



De-risking and Accelerating Innovation in Ag Biologicals

Ginkgo Bioworks

October, 2023

AGENDA

Today we'll talk about

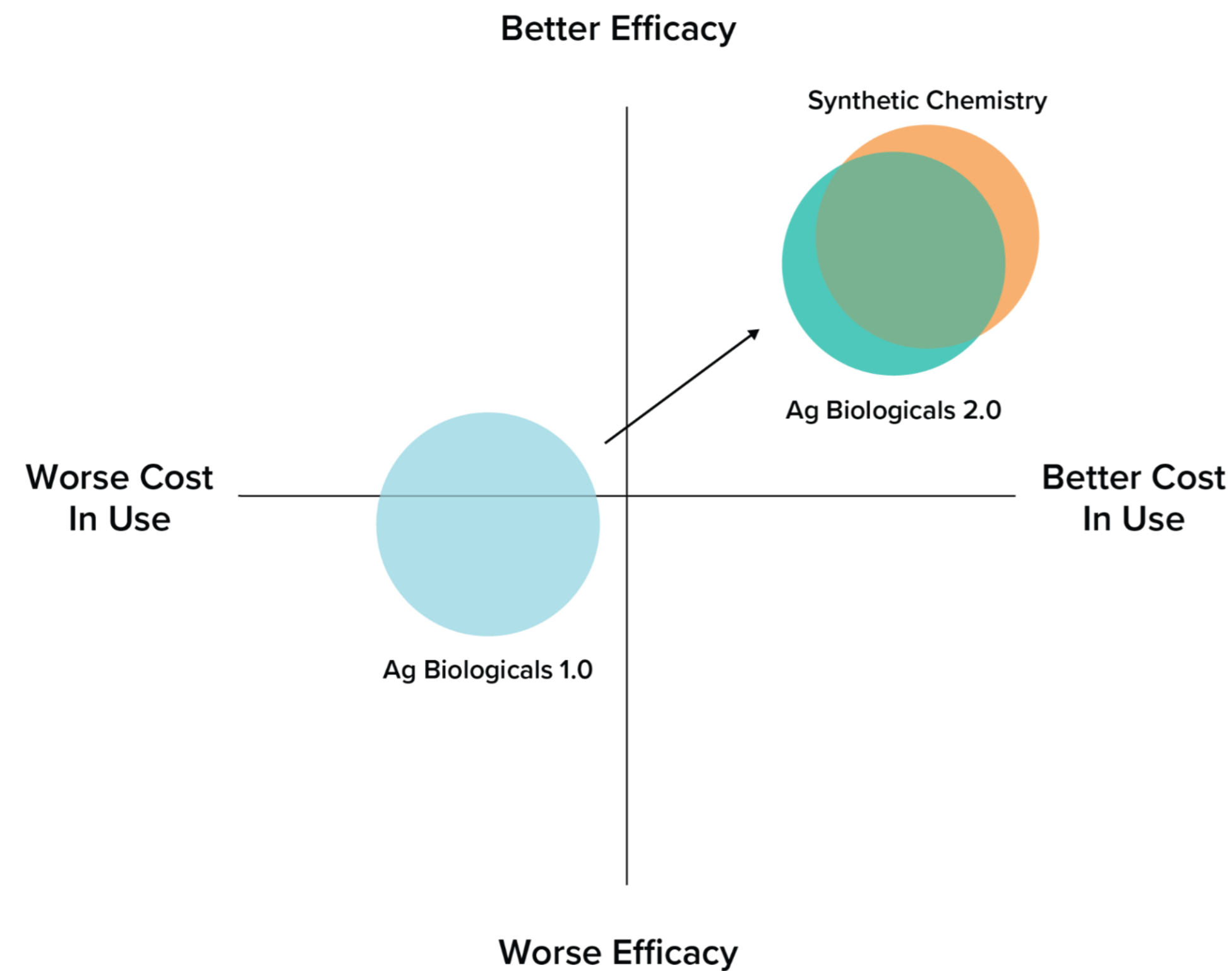
**Synthetic Biology's Implications
for Agriculture**

**Why Companies Choose Ginkgo:
The Synthetic Biology Platform**

**Ginkgo's Offerings for
Ag Biologicals Innovators**



Future ag biological products must match synthetic chemistry on efficacy and cost-in-use



Consistently high performance

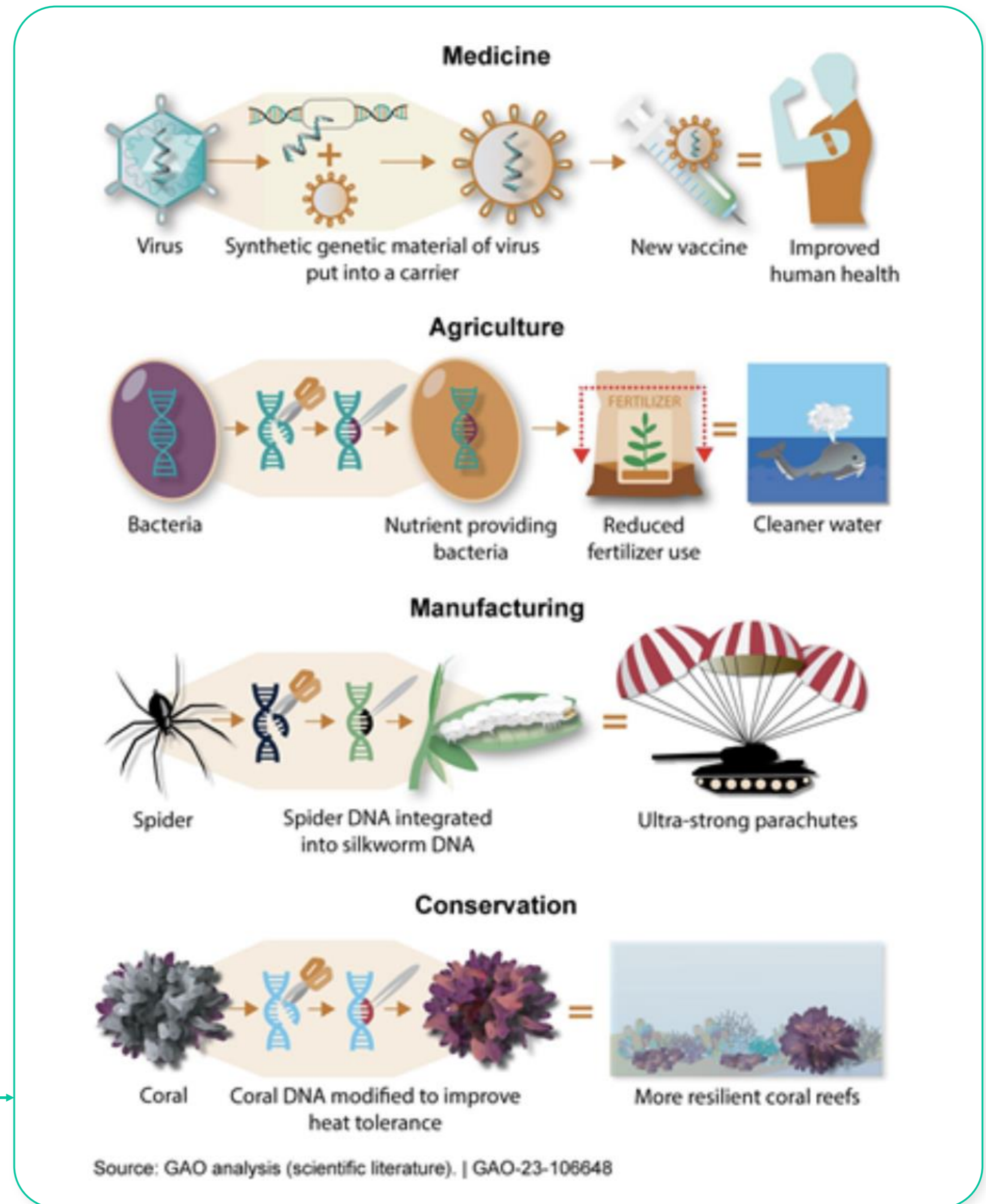
Stable in formulation and on the shelf

Cost-effective to produce

Synthetic biology harnesses large datasets to transform therapeutics, manufacturing, conservation and agriculture

An area of scientific research that involves the purposeful **editing and redesigning** of genetic components of organisms such as bacteria, yeast, and fungi to make new material—**proteins, small molecules, and microbes**—with altered functionality.

Examples of the Power and Impact of Synthetic Biology

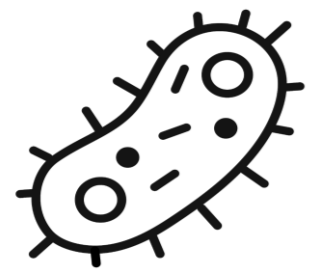


Synthetic biology can deliver the next generations of ag biologicals

Microbes Applied to the Field – Live or Dead (“whole or intact-cells”)

Generation 1

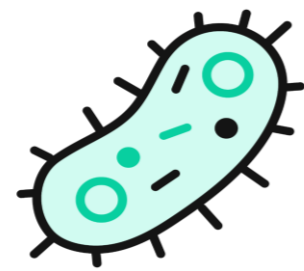
Wild Type Microbe



Entry point for most product classes

Generation 2

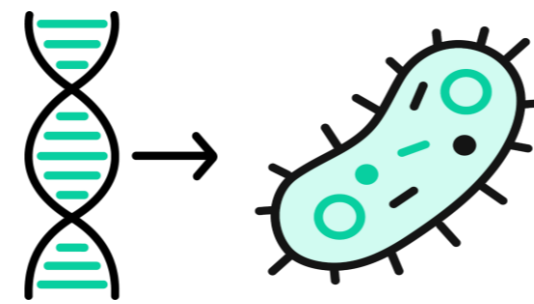
Randomly Mutagenized Microbe



Increased potency with reduced regulatory burden

Generation 3

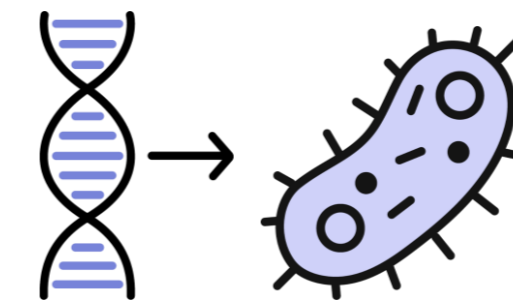
Engineered Microbe: Cisgenic Approaches



Maximized species potency for select markets

Generation 4

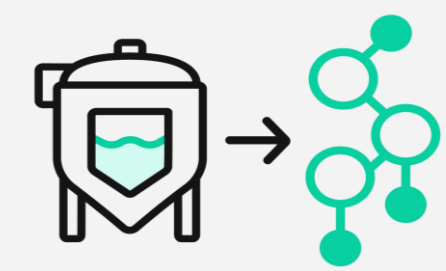
Engineered Microbe: Transgenic Approaches



Maximized potency for select markets

Biochemicals

Wild Type, Mutagenized or Engineered Microbe



Discrete & bespoke production of natural compounds

Not genetically engineered



An aerial photograph of a lush green field, possibly a farm or park, with rows of crops. A large, solid black silhouette of a person's head and shoulders is positioned in the upper left foreground, partially overlapping the field. The background is a dark, solid black color.

Ginkgo Bioworks

The Platform

Our mission: Make biology easier to engineer

Ginkgo combines the world's leading platform for engineering biology with significant agriculture assets and expertise

QUICK STATS

\$1.6B Raised

Founded in 2008. Went public in 2021.

>500 Scientists

Expertise spans computational and molecular biology, plant physiology analytical chemistry

6,000 Robots

With integrated automation, software, and biological tools

>175,000 ft²

Plant testing facility in West Sacramento

>200 Partnerships

Cell programming partners spanning agriculture, industrial biotech, pharmaceuticals

PLATFORM EXPANSION ACTIVITY



Acquired Bayer's Ag Biologicals R&D Division

Fully integrated team of **80+ scientists**, state-of-art R&D facility including greenhouses, microplots, and **3000 L pilot plant** in West Sacramento. Folded in Joyn Bio, former JV with Bayer Crop Science



Acquired Zymergen

Leading synthetic biology automation technology, proprietary UMDB metagenomic database comprised of **2B+ genes** from agronomically relevant sources. Team with deep experience in natural products discovery.



Acquired FGen

Swiss biotechnology platform for single-cell encapsulation and screening. **Ultra-high throughput capacity** for screening secretion-based phenotypes and diverse array of cell types.



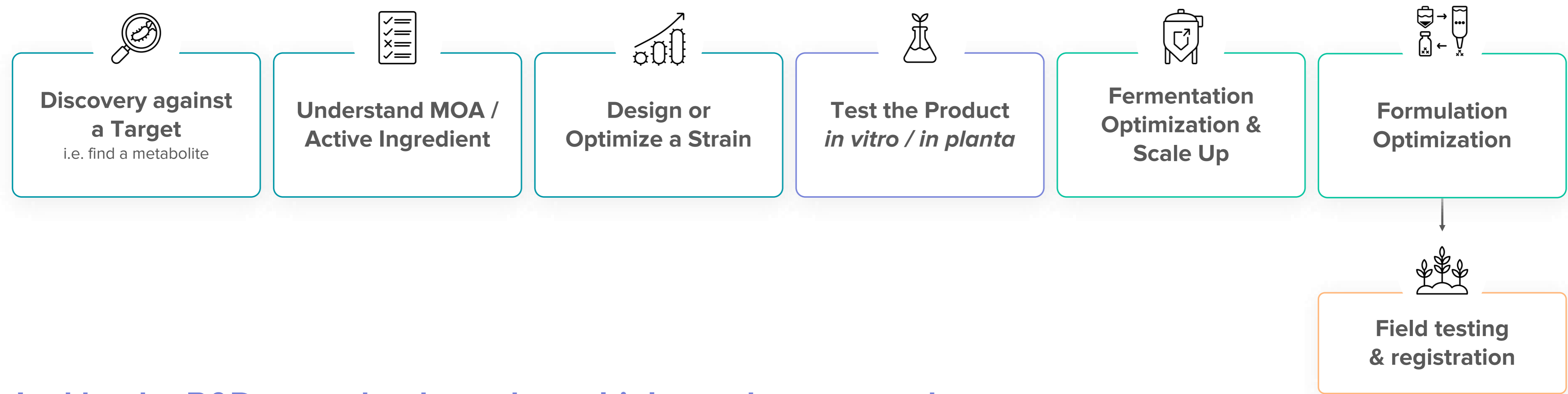
Entered Strategic Partnership with Google Cloud

Multi-year services and collaboration agreement to develop industry-leading **generative AI models** for biology

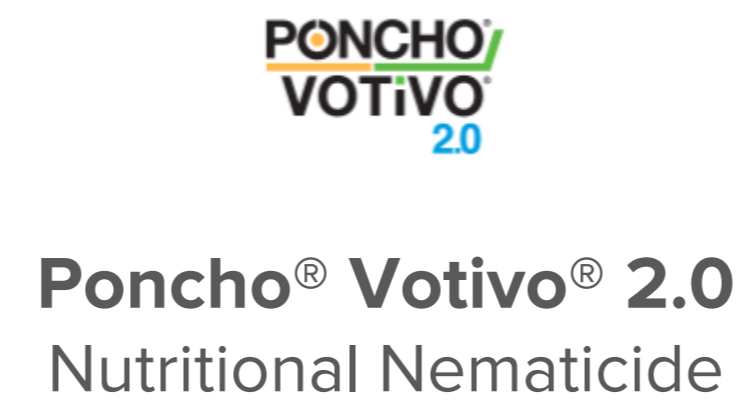


With the addition of Bayer's biologicals R&D team and assets, Ginkgo's platform supports ag biologicals innovation from discovery to development

Our end-to-end R&D platform for biological crop inputs product development



Led by the R&D team that brought multiple products to market



Why are companies outsourcing to our platform?

Get More Data per R&D Dollar


Access Existing Large Data Asset and Scientific Experts to Help Navigate it

Accelerate Product Development

Save Laboratory CapEx

Replace Fixed Cost with Variable Cost



An aerial photograph of a lush green agricultural field, possibly a cornfield, with distinct rows of crops. The image is partially obscured by a large, solid black silhouette of a person's head and shoulders, positioned in the upper left and center. The background is a solid black color.

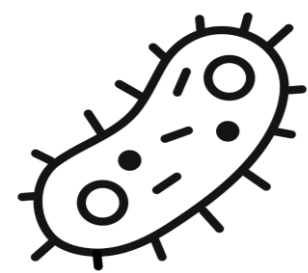
Partnering to De-risk and
Accelerate Innovation in Ag
Biologicals

Ginkgo's Services for Ag Biologicals make it easy for you access synthetic biology tools to develop your portfolio

Microbes – Live or Dead (applied to the field as “whole or intact-cells”)

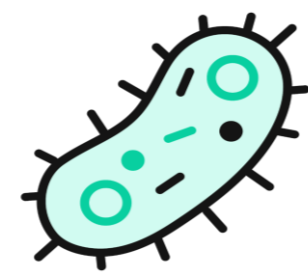
Generation 1

Wild Type Microbe



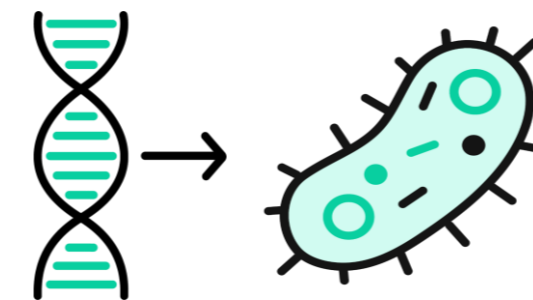
Generation 2

Randomly Mutagenized Microbe



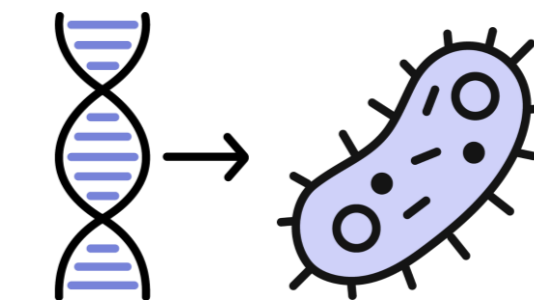
Generation 3

Engineered Microbe:
Cisgenic Approaches



Generation 4

Engineered Microbe:
Transgenic Approaches



Ginkgo's Services for Ag Biologicals*

Product Headstarts

Rapid Strain
Optimization

Rational Strain Engineering

Fermentation Process and Formulation Optimization

*Note: Services are applicable to biochemical production strain discovery and development



Accelerate discovery with our Product Headstarts: active ingredients or strains shortlisted for known or putative agronomic benefits

200,000+

Microbial strain isolates

3,000+

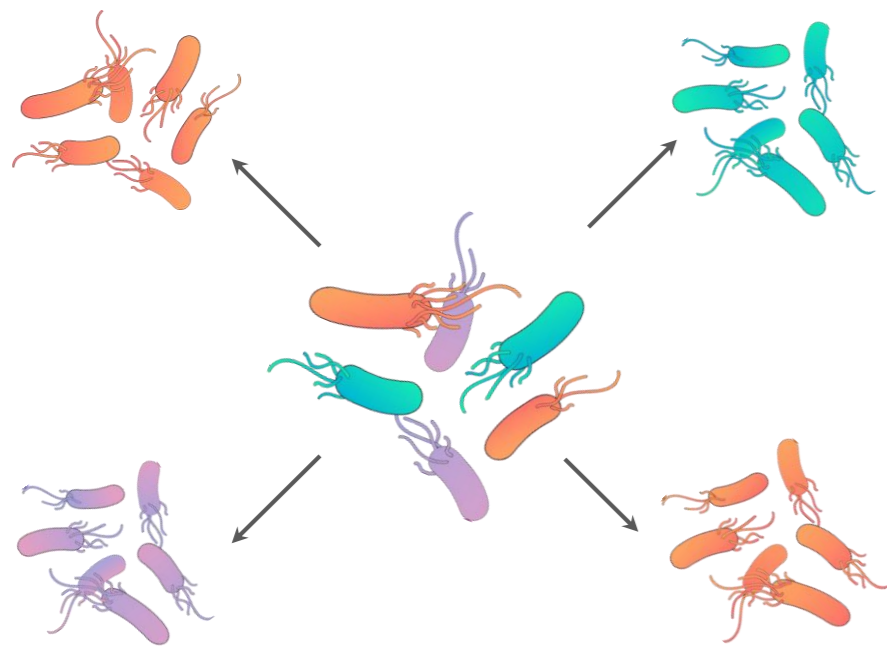
Unique species

	Application	Lead Candidate Type	<i>In silico</i> hits	<i>In vitro</i> leads	<i>In planta</i> leads
CROP PROTECTION	Bionematicides	Novel active ingredient	✓	✓	✓
	Biofungicides	Novel strains	✓	✓	✓
	Bioinsecticides	Novel strains	✓	✓	✓
CROP NUTRITION	Nitrogen fixation	Novel strains	✓	In Progress	Not tested
	Phosphate solubilization	Novel strains	✓	Not tested	Not tested
	Plant growth regulators	Novel strains	✓	Not tested	Not tested
	Carbon sequestration	Novel strains	✓	Not tested	Not tested

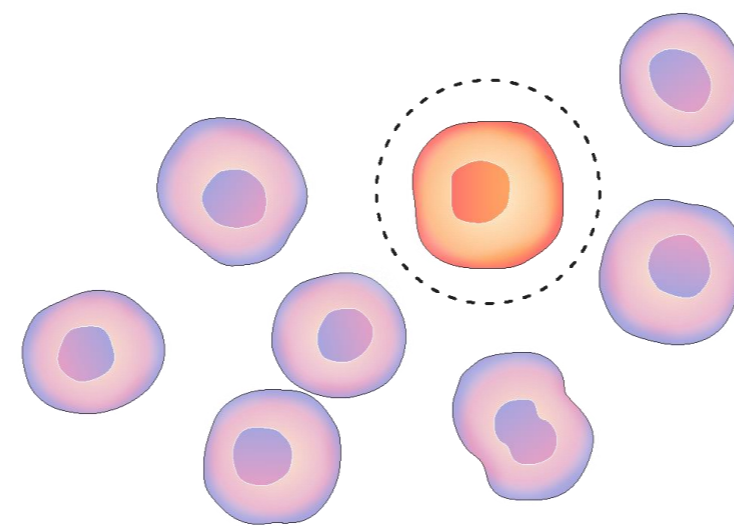


Combine mutagenesis and ultra-high throughput screening for 1.5-5x performance improvement

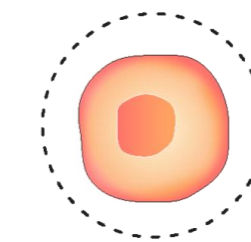
Random mutagenesis techniques rapidly generate millions of strain variants



But conventional methods to screen millions of strains are costly and time-consuming



Screen up to **1 million variants per day** with EncapS: Ginkgo's proprietary encapsulation and screening technology



Find the needle in the haystack typically in less than one year



Bridge the gap to commercialization with our fermentation scale-up, formulation, and *in planta* testing capabilities

AMBR250s



5.26 ACRE *IN PLANTA* TESTING FOOTPRINT



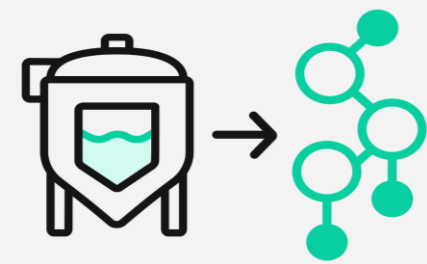
PILOT PLANT



The same tools can be applied to optimize biochemical products

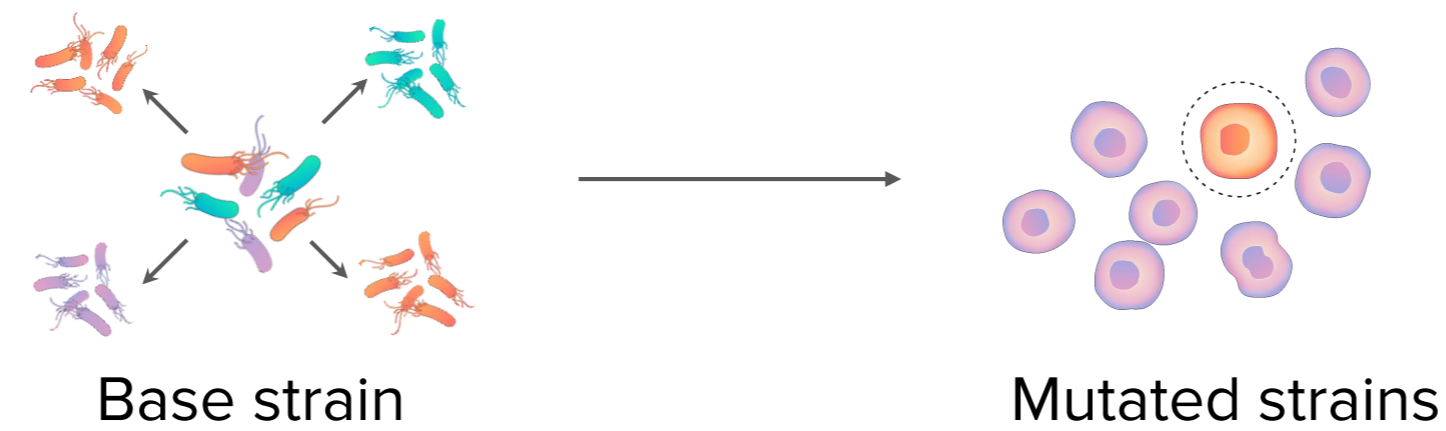
Biochemicals

Wild Type,
Mutagenized or
Engineered
Production Strain

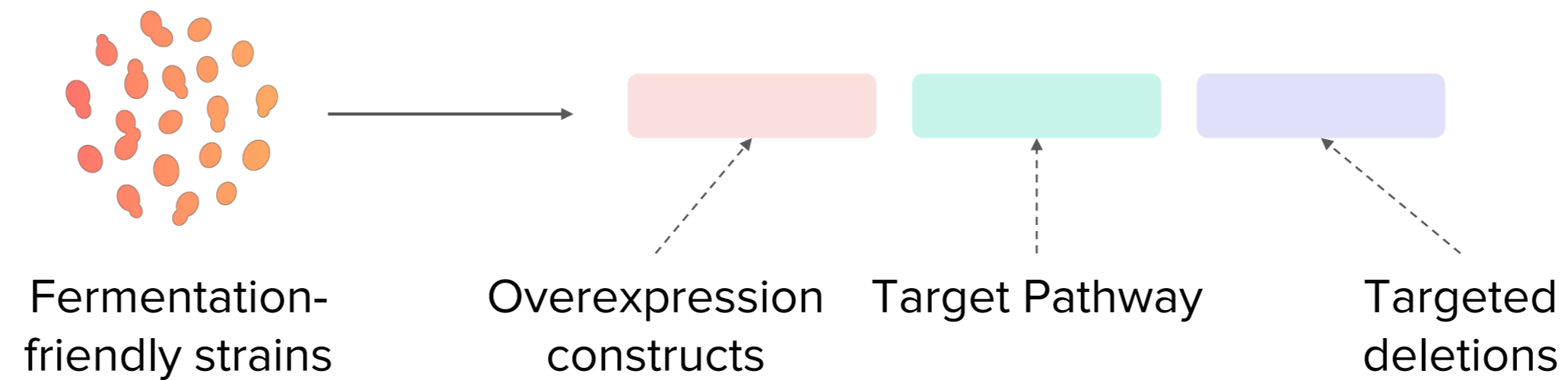


Discrete & bespoke
production of natural
compounds

RAPID STRAIN OPTIMIZATION



RATIONAL STRAIN ENGINEERING



FERMENTATION PROCESS OPTIMIZATION



**Final strain
and process:
commercially
viable titer**



Partners leveraging our services for ag biologicals today:

Ginkgo's Services for Ag Biologicals R&D



Product Headstarts



Rapid Strain Optimization



Rational Strain Engineering



Fermentation Process and Formulation Optimization

Just launched!

AgBiome Leverages Ginkgo Strain Optimization Services to Optimize Agricultural Biological Pipeline

Globe Newswire — 06.23.23

c&en
CHEMICAL & ENGINEERING NEWS

Bayer outsources biologicals research to Ginkgo

Ginkgo absorbs a partnership, and Bayer remains an anchor customer

by **Matt Blois**

April 28, 2022 | A version of this story appeared in **Volume 100, Issue 15**

AFN

Exacta Bioscience teams up with Ginkgo Bioworks to address scalability challenge for biologicals

by **Elaine Watson** — 08.31.23



Synthetic biology is transforming agriculture

Learn more:

- [Foundry Theory](#)
- [Ginkgo's Services for Ag Biologicals Discovery and Development](#)

Questions?



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