Agonomycetes

Fungi which usually produce neither sexual (meiotic) nor asexual (mitotic) spores. These fungi have been denoted by various names. The most common names are Mycelia Sterilia (having sterile mycelium), Agonomycetales (used when classifying these fungi at the level of order), or Agonomycetes (used when assigning their rank at the level of class). These fungi make up an artificial (nonphylogenetic) group consisting of both ascomycetes and basidiomycetes. A few species have associated sexual states, but these sexual states are infrequently produced. Although true spores are mostly lacking in this group, some species produce sporelike structures which function effectively in survival and dispersal of the species. Some of these sporelike structures mimic true spores so well in form and function that the genera producing them (for example, *Beverwykella*, *Cancellidium*, and *Tretopileus*) have occasionally been classified with spore-forming fungi. *See* ASCOMYCOTA; BASIDIOMYCOTA; DEUTEROMYCOTINA; FUNGI.

Morphology and function. The most common sporelike structures are allocysts, bulbils, chlamydospores, papulospores, and sclerotia. These structures are not formed in the same manner as sexual spores (via meiosis), nor are they formed like true asexual spores, because the sporelike structures are simply modified hyphae. Chlamydospores originate from terminal or intercalary hyphae, have thickened walls, and are primarily a survival structure; they tend to be unicellular but often occur in pairs or chains. Allocysts resemble chlamydospores but store metabolic by-products and do not germinate. Bulbils are compact, multicellular, and internally undifferentiated propagules (somatic structures of propagation or survival); they resemble papulospores except that the latter have a core of large cells and a sheath of smaller cells. There are propagules intermediate between bulbils and papulospores as well. Sclerotia are larger, multicellular aggregations of hyphae and are often differentiated into layers at maturity. Outer layers may have dark, thick-walled cells and the inner layers may have thin-walled cells, but such differentiation is not universal. Sclerotia occur in a range of sizes and shapes, depending on the species forming them, and the smaller ones are termed microsclerotia. These various structures formed from hyphae may also be present in species of fungi producing true spores (sexual and/or asexual). Chlamydospores and sclerotia are especially common. In general, the larger propagules serve for survival more than dissemination, but any propagule may be transported in soil particles by machinery or tools, movement of animals or humans, irrigation water, or strong winds. Sclerotia and chlamydospores may also be disseminated with plant seed, vegetative plant parts, and nursery stock.

Identification, pathology, and economic significance. The absence of true spores and structures producing true spores renders identification difficult. However, morphology-based keys to genera have been constructed using such characters as whether hyphae are simple or aggregated, the manner in which hyphal aggregations are formed, the presence of dolipore septa or clamp connections (indicating affiliation with basidiomycetes), and the manners in which chlamydospores, bulbils, sclerotia, papulospores, or other propagules are formed and positioned. Commercially produced kits are available for identification of *Rhizoctonia* and *Sclerotinia* (by ELISA [enzyme-linked immunosorbent assay] or PCR [polymerase chain reaction]), and experimental identification of selected genera of Agonomycetes has been published using techniques such as PCR-RFLPs [restriction fragment length polymorphisms], RAPDs [random amplifications of polymorphic DNA], and DNA (deoxyribonucleic acid) sequence analyses.

Several members of the Agonomycetes are of extreme importance as plant pathogens. *Rhizoctonia* species (which have infrequently produced sexual states in *Ceratobasidum* or *Thanatephorus*) cause root diseases. *Rhizoctonia solani* is a pathogen with an exceptionally broad host range encompassing dozens of genera, but is especially important on beans, carrots, cabbage, and other vegetables, and *R. cerealis* is important on wheat and other small grains. Interestingly, some *Rhizoctonia* species are beneficial mycorrhizal symbionts with orchid roots. In general, a nonsporulating fungus can be identified as *Rhizoctonia* by the thickness, septation, growth rate, and branching patterns of its hyphae. However, the taxonomy and identification of *Rhizoctonia* as to species and important subspecific groups is complex, and depends to considerable extent on anastomosis groupings, that is, how pairs of isolates behave when confronted with each other on artificial laboratory media.

Also important is the form-genus *Sclerotium*, species of which produce sclerotia. Some *Sclerotium* isolates will produce sexual states in *Athelia* (a basidiomycete) or other genera. The most important plant pathogens include *S. rolfsii* (corresponding to *Athelia rolfsii*) which is a pathogen of many crops, especially vegetables, and *S. cepivorum*, the causal agent of white rot of onion and garlic. A fungus sometimes classified and keyed with the Mycelia Sterilia is *Sclerotinia sclerotiorum*. Many isolates of this fungus reproduce sexually in nature or under proper, carefully controlled laboratory conditions, and some also produce small, nongerminating asexual spores, but on artificial media in the laboratory isolates often produce only sclerotia. *Sclerotinia sclerotiorum* has an exceptionally broad host range but is especially important on vegetables. *Sclerotinia trifoliorum* and *S. minor* are important on legumes and lettuce, respectively. Prior to the advent of molecular genetics, and still today in routine diagnoses, species of *Sclerotinia* are separated on the basis of characters of the colonies and sclerotia on artificial media. Once established in soil, sclerotia may survive for years, even decades, rendering disease control extremely difficult.

Other notable members of the Agonomycetes are *Papulaspora byssina*, troublesome in commercial mushroom operations, and *Cenococcum geophilum*, an ectomycorrhizal fungus symbiotic with many species of higher plants. *See* PLANT PATHOLOGY.

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Bibliography. H. L. Barnett and B. B. Hunter, *Illustrated Genera of Imperfect Fungi*, 1998; E. Kiffer and M. Morelet, *The Deuteromycetes: Mitosporic Fungi, Classification and Generic Keys*, 2000; J. A. von Arx, *Plant Pathogenic Fungi: Beihefte zur Nova Hedwigia*, vol. 87, 1987.