George Bekiaris

• PhD student at: Nationality: Supervisor:
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• Subproject title:
  – ESR-3-1: New spectroscopic and thermogravimetric methods for determining manure composition and degradability

• Start date: 01-09-2012

• Educational background:
  – B.Sc./ M.Sc. in Agricultural Science / Agricultural University of Athens
  – M.Sc. in Biotechnology/ Agricultural University of Athens

• Research and work experience:
  – Conferences: “IMA 2011-Instrumental Methods of Analysis-Modern Trends and Applications” (poster presentation)
Manure organic matter and nutrient characterization: New spectroscopic methods for the determination of manure composition

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Introduction

A very important aspect for the use of waste as source of energy and fertilizers is the speciation of the different elements (Hansen et al., 2004, Toor et al., 2005). Spectroscopic methods can be very efficient techniques for characterization of the speciation (Malley et al., 2002, Toor et al., 2006, He et al., 2007).

Research objectives

The main objective of this project is to develop spectroscopic methods for the characterization of manure in terms of phosphorus, nitrogen and carbon speciation. Advanced chemometrics will be used to create prediction models of the usefulness of the manure as assessed in assays (Fig. 2):

Materials and Methods – Research plan

Samples collections:
• 69 manure samples (different areas, separation techniques and treatments) + 12 manure biochars
• 17 sludge samples (different treatments or areas) + 50 potential reed bed sludge samples
• 5 household wastes
• Potential samples from the ReUseWaste partners

Spectroscopic methods:
• X-Ray absorption near edge structure (XANES) spectroscopy [phosphorus speciation (Toor et al., 2006)] (Fig. 1)
• Fourier Transform Infrared Reflectance Photoacoustic (FTIR-PAS) spectroscopy [phosphate species and characterization of organic matter (Mao et al., 2008)]
• Near Infrared (NIR) spectroscopy

Assays of usefulness of the manure (Fig. 2):
• Phosphorus plant availability [Diffusive Gradients in Thin-films (DGT)]
• Carbon and nitrogen mineralization [incubations]
• Biochemical methane potential [BMP tests]
• Ash

Results – Work outline

Half of the samples has already been incubated for nitrogen and carbon mineralization or incubated during this period. The rest of them will be incubated later. Meanwhile, spectroscopic analysis with XANES, FTIR-PAS and NIR will be done to characterize the samples in terms of phosphorus, nitrogen and carbon speciation. After the incubations, all the data will be used to create prediction models.

References

Individual results and impacts

- Individual results - secondments/deliverables/outreach/dissemination:
  - No results yet (ongoing incubations, spectroscopic measurements)
  - Possible secondment in Canadian light source facilities for XANES measurements (spring 2014) and in the University of South Australia for the processing of the XANES results with professor Enzo Lombi.

- Impact of work in the project:
  - Skills improvement/techniques/knowledge acquired during the project
    - Spectroscopic techniques (XANES, FTIR-PAS, NIR)
    - Lab experience (incubations, BMP tests, DGT)
    - Multivariate analysis
    - Conferences, Meetings etc.
  
  - Future: How will participation in RUW improve your career perspectives? What will you do after the project?
    - Gain experience and knowledge
    - Extend Network
    - PostDoc