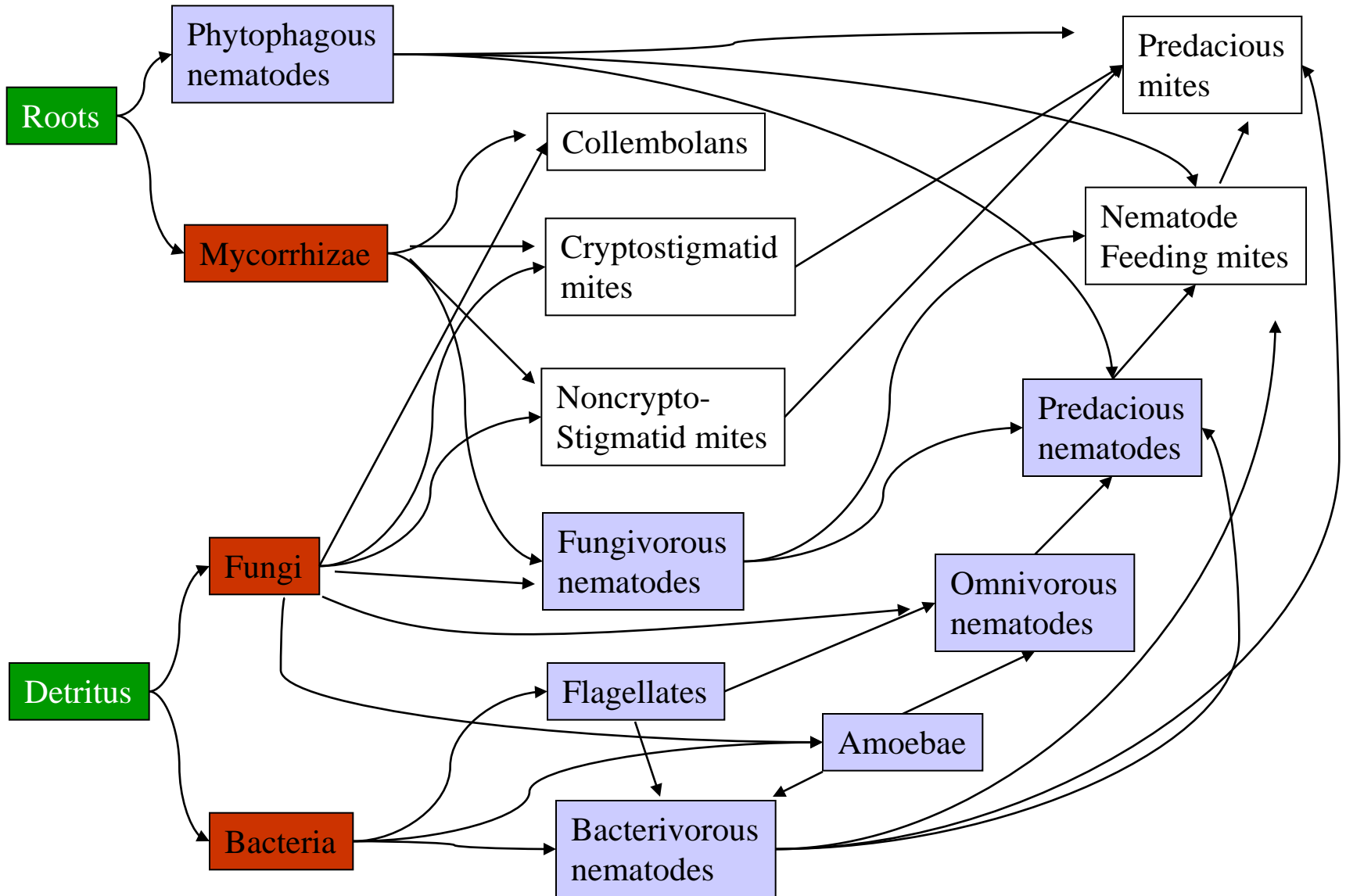


The Soil Food Web: **Who are they and what do they do?**

Tom Forge
Agriculture Canada,
Agassiz

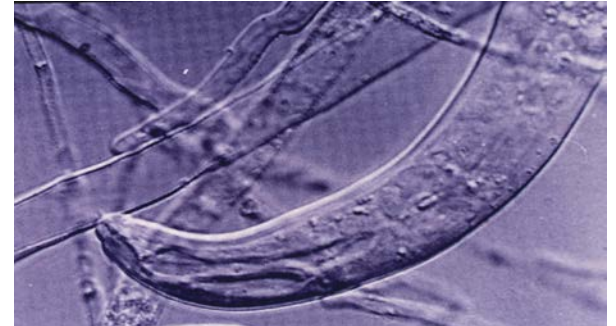
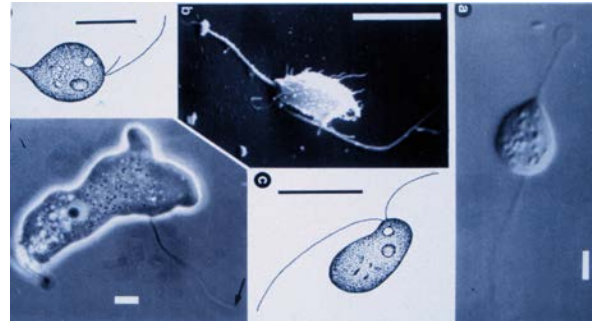
A "typical" soil food web



Soil microfauna

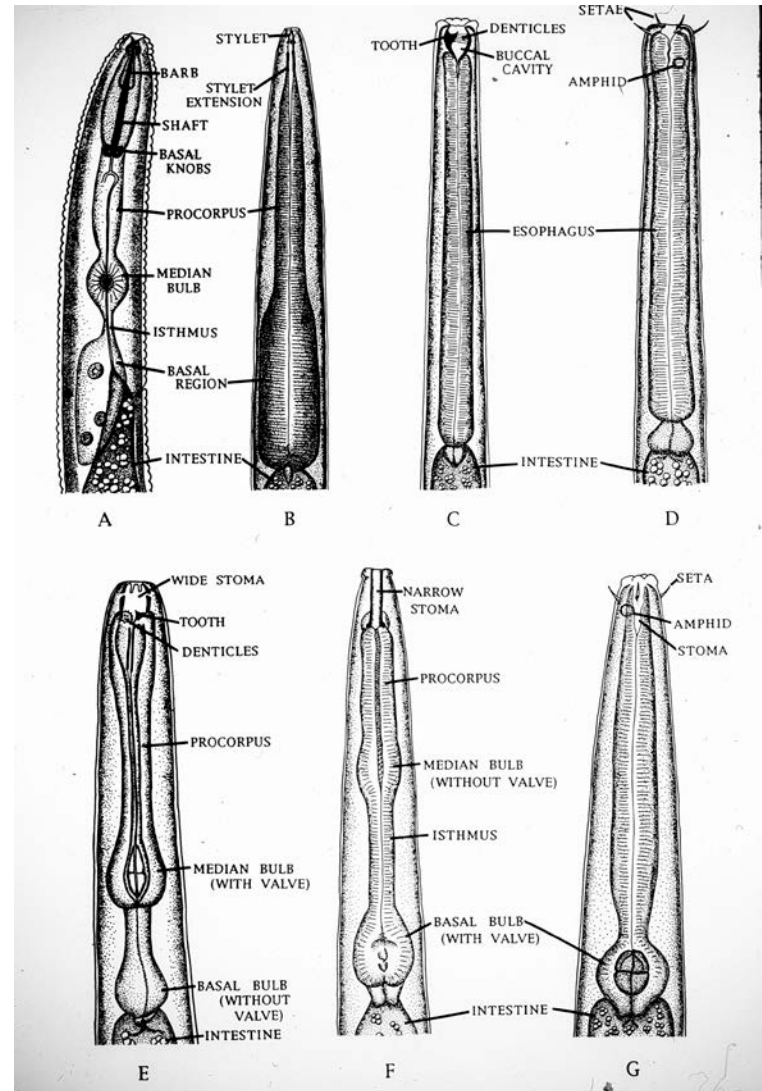
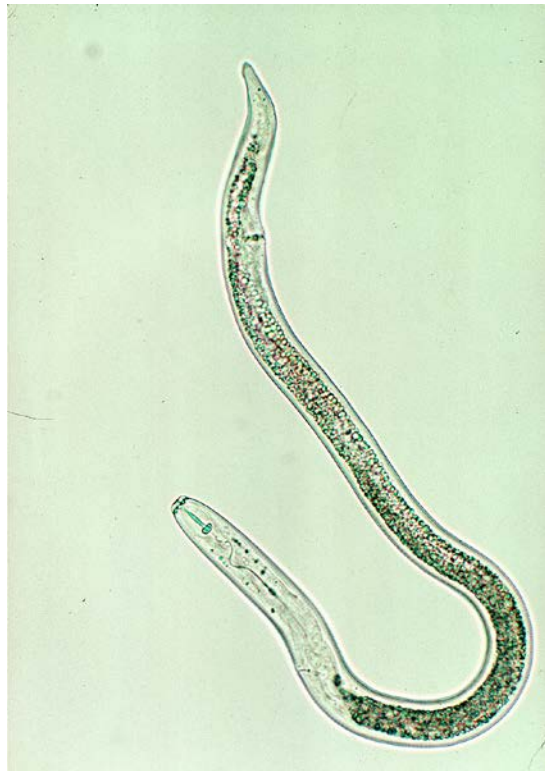
Integral components of the soil food web

- Multi-trophic*
- Abundant & diverse*
- ”Information dense”*



Soil Nematodes

- Morphological identification
- Function inferred from morphology



Genera and feeding groups of nematodes in an orchard Summerland, BC

Bacterivorous	Fungivorous	Omnivorous	Predacious	Phytophagous
<i>Acrobeles</i>	<i>Filenchus</i>	<i>Thonus 1</i>	<i>Nygolaims</i>	<i>Cephalenchus</i>
<i>Acrobelloides</i>	<i>Aglenchus</i>	<i>Thonus 2</i>	<i>Discolaimus</i>	<i>Pratylenchus</i>
<i>Cervidellus</i>	<i>Lelenchus</i>	<i>Microdorylaimus</i>	<i>Aporcelaimellus</i>	<i>Mesocriconema</i>
<i>Cephalobus</i>	<i>Boleodorus</i>	<i>Epidorylaimus</i>	<i>Paraxonchium</i>	<i>Paratylenchus</i>
<i>Heterocephalobus</i>	<i>Ditylenchus</i>	<i>Eudorylaimus</i>	<i>Carcharolaimus</i>	<i>Xiphinema</i>
<i>Eucephalobus</i>	<i>Nothotylenchus</i>	<i>Mesodorylaimus</i>	<i>Sectonema</i>	<i>Paratrichodorus</i>
<i>Panagrellus</i>	<i>Hexatylus</i>	<i>Prodorylaimus</i>	<i>Seinura</i>	
<i>Panagrolaimus</i>	<i>Aphelenchus</i>	<i>Ecumenicus</i>	<i>Clarkus</i>	
Rhabditidae	<i>Paraphelenchus</i>	<i>Pungentus</i>	<i>Tripyla</i>	
<i>Bunonema</i>	<i>Aphelenchoides</i>	<i>Tardigrada</i>		
<i>Diploscapter</i>	<i>Tylencholaimus 1</i>			
Diplogasteridae	<i>Tylencholaimus 2</i>			
<i>Butlerius</i>	<i>Tylencholaimus 3</i>			
<i>Plectus</i>	<i>Tylolaimophorous</i>			
<i>Wilsonema</i>	<i>Diphthorophora</i>			
<i>Chronogaster?</i>				
<i>Metateratocephalus</i>				
<i>Prismatolaimus</i>				
<i>Eumonhystera</i>				
<i>Geomonhystera</i>				
<i>Rhabdolaimus</i>				
<i>Cylindrolaimus</i>				
<i>Achromadora</i>				
<i>Alaimus</i>				
<i>Aulolaimus</i>				

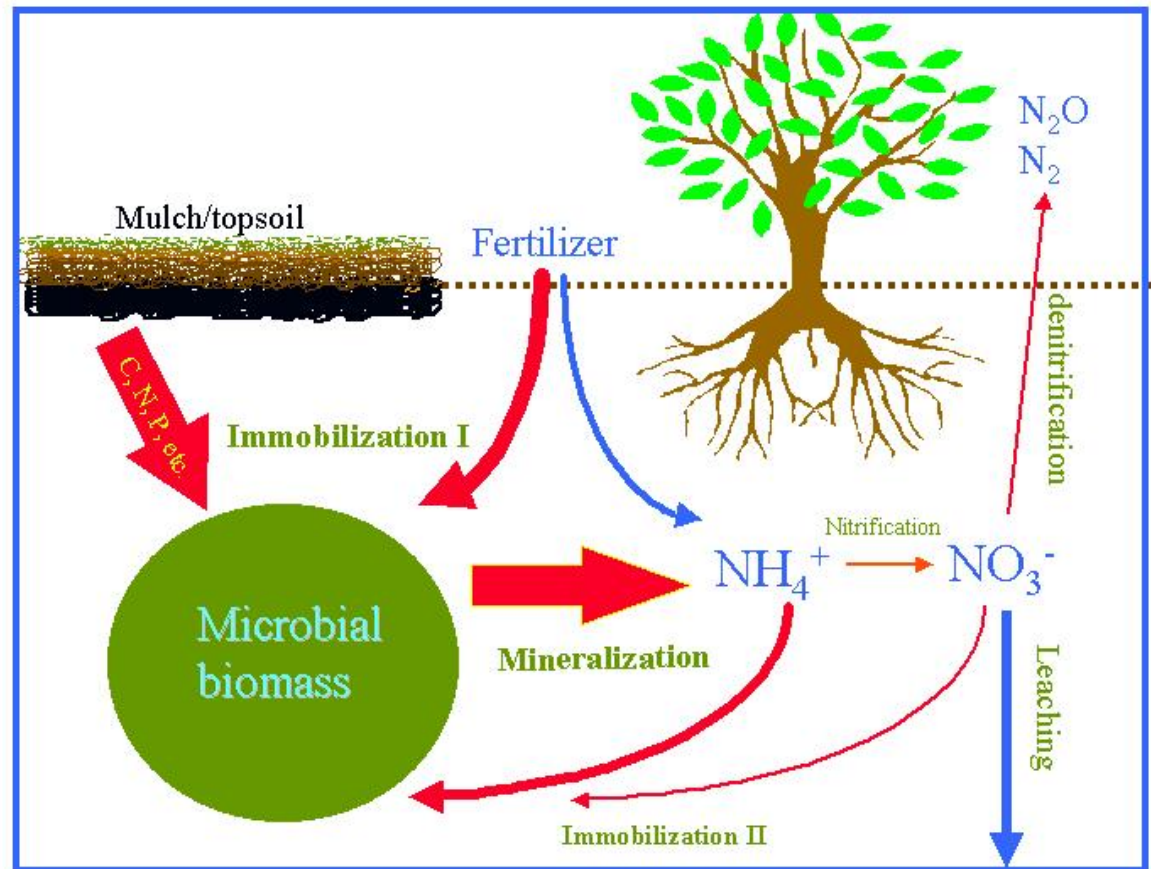
Purpose of soil food web studies:

-Mineralization-

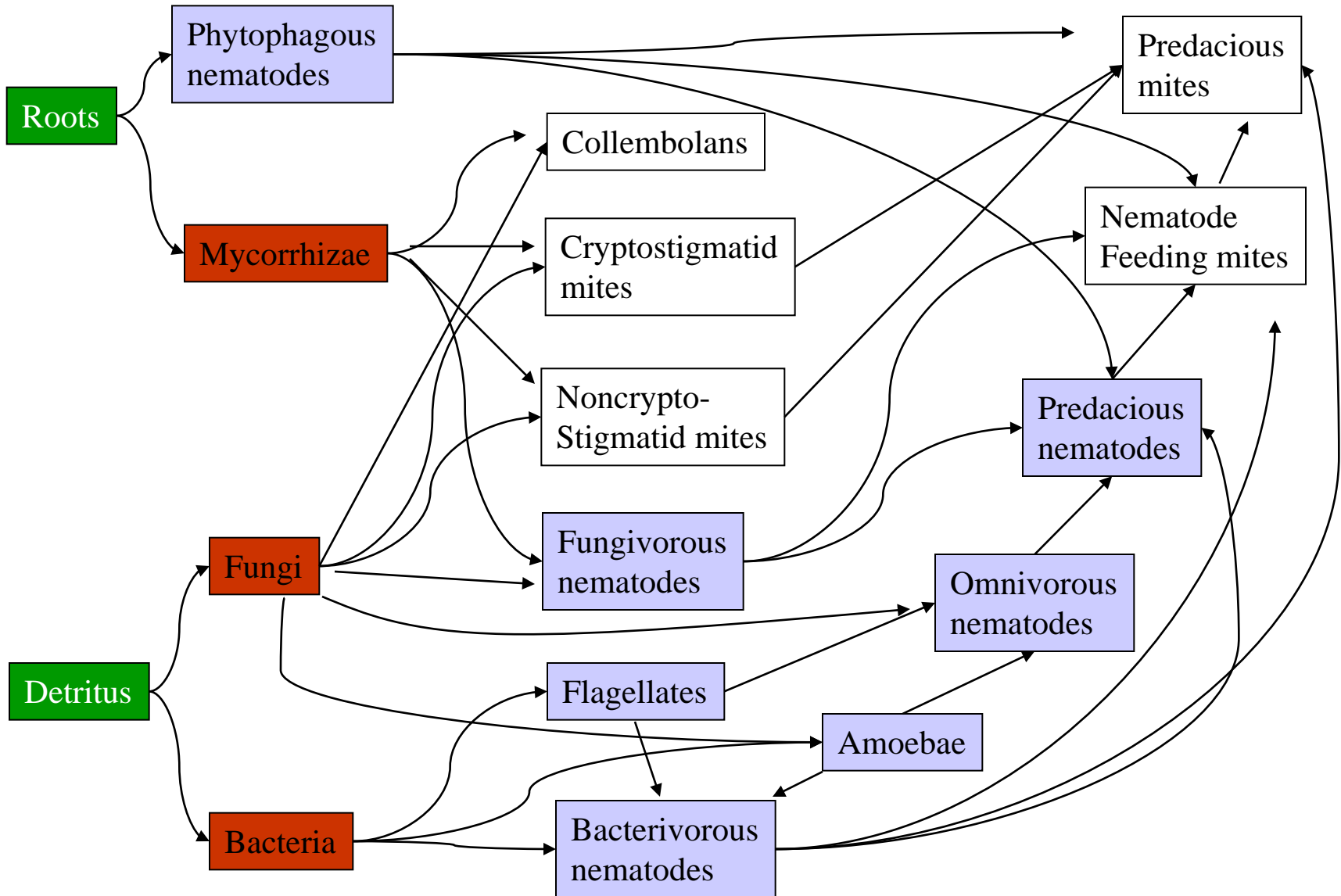
Trophic interactions occurring within the microbial biomass influence mineralization

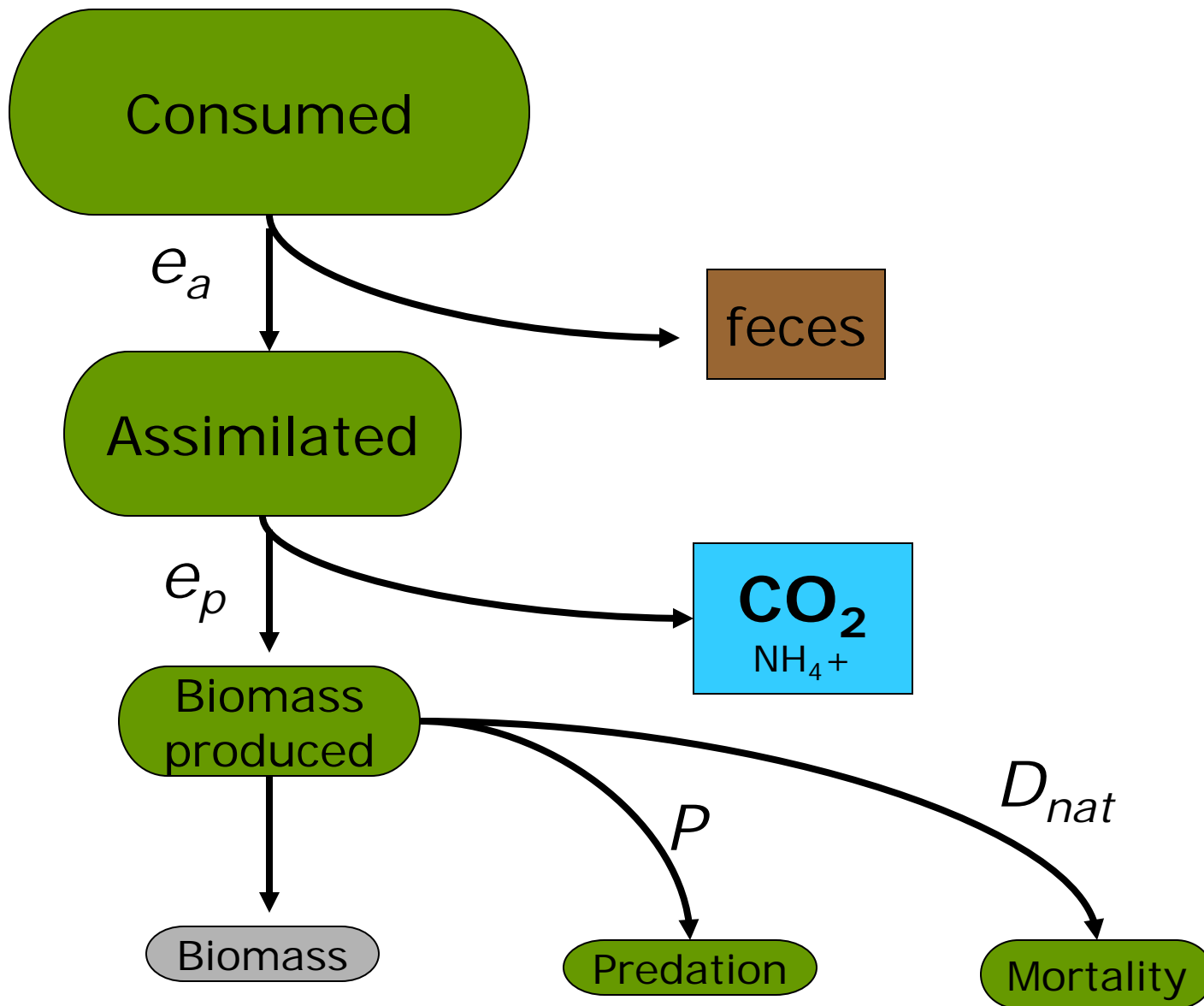
-microcosms

-food web models



A "typical" soil food web



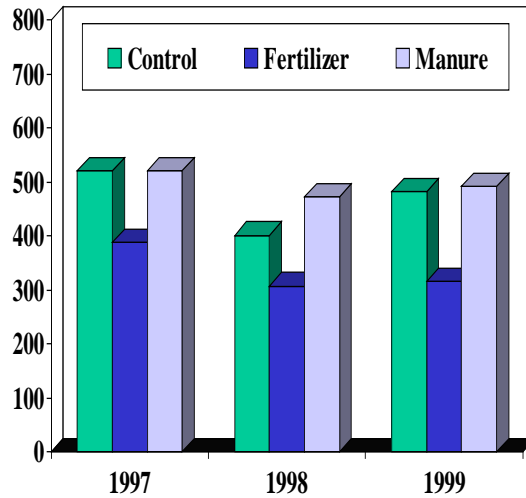


Use of the soil food web model: Effects of long-term manure applications

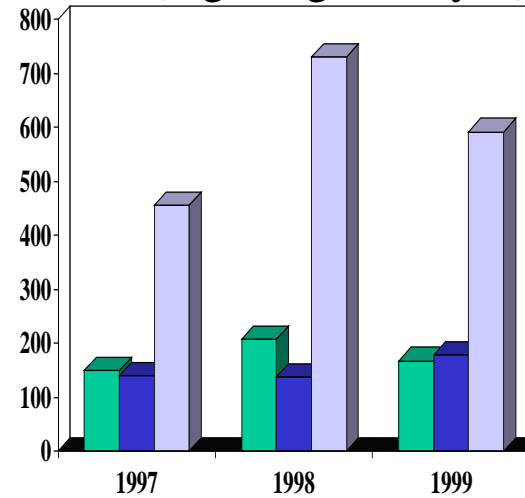
- Long-term evaluation of dairy slurry/fescue hay
- Established 1994
- 10 treatments including:
 - **High N manure**
 - **High N fert**
 - **Control**
- MBM & MF studied 1997-1999



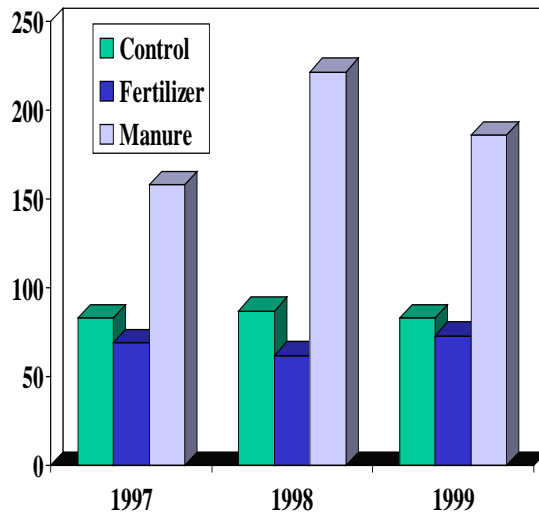
Microbial biomass
(mg C kg⁻¹ soil)



Microbial consumption
(mg C kg⁻¹ soil yr⁻¹)



N mineralization (mg kg⁻¹ yr⁻¹)



Food web model is a useful tool for probing microbial turnover and mineralization rates

Soil organisms perform many valuable functions:

- Decomposition & mineralization
- Retention/cycling of nutrients
- Aggregation and porosity
- Suppression of plant pathogens
- Production of plant growth regulators
- Degradation of pollutants/pesticides

Therefore, soil food web analyses are indicative of soil quality/health, or ability to support crop growth.....?

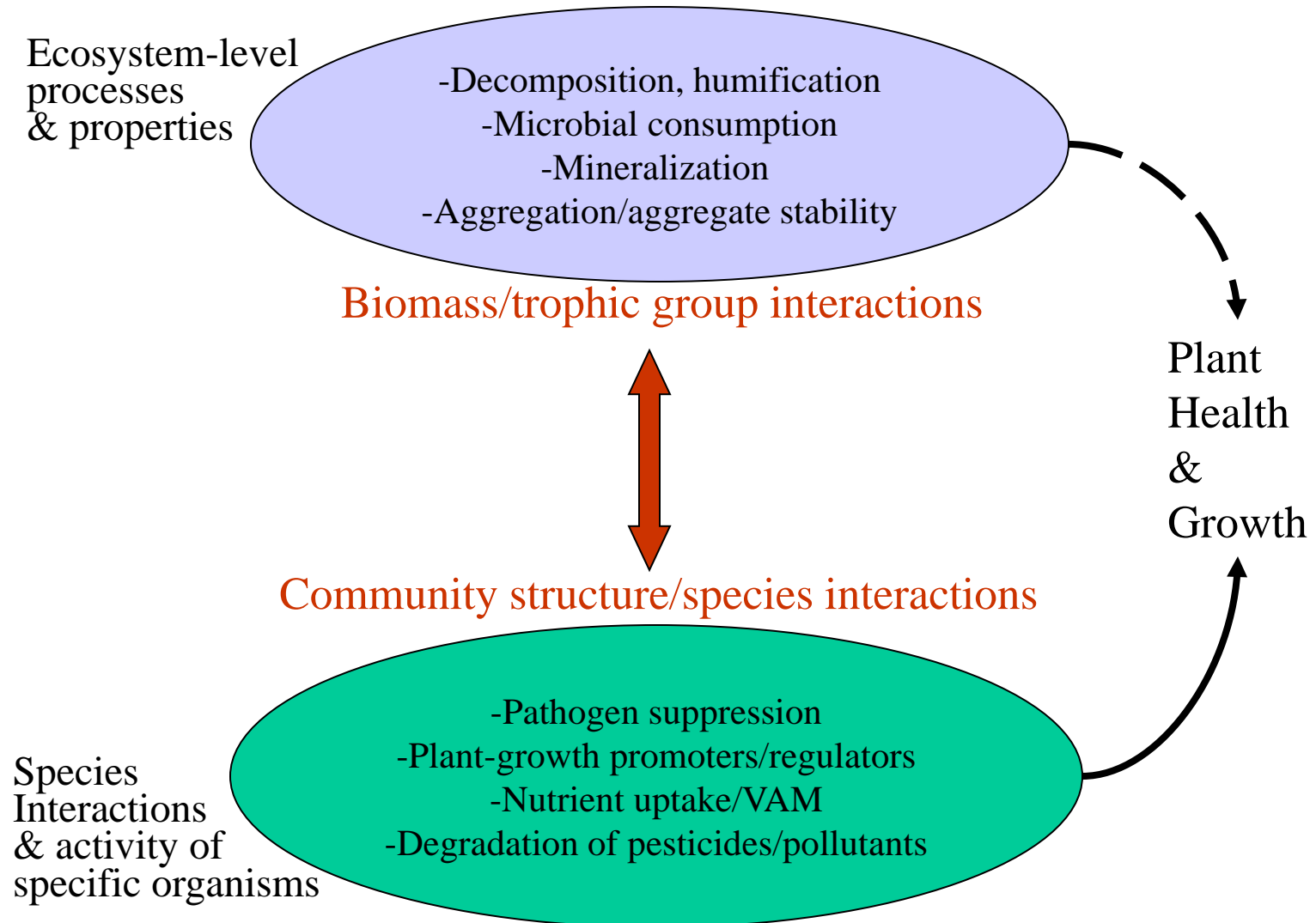
Limitations of soil food web analyses

- “Food web” is an operational definition, not a concrete entity
- “one conceptual representation of the biomass; organized into “trophic groups”
- “trophic groups” defined so as to describe major channels of flow of elements

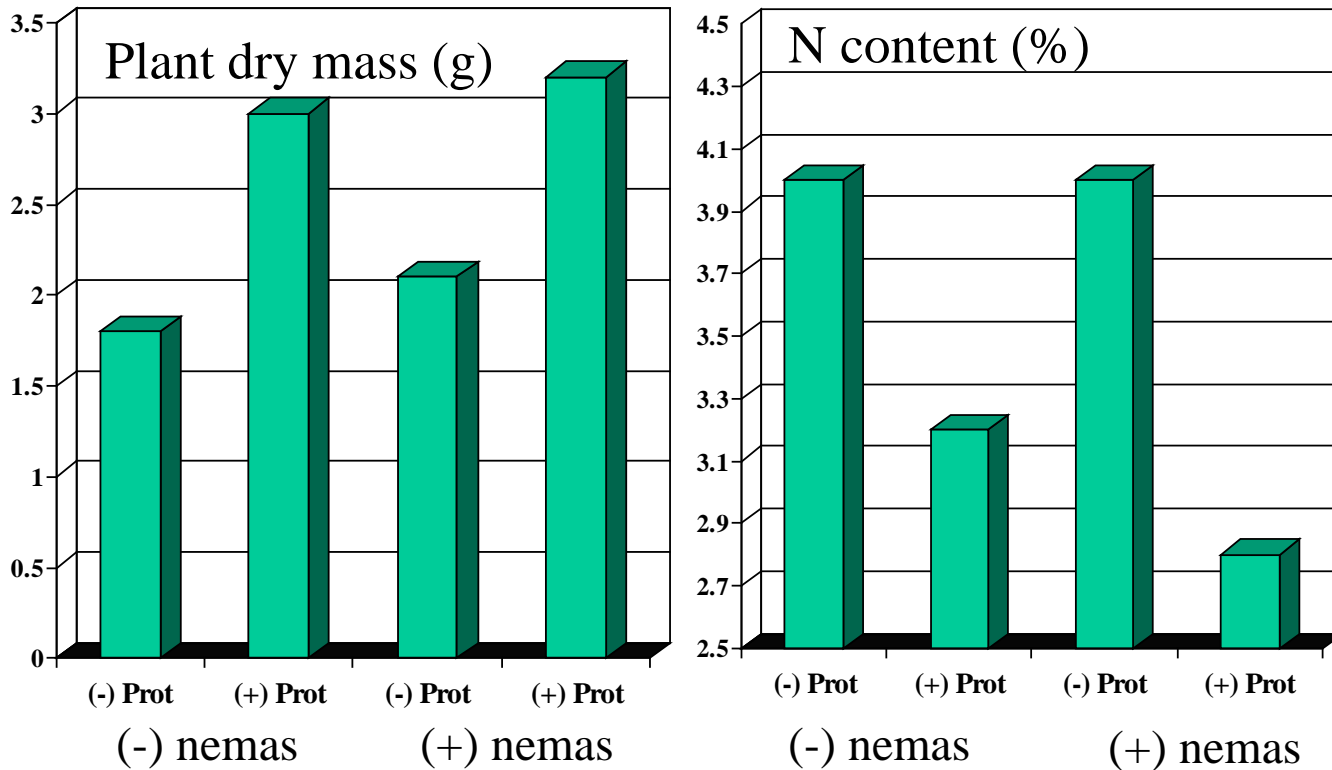
Limitations of soil food web analyses

- Trophic group/biomass level of resolution not indicative of:
 - Functions performed by specific organisms (e.g. biocontrol, pesticide degradation)
 - Non-mineralization effects of grazing/microfauna
- Difficult to obtain useful data:
 - No universally accepted “food web”
 - Spatial & temporal variation in trophic group biomass

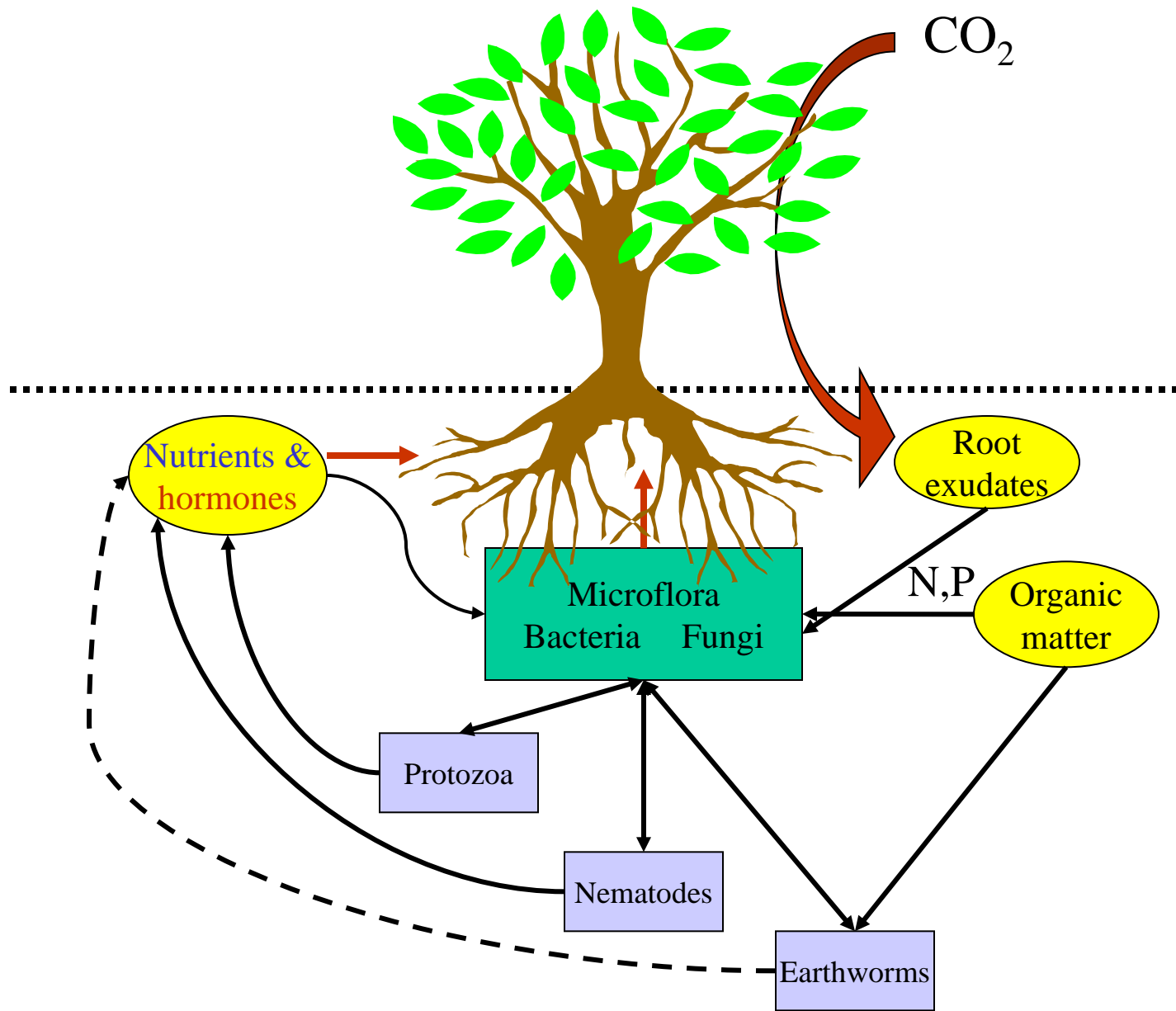
Hierarchical nature of soil ecology



Non-mineralization effects of trophic interactions/microfauna

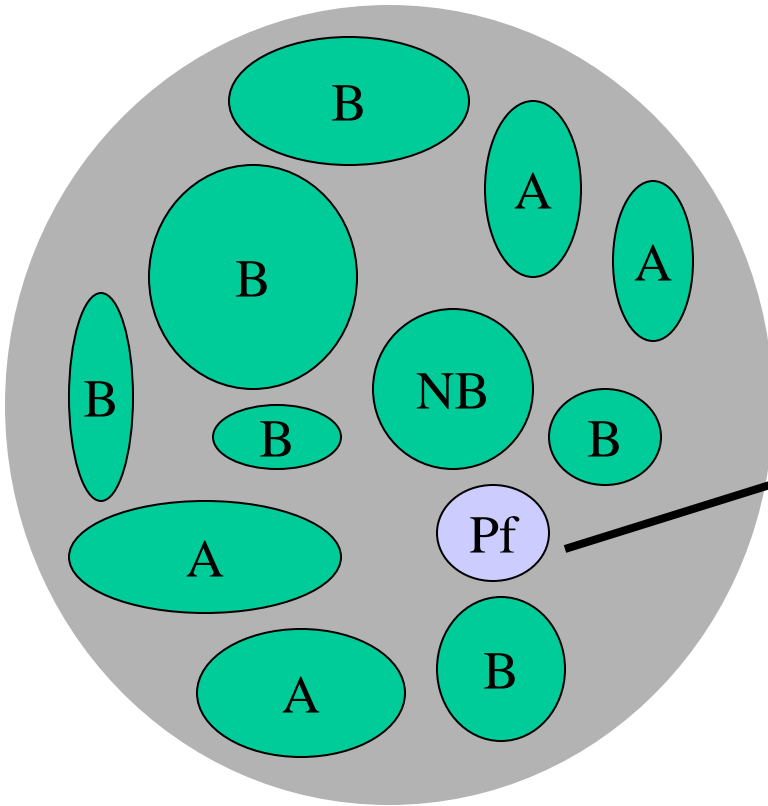


From: Apei et al. 1996. *Oecologia* 106: 111-126

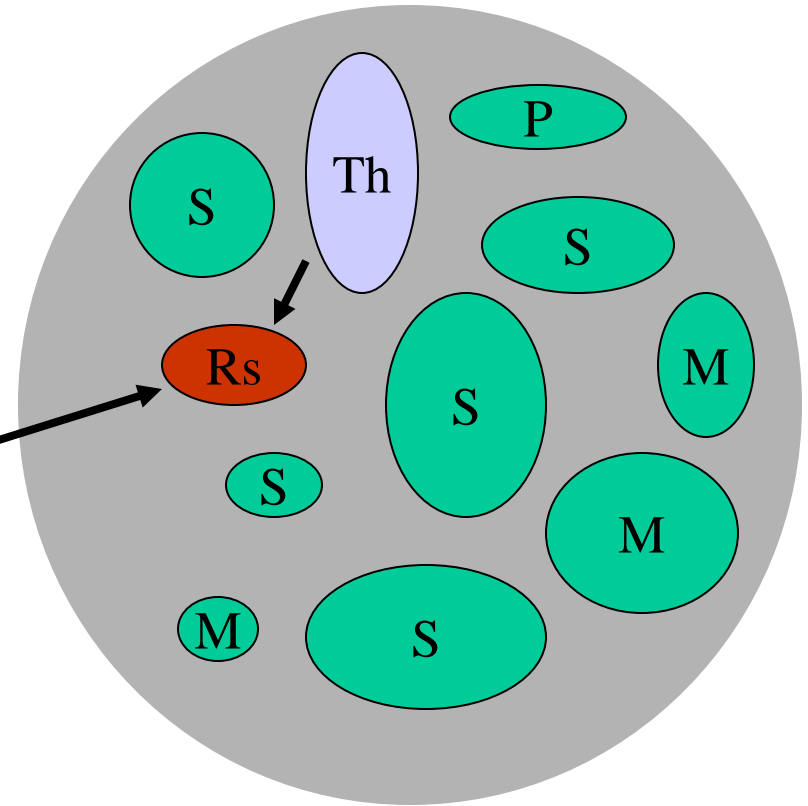


Relevance of biomass data to disease suppression?

Bacterial biomass



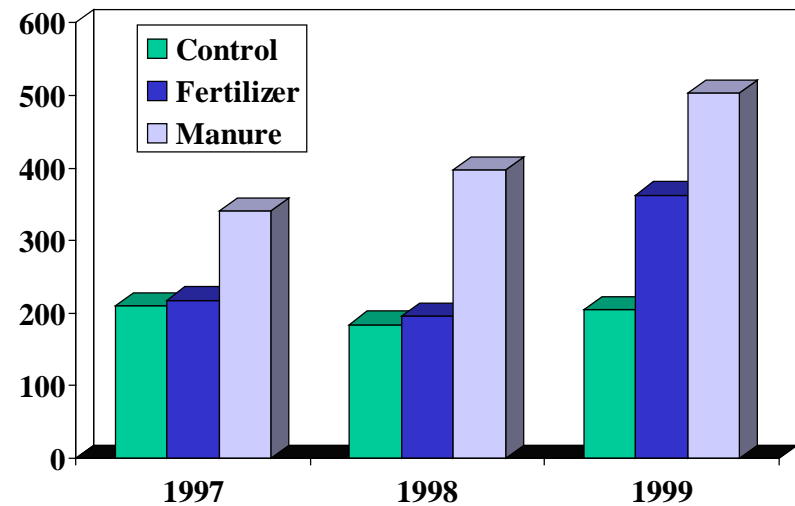
Fungal biomass



Factors increasing microbial/food web biomass do not necessarily result in pathogen suppression



Root-lesion nematodes
Pratylenchus penetrans



Inconsistent methods and data

- **No universally accepted “food web”**
 - What portion of food web is being analyzed?
 - How are functional groups defined?
 - mycorrhizae included in fungal biomass?
 - amoebae and flagellates analyzed separately?
 - actinomycetes separated from “bacteria”?
- **Spatial and temporal variation**
 - Unreplicated &/or single point-in-time measurements can be misleading