

The story of gametocidal („cuckoo“) chromosomes

History of Gc chromosomes/genes

- Gc chromosomes are best known in cereals (*Poaceae*)
- Gc chromosome ensures its transmission by causing chromosome breaks in meiospores lacking Gc chromosome
- the gametes with semi-lethal chromosomal breakage can be fertilized to produce offspring carrying chromosomal mutations. This is used to produce addition lines of alien cereal chromosomes in the wheat background. The effect of the Gc gene is variable - from lethal to semi-lethal; depending on the genotypes of wheat lines

Gc chromosome and evolution

- Gc chromosomes are selfish (eliminating gametes without themselves)
- Gc chromosomes/genes most likely played an evolutionary role in reproductive isolation and genome rearrangements
- Gc chromosomes probably spread from one population to other, and from one species to another by introgression
- Gc chromosomes could contribute to chromosome rearrangements occurring in nature

Gametocidal chromosomes of *Aegilops cylindrica* (jointed goatgrass)

- In wheat (*Triticum aestivum*), a Gc chromosome of *Aegilops cylindrica* causes structural **chromosome aberrations such as deletions** in the gametes not carrying the gametocidal chromosome.
- In wheat plants with the Gc chromosome and barley/rye chromosome [42 wheat chromosomes + 1 *Ae. cylindrica* chromosome + 2 barley/rye chromosomes], the **Gc chromosome induces chromosome mutations in barley/rye chromosomes.**



example: aberration of barley chromosome 7H >> an isochromosome of short arms of 7H

The Gc gene is causing extensive chromosome breakage in wheat immature pollen.



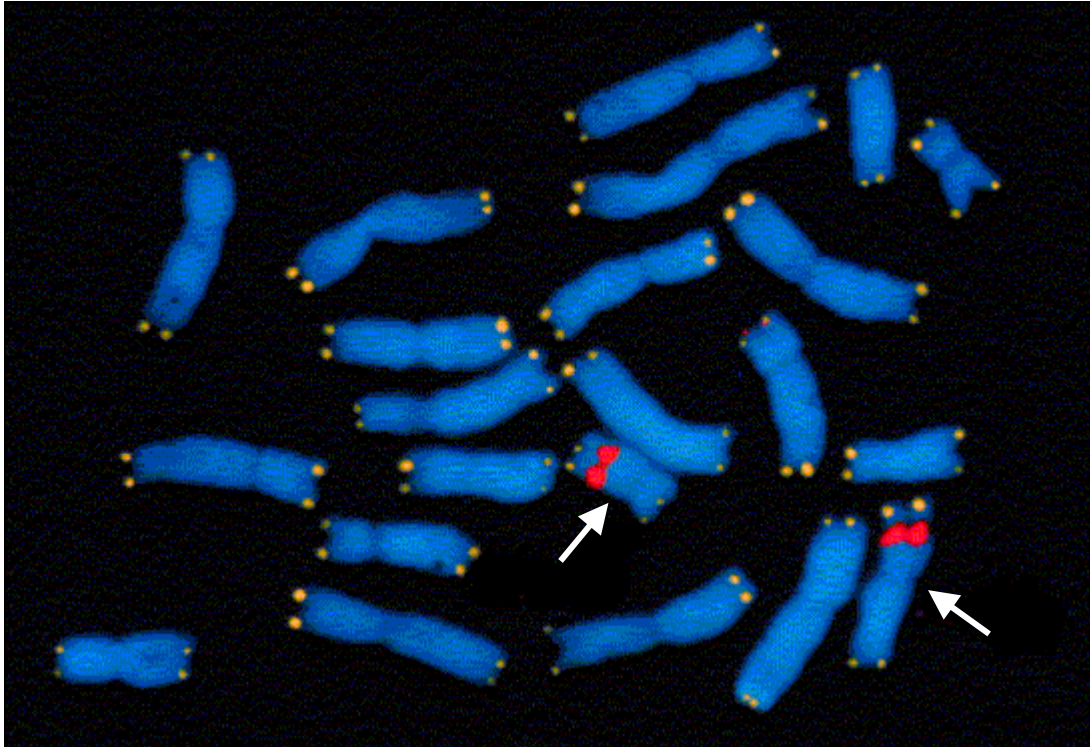
pollen carrying the Gc gene - normal mitosis

The Gc gene ensures pollen maturation and thus transmission of Gc genes.

pollen lacking the Gc gene - abnormal mitosis

The absence of the Gc genes causes extensive chromosome fragmentation.

Healing of gemetocidal gene-induced chromosome breaks



Wheat mitotic chromosomes of a plant with a deletion in the long arm of a wheat chromosome 1B. The deletion was induced by the Gc gene of *Aegilops cylindrica*.

One 1B normal; one 1B deleted. Telomeric probe labels also the deletion breakpoint in the deleted 1B. The healing of gemetocidal gene-induced chromosome breaks is achieved by the addition of telomeric repeats to the breakpoint.