

Selected Literature

- Goker, m. H. Voglmayr et al. 2003. Taxonomic aspects of Peronosporaceae inferred from Bayesian molecular phylogenetics. CJB 81:672-683.
- Choi, Y-J et. al. 2003. Diversity of the *Hyaloperonospora parasitica* complex from core brassicaceous hosts based on ITS rDNA sequences. Mycol. Res 107:1314-1322.
- Thines, M. 2007. Characterisation and phylogeny of repeated elements giving rise to exceptional length ITS2 in several downy mildew genera (Peronosporaceae) Fungal Genetics and Biology 44:199-207.
- Voglmayr, H. 2003. Phylogenetic relationships of *Peronospora* and related genera based on nuclear ribosomal ITS sequences. Mycol. Res. 107:1132-1142.

Taxonomy of the Downy Mildews

Kingdom: Stramenopila
Phylum: Oomycota
Order: Peronosporales
Family: Peronosporaceae

Peronospora species –
Sporangiophore and
sporangia



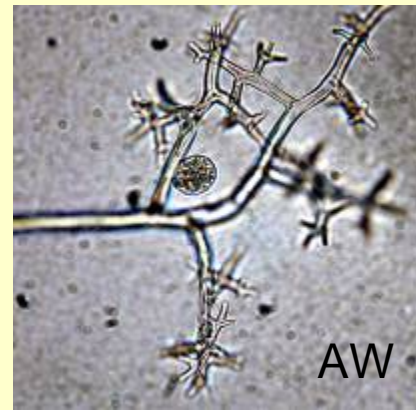
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More Traditional Taxonomic Viewpoint

- Sporangiophores have determinate growth and are more highly differentiated compared to most species of the Pythiaceae (*Pythium* and *Phytophthora*) – see more recent viewpoint on some species of *Phytophthora*
- Genera delimited on sporangiophore morphology and and somewhat on mode of germination of sporangia, and morphology of haustoria
- Species based typically on host or host range

Plasmopara species,
sporangiophore and
sporangium

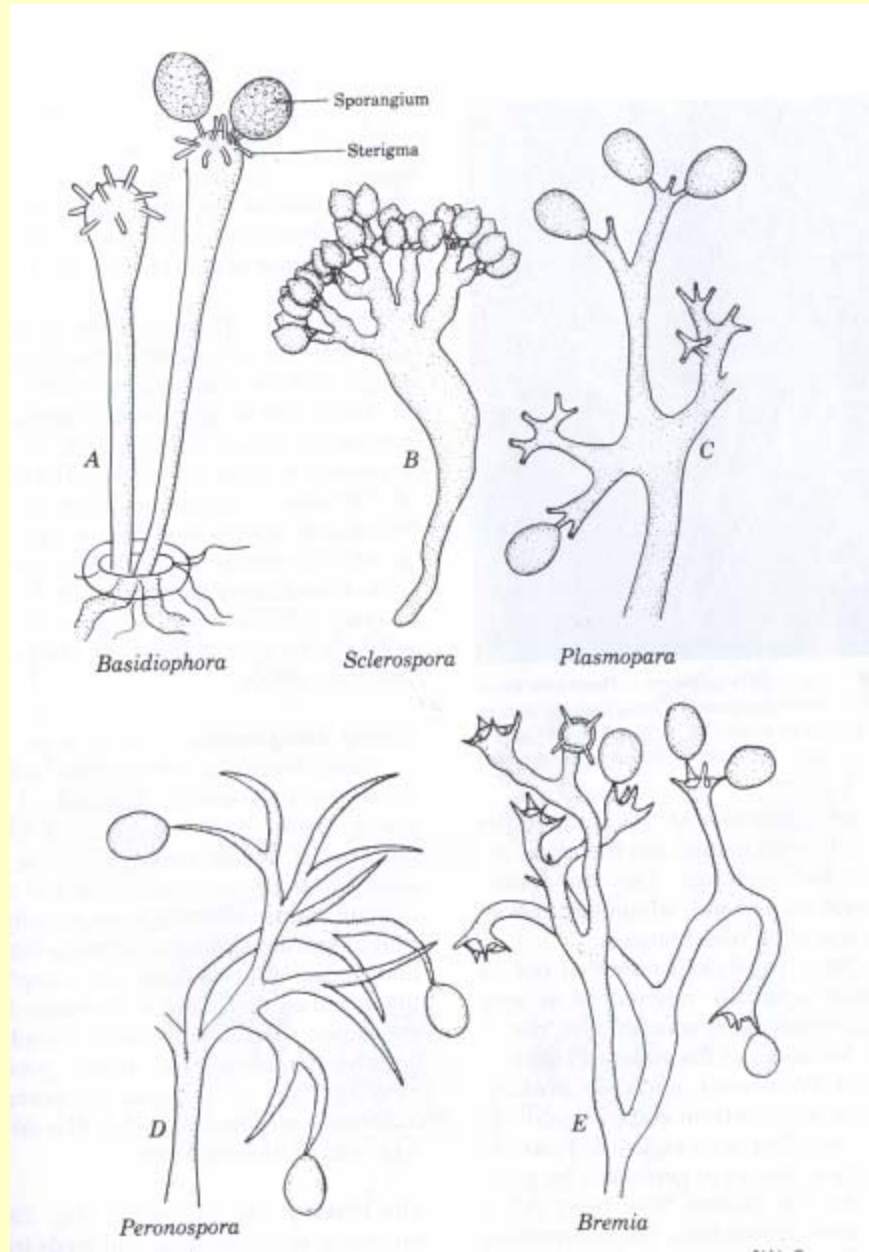


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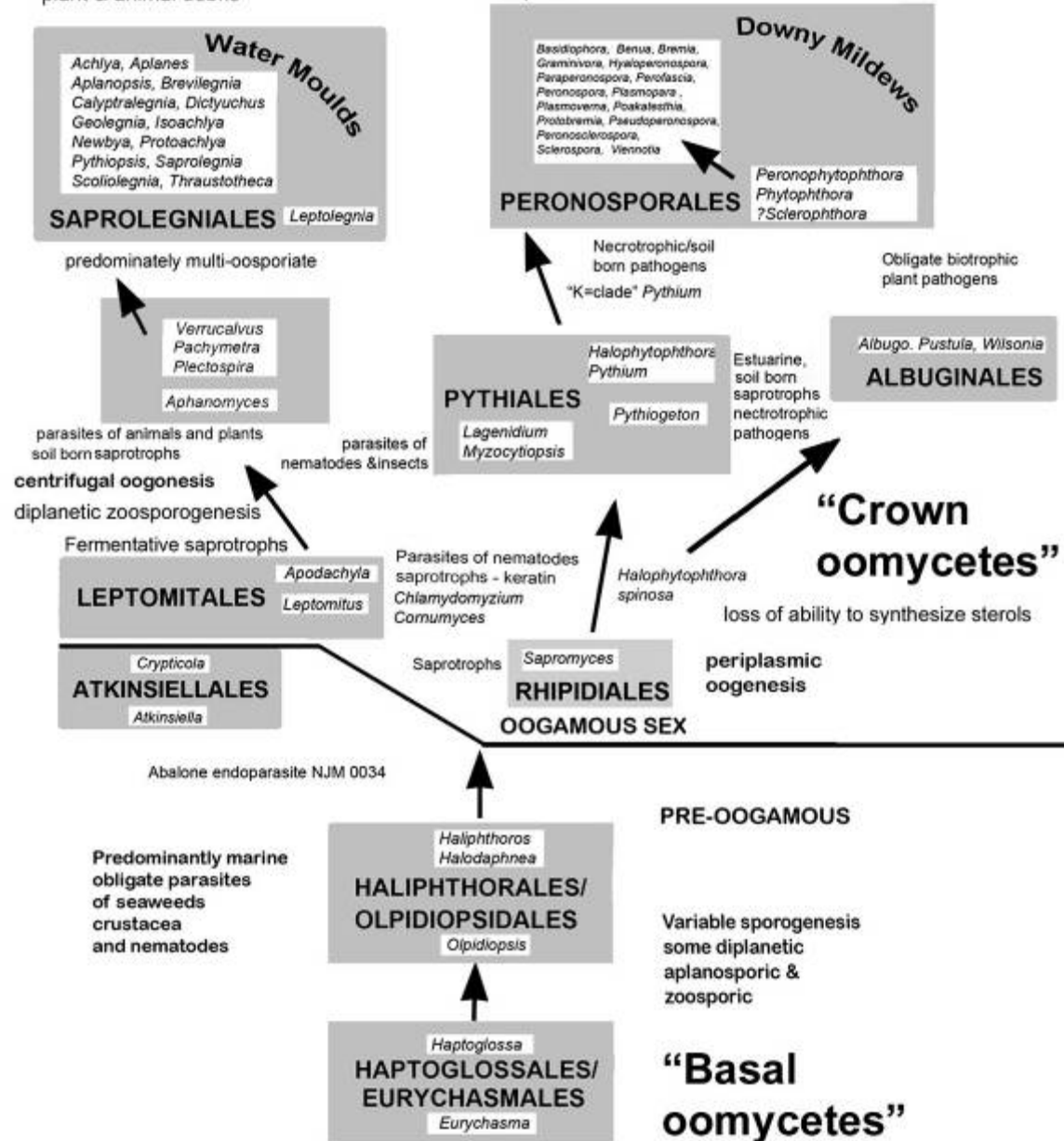
Genera Traditionally Included in the Peronosporaceae

- Peronospora* (D)
- Basidiophora* (I)
- Sclerospora* (I - D)
- Plasmopara* (I)
- Bremia* (I)
- Bremiella* (I)
- Pseudoperonospora* (I)



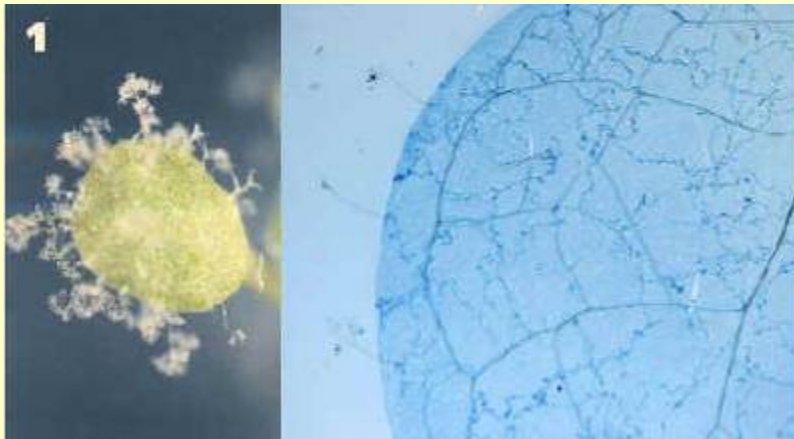
Predominantly freshwater saprophytes
plant & animal debris

Obligate biotrophic pathogens mainly of aerial parts
of plants



New Genera of the Downy Mildew

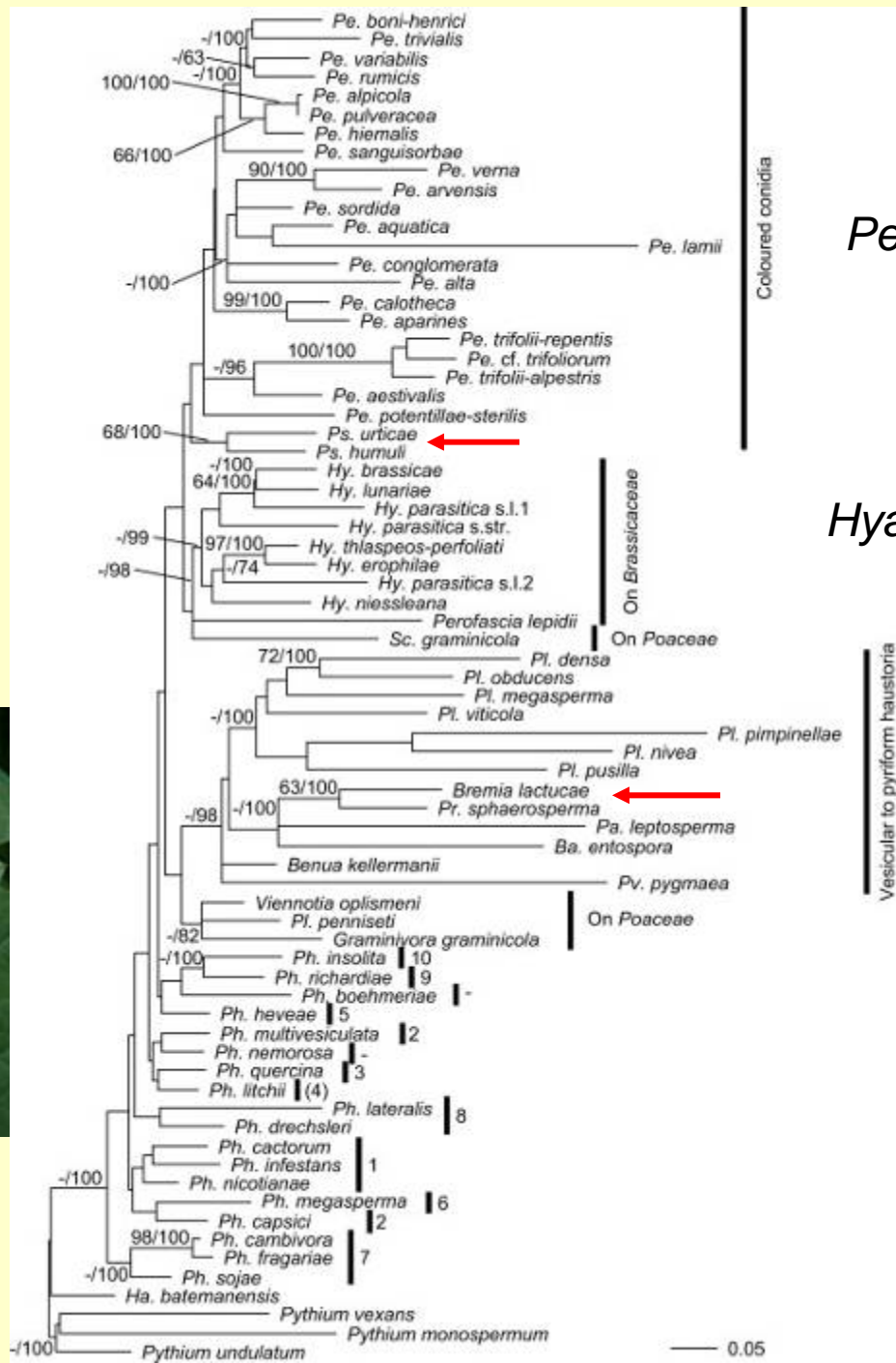
- *Basidiophora*
- *Benua*
- *Bremia*
- *Graminivora*
- *Hyaloperonospora*
- *Novotelnova*
- *Paraperonospora*
- *Perofascia*
- *Peronosclerospora*
- *Peronospora*
- *Plasmopara*
- *Plasmoverna*
- *Protobremia*
- *Pseudoperonospora*
- *Sclerophthora*
- *Sclerospora*
- *Viennotia*



Hyaloperonospora species
on *Arabidopsis*



Downy mildew of
Rudbeckia



Peronospora spp.

Hyaloperonospora spp.

Plasmopara spp.

Phytophthora spp.

Phylogenetic relationships of *Peronospora* and related genera based on nuclear ribosomal ITS sequences

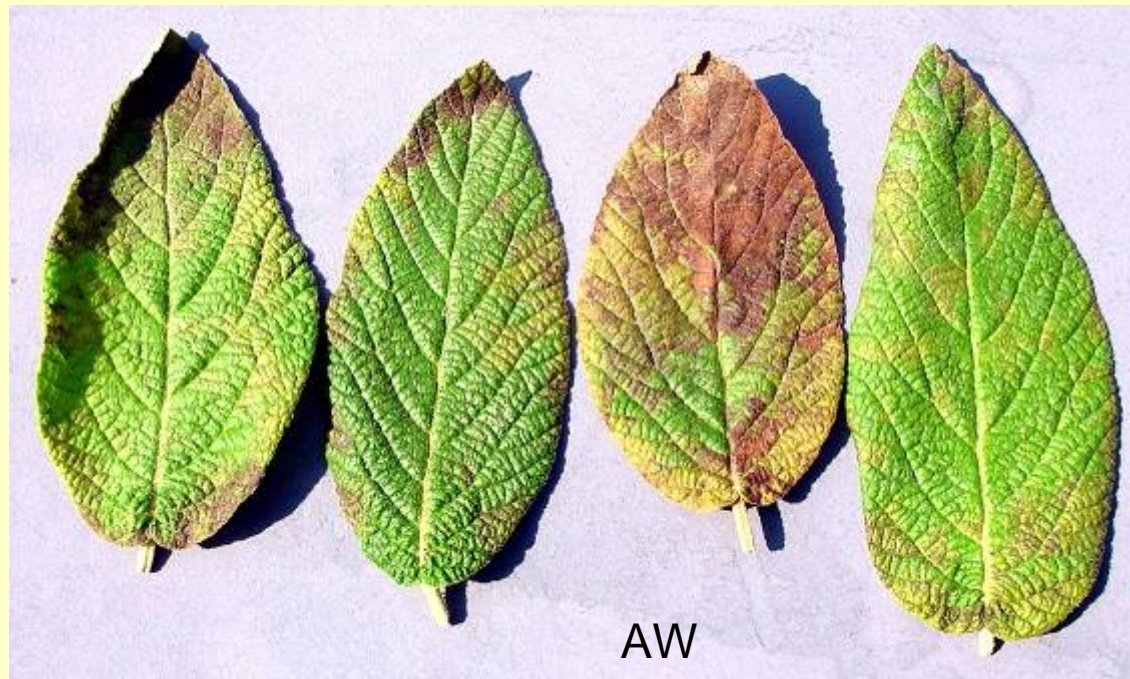
Hermann VOGLMAYR

Peronospora spp. (traditional classification) and “newly” erected genera e.g. *Hyaloperonospora* spp., are well-supported and -segregated by host species. Appears to be frequent host jumping rather than strict co-evolution.

SOME NAME CHANGES

- All *Peronospora* spp. on brassicae -- now *Hyaloperonospora* species (hyaline sporangia)
- *Plasmopara oplismeni* (on grass) – now *Viennotia oplismeni*
- *Peronospora lipidii* -- now *Perofascia lipidii*

Downy mildew
(symptoms) on
Viburnum



Based on Molecular (ITS, Cox2) Work and Some Morphology

Supports the delineation of *Peronospora* (sensu lato) into at least two genera:

Peronospora and *Hyaloperonospora*. *Perofascia lipidii* (formerly *Pe. lipidii*)

may be considered derived from *Peronospora*, but may have another lineage?

Supports the erection of several other genera to accommodate some phylogenetic relationships.

Supports the transfer of the genus *Phytophthora* in the Pythiaceae (sensu lato Alex) to the Peronosporaceae or downy mildews or more broadly, those organisms infecting primarily aerial portions of hosts.

Bottom Line?

The recent molecular studies of the downy mildews and allies provide some very powerful insights into the phylogenies of these groups. The insights generally follow logical sequences and the resultant changes in taxonomic groupings probably represent accurate conclusions.

HOWEVER

At the end of the day, downy mildews are still downy mildews regardless of their taxonomic names.



Downy Mildew
of Coleus

