


Plant colonising microorganisms:

the importance of educating and aligning regulatory gatekeepers

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BIOPESTICIDE STRATEGISTS

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Binary approach to plant protection

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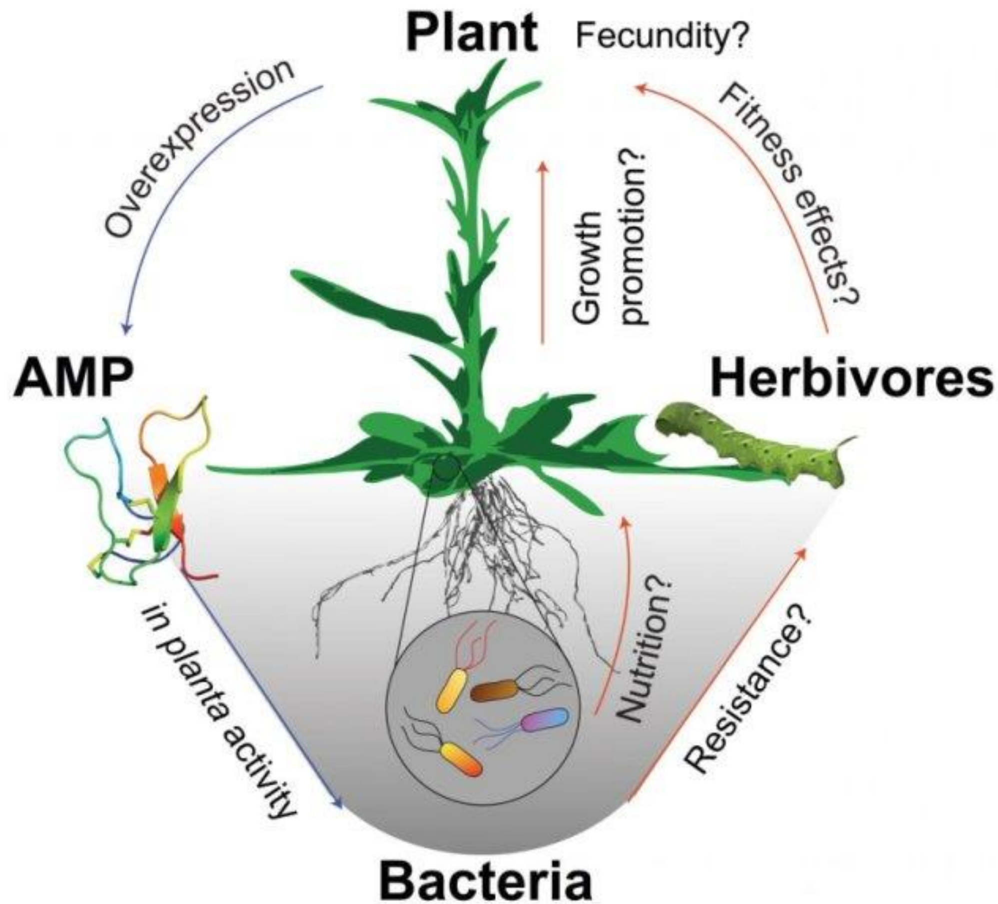
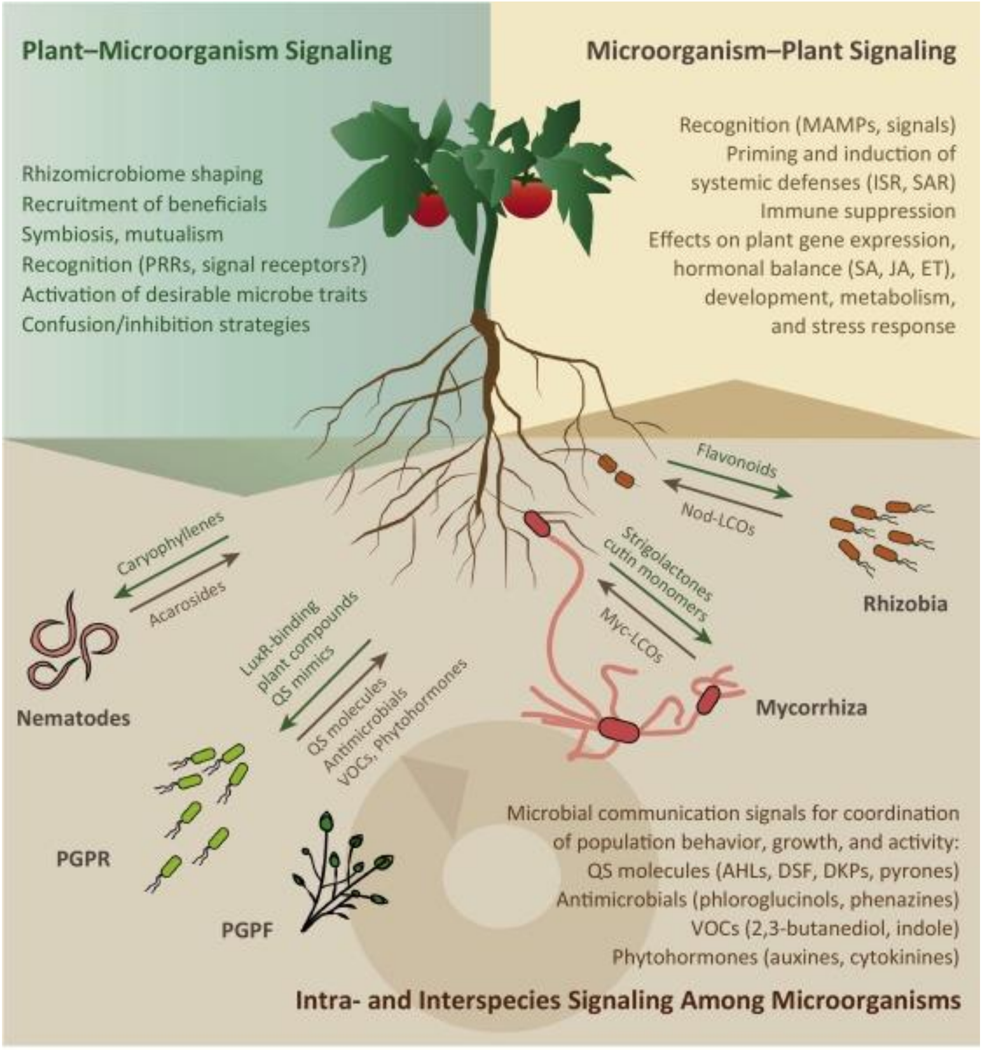
Plant microbiome – effects on plants



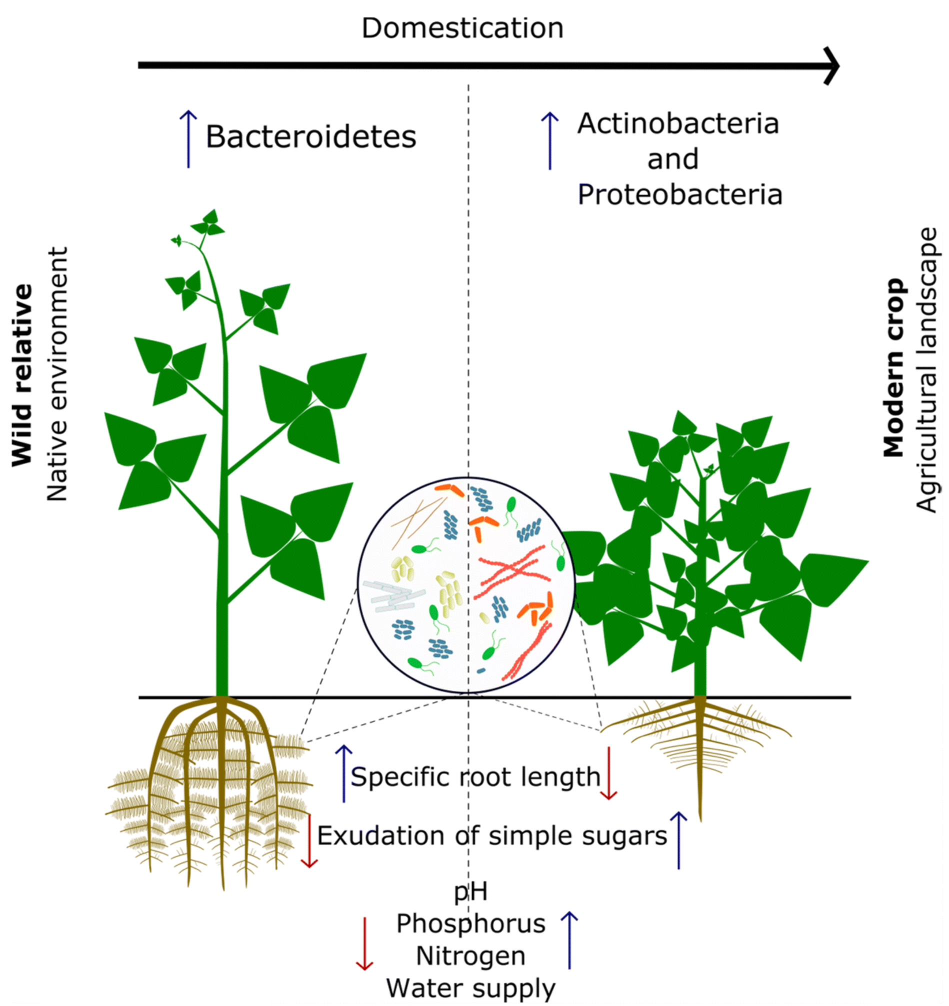
Source: Max Planck Institute for Chemical Ecology 2017

Plants – effects on microbiome

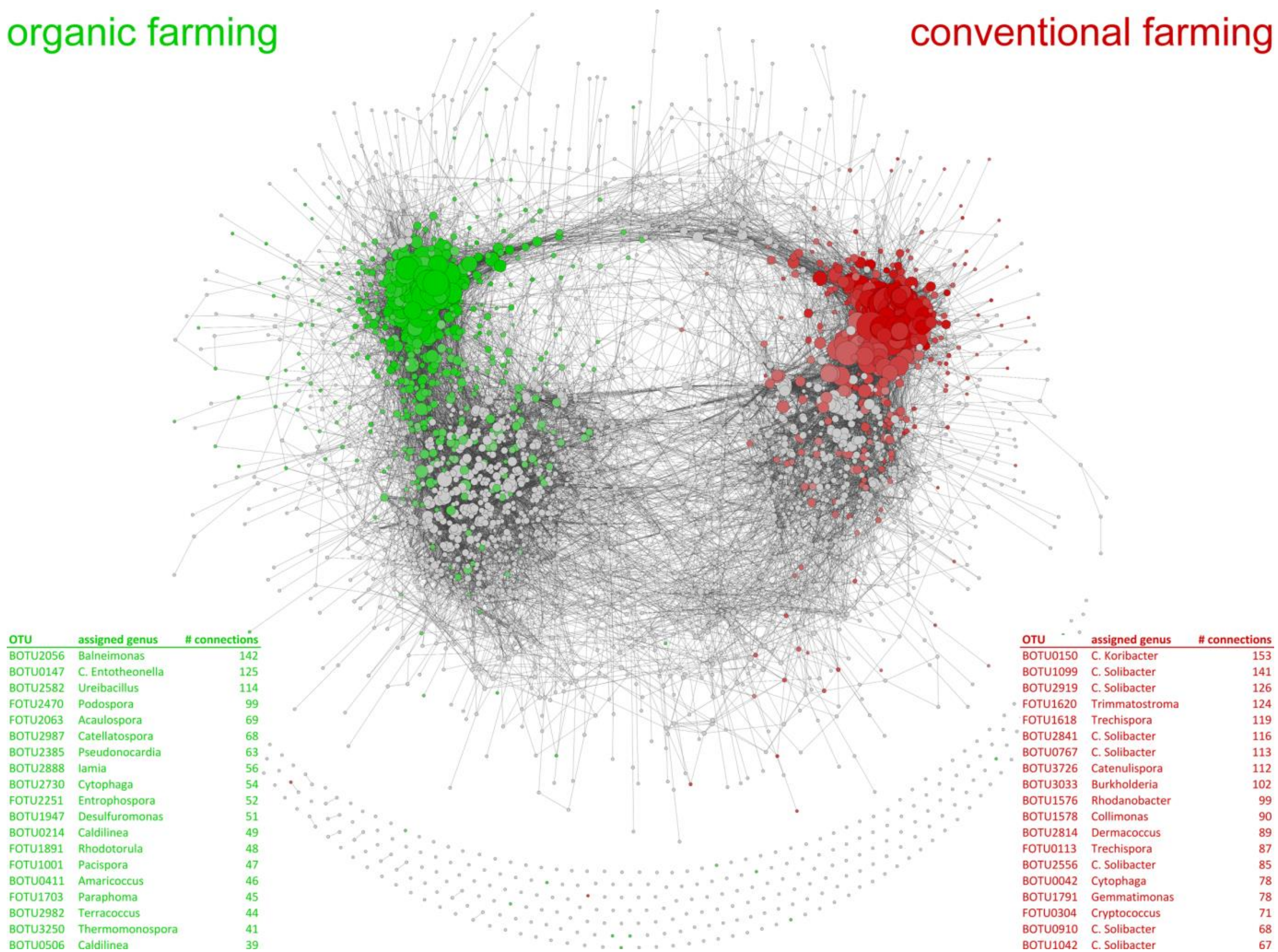


Trends in Plant Science

Plant breeding – effects on microbiome



Microbiome – effects of farming practice



OTU	assigned genus	# connections
BOTU2056	Balneimonas	142
BOTU0147	C. Entotheonella	125
BOTU2582	Ureibacillus	114
FOTU2470	Podospora	99
FOTU2063	Acaulospora	69
BOTU2987	Catellatospora	68
BOTU2385	Pseudonocardia	63
BOTU2888	Iamia	56
BOTU2730	Cytophaga	54
FOTU2251	Entrophospora	52
BOTU1947	Desulfuromonas	51
BOTU0214	Caldilinea	49
FOTU1891	Rhodotorula	48
FOTU1001	Pacispora	47
BOTU0411	Amaricoccus	46
FOTU1703	Paraphoma	45
BOTU2982	Terracoccus	44
BOTU3250	Thermomonospora	41
BOTU0506	Caldilinea	39

OTU	assigned genus	# connections
BOTU0150	C. Koribacter	153
BOTU1099	C. Solibacter	141
BOTU2919	C. Solibacter	126
FOTU1620	Trimmatostroma	124
FOTU1618	Trechispora	119
BOTU2841	C. Solibacter	116
BOTU0767	C. Solibacter	113
BOTU3726	Catenulispora	112
BOTU3033	Burkholderia	102
BOTU1576	Rhodanobacter	99
BOTU1578	Collimonas	90
BOTU2814	Dermacoccus	89
FOTU0113	Trechispora	87
BOTU2556	C. Solibacter	85
BOTU0042	Cytophaga	78
BOTU1791	Gemmatimonas	78
FOTU0304	Cryptococcus	71
BOTU0910	C. Solibacter	68
BOTU1042	C. Solibacter	67

Source: Marcel G. A. van der Heijden & Martin Hartmann, 2016 Networking in the Plant Microbiome. PLOS Biology | DOI:10.1371/journal.pbio.1002378

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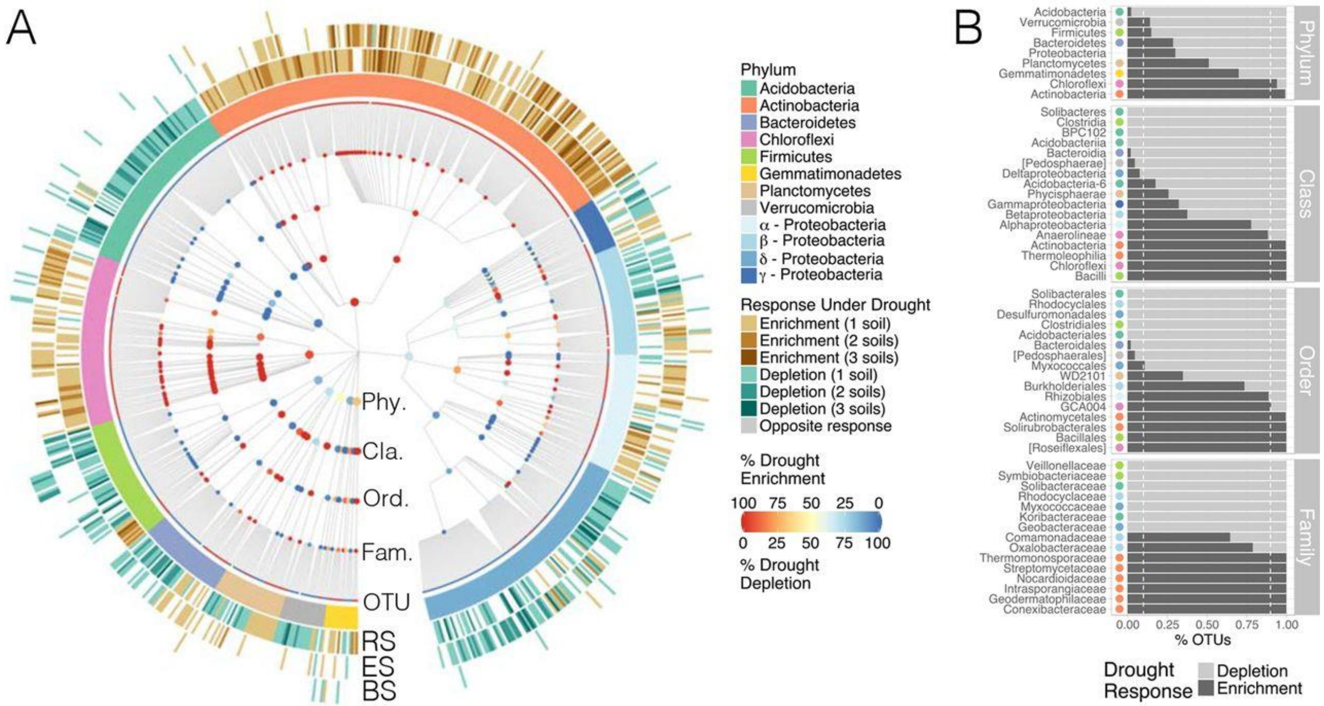
Microbiome – environment e.g. drought response



Drought response is generally coherent within higher taxa.
A. Taxonomy dendrogram displaying the drought-responsive OTUs ($P < 0.05$) detected across all compartments and soil types. The three outermost rings indicate the number of soil types in which the relative abundance of an OTU was significantly higher (brown) or lower (green) under drought in the rhizosphere (RS), endosphere (ES), and bulk soil (BS) communities.
B. Percentage of OTUs within individual taxa that were enriched or depleted under drought stress. Only taxa with more than 15 OTUs are shown. The coloured point to the left of each bar indicates the phylum or *Proteobacteria* class to which the taxon belongs.

Source: Christian Santos-Medellín et al. mBio 2017; doi:10.1128/mBio.00764-17

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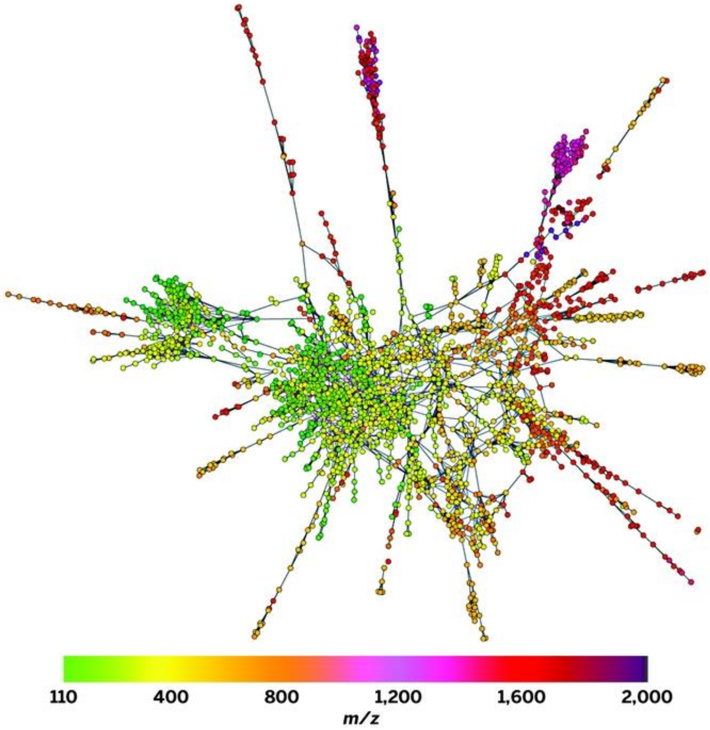
Plant microbiome



CHEMICAL CONSTELLATIONS
A spectral network shows the chemical universe of compounds produced by 59 bacteria. Each node represents an individual compound (coloured according to mass); branched clusters show compounds with structural similarity based on nanoDESI MS. (Credit: Don Nguyen)

- Plant microbiome studies driving the discovery of new compounds for agriculture or medicine.
- e.g. > 2,000 species of microbials and >100,000 strains on maize roots, each strain produces about 2,000 proteins.
- Studies now of host communities.

- Although the genomic tools available are powerful, the challenge is **complexity**.

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Plant colonising microorganisms - summary

Endophytes are common – no plant is microbial free

Secondary compounds will be produced

Endophyte will affect plant physiology

Persistence

Interactions operate at multiple levels

Inevitably studies of interactions are complex to perform

Difficult to attribute effects

Complexity/diversity = stability

Ecosystem services

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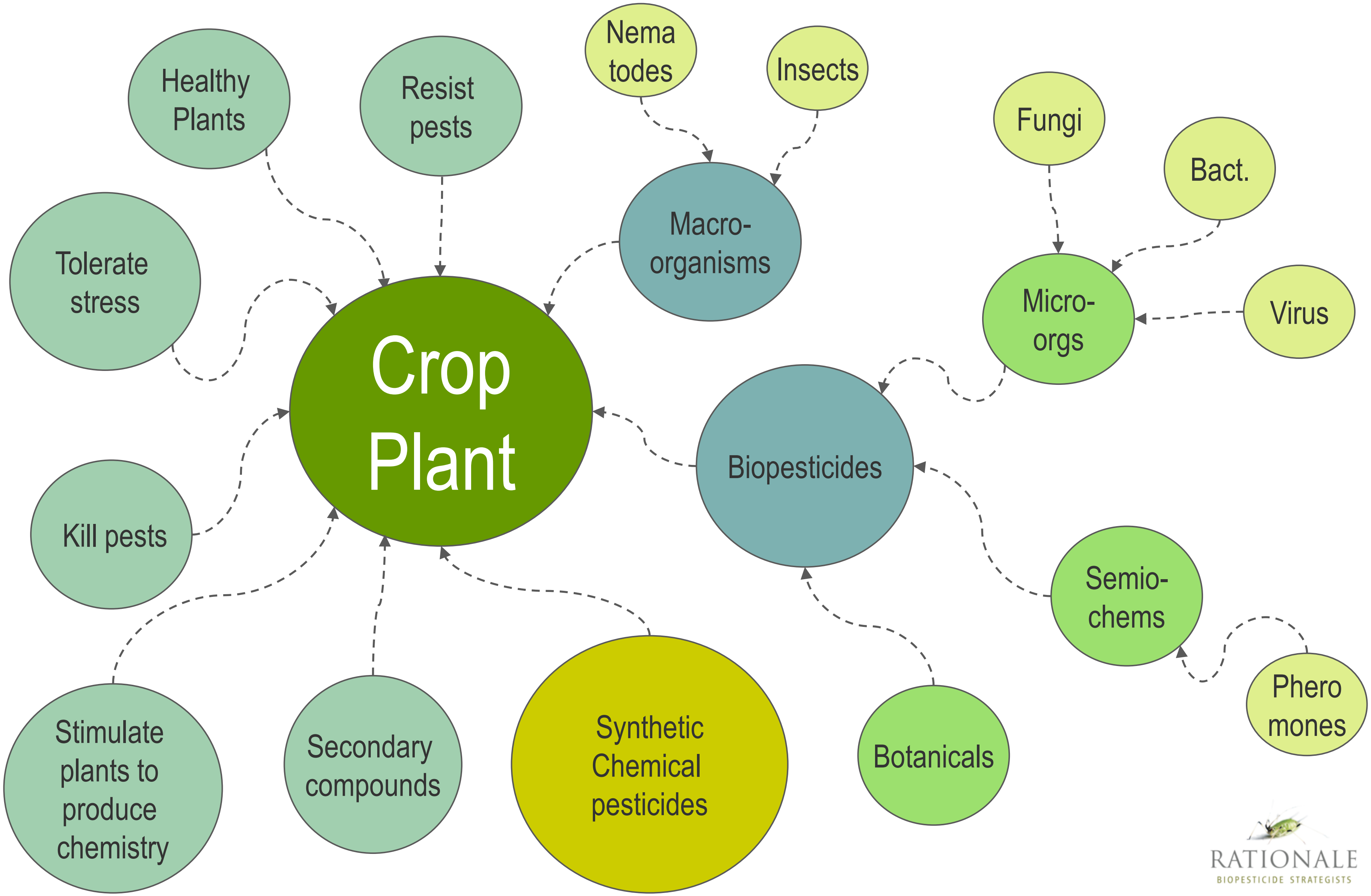
Plant colonising microorganisms – multi interactions



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Commercialisation

What is the product?

What are product benefits ?

How to regulate?

How to educate end users?

Who are the gatekeepers?

Research organisations
Product development experts
Innovation developers
Commercialisation companies
Investors
Contract testing organisations
Trialists
Distributors
Growers/farmers

Regulators

- Plant health – import/export authorities
- Plant protection product regulators
- Government/parliaments/politicians

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Plant colonising microorganisms - knowledge

soil ecology, plant ecology, landscape ecology, biology, microbiology, genetics, microbial ecology, population biology, plant physiology, population modelling, landscape modelling, population ecology, etc………………….

and maybe, sometimes, even chemistry

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Ways forward for regulating bioprotectants?

- Complex – but do we need to know all – does this tell us it is robust
- Ecosystem service by increasing complexity counteracting other farming practices
- Moving way too slow – microbial about 50 years still not got appropriate regulation – plant microbiome, complexity of species – not even started
- First we need to ask the right questions then get good answers then we know most likely areas of risk
- Plant have complex microbiomes: more complexity = stability
- Adding microbials – altering the diversity for a short period – tipping the balance in favour of the crop not the pathogen or insect

Do we need to know everything?

What is critical to know?

Education – all stakeholders

Partnership between all gatekeepers

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Streamlining – by global harmonisation

Is one country truly ‘safer’ or less risky than another?

Is the agronomy so different between countries?

Sharing knowledge and skills: align date requirements and decisions

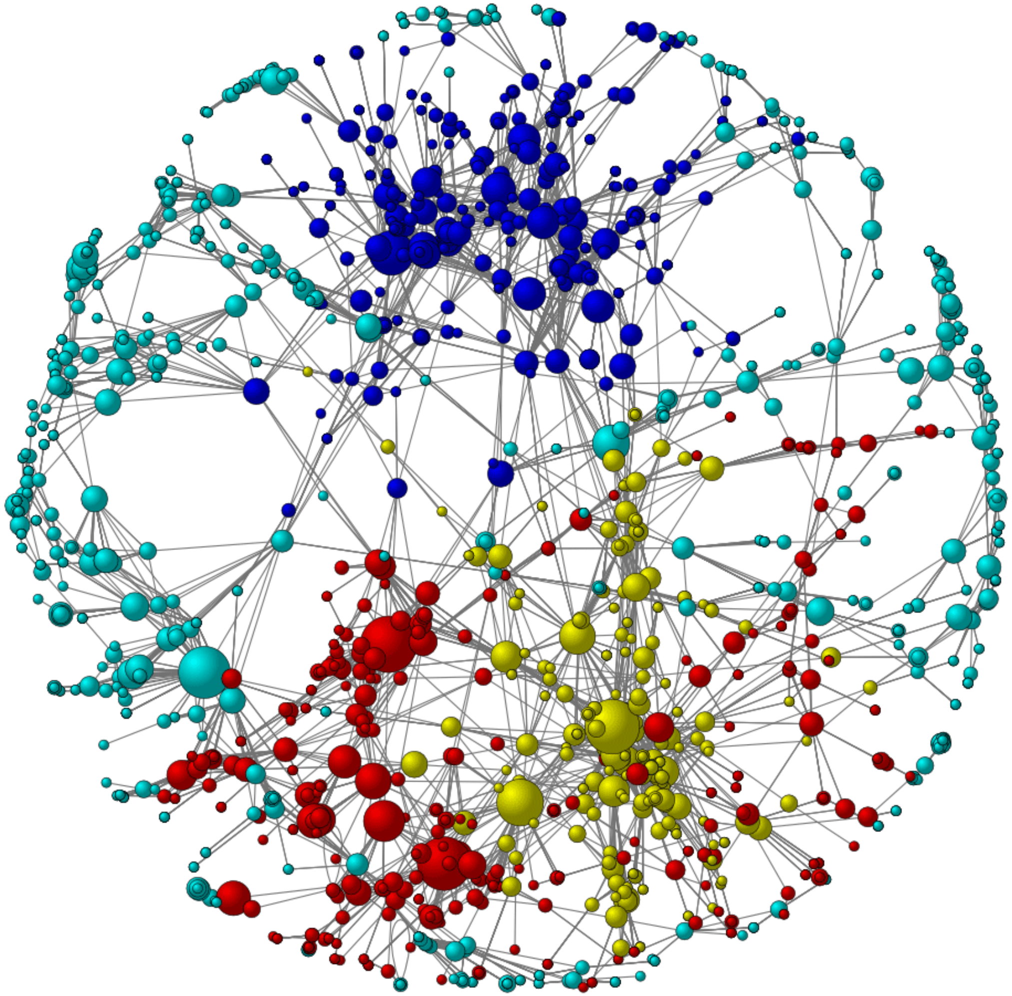
Reciprocity of evaluations

Trust

Network of expertise

Collaboration

Gatekeepers – knowledge network



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Thank you for your attention

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