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Mycological Research News[1]

This number of Mycological Research News features: In this issue; and Novel nitrogen transfer by AM fungi.

Thirteen papers are included in this part, eight utilizing molecular approaches. These concern the detection of tooth fungi, identification of *Armillaria tabescens, Armillaria* species in Africa, a new genus for *Entyloma ossifragi*, *Anamika* species from Asia, a new *Hypocrella,* the *Peronospora* attacking sweet basil, and a diagnostic assay for *Metarhizium anisopliae* var. *acridum.*

Also included are articles on foraging behaviour of *Armillaria* rhizomorphs, basidiospore release and dispersal by *Amanita muscaria* var. *alba,* metabolites of *Penicillium albocoremium,* interactions between rock-inhabiting fungi and algae from lichens, and root colonization by *Monosporascus cannonballus.*

The following new scientific names are introduced: *Gjaerumiaceae* fam. nov.; *Gjaerumia* gen. nov.; *Anamika angustilamellata,* and *Hypocrella macrostroma* spp. nov.; and *A. lactariolens* (syn. *Alnicola lactariolens*), and *G. ossifragi* (syn *Entyloma ossifragi*) combs. nov.

IN THIS ISSUE

Confirmation of the presence of a fungus when it is suspected, but in the absence of fruit bodies or when attempts at isolation have failed, can be a valuable adjunct to studies on the status of rare species. Here, a PCR method using newly designed specific primers for the detection of *Creolophus* and *Hericium* species in wood is described (pp. 1187-1194). Three papers concern species of *Armillaria.* The foraging systems of rhizomorphs of different species growing in agar and in sand are compared, and behavioural and morphological differences reported, especially between parasitic and saprotrophic species (pp. 1195-1207). A survey of numerous strains of *A. tabescens,* which causes a root rot in peach trees in the southern USA, established that its nuclei represented two different haplotypes; a PCR-based detection method to enable the species to be distinguished from many other North American species of the genus is also described (pp. 1208-1222). Phylogenetic studies of African isolates gave a surprising result; they formed a separate clade from strains from Asia, Australasia, Europe, and North America and represented two distinct species, *A. fuscipes* and one yet the described (pp. 1223-1234).

In apparently the first ever study of its kind, spore dispersal from naturally arising macromycete fruit bodies has been documented and the ability of basidiospores to penetrate a nearby residence assessed, using *Amanita muscaria* var. *alba* (pp. 1235-1242). The highest spore concentration recorded was 281 738 spores m^{-3} air, release dropping by 95-99 % after three days; only 5 % of the spores reached a spot 5 m away from the fruit bodies, and less than 0.1 % penetrated the residence. Five metabolite markers consistently produced by strains of *Penicillium albocoremium* have been characterized and found to be the protein farnesyl transferase inhibitors andrastin A, and barceloneic acids and compounds, including a previously unknown methyl ester, methyl barceloneate (pp. 1243-1249).

Molecular phylogenetic studies reveal that the smut previously known as *Enyoloma ossifragi* on *Narthecium ossifragum* belongs in the *Georgefischeriales,* but requires a new genus and family name; the fungus also has dolipore septa unlike those known in other members of the order (pp. 1250-1257). The hebelomatoid agaric genus *Anamika* was

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described in this journal in 2002 for a new species discovered in India[2]; two additional species are recognized here from Asia, one new to science and the other previously referred to *Alnicola* (pp. 1258-1266). A new species of *Hypocrella* discovered in Bolivia and Cost Rica with large stromata is compared morphologically and molecularly with other species of the genus; the resultant trees place it in a clade with others that have large stromata (pp. 1267-1274). Real time PCR demonstrates that the *Peronospora* attacking sweet basil (*Ocimum basilicum*) is not *P. lamii*, but evidently an undescribed species; it also has somewhat larger conidia and forms a sister clade to species on *Veronica* (pp. 1275-1286). Development of a specific PCR-based diagnostic assay for *Metarhizium anisopliae* var. *acridum* is reported; the fungus is used for the biocontrol of grasshoppers and locusts, and this method which will facilitate detection in environmental samples and non-target organisms (pp. 1301-1311).

The interaction between black-yeast like melanized fungi isolated from rock surfaces and four green algae from lichens has been investigated in pure culture; after 2-12 months an overlapping structure developed involving both partners, with dense hyphal growth around the algae and close cell wall contacts (pp. 1287-1295). These fungi, while not considered lichen-forming, evidently have the potential to enter into close associations with algae likely also to be present on rocks in nature. The penetration and growth of *Monosporascus cannonballus* within cantaloupe roots is documented by light and scanning electron microscopy; hyphae were predominantly intracellular and grew extensively inside metaxylem vessels, the behaviour recalling that of a vascular wilt pathogen (pp. 1296-1300).

NOVEL NITROGEN TRANSFER BY AM FUNGI

The transfer of nitrogen into plants by arbuscular mycorrhizal (AM) fungi has been investigated using stable isotope labelling experiments by Govindaraju *et al.* (2005). Divided Petri dishes were used with carrot roots colonized by *Glomus intraradices* in one compartment (intraradical), and the fungus alone in the other (extraradical). Nitrogen, supplied as labelled ammonium and nitrate ions to the extraradical mycelium was incorporated into amino acids and translocated from the extraradical mycelium to the intraradical as arginine.

They also discovered that the genes for primary nitrogen assimilation were preferentially expressed in the extraradical tissues of the fungus, but that those for arginine breakdown were most highly expressed in the intraradical mycelium. The arginine breaks down to release ornithine and urea, and these compounds in turn are converted to ammonium ions and then pass through the walls of the fungal mycelium to the host plant's roots where they can be used to make plant amino acids and proteins. Differences in available nitrogen in these two parts of the AM-root interaction are thought to be responsible for the differential expression of genes. Further, the use of the catabolic part of the urea cycle allows the transfer of nitrogen into the host plant with a minimal loss of carbon by the fungus.

The elucidation of this elegant mechanism also means that the AM symbiosis may be playing a major and hitherto largely unexpected role in the global nitrogen cycle as so many plants form arbuscular mycorrhizas.

Govindaraju, M., Pfeffer, P. E., Jin, H., Abubaker, J., Douds, D. D., Allen, J. W., Bücking, H., Lammers, P. J. & Shachar-Hill, Y. (2005) Nitrogen transfer in the arbuscular mycorrhizal symbiosis. *Nature* **435**: 819-823.

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[2] Thomas, K. A., Peintner, U., Moser, M. & Manimohan, P. (2002) *Anamika*, a new mycorrhizal genus of *Cortinariaceae* from India and is phylogenetic position based on ITS and LSU sequences. *Mycological Research* **106**: 245-251.

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Book Reviews[1]

FUNGAL BIOLOGY

Fungal Biology. By Jim [W.] Deacon. 10 June 2005 ['2006']. Fourth edition. Pp. vii + 371, illustrations 351. ISBN 1 4051 3066 0. Blackwell Publishing, Oxford. Price: £ 27.50.

Since the first edition of *Introduction to Modern Mycology* (Blackwell Scientific Publications, Oxford) first appeared in 1980, 'Deacon' has become the standard text for broadly based mycology courses. The title change for this fourth edition is welcome. Everyone knew that the words 'modern mycology' were a code for 'not taxonomy', but the new title is much more self-apparent and is certainly more appropriate.

The Introduction (Ch. 1) is a racy overview of fungi and what they do, placing them in the molecular tree of life, stressing how they differ from animals and plants, their early evolution, and especially their importance, particularly to humans in the form of food, health-care products, and industrial chemicals and enzymes. But an account of the enormous range of forms exhibited by fungi could hardly but be presented other than in a taxonomic framework. This is done in Ch. 2 on diversity, against a molecular phylogenetic background numerous with clear drawings and photographs. I was also pleased to see the fungal-like organisms that are not part of the kingdom *Fungi*, such as the slime moulds and straminipiles, still covered here; if these groups are not taught in mycology classes, they will not be taught at all.

The treatment of structure and ultrastructure (Ch. 3) is mainly devoted to the latter, but lucidly presented with excellent drawings and photographs. That leads naturally in to one on hyphal growth (Ch. 4), focussing on branching and the tips, but moving up in scale to the air-lift fermenter used to manufacture the mycoprotein Quorn®. Differentiation and development (Ch. 5) perhaps tries to cover too much; dimorphism, infection and penetration, translocation, conidiogenesis, hydrophobins, mating type genes, hormones, commercial mushroom cultivation, etc., etc. – but nothing on how the complex fruit bodies of macromycetes develop or references to the cyberfungus computer models. That one merits a re-think for the fifth edition. In contrast those on fungal nutrition (Ch. 6) and fungal metabolism and products (Ch. 7) are more balanced; the numerous structural formulae in the latter are good to have to hand. In environmental conditions and tolerance of extremes (Ch. 8) there are some first-rate graphic presentations, though I expected at least on the ecophysiological adaptation of hot-desert or Antarctic lichens. Fungal genetics, molecular genetics and genomics (Ch. 9) is for me one of the best; up to date, and with succinct summaries of the comparative data now coming from whole-genome comparisons.

The next chapters focus on ecology and interactions, starting with spores (Ch. 10) which embraces dormancy, germination, fairy rings, succession, discharge, dispersal, zoospore functioning and encystment, liberation, and the air spora – but surprisingly nothing on the fluid mechanics of Buller's drop in basidiospore discharge, now so elegantly explained by John Webster and co-workers. That is followed with ones on: saprotrophs (Ch. 11); fungal

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interactions: mechanisms and practical exploitation (Ch. 12), which is especially good on mycoparasitism; symbiosis (Ch. 13), that might have been better-termed ‘mutualisms’, and pleasingly had a much better coverage of lichens than I expected to see; plant pathogens (Ch. 14); parasites of insects and nematodes (Ch. 15), with a useful list of registered mycoinsecticides; and ‘moulds of man’ (Ch. 16), a balanced overview, though many mentioned certainly attack women!

The final chapter (Ch. 17), as in previous editions, is on the control of fungal growth, and particularly strong on antifungal compounds and their sites of action, also covering biocontrol, fungicides, and phytosanitary practices.

The book lacks any illustrations in colour, but it is supported by a web site (www.blackwellpublishing.com/deacon) with over 600 images, many of which are in colour; those of the author ‘can be used freely, without restriction’.

Inevitably there are slips and inconsistencies, but I will not draw attention to any here as that could detract from the impression of this being a really first-rate text. Though I do find it annoying when the date given inside a book by the publisher is not that of its actual publication; this means it is destined to be frequently cited incorrectly.

No two mycologists would ever agree on the balance between topics in such an over-arching book. Yet what makes this one so valuable is its readability and style of presentation. Each chapter is short enough to be read at a sitting, has a grey box at the start with key points as to what is to be covered, and references split in many cases into websites, general texts, and cited literature. There are also amusing asides sure to catch a student's attention, such as the caption: ‘An attempt to produce a homemade cake of tempeh, which tasted only marginally better than it looks' (p. 11). It merits use in microbiology and mycology courses worldwide, and fortunately is not priced beyond the student pocket.