

## References for phylogeny accompanying table S1

- Aanen, D.K. & Kuyper, T.W. 1999. Intercompatibility tests in the *Hebeloma crustuliniforme* complex in northwestern Europe. *Mycologia* **91**: 783-795.
- Albert, H.H. & Schenck, S. 1996. PCR amplification from a homolog of the bE mating-type gene as a sensitive assay for the presence of *Ustilago scitaminea* DNA. *Plant Dis.* **80**: 1189-1192.
- Anderson, J.B. & Ullrich, R.C. 1979. Biological species of *Armillaria mellea* in North America. *Mycologia*: 402-414.
- Bakkeren, G. & Kronstad, J.W. 1994. Linkage of mating-type loci distinguishes bipolar from tetrapolar mating in basidiomycetous smut fungi. *Proc. Natl. Acad. Sci. U. S. A.* **91**: 7085-7089.
- Biggs, R. 1937. The species concept in *Corticium coronilla*. *Mycologia* **29**: 686-706.
- Binder, M., Hibbett, D.S., Larsson, K.H., Larsson, E., Langer, E. & Langer, G. 2005. The phylogenetic distribution of resupinate forms across the major clades of mushroom-forming fungi (Homobasidiomycetes). *Syst. Biodivers.* **3**: 113-157.
- Butler, G. 2010. Fungal Sex and Pathogenesis. *Clin. Microbiol. Rev.* **23**: 140-159.
- Casselton, L.A. & Kües, U. 2007. The origin of multiple mating types in model mushrooms *Coprinopsis cinerea* and *Schizophyllum commune*. In: *Sex in Fungi: Molecular determination and evolutionary implications*, (Heitman, J., Kronstad, J. W., Taylor, J. W. & Casselton, L. A., eds.). pp. 283-300. ASM Press, Washington D.C.
- Chase, T.E. & Ullrich, R.C. 1983. Sexuality, Distribution, and Dispersal of *Heterobasidion annosum* in Pine Plantations of Vermont. *Mycologia* **75**: 825-831.
- Coelho, M.A., Rosa, A., Rodrigues, N., Fonseca, Á. & Gonçalves, P. 2008. Identification of mating type genes in the bipolar basidiomycetous yeast *Rhodospiridium toruloides*: first insight into the MAT locus structure of the Sporidiobolales. *Eukaryot. Cell* **7**: 1053-1061.
- Coelho, M.A., Sampaio, J.P. & Gonçalves, P. 2010. A deviation from the bipolar-tetrapolar mating paradigm in an early diverged basidiomycete. *PLoS Genet.* **6**: e1001052.
- Day, P. 1963. Mutations of the A mating type factor in *Coprinus lagopus*. *Genet. Res.* **4**: 55-64.
- Dhitaphichit, P. & Nawawongwiwat, J. 2006. Mating system of five edible species of the mushroom, genus *Lentinus*. *Songklanakarin J Sci Technol* **28**: 285-292.
- Duplessis, S., Cuomo, C.A., Lin, Y.-C., Aerts, A., Tisserant, E., Veneault-Fourrey, C., et al. 2011. Obligate biotrophy features unraveled by the genomic analysis of rust fungi. *Proceedings of the National Academy of Sciences* **108**: 9166-9171.
- Duran, R. & Cromarty, R. 1977. *Tilletia indica*: a heterothallic wheat bunt fungus with multiple alleles controlling incompatibility. *Phytopathology* **67**.
- Findley, K., Sun, S., Fraser, J.A., Hsueh, Y.P., Averette, A.F., Li, W., et al. 2012. Discovery of a modified tetrapolar sexual cycle in *Cryptococcus amyloletus* and the evolution of MAT in the *Cryptococcus* species complex. *PLoS Genet.* **8**: e1002528.
- Fraser, J.A., Subaran, R.L., Nichols, C.B. & Heitman, J. 2003. Recapitulation of the sexual cycle of the primary fungal pathogen *Cryptococcus neoformans* var. *gattii*: implications for an outbreak on Vancouver Island, Canada. *Eukaryot. Cell* **2**: 1036-1045.
- Gilbertson, R.L. 1980. Wood-rotting fungi of North America. *Mycologia* **72**: 1-49.
- Giraud, T., Yockteng, R., Lopez-Villavicencio, M., Refregier, G. & Hood, M.E. 2008. Mating system of the anther smut fungus *Microbotryum violaceum*: selfing under heterothallism. *Eukaryot. Cell* **7**: 765-775.
- Gordon, S.A. & Petersen, R.H. 1992. Interbreeding populations of some *Marasmius* species. *Mycologia* **84**: 204-208.
- Griffith, G.W. & Hedger, J.N. 1994. Spatial Distribution of Mycelia of the Liana (L-) Biotype of the Agaric *Crinipellis perniciosa* (Stahel) Singer in Tropical Forest. *New Phytol.* **127**: 243-259.
- Harder, C.B. & Aanen, D.K. 2009. Unilateral nuclear migration in Basidiomycetes: pheromone interaction, genomic conflicts and mating-system reversion. *Fungal Biology Reviews* **23**: 48-54.
- Hibbett, D.S. & Donoghue, M.J. 2001. Analysis of Character Correlations Among Wood Decay Mechanisms, Mating Systems, and Substrate Ranges in Homobasidiomycetes. *Syst. Biol.* **50**: 215-242.
- Hintz, W.E.A., Anderson, J.B. & Horgen, P.A. 1988. Nuclear migration and mitochondrial inheritance in the mushroom *Agaricus bitorquis*. *Genetics* **119**: 35-41.
- Huang, Y., Xiao, Y., Wang, Z. & Bian, Y. 2005. Analysis of the polarity of the jelly basidiomycete *Auricularia auricula*. In: *Proceeding of the fifth international conference on mushroom biology and mushroom products. Acta Edulis Fungi*, Vol. 12. pp. 194-199.
- James, T.Y. 2007. Analysis of mating-type locus organization and synteny in mushroom fungi: beyond model species. *Sex in Fungi Molecular Determination and Evolutionary Implications*.
- James, T.Y., Lee, M. & van Diepen, L.T.A. 2011. A single mating-type locus composed of homeodomain genes promotes nuclear migration and heterokaryosis in the white-rot fungus *Phanerochaete chrysosporium*. *Eukaryot. Cell* **10**: 249-261.
- James, T.Y., Srivilai, P., Kües, U. & Vilgalys, R. 2006. Evolution of the bipolar mating system of the mushroom *Coprinellus disseminatus* from its tetrapolar ancestors involves loss of mating-type-specific pheromone receptor function. *Genetics* **172**: 1877-91.
- Julián, M.C., Acero, J., Salazar, O., Keijer, J. & Rubio, V. 1999. Mating type-correlated molecular markers and demonstration of heterokaryosis in the phytopathogenic fungus *Thanatephorus cucumeris* (*Rhizoctonia solani*) AG 1-IC by AFLP DNA fingerprinting analysis. *J. Biotechnol.* **67**: 49-56.
- Kay, E. & Vilgalys, R. 1992. Spatial distribution and genetic relationships among individuals in a natural population of the oyster mushroom *Pleurotus ostreatus*. *Mycologia* **84**: 173-182.
- Kemp, R. 1974. Bifactorial incompatibility in the two-spored basidiomycetes *Coprinus sassii* and *C. Bilanatus*. *Transactions of the British Mycological Society* **62**: 547-555.

- Kemp, R. 1980. Genetics of ABC type heterokaryon incompatibility in *Coprinus bisporus*. *Transactions of the British Mycological Society* **75**: 29-35.
- Koltin, Y., Stamberg, J. & Lemke, P.A. 1972. Genetic structure and evolution of the incompatibility factors in higher fungi. *Bacteriological Reviews* **36**: 156-171.
- Kothe, E., Gola, S. & Wendland, J. 2003. Evolution of multispecific mating-type alleles for pheromone perception in the homobasidiomycete fungi. *Curr. Genet.* **42**: 268-275.
- Kües, U., James, T.Y. & Heitman, J. 2011. Mating type in basidiomycetes: Unipolar, bipolar, and tetrapolar patterns of sexuality. In: *Evolution of fungi and fungal-like organisms, the mycota XIV*, (Pöggeler, S. & Wöstemeyer, J., eds.). pp. Springer-Verlag, Berlin, Heidelberg Germany.
- Kües, U. & Navarro-González, M. 2010. Mating-type orthologous genes in the primarily homothallic *Moniliophthora perniciosa*, the causal agent of Witches' Broom Disease in cacao. *J. Basic Microbiol.* **50**: 442-451.
- Kwon-Chung, K.J., Edman, J.C. & Wickes, B.L. 1992. Genetic association of mating types and virulence in *Cryptococcus neoformans*. *Infect. Immun.* **60**: 602-605.
- Labarere, J. & Noel, T. 1992. Mating type switching in the tetrapolar basidiomycete *Agrocybe aegerita*. *Genetics* **131**: 307-319.
- Lee, S.C., Ni, M., Li, W., Shertz, C. & Heitman, J. 2010. The evolution of sex: a perspective from the fungal kingdom. *Microbiol. Mol. Biol. Rev.* **74**: 298-340.
- Lengeler, K., Fox, D., Fraser, J., Allen, A., Forrester, K., Dietrich, F., et al. 2002. Mating-type locus of *Cryptococcus neoformans*: a step in the evolution of sex chromosomes. *Eukaryot. Cell* **1**: 704.
- Maekawa, N. 1987. A new species of the genus *Cerinomyces*. *Canadian journal of botany* **65**: 583-588.
- Marmeisse, R., Guidot, A., Gay, G., Lambilliotte, R., Sentenac, H., Combiér, J.P., et al. 2004. *Hebeloma cylindrosporum*—a model species to study ectomycorrhizal symbiosis from gene to ecosystem. *New Phytol.* **163**: 481-498.
- Martinez, D., Challacombe, J., Morgenstern, I., Hibbett, D., Schmoll, M., Kubicek, C.P., et al. 2009. Genome, transcriptome, and secretome analysis of wood decay fungus *Postia placenta* supports unique mechanisms of lignocellulose conversion. *Proceedings of the National Academy of Sciences* **106**: 1954-1959.
- Murphy, J.F. 1997. Intersterility groups in *Collybia subnuda*. *Mycologia* **89**: 566-577.
- Murphy, J.F. & Miller, O.K.J. 1993. The Population Biology of Two Litter Decomposing Agarics on a Southern Appalachian Mountain. *Mycologia* **85**: 769-776.
- Narisawa, K., Yamaoka, Y. & Katsuya, K. 1994. Mating type of isolates derived from the spermogonial state of *Puccinia coronata* var. *coronata*. *Mycoscience* **35**: 131-135.
- Niculita-Hirzel, H., Labbé, J., Kohler, A., Le Tacon, F., Martin, F., Sanders, I.R., et al. 2008. Gene organization of the mating type regions in the ectomycorrhizal fungus *Laccaria bicolor* reveals distinct evolution between the two mating type loci. *New Phytol.* **180**: 329-342.
- Olson Å, A Aerts, F Asiegbu, L Belbahri, O Bouzid, et al. 2012. Insight into trade-off between wood decay and parasitism from the genome of a fungal forest pathogen. *New Phytol.* **194**: 1001-1013.
- Pérez-Sierra, A., Guillaumin, J.J., Spooner, B.M. & Bridge, P.D. 2004. Characterization of *Armillaria heimii* from Africa. *Plant Pathol.* **53**: 220-230.
- Pilotti, C.A., Sanderson, F.R. & Aitken, E.A.B. 2002. Sexuality and interactions of monokaryotic and dikaryotic mycelia of *Ganoderma boninense*. *Mycol. Res.* **106**: 1315-1322.
- Raper, C.A. 1976. Sexuality and life-cycle of the edible, wild *Agaricus bitorquis*. *Journal of General Microbiology* **95**: 54-66.
- Raper, C.A., Raper, J.R. & Miller, R.E. 1972. Genetic analysis of the life cycle of *Agaricus biporus*. *Mycologia* **64**: 1088-1117.
- Raper, J.R. 1966. *Genetics of sexuality in higher fungi*. Ronald Press, New York.
- Raper, J.R., Krongelb, G.S. & Baxter, M.G. 1958. The number and distribution of incompatibility factors in *Schizophyllum*. *Am. Nat.* **92**: 221-232.
- Rayner, A.D.M. & Todd, N. 1979. *Population and community structure and dynamics of fungi in decaying wood*. Academic Press.
- Schirawski, J., Heinze, B., Wagenknecht, M. & Kahmann, R. 2005. Mating type loci of *Sporisorium reilianum*: novel pattern with three a and multiple b specificities. *Eukaryot. Cell* **4**: 1317-1327.
- Schmidt, O. 2006. *Wood and tree fungi: biology, damage, protection, and use*. Springer.
- Smith, A.H. & Brodie, H.J. 1935. Cultural characters and pairing reactions of monosporous mycelia and development of the fruit body of *Pholiota (Flammula) polychroa*. *Botanical Gazette* **96**: 533-546.
- Smith, M.L., Bruhn, J.N. & Anderson, J.B. 1992. The fungus *Armillaria bulbosa* is among the largest and oldest living organisms. *Nature* **356**: 428-431.
- Stamberg, J. & Koltin, Y. 1973. The organisation of the incompatibility factors in higher fungi: the effect of structure and symmetry on breeding. *Heredity* **30**: 15-26.
- Statzell-Tallman, A., Belloch, C. & Fell, J.W. 2007. *Kwoniella mangroviensis* gen. nov., sp. nov. (Tremellales, Basidiomycota), a teleomorphic yeast from mangrove habitats in the Florida Everglades and Bahamas. *FEMS Yeast Res.* **8**: 103-113.
- Thomas, P.L. 1991. Genetics of Small-Grain Smuts. *Annu. Rev. Phytopathol.* **29**: 137-148.
- Toda, T. & Hyakumachi, M. 2006. Heterokaryon formation in *Thanatephorus cucumeris* anastomosis group 2-2 IV. *Mycologia* **98**: 726-736.
- Trail, F. & Mills, D. 1990. Growth of haploid *Tilletia* strains in planta and genetic analysis of a cross of *Tilletia caries* X *T. controversa*. *Phytopathology* **80**: 367-370.
- Ullrich, R.C. 1977. Natural Distribution of Incompatibility Factors in Basidiomycetous Fungi. *Mycologia* **69**: 714-719.
- Ullrich, R.C. & Raper, J.R. 1975. PRIMARY HOMOTHALLISM—RELATION TO HETEROTHALLISM IN THE REGULATION OF SEXUAL MORPHOGENESIS IN *SISTOTREMA*. *Genetics* **80**: 311-321.

- Van der Nest, M.A., Slippers, B., Steenkamp, E.T., De Vos, L., Van Zyl, K., Stenlid, J., *et al.* 2009. Genetic linkage map for *Amylostereum areolatum* reveals an association between vegetative growth and sexual and self-recognition. *Fungal Genet. Biol.* **46**: 632-641.
- van der Nest, M.A., Slippers, B., Stenlid, J., Wilken, P.M., Vasaitis, R., Wingfield, M.J., *et al.* 2008. Characterization of the systems governing sexual and self-recognition in the white rot homobasidiomycete *Amylostereum areolatum*. *Curr. Genet.* **53**: 323-336.
- van Peer, A.F., Park, S.Y., Shin, P.G., Jang, K.Y., Yoo, Y.B., Park, Y.J., *et al.* 2011. Comparative genomics of the mating-type loci of the mushroom *Flammulina velutipes* reveals widespread synteny and recent inversions. *PLoS ONE* **6**: e22249.
- Whitehouse, H.L.K. 1949. Multiple-allelomorph heterothallism in the fungi. *New Phytol.* **48**: 212-244.
- Wong, G.J. & Wells, K. 1985. Modified bifactorial incompatibility in *Tremella mesenterica*. *Transactions of the British Mycological Society* **84**: 95-109.
- Xu, J., Linning, R., Fellers, J., Dickinson, M., Zhu, W., Antonov, I., *et al.* 2011. Gene discovery in EST sequences from the wheat leaf rust fungus *Puccinia triticina* sexual spores, asexual spores and haustoria, compared to other rust and corn smut fungi. *BMC Genomics* **12**: 161.
- Xu, J., Saunders, C.W., Hu, P., Grant, R.A., Boekhout, T., Kuramae, E.E., *et al.* 2007. Dandruff-associated *Malassezia* genomes reveal convergent and divergent virulence traits shared with plant and human fungal pathogens. *Proceedings of the National Academy of Sciences* **104**: 18730-18735.
- Yi, R., Tachikawa, T., Ishikawa, M., Mukaiyama, H., Bao, D. & Aimi, T. 2009. Genomic structure of the A mating-type locus in a bipolar basidiomycete, *Pholiota nameko*. *Mycol. Res.* **113**: 240-248.
- Zhe, J., Yu-Xiang, L. & Shu-Yu, X. 2004. Mating system of *Pholiota adiposa*. *Mycosystema* **23**: 38-42.