MICROBIAL VOLATILE ORGANIC COMPOUNDS IN AMENDED SOILS DETECTED BY PTR-MS TECHNIQUE

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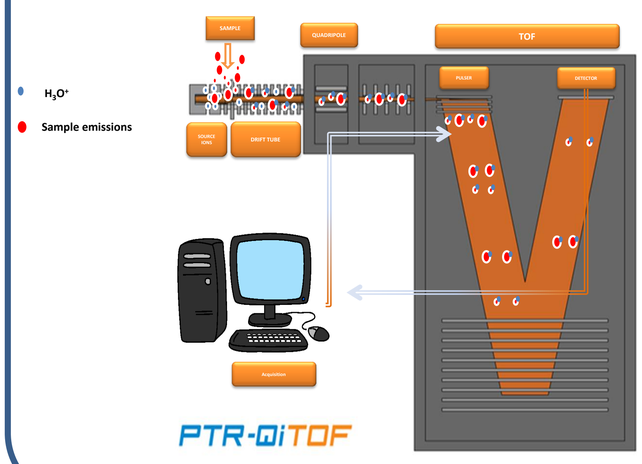
INTRODUCTION

The aim of this research is to determine whether soil amended with different organic waste have a differentiated volatile organic compound signature. All emissions are detected by the PTR-TOF-MS (Proton Transfer Reaction- Time of Flight- Mass Spectrometry) technique. We analyzed how the PTR-TOF-MS technique can be used for mVOC soil analysis and how results of the spectrum coming from mVOC emissions depends on the type of organic waste in the analyzed soil. First results of mVOCs released soils amended with 4 different organic waste are shown.

PTR-MS

HOW IT WORKS



ADVANTAGES

- SIMULTANEOUS ON-LINE MONITORING OF VOLATILE ORGANIC COMPOUNDS;
- LIMIT OF DETECTION <10 pptv

COUPLED WITH TIME OF FLIGHT:
- SPEED
- HIGH RESOLUTION

EXPERIMENTAL SET-UP

4 TYPES OF ORGANIC WASTE WITH AND WITHOUT N ADDITION:

AMENDED IN 2015

MSW: Municipal solid waste
GWS: Green waste and sludge
BIOW: Bio-waste
FYM: farmyard manure
CN: control without organic inputs

SAMPLES PREPARATION:

1. COLLECTED IN SOERE PRO FEUCHEROLLES FR (33 SAMPLES);
2. DRIED DURING 2 WEEKS;
3. HOMOGENIZED PASSING THE SOIL THROUGH A 2 MM SIEVE;
4. STOCKED IN A COLD CHAMBER (4 °C) UNTIL ANALYSIS
5. SAMPLES WERE REHYDRATED WITH 15mL H2O (60% WATER HOLDING CAPACITY)
6. EMISSION DURING 5 MIN FOR EACH SAMPLE (AIR FLUX RATE = 200 mL min $^{-1}$)

RESULTS

Results from the PCA analysis show a differentiation in three main groups (figure 1).
Results from BCA analysis have shown a differentiation of the CN and GWS+ samples and the rest (figure 1 and 2). The compounds mainly explaining the differences are given in Table 1 and 2.

Table 1. compounds identification affecting CN patterns in the PCA

Masses	91.05	91.06	91.07	93.03	94.03	109.06	110.06
Formula	(C2H6N2O2)H+	(C4H10S)H+	(C4H10S)H+	(C6H5O)+	(C6H5O)H+	(C7H8O)H+	(C6H7NO)H+
Name		Isopropyl Methyl Sulfide	Isopropyl Methyl Sulfide	Toluene		Methoxybenzene	

Table 2. compounds identification affecting GWS+ patterns in the PCA

Masses	62.02	98.09	104.06	143.13	144.14	157.15	158.16
Formula			(C8H8)+	(C9H18O)H+	?	(C10H20O)H+	?
Name				Nonanal/ nonanone		Decanal/ Decanone	

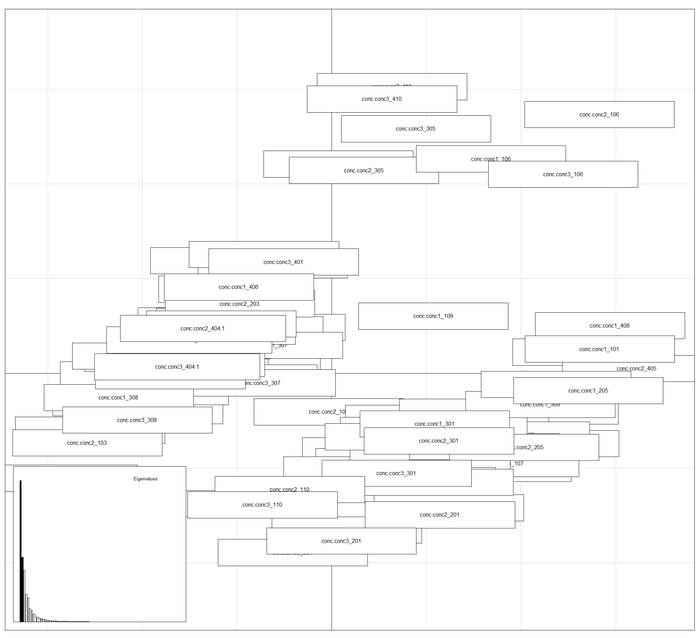


FIGURE 1. Results from PCA analysis . Numbers in the labels are related to a specific parcel in the field (Feucherolles site).

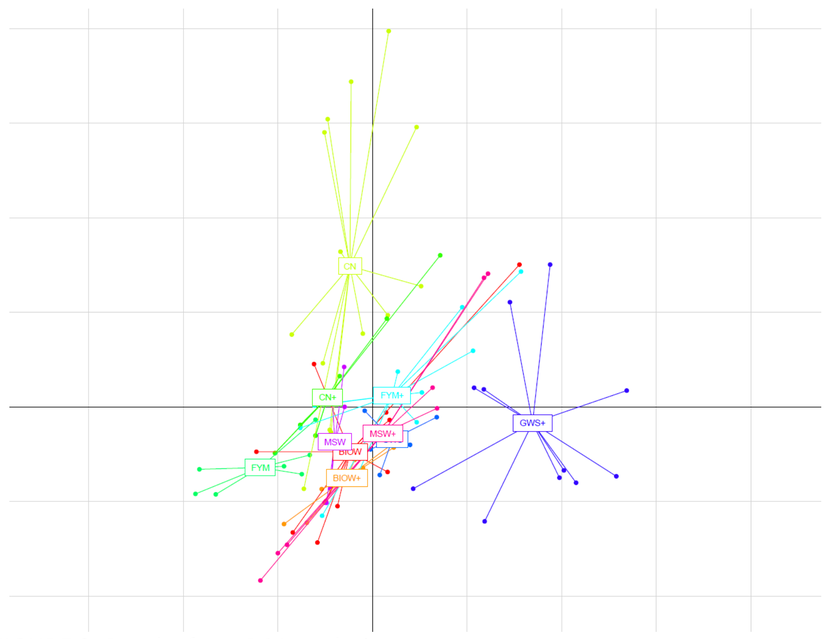


FIGURE 2. Results from BCA analysis.
MSW: Municipal solid waste, GWS: Green waste and sludge, BIOW: Bio-waste, FYM: farmyard manure, CN: control without organic inputs
(+) = parts of the field with optimal N mineralization

PCA & BCA

Principal component analysis (figure 1) is a procedure for identifying a smaller number of uncorrelated variables (in this case 2 variables=principal component) from a large amount of data. The goal is to explain the maximum amount of variance with the fewest number of principal components. Between Class Analysis follow the same principle of the PCA giving more importance to the differences between classes (classes= type of organic waste)

Hierarchical cluster analysis in figure 3 put in evidence a pattern: samples with an optimal N concentration tend to stay in one big family (blue labels). On the other hand, samples with a low N concentration settle in one big family. Figure 4 shows how VOCs profile emitted from one sample can be related to samples coming from the same type of organic waste in the soil. Little families coming from the same type of organic waste are shown in colors.

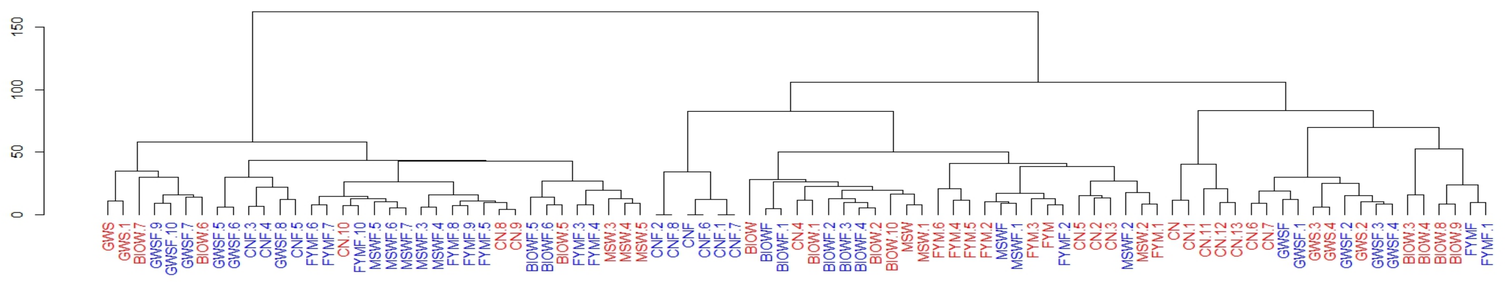


FIGURE 3. Hierarchical Cluster analysis. Blue= optimal N mineralization, Red= Low N mineralization

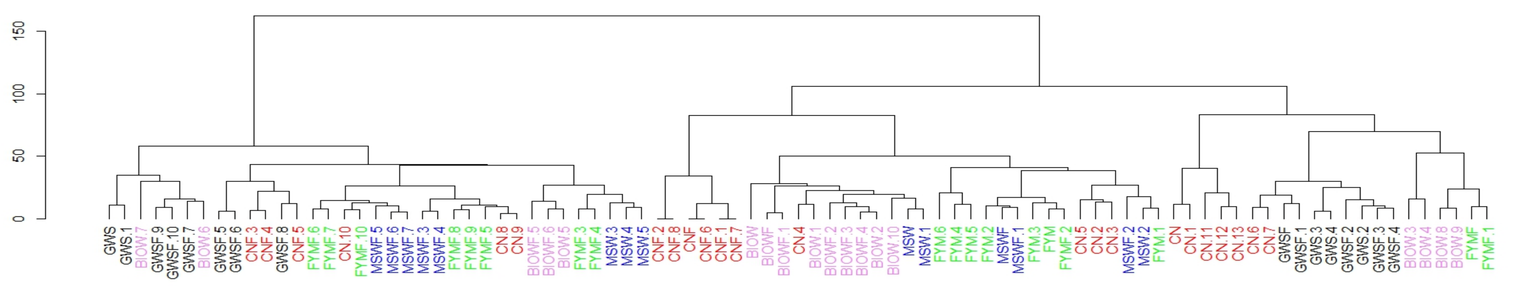


FIGURE 4. Hierarchical Cluster Analysis, **MSW: Municipal solid waste, GWS: Green waste and sludge, BIOW: Bio-waste, FYM: farmyard manure, CN: control without organic inputs**
(F) = parts of the field with optimal N mineralization

HCA

How hierarchical cluster analysis (fig. 3 & 4) require a distance matrix with Euclidean distances between samples (equation 2):

$$d(\mathbf{p},\mathbf{q}) = \sqrt{\sum_{i=1}^{n}(q_i - p_i)^2}. \quad (2)$$

Where p and q are two concentrations of the same compound released from different samples. Based on Euclidian distance , we perform Ward.D2 HCA using R.

CONCLUSION AND FUTURE WORK

We can narrow the results from the PCA and BCA into three main groups based on their common patterns. Given our current state of the analysis, we can so far explain that the patterns behind CN and GWS+ position in the PCA are affected by the list of compounds in table 1 and 2. The relationship between samples can be affected by the chemical composition of the soil. Other PCA concerning soil chemical analysis are planned in order to relate the influence of the chemical composition in soil to the microbial VOCs emission. Hierarchical analysis highlight: (1) a different pattern between optimal and low N concentration, (2) different patterns concerning all the type of organic waste. In conclusion, these preliminary results show a non-definitive relationship between the type of organic waste in the soil and the VOCs spectrum emitted from each sample.

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