Food and Agriculture Organization of the United Nations

DIPARTIMENTO DI AGRARIA

Global Symposium on Soil Biodiversity (GSOBI20)

Repeated Applications of Organic Amendments Promote Beneficial Microbiota, improve Soil Fertility and Increase Crop Yield

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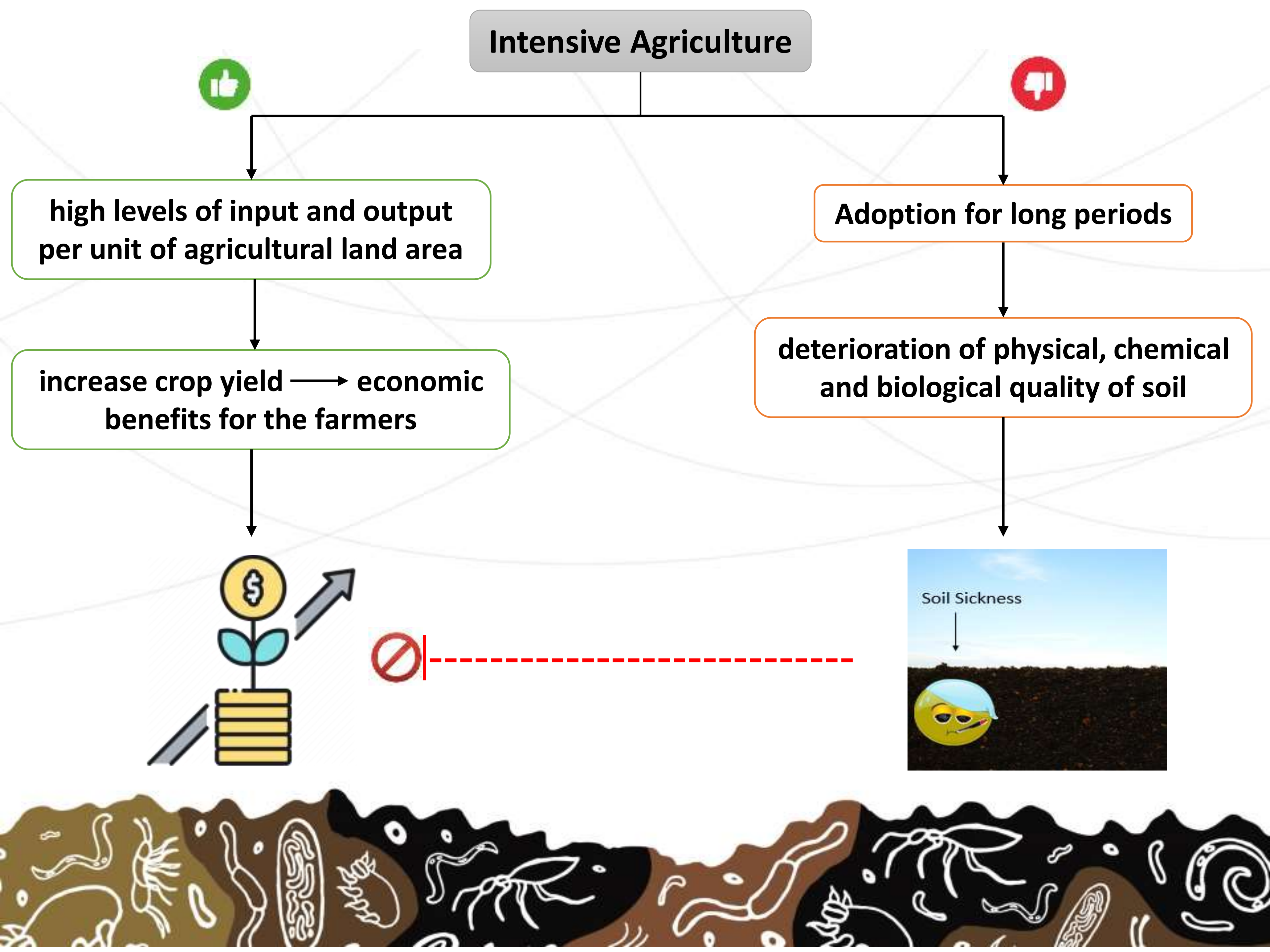
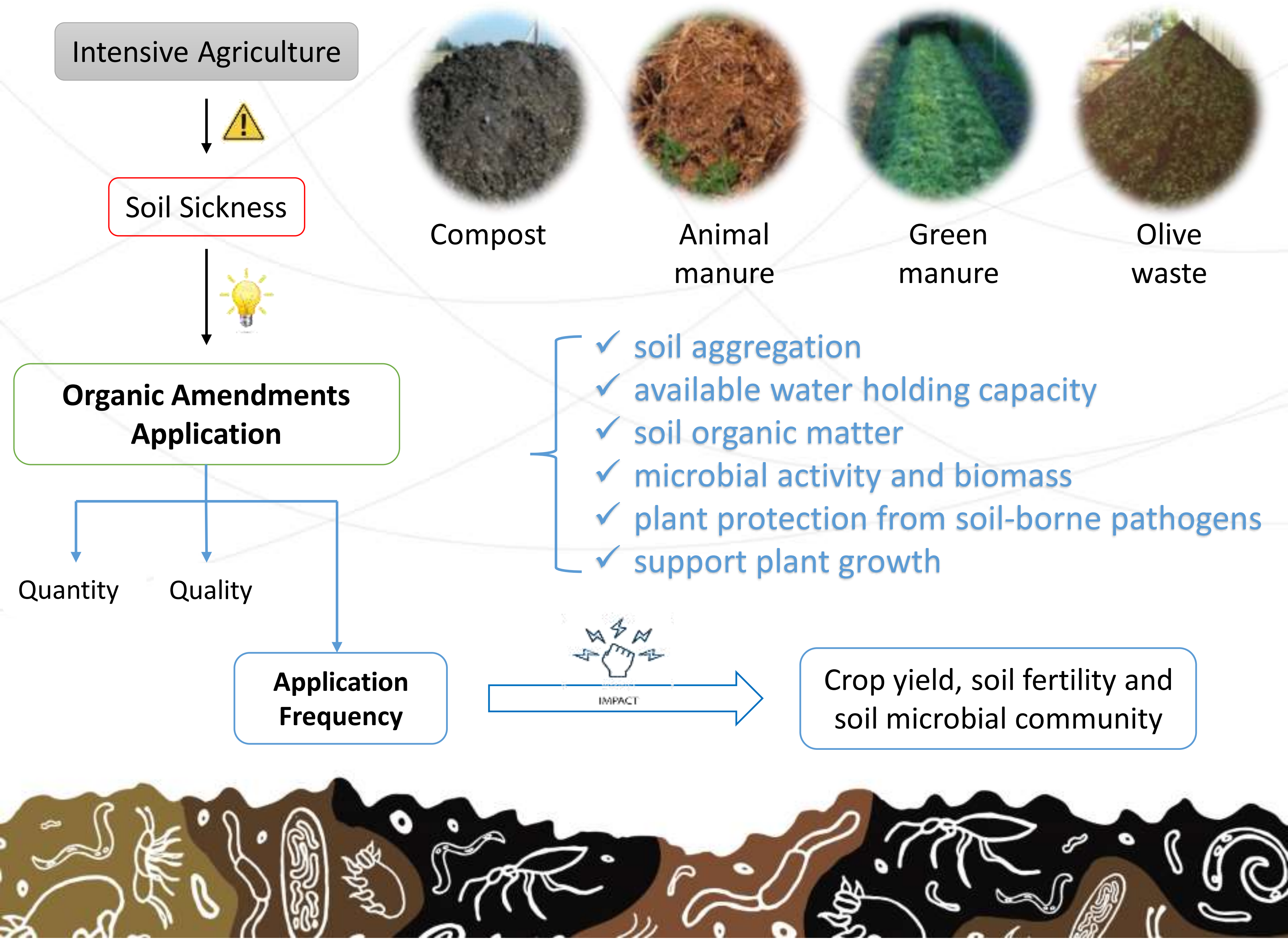


Intensive Agriculture
high levels of input and output per unit of agricultural land area
increase crop yield → economic benefits for the farmers
Adoption for long periods
deterioration of physical, chemical and biological quality of soil
Soil Sickness


Intensive Agriculture
Soil Sickness
Organic Amendments Application
Quantity
Quality
Application Frequency
Compost
Animal manure
Green manure
Olive waste
soil aggregation
available water holding capacity
soil organic matter
microbial activity and biomass
plant protection from soil-borne pathogens
support plant growth
IMPACT
Crop yield, soil fertility and soil microbial community

Aims

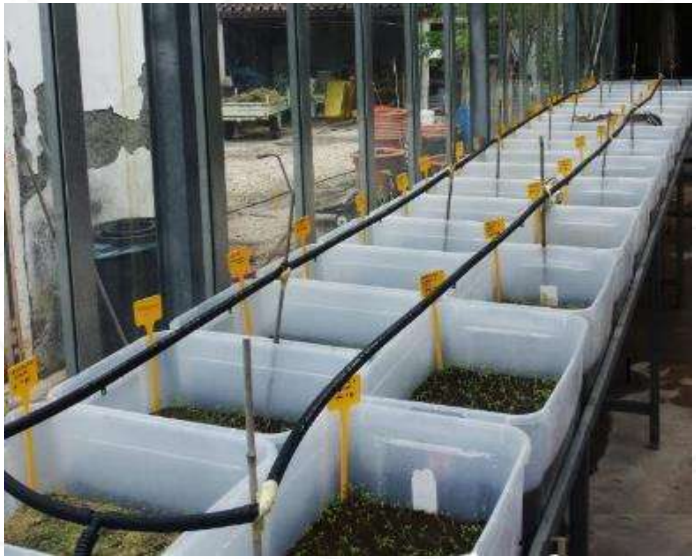
To assess the effects of different organic amendment types and application frequency on:

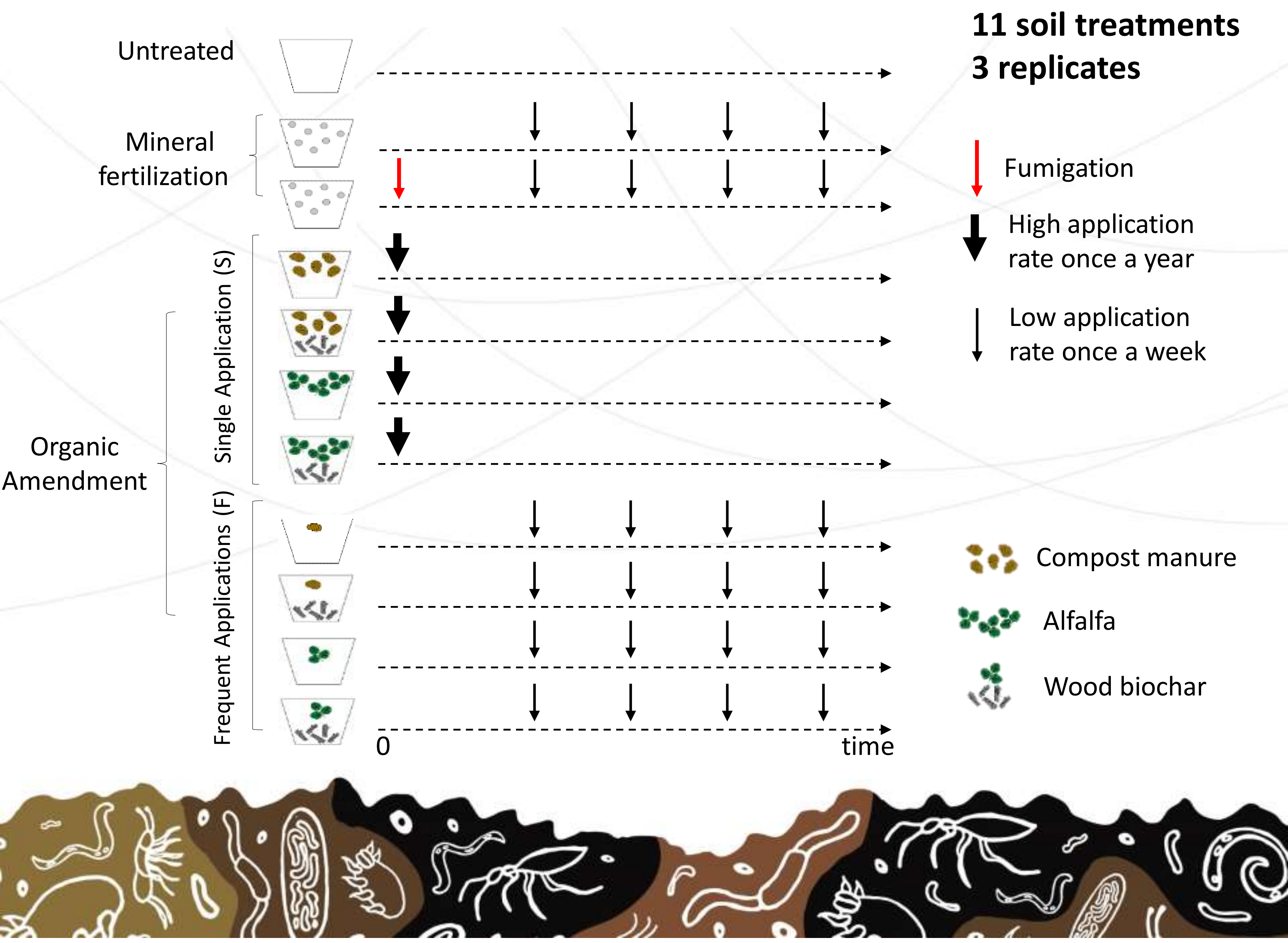
- Crop yield of rocket (*Eruca sativa*)
- Soil fertility, including physical, chemical and microbiological properties;
- Soil microbiota;
- Soil suppressiveness against soil-borne phytopathogenic fungi and viruses

Experimental design

Organic amendments were combined considering their complementary properties :

- ***Medicago sativa* hay** and **compost manure** have more recalcitrant C and are source of organic N;
- **Wood biochar** provides safe sites for microbial development and improves soil physical properties.





11 soil treatments
3 replicates
Untreated
Mineral fertilization
Organic Amendment
Single Application (S)
Frequent Applications (F)
Fumigation
High application rate once a year
Low application rate once a week
Compost manure
Alfalfa
Wood biochar
0
time

Experimental design

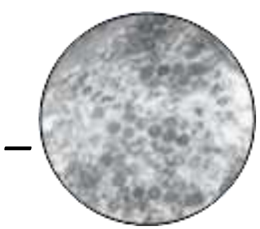
Ten consecutive cycles of rocket (*Eruca sativa*) cultivation were made during two years.

The following soil properties were evaluated:

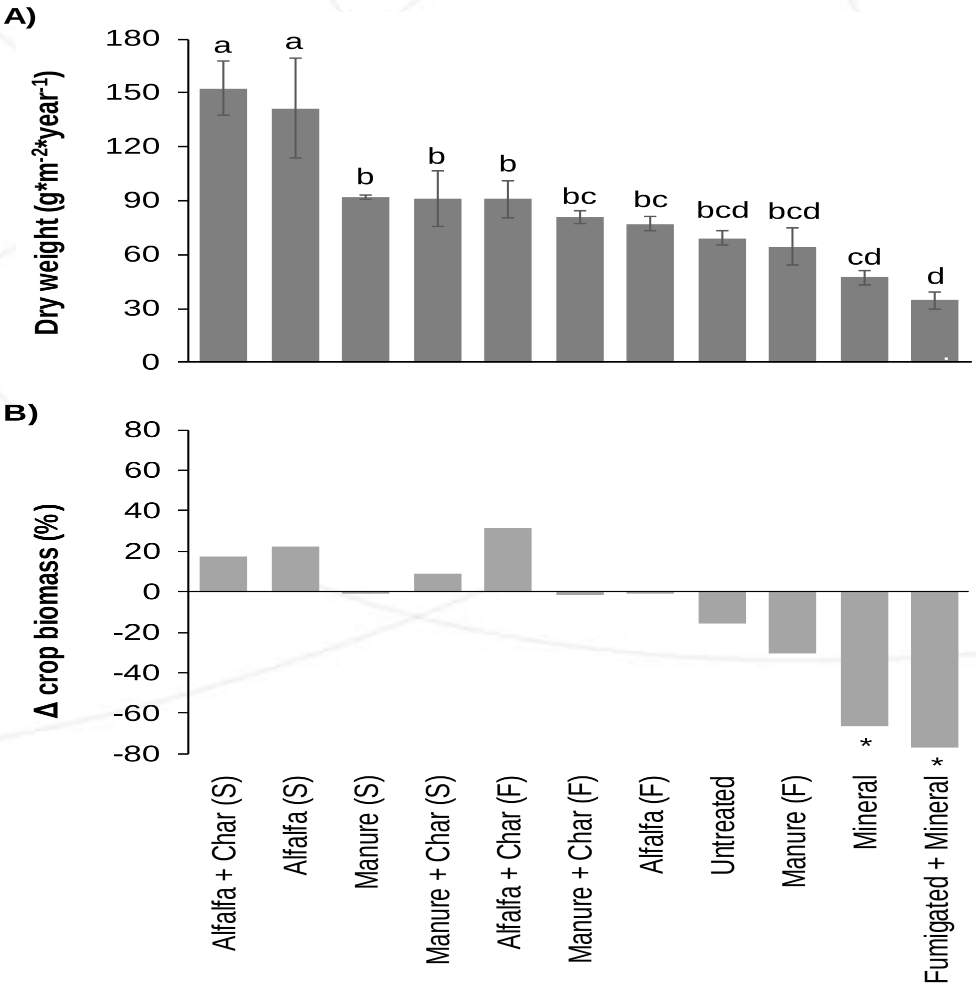
- Soil aggregation;

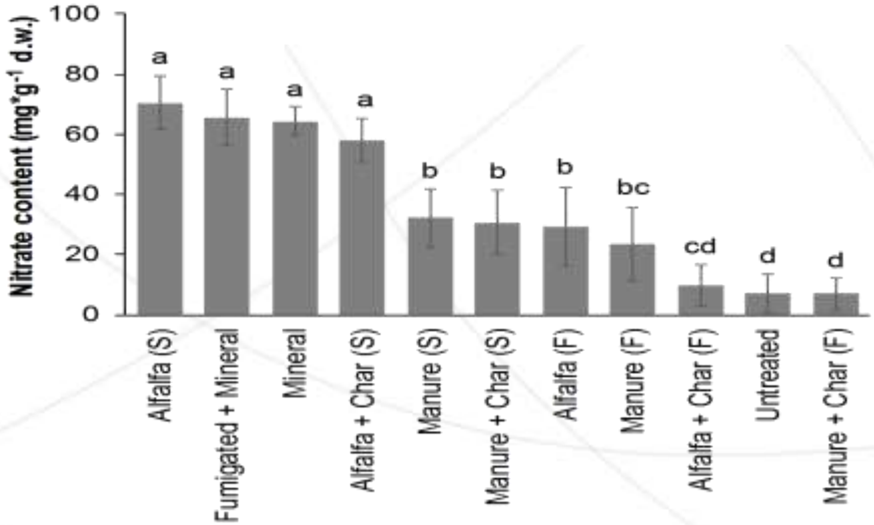
- Soil chemical properties (pH, EC, OC, total N, N-NO_3^-, N-NH_4^+, C/N, CEC, P_2O_5, K^+, Mg^{2+}, Ca^{2+}, Na^+);
- Microbiological parameters (Biolog EcoPlates^{TM} and FDA);

- Soil microbiota (high-throughput sequencing of 16S and 18S rRNA gene markers).
- Disease suppression test: *Tomato Spotted Wilt Virus – tomato*

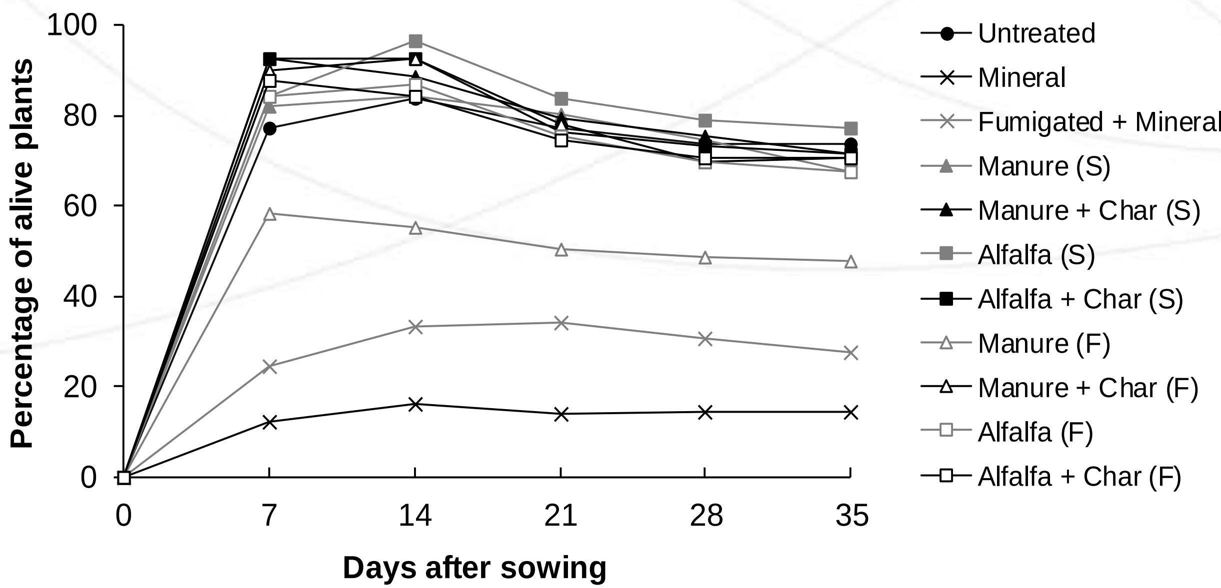


Results: crop yield





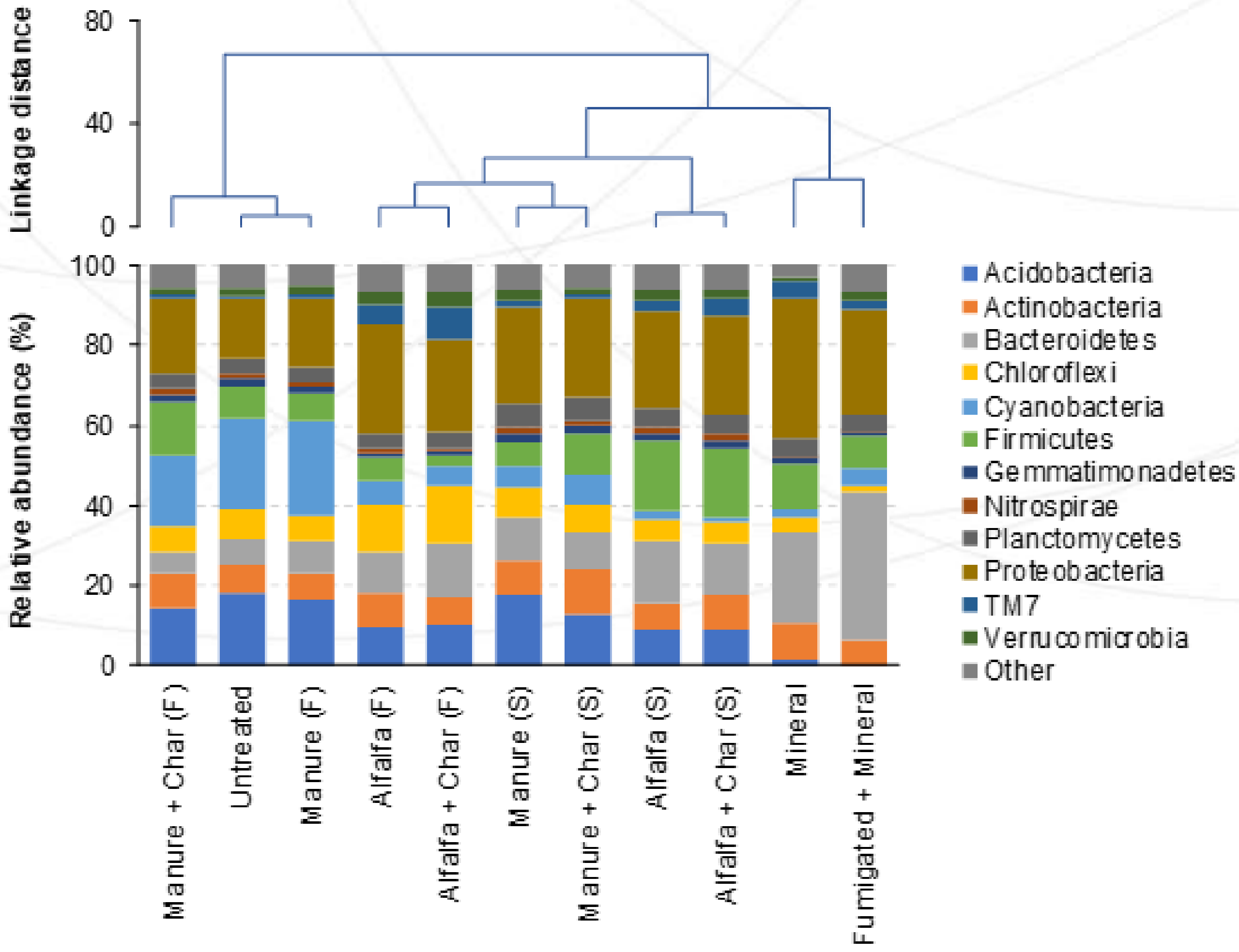
Nitrate content (mg*g-1 dry weight) in leaves of rocket grown in mesocosms with different soil treatments.



Percentage of alive plants recorded in different treatments during the fourth cultivation cycle (35 days length).

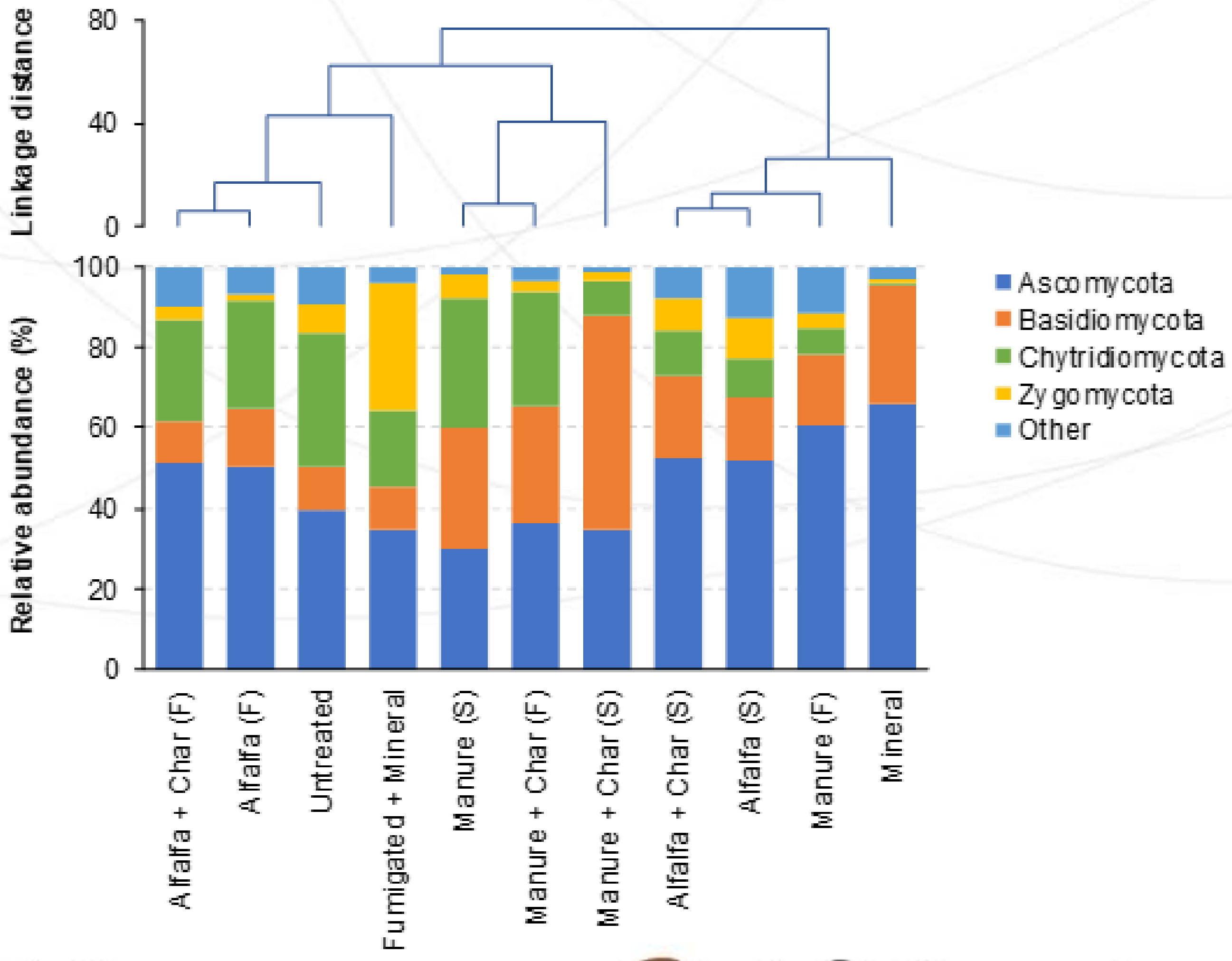
Results: soil microbiota 16S

Relative abundance of bacterial phyla in different soil treatments

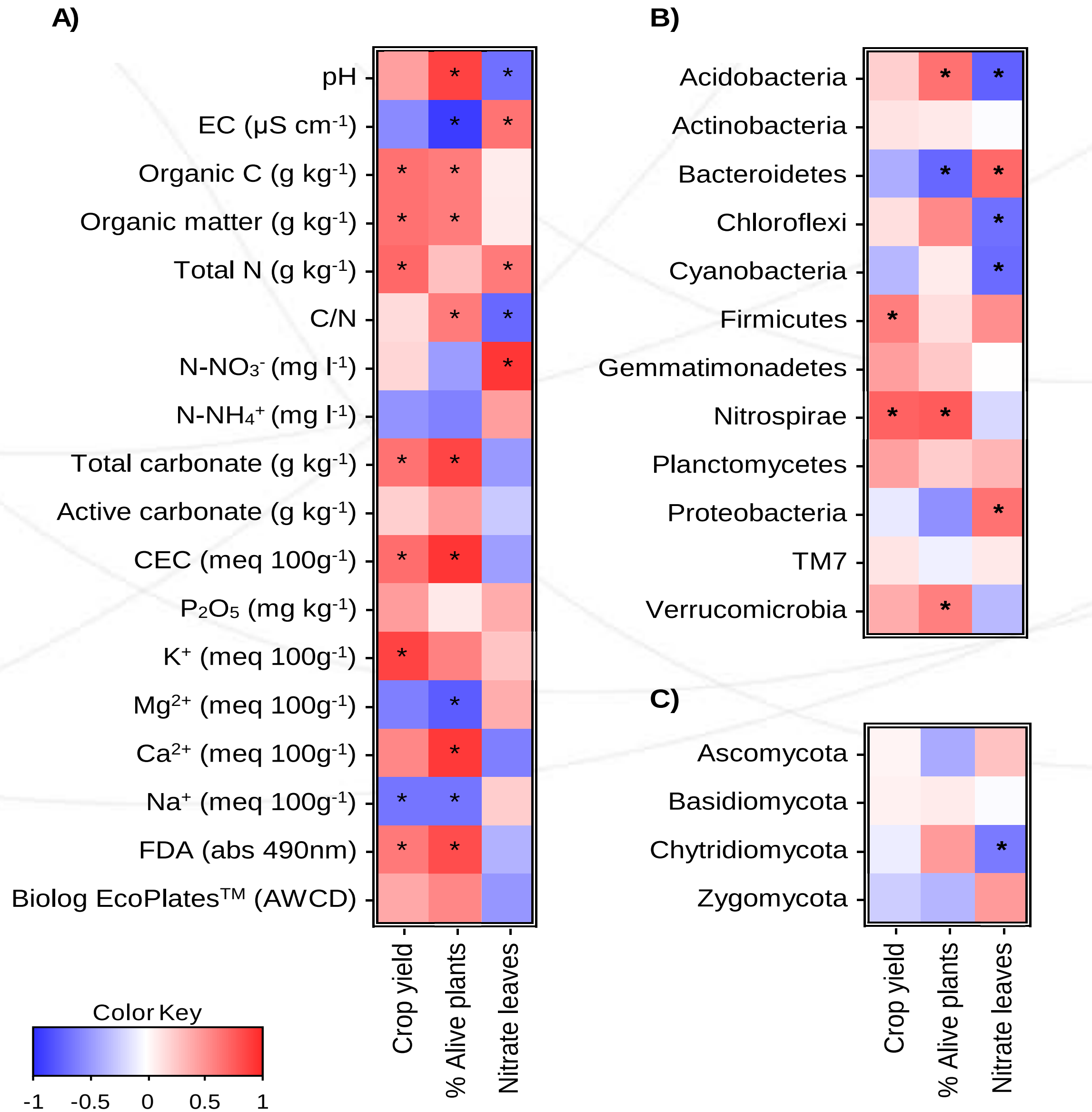


Results: soil microbiota ITS

Relative abundance of fungal phyla in different soil treatments

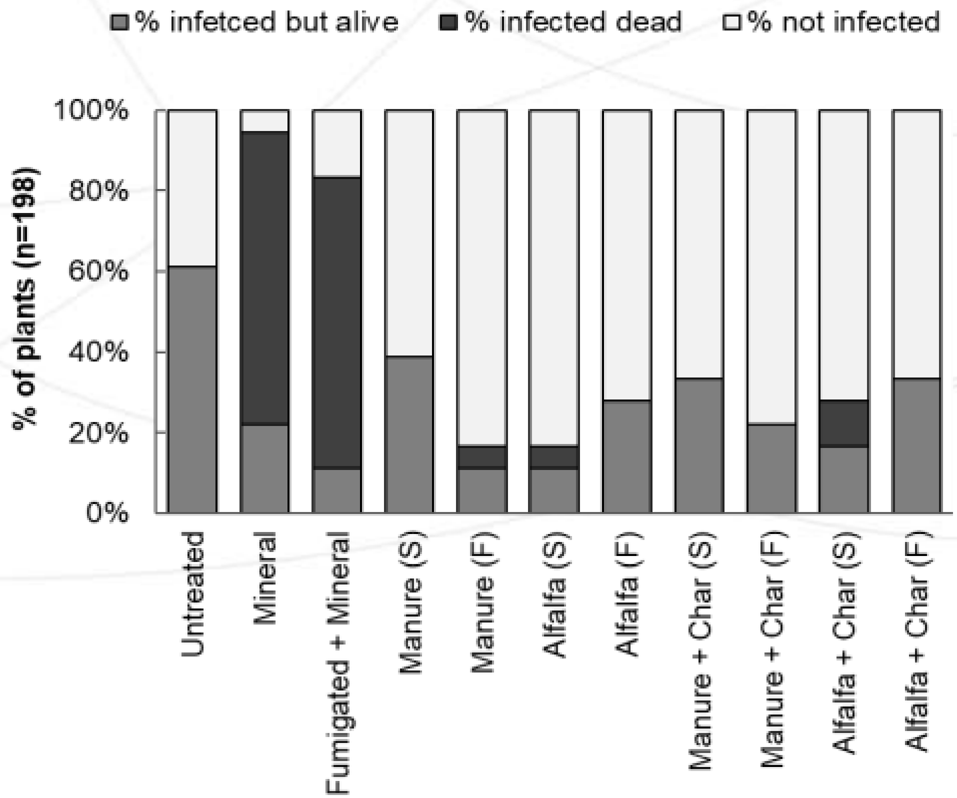


Heat-plot of correlation (Pearson’s r) between crop yield, percentage of alive plants and nitrate leaves content with soil chemical and microbiological parameters **(A)**, relative abundance of bacteria **(B)** and fungi **(C)** collapsed at phylum level



Results: suppressiveness

Percentage of healthy and infected plants in the *TSWV* – tomato pathosystem.



Values are means of 18 replicas
(S)= single, high dose application
(F)= frequent, low dose applications

General conclusion and future perspective

- Application of organic materials, compared with the use of synthetic fertilizers, have an immediate positive effect on soil fertility as well as on soil microbiota, while the increase of crop productivity are of longer-term nature.

- For the first time, we found that use of organic amendments reduced the incidence of *TSWV* infection, as well as the mortality of infected plants.

- Future studies that include different combinations of organic amendment types and application frequencies, as well as different soil types, crop species and patho-systems, are needed to better understand the role of organic matter as a means to recover of soils affected by soil sickness.


Thank you
for your attention