Popular scientific result summary for project funded by Ekhagastiftelsen

Popular scientific result summary is to be submitted by e-mail within 3 months of project end.

Application number:	2021-69
Project title:	Pilot: Microbial diversity in agricultural systems and its effects on the human microbiome. An exploratory basis for follow-up research
Receiver of grant (name, address):	Louis Bolk Institute Kosterijland 3-5 NL-3981 AJ Bunnik The Netherlands
Contact / project manager:	Ir. Peter Keijzer
Project start (yyyy-mm-dd):	2021-10-15
Project end (yyyy-mm-dd):	2022-12-31
By Ekhagastiftelsen granted sum:	1.000.000 SEK

Result summary: (max 900 words)

Background and aims of the project

The microbiome is of major importance to human and plant health. The microbiome contains species that are beneficial to the organism but can also contain harmful ones. For an organism to be healthy, the beneficial microorganism must outcompete the harmful ones.
For the human immune system it is essential to have intestines which are populated by a healthy gut microbiome. Also for plants to be able to grow and prosper, a well-balanced soil/root microbiome is essential.
The influence of the management system on the microbiome was first studied in an Austrian project on apples. Differences in microbiome between organic and non-organic management were confirmed for fresh rocket salad.

In our pilot project we wanted to study the differences between organic and conventionally grown tomatoes, and to study whether these differences were preserved after passage through the human gastro-intestinal duct. In case these observed difference between organic and non-organic fresh consumed vegetables would be transmitted into the human gut, it could contribute to human health.

Theory and method

Our hypothesis is that organically grown tomatoes contain more an better balanced bacterial and fungul microbiome species which, after fresh and non-processed consumption, are transmitted through the gastro-intestinal duct into the human gut, where it can contribute to human health.

We collect tomatoes from organic and non-organic growers in the Netherlands and have the microbiome analysed both from fresh tomatoes and after passage through an artificial gastro-intestinal tract system.

Results from the project

The number of growers included in this study was low, as we encountered problems due to prohibitions in privacy legislation. Therefore, we could not include sufficient tomato growers and thus ensuring uniformity of sampled varieties and rootstocks.

Samples that were collected and analysed for microbiome on fruits and leaves showed differences in bacterial and fungal profiles between organic and non-organic growers. Data for bacteria from organically grown tomatoes compared with those from non-organically grown tomatoes showed an overall larger alpha diversity, both in Shannon index and Faith's phylogenetic diversity. Faith's PD is also larger in bacteria and fungi on organically grown tomato leaves. The observed number of features is also higher in bacteria samples from organically grown tomato fruits and leaves, and also from fungi on leaves. Additionally, an overall significant difference in beta-diversity was found between bacteria samples from organic and non-organic grown tomato fruits and leaves (not for the fungi on leaves).
However, the beta-diversity analysis shows that there is a large diversity as well between the four companies included in this study which could also explain this result.
Pielou's evenness index is lower in bacteria samples from organically grown tomato fruits and leaves, indicating that in the organically grown samples a smaller number of species are dominant.

Due to low resolution of the obtained microbiome data and amount of microbiome DNA relative to confounding tomato DNA this part of the study in which samples passed through an artificial gastro-intestinal tract system was decided not to be carried out.

Conclusion

Data seem to confirm that differences between bacteria and fungi in samples from organic and non-organic grown tomato fruits and leaves have been found. However, beta-diversity indicated as Jaccard dissimilarity for bacteria on tomatoes grouped growers according to rootstock used, independent from management differences.

Further research should establish more insight and information about whether these differences in diversity are caused by variations between growers that are specific to organic or non-organic growing methods or other factors such as rootstocks used. Future study should also include a larger number of organic and non-organic growers, carefully record cultivation methods, and include more samples per grower.

Further, it is advised to consider such further study in a crop with no or less phytosanitary restrictions to facilitate the collection of samples of sufficient growers. And to start organizing sample collection from the seed and rootstock/plant producers onwards in the production chain, in order to ensure transparancy and uniformity of varieties and rootstocks, and avoid privacy regulations. All this to minimize differences other than the intended contrast in crop management: organic versus conventional, and thus maximum resolution within the data obtained.

List of publications

Final scientific report of this study - Publication number: 024-6245-LbP
downloadable from https://louisbolk.nl/en#publicaties