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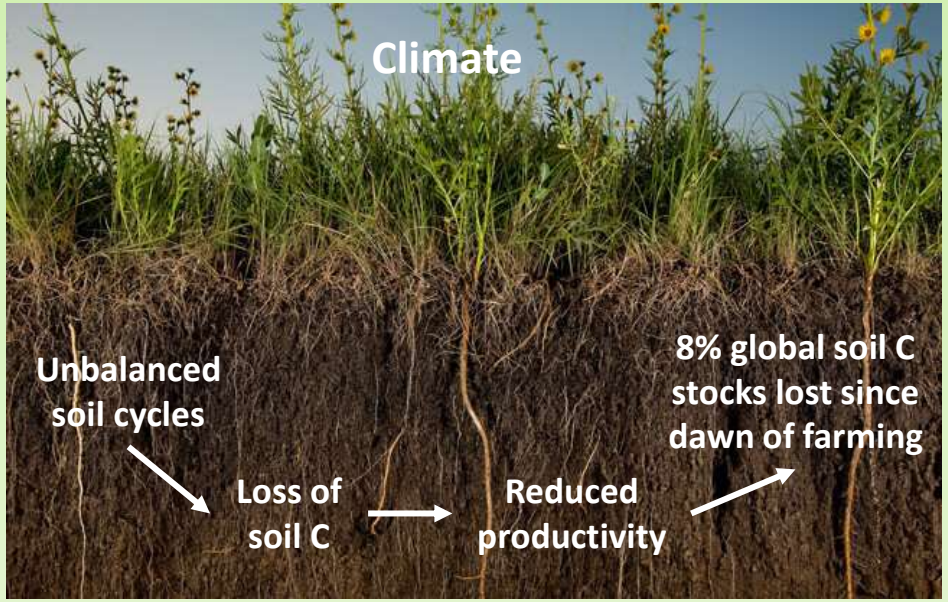
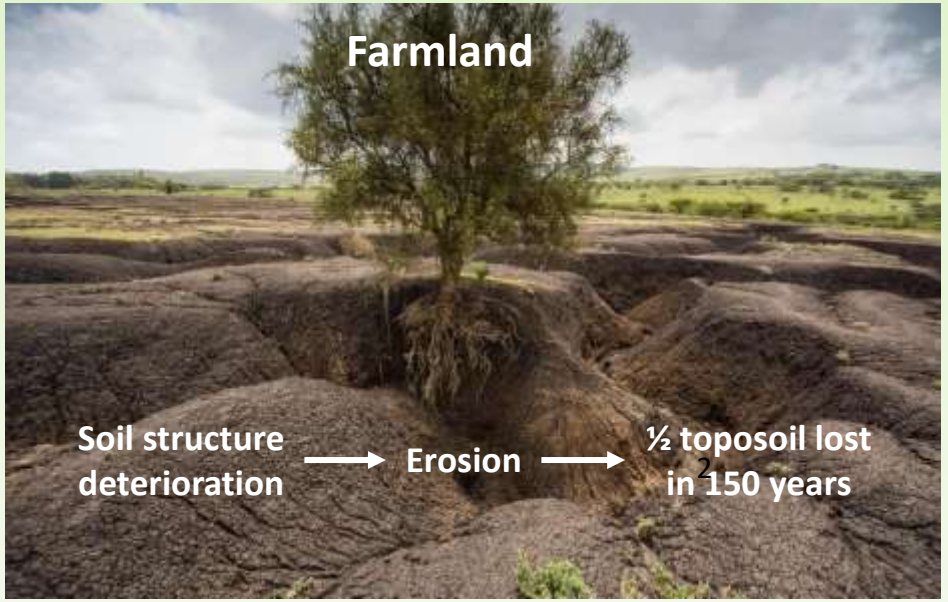
Application of Compost to Alfalfa to Improve Soil Structure and Soil Nutrient Content

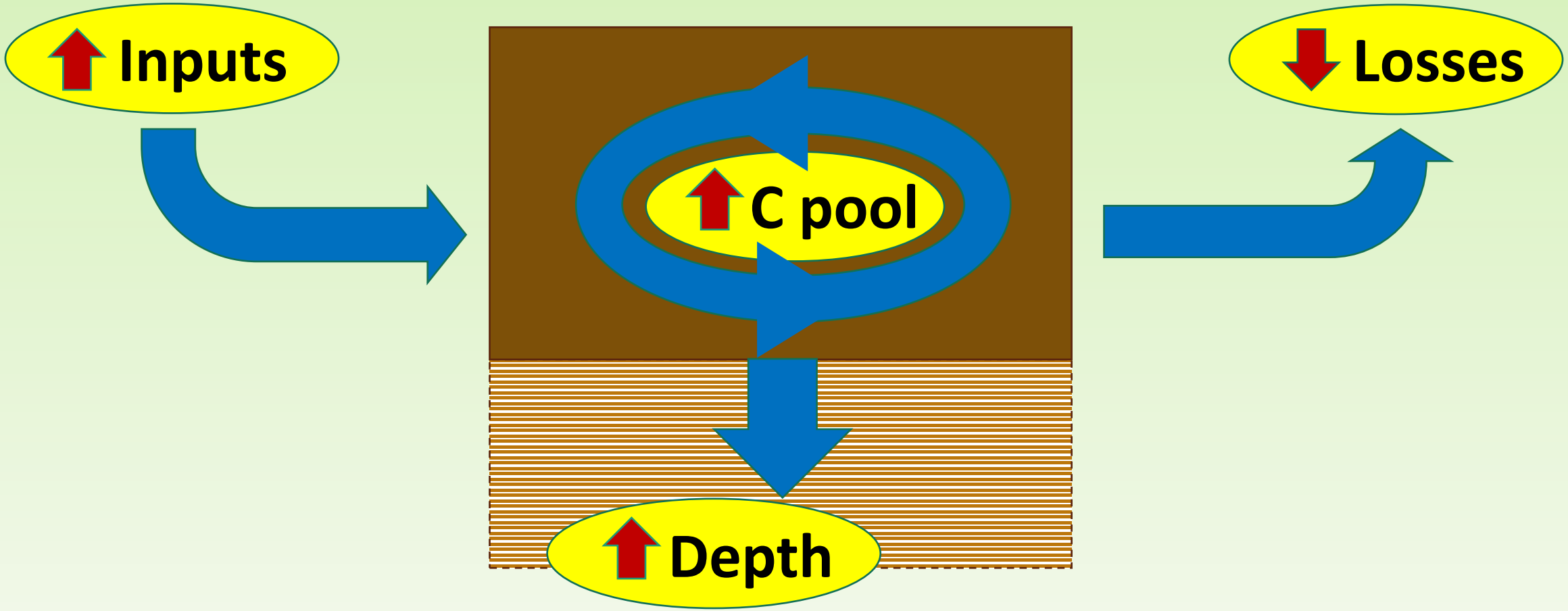
Importance of soil management





Importance of soil management

What can we do to increase SOM?



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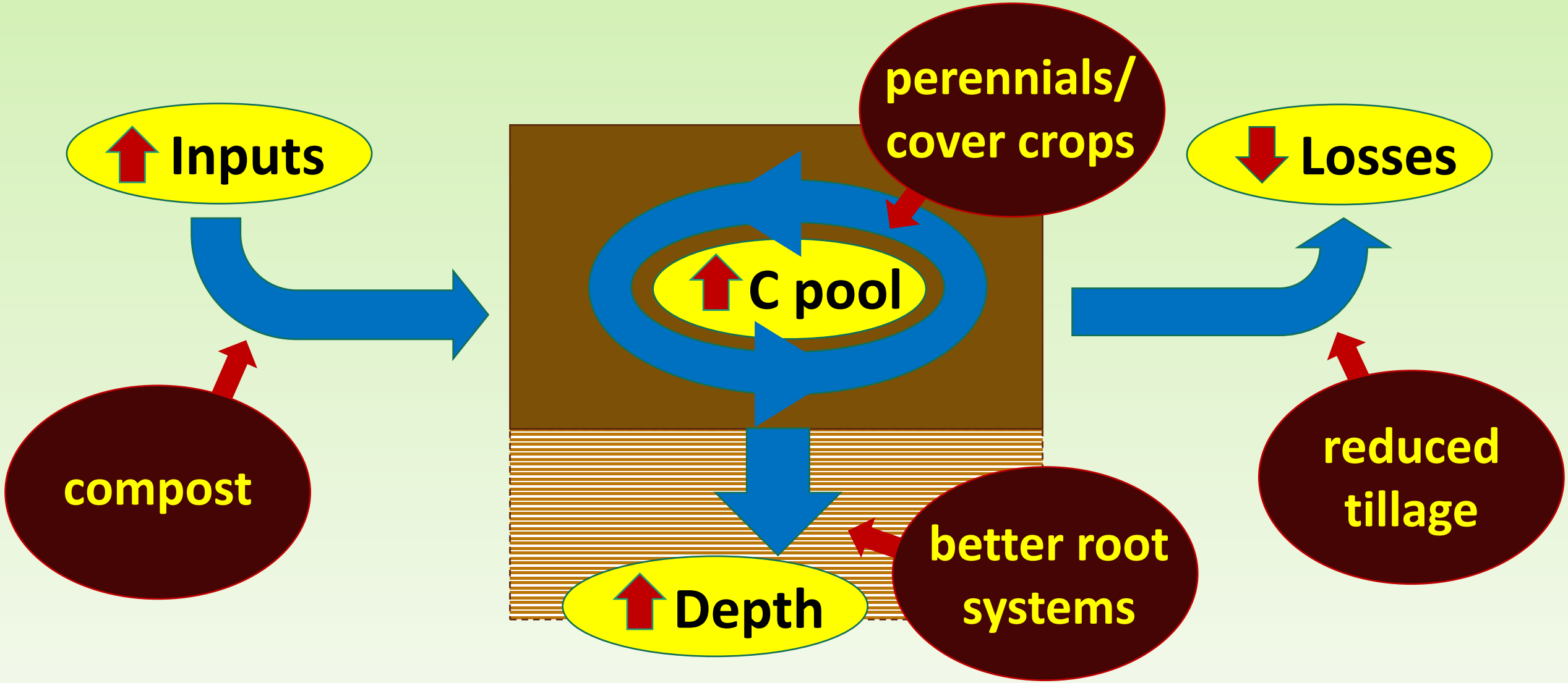
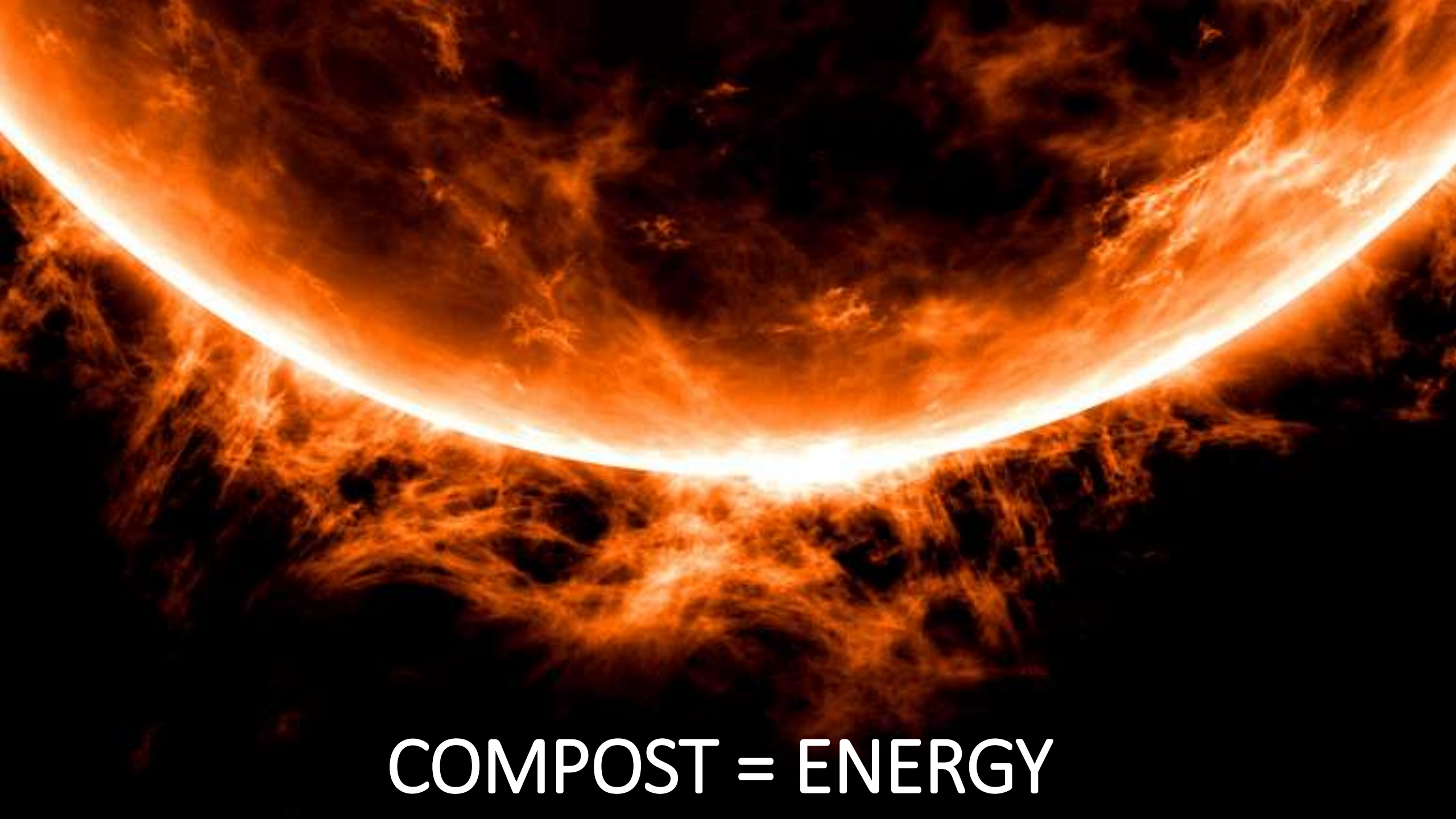
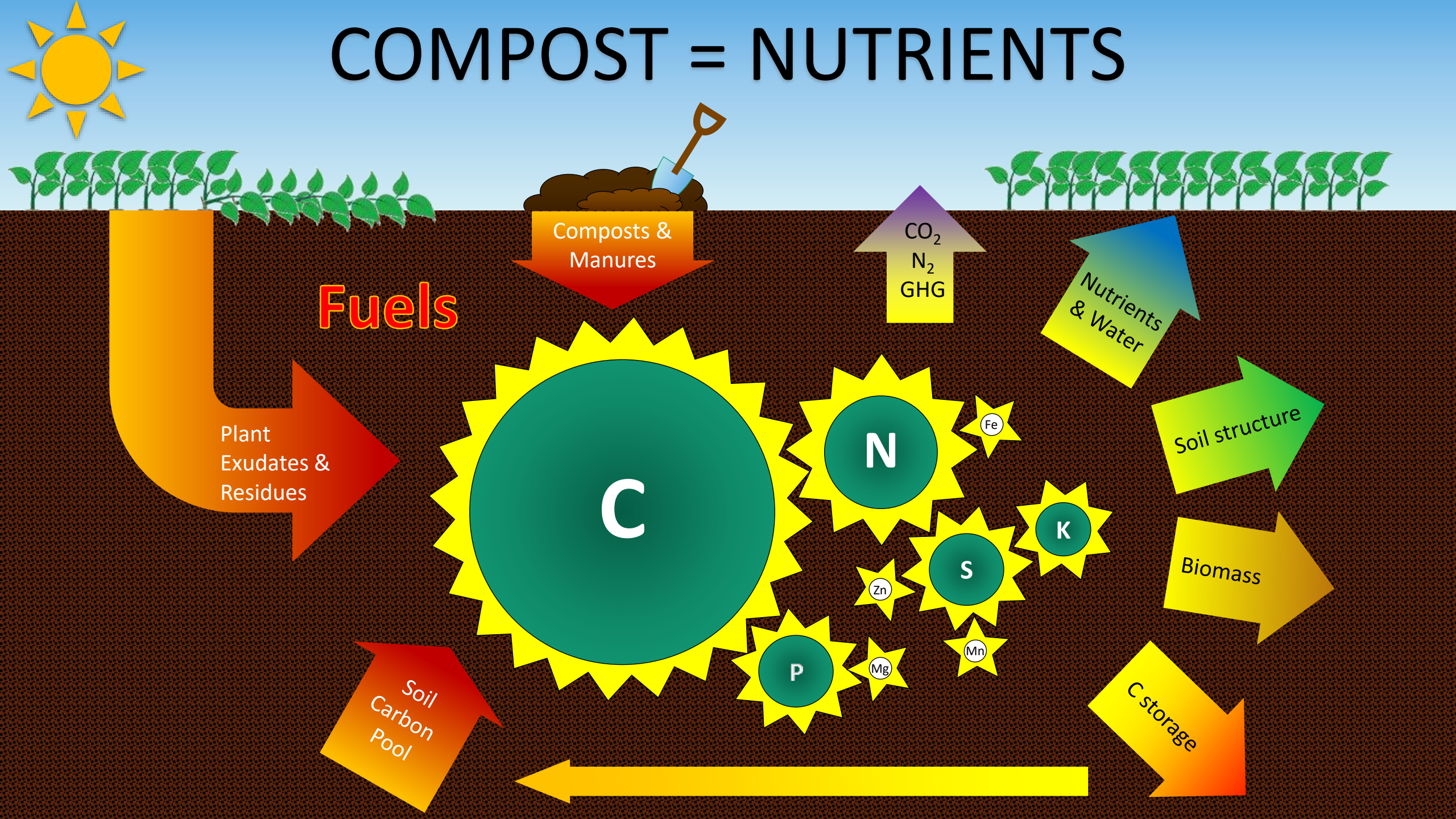


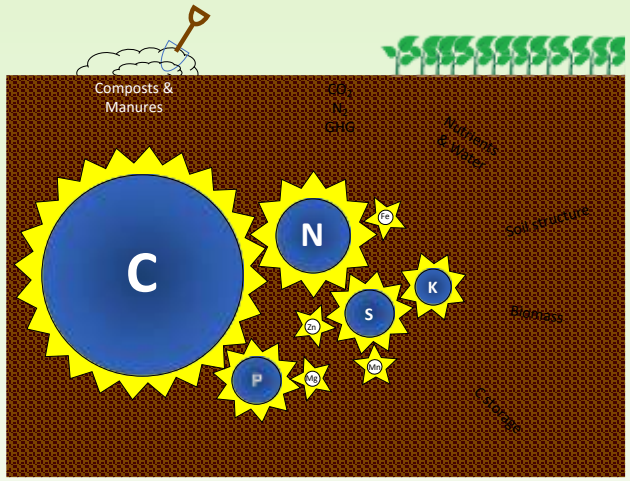

COMPOST = ENERGY

COMPOST = NUTRIENTS

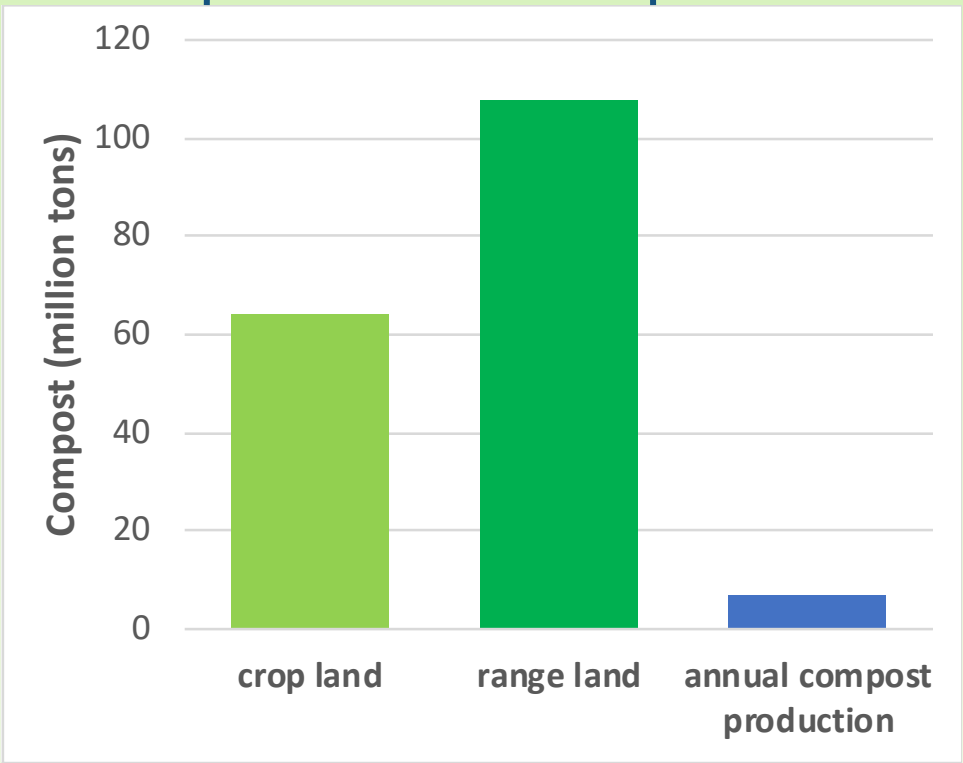


Compost application

- Slow release of nutrients over the course of the year
  - steady food supply for microbes
- Variety of organic compounds
  - promote metabolic diversity
  - feed range of soil cycles



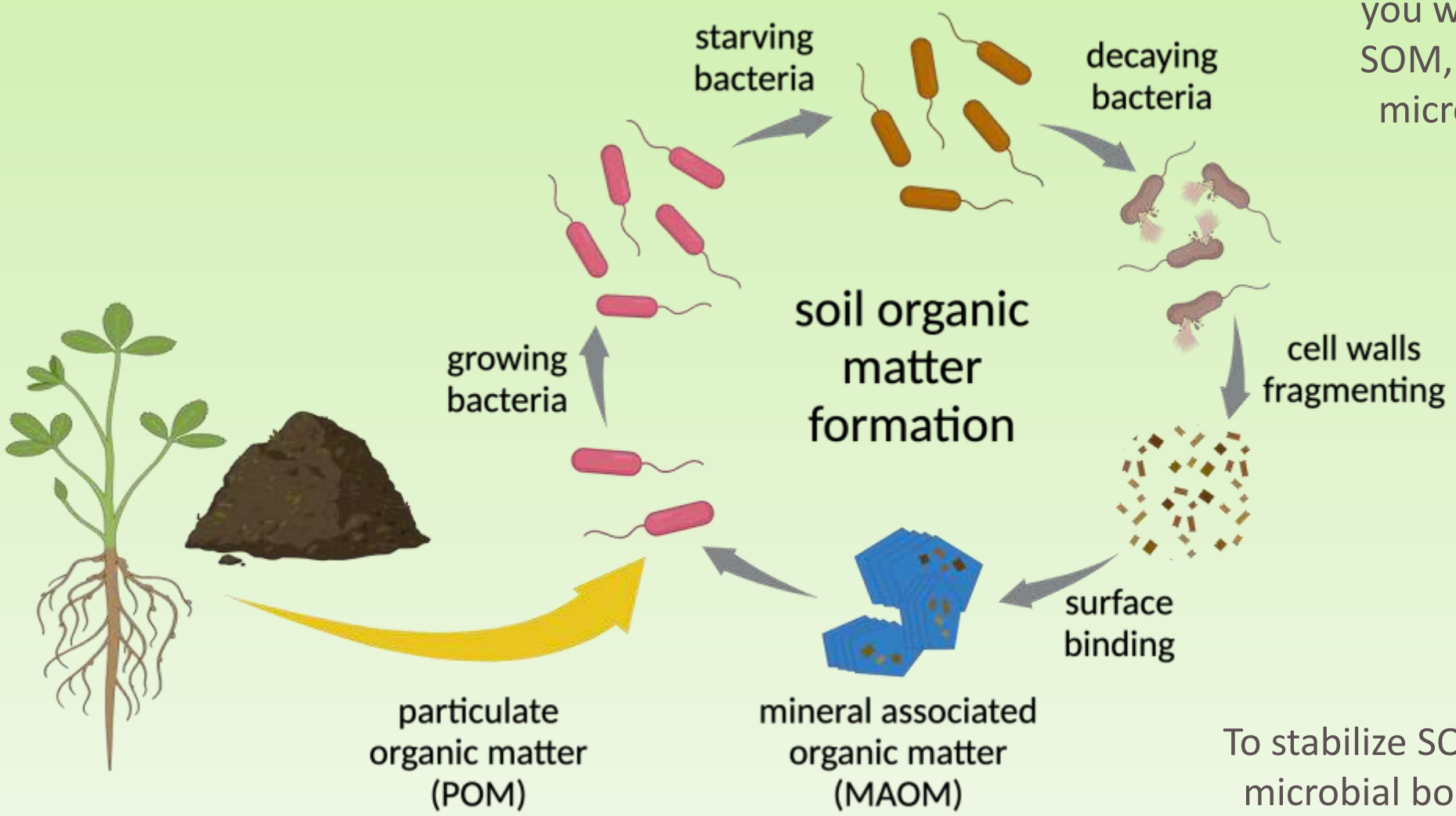
Compost needed for moderate application rate (4 tons/acre)



California compost application potential gap

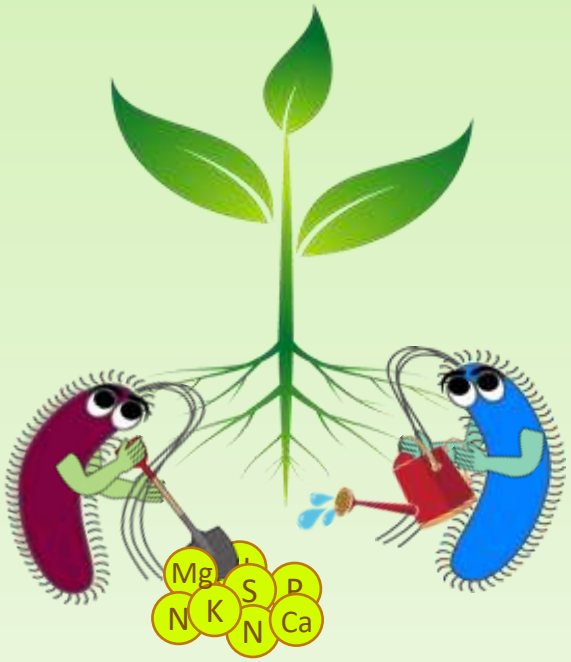
Building SOM

50-80% of SOM is simply dead microbial bodies. If you want to increase SOM, you must build microbial biomass.

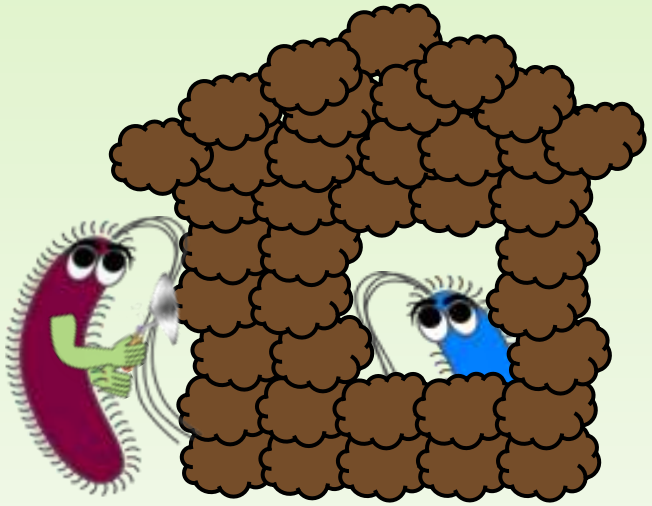


To stabilize SOM, the C from microbial bodies needs to bind with soil minerals.

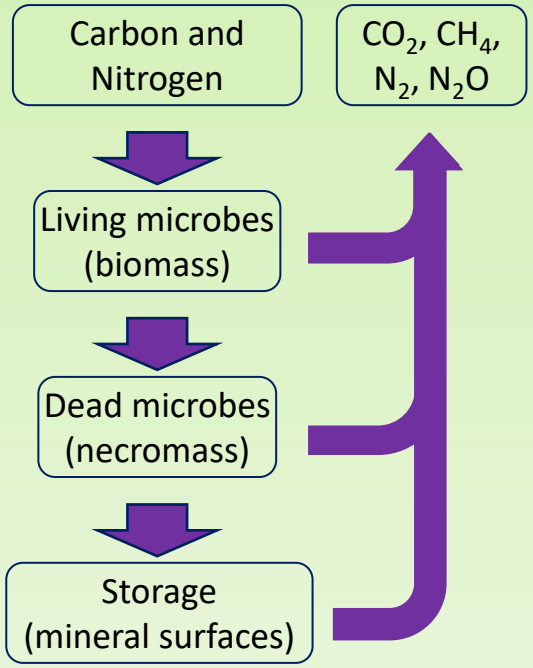
What can soil microbes do?

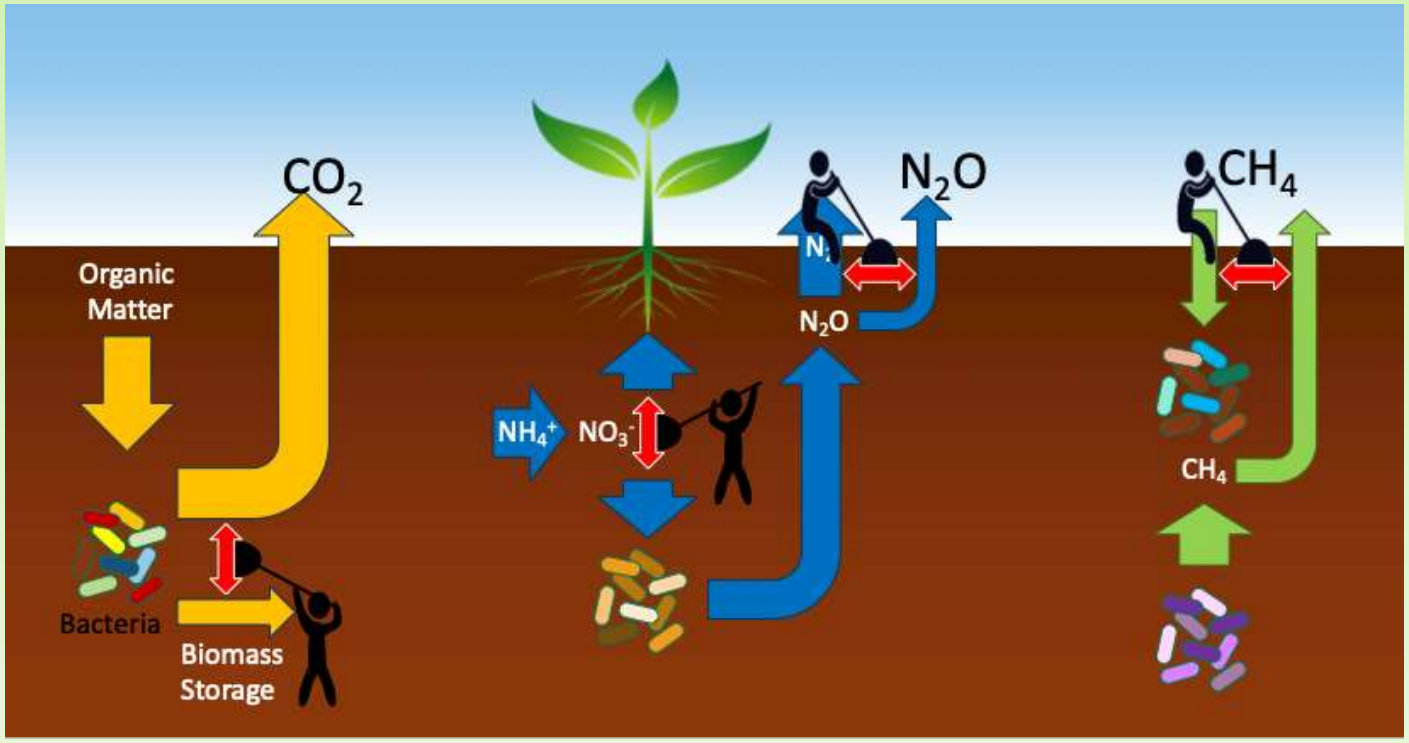


- Transform C inputs into SOM
  - store carbon
  - feed other soil fauna
- Mine and cycle nutrients
  - provision nutrients
  - transport nutrients to plants
- Build soil structure
  - prevent soil erosion
  - water infiltration and storage
  - water purification
  - oxygen permeation
  - root growth



What can gas efflux sampling tell us about soil microbes?



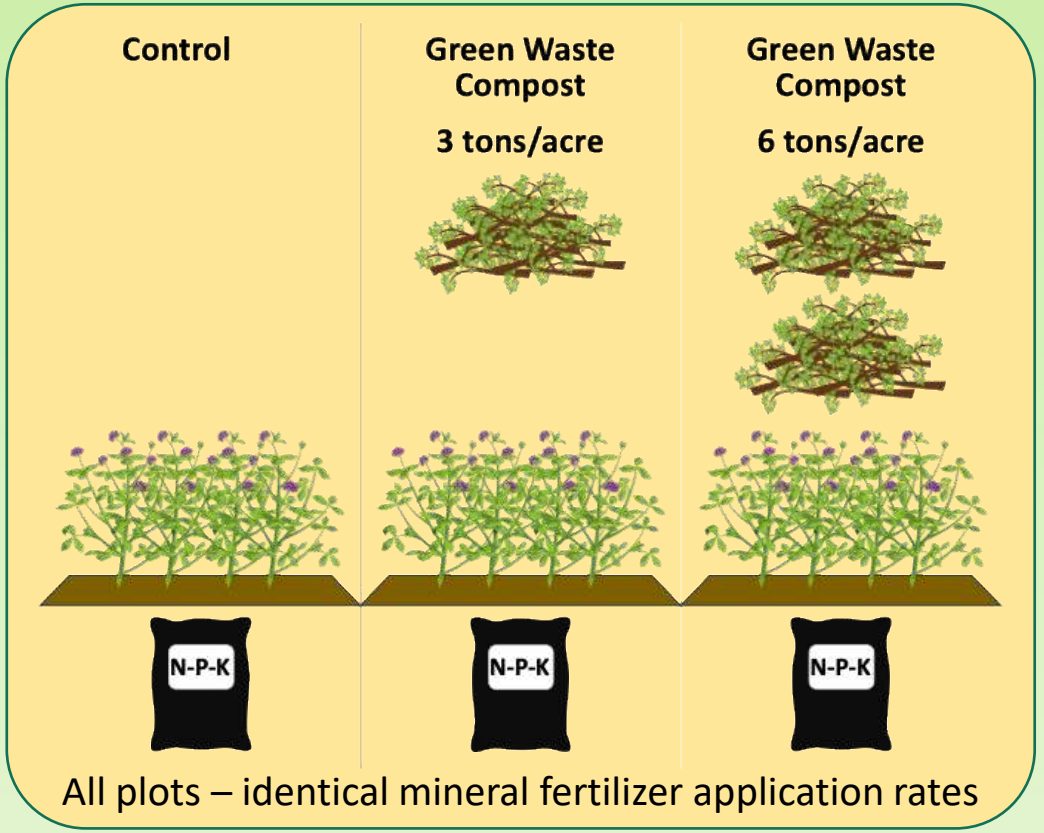


How do we move the microbe levers to change soil nutrient cycles ?

- Gas fluxes are signatures of microbial activity
- Different farming practices provide conditions that shift ”levers” in soil nutrient cycles
- Microbial community and makeup determine fate of organic and inorganic input materials
  - Turned into biomass/stored *or* respired/lost

Alfalfa Compost Trial

- Two field sites - San Joaquin and Yolo county
- Green waste compost application at two rates - 3 or 6 tons/acre
- Triplicate plots for each treatment and control
- Compost was applied in fall each year for three years
- Alfalfa flood irrigated
- Biomass sampled at each harvest
- Soil sampled in October of each year
- Infiltration and soil aggregation determined in final year of study
- Greenhouse gas fluxes (GHG) sampled monthly

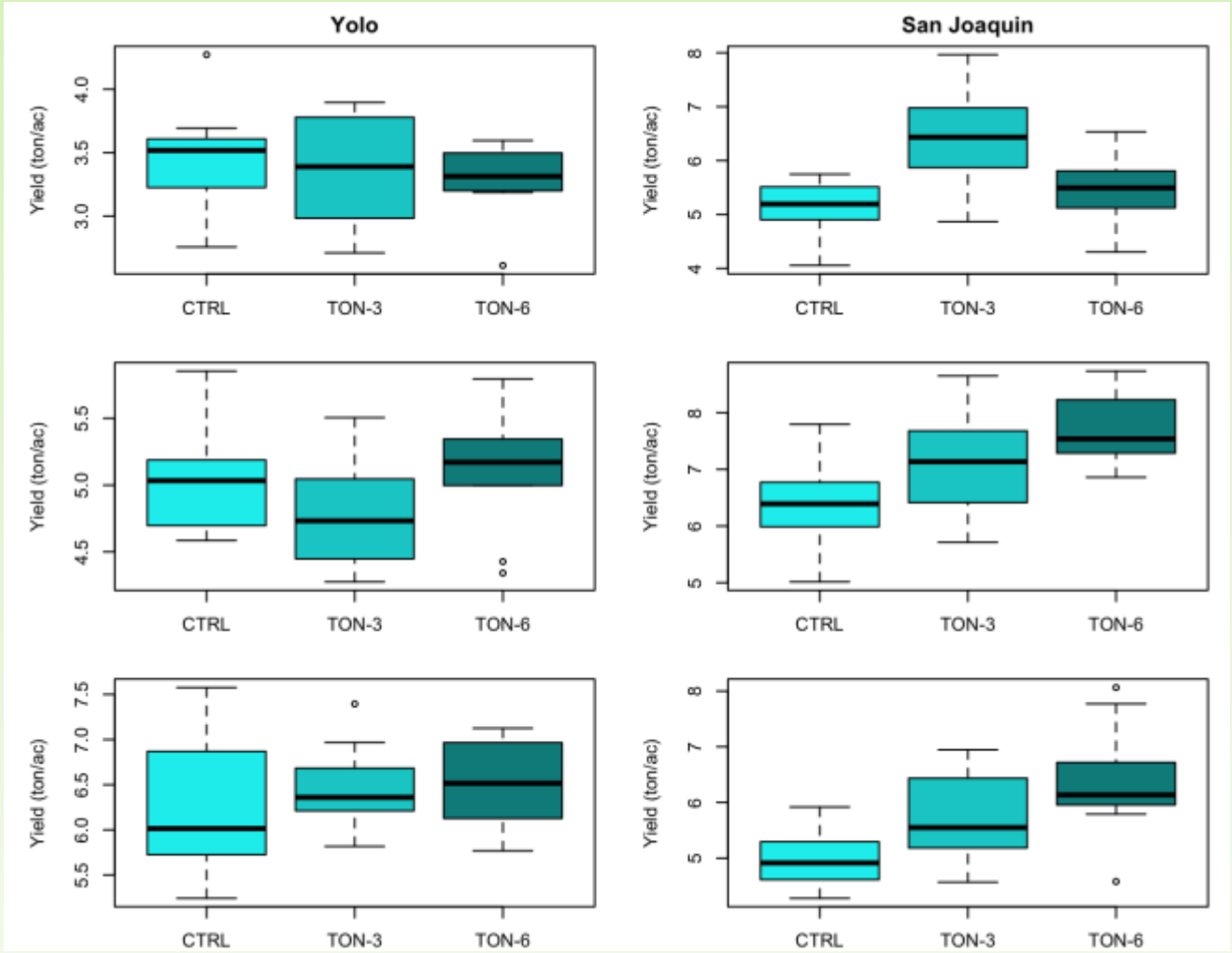


All plots – identical mineral fertilizer application rates

Alfalfa Compost Trial

- Compost treatments had similar yields to no compost controls during first season
- Increased yield with compost at San Joaquin site in second and third seasons

Yield



Alfalfa Compost Trial

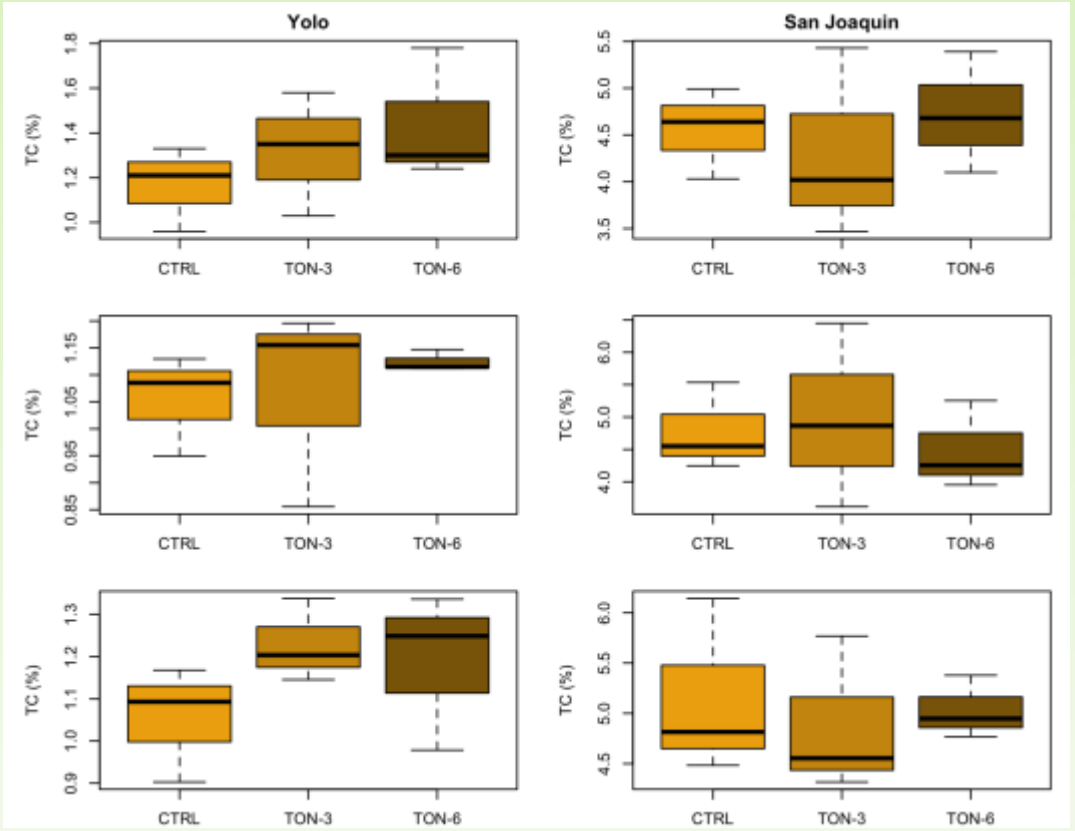
Major nutrients (T and N) only changed in Yolo site soil

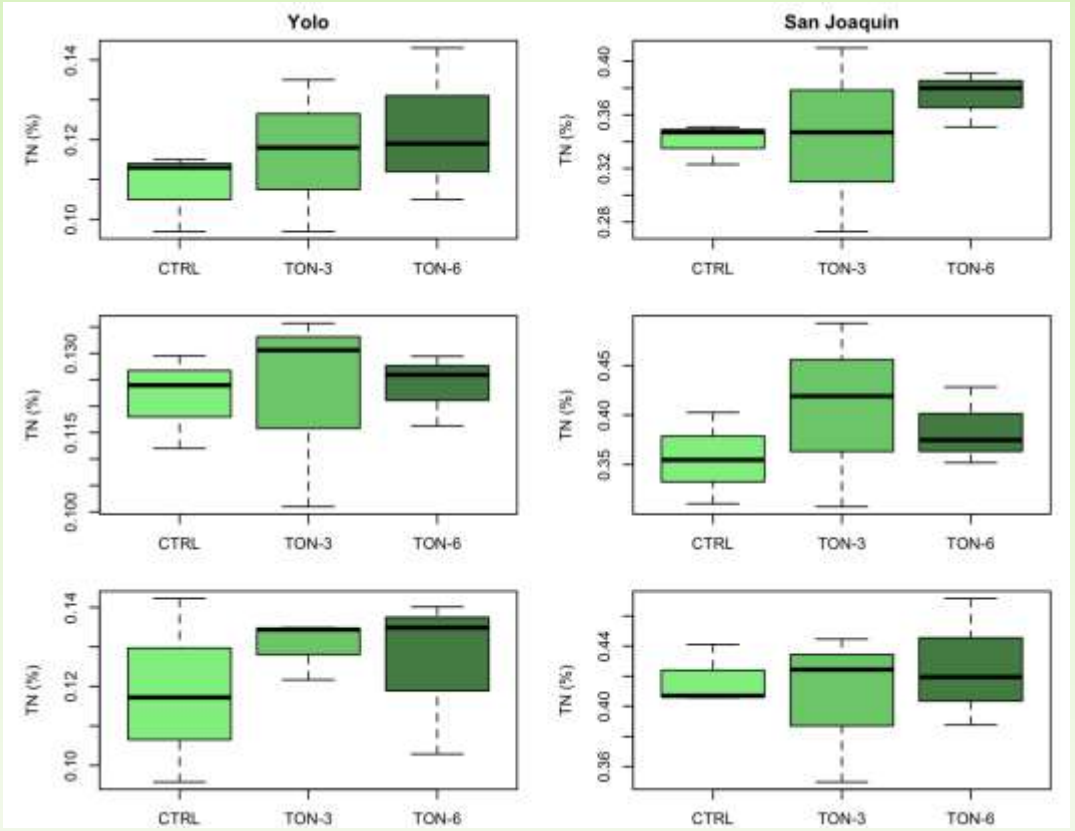
- Total C and N
  - No significant changes in San Joaquin soil (high OM soil)
  - Increased trend in C and N in Yolo soil (low OM soil)

2021

2022

2023





Alfalfa Compost Trial

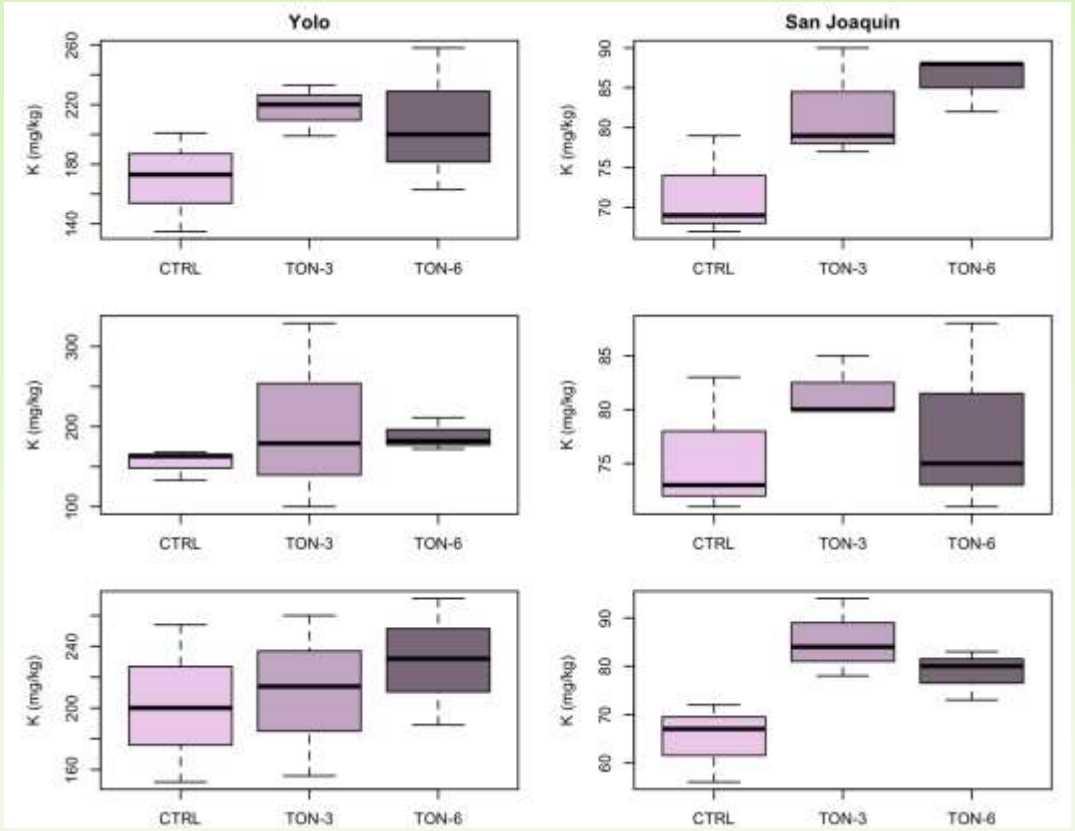
Potassium and pH only changed in San Joaquin site soil

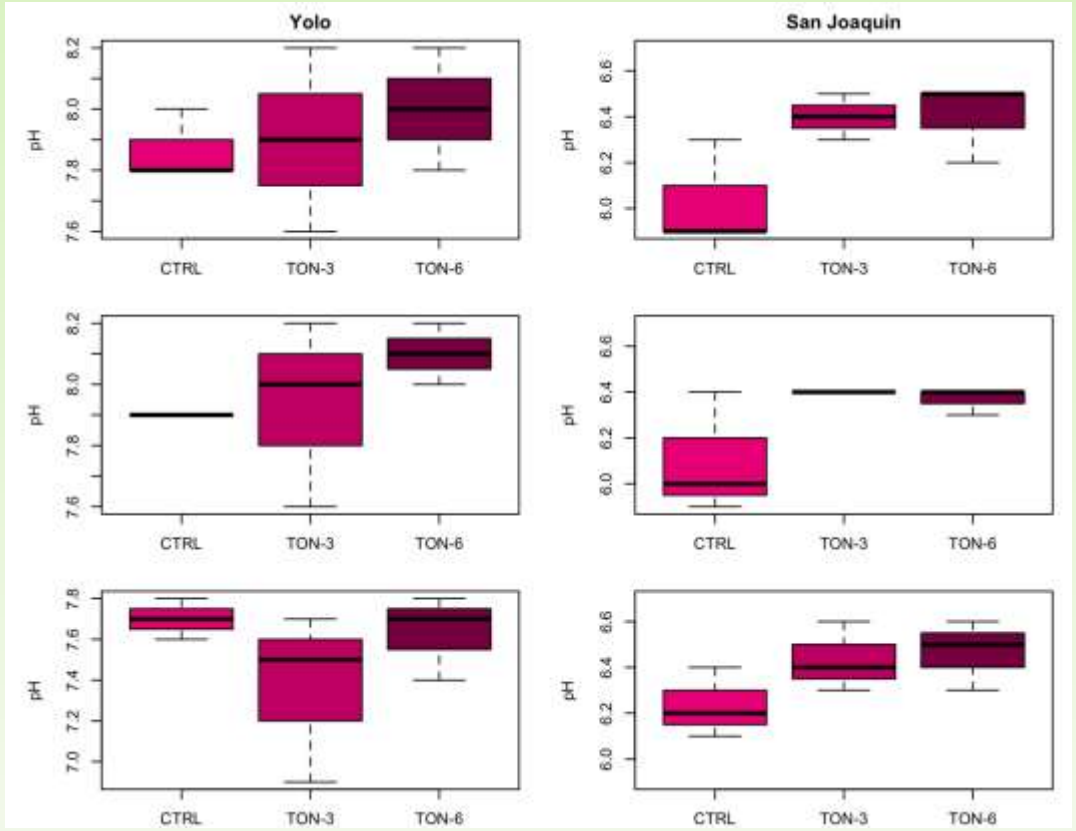
- Potassium (K)
  - No change in Yolo soil; Increase in San Joaquin soil
- pH
  - No change in Yolo soil; Increase in San Joaquin soil

2021

2022

2023

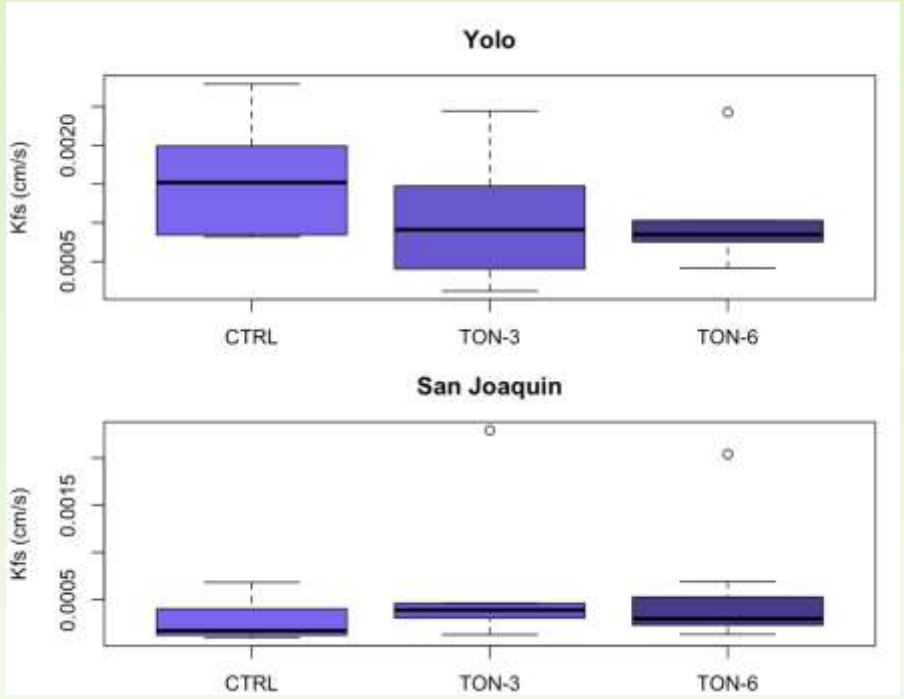




Alfalfa Compost Trial

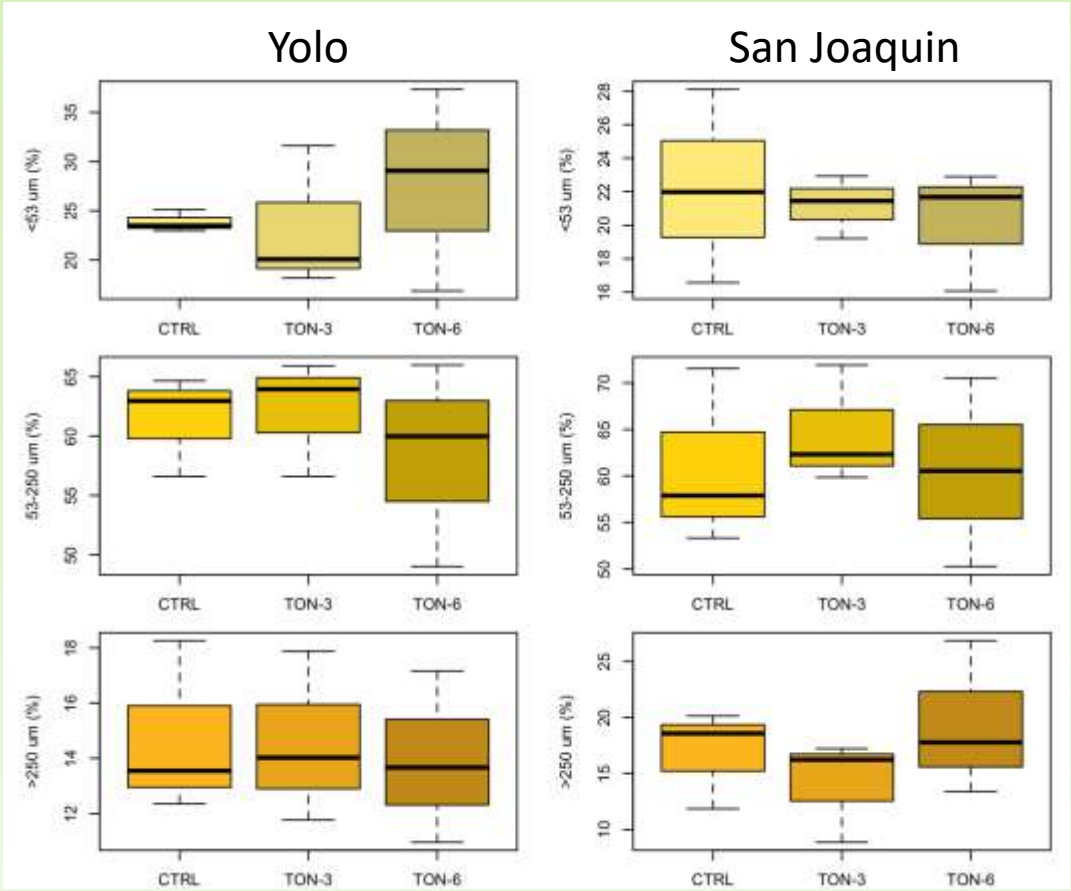
Infiltration rates

did not change



Water stable aggregates

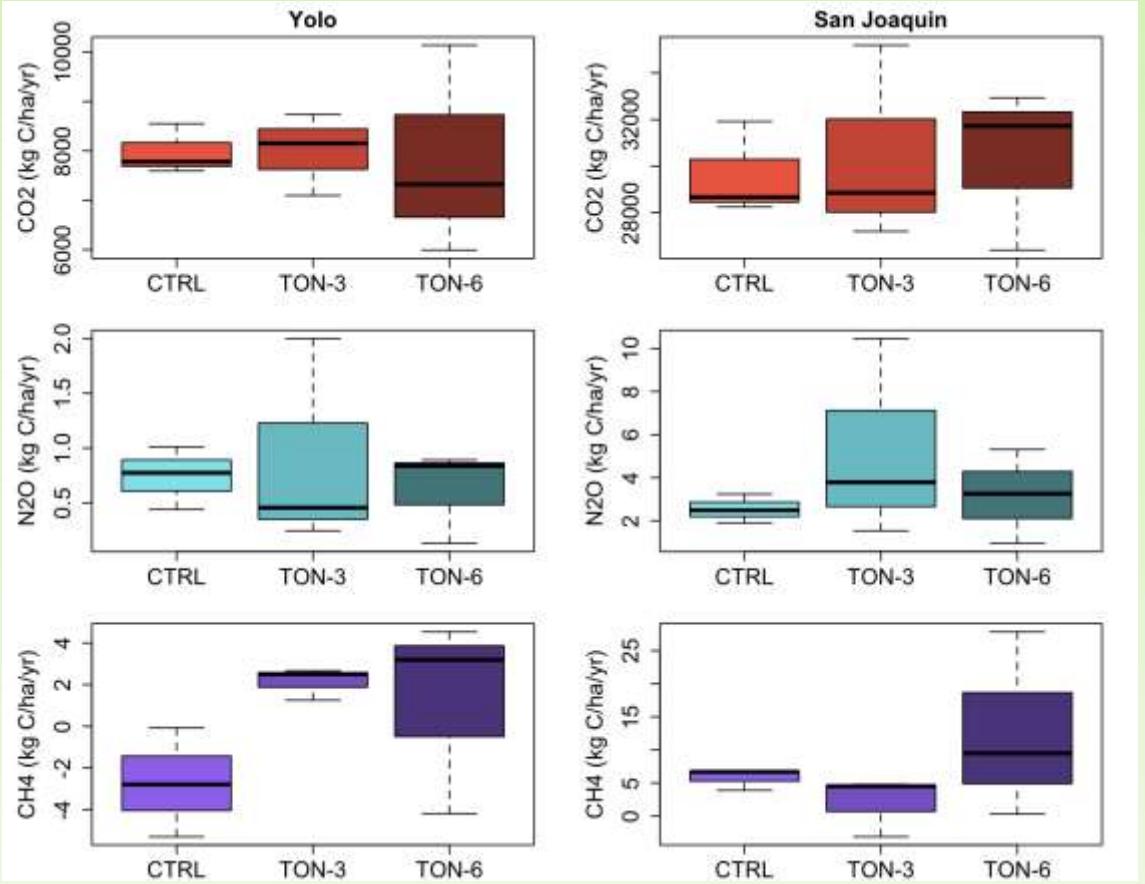
did not change



Alfalfa Compost Trial

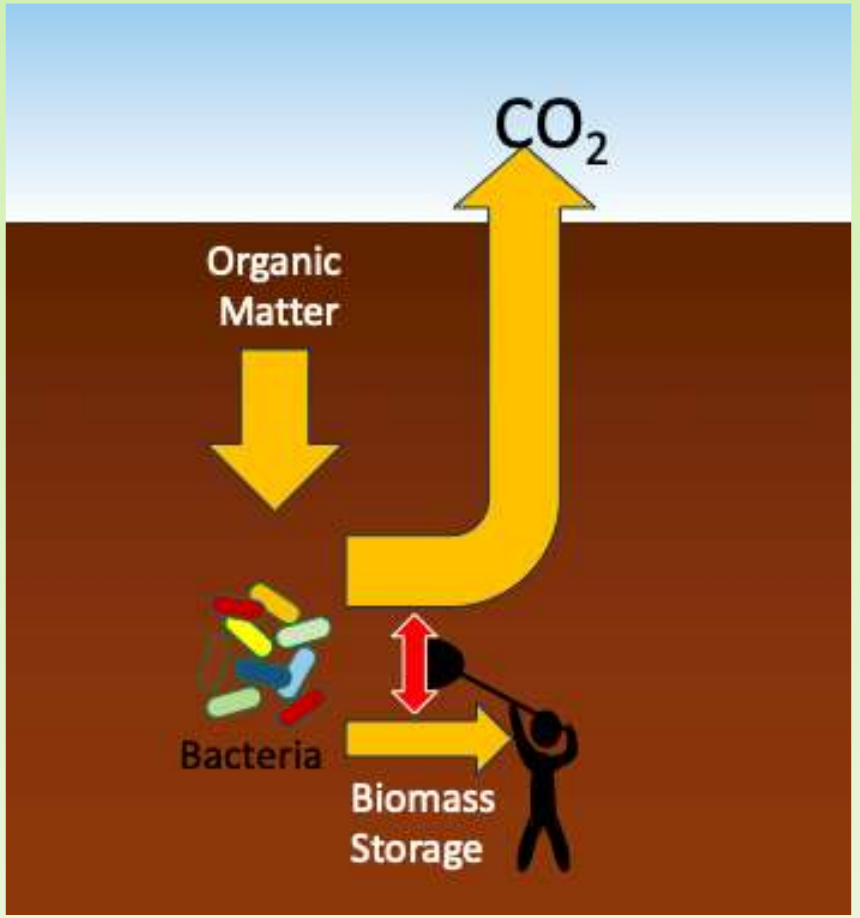
- Carbon dioxide (CO_2)
  - similar CO_2 efflux to control
- Nitrous oxide (N_2O)
  - Similar efflux between control and compost additions
- Methane (CH_4)
  - High variability between sites and sampling events

No significant changes in GHG fluxes



Final year GHG fluxes for Yolo and San Joaquin sites

Alfalfa Compost Trial

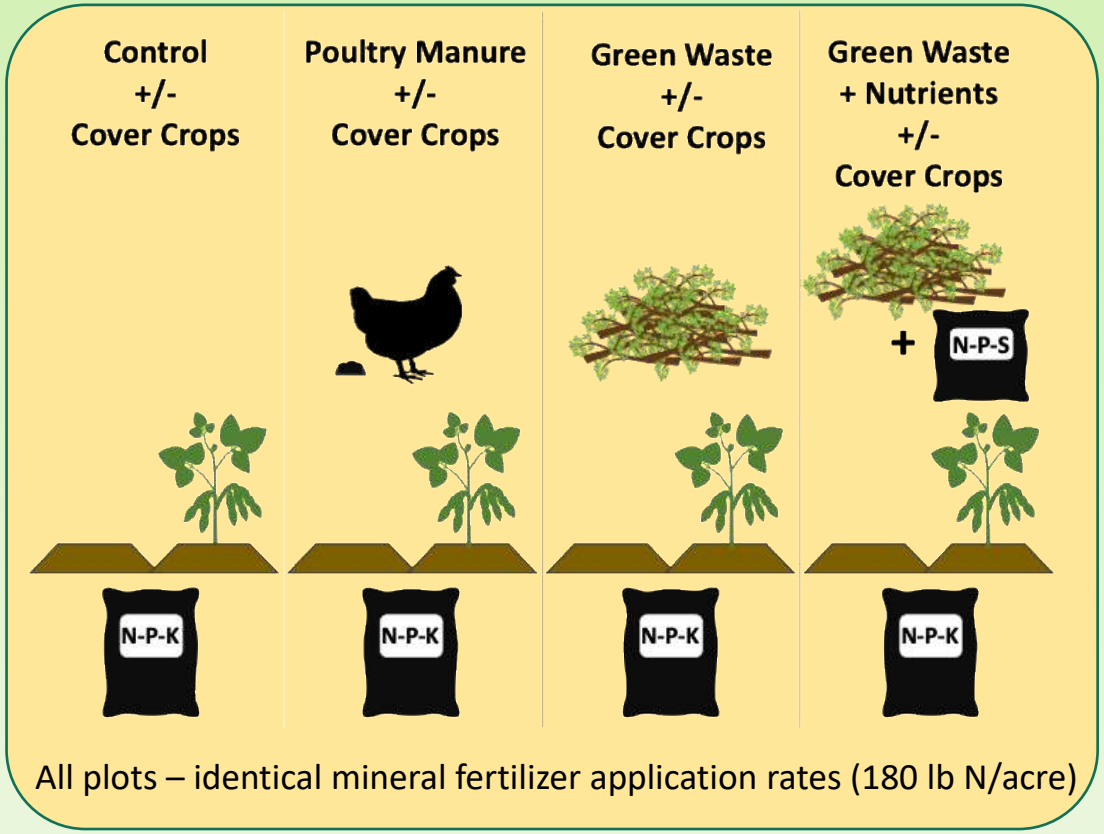


Conclusions

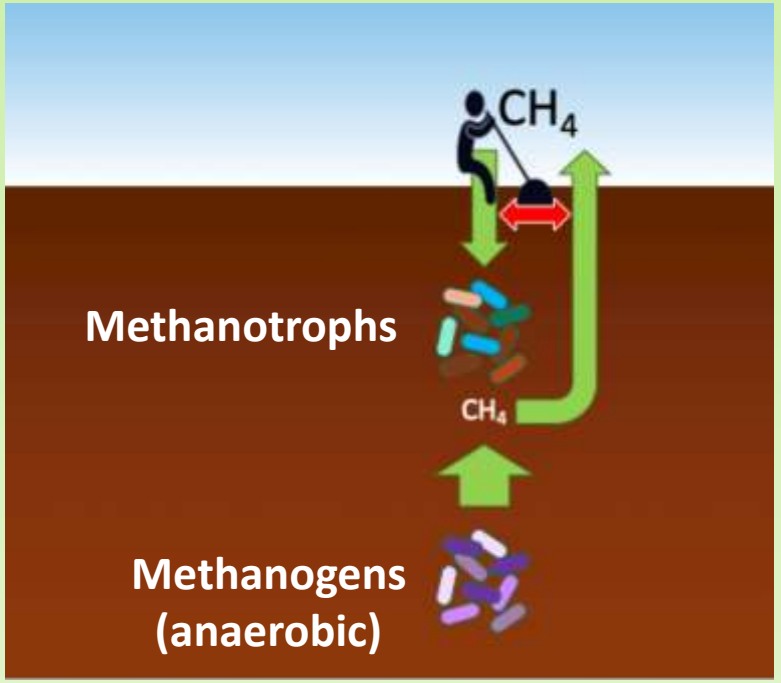
- Compost application led to improved nutrient content in *deficient* soils
- Higher yields correlated with more neutral pH, better soil nutrient balance
- Similar GHG fluxes between control and compost treatments are consistent with more carbon stored in soil

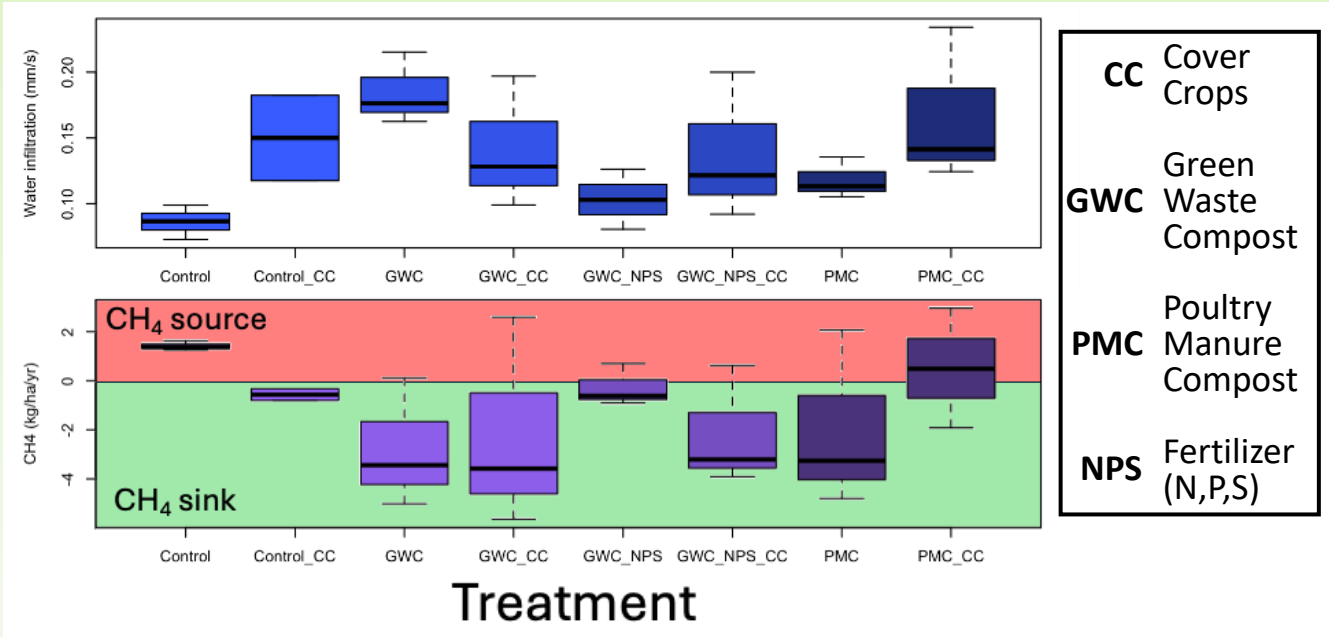
Soil structure effects: methane flux linked to infiltration

Compost application in a tomato-corn rotation



All plots – identical mineral fertilizer application rates (180 lb N/acre)

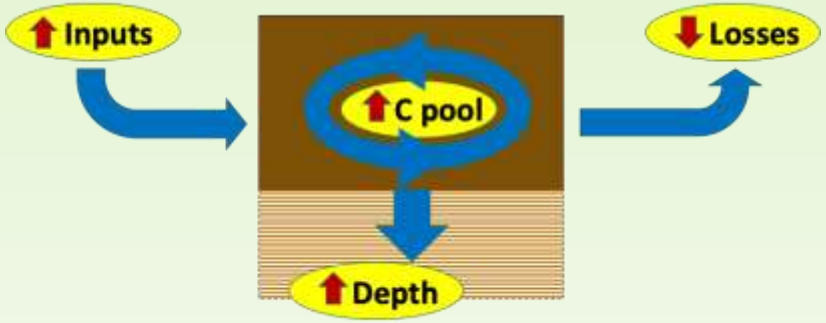




- Soil = CH_4 sink with compost and/or cover crops
- Higher infiltration = soils change from CH_4 source to sink

Managing for soil health = managing soil biology

- Feed the soil
- Minimize disturbance
- Maximize diversity of plants
  - Crop rotations
  - Cover crops
- Keep living roots present as much as possible
- Keep soil covered (plants and residues)
- Reduce chemical use



Acknowledgements

Collaborators

Michelle Leinfelder-Miles
Rachael Long
Daniel Rivers
Suellen Witham
Our awesome farmer partners

The Scow Lab

Nicole Tautges
Adrienne Lim
Sandipan Sammadar

Undergrad helpers

Ryan Gault
Adele Nemer
Claire Tauber

Healthy Soils Program
CDFA OFFICE OF ENVIRONMENTAL FARMING & INNOVATION

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