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Estonian University of Life Sciences

AGRO ECO 2020
3rd International Scientific Virtual Conference
AGROECOSYSTEM SUSTAINABILITY
Links between Carbon Sequestration in Soils, Food Security and Climate Change
Vytautas Magnus University Agriculture Academy, Lithuania, 2–3 December, 2020

Crop Rotation Outperform Organic and Conventional Cropping Systems in Structuring Soil Microbial Communities

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Introduction and Methods

Sustainable agriculture is the main aim in crop production. To identify the farming systems as well as crop rotation, as a conservative tools for maintaining soil fertility, that would be sustainable for a longer period, the field experiment was established at Estonian University of Life Sciences on 2008. The experiment was set up in systematic block design with four replicates of each treatment. The organic system had three subtreatments: Org0, org1 with cover crops, and org3 with cover crops and composted cattle manure. Conventional system had four subtreatments: $N_0P_0K_0$; $N_{40}P_{25}K_{95}$; $N_{80}P_{25}K_{95}$, and $N_{120}P_{25}K_{95}$,. The five-field crop rotation based on following order of the crops: barley with undersown red clover, red clover, winter wheat, pea, potato. Soil samples were collected on 2013 and 2018 (beginning and end of the second rotation). Soil genomic DNA samples were samplified by universal tagged primers and sequenced by Illumina Miseq. Bioinformatic tools were used to convert raw data to the result.

Figure 1: field experiment at Estonian University of Life Sciences, Tartu (58°22'N, 26°40'E) during 2008-2018. The size of each plot is 60 m^2 with soil type of *Stagnic Luvisol* (sandy loam surface texture, C 1,38% and N 0,13%, pH_{KCL} 6,0).

Conclusion

crop rotation and organic fertilizers led to an increase in the frequency, diversity and activity of bacteria and fungi,

Results

Microbial alpha-diversity

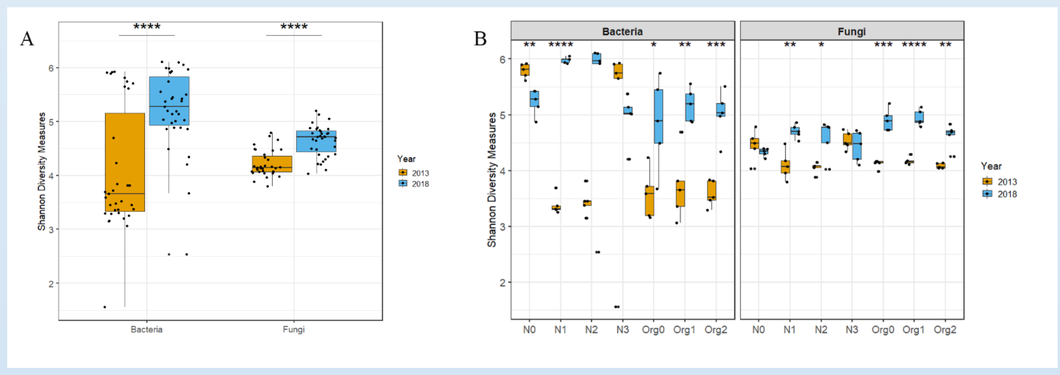

Fig. 2. Effects of crop rotation (A) and cropping systems (B) on bacterial and fungal alpha-diversities in 2013 and 2018 estimated by Shannon index.

Bacterial and to a lesser extent fungal diversity increased by the end of the rotation in all organic treatments and in conventional treatments with low to medium nitrogen rate (20-100 kg of nitrogen per hectare).

Microbial functional groups

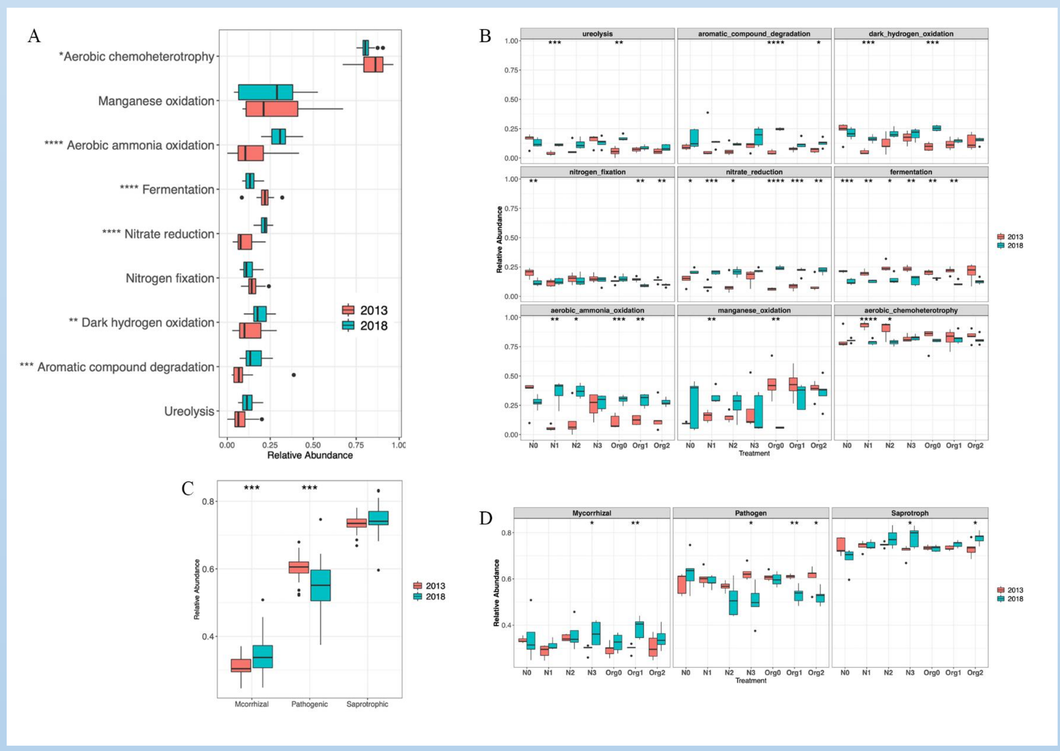

Figure 3: Most abundant bacterial and fungal functional groups in different years (A) and (C) in different cropping systems (B) and (D).

Crop rotation decreased pathogenic and increased mycorrhizal fungi abundance. Five years crop rotation significantly increased the relative abundance of aerobic ammonia oxidation, nitrate reduction, dark hydrogen oxidation and aromatic compound degradation and decreased fermentation and aerobic chemoheterotrophy relative abundance.

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This research was supported by European Social Fund's Dora Plus Programme

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