

Hybrid plants with over-reactive immune system

November 17 2010



Incompatible hybrids from crosses between the *Arabidopsis thaliana* accession Ler and different accessions from Central Asia at low temperatures (14°). Each pair represents two second-generation plants, which are heterozygote (left) or homozygote (right) for the incompatible allele interaction. Because incompatible alleles are recessive, only homozygotes display dwarfism. In contrast, the heterozygotes grow normally. Image: Max Planck Institute for Plant Breeding Research

(PhysOrg.com) -- Individuals from the same species can often be crossed without any trouble. However, genes also have their preferences, and some gene variants are not compatible with those found in other individuals of the same species. Natural selection can give rise to gene variants that do not suit the genes of plants from other populations

within the same species. In this way, new species may arise.

Scientists at the Max Planck Institute for Plant Breeding Research in Cologne have now identified such a gene combination. This combination ensures that the incompatible hybrids do not grow well in cold conditions and are unable to control their [immune response](#) to pathogens. ([Nature Genetics](#), October 31, 2010)

Hybrid plants that carry two or more incompatible gene variants - also known as incompatible alleles - are often sterile and slow-growing. Breeding researchers call such plants with conflicting gene variants incompatible hybrids. However, these deleterious alleles do not simply disappear from nature; some are surprisingly frequent. This would suggest that they are advantageous in their original genetic backgrounds and show their bad side only after breeding. Matthieu Reymond, Rubén Alcázar and their colleagues from the Max Planck Institute for Plant Breeding Research have studied incompatible hybrids that are produced by crossing *Arabidopsis thaliana* accessions.

The natural range of this familiar weed, which is also known as thale cress, extends from Japan to the Cape Verde islands and North America, and from North Africa to northern Sweden. The different variants of the species are known as accessions. If the European accession Ler is crossed with the Asian accession Kas-2 or Kond, incompatible hybrids are produced that only grow as a dwarf form at temperatures below 14 degrees Celsius.

Overactive immune system impedes growth

The Cologne scientists have now discovered the critical allele in Kas-2 and Kond. It is a receptor-like kinase that is involved in the immune response. This allele allows the production of a protein that triggers a stronger immune response in the plant.

The critical allele in Ler maps to within a cluster of Resistance [genes](#). Their gene products also support the plant in defending itself against pathogens. Reymond and Alcázar had demonstrated this connection before, and are still analyzing the precise Ler allele polymorphism(s) within the complex cluster which triggers incompatibility with the Kas-2 and Kond receptor-like kinase alleles. "The dwarf growth would suggest that the Ler allele must have something to do with the plant's immune system. An activated immune defence system demands considerable metabolic activity of the plant and always operates at the cost of growth," says Matthieu Reymond.

The Cologne scientists remark that isolated Arabidopsis populations accumulate genetic differences over time. Certain genetic differences arise randomly while others are selected because they enable the plant to adapt particularly well to local environments. The incompatible Kas and Kond kinase alleles are common in Asia and show signatures of selection, but do not exist in other parts of the world. They were probably able to spread in Asia as they helped the populations there to attain an optimal immune response. The disastrous over-activity of the immune system only arises when they are crossed with the Ler accession, which they probably never encounter in nature due to the large distance between them. Therefore, a selection pressure against is not expected to be harmful to allele combination.

"The spreading of the incompatibility between the Ler accession and the Asian accessions is a by-product of [natural selection](#) in their local environments. This is a good example of how new species may arise that can no longer be crossed with each other," explains Rubén Alcázar.

More information: Rubén Alcázar, Ana V. García, Ilkka Kronholm, Juliette de Meaux, Maarten Koornneef, Jane E Parker & Matthieu Reymond, Natural variation at Strubbelig Receptor Kinase 3 drives immune-triggered incompatibilities between Arabidopsis thaliana

accessions, *Nature Genetics* [doi:10.1038/ng.704](https://doi.org/10.1038/ng.704)

Provided by Max-Planck-Gesellschaft

Citation: Hybrid plants with over-reactive immune system (2010, November 17) retrieved 26 April 2024 from <https://phys.org/news/2010-11-hybrid-over-reactive-immune.html>

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