

Exploring Benefits and Risks of Synthetic Cells Applied to Agriculture

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National Academy of Sciences Information Gathering Session

24 September 2025





Target Approaches/Benefits

- Synthetic Biology needs to find its own way in addressing DBTL (Agile vs. Waterfall)
- Fully embracing AI/ML – Both in the DBTL process as well as an enabler for predictive design for the added environmental dimensions of where Defense Biosensors will operate
- Whole cell models to study redundancy and evolvability of cells
 - ✓ Handling multi-target gene editing by controlling redundancy of cells
 - ✓ Conquering dark interactome beyond binary interactions for studying pathogen-host crosstalk
- Modular Open System Architecture – “Biosensors Defense Weapon System” (options for vendors, system integrators and capabilities across the mission space)
- Detection Limits Related to Microbial Quiescence (dormancy) and Senescence (aging)
- Enhanced or Bypassed Photosynthesis through over-expression, transcription, regulation and altered pathways
- Climate Resilience via Better H₂O and CO₂ Use Efficiency

Risks Mitigation

- Kill Switches Using CRISPER, via External Agent for Survival, or Toxin/Antitoxin Systems
- Synthetic Auxotrophy—Dependence on Non-Native Molecules or Metabolites (e.g. Phosphite, NSAA)