HIGHLIGHTS

CHROMOSOME BIOLOGY

One is enough

New evidence indicates that one is the luckiest number when it comes to meiotic crossovers in *Caenorhabditis elegans*: a finding that might have implications for our understanding of eukaryotic meiosis in general.

Many geneticists think of meiotic crossing over as a means to an end: the end being the breaking up of combinations of genes on the same chromosome that would otherwise be inherited as one huge locus. However, in most cases, crossovers are also essential to direct meiotic chromosome segregation.

This makes it all the more surprising that eukaryotes usually have few crossovers. If crossing over is a random process, you would expect most chromosomes to have many crossovers to ensure that they all have at least one. *C. elegans* is the classic example: even its largest chromosome (20.9 Mb) has only one crossover per meiosis and yet chromosomes without crossovers are rare.

So, if crossing over is not random it must be regulated — but how? Kenneth Hillers and Anne Villeneuve attacked this problem in an ingenious way: they stuck pairs of *C. elegans* chromosomes together to make longer chromosomes and then looked at how this affected meiotic recombination.

By measuring recombination frequencies between pairwise combinations of visible markers in worms that were homozygous for the fused chromosomes, they showed that, amazingly, their map length was almost the same (~50 centimorgans) as the single 'parent' chromosomes. Despite this huge reduction in the rate of crossing over per Mb of DNA (40–50%), they could not find any chromosome pairs that lacked chiasmata in late prophase nuclei and almost all progeny from these fusion homozygotes were viable.

Hillers and Villeneuve obtained almost identical results using a fusion of three chromosomes that totalled over one-half of the worm genome. Clearly, the mechanism that regulates crossing over in *C. elegans* not only makes sure that each chromosome has at least one chiasma but also discourages further crossovers in the same chromosome regardless of how big it is. What is not so obvious is how this mechanism immediately recognizes that previously separate sections of the genome have been fused to form a larger chromosome.

Worms that were heterozygous for a fused chromosome shed some light on this question. Roughly one-half of meioses in these heterozygous worms have more than one chiasma per fused chromosome, which indicates that a discontinuity along one of the two partners impairs the ability either to communicate the presence of a nascent crossover or to inhibit the formation of another in response. This shows that structural continuity of meiotic chromosome axes or mature synaptonemal complexes might be the key to suppressing further crossovers once one has formed.

No doubt future studies will reveal more of this mechanism of crossover regulation, but the most important aspect of this new study is that it shows how robust this mechanism is to large-scale changes in karyotype. As the authors point out, this mechanism might rapidly stabilize new karyotypes: a possibility that those interested in chromosomal speciation will find fascinating.

Nick Campbell

References and links

ORIGINAL RESEARCH PAPER Hillers, K. J. & Villeneuve, A. M. Chromosome wide control of meiotic crossing over in *C. elegans*. *Curr. Biol.* **13**, 1641–1647 (2003)