

Milestones in the history and progress of medical mycology in India: future directions

Short Title: Medical mycology in India

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Introduction

Studies on fungi and in the field of mycology in India began with arrival of “foreigners” mainly from Britain who set about collecting both fungal organisms and relevant clinical specimens which were subsequently referred to various laboratories in Europe for their identification and further assessment. Spurred on by local need for fungal identification, the earliest record of identification of a “hyphomycete” in India was made by August Carl Corda in 1837. The studies of Indian fungi were continued by Sir J.D. Hooker, a British botanist and explorer, which led to a series of papers by an English mycologist. Reverend M.J. Berkley. Studies on mycology and plant pathology in India began thus with the establishment of the Imperial Agricultural Research Institute at Pusa, Bihar and with Sir E.J. Butler (a physician interested in the study of fungi and plant diseases) joining that institute in 1905 as the first imperial mycologist to the government of India. These aspects are covered in Indian Society for Human and Animal Mycologists (SIHAM) 2006 Presidential oration by the author of the present article. (https://s3-eu-west-1.amazonaws.com/awarticles/mycology_in_india.pdf).

Through the course of time, only one of several reviews of the history of mycology in India has included the mention of dermatomycoses in the section “Mycoses of man and animals”.¹ The present review updates knowledge on the history, recent progress of medical mycology in India, and suggests directions for its future.

Brief historical account (with extracts from

https://s3-eu-west-1.amazonaws.com/awarticles/mycology_in_india.pdf)

Globally, the first recognition of fungal infection was by Robert Remak, an ardent German microscopist and physiologist in Berlin in 1835.² He observed the microscopic structures of “favus” lesions, but did not recognize them as being of fungal origin even when he indicated the infectious nature of material from such lesions in 1839. Later, he cultivated the agent of “favus” growing on apple slices, described it in 1845 and named it as new species of fungus, *Achorion schoenleinii* in honor of Professor Schoenlein, Professor of Pathology, although no pure culture was obtained.³ Research by the Italian bacteriologist Agostino Bassi (1773–1856) on the “muscardine disease” that devastated the French silkworm industry further led to the discovery

of *Beauveria bassiana*, the first report of any animal disease caused by a microbe (Encyclopaedia Britannica). Scientific study of plant pathology began in early 19th century and in 1845–1849, an epidemic of potato late in Ireland was described.³ Heinrich Anton de Bary (1831-1888) a German surgeon, botanist, microbiologist and mycologist (specialist in fungal systematics and physiology), who researched into the roles of fungi and other agents in causing plant diseases earned distinction as a founder of modern mycology and plant pathology.⁴⁻⁸

At about the same time, in 1846, Godfrey, a Garrison surgeon working in Bellary described mycetoma as “morbus “tuberculosis pedis”) and Eyere, one of Godfrey`s colleagues described 40 cases of such treated between 1844 and 1848.⁹ Carter in 1860 first suggested the fungal etiology of the disease and later in 1874 published a monograph “*On Mycetoma and Fungus Diseases of India*”.^{10,11}

However, the first isolation of a fungal causative organism was not made until 1906 by Brumpt.¹² Powell, a Dermatologist serving in British Indian Army reported on ringworm from Assam in 1904.¹³ Organized medical mycological research in India started in 1920 under Lt. Col. H.W. Acton (with C. McGuire, G. Panja & K.P. Banerjee) as a part of Pathology & Microbiology Department in Calcutta School of Tropical Medicine, Calcutta. In April 1965, a Department of Medical Mycology was established in this school, with Maya Sanyal, N. Basu, Anjali Roy and A. Thammayya as faculty staff. It is from here that a natural focus of *Histoplasma capsulatum* was in soil admixed with bat excreta in a 300-yr-old building infested with bats in Serampore (near Kolkata) was discovered for first time in 1975.¹⁴ However, after 1995, the Department ceased to exist where instead, the staff engaged in mycological work joined the faculty of the Microbiology Department, and thereafter to other faculties.

The contribution of missionary, Dr. A.H. Klokke, and a German Pathologist Dr. H.L.E. Grueber, who worked in Christian Medical College (CMC), Ludhiana, Punjab requires acknowledgment. Indeed, the first report of mycetoma due to *Nocardia brasiliensis* in Asia published in 1964 was from this college.¹⁵ Later the author of the report joined the Microbiology Department of CMC, Vellore and in association with other colleagues did extensive work on the causal agents of

mycetoma, and on the etiology of superficial mycoses and mycetomas in North India as well as south India.¹⁶⁻¹⁸⁾ Klokke et al. also published a paper on cryptococcosis from India.¹⁹ In addition, Klokke was one of the few early medical mycologists who contributed fungal isolates into the Centraal Bureau voor Schimmelcultures (CBS) culture collection, Westerdijk Fungal Biodiversity Institute (Utrecht, the Netherlands). The first report of mycetoma due *Streptomyces somaliensis* from North India was also from CMC, Ludhiana.²⁰ One of the authors, Dr. Grueber, worked for 10 years in this college including two as Head of Department of Pathology, set up a museum of Pathology from autopsies performed during 1969-1971.

It is further relevant that the work on fungal diseases of plants in India was also started by a British physician, E.J. Butler, from Queen's College, Cork where in 1998 he earned M.B., B.Ch. and B.A.O. Butler worked for some time in Royal Botanic Gardens, Kew, and was later appointed as the first cryptogamic (referring to spore-producing plants) botanist to the Government of India at Calcutta. He worked for 21 years in India, published in 1903 the monograph on "Potato diseases of India"²¹ and is aptly the father of Plant Pathology. From 1905-1921 he worked as Imperial Plant Pathologist at the Indian Institute of Agricultural Research in Pusa, Bihar, establishing a strong school of mycology and plant pathology. This institute is now located in Delhi and re-named as the Indian Agricultural Research Institute (IARI). Between 1910 and 1912 Butler additionally held the office of Director and Principal at the Agricultural College in Pusa. He worked and published on fungal diseases of several plants including of the coconut and other palms, cotton, sesamum and forest trees, writing a book entitled "Fungi and disease in plants".²² Later he published an authoritative list of Indian fungi in 1931 in collaboration with G.R. Bisby (Butler & Bisby)²³ This publication has been continuously updated.²⁴ Butler also qualified with an MSc in Botany in 1920 from University College Cork, and is the father of "Indian Plant Pathology". His book Plant Pathology authored jointly with SG Jones²⁵, is a classic text book and is still a source of reference. It is important to note that three plant diseases epidemics due to fungi, viz. *Helminthosporium* blight of rice resulting in Bengal famine of 1942, wheat rust to *Puccinia tritici* causing severe wheat shortage in Madhya Pradesh in 1946-1947, and the red rot of sugarcane, caused by *Colletotrichum falcatum* in several parts of northern India in 1938-1942 greatly stimulated the research on fungal diseases of plants. Conversely, , there was no similar stimulus then to invigorate research on fungus infections in

humans until advent of HIV/AIDS. The manifestation of certain opportunistic infections as indicator diseases in AIDS in the past several decades has promoted the study of human fungus infections to a great extent including in India.

Recent progress of medical mycology in India

Many medical professionals (with MD, MS and Doctor of Medicine degrees) and scientists with PhDs in medical microbiology/medical mycology have undertaken the study of human pathogenic fungi and infections in India. The author of this article has inducted several MDs into the discipline of medical mycology. During the past two decades, medical mycological research has progressed phenomenally, with medically qualified mycologists (MD, MD/PhDs) and biomedical scientists with PhD. in microbiology/medical mycology contributing to the progress of this interdisciplinary subspecialty of medicine by working on pathogenesis, diagnosis and epidemiology of fungal infections, frequently involving molecular techniques. As a result of this, several world class excellent centers have emerged for training and research in medical mycology – the Post-graduate Institute of Medical Education & Research (PGI) Chandigarh, Vallabhbhai Patel Chest Institute (VPCI), University of Delhi, Delhi and various AIIMS institutions and medical colleges. A special mention should be made of Center of Advanced Research in Medical Mycology and World Health Organisation Collaborating Center for Reference and Research on Fungi of Medical Importance at the PGI, Chandigarh, lead by Professor Arunaloke Chakrabarti, Head of Division of Medical Mycology. This center undertakes confirmation of species identification of the fungal isolates referred from all parts of India. Professor Chakrabarti also shares joint responsibility with Dr. Thomas Chiller of Centre for Diseases Control (CDC), Atlanta, Georgia, USA for Surveillance of Antimicrobial Resistance in invasive *Candida* infection under the auspices of WHO.

As such, with the collaboration of globally re-knowned physicians and infectious diseases specialist enabled steady and continuous progress in research in different institutions on fungal diseases. Key areas have included: candidemia in ICU settings, molecular techniques in the rapid diagnosis of fungal infections, epidemiology of chronic infections such as pulmonary aspergillosis, superficial mycoses and their management, neglected tropical diseases such as histoplasmosis, mycetoma, chromoblastomycosis, and sporotrichosis, and of recurring and novel fungal infections, infections in AIDS patients (e.g. cryptococcosis and talatomycosis). Work on

antifungal stewardship of all fungal diseases especially in the Indian setting with limited resources was also priority. Another noteworthy feature of progress in medical mycology is that globally recognized excellent centers of research on ocular fungal infections have been established in South India.

It is particularly noteworthy to recall the discovery of a new genus, *Saksenaea* (species description, *Saksenaea vasiformis*) of the order Mucorales by the mycologist, Dr S.B. Saxena in 1953.²⁶ from forest soils in Sagar, Madhya Pradesh, India. The genus name *Saksenaea* was awarded to this fungus in honor of his teacher Professor R.K. Saxena, Allahabad University. The species, or now species complex, is now well described as pathogen in several geographic regions. In 2010, Alvarez *et al*²⁷ demonstrated by molecular analysis that *S. vasiformis* is a complex of at least three species, *S. vasiformis*, *Saksenaea oblongispora*, characterized by oblong sporangiospores and inability to grow at 42°C, and *Saksenaea erythrospora*, characterized by large sporangiophores and sporangia and by ellipsoid sporangiospores appearing biconcave in the lateral view. Another pathogenic Mucorales, *Apophysomyces elegans* first isolated in 1979 from soil of a mango orchard in north India by Misra *et al.*²⁸ is designated as a complex of four species, namely *A. elegans*, *A. ossiformis*, *A. trapeziformis*, and *A. variabilis*. Most isolates from India have been found to be of *A. variabilis* clade²⁹ whilst Chakrabarti *et al.*³⁰ have described cases of infection due to *A. elegans* complex.

Notwithstanding the importance of *Saksenaea* and *Apophysomyces* fungi, the account or progress of medical mycology would not be complete without mentioning here the discovery of other novel species of pathogenic fungi by Indian mycologists enabled by advancement in laboratory diagnostic techniques. Two new species of *Curvularia* - *Curvularia tamilnaduensis* and *C. coimbatorensis* - have been described as agents of keratitis by staff of the Ocular Mycology Center, Coimbatore, in collaboration with Dr. Noemi Kiss, Department of Microbiology, University of Szeged, Hungary.³¹ Rameskumar *et al.* and Dudeja *et al.* from the same Ocular Mycology Center, reported fungal keratitis caused by *Podospora austroamericana*, *Myrothecium* sp. and *Laetisaria arvalis*^{32,33,34} Braddo *et al.*³⁵ have described rhinosinusitis due to *S. erythrospora* in an Indian, immunocompetent patient; previously, this fungus had not been described as a cause of mycosis. With regards to allergic bronchopulmonary aspergillosis and its serologic diagnosis, Sandhu *et al.*³⁶ reported on these aspects for the first time in the Indian

context. Chowdhary et al *et al.*³⁷ further described *Schizophyllum commune* as causal agent of one case each of allergic broncho-pulmonary mycosis (ABPM) and pulmonary fungal ball. Of note, Kamalan and Thambiah described unusual lymphoedema with subsequent elephantiasis in a case of chronic basidiobolomycosis.³⁸ Other examples of descriptions of novel fungi include a new species of yeast, *Malassezia arunalokei* recovered from patients of seborrheic dermatitis and healthy individuals in India³⁹, keratitis due to *Neocosmospora vasinfecta*, *Aspergillus nomius* and *Graphium eumorphum*^{40,41} and *Colletotrichum truncatum* as a cause of mycotic keratitis and endophthalmitis.⁴² New or emerging opportunists include *Candida nivariensis*⁴³, *Trichosporon mycotoxinivorans* (bloodstream infection)⁴⁴ and an outbreak of neonatal fungaemia caused by *Dirkmeia churashimaensis*. Other honours include the first two known cases of keratitis caused by *Aspergillus tubingensis* in India⁴⁶, keratitis due to *A. tamaris* described by Houma et al.,⁴⁷ and white piedra of the scalp due to *Trichosporon inkin* and *Trichosporon mucoides*.⁴⁸ Keratitis due to *Chaetomium atrobrunneum* and *Pseudopezalotiopsis theae* was described as the first world record of ocular infection due to these fungi by Sane *et al.*⁴⁹ whilst Shankarnarayan *et al.*⁵⁰ described several cases of bloodstream infections due to *Candida viswanathii*, a new species discovered by R. Vishwanathan and H.S. Randhawa⁵¹ in 1959 as a cause of meningitis. It is noteworthy that H.S. Randhawa was the first medical mycologist of India, and the V. P. Chest Institute from where this new species was reported is the first center of research in medical mycology opened in India in 1955. Meena et al.⁵² described *Exophiala jeanselmeii* and *Rhizopus oryzae* coinfection in a post renal transplant, the first record of the coinfection due to these fungi, whilst a nodular swelling caused by *Medicopsis romeroi* was published.⁵³ Finally, Mishra and Randhawa⁵⁴ developed a paraffin-baiting technique for isolation of *Nocaidia asteroides* from clinical specimens whilst a new medium, Tobacco agar for pigment production of *Cryptococcus neoformans*, and one based on brown mustard seed for differentiation of species within the *C. neoformans* complex have been described.^{55,56}

Future directions for development

These are offered below in the context of education and training, clinical studies and novel approaches to managing fungal infections.

Training of our mycologists

India is a large country with a huge population. There is dire need to set up diagnostic medical mycology laboratories in medical colleges and government hospitals, where these do not exist. These colleges and hospitals should avail of the facilities for training of their staff and laboratory technicians as exemplified by the large referral centers mentioned above e.g. PGI, Chandigarh.

E-learning medical mycology

In 2019, the International Society for Human and Animal Mycology (ISHAM) launched an eLearning course on 'Diagnostic Medical Mycology'. The details of the course may be obtained from the ISHAM website. "The main goal of the course is to provide a comprehensive resources to learn diagnostic medical mycology via an online learning platform. At the end of the course, participants should have a good understanding of the range of diagnostic techniques that are currently available, the relative advantages and disadvantages of each of the methods and how the methods can be used in different patient populations and different diseases. The course consists of 12 modules and includes an overview of fungal diseases and antifungals, the fungal kingdom and an introduction to diagnostic techniques. Each of the diagnostic methods is then covered in detail in individual modules which include identification of yeasts and molds; direct microscopy, culture and histopathology; antigen detection; antibody detection; molecular diagnosis, antifungal susceptibility testing and approaches to diagnosis in different patient populations.

With extensive reading lists and bibliographies, textbooks recommendations and a fully linked glossary, the course is ideal for those with limited experience in mycology as well as those who have some experience in this area."

The course can be accessed directly at <https://isham.scholarlms.com/>.

Community studies in fungal infections and preventive measures

Fungal diseases are frequently caused by fungi that are common in the human environment. One option is for facilities such as the Departments of Preventive and Social Medicine across India to carry out community surveys in collaboration with state departments of health/primary health centers in selected communities to investigate the burden of fungal infections such as tinea,

keratitis and mycetoma with the aim of informing preventive measures. Keratitis surveys may also be performed in collaboration with ophthalmologists. There may be a need for instituting preventative chemotherapy in the form of a combined antifungal +/-antibacterial preparations for immediate “prophylactic” first aid for at risk populations such as farmers and carpenters particularly in rural areas, who frequently sustain corneal injuries leading to corneal ulcers. As aligned with the vision of the US CDC, national awareness campaigns about fungal diseases is essential in improving early recognition and reducing delays in diagnosis/treatment, with roll out of preventive measures. A key clue to when a person may have a fungal disease is that he or she is being treated with medicine for another type of infection but does not get better. The community requires awareness of hand hygiene in home and workplace, and to avoid activities such as sharing of towels at home and in community bathing places e.g. swimming pools, where fungal skin diseases are problematic. Teachers should advise their pupils not to excessively roll on the ground while playing in the school playground to avoid infection by soil-borne dermatophytes. Farmers need to be advised not to work in their fields barefooted, to avoid foot injury which may lead to mycetoma. People residing near bat roosting sites and chicken pens should avoid contact with accumulations of bat guano and chicken excreta to reduce the risk of infections such as histoplasmosis. Finally, development and accessibility of myco-serological/molecular techniques to detect early infection is an immediate need.

Herbal Therapy

Many current antifungal drugs have a degree of drawback in terms of toxicity, efficacy and cost, and their frequent use has led to the emergence of resistant strains of fungi. This has led to a search for alternative treatments including the study of medicinal plants and compounds isolated from them, for their antifungal properties. Vaijayanthimala *et al*⁵⁷ tested the antifungal activity of 23 south Indian medicinal plants against clinical isolates of *Trichophyton rubrum* and *T. mentagrophytes*; alcoholic extracts of *Allium sativum* (Garlic), and *A. schoenoprasum* (chives) showed highest anti-dermatophytic activity. In another publication from south India, Balakumar *et al.*⁵⁸ demonstrated significant *in vitro* antifungal activity of *Ocimum sanctum* (Tulsi) against clinical isolates of *T. rubrum*, *T. mentagrophytes*, *Epidermophyton floccosum*. and *Microsporium gypseum*. In Brazil, another species of *Ocimum*, *O. gratisimum* has been shown to have antifungal activity against *Cryptococcus neoformans*.⁵⁹ *Ocimum gratisimum* (known as Ram

Tulsi and Ban Tulsi in Hindi) commonly occurs in India. The clinical use of both types of Tulsi in dermatophytic and cryptococcal infections may warrant further study. Very recently, rosemary (*Rosemary officinalis*), commonly cultivated in gardens in India was found to have antifungal properties against *M. gypseum* and *T. rubrum*.⁶⁰ Propolis, a sticky natural substance collected by the honey bees from the resin of flowers, leaves of trees and plants and it after mixing it with their saliva is also shown to have significant activity against *Paracoccidioides brasiliensis*, a dimorphic fungus.⁶¹

Professional societies and their role in mycology

Indian Society of Medical Mycologists (ISMM): until recently (2020) this was the Indian Society for Human & Animal Mycologists (SIHAM) founded by Prof. SM Singh of the Department of Biological Sciences, Rani Durgawati University, Jabalpur, where its first conference was held in 1994. Since then the Society has met every two years. The Society has grown by leaps and bounds over the past two decades with a total membership of 570. The current office bearers are President- Prof. Anupma Jyoti Kindo (SRMC, Chennai), Vice-President-Prof. Immaculata Xess (AIIMS, New Delhi), General Secretary-Prof Jayanthi Savio (St John's College, Bengaluru), Joint Secretary-Dr. Bansidhar Tarai (Super Specialty Max Hospital, Delhi), and Treasure-Prof Anoop Ghosh (PGI, Chandigarh). The zonal executive members are: North-Dr. Pratibha Kale (Institute of Biliary and Pancreatic Sciences, New Delhi), West-Prof. Anuradha Sharma (AIIMS, Jodhpur), South-Prof. Lalitha Prajna (Aravind Eye Institute and Hospital, Madurai), East-Dr. Vinay Kumar Hallur (AIIMS, Bhubaneswar), Central-Dr. Anand Kumar Maurya (AIIMS, Bhopal). Though the leadership of the society in initial years was provided by laboratory scientists, many clinicians who recognize the challenge of emerging fungal infections in their clinical practice are taking more interest in the society. It is inspiring and encouraging to observe that the clinicians and biomedical scientists are working hand in hand to improve the outcome of patients with fungal disease in India. In 2022, ISMM and Fungal Infections Study Forum (FISF) together will organize the 21st ISHAM Congress at Delhi, an excellent opportunity for the mycologists, physicians and researchers to participate in this scientific event. All this has been possible due to the laudable efforts of the past presidents of SIHAM - ArunaIoke Chakrabarti and Shivaprakash M Rudhramurthy (who are also the

current president and vice-president respectively of ISHAM), and previous presidents of ISMM (SIHAM), notably KR Joshi, Uma Banerjee, and Hemashatiar. ISMM has progressed to be an important internationally recognized mycological society and is affiliated to ISHAM. Several eminent medical mycologists from England, Netherlands, Germany, Israel, USA, and South America, have been attending the SIHAM Conferences. The 13th National Conference of SIHAM was held in Jodhpur (Rajasthan) from 12-15th February. In addition to members of our society, council members of ISHAM, and Fungal Infection Study Forum (FISF) members were the invited faculty of this conference. The theme of this conference “Paradigm Shift in Fungal Infections- A Global Health Challenge” was aptly chosen to discuss the challenges in the fungal infections such as emergence of *Candida auris* infection, recurrent dermatophytosis, and increase in the incidence of invasive mould infections etc. Several globally re-known medical mycologists, pathologists, molecular biologists and clinicians (Malcolm Richardson (Mycology Reference Centre-ECMM, Centre of Excellence in Mycology, NHS Foundation Trust, University of Manchester, Wythenshawe Hospital, Manchester, UK), Jacques F. Meis (Canisius Wilhelmina Hospital, Department of Medical Microbiology & Infectious Diseases, Nijmegen, The Netherlands), John Perfect (Department of Medicine, Duke University School of Medicine, Durham NC, USA), Karl Clemons (Department of Medicine, Stanford University, Stanford, CA, USA), Beatriz Gomez (Corporacion para Investigaciones Biologicas, Medellin, Colombia), Oliver O. Cornely (Director of Translational Research, University Hospital, Cologne, Germany) eloquently delivered their state of the art lectures. Members of the Indian faculty, OC Abraham, Mailini Capoor, Arunaloke Chakrabarti, Jagdish Chander, Shukla Das, Khurajam Ranjana Devi Anup Ghosh, Vinaykumar Hallur, Ram Goplakrishnan, Ranganathan Iyer, KR Joshi, Pratibha Kale, Harsimran Kaur, Anupam Kindo, Rungmei SK Marak, Sangeetha Mohan, Joy Sarojni Miachael, Niranjana Nayak, Jaswinder Oberoi, Umabala Pamidimukkala, Atul Patel, Lalith Pranja, Rajendra Prasad, Jayanthi Savio, Nandni Sethuraman, Anuradha Sharma, Savitri Sharma, Gagandeep Singh MR Shivaprakash, Rajeev Soman, Subramaniam Swaminathan, Bansidhar Tarai, Karuna Tadepali, Subhash Todi, and Immaculata Xess also gave excellent presentations.

ISMM (SIHAM) Awards

At every ISMM (SIHAM) Conference, papers presented as oral presentations in separate sessions are assessed for the GP Agarwal Award for young mycologists, the Kamalam Glaxo

Award, and Pankajlakshmi Award for best oral presentations. At selected conferences, the MJ Thirumalachar Life Time Achievement Award (funded by Dr. Arvind A Padhye, USA) is given to outstanding medical mycologists. Dr. Padhye has co-authored several important publications with medical mycologists from India.

ISMM (SIHAM) Newsletter

This newsletter started in 2002 by Arunaloke Chakrabarti, initially with financial support of M/S Pfizer, India is now sponsored by MDH Pharmaceuticals PVT. Ltd, India. It is edited by Savitri Sharma with the assistance from the editorial board (Malini Raj Capoor, Lalitha Pranja, Vijayalatha Rastogi, Shivaprakash M Rudhramurthy, Ruchi Mittal, P. Manikandan, Mamatha Ballal, Joveeta Joseph, and Shukla Das). The newsletter has continued to serve as a source of educational material on fungal infections, and is a very good forum for posting the abstracts of research papers or published papers on all aspects of mycology.

Conclusions

The brief historical account illustrates how plant pathology and medical mycology are inter-related. As seen, medical mycology in India made a good start with contributions from German, British, and Dutch physicians and pathologists in the 18th and 19th centuries. Some of these medical scientists contributed to the development of plant pathology in India and in the countries of their birth. A remarkable feature revealed in this review is that British mycologists and physicians contributed to the early progress of plant pathology and medical mycology, and later, one of them, Sir E.J Butler was recognized as the Father of Plant Pathology in India for his work and contributions. It naturally dwells now on the mycologists and plant pathologists in India to pay debt to the development and progress of medical mycology in India, taking inspiration in the work of their counterparts in the United Kingdom, Europe, North America and South America. It is time now for our mycologists and biomedical scientists to continue to make significant contributions. Numerous species of plant pathogenic fungi are known to cause human infections. Our plant pathologists while surveying fungal plant diseases in crop plantations should assess the possibility of transmission of infection to the farm workers and others likely to come in contact with infected plants. It may not be out of place to mention here an unusual instance of a commensal yeast and human opportunistic pathogen *Candida tropicalis*, causing an outbreak of

maize stall rot in 1974 in India.⁶² Finally it is suggested, that all mycologists continue to embrace advancements in diagnostics as required including molecular methods.⁶³

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