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► To cite this version:

Valérie Coudrain, Mickael Hedde, Matthieu Chauvat, Pierre-Alain Maron, Emilie Bourgeois, et al.. Temporal differentiation of soil biota communities and of trophic networks in response to arable crop management strategies. *Sféologie-2016, International Conference of Ecological Sciences, Société Française d'Ecologie (SFE)*. FRA., Oct 2016, Marseille, France. hal-01602967

HAL Id: hal-01602967

<https://hal.science/hal-01602967>

Submitted on 3 Jun 2020

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Temporal differentiation of soil biota communities and of trophic networks in response to arable crop management strategies

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Abstract

Promoting diverse and functional biological communities is an important objective of agroecology, with increasing attention given to the important role of soil biodiversity. In an experimental study conducted in actual field conditions, we followed over four years the dynamic of soil organisms from microorganisms to micro-, meso- and macro-fauna in a cropping system submitted to four different treatments that varied in tillage, residue management and N fertilization rate. Differentiation in taxonomic diversity, in the abundance and diversity of the multiple trophic groups and in food-web structure was evaluated. A co-statis analysis was used to investigate the joint dynamics of food-web structure and soil functions linked to C and N dynamics.

Our study demonstrated a delayed but effective differentiation in soil biota diversity following implementation of the agricultural practices. Soil biodiversity varied throughout time with some groups responding more readily than others. While tillage appeared a main factor of influence, surprisingly little impact of residue management and nitrogen fertilization could be observed. Significant interactive effect of year and treatment was found on the mean trophic level and the bacterial to fungal path ratio, but not on the number of trophic groups and Shannon's link diversity. Finally, co-statis analysis revealed significant differences in

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co-dynamics between food-web structure and soil functions over four years, mainly drove by conventionally tilled vs reduced tilled treatments.

Through its multi-taxonomic approach, the present study increases our understanding of the dynamic of soil communities in agricultural cropping systems and helps identify possible consequences for soil functioning.

Keywords: Trophic groups, Invertebrates, Microorganisms, Tillage, Plant residues, Fertilization, Functional traits