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Smut fungi: a compendium of their diversity and distribution in India

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Abstract

A compendium of Indian smut fungi with respect to their diversity and distribution is provided in this paper. After compiling all the information available in online and offline resources, it was revealed that Indian smut fungi comprise 18 genera and 159 species belonging to five families. About 189 host plant species belonging to eight families are reportedly infected by smut fungi, *Poaceae* being the most infected. Similarly, *Ustilago* was reported with highest number of species (48) from India that accounts for 30.38 % of total number of species. *Ustilago* was followed by *Sporisorium* and *Anthracocystis*. Other genera recorded from India are *Ahmadiago, Bambusiomyces, Cintractia, Clinoconidium, Eriocaulago, Farysia, Franzpetrakia, Macalpinomyces, Melanopsichium, Melanotaenium, Moesziomyces, Pericladium, Stollia, Tolyposporium* and *Tranzscheliella*. Inaccessibility of literature on online platforms and ceased publications of many journals are the reasons for the dispersed literature of Indian smut fungi. This causes difficulties to researchers, especially young and emerging mycologists working on, or starting taxonomic work on smut fungi. The present paper provides a complete account of diversity and distribution of Indian smut fungi in a single-source document, for the benefit of national and international students and plant pathologists working on smut fungi.

Key words: *Basidiomycota*, checklist, diversity, India, smut fungi, *Ustilaginales*

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Introduction

The smut fungi (*Ustilaginales, Ustilaginomycetes, Basidiomycota*) are a group of specialist parasites infecting hosts belonging to grasses, sedges and many other plant groups. They are obligate biotrophic plant parasites, infecting mostly herbaceous host plants almost all over the globe in grassland, swamp, savannah and roadside. Interestingly, they are almost absent in primary forest regions (Piepenbring 1998). They are major pathogens of grasses and infect inflorescence of their host plants. While, approx. 40 % of known smut fungi infect grasses (*Poaceae*), about 15 % are pathogenic to sedges (*Cyperaceae*). Smut is a German word used for dirt, hence, these fungi are named because of their dark, thick-walled, and dust-like mass of spores. These fungi are recognized mostly by black or brown powdery spore masses or sori forming on the inflorescences, the leaves, or the stems of their hosts.

Smut fungi often target specific organs instead of infecting the whole plant. They mainly infect the reproductive system of host plants and produce disease symptoms on floral parts or inflorescences. Many smut fungi infect embryos or seedlings to enter the plants, develop infection systemically and visible only when the plants are near to maturity. Some smut fungi infect the actively growing tissues and produce localized symptoms. Smut fungi are the second largest group of phytopathogenic fungi after rusts, with approx. 1450 species in about 77 genera (Vánky 2007, Wijayawardene et al. 2020). Several smut fungi are harmful to agricultural cash crops such as wheat, rice, sugarcane, etc. Smut fungi are, therefore, investigated swiftly (like rust fungi) to assess possible crop losses and methods to control them. The regions with temperate climate witness a high occurrence of smut fungi, compared to those areas with tropical climatic conditions. The optimum range of temperature between 25 to 40 °C is considered ideal for germination of smut spores. However, highest number of spore germination is observed at 30 °C with 100 % relative humidity (Waller 1969). Such agro-climatic conditions prevail throughout the world, which promote the growth and development of smuts. This may be a possible reason for the global distribution of smut fungi.

As smut fungi cause damage to cash crops, farmers and researchers are curious about their life cycle, characteristics, classification, their prevention and control. Like all countries of the world, the research on Indian smut fungi was initiated in late 19th century by overseas mycologists, who identified or named fungal specimens from India. Two British mycologists (medical officers by profession) namely; D. D. Cunningham and A. Barclay made important contributions to the knowledge of *Ustilaginales* of India. The contribution of Sir E. J. Butler is enormous in the initiation and development of research on mycology and plant pathology including smut fungi in India. Along with initiating work on forest pathology and fungal diseases of Indian crop plants, Butler jointly with some other pioneer mycologists set up an Herbarium of Fungi at the (Imperial Agricultural Research Institute) (then in Pusa, Bihar), now known as the Herbarium Cryptogamae Indiae Orientalis (HCIO) and located at the Indian Agricultural Research Institute in New Delhi. After him, many scientists contributed towards the understanding of Indian smut fungi. The main credit goes to B.B. Mundkur, A.R. Patil, B.V. Patil, J.N. Mishra, J.H. Mitter, M.S. Patil, M.S. Pavgi, M.J. Thirumalachar, R.N. Tandon, S.D. Patil, T.M. Patil, T.S. Ramakrishnan. Dr. K. Vánky also dealt with number of smut fungi of India. The research on smut fungi gained momentum during 1950-75 when nearly 52 research papers were published. However, this number was reduced to 16 in next 25 years (1976-2000). There are about 23 research papers published during the present century. Recently, Singh et al. (2020) published a new species of smut namely *Clinoconidium lauracearum* on fruits of *Cinnamomum tamala* and Vikas et al. (2020) reported a smut

disease caused by *Tranzscheliella hypodytes* (Schltdl.) Vanky & McKenzie on *Leymus secalinus* (Georgi) Tzvelev. The occurrence of smut fungal genus namely *Clinoconidium* was confirmed by Jayawardena et al. (2020).

Form India, about 329 species of smut fungi have been reported till 1997, out of which only 35 species were reported from East and North-Eastern India (Bag and Agarwal 2001). A taxonomic revision based on molecular data of *Ustilago*, *Sporisorium* and *Macalpinomyces*, carried out by McTaggart et al. (2012), resulted in intergeneric shifting of number of smut genera/ species, which reduced overall number of taxa of smut fungi. In the present paper, we have considered all the accepted taxa and omitted the rest. But the Indian literature on smut fungi is still scattered and not readily available to researchers working on or to start work on these fungi. Inaccessibility of literature on online platforms and ceased publication of many journals are the reasons that highlight the need for a comprehensive review of Indian smut fungi. Our present paper is such an effort to compile the literature on Indian smut fungi in a single-source document, so that it can be accessed by national and international students and plant pathologists.

India: a general description

India is one of the largest (seventh) countries by land area in the world. Situated in South Asia, India is surrounded by the Arabian Sea, the Indian Ocean and the Bay of Bengal. The country is situated north of the equator between 8°4' and 37°6' north latitude and 68°7' and 97°25' east longitude. India occupies maximum of the South Asian continent, covering an area of 3,287,590 square kilometers. The country is union of twenty-eight states and eight union territories. With the huge area of the country, a total eight agroclimatic zones are found in India. This diversity ranges from temperate and alpine conditions in the northern Himalayas to tropical in the southern regions. The four type of seasons mainly found in India are named as: dry, cool winter (December through March); hot spring (April to May); the rainy summer (June through September) and less-rainy autumn (October and November). Diversified seasons with great variations in temperature (average high of 38° to 40 °C and average low of 10°C) and Rainfall (reaches up to an average of 105 cm (41 inches) are generally found in the country.

India is a rich centre of diversity of fauna and flora (both agricultural and non-agricultural plants). It is ranked ninth in the world, among all the countries for its ‘mega diversity’ with respect to richness in plant diversity. While 23.68 % land area of India is covered by forests, it comprises two major biodiversity hotspots of the world having extraordinarily higher levels of species-richness with large number of endemic and threatened species (Venkataraman and Sivaperuman 2018). It is home to many domesticated crops such as cereals, legumes, millets and vegetables along with many temperate and tropical fruit plants, fibre crops, medicinal and aromatic plants. The great biological diversity of the country along with variable climatic conditions favour the growth and development of various plant pathogenic and saprobic fungi. Among massive fungal diversity of India, smut fungi occupy an important share of it as they infect reproductive parts of many agricultural, non-agricultural and forest plantations. Nearly all states of India reported the occurrence of smut fungi on various plant hosts.

Material and methods

This checklist is prepared after an exhaustive bibliographic survey of the literature published on smut fungi of India in various national and international journals, monographs, books, book chapters and magazines up to September 2020.

Data collection

The information on Indian smut fungi was retrieved from various offline and online sources. The literature consulted for present study included several books on Indian smut fungi including:

- Smut fungi of the Indian subcontinent (Vánky 2007)
- Fungi of India (Butler & Bisby 1931, Vasudeva 1962, Mukherji & Juneja 1974, Sarbhoy et al. 1975, 1980, Bilgrami et al. 1991, Jamaluddin et al. 2004)
- New plant fungal diseases during 21st century in India (Gautam et al. 2012).
- *Ustilaginales* of India (Mundkur and Thirumalachar 1952)

Different journals (both offline and online) were referred to, whatever feasible. The list of journals is lengthy. Only selected journals having majority of the information are mentioned here:

- Annals of Mycology
- Annales Mycologici
- CMI Mycological Papers
- Current Science
- Indian Phytopathology
- Journal of University of Poona
- Journal of Indian Botanical Society
- JNKVV Research Journal
- Journal of Mycology and Plant Pathology
- Mycologia
- Mycological Papers
- Mycological Progress
- Mycopathologia
- Mycopathologia et Mycologia Applicata
- Mycosystema
- Mycotaxon
- Persoonia
- Phytotaxa
- Plant diseases
- Science and Culture
- Sydowia
- The Proceedings of the National Academy of Sciences, India.
- The Vikram
- Transactions of the British Mycological Society

Apart from book and scientific journal, a bibliographic search was also carried out using online sources.

- Scopus (www.scopus.com)
- Web of Science (www.webofknowledge.com)
- Google Scholar (https://scholar.google.com)
- MycoBank (www.mycobank.org)
- Index Fungorum (http://www.indexfungorum.org)
- The Plant List (http://www.theplantlist.org)

- ResearchGate (https://www.researchgate.net/)
- Fungal Databases, U.S. National Fungus Collections (https://nt.ars-grin.gov/fungaldatabases/)

Compilation of checklist

The checklist of Indian smut fungi is arranged as order, family, genus, species, host scientific names with family, locality where smut fungi occurred and literature cited. The host-name given in the original citation is sometimes changed to be consistent with current taxonomy based on The Plant List (http://www.theplantlist.org). The names of smut fungi as reported in the cited publications have been replaced by currently accepted name according to MycoBank and Species Fungorum (accessed on 11.10.2020). Fungal Databases of U.S. National Fungus Collections, ARS, USDA (an important online source of plant pathogens and their hosts) (Farr and Rossman 2021) are also referred during the compilation.

Analyses of published studies on smut fungi

The detailed information obtained from published literature on Indian smut fungi was analysed for numerical and graphical summaries. The publication indices of Indian smut fungi on year wise, decade wise and era wise basis were analysed and presented in this paper. Besides the information on total number of records, genera and species of smut fungi reported from India, the data on host family wise and state wise occurrences is also presented. In addition, a detailed outline of Indian smut fungi is prepared and included here. The latest outline of fungi including smut fungi given by Wijayawardene et al. (2020) is adopted in this study. However, taxonomic revision based on McTaggart et al. (2012) was also kept in consideration to provide updated classification and checklist of Indian smut fungi. The proposed revision in existing names of various genera and species of Indian smut fungi along with their currently accepted names is provided (Table 2). This will help in explaining the important morphological and molecular changes implemented in this system.

Results

Richness of smut fungi in India

A total of 395 reports of *Ustilaginales* fungi were recorded from India. Smut fungi were recorded in nearly from all states (21 states) of the country of which, highest number was recorded in Maharasthtra (65) followed by Karnataka (31), Tamil Nadu (22), Uttar Pradesh (21), Bihar (20), Madhya Pradesh (17), Assam (14), West Bengal (12). Nearly thirteen states were found with less than ten records of smut fungi. Total ten records of smut fungi were recorded from Uttarakhand, a himalayan state of India. The two states namely; Himachal Pradesh and Jammu & Kashmir were found with eight records of smut fungi respectively. Similarly, each one of the following states viz. Kerela, Meghalaya, Punjab and Rajasthan showed occurrence of smut with seven records. While six records were found in New Delhi, five were from Odisha and four from Andhra Pradesh, Haryana and Manipur, respectively.

Outline of smut fungi reported from India

The 395 occurrences of smut fungi were attributed to five families in the order *Ustilaginales*, comprising 18 genera and 159 species. More than 189 host plants belonging to eight plant families are reported to be infected by smut fungi. Among all the families, *Poaceae* showed highest 130 records of these fungi on 160 plant hosts which contains ten genera and 130 species. Similarly, totally ten records of smut fungi with three genera and ten species were recorded on 19 host plants in the family *Cyperaceae*. The fungal records on other host families were reported as; *Alismataceae* (genus=1, species=1, host=1, total records=1);

Eriocaulaceae (genus=1, species=1, host=1, total records=1); *Euphorbiaceae* (genus=2, species=2, host=2, total records=2); *Lauraceae* (genus=1, species=1, host=1, total records=1); *Malvaceae* (genus=1, species=3, host=4, total records=3) and *Polygonaceae* (genus=2, species=2, host=2, total records=2).

Ustilago was reported with highest number of species (48) from India, which accounts for 30.38 %, followed by *Sporisorium* (43) and *Anthracocystis* (26) represented 27.26 % and 16.45 %, respectively of the total number of species recorded. Other genera namely; *Melanotaenium* (10); *Macalpinomyces* (7); *Cintractia* (5); *Tolyposporium* (4); *Farysia* (3); *Pericladium* (3); *Melanopsichium* (2); *Ahmadiago* (1); *Bambusiomyces* (1); *Clinoconidium* (1); *Eriocaulago* (1); *Franzpetrakia* (1); *Moesziomyces* (1); *Stollia* (1) and *Tranzscheliella* (1) were recorded with number of species equal to or less than ten. All the 159 species were positioned under five families namely as: *Ustilaginaceae* with highest 12 genera and 133 species followed by *Anthracoideaceae* (3 genera and 12 species); *Melanotaeniaceae* (1 genus and 10 species); *Pericladiaceae* with one genus and three species and *Cryptobasidiaceae* with one genus and one species. The information presented in the outline is arranged as phylum followed by subphylum, class, order, family, genus and species.

Taxonomy

Basidiomycota R.T. Moore
Ustilaginomycotina Doweld (2001)
Ustilaginomycetes R. Bauer, Oberw. & Vánky (1997)
Ustilaginales G. Winter (1880)

1. ***Anthracoideaceae*** Denchev, Mycotaxon 65: 413 (1997)
Cintractia Cornu, Annls Sci. Nat., Bot., sér. 6 15: 279 (1883)
C. amazonica Syd. & P. Syd., Annls mycol. 14(1/2): 73 (1916)
C. axicola (Berk.) Cornu, Annls Sci. Nat., Bot., sér. 6 15: 279 (1883)
C. clintonii Cif., Annls mycol. 26(1/2): 30 (1928)
C. leioderma (Lagerh.) Cif., Annls mycol. 29(1/2): 72 (1931)
C. limitata G.P. Clinton, Proc. Boston Soc. nat. Hist. 31(9): 399 (1904)
Farysia Racib., Bull. int. Acad. Sci. Lett. Cracovie, Cl. sci. math. nat. Sér. B, sci. nat. 3: 354 (1909)
F. americana Cif., Annls mycol. 29(1/2): 73 (1931)
F. butleri (Syd. & P. Syd.) Syd. & P. Syd., Annls mycol. 17(1): 42 (1919)
F. pseudocyperi (Sacc.) Zundel, Mycologia 23 (4): 297 (1931)
Tolyposporium Woronin, Abh. senckenb. naturforsch. Ges. 12: 577 (1882)
T. andropogonis Patel & N.B. Kulk., in Patle, Gokhala & Kulkarni, Indian Phytopath. 4: 65 (1951)
T. christensenii Ragunath, Mycopath. Mycol. appl. 34(120): 1968 (1968)
T. evernium Syd., Annls mycol. 37(4/5): 443 (1939)
T. globuligerum (Berk. & Broome) Ricker, J. Mycol. 11(3): 112 (1905)

2. ***Cryptobasidiaceae*** Malençon ex Donk, Reinwardtia 4: 114 (1956)
Clinoconidium Pat., Bull. Soc. mycol. Fr. 14: 156 (1898)
Clinoconidium lauracearum A. Singh, M.C. Nautiyal, A.K. Gautam, P.N. Singh & S.K. Singh, Phytotaxa 450 (1): 073 (2020)

3. ***Melanotaeniaceae*** Begerow, R. Bauer & Oberw., Can. J. Bot. 75(12): 2053 (1998) [1997]
Melanotaenium de Bary, Bot. Ztg. 32(7): 105 (1874)
M. apludae Thirum. & M.C. Sriniv., in Srinivasan & Thirumalachar, Sydowia 17(1-6): 21 (1964)
M. arundinellae M.S. Patil, Indian Phytopath. 45(2): 179 (1992)
M. dimeriae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 841 (2004)
M. echinochloae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)
M. eragrostidis A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 842 (2004)
M. euphorbiae (L.W. Lenz) M.D. Whitehead & Thirum., Bull. Torrey bot. Club 80(6): 499 (1953)
M. metzii A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 842 (2004)
M. spermacoces Thirum., Patel, G.W. Dhande & V.V. Bhatt, Indian Phytopath. 9(1): 10 (1956)
M. tuberculatae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)
M. urochloae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)

4. ***Pericladiaceae*** Vánky, Mycol. Balcanica 8(2): 151 (2011)
Pericladium Pass., Nuovo G. bot. ital. 7(2): 185 (1875)
P. flavesci Prasad & Tyagi, J. Indian bot. Soc. 40(4): 498 (1961)
P. grewiae Pass., Nuovo G. bot. ital. 7(2): 185 (1875)
P. tiliacearum Mundk. & Thirum., in Thirumalachar, Lloydia 13: 176 (1950)

5. ***Ustilaginaceae*** Tul. & C. Tul. [as 'Ustilagineae'], Annls Sci. Nat., Bot., sér. 3 7: 14 (1847)
Anthracocystis Bref., Unters. Gesammtgeb. Mykol. (Liepzig) 15: 53 (1912)
A. andropogonis-aciculati (Petch) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)
A. andropogonis-finitimi (Maubl.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)
A. apludae (Mishra) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)
A. apludae-aristatae (B.V. Patil & Thirum.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. apludae-muticae (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. azmatii (Mundk.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. caledonica (Pat.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. chrysopogonicola (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. chrysopogonis-fulvi (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)
A. cryptica (Cooke & Massee) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 121 (2012)

A. dichanthii (Vánky & N.D. Sharma) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 122 (2012)
A. ehrenbergii (J.G. Kühn) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 121 (2012)
A. eulaliae (L. Ling) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 122 (2012)
A. glutinosa (Zundel) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)
A. heteropogonicola (Mundk. & Thirum.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)
A. ischaemiana (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)
A. leersiae (Mishra) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 124 (2012)
A. lophopogonis (Thirum. & Pavgi) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 124 (2012)
A. ovaria (Griffiths) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 125 (2012)
A. penniseti (Rabenh.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)
A. pseudanthistiriae (Syd., P. Syd. & E.J. Butler) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)
A. rubyana (Vánky) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)
A. sehimatis (M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)
A. spermoidea (Berk. & Broome) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)
A. sulcati (M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)
A. themedae-cymbariae (Vánky) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)

Ahmadiago Vánky, Mycotaxon 89(1): 102 (2004)
A. euphorbiae (Mundk.) Vánky, Mycotaxon 89(1): 103 (2004)

Bambusiomyces Vánky, Mycol. Balcanica 8(2): 141 (2011)
B. shiraianus (Henn.) Vánky, Mycol. Balcanica 8(2): 142 (2011)

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E. jagdishwari (Mishra) Vánky, Mycol. Balcanica 2(2): 114 (2005)

Franzpetrakia Thirum. & Pavgi, Beih. Sydowia 1: 2 (1957) [1956]
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M. chrysopogonicola (Mundk. & Thirum.) Vánky, Mycotaxon 78: 320 (2001)
M. chrysopogonis (S. Ahmad) Vánky, Mycotaxon 62: 129 (1997)
M. effusus (Syd. & P. Syd.) Vánky, Mycotaxon 62: 129 (1997)
M. neglectus (Niessl) Vánky, Mycotaxon 89(1): 106 (2004)
M. patilorum Vánky & A.R. Patil, in Vánky, Mycotaxon 99: 47 (2007)
M. sharmae Vánky, Mycotaxon 54: 223 (1995)
M. tripogonis (M.S. Patil) Vánky, Mycotaxon 59: 119 (1996)

Melanopsichium Beck, Annln K. K. naturh. Hofmus. Wien 9: 122 (1894)

M. eleusines (Kulk.) Mundk. & Thirum., Mycol. Pap. 16: 1 (1946)
M. pennsylvanicum Hirschh., Not. Mus. La Plata, Bot. 6(no. 32): 149 (1941)

Moesziomyces Vánky, Bot. Notiser 130(2): 133 (1977)
M. bullatus (J. Schröt.) Vánky, Bot. Notiser 130(2): 133 (1977)

Sporisorium Ehrenb. ex Link, in Willdenow, Sp. pl., Edn 4 6(2): 86 (1825)
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S. andropogonis-annulati (Bref.) S.R. Wang & M. Piepenbr., Mycol. Progr. 1(4): 403 (2002)
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S. eragrostidis-viscosae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 782 (2004)
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U. amphilophidis Zundel, Mycologia 36(4): 400 (1944)
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U. trichophora (Link) Kunze, Flora, Regensburg 13: 369 (1830)
U. tritici (Bjerk.) Rostr., Overs. K. danske Vidensk. Selsk. Forh.: 15 (1890)
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Records of smut fungi

The number of publications in any group of fungi is an important factor to assess their research status in a country. Simultaneously, presentation of research publication indices can throw additional light on it. The year, decade and era wise indices of publications on Indian smut fungi are presented here in this section of the paper. We have presented the publication indices on smut fungi of India from the very beginning of 20th centuary. We have found only one research paper published during first decade (1901-1910) of 20th century, while two in second (1911-1920) and third (1921-1930) each. This number increased subsequently to four (1931-1940), eight (1941-1950), 26 (1951-1960) and 14 (1961-1970). The number of research publication then reduced to six (1971-1980), five (1981-1990) and eight (1991-2000). Totally 75 research papers were published during 20th century of which, ten research papers were published in pre-independence era, while nearly 82 in post-independence period. Of total 20 research papers published during current century, 15 have been published in first decade. In comparison to previous century, the reseach publications are comparatively high in current time because of advancement of research techniques and infrastructural facilities. The information on publication indicies on Indian smut fungi presented here is solely based on research published on record, new species or genera. No other aspects are covered in this compilation.

Checklist of diversity and distribution of smut fungi in India

The compilation of all the smut fungi recorded so far from India resulted in 395 records attributed to 5 families in the order *Ustilaginales*, comprising 18 genera and 159 species.

More than 189 host plants belonging to eight plant families are being reported as infected by smut fungi. Among all the families, highest records of these fungi were observed in *Poaceae*. Total 130 records of these fungi on 160 host plants which contains 10 genera and 130 species were reported in this family. Similarly, total records 10 of smut fungi with 3 genera and 10 species were reported on 19 host plants in the family *Cyperaceae*. The fungal records on other host families were reported as; *Alismataceae* (genus=1, species=1, host=1, total records=1); *Eriocaulaceae* (genus=1, species=1, host=1, total records=1); *Euphorbiaceae* (genus=2, species=2, host=2, total records=2); *Lauraceae* (genus=1, species=1, host=1, total records=1); *Malvaceae* (genus=1, species=3, host=4, total records=3) and *Polygonaceae* (genus=2, species=2, host=2, total records=2). Among all the eighteen smut genera reported from India, the highest number species were belonging to *Ustilago*, followed by *Sporisorium* and *Anthracocystis*. The other genera of smut fungi reported are *Ahmadiago, Bambusiomyces, Cintractia, Clinoconidium, Eriocaulago, Farysia, Franzpetrakia, Macalpinomyces, Melanopsichium, Melanotaenium, Moesziomyces, Pericladium, Stollia, Tolyposporium* and *Tranzscheliella*. The detailed data of Indian smut fungi like order, family, genus, species, host, locality and reference is presented in the Table 1. In a few cases, all the locations where occurrence of fungi is found, are included. In addition, all the references related to records of smut fungi in India are added and presented, whereever possible.

Table 1. Smut fungi recorded in India.

Phylum: ***Basidiomycota*** **R.T. Moore**

Sub Phylum: ***Ustilaginomycotina*** Doweld (2001)
Class: ***Ustilaginomycetes*** R. Bauer, Oberw. & Vánky (1997)
Order: ***Ustilaginales*** G. Winter (1880)

Genus/ Species	Host (Family)	Locality	Reference
Ahmadiago euphorbiae (Mundk.) Vánky, Mycotaxon 89(1): 103 (2004)	*Euphorbia dracunculoides* (*Euphorbiaceae*)	Rotang Pass, Kullu (Himachal Pradesh)	Mundkur 1940, Vánky 2004a
Anthracocystis andropogonis-aciculati (Petch) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)	In the inflorescence of *Chrysopogon aciculatus(*Retz.) Trin. (*Poaceae*)	Sawantwadi (Maharashtra)	Patil et al. 2004b
A. andropogonis-finitimi (Maubl.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)	Ovaries of *Cymbopogon flexuosus* (*Poaceae*)	Nandi Hills (Karnataka)	Mundkur and Thirumalachar 1952, McTaggart et al. 2012
A. apludae (Mishra) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 119 (2012)	In spikelets of *Apluda varia* (*Poaceae*)	Bihar	Mishra, J.N. 1956, McTaggart et al. 2012
A. apludae-aristatae (B.V.	On spikes of *Apluda*	Maharashtra	Patil and

Patil & Thirum.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	*aristata* (*Poaceae*)		Thirumalachar 1966, McTaggart et al. 2012
A. apludae-muticae (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	In spikelets of *Apluda mutica* (*Poaceae*)	Maharashtra	Patil and Thirumalachar 1966, McTaggart et al. 2012
A. azmatii (Mundk.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	*Chrysopogon Caeruleus* (*Poaceae*)	Bilikere, Mysore (Karnataka)	Mundkur 1939, McTaggart et al. 2012
A. caledonica (Pat.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	*Heteropogon contortus* (*Poaceae*)	Uttar Pradesh, Tehri, Garwal Himalaya Mt (Uttarakhand)	McTaggart et al. 2012
A. chrysopogonicola (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	In inflorescence of *Chrysopogon fulvus* (*Poaceae*)	Maharashtra	Patil et al. 2004a, McTaggart et al. 2012
A. chrysopogonis-fulvi (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 120 (2012)	In ovaries of *Chrysopogon fulvus* (*Poaceae*)	Maharashtra	Patil et al. 2004a, McTaggart et al. 2012
A. cryptica (Cooke & Massee) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 121 (2012)	In the ovaries of *Eulalia trispicata* (Schult.) Henrad (*Poaceae*)	Panhala (Distt: Kolhapur (Maharashtra)	Patil et al. 2004b
A. dichanthii (Vánky & N.D. Sharma) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 122 (2012)	In all spikelets of inflorescence of *Dichanthium aristatum* (*Poaceae*)	Jabalpur (Madhya Pradesh)	Vánky 2004b, McTaggart et al. 2012

A. ehrenbergii (J.G. Kühn) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 121 (2012)	In the ovaries of *Sorghum deccanense* Stapf. ex Bor. (*Poaceae*)	Gokul Shirgaon, Kolhapur (Maharashtra)	Patil et al. 2004b
A. eulaliae (L. Ling) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 122 (2012)	In the ovaries of *Eulalia trispicata* (Schult.) Henrad (*Poaceae*)	Panhala. Kolhapur (Maharashtra)	Patil et al. 2004b
A. glutinosa (Zundel) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)	On *Andropogon triticeus* (*Poaceae*)	Poona (Maharashtra)	Patel et al. 1951, McTaggart et al. 2012
A. heteropogonicola (Mundk. & Thirum.) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)	On *Heteropogon contortus* and *Cymbopogon caesium* (*Poaceae*)	Nandi Hills (Karnataka); Bihar	Thirumalachar and Mundkur, 1951, Thirumalachar and Pavgi 1966, McTaggart et al. 2012, Mundkur and Thirumalachar 1952
A. ischaemiana (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 123 (2012)	In inflorescence of *Ischaemum* sp. (*Poaceae*)	Karnataka	Patil et al. 2004a, McTaggart et al. 2012
A. leersiae (Mishra) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 124 (2012)	In inflorescence of *Leersia hexandra* (*Poaceae*)	Bihar	Mishra, 1956b, McTaggart et al. 2012
A. lophopogonis (Thirum. & Pavgi) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 124 (2012)	In inflorescence of *Lophopogon tridentatus* (*Poaceae*)	Maharashtra	Thirumalachar and Pavgi 1966, McTaggart et al. 2012
A. ovaria (Griffiths) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 125 (2012)	On ovaries of *Brachiaria ramosa* (*Poaceae*)	Pollachi (Tamil Nadu)	Ramakrishanan 1952, McTaggart et al. 2012
A. penniseti (Rabenh.) McTaggart & R.G. Shivas, in	*Cenchrus ciliaris* (*Poaceae*)	Institute of Forest Genetics & Tree	Fide McTaggart et al. 2012

McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)		Breeding, Guest House, Coimbatore (Tamil Nadu)	
A. pseudanthistiriae (Syd., P. Syd. & E.J. Butler) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)	*Pseudanthistiria hispida* (*Poaceae*)	Shivaji University, Kolhapur (Maharashtra)	Fide McTaggart et al. 2012
A. rubyana (Vánky) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 126 (2012)	*Capillipedium assimile* (*Poaceae*)	Jabalpur (Madhya Pradesh)	Fide McTaggart et al. 2012
A. sehimatis (M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)	In ovary of *Sehima nervosus* (*Poaceae*)	Maharashtra	Patil and Sawant 1991, McTaggart et al. 2012, Patil et al. 2004b
A. spermoidea (Berk. & Broome) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)	*Cymbopogon martinii* (*Poaceae*)	Madurai (Tamil Nadu)	Fide McTaggart et al. 2012
A. sulcati (M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)	In inflorescence of *Sehima sulcatum* (*Poaceae*)	Maharashtra	Patil and Sawant 1991, McTaggart et al. 2012
A. themedae-cymbariae (Vánky) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 127 (2012)	*Themeda cymbaria* (*Poaceae*)	Bandipur, Mysore (Karnataka)	McTaggart et al. 2012
Bambusiomyces shiraianus (Henn.) Vánky, Mycol. Balcanica 8(2): 142 (2011)	Stem of *Bambusa* spand *Arundinaria wightiana*. (*Poaceae*)	Dehradun, (Uttarakhand); Gorakpur, (Uttar Pradesh); Poona (Maharashtra); Ootacamund (Tamil Nadu)	Mundkur and Thirumalachar 1952, Ramakrishnan and Ramakrishnan 1948, Vánky 2011
Cintractia amazonica Syd. & P. Syd., Annls mycol. 14(1/2): 73 (1916)	In the inflorescence of *Rhynchospora Wallichiana* Kunth. (*Cyperaceae*)	Sawantwadi (Maharashtra)	Patil et al. 2004b

C. axicola (Berk.) Cornu, Annls Sci. Nat., Bot., sér. 6 15: 279 (1883)	On the culms and spikelets of *Cyperus scariossus* L., (*Cyperaceae*), On the culms and spikelets and Inflorescence of *Fimbristylis dichotoma*, *F. quinqueangularis, F. annua,* and *F. dichotoma* (*Cyperaceae*)	Coochbehar (West Bengal); Guwahati (Assam); Yelwal (Karnataka); Wynaad (Kerala)	Bag and Agarwal 2001, Mundkur and Thirumalachar 1952
C. clintonii Cif., Annls mycol. 26(1/2): 30 (1928)	Ovaries of *Fimbristylis dihylla var. annua* (*Cyperaceae*)	Banaras (Uttar Pradesh)	Pavgi and Thirumalachar 1953
C. leioderma (Lagerh.) Cif., Annls mycol. 29(1/2): 72 (1931)	Ovaries of *Carex incurve* (*Cyperaceae*)	Babeh Pass (Himachal Pradesh); Punjab	Mundkur and Thirumalachar 1952, Pavgi and Mundkur 1948
C. limitata G.P. Clinton, Proc. Boston Soc. nat. Hist. 31(9): 399 (1904)	*Cyperus pangorei, C rotundus, C. compressus* and *C. pangorei* (*Cyperaceae*)	Lucknow, Varanasi (Uttar Pradesh); Yellareddy, Hydrabad (Andhra Pradesh); Bangalore, Hebbel (Karnataka); Bihar; West Bengal; Madras (Tamil Nadu); Bombay (Maharashtra); Idhikhi (Kerala)	Wadhwani and Mehrotra 1982, Mundkur and Thirumalachar 1952, Hosagoudar 1985, Bag and Agarwal 2001
Clinoconidium lauracearum A. Singh, M.C. Nautiyal, A.K. Gautam, P.N. Singh & S.K. Singh, Phytotaxa 450 (1): 073 (2020)	On living fruits of *Cinnamomum tamala* (*Lauraceae*)	Paunthi of district Rudraprayag (Uttarakhand)	Singh et al. 2020
Eriocaulago jagdishwari (Mishra) Vánky, Mycol. Balcanica 2(2): 114 (2005)	In ovules of *Eriocaulon* (*Eriocaulaceae*)	Dumka (Bihar)	Vánky 2005a, Mishra 1956a
Farysia americana Cif., Annls mycol. 29(1/2): 73 *(1931)*	Ovaries of *Carex baccans* and *C. filicina* (*Cyperaceae*)	Kodaikanal (Tamil Nadu); Kemmangundi (Karnatka)	Mundkur and Thirumalachar 1952
F. butleri (Syd. & P. Syd.) Syd. & P. Syd., Annls mycol. 17(1): 42 (1919)	Ovaries of *Scleria alata* and *Scleria* sp. (*Cyperaceae*)	Thurya, Assam; Cherrapunji & Syndai, Meghalaya	Mundkur and Thirumalachar 1952
F. pseudocyperi (Sacc.) Zundel, Mycologia 23 (4): 297 (1931*)*	Ovaries of *Carex condensate* (*Cyperaceae*),	Khasi hills (Assam)	Mundkur and Thirumalachar 1952
Franzpetrakia microstegii Thirum. & Pavgi [as 'microstegiae'], Beih.	In inflorescence of *Microstegium* sp. (*Poaceae*)	Mussoorie (Uttarakhand)	Pavgi and Thirumalachar 1957

Sydowia 1: 2 (1957) [1956]

Macalpinomyces chrysopogonicola (Mundk. & Thirum.) Vánky, Mycotaxon 78: 320 (2001)	On *Chrysopogon aciculatus* and *Chrysopogon* sp. (*Poaceae*)	Uttarhalii (Karnataka); Varanasi (Uttar Pradeh)	Thirumalachar and Mundkur, 1951, Mundkur and Thirumalachar 1952, Sydow et al. 1912, Vánky 2001
M. chrysopogonis (S. Ahmad) Vánky, Mycotaxon 62: 129 (1997)	On *Chrysopogon fulvus* (*Poaceae*)	Dharwar (Karnataka)	Kulkarni 1971, Vánky 1997
M. effusus (Syd. & P. Syd.) Vánky, Mycotaxon 62: 129 (1997)	Culm and leaves of *Chrysopogon aciculatus* and *Arundinella wallichii* (*Poaceae*)	Cherrapunji (Meghalaya); Wahjain (Assam)	Mundkur and Thirumalachar 1952, Pavgi and Mundkur 1948, Vánky 1997
M. neglectus (Niessl) Vánky, Mycotaxon 89(1): 106 (2004)	Ovaries of *Setaria glauca* (*Poaceae*)	Armoli & Chikalda Plateau (Madhya Pradesh); Bellary, Mysore Karnataka); Chaubatia (Uttar Pradesh)	Mundkur and Thirumalachar 1952, Payak 1949, Vánky 2004a
M. patilorum Vánky & A.R. Patil, in Vánky, Mycotaxon 99: 47 (2007)	In ovaries of *Digitaria ternata* (*Poaceae*)	Maharashtra	Patil et al. 2004a, Vánky 2007a
M. sharmae Vánky, Mycotaxon 54: 223 (1995)	On *Panicum sumatrense* (*Poaceae*)	Madhya Pradesh	Vánky 1995, Sharma and Khare 1987
M. tripogonis (M.S. Patil) Vánky, Mycotaxon 59: 119 (1996)	In ovary of *Tripogon bromoides* (*Poaceae*)	Maharashtra	Patil and Sawant 1991, Vánky 1996
Melanopsichium eleusines (Kulk.) Mundk. & Thirum., Mycol. Pap. 16: 1 (1946)	Ovaries of *Eleusine coracana* (*Poaceae*)	Malakapur, Kohlapur (Maharashtra); Hebbal (Karnataka)	Mundkur and Thirumalachar, 1946; Patro and Rani 2008; Mundkur and Thirumalachar 1946, 1952
M. pennsylvanicum Hirschh., Not. Mus. La Plata, Bot. 6(no. 32): 149 (1941)	In inflorescence and leaves, pedicel of *Polygonum glabrum* (*Polygonaceae*)	Pusa (Bihar); Bangalore and Ramgiri (Karnataka); Khandala, Poona (Maharashtra)	Mundkur and Thirumalachar 1946, Mundkur and Thirumalachar 1952, Thirumalachar and Pavgi 1966, Patil 1962
Melanotaenium apludae Thirum. & M.C. Sriniv., in Srinivasan & Thirumalachar, Sydowia 17(1-6): 21 (1964)	Leaves of *Apluda aristata* (*Poaceae*)	Yercaud (Tamil Nadu)	Srinivasan and Thirumalachar 1963

M. arundinellae M.S. Patil, Indian Phytopath. 45(2): 179 (1992)	Leaves of *Arundinella setosa* (*Poaceae*)	Maharashtra	Patil and Sawant 1991
M. dimeriae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 841 (2004)	On leaves of *Dimeria ornithopoda* (*Poaceae*)	Maharashtra	Patil et al. 2004a
M. echinochloae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)	Leaves of *Echinochloa* sp. (*Poaceae*)	Maharashtra	Patil and Sawant 1991
M. eragrostidis A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 842 (2004)	Leaf and leaf sheath of *Eragrostis pilosa* (*Poaceae*)	Maharashtra	Patil et al. 2004a
M. euphorbiae (L.W. Lenz) M.D. Whitehead & Thirum., Bull. Torrey bot. Club 80(6): 499 (1953)	Leaves branches and stem of *Euphorbia hypercifolia* (*Euphorbiaceae*)	Maharashtra (Kohlapur)	Kundalkar and Patil 1983
M. metzii A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 842 (2004)	Leaves of *Arundinella metzii* (*Poaceae*)	Maharashtra	Patil et al. 2004a
M. spermacoces Thirum., Patel, G.W. Dhande & V.V. Bhatt, Indian Phytopath. 9(1): 10 (1956)	Leaves of *Spermacoce hispida* (*Rubiaceae*)	Ambernath, Bombay (Maharashtra)	Thirumalachar et al. 1956
M. tuberculatae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)	Leaves of *Arundinella tuberculata* (*Poaceae*)	Maharashtra	Patil and Sawant 1991
M. urochloae M.S. Patil, Indian Phytopath. 45(2): 180 (1992)	Leaves of *Urochloa trichopus* (*Poaceae*)	Maharashtra	Patil & Sawant 1991
Moesziomyces bullatus (J. Schröt.) Vánky, Bot. Notiser 130(2): 133 (1977)	In the ovaries of *Panicum miliaceam* (*Polygonaceae*)	Coochbehar (West Bengal)	Bag and Agarwal 2001
Pericladium flavesci Prasad & Tyagi, J. Indian bot. Soc. 40(4): 498 (1961)	On twigs and stems of *Grewia flavescens* (*Malvaceae*)	Bagadra (Madhya Pradesh); Udaipur (Rajasthan)	Prasad and Tyagi 1961
P. grewiae Pass., Nuovo G.	On twigs and stems of	Ajmer (Rajasthan);	Joshi 1958, Patil and

bot. ital. 7(2): 185 (1875)	*Grewia orbiculata* (*Malvaceae*)	Malegaon Nasik (Maharashtra)	Thirumalachar 1966
P. tiliacearum Mundk. & Thirum., in Thirumalachar, Lloydia 13: 176 (1950)	On *Grewia rotundifolia* and *G. titiaefolia* (*Malvaceae*)	Channapatna, Mysore (Karnataka); Santaveri, Vandalur (Tamil Nadu)	Thirumalachar, 1950, Mundkur and Thirumalachar 1952
Sporisorium agropyri Bag & D.K. Agarwal, Indian Phytopath. 54(2): 219 (2001)	In inflorescence of *Agropyron strigosum* (*Poaceae*)	West Bengal	Bag and Agarwal 2001
S. andropogonis-annulati (Bref.) S.R. Wang & M. Piepenbr., Mycol. Progr. 1(4): 403 (2002)	Ovaries of *Andropogon annulatus* (*Poaceae*)	Khusmoda, (Maharashtra)	Jain et al. 1966, Wang and Piepenbring 2002
S. anthephoroidis A.R. Patil, T.M. Patil & M.S. Patil [as 'anthephoroidae'], Journal of Mycology and Plant Pathology 34(3): 778 (2004)	In ovaries of *Iseilema anthephoroides* (*Poaceae*)	Maharashtra	Patil el al. 2004a
S. arthraxonis (Pat.) L. Guo, Mycosystema 2: 221 (1989)	In ovaries of *Arthraxon lanceolatus* (*Poaceae*)	Maharashtra	Guo 1989
S. arthraxonis-lanceolati A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 779 (2004)	In ovaries of *Arthraxon lanceolatus* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. assamense Bag & D.K. Agarwal, Indian Phytopath. 54(2): 220 (2001)	In inflorescence of *Digitaria* sp. (*Poaceae*)	Assam	Bag and Agarwal 2001
S. assamicum (A.K. Roy) Vánky, Australas. Pl. Path. 29(3): 156 (2000)	On inflorescence of *Andropogon aciculatus* (*Poaceae*)	Assam	Roy 1964, Vánky 2000a
S. benguetense (Zundel) L. Guo, Mycosystema 3: 76 (1990)	In the inflorescence of *Themeda* sp. (*Poaceae*)	Amba, Distt. Kolhapur (Maharashtra)	Patil et al. 2004b
S. chrysopogonis-grylli (Thirum. & Pavgi) Vánky, Fungal Diversity 18: 181 (2005)	In inflorescence of *Chrysopogon gryllus* (*Poaceae*)	Jammu and Kashmir	Thirumalachar, and Pavgi 1966, Vánky 2005b
S. dichanthiicola (Mundk. & Thirum.) Vánky, Fungal Diversity 15: 229 (2004)	On *Dichanthium caricosum* (*Poaceae*)	Hebbal (Karnataka)	Thirumalachar and Mundkur 1951, Vánky 2004b, Mundkur and Thirumalachar 1952
S. dimeriae (B.V. Patil & Thirum.) Vánky, Mycotaxon	On ovaries of *Dimeria gracilis* (*Poaceae*)	Ramgarh, Ratnagiri, (Maharashtra)	Patil and Thirumalachar 1966,

48: 39 (1993)			Ványky 1993, Patil and Thirumalachar 1966
S. eragrostidis A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 782 (2004)	In ovaries of *Eragrostis japonica* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. eragrostidis-viscosae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 782 (2004)	In ovaries of *Eragrostis viscosa* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. exsertum (McAlpine) L. Guo, Mycosystema 3: 80 (1990)	In the inflorescence of *Themeda* sp. (*Poaceae*)	Pashan, Distt. Pune (Maharashtra)	Patil et al. 2004b
S. glyphochloae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 783 (2004)	In ovaries of *Glyphochloa santapaui* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. indicum (Syd., P. Syd. & E.J. Butler) Ványky, Mycotaxon 74(1): 184 (2000)	In panicles of *Ischaemum angustifolium* (*Poaceae*)	Punjab	Mundkur 1944a&b, Mundkur and Thirumalachar 1952, Sydow et al. 1912, Ványky 2000b
S. ischaemi-rugosi (Mishra) Ványky, Mycotaxon 89(1): 99 (2004)	In inflorescence of *Ischaemum rugosum* (*Poaceae*)	Bihar	Mishra 1956a, Ványky 2004a
S. konkanense A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 786 (2004)	In inflorescence of *Glyphochloa* sp. (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. lacrymae-jobi (Mundk.) Ványky, Mycotaxon 54: 234 (1995)	On *Coix lacryma-jobi* (*Poaceae*)	Junagadh (Gujarat)	Mundkur 1940, Mundkur and Thirumalachar 1952, Ványky 1995
S. leersiae Bag & D.K. Agarwal, Indian Phytopath. 54(2): 221 (2001)	In inflorescence of *Leersia hexandra* (*Poaceae*)	Assam	Bag and Agarwal 2001
S. lingii Ványky, Mycotaxon 51: 160 (1994)	In the inflorescence of *Themeda triandra* Forssk. (*Poaceae*)	Thoseghar (Distt. Satara (Maharashtra)	Patil et al. 2004b
S. mandlaicum Ványky & N.D. Sharma, Mycotaxon 106: 141	In racemes of *Sehima nervosum* (*Poaceae*)	Madhya Pradesh	Ványky 2008

(2009) [2008]			
S. martini Bag & D.K. Agarwal, Indian Phytopath. 54(2): 221 (2001)	In ovaries of *Cymbopogon martini* (*Poaceae*)	West Bengal	Bag and Agarwal 2001
S. mnesitheae (Mishra) Vánky, Mycotaxon 89(1): 107 (2004)	In ovaries of *Mnesithea laevis* (*Poaceae*)	Bihar	Mishra 1957, Vánky 2004a
S. monakai (Mishra) Vánky, Mycotaxon 54: 235 (1995)	In ovaries of *Isachne dispar* (*Poaceae*)	Bihar	Mishra 1956b, Vánky 1995
S. mysorense (Pavgi & Thirum.) Vánky, Mycotaxon 54: 230 (1995)	In ovaries of *Capillipedium hugelii* (*Poaceae*)	Karnataka	Thirumalachar and Pavgi 1952, Vánky 1995
S. oropetii A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 786 (2004)	In ovaries of *Oropetium roxburghianum* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. polytocae (Mundk.) Vánky, Mycotaxon 78: 286 (2001)	In ovaries of *Polytoca barbata* (*Poaceae*)	Karnataka	Mundkur 1939, Vánky 2001
S. polytocae-barbatae (Mundk.) Vánky, Mycotaxon 78: 286 (2001)	On *Polytoca barbata* (*Poaceae*)	Maharashtra	Mundkur 1940, Mundkur and Thirumalachar 1952, Vánky 2001
S. pseudanthistiriae-hispidae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 787 (2004)	In ovaries of *Pseudanthistiria hispida* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. punctatum (L. Ling) Vánky, Mycotaxon 51: 163 (1994)	In the inflorescence of *Themeda triandra* Forssk. (*Poaceae*)	Satara (Maharashtra)	Patil et al. 2004b
S. punensis A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 787 (2004)	In inflorescence of *Andropogon pumilus* (*Poaceae*)	Maharashtra	Patil et al. 2004a
S. sacciolepidis (Thirum.) Vánky, Mycotaxon 48: 41 (1993)	On *Sacciolepis indica* (*Poaceae*)	Mysore, Bhadravati (Karnataka)	Thirumalachar 1950 a&b, Vánky 1993
S. sahayae (Mundk.) Vánky [as 'sahayai'], Fungal Diversity 15: 237 (2004)	On *Andropogon annulatus*, In the inflorescence of *Dichanthium Annulatum* (Forssk.) Stapf. (*Poaceae*)	Odisha; Kolhapur (Maharashtra)	Mundkur 1939, Vánky 2004a, Patil et al. 2004b

S. scitamineum (Syd.) M. Piepenbr., M. Stoll & Oberw., Mycol. Progr. 1(1): 75 (2002)	On *Saccharum barberi, S. officinarum, S. spontaneum,* and *Andropgon* sp. (*Poaceae*)	Pratapgarh, (Uttar Pradesh); Amritsar (Punjab); Sipaya, Muzaffarpur & Pusa (Bihar); Hoshangabad, (Madhya Pradesh); Sambalapur (Orissa)	Mundkur 1940, Mundkur and Thirumalachar 1952
S. semisagittatum (Thirum. & Pavgi) Vánky, Mycotaxon 95: 60 (2006)	In ovaries of *Ischaemum semisagittatum* (*Poaceae*)	Khandala (Maharashtra)	Thirumalachar and Pavgi 1966, Vánky 2006
S. setariicola (Thirum. & Safeeulla) Bag & D.K. Agarwal, Indian Phytopath. 54(2): 224 (2001)	On *Setaria pallide-fusca* (*Poaceae*)	Coorg (Karnataka)	Bag and Agarwal 2001
S. spodiopogonis (M.S. Patil) Vánky, Mycotaxon 62: 139 (1997)	In ovary of *Spodiopogon rhizophorus* (*Poaceae*)	Maharashtra	Patil and Sawant 1991,Vánky 1997
S. taianum (Syd.) L. Guo, Mycosystema 3: 85 (1990)	In inflorescence of *Sorghum nitidum* (Vahl.) Pers. (*Poaceae*)	Agri. College Campus, Kolhapur (Maharashtra)	Patil et al. 2004b
S. tanglinense (Tracy & Earle) L. Guo, Mycosystema 3: 85 (1990)	In inflorescence of *Triplopogon ramosissimum* (Hackel) Bor. (*Poaceae*)	S.U.C., Kolhapur (Maharashtra)	Patil et al. 2004b
S. themedae-triandrae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and Plant Pathology 34(3): 788 (2004)	In ovaries of *Themeda triandra* (*Poaceae*)	Maharashtra	Patil et al. 2004a, b
S. tripogonis Gandhe, N.D. Sharma & Vánky, Mycotaxon 48: 34 (1993)	On *Tripogon jacquemontii* (*Poaceae*)	Madhya Pradesh	Vánky 1993
S. wynaadense (Sundaram) Vánky & R.G. Shivas, Mycotaxon 80: 346 (2001)	In ovaries of *Sorghum nitidum* (*Poaceae*)	Kerala	Sundaram 1964, Vánky and Shivas 2001
Stollia pseudanthistiriae (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, in McTaggart, Shivas, Geering, Vánky & Scharaschkin, Persoonia 29: 129 (2012)	Ovaries of *Pseudanthistiria hispida* (*Poaceae*)	Maharashtra	McTaggart et al. 2012
Tolyposporium andropogonis Patel & N.B. Kulk., in Patle, Gokhala & Kulkarni, Indian	On *Andropogon triticeus* (*Poaceae*)	Poona (Maharashtra)	Patel et al. 1951

Phytopath. 4: 65 (1951)			
T. christensenii Ragunath, Mycopath. Mycol. appl. 34(120): 1968 (1968)	On inflorescence of *Cymbopogon flexuosus* (*Poaceae*)	Aruvikkara (Kerala)	Ragunath 1968
T. evernium Syd., Annls mycol. 37(4/5): 443 (1939)	Ovaries of *P. distichum* and *Paspalum* sp. (*Poaceae*)	New Delhi; Jabalpur (Madhya Pradesh)	Chona et al. 1958, Mishra et al. 1976
T. globuligerum (Berk. & Broome) Ricker, J. Mycol. 11(3): 112 (1905)	Ovaries of *Leersia hexandra* (*Poaceae*)	Assam	Mundkur 1940, Mundkur and Thirumalachar 1952
Tranzscheliella hypodytes (Schltdl.) Vánky & McKenzie, Fungal Diversity Res. Ser. 8: 156 (2002)	Culm of *Leymus secalinus* and *Oryzopsis lateralis* (*Poaceae*)	Leh (Jammu & Kashmir); Losar, Lahul Spiti (Himachal Pradesh)	Vikas et al. 2020, Mundkur and Thirumalachar 1952, Sydow 1938
Ustilago amphilophidis Zundel, Mycologia 36(4): 400 (1944)	Ovaries of *Bothriochloa ischaemum* (*Poaceae*)	Pathankot (Punjab)	Mundkur and Thirumalachar 1952
U. andropogonis-tuberculati Bref., Unters. Gesammtgeb. Mykol. (Liepzig) 12: 108 (1895)	Ovaries of *Andropogon tuberculatus* (*Poaceae*)		Mundkur and Thirumalachar 1952.
U. avenae (Pers.) Rostr., Overs. K. danske Vidensk. Selsk. Forh.: 13 (1890)	Ovaries and leaves of *Avena* spp. (*Poaceae*)	Several Parts of India	Mundkur and Thirumalachar 1952, Prasad and Sinha 1962, Butler and Bisby 1931, Payak 1949
U. bullata Berk., in Hooker, Bot. Antarct. Voy. Erebus Terror 1839-1843, II, Fl. Nov.-Zeal.: 196 (1855)	Ovaries of *Bromus catharticus* (*Poaceae*)	New Delhi; Shimla (Himachal Pradesh)	Ling 1953, Chona and Munjal 1956
U. calamagrostidis (Fuckel) G.P. Clinton, J. Mycol. 8(3): 138 (1902)	Leaves and culms of *Calamagrostis emodensis* (*Poaceae*)	Ramgarh (Uttar Pradesh)	Mundkur and Thirumalachar 1952.
U. caricis-wallichianae Thirum. & Pavgi, Sydowia 7(1-4): 98 (1953)	On *Carex wallichiana* (*Cyperaceae*)	Ramgarh (Uttar Pradesh)	Thirumalachar, and Pavgi 1953
U. caricis-wallichianae Thirum. & Pavgi, Sydowia 7(1-4): 98 (1953)	On *Carex wallichiana* (*Cyperaceae*)	Ramgarh (Uttar Pradesh)	Thirumalachar and Pavgi 1953
U. coelachyrae A.R. Patil, T.M. Patil & M.S. Patil, Journal of Mycology and	In ovaries of *Coelachyrum lagopoides* (*Poaceae*)	Tamil Nadu	Patil et. al. 2004a

Plant Pathology 34(3): 842 (2004)			
U. coicis Bref., Unters. Gesammtgeb. Mykol. (Liepzig) 12: 110 (1895)	Ovaries of *Coix lachrymal-jobi* (*Poaceae*)	Shillong (Meghalaya); Sindewahi (Madhya Pradesh)	Mundkur and Thirumalachar 1952.
U. consimilis Syd., Annls mycol. 22(3/6): 281 (1924)	On Inflorescence & culms of *Saccharum fuscum*, *S. spontaneum* and Inflorescence of *Narenga porphyrochroma* (*Poaceae*)	Sibsagar (Assam); Imphal (Manipur)	Mundkur 1940, Mundkur and Thirumalachar 1952, Singh et al. 1978
U. courtoisii Cif., Annls mycol. 29(1/2): 71 (1931)	In ovaries of *Saccharum arundinaceum* (*Poaceae*)	Tiruvadi, Madras (Tamil Nadu)	Mundkur1944a&b, Mundkur and Thirumalachar 1952
U. crameri Körn., in Fuckel, Jb. nassau. Ver. Naturk. 27-28: 11 (1874) [1873-74]	Ovaries of *Setaria italic* (*Poaceae*)	Manjari, Bombay (Maharashtra); Madras (Tamil Nadu); Mysore (Karnataka); Jabalpur (Madhya Pradesh)	Mundkur and Thirumalachar 1952, Nema and Agarwal 1960
U. crus-galli Tracy & Earle, Bull. Torrey bot. Club 22: 175 (1895)	Inflorescence and ovaries of *Echinochloa frumentacea* and *E. colona* (*Poaceae*)	Pusa (Bihar); Assam	Ling 1951, Chowdhary 1957, Mishra et al. 1976, Mundkur and Thirumalachar 1952
U. cynodontis (Pass.) Henn., Bull. Herb. Boissier 1: 114 (1893)	Inflorescence of *Cynodon dactylon* (*Poaceae*)	Throughout India	Mundkur and Thirumalachar 1952, Butler and Bisby 1931, Payak 1949, Prasad and Sinha 1962, Jain et al. 1966, Hardev 1965
U. dactylocteniophila Henn., Hedwigia 38(Beibl.): (66) (1899)	In the florets of *Dactyloctenium aegyptiacum* (L.) Beauv. (*Poaceae*)	Kolhapur (Maharashtra)	Patil et al. 2004b
U. darjeelingensis Bag & D.K. Agarwal, Indian Phytopath. 54(2): 223 (2001)	In ovaries of *Setaria* sp. (*Poaceae*)	West Bengal	Bag and Agarwal 2001
U. deserticola Speg., Anal. Mus. nac. Hist. nat. B. Aires 6: 209 (1898) [1899]	On *Chloris villosa* (*Poaceae*)	Surat (Gujrat)	Mundkur 1938
U. egenula Syd., P. Syd. & E.J. Butler, Annls mycol. 10(3): 251 (1912)	In ovaries of *Eragrostis nutans* (*Poaceae*)	Pusa (Bihar)	Mundkur and Thirumalachar 1952.
U. flagellata Syd. & P. Syd., Annls mycol. 9(2): 144	In ovaries of *Rottboellia exaltata* and *R. compressa* (*Poaceae*)	Annamalai (Tamil Nadu); Yeshwantpur (Karnataka)	Mundkur and Thirumalachar 1952.

(1911)			
U. glabra (A.R. Patil, T.M. Patil & M.S. Patil) Vánky & A.R. Patil, in Vánky, Mycotaxon 99: 49 (2007)	In ovaries of *Echinochloa crus-galli* (*Poaceae*)	Karnataka	Patil et al. 2004a, Vánky 2007a
U. hitchcockiana Zundel, Mycologia 29(5): 585 (1937)	On *Cynodon dactylon* (*Poaceae*)	Mysore (Karnataka); Srinagar (Jammu and Kashmir)	Barnabas et al. 2015, Khan et al. 2019
U. hordei (Pers.) Lagerh., Mitt. bad. bot. Ver.(59): 70 (1889)	Spike of *Avena sativa* and *Hordeum vulgare* (*Poaceae*)	All India	Mundkur and Thirumalachar 1952, Prasad and Sinha 1962, Payak 1949, Mitter and Tandon 1930 a&b, Goyal et al. 1971, Sharma 1965
U. idonea Syd., Annls mycol. 37(4/5): 442 (1939)	Inflorescence of *Dactyloctenium cylindrica* (*Poaceae*)	Rohtak (Haryana)	Ling 1950, Mundkur and Thirumalachar 1952.
U. imperatae Mundk., Indian Journal of Agricultural Research 14: 49 (1944)	On *Imperata cylindrica* (*Poaceae*)	Naga Hills (Assam)	Mundkur and Thirumalachar 1952, Mitter and Tandon 1930 a&b
U. kyllingae B.V. Patil & Thirum., Sydowia 20: 47 (1968) [1966]	On inflorescence of *Kyllinga triceps* (*Cyperaceae*)	Maharashtra	Patil and Thirumalachar 1968
U. longiflora Mundk. & Thirum., Mycol. Pap. 40: 2 (1951)	*On Digitaria longiflora* (*Poaceae*)	Bangalore (Karnataka)	Thirumalachar and Mundkur 1951
U. maydis (DC.) Corda, Icon. fung. (Prague) 5: 3 (1842)	*Zea mays* (*Poaceae*)	Kashmir Valley (Jammu and Kashmir)	Kaul 1957
U. microchloae Syd., P. Syd. & E.J. Butler, Annls mycol. 4(5): 427 (1906)	In flowers of *Microchloa setacea* (*Poaceae*)	Mysore (Karnataka); Angul (Orissa)	Mundkur and Thirumalachar 1952, Pavgi and Mundkur 1948
U. neyraudiae Mundk., Trans. Br. mycol. Soc. 24(3): 323 (1941) [1940]	On *Neyraudia arundinacea* (*Poaceae*)	Dehradun (Uttarakhand)	Mundkur 1940, Mundkur and Thirumalachar 1952, Mundkur 1940
U. nuda (C.N. Jensen) Kellerm. & Swingle, Ann. Rep. Kansas Agric. Exp. Stn 2: 22 (1890)	Spikelet of *Hordeum vulgare,* earhead of *Triticum sativum* and *T. vulgare* (*Poaceae*)	Varanasi (Uttar Pradesh); Muzaffarpur (Bihar); Kashmir (Jammu and Kashmir); Jobner (Rajasthan)	Mundkur and Thirumalachar 1952, Payak 1949, Prasad and Sinha 1962, Pandotra 1966, Goyal et al. 1971
Ustilago operta Syd., P. Syd. & E.J. Butler, Annls mycol. 4(5): 426 (1906)	In ovaries of *Panicum villosum, Brachiaria semiundulata* and *Penicum Javanicum*	Ootacamund (Tamil Nadu); Tukwar, Darjeeling (West Bengal); Allahabad	Mundkur and Thirumalachar 1952, Sydow and Butler 1901

	(*Poaceae*)	(Uttar Pradesh)	
U. ornata Tracy & Earle, Bull. Torrey bot. Club 22: 175 (1895)	In ovaries of *Leptochloa filiformis* (*Poaceae*)	Allahabad (Uttar Pradesh)	Pavgi and Thirumalachar 1953
U. panici-frumentacei Bref., Unters. Gesammtgeb. Mykol. (Liepzig) 12: 103 (1895)	Ovaries of *Echinochloa frumentacei* and *E. crusgalli* (*Poaceae*)	Shimla (Himachal Pradesh); Nambur & Nanganeri, Madras (Tamil Nadu); Jabalpur (Madhya Pradesh); Banaras (Uttar Pradesh)	Mundkur and Thirumalachar 1952, Mishra et al. 1976, Pavgi and Thirumalachar 1952
U. paradoxa Syd., P. Syd. & E.J. Butler, Annls mycol. 9(2): 144 (1911)	In ovaries of *Panicum frumentaceum* (*Poaceae*)	Pusa (Bihar) Bombay (Maharashtra)	Mundkur and Thirumalachar 1952
U. parasnathii Thirum. & Pavgi, Mycopathologia 7: 286 (1956)	In inflorescence of *Rottboellia compressa* (*Poaceae*)	Bihar	Pavgi and Thirumalachar 1954
U. pimprina Thirum. & Pavgi, Sydowia 22(1-4): 251 (1969) [1968]	In ovaries of *Arundinella* sp. (*Poaceae*)	Maharashtra	Thirumalachar and Pavgi 1968
U. rickeri G.P. Clinton [as 'rickerii'], N. Amer. Fl. (New York) 7(1): 11 (1906)	In the ovaries of *Paspalidium flavidum* (Forssk.) Stapf (*Poaceae*)	Kolhapur (Maharashtra)	Patil et al. 2004b
U. royleani Syd., P. Syd. & E.J. Butler, Annls mycol. 4(5): 426 (1906)	In spicules of *Paspalum royleanum* (*Poaceae*)	Uttarakhand	Mundkur and Thirumalachar 1952, Pavgi and Mundkur 1948
U. sabouriana Mishra, Mycologia 48(6): 873 (1957) [1956]	In ovaries of *Bothriochloa pertusa* (*Poaceae*)	Bihar	Mishra 1956a
U. sparsa Underw., Bull. Torrey bot. Club 24: 86 (1897)	In ovaries of *Dactyloctenium aegyptium* (*Poaceae*)	Pusa (Bihar); Allahabad & Kanpur (Uttar Pradesh); New Delhi; Pimpri & Poona (Maharashtra)	Mundkur and Thirumalachar 1952, Mundkur 1939, Thirumalachar et al. 1956
U. sporoboli-tremuli T.S. Ramakr. & K. Ramakr., Proc. Indian natn Sci. Acad., Part B. Biol. Sci. 28: 58 (1948)	On *Sporobolus tremulus* (*Poaceae*)	Coimbtoor (Tamil Nadu)	Mundkur and Thirumalachar 1952, Ramakrishnan and Ramakrishnan 1948
U. striiformis (Westend.) Niessl, Hedwigia 15: 1 (1876)	Leaves of an undetermined grass (*Poaceae*)	Sonamarg (Jammu and Kashmir)	Clements and Zundel 1938
U. syntherismae (Schwein.) Peck, Ann. Rep. N.Y. St. Mus. nat. Hist. 27: 115 (1875)	Inflorescence of *Sagittaria sanguinalis* (Fam. Alismataceae) Paspalum *scrobiculatum* and *Digitaria pedicillaris*	Tukwar, Darjeeling (West Bengal);Shillong (Meghalaya); Varanasi (Uttar Pradesh)	Pavgi and Mundkur 1948, Mundkur and Thirumalachar 1952, Thirumalachar and Pavgi 1966,

[1874]	(*Poaceae*)		Chowdhary 1955
U. tragana Zundel, Mycologia 35(2): 166 (1943)	On *Tragus biflorus* (*Poaceae*)	Coimbatore (Tamil Nadu)	Ramakrishnan and Srinivasan 1950
U. trichophora (Link) Kunze, Flora, Regensburg 13: 369 (1830)	Ovaries of *Echinochloa colona* and *Paspalidium gemminatum* (*Poaceae*)	Mysore, Nandi Hills (Karnataka); Poona (Maharashtra)	Mundkur and Thirumalachar 1952
U. tritici (Bjerk.) Rostr., Overs. K. danske Vidensk. Selsk. Forh.: 15 (1890)	Floral parts and leaves of *Triticum vulgare, Triticum* spp.and *Secale cereal* (*Poaceae*)	Alllahabad & Kanpur (Uttar Pradesh); Jabalpur (Madhya Pradesh); Tutikandi (Himachal Pradesh)	Mundkur and Thirumalachar 1952, Mitter and Tandon 1930 a&b, Prasad and Sinha 1962, Agarwal et al. 1959, Chona and Munjal 1956
U. valentula Syd., Annls mycol. 35(1): 24 (1937)	Penicles of *Chloris bournei* (*Poaceae*)	Nilamber, Malabar (Maharashtra); Madras (Tamilnadu)	Mundkur and Thirumalachar 1956, 1952
U. vilfae G. Winter, Bull. Torrey bot. Club 10(1): 7 (1883)	*On Lasiurus scindicus* (*Poaceae*)	Jodhpur (Rajasthan)	Agarwal et al. 1977

Excluded and replaced names of smut fungi in India

Smut fungi in India are mostly identified based on their morphological characters including sori replacing inflorescences, covering of peridium of vacuolated fungal cells by host cells, types of hyphae, spore characters and presence and absence of sterile cells. In addition, identification of host plant is also considered important in the identification process. The formation of dusty thick-walled dark coloured spore masses which upon germination produce basidia is one of the main characterstics of these fungi. Molecular techniques have been regularly employed to study agriculturally important smuts. However, there is a need to study the Indian smut fungi with the use of moden DNA based techniques. Use of molecular techniques along with morphotaxonomic characters has made identification and characterization of smut fungi more efficient and accurate. The names of many rust genera/species as reported in the cited publications have been replaced with new accepted names (McTaggart et al. 2012). Numbers of genera and species of Indian smut fungi have also been replaced with currently accepted name according to MycoBank (www.mycobank.org)/ and Species Fungorum (www.speciesfungorum.org) websites. A list of such genera and species is provded in Table 2.

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Table 2. Excluded and replaced names of rust fungi in India (McTaggart et al. 2012; Index Fungorum 2021; Mycobank 2021)

Old Name	Current Name
Sorosporium apludae Mishra, Mycologia 48: 875. 1956	*Anthracocystis apludae* (Mishra) McTaggart & R.G. Shivas
Sorosporium apludae-aristatae B.V. Patil & Thirum., Sydowia 20: 48. 1968	*Anthracocystis apludae-aristatae* (B.V. Patil & Thirum.) McTaggart & R.G. Shivas
Sorosporium apludae-muticae A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34: 839. 2004	*Anthracocystis apludae-muticae* (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas
Sorosporium azmatii Mundk., Trans. Brit. Mycol. Soc. 23: 115. 1939.	*Anthracocystis azmatii* (Mundk.) McTaggart & R.G. Shivas
Sorosporium caledonicum Pat., Bull. Soc. Mycol. France 3: 173. 1887.	*Anthracocystis caledonica* (Pat.) McTaggart & R.G. Shivas
Sporisorium chrysopogonicola A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34: 779. 2004	*Anthracocystis chrysopogonicola* (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas
Sorosporium chrysopogonis-fulvi A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34: 839. 2004	*Anthracocystis chrysopogonis-fulvi* (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas
Tolyposporium cymbopogonis Mundk., Indian J. Agric. Sci. 14: 51. 1944.	*Anthracocystis cymbopogonis* (Mundk.) McTaggart & R.G. Shivas,
Sporisorium dichanthii Vánky & N.D. Sharma, Fung. Diversity 15: 230. 2004.	*Anthracocystis dichanthii* (Vánky & N.D. Sharma) McTaggart & R.G. Shivas
Sorosporium heteropogonicola Mundk. & Thirum., Mycol. Pap. 40: 5. 1951.	*Anthracocystis heteropogonicola* (Mundk. & Thirum.) McTaggart & R.G. Shivas,
Sporisorium ischaemianum A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34: 783. 2004	*Anthracocystis ischaemiana* (A.R. Patil, T.M. Patil & M.S. Patil) McTaggart & R.G. Shivas, comb
Sorosporium leersiae Mishra, Mycologia 48: 876. 1956	*Anthracocystis leersiae* (Mishra) McTaggart & R.G. Shivas
Sporisorium leersiae Bag & D.K. Agarwal, Indian Phytopathol. 54: 221. 2001.	*Anthracocystis leersiae* (Mishra) McTaggart & R.G. Shivas
Sorosporium lophopogonis Thirum. & Pavgi, Sydowia 20: 23. 1968.	*Anthracocystis lophopogonis* (Thirum. & Pavgi) McTaggart & R.G. Shivas
Sorosporium pseudanthistiriae Syd., P. Syd. & E.J. Butler, Ann. Mycol. 10: 254. 1912	*Anthracocystis pseudanthistiriae* (Syd., P. Syd. & E.J. Butler) McTaggart & R.G. Shivas
Sorosporium pseudanthistiriae-umbellatae A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34: 841. 2004	*Anthracocystis pseudanthistiriae* (Syd., P. Syd. & E.J. Butler) McTaggart & R.G. Shivas
Sphacelotheca pennisetina S. Ahmad, Mycol. Pap. 64: 7. 1956	*Anthracocystis pennisetina* (S. Ahmad) McTaggart & R.G. Shivas
Sporisorium rubyanum Vánky & N.D. Sharma, Fung. Diversity 15: 234. 2004.	*Anthracocystis rubyana* (Vánky & N.D. Sharma) McTaggart & R.G. Shivas

Sorosporium sehimatis M.S. Patil (as 'sehimae'), Indian Phytopathol. 45: 181. 1992	*Anthracocystis scholzii* (Vánky) McTaggart & R.G. Shivas,
Sorosporium sulcati M.S. Patil, Indian Phytopathol. 45: 181. 1992.	*Anthracocystis sulcati* (M.S. Patil) McTaggart & R.G. Shivas
Sporisorium themedae-cymbariae Vánky, Mycotaxon 62: 141. 1997.	*Anthracocystis themedae-cymbariae* (Vánky) McTaggart & R.G. Shivas
Ustilago spermoidea Berk. & Broome, J. Linn. Soc., Bot. 14: 94. 1875.	*Anthracocystis spermoidea* (Berk. & Broome) McTaggart & R.G. Shivas

Discussion

Smut fungi cause some serious diseases of agricultural crops, resulting in poor quality and production of their produce. It is one of the extensively studied fungal groups in India as evident from the 395 records of smut fungi belonging to five families, eighteen genera and 159 species on about 189 host plants. It is well-studied in southeren India in comparison to rest of India. It is now known that these fungi have been investigated and recorded highest in Maharasthtra, Karnataka and Tamil Nadu. However, rest of the Indian states also witnessed the occurrences of these fungi.

About 100 genera and 1,650 species of smut fungi occurring on about 4,000 species of host plants have been reported. About 3,500 synonyms to the species and about 50 to the genera, including 10 anamorphic genera have also been reported (Vánky 2002; Vánky 2011). The outline presented here provides an overview of Indian smut fungi. This compilation validates that these fungi are extensively surveyed and explored, but many still need to be explored. Among all smut fungi investigated and reported, *Ustilago* contributes a major part with highest number of species. It reportedly causes loose smut of wheat and barley, covered smut of oats, wheat and barley. Hence smuts cause great losses to grain crops in India. Similarly, leaf-smut of rice, the grain smut of bajra or the long smut of jowar, are other known diseases by smut fungi in India.

Although, mophotaxonomy of smut fungi is well studied, but their molecular characterization is still scanty. There is much scope and potential to explore this fungal group. Many specimens were collected century ago. It is difficult to extract DNA from them for molecular work. Evaluation of a few morphological characters is difficult too. So, such genera or species of Indian smut fungi need to be recollected and epitypified. In addition, the use of advanced techniques in taxonomic studies of smut fungi will add accuracy in their correct identification in order to place them in the correct taxonomic position. Therefore, future research can focus on reassessing the samples of Indian smut fungi by molecular taxonomy in order to validate their identification based on morphotaxonomy.

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Conflict of interest

There are no conflicts of interest by the authors.

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