

*Photorhabdus* symbiology  
The Benefit of COST 850

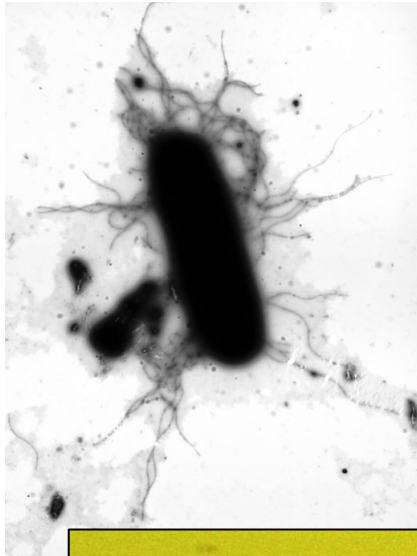
**Dr David Clarke**  
**Dept of Biology and Biochemistry**  
**University of Bath**

# WG1 Symbiosis Biology

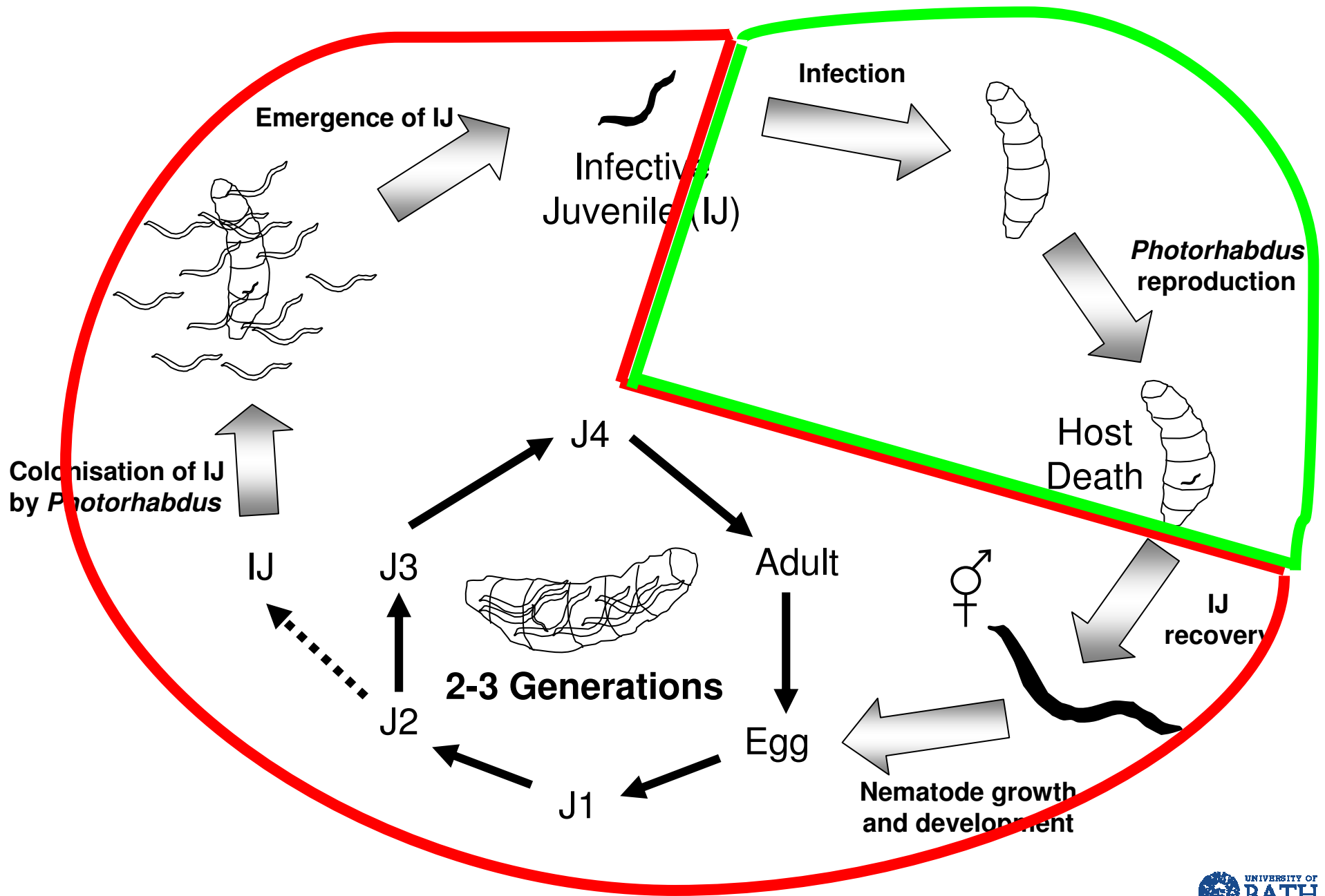
- 2 WG1 symposia were held in Kolymbari, Crete
  - July 6-9, 2002
  - July 15-17, 2005
- Attended by >50 researchers from 20 different countries
- Both symposia brought together a range of researchers with different interests in symbiology and genomics
  
- Dr Kostas Bourtzis



# *Photorhabdus*

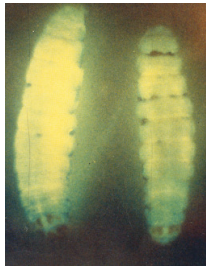


- Gram negative rod
- family *Enterobacteriaceae*
  - Close relative of mammalian pathogens
- bacterium with a complex symbiotic life cycle
  - Pathogen of insects
  - Mutualist of nematodes



# Genomes

- *Photorhabdus luminescens* TT01
  - Published in 2003
  - <http://genolist.pasteur.fr/PhotoList>
- *Photorhabdus asymbiotica*
  - Finishing
  - <http://www.sanger.ac.uk>
- *Xenorhabdus bovienni* and *Xenorhabdus nematophila*
  - <http://www.xenorhabdus.org>



# *Photobacterium luminescens* genome

## Bioluminescence

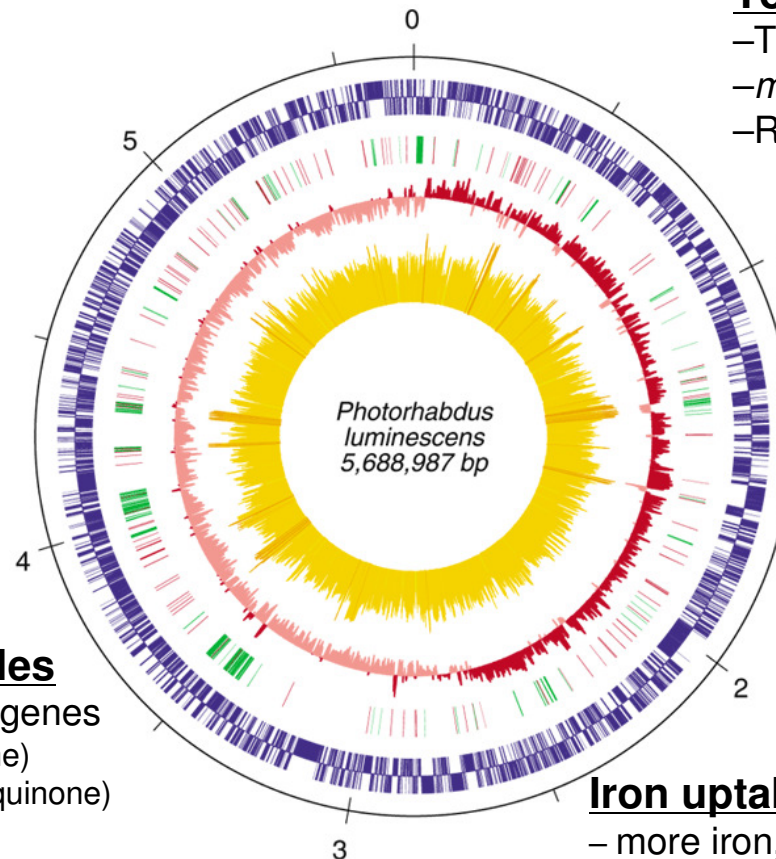
– Product of *luxCDABE* operon

## Extracellular enzymes

- lipase (10 genes)
  - phospholipase A and D
- protease
- chitinase

## Bioactive molecules

- 33 PKS and NRPS genes
  - Antibiotic (stilbene)
  - Pigment (anthraquinone)
  - Siderophores



## Toxins

- Tc toxins
- *mcf*
- RtxA-like toxins

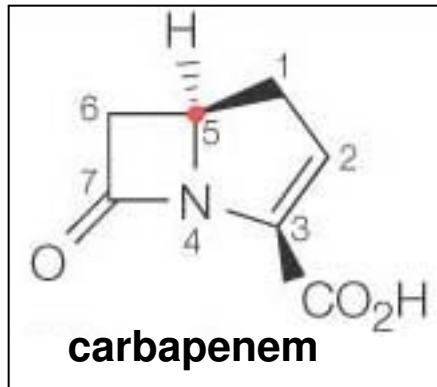
## Regulators

- 32 *luxR* genes
- 19 2CP
- 10  $\sigma$  factors
- no GGDEF/EAL-domain containing proteins

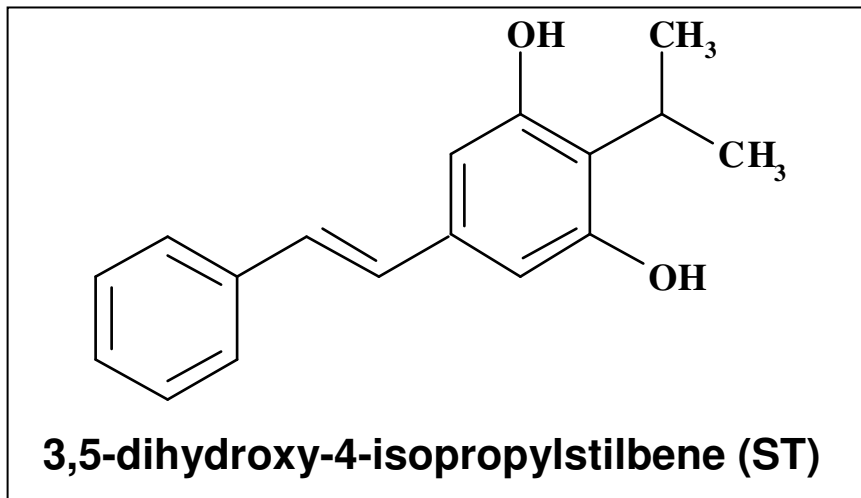
## Iron uptake

- more iron, heme, hemin and siderophore transporters than any other sequenced bacteria

# *Photorhabdus* antibiotics

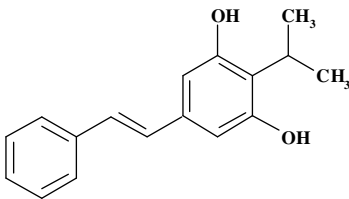


Exponential phase  
Active against Gram negative bacteria



Stationary phase  
Active against Gram positive bacteria,  
including MRSA

# ST antibiotic



antibiotic



phenoloxidase

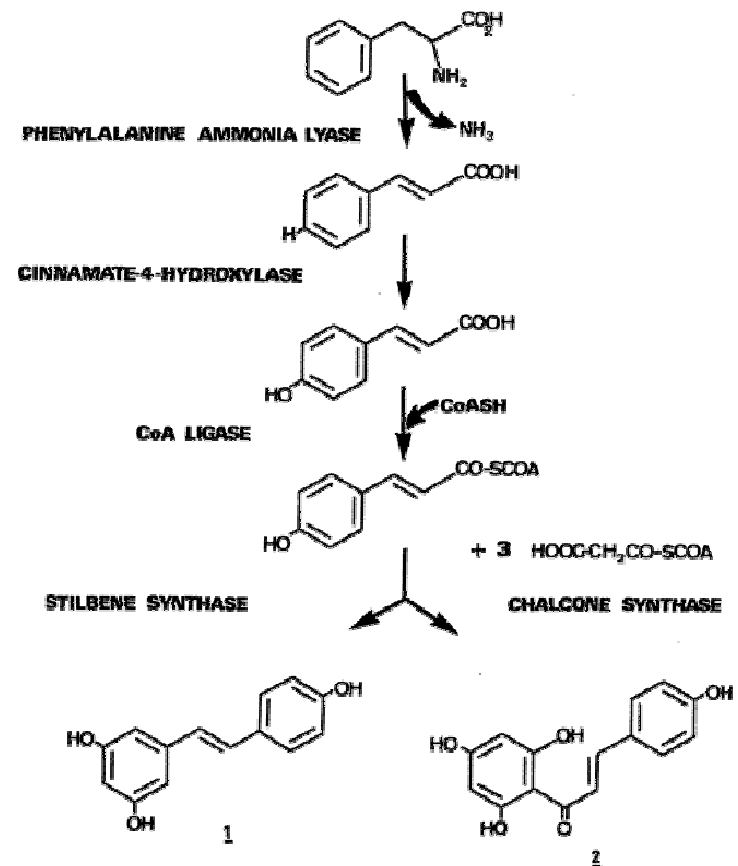
IJ recovery  
"food signal"

# Stilbenes

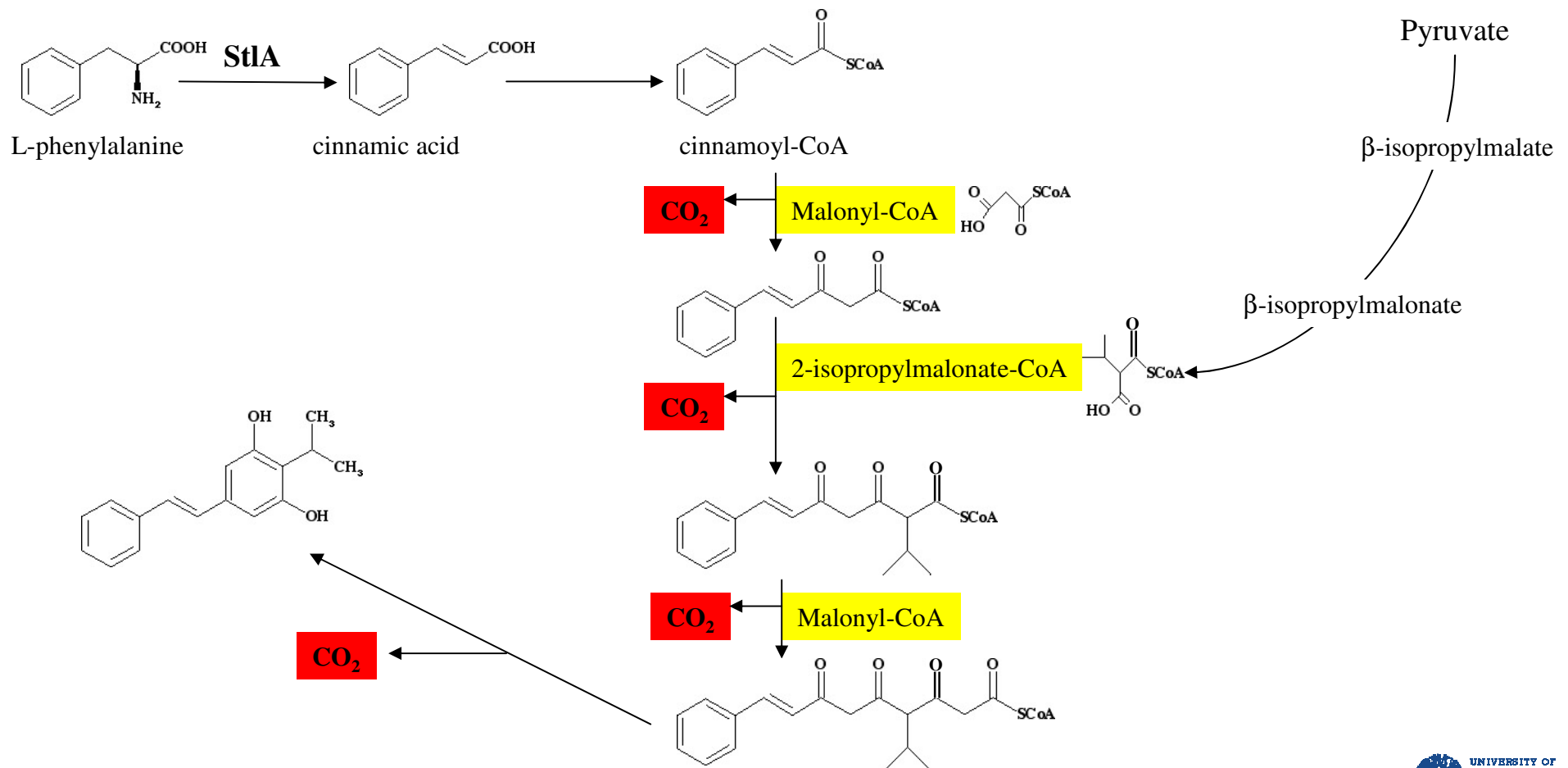
- An important family of polyketide molecules
- normally produced by plants

## Resveratrol

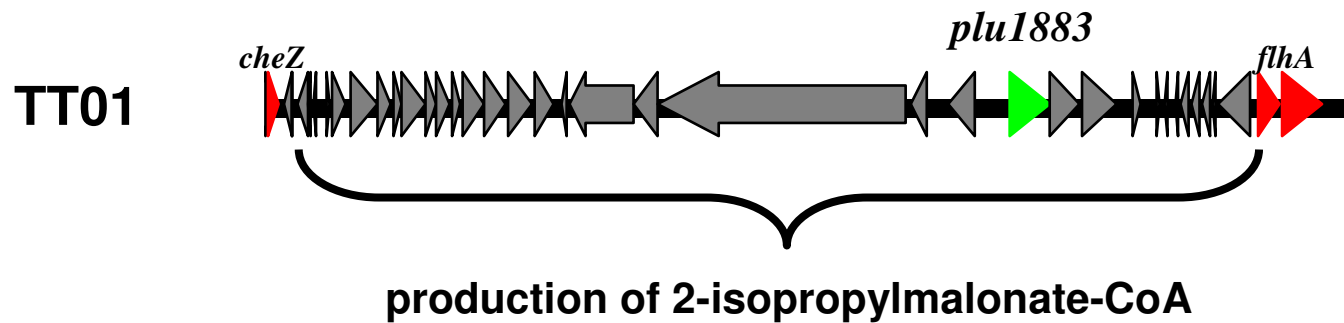
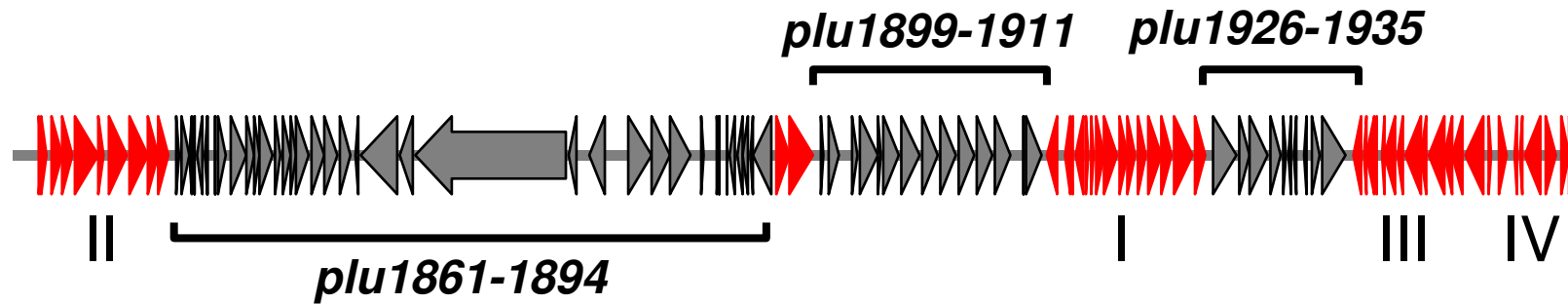
- stilbene produced by grapes
  - Highest levels found in Pinot noir grapes
- Associated with decreased risk of cardiovascular disease observed in moderate red wine drinkers
  - The “French paradox”
- In addition has been shown to have anti-inflammatory, anti-cancer, anti-microbial and anti-ageing affects



# ST production in *Photorhabdus* involves a novel biochemical pathway

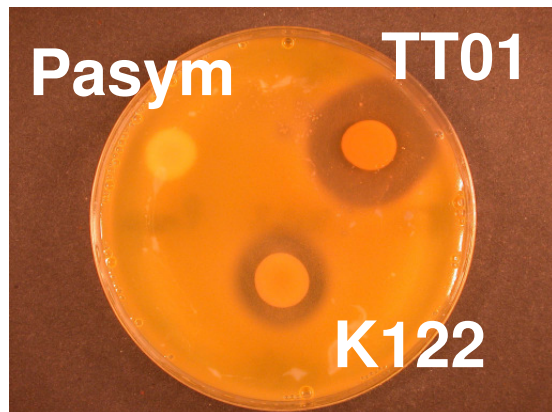


# The flagella biosynthesis locus



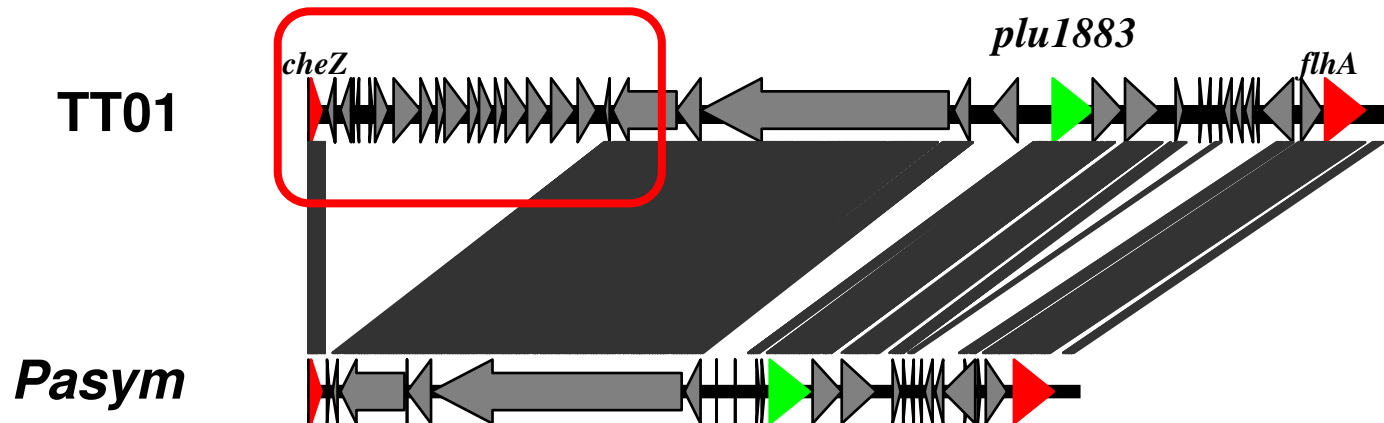
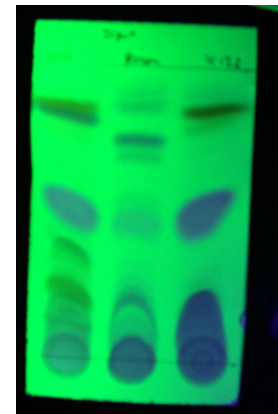
# Genomics and stilbene production

## *Micrococcus* overlay

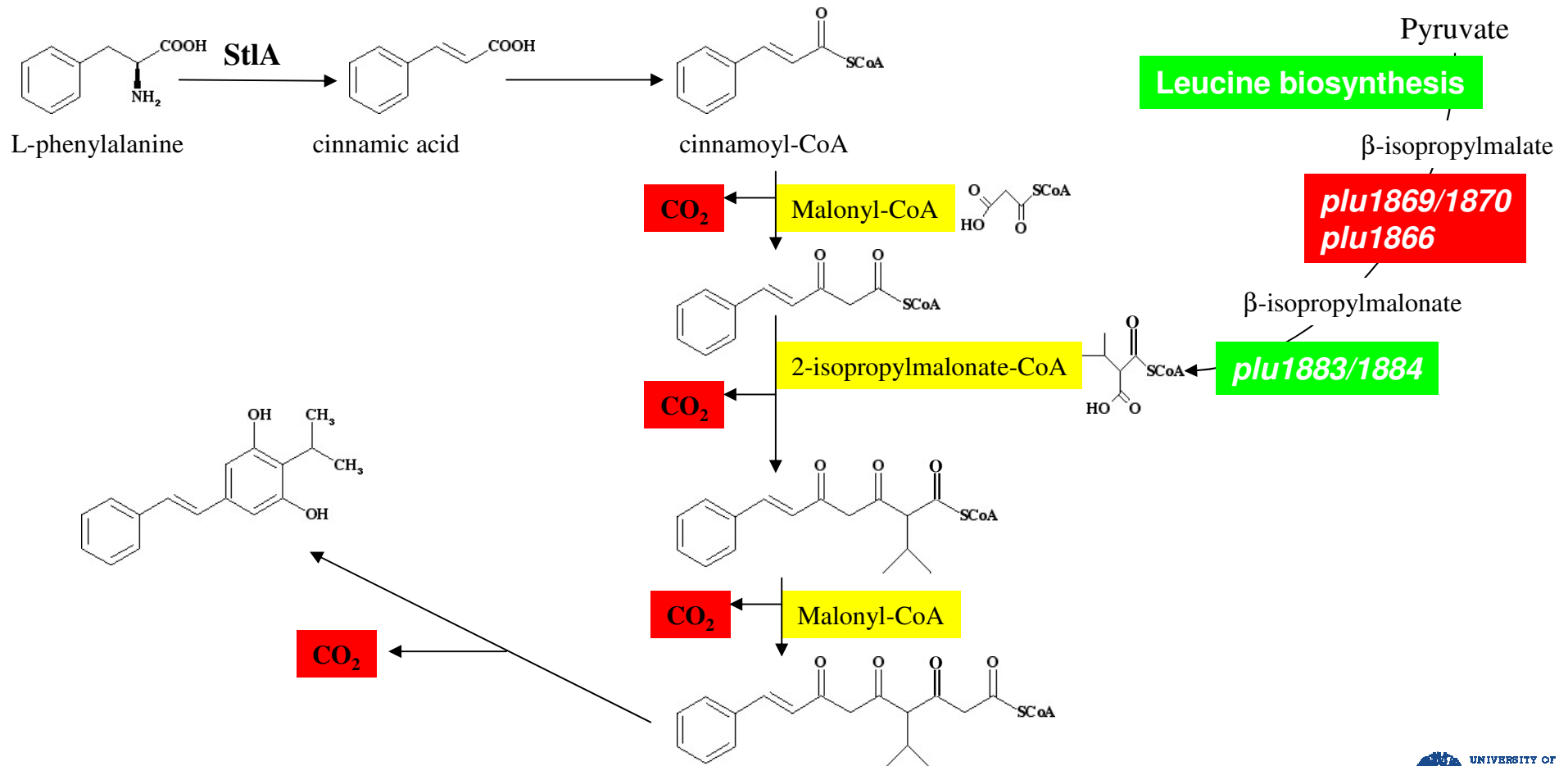


## TLC

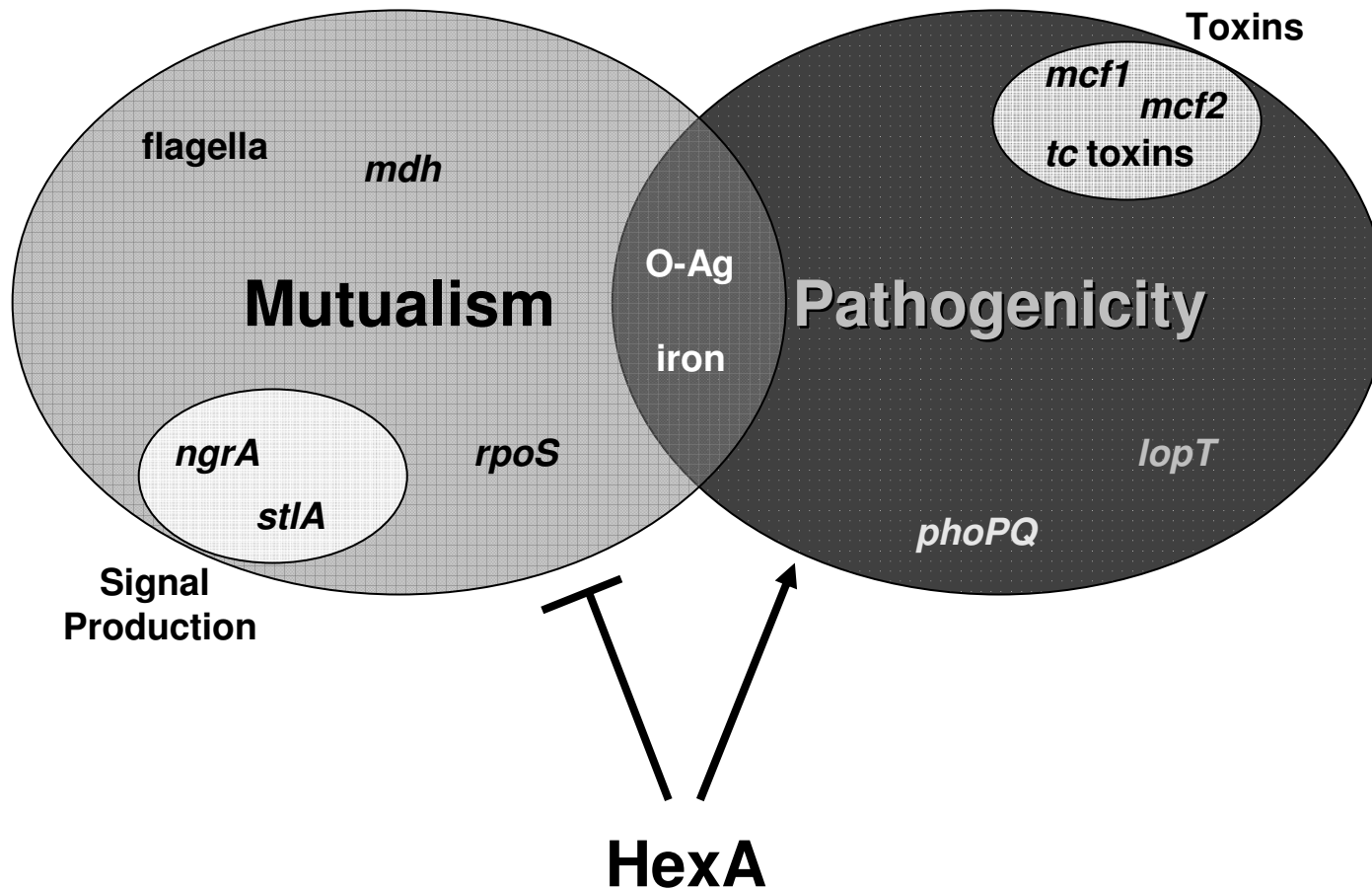
TT01 Pasym K122



# Reduced levels of ST production in *P. asymbiotica* due to reduced production of substrate



# Sym-Pathy



# Post-genomic future

- Functional genomics
  - Transcriptomics
  - Proteomics
- Drug discovery
  - Toxins
  - Novel bioactive molecules
- Systems biology
  - Metabolic engineering

# The Molecular Microbiology Laboratory

## Photorhabdus

- Dr. Susan Joyce
- Dr. Jane Williams
- Helen Bennett
- Rob Watson
- Hilton McWeeney
- Prof Itamar Glazer



## Collaborators

- RffC lab and SER lab





# WG1 Symbiosis Biology

- A key objectives of COST 850 was to increase the understanding of symbiosis biology (symbiology)
- During this COST action genome sequences from many different symbionts were published
- WG1 recognised the different ways that data being generated during sequencing projects could be exploited e.g. functional genomics, comparative genomics

# Photorhabdus OR Xenorhabdus

- 2000-2005: 273 publications (ISI Web of Science)

