Advanced Research + Invention Agency

ARIA

Synthetic Plants

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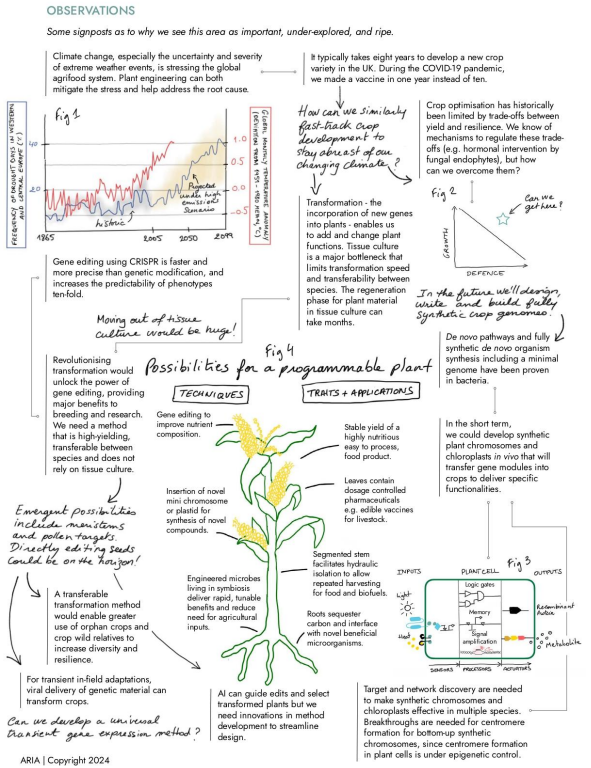
Opportunity space: Programmable Plants



Scale: Climate change is projected to decrease yield of major crops by up to -11%

We need food security in a changing climate, with:

+ **Lower emissions**

  Agriculture is responsible for ~20% of global GHG emissions

+ **Finite resources:**

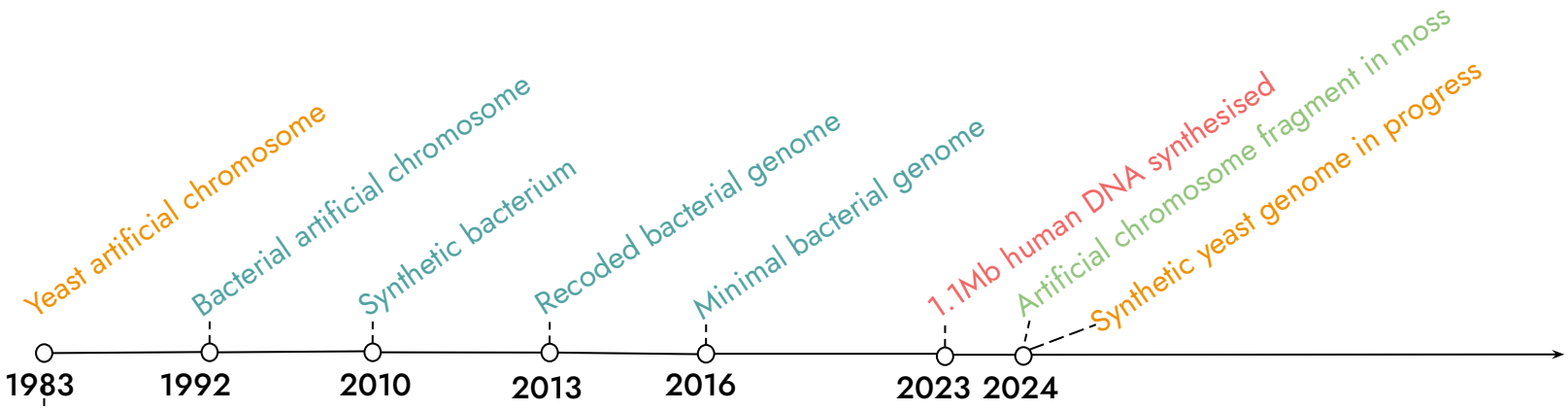
  Food production uses 50% of habitable land

+ **Better nutrition:**

  3.5 billion people are obese, overweight or malnourished

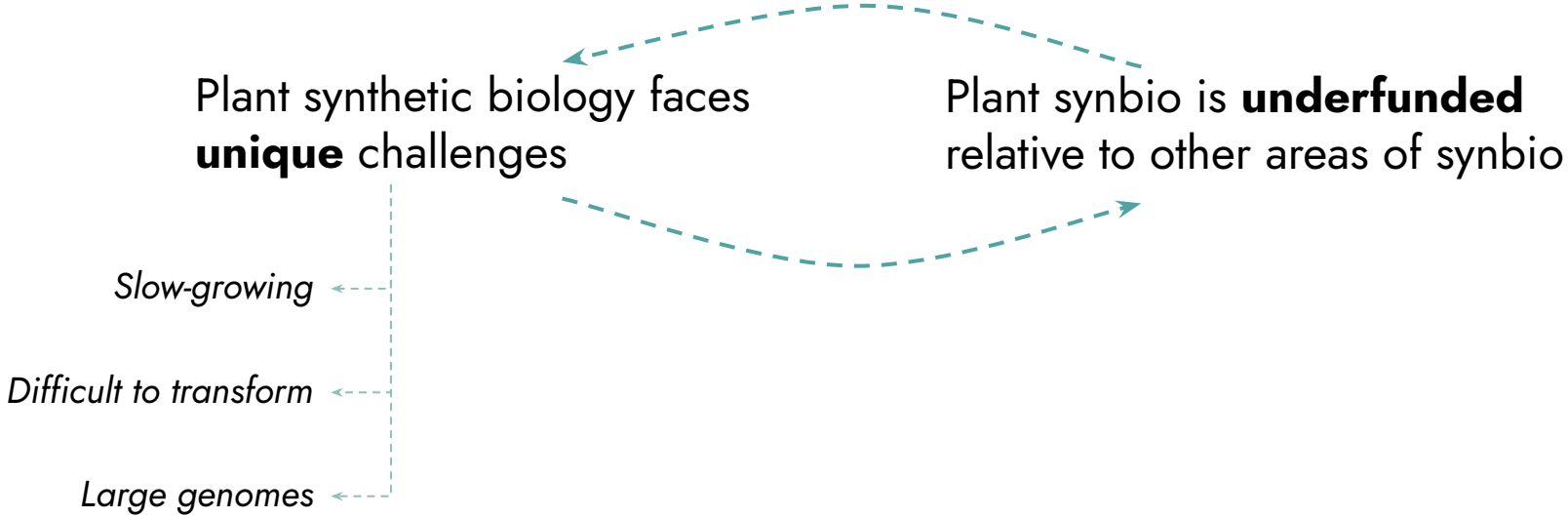
Programme: Synthetic Plants

Synthetic genomes offer exciting possibilities...but plants are woefully behind



Programme: Synthetic Plants

Plant synthetic biology is caught in a feedback loop



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Synthetic Plants

Establish synthetic genetic units in crop plants

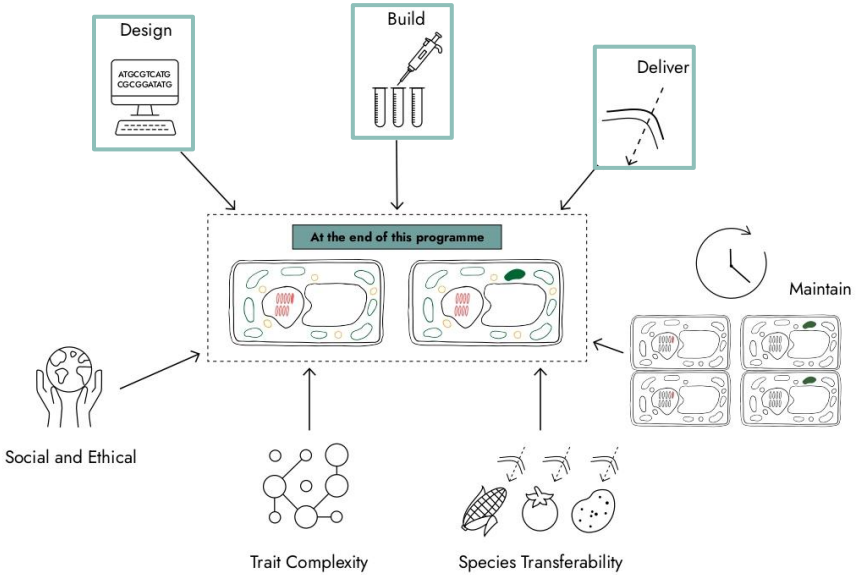
Programme: Synthetic Plants

Backed by **£62.4m** over five years, this programme will look to fund nine creator teams to:

+ Design, build, and deliver synthetic chromosomes and synthetic chloroplasts
+ Understand and address social and ethical considerations
+ Maintain the synthetic units
+ Establish synthetic units in different species
+ Build trait complexity

Technical Area 1

Design, Build & Deliver



# teams	3 teams for synthetic chromosomes 3 teams for synthetic chloroplasts
TA budget	£20.7m for each workstream - £41.4m
Length	3 years

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TA1.1: Design

Key Tasks:

+ Initially, developing multiple designs for units that deliver a simple trait
+ Subsequently, refining designs to improve trait delivery and to make necessary amendments based on the results of Build/Deliver
+ Development and testing of engineered biological 'switches' for turning units on and off *in vivo* (including a consideration of nuclear genes, for the chloroplast workstream)
+ Consideration of recoded genome approach for genetic isolation

Metrics of Success

+ Unit design delivers specified trait
+ Unit activity is regulated *in vivo* with at least the same level of nuance as in a natural occurrence of the trait

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TA1.2: Build

Key Tasks:

+ Synthesising DNA
+ Assembling large pieces of DNA
+ Testing viability of designed unit *in vitro*
+ Building units *in vitro* and *in vivo*

Metrics of Success

+ Unit is viable *in vitro*
+ Unit is viable and functional *in vivo* with at least the same level of functionality as in a natural occurrence of the trait

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TA1.3: Deliver

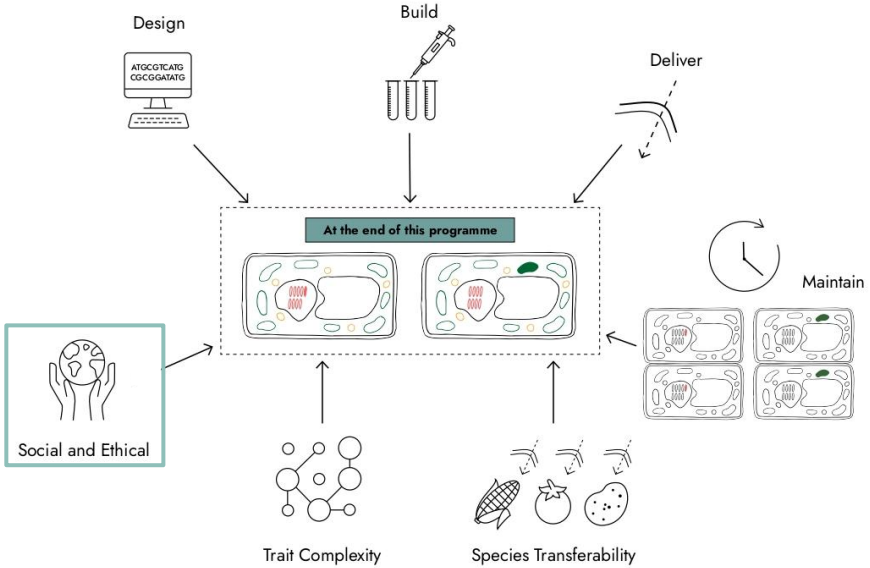
Key Tasks:

+ Developing and testing multiple delivery methods for inserting units into cells
+ Developing and testing assembly of units inside cells as an alternative to delivering assembled units
+ Developing and testing selection procedure for transformed organisms
+ For synthetic chromosomes: delivery of 1 Mb DNA into cell
+ For synthetic chloroplasts: delivery of 100-150 kb DNA into chloroplast within cell

Metrics of Success

+ Unit can be inserted into or assembled inside cells with >5% success rate
+ Transformed organisms can be selected rapidly and accurately, with a greater throughput for identifying transformants than is currently possible in tissue culture

Technical Area 2



Social & Ethical

# teams	3 teams
TA budget	£3.1m
Length	3 years

TA2: Social and Ethical

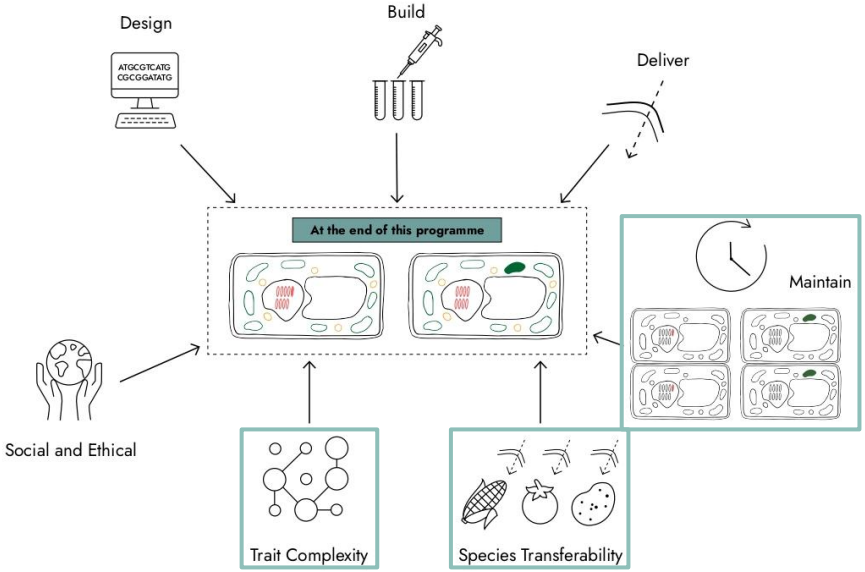
Key Tasks:

+ Studies of the possible opportunities and projected implications of synthetic plants (including advantages and disadvantages) for a range of stakeholders including farmers, industry supply chains, governance stakeholders and public
+ Review of ethical issues around synthetic plants
+ Public engagement to understand public opinion on synthetic plants and engage with public concerns, including understanding which of the proposed benefits of synthetic plants are considered credible and acceptable, and under which circumstances

Metrics of Success

+ Diverse stakeholders engaged
+ Ethics roundtable held and outcomes published in public domain
+ 5 public engagement activities carried out (including surveys and workshops)

Technical Areas 3 to 5



Maintain, Species Transferability, and Trait Complexity

# teams	2 teams for synthetic chromosomes 2 teams for synthetic chloroplasts
TA budget	£9m for each workstream - £18m
Length	2 years

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TA3: Maintain

Key Tasks:

+ Initially, considering what is necessary for maintenance and replication of the unit within the cell, and prototyping in this area
+ Subsequently, ensuring maintenance and replication of the unit within the cell
+ Testing the functionality of the unit within the cell
+ Development of appropriate biological containment methods for the unit

Metrics of Success

+ Unit replicates inside the cell
+ Unit remains stable, viable and functional after 5 cell divisions with the same level of functionality as prior to cell division
+ Growth rate is not significantly lower than in equivalent organisms without the synthetic unit

TA4: Species Transferability

Key Tasks:

+ Demonstrate that the unit functions in multiple species

Metrics of Success

+ Unit functions in three major crop species including one monocot and one dicot

TA5: Trait Complexity

Key Tasks:

+ Successfully deliver an agriculturally relevant complex trait using the synthetic unit

Metrics of Success

+ Unit delivers a complex trait that could not readily be introduced by breeding or gene editing

Next steps: Apply!

Applications open	4 September 2024
Concept paper submission deadline	25 September 2024 (12:00 BST)
Concept paper review + notification of encouraged/not encouraged to submit a full proposal	26 September 2024 - 15 October 2024
Full proposal submission deadline	12 November 2024 (12:00 BST)
Meet applicants	6 - 17 January 2025
Successful/Unsuccessful applicants notified	29 January 2025

Programme: Teaming

Purpose: A tool to allow creators to form teams to collaborate and produce a proposal

Launch: 12 August

Event: 11 September

Find out more

Read the call for proposals	www.aria.org.uk/synthetic-plants
Application portal walkthrough	www.aria.org.uk/wp-content/uploads/2024/03/ARIA-Applicant-walkthrough-of-the-Good-Grants-portal.pdf
Learn more about how we fund	www.aria.org.uk/how-we-fund www.aria.org.uk/faqs/faqs-how-we-fund
Any other questions	clarifications@aria.org.uk