# Soilborne disease suppression in vegetable crops

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# Interacting factors affecting plant health – understanding pathogens & microbial lifestyles

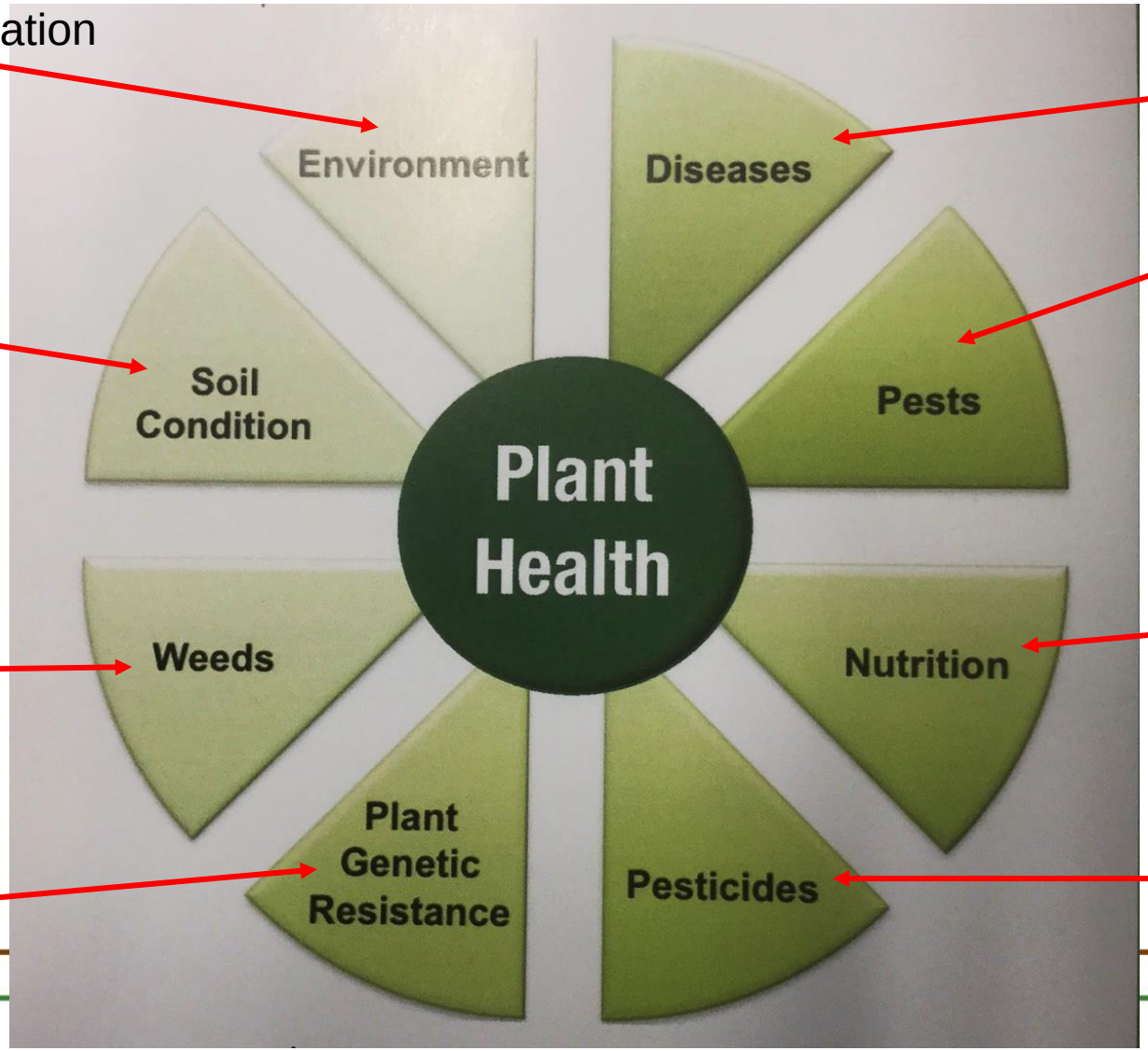
Integrated Crop Protection
PROTECTING CROPS
Soil Wealth
NURTURING CROPS

Wet, rainy, dewy, excess irrigation & particular temperatures can favour disease

Drainage, air-filled porosity, pH, EC
**Soil biology**

Alternative Hosts & competitors

Choose variety




Plant pathogens

Damage - infection
Some insects can spread fungal Spores, bacteria & viruses

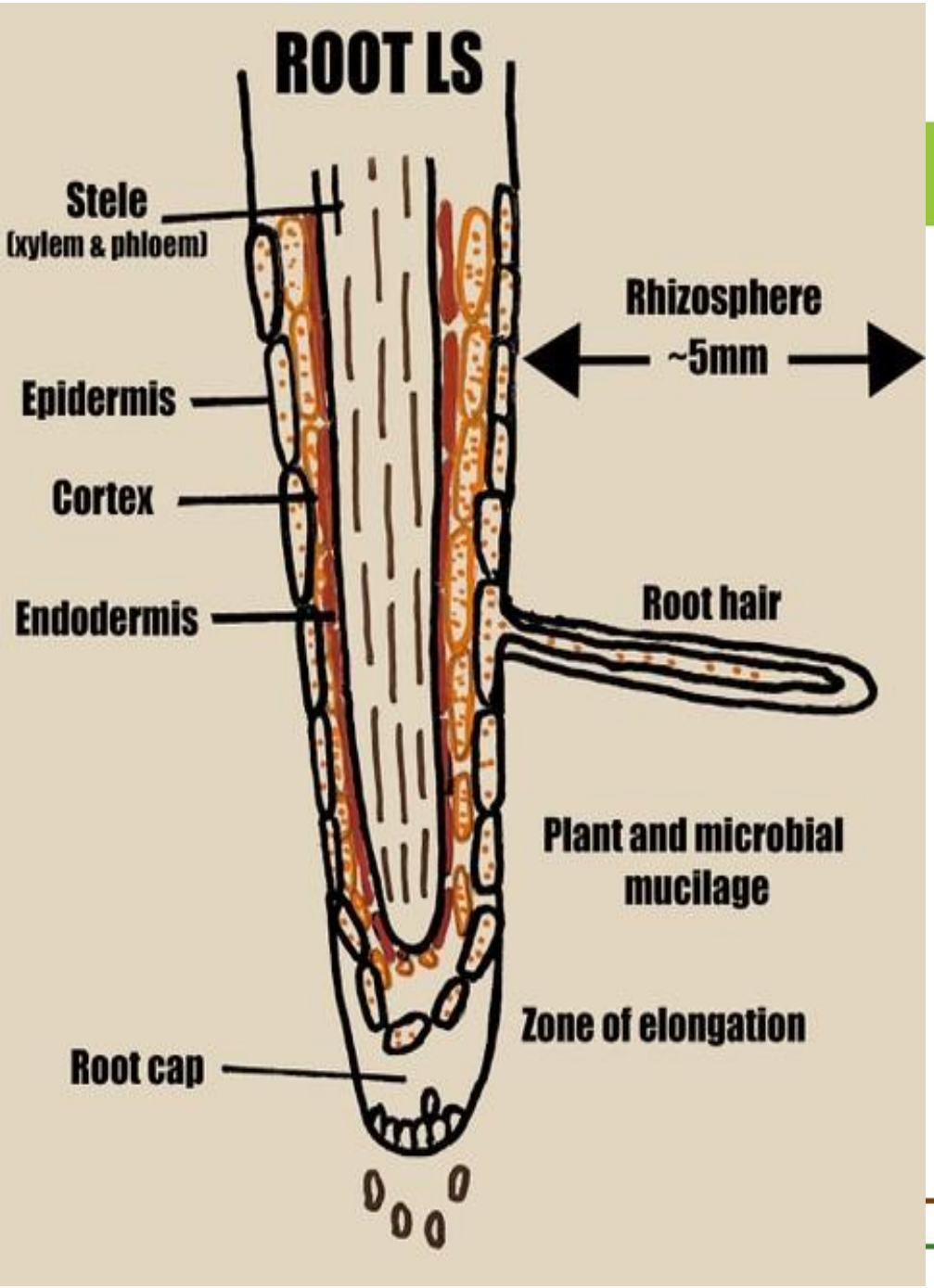
Goldilocks effect – not too much/not too little
**Organic forms**

Rotate & Strategic use

# Definitions of disease suppression by microbes

(Cook & Baker, 1974)

- ***General suppression*** results from competition between pathogens and a wide range of microbes in soils and media (particularly in the rhizosphere)
- ***Specific suppression*** is direct biocontrol by specific microbes such as hyperparasites and enzyme, detergent or antibiotic producers




The rhizosphere has its own '***rhizobiome***' made up of a menagerie of microbes and small animals including:

bacteria, filamentous fungi, chytrids, yeasts, oomycetes, amoebae & other protozoans, viruses, worms, mites & insects

Chemicals in plant exudates help determine the rhizobiome constituent microbes

The constituent microbes influence plant growth and defence against plant pathogens

Mutualism relationships - plants don't penalise low performing microbes

# Key microbes associated with disease suppression

- Wide variety of fungal & bacterial endophytes and saprophytes
- *Bacillus species* (and similar genera such as *Anoxybacillus* spp.)
- *Pseudomonas* spp. (and several other Proteobacteria)
- *Streptomyces* spp. & *Actinomyces* spp.
- *Trichoderma* spp.
- Arbuscular mycorrhizae (e.g. *Glomus* spp.)
- Bacteriophages & Mycoviruses

# Suppression driven by several microbial metabolites & lifestyles

- parasites of plant pathogens (hyperparasites)
- produce antibiotics, enzymes, small RNAs, CRISPr DNA systems & surfactants
- compete for space and food
- produce plant growth-promoting chemicals

(= Phytostimulation & Phytofertilisation)

- induce plant disease resistance & stress tolerance responses

# Disease suppressiveness modulated by:

- Organic amendments, residues of previous crops or cover crops etc.
- Time – a dynamic process –changes with microbial digestion of organic matter – changes to soil chemistry & physics
- Plant genetics & age

Analogy between disease suppression and an ‘orchestra’ - keeping physical, chemical & biological components ***in tune*** over time

- Pythium & Phytophthora disease suppression are associated with increased microbial activity
- Poorly composted OM (cellulosic) favours saprophytic growth of Rhizoctonia

# Summary -Disease suppression – research over past 60 years & where to now…

- Consistent generalised disease suppression requires a ***resonance effect*** in the microbial community that directly affects the pathogen and/or signals the plant to trigger defences
- Cultural practices that improve disease suppressiveness need to be integrated into broader disease management strategies – particularly use of agrichemicals (compatibility/synergy with fungicides, fertilisers & biostimulants, plant varieties etc.)
- There is a need for further research to find potential synergies between different disease management interventions for consistent disease suppression