

Correcting 'Hotheaded' genes

CSIRO has come up with a feasible explanation for why plants with the mutated version of the recessive 'Hothead' gene are able to produce healthy offspring.

Arabidopsis and the 'Hothead' gene

The mutated version of the 'Hothead' gene causes leaves and petals to fuse together in the plant *Arabidopsis*.

'Hothead' is a recessive gene so when two mutated versions of the gene are present it is just about inevitable, according to basic inheritance principles, that its offspring will also be mutated.

Indeed it is incredibly rare that the offspring are not mutated.

But in an article published in *Nature* (24 March 2005) titled 'Genome-wide non-mendelian inheritance of extra-genomic information in *Arabidopsis*' it was reported that, in a surprisingly large number of cases, the offspring had leaves and petals that separated normally.

Essentially the offspring had not inherited the mutated versions of the 'Hothead' gene as was expected. This goes against the entire theory of inheritance and was heralded as one of the most important discoveries in genetics of recent times.

Invisible RNA?

To explain the phenomenon the researchers of the original *Nature* article proposed that there was invisible RNA inherited from the plant's grandparents. This proposed



Normal Arabidopsis: it is unlikely that Arabidopsis uses 'invisible' RNA inherited from its grandparents to correct mutations.

invisible RNA played a role in providing a correct template to replace the faulty section of the mutated gene.

This theory relied on there being an invisible RNA cache that was eluding detection.

An alternative explanation

CSIRO researcher Dr Abed Chaudhury has come up with an alternative explanation for the ability of *Arabidopsis* to correct its own DNA so that its offspring do not have the same fused petals and leaves caused by the mutated 'Hothead' gene.

The CSIRO explanation, published in *Nature* (1 September 2005), shows that short sequences of existing DNA elsewhere in the *Arabidopsis* genome provide an exact, albeit shorter, match of the correct version of the mutated part of the 'Hothead' gene.

This correct sequence of DNA is copied to RNA which can then hybridise with the part of the DNA of the 'Hothead' gene which is mutated – correcting the gene in some subsequent generations.

CSIRO looked throughout the entire DNA of *Arabidopsis*, not just related genes, to find the short sections of DNA that could provide the correct template.

It can be compared with a company selling two different products. The company advertises under two different headings in the phone book – but one of the ads spells the company's name incorrectly.

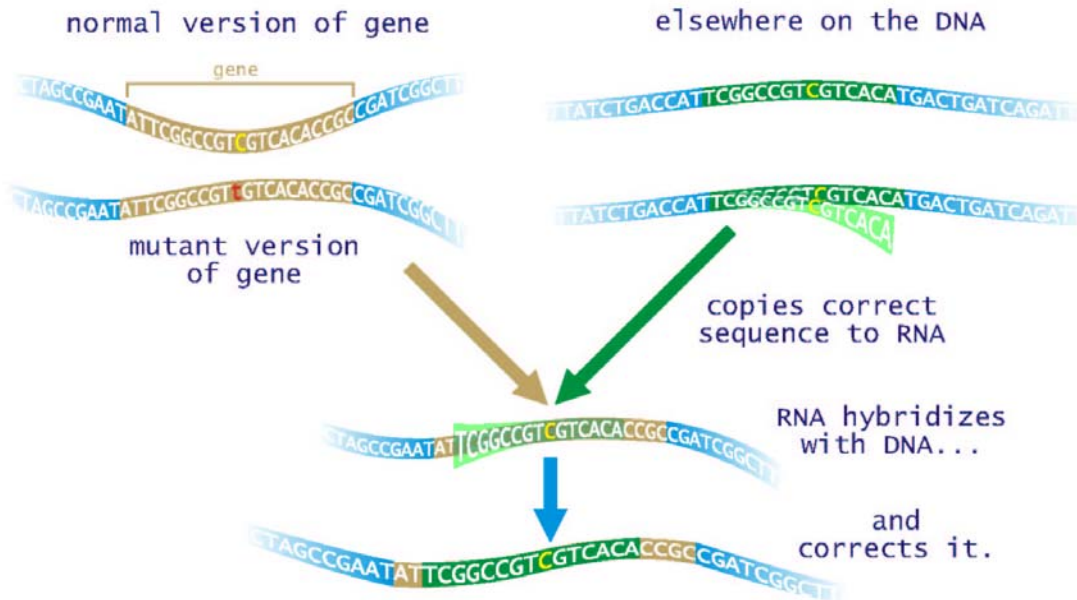
The editor then copies the spelling from the correct ad and pastes it over the incorrect spelling in the other ad – the next edition of the phone book will have both ads with the company name spelt correctly.

In the case of the 'Hothead' gene the copying doesn't always work so sometimes the offspring are still mutated, but the fact that copying even occurs and has a high rate of success is amazing.

Scientific reference

Chaudhury, A. (2005). *Hothead healer and extragenomic information*. Nature 1 September 2005.

CSIRO Plant Industry's alternative explanation for how mutated genes correct themselves by sourcing parts of correct DNA from elsewhere on the DNA.



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