

microBIOMETER®

Soil Health in the palm of your hand

How Soil Microbes Protect Plants ©

Judith Fitzpatrick, Ph.D.

Advantages of a strong plant immune system

Plant and soil are defended against disease

Less pesticides --

- Lower growing costs -Organic farms use 97% less of any type of pesticide
- Less pollution

Healthier food

THE BIGGEST HEALTH ADVANTAGE cited by ORGANIC BUYERS IS LESS PESTICIDES

NUTRITION: There are about 20,000 immune modulator molecules in organic food that enhance taste and contain antioxidant and other important nutrients.

Increasing microbes is the current best method of increasing plant health.

Increase your microbes by feeding them and not decreasing them with overuse of NPK.

Do not over fertilize with mineral fertilizers. The plant feeds the microbes, it stops feeding them when it gets its NPK from you.

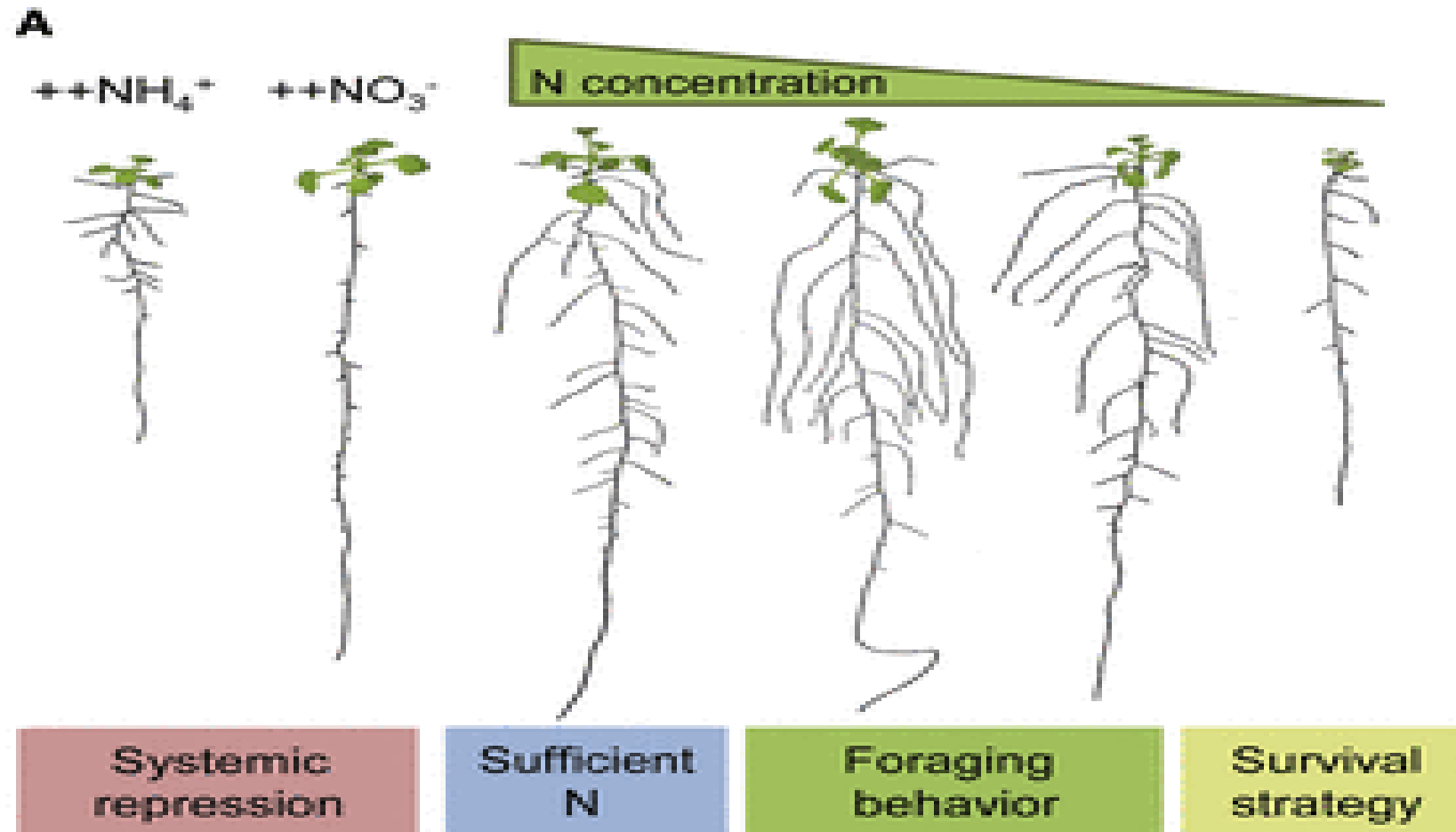
- Feed your microbes NPK. You can titer this with microBIOMETER.

Academics have shown that specific microbes on specific crops, in specific circumstances can greatly improve plant health, but this approach has proved hit or MISS -- before implementing this approach research its effect in your field by estimating the effect on microbial biomass.

Go for microbe food, and careful use of or no mineral fertilizer.

Effect of Excess N on root and rhizosphere

from https://www.researchgate.net/publication/264432617_Root_Nutrient_Foraging



The Plant Immune System

Like our system the functions are

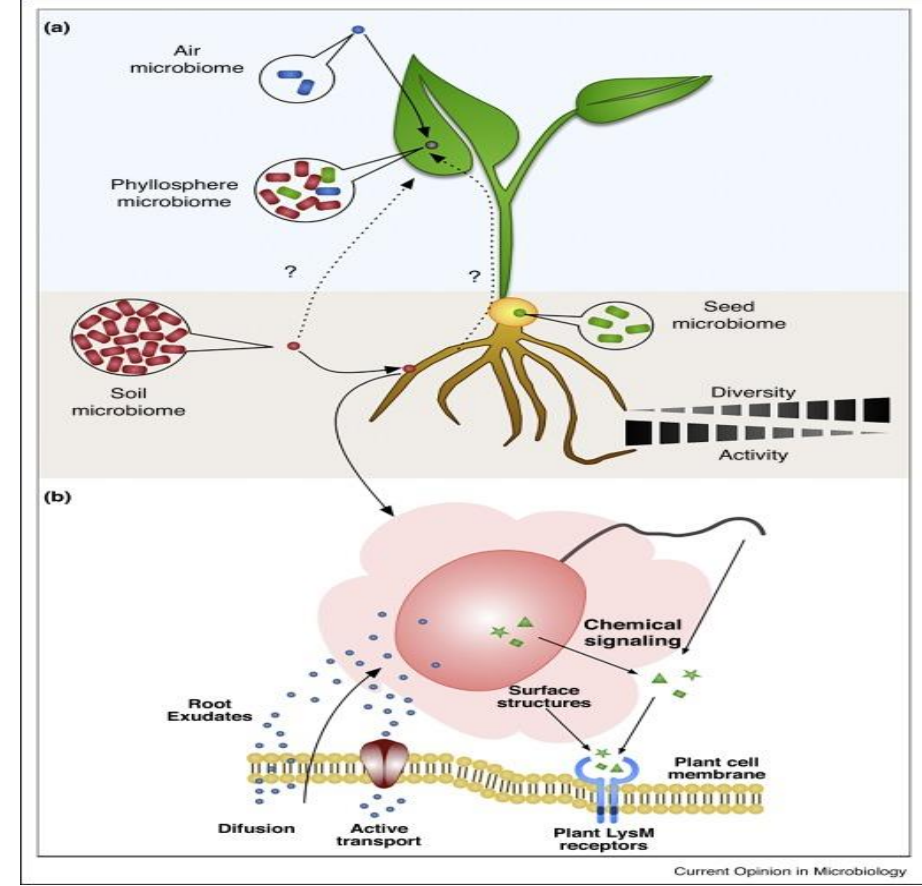
1. Protect against pathogens.
 - Specifically recognize and attack.
 - Non-specifically recognize and attack.
2. Heal wounds – which are portals of entry for pathogens.
3. Respond to environmental stress – e.g. we make cortisol.

OUR IMMUNE SYSTEM IS IN OUR BONE MARROW AND CAN BE CARRIED WITH US

THE PLANT IMMUNE SYSTEM IS IN THE PLANT BIOME, AIR, LEAVES AND SOIL – THEY CAN'T MOVE.



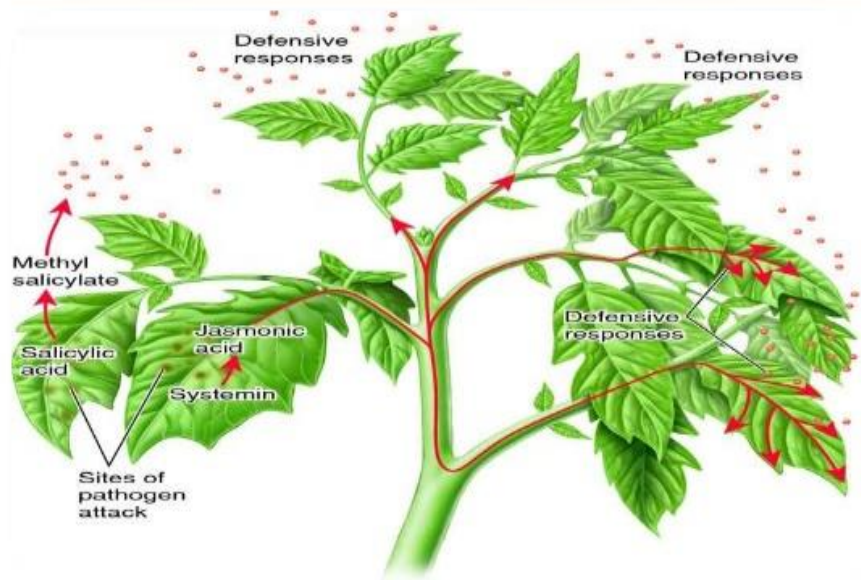
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Plants have 2 immune systems – both reliant on microbes.

SYSTEMIC ACQUIRED IMMUNITY

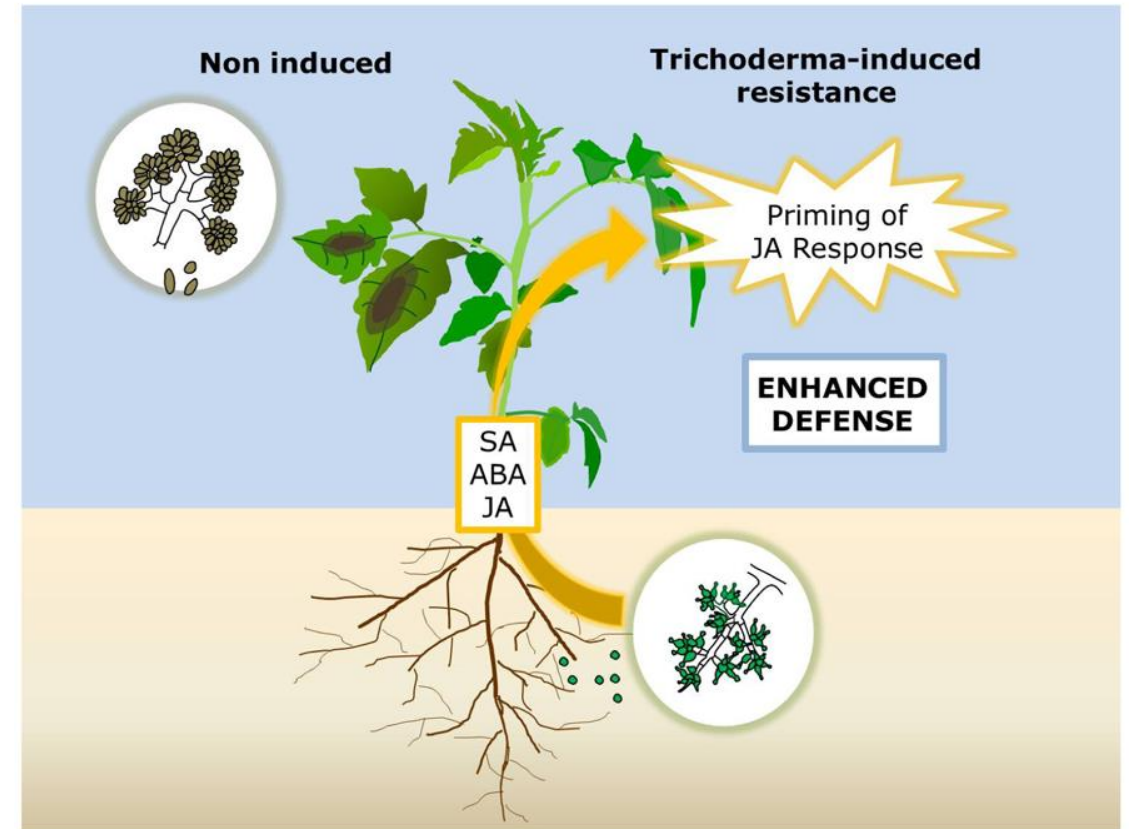
SYSTEMIC ACQUIRED RESISTANCE



Submitted to : Dr. KP Singh
Department of Plant Pathology

Sudha Nandini Sharma
Ph.D (Plant Pathology)
Id : 43970

SYSTEMIC INNATE IMMUNITY



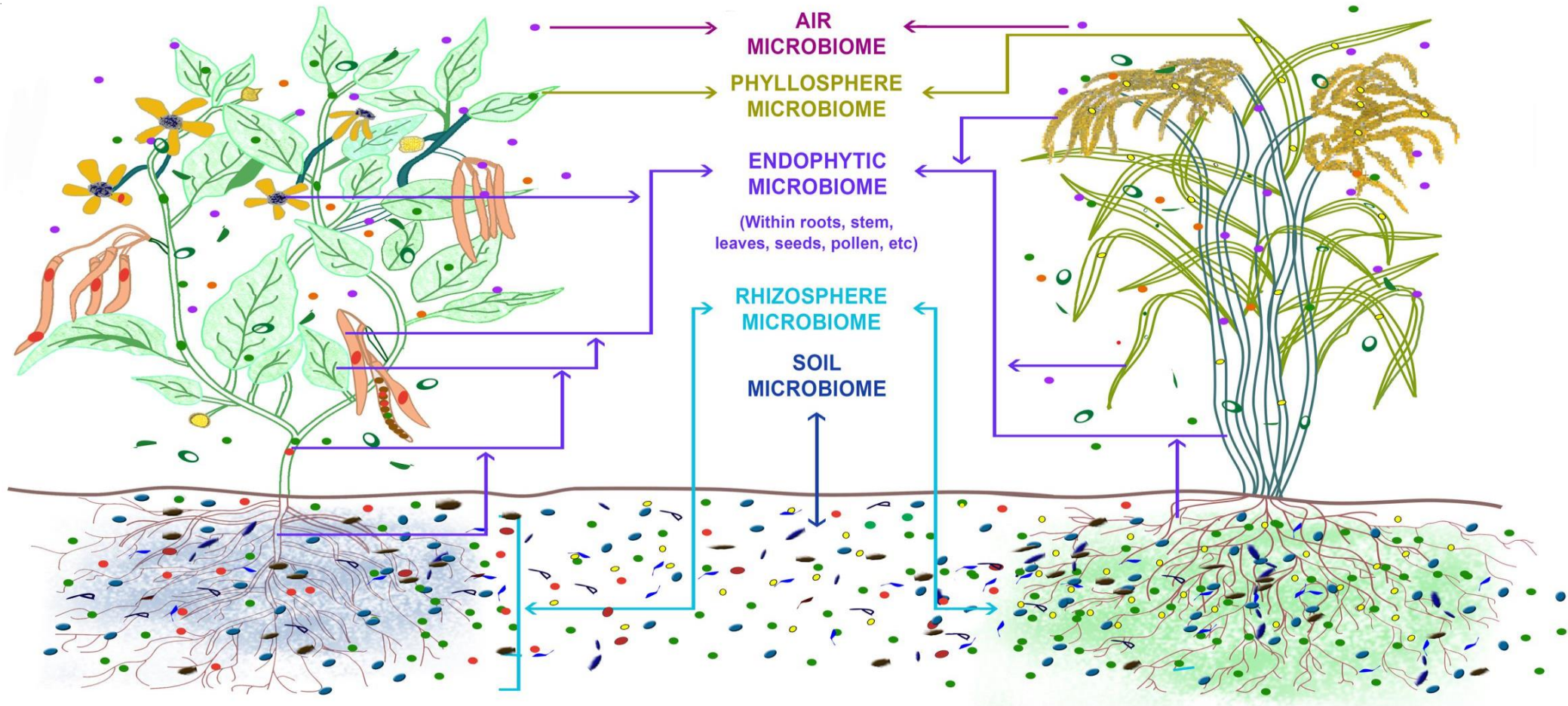
Big Energy Cost of Defensive Resources!

Fighting disease uses energy not going to productivity or growth.

So it pays to only activate those immune resources when they are needed.

But the plant needs to be prepared.

Innate Immunity is activated by rhizobacteria which are recruited from the soil microbial **COMMUNITY**



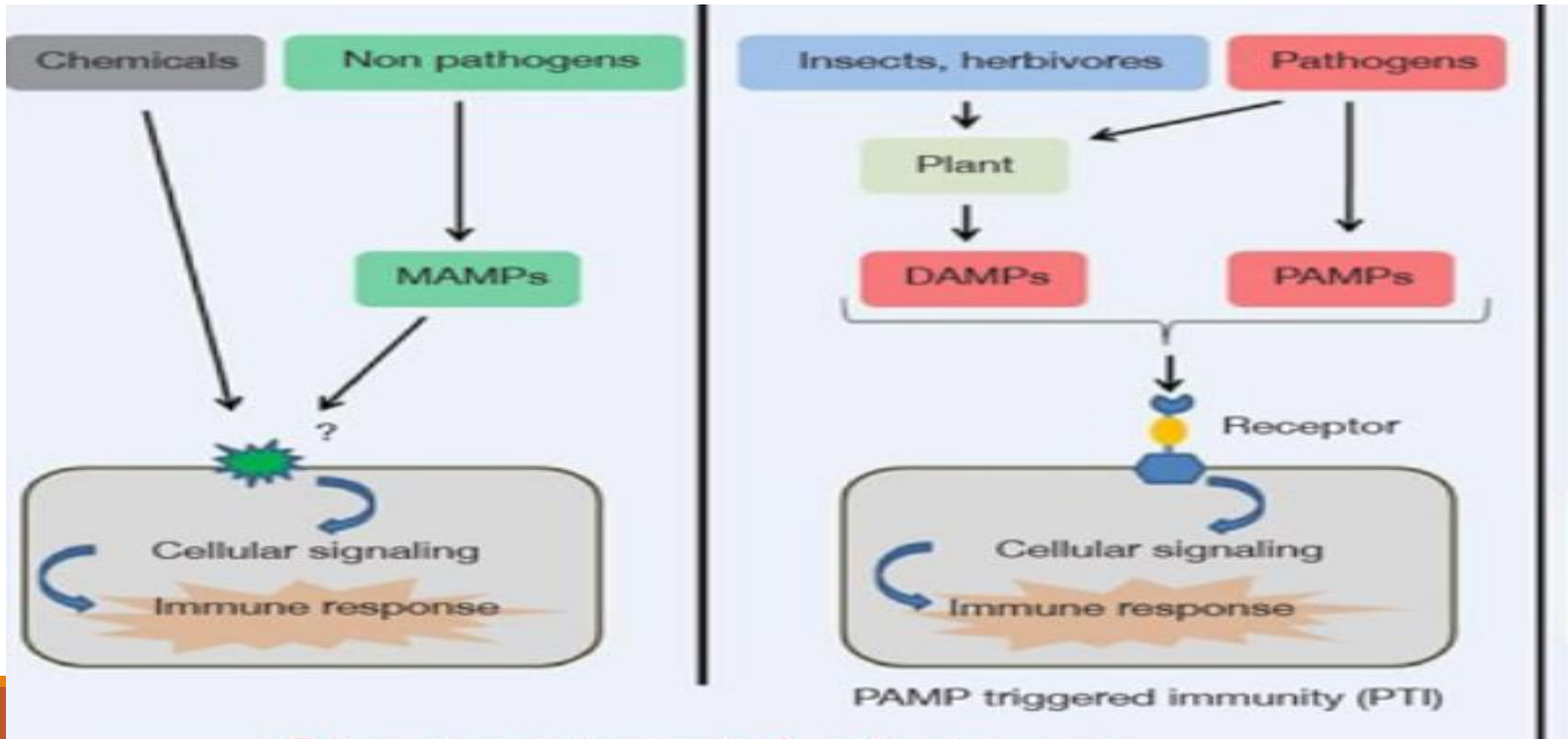
Microbes stimulate the alertness of the plant to its environment.

MAMPs – Microbe associated molecular patterns

DAMPs -- Damage associated molecular patterns

PAMPs -- Pathogen associated molecular patterns.

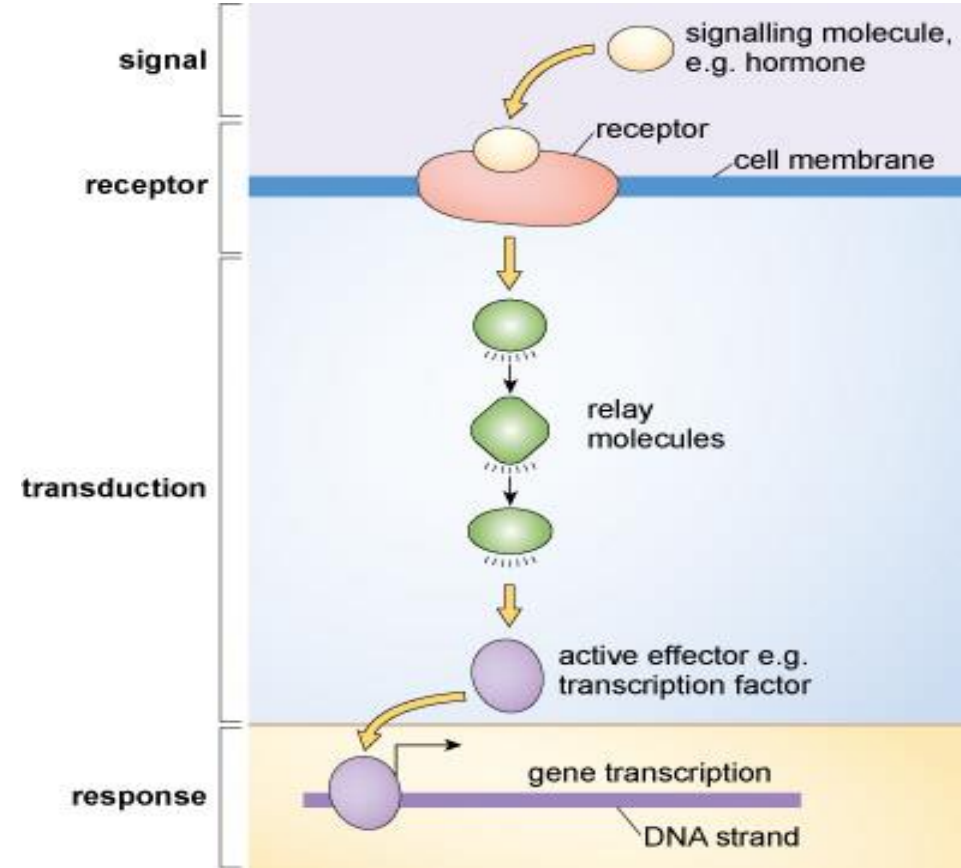
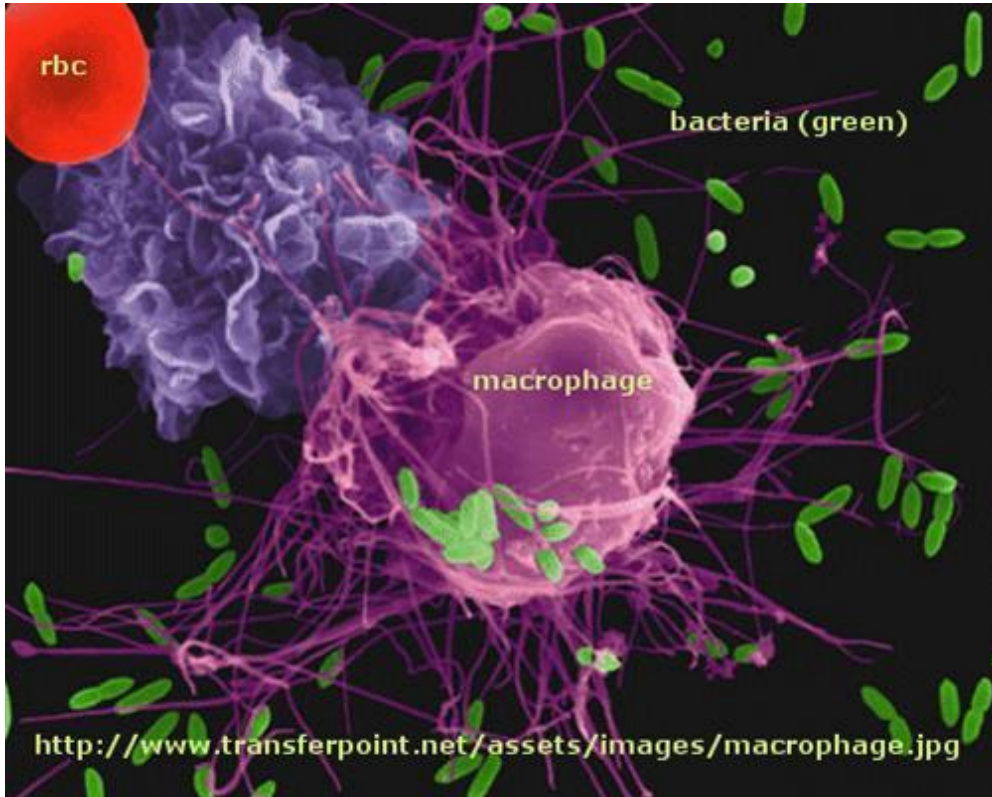
Induced system immunity primes the plant by increasing the number of receptors.



How this happens in humans (left) thru receptor

THE CELL MEMBRANE IS ACTUALLY A LARGE AREA.

HOW A MAMP INDUCES A RESPONSE.

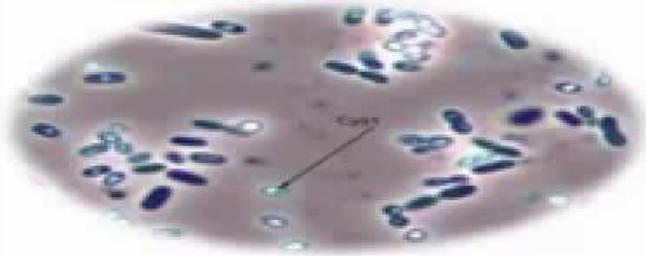


Plant Growth Promoting Microbes (PGPM) stimulate Induced Immunity in the plant. Includes creating a state of readiness to respond to both mechanical and pathogenic attack and the increase in Plant fitness provided by increasing MAMPS, PAMPS and DAMPS

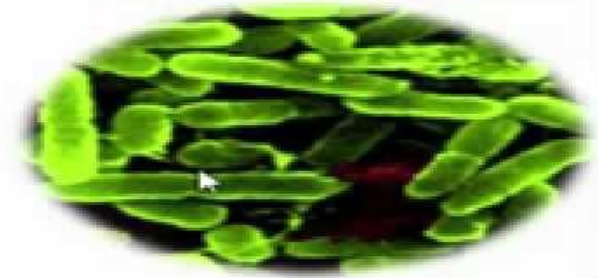
Innate Immunity -- Plant Growth Promoting

PGPR'S

Azospirillum



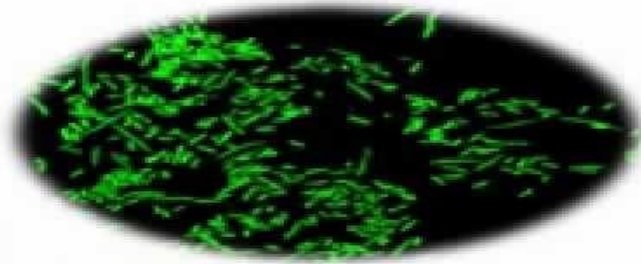
Pseudomonas



Rhizobium



Bacillus



Azotobacter



MECHANISM OF ACTION OF PGPR

DIRECT PLANT GROWTH PROMOTION

NITROGEN FIXATION

PHOSPHATE SOLUBILIZATION

PHYTOHORMONE PRODUCTION

SIDEROPHORE PRODUCTION

INDIRECT PLANT GROWTH PROMOTION

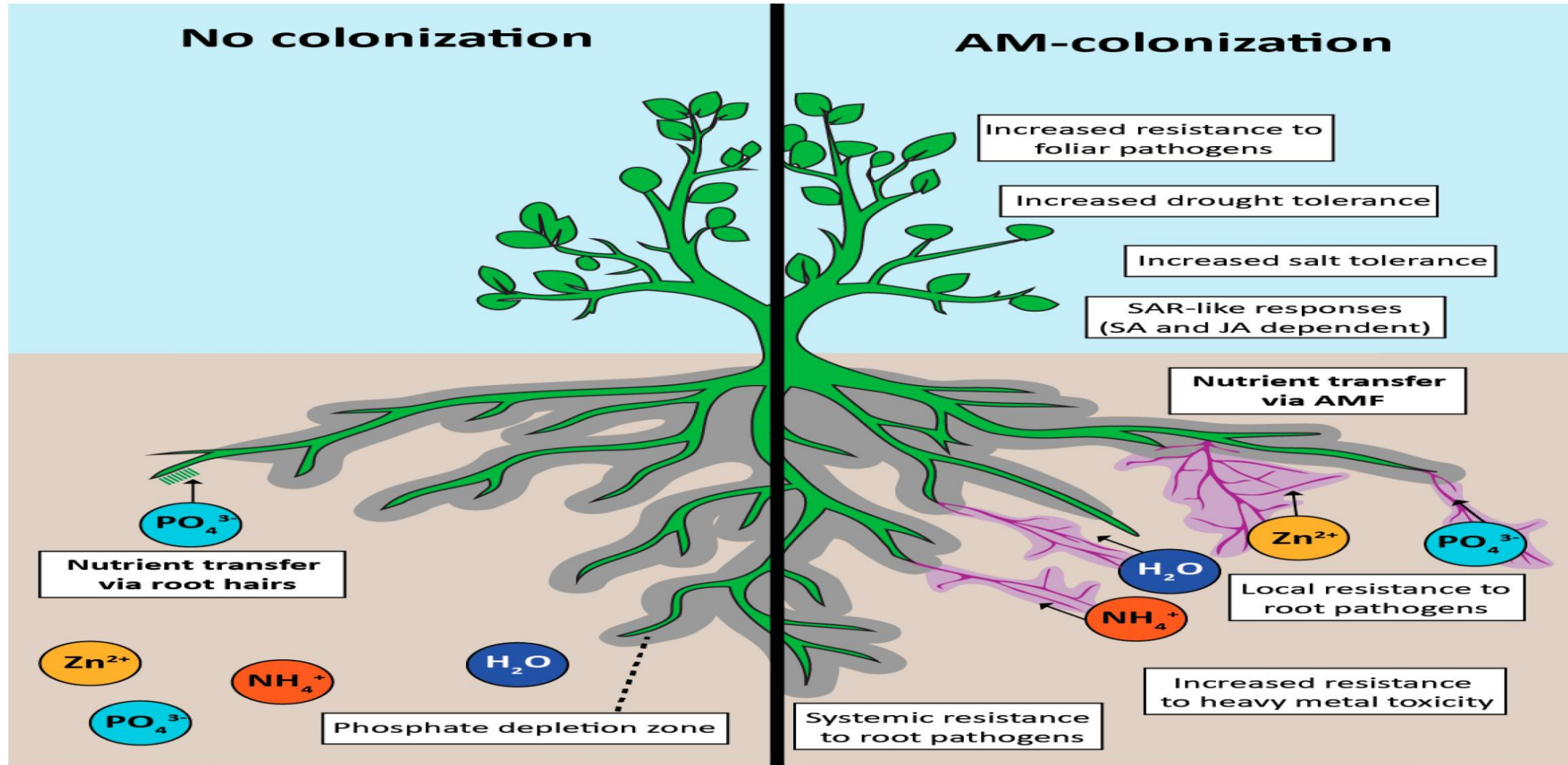
LYTIC ENZYMES

ANTIBIOTIC PRODUCTION

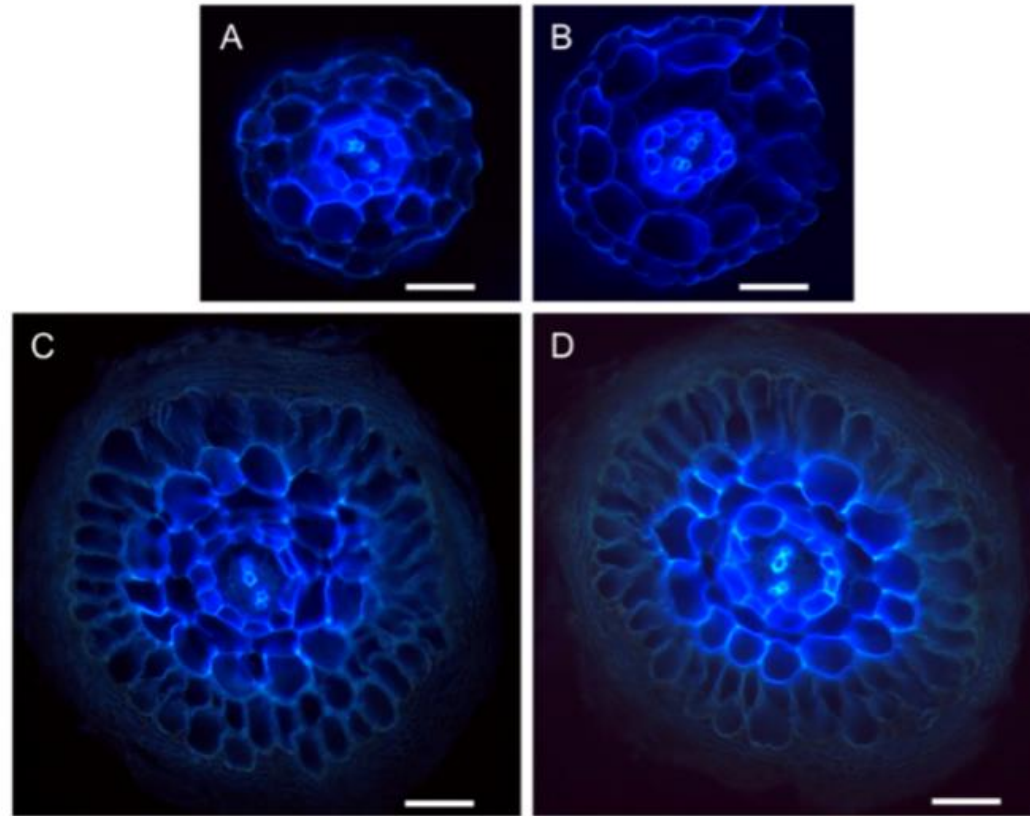
INDUCED SYSTEMIC RESISTANCE

EXO POLYSACCHARIDES PRODUCTION

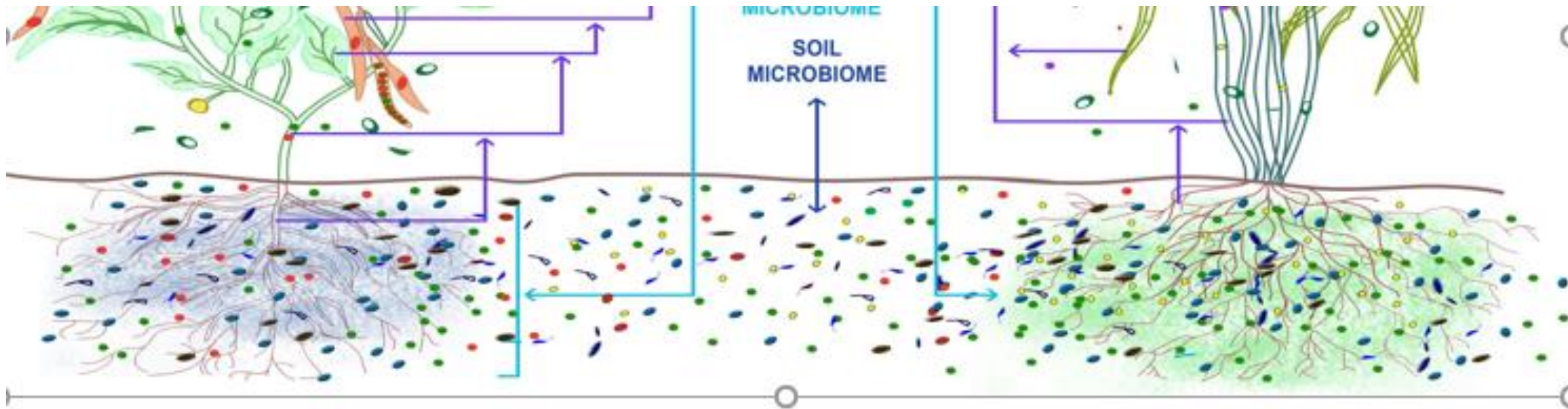
Mycorrhizal fungi (AM & EM) colonize ~90% of plants



Ectomycorrhizal fungi (EM) make plants more resistant to stress. This photo shows root tips under salt stress: C & D that have EM and A & B that do not. High sugar in C & D increase osmotic pressure allowing water influx. Luo et al 2009

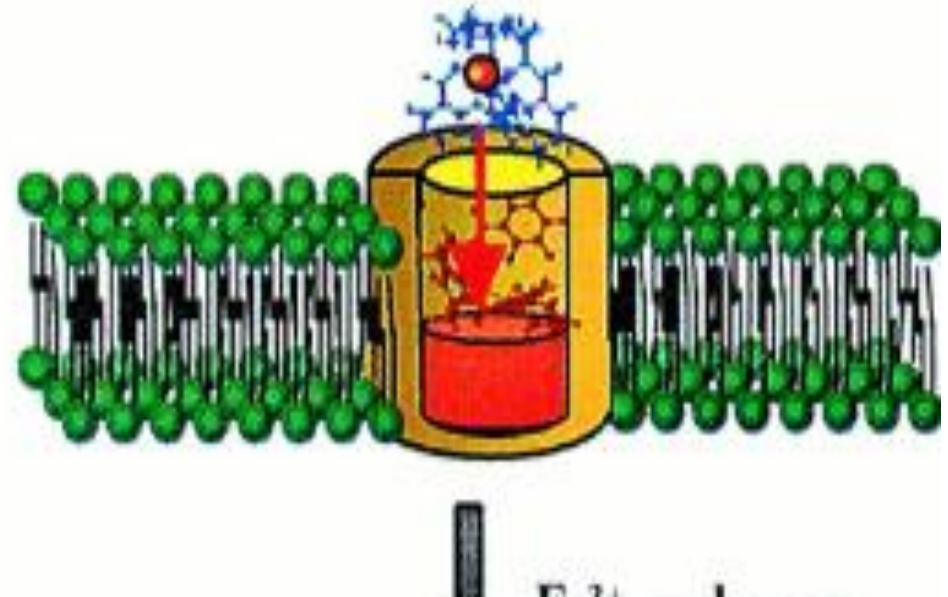


The mycorrhizal fungi and PGPB are recruited to the rhizosphere by the Plant.



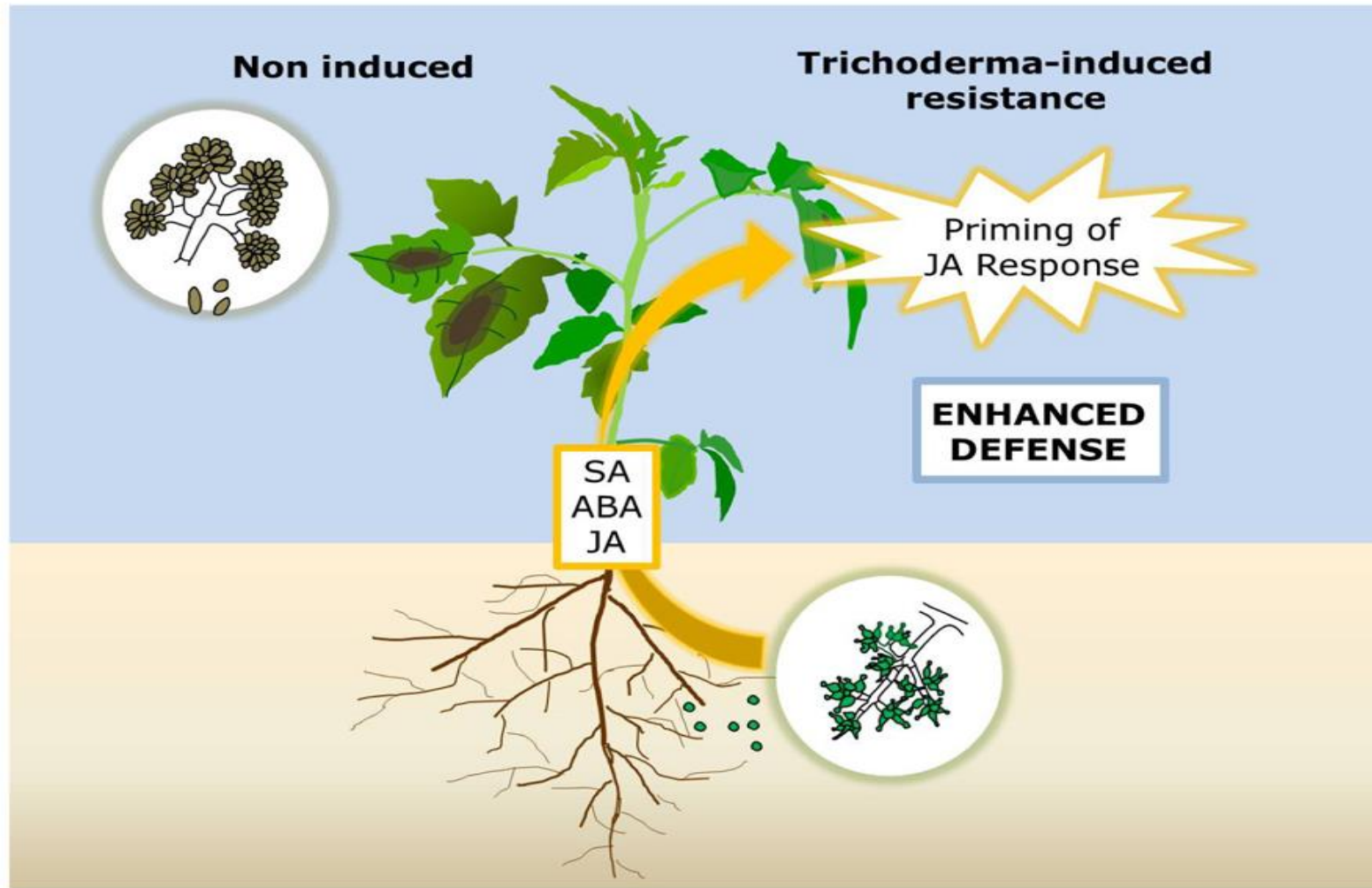
Some PGPM are nutrient providing.
A good immune system depends of a healthy plant.

Siderophores
capture metals
like iron, bind it
and the SM
complex is taken
up by the plant.



Induced Systemic Resistance by PGPF

FIGURES. Model for *Trichoderma*-induced resistance (TISR) against *Botrytis cinerea* in tomato. Root colonization with *Trichoderma* primes leaf tissues for enhanced activation of JA-regulated defense responses leading to a higher resistance to the necrotroph. Intact JA, SA, and ABA signaling pathways are required for TISR development. Front. Plant Sci., Martinez-Medina et al 24 June 2013 3 <https://doi.org/10.3389/fpls.2013.00206>



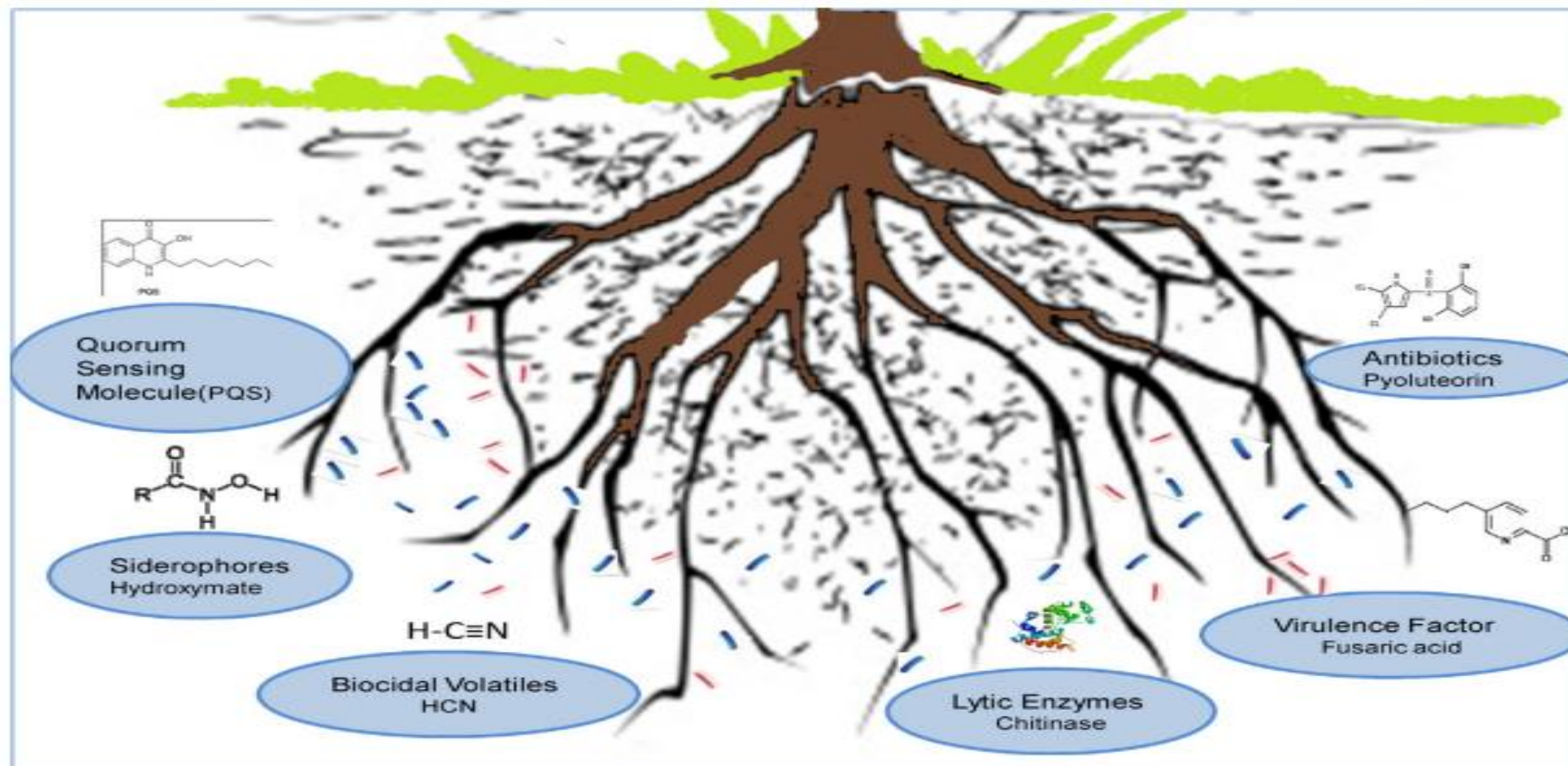
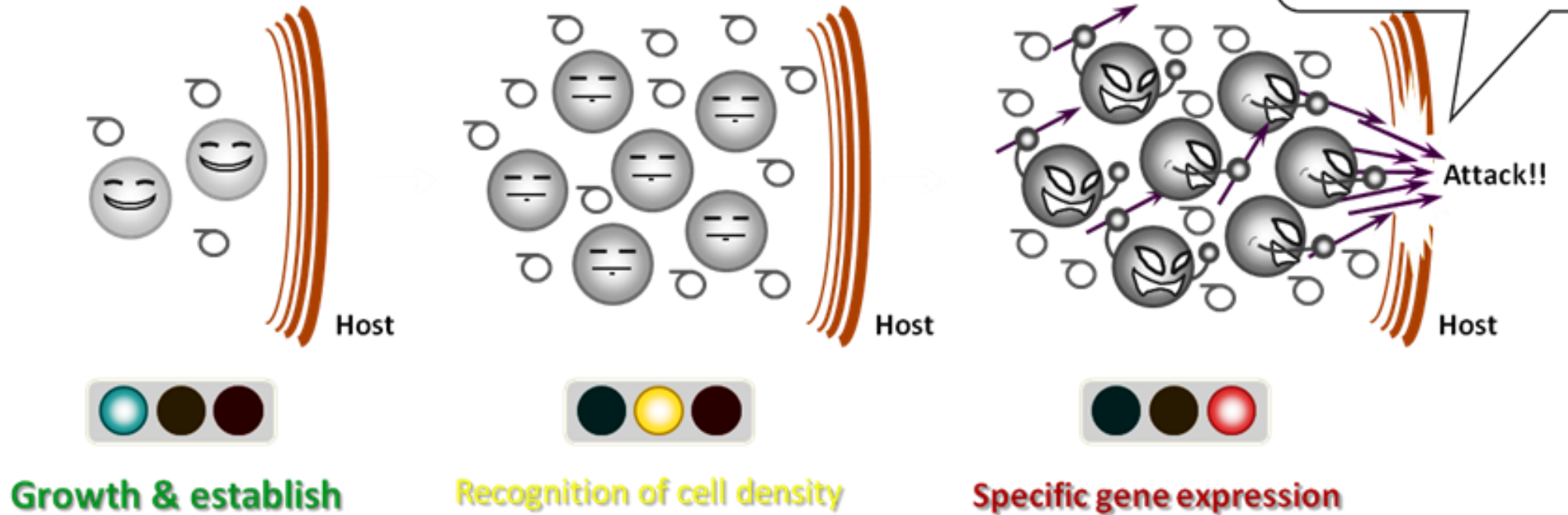


Fig. 1. Basic mechanisms of allelochemicals from rhizobacteria.

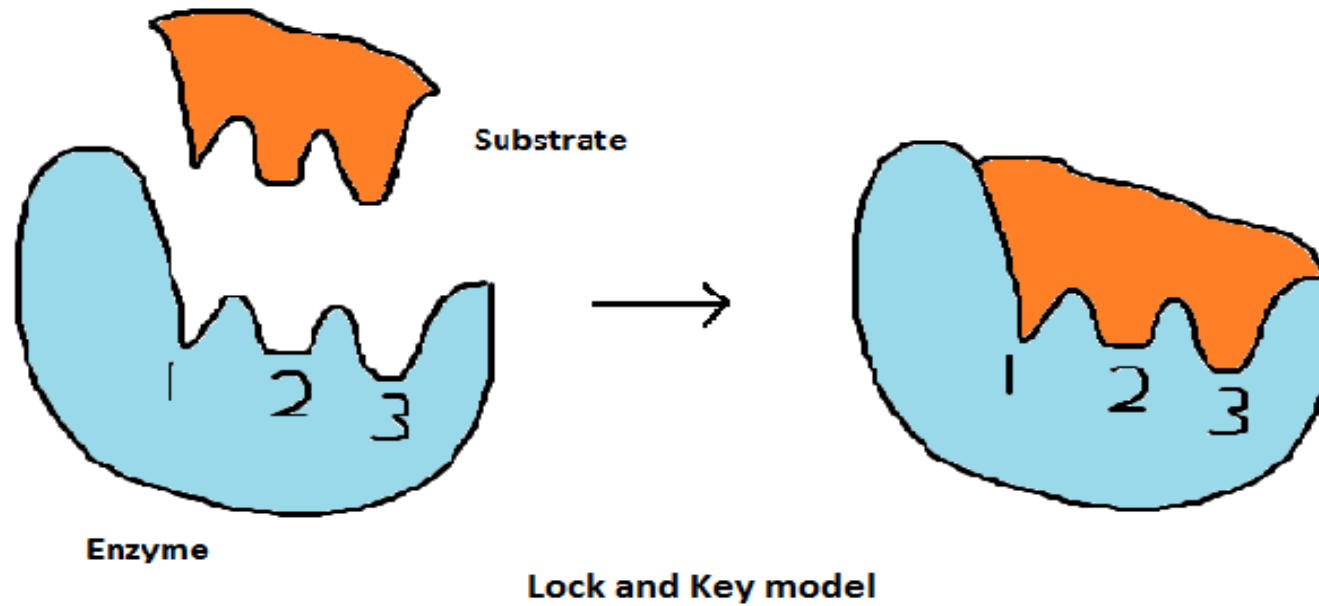
Quorum Sensing controls virulence.

⊖ : pheromones ↗ : pathogenic factors

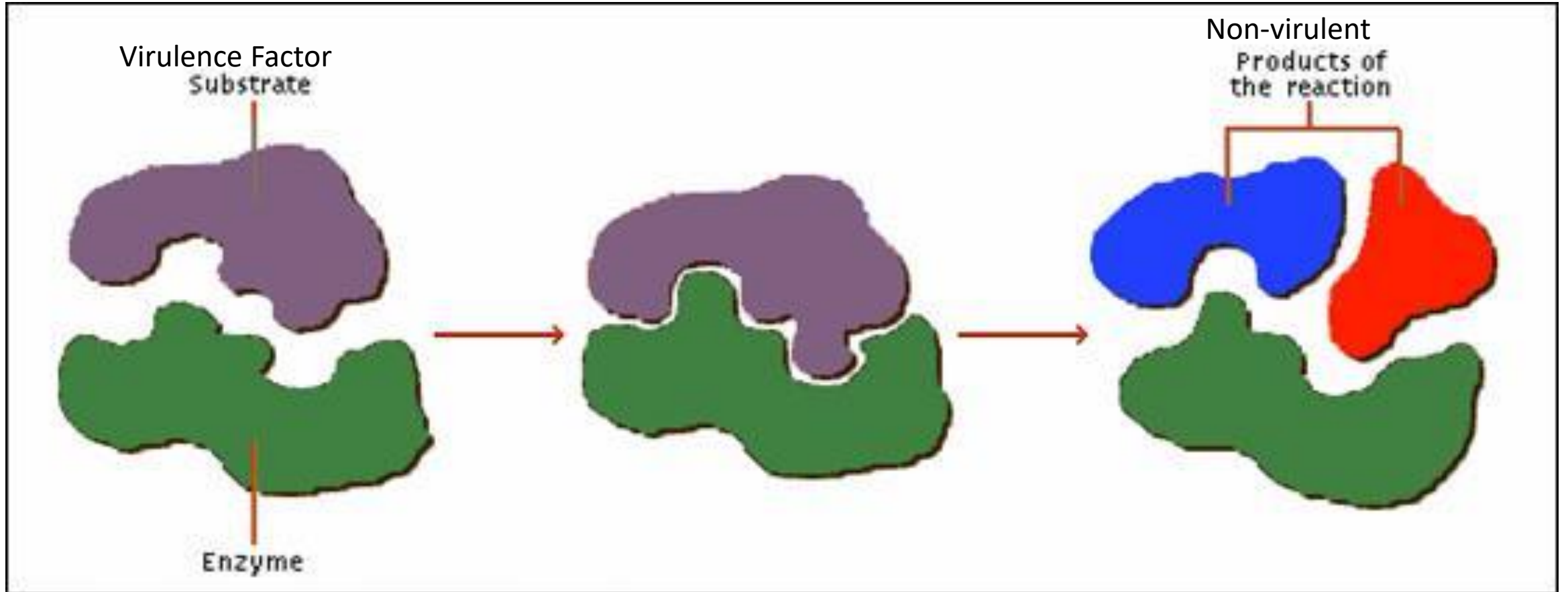


Cell density dependent gene expression in quorum sensing
(e.g. virulence expression)

PGPR molecules (blue) Can Inactivate Pathogen Quorum Sensing (orange)



Inactivate Virulence Factors.



Lytic Enzymes like chitinase

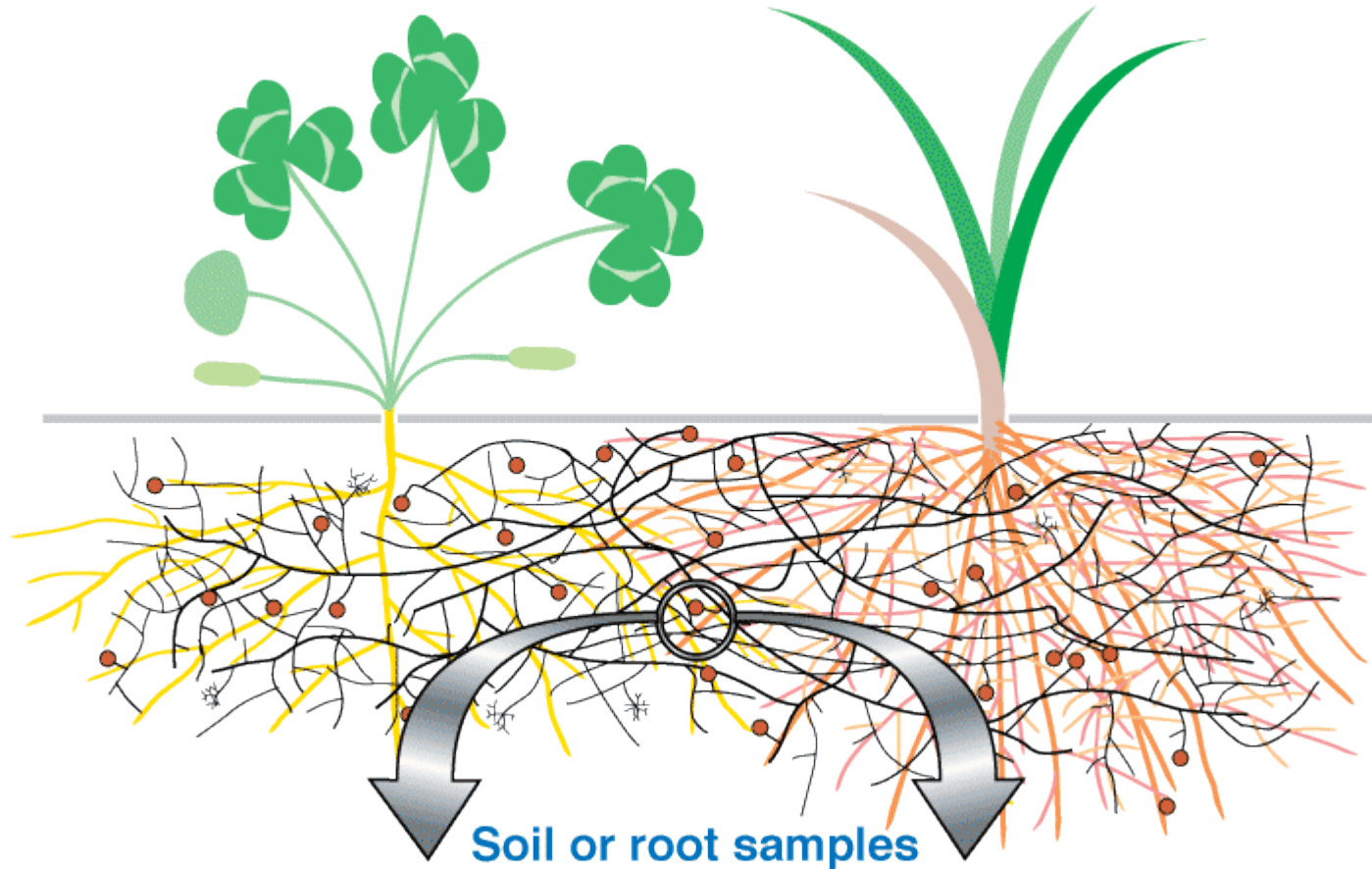
Break down chitin which is cell wall of fungi.



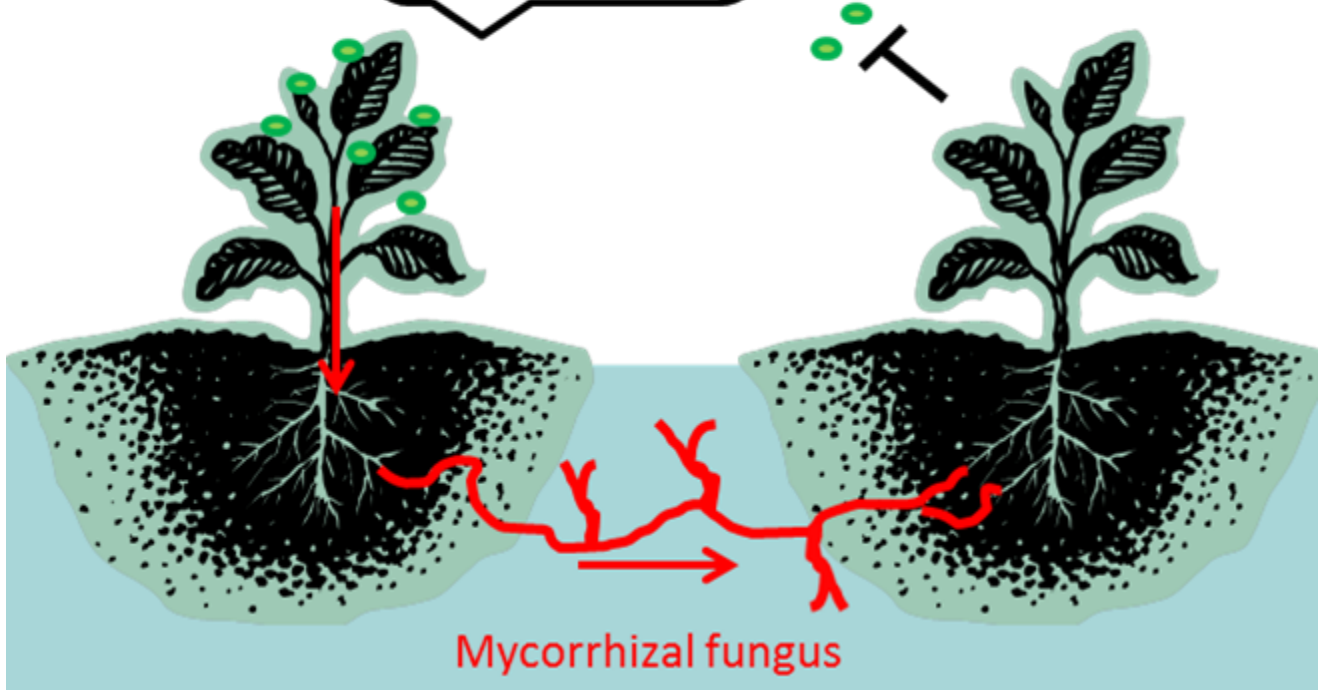
Antibiotics and Anti-fungals

Affect metabolism of organisms that are not resistant

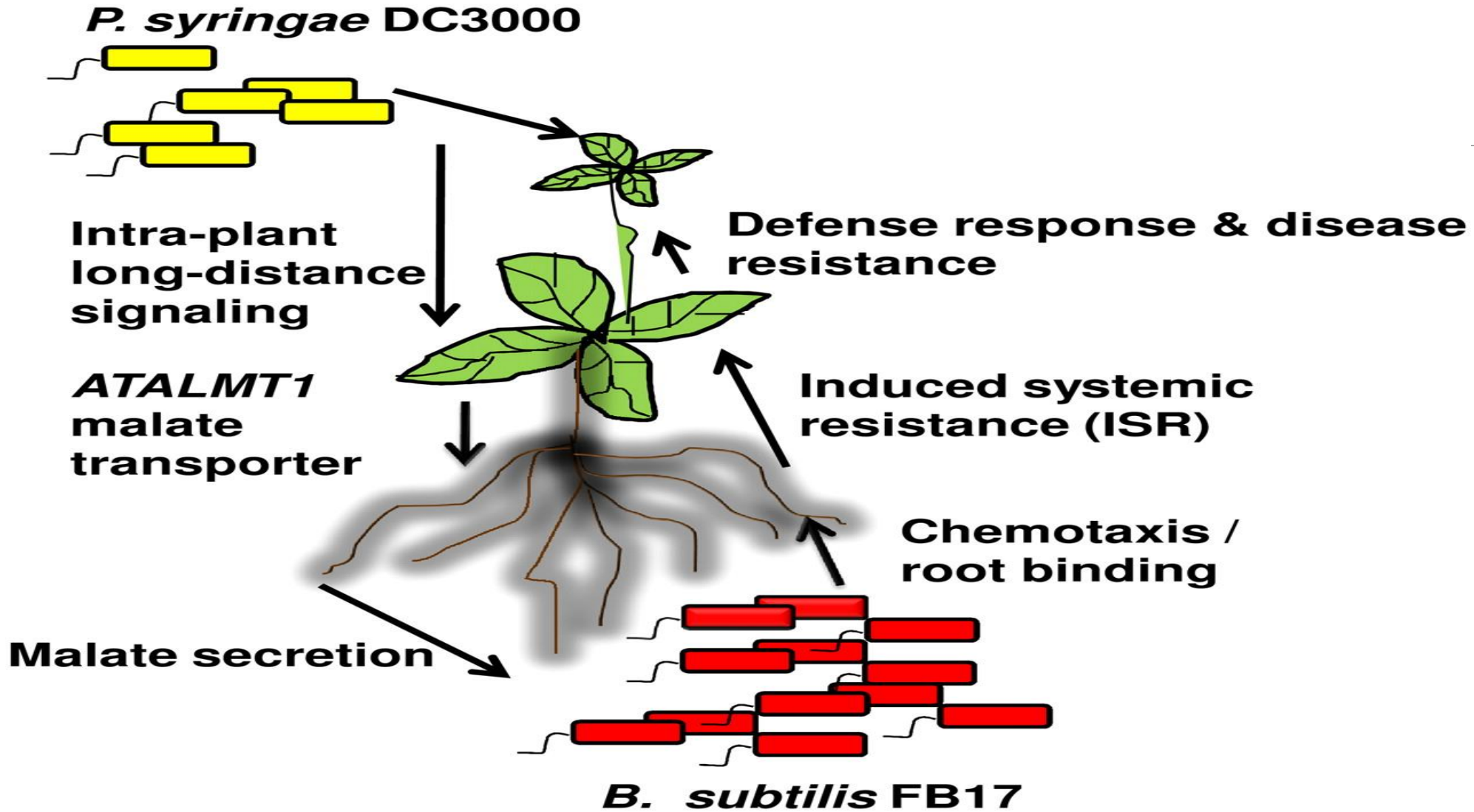
The microbial community is part of the plant community.
Plants that have been infected signal other plants and induce immunity through the fungal network.



Watch out
mate, aphids
are about!



Root-Secreted Malic Acid Recruits Beneficial Soil Bacteria
Thimmaraju Rudrappa, Kirk J. Czymmek, Paul W. Paré, Harsh P. Bais



The End.

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