Compost can reduce emissions and improve broadacre cropping productivity

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Compost is produced from decomposed organic materials, such as garden or food waste, crop residues, biosolids and manures. Compost is best applied to agricultural land in combination with synthetic fertilisers, to balance available nutrients and has the following benefits.

Increased soil organic matter (or at least slowing of decline), including sequestering carbon from the atmosphere into soil

Reduced synthetic fertiliser use, reducing emissions from manufacture and transport, and sometimes direct emissions on-farm

Improved soil health, by supplying nitrogen and other nutrients to crops, and through positive impacts on soil biology

Improved water holding capacity, through improved soil structure and protection from water loss from the soil surface

Reduced methane generation from when organic materials break down in landfill, although some emissions are produced during the composting process

The rate and extent of increase (or decrease) in soil organic matter with application of compost depends on the quality of the compost, the amount and frequency of application, soil and environmental conditions, and management practices. Soil carbon sequestration can be limited by nutrient supply and how much carbon is already in the soil. Sequestration is not necessarily permanent, and can be drawn down under some environmental conditions, especially from sandy soils (Biala 2011).

The benefits of reduced emissions by replacing some synthetic fertiliser with compost depends on the type of compost used and the relative emissions of producing, transporting and applying the two types of fertilisers (De Rosa et al 2022).

On-farm, compost can produce either more or less direct nitrous oxide, methane and carbon dioxide emissions compared with synthetic nitrogen fertilisers, depending on the type of compost used and the conditions (Charles et al 2017). Use of some raw organic materials, such as manures, that are easily accessible to microbial activity, can even result in a ‘priming effect’, stimulating increased microbial activity, leading to loss of the soil carbon already present (Biala 2021).

If compost is being added to increase soil organic carbon as part of an Australian Carbon Credit Units (ACCUs) soil carbon project, there are some key considerations and requirements (Clean Energy Regulator 2021, 2025).

- Adding compost is an allowed management activity under the ACCU scheme soil carbon methodology. Composts fall under the term ‘non-synthetic fertiliser’.
- The application of compost must represent a new activity that would not have occurred without the ACCU scheme project (‘additionality’), and the soil organic carbon increase must be maintained for the duration of the ‘permanence’ period, usually 25 years.

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- The use of compost must not result in ‘leakage’ (carbon losses or emissions outside of the project area) by being sourced from either a ‘designated waste stream’ or from within the project area (Clean Energy Regulator 2021).
- To maximise benefits, compost should be applied at a suitable rate, based on soil type, crop needs and compost characteristics, to avoid nutrient runoff or leaching. It should be applied at a time to maximise integration into soil, such as before planting or during periods of high microbial activity.
- Adding compost can result in emissions of greenhouse gases (methane, nitrous oxide and carbon dioxide) during production, transport, or application. These emissions must be accounted for in a project's net carbon balance. This risk can be reduced by ensuring the carbon sequestration benefits outweigh emissions associated with the compost and by sourcing locally to minimise transport emissions.
- Composts must comply with the Australian standard AS4454-2012 (Composts, Soil Conditions and Mulches) to ensure it is free from contaminants and pathogens (Standard Australia Limited 2021).
- There are regulations restricting the frequency of application or treatment level of some biosolids in some jurisdictions (Biala 2021).

So, application of compost can reduce emissions and increase soil carbon in broadacre cropping under some conditions. The impact of composts on greenhouse gas emissions is an active field of scientific research, with knowledge evolving and improving rapidly. Through this research, in the future better recommendations will be available for identifying which composts applied under which conditions will be beneficial for both farm productivity and reduction of greenhouse gas emissions.

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