Embracing the Complexity of the Phytobiome: Minding the Microbes

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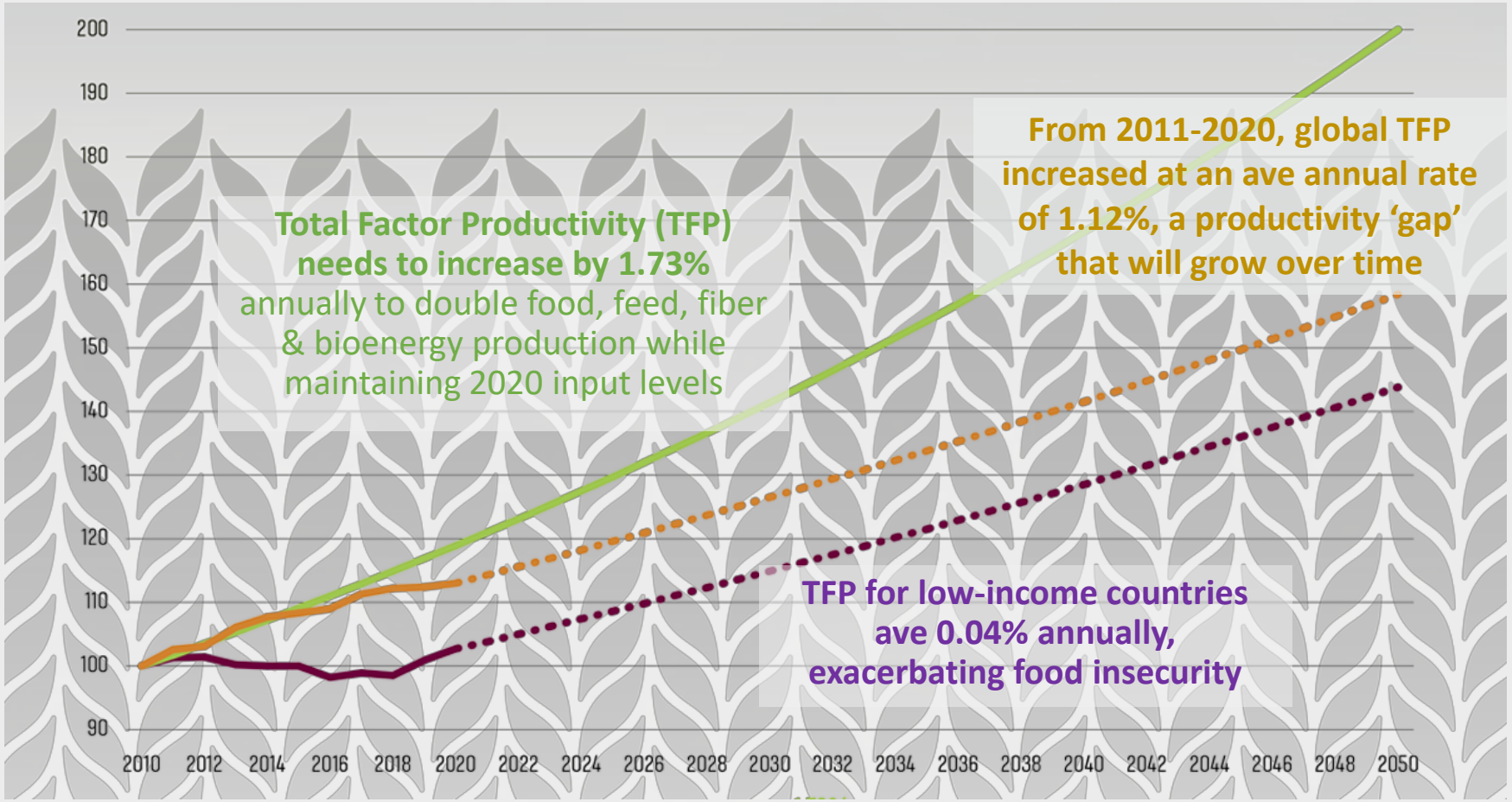
Colorado State University

Beyond the National Plant Genome Initiative:
New Frontiers and Grand Challenges in Plant Genomics
19 January 2023
PAG 30

Troublesome Trends

2022 Global Agricultural Productivity Index



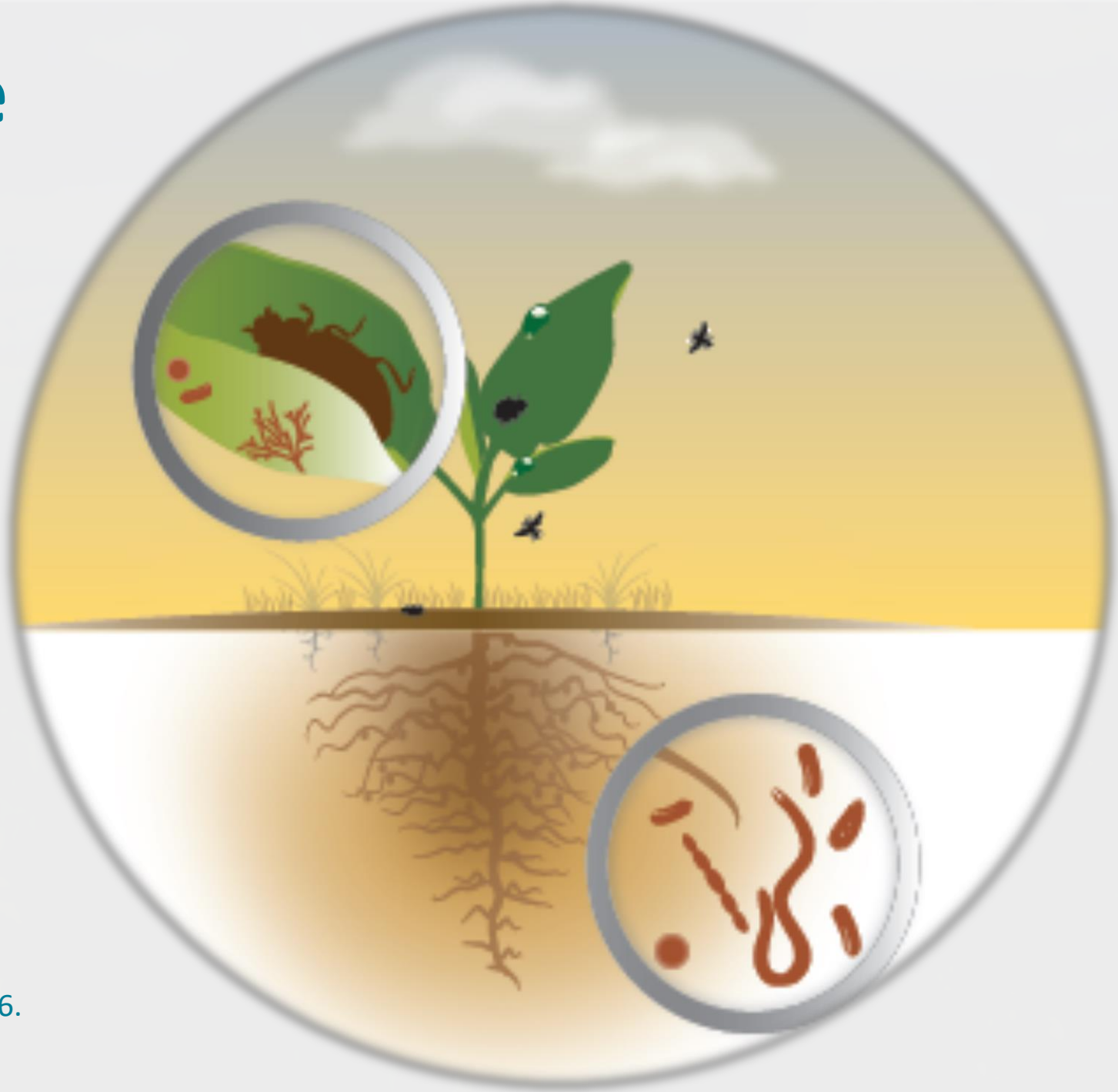
TOTAL FACTOR PRODUCTIVITY

www.globalagriculturalproductivity.org

Phytobiomes Science as part of the solution

Phytobiome:

- Interactions of the environment and living organisms that influence or are influenced by plants



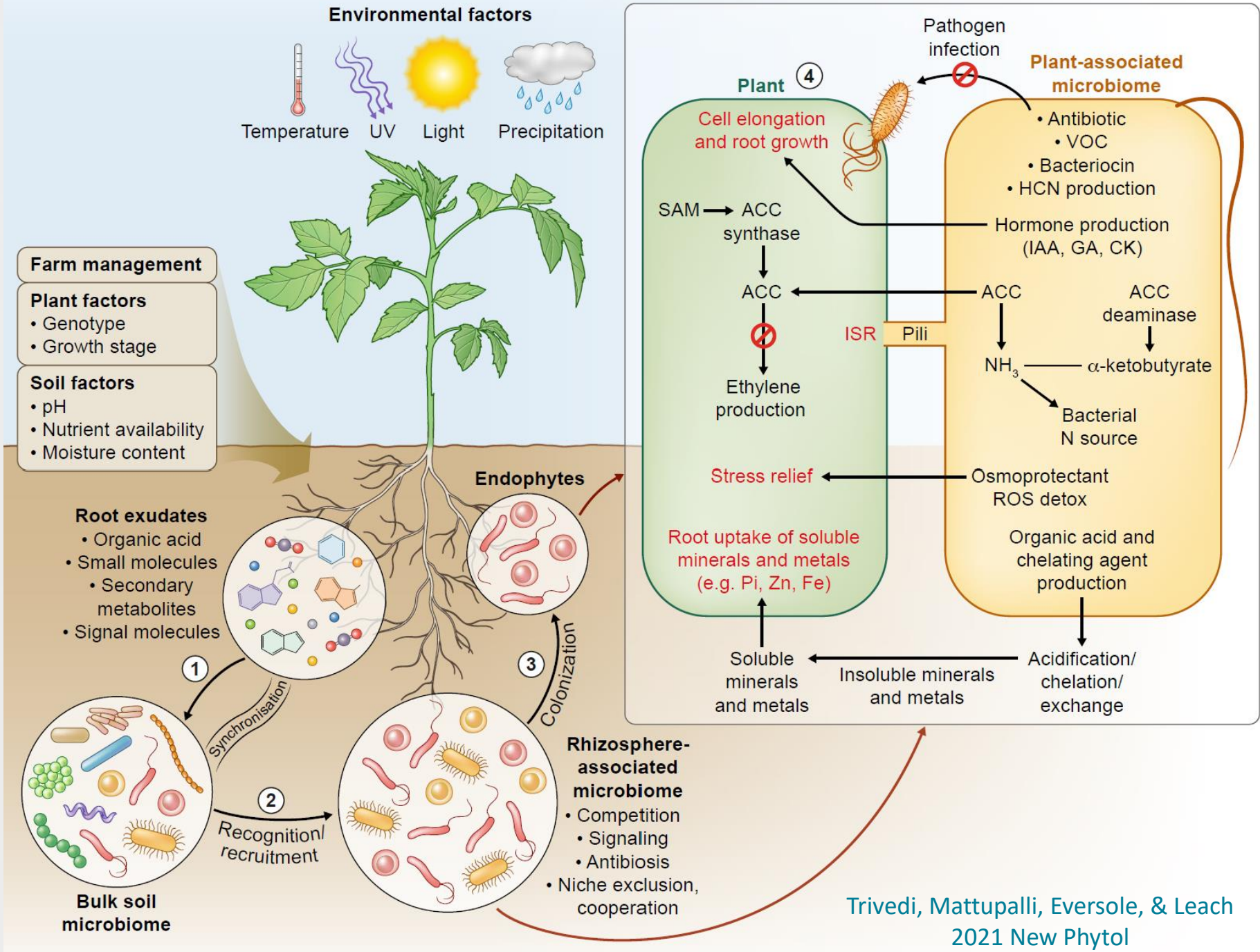
Phytobiomes: A Roadmap for Research and translation, 2016. St. Paul, MN: American Phytopathological Society, pp. 15

Holy Grail of Phytobiomes Science

To understand, predict, and control emergent phenotypes within specific phytobiomes for the sustainable production of food, feed, and fiber.

Interactions within the phytobiome are:

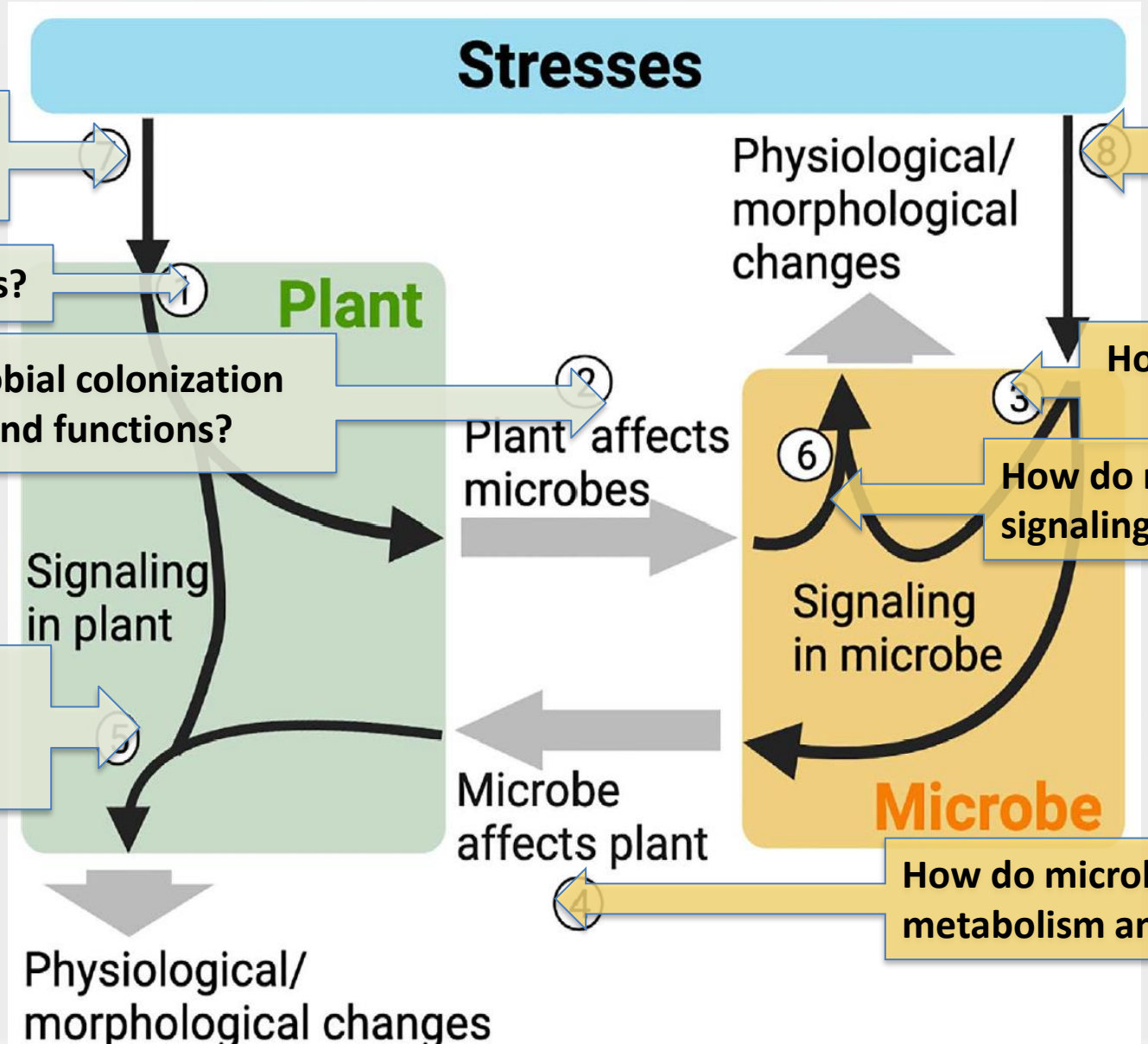
- interconnected
- dynamic
- <u>complex</u>



Trivedi et al 2021 New Phytol;
Omae & Tsuda 2022 MPMI;
Leach et al 2017 Cell

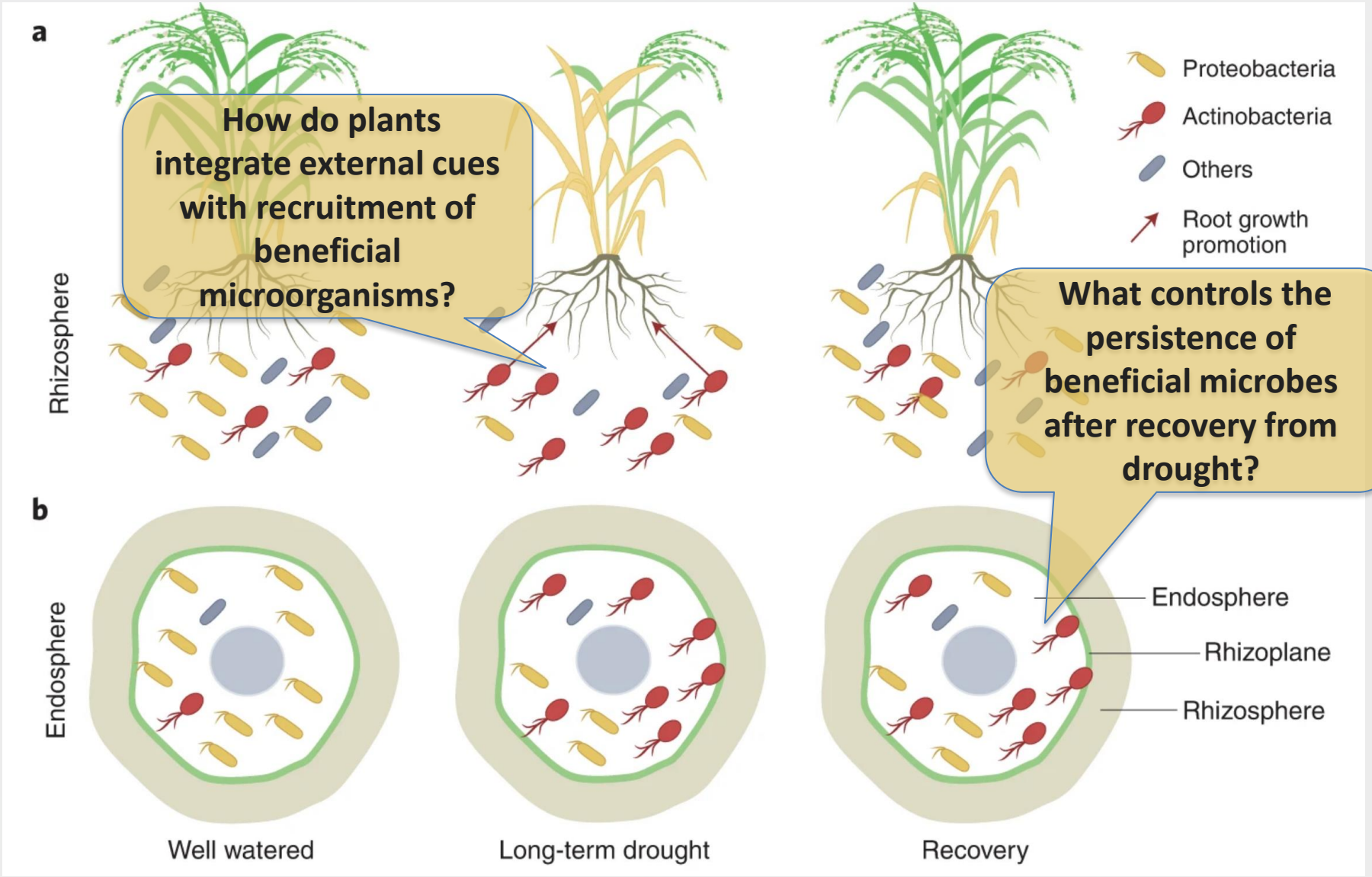
Trivedi, Mattupalli, Eversole, & Leach 2021 New Phytol

To exploit, we need a mechanistic understanding:



Adapted from Omae and Tsuda, MPMI 2022

Plants '*cry for help*' in response to stresses



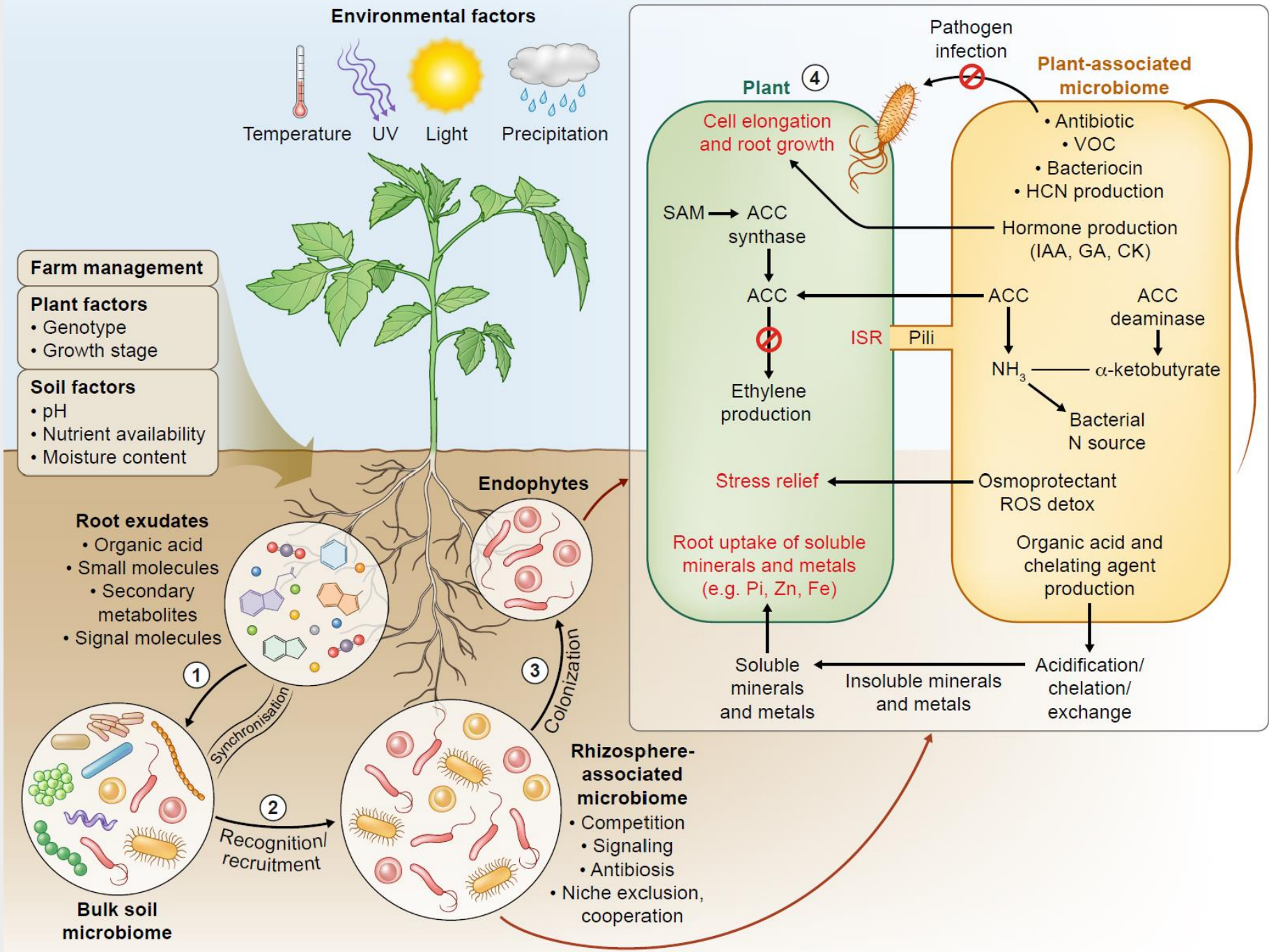
How can we exploit this to improve crop tolerance to stress?

"active recruitment of beneficial microorganisms might be a common evolutionary strategy to enhance plant fitness."

Song & Haney 2021 Nat Plants; Santos-Medellin et al 2021 Nat Plants

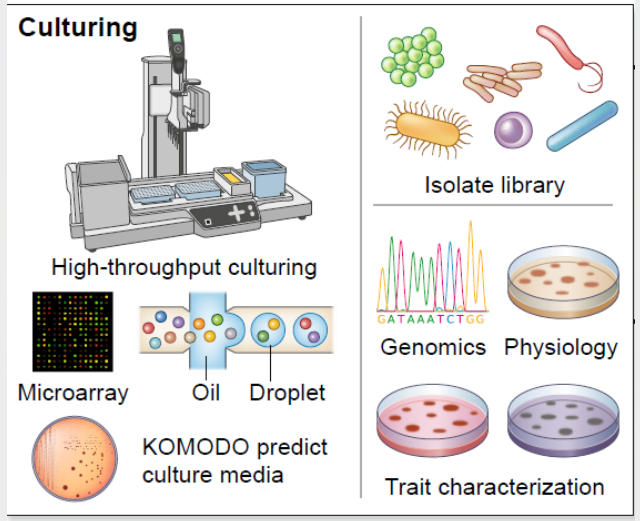
Embrace the complexity!

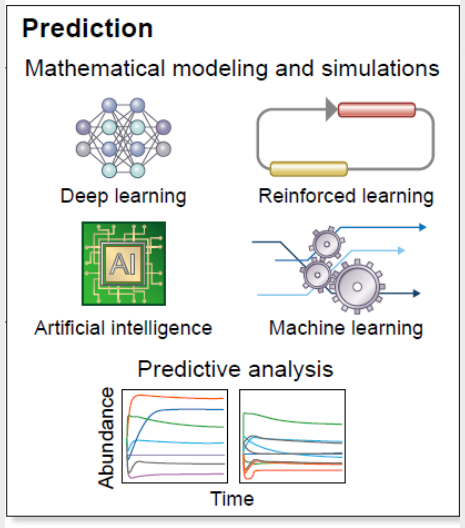
Understanding phytobiomes and using that knowledge to improve plant performance requires a systems approach.

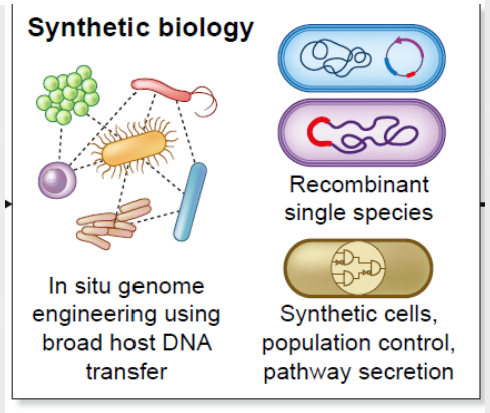


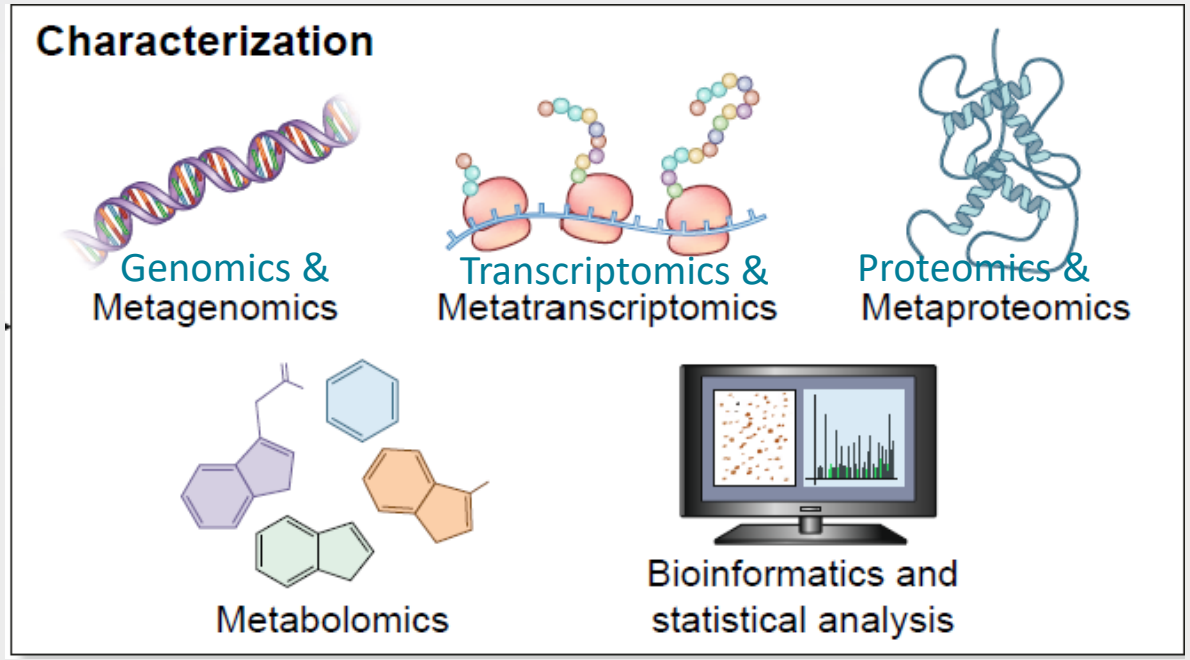
Trivedi, Mattupalli, Eversole & Leach
2021 New Phytol 230:2129

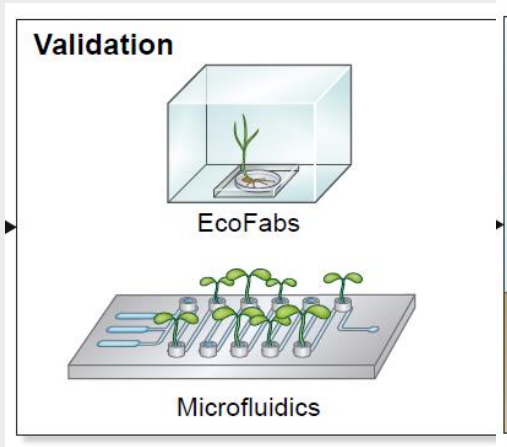
Going Forward: Continued Advancement in Enabling Technologies

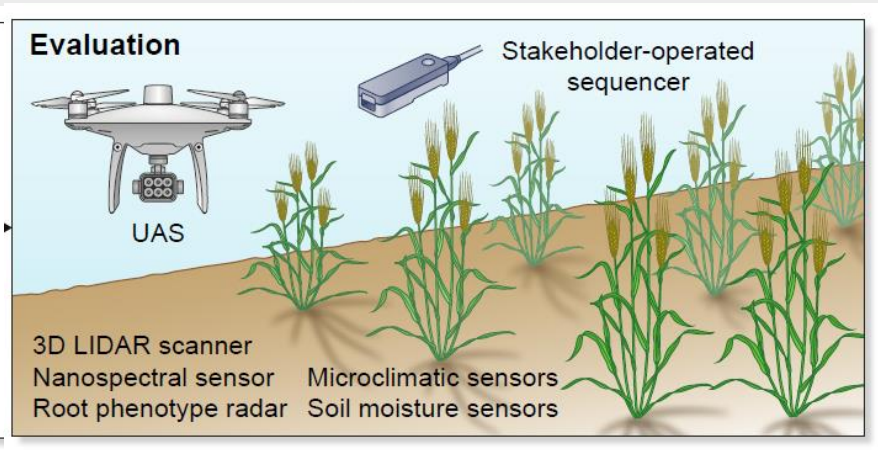












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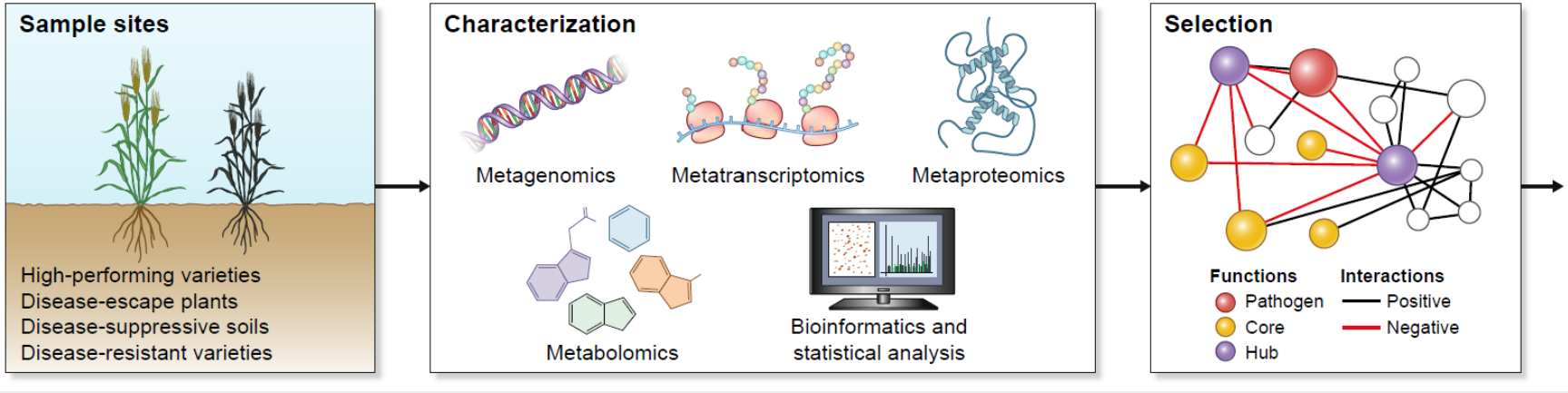
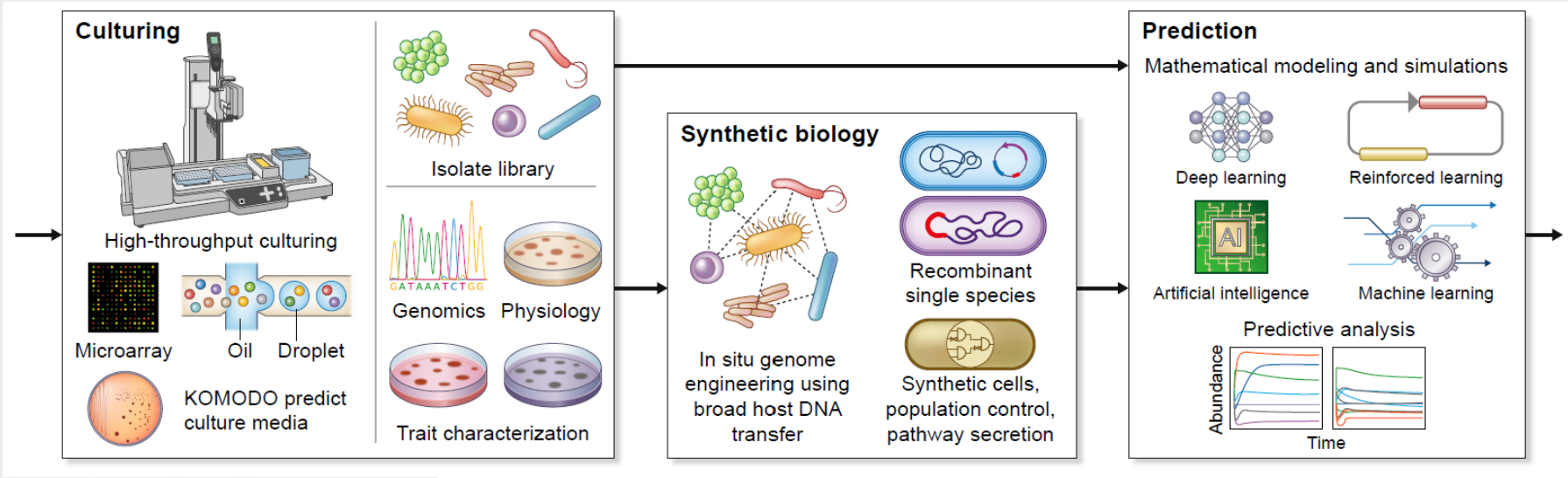
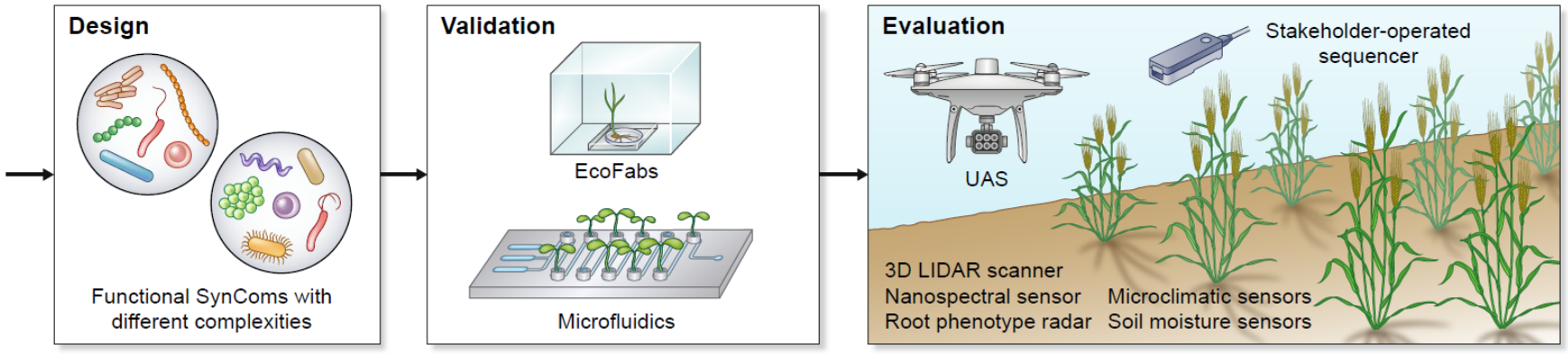
Application: Development of synthetic communities (SynComs) for Smart Farming Systems







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Going forward……..Embrace the Complexity!

- **Determine the makeup and functional potential** of plant-associated microbiomes to unravel complex interspecies ecological interactions and metabolic networks.
- **Move beyond correlation to causation**: get to mechanisms.
- **Model and predict** host genotype, microbiome genotype, environment, and management (G_H X G_M X E X M) interactions to tailor solutions.
- **Develop and adopt** standardized procedures for collecting, classifying, and reporting consistent and well-annotated metadata (Dundore-Arias et al., 2020).
- **Develop globally accepted standards** for plant-associated microbial products to ensure rapid translation of innovations in real world conditions.
- **Train the next generation** of collaborative phytobiome scientists with skills in integration and sharing of best practices across relevant disciplines.

Join us at PAG 30!

Exploring Phytobiomes

10:30 AM

Wednesday

January 18, 2023

Palm 3-4

Thank you!

Thanks to Kellye Eversole & Pankaj Trivedi for thought-provoking discussions!

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