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LETTER TO THE EDITOR

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Response to 'A well-established fact: Rapid mineralization of organic inputs is an important factor for soil carbon sequestration' by Angers et al.

In a recent opinion piece, Angers et al. (2022) comment on our earlier article about carbon sequestration in soils (Berthelin et al., 2022), and opine that in that article we present 'some interesting considerations, at least one of which is already well-known to soil scientists working on soil organic carbon (SOC), that is, a large portion (80%–90%) of fresh carbon inputs to soil is subject to rapid mineralisation'. They argue that the 'short-term mineralisation kinetics of organic inputs are well-known and accounted for in soil organic matter models', and they object to what they portray as our perspective that long-term predictions of soil carbon sequestration based on these models overlook short-term mineralisation.

Angers et al. (2022) evidently miss the main point made by Berthelin et al. (2022). Our argument is not that rapid mineralisation of organic inputs is overlooked per se, but that its significance in limiting SOC sequestration appears to be frequently overlooked in considerations of practices to sequester SOC in the context of mitigating climate change. In Berthelin et al. (2022) we take great care to explain that a significant body of literature has been devoted to the rapid mineralisation of fresh inputs and how the resulting information, by way of first-order kinetic parameters, has been incorporated into computer models that have been used extensively to predict the fate of SOC under different climate scenarios and agricultural practices.

A key point we make is that only about 10% of the C added in fresh organic additions becomes stabilised in the long term (say 30 years, as illustrated in figure 1 of Berthelin et al., 2022): Long-term stabilisation of C is a necessary requirement for mitigating climate change. Another way of expressing this is to say that to achieve a desired increase in stable SOC, 10 times this quantity must be added initially. This raises a major challenge concerning the sources of such large additional C inputs, as discussed in our paper and also by Janzen et al. (2022).

Angers et al. (2022) cite many examples of changes in agronomic practice that lead to increased SOC. These are entirely valid, beneficial and non-controversial. An excellent example they cite is the major change in cropping practice in the semi-arid Canadian Prairies to eliminate summer fallow and move to no-till instead of conventional ploughing. There is no question that where such changes are possible they should be encouraged using whatever policy, financial or advisory mechanisms available. The question in the context of slowing climate change is the scale of C sequestration that is achievable in practice.

Angers et al. (2022) also cite an example of SOC increases achieved in China since 1980 (Zhao et al., 2018). Unfortunately, this is a less convincing example of SOC sequestration contributing to climate change mitigation. At least part of the recorded SOC increases over a 30-year period resulted from increased crop yields caused by greatly increased applications of nitrogen fertiliser and the cited study takes no account of additional greenhouse gas emissions associated with this. Offsetting the beneficial impacts for climate of increased SOC sequestration by other greenhouse gas emissions was discussed by Gao et al. (2018) in the context of Chinese agriculture. A reminder that SOC sequestration must not be viewed in isolation.

To conclude, we are in full agreement with Angers et al. (2022) that it is vital to increase organic matter in soils to the extent possible to enable them to withstand the effects of climate change and facilitate the range of functions required by humanity (Baveye et al., 2020, 2022; Vogel et al., 2022). Where we disagree is the extent to which increasing SOC can contribute to climate change mitigation through the build-up of stable forms of C for the reasons we have discussed. Further interdisciplinary research is urgently needed to better understand the microscale processes involved in organic matter mineralisation and stabilisation and eventually make sound, scientifically-based recommendations to policymakers. In the context of climate change mitigation, it is worth recalling words by Bossio et al. (2020). They commented that SOC sequestration is not an alternative to emission reductions in other sectors, but an additional opportunity, and one that 'should be neither dismissed nor exaggerated'.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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