NATAE
North African Transition to AgroEcology

Improved agroecological use of manure in the Mediterranean and prospects for combining it with biostimulants

Agroecological zones

All areas combining agriculture and livestock farming

Introduction

Source: INAT, Tunisia

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Manure has been used in Mediterranean farming systems since the domestication of animals. However, management practices are evolving. In agroecology, it is advisable to compost manure to improve its quality as an organic fertilizer and avoid environmental and health risks. Ongoing research in the Mediterranean is also testing the combination of manure with biostimulants to accelerate crop growth and resistance to abiotic stresses (drought, salinity, etc.).

The importance of manure in agroecology and its limitations

Manure is an essential source of **organic matter** in agroecological systems. It is particularly important in Mediterranean soils, where organic matter degrades rapidly.

- **Nutrient enrichment of the soil**: Manure provides nutrients (nitrogen, phosphorus, potassium), which it releases slowly, making it more plant-friendly than rapid chemical fertilization, which is often subject to leaching losses. The use of manure reduces or eliminates the need for chemical fertilizers, which benefits both the environment and farm profitability.

- **Improved soil structure**: Manure enriches soil organic matter, improving its structure, water retention capacity and cation exchange capacity. It limits erosion and encourages root growth.
- **Renewal of soil biodiversity**: Manure stimulates soil microbial activity, helping to maintain biological balance and improve soil health.
- **Agricultural waste management**: Manure valorises organic waste from livestock.

Although it is an excellent soil improver and natural fertilizer, manure has certain limitations:

- **Risk of contamination**: Manure may contain pathogens (bacteria, parasites or viruses) that can contaminate crops and soil. Manure can also contain viable weed seeds, increasing the presence of weeds. It can sometimes introduce invasive weed species in the farm.
- **Risk of pollution**: Poor manure management can lead to air, soil and water pollution (volatilisation of nitrogen, leaching of nutrients and contaminants, etc.). Excessive application of manure can lead to an overabundance of nutrients, particularly nitrogen, phosphorus and potassium. This can lead to groundwater pollution following the leaching of excess nutrients, particularly nitrogen, which is highly mobile in the soil.

Improving the use of manure in agroecology

Several good practices limit the risk of contamination and maximize the benefits of manure:

a. Manure composting

During composting, manure is mixed with other organic matter (straw, leaves, other plant residues) to balance the ratio of carbon to nitrogen.

Composting manure before applying it to fields eliminates health risks and reduces the viability of weed seeds. Composting manure ensures optimum nutrient concentration, stabilizes nitrogen, limits methane emissions during manure storge and increases nutrient availability to plants.

This image was created using Artificial Intelligence (DALL-E 3)

Good composting methods avoid or limit the loss of nitrogen in the form of ammonia:

- The desired ratio between the elements carbon (C) and nitrogen (N) is between 20 and 30.
- Straw provides readily available carbon, but wood chips require a long composting period or the addition of sugar-rich materials (molasses).
- Compost should not be too damp and should be well aerated.
- In poultry manures, the addition of acidifying materials, such as fruit juice or potato waste, limits nitrogen losses.

The compost windrow should be located in a part of the field where water does not collect, ideally in a slightly elevated area, and should be covered with a geotextile to limit leaching losses.

b. Applying manure

Manure, like all fertilizers, must be applied in the right quantities and at the right time. Different crops have different total requirements and nutrient uptake dynamics, including humic compounds. In an agroecological context, manure applications must be rationed according to the needs of the crop and soil characteristics, to avoid excesses and minimize nitrogen losses.

Recommended compost inputs are:

- **On sandy soils**: 30 t/ha for field crops and 40 t/ha for market garden crops (every two years).
- **On clay-textured soils**: 10 t/ha for field crops and 30 t/ha for market garden crops (every two years).

The use of dehydrated or granulated manure can facilitate application on drier soils or during periods of low humidity.

Organic mulch combined with manure allows nutrients to be released slowly and evenly, while protecting the soil from erosion and temperature variations.

Combining biostimulants with manure: agroecological research in the Mediterranean

a. Expected benefits

Biostimulants are products of natural origin (or soft synthesis) that act on plant physiology. They are not fertilizers in the strict sense of the term, but can act as a complement to organic soil improvers such as manure.

Biostimulants are mainly used to:

- **Stimulate root growth** and improve nutrient absorption.
- **Improve tolerance to stress** (drought, salinity, high temperatures, etc.).
- **Increase resistance to disease** and parasites.
- **Enhance the synthesis of plant hormones** that regulate plant metabolism.

The combined use of manure and biostimulants in agroecology is an innovative approach that can maximize the benefits of manure while optimizing plant response to Mediterranean environmental challenges such as drought, salinity and soil poverty. Promising research is underway.

- **Improving soil fertility and health**
  - Adding biostimulants to manure can improve the **mineralization** of manure **nutrients**, by enhancing the activity of micro-organisms and earthworms.
  - **Humates** (derived from decomposed organic matter) and **fulvic acids** are biostimulants that promote the release of nutrients from manure, while increasing water retention capacity and improving soil structure.

- **Increased resilience to abiotic stresses**
  - **Amino acids**, **algae extracts** and **humic acids** can boost plant resistance to extreme climatic conditions, such as the prolonged dry spells typical of the Mediterranean.

- **Synergistic effect of manure and biostimulants on cereals and fruit crops**
  - For **cereal crops** such as wheat or barley, the combination of manure and biostimulants improves root growth and resistance to fungal diseases, while optimizing absorption of the nitrogen released by the manure.
  - In **olive groves**, algae- and root-based biostimulants can boost fruit production, improve photosynthesis and enhance drought tolerance.

b. Practical details

- **Biostimulants formulations**

Biostimulants can be formulated in different ways: liquid, granulated or solid. Liquid formulations can be sprayed directly onto plants or applied to the soil to improve nutrient uptake by roots.

- **Application of manure and biostimulants**
  - **Method**: Composted manure and biostimulants can be mixed in an aqueous solution or applied separately. Dosages must be adapted to soil type and crop objectives.
  - **Frequency**: Application may be annual or bi-annual, depending on crop nutrient requirements and soil conditions. A **soil analysis** is recommended before any application to adjust doses.

Challenges and limitations

Research is still needed into the types of biostimulants, doses and application methods best suited to Mediterranean crops. Some recent results are promising.

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