the demand for carbon storage and biodiversity conservation in forests.

To address this, the simulation model Iland (the individual-based forest landscape and disturbance model) is used to model the impact of four different management strategies (partially designed with input from local stakeholders) on indicators for the fulfillment of ecosystem services under various climate change and disturbance scenarios for a mountain forest landscape in the Northern Limestone Alps in Austria.

The simulation results will be used to evaluate and compare the performance of the landscape regarding ecosystem services under different management strategies and on the ability of each strategy to manage the forest to meet current and future demands of society.

Oral presentation - Session 3

Gel for simultaneous cationic solute and pH imaging in rhizosphere soil

Christoph Höfer[1], Jakob Santner[1], Sergey M. Borisov[2], Walter W. Wenzel[1], Markus Puschenreiter[1]

[1]Department of Forest and Soil Sciences, Institute of Soil Research, University of Natural Resources and Life Sciences, Vienna (BOKU), Konrad-Lorenz-Strasse 24, A-3430, Tulln, Austria
[2]Institute of Analytical Chemistry and Food Chemistry, Graz University of Technology, Stremayrgasse 9, A-8010, Graz, Austria

Abstract

In rhizosphere research, passive and diffusion-based sampling techniques such as diffusive gradients in thin films (DGT) and planar optode sensors (POS) are emerging tools.

Recently, a high resolution mixed binding gel (HR-MBG) was developed for simultaneous imaging of anionic and cationic species. This gel is urethane-based (Hydromed D4) and contains a mix of Zr-hydroxide and suspended particulate reagent-iminodiacetate (SPR-IDA) as binding agents. After solute sampling, the gel is analysed by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and an image is derived from the acquired data.

POS are thin films of an analyte-specific fluorophore-hydrogel cocktail, coated onto a polyester support foil. Fluorescent colour-ratiometric imaging is based on (i) excitation of the fluorophore at a specific wavelength, (ii) emission of fluorescent light by the excited fluorophore in response to the analyte concentration and (iii) capture of the raw RGB camera signal. After calibration of the RGB data, the image is plotted using image analysis software.

Here we attempt to merge DGT and POS in a single gel layer for simultaneous, co-localized imaging of dissolved anions and cations and pH. We investigate different combinations of anion and cation resins previously used for DGT imaging in combination with DCIFODA (2´,7´-dichloro-5(6)-N-octadecyl-carboxamidofluorescein) as pH indicator.

Preliminary results indicate interferences of anion binding materials with DCIFODA protonation for both, synthetic anion exchange resins and (oxy)hydroxide minerals. Observed long equilibration times (>72h) were probably related to the ampholytic properties of the (oxy)hydroxide surfaces. Cation chelating resins such as SPR-IDA showed no interferences due to their different solute binding mechanism and showed shorter equilibration times (90 min). For gel characterization, we tested relevant DGT properties.

We conclude that combining POS for pH and DGT has great potential for rhizosphere research.

Phosphorus in soils and fertilisers: resource use efficiency through recycling and improved laboratory tests

Olivier Duboc[1], Jakob Santner[2], Alireza Golestani Fard[1,2], Jessica Tacconi[1], Franz Zehetner[3], Walter Wenzel[1]

[1]University of Natural Resources and Life Sciences, Vienna, Institute of Soil Research, Konrad-Lorenz-Strasse 24, 3430 Tulln, Austria
[2]University of Natural Resources and Life Sciences, Vienna, Division of Agronomy, Konrad-Lorenz-Strasse 24, 3430 Tulln, Austria
[3]University of Natural Resources and Life Sciences, Vienna, Institute of Soil Research, Peter Jordan Straße, 1180 Vienna, Austria

Abstract

Phosphorus (P) - an essential plant nutrient - is a finite resource which we must optimize and recycle. Heterogeneous recycling fertilizers produced from P-rich biowastes such as sewage sludge, slaughterhouse waste or animal manures will therefore become increasingly relevant. Various waste treatment processes further increase the diversity of products. Given the limitation of standard extractions to predict P bioavailability in fertilizers and soils of contrasting chemical properties, there is a need to find methods which accurately assess P availability from increasingly heterogenous substrates. In the frame of the FERTI-MINE project we investigate a set of complementary approaches to characterize fertilizer P availability. With standard methods of fertilizer analysis (H_2O, 2% formic acid, 2% citric acid and neutral ammonium citrate extractions) as well as comparably new process-based approaches (diffusive gradient in thin films (DGT), depletion induced desorption of P from fertilizer and imaging of the diffusional behavior of fertilizer P in soil) more information about the characteristics of P fertilizers is expected to be gained than with standard extracts alone. The method evaluation was conducted on 13 P fertilizers of contrasting origins and solubility, with a 6-week pot trial (Rye) as reference. While sewage sludge biochars performed worst, chicken manure and struvite (magnesium ammonium phosphate) were as efficient as conventional superphosphate. The DGT method explained 90% of variance in plant growth (Mitscherlich equation fitting). Other approaches that assess fertilizer chemical solubility in water (i.e. without soil interaction) did not give a good prediction. Nevertheless, they could e.g. help predict the P release dynamics from granulated fertilizer, in particular when implemented in combination with chemical imaging. Overall, our preliminary results indicate the potential of these complementary approaches to help optimize fertilization and improve sustainable use of P resources.

NOTE: This presentation is complemented by 2 other presentations by Delia Cossu, and Jessica Tacconi.

Oral presentation - Session 3

Soil microbial toxicity assessment of a copper-based fungicide in two contrasting soils

Melanie Dober, Sophie Zechmeister-Boltenstern, Franz Zehetner, Katharina Keiblinger

Institute of Soil Research, University of Natural Resources and Life Sciences, Vienna

Abstract

The infestation with the fungus downy mildew (*Plasmopara viticola*) causes dramatic losses in wine production. Copper (Cu) based fungicides have been used in viticulture since the end of the 19th century, and until today both conventional and organic viticulture strongly rely on Cu to prevent and reduce fungal diseases. Consequently, Cu has built up in many vineyard soils and it is still unclear how this affects soil functioning. The aim of the present study is the evaluation of the soil microbial toxicity of Cu contamination.

Two contrasting agricultural soils, an acidic sandy and a calcareous loamy soil, were sampled to conduct an eco-toxicological greenhouse pot experiment. The soils were spiked with a commonly used fungicide based on Cu hydroxid in seven concentrations (0, 50, 100, 200, 500, 1500 and 5000 mg Cu kg-1 soil). Lucerne (*Medicago sativa* L. cultivar Plato) was grown for 3 months.

Sampling was conducted at the beginning and at the end of the study period to test copper's soil microbial toxicity in total microbial biomass and basal respiration, as well as enzyme activities, such as exoglucanase, β-glucosidase, exochitinase, phosphatase, protease, phenol-, peroxidase and urease. Additionally, DOC, TN, Cmic, Nmic, NO_3 and NH_4 were determined to provide further insight into the carbon and nitrogen cycle. Ergosterol was analysed as a fungal biomarker.

Hydrolytic extracellular enzymes were not clearly affected by rising Cu concentrations, while a trend of increasing and decreasing activity of oxidative enzymes (phenol- and peroxidase) was observed. Microbial respiration rate as well as the amount of Cmic and Nmic decreased with increasing Cu concentrations. Ergosterol was especially sensitive to Cu and started to decline at even lower concentrations at the first sampling time. In summary, the results showed distinct Cu toxicity effects on soil microbial biomass with a larger sensitivity of the loamy soil.

Landslide impact on carbon storage in a tropical forest ecosystem

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Abstract

Typhoon-induced landslides occasionally strip parts of the landscape off the vegetative cover and soil layer and export large amounts of biomass and soil organic carbon (OC). In the subtropical mountains of Taiwan and in other parts of the world, bamboo species may invade at a certain point in the succession of recovering landslide scars. Bamboo has a high potential for carbon sequestration because of its fast growth and dense rooting system. However, it is still largely unknown how these properties translate into soil OC re-accumulation rates after landslide disturbance.

In this study, we established a chronosequence on former landslide scars in the Central mountain ranges of Taiwan, ranging in age from 6 to 41 years post disturbance. The younger landslide scars were colonized by *Miscanthus floridulus*, while after approx. 15 to 20 years of succession, bamboo (Phyllostachys) species were dominating. Biomass and soil OC stocks were measured on the recovering landslide scars and compared to an old-growth *Cryptomeria japonica* forest stand in the area.

Biomass carbon accumulated rapidly in *Miscanthus* stands, with annual change in carbon stock of 2 ± 2.5 Mg C ha^{-1} yr^{-1} and continued to increase under bamboo but storage remained significantly lower compared to the old-growth coniferous forest. However, soil OC stocks on the recovering landslide scars approached the levels of the old-growth forest, with rates exceeding 2.5 Mg ha^{-1}-yr^{-1}. When looking at the whole ecosystem, including the soil, bamboo sequestered and stored carbon up to 148.7 ± 6.7 Mg ha^{-1} after only few decades of succession.

KEYNOTE: Knowledge and technologies for effective wood procurement (Tech4Effect)

Karl Stampfer

Institute of Forest Engineering, BOKU

Abstract

The strategic objective of TECH4EFFECT is to improve the efficiency of European forest management by enabling a data-driven knowledge-based revolution of the European forest sector while also providing key incremental improvements in technology.

The TECH4EFFECT Vision is one of a forest sector that continuously and systematically strives for greater efficiency in production and environmental performance, leading to greater wood mobilization with reduced costs and lower environmental impacts. The vision implies that the sector implements the possibilities for efficiency gains in incremental machine improvements and fully embraces the inherent possibilities within the digital revolution.

Specific Objectives:

1. To increase access to wood resources with focus on accelerated growth rates, improved silvicultural operations and improved business models for more efficient transactions in forest management.
2. To increase the efficiency of forest harvesting and collection with focus on infrastructure improvements, forest machine data exploitation, and improved work practices.
3. To reduce and monitor soil impacts from forest operations through machine technologies and machine mounted sensors combined with information technology.
4. To develop the TECH4EFFECT web-based benchmarking tool to collect and systematize data from forest management and provide a foundation for knowledge-based management of European forest operations in the future.
5. To implement TECH4EFFECT in a global European version and in country specific adaptations through industrial leadership.
6. To assess the environmental and socio-economic performance of the project results for the whole wood value chain.

Increasing timber harvesting efficiency in mountain forestry

Gerhard Pichler, Martin Kühmaier, Karl Stampfer

Institute of Forest Engineering, BOKU

Abstract

This study is conducted within the framework of the SLOPE project "Integrated proceSsing and controL systems fOr sustainable forest Production in mountain arEas", which is co-funded by the European Commission. Timber harvesting in steep terrain is much more complex than in flat lands, because of poor road network and limited storage and operational room. Due to the difficult terrain, cable cranes are often the only useful harvesting technology. To ensure competitiveness under steep terrain conditions, improvements are required.

The ultimate goal of SLOPE is to increase timber harvesting efficiency in mountain forestry, which shall be achieved by implementing a higher degree of mechanization, automation and intelligent technologies into the timber supply chain. Forest inventory and harvesting planning are supported by UAV (Unmanned Aerial Vehicle) and TLS (Terrestrial Laser Scanner) -survey. A 3D forest model is generated which provides data for marking operations (e.g. harvesting trees, cable lines…) with RFID (Radio Frequency IDentification) -tags. All technologies have interface to a FIS (Forest Information System), which allows monitoring the whole timber supply chain from felling until delivering the timber at the mill. Extraction by an intelligent carriage (GPS, RFID-tag reader, recording of line data, load cell) and debranching, topping and crosscutting by an intelligent processor head (RFID-tag reader and marker, sensors for determining timber quality), as well as transportation by an intelligent truck (RFID-tag reader, GPS and GPRS for data transmission) are further innovations of the SLOPE project. These innovative approaches should lead to higher efficiency and lower costs in steep terrain harvesting.

The innovations are evaluated regarding efforts, costs, advantages and disadvantages in comparison to the common approach. Process analysis and time studies are executed to determine timber harvesting efficiency for currently used and new technology. From this data necessary improvements are identified to increase this new system's competitiveness.

Assistance winch cable tension during ground based mechanized CTL-harvesting in steep terrain

Maximilian Kastner, Franz Holzleitner, Karl Stampfer

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Abstract

Timber mobilization is one of the main challenges in the Austrian forest and wood industry. Harvesting operation type and cost depend on several factors, such as type of silvicultural treatment, accessibility of the forest stand, harvesting volume and especially a productive harvesting technology. Cable assisted harvesting machines have a big potential for increasing cost-efficiency and decrease soil disturbance in steep terrain operations.

This novel harvesting technology is evaluated within the framework of a national project. Cable assisted harvester and forwarder are studied, with a focus on the cable tension and how it is affected by different work phases of the machine.

Productivity analysis is carried out in form of a video-based work efficiency study, which is a combination of on-board machine data and work captured by action cams mounted on the machine. Video documentation was used to determine the actual work phases and related them to the recorded cable tension. Thus potentially dangerous cable tension peaks can be detected. This is of great importance, as the machines work on slopes of up to 100%, where a break of the cable could entail dangerous accidents.

No or only shallow rutting is an indicator for a well-executed harvesting operation. Several factors like weather conditions, use of branches as soil protection material, soil type and machine configuration have an influence on the occurrence and extend of soil disturbances. Cable assisted machinery's impact is assessed in the study.

Fixing the winch cable to an anchor tree is very time consuming and has significant influence on the productivity of the whole system. What's more, the carrying capacity of tree anchors is usually unknown and can only be estimated roughly according to the formula of Pestal. In the study, tree anchors are pulled from the ground to determine carrying capacity on different tree sizes and species.

Solar drying of wood chips

Eva Bossert, Gernot Erber, Karl Stampfer

Institute of Forest Engineering, BOKU

Abstract

If fuel wood is stored in the form of chips, high moisture content entails degradation, health and self-ignition risks. Thus efficient methods for drying wood chips are vital. The present study evaluated the productivity of a solar drying system for wood chips developed by CONA Entwicklungs- und Handelsgesellschafts mbH. This system consists of solar-air collector panels, mounted on a roof, where air is heated up and then blown through wet wood chips, which are placed on sloping, perforated gratings inside the drying box.

Thirty drying plants, 12 in Bavaria and 18 in Upper Austria, were part of the survey. Installed panel ranged from 32 to 348 m², drying box volume from 40 to 200 m³ loose and the yearly drying capacity from 300 to 5.000 m³ loose.

Dry chips are mainly produced for owner's consumption and sale. In average, 17 m³ loose can be dried per m² of solar panel and year, resulting in an average final moisture content of 15 %. During the season of spring through autumn drying one lot of chips takes 1.5 to 3 weeks. Total manipulation efforts is about 2 hours per lot, resulting in costs of 1.0-1.5 € per loose cubic meter. For ventilation, in average 3.9 kWh electric power are required per m³ loose, which is equivalent to costs of 1.0 € per m³ loose. From one m³ loose of dry chips in average 0.75 MWh of heat could be produced, while 1.40 m³ loose were required per produced MWh.

In conclusion, this drying method proved to be very efficient and energy-saving. Dryer chips entail fuel savings and improved storability, reducing degradation, fungal contamination and self-ignition risk to a minimum. Moreover, efficiency in transport is increased through improved load volume utilization while reducing the number of required truck trips at the same time.

Evaluation of a modified centrifugal spreader to apply nutrient-rich fine fractions from woodchips as a fertilizer to cutover areas in steep terrain

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Abstract

Whole-tree harvesting, where whole trees including branches and tops are extracted from the stand, had become more common in cable logging in Central Europe due to higher mechanization and lower harvesting costs compared to cut-to-length or stem-only harvesting.

After whole-tree-harvesting, slash piles, which mainly consist of the nutrient-richest parts of the trees, remain close to the forest road. As an energy source, these logging residues often cause problems during thermal conversion due to their high portion of fines. Screening experiments already demonstrated that it is possible to achieve a high quality raw material by separating fines after chipping. Fines, which mainly consist of needles, contain high concentrations of nutrients.

Therefore, the objective of this study was to evaluate possibilities to return these nutrient-rich fractions as a fertilizer back to steep slopes. Field tests were performed to evaluate mass and nutrient distribution for a modified spin-type centrifugal spreader prototype, which is attached to the mainline of a carriage.

Tests showed that the ground clearance of the spreader and the moisture content of the material have a significant impact on distribution patterns and the productivity of the spreader. The greater the clearance of the spreader, the greater spread width is achievable. However, the risk of one-sided wind deposition also increases with increasing clearance. Furthermore, the productivity of the spreader is widely correlated with the moisture content of the material. High moisture content reduces the flow properties of the material resulting in lower productivities and higher system costs.

Oral presentation - Session 5

Population dynamics of the spruce web-spinning sawfly *Cephalcia abietis* in a recent outbreak area

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Abstract

The spruce web-spinning sawfly *Cephalcia abietis* (Hym., Pamphiliidae) is a forest pest of Norway spruce, *Picea abies*. Irregular mass outbreaks occur in Central and Northern Europe. The insect has a one to three year life cycle, accordingly population eruptions vary significantly. Adult wasps emerge in May or June from overwintering sites in the ground; females lay eggs on old spruce needles. Young larvae construct shelters of silk and frass where they hide and feed in groups by cutting the older needles. In late summer, mature larvae drop to the ground and burrow into the soil to overwinter. The resting (diapausing) larvae are called eonymphs (first stage) and pronymphs (last stage). Estimations of the insect attack level are based on the number of pronymphs present in the soil. In 2013 a new infestation was reported from a 10 ha pure spruce stand near Zwettl (Waldviertel, Lower Austria). In 2014 and 2015 only a small number of wasps emerged in spring; however, in autumn 2015 more than 90 % of the insects in the soil were pronymphs, indicating a main flight year in 2016. In this study we examine the sawfly population development from February to September 2016. Soil samples will be collected several times and larval densities, development and fitness will be analyzed. Several physiological tests will be performed with the diapausing nymphs, including respiration activities and super cooling point measurements. Additionally, larval sugar, glycogen, and lipid contents will be determined. In spring, emerging adult wasps will be trapped with photoeclectors, counted and sexed. In summer, mature larvae will be collected with funnels. Soil sample analysis from February showed an average density of 265 nymphs/m², with a ratio of pronymphs to eonymphs of 9:1. More than 30 % of the nymphs were parasitized. The ratio of living females to males was 1:1,3.

Overwintering behavior and survival of the spruce web-spinning Sawfly, *Cephalcia abietis*, from an outbreak area in the northern Waldviertel, lower Austria

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Abstract

In 2013, an outbreak of the spruce web-spinning sawfly, *Cephalcia abietis*, was reported from a spruce forest south of Zwettl, Waldviertel (Lower Austria). The area where the attack occurred covers a 10 ha pure spruce stand. The factors that trigger off a mass outbreak of the wasp are widely unknown. Usually the insect is of minor importance as forest pest; however in cases of defoliation, secondary pests such as bark beetles can infest and kill weak trees. The spruce web-spinning sawfly develops exclusively on Norway spruce, *Picea abies*. Larvae usually feed old spruce needles of 60 to 120 year old trees. In late summer, fully-grown larvae drop to the ground, burrow into the soil and overwinter as nymphs in an earthern hovel in a depth of about 25 cm. Diapause may last up to three years. The aim of this master thesis is to analyze the physiological status of the nymphs during their third winter period and the transition phase from diapause to pupation and adult emergence in spring. Soil samples were taken in autumn and sawfly density per square meter was determined. The nymphs were separated according to their development stage (eonymph, pronymph), weighed and analyzed for parasitism. The percentage of yellow and green color variation within the sawfly population was recorded. For overwintering, nymphs were kept under outdoor conditions and placed individually in micro well plates buried in soil. Super cooling points, respiration activity and the content of total fat were determined every month on a number of insects. Additionally, the nymphs were sorted into weight classes to follow adult male and female sawfly emergence under controlled conditions in climate chambers. Nymph densities in the soil were very high (>300 nymphs/m²). The ratio of pronymphs to eonymhs was 9 to 1; thus, we expect a high number of emerging sawflies in spring 2016 that will probably lead to severe infestations of the spruce trees.

Comparative studies on the preference of the East Himalayan bark beetle *Ips schmutzenhoferi* (Col., Scolytinae) for mistletoe-infected and non-infected Blue Pine (*Pinus wallichiana*) and Spruce trees (*Picea spinulosa*) in the coniferous forests of Western Bhutan

Chimi Tshering, Peter Baier, Thomas Kirisits, Axel Schopf

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Abstract

The two dominated tree species of the coniferous forests in western Bhutan, the spruce tree, *Picea spinulosa,* and the blue pine, *Pinus wallichiana,* are partly heavily infested by the specific dwarf mistletoe *Arceuthobium sichuanense* and *Arceuthobium minutissimum* respectively. The aim of the study was to investigate the effect of the mistletoe infections of both tree species on their attractiveness for the bark beetle *Ips schmutzenhoferi* (Col., Scolytinae), the most aggressive bark beetle of the two tested tree species.

The study was conducted at two southwestern exposed plots at the Chelela Mountain (Haa district) at 3074 m asl and 3285 m asl. At each plot four uninfected tree logs (1.5 m length: 2 spruce, 2 blue pine) and four mistletoe infected tree logs (2 spruce, 2 blue pine) of the same size were exposed for bark beetles' attack. The logs were weekly recorded on the number of beetles' entrance holes and the developmental stage of the breeding systems. Furthermore, the preference for infected and uninfected spruce and blue pine logs were tested under laboratory conditions in choice experiments at the Research center.

While there was no statistical difference in the density of breeding systems (number of nuptial chambers/dm²) in the various logs at the lower plot, both types of spruce trees showed higher attack rates than the blue pine logs at the upper site. At both plots the reproduction rate was higher in uninfected than in mistletoe-infected spruce logs and in blue pine, indicating a general preference of the bark beetle for spruce, but an inhibiting effect of mistletoe infection for its development.

Transmission of the microsporidium *Nosema lymantriae* via feces in the host insect *Lymantria dispar* and how it is affected by simulated rain

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Abstract

The present study investigates the effect of rain on the transmission success of the microsporidium *Nosema lymantriae* through feces of its host *Lymantria dispar*. Disease progression and the impact of simulated rainfall were tested with larvae on hornbeam foliage. Early instar larvae were inoculated with 1,000 spores each and incubated to reach an early (12 days post inoculation = dpi), middle (15-16 dpi) or late (18-20 dpi) stage of infection. At named infection times, 5 inoculated larvae were transferred to hornbeam twigs placed in plexiglas cages with two simulated rain events or without rain. After a 24 h exposure period the inoculated larvae were exchanged for healthy test larvae. When exposed to feces from early infection stages, the test larvae were not infected; also, simulated rain promoted transmission in only one out of six repeats. Exposure to feces from middle infection stages led to infection rates of 16.7 ± 36.15 % without rain, but increased infection rates to 57.4 ± 30.99 % with simulated rain. Feces of the late disease progression stages caused infection rates of 7.5 ± 9.57 % when dry and 68.3 ± 34.88 % when irrigated. Transmission rates were generally higher when the test larvae fed on hornbeam contaminated with inoculated larvae and their feces. In this case, rain did not have a significant impact on transmission success in any stage of infection. With infection rates of 83.3 ± 20.6 % and 88 ± 16.16 % the middle and late stages caused significantly higher infection rates in the test larvae than the early stage (36.7 ± 37.5 %). The experiments indicate that even light rain fall in advanced stages of disease progression can promote the transmission success of *N. lymantriae* considerably.

Poster presentations – Master and PhD students

Section Forest Ecology

Poster 1

Sulfur cycle in soils investigated by novel analytical methods

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Abstract

Sulfur (S) acts as an essential nutrient for vegetation. At the same time, S (in the form of sulfate) is co-responsible for the 'acid rain' phenomenon. Therefore, the understanding of the environmental S cycle is of highest interest. Sequential extraction of soil S fractions (readily available, adsorbed and HCl-soluble sulfate and ester sulfate and organic S) is one of the traditional analytical methods giving hint on S soil cycle. However, this approach is limited by non-specificity of the extraction procedures. Analysis of S stable isotopes in soil solution (sulfate output) and in rainwater (sulfate input) represents another, analytically more precise method revealing S dynamics and biogeochemistry. The factors historically limiting a precise isotopic analysis (low S concentration in rain water, low amount of sampled soil solution) can be overcome by application of multi-collector inductively coupled plasma mass spectrometry (MC ICP-MS). High analytical precision and combined measurement uncertainty of the MC device enables detection of differences in S isotopic composition in per-mile scale. However, sample preparation (purification) is necessary due to possible non-spectral interferences caused by cations present in the investigated water samples. Diffusive gradients in thin films (DGT) technique coupled to MC ICP-MS analysis seems to be promising for easy-to-handle and interference-free isotopic analysis of S in readily available sulfate. However, validation of the DGT MC ICP-MS technique will be necessary.

Reconstructing soil recovery from Acid rain in beech stands of the Vienna Woods as indicated by dendrochemistry

Selina Türtscher, Torsten W. Berger

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Abstract

Comparison between chemical parameters of soil from the infiltration zone of stemflow near the base of the stem and from the between tree area in 152 old beech stands by Lindebner (1990; sample collection in 1984) in the Vienna Woods proved a significant impact of deposition of atmospheric pollutants.

Based on his results and a recent survey in 2012 (Türtscher, 2014), we selected 14 of these 152 beech stands of which a part had been strip cut in the meantime. Thus, the cleared area of each stand provided stumps from different years of felling, representing the years when stemflow ceased to affect the soil. We hypothesized that soil recovery from Acid Rain is a function of time since felling due to the reduced input of acidifying substances with stemflow. Soil samples from different distances and directions from the stem were taken and analyzed for pH, total contents of S and N, and exchangeable base cations.

Furthermore, seven beech trees per stand were selected for coring. Our aim was to examine whether changes in soil chemistry over the last seven decades are reflected in the stem wood. In this context we tried to reconstruct soil recovery based on dendrochemical analysis. Cores were crossdated and half-decadal samples (1945-1949 to 2010-2014) were analyzed for Ca, Mg, Mn and Al.

We undertook this study to assess the suitability of dendrochemistry as an indicator of soil acidification and to evaluate the historical response of forest soils to atmospheric pollution.

Microbial biomass and enzyme activities in the Ethiopian highlands

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Abstract

Microbial biomass and Enzyme activities has play great important role for soil ecosystem process. This study was conducted in Glawudios, Ethiopia. The area geographically located in $11^0 38'$ N and $37^0 48'$ E with altitude of 2549 m a.s.l. as the recent data shown the area has about 100ha natural forest coverage.The aim of this study was to evaluate microbial biomass C and N concentration in the soil under natural forest, plantation forest and grazing land and also determine the type of enzyme activities that are found in the soil under natural forest, plantation forest and grazing land in Gelawudios. To conduct this study has been collected the top soil in the depth of 0-6cm. In natural forest about four dominant indigenous tree species were taken these were *C. mildbraedii, A. dimidiate, T. nobilis and C. molle* and from plantation forest the most two popular species these were *E. globulus* and *C. lusitanica* and also the soil samples were collected from grazing land. From each species about eight replications were taken. Totally 56 soil samples were collected. To determine microbial biomass the soils were collected in both seasons. As the summer season result shown that on microbial biomass carbon (C) among tree species statistically there is no significant difference because the P value was ≥ 0.5. However almost all tree species has significant different with grazing land the P value was ≤ 0.5. In microbial biomass nitrogen (N) there were significant difference between tree species. The highest microbial biomass N was recorded under *C. mildbraedii* tree species soil. Thus, *C. mildbraedii* has significantly different with *C. lustanica, E. globulus* and grazing land and *A. dimidiate* also has statistically significant different with both *E. globulus* and grazing land. Although the relationship between microbial biomass C and N was positively correlated because the R^2 value was 0.750732. In C: N ratio indicated that *E. globulus* tree species has higher than the other tree species which reaches about 10g/kg.

Forest structure as a mirror of past land use: dendroecology, demography, regeneration and spatial pattern of oak forests in Samothraki (Greece)

Carina Heiling, Georg Gratzer

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Abstract

The island of Samothraki is a rare example of an island in the Greek Aegean archipelago that was not strongly altered through mass tourism because of its remoteness and the fact that much of the land ownership on the island is legally contested. Almost three-quarters of the island's terrestrial area have been protected under the EU's *Habitats Directive.* However, the island has a long history of pastoral and silvo-pastoral land use. Currently, there are substantial threats to ecosystems mainly from overgrazing by goats and sheep. Because of their long life span, trees lend themselves as archives of land use history, both in their growth patterns and in their spatial structure. With the planned thesis, the spatial and demographic structure of *Quercus petrea* forests will be characterised and correlated with historic events like wars and socio-economic changes. Particular emphasis will be given to forest regeneration processes as critical process in forest dynamics. A lack in tree regeneration for prolonged periods because of intensive herbivory can drive forests beyond tipping points once the mature forest dies from disturbances or senescence. This is particularly true for Mediterranean forests. Assessing tree regeneration thus addresses a crucial indicator for future forest development. The study will use methods of citizen science for recording forest structure and tree regeneration combined with dendroecological methods on selected permanent sample plots.

Assessment of agroforestry interventions and its influences upon soil erosion and carbon stocks in fields of the Dagana district Bhutan

Shera Doelkar, Georg Gratzer, Andras Darabant, Herbert Hager

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Abstract

Soil erosion is a principal threat in a mountainous region and it is a widespread environmental challenge with climate change altering the phenomena of monsoon rain. In Bhutan, land degradation is caused mainly by human activities such as land-use change, deforestation, shifting cultivation, encroachment on forest land, forest fire, over grazing, etc. Our research focuses on intervention of agroforestry to improve the degraded farm fields through sustainable land management approaches and assessment of carbon stock through carbon inventory in both agricultural fields and forest to find out how much carbon has been increased by intervention of agroforestry systems. A prediction model known as Revised Universal Soil Loss Equation is used to compute soil loss and appropriate erosion control measures were developed to combat soil erosion. Support practice measures implemented at the study sites were constructing dry stone wall terraces where there is stones available and growing hedgerows where there is shortage of stones. These practices reduce the slope and length of the fields and our study computes the soil loss from the fields. Soil samples were also collected from the farm fields to compare the soil carbon and nitrogen after conversion of the LS factor and intervention of agroforestry systems. Carbon inventory was carried out on 14 sample plots and data on both forest and horticultural trees and saplings were collected. The result of the inventory for the study site will complement the result of inventory carried out on whole Dagana watershed and also find out how much carbon has been added by planting additional trees. The increase in the number of woody plants in the landscape in combination with the crops can increase the livelihood of the farmers and help in sustainable use of resources from the watershed. These activities will increase the overall performance of the watershed as a whole and contribute towards the goal of adaptation to climate change.

Cultivation of cardamom crops (*Amomum subulatum* Roxb.) in agroforestry systems with a special focus on the influence of shading trees in Dagana district, Bhutan

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Abstract

Black cardamom (*Amomum subulatum* Roxburgh.) which is also referred to as Nepal or Large cardamom is native to the Eastern Himalayas and commonly found in altitudes between 800 to 2,000 m. Its distribution ranges from the cool temperate to subtropical zones with 3,000 -3,500 mm of rainfall. Referring to T.K. Lɪᴍ 2012 the species naturally appears "under the shade of trees" such as Himalayan alder (*Alnus nepalensis*) and prefers well-drained soils with loamy texture in a moderate slope terrain. Used as a spice and medical plant, *A. subulatum* is an important agricultural cash crop and export commodity in Bhutan. Termed as a "low volume, high-value crop" (by Aᴠᴀsᴛʜᴇ et.al. 2011) cardamom developed to one of the significant livelihood sources for mountain people in the Himalayan region (Sɪɴɢʜ ᴀɴᴅ Pᴏᴛʜᴜʟᴀ 2013). In 2011 Bhutan produced 11 % (1,370 tons) of the total world production of around 12,280 tons.

The objective of this master thesis is to compare yield and growth rates of *A. subulatum* grown in the shade of trees versus open grown cardamom. An evaluation of the role of different tree species as shading trees and of the overall profitability of the different cultivation systems took place.   Additionally, quantitative interviews have been conducted to reveal the current local farming practice and farmers' knowledge about shading impacts. Data about overall carbon stocks of different systems have been gained to define REDD+ opportunities in the research area. Based on the results, management recommendations for *A. subulatum* are developed.

By comparing different morphological characteristics, the quantity and quality of cardamom harvest, impact of trees and other site specific parameters such as inclination and soil properties are used to verify if *A. subulatum* shows increased growth and yield behaviours below shade.

The drivers of soil respiration in two mountain forests in Bhutan

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Abstract

Soil respiration (*Rs*) was measured in two mountain forests in Bhutan viz; cool temperate conifer forest (CF) and warm temperate broadleaved forest (BF) from July to September 2015. Variations in *Rs* between the zone close to the stem and inter-stem space were studied. In addition we measured whether *Rs* differed between different forest types. We compared CF and BF because they are dominant in Bhutanese mountain forest. In laboratory incubation the dependence of *Rs* from soil water content and soil temperature were examined. R_{10} and Q_{10} were calculated with an exponential function with measured soil respiration and temperature.

The knowledge on the persistence of soil carbon and temperature sensitivity of soil respiration has been considered to be of paramount importance. Soil respiration and the temperature sensitivity of soil respiration are two important parameters that have been commonly used in predicting the rate of soil respiration at a given temperature.

There was a 30 % increase in *Rs* from canopy gap centre to the tree stem zone (n = 6; $p > 0.05$). The tree species effects on *Rs* was not significant (n = 6; $p > 0.05$). *Rs* reduced by 50% in dry soil at throughfall exclusion plot. The soil temperature and *Rs* showed a strong positive relationship ($R^2 > 0.90$). The soil moisture and *Rs* showed a unimodal relationship, where *Rs* was low at a lower soil moisture, increased to maximum at intermediate moisture and decreased at higher moisture content ($R^2 > 0.92$). The Q_{10} and R_{10} values ranged from 1.8 to 2.6 and 0.4 to 3.1 µmol CO_2 m^{-2} s^{-1}, respectively (n = 6). In both forest types, mineral soils were more sensitive to temperature than forest floor materials. The forest floor in lower elevation BF (Q_{10} = 2.3) was more temperature sensitive compared to the high elevation CF (Q_{10}= 2.0) (p = 0.02). Temperature sensitivity increased at a lower temperature. Soil moisture content decreased temperature sensitivity in both wet ($p > 0.05$) and dry soil ($p < 0.05$). Both, *Rs* and temperature sensitivity were strongly dependent on soil temperature and soil moisture. Therefore, a small change in these two factors is expected to immensely effect soil mineralization and subsequently the global carbon cycle.

Effects of ungulate herbivory on post disturbance forest soil carbon dynamics in the Northern Calcareous Alps

David Keßler, Mathias Mayer, Klaus Katzensteiner

Institute of Forest Ecology, BOKU

Abstract

Natural and anthropogenic disturbance events like windthrows and harvest operations influence various forest ecosystem services, including the ability of forests to act as carbon sinks. Post disturbance humus losses are particularly detrimental on shallow soils of the Northern Calcareous Alps, resulting in unfavorable conditions for tree regeneration. Mineralization is primarily driven by temperature. Losses via heterotrophic respiration are highest in young disturbed forest ecosystems with sparse ground vegetation and high insolation at the soil surface. Low gross primary production due to missing tree regeneration may lead to a negative ecosystem production for several years. Ungulate herbivory plays a crucial role for tree regeneration and the length of the phase until canopy closure. While disturbance effects on the carbon balance of forest ecosystems are relatively well known, information on the indirect influence of herbivores on post-disturbance carbon dynamics is sparse. Thus, this study will investigate the influence of herbivory on carbon pools and soil respiration. Ungulate exclosure (fenced) plots (FP) are compared to adjacent unprotected plots (UP). We hypothesize, that (a) soil respiration in FP is higher than in UP (mainly related to an increase in autotrophic respiration and higher litter input), (b) heterotrophic respiration in FP is lower than in UP (due to lower soil temperature), (c) the soil carbon pools in FP are higher compared to the pools in UP, and (d) the duration of the phase until canopy closure correlates with the difference in soil carbon pools. Several research sites, which differ in time since disturbance, will be established at south exposed slopes in different regions of the Northern Calcareous Alps. Above- and belowground carbon pools will be estimated via a systematic sampling of vegetation and soil cores. Carbon stocks in trees will be estimated using allometric equations. Above ground litter fall will be collected in litter boxes, soil respiration, soil temperature and soil moisture will be determined during campaigns in trenched and untrenched subplots. Results will be analyzed with ANOVA and generalized linear mixed models.

Hydrological characterization of two mountain forest ecosystems in Bhutan

Kuenzang Om, Bradley Matthews, Norbu Wangdi, Georg Gratzer, Klaus Katzensteiner

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Abstract

The main objective of the study is to provide soil and stand hydrological information for data-driven simulations of the forest water balance for two forest types in Bhutan. The thesis is part of a soil drought simulation/throughfall exclusion (TFE) experiment in two ecologically important forest types in Bhutan viz. Pangsho Goempa (PG), Wangdue Phodrang District (warm temperate broadleaved forests) and Trashigang Goempa (TG), Thimphu District (cool temperate conifer forests). At each site four homogeneous replicated plots of 725 m^2 (two control and two throughfall exclusion plots) have been selected. An integral part of the investigation is the hydrological characterization of the soil at the sites. The onset of drought stress is influenced by soil water availability, which even under the same meteorological conditions can vary significantly due variations in physical soil parameters. The study comprises the characterization of the hydraulic conductivities and soil water retention curves for different horizons of characteristic soil profiles in the laboratory. The influence of organic matter content and particle size distribution on the soil water retention curve and the saturated hydraulic conductivity are determined. Field measurements of soil water content were gathered in high temporal resolution over soil depth at selected locations, and in high spatial resolution for the topsoil during measurement campaigns. Climatic drivers (global radiation, wind speed, air temperature, relative humidity and precipitation) are continuously measured at climate stations, throughfall and stemflow as part of the water balance were determined in three week intervals from April 2014 to December, 2015. The stand parameters: height, leaf area, canopy conductance, rooting depth and intensity, which are additional important inputs for the hydrological model, were provided by the project partners. A process based hydrologic model: BROOK 90 is used for the simulation of the water balance at stand level.

Carbon budget baseline scenarios for the BOKU carbon offset project in two mountain communities in Nepal

Owen Bradley, Klaus Katzensteiner

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Abstract

In frame of the recently launched BOKU initiative 'Carbon offsetting as an opportunity for sustainable rural development in Nepal - a participatory, community based approach' implemented by (1) Nepal Academy of Science and Technology, Khumaltar, Lalitpur, (2) Tribhuvan University, Institute of Science and Technology, Department of Botany, Amrit Campus, Kathmandu and (3) University of Natural Resources and Life Sciences, Vienna, Austria, the carbon sequestration potential shall be evaluated for an area where future BOKU sponsored carbon offset shall take place.

The Master's Thesis project shall be a comparative study of two adjacent communities: one community where within a Swiss funded project which started 35 years ago and which was supported for more than 20 years, afforestation, agroforestry and grazing management activities were successful, the other, neighbouring community which did not participate in the described activities. While 35 years ago the forest integrity in the latter community was allegedly intact, the forest is now heavily degraded and overgrazed, leading to scarcity of fodder and wood supply. In a 'twinning' study together with a Nepalese student from Tribhuvan University the status of the two communities will be compared: with respect to biomass and soil carbon stocks (this study) and biodiversity (part of the Nepalese partner).

Within the thesis a stratified sampling and monitoring design will be developed and tested. Sample preparation shall be performed in Nepal, the analytical work will be done at BOKU. The thesis will improve our understanding of the efficiency of carbon offset interventions and its consequences for biodiversity and resources supply. Together with the results of another group working on social issues related to the interventions the case study will be a starting point for BOKUs activities in mountain communities of Nepal.

Machine learning approaches for root traits exploration

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Abstract

Exploring local crop cultivars is becoming more and more important, as they are the source for breeding. A standardized greenhouse experiment was conducted to distinguish 16 local faba bean (*Vicia faba* L.) cultivars based on root traits. Through manually excavating the root system of 70 days' old mature plants, we measured root traits which were vital for water and nutrients acquisition. Sixteen cultivars were clustered into two groups. The most important root traits distinguishing two clusters were whole root dry weight, lateral root dry weight and tap root dry weight between soil depths 5 and 10 cm. The classification accuracy was significantly improved through involving 3 selected "most important" root traits. Our results shows the potential of machine learning methods in root traits selection and cultivar classification.

Physiological and anatomical traits of 14 tree species in an Ethiopian highland forest

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[2]Institute for Botany, BOKU

Abstract

Ethiopia is a land with low forestry cover. The forest covers officially 11.8% of total land area with an annual decrease of 1,04% (FAO 2010) but realistic numbers are likely close to 3-4%. However, little information is available about plant physiological traits that influence the growth and distribution of tree species in the last remaining pristine forests ("church forests"), under present anthropogenic disturbance and changing climate. This study is about tree species ecology, focusing on fine root, xylem and leaf traits of 14 species in the Galaowdios forest in the Amhara region. Thus the study addressed the following research questions: (1) To what magnitude do observed traits differ? (2) Can correlations between the compartments (roots, xylem, leaves) be found? (3) Can surveyed trait sets be used to distinguish functional groups among the tree species?

Temperature sensitivity (Q10) of CO_2 fluxes of two plant functional types in a mesocosm experiment

Nadine Müller, Fritz Hörzinger, Mathias Mayer, Hans Göransson, Boris Rewald

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Abstract

Soil respiration is responsible for approximately 10 % of the atmospheric CO_2. It is controlled by various factors, like temperature, moisture and nutrient content. The research will focus on the differentiation of heterotrophic and autotrophic soil respiration and their reactions on temperature changes of two plant species with and without competition in a mesocosm experiment.

For the experiment soils were sampled from a beech forest in upper Austria, which are used as substrate for young beech and grass plants. The plants were put in pots and grown under controlled environmental conditions (temperature, humidity, light and water content). The treatments comprise pots with beech seedlings only, pots with grass, pots with both beech and grass, and pots with bare soil. The CO_2 fluxes will be measured with EGM - 4 IRGA. To differentiate the soil and the plant respiration two set-ups will be used, soil respiration chambers and ecosystem respiration chambers. These measurements will be repeated several times and under varying temperatures to determine Q10 values of soil and plant organs. The photosynthesis rate will be measured with the LICOR - 6400XT. Data will be correlated to root and soil microbial biomass to determine potential influencing factors of soil CO_2 efflux beside soil moisture and temperature and to locate the origin in temperature driven carbon flux changes (autotrophic and heterotrophic) under more realistic environmental conditions taken competition into account.

A study of exotic macrophytes for the phytoremediation of flooded agricultural land polluted with cadmium

Rodrigo Valencia, Hans Göransson, Boris Rewald

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Abstract

Heavy metals are inorganic pollutants that that are often found stored in the sediments of water bodies and soil. The origins of heavy metals are diverse: rooftop and street runoff, untreated industrial discharge, use of sewage sludge as fertilizers and coal mines among many others.

Once polluted the processes necessary to clean or dispose of soil and sediments are very expensive and usually the soil and sediments will end up being incinerated or disposed in a landfill.

This study is aimed to find a feasible solution to remediate flooded soil polluted with Cadmium (Cd) using aquatic plants (macrophytes). In land restoration and as flood protection arable land contaminated with Cd will be flooded. The effect of aquatic macrophytes on the potential mobilization of Cd to the water body and plant uptake from flooded agricultural land is unknown.

The experiment will consist of six different macrophytes species in 1.5 liter containers. Each container will have ca. 0.5 liter of Cadmium polluted soil, 1 liter of water and 1 plant. Every species will have 10 replicas with Cd polluted soil and 10 replicas of unpolluted soil.

Three times a week during approximately a month Cd concentration in the water will be measured using the inhibition effect of the water on the enzyme urease. At the end of the experiment the Cd concentrations in the leaves and in the roots will be measured using ICP. If the Cd concentration in the water decreases and we have a high accumulation of Cd in the plant tissue the species can be suitable for phytoremediation. If the concentration of Cd in the water increases due to mobilization of Cd in the root zone the species should be avoided.

The influence of nurse shrubs on growth and establishment of *Olea africana*

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Institute of Forest Ecology

Abstract

Ethiopia is rich in biodiversity but due to poverty biodiversity is declining, which further threatens rural livelihoods. *Olea europaea* subsp*. cuspidata* is a native multipurpose tree, which has declined due to over use. A restoration of this species would serve biodiversity conservation and improve the livelihood of the rural population.

Nurse shrubs are shrubs that can facilitate the growth and establishment of other individuals; therefore they can be a useful tool for forest restoration.

The aim of the study was to find out whether *Olea europaea* subsp*. cuspidata* occurs with nurse shrubs and - if so – whether these nurse shrubs influence *Olea europaea* subsp*. cuspidata* in regard to improved mycorrhization and nitrogen supply.

We took leaf samples and recorded the shrubs species occurring within the double average crown size radius of every third *Olea europaea* subsp*. cuspidata* along the path. Further we took leaf and root samples of *Olea europaea* subsp*. cuspidata* and recorded their growth. The leaf samples were analyzed for total leaf nitrogen and ^{15}N content. The root samples were stained; we then counted vesicles, hyphae and arbuscules to assess the mycorrhization.

The most common shrubs within the double average crown size radius were *Dodonea angustifolia, Carissa edulis* and *Clutia spec.*

Olea europaea subsp. cuspidata associated with other shrubs were significantly taller than not-associated individuals, but there were only very small to no differences in mycorrhization or nitrogen content between the groups, even though the number of vesicles and the nitrogen content were correlated to plant height.

Not-associated *Olea europaea* subsp*. cuspidata* are most likely smaller than associated individuals, because they are limited, not as we thought by mycorrhization or nitrogen supply, but by browsing. *Olea europaea* subsp*. cuspidata* associated with shrubs have a decreased browsing pressure and therefore grow better. This suggests that the influence of nurse shrubs on *Olea europaea* subsp*. cuspidata* is not species specific but general.

Fire risks in Bhutan's blue pine forests: anticipating and adapting to climate change

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Abstract

Forest fire risks are increasing in many parts of the world, often in conjunction with increased drought related to climate change. In the central Himalayan Mountain region, anecdotal evidence suggests similar trends, but no empirical research is available. Climate data indicate that timing and dynamics of the summer monsoon season, as well as intensification of the winter dry season, may already be occurring. In Bhutan, alteration of fire dynamics poses direct threats to human life and property, as well as ecosystem services, such as flood control, landslide prevention, and carbon sequestration. The most fire-prone system – Himalayan blue pine (*Pinus wallichiana*) – occupies the Wildland-Urban-Interface at mid-elevational zones surrounding major towns and villages in the northwestern part of the country. Our study investigates relationships between intra and inter-annual climate variability and forest fire intensity and extent in Bhutan's blue pine forests. Field data on fuel profile, burn intensity, vegetation impacts, and other variables were collected at 12 study sites. The design paired areas burned within the last 5 years with adjacent, unburned areas indicative of pre-burn conditions. Detecting a climate signal is challenging because fire activity is strongly affected by human land-use and ignition, as well as structure, age, management history, and site-variability within the forest ecosystem. Consequently, we are building a multivariate model predictive of fire risks that includes all of these sources of variation. We are also analyzing fire effects in blue pine stand and quantifying fuel conditions in both burned and unburned sites. The results will help inform adaptive management, including urban growth planning, fire management, and conservation efforts.

Occurrence of arbuscular mycorrhizal fungi (AMF) and dark septate endophytes (DSE) associated with *Eragrostis tef*

Gezahagn Getachew, Hans Göransson, Boris Rewald, Douglas L. Godbold

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Abstract

Teff (*Eragrostis tef* (Zucc.) Trotter) is a tropical and sub-tropical crop and is a staple food for Ethiopia. It is also useful as alternative source of forage, malt making and biogas. It grows under a wide range of agroecological conditions ranging from low land to the highlands, from water-stressed to water-logged sites. There is a gap of information on the associations of arbuscular mycorrhizal fungi (AMF) and dark septate endophyte (DSE) with *Eragrostis tef* under non- and fully-fertilized field conditions. In addition, is an open question if the diversity of arbuscular mycorrhizal fungi on agricultural fields in the Ethiopian highlands is diminished by erosion processes and thus inoculation with forest soil, which is supposed to hold a diverse mycorrhizal community, can increase mycorrhization rate of Teff. A pot experiment was conducted at ARARI green house to fill the existing knowledge gaps by determining the occurrence of AMF & DSE in roots of *Eragrostis tef* and AMF spores in the soil. The top soils were collected from three sites: Taragedam, Gelawdiwos and Injibara; Teff variety Guncho was sown in each pot. *Eragrostis tef* fine roots were stained by using 5% ink-vinegar solution and symbionts were counted at 100x, 200x and 400x magnification. The AMF spores were extracted from soil and counted at 230x magnification. The results showed that, AMF colonization in all treatments and only taragedam with gelawdiwos locations are highly significant and it ranges between 18.5 to 114 %. And, DSE colonization rate are highly significant between the inoculated treatment with both of the fertilized and non-inoculated treatments except in taragedam and are ranging from 7 to 73 %. Also, there is a statistical difference in spore density between the inoculated soil both with and without fertilizer but there is no significantly differences between the fertilized and non-inoculated soil (0.6-15.4 spores/gram). We conclude, that inoculation of farm land by forest soil enhanced the colonization rate of AMF and DSE in *Eragrostis te*f root but it reduced its occurrence by the addition of N-P fertilizer and the soil spore densities are also increased by the addition of AMF spores from the forest.

Do bark beetles construct niches for their host? The effect of *Ips typographus* disturbances on regeneration of *Picea abies*

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Abstract

The European spruce bark beetle (*Ips typographus*) is one of the most important biotic disturbance agents in European Norway spruce (*Picea abies*) forests. It creates disturbances destroying large areas of forest. However, where disturbances have occurred, resources are released and new plants have the chance to establish. Spruce regeneration appears in spatial patterns with recruits clustered around the mother trees forming a new stand that mirrors the stand before the disturbance. This could indicate coevolution between spruce and its major disturbance agent, the bark beetle. We hypothesized that creating a niche for young spruce seedlings by the death of the parental trees it promotes recruit establishment through more favourable conditions. In our study, we focused on the following questions: Does *Picea abies* germinate better on spruce litter from bark beetle infested trees than on other litter and is early growth different between different litter types? To test this, we set up a greenhouse experiment and analysed the germination and early growth on three different substrates, namely spruce litter, spruce litter mixed with beech litter and spruce litter from bark beetle infested trees. Results obtained suggest that spruce germinates slower and in lower numbers on bark beetle needle substrate in the beginning but is later catching up achieving nearly the same numbers and germination stages. Significantly higher root weights in normal spruce litter indicate a better vitality in this substrate. Also the higher specific root length in bark beetle litter points to a lower vitality. Considering these results, another factor, e.g. different competition by ground vegetation on different substrates, might explain the clustered patterns of spruce regeneration.

Mycorrhizal enzyme activity profiles at the tree line

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Abstract

At a tree line site (1700m) and a lower elevation site (1100m) in the Austrian Alps, Potential enzyme activities were determined using the high-throughput photometric and fluorimetric 96-well black microplate assays in 2014 and 2015. Four enzyme activities were measured on mycorrizal and non-mycorrhizal root tips: β-glucosidase (BG, which hydrolyses cellobiose into glucose), N-acetyl-glucosaminidase (NAG, which breaks down chitin), acid phosphatase (AP, which releases inorganic phosphate from organic matter), and leucine-amino-peptidase (LAP, which breaks down polypeptides) at tree line (*Picea abies*, *Pinus mugo* and *Rhododendron ferrugineum*) site and *Picea abies* of lower elevation site.

The results indicated that the absolute levels of activity of each of the enzymes were similar, but between morphotypes the levels of activity varied several fold for all enzymes between years. In 2015, thirteen ectomycorrhizal morphotypes from *Picea abies* at tree line and lower the elevation were determined and 8 ectomycorrhizal morphotypes from *Pinus mugo*. Averaged across all morphotypes of ectomycorrhizal species no significant differences were shown in any of the enzymes between tree species or elevation except that β-glucosidase activity was significant higher in *Pinus mugo*. On the fine roots of *Rhododendron ferrugineum* the activity of N-aceytyl glucosaminadase, acid phosphatase, and leucine aminopeptidase was significantly lower compared to the ectomycorrhizal morphotypes of the tree roots.

Changes in land use alter soil quality and aggregate stability in the Northern Ethiopia highlands

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Abstract

Changes in land use significantly alter biodiversity and ecosystem functioning across different biomes. This study investigated the effect of land use changes on major soil quality indicators and soil aggregate stability. Top soil samples (0-10cm) with 10 replications were collected from five major land use categories that share the land use change history (i.e., cropland, grassland, exclosure, eucalyptus plantation and natural forests). The soils from each land uses were analyzed for physical, chemical and biological quality indicators. The study revealed that land use change from natural forest to cropland and grassland significantly declines the soil organic C (SOC), total soil N (TSN), molybdate-reactive bicarbonate extractable P, and AMF spore density. Conversely, the exclosure and afforestation with eucalyptus trees have shown a significant improvement in soil aggregate stability (SAS) compared to the cropland. The pairwise analysis of similarity (ANOSIM) showed no significant separation in the overall patterns of enzyme activities between natural forest and eucalyptus plantation, and exclosure and cropland. The study suggested that *β*-glucosidase, chitinase, SOC and SAS are potential early warning indicators for the soil ecosystem stresses in response to land use changes. The finding also denoted that AMF spore density is not a reliable indicator for soil quality indicator due to its irregular correspondence with hyphal biomass. SAS is suggested to be used as an immediate and easy to measure the status of soil quality indicators for further analysis of respective quality indicators identified in this study. The land use changes, particularly to unsustainable cropland, demonstrated the significant decline on major soil quality indicators and SAS. However, restoration of degraded lands through exclosure significantly enhanced the TSN as compared to the cropland and grassland. Similarly, our study revealed that afforestation of degraded lands with eucalyptus trees significantly improved major soil quality indicators including, SAS, SOC, chitinase and protease activities. Our results highlighted the indispensable functions of natural forests in maintaining soil quality and stability.

Poster 21

Influence of photoperiod and changing temperature conditions on the development and overwintering behaviour of the Larch bark beetle, *Ips cembrae* Heer. (Col., Scolytinae)

Gerlinde Weizer, Martin Schebeck, Axel Schopf

Institute of Forest Entomology, Forest Pathology and Forest Protection

Abstract

The European larch bark beetle, *Ips cembrae,* lives on larches (*Larix* spp.) and occasionally on stone pine (*Pinus cembra* L.) of all age classes and is distributed from lowlands to the timber line in the alpine region. In context with climate change, this species may become more and more important in future forestry. To develop a monitoring and risk assessment programme for this bark beetle we will investigate its development under changing temperature and photoperiod conditions. On these results, the effective temperature sum, which is necessary for its development of one generation, will be determined. Especially the maturation process of young female beetles under the various rearing conditions will be studied.

Totally unknown is the beetle's overwintering behaviour. Our studies on the frost resistance of the different developmental stages under lab and field conditions as well as on other mortality factors during the overwintering period will provide new aspects on the insect's strategy to survive severe winter conditions in its natural habitat of the subalpine region.

The lower developmental threshold of three *Glyptapanteles* species in their host *Lymantria dispar*

Anna Jarzembowska, Christa Schafellner

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Abstract

The braconid wasps *Glyptapanteles liparidis* (gregarious), *Glyptapanteles fulvipes* (gregarious) and *Glyptapanteles porthetriae* (solitary) are larval endoparasitoids of Lepidoptera. The aim of the thesis is a detailed overview about the duration of the immature stages (egg, first, second and third instars, pupa) and total development from oviposition to adult wasp emergence of the three *Glyptapanteles* species under various temperature regimes in larvae of the gypsy moth, *Lymantria dispar*. Additionally, adult wasp longevity was tested at different temperatures. Gypsy moth larvae were parasitized as either second (with *G. porthetriae*) or third instars (with *G. liparidis* and *G. fulvipes*), according to their preferred host size in the field. The parasitized larvae were kept either individually or in small groups in glass Petri dishes in climate chambers at constant 15°C, 20°C and 25°C, respectively, under long day photoperiod until the parasitoids emerged from their host or until dissected. Adult wasps of *G. liparidis* and *G. fulvipes* were kept in plastic boxes in climate chambers at 15°C and 20°C, respectively, under long day photoperiod and fed honey and water. Endoparasitic development (i.e. from oviposition until parasitoid emergence from the host) at 15°C was 37, 35 and 31 days for *G. liparidis*, *G. fulvipes* and *G. porthetriae*. At 20°C, it was 21 (*G. liparidis, G. fulvipes*) and 16 days (*G. porthetriae*) and at 25°C it was 13 (*G. liparidis, G. porthetriae*) and 14 days (*G. fulvipes*). The pupal stage at 15°C lasted 14 (*G. fulvipes*) and 15 days (*G. liparidis*, *G. porthetriae*), respectively. At 20°C it was 7 (*G. liparidis*) and 8 days (*G. fulvipes*, *G. porthetriae*) and at 25°C it was 5 (*G. liparidis*, *G. fulvipes*) and 6 days (*G. porthetriae*). The lower developmental thresholds that were estimated from linear regression equations for the total combined immature stages were 10.0°C (*G. liparidis*), 8.5°C (*G. fulvipes*) and 7.1°C (*G. porthetriae*), respectively.

Crossbreeding and performance of two endoparasitic braconid wasps, *Glyptapanteles liparidis* and *Glyptapanteles fulvipes*, in their common host *Lymantria dispar*

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Institute of Forest Entomology, Forest Pathology and Forest Protection, BOKU

Abstract

Larvae of the gypsy moth, *Lymantria dispar*, are hosts for a large number of endoparasitic wasps. Specifically, braconid wasps of the genus *Glyptapanteles* are highly abundant and in Austria these wasps are among the most important natural enemies of gypsy moth. This thesis aims to clarify whether the two closely related species *G. liparidis* (laboratory colony on gypsy moth, originating from field-collected parasitized gypsy moth larvae) and *G. fulvipes* (lab colony on gypsy moth, originating from field-collected larvae of *Xestia xanthographa*, where the wasps overwinter) mate and produce fertile offspring, i.e. wheter they are separate species or not. Both adult males and virgin females of one *Glyptapanteles* species were put together with the opposite sex of the other species. Courtship behaviour and mating success were recorded and compared to those of pairs from the same species. Female wasps can determine the sex of their offspring by choosing whether or not to fertilize the eggs that are laid; fertilized, diploid eggs develop as females, unfertilized, haploid eggs become males (haplodiploid sex determination). Accordingly, crossings of the two *Glyptapanteles* species that produce female offspring indicate successful mating, sperm transfer and egg fertilization. If these females then produce fertile offspring chances are high that the species are not separate. If females from the crossing experiments produce only male offspring we assume that fertilization (mating, sperm transfer, …) was not successful and it is likely that the two wasps are separate species. Additionally, CO1 barcode primers were used to identify differences in the CO1 gene between the pure *Glyptapanteles* breedings and the offspring wasps from the crossing experiments. In a second set of experiments, both the pure and the crossbreeding wasps were tested according to various fitness parameters (longevity, fecundity).

Studies on the development and hibernation of *Ips acuminatus* (Gyll.) as basic requirements for hazard assessments

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Abstract

The pine engraver beetle, *Ips acuminatus* (Gyll.), is known as an important disturbance agent infesting Scots pine (*Pinus sylvestris* L.) in a wide-ranging distribution across Europe and Asia. Like all bark beetles it is a secondary pest that prefers weakened trees. At mass outbreaks also healthy trees can be killed and infestations can lead to large economic damage and loss of timber quality.

The partly pseudogamous species establishes galleries in the upper parts of the trunk and in thick branches. The larvae are phloeo-mycetophagous and pupae develop in pupal chambers in the phloem/ xylem. After maturation feeding, the young beetles emerge to start a new generation or stay in the bark for hibernation. Due to climate change combined with physiological weakness of pines, there is growing concern about epidemics of this bark beetle. The aim of this study was to gain information on the development of *I. acuminatus* (Gyll.) through field and laboratory studies on the temperature-dependent phenology as a basis for hazard modelling.

Pheromone traps and trap trees were used to study the development of the species in pine stands near Aicha and Spinges in South Tyrol. In the lab, the analysis of development was done using infested logs, which were kept at three constant temperature conditions (17°C, 20°C, and 25°C). Every week, bark samples were taken from these logs to determine the developmental state. The number of emerging parental and filial beetles was counted every day. In order to check the frost resistance of the adult beetles, we measured the super cooling point (SCP) every month during the winter period (October until March).

Are there interactions between bee products and entomopathogenic fungi?

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Abstract

Entomopathogenic fungi play a significant role in the biological control of pest insects. These fungi penetrate the cuticule and kill their hosts. Through the application of spore suspensions on agricultural fields and forests also beneficial insects, like the honeybees, can get in contact with these fungi. In this context the fungal isolate and the spore concentration is very important.

To ensure that spores, which are carried by bees into the hives, do not affect the honeybees, it is important to know the interactions between bee products and the germination and growth of entomopathogenic fungi. In human medicine there are already respective studies on the antifungal activity of honey on fungal diseases, such as *Candida ablicans* and *Aspergillus niger.*

In the course of this study the effects of acacia honey, lime honey, royal jelly and propolis on the germination and growth of the fungi *Beauveria bassiana*, *B. brongniartii, Metarhizium anisopliae, M. flavoviride* and *Isaria fumosorosea* are analysed**.**

Germination rate was determined after 24, 42 and 72 hours by counting the germinating spores in distance to the bee products. In the growth assay the inhibition zone around the bee product was measured 5 – 40 days.

Germination rates of all fungi were mostly inhibited by royal jelly. Also acacia honey, lime honey and propolis indicated antifungal activity. After 72h conidial germination wasn't inhibited any longer by all bee products.

The growth assay showed various effects on the different fungi, *I. fumosorosea* was fast growing and showed no more inhibition zones after one week. On the other hand *B. bassiana* grew slowly and indicated inhibition by royal jelly and propolis for more than one month.

Effects of oil formulations on germination and growth of entomopathogenic fungi

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Abstract

Concerns about harmful effects of chemicals on human safety and the environment as well as the development of resistance to chemical insecticides have triggered the development of alternative strategies for integrated pest control. One option could be the use of entomopathogenic fungi as microbial control agents.

There are positive results regarding application methods of oil-based formulations of mycoinsecticides such as UV-light stability, protection against drying-out of spores and persistence on the target insect. Although there is evidence that the dispersion of spores on target insects and plants shows better results in oil than in water-suspensions, negative effects of oil-additives in spore suspensions were demonstrated for different concentrations of oil formulations in several studies.

As most of such analyses were carried out to control agricultural pests or vectors of diseases, there is little knowledge about oil-based formulations of entomopathogenic fungi as a method of biological control in forests. The aim of the current study was to determine the effect of different oils on the germination and growth of the fungal species *Beauveria bassiana, Metarhizium anisopliae* and *Isaria fumosorosea.*

No significant impact of the tested substances (paraffin-oil; five vegetable oils: linseed, olive, pumpkin seed, sunflower, rapeseed; and two insecticides: Telmion and Micula on a rape oil basis) was found in *Beauveria bassiana* and *Isaria fumosorosea* which showed germination rates of 100 percent already after 24 hrs. Slight differences within the tested substances could be observed for *Metarhizium anisopliae* after 24 hrs and 48 hrs of observation. After 72 hours of observation, almost all samples showed 100 percent of germination.

Inhibiting effects on the growth of *Isaria fumosorosea* were observed for pumpkin seed oil, rapeseed oil and paraffin oil as well as for Micula and paraffin oil for *Beauveria bassiana,* and with Micula and sunflower oil in samples of *Metarhizium anisopliae.*

Poster 27

Biochar and compost as a mitigation strategy for Cu enriched soil - examination of the soil microbiology

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Abstract

Copper (Cu) enrichment in vineyard topsoils has been caused by the application of Cu-based fungicides over a period of more than a century. This has resulted in soil Cu-concentrations significantly exceeding biological effect levels. A longer-term mitigation strategy to reduce the copper bioavailability in topsoil layers of vineyard soils is of key importance as there are currently little alternatives for copper in plant protection in organic viticulture. A promising approach to reduce bioavailability of Cu and thus improve the soil as a habitat for microorganisms is the addition of organic soil amendments like biochar (BC) and compost.

In this study a greenhouse pot experiment was conducted. Two soils from different vineyards in Austria (varying in texture, pH, soil organic matter and Cu-content) were treated with 12 combinations of biochar compost amendments at application rates equivalent to 10 - 80 t ha^{-1}. Grape vine seedlings and cover crops (a mixture of legumes and non-legumes) were planted in the pots. The pots were incubated for more than a year with 3 samplings throughout the incubation period. Microbiological parameters such as potential extracellular enzyme activities (exoglucanase, ß-glucosidase, exochitinase, phosphatase, protease, urease, phenoloxidase and peroxidase activity), basal respiration, PLFAs, and pH-value, NO_3-N and NH_4-N were measured.

Microbial reactions to additives were soil-specific. In summary, our results indicate that no treatment consistently influenced soil microbial activity but showed a tendency of highest microbial activities for soils amended with acid-activated BCs and significantly changed microbial community.

Interactive effects of warming, elevated CO_2 and weather extremes on nitrogen gas fluxes in a managed grassland

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Abstract

Climate projections for the next decades, expect a significant increase in air temperature, atmospheric CO_2 concentrations and the frequency and intensity of extreme weather events. Weather extremes are of particular importance because they have a disproportionately impact on the biodiversity and N-cycling functions of the ecosystem feedbacks to the climate system. While the impact of individual environmental factors on microbial community structure and their functions on biogeochemical cycles of ecosystems are moderately well studied, the combined response of ecosystems to global environmental change is still largely unknown. The objective is to study the response of warming, elevated CO_2 concentrations and drought on N-gas emissions, microbial community structure and function and their combined effect in managed grassland.

The major aims are to evaluate changes through non-linear and non-additive effects of multiple factors of climate change in permanent grassland. This experiment situated in Raumberg-Gumpenstein (AREC) consists of 24 experimental plots where effects of individual and combined changes in air temperature (ambient, warming of 1.5 and 3°C), atmospheric CO_2-concentrations (ambient, +150, +300 ppm) and summer droughts on N-gas emissions were examined and afterwards related to soil microbial processes.

To achieve our objectives N_2O emissions will be analyzed in the field. Additionally the sampling of intact soil cores will allow the determination of N_2, NH_3, NO_x, N_2O fluxes in a lab incubation experiment. Simultaneously, soil samples will be taken to examine different N pools and for state-of-the-art sequencing technology in addition the abundance of nitrifying and denitrifying bacteria and the expression levels of involved N-cycling target genes (*amoA, nirK, nirS and nosZ*) will be analyzed. The determination of the influence of climate change on these factors provide the basis for the parameterization of ecosystem models that functionally integrate the data and can conclude the feedbacks between ecosystems and the climate system.

Recovery of forest soil microbial activity after multiyeardrought and heavy rainfall event simulations

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Abstract

Climate change research anticipates an increase in the frequency and intensity of extreme weather events like severe droughts and heavy rainfalls. Altered precipitation patterns can change microbial biomass and microbial community structures that produce and consume greenhouse gases.

Within an ongoing project of the Institute of Soil Research (BOKU), the following research questions are investigated: i) what are the effects of increased drought-rewetting frequencies on soil nutrient cycling and the availability of forest soil organic carbon? ii) will total soil emissions of greenhouse gases be reduced by extended drought periods or will potential pulses during rewetting periods compensate or even outweigh this reduction, thereby leading to increased overall fluxes? and iii) how do soil microbial communities respond to increased frequency and intensity of drying-rewetting cycles in a beech forest?

Drought and precipitation manipulations are carried out for meanwhile three vegetation periods, whereas 12 plots were set-up with four replicates for control plots, moderate-stress plots (4 weeks of drought followed by 75 mm irrigation) and severe stress plots (8 weeks of drought followed by 150 mm of rain). Soil CO_2, CH_4, and N_2O effluxes of the 12 plots were determined with an automated gas flux measuring system, and soil samples taken around the rainfall simulations. Collected samples were then analyzed for carbon, nitrogen, dissolvable organic carbon, microbial biomass, ammonia, nitrate, enzyme activities and PLFAs, and showed distinguished patterns according to the treatments.

To analyze the potential of the studied soil for recovery, no manipulative precipitation treatments will be applied in 2016, but all measurements will be continued to monitor the resilience of the forest soil ecosystem. For this, soil samples will be collected monthly from May to October and the above mentioned soil analysis conducted.

Bodenkundliche Untersuchungen von Feuchtwiesengesellschaften im mittleren Steirischen Ennstal

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Abstract

The aim of this master thesis is to investigate the influence of soil water regime and soil nutrient status on the species composition of grassland plant communities on moist and wet soils in Trautenfels (Styrian Enns valley). The vegetation types investigated are characterised by a high nature conservation value. Moreover, the relationships between data from routine soil analyses; forage quality and mineral element content in the above-ground phytomass will be assessed. For this purpose, soil field data, soil physical and chemical data, vegetation surveys, mineral element concentrations in the above-ground phytomass of various grassland plant communities will be analysed statistically.

Effects of long-term nitrogen deposition on soil microbial community structure

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Abstract

Menschliche Aktivitäten haben einen starken Einfluss auf die biogeochemischen Kreisläufe von Kohlenstoff (C), Stickstoff (N) und Phosphor (P). Vor allem der natürliche N-Kreislauf wurde durch den vermehrten Gebrauch von mineralischen Dünger und der Verbrennung fossiler Rohstoffe stark verändert: Menschen haben den Eintrag von reaktivem N in die terrestrischen Ökosysteme mindestens verdoppelt.

Untersucht wird die mikrobielle Gemeinschaft zweier Wälder der gemäßigten Zone, welche beide einem Langzeit-Stickstoffdünge-Versuch unterliegen. Zum einen der Standort in Klosterhede in Dänemark (seit 1992 [sandiger Boden]) und zum zweiten der Standort Alptal in der Schweiz(seit 1995 [lehmiger Boden]). In beiden Wäldern dominiert die Fichte die Vegetation. Die mikrobielle Gemeinschaftsstruktur wurde mittels Biomarker-Analyse (Phospholipidfettsäuren, PLFAs und Ergosterol) untersucht.

Wir erwarten folgende Veränderungen der mikrobiellen Gemeinschaften in Folge von Stickstoff-Düngung: 1) Abnahme der gesamten mikrobiellen Biomasse (Total PLFAs), 2) Verschiebung in der Gemeinschaftsstruktur mit Abnahme von Bakterien- und Pilzmarkern bei gleichzeitiger Zunahme von Actinomyceten-Markern. Weiteres erwarten wir eine Verschiebung des Bakterien-zu-Pilz-Verhältnisses mit der Bodentiefe, wobei eventuelle Interaktionen mit Stickstoff-Düngung von besonderem Interessen sind.

Die Bodenprofile der Exkursionen der Österreichischen Bodenkundlichen Gesellschaft

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Abstract

Die Dokumentation der seit über 50 Jahren durchgeführten Exkursionen der Österreichischen Bodenkundlichen Gesellschaft stellt mit ihren zahlreichen und meist umfassenden Profilbeschreibungen eine umfassende Quelle feldbodenkundlichen Wissens dar. Über Jahrzehnte haben Experten Wissen und Daten zu verschiedenen Bodentypen, Standorten und Rahmenbedingungen gesammelt, welche in den Exkursionsführern festgehalten wurden. Das Ziel dieser Arbeit ist, diese Informationen aus dem aktuellen Stand der Forschung zu sammeln und für die gegenwärtige Bodenkunde verfügbar zu machen.

Dazu werden die beschriebenen Profile aufgenommen, verglichen und deren Kerndaten festgehalten. Dabei wird ein allgemeiner historischer Abriss der Entwicklung der inhaltlichen Schwerpunkte und Exkursionsziele sowie der fachbodenkundlichen Vorgehensweise und Methodik erstellt. Zusätzlich werden die vorliegenden Analysedaten gesammelt und unter Zuhilfenahme diverser Fachliteratur die dabei ersichtlichen Veränderungen nachvollzogen und erklärt werden. An thematisch ausgewählten Jahresexkursionen wird eine tiefergehende Darstellung und inhaltliche Analyse der Rahmenbedingungen und Vorgehensweisen durchgeführt. Ausgehend von diesen werden die in verschiedener Form vorliegenden Daten gesammelt und auf das Format des Bodeninformationssystems BORIS vereinheitlicht.

Die Methoden, Schwerpunkte und Ergebnisse der bodenkundlichen Untersuchungen im Rahmen der Exkursionen haben sich über die Jahrzehnte der Aufzeichnungen stark verändert. Die umfassenden vorhandenen Standorts- und Analyseparameter stellen einen wertvollen Beitrag zur Erforschung und zum Verständnis österreichischer Bodenprofile dar. Die Arbeit dient ferner als Anleitung für eine künftige vollständige Umwandlung der Daten der Exkursionsführer.

Evaluation of waste-derived fertilizer products

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Abstract

Phosphorus (P) is an essential nutrient for plants and animals and insufficient soil P availability results in decreased crop yields. It is mainly found on Earth as phosphate rock and unfortunately this fundamental element is a finite and non-renewable resource so it is very important to enhance the sustainability of phosphorus management and to conserve the existing phosphorus reserves. On the other hand, a good availability of silicon (Si) appears to benefit plants when they are under biotic and / or abiotic stress, and also could help the increase of the stem strength.

The recovery of P and Si from wastes and residues such as municipal sewage sludge, meat and bone meal or animal manures to recycle them as soil nutrients permits the fertility preservation of the agricultural soils. Among other strategies, carbonization processes such as pyrolysis and hydrothermal carbonization produce biochars and hydrochars respectively. These processes may be used to recycle biowastes thereby also influencing the availability of these nutrients to plant.

The poster introduces an overview of literature on the effect of thermo-chemical treatments on the availability of phosphorus and silicon. Conventional and new laboratory methods to assess their availability to plants are also presented.

The localization of nutrient influx and efflux along the root axis and its importance for nutrient uptake kinetics

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Abstract

The localisation of influx (I) of some nutrients (such as P, Cl and Na) has been illustrated using excised roots in isotopically labelled nutrient solution. Several studies have demonstrated a spatially homogeneous P influx along the root axis up to 22 cm behind the root tip. Along with root nutrient influx, simultaneous loss of nutrients (efflux; E) has been well documented and as demonstrated for P it can be a significant component of net nutrient internalization. Some data on nutrient efflux localisation suggest homogeneous uptake along the root axis for Cl and co-localisation of I and E for phosphorus, however the chromatography paper used in these studies might have introduced diffusional artefacts (homogenisation) of the effluxed ions. Michaelis-Menten kinetics, a classical model for enzyme-substrate reactions, has been adopted for modelling the net root ion influx rate ($I_n = I - E$). A critical concentration c_{min} can be determined where $I=E$, below which no net influx I_n occurs. Summation of influx and efflux is however only possible if both processes are co-localised. A preliminary study using the DGT technique and autoradiography suggested that P efflux is highly localised to the tips of *Zea mays* L. roots and does not show a homogeneous pattern along the entire root axis.

We hypothesize, that in contrast to efflux being highly localised to the root tips, nutrient influx is more homogeneously distributed along the root axis. With no efflux for large parts of root axis, the root nutrient uptake capacity (I_n) might be much larger at low nutrient concentrations than predicted by the Michaelis-Menten model.

We will investigate the localization of nutrient efflux and influx for three plant species (*Zea mays*, *Phaseolus vulgaris*, *Helianthus annuus*) and for several important plant nutrients (P, K, S and Zn), using the DGT technique and digital autoradiography.

Spatial variability of chemical properties in soils of pannonic Croatia

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Abstract

Soil represents a complex structure of specific chemical and physical properties. Spatial variability in the soil depends on many factors: soil age, climate, parent material, topography and human activities. These factors, individually or in combination, affect soil parameters differently. In this thesis, data from a large number of field samples will be processed for observing spatial variation and differences between regions for pH, organic matter content, plant-available phosphorus and plant-available potassium. The target area includes 2202 samples which were collected from the area of Pannonic Croatia in a period of fifteen years. The aim of this investigation is to determine differences between regions, the spatial variability within and between regions as well as potential correlations between the investigated parameters. Descriptive statistic and geostatistical analysis will be applied for evaluating the soil data. The results of this investigation will provide a better overview on the spatial variability of basic soil parameters and their relationship in order to create prediction maps with significant accuracy, as well to reduce the required number of samples to describe and determine a soil region.

Improving the growth of metal hyperaccumulating plants on waste incineration slags

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Abstract

Incineration slags contain a lot of unused raw materials like e.g. metals. For recovery of those elements, the natural ability of some plants to hyperaccumulate metals is used. Due to the fact that this work is a sub-project of the project "Bergwerk Pflanze" one of the main emphasis of this work is the phytoextraction of those critical resources. Therefor it is important to implement the knowledge of the interaction between plants and their rhizosphere bacteria. In a pot plant experiment the used incineration slag is mixed with humus in a ratio of 80%/20%. The use of 3 different plant species and 4 different treatments should help to find out, which kind of action is the most appropriate one to make the metals available for the plants. In this specific case the objective of the species *Berkheya codi* and *Alyssum serpyllifolium* aims mainly on Ni accumulation and *Sedum plumbizincicola* focus on Cd and Zn accumulation. The different treatments with on the one hand mineral fertilizer on the other hand inoculation with microbes should give information about the impact of this treatments. Another step is to once combine mineral fertilizer and inoculation of microbes and once renounce any treatment. The aim is to optimize and improve the handling with contaminated soils, make those metals more plant available, increase the biomass production and make phytoextraction more viable for present utilization.

Endophytic colonization of *Setaria viridis*

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Abstract

Various studies suggest that all plants are inhabited by endophytes (Hardoim et al., 2015; Sessitsch 2013). Endophytes are fungi or bacteria which live at least a part of their life inside of plant tissue and cells without causing pathogenicity (Wilson, 1995). Similar to bacteria within the human gut, bacteria within plants seem to be crucial for plant development (Hooper et al., 2001). However, endophytes - their full functional role, colonization pathways and requirements are only fractionally understood. Particularly hazy is the life inside of seeds (Sessitsch, 2013). The following study is embedded in the ongoing FWF project "The Seed Microbiome – Ecology and relevance of bacterial seed endophytes on the C4 model plant *Setaria virids* for plant performance and development". The aim is to visualize closely related bacterial endophytes from *S. viridis* and to compare their colonization behavior inside of seeds from *S. viridis*. The hypothesis is that plants are colonized by different strains of the same bacterial genus, which have different functions manifested in distinct genomic characteristics (Sessitsch 2013). It is assumed that *Microbacterium* spp. and *Pantoeas* spp. isolated from seed and non-seed plant tissue have different colonization abilities within plant seeds due to different functional traits. *S. viridis* seeds will be inoculated with the strains. The strains that might colonize the seeds from *S. viridis* are labeled for the visualization with (1) probes for fluorescence in situ hybridization and (2) phylogenetic markers (gfp, gusA, FFlux). If the hypothesis proves as true further genetic analyzes will be carried out to identify specific functional characteristics responsible for transmission and adaptation of *Microbacterium* spp. and *Pantoeas* spp.. This knowledge might smooth the way for a future application of seed endophytes as beneficial bio effectors for agriculture. Besides this a better understanding of the plant as a holobiont will be gained.

Rhizo-degradation of PAHs by red clover in mixed-polluted soils with different metal availabilities

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Abstract

The natural potential of plants and associated microbial communities for immobilisation and degradation of pollutants in soils can be used as an environmentally friendly and economically feasible decontamination approach, i.e. phytoremediaton. A great number of studies already examined the degradation of organic pollutants in soil, such as polycyclic aromatic hydrocarbons (PAHs). However, knowledge about the effects of rhizosphere processes and co-present heavy metals on PAH degradation is still limited. In order to reveal influences of root exudates and nitrogen provided by a legume and its Rhizobia symbionts and the effect of different metal availabilities (with and without the addition of metal immobilising amendments) on microbial degradation of PAHs, a RHIZOtest experiment was conducted. The RHIZOtest is a standardised approach for assessing rhizosphere characteristics and processes. The experimental soil has been derived from a shooting range, which was contaminated with PAHs and heavy metals (HM), mainly Pb. A representative, easily available PAH, $[^{13}C_{14}]$-phenantrene biomarker, was added to observe PAH degradation after 0, 3, 6 and 10 days. By incorporation of the biomarker into microbial membranes (PLFAs) the contributing microbial communities will be estimated. Soil treated with amendments (1% biochar, m/m; 1% gravel sludge, m/m and 1% iron oxides, m/m) and controls, as well as planted and unplanted treatments were compared. The degradation is expected to be enhanced in soil treated with amendments as HM availability is likely to be reduced by pH increase and sorption processes. Furthermore, degradation will possibly be improved by enhanced nutrient concentrations present in the rhizosphere of clover, such as dissolved organic carbon and nitrogen deriving from biological nitrogen fixation. Based on this standardised experiment the mechanisms of natural attenuation of mixed-polluted sites will be assessed.

Silicon recovery from waste materials

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Abstract

Silicon is the second abundant element in Earth Crust with a mean value of 28% and in soil solutions at concentrations generally ranging between 0.1 to 0.6 mM. It can on the other hand, be present in plants in amounts similar to macronutrient elements such as calcium, magnesium, and phosphorus. Although still debatable, silicon has only been considered not essential but quasi-essential for many plants. Silicon in soil solution is mainly present as monomeric silicic acid (H_4SiO_4). Deficiency of Si mainly occurs in highly weathered tropical soils or upland Si-deficient soils with rice culture under rainfed conditions. The application of silicate fertilizers has lately become very common in Japan and Korea, for which an annual consumption of more than one million tons and 400,000 tons in amendments for rice growth have been reported. This indicates the clear demand for high amounts of Si fertilizers. There have been several studies using mineral, waste material or pyrolysis products as silicon fertilizers in order to improve certain plants growth and quality. Silicon compounds in soil are known to undergo different processes connected to soil characteristics which can affect the availability and finally the uptake of Si by plant, however the behavior, reactivity and availability of silicon-containing compounds after application in different soil conditions has not been clearly recognized. The aim of this study is to determine the chemical composition and characteristics of several waste materials including gravel sludge, wood ash, coal ash, and slag in order to create a favorable fertilizer composition containing higher Si content and lacking unfavorable elements. The investigations will target at optimized fertilizer production method including the removal of heavy metals, extraction or dissolving the present silicon in such material, and will be finalized by precipitation of silicon in compounds while having sufficient Si availability and reactivity after application.

From waste to fertilizer: evaluation of waste and waste-derived materials as nutrient source in agriculture

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Abstract

The deficiency of one of the most important natural resources, the plant nutrient phosphorus (P), will be soon a huge global problem; it is renewed only on a time scale millions of years and its supplies are expected to be depleted within the next 40 years. One potential solution of this challenge is the recycling of P.

The objective of this research was to determine the concentration of P in waste-derived P fertilizers in the soil and in the plants with efficient approaches. The fertilizers were obtained from various resources including municipal sewage sludge (MSS), meat and bone meal (MBM). The bioassay method is the most reliable procedure to reach this aim but it is cost and time consuming; for that reason we tested plant-independent conventional and novel alternative methods (water, 2% formic acid, 2% citric acid, the Diffusive Gels in Thinfilms – DGT, and the neutral ammonium citrate extraction).

We did a comparison between a pot trial and the chemical analysis of DGT to investigate the bioavailability of P. The pot trial was made up of 4 replications for each of the 11 fertilizers analysed (except for the Biogas Slurry, 1 pot, and for Chicken Meal BC, 2 pots). The setup of the pot was: 1 kg soil taken in the city of Melk (with a WHC of 65%), the P free nutrient solution, 100 mg P/kg soil added corresponding to a maximum yield of the 85% (decided through a previous test) and a time of plant growth of 6 weeks.

Plant biomass increase (g) was closely correlated to the concentration of DGT-labile P (C_{DGT}). We conclude that DGT is the most suitable method to measure P availability in soil.

Monitoring the biodegradation of polycyclic aromatic hydrocarbons in a co-contaminated soil using stable istotope labeling

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Abstract

Conventional remediation techniques like "dig and dump" are costly and limited in scale. Plant- and microbe-based alternatives, e.g. phytoremediation options, offer a cheap and environmentally friendly approach that can be applied on larger areas. However, the application of phytoremediation techniques to co-contaminated sites may be hindered due to a potential inhibition of biodegradation processes by the presence of heavy metals in soil. Therefore, the objective of this study is to test the hypothesis that the degradation of organic pollutants can be enhanced by immobilising potentially toxic heavy metals. This study aims to identify the influence of heavy metal immobilisation on the degradation of organic pollutants, and to determine chemical, physical and biological measures further accelerating these processes. The influence of heavy metals on organic pollutant degradation dynamics is assessed using ^{13}C-phospholipid fatty acid analysis (^{13}C-PLFA). Application of ^{13}C-labeled phenanthrene allows the identification of microbial groups responsible for the degradation process. For metal immobilisation and enhanced biodegradation, distinct mineral and organic soil amendments (iron oxides, gravel sludge, biochar) are deployed, partly in combination with fast-growing and pollution-tolerant woody plants (willow, black locust and alder). Results of an incubation batch experiment show a fast degradation of the phenanthrene label within the first two weeks by various microbial groups (gram negative bacteria as indicated by the cy17:0 peak) resulting in a decrease by up to 80% of the total PAH concentration (Σ 16 EPA PAHs) measured in soil. A similar trend was observed in the greenhouse pot experiment, whereby heavy metal accumulation in the woody plants growing on the co-contaminated soil significantly varied with plant species (willow > black locust, alder).

Poster 42

Analysis of the impacts on reforestation in alpine tree stands in the area of Salzkammergut, Upper Austria

Einflussfaktoren auf den Verjüngungserfolg im Bergwald des inneren Salzkammergutes

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Abstract

This master thesis concentrates on the different impacts on the regeneration success of the forest in the "Inner Salzkammergut". The research area is situated in the south of Upper Austria, in the forest district "Hallstatt" of the Austrian Federal Forests. The existing taper on the selected areas was raised by a fixed sample circuits. To get an estimated amount of trees and species on the reforest areas about 250 sample circles were taken into consideration. The sample areas were spread over the whole district and emerged both from regular and from calamity-related uses. As a part of this work it is examined whether a planned utilization affects significantly positive on the regeneration success. In addition, it is analyzed whether the frequently artificial regeneration of the forest show up the desired reforestation success. Last but not least the damaging effects on tree regeneration, focused on the influence of game are analyzed. As the analyzing variable, the composition of trees and the number on the hectare were used.

Die vorliegende Arbeit befasst sich mit den Einflussfaktoren auf den Verjüngungserfolg im Bergwald des Inneren Salzkammergutes. Untersucht werden hierbei Flächen im Wirkungsbereich des Forstrevieres Hallstatt der Österreichischen Bundesforste AG. Die vorhandene Verjüngung auf den ausgewählten Flächen wurde mittels fixer Probekreise erhoben. Die Probeflächen entstanden sowohl aus regulären sowie aus kalamitätsbedingten Nutzungen. Im Zuge dieser Arbeit soll untersucht werden, ob sich eine planmäßige Bewirtschaftung signifikant positiv auf den Verjüngungserfolg auswirkt. Darüber hinaus wird analysiert, ob die vielfach angewandte Kunstverjüngung zum gewünschten Verjüngungsziel führt. Nicht zuletzt sollen die schädigenden Einflüsse auf die Baumverjüngung, mit besonderem Schwerpunkt auf den Einfluss von Schalenwild, untersucht werden. Als Analysevariable für den Verjüngungserfolg dienen hierzu die Baumartenzusammensetzung sowie die Stammzahl am Hektar.

Determination of potential tree line and suitable areas for afforestation in the Chong-Kemin National Park, Kyrgyzstan

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Abstract

Forests not only protect against natural hazards, they are a sustainable source of energy and construction material. The long-term objective for the State Agency of Environmental Protection and Forestry of the Kyrgyz Republic is to increase the forest cover from now around 4.5% to 6% by 2025 – 2030. Afforestation work is therefore carried out all over the country. To choose only suitable areas for this works can be rather difficult in a country characterized by an arid, mostly continental climate that allows forests not everywhere to establish.

The potential forest distribution can be considered being a function of topography and climate parameters. In Central Asian Mountain areas, water supply during the vegetation period is often a limiting factor for trees to establish. An important role plays the aspect of ridges. On South oriented slopes, forest is mostly missing due to the above-mentioned dry periods in summer months and a high irradiation due to clear skies. Therefore this master thesis aims to estimate the forest tree line and the current forest distribution with remote-sensing data as a basis for further afforestation planning. With the data processing tool ArcGis different types of data are analysed:

- A digital forest map from a forest district in Eastern Kyrgyzstan
- Satellite images from Landsat plus a very high resolution image to delineate the spatial forest distribution
- Digital terrain models (DTM) from SRTM (spatial resolution: about 30m)
- Climate data: Global irradiation, Temperature and precipitation

Topographic parameters (slope, aspect, elevation) together with climate characteristics are examined to find the limits for different forest types to grow. The gap between the potential tree line and the actual upper and lower forest line will be used as an indicator for a possible anthropo-zoogenic influence on the today forest distribution.

Global trends in climatic changes are compared with local weather data (changes in precipitation patterns and temperatures). A prediction for temperature development for the coming decades can thus be made. With this prediction the possible scale of an upwards shift of future tree line can be estimated.

Silvicultural evaluation of Grand fir (*Abies grandis*) in Mühlviertel, Upper Austria

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Abstract

Caused by climate change and the so associated problems with spruce [Picea abies] outlandish tree species are a well discussed topic in the region of Mühlviertel in Upper Austria. This Silvicultural evaluation summarizes the growing performance, the wood market, the abiotic and biotic agents as well as the invasive capacity of Grand fir in the region of Mühlviertel.

The general basis of the study is built by a forest growth research of a Grand fir stand located in St. Nikola an der Donau. For the investigation on this 2-hectar stand, 10 plots with a size of 225 m²/plot were installed to get comparative values to other stands in the region. The result of 476 m³/ha at the age of 25 years shows the extraordinary growth potential of Grand fir stands.

Differences of achieved timber prices can be explained by various market positions of forestries. Dramatically reduced water availability during the growing period leads to stem cracks and mortality. More relevant then abiotic factors are biotic ones like the honey fungus [*Armillaria mellea*] or *Heterobasidion annosus*. Damage caused by game is not as relevant as it is at the native *Abies alba*. The environmental consequences have to be taken into consideration to give a silvicultural cultivation recommendation. Comprehensive knowledge about Grand fir cultivation in middle Europe shows no potential of invasiveness. Taking into account the climatic needs of Grand fir, the cultivation in the region of Mühlviertel provides the opportunity to cultivate a species with above-average growth by comparison with other tree species. Especially at altitudes between 350 m and 900 m the cultivation of Grand fir should be possible with carrying a low risk even with an expected climate change.

Waldbauliche Grundlagenerhebung zur Baumartenwahl und Ableitung von Behandlungstypen im Forstbetrieb Lausnitz im Anbetracht des Klimawandels

Freda v. Gilsa, Eduard Hochbichler

Institut für Waldbau

Abstract

Ziel der Arbeit ist es aufgrund der Beschreibung von verschiedenen waldbaulichen Ansätzen eine Entscheidungsgrundlage zu liefern, aufgrund derer der sich in Thüringen befindliche untersuchte Forstbetrieb sein Handeln überprüfen kann. Anstoß für diese Arbeit gaben die sich häufenden Naturereignisse, wie vermehrtes Auftreten von Kalamitäten. Die Thüringer Landesforste haben zum Beispiel bereits einen umfangreichen Katalog für neue Bestandeszieltypen in Thüringen formuliert.

Um eine stichhaltige Aussage treffen zu können, werden auf 2 Waldorten, die den Gesamtbetrieb standörtlich repräsentieren können, insgesamt 63 Probenflächen aufgenommen. Mithilfe des Waldwachstumssimulators BWinPro werden pro Waldort Szenarien entwickelt, die von einer unterschiedlichen Behandlung und zukünftigen Baumartenzusammensetzung ausgehen. Dabei werden zum ersten die Empfehlungen der Thüringer Landesforste berücksichtigt, zum zweiten die Vorstellungen des Bewirtschafters und Eigentümers und zum dritten wird ein Szenario erstellt, dass auf die reine Bewirtschaftung ausgelegt ist, ohne die Einbringung weiterer Baumarten. Weiterhin werden aufgrund der simulierten zukünftigen anfallenden Sortimente Deckungsbeiträge einschließlich Kulturkosten und –pflege berechnet, um einen wirtschaftlichen Vergleich ermöglichen zu können.

Vor dem Hintergrund aktueller Studien zur Entwicklung des Klimas in Thüringen und den eigenen Erhebungen soll ein umfassendes Bild erstellt werden, dass als Handlungsempfehlung betrachtet werden kann. Berücksichtigt werden dabei ökologische wie auch ökonomische Aspekte, um langfristig einen stabilen Waldbestand zu erhalten. Der Betrieb soll auch in Zukunft die Lebensgrundlage einer Familie sichern können.

Small scale forestry: Silvicultural planning and forest management with focus on conversion from even aged to uneven aged stand structures

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Abstract

This paper deals with silvicultural planning and forest management in small scale forests. The objective of the master thesis is to develop silvicultural and forest management basics for conversion even aged stands to multiaged stand structures

The study area is located in West-Styria, in the eco region 5.4 (Weststeirisches Bergland), at an altitude between 650 to 850 meters above sea level. The potential natural forest vegetation type is spruce-fir-beech forest with cross over to beech-, and oak forest associations. The forested area, dominated by one-age cohort forests, was influenced by a windthrow in 2008.

Data were collected by a random sample survey (78 sample plots; angle count sampling) combined with stand estimation. Stand and regeneration parameters including deadwood were measured.

Based on the data simulation process was started whereby the program Prognaus Vers. Px 1.1 (Ledermann, 2007) was used. Four various treatment concepts (clear cutting system and tree variants of target diameter harvesting with target diameter 55cm and different intervention levels) were simulated for a period of 40-50 years.

The results show a better goal oriented progress of the forest stands by target diameter harvesting compared to clear cutting system. The cumulated felling volume is higher in target diameter treatment than in clear cut management. The target diameter harvesting shows better results in evolution of stocking volume, volume and diameter increment and H/D ratio. The performance in harvesting is also increasing. Based on these results, a target diameter harvesting is recommended.

Application of the MOSES – Model for Sitka Spruce *(Picea sitchensis)*

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Abstract

The aim of this master thesis is the validation of the application of the MOSES – Model for Sitka spruce *(P. sitchensis)*. MOSES (MOdelling Stand rESponse) is a potential growth dependent tree growth model developed at the University of Natural Resources and Applied Life Sciences, Vienna. The structural basis of the MOSES modelling approach are statistically admitted models. Jonathan Dash (University of Wales) assessed the parameters for *P. sitchensis* in an international study in 2006. Now the practical application is tested. Therefore estimated parameters were used for the calculation of real growing stands. Validation is evaluated by using different tree parameters. The master thesis should also give a practical connection for the application of dynamic tree growth models in forest management. Different management scenarios are used to test common and new silvicultural arrangements for *P. sitchensis*.

The research took place in the south west of Scotland. The forests are situated between St. John´s Town of Dalry and Galloway. For evaluation stands with strong differences in age, site quality and management were chosen. Therefore about 39 different stands of *P. sitchensis* were measured. Parameters about the stands and trees were measured by randomly distributed circular plots. MOSES requires exact data about the stand and the trees in the stand. Some of the needed data were not available in the estimated dataset. To get the missing data, different models and functions from the Moses Framework were used. Within the completed dataset calculations in the MOSES Framework were done.

A first validation of MOSES was done by observing the increment. Values were estimated within the predicted and the observed five year diameter increment. After validation the adaptability of forest management scenarios will be made. Past management scenarios are simulated with MOSES to compare predicted with observed values. Especially mid rotation stands with management arrangements in the past –respacing and thinning- are considered for this. Another important outcome is the virtual testing of new forest treatment strategies for practical use. Finally, the regenerated data are used to calculate an optimized financial rotation time.

The tolerance of broadleaved trees against high sludge deposition after the flood in the year 2013 in the floodplain forests of Upper Austria.

Die Toleranz von Laubbaumarten gegenüber hohen Schlammablagerungen nach dem Hochwasser im Jahr 2013, in den Auwäldern von Oberösterreich.

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Abstract

This master thesis is concerned with the tolerance of broadleaved tree species against high sludge depositions after floods. The study area is located in the northeast of Upper Austria in the "Mühlviertel", in the lowland forests of the districts "Urfahr" and "Perg". The Chamber of Agriculture of Upper Austria established in the year 2013 approximately 70 receiving points for collecting the influence of the sludge level on different tree species. At the beginning of the research the recodring point were calibrated with the GPS and for each point 15 trees were chosen. The sludge depth was drilled with a percussion drill. Only the first 5 out of 15 trees per each recording point were the height and the crown bases measured. On the contrary the BHD was measured and the crown state of was addressed per every tree. The method to determine the Crown states carried out by ROLOFF (1985). The recordings were repeated in the year 2014 and 2015. In 2015, on all points were the tree species ash occurred, the ash were recorded and addressed with the recording key for the ash dieback. This recording key was developed by Professor Thomas Kirisits. The mean research question which tree species has the highest resident against high sludge depositions after floods. The aim is to define an afforestation recommendation for the concerned areas.

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Analyse von Elsbeer-Naturverjüngung im Leithagebirge

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Abstract

Einer der östlichen Ausläufer der Alpen bildet das Leithagebirge. Durch das subillyrische Klima werden in dieser Region viele verschiedene Laubbaumarten begünstigt. Zu ihnen zählt die im europäischen Vergleich eher seltene Elsbeere (*Sorbus torminalis* L.). Sie bevorzugt warme, sonnige Hänge und findet auf nährstoffreichen, tiefgründigen Böden mit guter Durchlüftung ihr Optimum.

Die Elsbeere hat in Österreich ihren Verbreitungsschwerpunkt im Wienerwald sowie im Leithagebirge. Auch im Bereich der Heeresforstverwaltung Bruckneudorf ist die Elsbeere zahlreich vertreten. Die vorliegende Arbeit geht den Fragen nach:

a) ob eine natürliche Verjüngung der Elsbeere flächig möglich ist und
b) wie die naturverjüngten Elsbeerpflanzen auf konkurrierende Baumarten, wie Speierling *Sorbus domestica*, Gemeine Esche *Fraxinus excelsior*, Traubeneiche *Quercus petraea*, Götterbaum *Ailanthus altissima* etc. reagiert.

Da *Sorbus torminalis* Hitze gut verträgt und ihr Holz eines der wertvollsten der europäischen Baumarten ist, wird sie den Gewinnern im Klimawandel zugeordnet.

Vergleichende Analyse der Regelungen in Österreich und Deutschland in Bezug auf Substanzbesteuerung und unentgeltliche Übertragung in der Forstwirtschaft

Rupert Tausendpfund

Abstract

In der Bachelorarbeit wird der Substanzbesteuerung und der unentgeltlichen Übertragung in der Forstwirtschaft in Österreich und Deutschland auf den Grund gegangen. Hierbei werden die Grundsteuer, die Grunderwerbsteuer und Grundbucheintragungsgebühr, die Immobilienertragsteuer, die (in Österreich abgeschaffte und in Deutschland ausgesetzte) Vermögenssteuer, sowie die Abgabe von land- und forstwirtschaftlichen Betrieben und die Aufdeckung bzw. Übertragung stiller Reserven erläutert. Außerdem wird auf die in der Bundesrepublik Deutschland erhobene Erbschafts- und Schenkungssteuer eingegangen. Die Steuersysteme Österreichs und Deutschlands wirken auf den ersten Blick ähnlich, weisen jedoch bei detaillierter Betrachtung wesentliche Unterschiede auf. Nach einer kurzen Erklärung von Substanzbesteuerung und unentgeltlicher Übertragung werden die steuerlichen Regelungen (ihr Zweck, ihr Ziel,...) analysiert, in Bezug auf Ziel-Mittel-Zusammenhänge verglichen und mithilfe von Fallbeispielen verdeutlicht, Unterschiede und Gemeinsamkeiten werden hervorgehoben. Auf die von Land- und Forstwirtschaft genossenen Steuervorteile wird verwiesen. Neben der Analyse von Wesen und Funktion der Steuerarten werden insbesondere die Intentionen des Gesetzgebers die jeweilige Steuer betreffend mit der Arbeit aufgezeigt. Im Zuge dieser bedarf es eines ständigen Verweises auf die Gesetzestexte, in welchen die Rechtslage der jeweiligen Steuerart angeführt ist. Neben der Auswertung von Fachliteratur werden zur Erstellung der Arbeit ExpertInnenauskünfte herangezogen. Diese dienen neben der Generierung zusätzlichen Wissens als Erklärungshilfe.

Waldbauliche Untersuchung in tannenreichen Stangeholz-Mischbeständen

Lukas Schaffer, Gabriel Türkis

Abstract

Diese Arbeit beschäftigt sich mit einer Mischwaldaufforstung in Losensteinleiten, welches im Wuchsgebiet „Nördliches Alpenvorland - Westteil" auf 350 m Seehöhe liegt. Anfang der 90er Jahre wurde der durch mehrheitlich Fichten dominierte Wald fast vollständig durch einen Windwurf zerstört und anschließend wieder aufgeforstet. Der Waldbesitzer legte dabei großen Wert auf möglichst viele Baumarten in unterschiedlicher Mischungsart und Mischungsform, um mehr Stabilität für die Zukunft zu erreichen. So kommen neben den Nadelbaumarten Tanne, Lärche, Fichte, Kiefer und Douglasie, die Laubhölzer Bergahorn, Grauerle, Stieleiche, Esche und Birke vor. Trotz vergleyter Bodenverhältnisse kann besonders die Tanne ein außergewöhnlich gutes Wuchsverhalten vorweisen, weshalb wir in unserer Arbeit das Augenmerk auf diese richten. Um dies zu veranschaulichen, wurde ein Stichprobenraster mit 40 Probekreisen angelegt, wo jeweils die Höhen und Brusthöhendurchmesser aller Bäume, Durchmesser der Stöcke in 10 cm Höhe und der Primärkronenansatz der Zentralstämme gemessenen wurde. Anhand dieser Daten wird eine Bestandesanalyse durchgeführt, welche Aufschluss über das Wuchsverhalten einer solchen Aufforstung unter gegebenen Bedingungen bringen soll.

Phenological diversity of Douglas-fir origins

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Abstract

In this bachelor thesis the bud burst of 10 Douglas-fir origins have been compared based on preliminary studies about the genetics of those orignis. 5 of those origins are from America, 3 from Germany and 2 from Austria. The plants came from the company Lieco and have been moved to Vienna by myself. They have been stored at university ground until all the genetic work was done and have then been moved to the universitary research institute „Knödelhütte". The plants were about 2 to 3 years and there was just the species of the coastal Douglas-fir (*Pseudotsuga menziesii* var. *Menziesii).*
Phenological work was just about the bud burst and therefore we introduced a 3-step scale to determine when the bud burst starts. For 15 days the plants (n=1017) were checked daily in the greenhouse and the data was used to see differences between the origins using software like SPSS or Microsoft Excel. At the end of this study the small trees have been planted in the area of Knödelhütte.

Design and setup of forestry experiments

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Abstract

In studies about yield, it is generally stated that trees are special members of the plant kingdom, mostly due to their exceptionally long lives, and therefor pose unusual challenges for observation and study. When observing trees in experimental plots rather than naturally growing forests, additional care must be taken when defining the starting conditions of the experiment. Several parameters (density, species composition, positioning, etc.) have to be merged into creating such a plot and the applied forest management in order to study competition, productivity and yield of managed or pristine forests. When planting trees for forestry experiments, an accurate and applicable setup or design, which ideally incorporates as many parameters as possible, is necessary. Several designs for experimental plots for mixed species stands have been discussed and suggested, but their accuracy and applicability have been questioned.

This study is a review of studies and research conducted over several decades and recounts an academic dispute over a specific choice of methods: additive and substitutive design have both been widely used in forestry experiments studying competition, even though neither method is specific to trees. The use of both designs has been heavily criticized, even outside the field of forest ecology. The review of this discussion singles out a sample of studies on tree competition in which either method was used. It also provides the respective criticism of both designs in following studies, in which (mostly) other methods for plot designs are suggested.

Differenzierte Betrachtungsweisen der Land- und Stadtbevölkerung zu Themen der Holz- und Forstwirtschaft - eine empirische Erhebung

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Abstract

Artensterben, Ozonloch, Klimaerwärmung, Waldschäden: Die Liste von neuartigen, drastischen Veränderungen des Weltökosystems ist mühelos verlängerbar. Das wachsende Umweltbewusstsein und das gestiegene gesellschaftliche Interesse an Themen der Nachhaltigkeit haben in den letzten Jahrzehnten dazu geführt, dass der Forst-Holz-Sektor im zunehmenden Maße in das Blickfeld der Gesellschaft geraten ist. Das gesteigerte Interesse und neue Anforderungen führen dazu, dass der Forst-Holz-Sektor in viel stärkerem Maße gefordert ist, sich mit Themen wie dem Klimawandel, der Rohstoffversorgung und der Bioökonomie auseinanderzusetzen und diese zu kommunizieren. In Österreich sind mehr als 47% der Landesfläche mit Wald bedeckt, durch diese Tatsache ergibt sich für die Nutz- und Erholungsfunktion ein großer Stellenwert in der österreichischen Bevölkerung.

Diese Arbeit soll veranschaulichen, wie sich in Österreich die Einstellung gegenüber der Forst- und Holzwirtschaft bemerkbar macht. Welche differenzierten Betrachtungsweisen lassen sich zwischen der Stadt- und Landbevölkerung aufzeigen? Unterscheiden sich diese Betrachtungsweisen auch hinsichtlich dem Bezug zur Forst- und Holzwirtschaft?

Durch die Aufarbeitung der vorhandenen Literatur wurden zwei Zielgruppen definiert. Die erste sollte vor allem junge Personen aus der Stadt, und die zweite Gruppe gezielt berufstätige Personen vom Land enthalten. Durch die Befragungsorte (Fair Trade Shop, Bioladen) wurde versucht Personen ohne einen offensichtlichen Bezug zur Forst- und Holzwirtschaft, jedoch mit hohem Umweltbewusstsein zu befragen.

Die Erhebung der Daten erfolgte mit Hilfe einer quantitativen Befragung, welche mit einem standardisierten Fragebogen durchgeführt wurde. Die nachfolgende Auswertung der Daten erfolgte mit einem Statistik Programm. Es erfolgte eine Einteilung in Stadt- und Landbevölkerung sowie Personen mit und ohne Bezug zur Forst- und Holzwirtschaft.

Durch die Auswertung sind Zusammenhänge zwischen der Stadtbevölkerung und Personen ohne Bezug zur Forst- und Holzwirtschaft zu erkennen. Bei einem Großteil der Fragen stimmten alle Gruppen gleichmäßig zu. Im Vergleich zwischen Stadt- und Landbevölkerung ist auffallend, dass der Anteil mit neutraler Antwort bei der Landbevölkerung immer größer war als bei der Stadtbevölkerung.

Prognose der Erholung der Böden vom Sauren Regen in Buchenbeständen des Wienerwaldes

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Abstract

Lindebner (1990, Probenwerbung 1984) untersuchte in seiner Arbeit „Der Bodenzustand in Buchenwäldern des Wienerwaldes" den längerfristigen Einfluss von Luftschadstoffen auf chemische Bodeneigenschaften. Die erhöhte Immissionsbelastung führte damals vor allem im Einsickerungsbereich des Stammabflusses von Altbuchen zu starker Bodenversauerung. Basierend auf diesen Ergebnissen und einer aktuellen Probenwerbung im Jahr 2012 (Türtscher, 2014) wurden 14 Altbuchenbeständen ausgewählt, welche jeweils zu einem Teil vor unterschiedlich langen Zeiträumen gefällt wurden. Im Zuge dieser Arbeit wurden nun Boden pH-Werte im ehemaligen Stammabfluss- und Zwischenflächenbereich der Baumstöcke gemessen. Während aus dem Vergleich der alten und rezenten Werte der Bestände auf eine Veränderung innerhalb der letzten 3 Jahrzehnte geschlossen werden kann, lautet die Arbeitshypothese unter Einbeziehung der Baumstockdaten wie folgt: die Erholung der Böden vom Sauren Regen ist eine Funktion der Zeit und kann entsprechend einer falschen Zeitreihe (Wegfall des sauren Stammabflusses zum Zeitpunkt der Fällung) prognostiziert werden.

Untersuchungen zur temperaturabhängigen Entwicklung des "Kleinen achtzähnigen Fichtenborkenkäfers", *Ips amitinus* (Col., Scolytinae)

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Abstract

Um eine Risikoabschätzung mit Hilfe eines Phänologiemodells für den Fichtenborkenkäfer, *Ips amitinus,* erstellen zu können, wurden in dieser Arbeit die Entwicklungsdauer und die Entwicklungsgeschwindigkeit des Käfers, in Abhängigkeit von drei verschiedenen Temperaturen (15°C, 20°C und 25°C) bei Langtag-Bedingungen (16h Licht: 8 Stunden Dunkelheit) untersucht. Die Experimente fanden sowohl mit individuell an Fichtenstämmen angesetzten Käfern (Kapselzwinger-Methode) als auch mit „freiem Ansatz" statt, bei dem sich ca. 100 Käfer/Stamm für die Brutanlage in die Stämme einbohren konnten. In täglichen Kontrollen wurde der Schlüpftermin der einzelnen Käfer unter den jeweiligen Bedingungen registriert. Nach Beendigung der Schlupfperiode wurden die Stämme entrindet und die Brutsysteme hinsichtlich verschiedener Brutparameter, Schlüpfrate und Mortalität untersucht. Aus den Entwicklungsdaten wurde mit Hilfe einer Regressionsgeraden der untere Entwicklungsnullpunkt für die Gesamtentwicklung einer Käfergeneration bestimmt.

Changes in root biomass in a mountainous forest after disturbance

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Abstract

Partially due to climate change, natural disturbance regimes such as windthrow and bark beetle events are increasing. Therefore important forest ecosystem functions such as carbon storage capacity, which plays a major part in the global carbon cycle, are hampered. Simulations of common disturbance events were carried out in a in mountainous beech forest next to the Calcareous Alps National Park. Part of this project was to analyze the amount of living fine and coarse roots per soil layer before the treatments in May and again afterwards in September. The treatments themselves took place in August. Three blocks were established, each with four experimental treatments: a simulated bark beetle attack (girdling), two simulated windthrows (clear-cuts), one with and one without woody debris on site, and one undisturbed control stand. The amount of living and dead root biomass was studied throughout the year. No consistent shift in favor of the dead root density could be discovered by comparison between the two sampling campaigns in May and September, respectively. On the control plots, living root biomass increased compared to dead root mass from May to September. In conclusion, the time between the implementation of the treatments in August and the second sampling in September was not long enough to show significant changes in the ratio of living and dead roots, and thus in the stored carbon in root biomass.

Längen- und Dickenwachstum der Äste im Vergleich zum Stamm

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Zusammenfassung

Da die Vitalität und somit das Wachstumspotential eines Baumes sich unmittelbar an den Kronenzustand anlehnt, beschäftigt sich diese Arbeit mit Astmerkmalen und ihrer Verteilung am Stamm an Fichten. Beim Nadelholz spielen Astmerkmale insbesondere auch für die Holzqualität eine wichtige Rolle.

Die Fichte nimmt in Österreich mit circa 1,7 Millionen Hektar rund 50 Prozent der Österreichischen Waldfläche ein.

Für diese Arbeit sind im Lehrforst neun Fichten (*Picea abies*) ausgezeigt worden. Jeweils drei Individuen nehmen eine differente soziale Stellung ein.

Diese gliedern sich in:

- Vorherrschend
- Herrschend
- Beherrscht

An den Fichten wurden Stammscheiben am Stock, in Brusthöhe, am D03 und den Kronensechsteln an jedem Baum geworben und im Labor analysiert.

Von jedem Baum wurde an allen lebenden Ästen, Astdurchmesser, horizontale und lineare Länge, und Austrittswinkel gemessen.

Für die Jahrringanalyse der Äste sind vom ersten Quirl über jedem Kronensechstel alle Äste aufgenommen worden. Diese sind dann analog zu den Stammscheiben ebenfalls einer Jahrringanalyse unterzogen worden.

Mit diesen Daten werden nun Zusammenhänge zwischen Astdurchmesser und Astlänge, die Verteilung von Astdurchmessern, Astlänge und Astwinkel über den Höhenverlauf des Baumes untersucht und der Einfluss der sozialen Stellung geprüft. Die Modelle wurden mit bestehenden Modellen für die Astverteilung verglichen.

Index of contributors