

CeBiTec – Quarterly

Summer 2019



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Deep metagenome sequencing of an agricultural soil microbiome enabled reconstruction of hitherto unknown genomes encoding potential plant beneficial genes

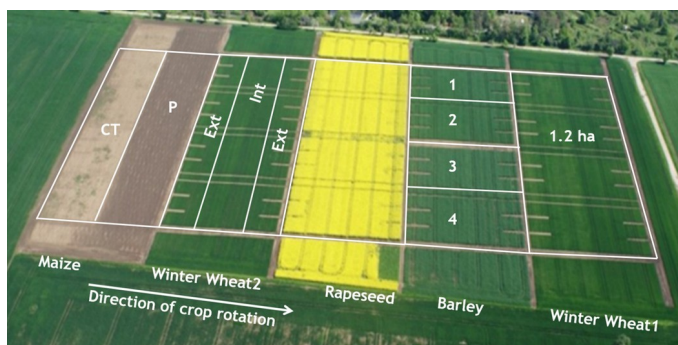
Members of the CeBiTec groups Genome Research of Industrial Microorganisms (Prof. Dr. Alfred Pühler) and Computational Metagenomics (Dr. Alexander Sczyrba) published a research article on the topic “Effect of Long-Term Farming Practices on Agricultural Soil Microbiome Members Represented by Metagenomically Assembled Genomes (MAGs) and Their Predicted Plant-Beneficial Genes” in the latest issue of the MDPI Journal “Genes”.

Within the DiControl (Disease Control) project of the BonaRes initiative (Soil as a Sustainable Resource for the Bioeconomy), the CeBiTec cooperated with partners from the Leibniz-Institute of Vegetable and Ornamental Crops (IGZ, Großbeeren) and the Anhalt University of Applied Sciences (AUAS, Bernburg) on soil microbiome analyses addressing a long-term field experiment (LTE) located at Bernburg (Saxony-Anhalt). Purpose of the project was to investigate the impact of soil management practices and application of biocontrol strains on the suppression of plant pathogens for improved soil health and sustainable plant production. Maintaining soil health and fertility during intensification of agricultural production to

satisfy the demands of food and energy supply of a growing world population is one of the major challenges in agriculture. The published study was made possible by taking advantage of the CeBiTec infrastructure such as availability of high-throughput -omics technologies, compute and bioinformatics resources and opportunities to access the de.NBI infrastructure (German Network for Bioinformatics Infrastructure) comprising a cloud computing environment.

Deep metagenome sequencing of the LTE-microbiome and application of advanced bioinformatics analysis workflows now revealed genome sequence information of hitherto unknown potential plant beneficial species featuring plant-growth-promoting (PGP) capabilities. Moreover, soil treatment practices affected abundances of several PGP bacteria offering opportunities regarding soil microbiome shaping with the aim to enhance plant productivity.

Hence, the published article contributes to a better understanding of the taxonomic and functional composition of an agricultural soil microbiome and on how soil management strategies may affect microbiome structures regarding plant beneficial community members with the aim to improve sustainable plant production. Thereby, the authors intend to encourage exploitation of microbiome resources established in their study to develop innovative concepts addressing management and engineering of similar agricultural soil microbiomes.



The long-term experimental (LTE) field site at Bernburg-Strenzfeld (Saxony-Anhalt) sampled for soil microbiome analyses. CT and P describe tillage variants and Ext and Int indicate different fertilization intensities. Numbers 1 to 4 represent replicated field plots. The sequence of crop rotation is the following: maize, winter wheat, rapeseed, barley and winter wheat.

Nelkner J, Henke C, Lin TW, Pätzold W, Hassa J, Jaenicke S, Grosch R, Pühler A, Sczyrba A, Schlüter A. (2019). Effect of Long-Term Farming Practices on Agricultural Soil Microbiome Members Represented by Metagenomically Assembled Genomes (MAGs) and Their Predicted Plant-Beneficial Genes. *Genes* 10(6), pii: E424. doi: 10.3390/genes10060424, PMID: 31163637.

The Multiscale Bioengineering group is a new CeBiTec member

The research group Multiscale Bioengineering headed by Jun. Prof. Dr.-Ing. Alexander Grünberger was founded in April 2017 at the Faculty of Technology of the Bielefeld University with the aim of developing and establishing new microfluidic methods and tools for biotechnology and bioprocess engineering.

The research focus of the group covers currently two main topics: (i) The development and application of new microfluidic (single-cell) cultivation methods (ii) the investigation of population heterogeneity in bioprocesses. In the next years, we will increase our efforts to investigate how microfluidic methods and single-cell data can be transferred and integrated into laboratory work routines and scales.

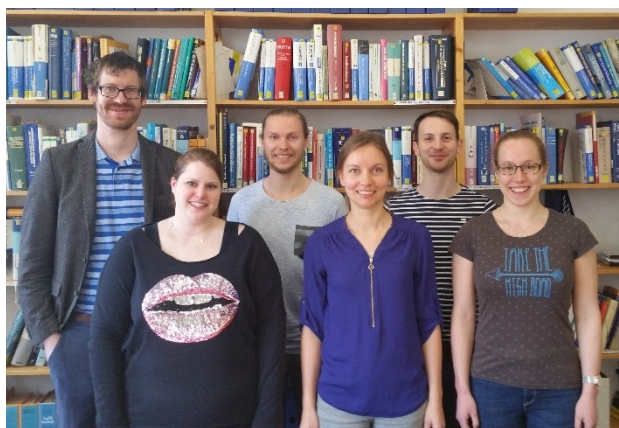
In the initial time at Bielefeld University different collaborations have been started. For example in collaboration with Prof. Dr. Thomas Noll we have started to investigate the growth behaviour and heterogeneity of industrially relevant CHO cells.

The group currently consists of three PhD students, Alina Burmeister, Julian Schmitz and Sarah Täuber. Alina Burmeister is developing novel microfluidic cultivation system for the analysis of interactions within synthetic microbial consortia. In the PhD project of Julian Schmitz, novel microfluidic systems for the cul-

tivation of CHO cells are developed and applied. Sarah Täuber's aim within her PhD is the development and application of novel microfluidic systems that allow the cultivation of microbial cells at dynamic but defined environmental conditions. Several Bachelor and Master students are continuously joining (and leaving) our lab, working on different topics ranging from microfluidic fabrication, single-cell cultivation to data analysis.

The topics we are working on have a high interdisciplinary character at the interface between microfluidics, microbiology, bioinformatics and bioprocess engineering. Only by expanding this interdisciplinary approach new methods can be established in the field of biotechnology. We pursue this goal together with proven experts in their respective field of research both within the Bielefeld University as well as through national and international cooperation. We hope, that the admission into the CeBiTec consortium will initiate new discussions, strengthen our connection to other groups and enable us to contribute to the high quality research within the consortium.

With our experience at the interface between biotechnology and microfluidics, we are happy to serve as a contact and discussion partner for questions in this still new but promising field.



Federal Ministry of Food and Agriculture continues funding of biogas microbiome research

Funding of the new BIOGAS-GeneMining project on “Characterization of the genetic and enzymatic potential of biogas microbiomes by means of meta-analyses of metagenome datasets” by the Federal Ministry of Food and Agriculture (BMEL) through its project management agency *Fachagentur Nachhaltende Rohstoffe e.V.* (FNR) will start in summer this year. The project partners Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB, Potsdam) and the CeBiTec will cooperate on meta-analyses of microbiomes involved in production of the renewable energy source biogas.

Biogas production through the anaerobic digestion (AD) of biomass has become important in the renewable energy portfolio since biogas represents a clean and environmentally friendly energy source. Decomposition and fermentation of organic material to produce biogas involves cooperation of complex microbial populations. Finally, the AD process leads to the synthesis of methane, the energy-rich component in biogas. Most of the microorganisms in biogas-producing microbiomes are unknown. Analysis of the microbiome involved in biogas production is considered to represent the key to optimize the AD process.

The aim of the project is to use publicly available metagenome sequence datasets for reconstruction of microbial community genomes by means of bioinformatics strategies such as assembly of metagenome sequence reads and taxonomic binning of resulting contigs. Metagenomically Assembled Genomes (MAGs) represent the basis for further characterization of the biogas microbiome including metabolic reconstructions, MAG abundance estimations, co-occurrence and network analyses considering metadata.

The project partners rely on the CeBiTec infrastructure regarding high-throughput -omics technologies and bioinformatics resources, especially the cloud computing setting established in the frame of the German Network for Bioinformatics Infrastructure (de.NBI). Big-data management strategies, bioinformatics high-throughput workflows and tools for the analysis of microbiome datasets will be developed in the Computational Metagenomics Group of the CeBiTec headed by Dr. Alexander Sczyrba. Biological data interpretation is the task of the CeBiTec Group Genome Research of Industrial Microorganisms led by Prof. Dr. Alfred Pühler who also coordinates the de.NBI initiative at Bielefeld University.

The BIOGAS GeneMining project partners expect that functional interpretation of Metagenomically Assembled Genomes will provide access to the currently unknown, non-cultivable fraction of AD microbiomes.

CeBiTec Students Academy in summer holidays and *teutolab*-Academy Systems Biology in autumn holidays

Like the last years, the *teutolab*-biotechnology organizes two projects for gifted and talented students in the coming holidays.

***teutolab* biotechnologie** Since 8 years, the CeBiTec Students Academy takes place in the summer holidays and is financially supported by the *Osthushenrich-Stiftung*. The date of the event with the focus on “The Role of Genome Sequencing and Bioinformatics in Biotechnology/Synthetic Biology” is this year August 19 to 23. In the Students Academy, many different research groups of the CeBiTec are involved and work together in a well balanced programme of lectures and experiments. This year, the lab work will focus on the characterization of bacteria from soil. The participants will characterize them by microbiological tests and a molecular genetic analysis. Further on, the genome will be examined by Nanopore Sequencing Technology and bioinformatic inquiry. In addition, the iGEM-team will offer an experiment in the field of synthetic biology. Particularly scientifically interested and talented young people can apply to participate in this academy, which has 20 places available. The application period will end at July 15, 2019. Further information for interested students is provided under: <https://www.uni-bielefeld.de/teutolab/fachorientiert/biotechnologie/Aktionen/2019-CeBiTec-Sch%C3%BClerakademie.html>.



The *teutolab*-Academy Systems Biology combines biological experiments with mathematical modelling and is supported by the Joachim Herz Foundation. It will take place from October 14 to 18, 2019. The one-week course focuses on the investigation of the regulation of the *lac* operon in the bacterium *E. coli*. The students generate data about the bacterial growth depending on the use of different sugar sources. In addition, the students learn how to visualize/simulate relevant biochemical reactions of lactose utilization using the programme CellDesigner. Accompanying lectures by scientists as well as the visit of a biotechnological research institution complete the program. Particularly scientifically interested and talented young people can apply to participate in this academy, which has 20 places available. The application period will end at July 15, 2019. Further information for interested students is provided under: <https://www.uni-bielefeld.de/teutolab/fachorientiert/biotechnologie/Aktionen/2019-teutolab-Akademie-Systembiologie.html>.

9th International CeBiTec Research Conference – Advances in Industrial Biotechnology: Renewable feedstocks and synthetic pathways for production of fine chemicals

The 9th International CeBiTec Research Conference, which will take place at the Center for Interdisciplinary Research (ZiF), Bielefeld University, from September 23 to 25, 2019, continues the annual conference series in Advances in Industrial Biotechnology. This year's conference is dedicated to the role of renewable feedstocks and synthetic pathways for production of fine chemicals in industrial biotechnology. The major topics to be addressed are Aroma Biotechnology, Synthetic Pathways, Alternative Feedstocks and C1 Utilization. A podium discussion on white biotechnology will bring together experts from industry and academia.



<https://www.cebitec.uni-bielefeld.de/events/conferences/555-2019-09-23-9th-int-cebitec-research-conference-bielefeld>

Miscellaneous

In May, 2019, Dr. Nadja Alina Henke and Bicomer won first prize at the pitch competition at Biocamp 2019 in Breda, the Netherlands. The competition was part of the specialized business training which was organized by BioBase4SME and held in the cloister of Bovendonk. 19 bio-based start-ups from five countries from north-western Europe participated and worked for 6 days on their businesses. The final pitch competition that took place in the chapel of the cloister was evaluated by three venture capitalists. See also on Twitter.

Prof. Dr. Volker Wendisch received the Distinguished Scientist Award of the International Bioprocessing Association (IBA-IFIBiop). The prize was awarded May 2, 2019, during the opening ceremony of 8th IBA-IFIBiop-Conference, held in Miri, Sarawak (Malaysia).

Upcoming Events

- ▶ September 9 – 10, 2019 | Landwirtschaftszentrum Haus Düsse, Bad Sassendorf
5th CeBiTec Retreat
- ▶ September 23 – 25, 2019 | Center for Interdisciplinary Research (ZiF), Bielefeld University
9th International CeBiTec Research Conference Bielefeld: Renewable feedstocks and synthetic pathways for production of fine chemicals
- ▶ September 30 – October 02, 2019 | Center for Interdisciplinary Research (ZiF), Bielefeld University
ZiF Workshop: Computational Pan-Genomics
- ▶ December 02 – 04, 2019 | Center for Interdisciplinary Research (ZiF), Bielefeld University
13th CeBiTec Symposium: Multi-Step Syntheses in Biology & Chemistry – An International Young Investigator Conference
- ▶ further events are announced on the CeBiTec web page

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