Food and Agriculture Organization of the United Nations

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Convention on Biological Diversity

CABI

IOBC-WPRS

Open-ended workshop on biological control agents and biostimulants

Institutional and disciplinary context of biological control

Kris A.G. Wyckhuys, PhD

Time for introspection

- **Biological control: central tenet of IPM**

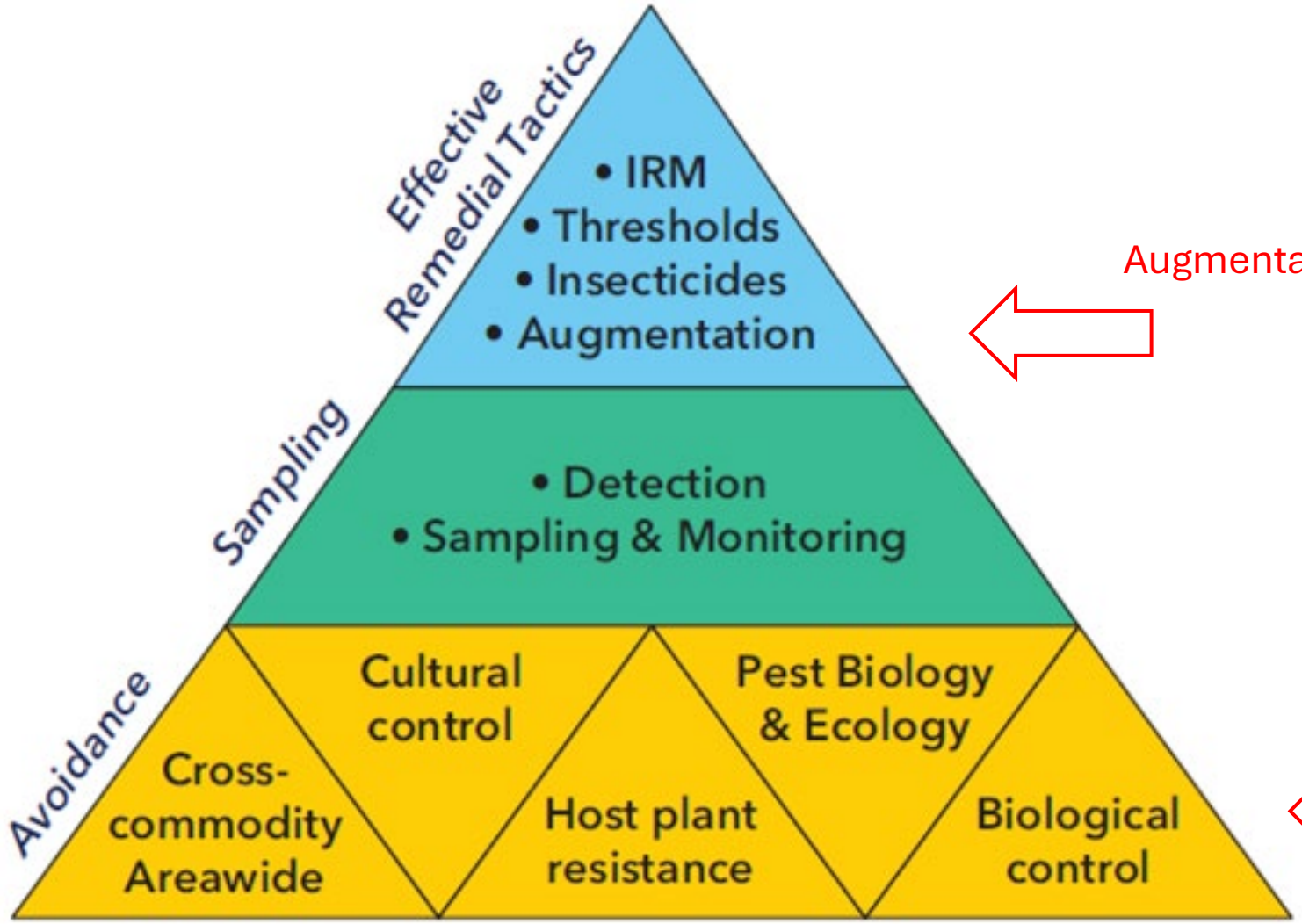
- **IPM has 'lost its way'**
- Put pest management science on the **right track**
  - Systems approaches & interdisciplinary science

- **Leverage points for enhanced impact at scale**
  1. Scientific underpinnings
  2. Odds of success
  3. Disciplinary breadth and depth
  4. Institutional engagement
  5. International networking

Core principles

Building blocks of the IPM conceptual framework

Synthetic pesticide use as a measure of last resort



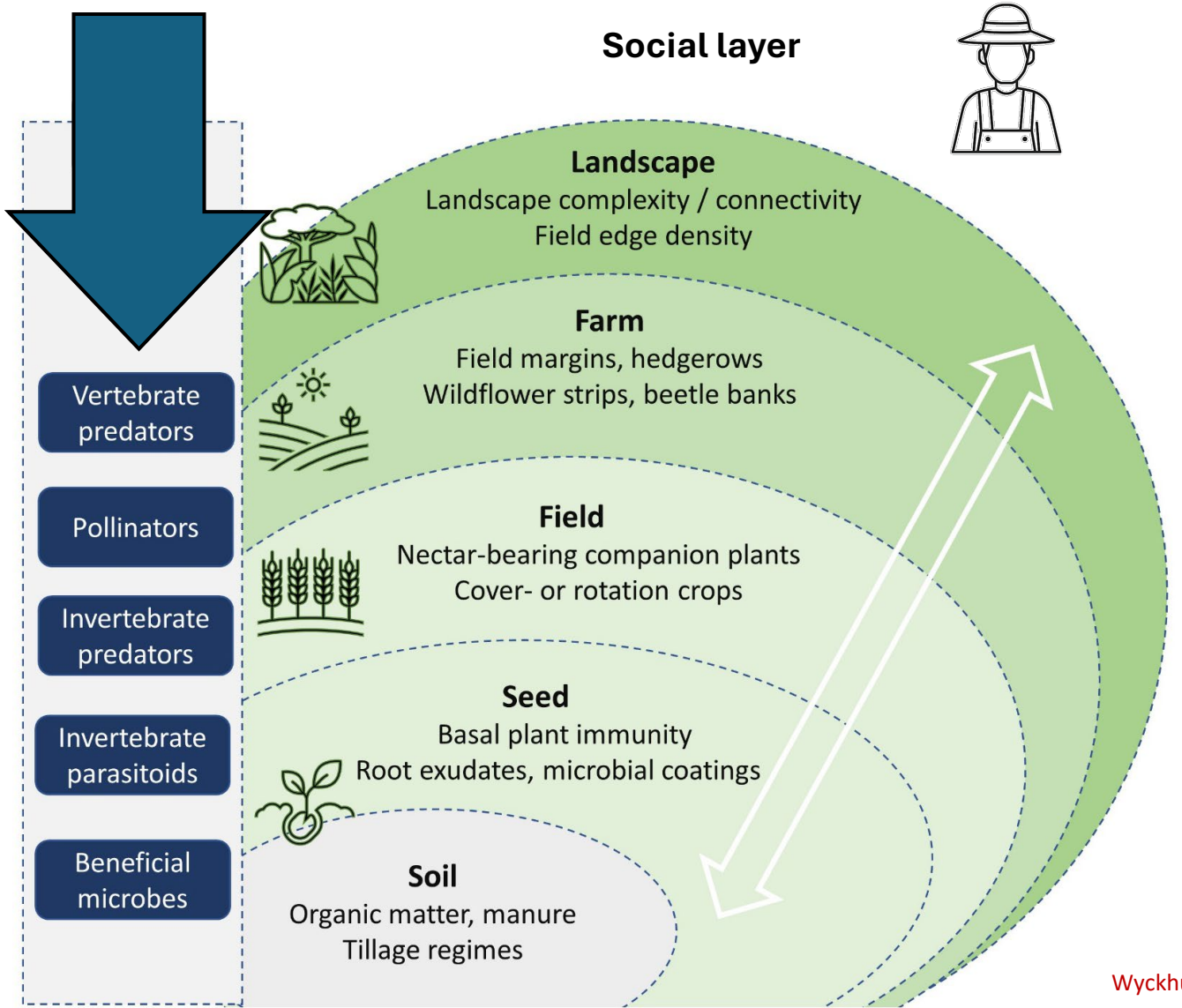
Augmentation BC

Conservation & classical BC

Naranjo et al., 2019

Core principles

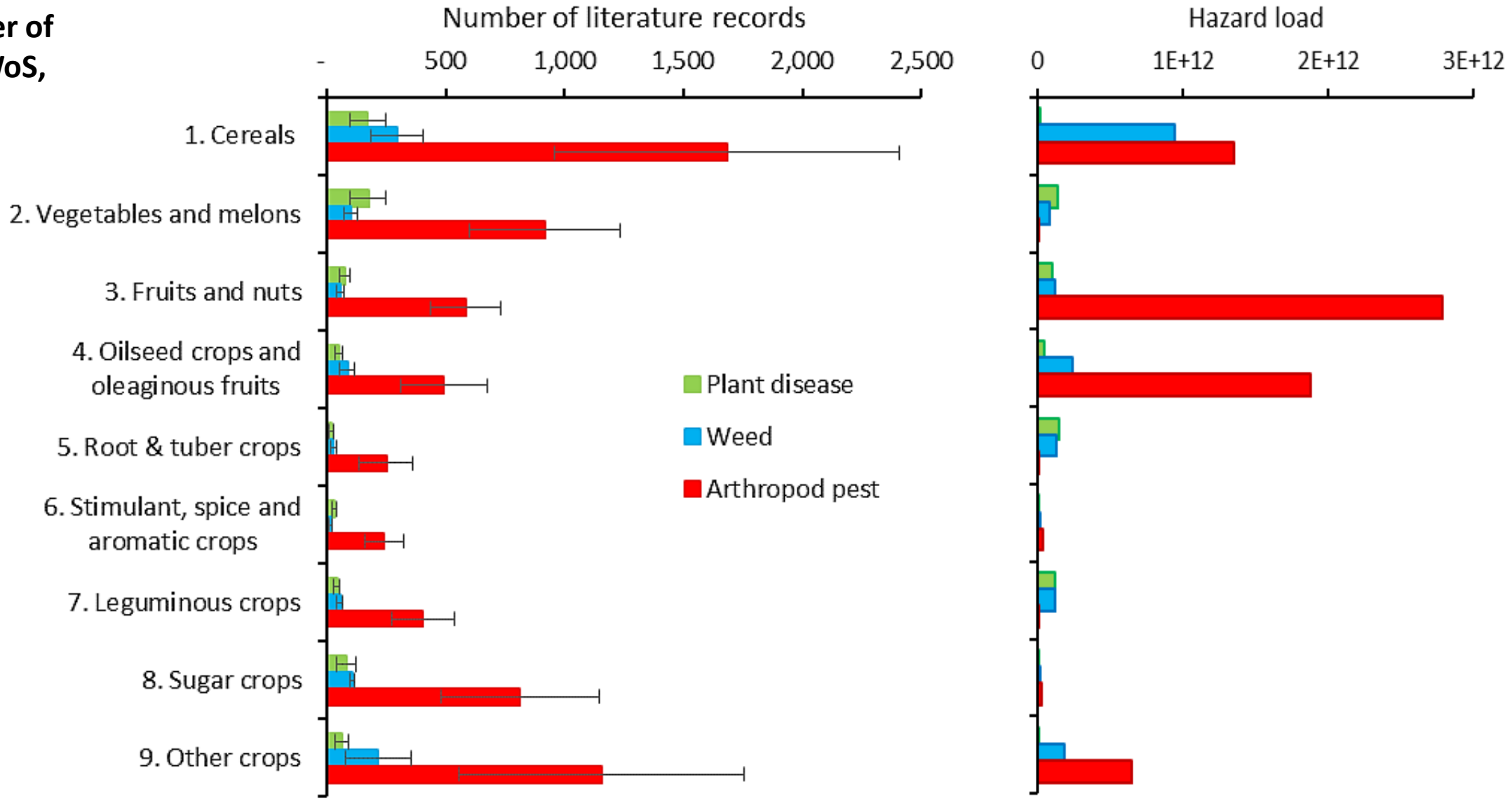
Farming system stratification as an analytical lens



Wyckhuys et al., 2022. COSUST

1. Scientific foundation

All-time number of publications, WoS, 1900-2023



Wyckhuys, Gu et al., 2024. JEMA


CODE CHECKER
DATA
ORIGINAL
NEW
DATA
HYPOTHESIS TESTER
REPETITIONS

2. Odds of success

Augmentation BC

	Chemical control[a]	Biological control[b]
Number of "ingredients" tested	>3.5 million	3,500
Success ratio	1:140,000	1:10
Developmental costs	256 million US$	2 million US$
Developmental time	10 years	10 years
Benefit/cost ratio	2:1	2.5–20:1
Risks of resistance	Large	Nil/small
Specificity	Small	Large
Harmful side-effects	Many	Nil/few

Classical BC

Location	Target	Benefit : cost ratio
USA	Citrophilus mealybug	12,698 : 1
USA	Klamath weed	11,464 : 1
St. Kitts	Diatraea sp.	3,302 : 1
USA	Rhodes grass mealybug	1,285 : 1
Antigua	*Diatraea* sp.	796 : 1
Sub-Saharan Africa	Cassava mealybug	370-740 : 1
Papua New Guinea	Banana skipper	607 : 1
Principe	Coconut scale	238 : 1
Nevis	*Opuntia triocantha*	241 : 1
Kenya	Coffee mealybug	202 : 1
St. Lucia	*Diatraea* sp.	159 : 1
Mauritius	*Cordia macrostachya*	132 : 1
Kenya	*Bactrocera dorsalis*	93 : 1
Barbados	Sugarcane borer	88 : 1
Australia	*Opuntia* sp.	86 : 1

Waterhouse et al., 1998; Guttierez et al., 1999
Van Lenteren, 2012; Agboka et al., 2024

CGIAR

DEPARTMENT OF AGRICULTURE

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FIAT PANIS

CABI

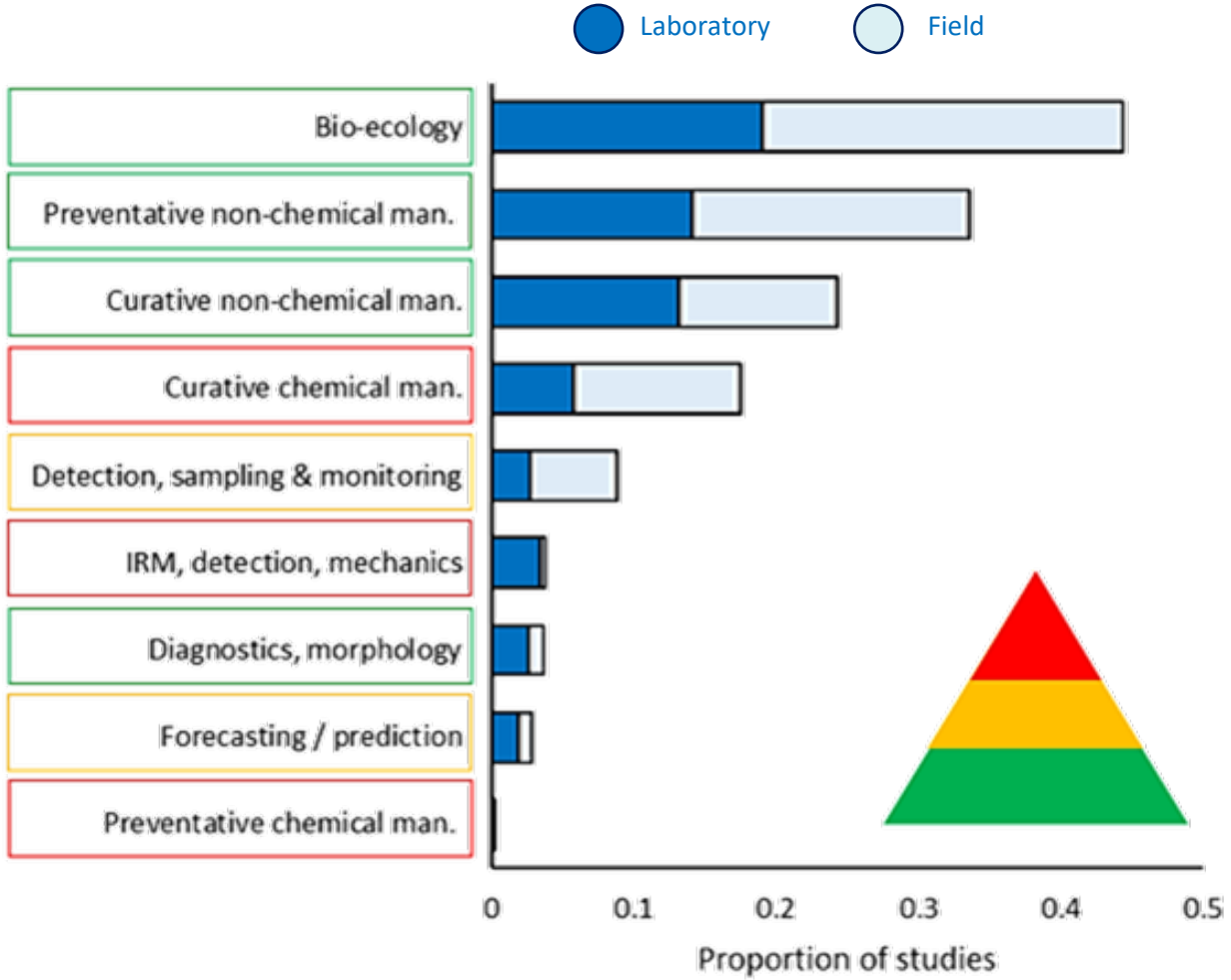
Burra et al., 2021
Wyckhuys et al., 2020. COSUST
Herren & Neuenschwander, 1991

3. Disciplinary breadth and depth

- Systematic literature review covering pest management, 65 countries in Global South, **2010-20** (N= 3,407)

- **Only 1/2** studies comprise **field work**
- Primary focus on **pest biology & ecology**
- Key attention to **non-chemical measures**
  - Biological control: 33% studies
  - Host plant resistance: 8% studies
  - Botanicals, mating disruption, etc.

- **Well-aligned with IPM conceptual framework, but…**



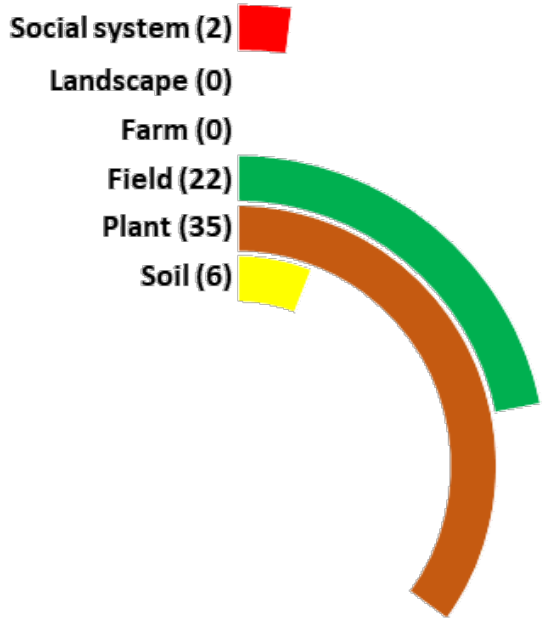
Wyckhuys, Tang & Hadi, 2023

3. Disciplinary breadth and depth

Four major limitations

1. Science conducted in **simplified experimental settings** with near-exclusive pest foci and within crop delimitations; silo-approaches prevail
2. Overall attention geared towards **curative** vs. preventative measures
3. 80% studies address **single-factor solutions**; little or no technology integration e.g., breeding x biological control
4. **Social layers** virtually overlooked

Bemisia tabaci



Ramifications

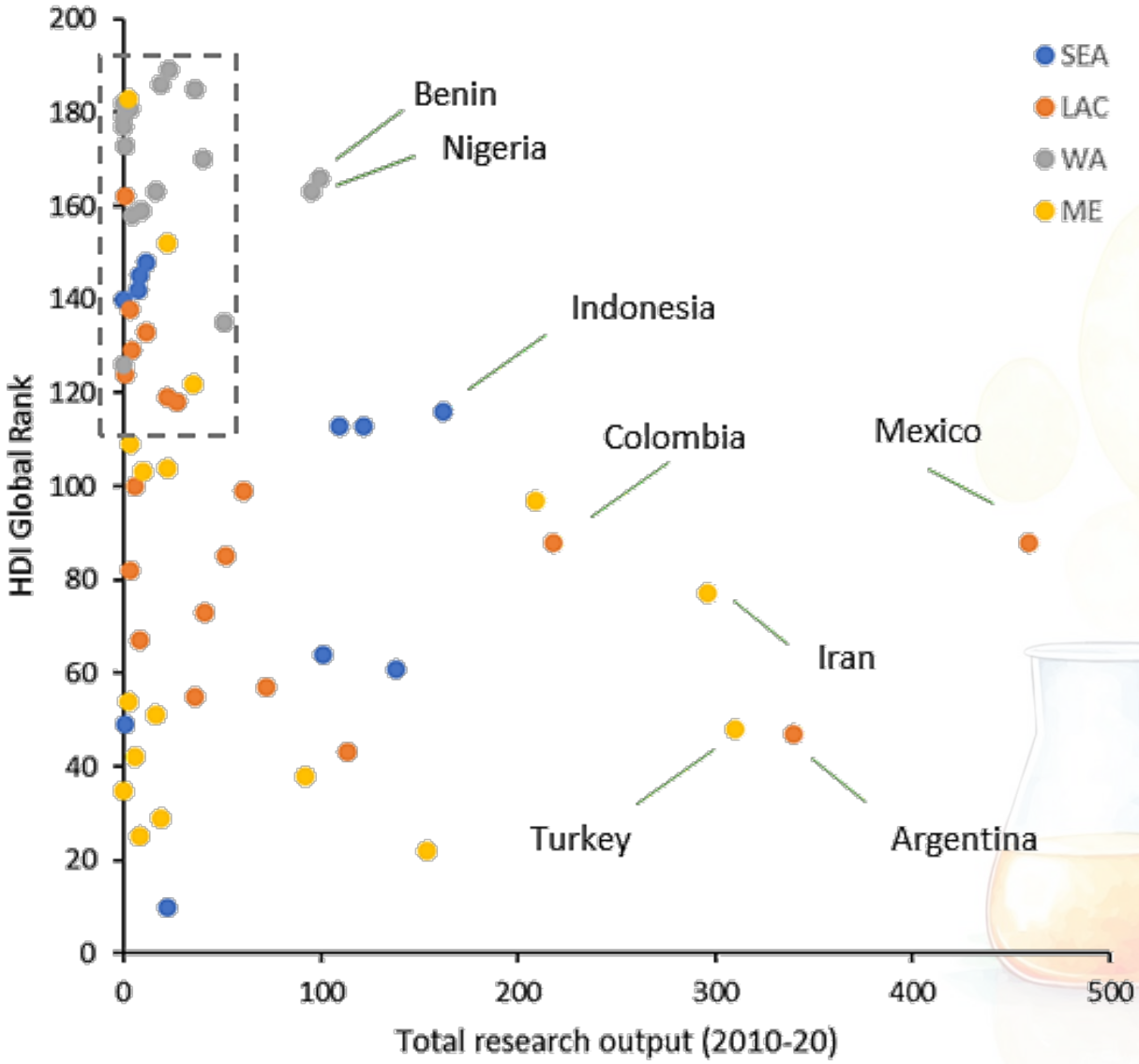
- Biological control technologies do not resonate with end-users

- Pesticide use increased by 153% in low-income countries over 2010-2020 (Shattuck et al., 2023)

Wyckhuys, Tang & Hadi, 2023

4. Institutional engagement

Country-level scientific output (2010-2020) – pest management in the Global South



Wyckhuys & Hadi, 2023

4. Institutional engagement

CGIAR

Among the all-time technology portfolio of the CGIAR, biological control offers by far the **highest returns on investment**

In Africa, **80% of documented benefits of CGIAR science** stem from biological control

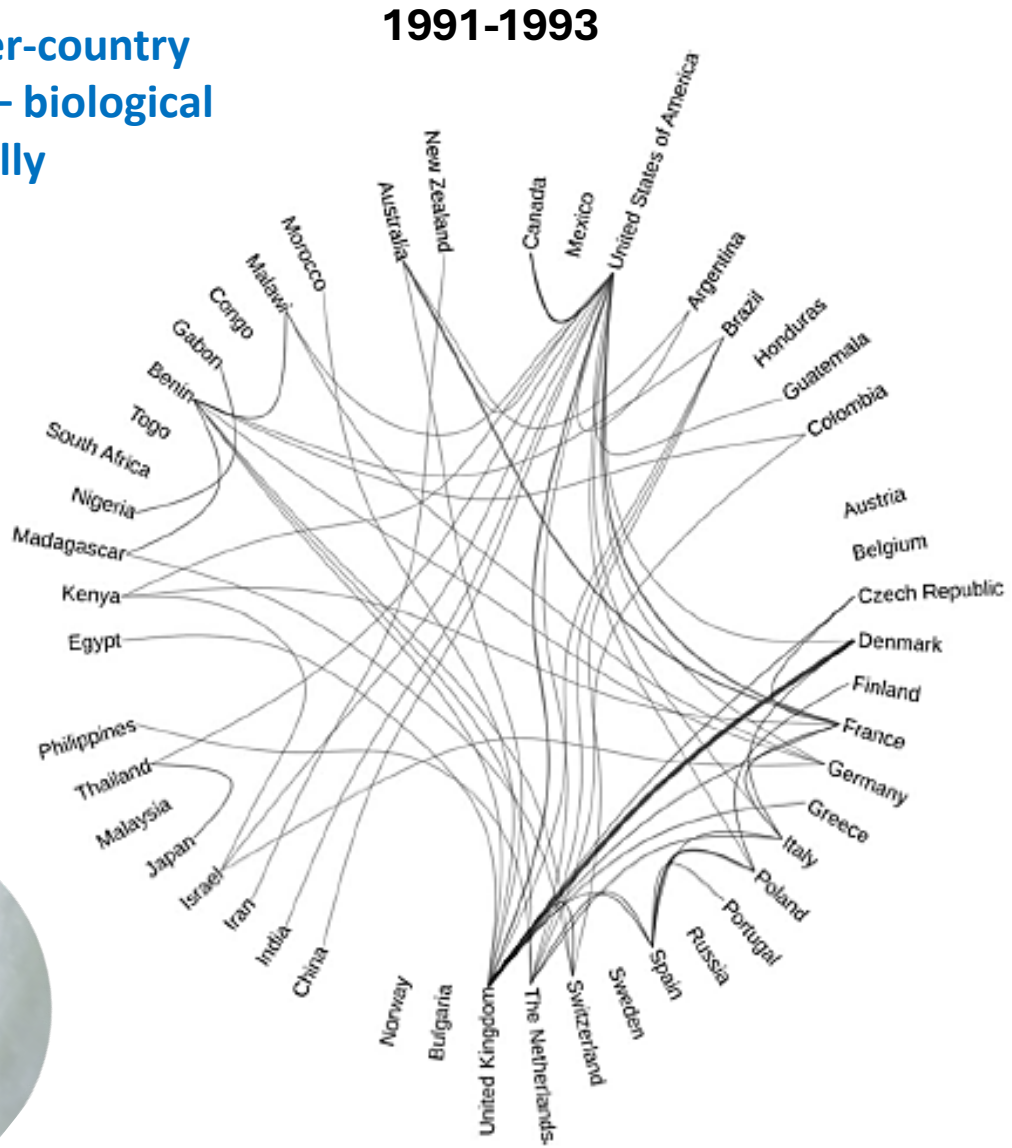
In the Asia-Pacific, biological control – as promoted by FAO, CGIAR and Australian entities – generates on-farm benefits up to **US$20 billion/year**

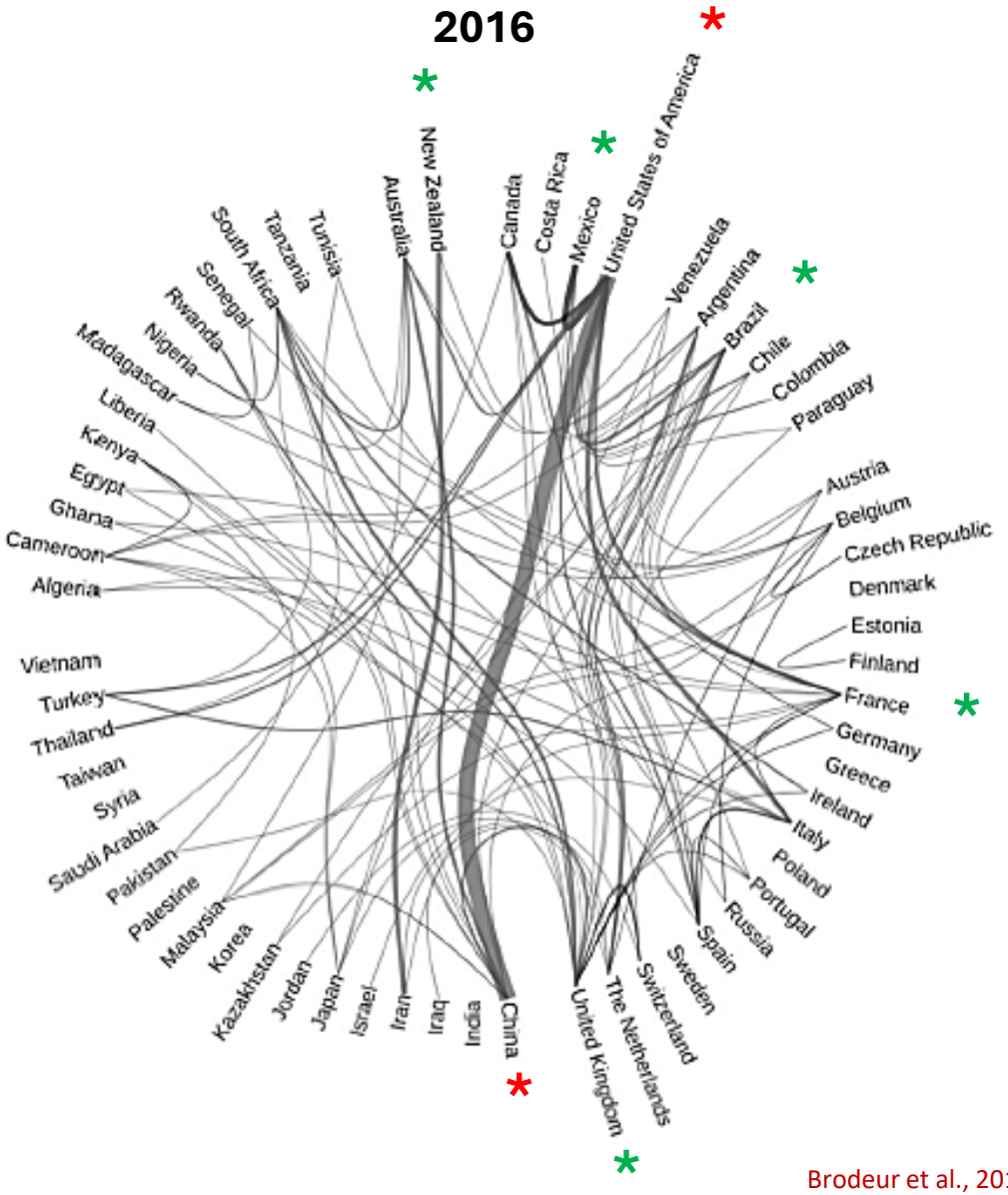
Raitzer & Kelley, 2008; Maredia & Raitzer, 2010
Wyckhuys et al., 2020; Neuenschwander et al., 2023

Wyckhuys & Hadi, 2023

5. International networking

Extent of inter-country cooperation – biological control globally





Brodeur et al., 2018. BioControl

What is needed?

1. Raise awareness
2. Fortify the ecological underpinnings of biological control, while embracing complexity
3. Break down silos - engage in interdisciplinary science and collaboration, viewing the farming system as a ‘whole’
4. Integrate application of ecologically sound technologies
5. Meaningfully relate to people e.g., by involving farmers and social scientists
6. Incentivize institutional reform of development partners to harness ecosystem services more effectively
7. Boost funding

Wyckhuys et al., 2024. JEMA