

Are biobased fertilizers an alternative to chemical fertilizers in promoting sustainable and circular economy processes?

¹Carmo Horta, ²Verónica Oliveira, ³Berta Riaño and ⁴María Cruz García-Gonzalez

¹*Polytechnic Institute of Castelo Branco, School of Agriculture, Quinta da Sra. de Mércules, 6001-909 Castelo Branco, Portugal.* ²*CERNAS-IPCB Research Centre for Natural Resources, Environment and Society. Polytechnic Institute of Castelo Branco, 6001-909 Castelo Branco, Portugal*

²*Polytechnic Institute of Coimbra, Applied Research Institute, Rua da Misericórdia, Lagar dos Cortiços - S. Martinho do Bispo, 3045-093 Coimbra, Portugal.* ⁴*Research Centre for Natural Resources, Environment and Society (CERNAS). Polytechnic Institute of Coimbra, Bencanta, 3045-601 Coimbra, Portugal*

³*Agricultural Technological Institute of Castilla y León, Ctra. Burgos, Valladolid, Spain*

⁴*Superior Technical School of Agricultural Engineering, University of Valladolid, Avda. de Madrid, 57, 34004 Palencia (Spain).*

Abstract

To maintain or increase the agricultural production, the soil fertility level is a critical factor. Therefore, fertilizers are needed to improve soil fertility and consequently, plant nutrient uptake. These fertilizers can become from two kinds of sources: i) mineral natural resources (e.g. phosphate rocks) or ii) organic amendments provided by waste streams, such as livestock effluents, agricultural residues and urban wastes. In order to save fossil fuel reserves and natural sources of nutrients used to manufacture the mineral fertilizers, the use of nutrients from those organic amendments is considered a sustainable agricultural practice. Currently, the intensification of the livestock production causes the production of high amounts of a liquid effluent called slurry, consisting of animal excrement and washing water from the livestock facilities. Since slurry also contains organic matter, it has a high level of biodegradable organic compounds (high BOD level), which caused negative effects when discharged in waterbodies without treatment. The anaerobic digestion process, applied to valorize this slurry, has proved to be a good sustainable option. Also, the organic fraction of the municipal solid wastes (MSW) can be used to produce biogas through the anaerobic digestion process. So, the products resulted from the anaerobic digestion of these organic materials are (i) biogas (CH₄) which is a source of energy that can be used for example in the livestock facilities, for crop irrigation, etc., and (ii) digestate, a final product (effluent) containing nutrients and organic matter that can be used as soil fertilizer, if it meets each country regulations.

In addition to the use of digestate directly or after composting as a soil fertilizer, it can be treated by physical-chemical processes which allow the extraction of major nutrients, namely nitrogen and phosphorus, to obtain mineral biobased fertilizers (Horta et al., 2022; Oliveira et al., 2021). These mineral biobased fertilizers have the advantage of having a known mineral composition and an easier transportation. So, the use of the circular economy processes to the valorization of the livestock and urban effluents allows to (i) increase the competitiveness of the agricultural and animal production and (ii) save natural resources as well as can contribute to develop industry to support the above-mentioned recovered process. In this work we will present an overview of the development of biobased fertilizers, and of the agronomic results obtained with the fertilization with two different mineral biobased fertilizers. One mineral biobased fertilizer was the secondary struvite obtained from phosphorus recovered from the anaerobically digested organic fraction of municipal solid waste through the electro-dialytic process and chemical precipitation. The other is a liquid ammonium sulphate fertilizer obtained from the gas-permeable membrane (GPM) technology to recover N from an anaerobic digestate from livestock production. The agronomic results showed that these biobased fertilizers, providing N and P to crops, have the same or even higher agronomic value than the traditional NP mineral fertilizer

Keywords: Agronomic effectiveness, Nitrogen fertilizers, Phosphorus fertilizers, Wastes valorization.

References

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Acknowledgments: This research was funded by National Funds through FCT—Foundation for Science and Technology under the Project [UIDB/00681/2020] [CERNAS-IPCB]. The European Union funded the work for the recovery of nitrogen with the gas permeable membranes through the Project Life+ AMMONIA TRAPPING (LIFE15-ENV/ES/000284). Verónica Oliveira thanks the National funding by FCT - Foundation for Science and Technology, P.I., through the institutional scientific employment program-contract (CEECINST/00077/2021).