



SOIL HEALTH MANAGEMENT

Regenerative Agri/AgroEcology/Natural Farming

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Overview

- ♦ Significance of Natural Farming
- ♦ Importance of Soil Health
- ♦ Discussion on soil health principles and practices



Introduction

Context

- ♦ Ecological & climate crises
- ♦ Agrarian livelihoods are in distress
- ♦ Nutrition Integrity compromised

‘Business as Usual’ is not the solution – Governments are gearing up to find sustainable alternatives, of which Agroecology practices **are** very effective and feasible.

Natural Farming approaches achieve

Soil Carbon Sponge

Synergies in the crop ecosystem;

Building Resilience

Increased productivity and incomes

Minimized risks and costs

9 NF Principles & Practices

1. Cover crops
2. Crop Diversity
3. No/Low till
4. Integrate animals
5. Bio-stimulants
6. Addition of diverse organic residues
7. Use of Local seeds
8. Pest Management with non-chemical options
9. No Chemical stresses

1. CROP COVER

- ♦ [Rhizodeposition](#) of photosynthates as root exudates
- ♦ [The Soil Food Web](#)
- ♦ Atmospheric gaseous Carbon >> Solid Soil Carbon
- ♦ Multiple crops - Sunlight harvest at different levels >> More Carbon deposition, diverse carbon compounds; & at deposition at various [depths](#)
- ♦ [Rhizodeposition](#) >> happens more in vegetative stage – Ensure rhizodeposition through out the year ([365DGC](#))
- ♦ Rhizodeposition – Soil Carbon build-up is 5 - 30 times faster
- ♦ Economically important crops

2. POLY CROPS

- Above ground diversity >> Below ground diversity of soil microbiome
- *Recommendation*: >4 plant groups >> 8-12 species.
- Diversity >> Crop productivity
- Jena Experiment
 - Association of dissimilar plant groups >> More plant productivity
- Risk management
- Natural barriers against pests & diseases



YouTube video - **Jena Experiment Intro english**
<https://www.youtube.com/watch?v=j3SvG2nBCTM>



3. NO / LOW TILLAGE

- ♦ Loss of valuable soil Carbon by oxidation
- ♦ Breaking down & weakening of soil aggregates – leading to erosion
- ♦ Tillage destroys tunnels in soils – leading to disruption in soil life & **compaction**.
- ♦ Goal is to create Water Resistant Soil Aggregates >> facilitated by high soil carbon

4. INTEGRATE ANIMALS

Nature doesn't farm plants without animals

- ♦ Integrated Farming systems
- ♦ Plant biomass >> Animal Fodder >> Animal byproducts >> Plant bio-stimulants

5. BIO-STIMULANTS

- ♦ Definition – Substances/microbes – Applied on plant/in rhizosphere – stimulate to enhance/benefit – nutrient uptake, tolerance to stresses, increase crop quality
- ♦ Shifts
Animal based manure >> Plant based manure >> Microbes based bio-stimulants
- ♦ Lower quantities, easy access, simple preparation techniques
Seed treatment ([Rhizophagy](#)), Soil & Foliar application
- ♦ Multiplication of beneficial microbes; proximity to plants
25000 km of fungal hyphae in 1 m³ of healthy soil
[Jiwamrut](#) / [Bijamrut](#)



6. ORGANIC MATTER ADDITION

- ♦ 2-inch-thick mulch – groundnut shells, paddy straw, etc
- ♦ Surface mulch – No incorporation
- ♦ Root biomass of crops
- ♦ Enhance habitat for soil organisms, protecting soil from extreme temperatures and rain-water effect.
- ♦ Biochemically locked water in organic matter



Soil Carbon Sponge



Soil Carbon Sponge



Soil Carbon Sponge



7. LOCAL SEEDS

- Farmer-bred, local seeds respond better to NF input practices
- Diversity - nutrition
- Commercial seed bred for high yields and are susceptible to pests, droughts, etc.
- Seed sovereignty

8. PEST MANAGEMENT

- ♦ Prevention

Crop design – *barrier crops, traps crops, habitat for beneficial insects*

- ♦ Monitoring

pheromone traps

- ♦ Curative – foliar sprays

Botanical - *extracts / decoctions / concoctions: Neem, Vitex, etc.*

Mechanical – *sticky traps,, light traps, Bird perches*

- ♦ No pesticides

9. NO CHEMICAL STRESSES

- ♦ **Pesticides**

Selective breeding of super pests – Destruction of non-target beneficial insects

Severe acute and chronic health affects

- ♦ **Fertilisers**

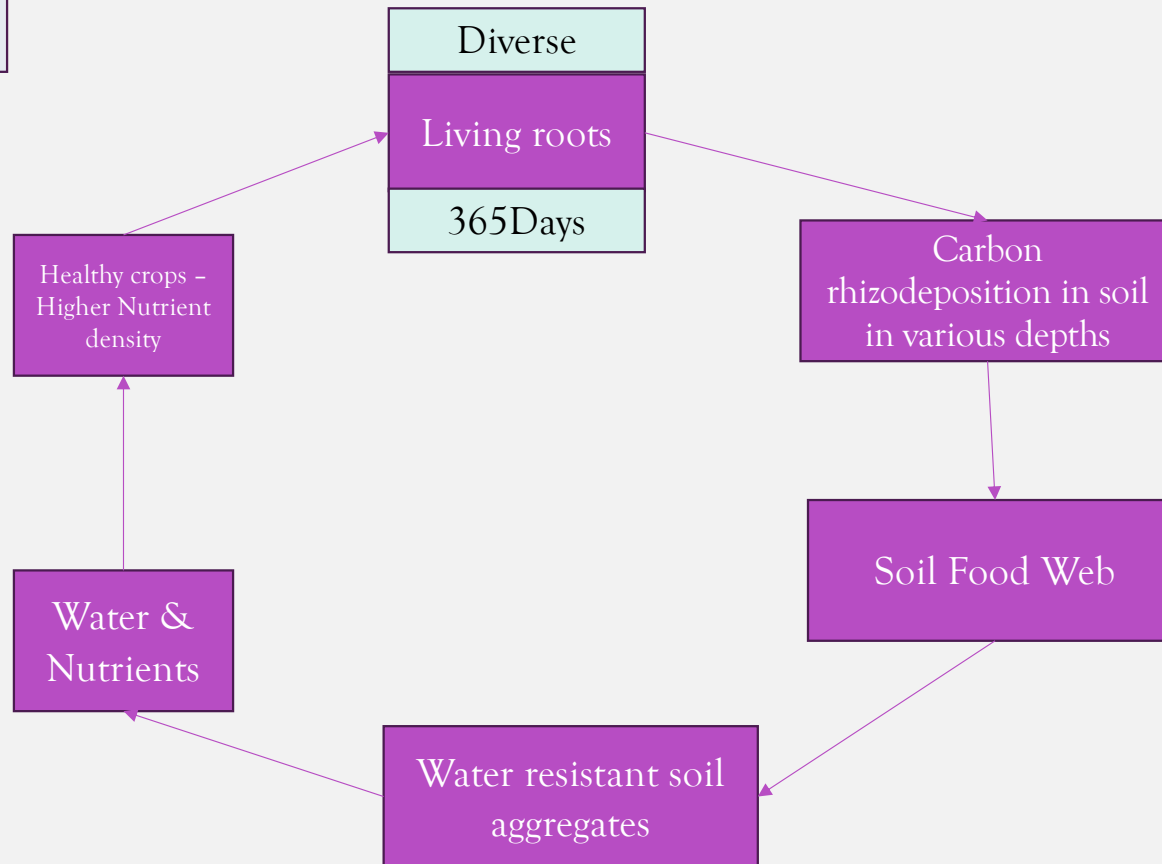
Creates nutrient imbalances (antagonistic reactions), alters pH, destroys soil aggregation, increases pest population,

Affects [rhizo-sheath](#) formation

Protein Synthesis rate within plant is disrupted making it vulnerable to pests and diseases

Growing crops in drier months

1. Seed pelletisation
2. Org mulch



APCNF's 9 NF Principles

1. Cover crops
2. Crop diversity
3. No/Low tillage
4. Integrate animals
5. Biostimulants
6. Diverse organic residues
7. Local seeds
8. Pest management
9. No Agrochemicals

Soil health indicators

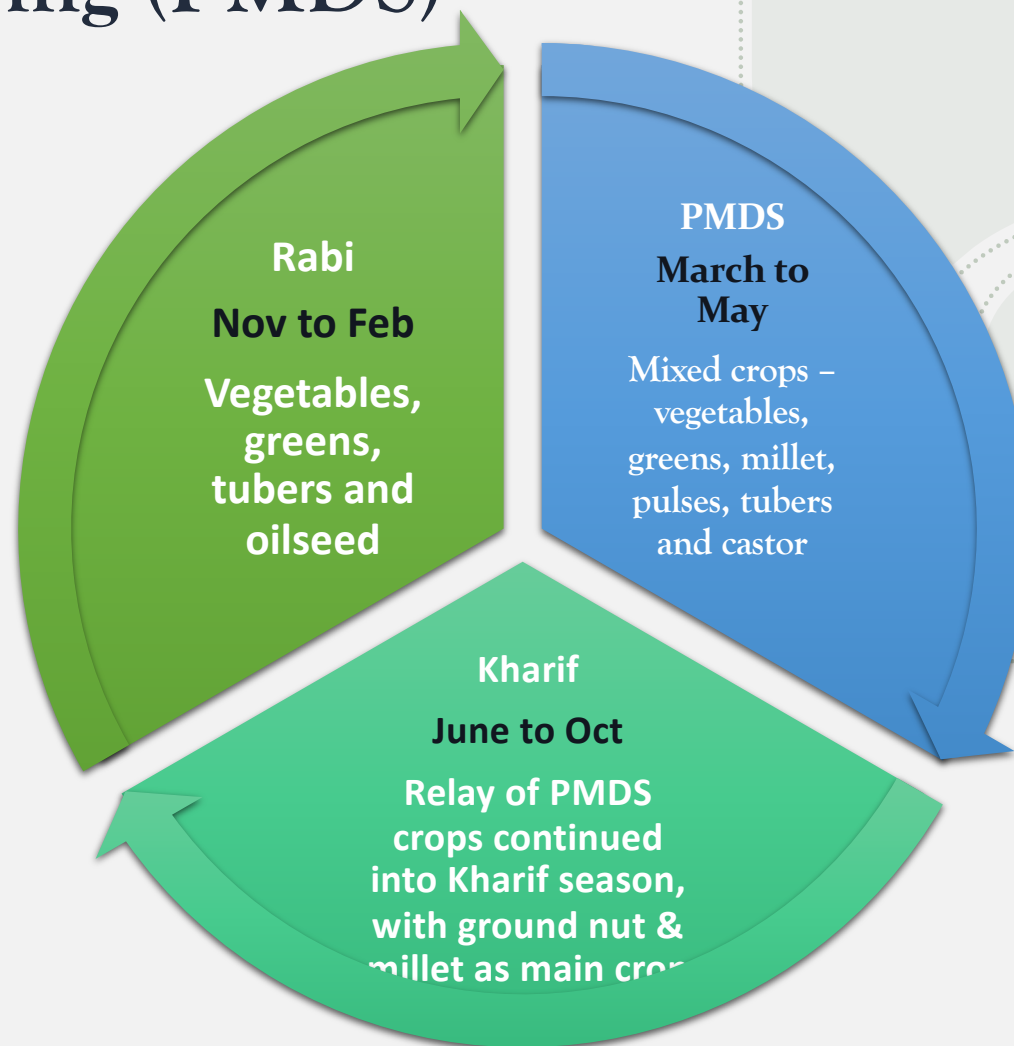
- ♦ Water stable soil aggregates
- ♦ Dark colour
- ♦ Porosity
- ♦ Medium to high organic C content
- ♦ Rhizosheaths around roots
- ♦ High fungal population
- ♦ Longevity of crops
- ♦ Ability to grow crops throughout the year



365 Days Green Cover

- **365Days Green Cover (365DGC)** strategy has **PreMonsoon Dry Sowing (PMDS)** as main component. To grow crops in the fallow periods.
 - Increases cropping intensity (CI)
 - income
 - food & fodder availability
 - soil health
- PMDS success in the field is mainly attributed to the **Pelletisation of seeds** with clay, ash and bio-stimulants – to ensure seed is stay put where it is sown; to increase viability, germination and establishment

Pre-Monsoon Dry Sowing (PMDS)



Growing crops with minimal moisture, round the year

- Biochemically locked water in OM is released helping seeds germinate
- Bio-stimulant coating around seed makes mycorrhiza colonize roots as soon as it germinates
- Mycorrhizae fetch water and nutrients. 25000 km long fungal hyphae in 1 cu.m. soil
- Improved soil structure holds more water
- Shoot emerges and offer cooler surface for water vapour to condense. Atmosphere has 50000 ppm water

Seed pelletization : Critical part of Summer sowing, PMDS



Seed pelletization: Seeds are coated with a mixture of sifted GJM, fine clay, ash, lime, with sprinkling of water.

The resulting pellet is 10 times the size of the original seed.

The seed pellet protects the seed, allows for moisture retention and favorable conditions for seed germination



Navdhanya seed mix, consisting of 9 pulses and legumes

The image below: process of pelletization. It is a snapshot of a YouTube video which demonstrates the same.

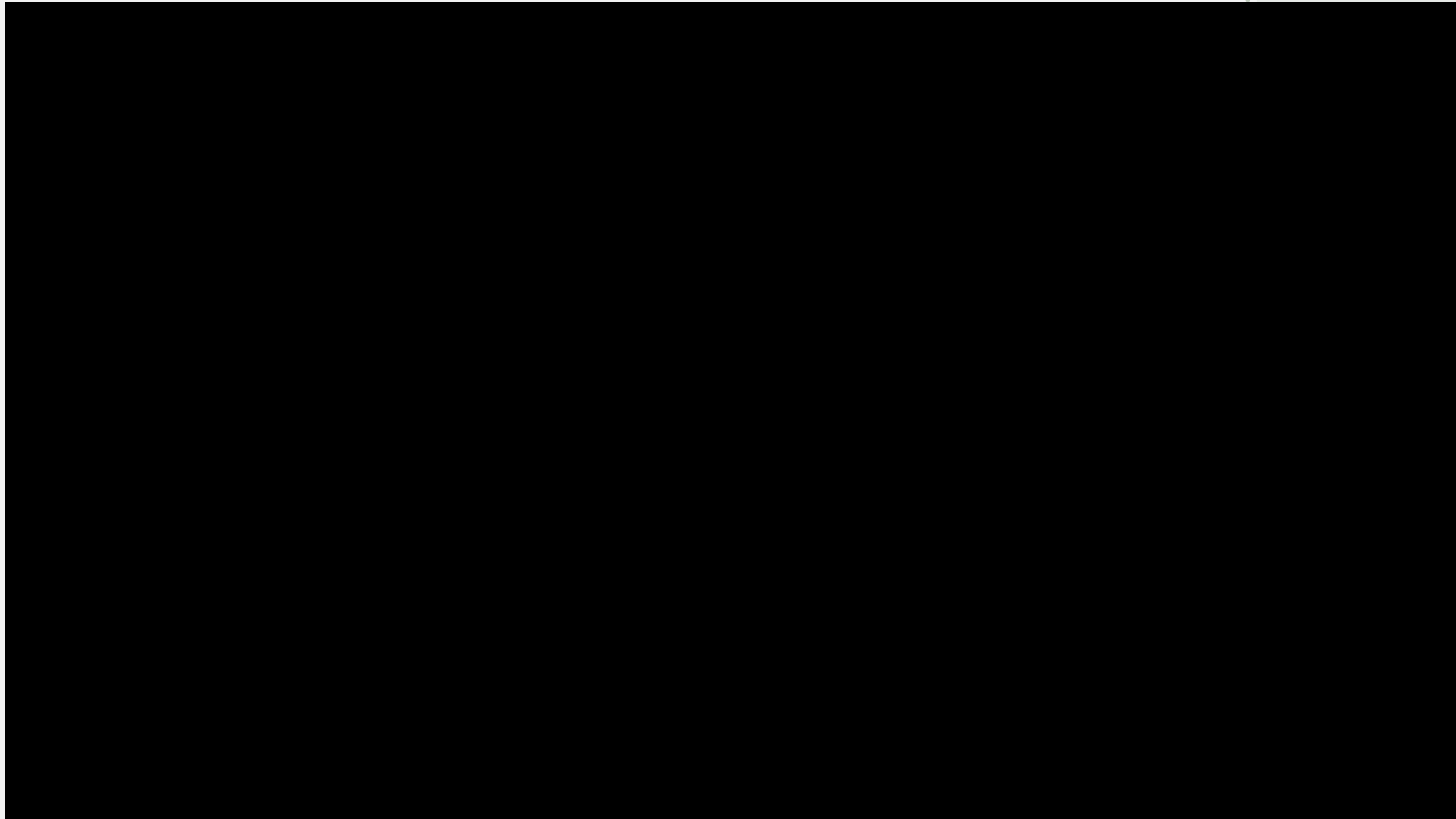


<https://www.youtube.com/watch?v=NCKeqfc2NCY&t=504s>



Almost ready for a harvest, Sreedevi's field in Ananthapuram looks like a mini forest, rich with multiple types of nutritious produce, in the month of May

Case Story of 365 Days Green Cover



<https://youtu.be/zx5ZB-7TU10> - B Pushpavathi, Ananthapur

FAQs

- ♦ How crops can be grown without chemical inputs or without bulky organic manures? How are nutrients managed?
- ♦ What is the yield penalty of crops after switching to NF. How does farmers cope with it?

Summary

We have learnt

1. The need of Natural Farming
2. Main principles and practices of Natural Farming
3. Natural processes in scientific terms
4. 365 Days Green Cover is possible even in driest regions
5. FAQs



THANK YOU & BEST WISHES

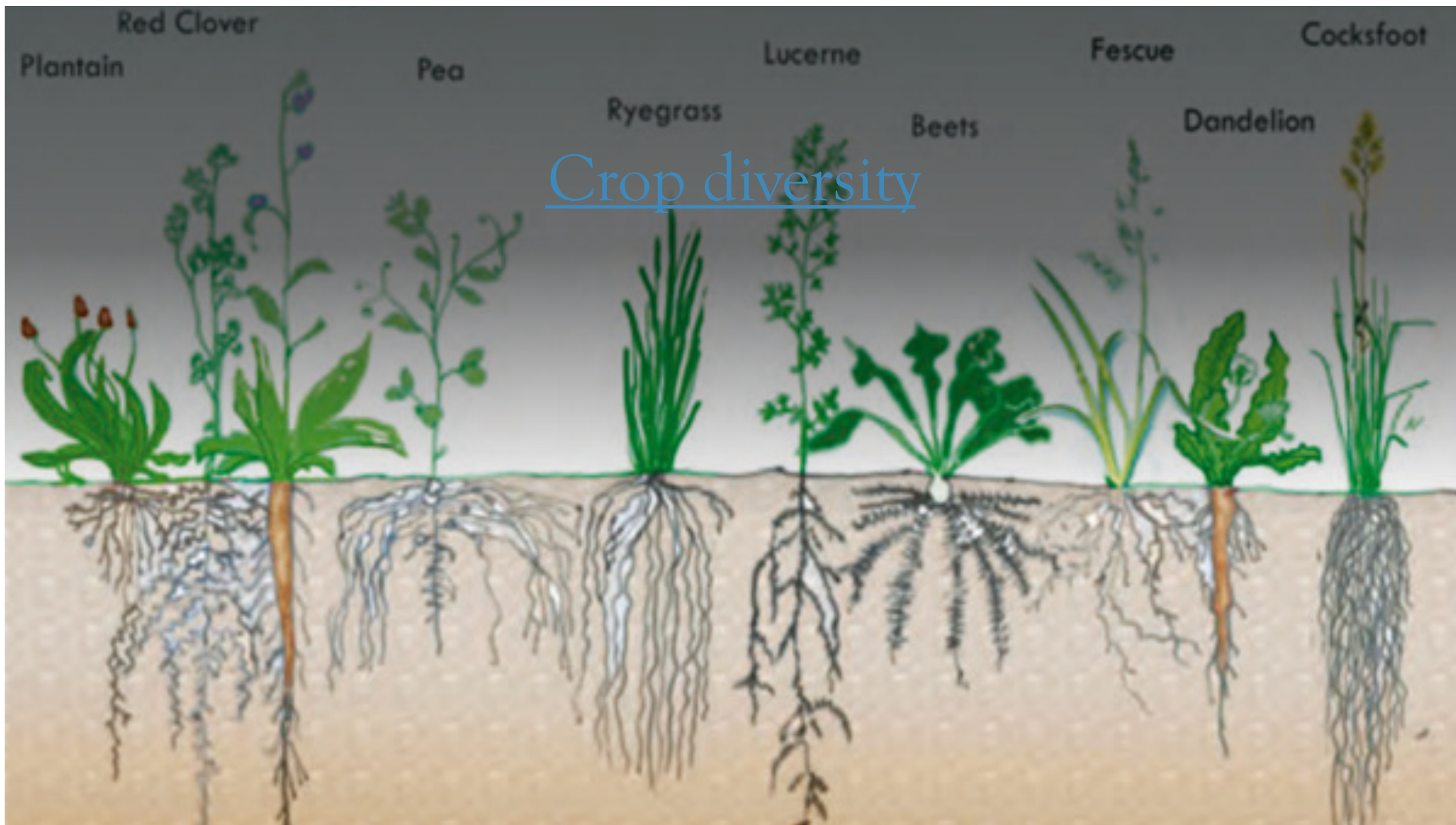
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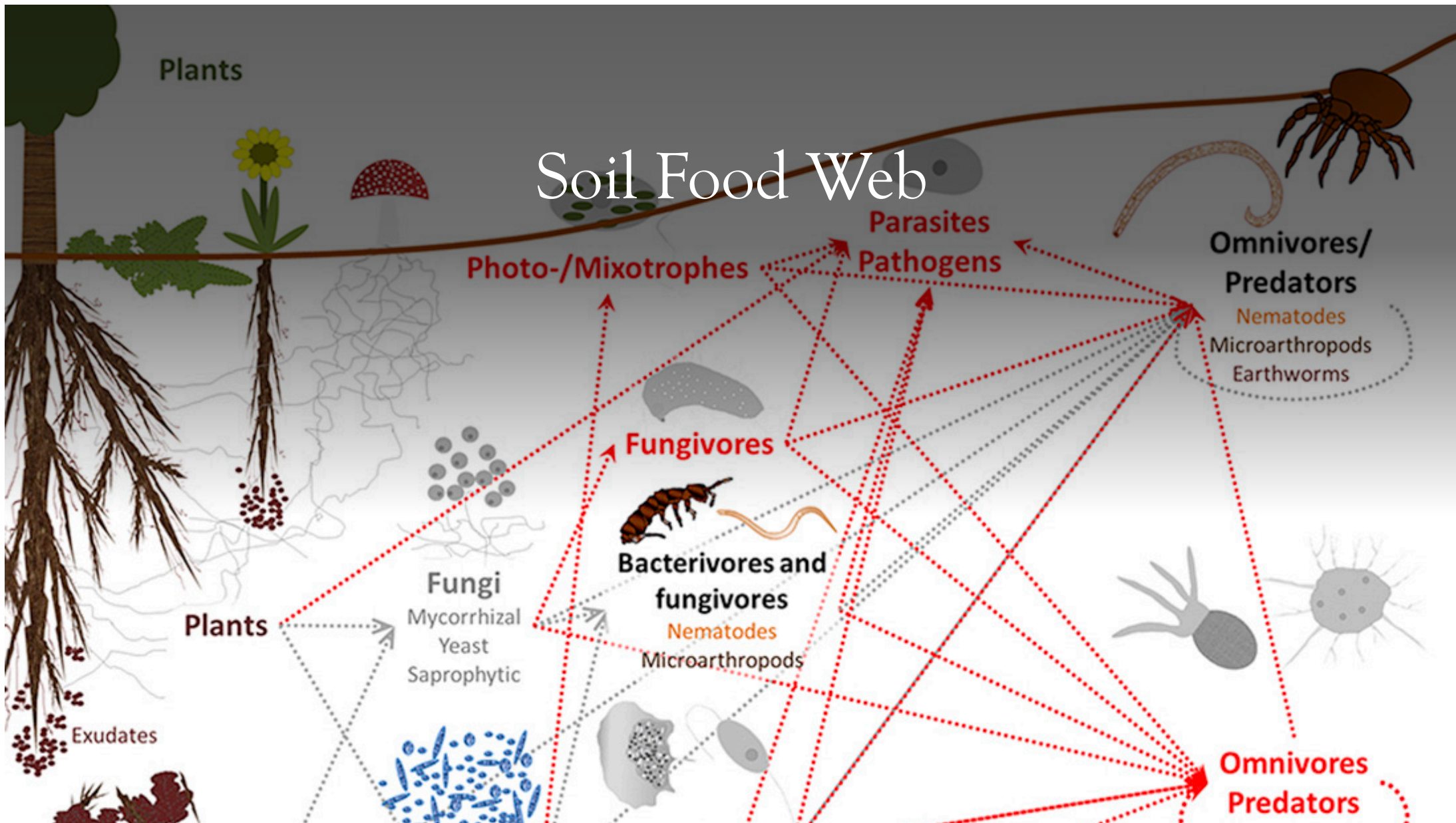
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Rhizosheaths





Soil Food Web



1

Microbe Exit Zone

(Microbes Stimulate Elongation of Root Hairs and Exit at the Tips of Hairs Where Walls are Thin. Microbes Reform Cell Walls Once Outside Root Hair.)

Plant Cell Entry Zone

(Microbes Become Intracellular in Meristem Cells as Wall-less Protoplasts.)

A

B

Bacteria (arrow) in root parenchyma cell near root tip meristem.

meristem

Nutrients Extracted from Microbes By Reactive Oxygen Produced by NOX on Root Cell Plasma Membranes

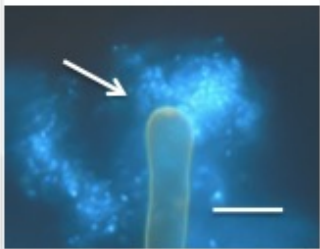
Microbes Enter Root Cell Periplasmic Spaces Carrying Nutrients From Soil

Microbes Exit Root Hairs Exhausted of Nutrients

RHIZOPHAGY CYCLE

Microbes Recharge with Nutrients in the Rhizosphere

C



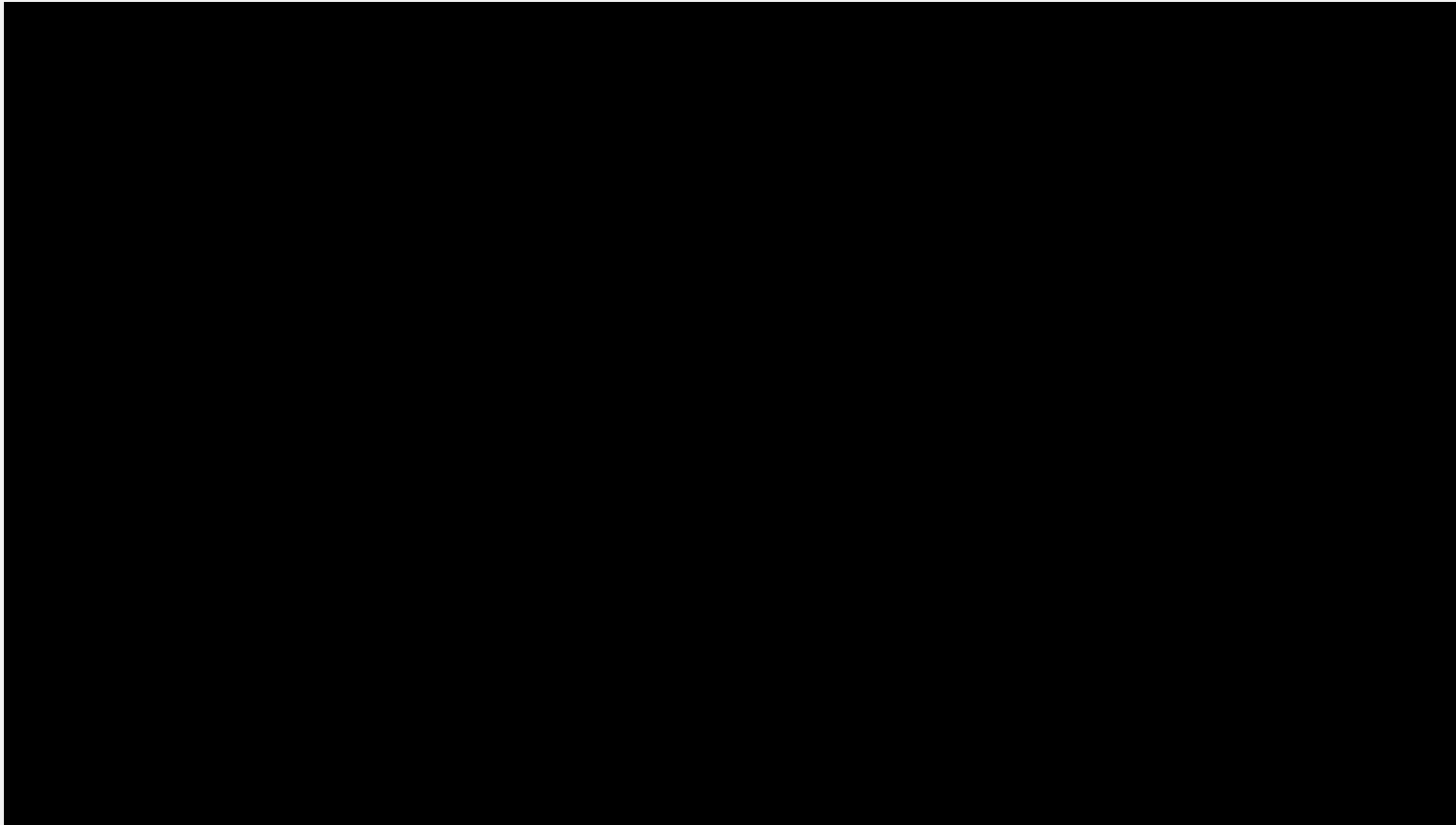
Bacteria (arrow) emerging from root hair tip of millet seedling.

Rhizophagy

- Plant nutrients absorption
- Improve stress tolerance
- Suppress pathogens
- Modulate root development (elongation, branching, rootability)
- Alter plant chemical constituents

James F White, BioFarm 2020, Ireland's Biological Farming Conference, 2020

Rhizodeposition – Root exudates



Zoospore Infection - *Phytophthora nicotianae*

YouTube video - <https://www.youtube.com/watch?v=PxF8OwDtJh0>

Root Exudates (*around 30% photosynthates 'leak' into soil*)

MAIZE ROOT TIP

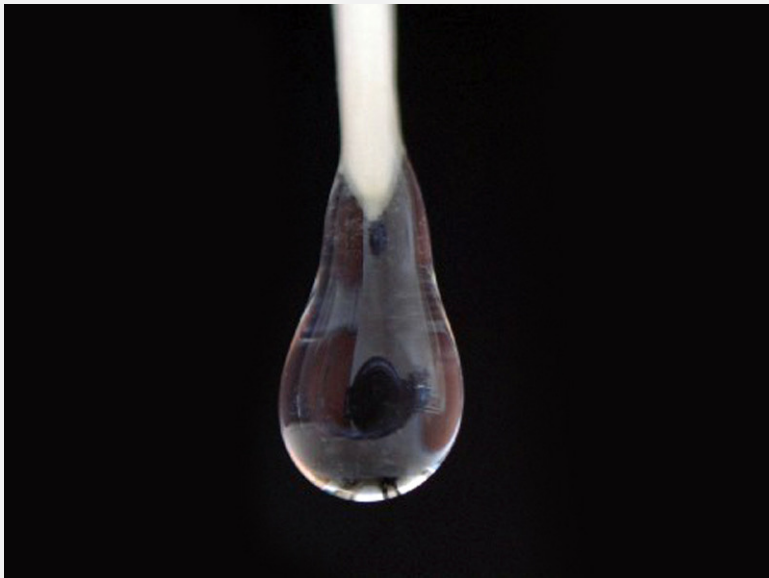
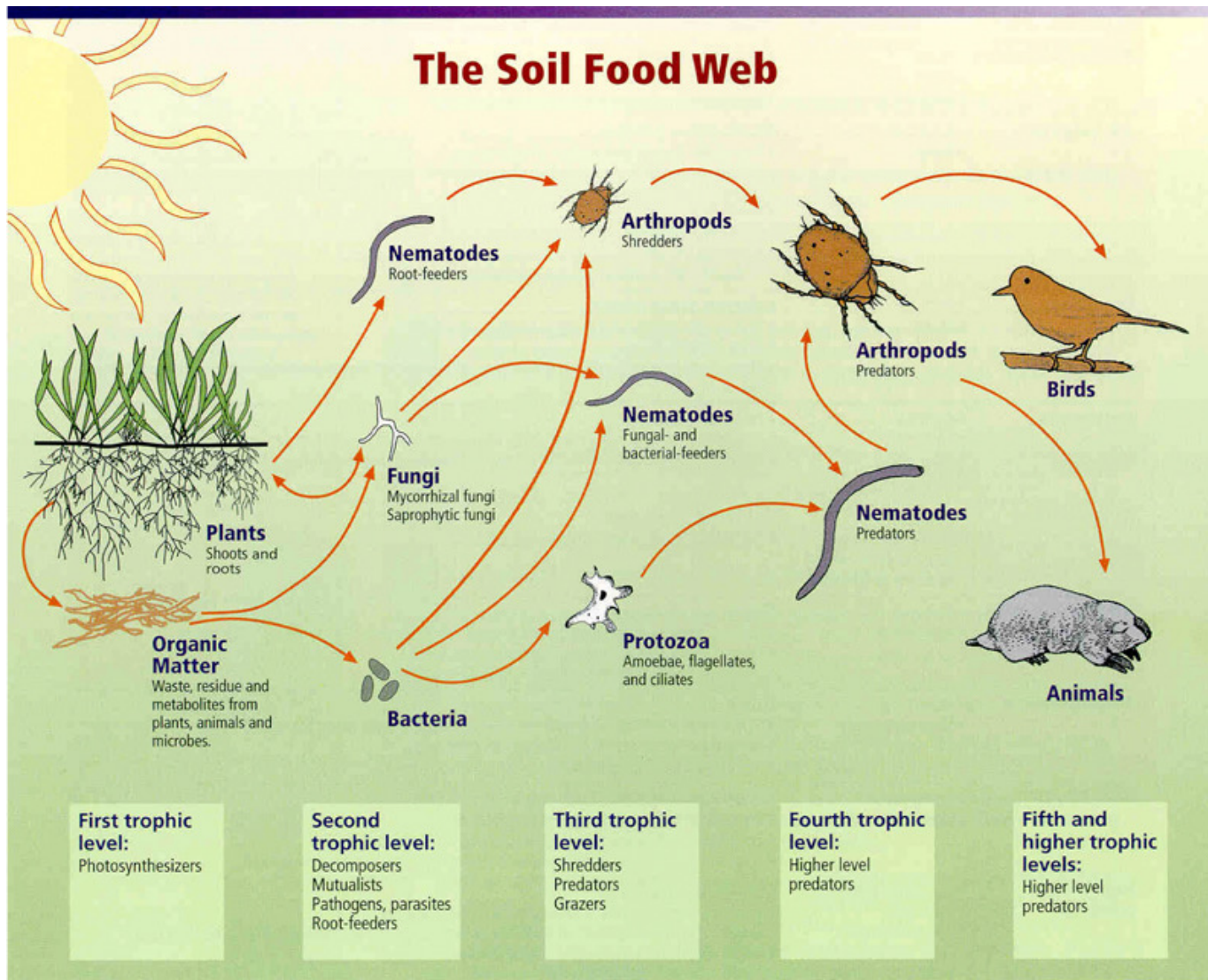


Photo credit Glyn Bengough.

EXUDATES FROM ROOT HAIR





The Soil Food Web

Relationships between soil food web, plants, organic matter, and birds and mammals

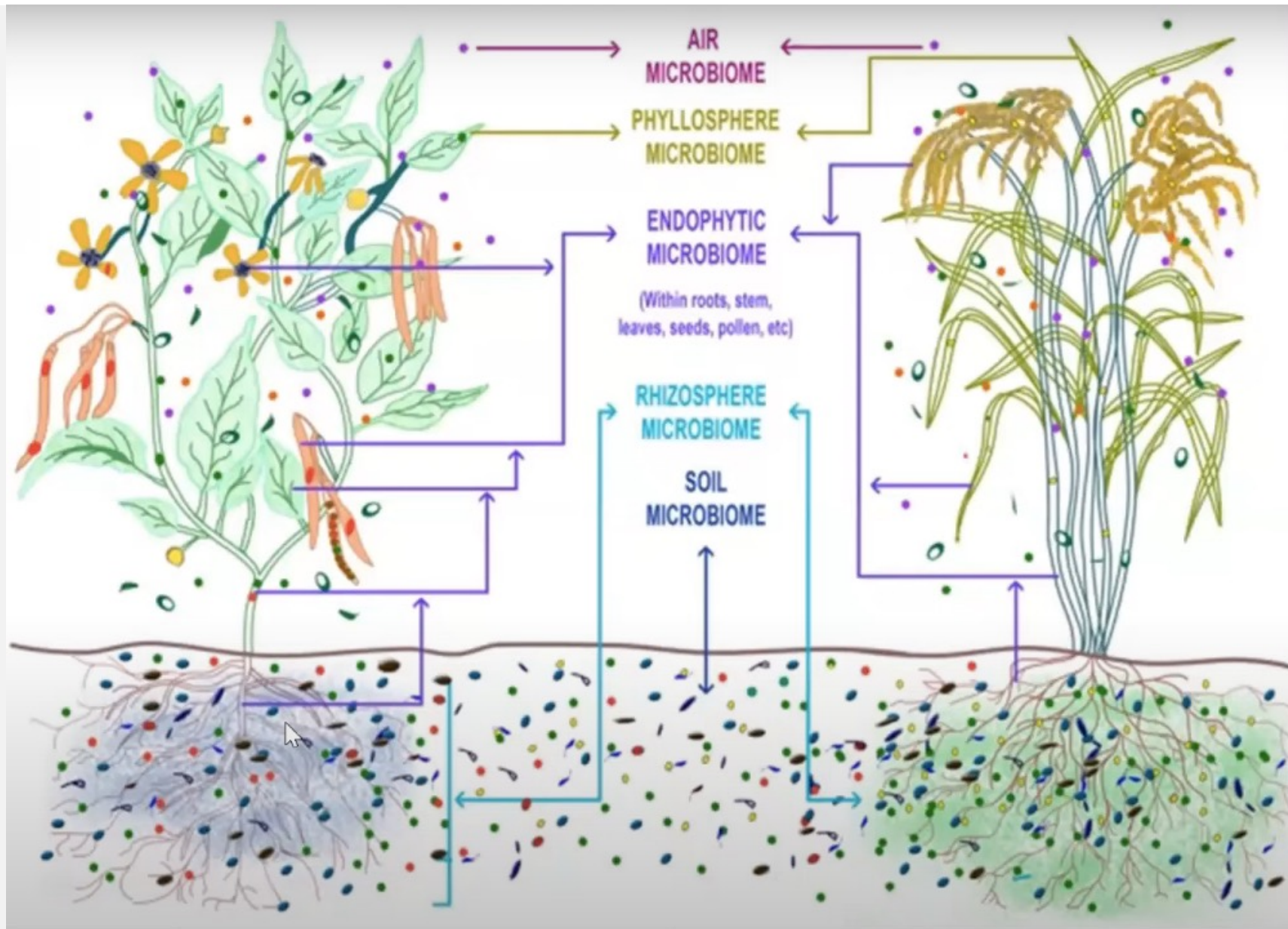
Image courtesy of USDA Natural Resources Conservation Service

http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.



Water
resistant
soil
aggregates

Microbiomes



Soil structure - importance



ఆంధ్రప్రదేశ్ ప్రభుత్వం
వ్యవసాయ శాఖ - ప్రకృతి వ్యవసాయ విభాగం
సమర్పించు

Dravajiwamrut