Histone H1
meiotic chromosome axis
and recombination
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Meiosis
- Meiosis is an evolutionarily conserved process to produce haploid gametes
- It reduces the number of chromosomes to half the somatic number, thus compensating for fertilization
- It leads to genetic recombination as a result of independent segregation of chromosomes and crossovers

Meiotic Atlas of Arabidopsis

The Early Crossover decision model of meiotic recombination

Arabidopsis Meiotic Time Course

Meiotic chromatin structure
**Histone linker H1**

- Central globular domain and long terminal tails
- H1 binds to the linker DNA (~ 80 bp) region between the nucleosomes
- H1 is thought to facilitate the transition from the 10-nm fiber to the 30-nm chromatin fiber

**Histone H1 depletion in Xenopus**

- H1 facilitates transition from 10nm fibre to the higher order chromatin fibre in vitro
- We would expect that H1 depletion would produce fuzzier and wider chromosomes

“**A riddle, wrapped in a mystery, inside an enigma**”

Andrew Belmont 2006

Current Opinion in Cell Biology 18:632-638

**Arabidopsis Histone H1 linker isoforms**

- Arabidopsis genome contains 10 histone H1 isoforms
- H1 isoforms are constitutively expressed along the different stages of the plant development

**Histone H1 linker mutants**

- Plant development and flowering time are delayed in H1 single mutant lines
- Nevertheless, most of the mutant lines will develop normal size
Fertility Assessment in H1 mutants
- H1-like domain mutants show reduced seeds count

Numbers of seeds/silique

H1.1 Gene Structure and Mutants
- h1.1-1, h1.1-2 and h1.1 RNAi kd mutant shows reduced fertility levels with 90%, 17% and 40.9% respectively

Meiosis is affected in h1.1 mutants
- Meiosis is affected in h1.1 mutants

h1.1-2 & h1.1-1 allelic test
- Double heterozygote for h1.1-2 & h1.1-1 TDNA mutants showed 37% reduction in fertility
- Failure to restore normal fertility levels indicates that the mutant phenotypes are due to the h1.1 mutations
**CONCLUSION**

- Histone H1.1 role might be to organise the mitotic and meiotic chromosome axis
- Destabilization of H1.1 produces changes in chromosome length in mitosis and thus chromosome missegregation (dwarf phenotype)
- Lack of H1.1 produces changes in the meiotic chromosome axis (ASY1) which lead to incomplete synopsis and a reduced number of crossovers

**SUMMARY**

- Histone H1 isoform mutants display delayed vegetative growth and flowering time, and a reduction in fertility
- Histone h1.1 mutant phenotype:
  - Dwarf plants
  - Elongated mitotic metaphase chromosomes
  - Semi-sterile
  - Uncompleted homologous chromosome synopsis
  - Reduced levels of recombination (Xmate/DMC1/MLH1)
  - Meiotic chromosome axis is aberrant (diffuse ASY1)

**THANKS**