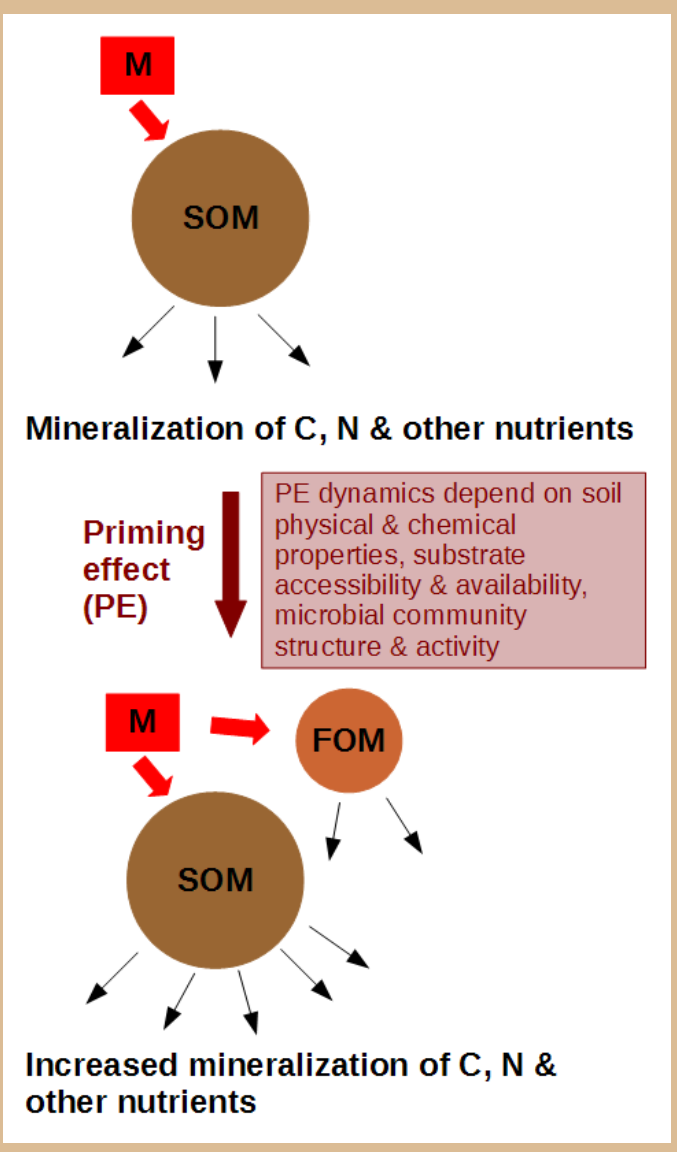
The soil priming effect

Soil organic matter is a keystone component of ecosystems. It stores water, is an energy store driving many soil-based processes, and adds to the available nutrient pool.

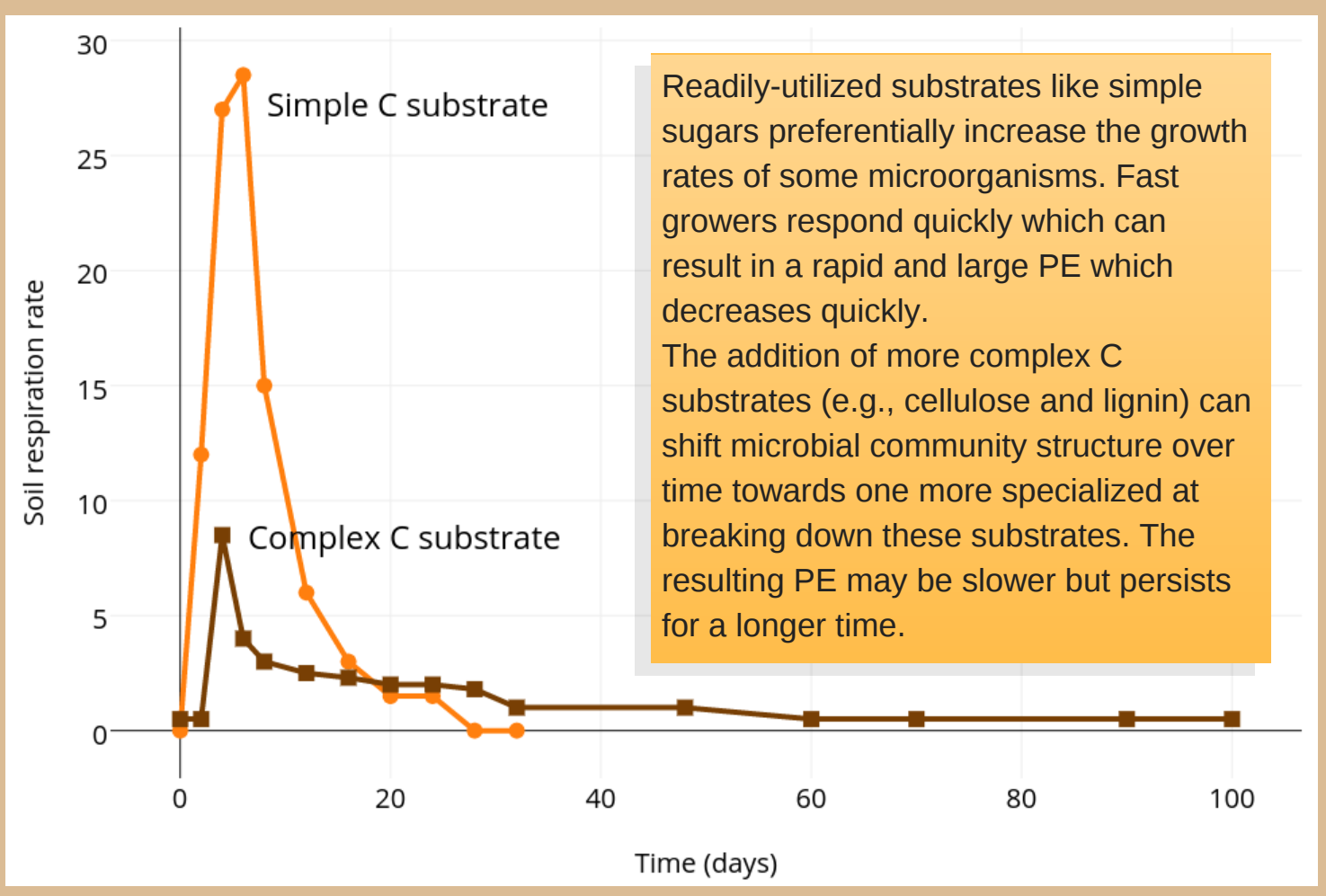
What is the soil priming effect?



- Priming effects (**PE**) are changes in the turnover of soil organic matter (**SOM**) that result from comparatively moderate soil treatments.
- These treatments can be organic or mineral fertilizer inputs, exudation of organic substances by roots, mechanical treatment of soil, or soil drying and rewetting.
- During PE large amounts of C, N and other nutrients can be released in a soil in a short time.
- PE result from increased decomposition of SOM due to enhanced microbial activity (**M**) and commonly follow the input of fresh organic matter (**FOM**) to soils.
- PE occur in most plant–soil systems.

What C substrates cause priming effects and how long do they last?

Soil microbial activity is often energy limited because soil C occurs mainly as complex SOM with smaller quantities of high-energy, easily-decomposed C. SOM decomposition is mediated by energy-requiring processes that require enzymes produced by soil microbial communities.



The size of the PE usually increases with the amount of treatment added. Although it will decline over time, it can last for months.

Are priming effects similar in all soils?

The PE response will vary with a soil's history and the populations of microorganisms in it. Microbes drive PE, so different soils with diverse microbial communities can respond to substrate addition differently. However, PE tend to decline faster in soils with higher clay and moisture contents.

Why are priming effects important?

PE, or the enhanced decomposition of existing SOM by fresh C inputs, are a key process determining soil C dynamics and the supply of nutrients to plants and microbes. Unlike native soils, agricultural and horticultural systems can lack natural inputs of FOM. But the induction of PE by modest FOM inputs can unlock the energy and nutrient potential of SOM by increasing its decomposition and therefore the release of important soil nutrients such as N and P.

As microorganisms drive this process, the composition of a soil's microbial community is important to the PE. Simple C inputs (such as soil treatments containing molasses) can provide a short term boost to SOM mineralization but require frequent re-applications for continued effect and tend to promote bacterial growth. More complex C inputs can shift a soil's microbial community structure towards one more adapted to breaking down the complex C substrates typically occurring in SOM, resulting in a longer PE. They stimulate the filamentous actinomycetes and fungi which are typically disturbed through agricultural practices.

The energy and nutrient potential of SOM can be unlocked through microbially-driven PE, but to maximize the PE it is important to know a soil's microbial community composition so that appropriate FOM is added.