Carbon farming initiative: role of the olive sector in CO_2 removals

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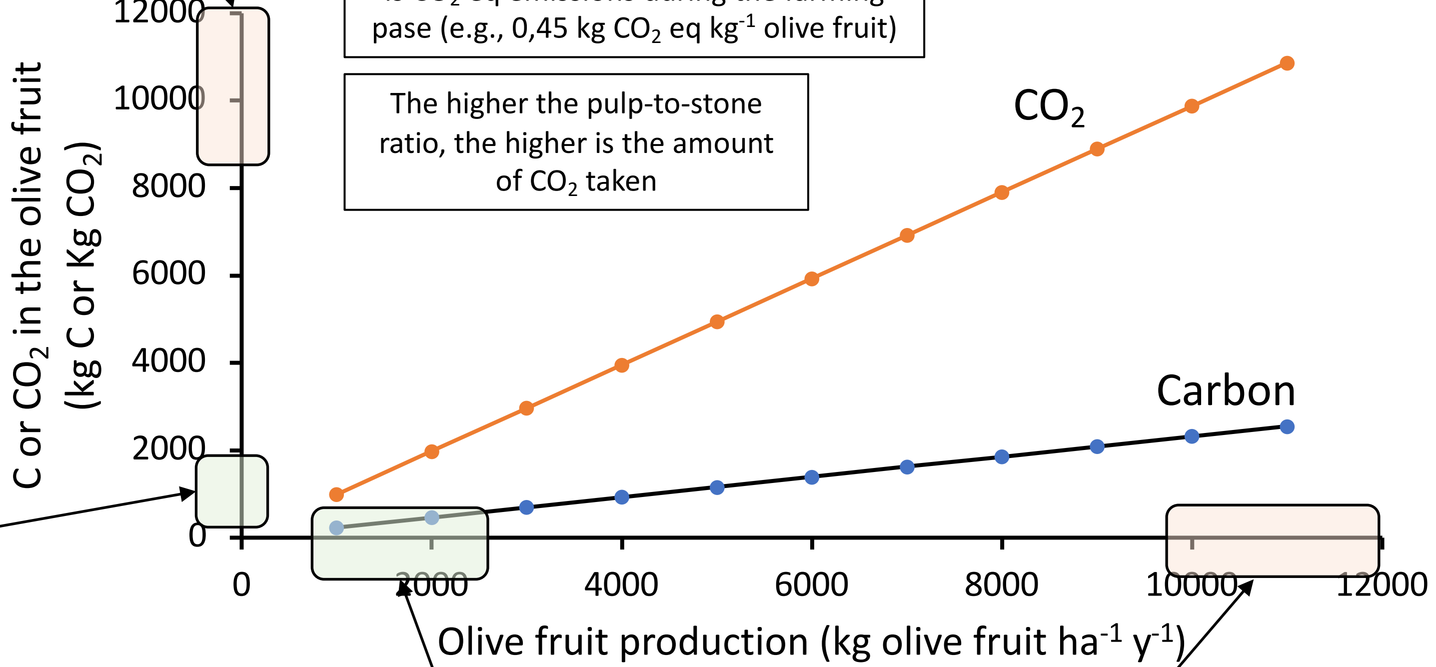
Most of the CO_2 taken annually from the atmosphere occurs aboveground: *The olive fruit*

2500 kg C o 11000 kg CO_2 ha^{-1} y^{-1}

The higher is the production, the higher is CO_2 eq emissions during the farming pase (e.g., 0,45 kg CO_2 eq kg^{-1} olive fruit)

It is expected very high inter-annual variability

The higher the pulp-to-stone ratio, the higher is the amount of CO_2 taken



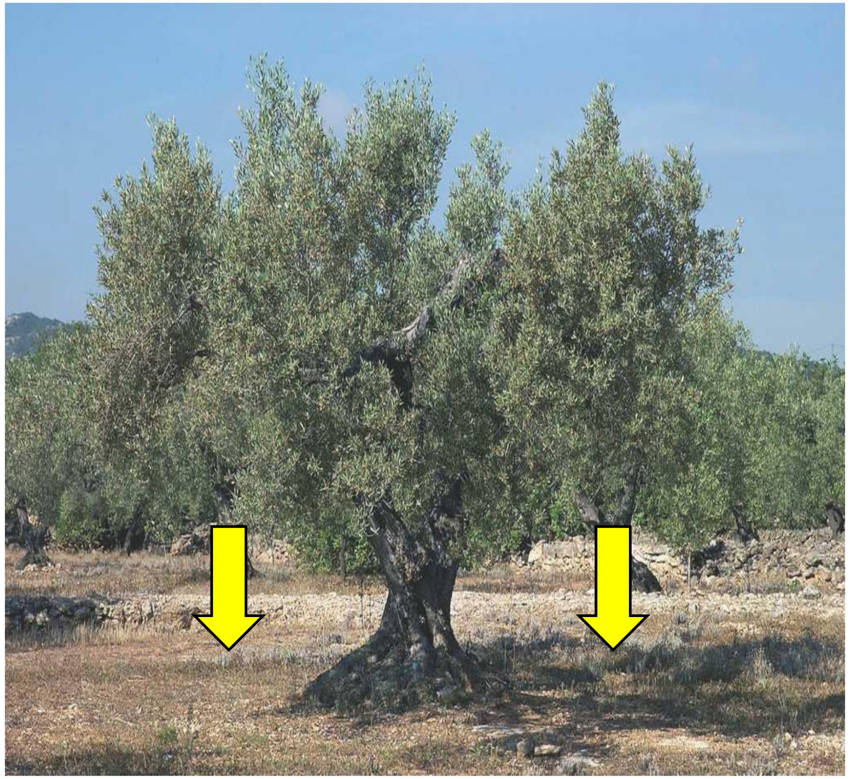
350 kg C o 500 kg CO_2 ha^{-1} y^{-1}

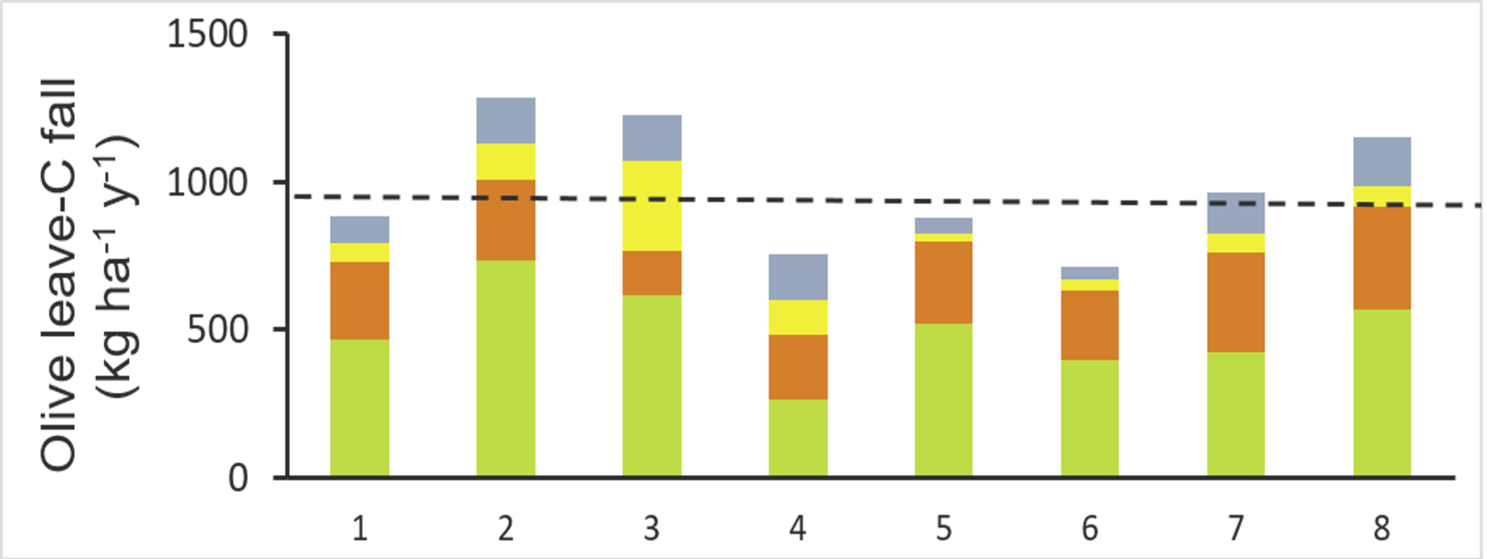
This C transformed from CO_2 to organic C might be taken into account in the C footprint calculations, but not in carbon farming as is taken out of the land

Low tree density low mechanised traditional olive groves

Very high tree density highly mechanised superintensive

Most of the CO_2 taken annually from the atmosphere occurs aboveground: *The leaves and flowers*





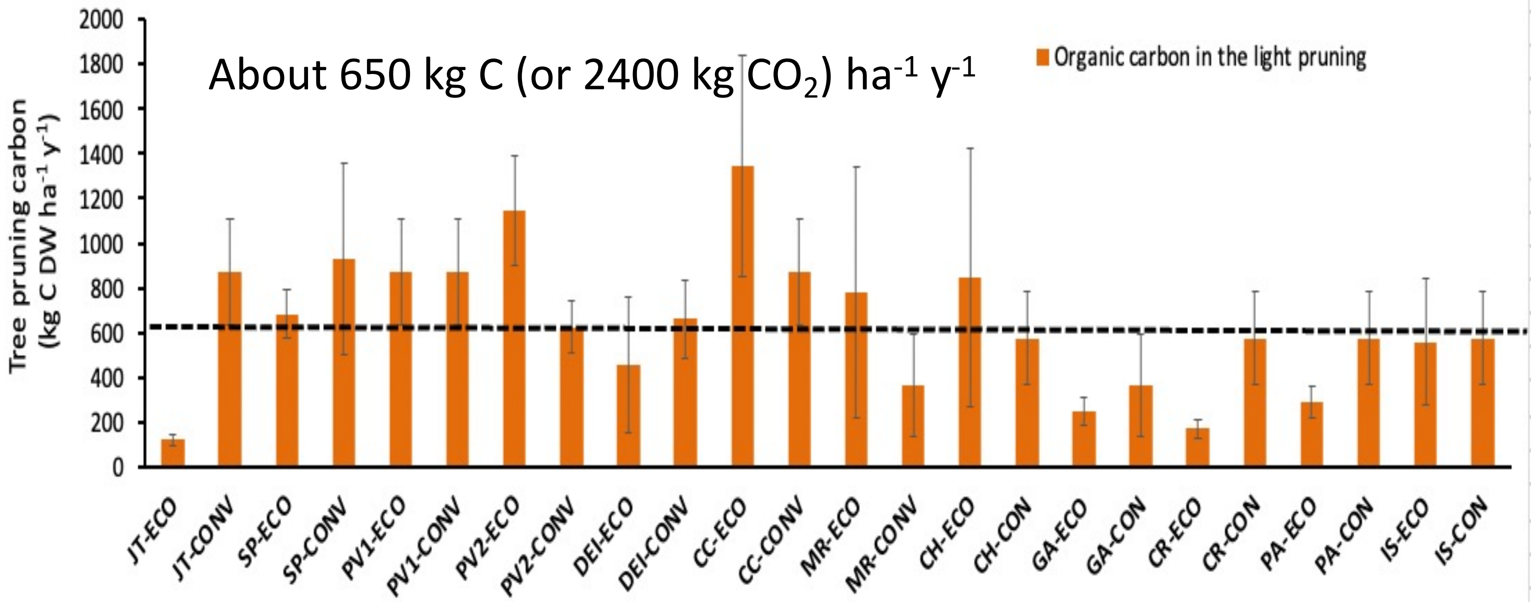
About 950 kg C (or 3500 kg CO_2) ha^{-1} y^{-1}

As far as I am concern, there are no studies which have assessed the potential relationship between cultivars or model of cultivation and the magnitude of this atmospheric-CO_2-tree-soil flux. There is not guarantee that 100 % of this C will end to the soil

It is expected high inter-annual variability

Most of the CO_2 taken annually from the atmosphere occurs aboveground: *tree pruning/firewood*

High spatial and temporal variability according to the objective of the tree pruning and the "local" mode of pruning. It is expected high variability due to the cultivars.

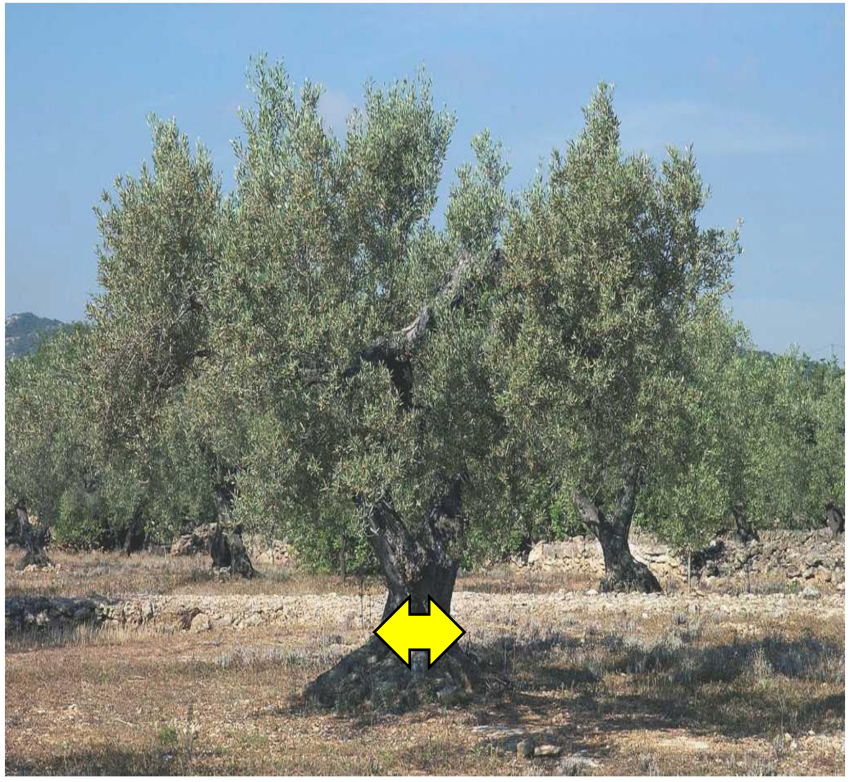


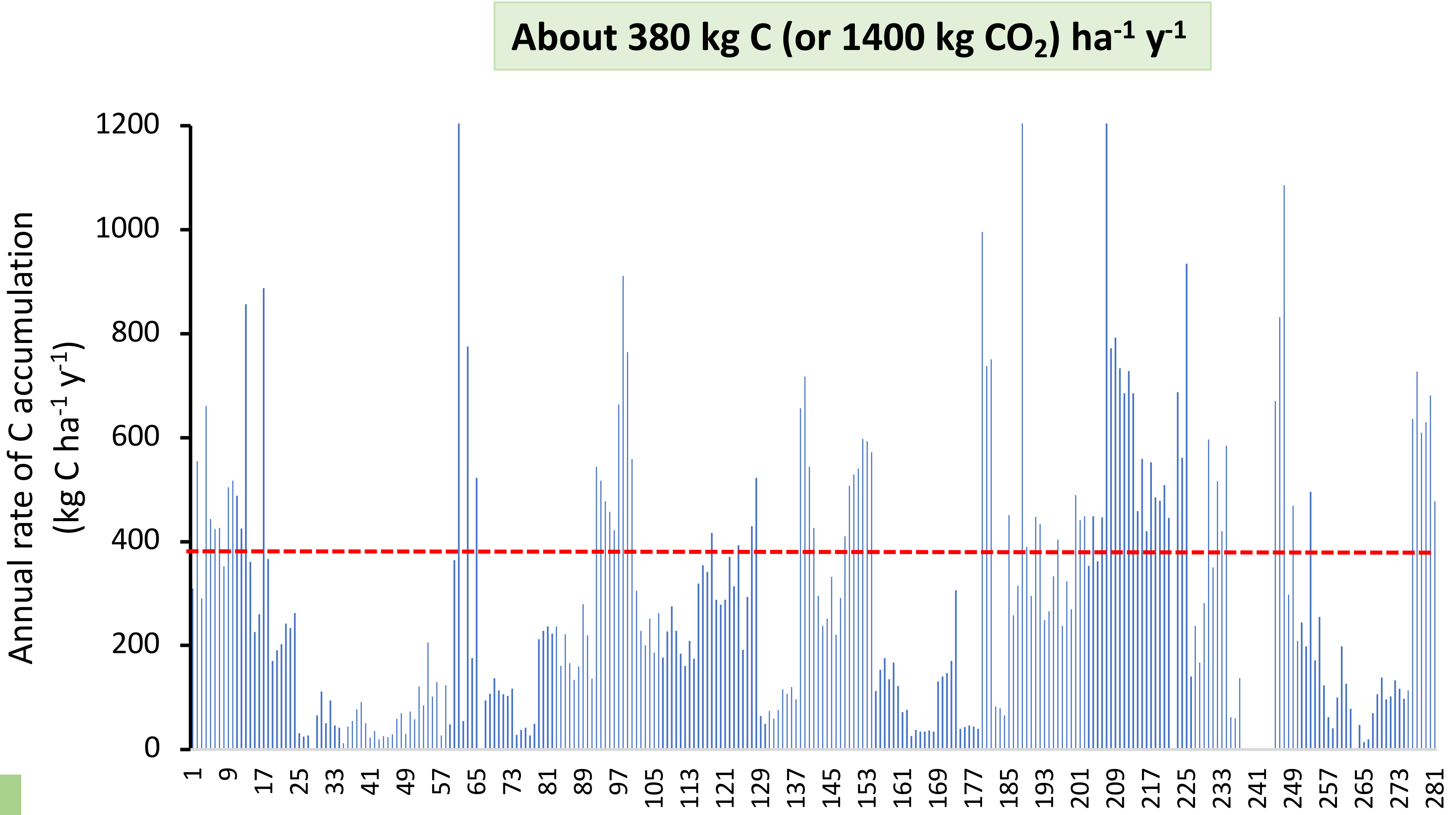
If tree pruning are burnt, then this C should not be taken into account in C footprint and carbon farming

The high variability masks the potential differences among cultivars, tree densities and cultivation model

There are models which related tree pruning with olive production or tree morphology features; however these have not been sufficiently validated

Most of the CO_2 taken annually from the atmosphere occurs aboveground: *Permanent structure of the tree*

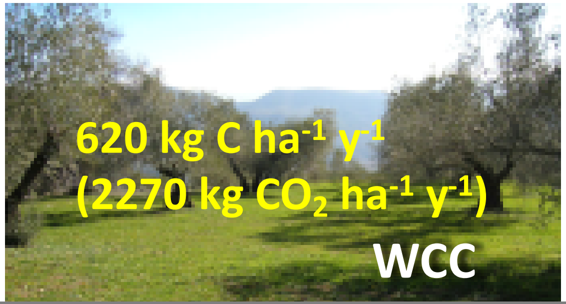




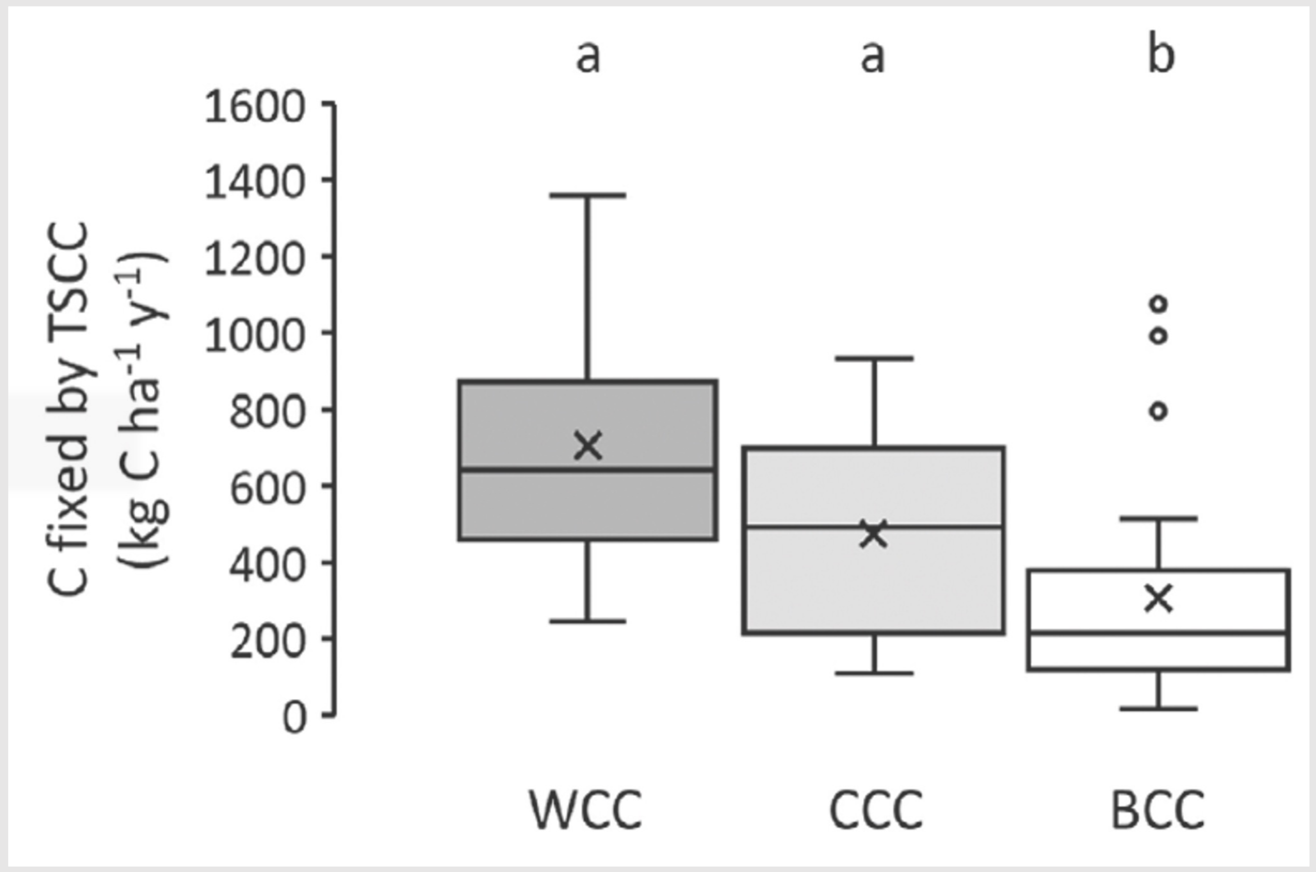
This annual rate of C accumulation should be taken into account for intensive or superintensive?

There are NOT models which relates this C flux with tree ages, cultivars or the production model

Management practices can increase the capture of atmospheric CO_2: *Spontaneous cover crops*



420 kg C ha^{-1} y^{-1} (1540 kg CO_2 ha^{-1} y^{-1})



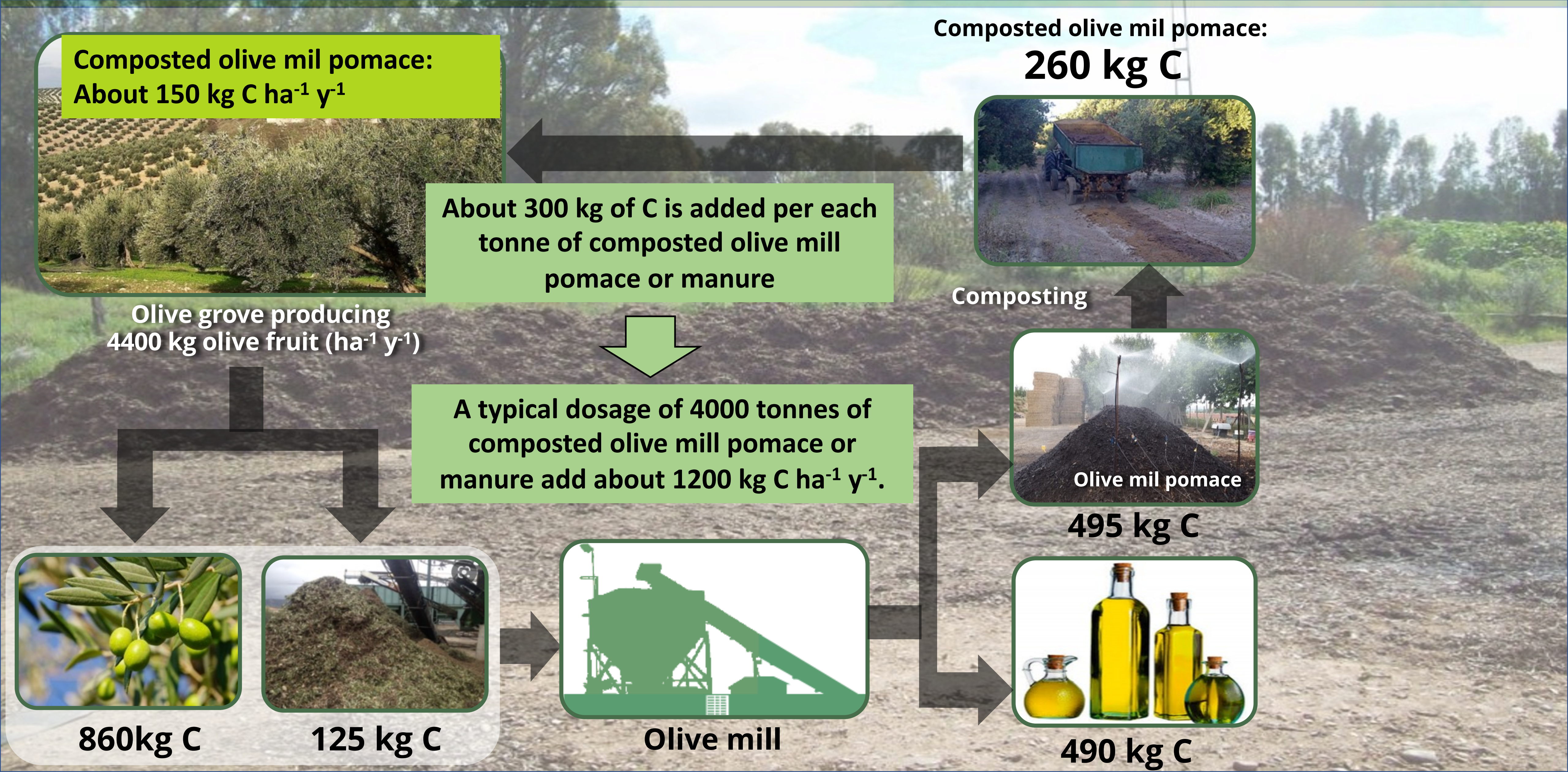
High spatial and inter-annual variability.

More C (CO_2) if the belowground biomass is considered.

It could be possible to create a model which relates cover crop biomass and data obtained by satellite imagen processing.

Frontiers in envrionmental sciende 2022 (in press). Torrús-Castillo, Domouso De Agar, et al.

Management practices can increase the capture of atmospheric CO_2: *composted olive mill pomace and manure*

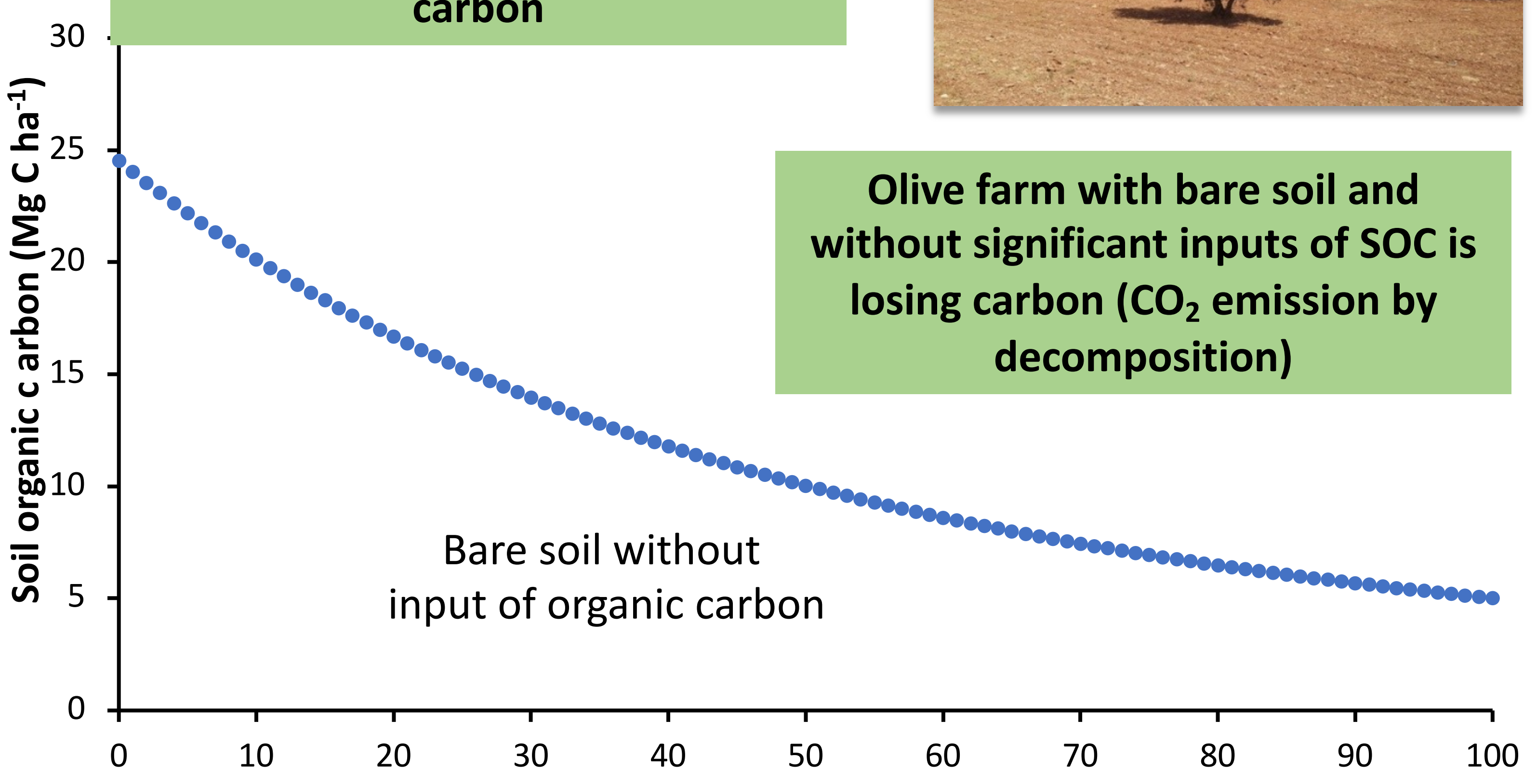


Soil is an "heterotrophic" environment which is continuously losing organic carbon as CO_2 due to organic matter (organic carbon) decomposition

Soil CO_2 emission during the decomposition of the soil organic carbon.

Typically, this is a fraction of the amount of SOC, depend on soil texture and the climate conditions.
This can be (easily) modelled.

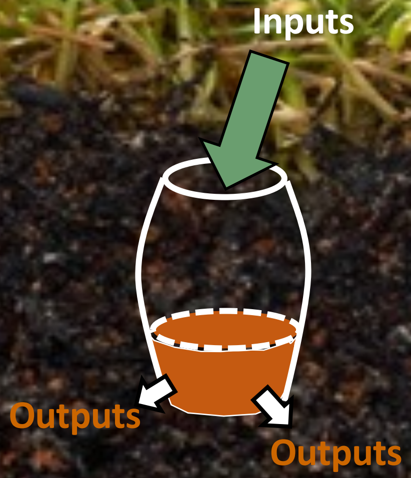
There are currently easy-to-apply and complex models to predict the changes in the stock of soil organic carbon



Olive farm with bare soil and without significant inputs of SOC is losing carbon (CO_2 emission by decomposition)

Losses can be greater if soil erosion/runoff are considered (about 200 kg C ha^{-1} y^{-1})

Changes in soil organic carbon cannot be measured at the short term.



A typical amount of soil organic carbon (SOC) in olive groves is about 25 Mg C ha^{-1} (top 30 cm of soil). Typically, it would be needed an increase of more than 2.5 MgC ha^{-1} to verify significant changes in SOC.

Therefore, sampling for SOC should be programmed with a cadence of about 3-5 years to measure a tendency on SOC.

The extend to which the sources of organic carbon will increase the pool of soil organic carbon depends on the amount of organic carbon and the decomposibility of the sources of organic

Inputs

On farm

Tree pruning
Cover crops
(spontaneous or seeded)
Olive leaves falling down

On/Off farm

Composted olive mil pomace

Off farm

Manure

No or minimum tillage

Outputs

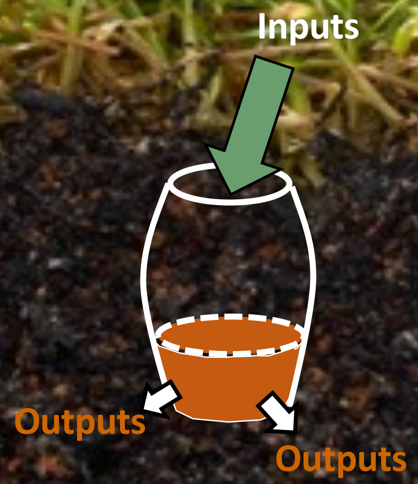
Outputs

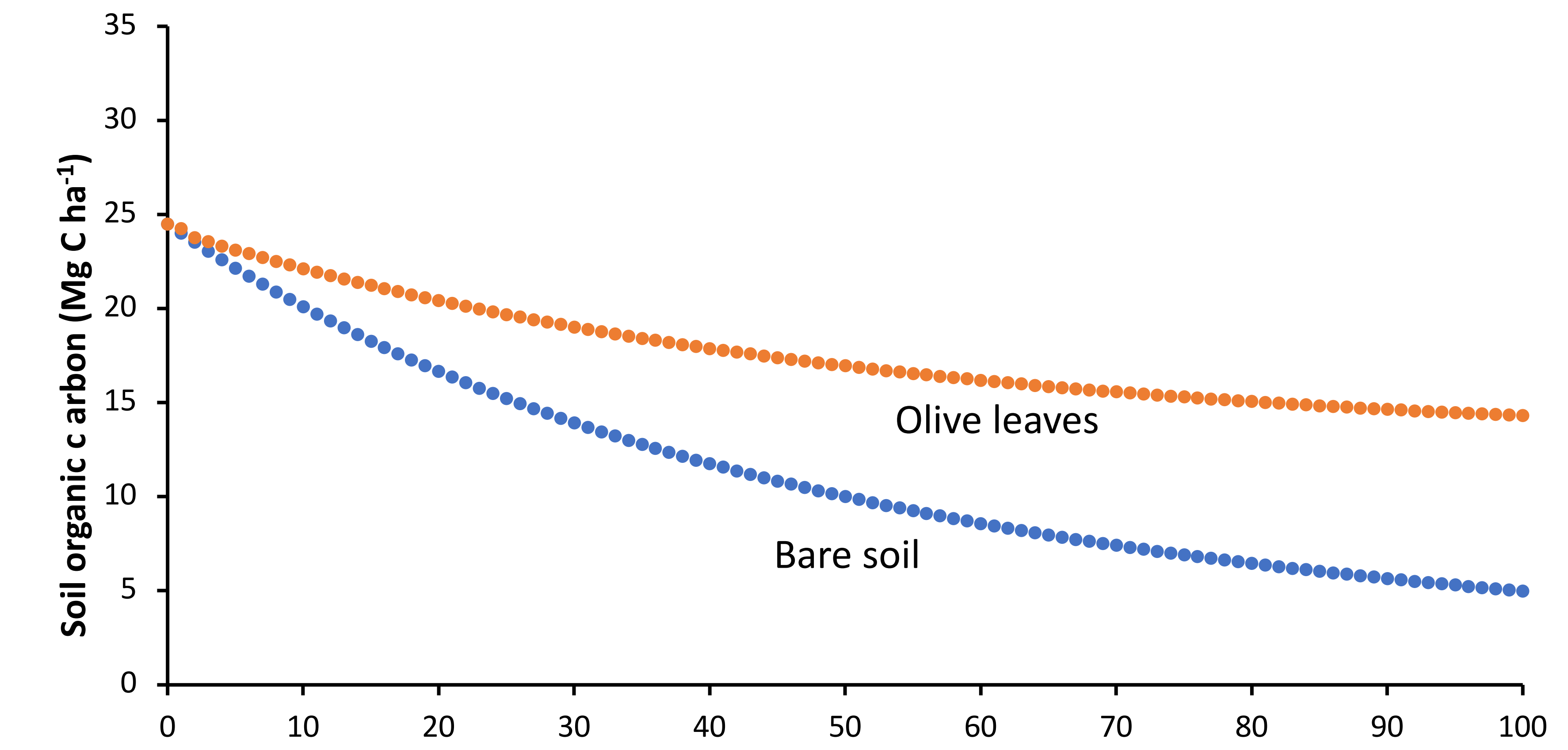
Reduce soil erosion/runoff

The extend to which these sources of organic carbon can increase the SOC, depends on the amount of organic carbon added and the "decomposability" of the source of organic carbon (among others)

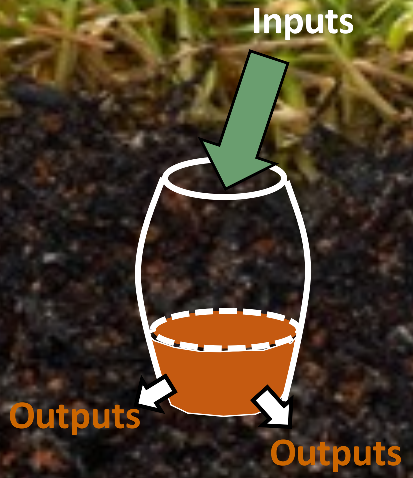
It is required a compilation and an harmonization of the methodologies to quantify the "decomposability" of the main sources of organic carbon in the olive sector

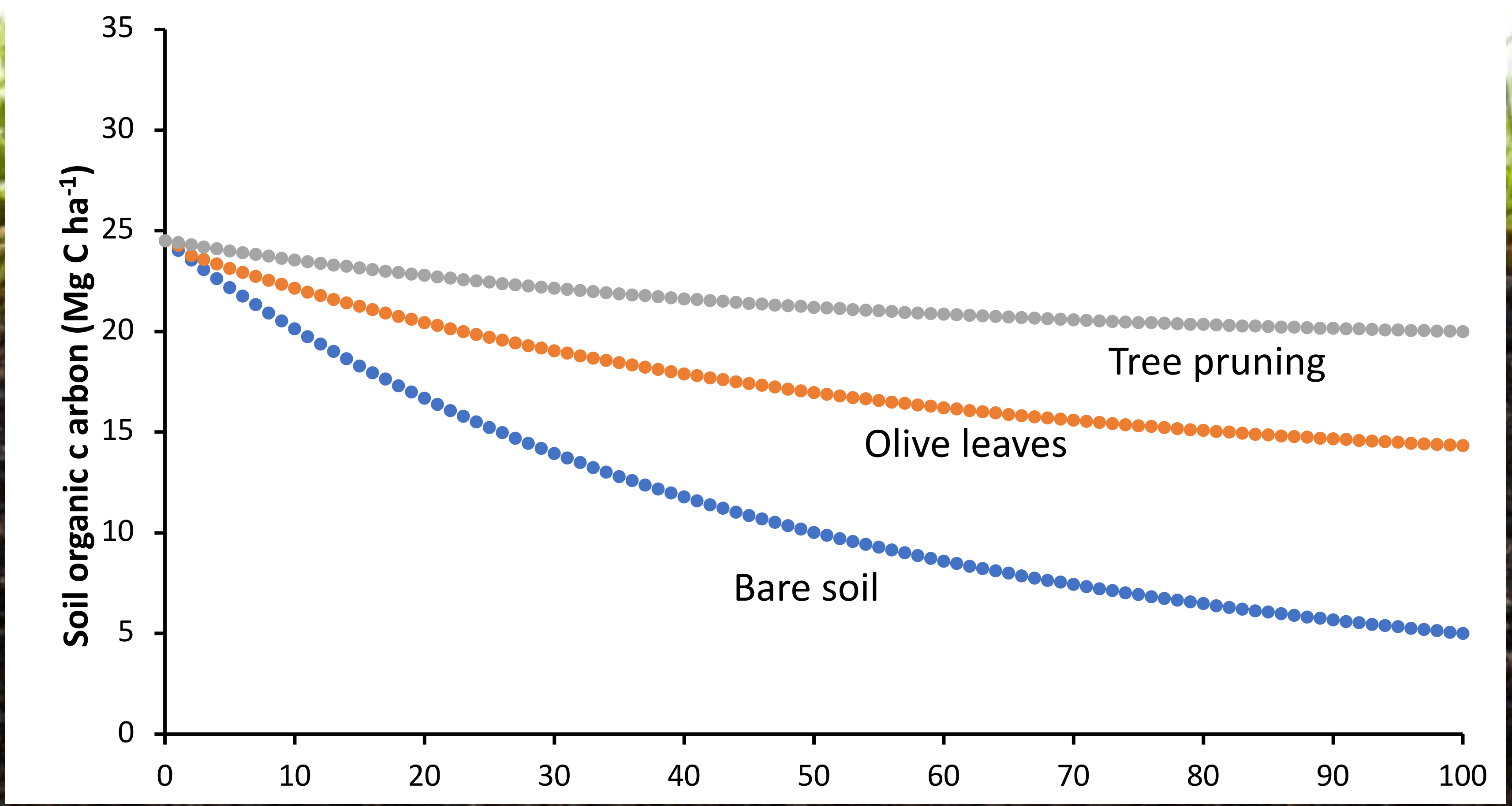
Dynamic of soil organic carbon under main sources of organic carbon





Dynamic of soil organic carbon under main sources of organic carbon





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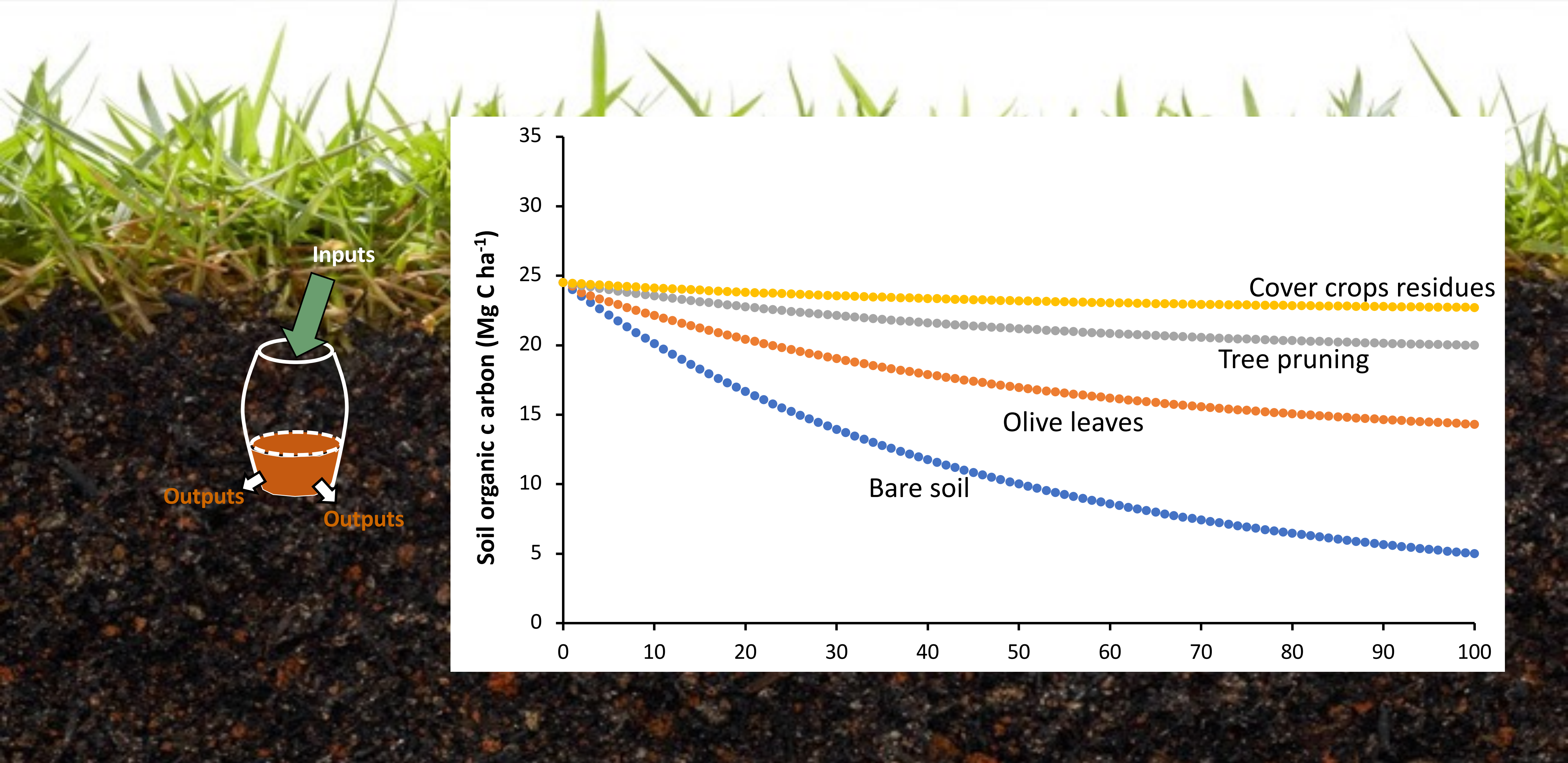

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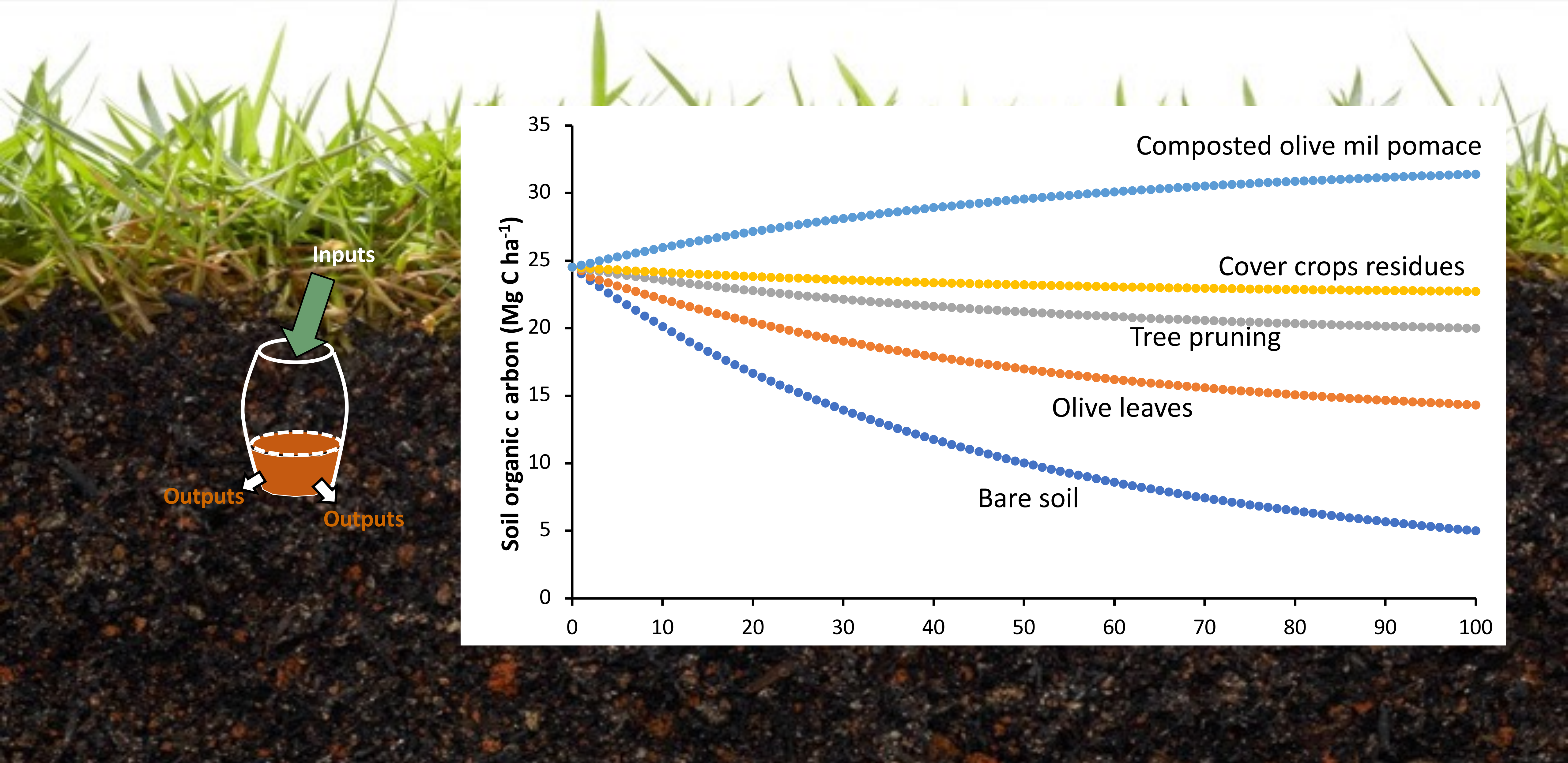
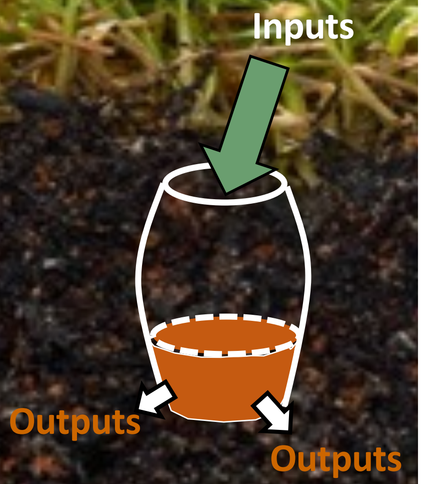
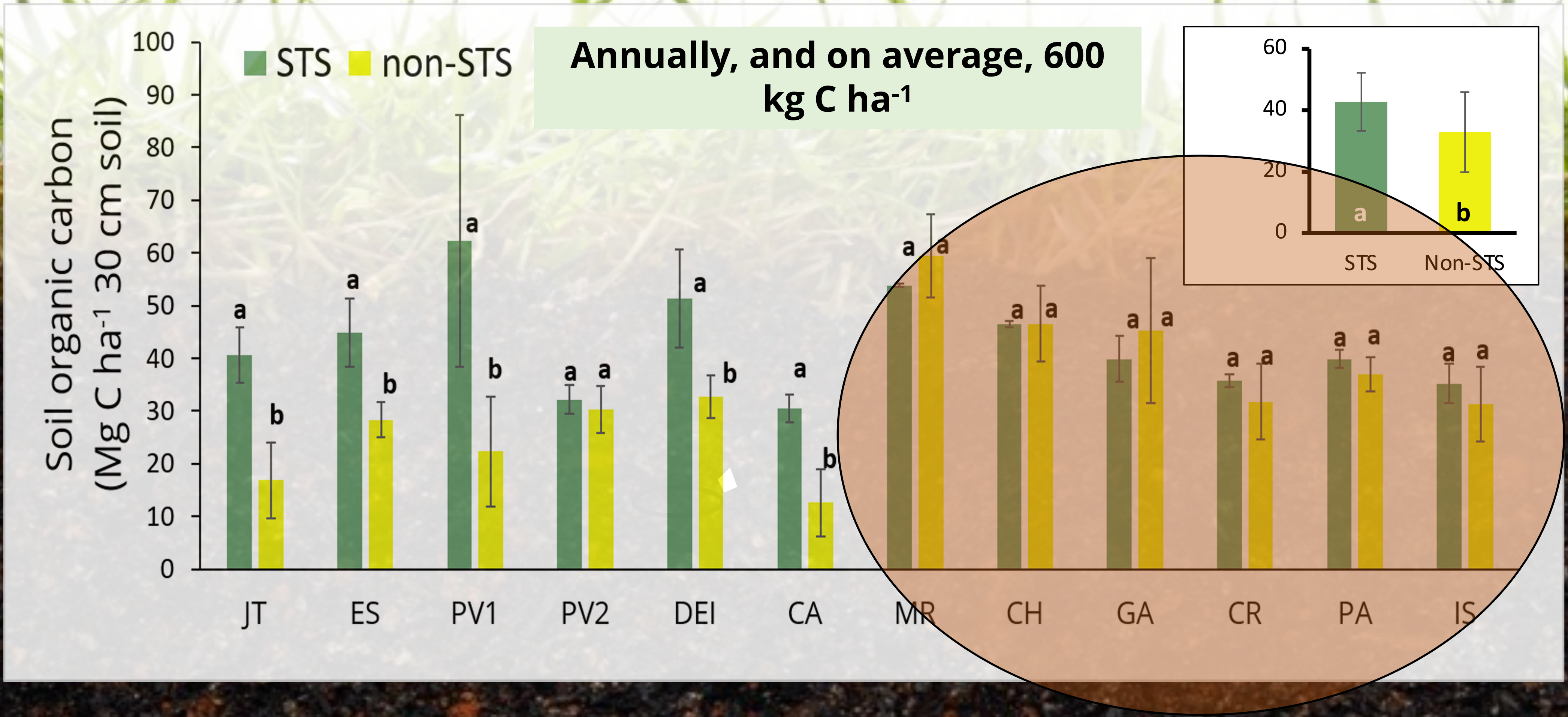


Potential contribution of the main sources of organic carbon in the changes of the SOC

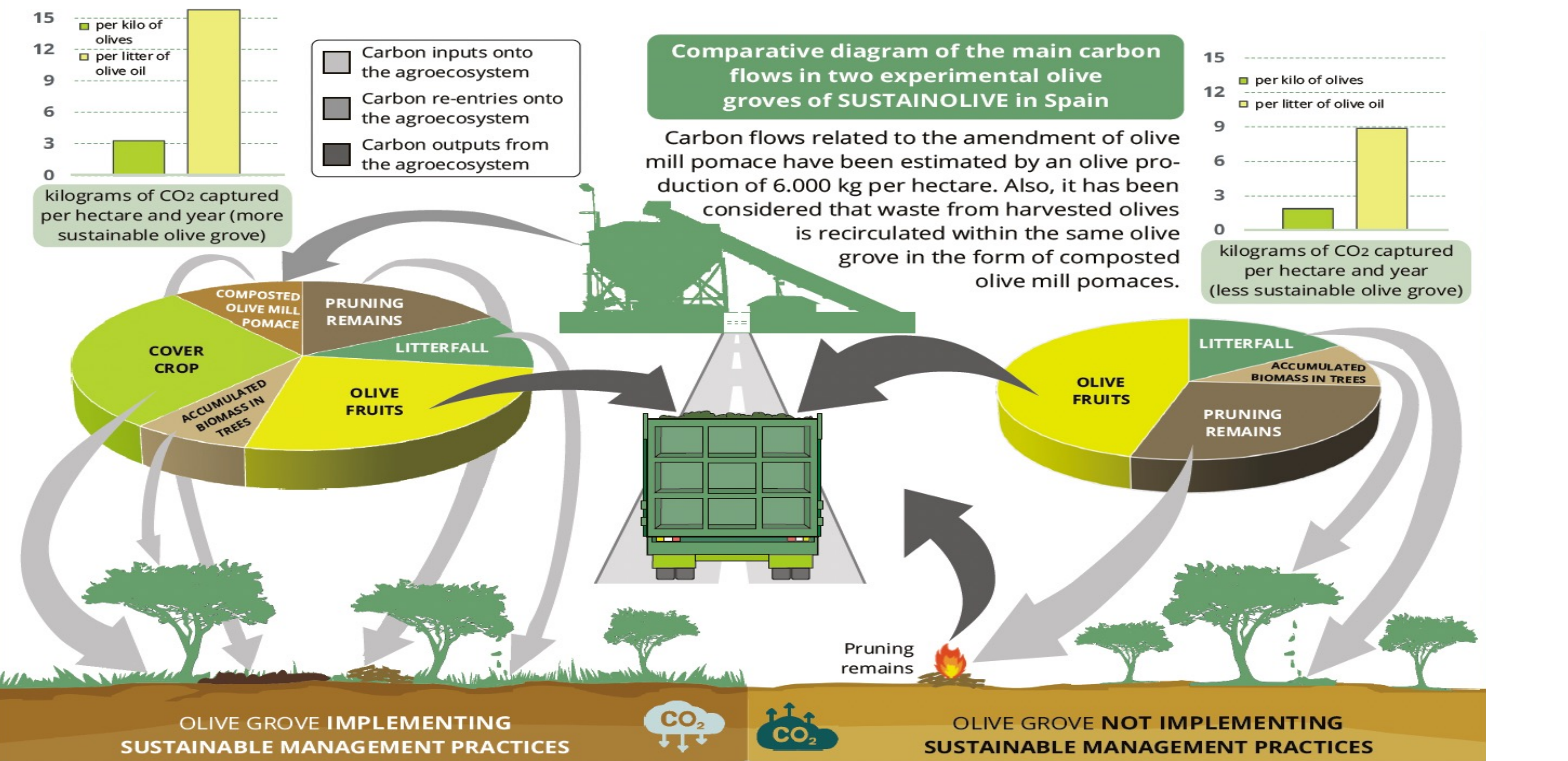


An annual rate of 0.42 Mg C ha^{-1} y^{-1} = 130 euros per year ha^{-1} in the CO_2 market

There are many examples of increases in the stock of soil organic carbon under "sustainable" management practices



C footprint af olive groves with/without implementing sustainable management practices



C footprint is not the same that cabono balance (C farming)

Kg C per hectare and year
(balance between inputs and outputs)

Olive grove applying sustainable management practices

Comparable olive groves without sustainable management practices