

This is a repository copy of *Molecular tools to engineer cyanobacteria for industrial biotechnology*.

White Rose Research Online URL for this paper:  
<http://eprints.whiterose.ac.uk/132410/>

---

**Conference or Workshop Item:**

(2017) *Molecular tools to engineer cyanobacteria for industrial biotechnology*. In: *Cyanobacterial biotechnology: technologies to applications to products*, 11-12 May 2017.

---

**Reuse**

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

**Takedown**

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing [eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk) including the URL of the record and the reason for the withdrawal request.

# Molecular tools to engineer cyanobacteria for industrial biotechnology

Mary Ann Madsen<sup>1</sup>, Graham Hamilton<sup>2</sup>, Thierry Tonon<sup>3</sup>, Pawel Herzyk<sup>2</sup>, Anna Amtmann<sup>1</sup>

<sup>1</sup> Institute of Molecular, Cell and Systems Biology, College of Medical, Veterinary and Life Sciences, University of Glasgow

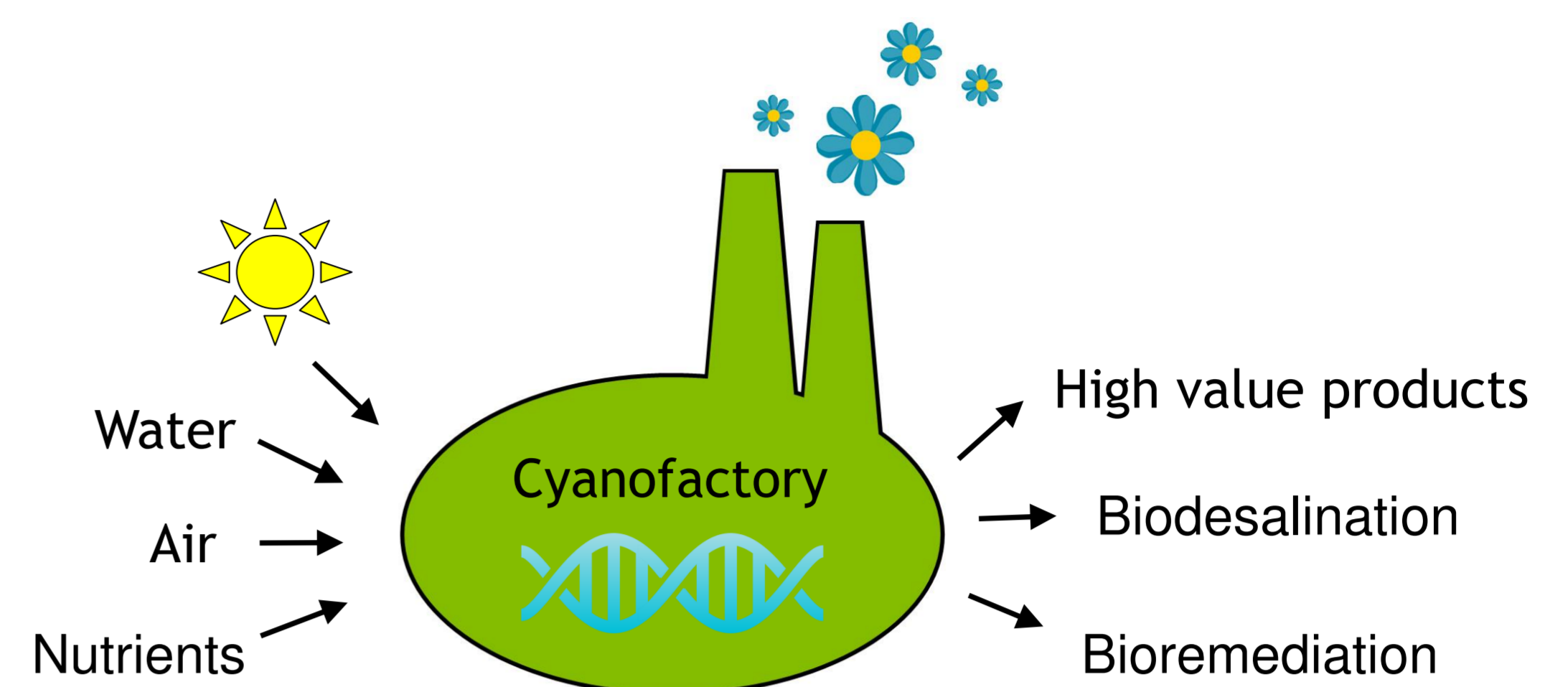
<sup>2</sup> Glasgow Polyomics, College of Medical, Veterinary and Life Sciences, University of Glasgow, G128QQ

<sup>3</sup> Centre for Novel Agricultural Products, Department of Biology, University of York

## Cyanobacteria as a sustainable chassis

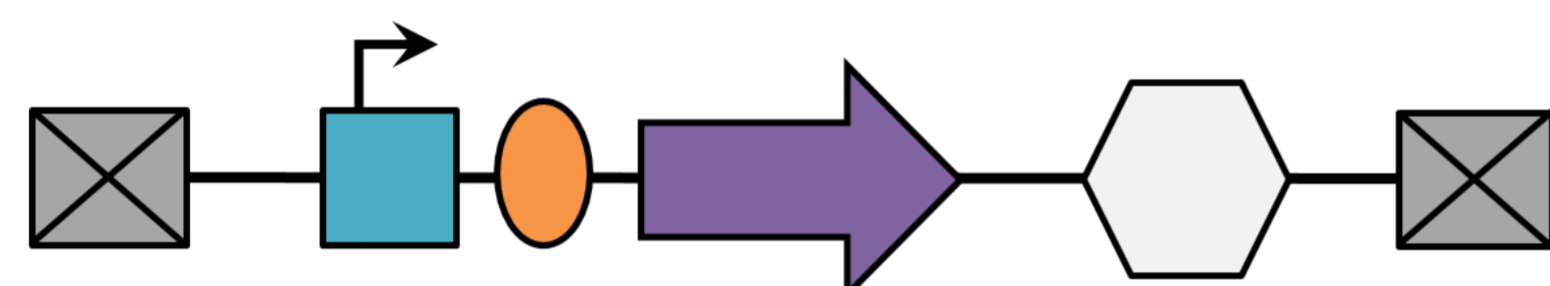
- Prokaryotes - simple organisms, rapid growth, small genomes, easily transformed
- Photosynthetic - minimal input, therefore cheap feedstock and lower risk of contamination
- Extremely diverse - habitat, morphology, metabolism, wide range of natural products

...but the engineering toolbox is still limited



## Introducing foreign DNA

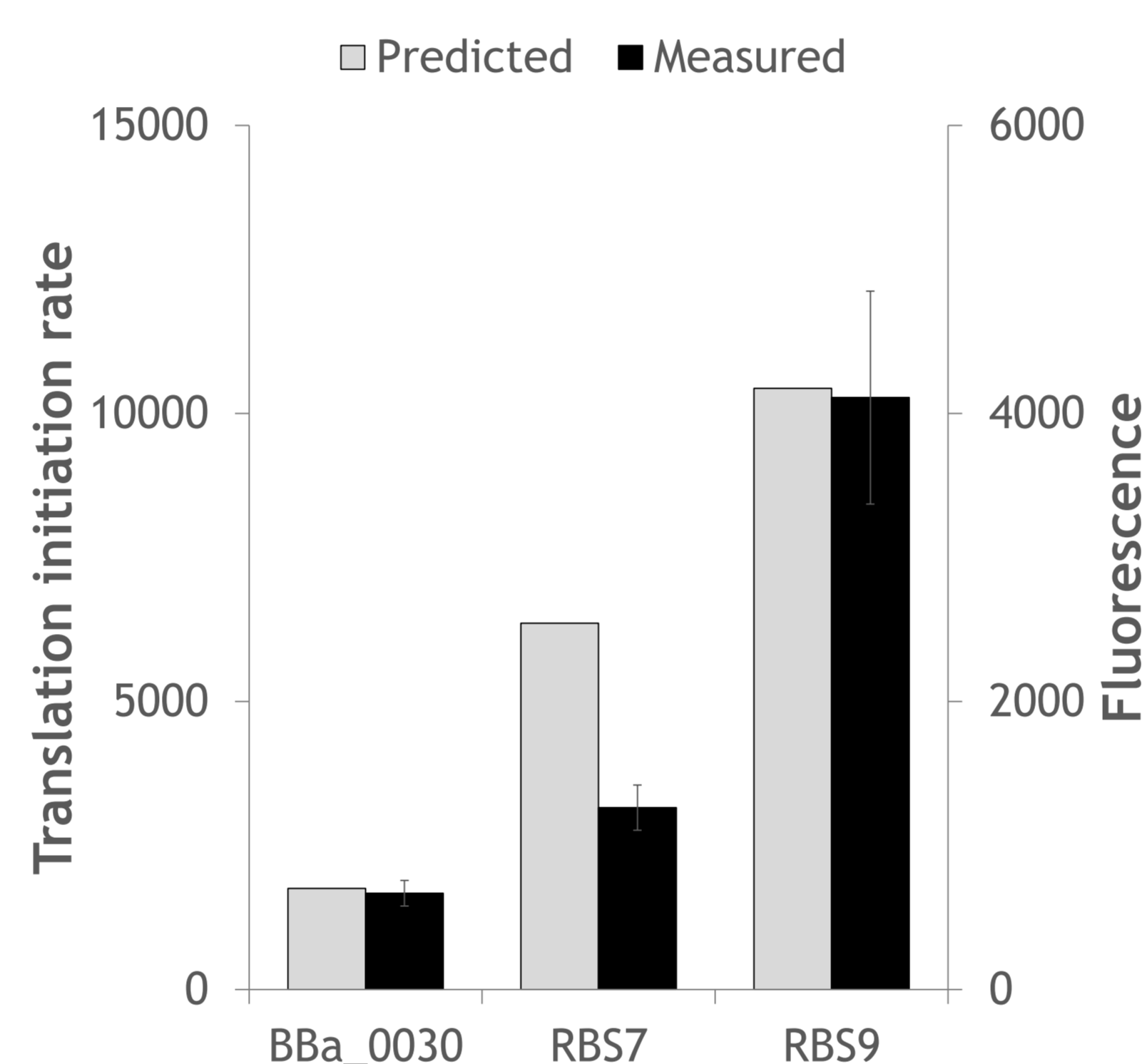
- Plasmid vectors for stable integration to neutral sites in the genome
- BioBrick compatible



- ⊠ Homologous recombination sites
- Promoter
- Ribosome binding site
- Protein coding sequence
- ⬡ Selectable marker

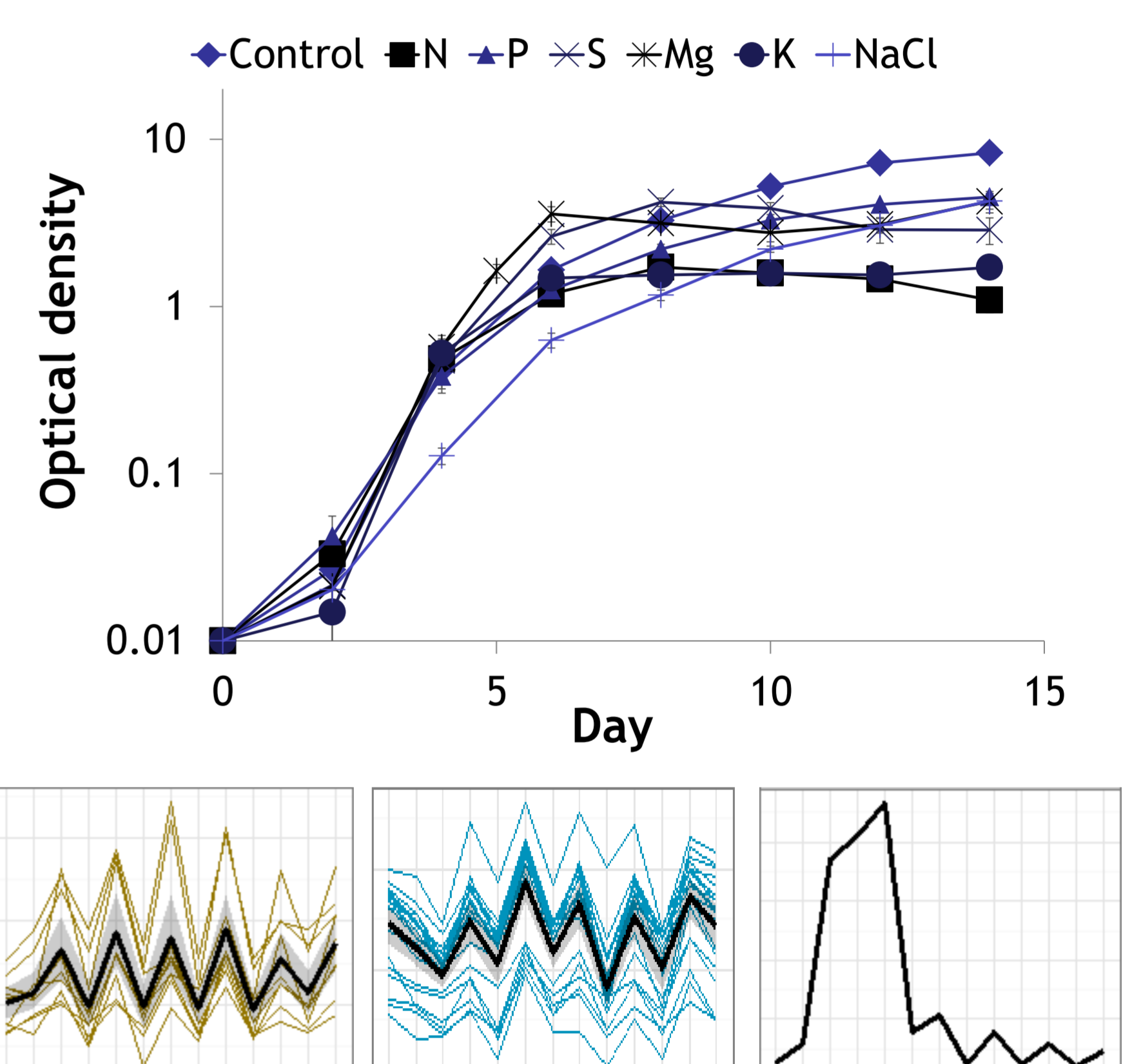
## Controlling translation initiation

- Forward engineering of synthetic ribosome binding sites based on *in silico* calculators



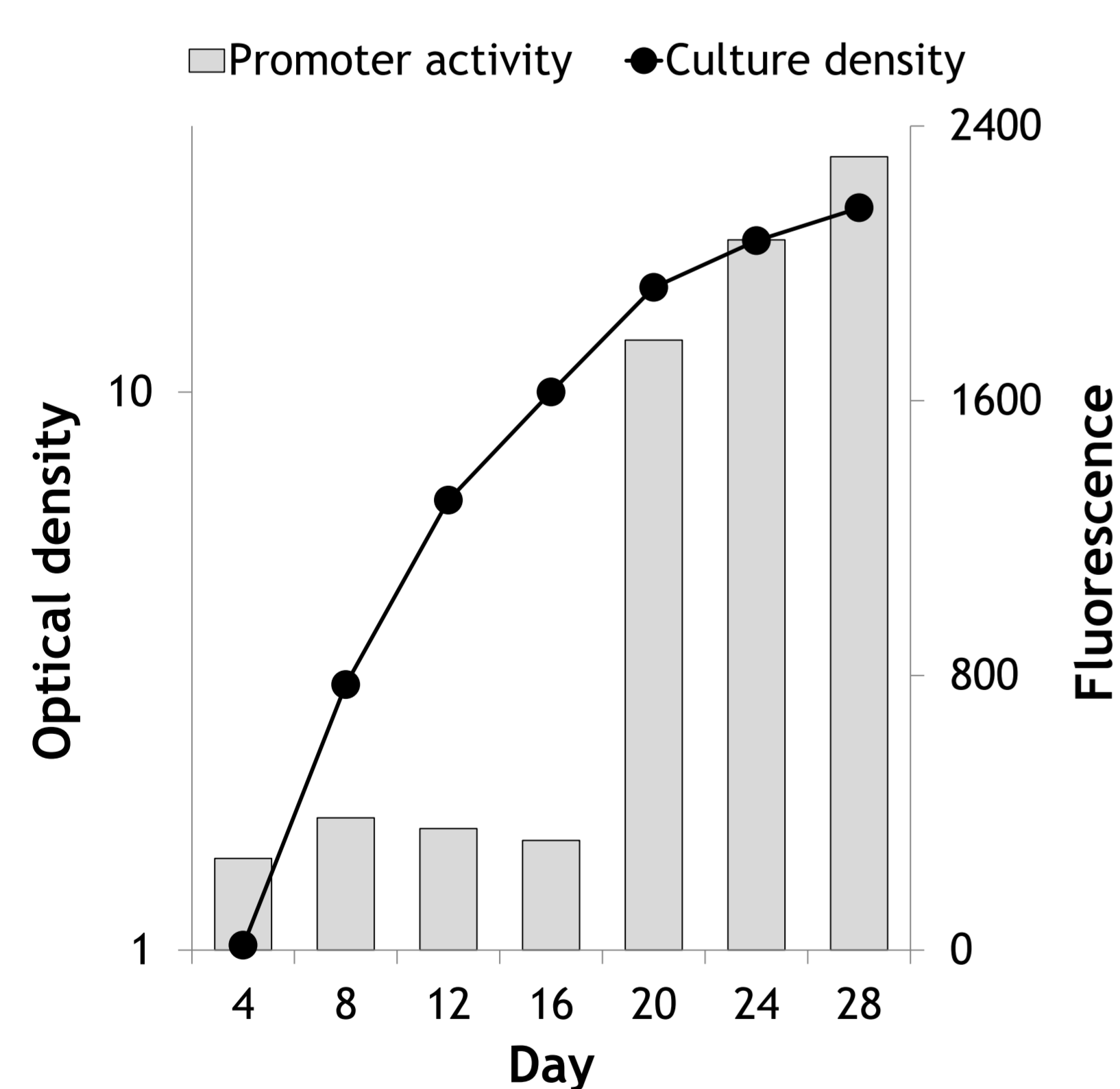
## Controlling growth kinetics

- Defined conditions, extensive RNAseq analysis



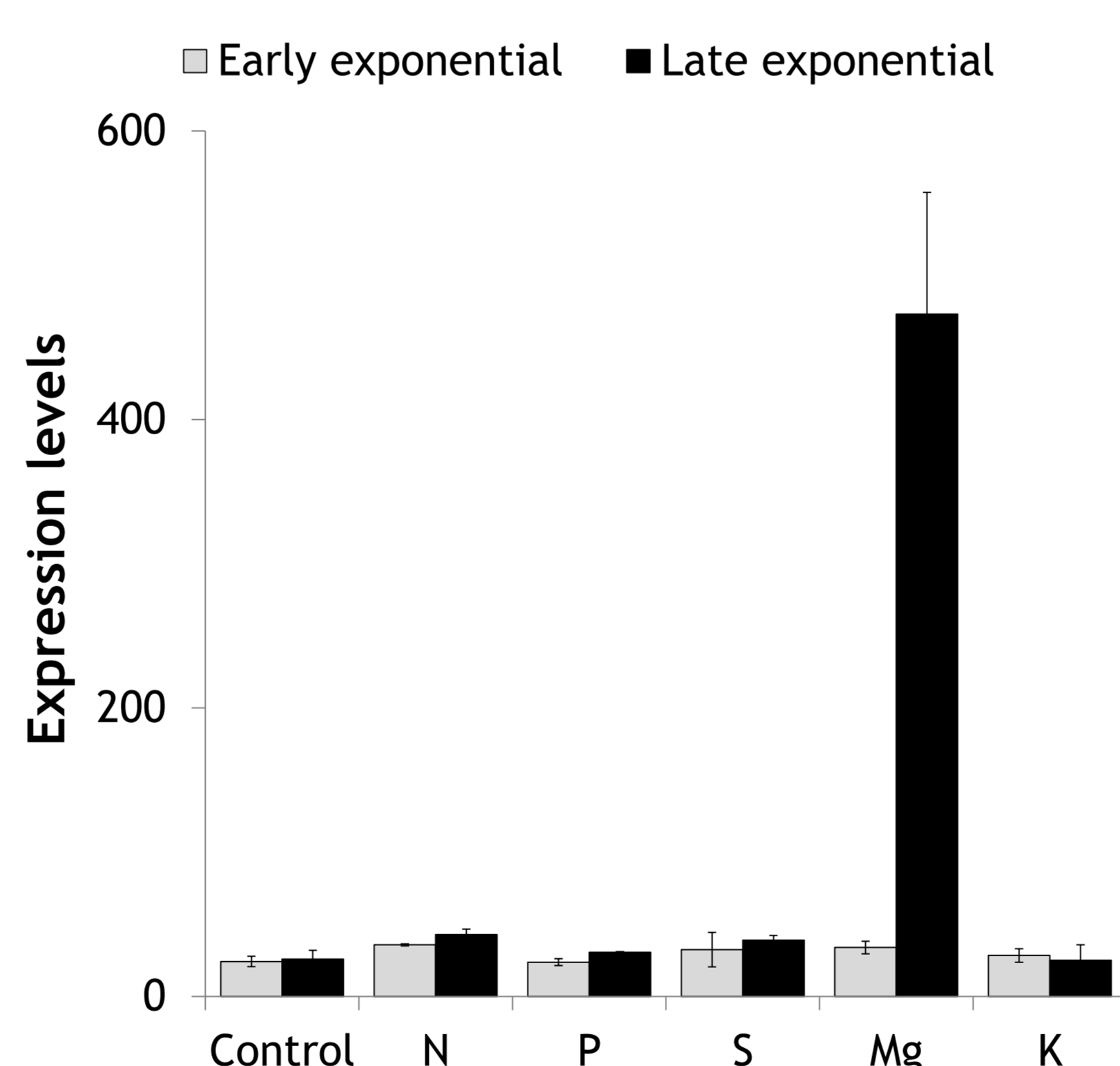
## Growth-responsive transcription

- Induced in the late exponential phase



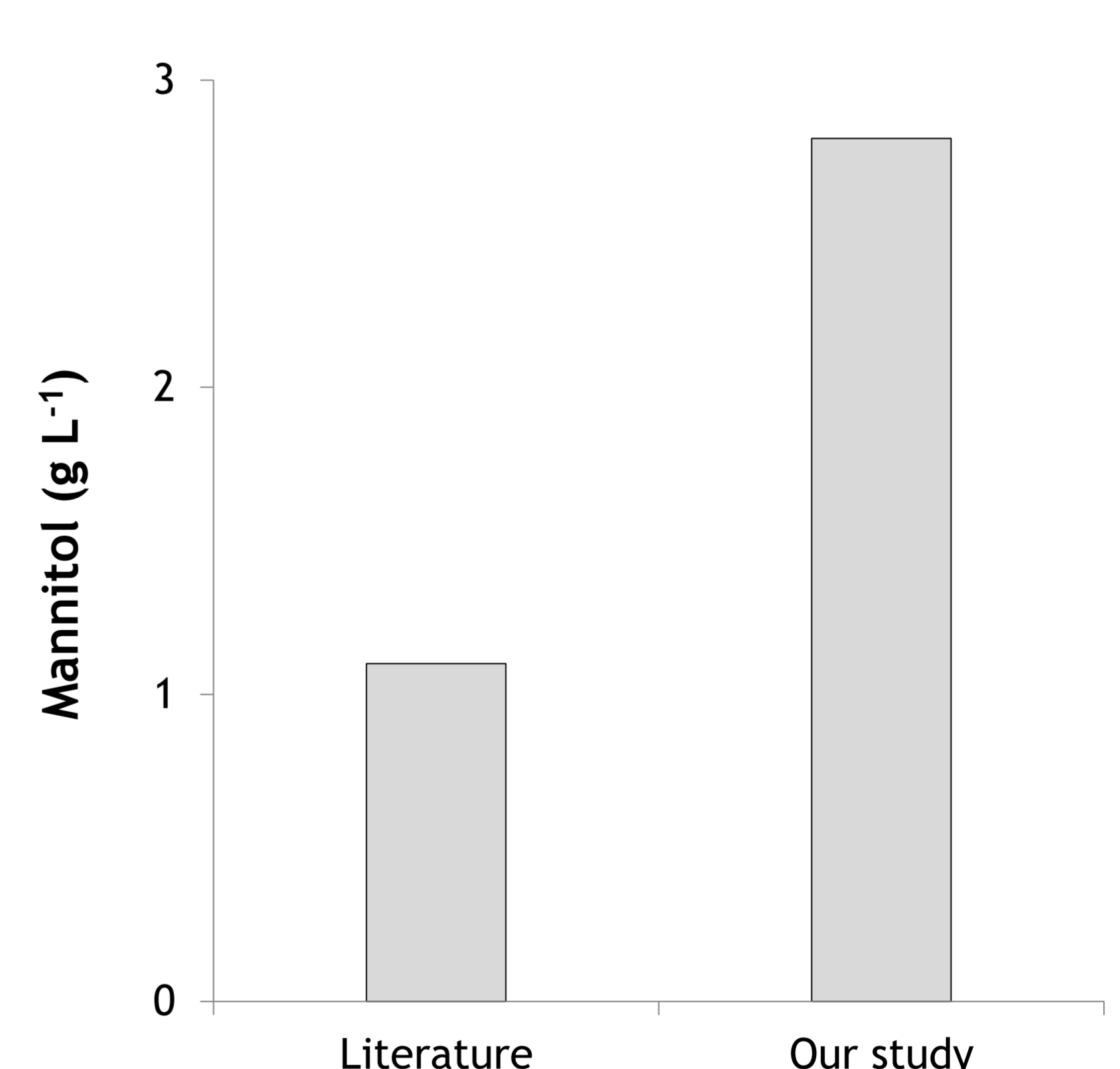
## Nutrient-responsive transcription

- Induced under specific nutrient limitations



## Enhanced product synthesis

- Better tools make for better titres



## Summary

- A comprehensive toolkit has been established for rapid, rational design of cyanobacteria
- Control at various levels of the production process: culture growth, transcription, translation and ultimately product synthesis
- Novel conditions to modulate growth kinetics identified and transcriptomic responses analysed
- Novel growth phase- and nutrient-responsive promoters developed

