Lecture 16: Regulation of floral organ identity

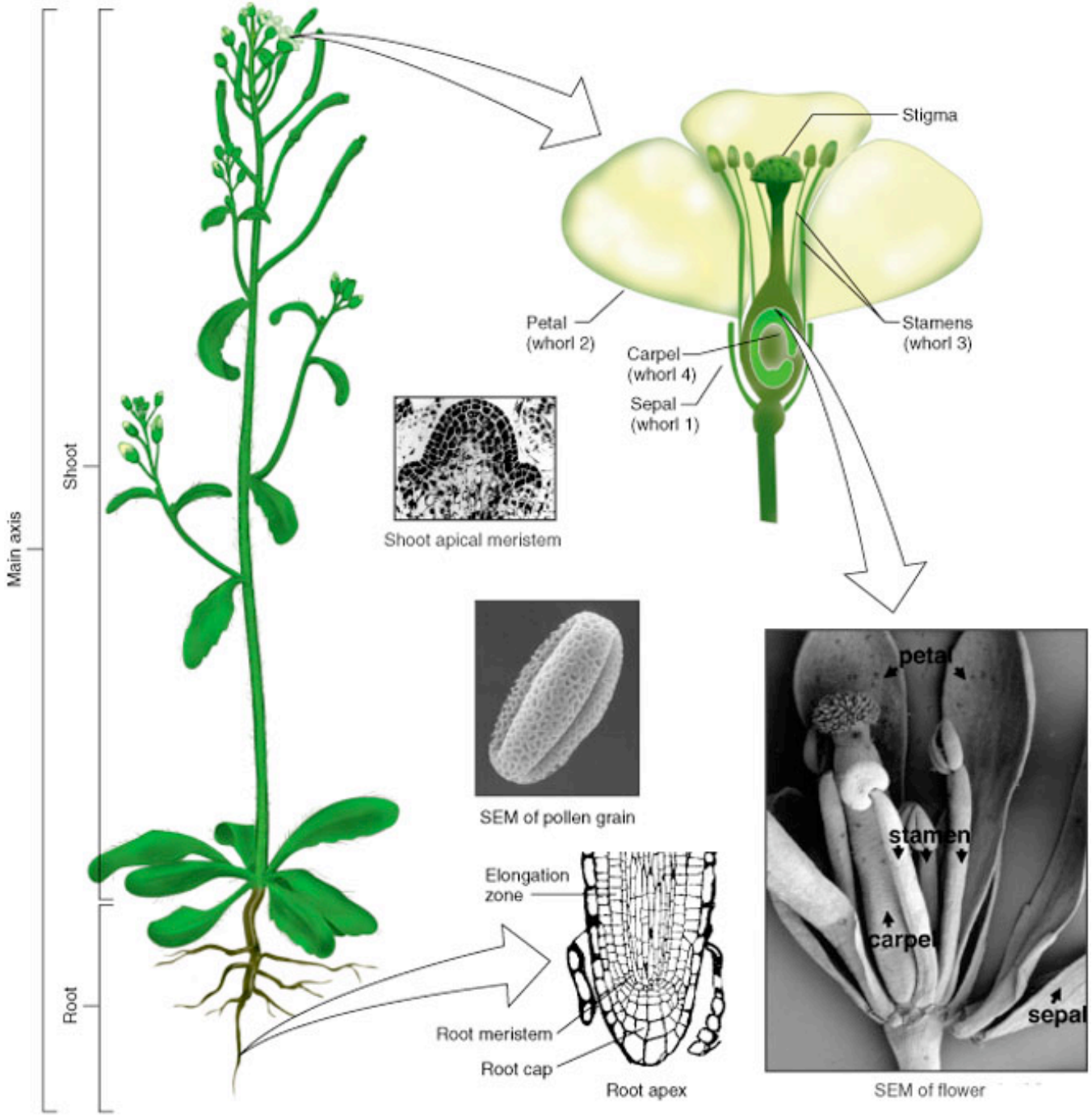
Read 580-585
Fig. 13.37, 38, 39, 40

Fig. B.1

Advantages of studying Arabidopsis thaliana
(Arabidopsis: same family as mustard and cabbage)

Small in size
Fast life cycle (6 weeks per generation)
Large amount of seeds (10,000-40,000/plant)
Self fertilization
Easy to grow
Five chromosomes
Little repetitive DNA
25,498 genes
Easy transformation
Genome has been completely sequenced

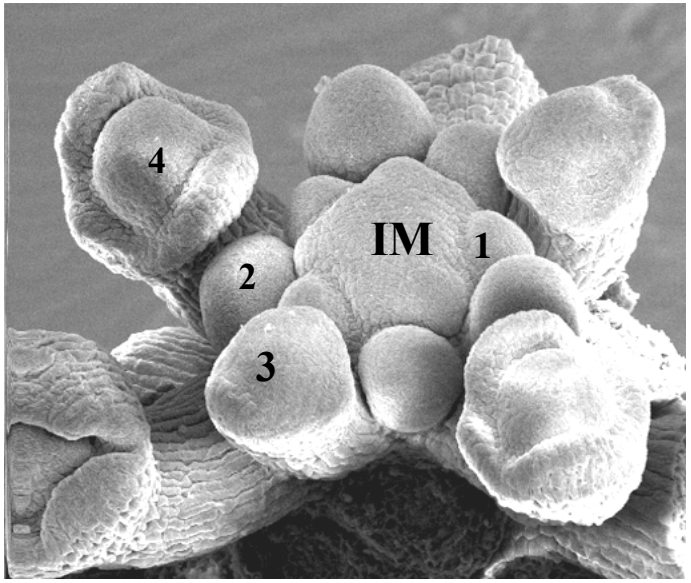
Fig. B.5



Inflorescence

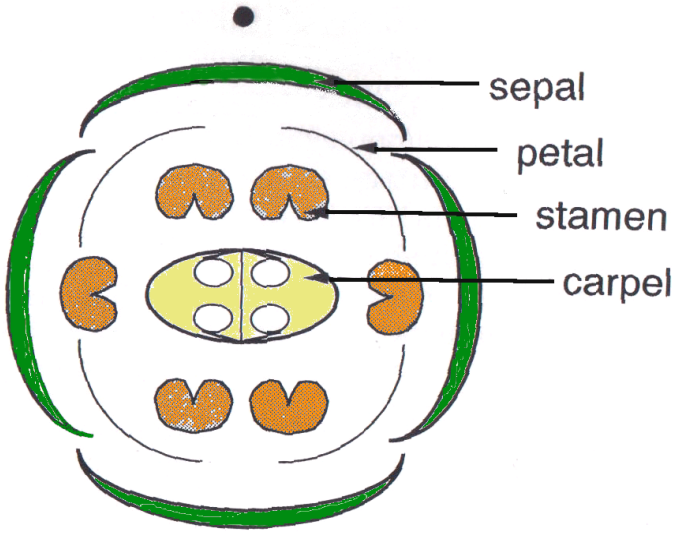
2^0 shoots

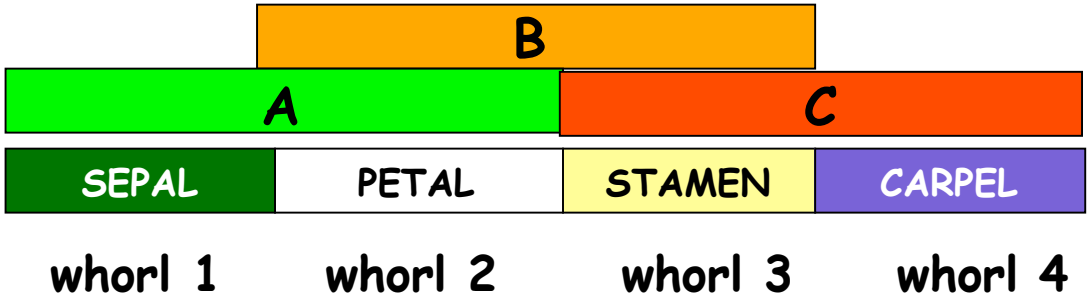
Rosette leaf



Inflorescence Meristem (IM)

The ABC's of *Arabidopsis thaliana* flower development





C class: AGAMOUS (AG)

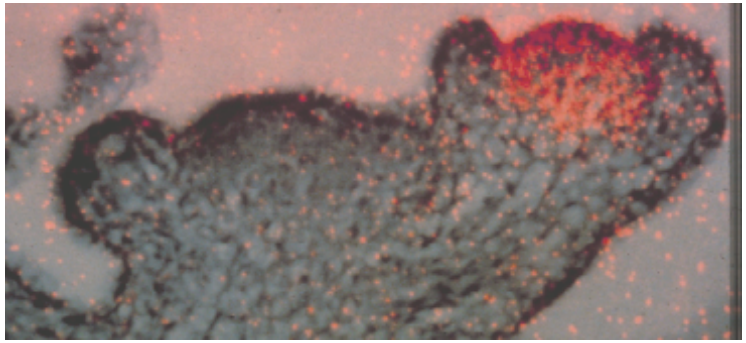
AG is a MADS box transcription factor

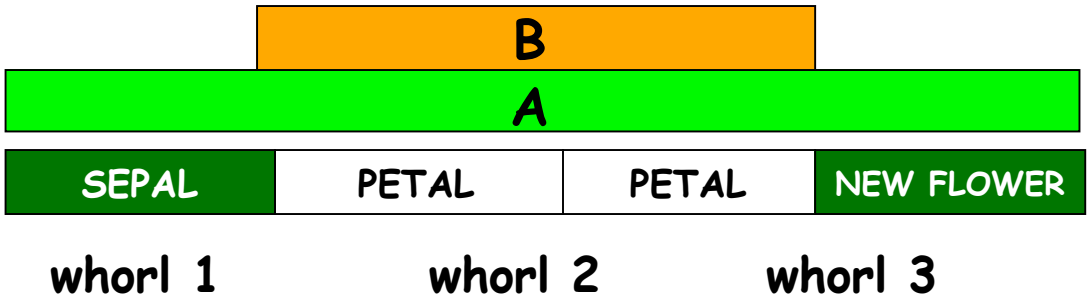
AG specifies stamen and carpel identity

AG represses sepal and petal identities

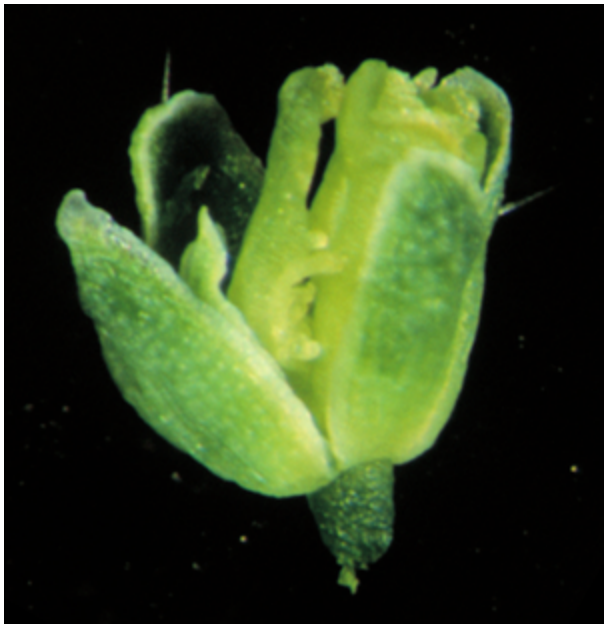
AG controls floral meristem determinacy

Expressed in whorls 3 and 4





B class: PISTILLATA (PI)
APETALA3 (AP3)

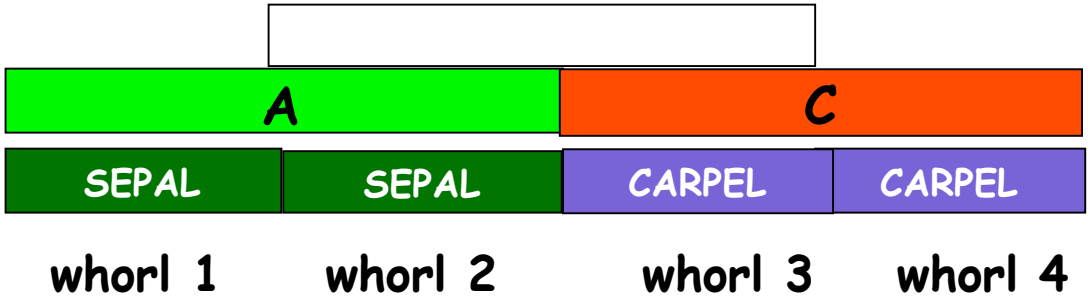


MADS box genes

Specifies petal and stamen

Expressed in whorls 2 and 3

Heterodimerize with each other *in vitro*



A class: APETALA1 (AP1)

MADS box protein

Meristem identity specification:

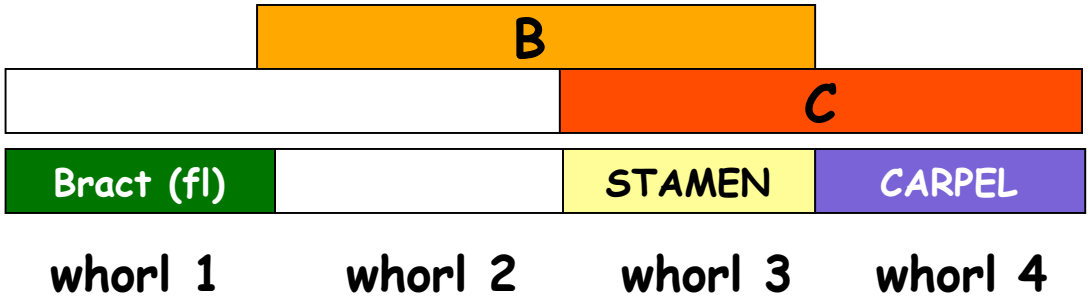
activate floral homeotic gene expression

Organ identity specification:

specifies sepal and petal identity

Early expression: in the entire floral meristem

Later expression: in whorls 1 and 2



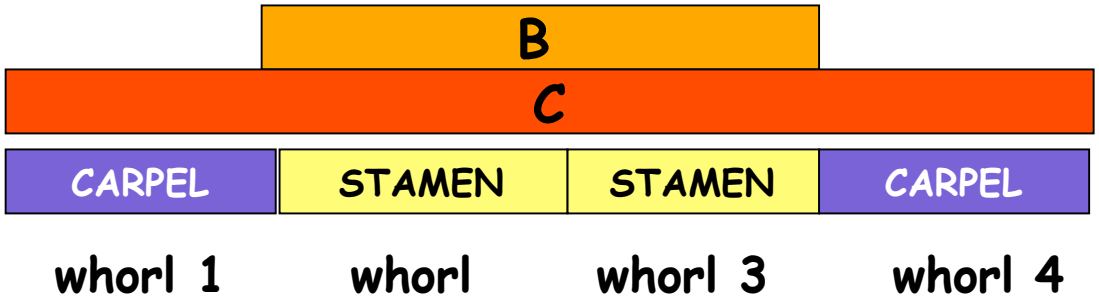
A class: APETALA2 (AP2)

AP2 encodes a novel type transcription factor with two 68 aa. *AP2* domains

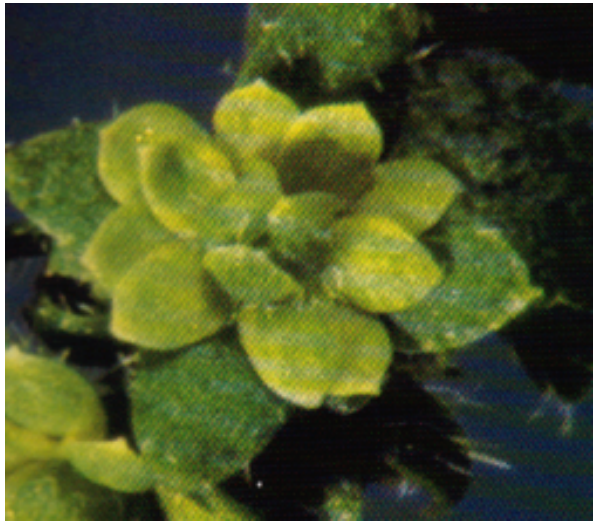
AP2 specifies sepal and petal development

AP2 negatively regulates *AG*

Expressed in all four whorls



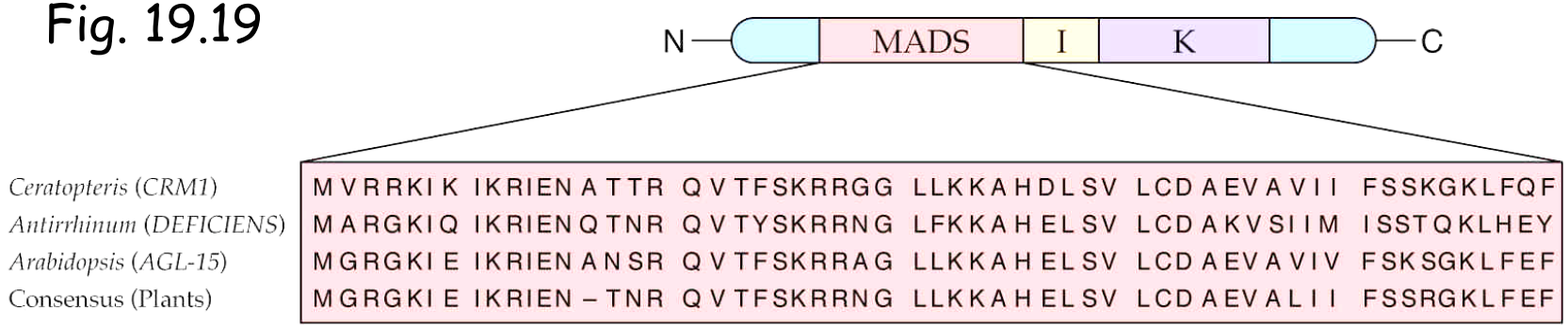
ac



bc

abc

Fig. 19.19



·MADS box (56 aa.): highly conserved domain required for DNA binding and dimerization.

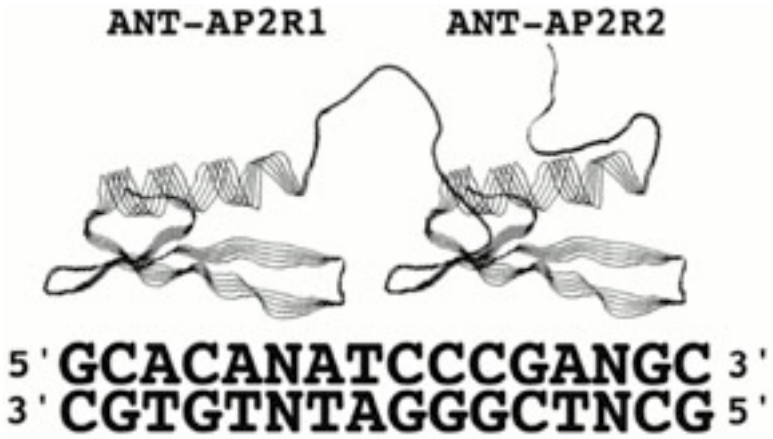
·I (31-37 aa.): an intervening region with dimerization function and specificity

·K box (66 aa.): protein-protein interaction domain

·COOH (54-98 aa.): transcription activation domain in AP1

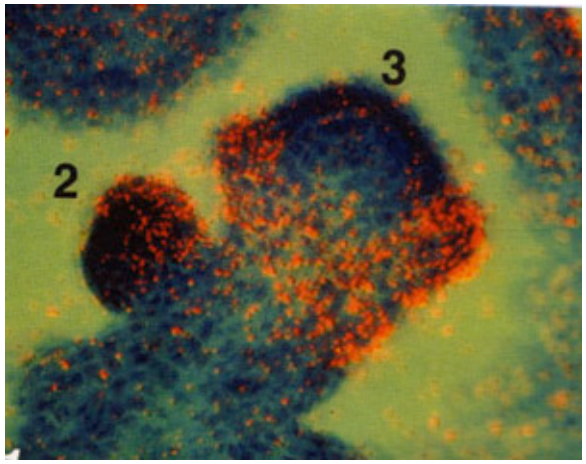
MADS proteins bind cArG box (CC(A/T)6GG) in vitro

AP2 domain: a DNA binding domain

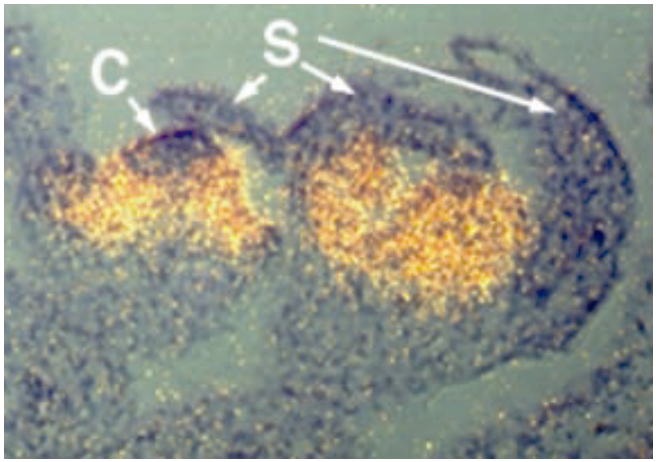


Nole-Wilson and Krizek, Nucleic Acid Research vol 28, 4076-4082, 2000

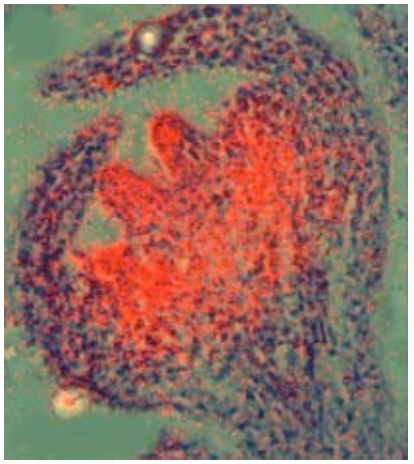
A, B, C gene mRNA expression pattern revealed by in situ hybridization



AP1

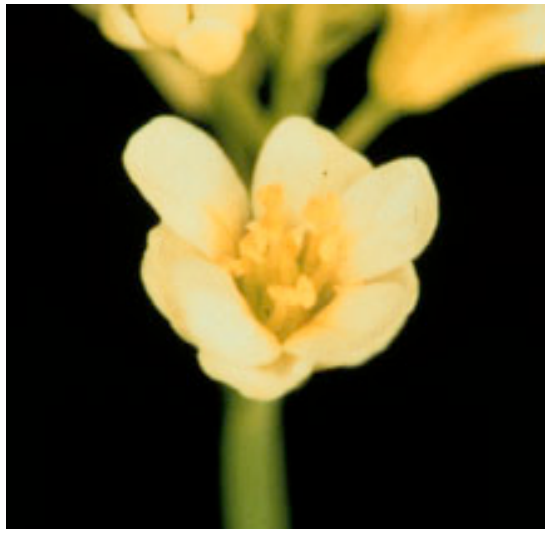


AP3



AG

35S::PI
35S::AP3



35S::B
c mutant

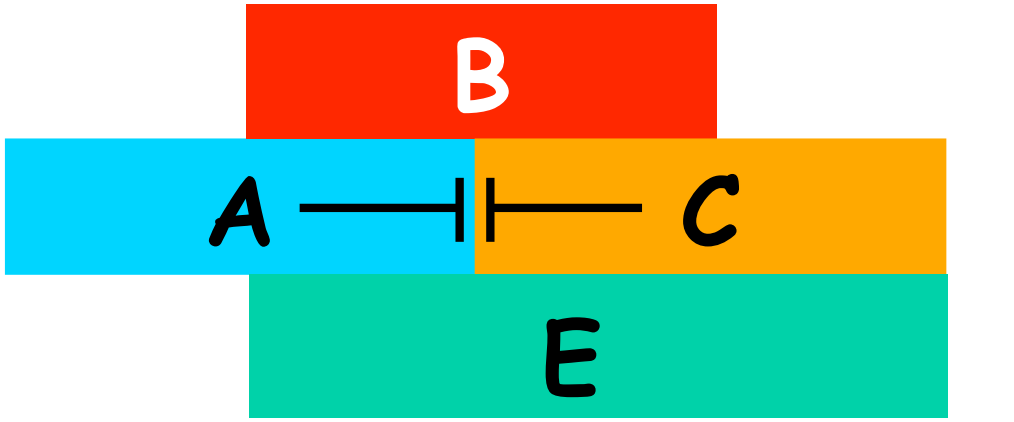
35S::B
a mutant

Fig. B.2

(a)

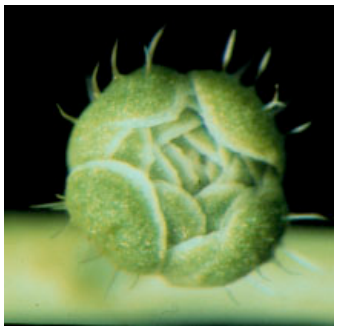
(b)

"Revisionist" ABC Model 2000



sepal petal stamen carpel

SEP1 (AGL2), SEP2 (AGL4), SEP3 (AGL9) = E class



MADS box proteins (most similar to AP1)

Have redundant function

Single mutants show subtle phenotype

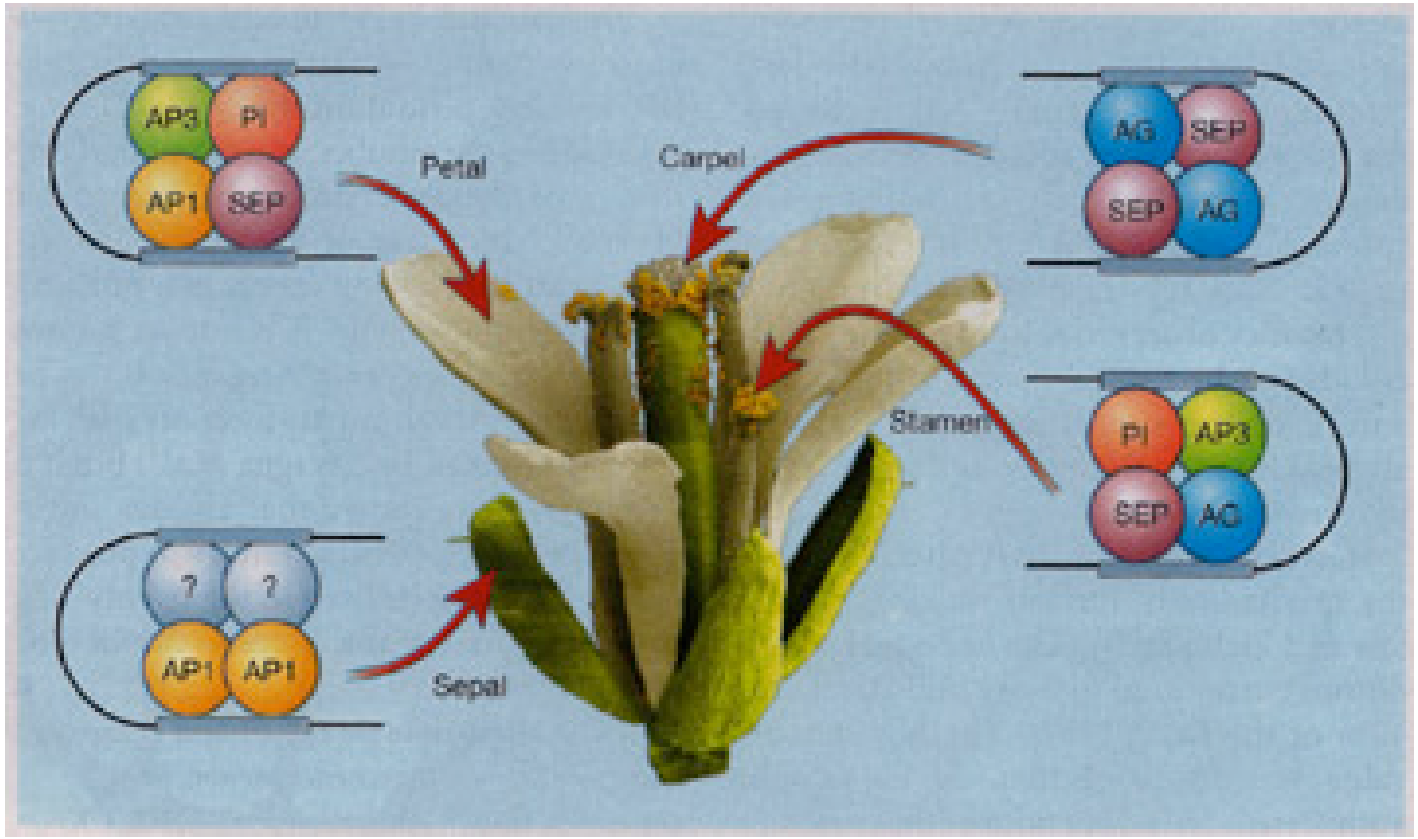
Triple mutant show flower phenotype similar to *bc* double mutant

SEP1,2,3:expressed in whorls 2-3 (*SEP 1,2* also in whorl1 in young flowers)

Interact with B and C proteins based on yeast two-hybrid assay

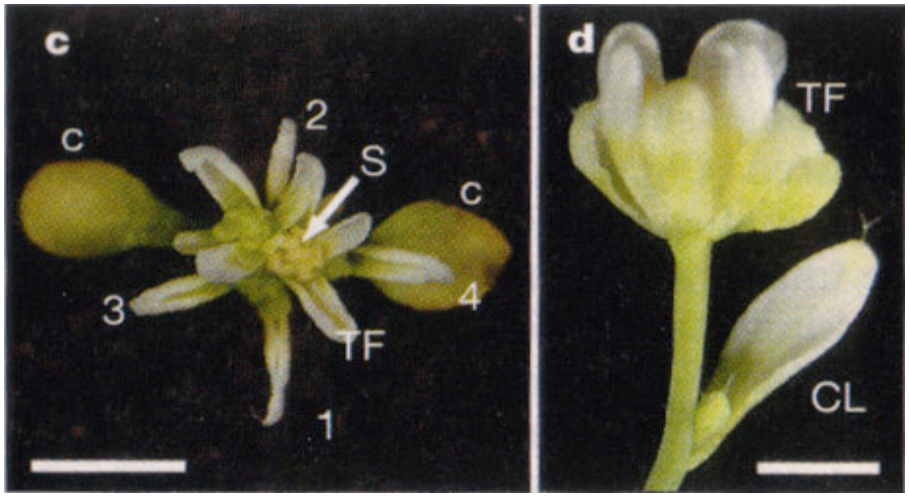
Pelaz et al., Nature 405, 200-203, 2000

A+B+E:	Petal
B+C+E:	Stamen
C+E:	Carpel
A+?:	Sepal



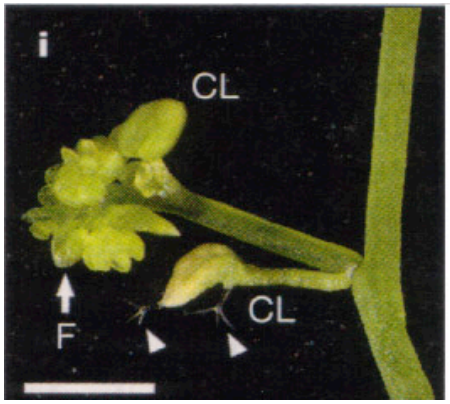
35S::AP3
35S::PI
35S::SEP3

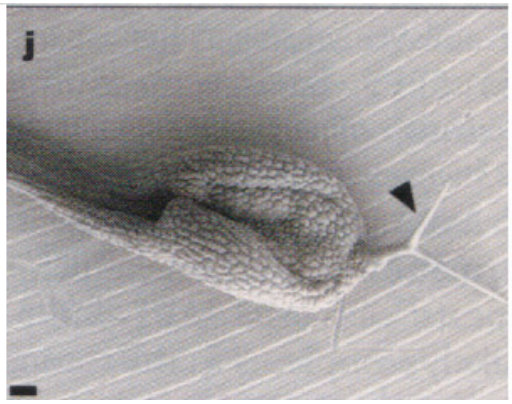
35S::AP3
35S::PI
35S::AP1

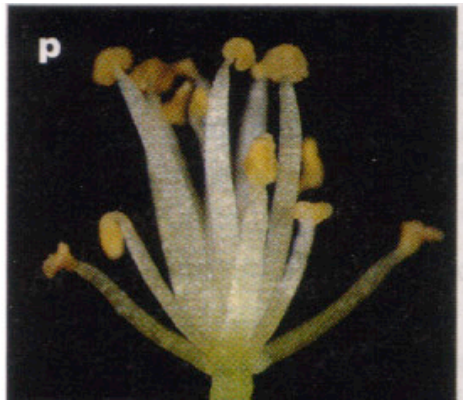


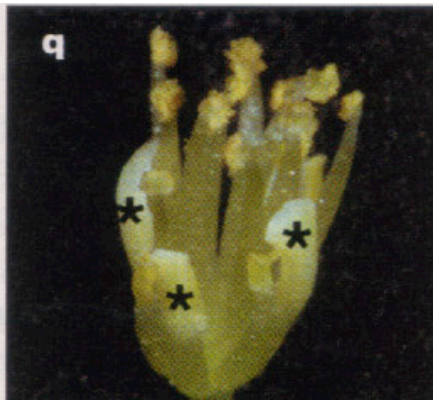
i, j, p
35S::AP3
35S::PI
35S::AG
35S::SEP3

q
35S::AP3
35S::PI
35S::AG



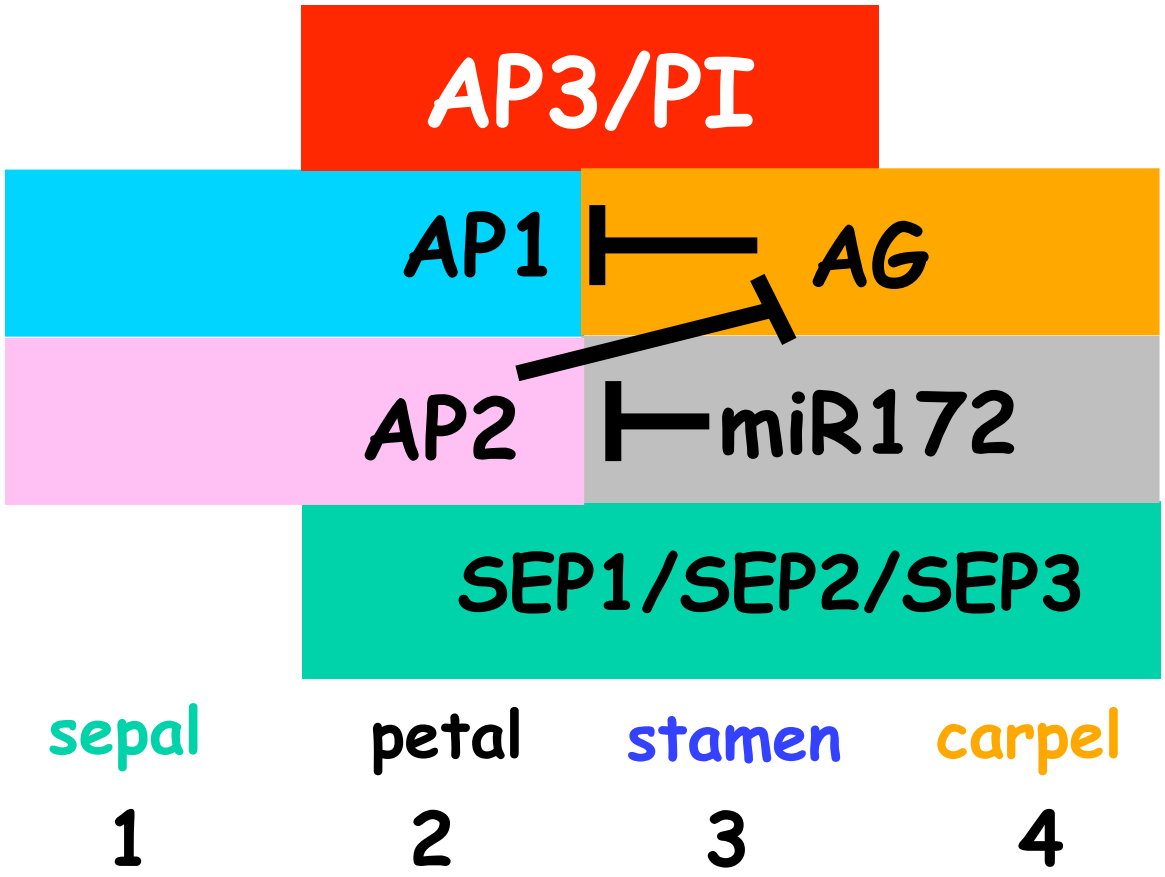


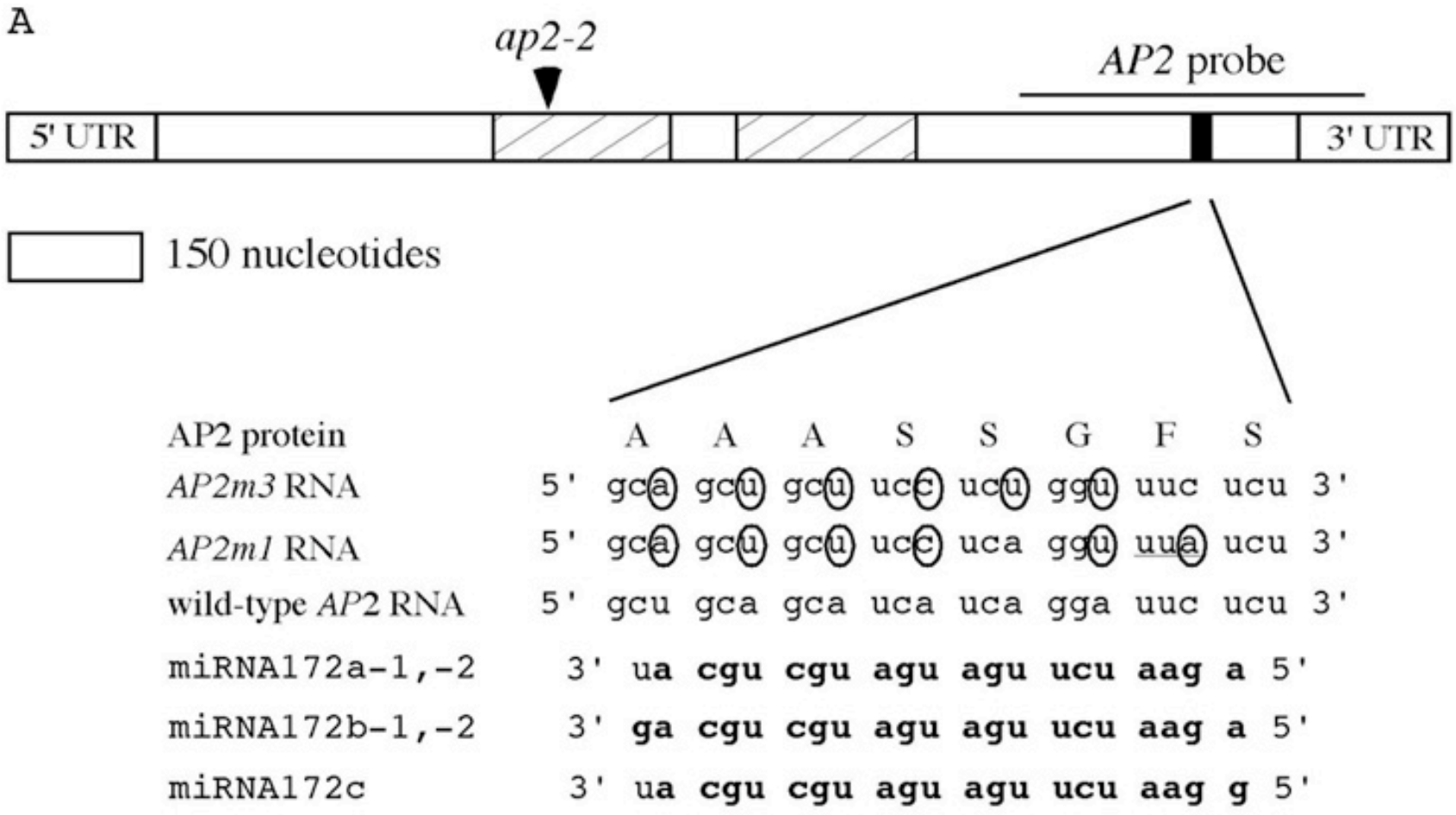




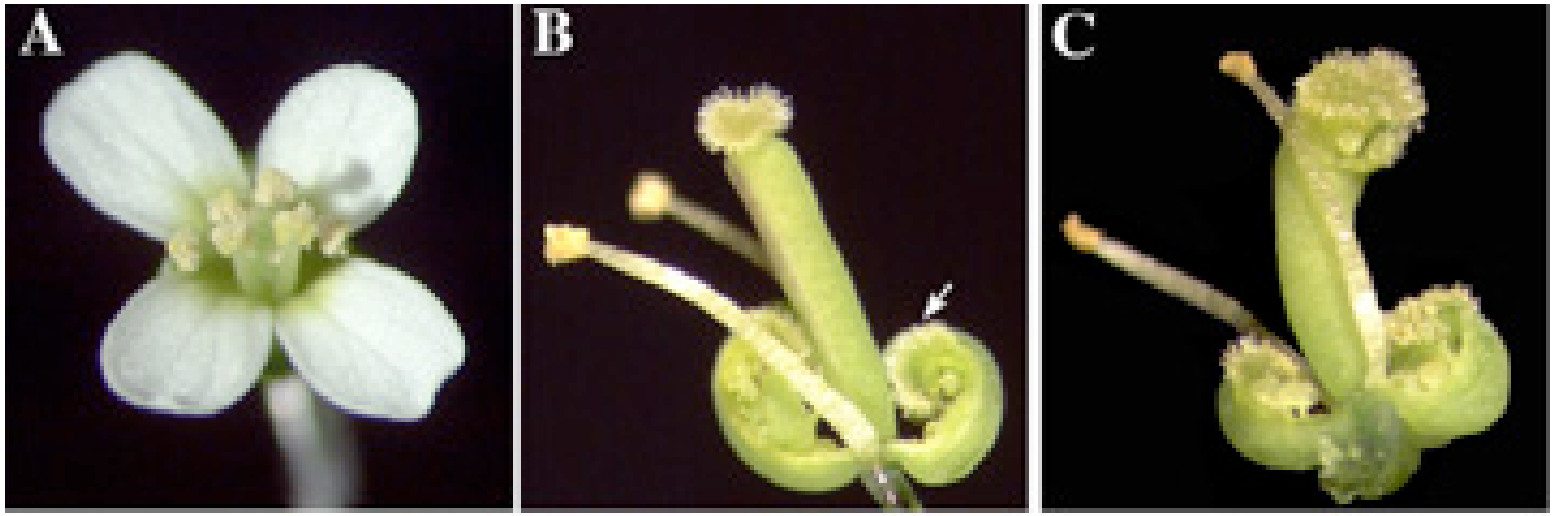
Honma and Goto, Nature 409, 525-529, 2001

A new dimension to the ABCE model?
AP2 is regulated by microRNA (2003)

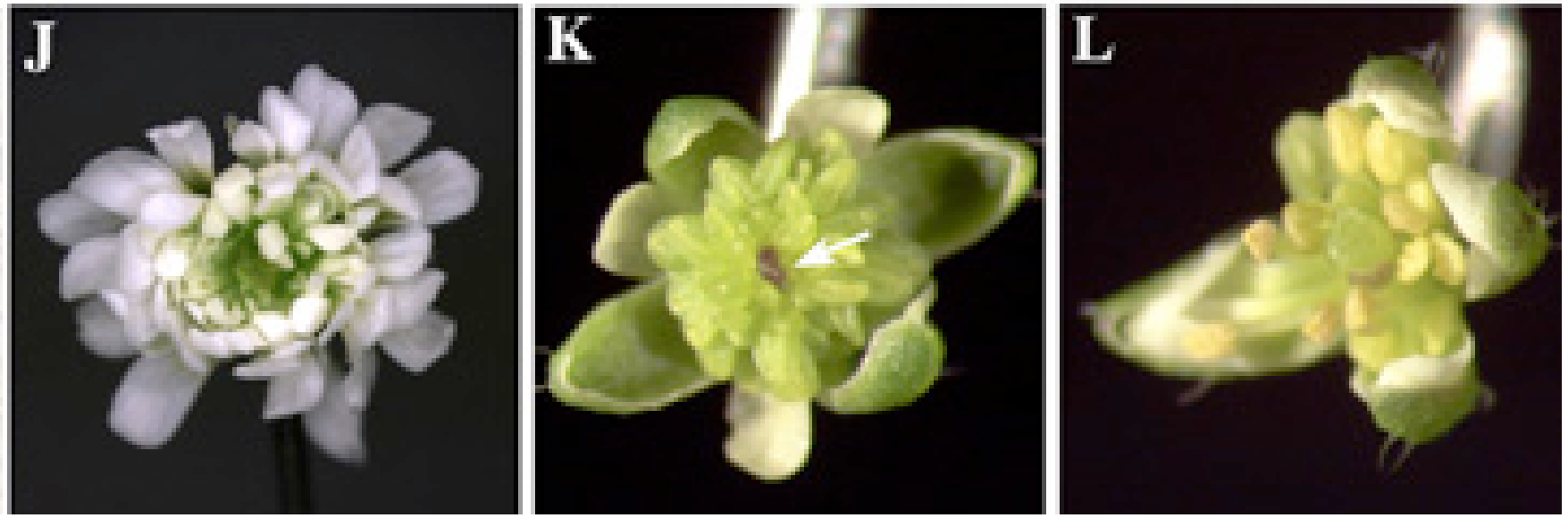




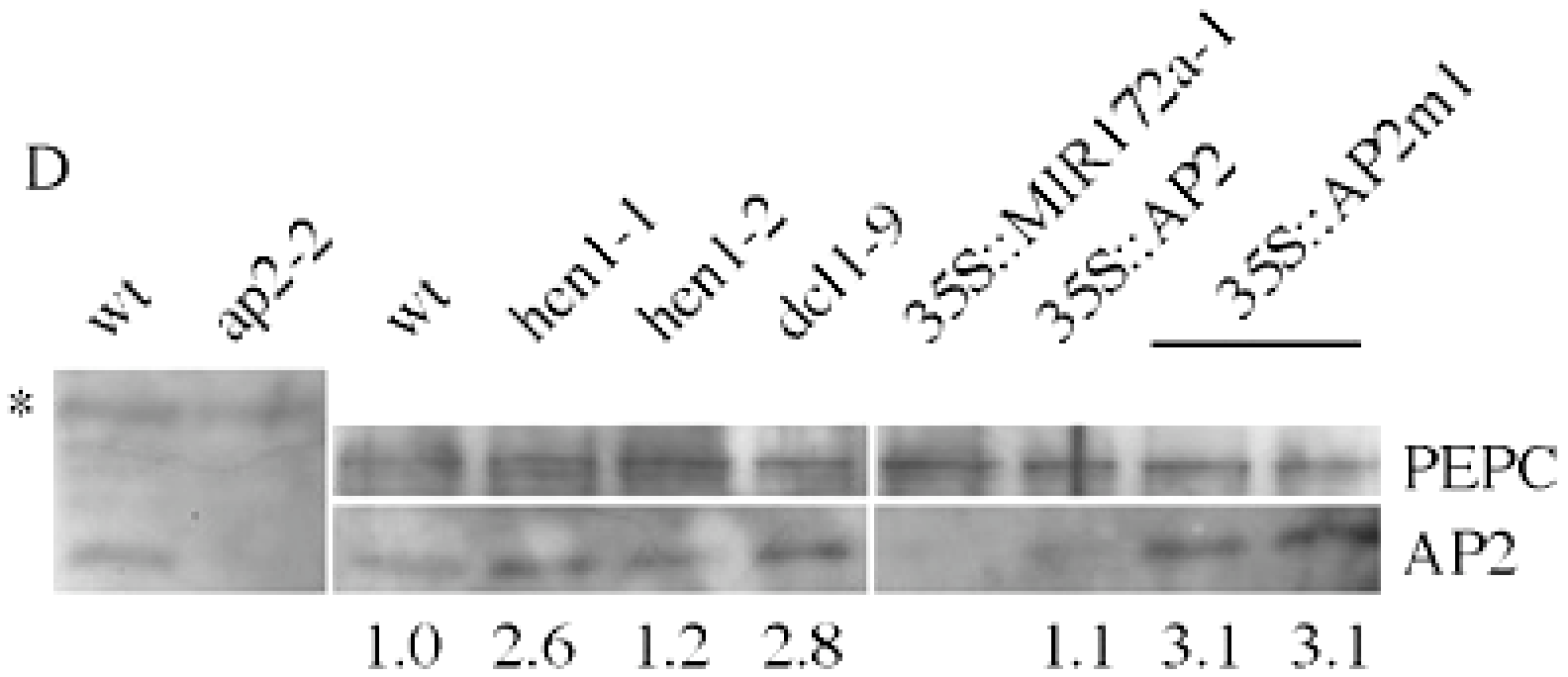
Chen X. (2004) Science 303, 2022

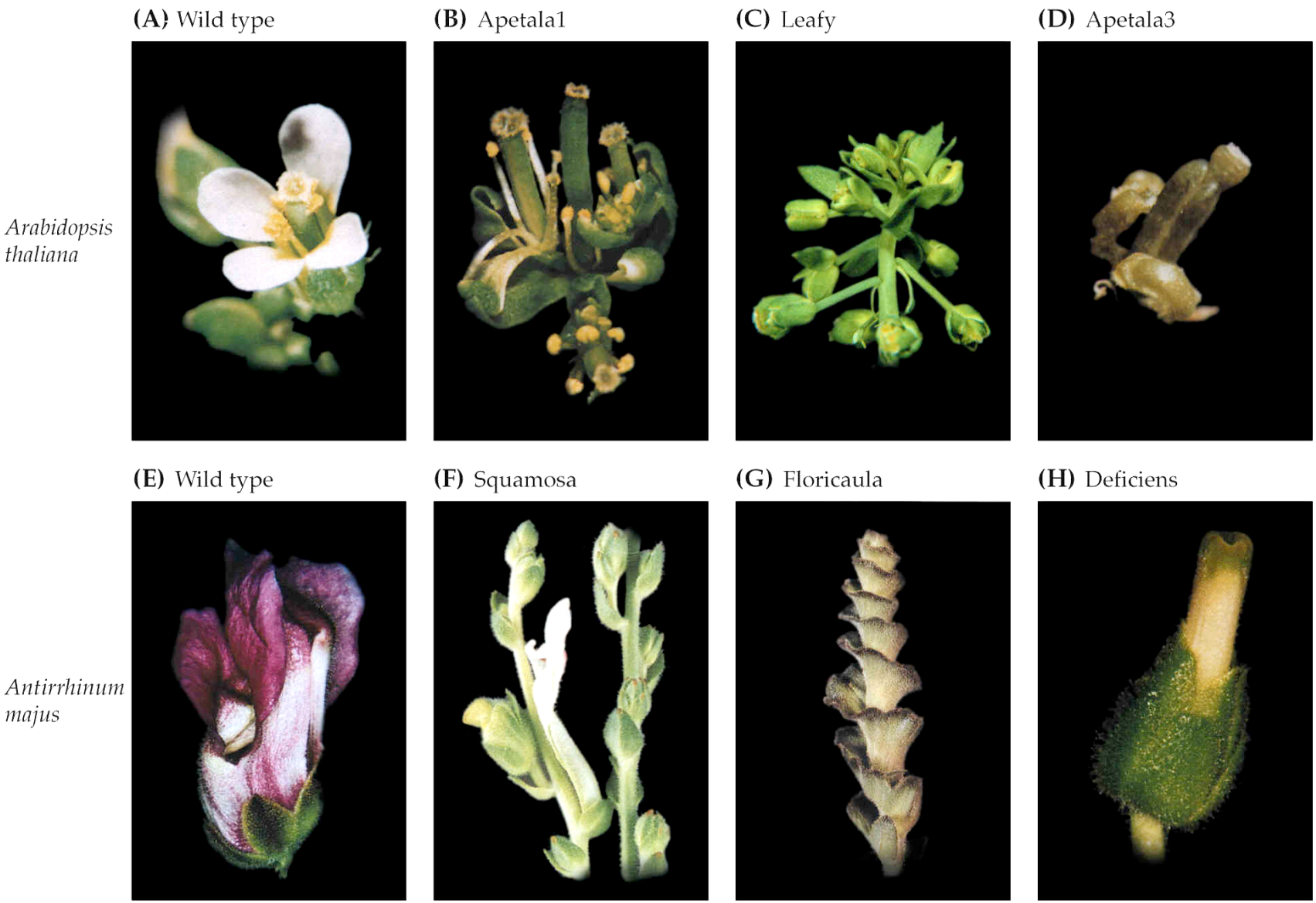


Wild type ap2 35S::mir172



35S::AP2m1 35S::AP2m1 35S::AP2


D
wt
ap2-2
wt
hen1-1
hen1-2
dcl1-9
35S::MIR172a-1
35S::AP2
35S::AP2m1
*
PEPC
AP2
1.0
2.6
1.2
2.8
1.1
3.1
3.1



Box 19.2 (text book)