

# Optimising wheat grain shape and size for improved processing quality

Crop Science Initiative funded - 4 year project

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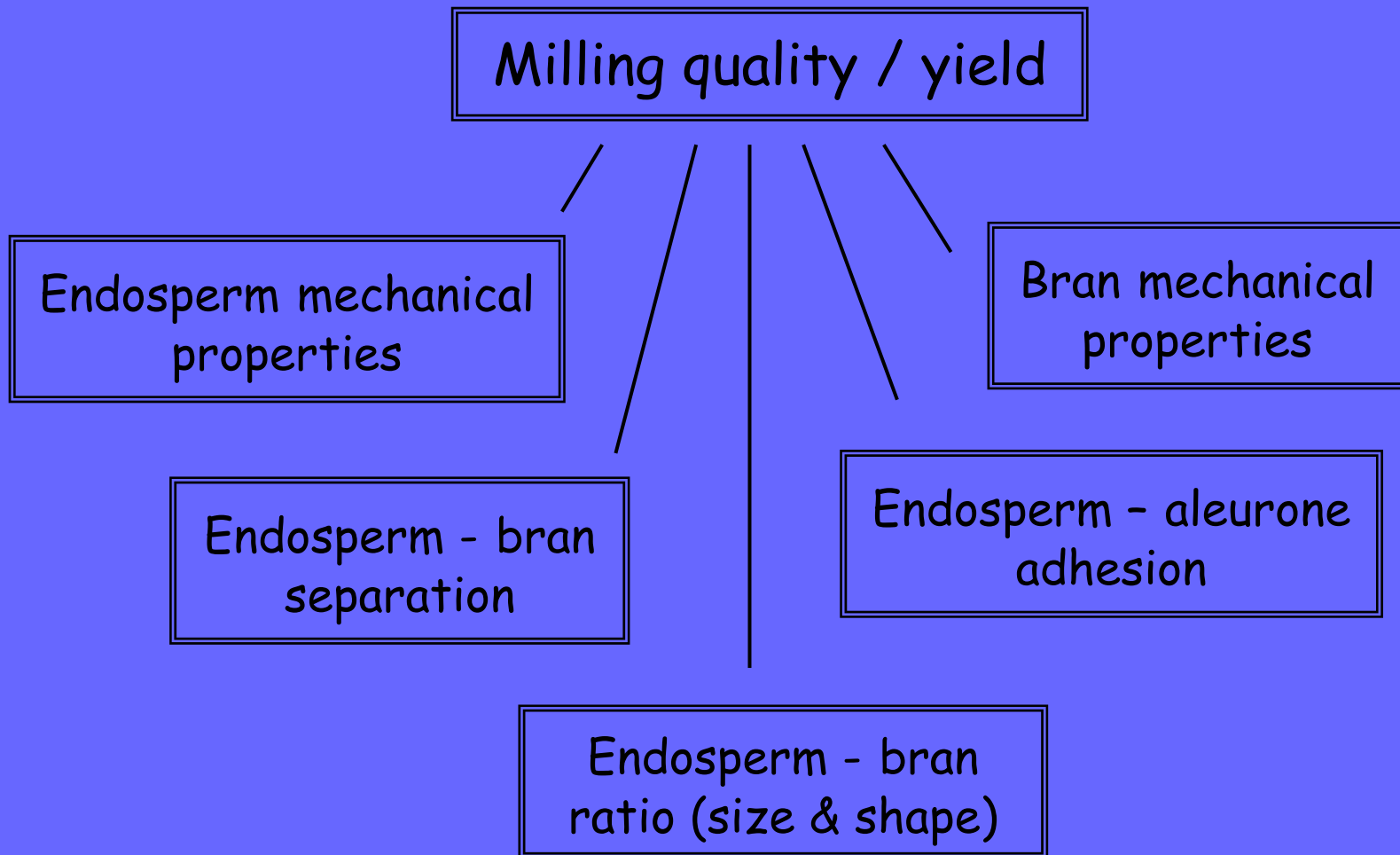
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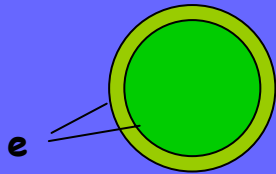
# Optimising wheat grain shape and size for improved processing quality



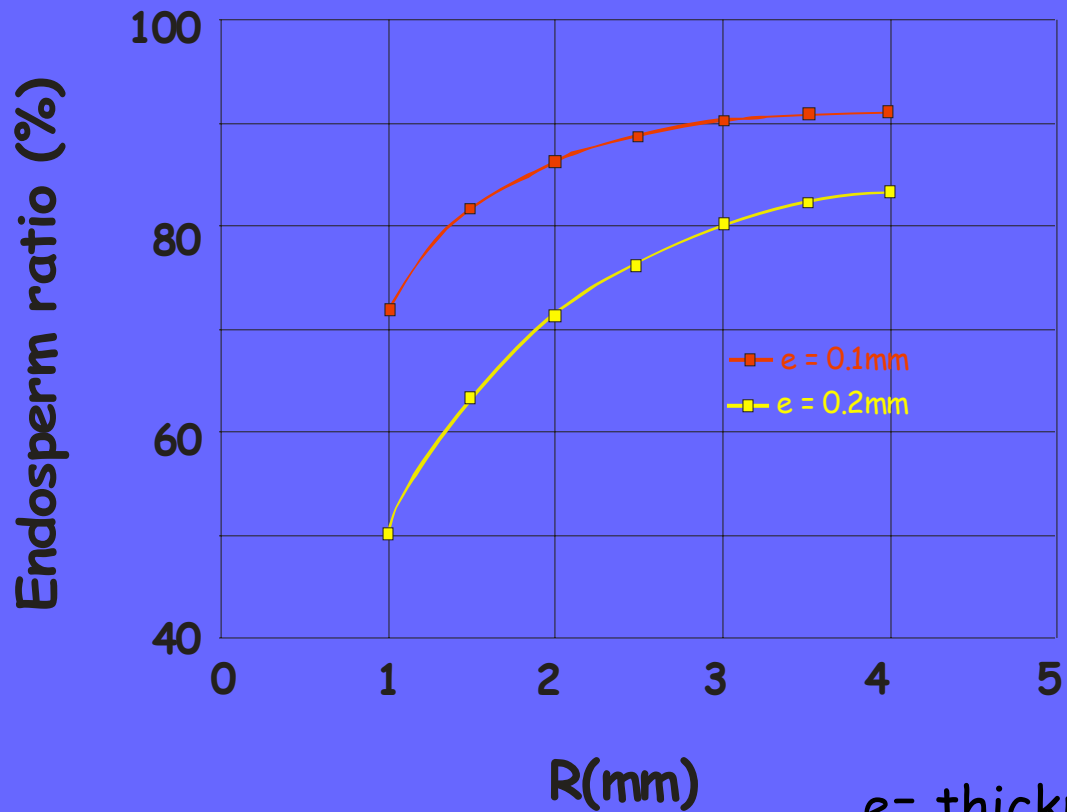
In general :

- You can obtain more flour from:
  - Large, uniform, well filled, 'round' grains
- Maltsters can obtain better malting consistency from:
  - Round, plump grains

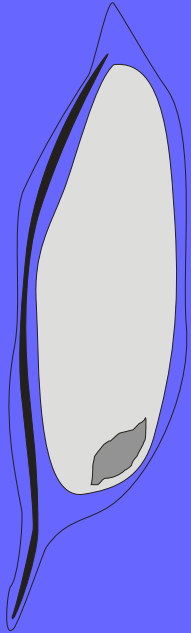
# Optimal shapes and sizes



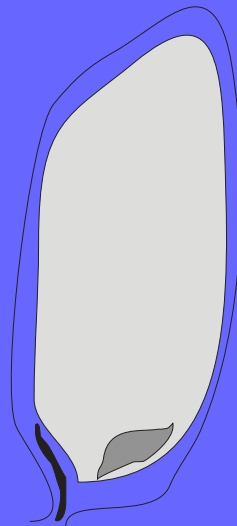
- Sphere – simple, ideal shape
- milling yield easy to evaluate



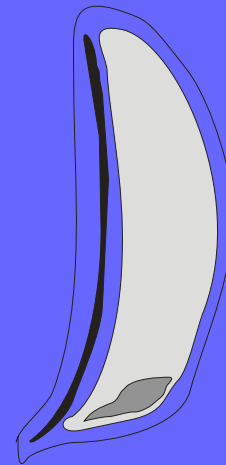
Grains are complex shapes 'less than ideal'



Rice



Maize

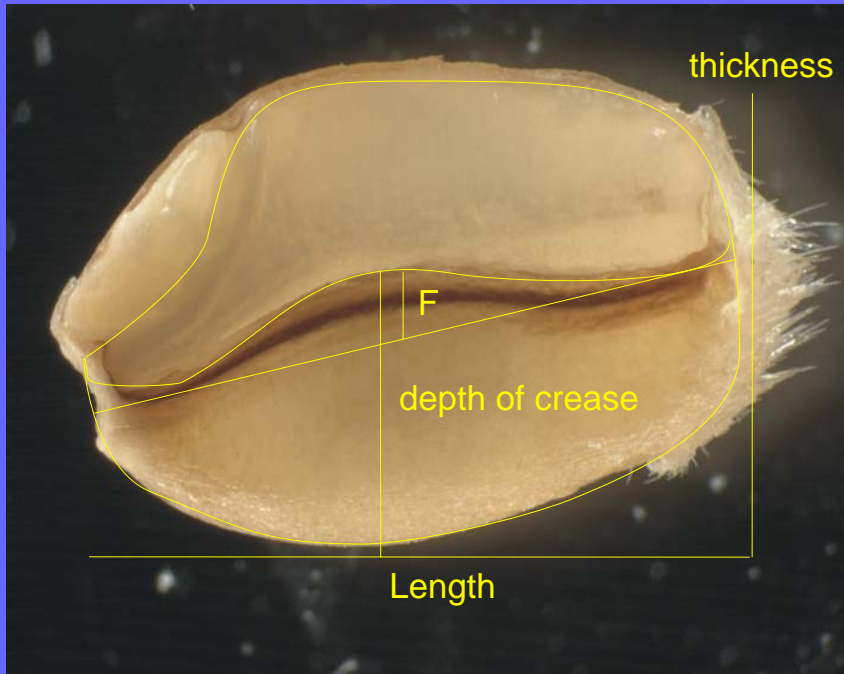


Wheat / barley

# Models Predicting milling yield

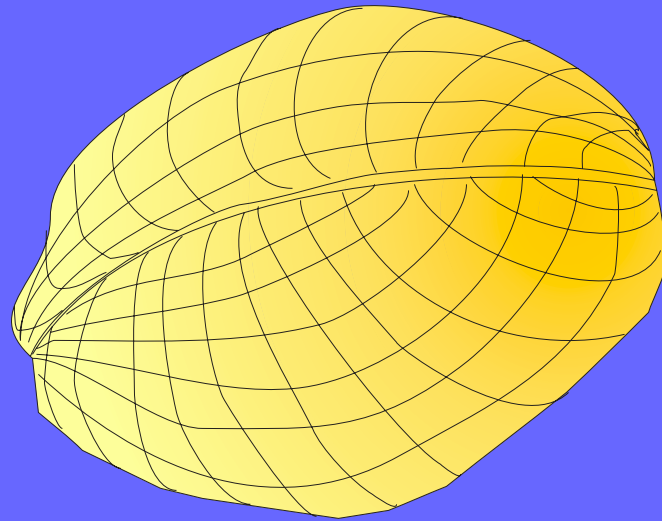
Parametric model based on:

length, grain thickness, half-width, depth of crease and 'F' factor



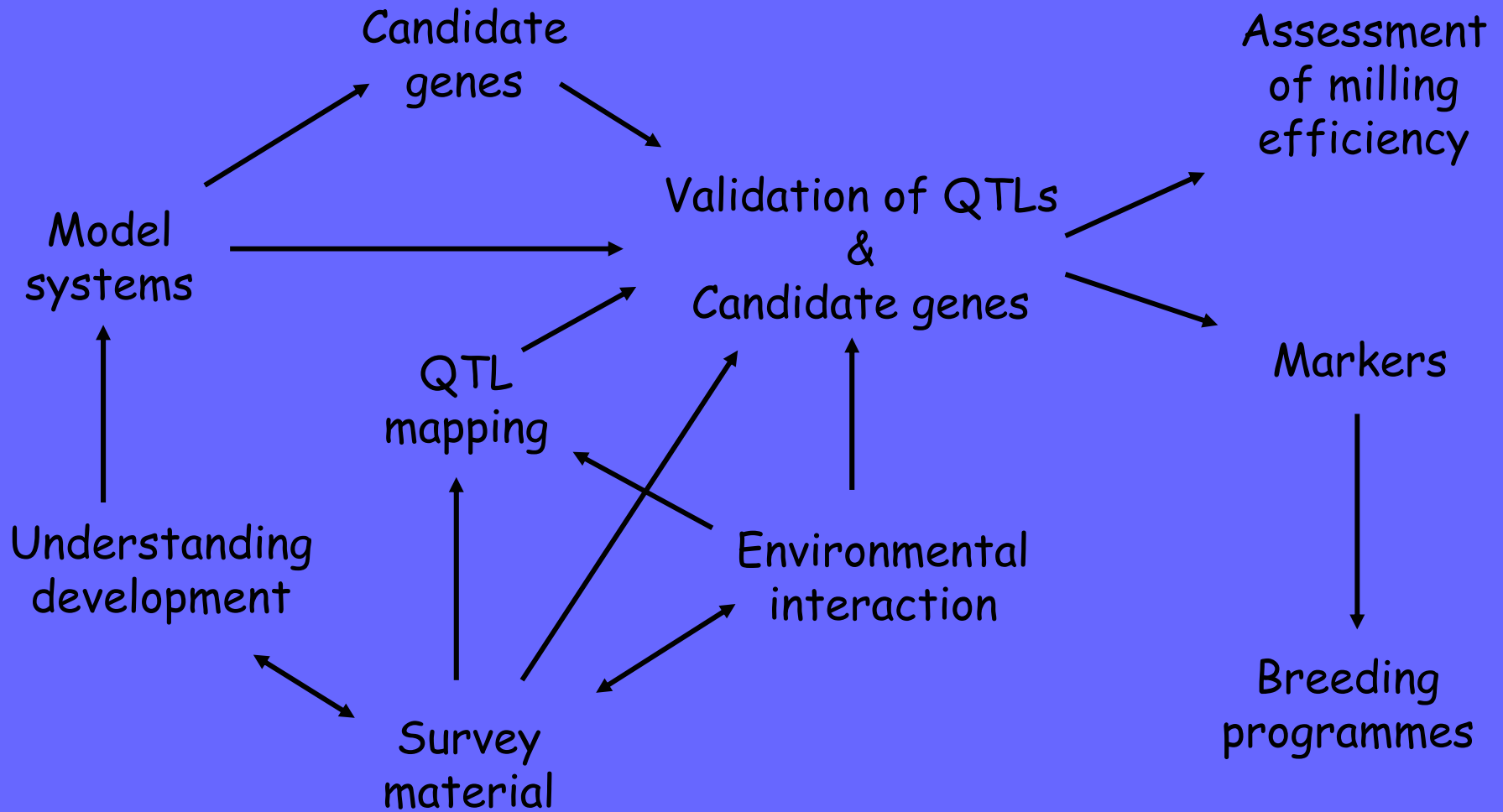
By F.Mabille and J. Abecassis (INRA- Montpellier)

Generate 3D - model of grain



- Predicts importance of the crease

# Multidisciplinary programme of work

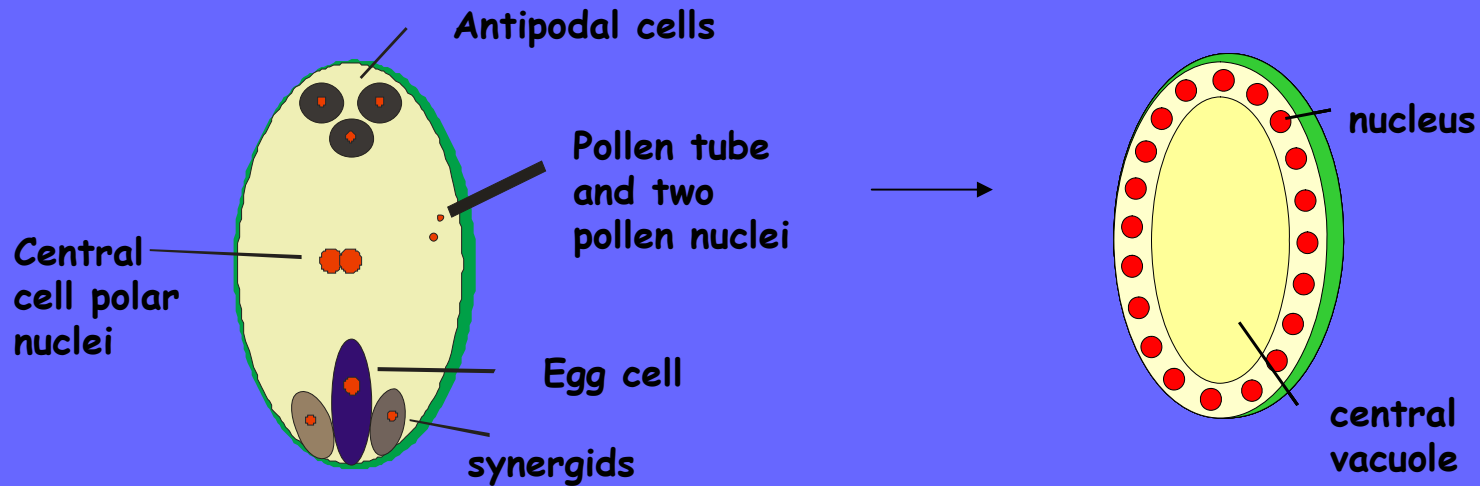




# Endosperm development

First triploid endosperm nucleus:  
formed from fertilisation of  
central cell polar nuclei by  
second male gamete

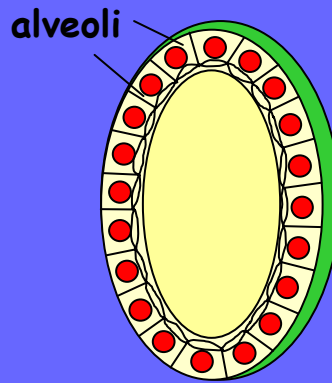
Multiple rounds of mitosis ensue  
without cell wall formation  
leading to formation of the  
coenocycle



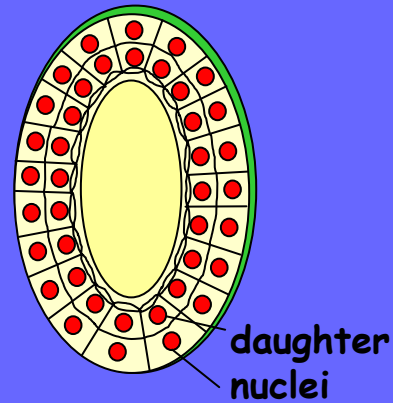
Stage 1  
Formation of the coenocycle

## Stage two Cellularization

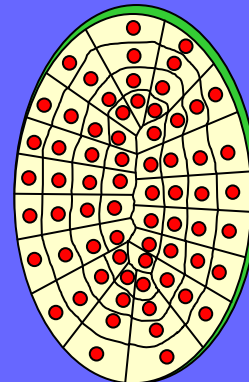
Cellularization begins with formation of tube-like structures called alveoli



Nuclei within alveoli divide in periclinal plane with cell wall formation between daughter nuclei

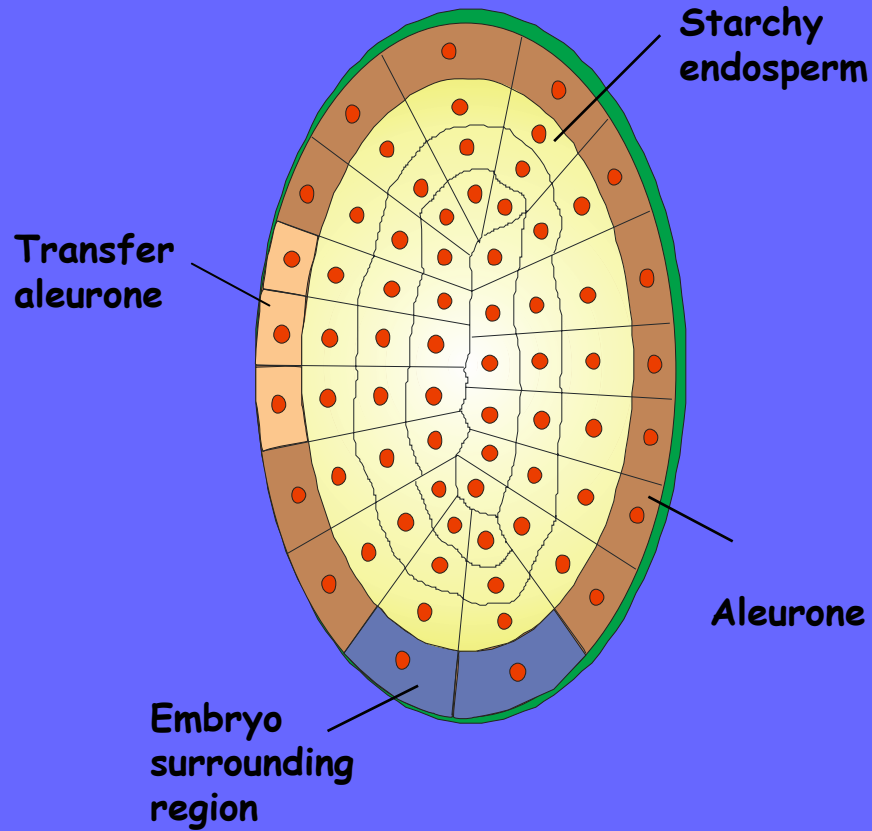


This process continues until files of cells fill the central cell vacuole



# Stage three Differentiation

Cells differentiate into starchy endosperm, aleurone, transfer aleurone and embryo surrounding region

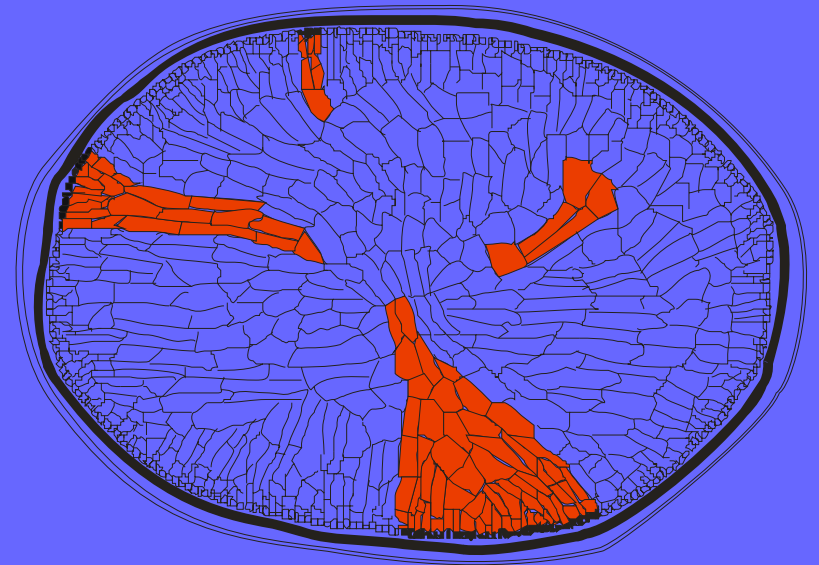


# Development of the maize endosperm revealed by Ac/Ds transpositions



Clonal sectors originating from events in single cells

pericarp

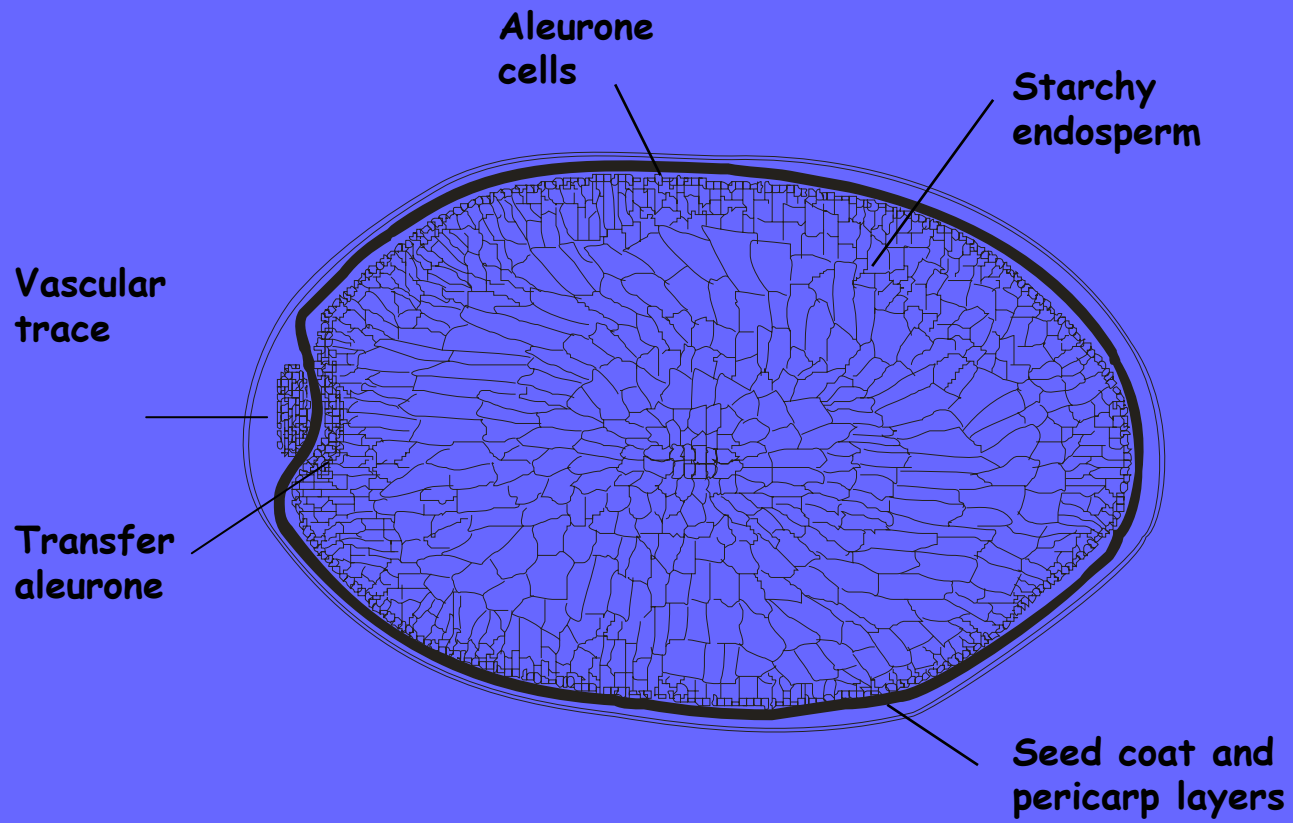


starchy endosperm



aleurone

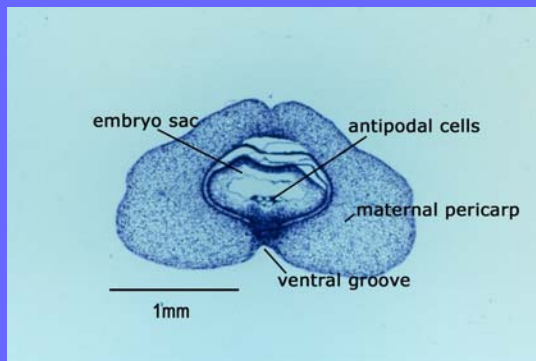
Cell division tightly controlled  
in different cell layers



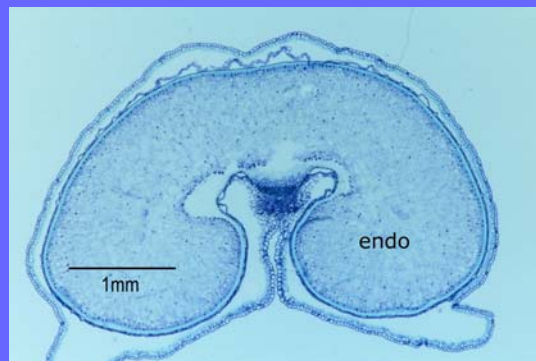
Rice



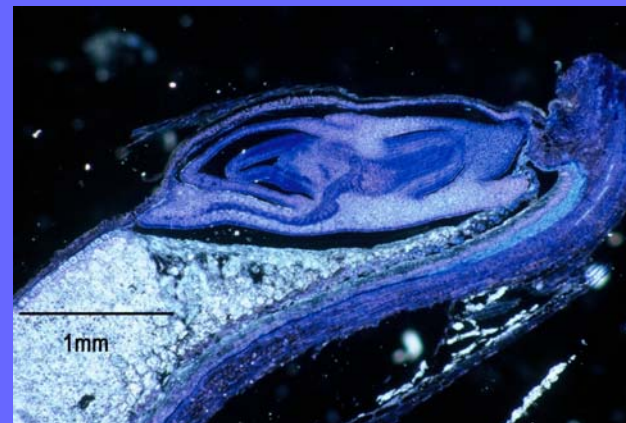
# Wheat / barley endosperm - more complex



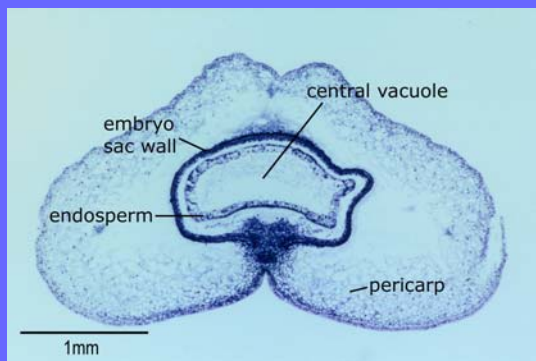
2dpa



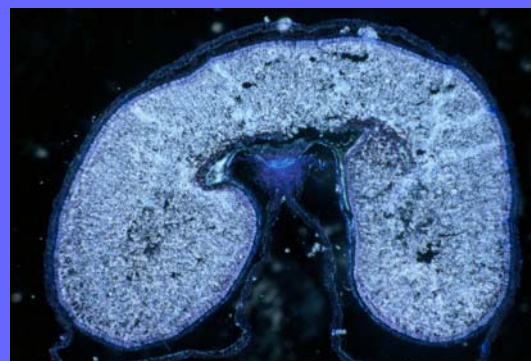
21dpa



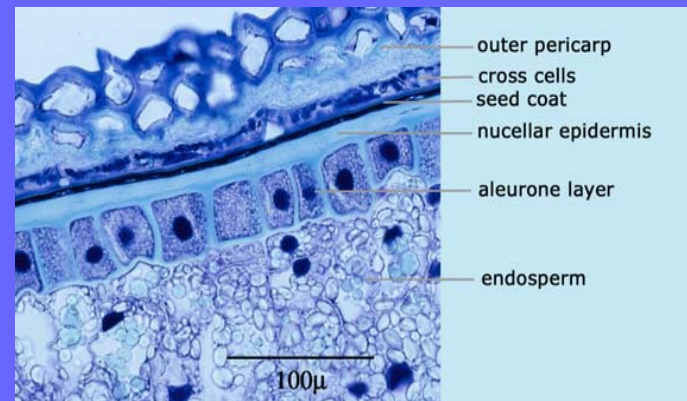
25dpa



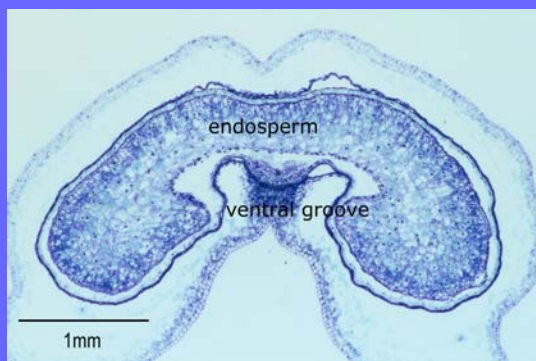
7dpa



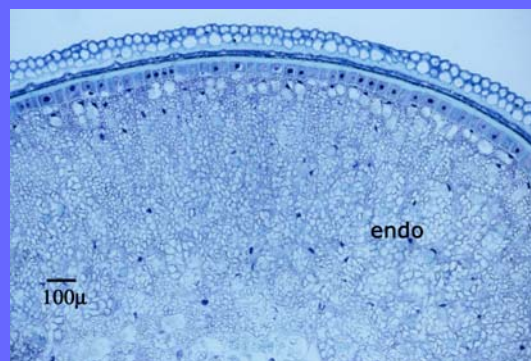
21dpa



26dpa



11dpa

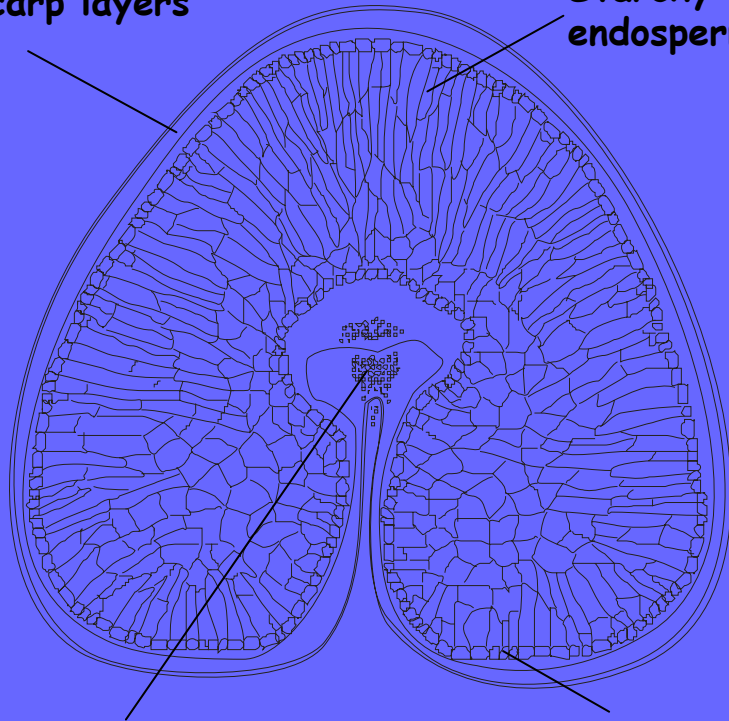


26dpa

# *Triticum aestivum* subsp *aestivum* cv Cadenza

Seed coat and pericarp layers

Starchy endosperm

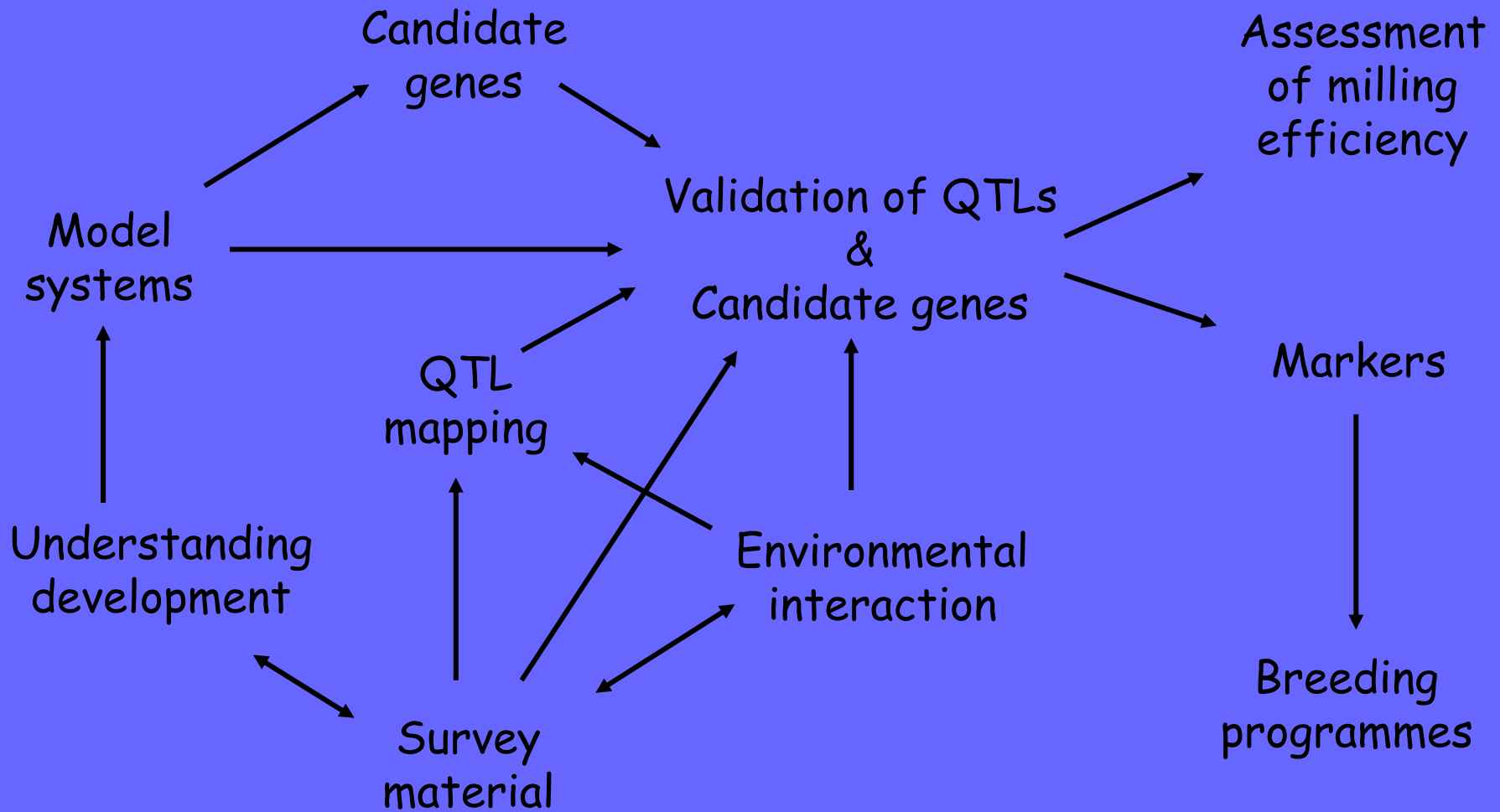


Vascular trace

Aleurone cells



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# Variation in grain shape: Elite lines

**Beaver**



**Soissons**



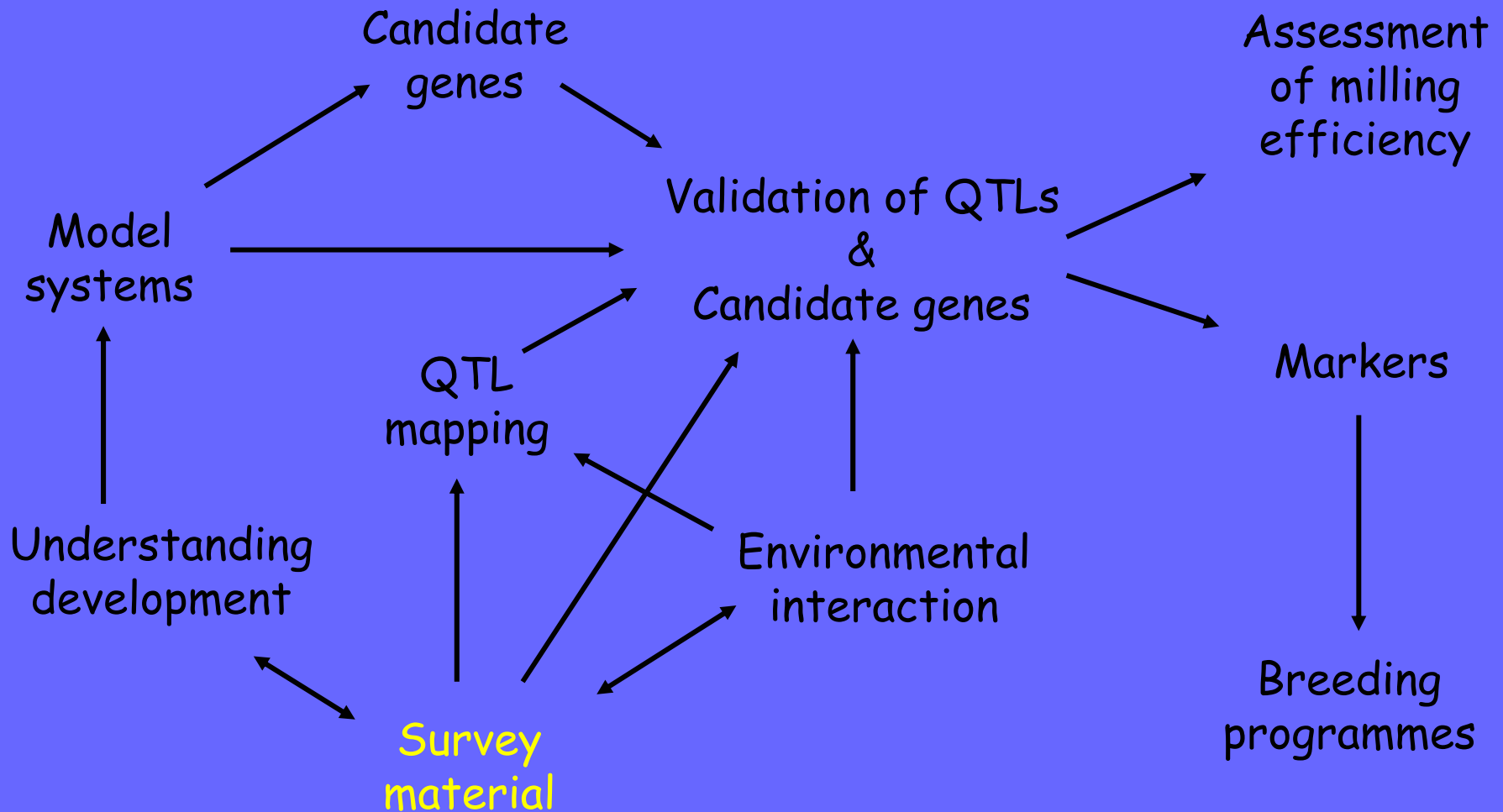
**Rialto**



**Spark**



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# Total range of material

*Triticum*  
*uratu* AA



*Aegilops*  
*tauschii*  
DD



*Triticum*  
*monococcum*  
AA



*Triticum*  
*dicoccum*  
AABB



*Triticum*  
*durum*  
AABB



*Triticum*  
*polonicum*  
AABB



*Triticum*  
*aestivum*  
AABBDD



*Triticum*  
*sphaerococcum*  
AABBDD

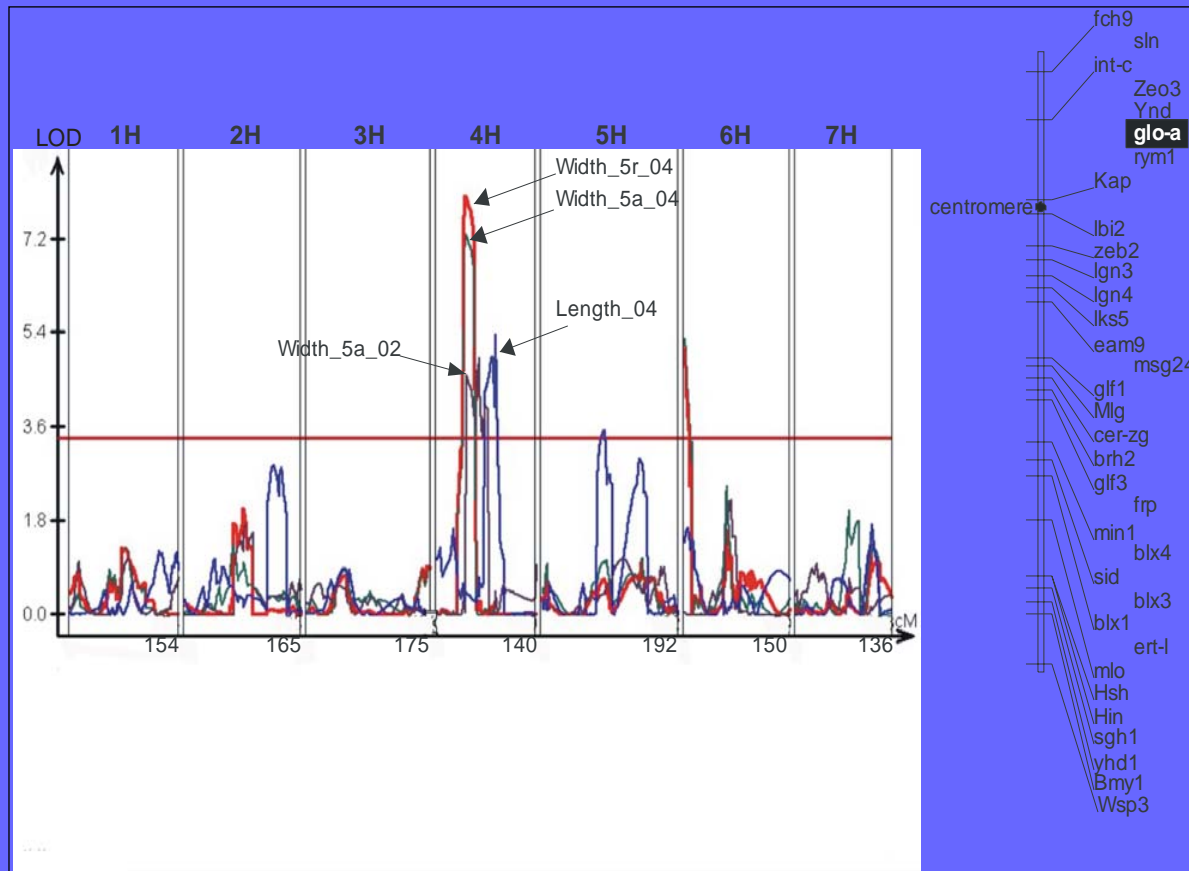


*Triticum aestivum* subsp *sphaerococcum*



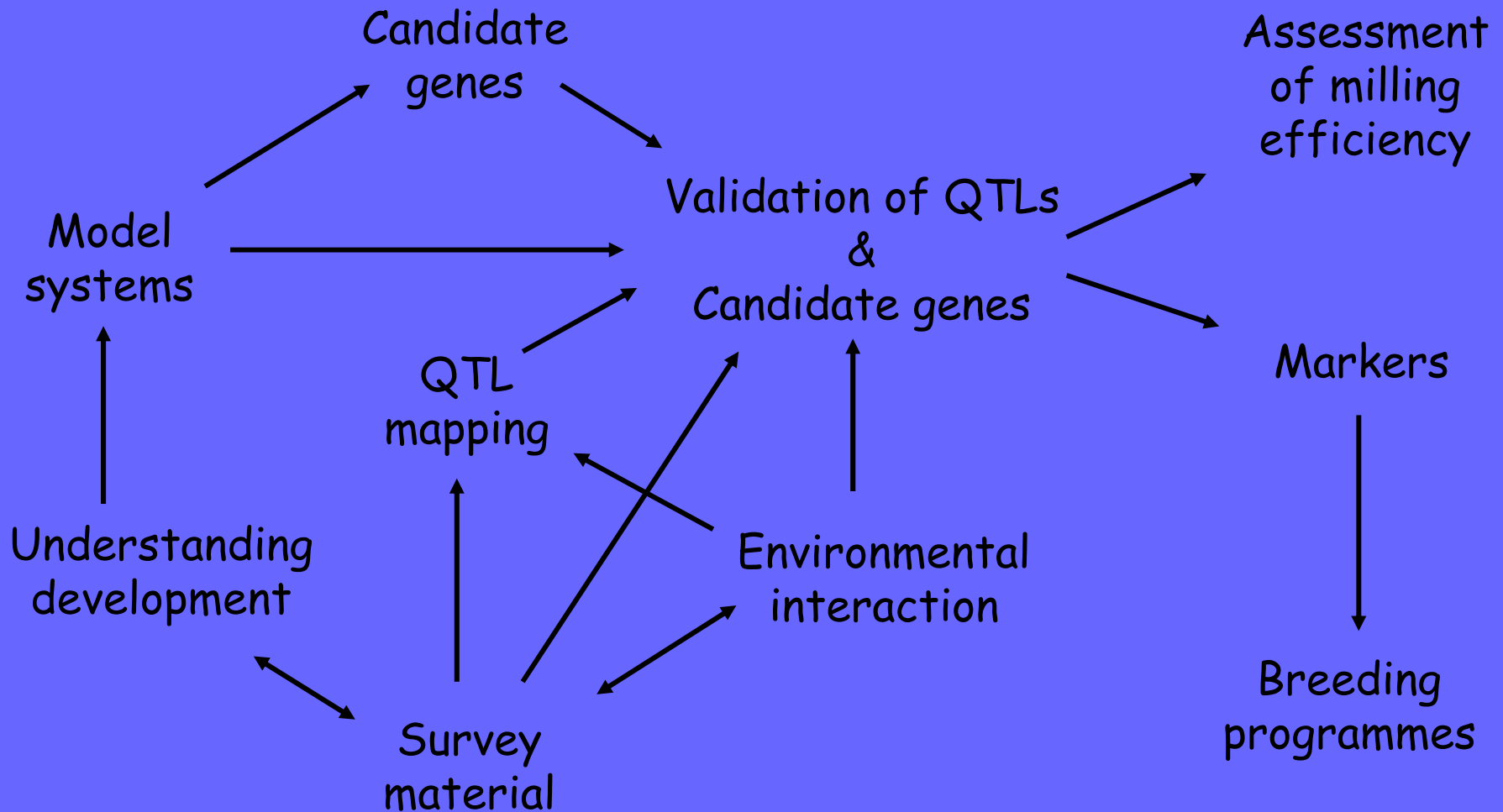
# Sphaerococcoid mutants in Barley

## Barley *gloA-F* mutant



Composite interval mapping of a Steptoe x Morex recombinant population

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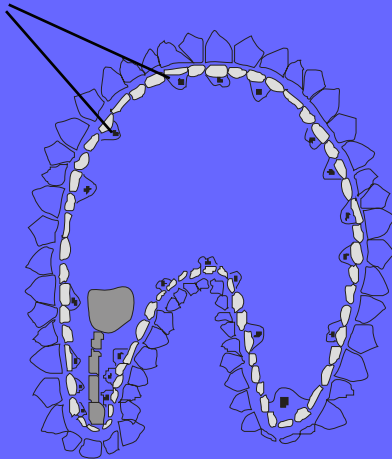




# Model systems as a source of candidate genes

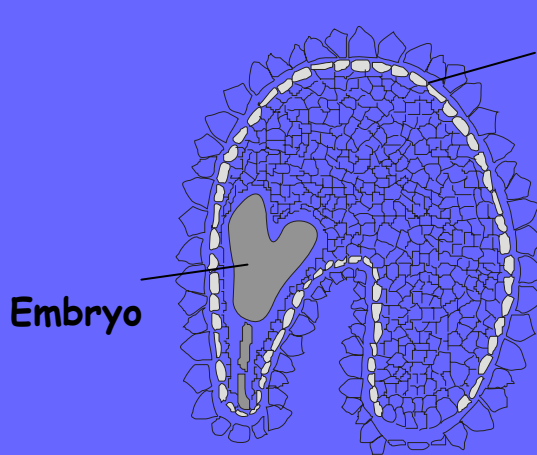
## Maize and Arabidopsis

Free nuclei



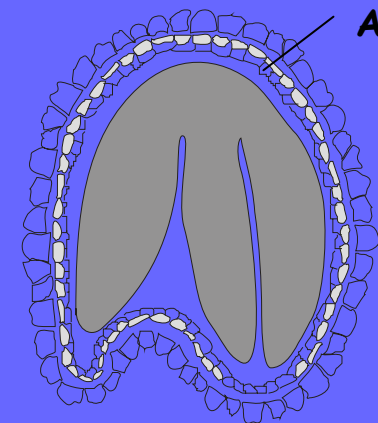
Coenocyte formation

Seed coat & pericarp



Cellularisation  
Differentiation

Aleurone



Retention of peripheral  
layer of endosperm  
(aleurone)

Arabidopsis •Parallel patterns of endosperm development

•Manipulation of cell division v differentiation in Arabidopsis and maize

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