Cover crop management for healthy vineyard soils

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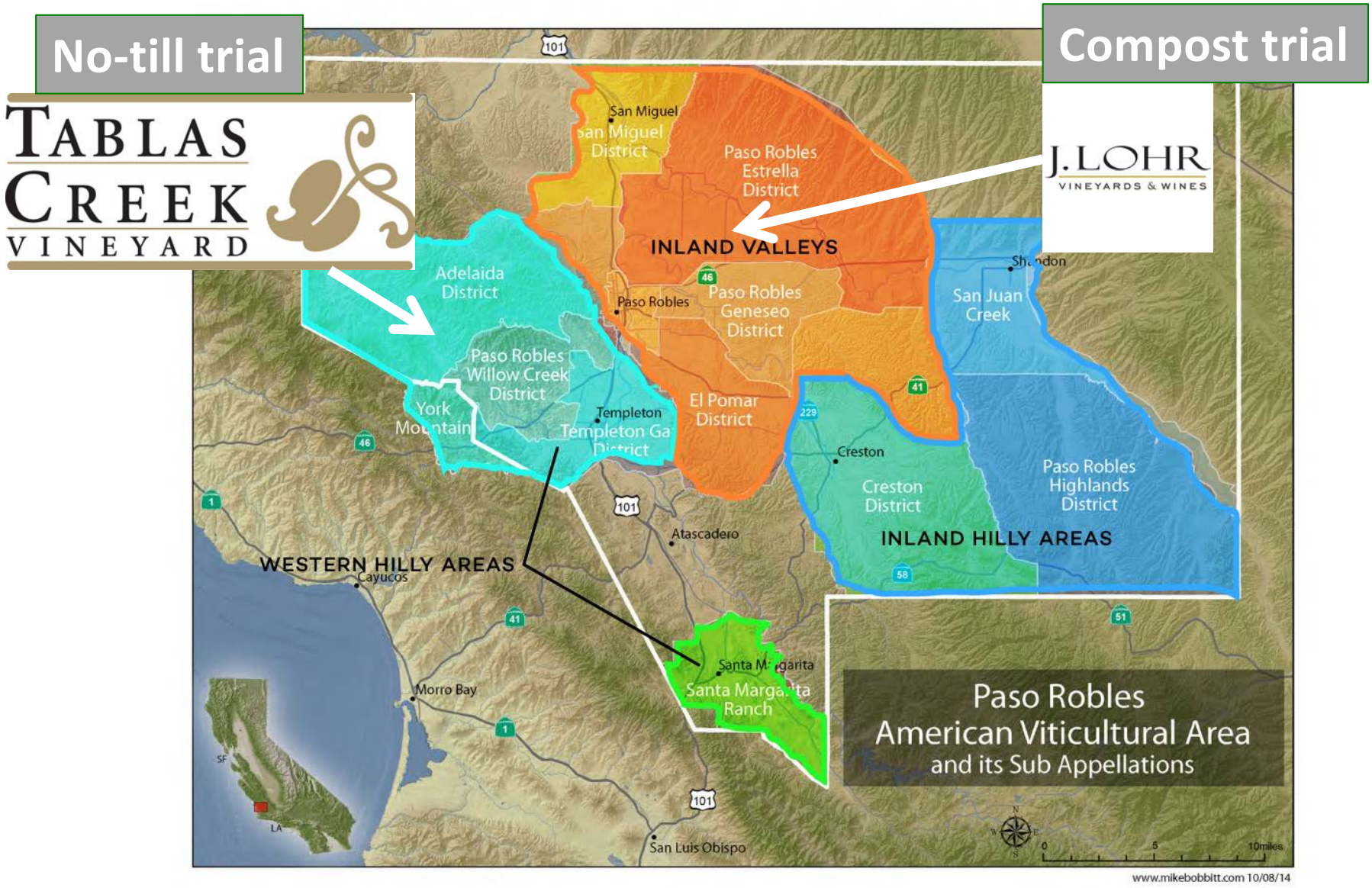
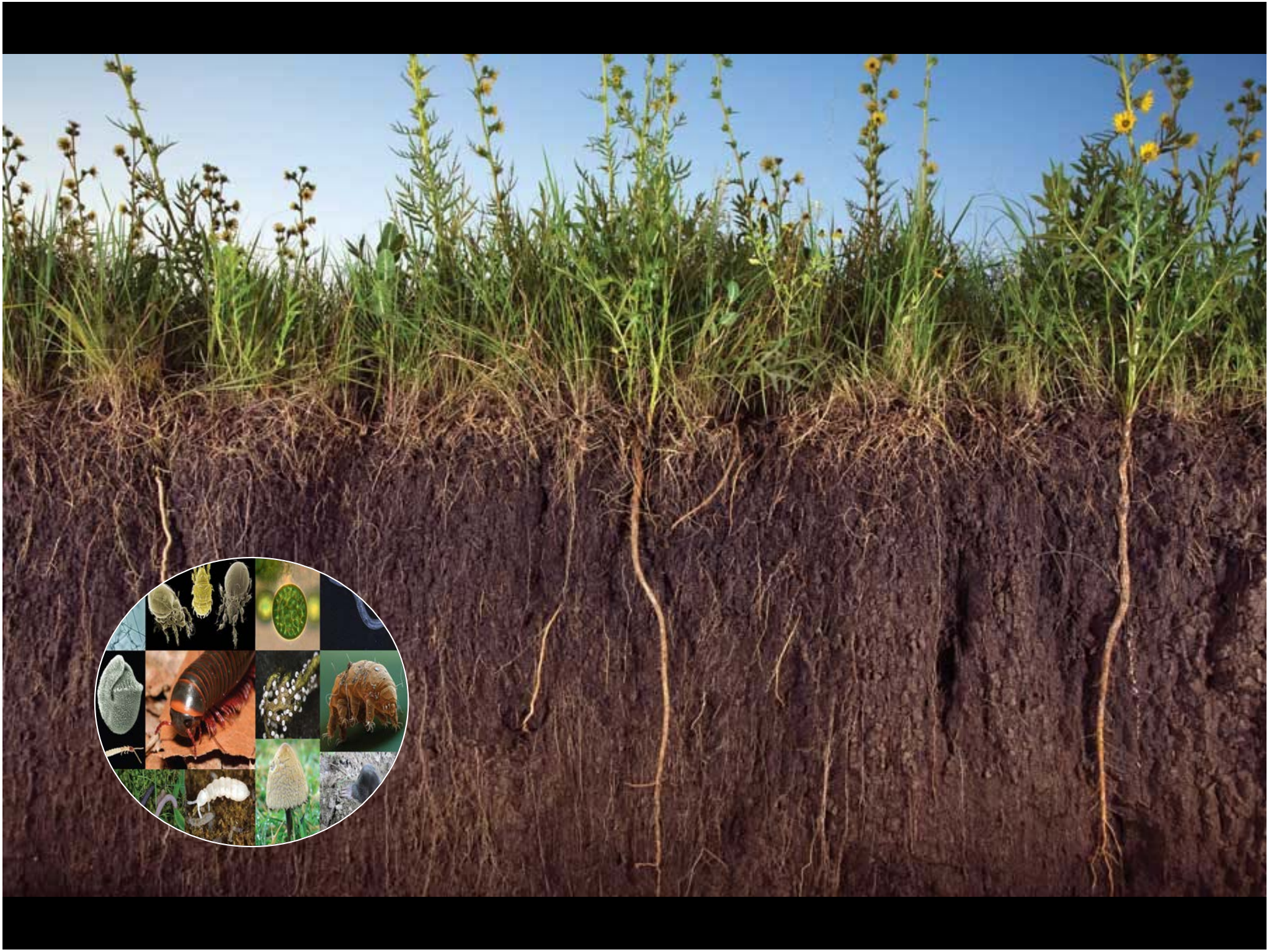
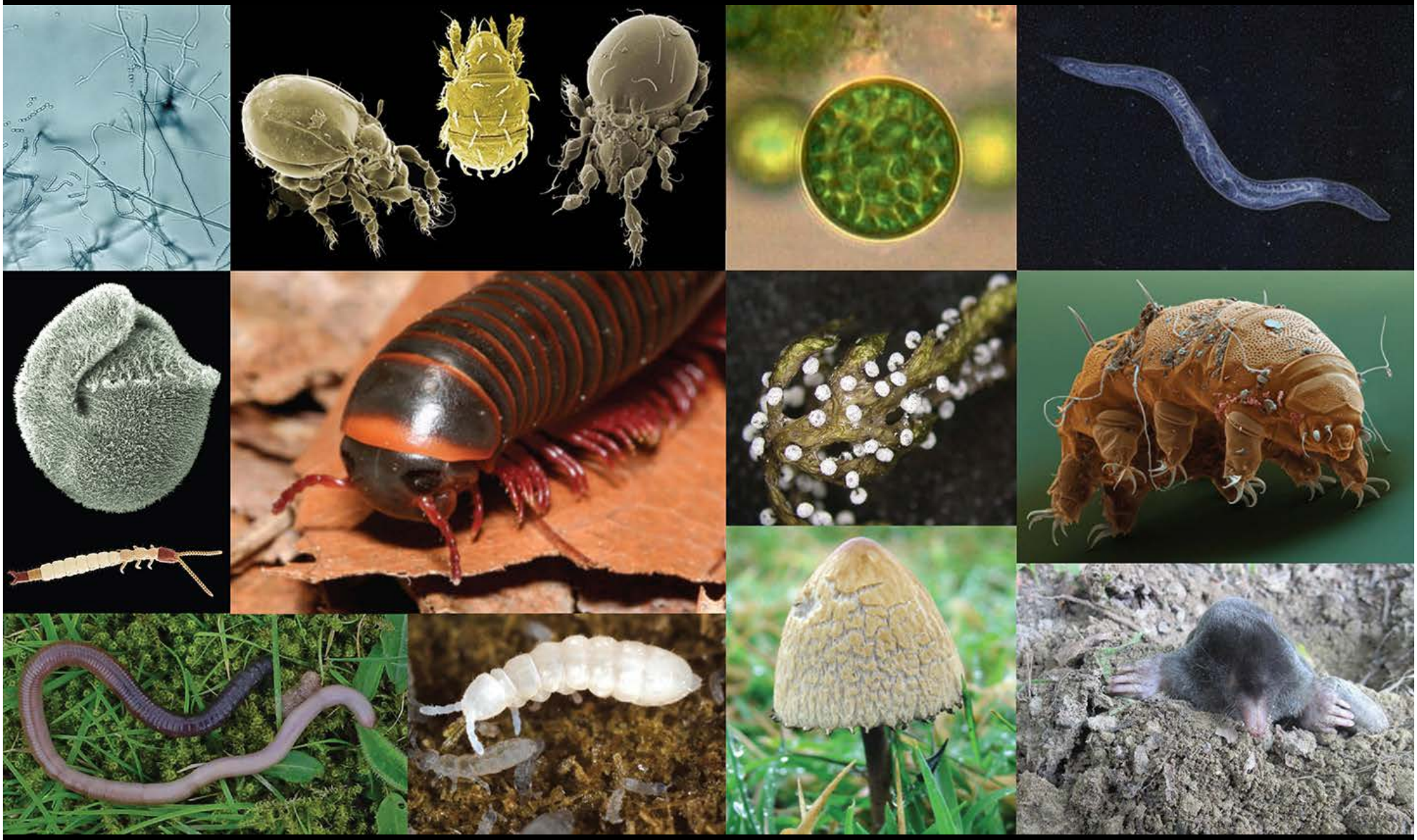
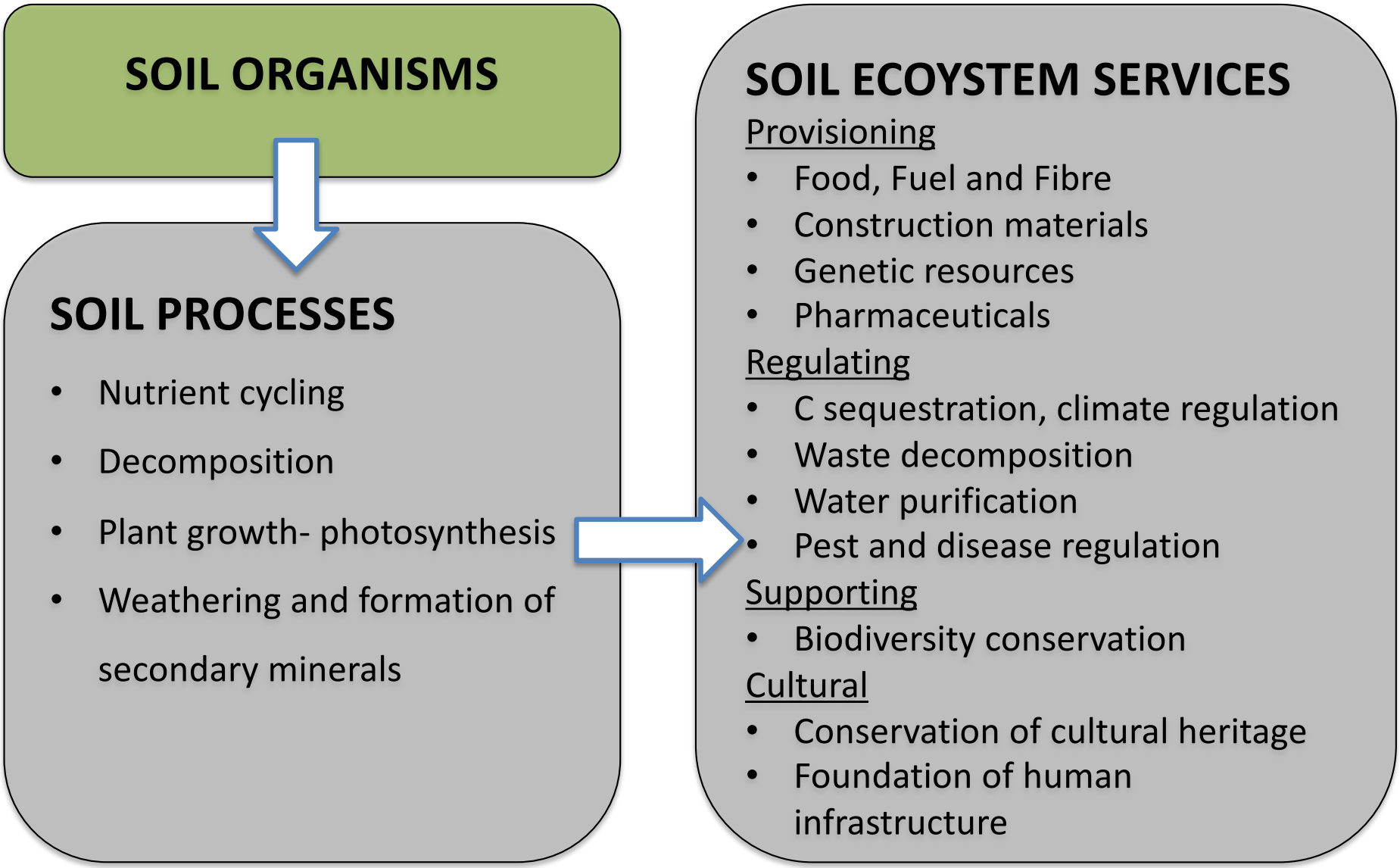
Assessment of no-till, compost and grazing on soil health, soil carbon and greenhouse gas emissions in wine grape production

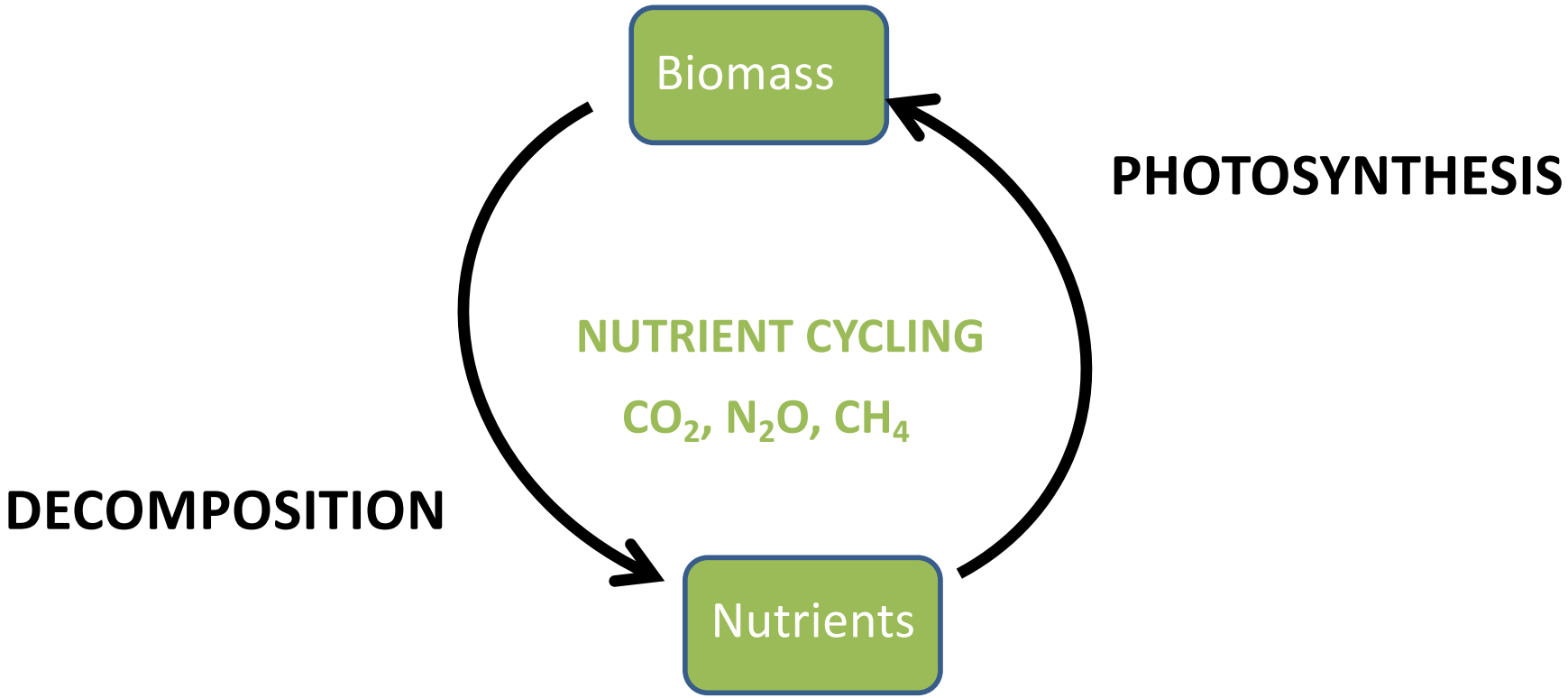







SOIL ORGANISMS
SOIL PROCESSES
• Nutrient cycling
• Decomposition
• Plant growth- photosynthesis
• Weathering and formation of secondary minerals
SOIL ECOYSTEM SERVICES
Provisioning
• Food, Fuel and Fibre
• Construction materials
• Genetic resources
• Pharmaceuticals
Regulating
• C sequestration, climate regulation
• Waste decomposition
• Water purification
• Pest and disease regulation
Supporting
• Biodiversity conservation
Cultural
• Conservation of cultural heritage
• Foundation of human infrastructure

Soil biota supports the two major ecological processes in nature



Soil biota regulates atmospheric composition

The Washington Post
Democracy Dies in Darkness

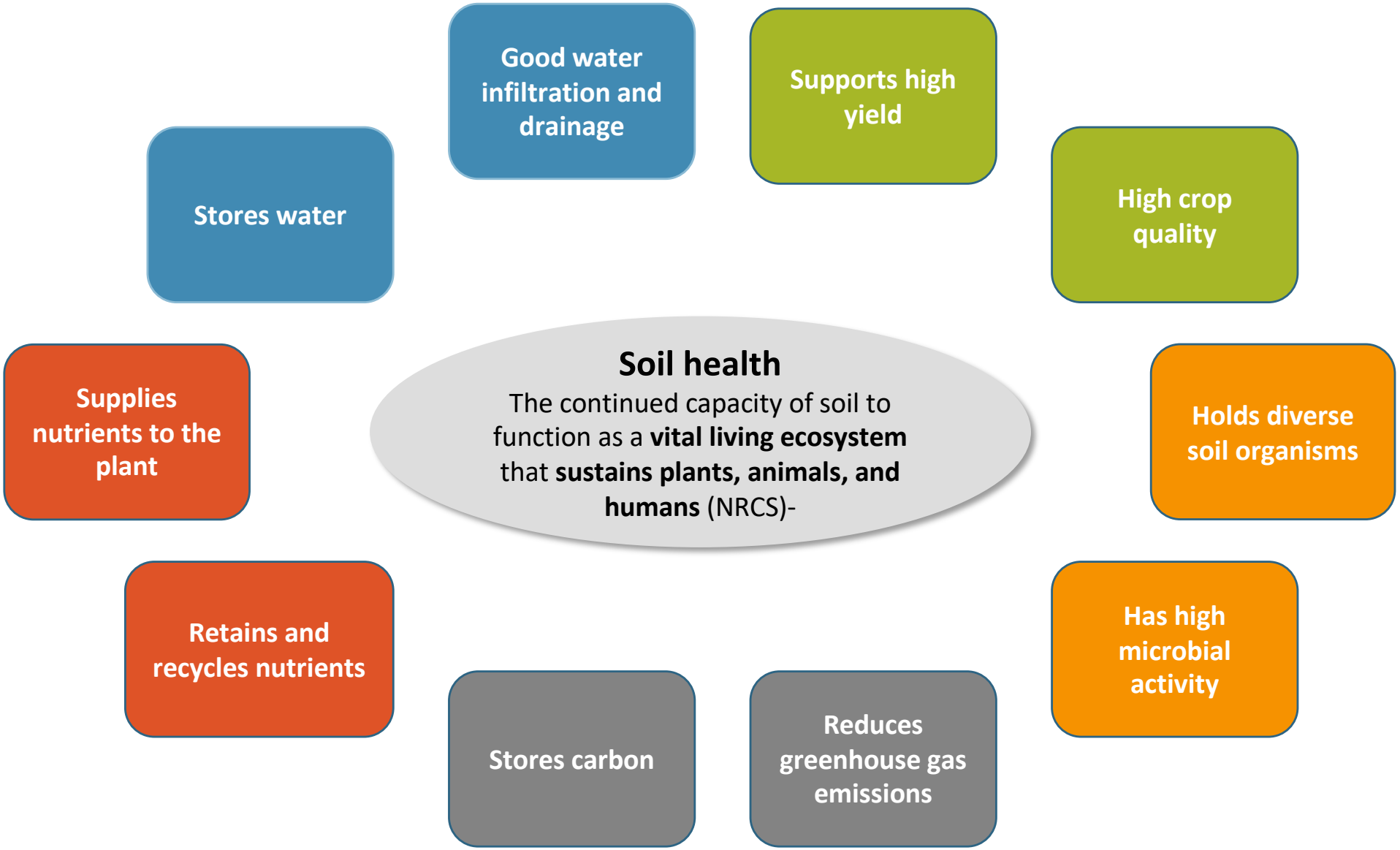
Business

The new plan to remove a trillion tons of carbon dioxide from the atmosphere: Bury it.

It sounds like an idea plucked from science fiction, but the reality is that trees and plants already do it.

- Atmospheric CO_2 is at record levels (more than 415 ppm)
- Managing soils and soil biota is one of the most promising strategies to fight climate change

Properties of a healthy cropping soil



Management strategies to support soil health

Increase soil organic matter

Use of organic fertilizers (compost, manure, sewage sludge)

Cover crops

Incorporation of crop residues

Reduce disturbance

Keep the soil covered- cover crops

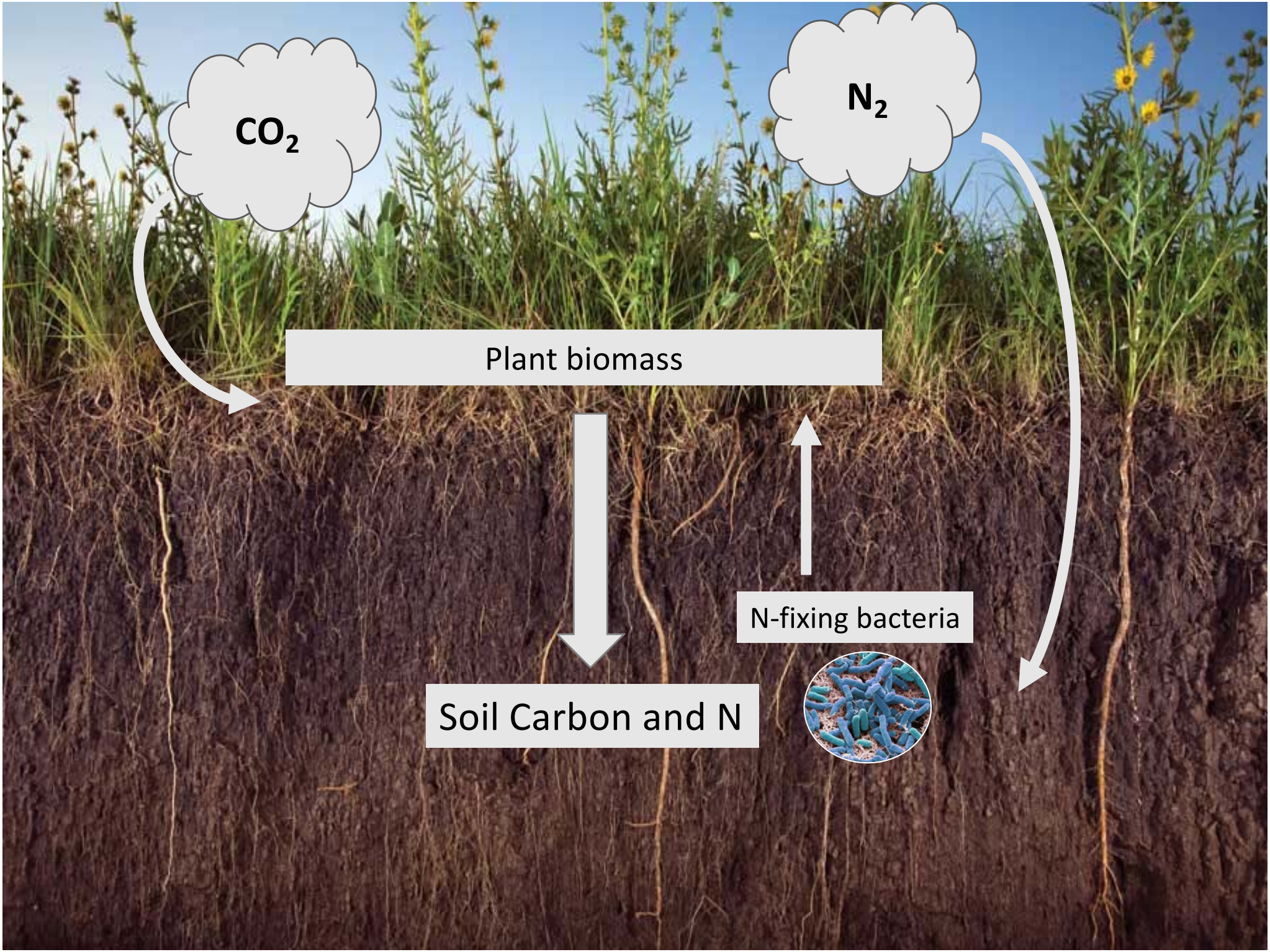
No-till or low till management

Management of vegetation cover through grazing or mowing

Increase diversity

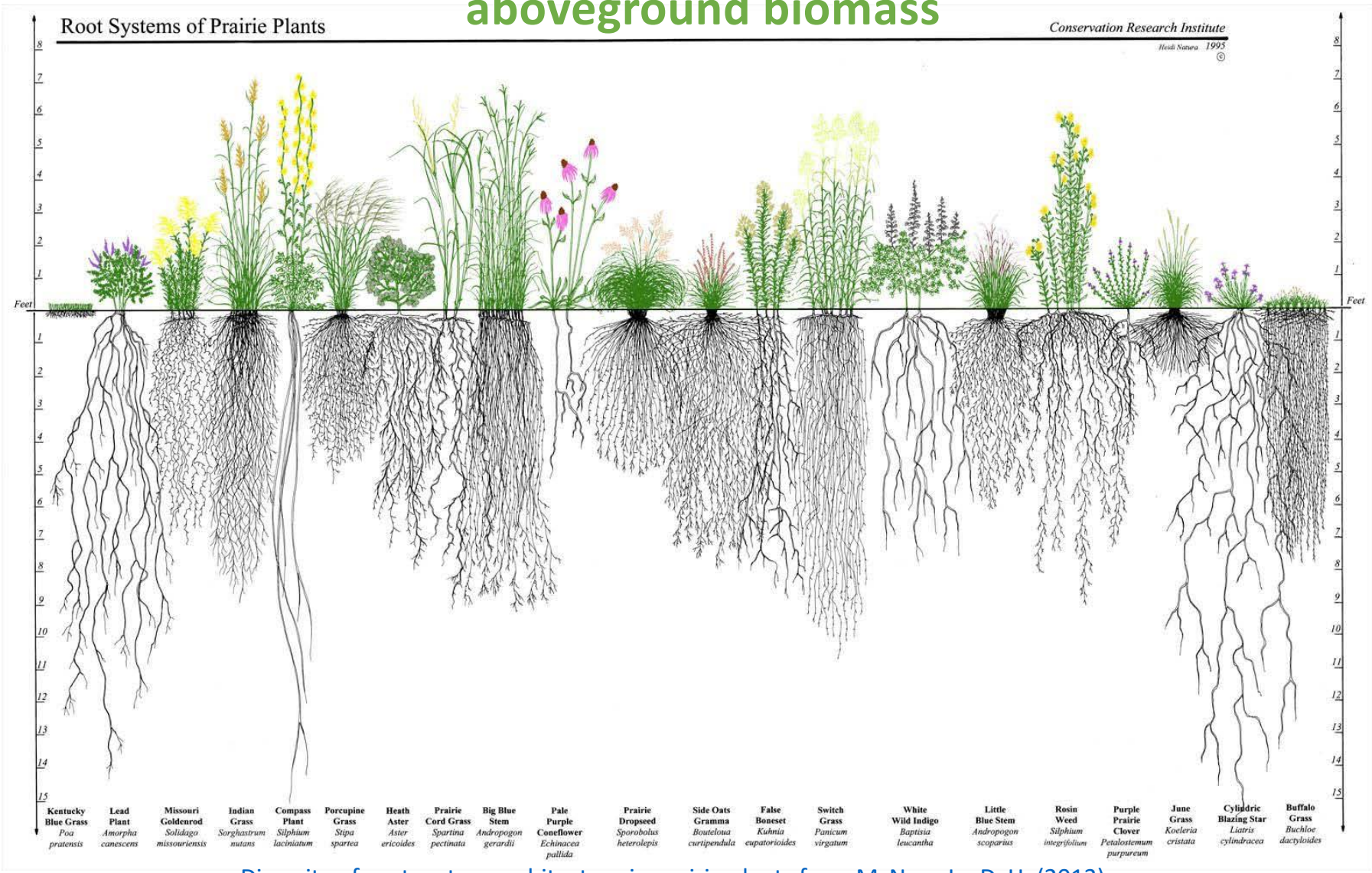
Crop rotations

Cover crops

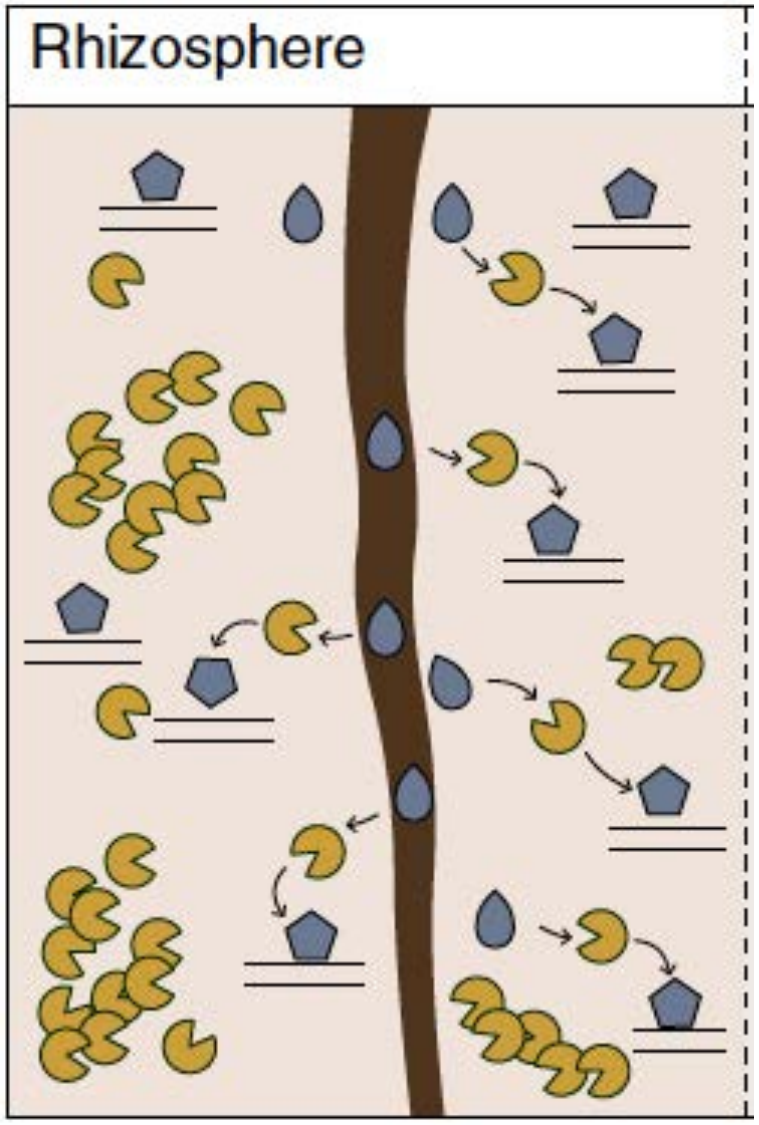

CO_2
N_2
Plant biomass
N-fixing bacteria
Soil Carbon and N

The contribution of roots to soil C

Belowground biomass in roots can be larger than aboveground biomass



Diversity of root system architecture in prairie plants from McNear Jr., D. H. (2013)



Sokol and Bradford (2019)

Root exudates: Constant input of labile C to the soil that feeds the microbes

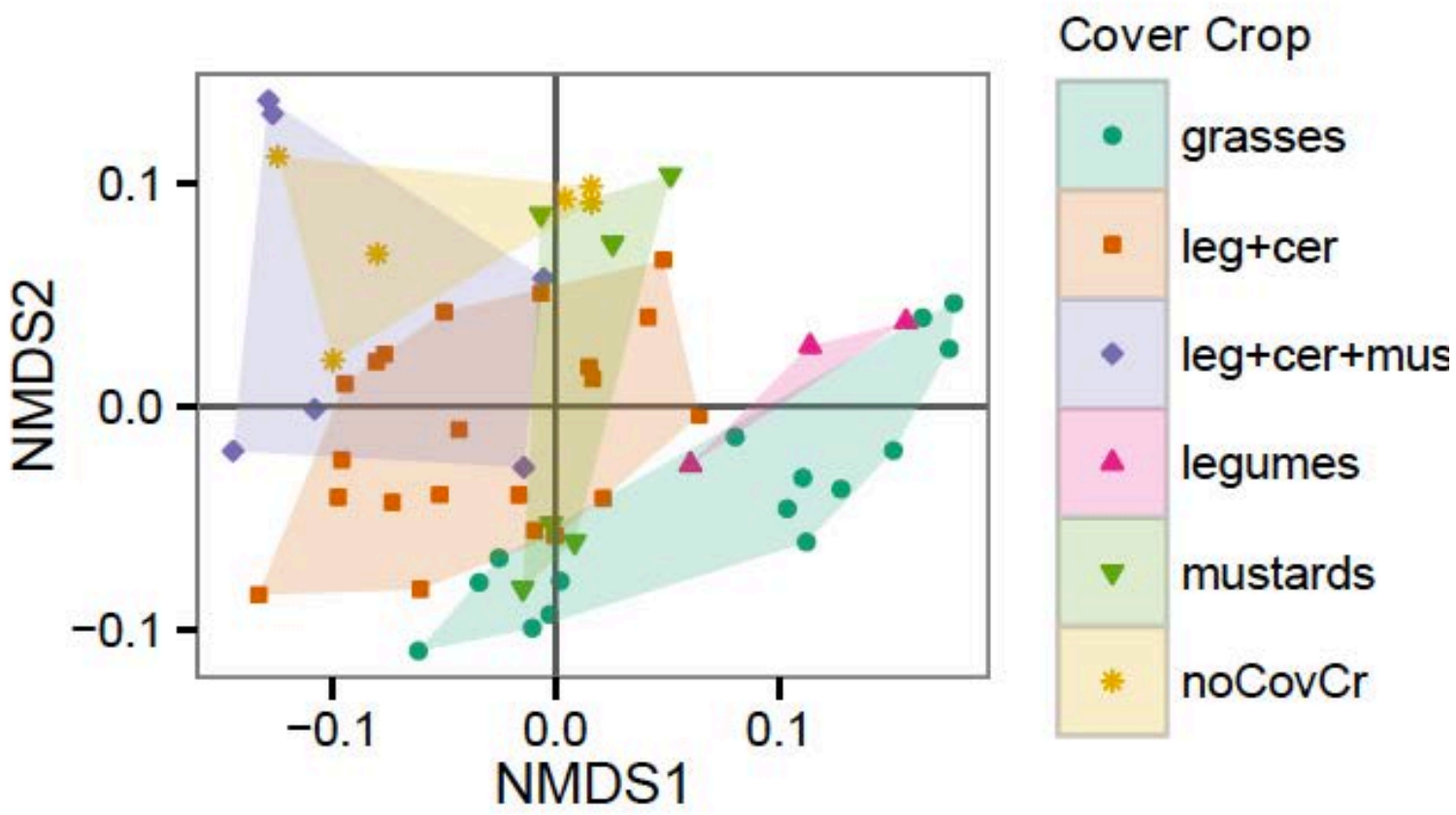
- Higher microbial activity
- Higher microbial biomass
- Higher C sequestration trough association of microbial residues with soil minerals

Dead plant roots over the dry season contribute to the formation of large soil aggregates

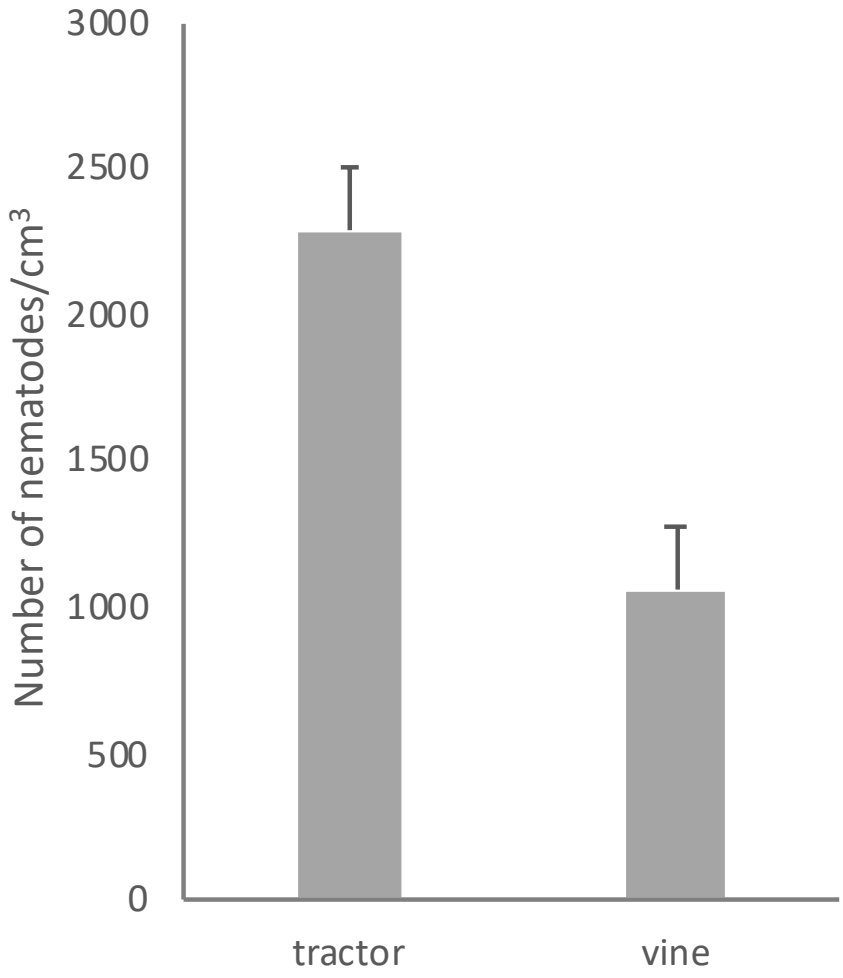
Blankinship et al (2016)

Cover crops change soil microbial community

K.N. Burns et al. / Soil Biology & Biochemistry 103 (2016) 337–348

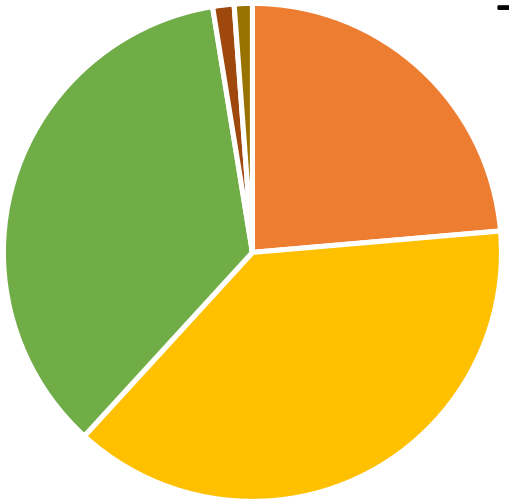


Cover crops increase the abundance of nematodes

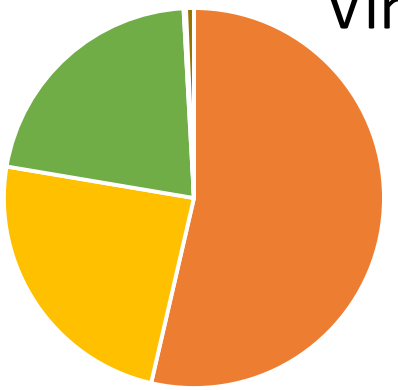


Deniston- Sheets et al. 2019 (in preparation)

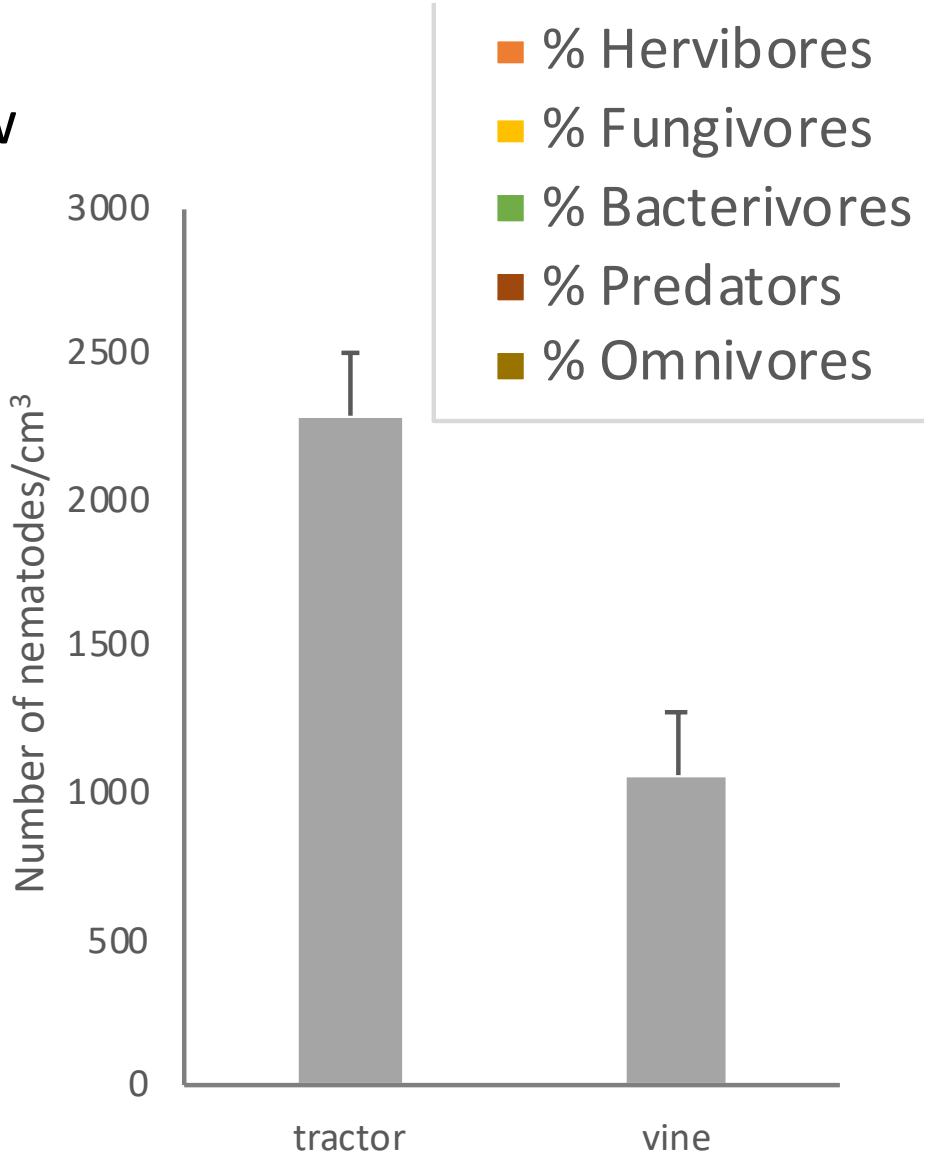
Cover crops increase the abundance of beneficial nematodes



Tractor row



Vine row



Deniston- Sheets et al. 2019 (in preparation)

Cover crop management

Termination

One of the most critical management decisions, since it can have profound impacts in soil physical, chemical and biological properties

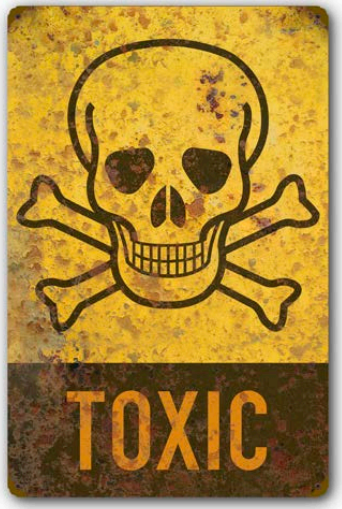
What are the options?

Termination

Herbicide:

Advantages: effective

Disadvantages: several non-targeted effects on soil biota and human health



Tillage

- Promotes mixing and aeration of the soil accelerating decomposition and release of nutrients
- Increases infiltration and aeration in heavy clay soils

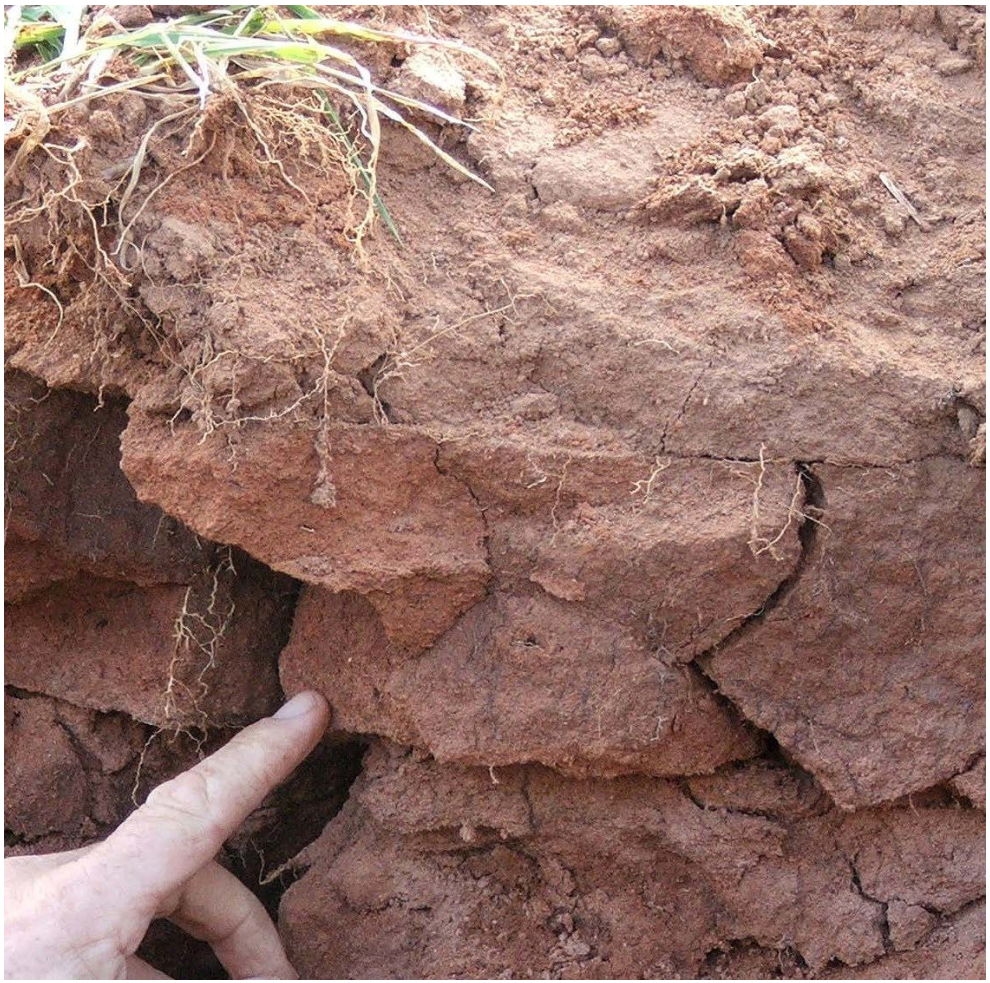
Disadvantages

- Heavy tillage: destruction of soil structure and compaction

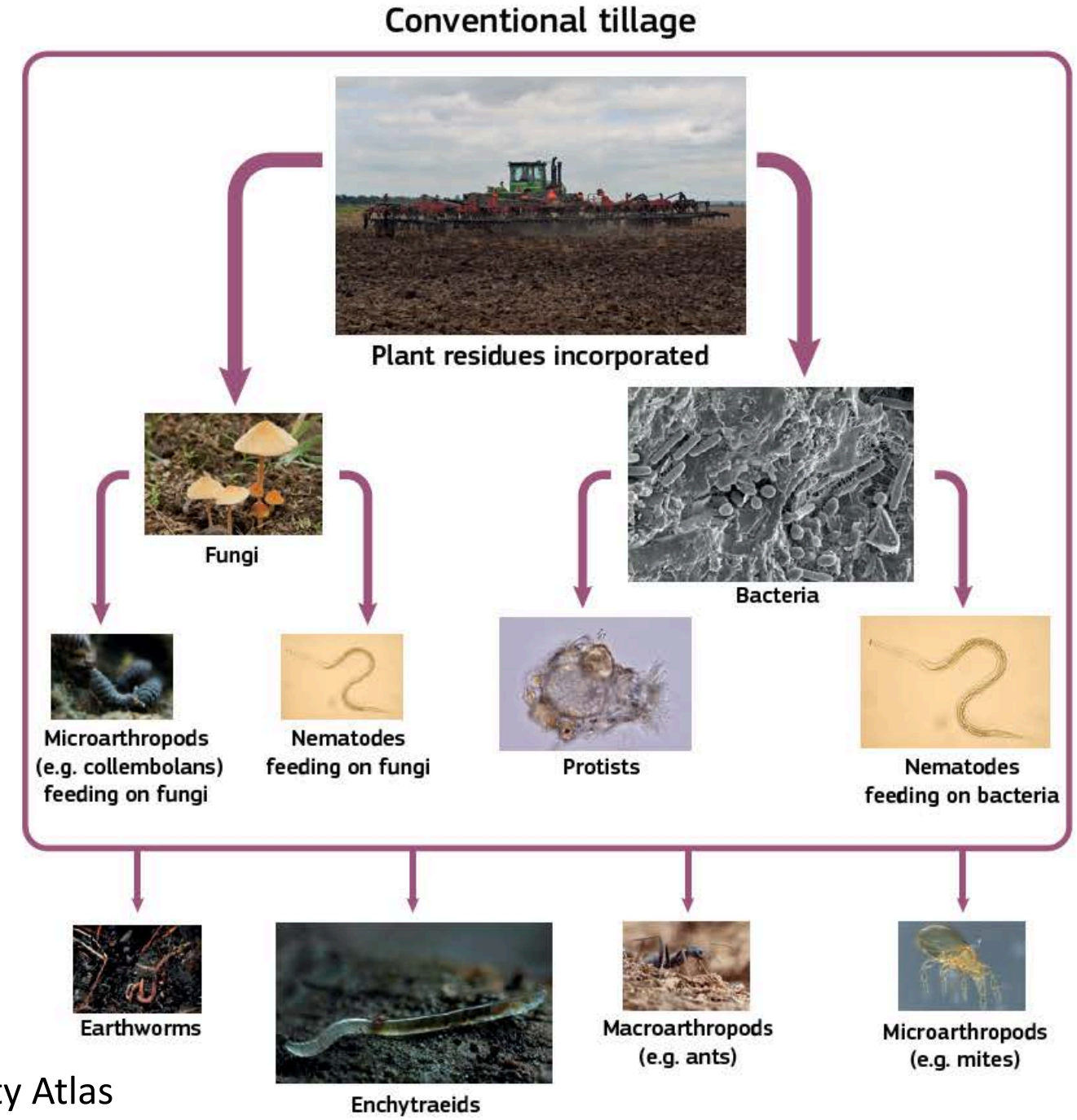
Tillage

Plough pan

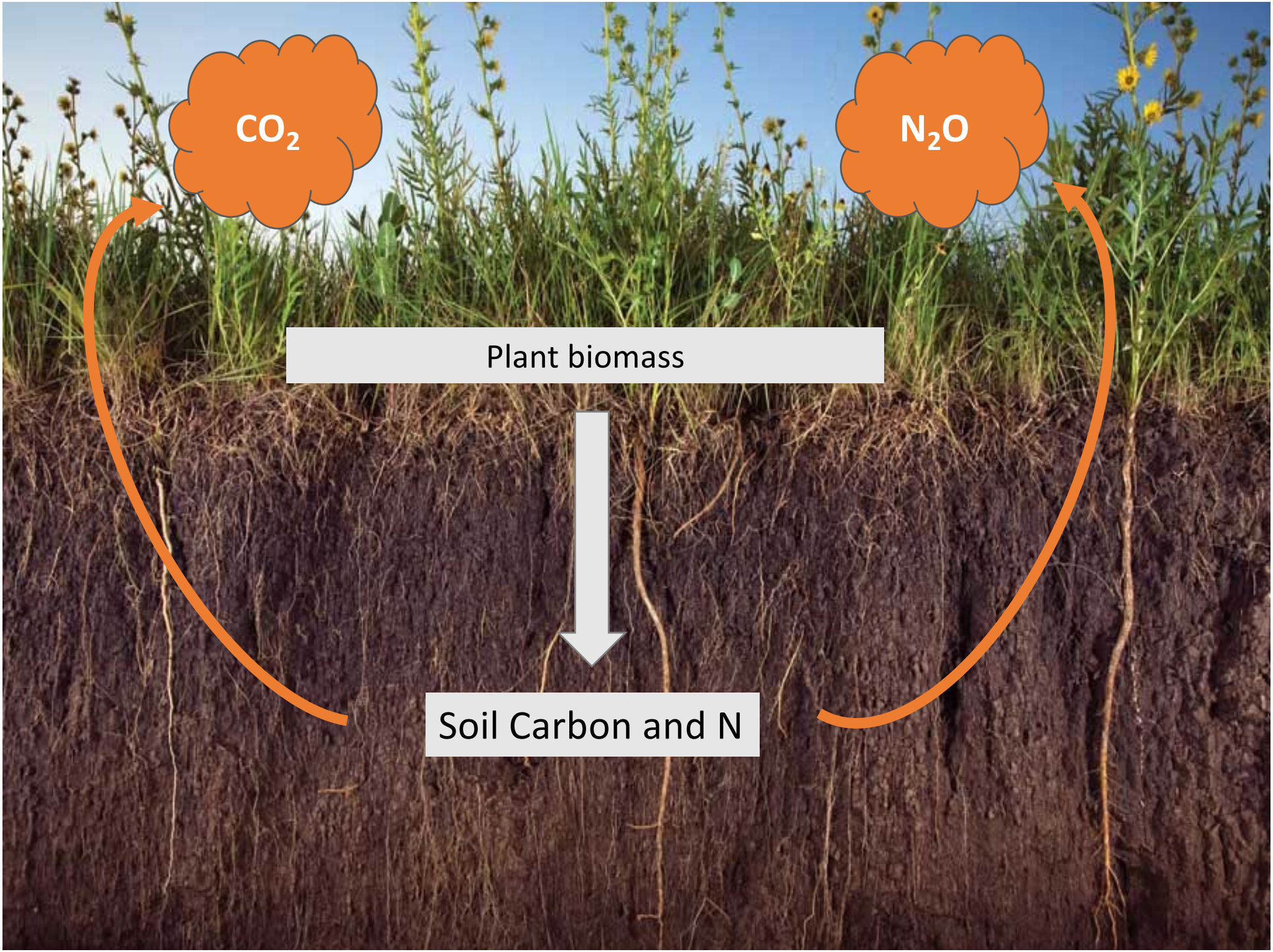
A layer of compacted soil that restricts root growth and water infiltration



Effects on the soil physical properties are reflected in the soil foodweb

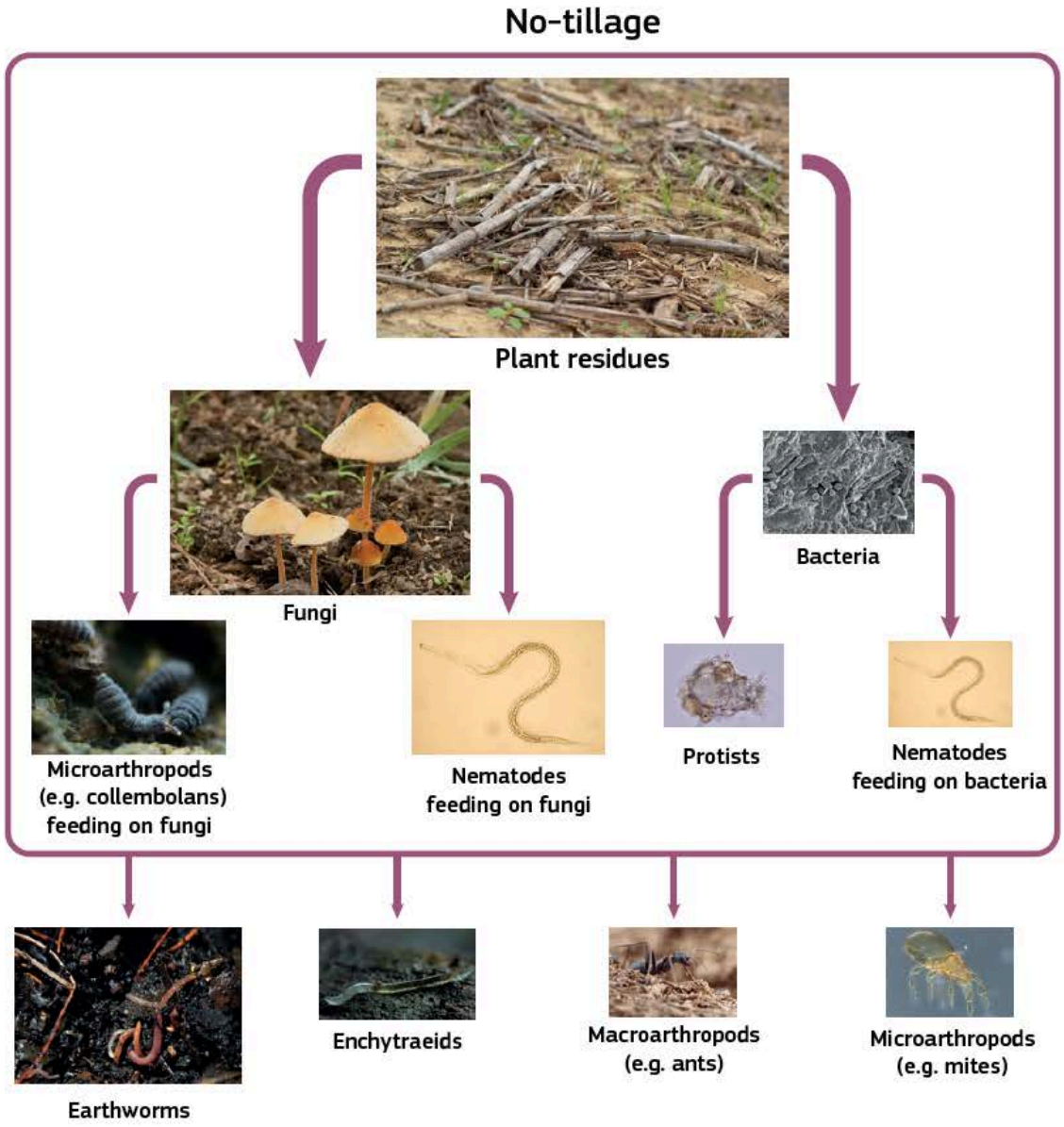


Source: Global Soil Biodiversity Atlas


CO_2
N_2O
Plant biomass
Soil Carbon and N

No till or reduced till

- Improved soil structure
- Higher soil organic matter and C



No till or reduced till

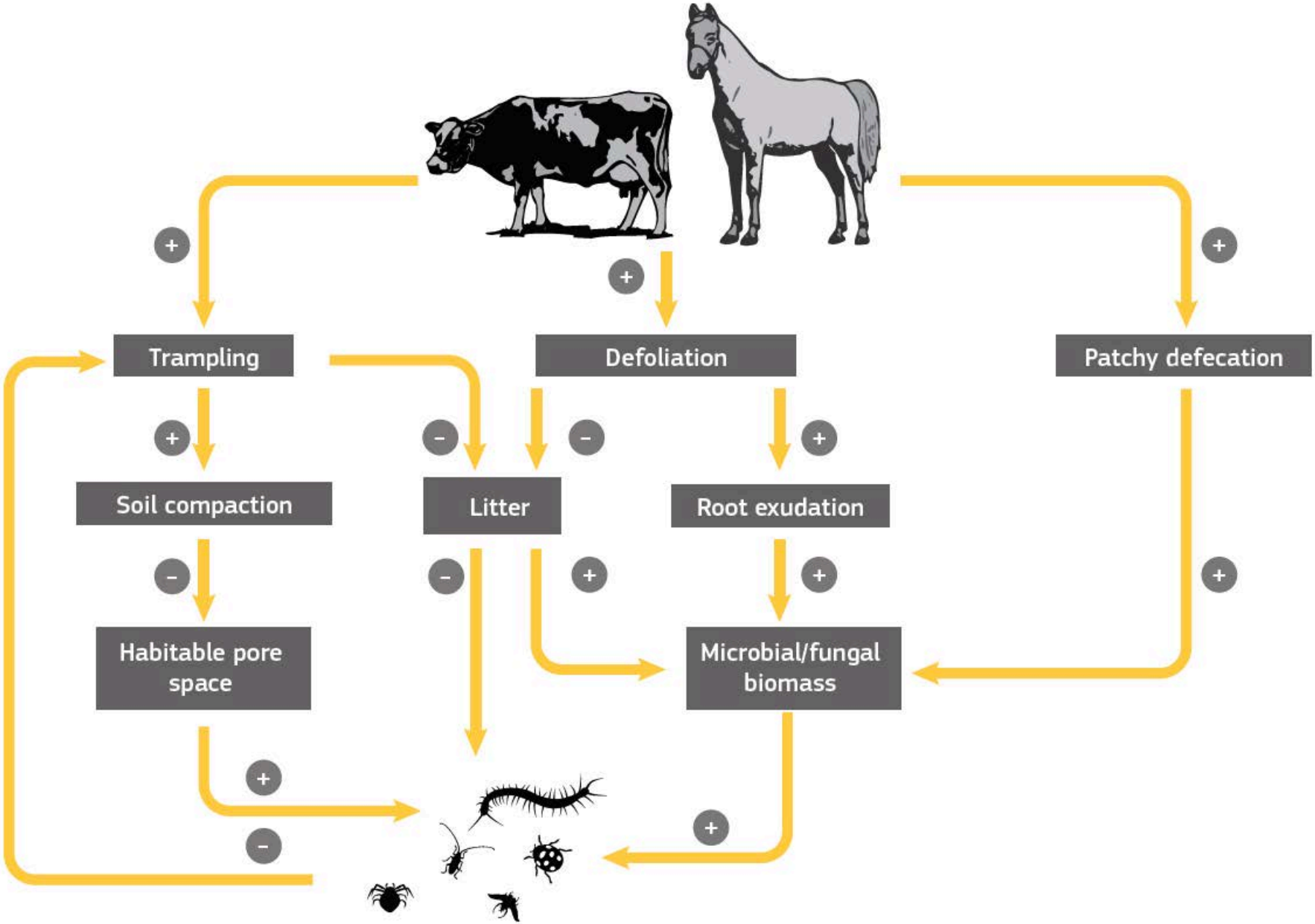
- No till may be an issue in heavy clay soils (reduced infiltration)
- Still need to terminate the cover crop:

  Mowing or rolling:

  - Advantages: mulching effect, protection from erosion, preservation of soil moisture, reduction of weeds
  - Disadvantages: Incorporation to soil is slower

  - **Grazing**

Effects of grazing on soil biota



Source: Global Soil Biodiversity Atlas

Grazing

Advantages: manure (N additions), the right amount of grazing pressure stimulates cover crop

Disadvantages:

- Overgrazing and compaction.
- Can't be done after budbreak
- Potentially more GHG emissions (CH_4)

Cover crops have clear benefits for soil health as they provide an input of C and organic matter to the soil. However, the benefits of cover crops seem to be dependent on cover crop management

Tillage reduces soil organic matter and disrupts the soil foodweb, having negative effects on soil health and C sequestration as compared to no –till

Grazing is a promising strategy to integrate livestock production into vineyards that could promote soil health: no research to support this

No silver bullet: benefits and drawbacks need to be assessed for each specific case

Questions?