THE POWER OF COMPOST AND COMPOST TEA IN SUSTAINABLE ORGANIC VINEYARD AND CHERRY ORCHARD FARMING

Every year, farms produce vast amounts of organic waste and residues that often end up being burned or sent to landfills. But what if this 'waste' could become a powerhouse for soil health and crop productivity? By composting these residues, farmers can create nutrient-rich humus and compost tea, transforming agricultural byproducts into sustainable solutions. Compost improves soil structure, enhances water retention and reduces reliance on synthetic fertilisers, while compost tea serves as a natural biostimulant. The application of both leads to higher quality products, allows farmers to cut costs and contributes to a circular economy.

WHAT ARE THE KEY BENEFITS OF USING ON-FARM RESIDUES FOR COMPOST PRODUCTION?

On-farm residues are often seen as waste but can be valuable when repurposed through composting. Composting is a biological process where biodegradable organic compounds are transformed into compost. As organic amendments, composts are rich in humified organic matter and can be used as a slow-release source of nutrients, in alternative to mineral fertilisers. Composts improve the physical, chemical and biological properties of soils, by increasing the available nutrients mainly in the organic soil fractions, and they have a high water retention capacity, which increases soil water content [1]. These modifications positively affect plant cover by improving plant nutrition and growth and help reduce the risk of erosion [1]. Furthermore, composting helps lower greenhouse gas emissions by preventing biodegradable materials from ending up in landfills, where they would produce methane.

Moreover, compost tea can be applied directly to plant roots or foliage, providing a quick boost of beneficial macronutrients, phytohormones and humic acid, with a prompt effect that can promote plant growth, help with the biocontrol of fungal pathogens and have positive effects on soil quality and plant health [2, 3].

By utilising on-farm residues for compost and compost tea, farmers can close the nutrient loop, reduce waste and enhance the sustainability of their agricultural practices — all while improving yields and soil health over time.

WHAT ARE THE ESSENTIAL STEPS FOR COMPOSTING RESIDUES?

According to the OG OLTREBIO, the first phase of the process involved preparing the piles after crushing and mixing the raw materials (Fig. 1), i.e., crop residues mixed with grass cuttings. The pile is then covered with a sheet, and oxygenation is ensured by the aeration system, which is activated at regular intervals (ten minutes every two hours in the first two weeks). The temperature should be measured continuously with probes connected to a data logger, while the humidity should be checked weekly (40–70%). To allow the homogenisation and fermentation of the materials, the pile was turned twice weekly in the first two weeks and then once again before the end of the process.

Fig. 1. On-farm composting at the CREA-AA experimental farm: 1) collection of farm waste; 2) shredding and mixing; 3) preparing and oxygenating the pile; 4) checking the temperature and humidity; 5) storing the mature compost; 6) application in the field https://feder.bio/wp-content/uploads/2017/07/Compost-ed-estratti-per-la-sostenibilita-dei-sistemi-agricoli.pdf [4]

Table 1 Presents the main characteristics of the compost produced within the OG. The parameters comply with Italian legislation and indicate a good level of maturity and quality of the compost.

TABLE 1. OG OLTREBIO compost characterisation [4]:

Parameters	Value
Dry matter (%)	76.2
pH	8.09
Total organic carbon (%)	20.85
Total nitrogen (%)	2.43
Carbon to nitrogen ratio (C:N)	8.58

HOW DOES COMPOST TEA DIFFER FROM TRADITIONAL COMPOST, AND WHAT ARE ITS ADVANTAGES?

In recent years, compost-derived products such as compost tea have gained popularity in agriculture for their positive effects on crops. Compost tea is a liquid organic formulation made by extracting compost materials in water under controlled conditions. Unlike traditional compost, which is applied directly to soil in solid form, compost tea provides a rich microbial and nutrient infusion that is immediately bioavailable to both plants and soil microbiota. Traditional compost improves soil structure and nutrient reserves over several months, whereas compost tea acts quickly, enhancing plant health through increased foliar nutrient uptake — especially nitrogen — and promoting stronger root development. Additionally, compost tea can be produced rapidly (24–48 hours) and used immediately. Essentially, compost tea enhances the benefits of compost by utilising its living components in a dynamic and targeted manner.

Compost teas contain essential macronutrients (nitrogen, phosphorus, potassium), micronutrients (copper, zinc, iron, manganese), phytohormones (IAA, cytokinins, salicylic acid) and humic acids, all dissolved in water for immediate availability. They also host diverse microbial communities, including fungi, bacteria and protists, which support plant growth and help control fungal pathogens [2, 5, 6]. These microorganisms contribute to compost tea's properties by providing biological control of diseases and stimulating plant development. Many bacterial strains in compost tea act as plant growth–promoting rhizobacteria (PGPR), enhancing plant resistance to stresses and improving growth [7, 8]. Various studies have reported successful biostimulation outcomes across different crops, making compost tea a valuable tool for sustainable agriculture [9, 10].

HOW IS THE COMPOST TEA PRODUCED?

The most common compost teas are aerated compost teas (ACTs), produced by continuously or intermittently aerating dechlorinated water for a period ranging from 24 hours to one week to promote microorganism growth [2]. Filtration is typically achieved with a porous bag or screen. Practitioners often add nutrients or adjuvants to ACTs during or after preparation [2]. The amount of compost used depends largely on the size and type of the brewing vessel and equipment used [11]. The size of the brewing vessel varies from small (a few litres) to several hundred litres. Optimal conditions for producing quality compost teas, as reported by Zaccardelli et al. [12] and adopted by the OG OLTREBIO, include a compost-to-water ratio of 1:5; high-quality compost, especially where derived from plant residues rich in aromatic compounds, such as artichoke, fennel, walnuts and aromatic plants; a temperature of 28 °C during production; oxygenation for five minutes every three hours or 15 minutes every six hours; and a brewing period of seven days [2] (see Fig. 2). Generally, different additives such as molasses, sugar, fish meals, whey, etc. can be added to compost tea, but their addition does not always improve the quality and biological effects. To achieve higher-quality compost teas, it is crucial to use good-quality compost.

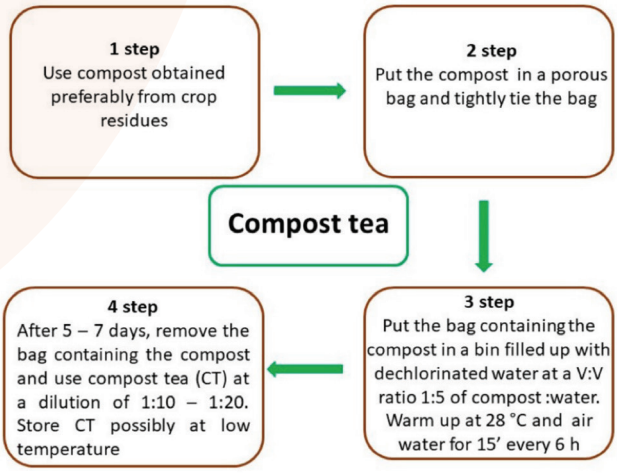

Fig 2. Steps in compost tea production [2]

DIFFERENT TYPES OF COMPOST TEA

There are two types of compost tea, depending on whether the maceration liquid is aerated or not.

- **Aerated compost teas (ACTs):** Produced by continuously or intermittently aerating dechlorinated water mixed with compost for 24 hours up to one week. Aeration promotes the growth of aerobic microorganisms. Filtration uses porous bags or screens.
- **Non-aerated compost teas (NCTs):** Made without aeration, incubated for seven to 14 days. NCTs rely on natural fermentation, dominated by anaerobic microbes, and they require less energy and are preferred where electricity is limited.

Oxygen and microbial communities:

- ACTs typically have aerobic microbes; NCTs have anaerobes.
- However, there is no clear scientific consensus on the oxygen levels that distinguish these types.
- Dissolved oxygen (DO) above 5.5 mg/L is recommended for ACTs, but often not measured.

WHAT CHALLENGES MIGHT FARMERS FACE WHEN COMPOSTING FARM RESIDUES, AND HOW CAN THEY OVERCOME THEM?

Farmers may encounter several challenges when composting on-farm residues:

Slow decomposition

- Woody materials (e.g., vine branches) decompose slowly.

> **Solution:** Chip or shred residues before composting.

Imbalanced carbon-to-nitrogen (C:N) ratio

- Excess carbon slows decomposition.
- Excess nitrogen causes odours and leachate.

> **Solution:** Aim for a C:N ratio of 25–30:1 by mixing dry (straw, leaves) and wet (manure, green waste) materials.

Poor moisture and aeration

- Too much moisture causes anaerobic conditions.
- Too little dries out microbes.

> **Solution:** Maintain 50–60% moisture (like a wrung-out sponge). Turn piles regularly to introduce oxygen.

Temperature control

- Compost must reach 55–65 °C to destroy pathogens and weed seeds.

> **Solution:** Monitor with a compost thermometer and insulate piles during cold weather.

Odours

- Anaerobic conditions cause foul smells.

> **Solution:** Turn the pile regularly and maintain proper moisture levels.

Labour and time demands

> **Solution:** Use simple compost turners or work together in cooperatives to share labour and equipment.

Space constraints

- Large-scale composting requires ample space.

> **Solution:** Use windrows or modular bins to optimise the area.

Pest attraction

- Fruit waste and improper composting can attract rodents or insects.

> **Solution:** Avoid meat or dairy. Bury fruit waste deep in the pile and cover the pile to deter pests.

By addressing these challenges proactively, farmers can ensure efficient composting and high-quality outputs for their vineyards and orchards.

WHAT ARE THE BEST PRACTICES FOR APPLYING COMPOST AND COMPOST TEA IN VINEYARDS AND ORCHARDS?

Applying compost and compost tea supports soil fertility, microbial activity and plant health in vineyards and orchards. Compost should be applied in early spring or during dormancy in a 2–5-cm layer along tree or vine rows, avoiding direct trunk contact to prevent disease. However, compost tea is best applied during the growing season. It can be used as a foliar spray to improve nutrient uptake and disease resistance or as a soil watering for root health. Freshly brewed tea should be used within hours to maintain microbial viability [2, 13]. Applications every 2–4 weeks are effective, especially after rain or irrigation.

Combining compost with compost tea offers long-term benefits, improving biodiversity and disease suppression. The OG OLTREBIO applied the mature compost for three years as fertiliser in organic table grape vineyards (Sofia and Crimson Seedless varieties) in doses of 2.1 tons/ha in combination with compost tea as soil watering in the dose of 1.5 L/vine at a shoot length of approximately 15 cm and in the post-fruit set and veraison stages [14]. These applications allowed the farm to maintain the quality of table grapes and reduced the inputs and fuel used by the farm by 70% and 10%, respectively [4]. Moreover, the OG OLTREBIO applied the compost tea in an organic cherry orchard as soil treatment (3 L/tree) and foliar treatment (250 mL/tree) at the pink bud, post-fruit set and veraison stages. The application of compost and compost tea significantly increased the fruit sugar content in table grapes, Sophia Seedless variety (17.40 °Brix), and cherries, Lapins variety (22.81 °Brix), compared to the control (15.67 and 20.63 °Brix, respectively) and contributed to improving the water condition of the plants compared to the control under severe water stress conditions (< -1.5 MPa).

TO FIND OUT MORE

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