PROMEDRICE
PROTECTING MEDITERRANEAN RICE-BASED AGRO-ECOSYSTEMS

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FACTSHEETS

COMPOST IN RICE AGRO-ECOSYSTEMS

Why use compost?

Agricultural soils in the Po Valley (North Italy) have experienced a progressive decline in organic matter content, with soil carbon concentrations, generally around 1–2%, with negative consequences for soil fertility and the provision of ecosystem services. In this context, compost can be an effective strategy for restoring soil organic matter while recycling nutrients from organic residues within a circular-economy framework.
Compost, which is produced through the aerobic biological treatment of organic waste and sewage-sludge-based feedstocks is primarily used as an organic soil conditioner. It supplies stabilized organic matter and nutrients, improving soil properties in the medium to long term.

Its application can improve several soil properties, including:

- soil organic matter and chemical, physical, and biological properties;
- cation exchange capacity and water-holding capacity;
- soil structure and microbial activity;
- nutrient availability, particularly phosphorus.

However, its use must be optimized in order to minimize the environmental impact of compost production and transportation.
Potential limitations include the presence of contaminants, such as heavy metals, and variability in nutrient availability, which strongly depends on the compost quality and maturity. Furthermore, nitrogen is predominantly present in organic forms and must therefore undergo gradual mineralization before becoming available to plants. Consequently, nitrogen release from compost is slower than from mineral fertilizers.

How to apply compost?

Compost should be regarded as a soil conditioner that has a gradual and long-term effects. Its effectiveness depends on product quality, application rate and timing.
In general, compost should be applied during soil preparation, before sowing and flooding, to facilitate its incorporation and interaction with the soil (Figure 1).
In rice-based systems, compost application should be integrated into a balanced fertilization program that considers the gradual mineralization of organic nitrogen and the potential for nitrogen losses through leaching or gaseous emissions.



Figure 1 - Compost application at the PROMEDRICE experimental site.

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What did we observe in PROMEDRICE?

During the two experimental seasons, different application rates of compost were used, with the compost being applied a few days before plowing.

2024 – Compost application rate 50 t ha^{-1}
The material had a pH of 6.4, a total nitrogen concentration of 2.13%, a C/N ratio of 16.9, and a moisture content of 42.01% (Table 1). Grain yield reached 7.71 t ha^{-1}, which was 6.5% lower than the untreated control (Table 2). The crop exhibited high vegetative vigor, which delayed grain maturation. Unusually low temperatures in September prevented the complete maturation of panicles on secondary tillers.

2025 – Compost application rate 70 t ha^{-1}
The compost application rate was increased by 40% compared with the previous growing season. The material had a pH of 8.4, a total nitrogen concentration of 2.16%, a C/N ratio of 13.5, and a moisture content of 43.2% (Table 1). Grain yield in the compost-treated plot reached 8.46 t ha^{-1}, corresponding to an increase of 11.8% compared with the untreated control (Table 2).

After only two growing seasons and two compost applications, soil organic matter increased by 52.38%, organic carbon by 52.81%, and total nitrogen by 65.06% relative to the pre-trial values measured in 2023.

Table 1 - Characteristics of the compost applied in the two years of experimentation

Year	Application rate (t ha^{-1})	pH	C/N ratio	Total N (%)	Moisture (%)
2024	50	6.4	16.9	2.13	42.01
2025	70	8.4	13.5	2.16	43.20

Table 2 - Paddy rice production obtained from the compost treatment compared to the untreated control

Year	Compost applied (t ha^{-1})	Untreated control (t ha^{-1})	Relevant conditions
2024	7.71	8.25	High crop vigour and delayed grain maturation; unusually low September temperatures prevented complete panicle maturation on secondary tillers
2025	8.46	7.57	An August hailstorm caused an estimated 30% yield reduction across all experimental plots

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