COMMENTS & LETTERS TO THE EDITOR

Letter to the Editor on “Can Incubations Be Used to Measure Meaningful Pools of Soil Organic Matter?”

The question of measuring meaningful pools of soil organic matter (SOM) for use in SOM models has been intensely debated. Recently, Paul et al. (2006) reviewed the literature on the use of acid hydrolysis and long-term incubations for such purposes and concluded that these methods give rise to meaningful SOM pools. In this letter we argue that the success of the incubation method for distinguishing between an active and a slow pool is dependent on the assumption that these pools actually exist.

Considering the large number of chemical compounds present in SOM and the different mechanisms that can protect it, the quality of SOM is probably better described as a quality continuum rather than a number of discrete pools. Paul et al. (2006) suggest that the decay pattern of SOM observed in incubations allows a distinction to be made between an active and a slow pool. However, there are generally difficulties associated with separation of a combination of exponential processes into meaningful components (Van Liew, 1962). Here, we assumed different quality distributions of SOM and interpreted the decay patterns in light of the two-pool concept.

We employed a model describing SOM by a quality distribution. Quality (q) is related directly to decay rate by definition; \( k(q) = \exp(-q) \). To test the consequences of different conceivable initial SOM distributions, we used a uniform, a bimodal, a trimodal, and two bimodal distributions skewed in either direction (Fig. 1a). Subsequently, we allowed the distributions to decompose and fitted a two-pool model to the decay pattern.

In all the cases we investigated, the two-pool model resulted in very good fits with \( R^2 \) values above 0.997 (Table 1). As an example, the fit of the two-pool model to the decomposition of the SOM with an initially uniform quality distribution is shown in Fig. 1b. The very good model fit could lead us to conclude that the material is well described by two pools, but this was also the case where the initial distribution was far from being bimodal with the uniform and trimodal distributions.

In the case of the bimodal distribution, half the SOM was found at either end of the distribution and therefore we expected the model fit to have 0.5 of the SOM in the active pool and 0.5 in the slow pool. The model fit results in 0.42 in the active pool, and therefore it may be argued that the parameters obtained are useful for interpretations. The distribution that was skewed to the right resulted in 0.72 SOM in the active fraction when in fact there is 0.09 in the “fast decay peak” of the distribution. Less satisfying was the fit to the decay pattern of the left-skewed distribution, which resulted in 0.72 SOM in the active pool, when in fact there was 0.91 in the “fast decay peak” of the distribution. In the cases of the uniform and trimodal distributions, we also obtained two pools in the fitting procedure, and these can scarcely be used for useful interpretations.

In conclusion, fitting a two-pool model to incubations is only likely to give rise to meaningful pools of SOM if in fact two pools of SOM exist in the soil. More importantly, however, the good fit of a two-pool model cannot be used as proof of their existence.

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REFERENCES
