References: Url1.: https://en.wikipedia.org.
Url2.: http://tolweb.org/Pucciniomycotina.
Url3.: http://tolweb.org/Ustilaginomycotina.

SYSTEMATICS OF BASIDIOMYCOTA 4

Subdivision: *Pucciniomycotina* (Rust Fungi)

Pucciniomycotina contains 9 classes, 20 orders, 37 families and 215 genera. Over 8400 species of Pucciniomycotina have been described - more than 8% of all described fungi. More than 95% of the species and 75% of the genera in this group are placed in the *Pucciniales* (*Pucciniomycetes*), the plant parasitic rust fungi. The next largest orders, Septobasidiales (*Pucciniomycetes*) and *Microbotryales* (*Microbotryomycetes*), collectively constitute approximately 5% of the species and 4% of the genera. Nearly 20% of the rust genera and 60% of the nonrust genera are monotypic (containing only one species). The rust fungi and several of the yeasts have been more extensively studied than have other taxa, and the surprisingly large percentage of monotypic genera may be artificially high due to the limited research on these often obscure fungi.

The rusts are undeniably the most economically important fungi in this clade, as obligate parasites on a wide range of crop plants including cereal grains, legumes, and trees such as coffee, apple, and pine, where they can cause extensive reduction in yield and even host death. Other phytopathogenic Pucciniomycotina can be of economic importance, but on a much smaller scale than rust fungi. Species of *Helicobasidium* (*Pucciniomycetes: Helicobasidiales*) cause root rot diseases of many economically important plants such as asparagus, beet, mulberry, and pear. *Microbotryum violaceum* (Microbotryomycetes: Microbotryales) causes anther smut of plants in the Caryophyllaceae, while smut on buckwheat is caused by *Sphacelotheca fagopyri* (*Microbotryomycetes: Microbotryales*). These smuts are not closely related to the smuts in the Ustilaginomycotina with which they were confused until molecular sequence data became available.

Ecology

Pucciniomycotina have a diverse range of ecologies as insect parasites, mycoparasites, and orchid mycorrhiza; some have been detected in soil and water or asymptotic members living on leaves. Most are plant pathogens. Many *Pucciniomycotina* are rust fungi and are placed in the order *Puccinales*. Some members of the group are of economical importance as a pathogen on a wide range of commercial plants,

Life cycle

Some members are only known from their anamorphs, and asexual stages predominate in most; in some species this is the only known form. A striking characteristic of *Puccinomycotina* is the unique developmental pattern. Rust Fungi or plant pathogenic members in Puccinales have the most complex life cycles known in the fungal kingdom, with five different spore stages. Studies have shown that *Puccinales* also has one of the largest genomes in the fungi kingdom, and that genome size expansion may be common. This explains the complex life cycles within the group.

Subdivision: *Ustilaginomycotina*

Ustilaginomycotina consists of the classes *Ustilaginomycetes* and *Exobasidiomycetes*, and in 2014 the subdivision was reclassified and the two additional classes *Malasseziomycetes* and *Moniliellomycetes* added.

Ustilaginomycotina comprises 115 genera with more than 1700 species. The subdivision is mostly plant parasites on vascular plants, and the distribution of the subdivision is therefore restricted to the distribution of the host. The group is also called the true smut fungi because of the production of teliospores. The name smut is still used as a term since it circumscribes the organization and life cycle of *Ustilaginomycotina*, but it is not a taxonomic term.

Ustilaginomycotina has some of the best known and studied genera of plant parasites like *Ustilago* and *Tilletia* and it is also of great economic importance.

The class *Ustilaginomycetes* comprises more than 1400 species of basidiomycetous plant parasites, which are distributed in approximately 70 genera. They occur throughout the world, although many species are restricted to tropical, temperate or arctic regions. Some species of *Ustilago* and *Tilletia*, e.g. the barley, wheat or maize smut fungi, are well known because they are of economic importance.

Ecology

Ustilaginomycotina members are plant parasites and they are restricted to the host species of vascular plants, and mainly on angiosperms and monocots. This encompasses a geographical distribution in both tropical, temperate and arctic regions. Most species are highly host-specific and this may be a product of coevolution with different angiosperm lineages. This is supported by studies that shows that some monophyletic lineages in the *Ustilaginomycotina* are restricted to monophyletic lineages in the angiosperms. But not all taxa in *Ustilaginomycotina* are host-specific, some have a broad host range and others have also made a host jump to other vascular plants and not only monocots in the angiosperms.

Ustilaginomycotina have an array of plant pathogens, and some are parasitizing on economically important species like wheat, barley and corn. In some cases the yield loss is minimal, in other the crops has to be quarantined. Some of the galls produced by the smuts is considered as a delicacy in some parts of the world.

The life cycle of the subdivision is dimorphic and it consists of two phases in the life cycle. One saprobic haploid phase and a parasitic (biotrophic) dikaryotic phase. The saprobic phase is initiated by the production of haploid yeasts, which fuses with another spore and produce the n+n hyphae which will infect the host. The infection happens with the production

of a structure called appressoria, which is a specialized cell that is used to penetrate the host cuticle. Inside the host, the fungi will produce hyphae and another specialized structure called haustoria. This will take nutrition from the plant, and is a parasitic feature. Almost all of the Ustilaginomycotina will then sporulate inside the host, and this happens with the spore becoming thick-walled and will separate, now called a teliospore. The teliospore is the most conspicuous part of the individual and represent the smut syndrome. This teliospore is a specialized resting spore that can survive outside their host. The teliospore is released from the host, and it will produce a diploid basidium and the cycle starts over.

REFERENCES

Url1.: https://en.wikipedia.org.

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