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Improvement of vineyard sustainability according to biogeochemical cycle of nitrogen in field

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1 Introduction

Good and yield wine production implies a well-balanced biogeochemical cycle of nitrogen (BCN) at field level e.i. in soil and in plant (Guilpart, *et al.*, 2014). Nitrogen is very important for grape quality and quantity and field sustainability. The mineralization of organic nitrogen, depending on soil microbial activity which is linked to soil cover crop management, is the main source of mineral nitrogen for the vine (Barlow *et al.*, 2009; Ingels *et al.*, 2005; Raath and Saayman, 1995; Thiebeau *et al.*, 2005). This paper is focused on a useful indicator fulfilling a sustainability assessment method: functional microbial populations implicated in BCN in vineyard field.

2 Materials and Methods

An experimental network with 6 platforms gathering 45 fields located in Atlantic coast (Loire valley and Bordeaux) and in North-East (Alsace) of France has been set up since 2012 (extract presented in Table 1). These vine sites represent a diversity of environmental factors (i.e. soil and climate) and the same method is used to assess them: agricultural, environmental, social and economical. The tested prototypes are tested according to the following goals: same yield, harvest quality, working time and production costs. The added value approach is based on assessing nitrogen dynamic in soil, i.e. nitrogen mineralization, regarding microbial biomass and activity.

Table 1. Alsacian sites-system characteristics.

Name	Site	Designed system	Vine age	Variety	Soil
Ribeau_AB	INRA-Ribeauvillé	Organic	16	Riesling	Loamy, sandy and clayey
Ribeau_PI		Integrated	16		
Rouff_PI	Rouffach agriculture school	Integrated	32	Pinot Gris	
Rouff_Piopti		Integrated-Rate-sprayingreduction	32		
Chaten_AB	OPABA-Chatenois	Organic and Biodynamic	17	Riesling	Sandy silty and clayey
Inger_AB	OPABA-Ingersheim		26		Sandy loam

3 Results – Discussion

For all AB-systems, functional richness (Fig.1A) at bud-break is very much higher than for all PI-systems (respectively 24-25 and 16-19). For sites Ribeauvillé and Rouffach, functional richness is not significantly different between designed systems at bud-break, whereas, for both sites, it is significantly different at veraison. Comparing all sites according to designed-systems, functional richness is significantly different between designed-systems at the two vine vegetative periods.

For all Designed-systems in a same site, bacterial abundance (Fig. 1B) is never significantly different between. At bud-break, bacterial abundance is between 28 and 45 ng/g of dry soil. For sites-systems Chaten_AB and Inger_AB, bacterial abundance is statistically different than the others sites-systems (respectively between 496-527 and between 65-141 ng/g of dry soil during veraison vine). One reason may be the number of years of organic farming in Inger_AB and Chaten_AB (more than 10 years) against less than 10 years for Ribeau_AB, and the others PI_Designed_system. Comparing all sites according to designed-systems, bacterial abundance is significantly different between designed systems only for veraison period.

Nitrogen mineralization kinetic (Nmin-kinetic) does not allowed to separate either PI and AB designed-systems, neither sites-systems (Fig. 1C).The top Nmin-kinetic is for Ribeau_PI site-system whereas the slowest one are for Ribeau_AB and Rouff_PI sites-systems. Rouff_Piopti, Inger_AB and Chante_AB sites-systems have touchily the same

Nmin kinetic.

It possible to separate PI and AB designed-systems according to PC2 axis of the PCA (Fig.1D): AB-systems under zero and PI-systems up to zero. Ribeauvillé-site is just on the y-axis for both systems AB and PI, i.e. there is no such difference between the two designed systems on this site. Inger_AB and Chante_AB are mainly explained by variables functional richness at bud-break and at veraison, whereas Rouff and Ribeau systems are mainly explained by bacterial abundance.

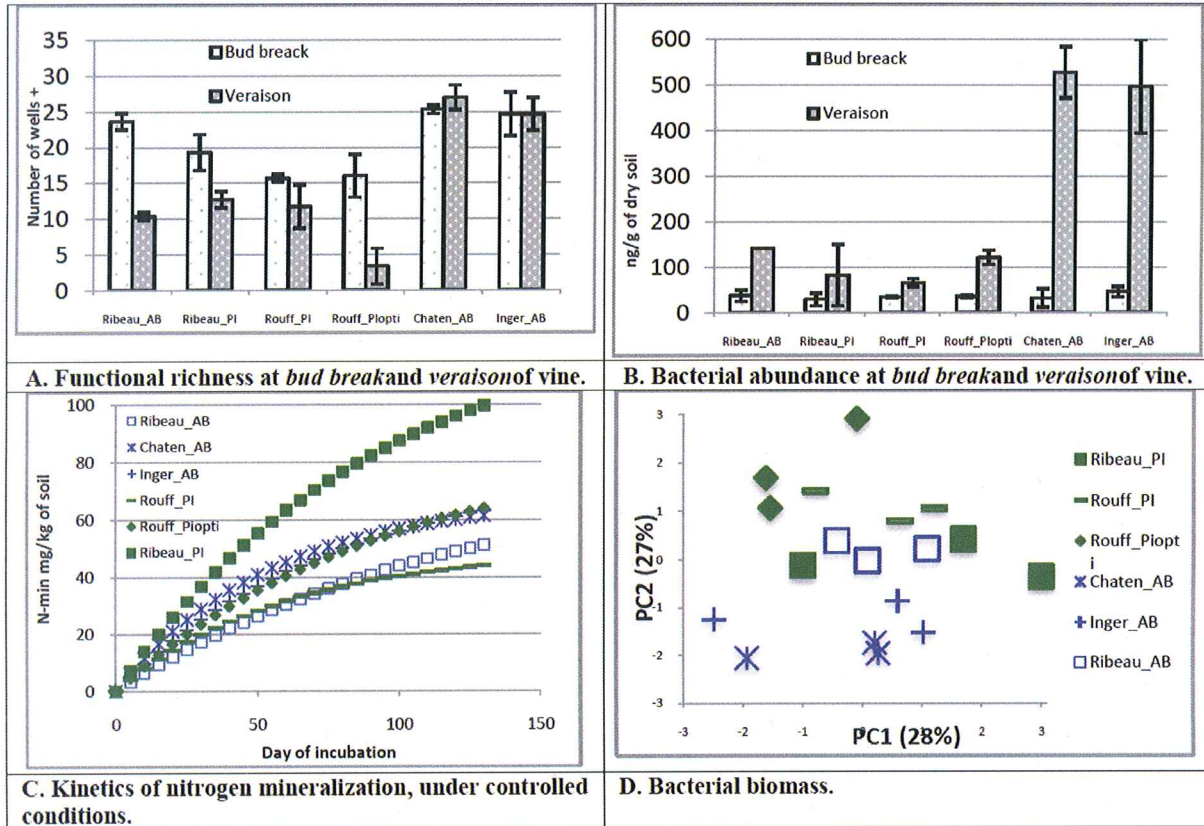


Fig. 1. Multicriteria results for all the sites-systems in Alsace, for 2014 vintage (France).

4 Conclusions

In this paper, we show that some of the analyzed BCN indicators are interesting to assess new designed-systems in different vineyard.

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