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

- Shoot apical meristem
- SEM of pollen grain
- Elongation zone
- Root meristem
- Root cap
- Root apex
- SEM of flower
- Stigma
- Petal (whorl 2)
- Carpel (whorl 4)
- Sepal (whorl 1)
- Stamens (whorl 3)
Arabidopsis plant

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.
• **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
35S::PI
35S::AP3

35S::B
c mutant

35S::B
a mutant
Fig. B.2
“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
Honma and Goto, Nature 409, 525-529, 2001
Box 19.2 (text book)