Difference Between Homothallic and Heterothallic Fungi

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Key Difference - Homothallic vs Heterothallic Fungi

Sexual reproduction is one type of reproduction that commonly occurs in fungi. It is considered as the most efficient mechanism to maintain genetic variability within fungal populations. Sexual reproduction of fungi happens in two main ways, based on the type of fungi. There are two main types of fungi named homothallic fungi and heterothallic fungi. Homothallic fungi rely on self-fertilization while heterothallic fungi perform outcrossing. The key difference between homothallic fungi and heterothallic fungi is that **homothallic fungi produce both types of mating nuclei to form a zygote from the same thallus** while **heterothallic fungi produce only one type of mating nuclei and need two different individuals to form a zygote.** Sexual reproduction in heterothallic fungi occurs between genetically different and compatible mycelia. Sexual reproduction of homothallic fungi occurs between two male and female reproductive structures developed from the same thallus.

What are Homothallic Fungi?

Sexual reproduction increases the genetic variation and reduces the expression of deleterious recessive mutations in the progeny. Fungi like eukaryotic organisms often depend on the sexual reproduction to maintain their genetic variability and desirable phenotypes. Sexual reproduction of fungi happens in two types of fungi called homothallic and heterothallic fungi. Homothallic fungi possess both male and female nuclei derived from the same thallus for sexual reproduction. They do not need a partner for sexual reproduction. This is a form of self-fertilization or selfing. The opposite sexual functions are performed by two different cells derived from the same mycelium. Two mating nuclei are produced from the single individual and they fuse to form a zygote.

Homothallic fungi are successful than heterothallic fungi when the environmental conditions are harsh for successful sexual reproduction. Homothallic fungi do not depend on another mating partner to complete their sexual reproduction. Most of the lichen-forming fungi are homothallic and they reproduce by self-fertilization. Homothallism is a common condition in fungi though it causes reduced genetic

variability within populations. *Neurospora galapagoensis* is one type of homothallic fungal species.

What are Heterothallic Fungi?

Heterothallic fungi are the fungal strains which bear one type of mating type. They are unisexual in nature. Sexual reproduction of heterothallic fungi occurs between two different compatible mycelia. Both mating partners contribute nuclei for the formation of zygote. Identification of the mating partners is a complex process and it happens via mating type-specific peptide pheromones and receptors. The recognition between compatible mating types is essential for a successful sexual reproduction of heterothallic fungi. These two mating types are similar in morphology and differ genetically and physiologically.

Since heterothallic fungi rely on outcrossing, the genetic variation within the populations is high. Some heterothallic fungi also exhibit homothallism under specific environmental conditions. Homothalism – heterothallism transition is found in many fungal species at different environmental conditions.

Neurospora crassa is considered as the most analyzed heterothallic fungal species.

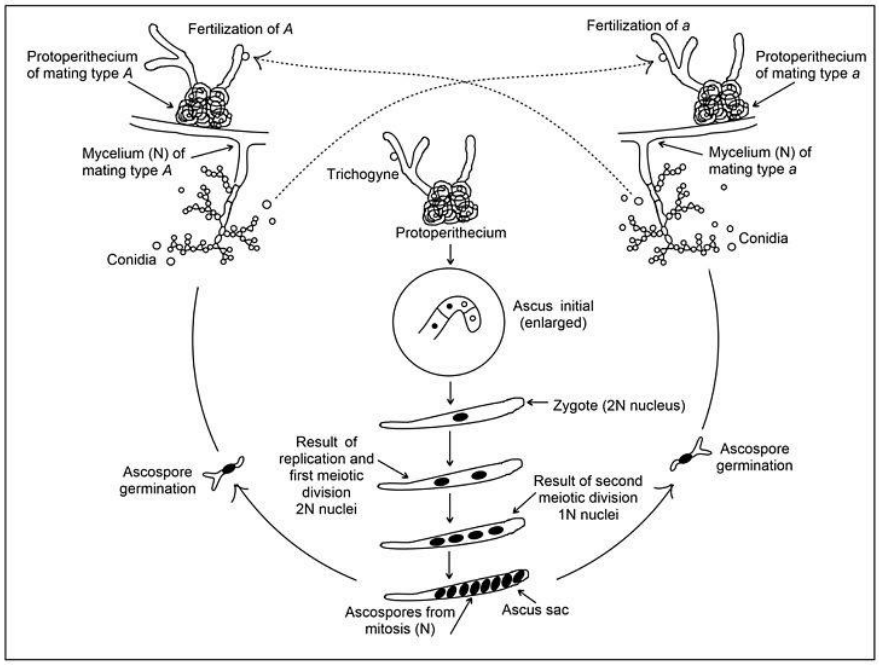

Figure 01: Life Cycle of Neurospora Crassa

What is the difference between Homothallic and Heterothallic Fungi?

Homothallic vs Heterothallic Fungi	
Homothallic fungi are the fungal strains which are able to produce both male and female mating types for sexual reproduction from the same thallus.	Heterothallic fungi are the fungal strains which have only one type of mating type and depend on a compatible mating partner for sexual reproduction.
Sexuality	
Mycelium of the homothallic fungi is bisexual.	Mycelium of the heterothallic fungi is unisexual.
Type of Sexual Reproduction	
Homothallic fungi perform self-fertilization.	Heterothallic fungi perform outcrossing.
Genetic Variation	
Homothallic fungal sexual reproduction reduces genetic variation.	Heterothallic fungal sexual reproduction increases genetic variation.
Requirement for a Mating Partner	
Homothallic fungi do not depend on a mating partner from another thallus.	Heterothallic fungi need a different but compatible mating partner.
Mating Partner	
Homothallic mating types are genetically more or less similar.	Heterothallic mating types are genetically different.
Examples	
Examples of homothallic fungi examples include *Aspergillus nidulans*, *Neurospora* galapagoensis, *etc.*	Examples of heterothallic fungi include *Neurospora Crassa*, *Saccharomyces cerevisiae*, *Aspergillus fumigatus*, *Aspergillus flavus*, etc.

Summary - Homothallic vs Heterothallic Fungi

Sexual reproduction is an essential mechanism in eukaryotic evolution to increase genetic diversity and eliminate deleterious mutations. Fungi show two evolved paradigmatic sexual systems named homothallism and heterothallism. Homothallic fungi reproduce sexually by self-fertilization. These fungi are able to produce both

types of reproductive structures or mating types from the same mycelium. They do not depend on a different mating thallus for sexual reproduction. Two types of nuclei are produced from the single mycelium in homothallic fungi to produce a zygote. This is opposite in heterothallic fungi. Two different mating thali contribute nuclei to form a zygote. Heterothallic fungi are unisexual and produce only one type of mating gametes or structures. They reproduce by outcrossing, which increases the genetic variability in progeny fungi. This is the difference between homothallic and heterothallic fungi. Homothallism and heterothallism coexist in some fungal strains and transition between homothallism and heterothallism is also common in many fungal phyla.

References:

1. "Heterothallism." Wikipedia. Wikimedia Foundation, 02 May 2017. Web. Available here. 05 June 2017.
2. Ni, Min, Marianna Feretzaki, Sheng Sun, Xuying Wang, and Joseph Heitman. "Sex in Fungi." Annual Review of Genetics. U.S. National Library of Medicine, 2011. Web. Available here. 05 June 2017.

Image Courtesy:

1. "Neurospora crassa life cycle" By Chaya5260 - Own work (CC BY-SA 3.0) via Commons Wikimedia

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