Organic World Congress 2020 | FRANCE

SEPTEMBER 21ST TO 27TH, 2020 IN RENNES
AT THE COUVENT DES JACOBINS • RENNES MÉTROPOLE CONFERENCE CENTRE
www.owc.ifoam.bio/2020

OWC 2020 Paper Submission - Science Forum

Topic 4 - Innovation in Organic farming: "thinking out of the Box"

OWC2020-SCI-1062

RELEVANCE OF REDUCED TILLAGE PRACTICES ON SOIL BIOLOGICAL, CHEMICAL AND PHYSICAL QUALITY AND ECOSYSTEM SERVICES UNDER ORGANIC FARMING CONTEXT IN BRITANY

Guénola Pérès[*1], Florent Lelu[1], Daniel Cluzeau[2], Patrice Cotinet[3], Yannick Bénard[4], Vincent Hallaire[4], Djilali Heddadj[3], Olivier Manceau[3], Safya Menasseri[1]

[1]UMR SAS, AGROCAMPUS OUEST, [2]UMR EcoBio, University Rennes 1, [3]CRAB, [4]UMR SAS, INRA, Rennes, France

Preferred Presentation Method: Oral or poster presentation

Full Paper Publication: Yes

Abstract: Avoiding or limiting ploughing under organic farming management remains a big challenge for organic farmers. By developing an holistic approach, the aim of this study was to evaluate the impact, under organic farming management, of different tillage techniques on soil biological, physical and chemical quality and ecosystem services. In an experimental site located in Britany (France) four tillage techniques were compared: conventional ploughing (CP), agronomic ploughing (AP), superficial non-inversed tillage (C15) and very superficial non-inversed tillage (C8). Results, obtained during 10 years (from 2003 to 2013), showed a strong temporal variability between years, however some results appeared consistent. Positive impact of reduced tillage on hydraulic conductivity and organic matter content was limited to the 0-5 cm depth. No-inversed tillage (C15, C8) and agronomical ploughing (AP) significantly improved microbial biomass. C8 is the only technique which significantly decreased nematofauna. Earthworm biomass significantly decreased under conventional ploughing (CP) due to the decrease of anecic species while ploughing techniques (CP, LA) preserved total earthworm abundance due to endogeic species. Endogeic species had a negative impact on hydraulic conductivity whereas anecic enhanced the conductivity and Carbon and Phosphorus contents. No-inversed tillage techniques (C8, C15) leaded to a decrease of the crop yield, due to an increase of weeds which increased water and nutritive competition. This study highlighted the interests and limits of no-inversed techniques and agronomical ploughing applied in organic farming management for enhancing soil quality and crop yield.

Introduction: While no-ploughing farming techniques are increasingly used by farmers all over the world, the relevance of these technique for improving soil quality remains under questions for organic farmers considering ploughing technique as one of their levers to manage weeds. Moreover, if the effects of no-ploughing techniques on soil properties are more and more documented, the holistic assessment, meaning the effect on biological, physical and chemical properties is still poorly documented. The aim of this study was, by developing a holistic approach, to evaluate the impact, under organic farming management, of no-ploughing farming techniques on soil biological, physical and chemical quality and ecosystem

services such as water regulation and crop yield. This study was part of the project SUSTAIN (European call SNOWMAN).

Material and methods: This study was conducted at the experimental site of Kerguéhennec (Britany, France).This site, subdivided in 4 blocks and managed under organic farming, presented a loamy texture, high organic matter content (4%), pH 6. Crop rotation was defined by maize/wheat/triticale. In each block, four tillage techniques were compared since 2003: conventional ploughing “CP” (ploughing at 25 cm depth), agronomic ploughing “AP” (ploughing at 15 cm deep), superficial no-inversed tillage “C15” (15 cm depth) and very superficial no-inversed tillage “C8” (8 cm depth). Biological (earthworms and nematodes community, microbial biomass), physical (hydraulic conductivity, bulk density) and chemical (Carbon, Nitrogen, Phosphorous, Organic Matter) measurements were realized over 10 years at height dates.

Results: Results, obtained from 2003 to 2013, showed a strong variability between years linked to climate conditions and crop. However, some results appeared consistent. No-inversed tillage techniques (C15, C8) had a positive impact on hydraulic conductivity at 5 cm depth, while conventional ploughing (CP) maintained better conductivity at sub-surface (15 cm depth) ($p>0.1$). No-inversed tillage technique (C8) significantly decreased bulk density. Furthermore, C8 increased organic matter content at 0-5 cm depth, while there is no difference between all treatments below (5-15 cm depth, neither 15-25 cm). No-inversed tillage (C15, C8) and agronomical ploughing (AP) significantly improved microbial biomass. Very superficial no-inversed tillage (C8) is the only technique which significantly decreased nematofauna. Earthworm biomass significantly decreased under conventional ploughing (CP) due to the decrease of anecic species ($p<0.01$) while ploughing techniques (CP, LA) preserved total earthworm abundance due to endogeic species ($p>0.1$). Endogeic species had a negative impact on hydraulic conductivity whereas anecics (*Lumbricus r. rubellus*) enhanced conductivity and Carbon and Phosphorus contents. In contrast, no-inversed tillage techniques (C8, C15) leaded to a decrease of the crop yield, due to an increase of weeds which increased water and nutritive competition.

Discussion: In conclusion, by a multi-parameters approach (biological, physical, chemical and agronomical parameters) this study highlighted the interests and the limits of no-ploughing farming techniques (C15, C8) in organic farming management for enhancing soil quality (figure 1). It also recommended the occasionally use of agronomic ploughing (AP) for limiting the development of weeds and enhancing the crop yield. In order to develop sustainable approach in organic farming, this mechanical action should be considered as one lever within wilder offer including length and diversity of rotation.

Figure

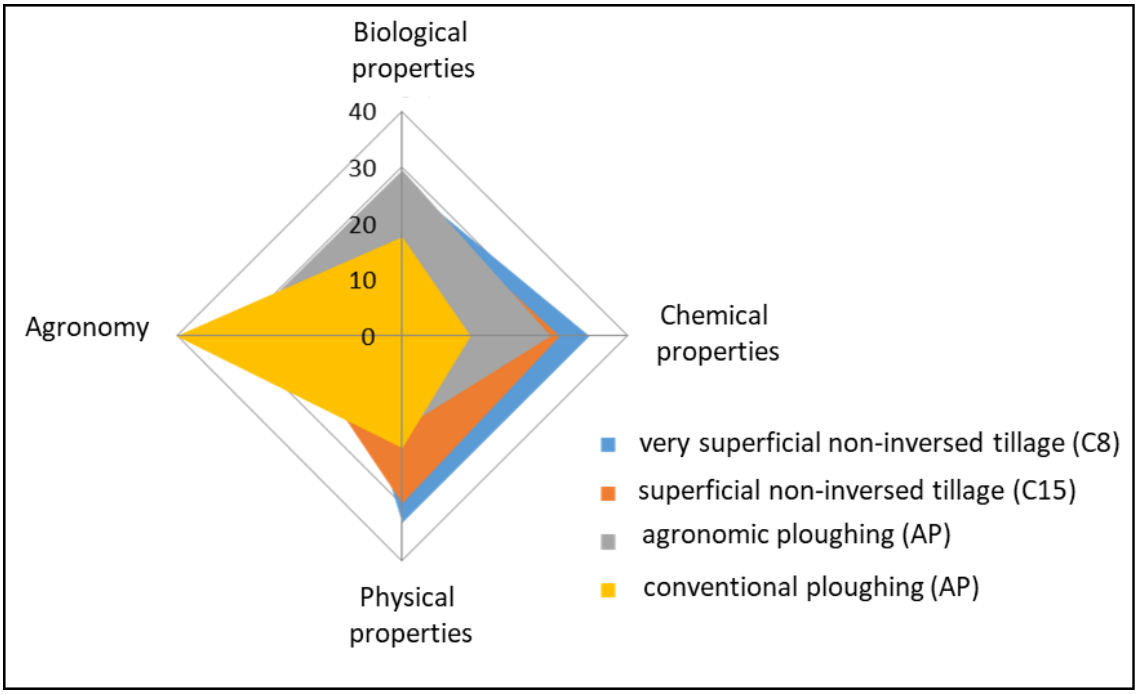

Figure 1: effect of four tillage practices on soil and agronomy properties

Disclosure of Interest: None Declared

Keywords: reduced tillage practices, organic farming, soil quality, soil biodiversity, ecosystem service, crop yield.