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Oral presentations

Parallel session 1

19. Ferti-Dig: a French approach to optimize the agronomic benefits of on-farm digestates through typology establishment and assessment of the effects on agroecosystems

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Introduction

To address climate change, and optimize agricultural resources, anaerobic digestion (AD) has rapidly grown in Europe, particularly in France, supported by European and national policies (EBA, 2022). AD recycles organic waste into renewable energy (biogas) and generates digestates (biofertilizer). In France, 73% of AD plants are on-farm, producing digestates for agricultural use (ADEME, 2024). A major challenge is understanding digestates' agronomic properties to optimize their benefits for soil quality and crop growth and avoid harmful environmental and health impacts (Nkoa, 2014). This requires establishing references and characterizing the factors influencing digestates properties, which vary due to feedstocks, post-treatments, and AD conditions (Guilayn et al., 2019). The French "Ferti-Dig" project aims to contribute to this understanding by (i) classifying on-farm digestates based on a comprehensive physicochemical properties database, (ii) linking this typology with effects on soil and agronomic properties, and (iii) producing a user-friendly fertilization guide.

Methodology

To achieve the research objectives, two databases were created: (i) the physicochemical description of 608 digestates and associated AD plant conditions, and (ii) field-effect indicators from twenty field trials, including crop available nitrogen, soil biological, and physical indicators. Missing data were addressed by sampling and characterizing 30 additional digestates and conducting four field experiments in 2022 across two French regions with contrasted pedoclimatic conditions. Statistical analysis was then applied to the first database to propose a digestates typology and assess their impacts on agroecosystem indicators from the second database.

Results and discussion

Hierarchical classification of the physicochemical database identified seven groups of digestates, based on AD process conditions (wet or dry), post-treatments (phase separation and composting), and main feedstocks (cattle manure, vegetal biomass, pig slurries co-digested with agro-food or biowastes). Depending on the feedstocks, obtained digestates presented either more soil improver-like properties (high dry matter, low available nitrogen content, high C/N) as for cattle manure or more fertilizing properties (low dry matter, high available nitrogen content, low C/N) as in pig slurry co-digestion. Post-treatments exacerbated these properties. The typology is significantly correlated to certain indicators, such as agronomic properties (e.g., C and N mineralization on soil) and nitrogen fertilizer replacement value, with high variability explained by the type of crop fertilized, spreading methods, and pedoclimatic conditions. However, the available data were insufficient to conclude about the impact of the typology on indicators related to soil quality (microorganisms, structural stability). Moreover, the impact of farming practices and pedoclimatic conditions also added complexity to understanding the typology's effects. Based on the compiled database (<https://doi.org/10.57745/M1JSU5>), digestate fact sheets were created detailing properties, soil improver and fertilizer value, application practices, and regulatory alerts, and are included in a user guide accessible online: <https://fertiliser-avec-des-digestats.fr>.

Conclusion

The digestates typology was relevant for describing their soil improver and fertilizing potential. However, variability in field indicators highlights the need to consider agricultural practices and pedoclimatic conditions to ensure optimal crop growth and avoid environmental harm. Ferti-Dig made research data accessible through an online guide, aimed at becoming a reference on on-farm digestates in France.

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