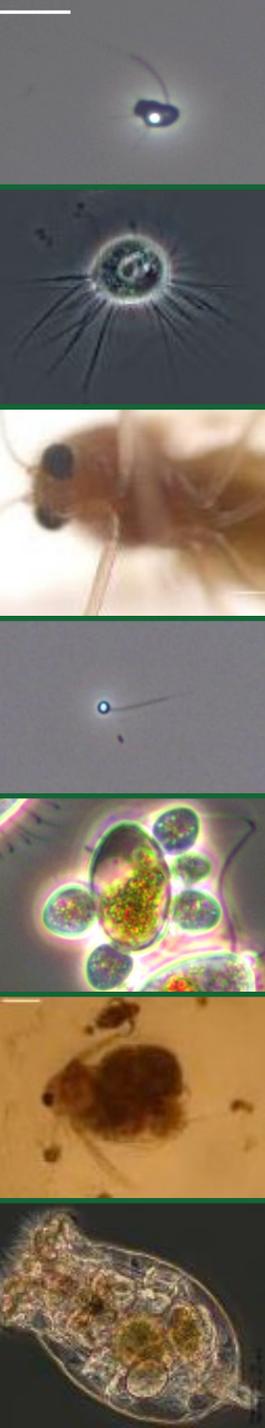


Barriers to Scale: Algae Crop Protection Workshop

Session 2: Alternative Crop Protection Approaches to Chemicals
and Pesticides

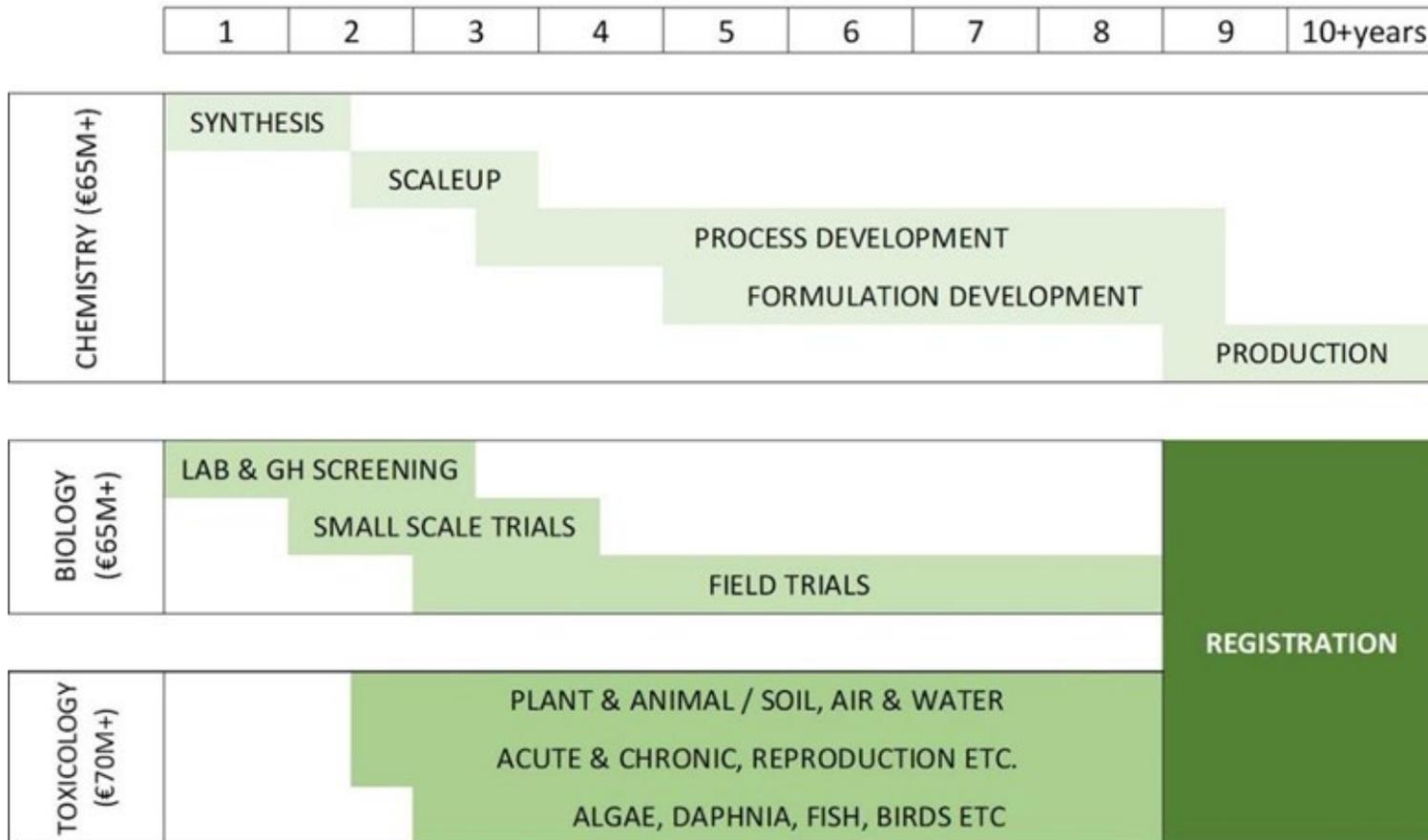
Moderator: Philip Lee

Rapporteur: Amanda Barry

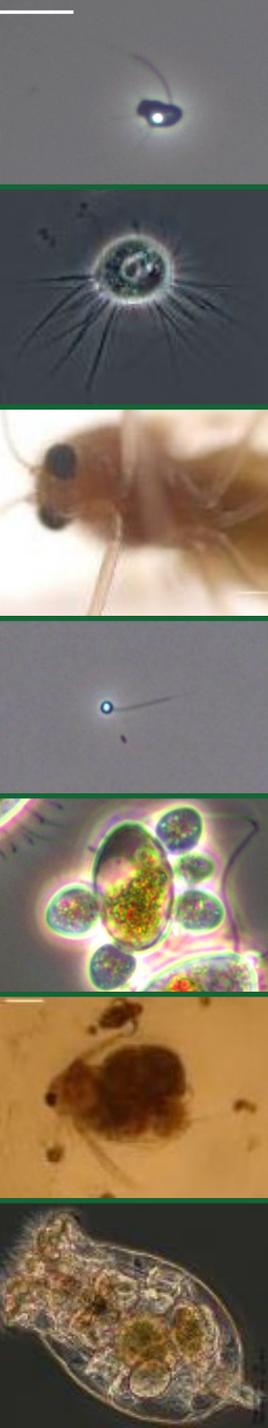


Development costs for pesticides

- ▶ “It takes over ten years and R&D expenditure of \$100-350 million to develop and market a new agrochemical” (Nishimoto, 2019)



Adapted from: Innovation: the secret of our success (BASF, 2018)



Alternative Crop Protection Approaches to Chemicals and Pesticides

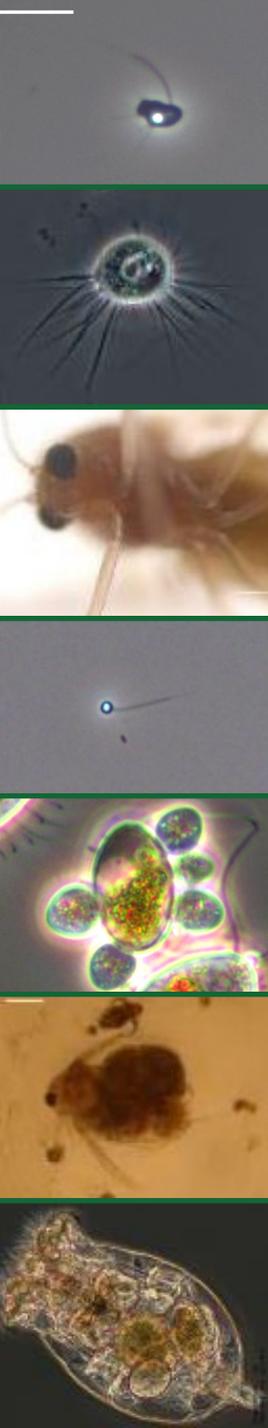
► Why Pesticides? (Sapphire experience)

- First major pests were single celled zoosporic fungi or related organisms
- Once Pathogenic organisms were controlled, weed algae became an issue
- Looking to Ag - Fungicides and Herbicides are an obvious solution
- Reacting to potential short-term loss by adding something to the pond

► Why not pesticides?

- Regulations, cost, consumer acceptance, safety, resistance, etc....

Cost/acre shown in 2015 USD

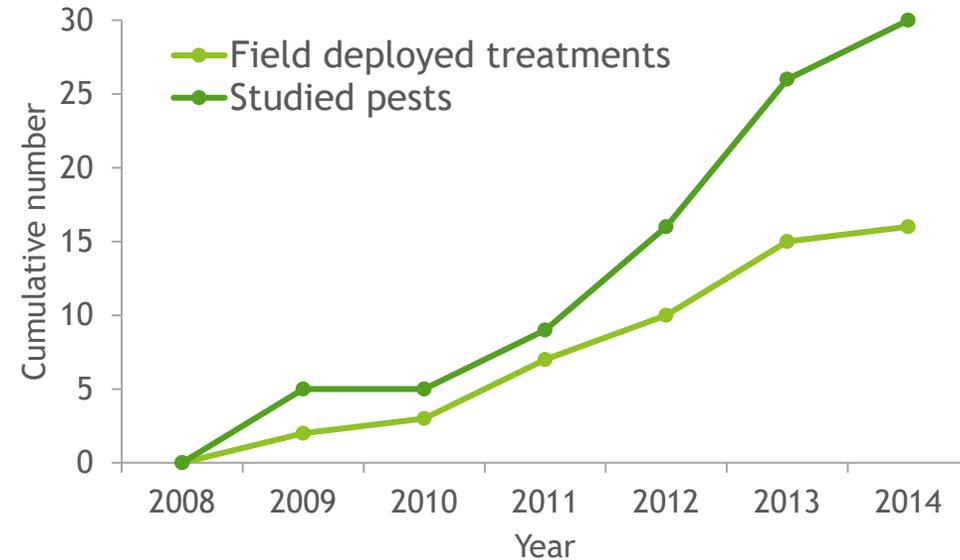


Some Alternatives

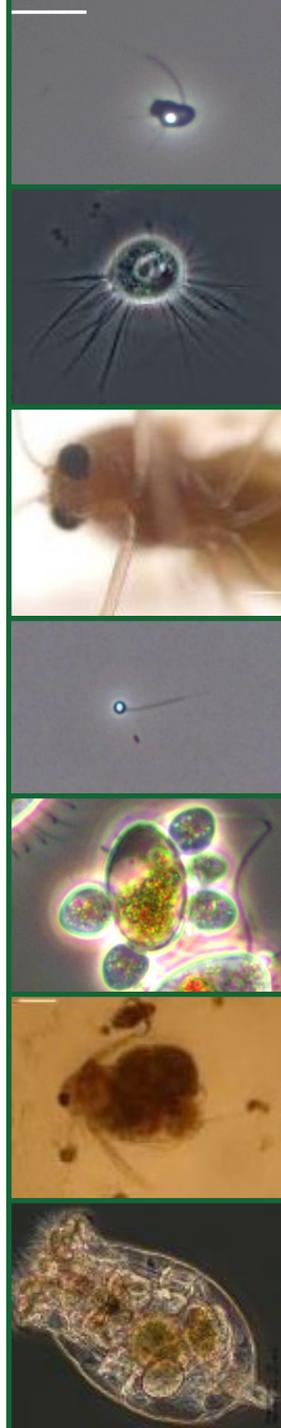
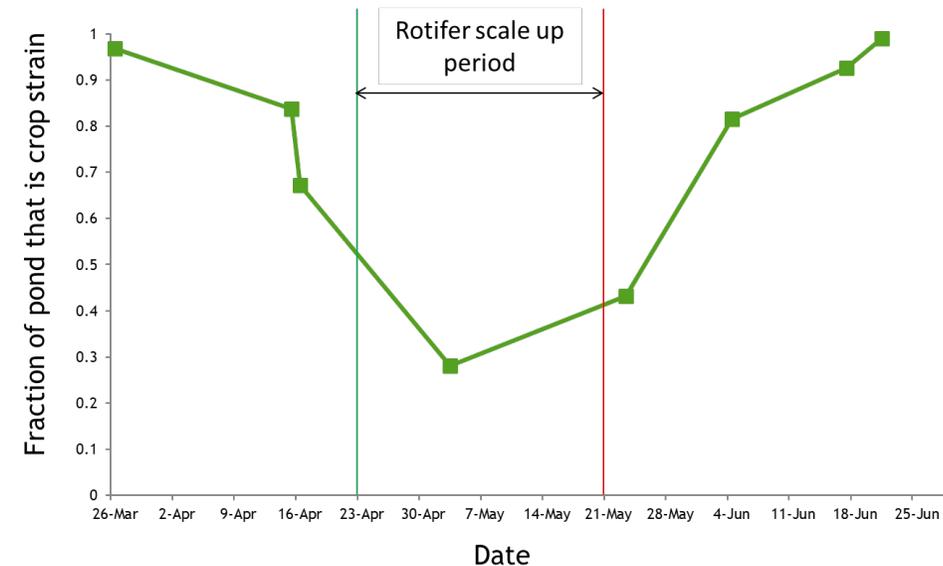
- ▶ Mechanical
 - ▶ Paddle wheel speed, pumping, cavitation
- ▶ Cultural
 - ▶ Alkalinity, TDS, harvest timing / culture density, nutrient levels, nutrient source
- ▶ Biological control
 - ▶ Small Rotifers released to consume weed algae but not crop
- ▶ Strain Development
 - ▶ Evolution of resistance, screening for better strains

→ The combination of [Phosphate], TDS, Alkalinity, Rotifers, and Fungicides (Omega, Thiram, Bravo) were all essential to continuous multi-year cultivation of *Desmodesmus*.

Cumulative Pests and Treatments



Deploying Rotifers for Weed Control

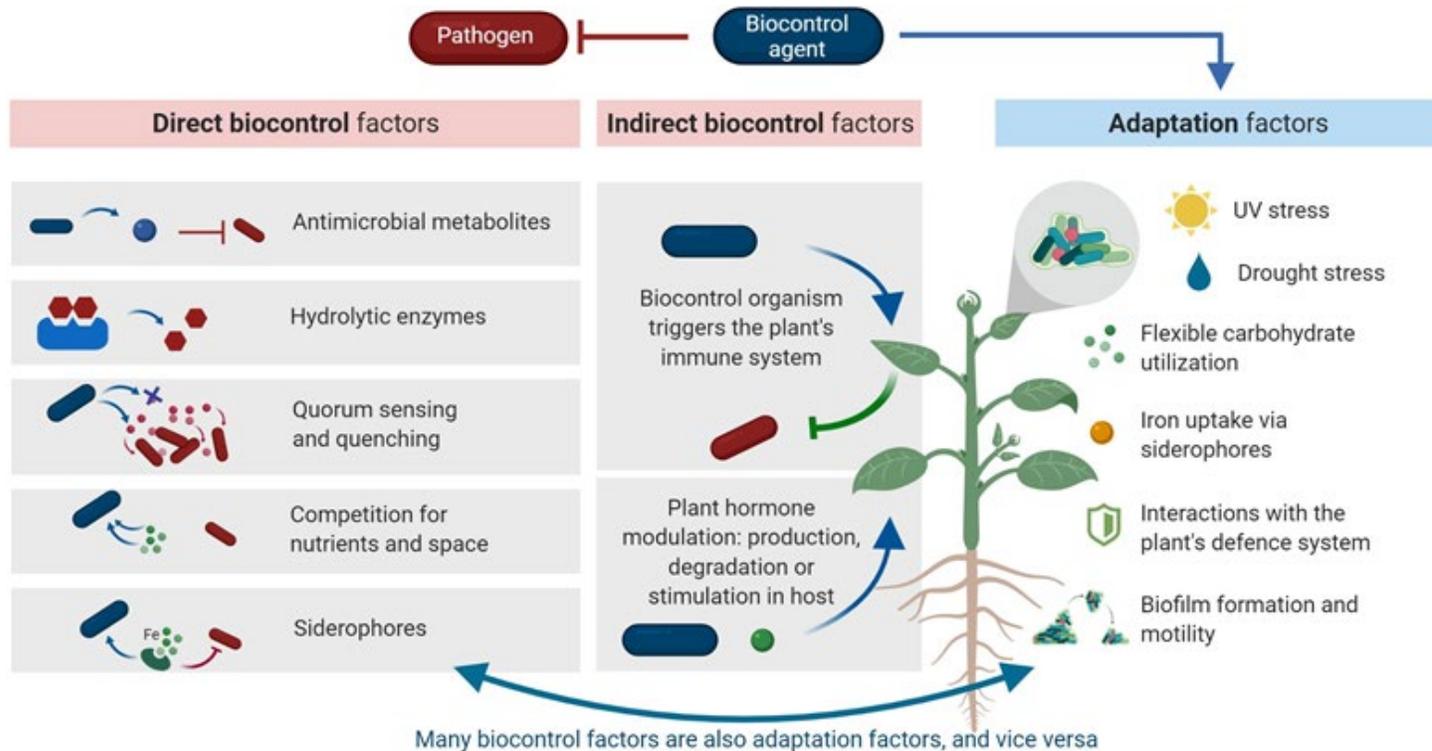




Phosphite: fertilizer/fungicide



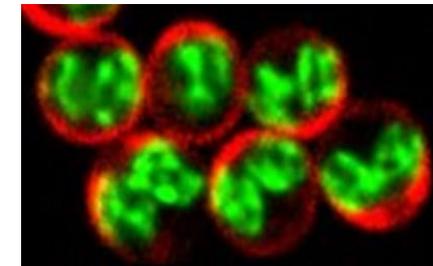
Yeast fermentation production of pheromones for insect control



From Savary et al 2019 <https://pubmed.ncbi.nlm.nih.gov/30718852/>



RNAi against corn rootworm, Bayer.
Approved 2017, in field 2022



<https://doi.org/10.1016/j.algal.2021.102197>

Protein expression e.g. Bt, chitinases, gluconases...

Panelists



- ▶ Rhona Stuart
 - ▶ Lawrence Livermore National Laboratory
- ▶ Kim Ogden
 - ▶ University of Arizona
- ▶ Jeremy Guest
 - ▶ University of Illinois Urbana-Champaign

