



# The John Innes Centre

Inward Mission on Crops and Agri-biotech

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# Institute Strategic Programmes

## SUS



- PLANT-ENVIRONMENT INTERACTIONS
- RESPONSES TO BIOTIC & ABIOTIC STRESS
- NUTRIENT ACQUISITION

LIVING WITH ENVIRONMENTAL CHANGE

## MET



- PLANT AND MICROBIAL METABOLISM
- MICROBIAL SYSTEMS BIOLOGY
- NATURAL PRODUCTS
- RAW MATERIAL QUALITY

BIO-BASED PRODUCTS SUSTAINABLE PRODUCTION

## GRO



- PLANT GROWTH AND DEVELOPMENT
- CROP GENETICS
- CROP PRODUCTIVITY
- BREEDING SYSTEMS

SUSTAINABLE YIELD FOR FOOD SECURITY

# Delivery

- **60 Project Leaders and Strategic Research Scientists**
- Extensive collaboration within and between themes
- **Integrated ‘research clusters’ – translation**
- Embedded specialist technologies

# Health: Development of Model Foods

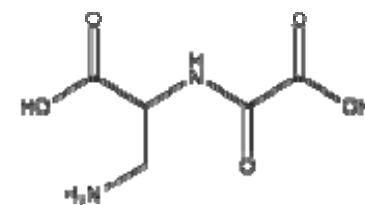
## Understanding the links between food and health



Broccoli - glucosinolates



Tomato - flavonoids



ODAP

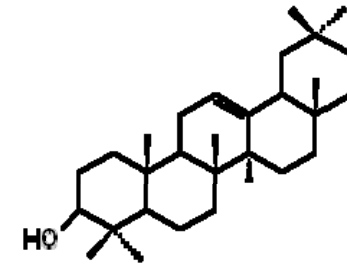
Acyanogenic –  
Cassava & Sorghum

## BioActives in vegetable crops

# BioActives from Plants



**Herbicides**  
**Antibiotics**  
**Fungicides**  
**Insecticides**  
**Nematocides**



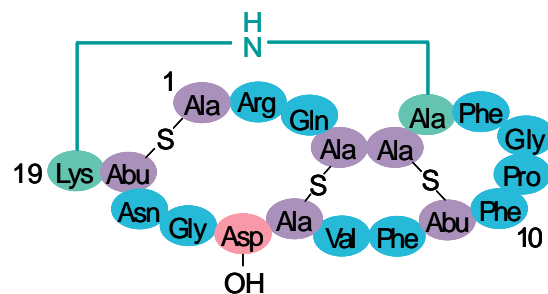
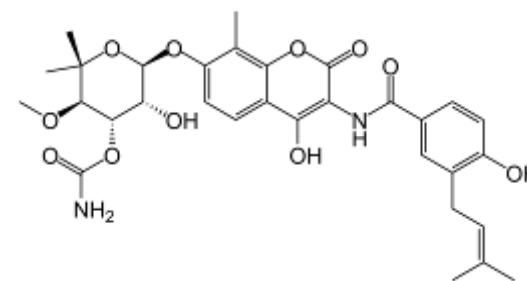
**Triterpines**



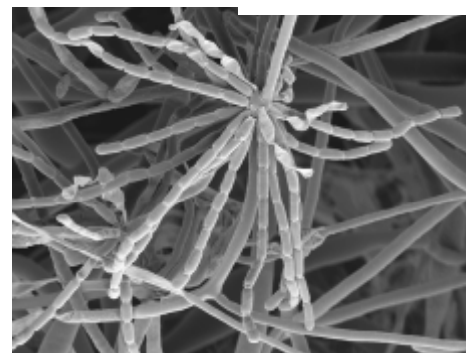
# BioActives from Microbes



## Streptomyces

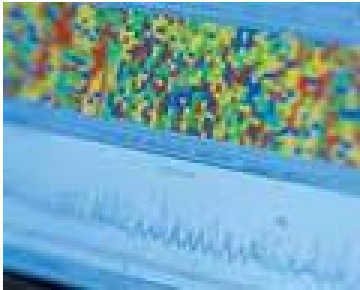


Cinnamycin



# Mutation Breeding

## TILLING



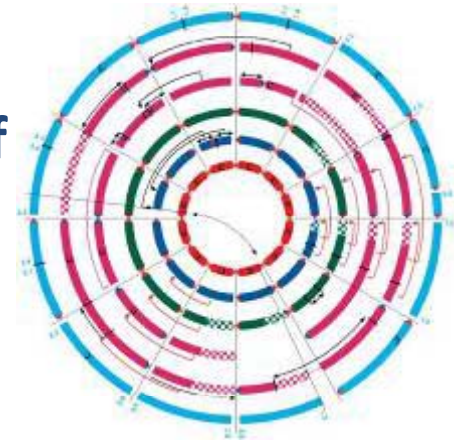
- **Non GM strategy for crop improvement**
  - Chemical mutagenesis
  - Reverse genetic screening
  - Recovery of allelic mutant series
  - Screening for trait improvement
- **Deployment**
  - Elite breeding lines
  - Anti-nutritionals
  - Viral resistance

**RevGenUK**

# Wheat improvement: Alien variation

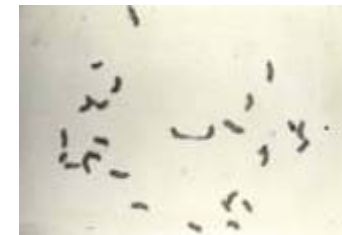


- Step changes in wheat improvement (conserved order of genes in different crops)
  - ❑ Synteny and breeding
  - ❑ *Ph1* and introgression
- New opportunities
  - ❑ new synthetics
  - ❑ alien introgression
- Crossability, heterosis, perenniality, apomixis, parthenocarpy

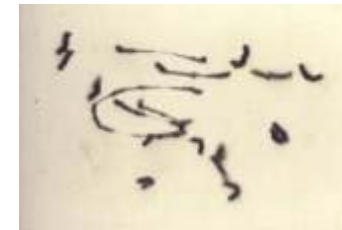


Wheat hybrid

*Ph1* +

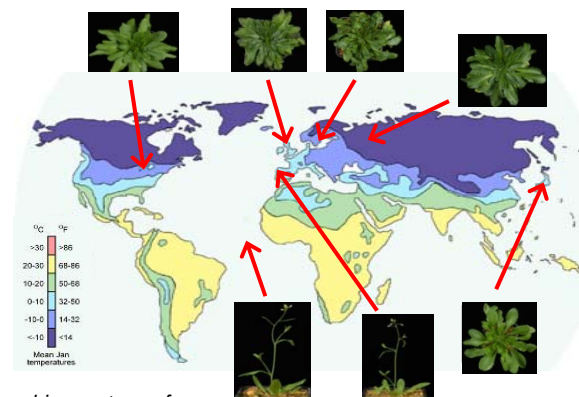


*Ph1* -



# Adapting to climate change

- Re-adapting crops to changed season lengths, winters (vernalisation, Ppd1...)
- Protecting against new pests and pathogens
  - ❑ Durable broad spectrum resistance: basal and partial resistance, engineering major R genes (TSL interactions)
  - ❑ Understanding epidemics, variation & populations
- Resilience to physical stresses
  - ❑ temperature, drought, salinity...



Graphic courtesy of Paul Pople (TOC)

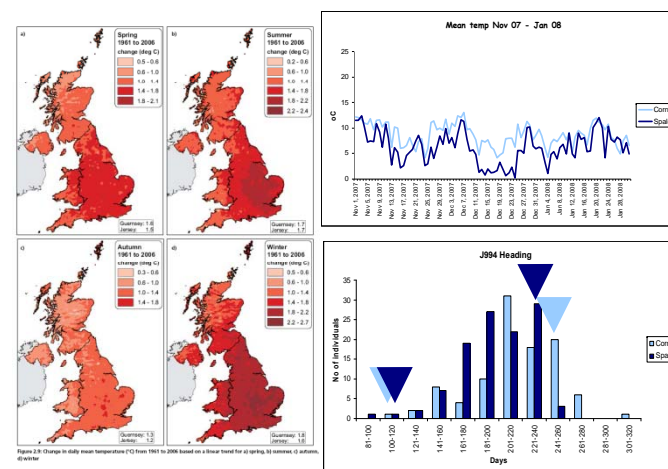
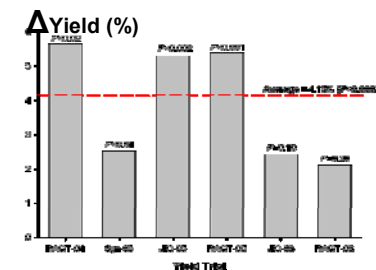
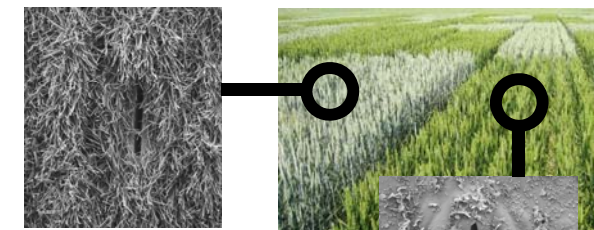
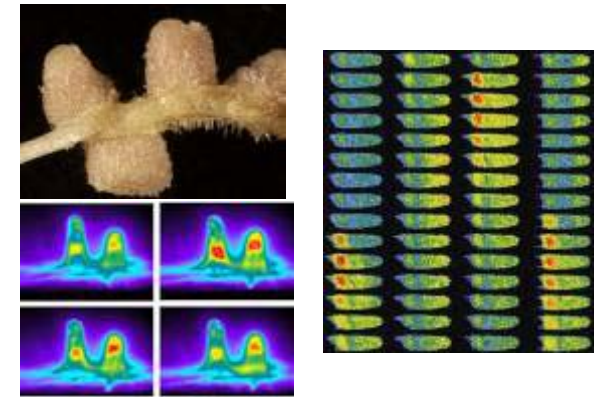


Figure 2.9: Change in daily mean temperature (°C) from 1961 to 2006 based on a linear trend for (a) spring, (b) summer, (c) autumn, (d) winter.

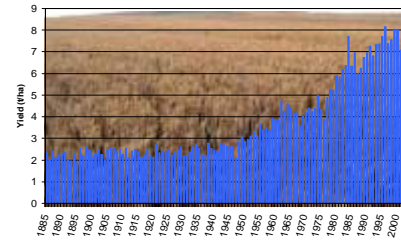
# Reducing footprints, inputs, ghg emission

- **Extending the range of biological nitrogen fixation from legumes**
  - ❑ Inorganic fertiliser main energy cost, source of ghg emission in agriculture
  - ❑ Key bottlenecks identified suggest can extend from legumes... rice... wheat...
- **Enhancing nutrient use efficiency**
  - ❑ N, P, K water

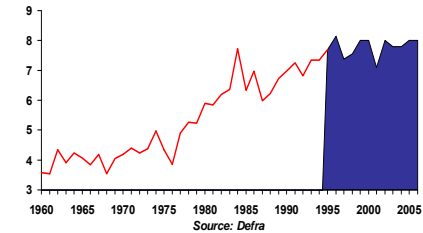


# Enhancing yield, yield resilience

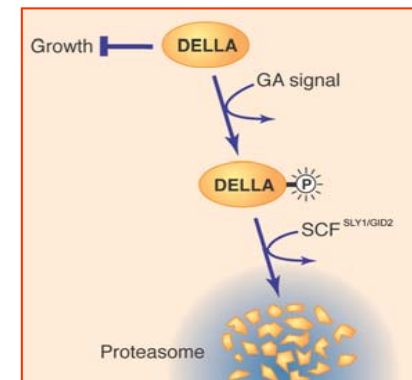
➤ Stagnation in yield gains



➤ Yield penalty, balancing health and quality gains with yield losses



➤ Novel yield, yield-resilience genes from cereal genetics

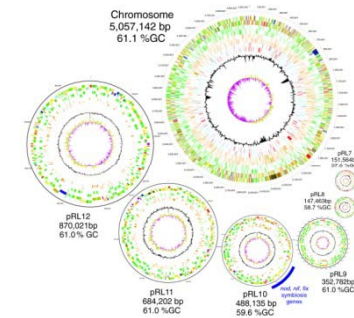


➤ Yield QTLs “coming in range”

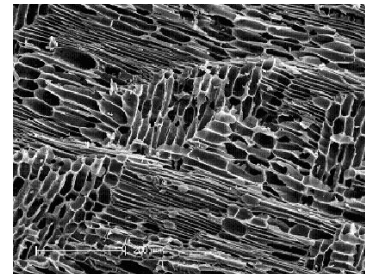


# Soil Improvement

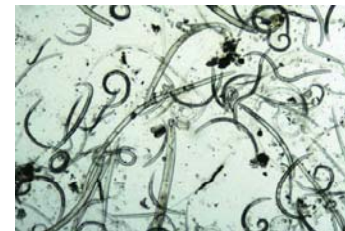
- **Microbial inoculums**
  - Rhizosphere colonisation
  - Metagenomics
  - Metabolic Maps
  - Metatranscriptomics



- **Soil conditioners**
  - Chars
  - Digestates



- **Bio-pesticides**
  - Natural plant oils



## Materials & Chemicals

- Novel industrial polymers
- Improved fibre
- Lignin as bioresins



## Biofuels

- Bio-conversion wheat and Brassica straw
- Optimal alcohols



# JIC: 100 years of genetics

*Genetics*

John Innes

*100 years on*