Manure biostabilization as a way to improve its agronomic value

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Effective microorganisms (EM) are mixed cultures of beneficial naturally-occurring organisms that can be applied as inoculants to increase the microbial diversity of an ecosystem. The concept of EM was developed in the 1980s (Higa, 1991). EM contains selected species of microorganisms including predominant populations of lactic acid bacteria and yeasts, photosynthetic bacteria and other types of organisms. All of these are mutually compatible with one another and can coexist in liquid culture.

The traditional logic behind effective microorganism is based on a media inoculation with mixed cultures of beneficial microorganisms to create a more favourable environment for plant growth and health when the media is the soil. Olle and Willians (2013), studied the effect of EM when applied to soil on growth, yield, quality, and protection of vegetables, stated that 70% of published studies on this issue concluded that EM had a positive effect on growth of plants. The same authors concluded in another paper (Olle and Willians, 2015) that EM interact with the soil-plant ecosystem to suppress plant pathogens and agents of disease, to solubilise minerals, to conserve energy, to maintain the microbial-ecological balance of the soil, to increase photosynthetic efficiency, and to fix biological nitrogen.

Following this rationale, other research works have been focused on studying the effect of EM when they are included in animal diets. Ballena (2011), in a study with laying hens, concluded that the application of EM in feeds improved production and economic parameters in hen farms, becoming a viable alternative in poultry production.

The purpose of this research is to go one step further in the study of potential uses for MS and evaluate the influence of effective microorganisms on the biostabilization of manure before its use as a fertilizer. For this, two treatments are proposed in pig, cattle and poultry farms: 1. with the addition of effective microorganisms to the slurry; 2. without addition of effective microorganisms to the slurry (control). In both experiments, a study of the evolution of manures will be carried out with special attention to the parameters of agronomic interest: organic matter, organic carbon, humic acids, fulvic acids, nitrogen (total, ammoniacal, organic, nitric, ureic), phosphorus, potassium, calcium, magnesium, sodium, sulphur, chlorides (all of them total and soluble), metals and pathogens (*E. Coli* and *Salmonella*), among others, without forgetting aspects of animal welfare, such as ambient air quality and the presence of odours.

Figure 1. Selected demo sites for manure biostabilization: a) poultry farm Casasblancas; b) cattle farm Santa Rosalía; c) pig farm Copiso.

The study will be carried out in three Spanish farms as selected demo cases (Figure 1). As EM source, a commercial product (Polizymes, Agrozymes S.L., Spain) will be used. Species used in this EM mixed culture of beneficial, naturally-occurring micro-organisms, include phototrophic bacteria (e.g., *Rhodopseudomonas palustris, Rhodobacter sphaeroides*), lactobacilli (e.g., *Lactobacillus plantarum, L. casei, and Streptococcus lactis*) and yeasts (e.g. *Saccharomyces spp*.) presented as a liquid suspension in a natural environment based on sugar cane molasses (Figure 2).

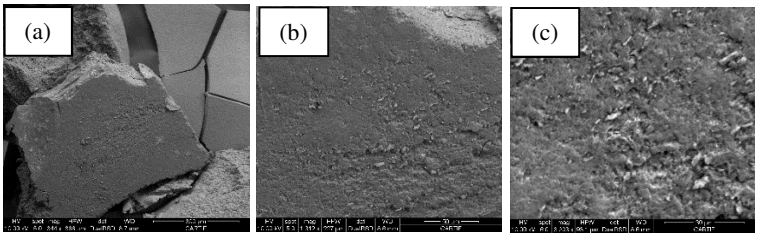

Figure 2. SEM images of EM mixed culture on sugar cane molasses basis: (a) x300; (b) x1300; (c) x3200.

The mixed culture contains aerobic and anaerobic microorganisms that produce the breakdown of organic matter. Manure fermentation is an anaerobic process in which microorganisms and complex organic molecules break down into simpler organic parts that can often be directly absorbed by plants. During fermentation, little energy is generated compared to aerobic decomposition of the same substrate through the same group of microorganisms. Aerobic decomposition causes a complete oxidation of a substrate and releases a large amount of energy, gas and heat, producing carbon dioxide and water. The microflora of the soil and the root environment (rhizosphere) enhances the growth of plants and increases their capacity to resist diseases and parasites through the production of bioactive substances.

The aim of the lactic bacteria is to transform part of the carbohydrates into lactic acid with a resulting effect that is the lowering of the pH with great control of pathogenic microorganisms. Phototrophic bacteria carry out incomplete anaerobic photosynthesis, being very useful because they will be capable of detoxifying the manure of toxic substances for the plant that are formed during fermentation. They are also able to conserve nitrogen during the transformation of the manure.

The selected microorganisms constitute the growth environment of the plants with a great rooting and biostimulant effect, directly affecting the quality of the crops and the soil. The biostabilized manure, when applied to the soil, it is expected that progressively inhibit the attack of other bacteria and microorganisms that cause pathologies by having a colonizing effect on the ground due to the displacement produced by the space they occupy and by reducing their power supply.

Field trials with raw and biostabilized manure will be carried out in cereal and vineyard crops in order to assess the yield of the crops production (Figure 3).

Figure 3. Selected demo sites for crop testing: a) cereal fields Casasblancas; b) vineyard Santa Rosalía.

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References

- Ballena, K. M. (2011). Efecto del uso de microorganismos eficaces (Bacterias Fototróficas, Bacterias Ácido Lácticas y Levaduras) en el alimento sobre los parámetros productivos de gallinas de postura de la línea Lohmann Brown. Doctoral Thesis. Universidad Nacional de Trujillo. http://190.223.54.254/handle/UNITRU/10188. Last access 30/12/2019.
- Higa, T. (1991). Effective microorganisms: A biotechnology for mankind. p. 8-14. In J.F. Parr, S.B. Hornick, and
C.E. Whitman (ed.) Proceedings of the First International Conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington, D.C., USA.
- Olle, C., Williams, Y. (2013). Effective microorganisms and their influence on vegetable production – a review. Journal of Horticultural Science & Biotechnology, 88 (4), 380-386.
- Olle, M., Williams, I. (2015). The influence of effective microorganisms on the growth and nitrate content of vegetable transplants. Journal of Advanced Agricultural Technologies Vol, 2(1), 25-28.