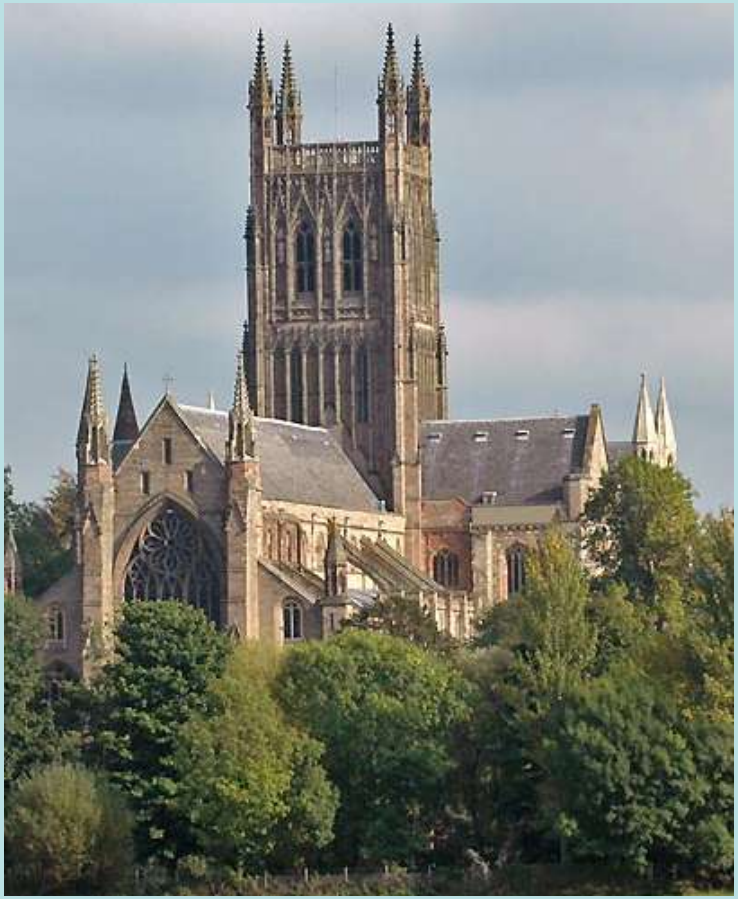
From crops to weeds: investigations into an abominable mystery

Professor John Newbury

June 2nd 2009



Darwin Today

RESEARCH COUNCILS UK

University of Worcester

UNIVERSITY OF LEEDS

Early influences …….

Irene Manton

Harold Woolhouse

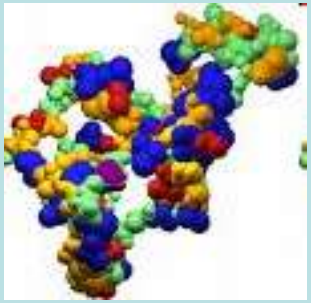
Jim Callow

These molecules and processes……

DNA

messenger RNA

Proteins



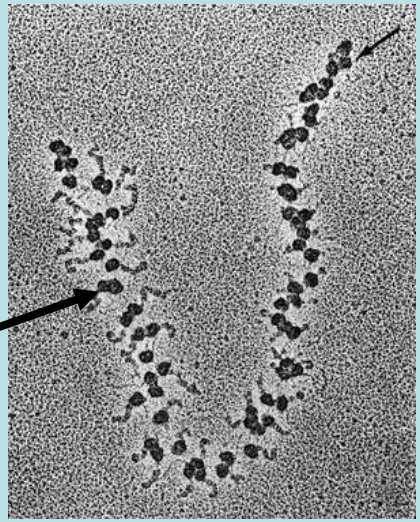
In these plants ……..

PhD project: Plant 80S ribosomes

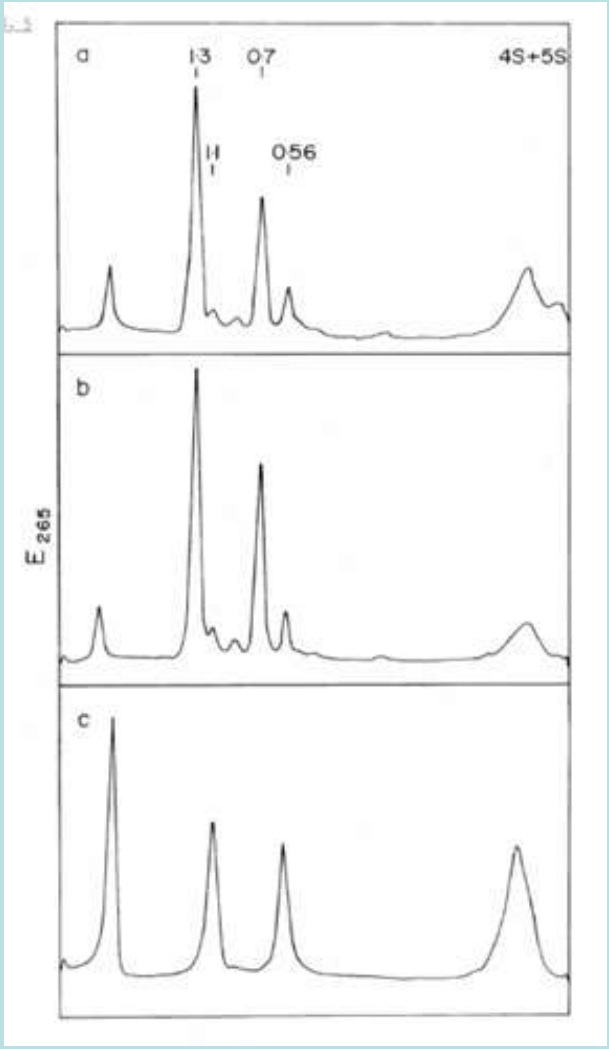
DNA

messenger RNA

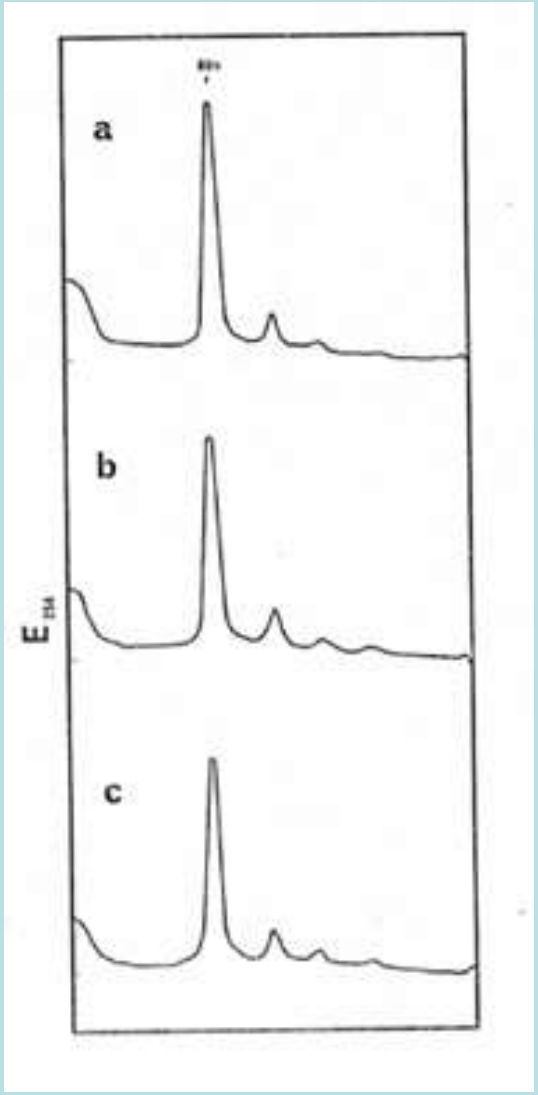
ribosomes



Proteins



Ribosomal RNAs separated by gel electrophoresis

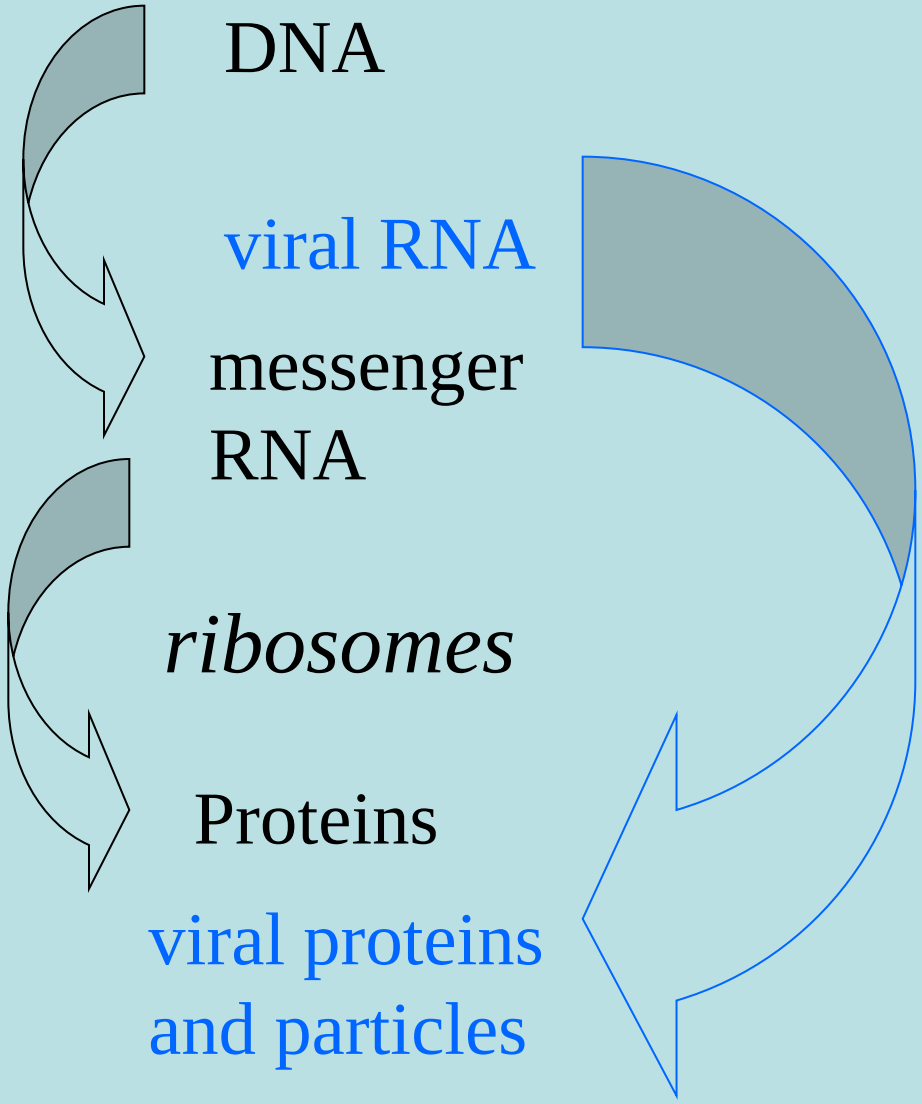


Ribosomes separated in sucrose gradients

Australia

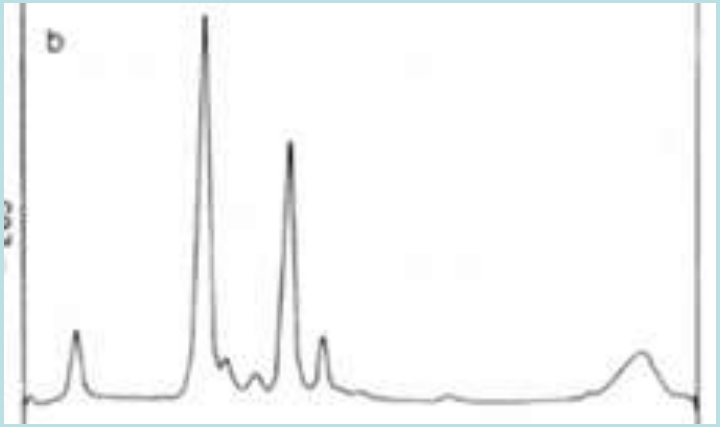
John Possingham

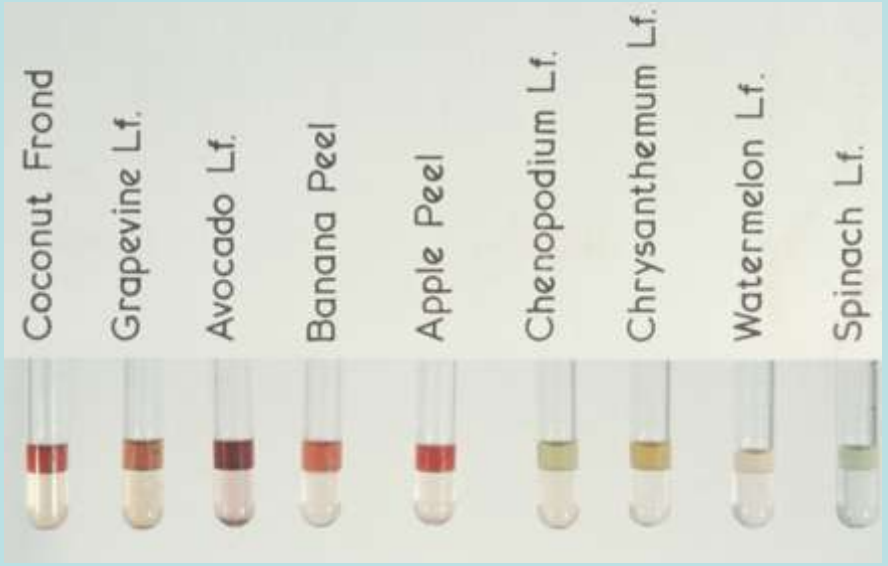
Diseases of grapevines



Grapevine fanleaf virus

Detection of viral RNA in grapevine leaves

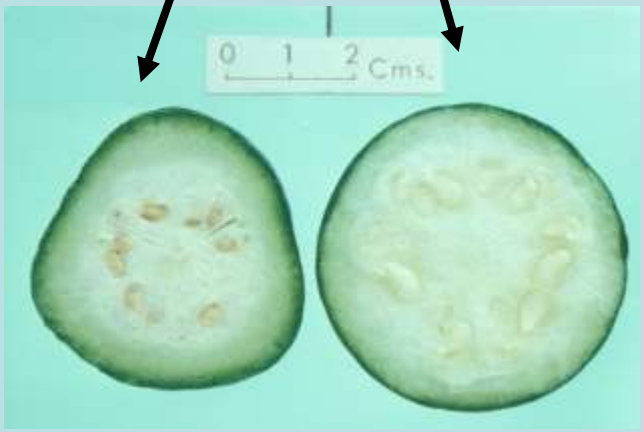




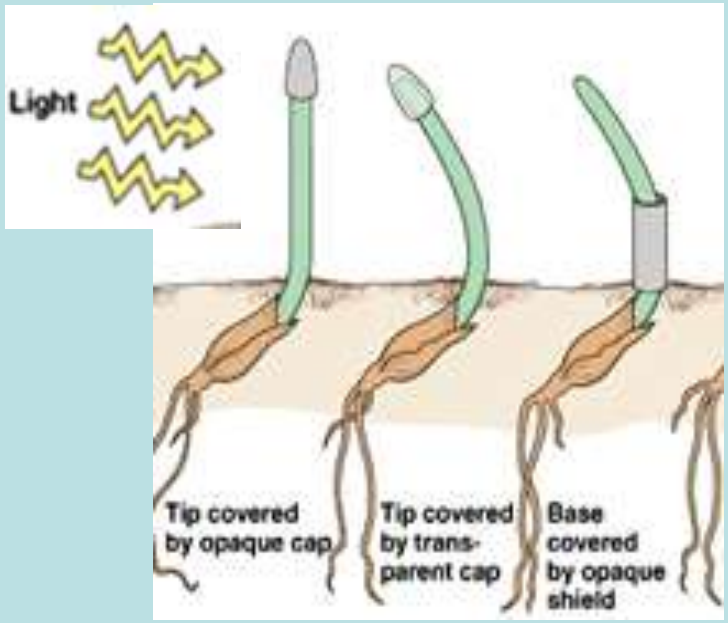
Fruit development

auxin

pollination



Auxin discovery



DNA

messenger RNA

Proteins

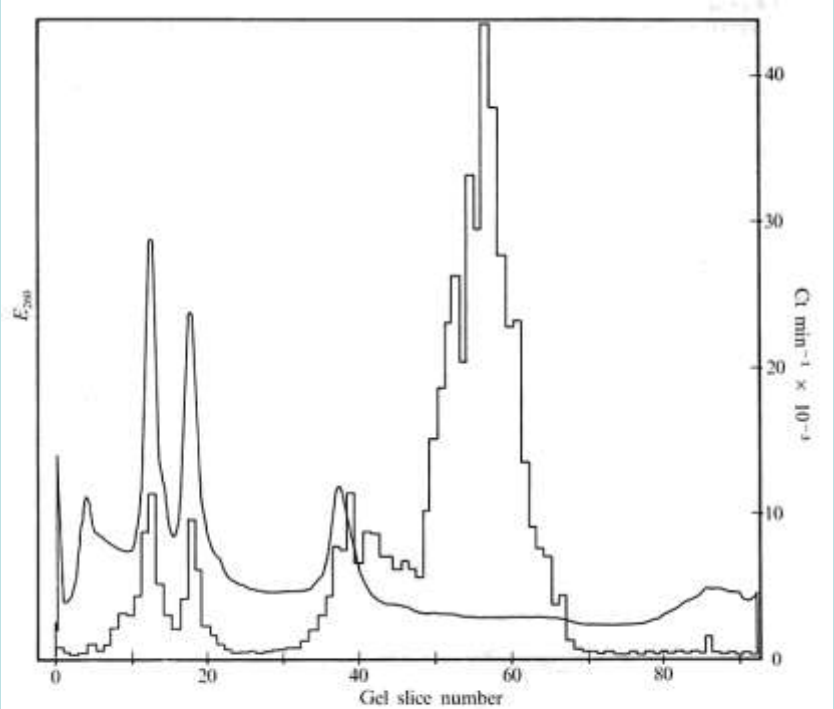
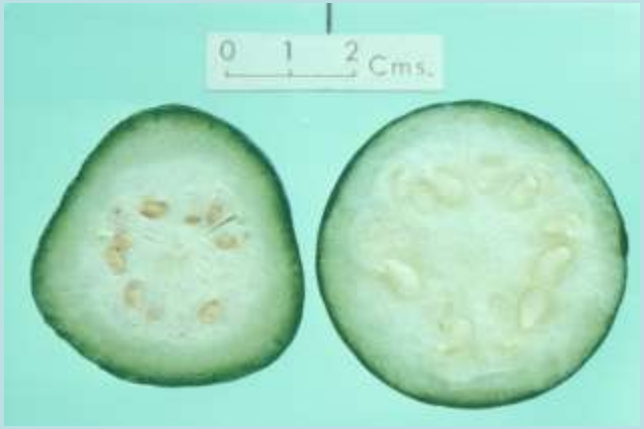
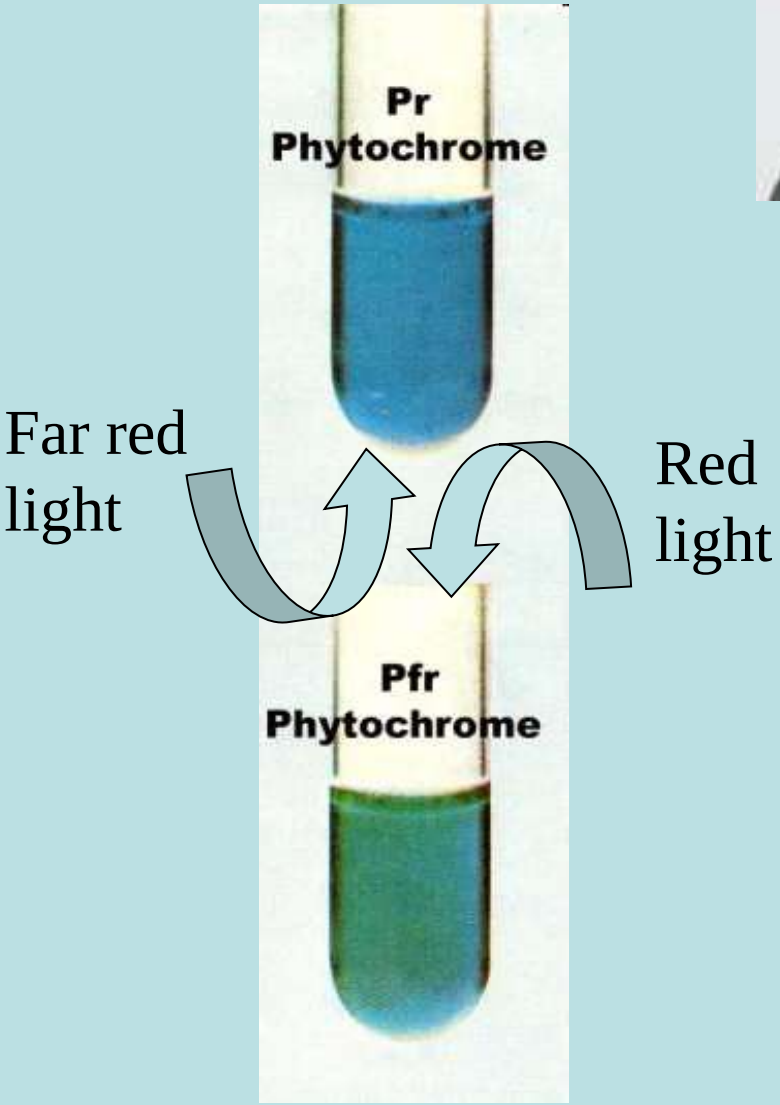


FIG. 6. Watermelon ovaries were excised, treated with NAA, and fed ^{32}P for 24 h. Intact RNA was then extracted and subjected to electrophoresis in 2·4% polyacrylamide gels for 1 h at 5 mA/gel. Gels were scanned at 260 nm (—) and then sliced and the radioactivity of the slices monitored (histogram).



Back to the UK

Harry Smith

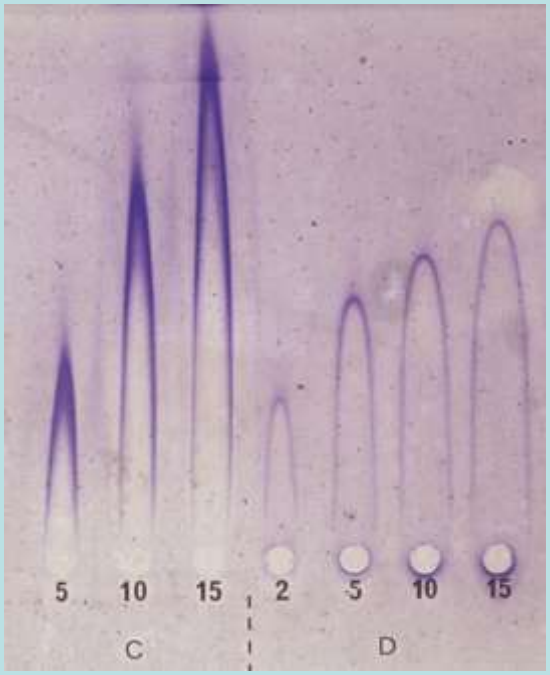


Phytochrome control of ascorbate oxidase activity

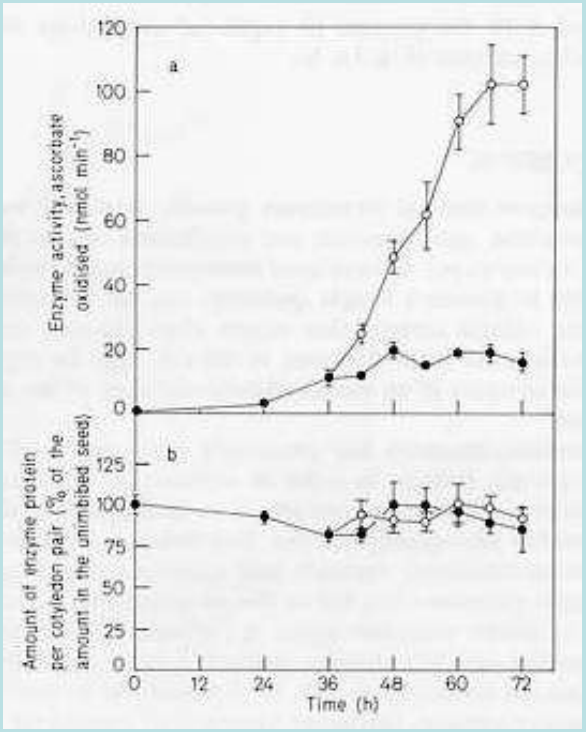
DNA

messenger RNA

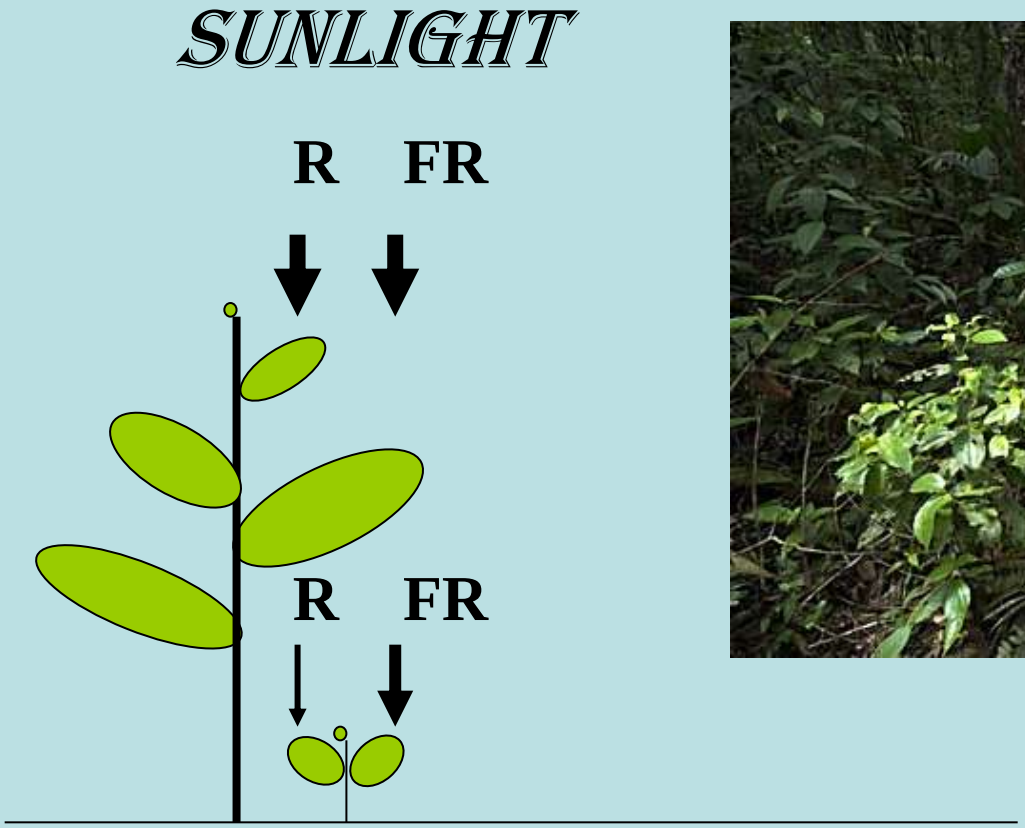
Proteins



Immuno-electrophoresis using antibody to ascorbate oxidase



Plants can ‘perceive’ when they are being shaded by other plants



Darwin's *tangled bank*

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A move to Birmingham

John Jinks

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Antirrhinum transposons

bbsrc
biotechnology and biological sciences research council

DNA

messenger RNA

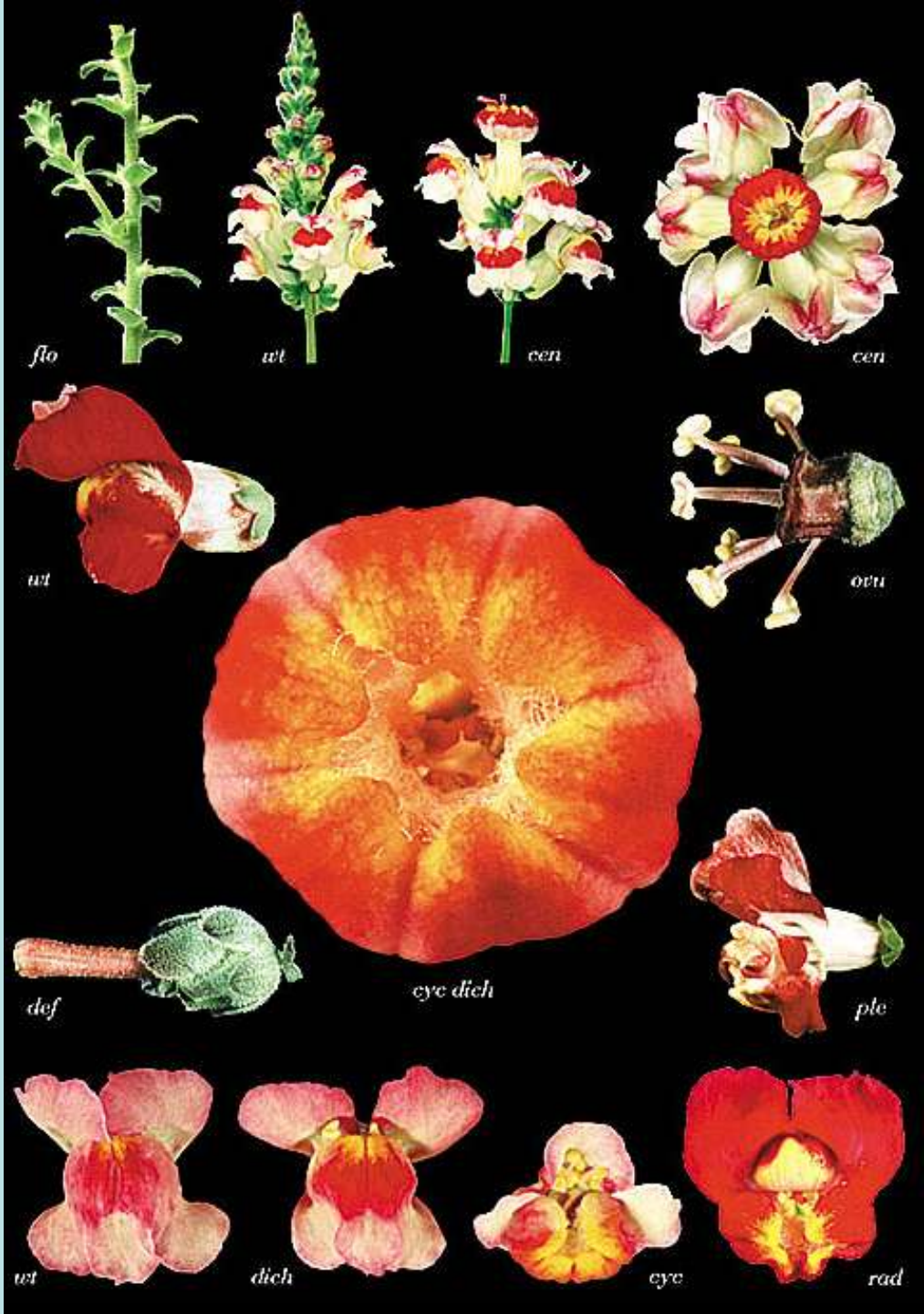
Proteins

pallida recurrens

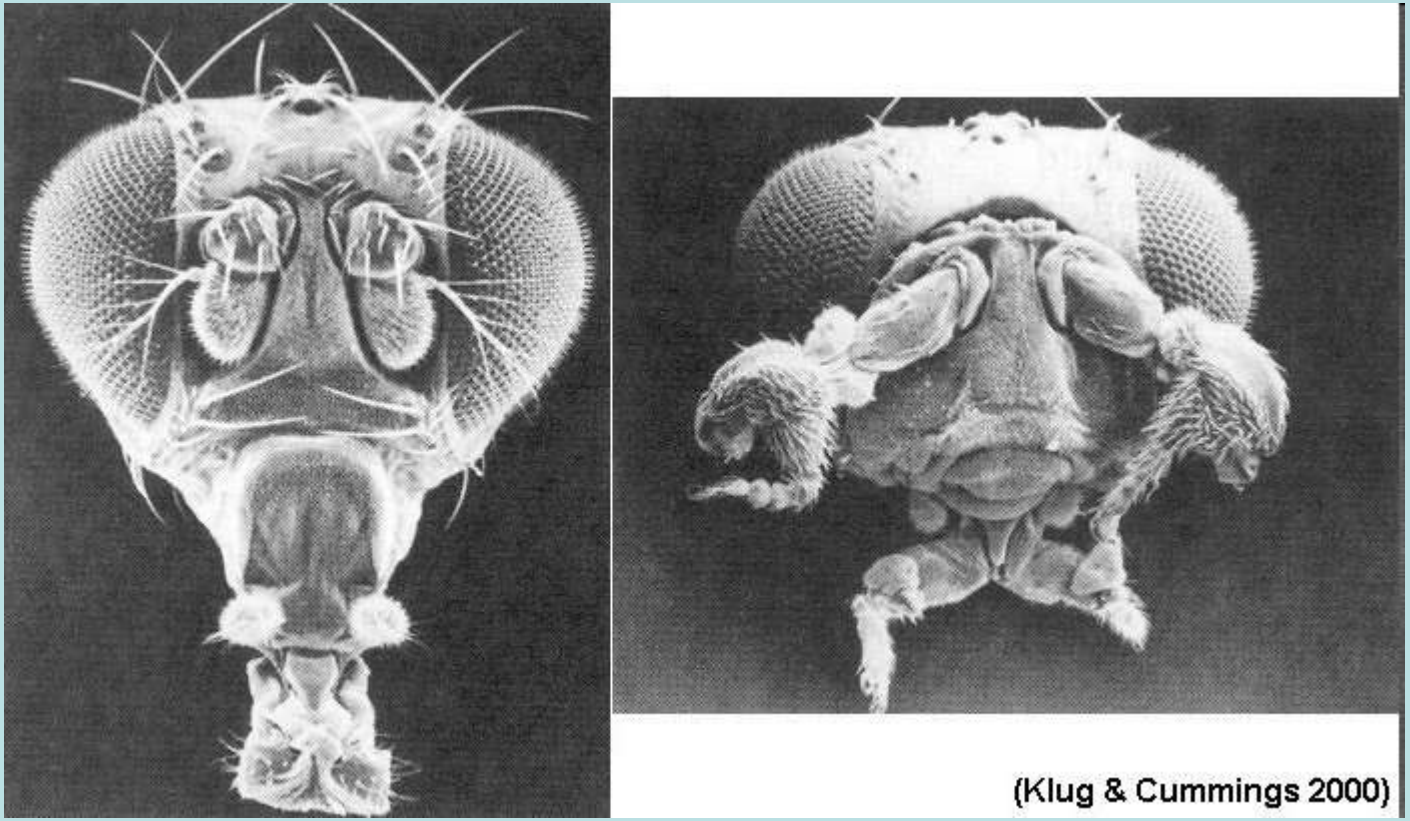
Homeotic mutants

John Innes Centre

Rico Coen



‘Evo-devo’



antennapedia

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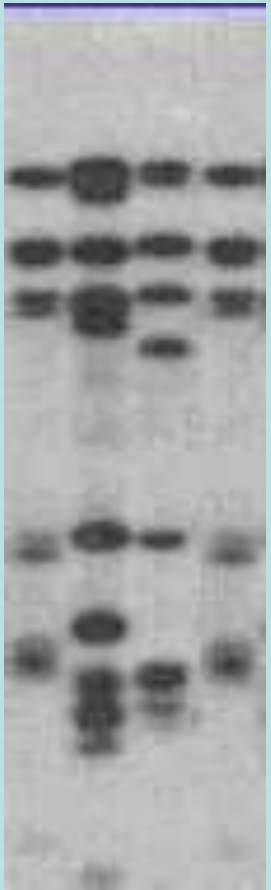
Plant genetic diversity

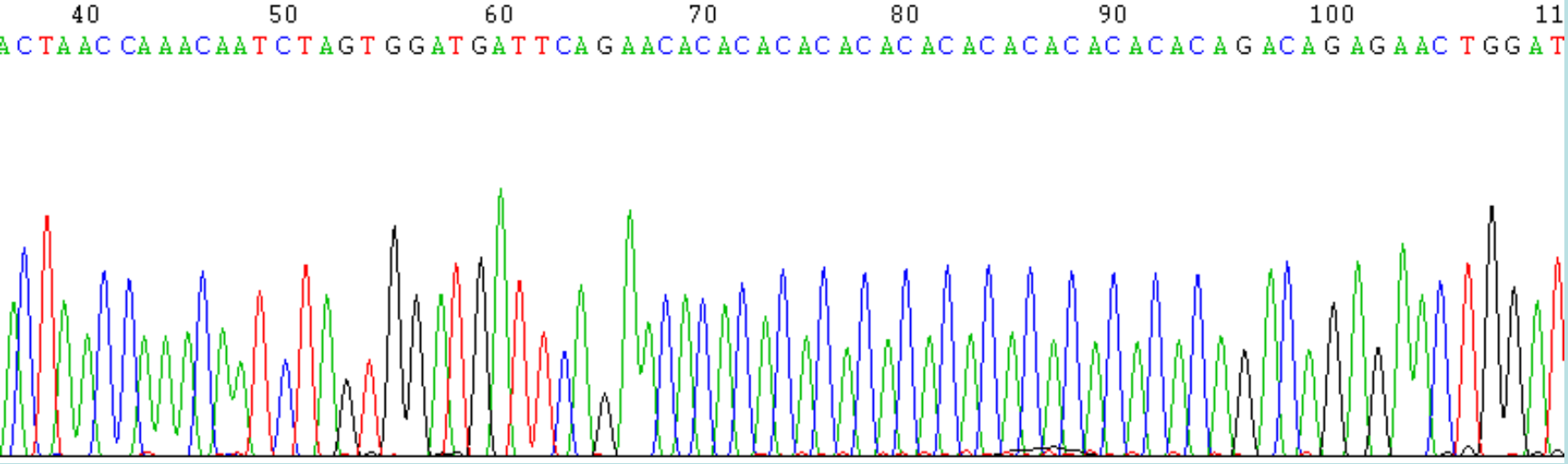
DNA *DNA markers*

messenger RNA

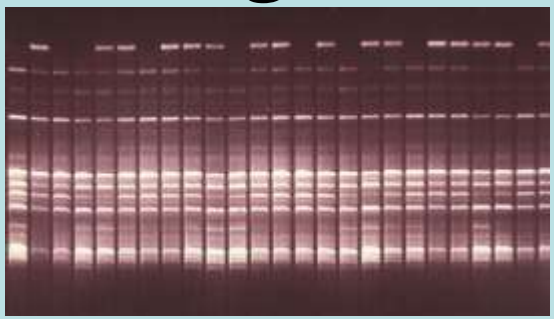
Proteins

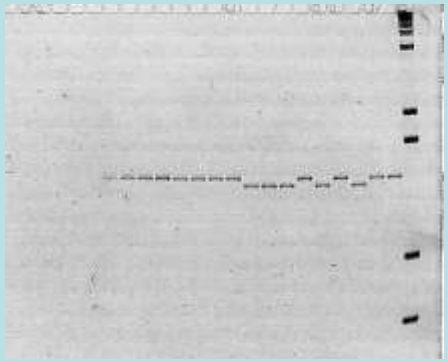
Professor Sir Alec Jeffreys

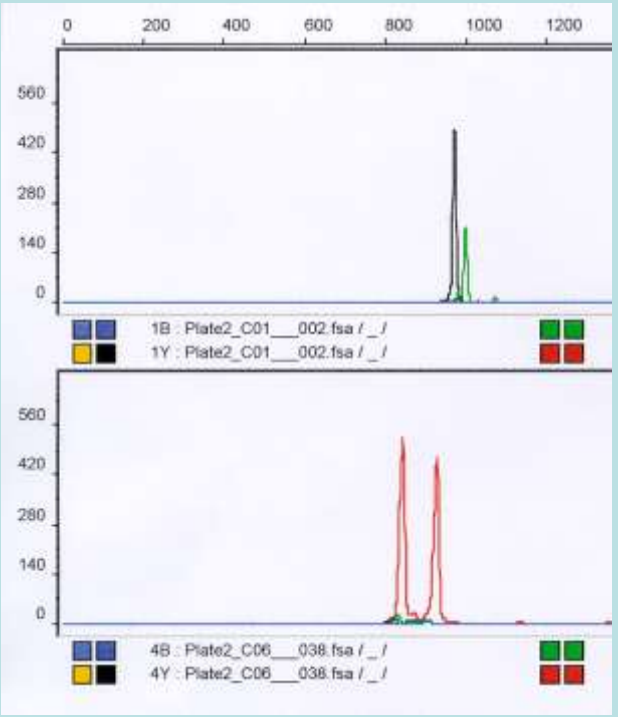


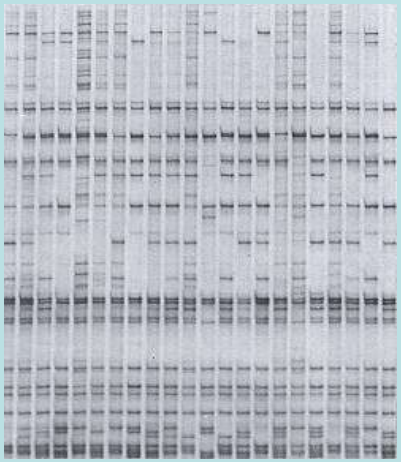


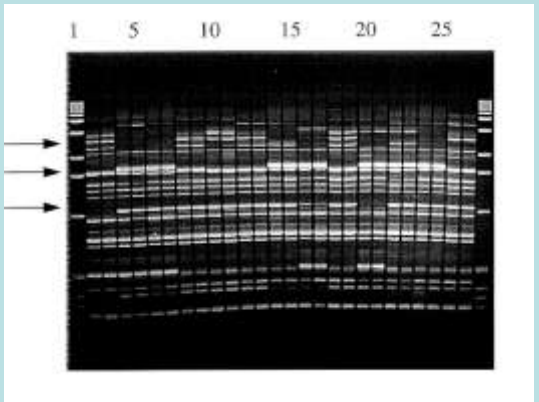
Range of molecular marker techniques











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IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

DFID Department for International Development

Rice genetic diversity

Brian Ford-Lloyd

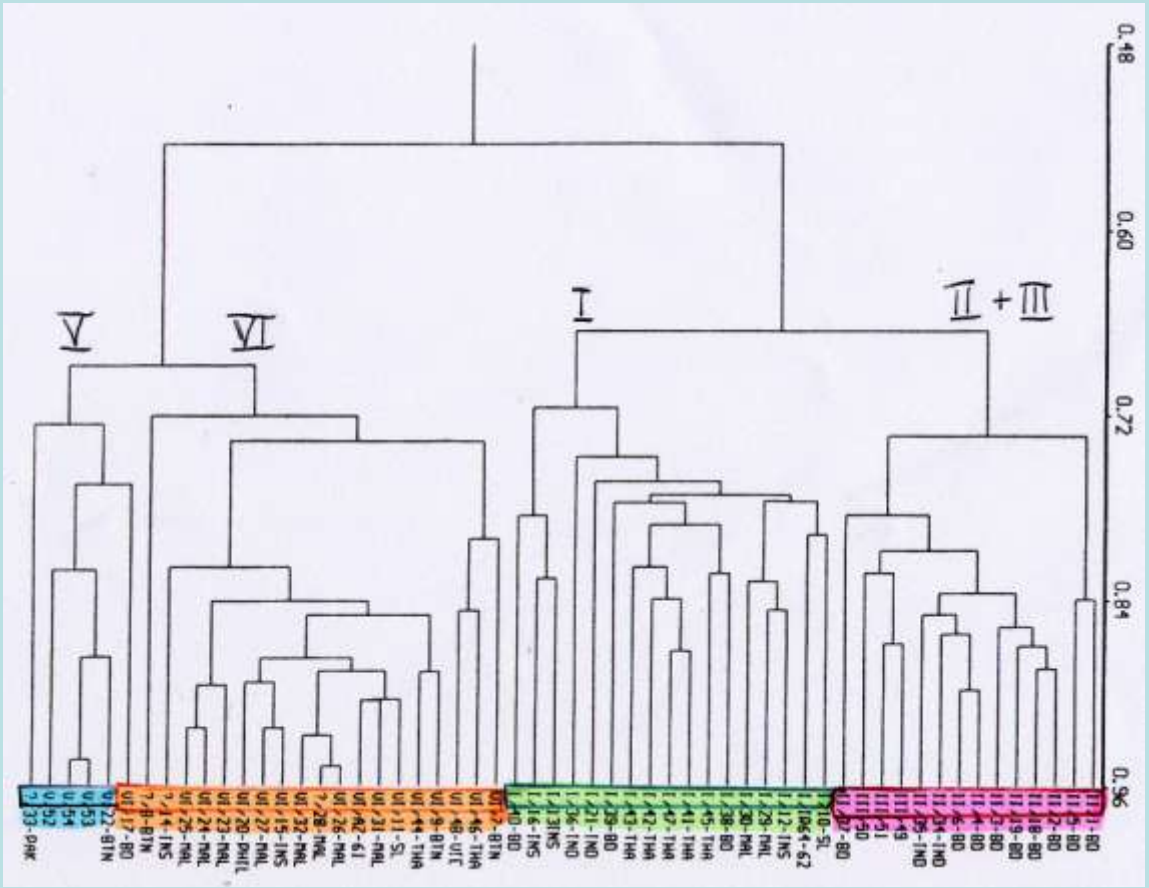
IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

Dr Mike Jackson in the germplasm library

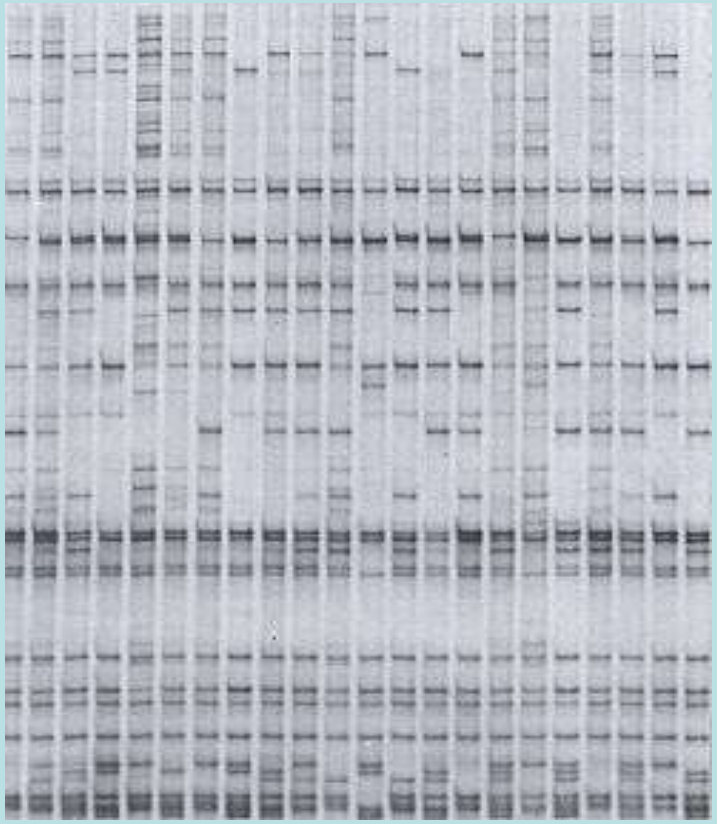
Gene bank and landraces

Use to rice breeders

Insert cluster diagram showing relationships between 6 crossability groups.



Prediction of characters on basis of marker bands



Statistical associations between presence/absence of some bands with performance in the field

Variability ‘explained’ by markers

For example:

Characteristic	**Markers**	r^2
Days to flowering	29	0.99

Multiple regression analysis (e.g. for flowering time) allows predictions to be made

$$Y = a + b_1m_1 + b_2m_2 + ...b_jm_j.....b_nm_n + d + e$$

Y = average flowering time

a = intercept of line on axis

m_1, m_2 etc = mean marker presence across accessions

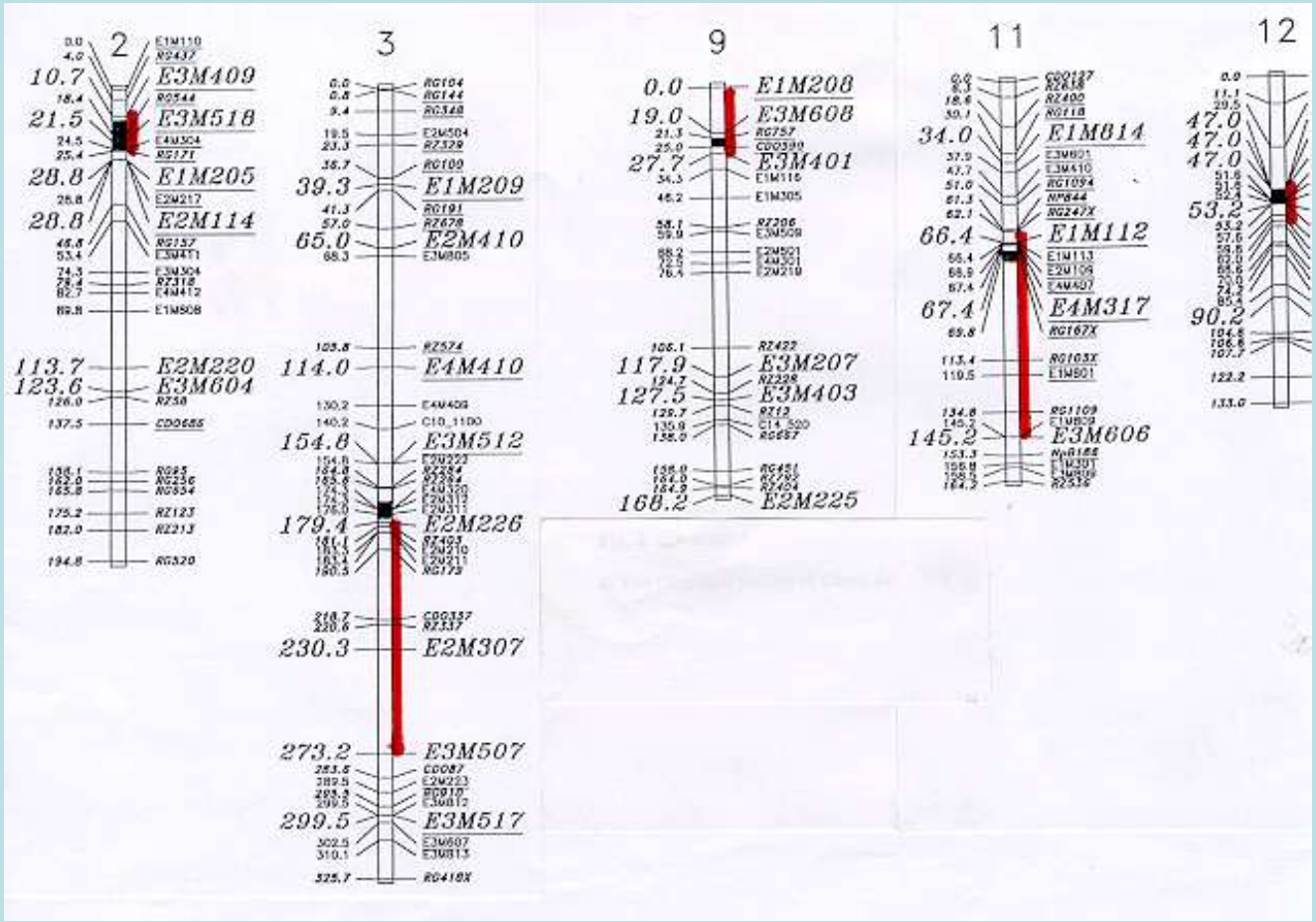
b_1, b_2 etc = the partial regression coefficients that specify the empirical relationships between Y and m_j

d = between accession residual

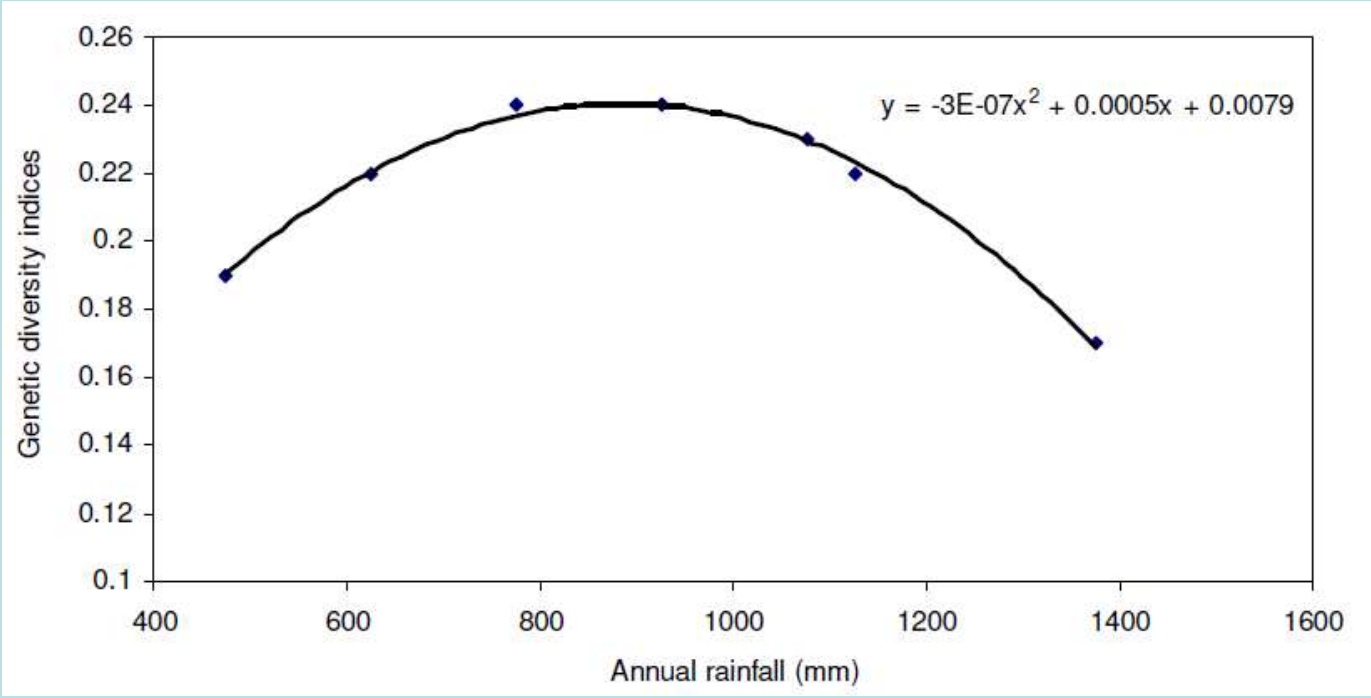
e = random error of Y

Genetic basis of associations?

Linkage disequilibrium …….



Diversity and rainfall: *Oryza longistaminata* collected from sites within 8 African countries



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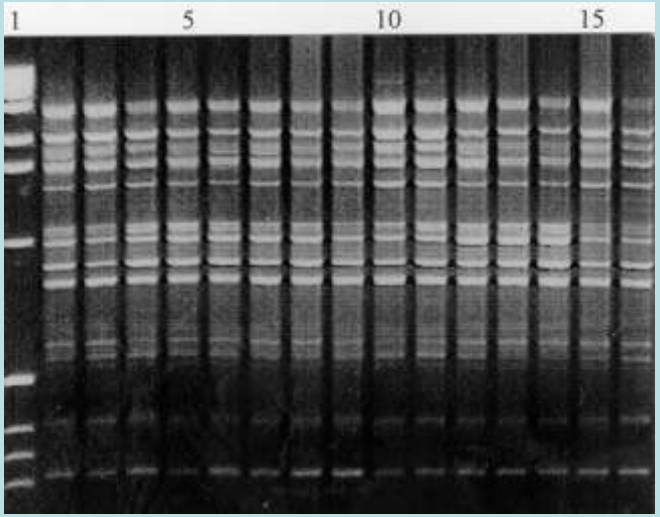
DFID Department for International Development

KATHOLIEKE UNIVERSITEIT LEUVEN

Bananas and plantains



RAPD markers for 14 landraces of African plantain

Rony Swennen

Wind of change …….

Genomics ……..

Arabidopsis thaliana

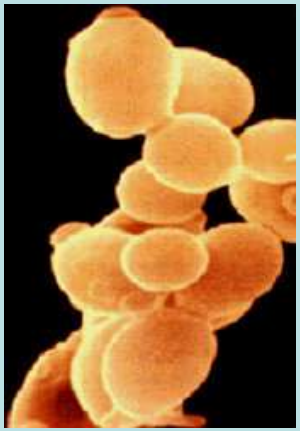
Why Arabidopsis?

Seed to seed takes about 6 weeks

Can grow hundreds of plants in a small area in a glasshouse

Genome size

Other model species ……..



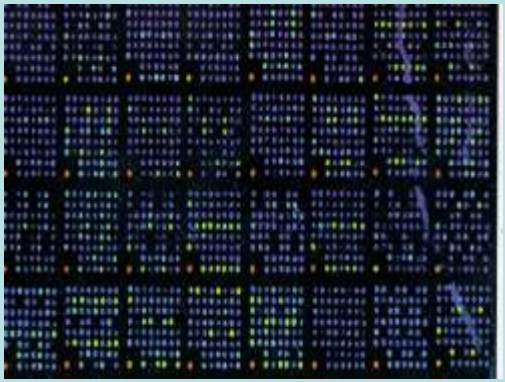
What is not going to be covered …..

DNA

messenger RNA

Proteins

transcriptomics



Zinc tolerance and hyper-accumulation in *Arabidopsis*

Chromosome substitution lines in *Arabidopsis*

Salt tolerance in *Arabidopsis*

Quantitative genetic analysis of flowering time and transformability in *Brassica*

Interactions between plants and greenfly

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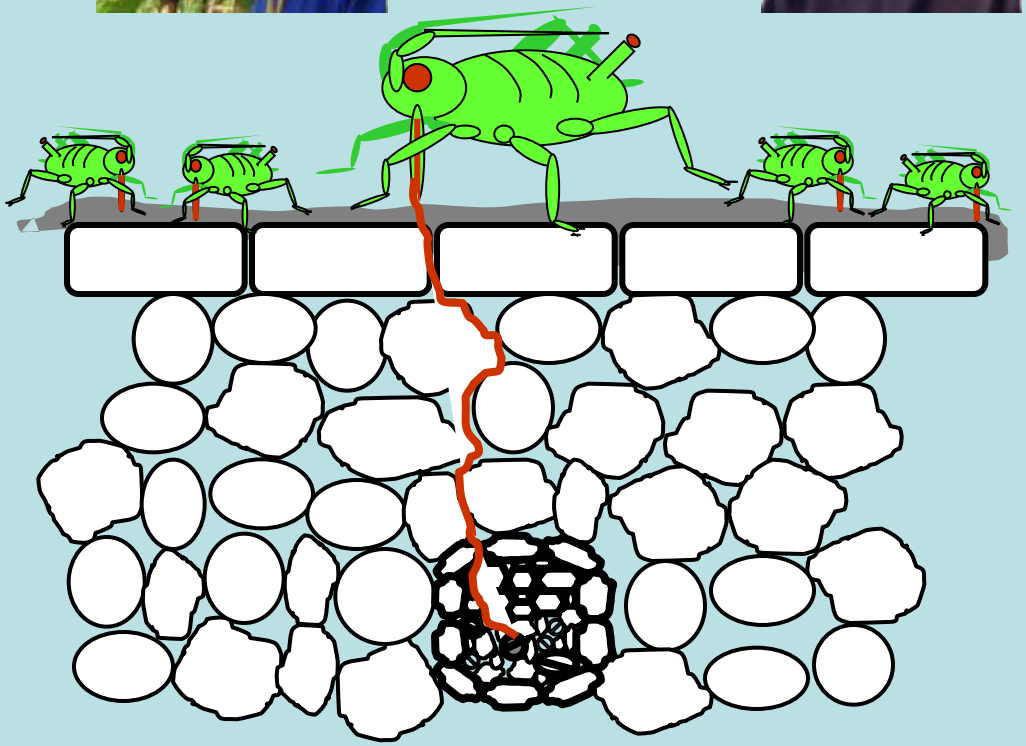
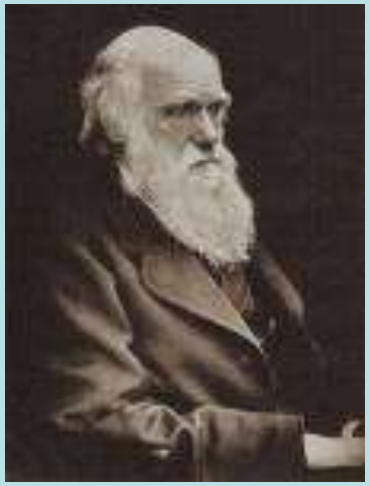


Plants, insects and Darwin



Collaborative research on aphid nutrition

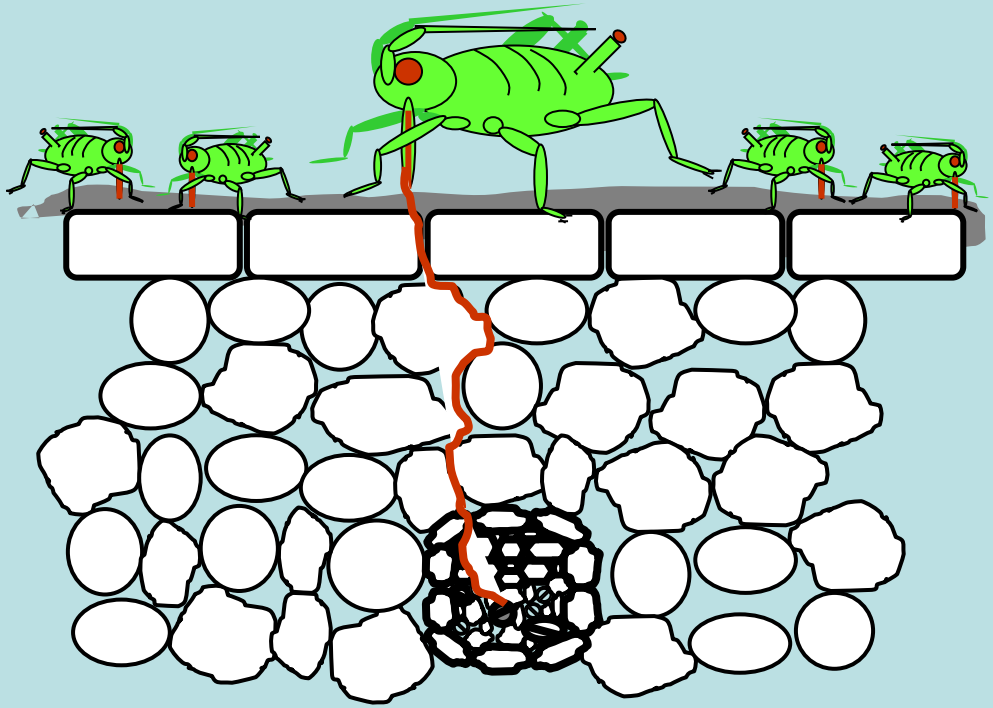
bbsrc
biotechnology and biological sciences research council

UNIVERSITY OF BIRMINGHAM

University of Worcester

The University of Nottingham

Question: how do aphids get their amino acids and how do they respond when the amino acid content of their diet varies?



Can we obtain samples of the aphid diet?

Collection of phloem contents

Can we obtain samples of the material coming out of the aphid?

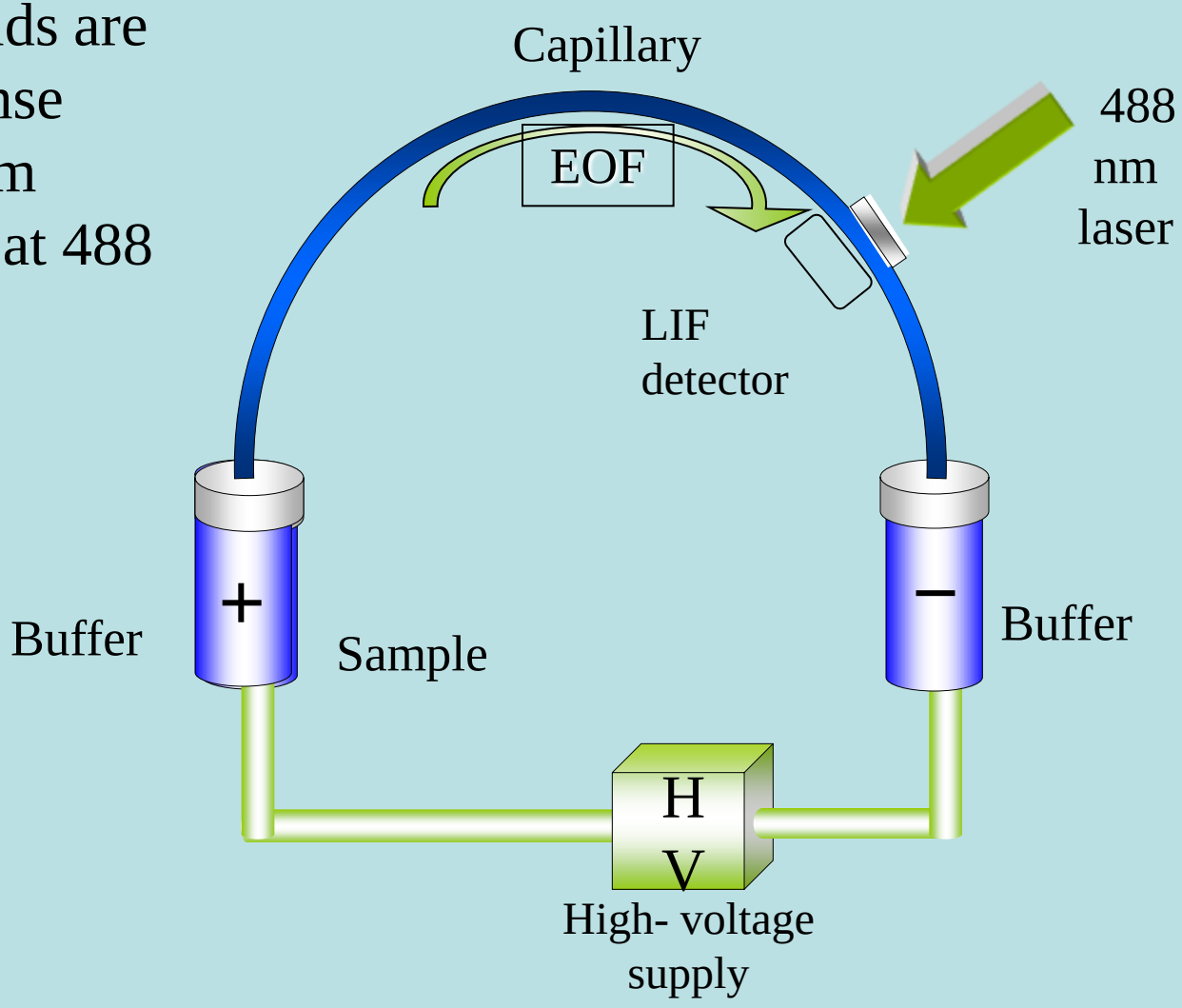
The amount can be assessed by use of honeydew clocks which allow the measurement of honeydew volume over time

Can we measure the level of amino acids in such small volumes?

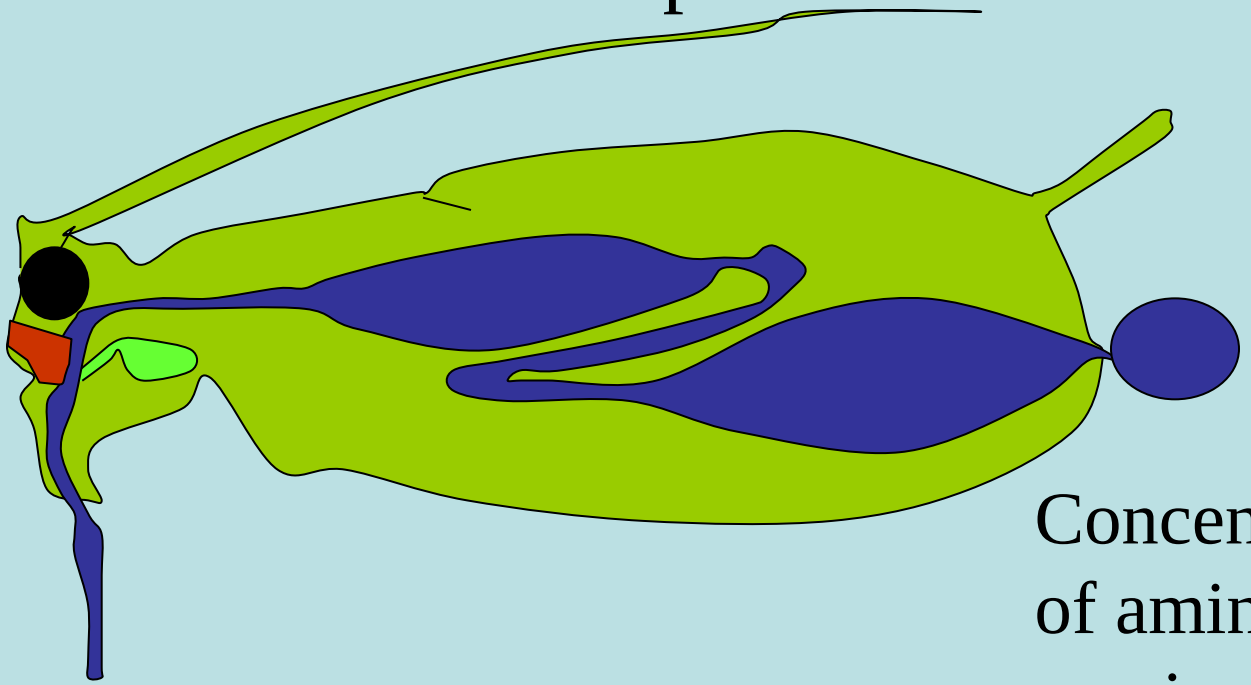
Capillary Electrophoresis and Laser Induced Fluorescence detection of amino acids

Derivatised amino acids are detected by their intense fluorescence at 530 nm using laser excitation at 488 nm

Dave Barrett.



Calculation of total amounts of amino acids taken up



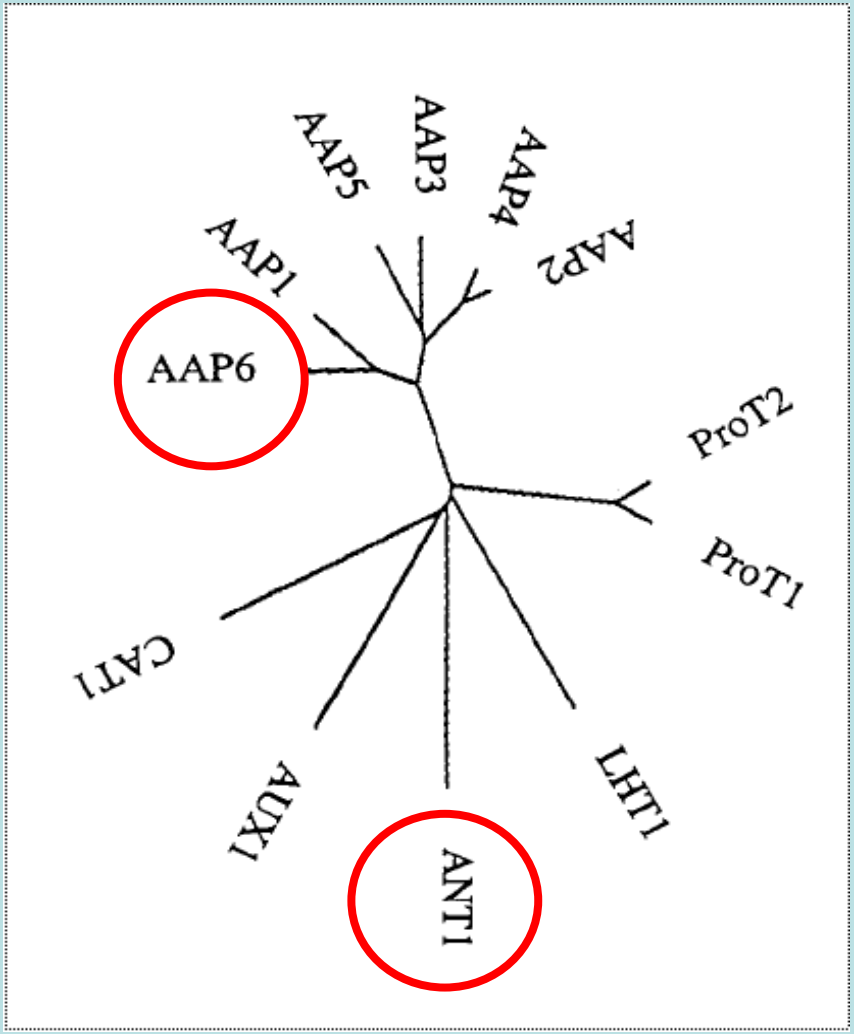
Concentration of amino acids going in

Concentration of amino acids coming out

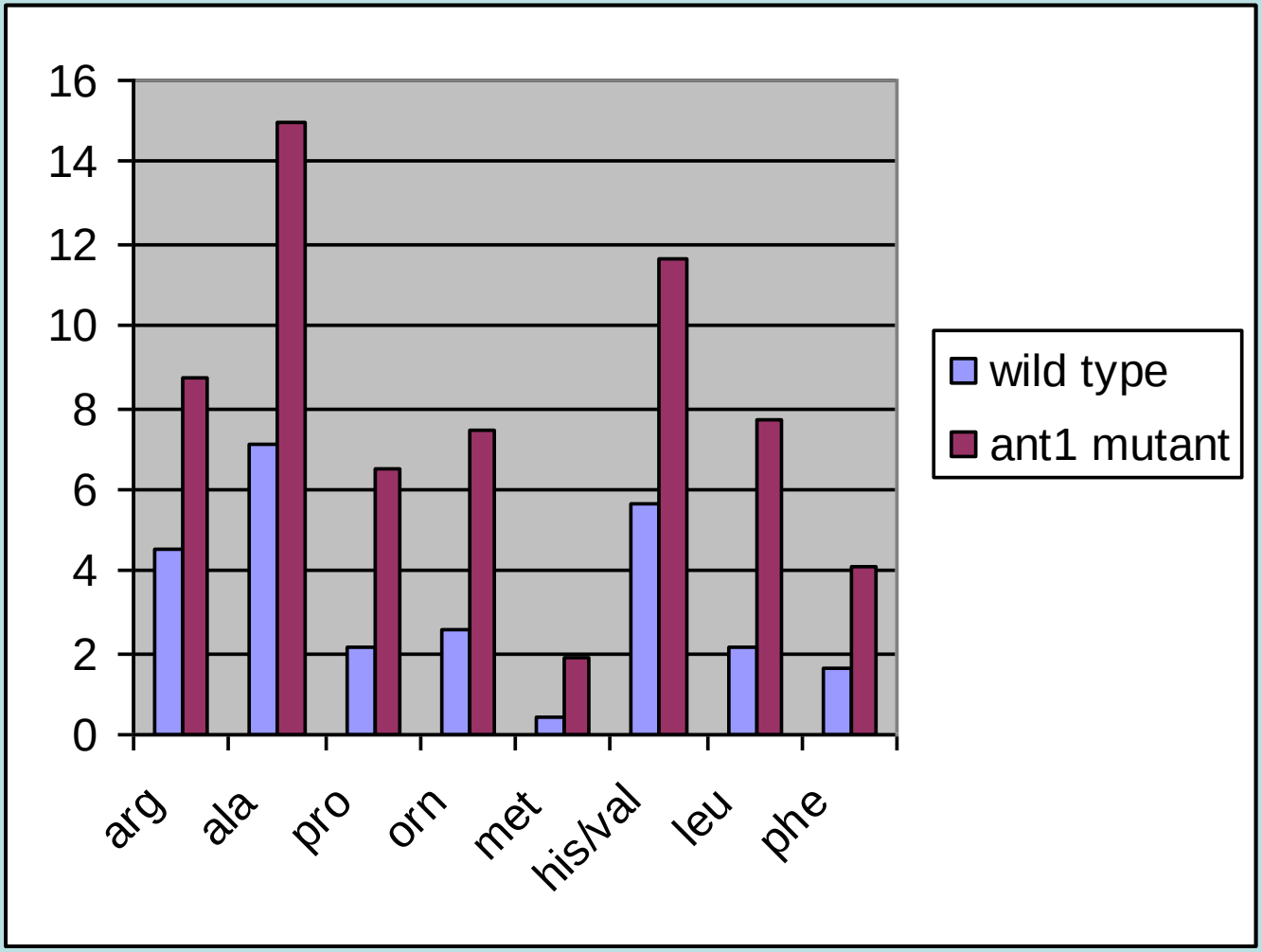
Volume of honeydew coming out

pmoles of each amino acid taken up by the aphid

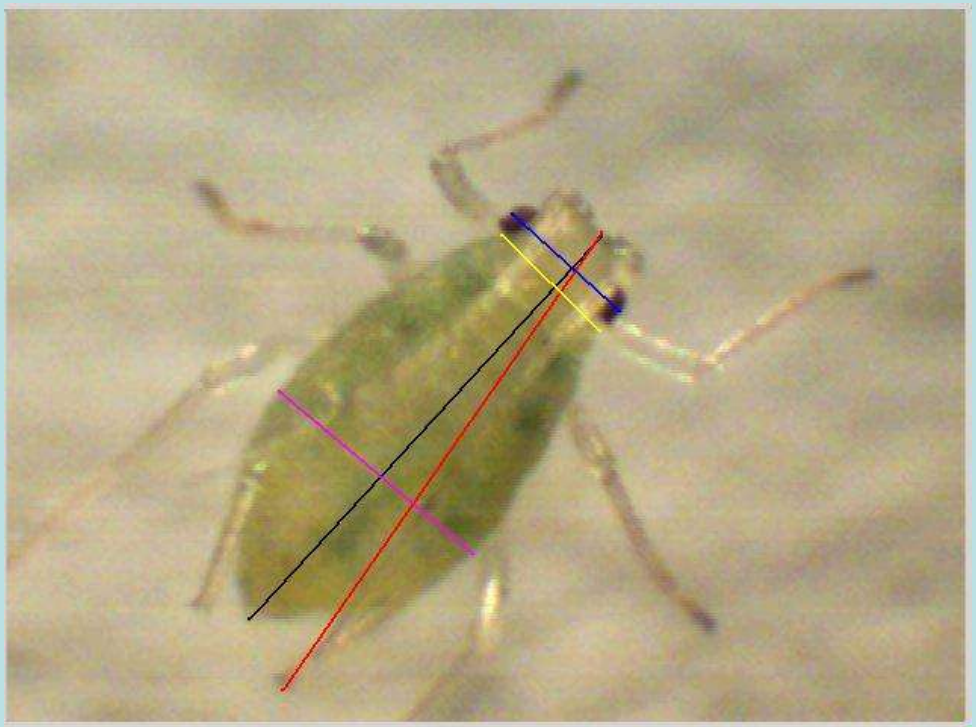
Can we change the level of amino acids in the phloem?



Effects of mutations in permease genes on phloem amino acid content



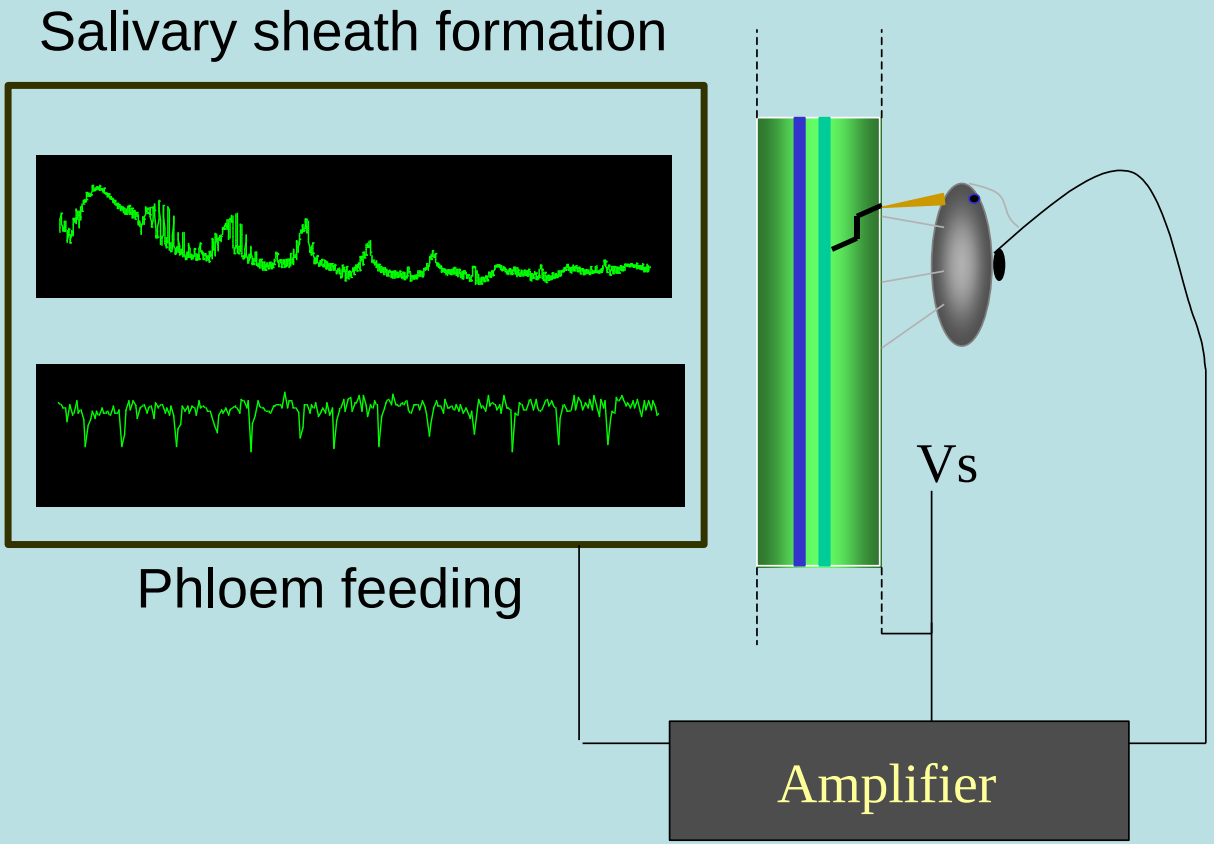
Growth rates

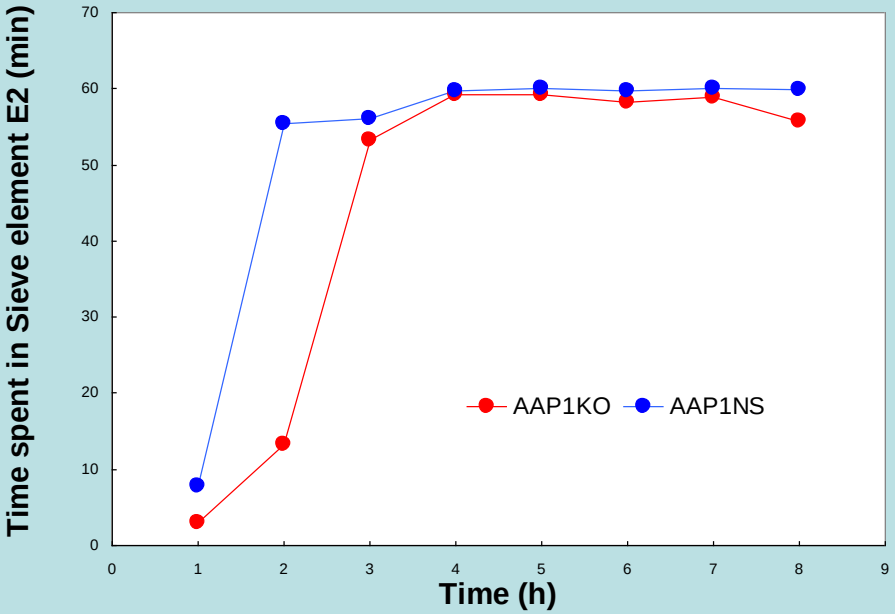


Reproductive rates

Can we assess what happens to the aphid when the phloem diet changes?

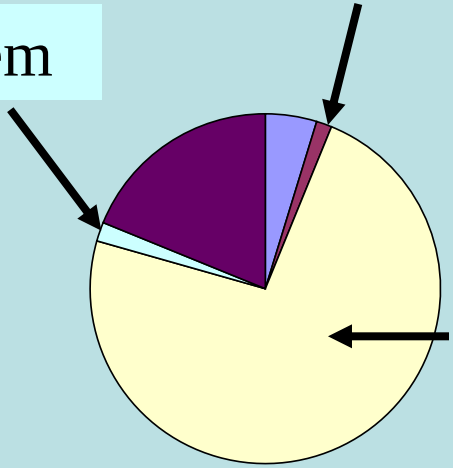
Feeding behaviour can be monitored using Electrical Penetration Graph technology





Salivation, E1

Xylem



Phloem feeding, E2

……. the story so far