An overview of *Penicillium* (Hyphomycetes) and associated teleomorphs in southern Africa

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ABSTRACT

Literature on the hyphomycete genus *Penicillium* Link and its teleomorphs, *Eupenicillium* Ludwig and *Talaromyces* C.R. Benjamin, is surveyed in the Republic of South Africa, Lesotho, Mozambique, Namibia, Swaziland and Transkei up to 1990. References are grouped under the headings, general mycology, plant pathology, industrial application, medical importance, mycotoxins and chemical work. An alphabetical list of the species recorded in southern Africa as well as the host and/or substrate from which each species has been reported is presented with relevant literature references; specimens in various culture collections are also incorporated. Although most of the known *Penicillium* species have already been reported from southern Africa, in-depth work is still required in all fields of research concerning this genus.

INTRODUCTION

'Species of *Penicillium* are so abundant and so conspicuous in all sorts of stale or decaying organic matter that they constitute a part of the common conception of mould, and are loosely referred to as 'blue' or 'green' mould' (Raper & Thom 1949). Representatives of this multi-faceted genus are of ecological importance because they are abundant and widespread in the environment; they are fruit deteriorators and contribute greatly to post-harvest decay; they have industrial applications such as in cheese-making; and they produce secondary metabolites and mycotoxins, including the indispensable antibiotics.

The generic name *Penicillium* (Latin, *penicillus* = little brush) was first introduced in 1809 by Link who very briefly described the genus with three species, namely *P. candidum* Link, *P. expansum* Link and *P. glaucum* Link. The true identity of these fungi has been difficult to determine, but an apple-rotting fungus was linked to *P. expansum* by Thom (1910). Although the validity of the generic name has been questioned over the years, *P. expansum* was confirmed at the First international workshop (Samson & Pitt 1985), when Pitt's species concept and methods were incorporated in the recommendations for future taxonomic practice in this genus.

Succeeding the works of Thom (1910, 1930), the manual by Raper & Thom (1949) has been the standard work on *Penicillium* for nearly 30 years. Subsequently, a new era in *Penicillium* identification was heralded by Pitt (1973), who used the ability of isolates to grow at reduced water activity, correlated with penicillus types, as well as growth rates at 5°C and 37°C, as differential criteria. This concept was later fully developed in a monograph (Pitt 1979). Shortly afterwards, a well-illustrated atlas of penicillia by Ramirez (1982) was published. However, the value of Pitt's (1979) guide to the taxonomy of *Penicillium* was confirmed at the First international *Penicillium* and *Aspergillus* workshop (Samson & Pitt 1985), when Pitt's species concept and methods were incorporated in the recommendations for future taxonomic practice in this genus.

Previously, the name *Penicillium* was applied to both the hyphomycetous and ascomycetous states. However, separation of the teleomorphic states of *Penicillium* from the anamorph, as implemented by Pitt (1979), is in accordance with Art. 59 of the International Code of Botanical Nomenclature and is of practical value for the taxonomist. Stolk & Scott (1967) re-introduced the use of the teleomorph name *Eupenicillium* Ludwig for a portion of the genus *Penicillium*. Monographic contributions to the genus *Eupenicillium* were made by Scott (1968a, b) and Stolk & Samson (1983). The teleomorphic genus *Talaromyces* C.R. Benjamin is separated from *Eupenicillium* on the basis of ascocarp morphology. The former genus is characterised by the production of gymnothecia composed of loosely intertwined hypheae, as opposed to cleistothecia. Stolk & Samson (1972) as well as Pitt (1979) have contributed to the taxonomy of this group.

A multidisciplinary approach to the identification of *Penicillium* is becoming more prevalent (Bridge et al. 1985). Protein electrophoresis (Bent 1967), the API ZYM testing system (Bridge & Hawksworth 1984), pyrolysis gas chromatography (Söderström & Frisvad 1984), physiological and biochemical methods (Bridge 1985), enzyme electrophoresis (Cruickshank & Pitt 1987), studies on
thermal denaturation of DNA (Paterson et al. 1990), electron microscopy (Ramirez 1982; Kozakiewicz 1989) and the production of secondary metabolites and mycotoxins (Frisvad & Filtenborg 1983; Frisvad et al. 1990) have recently been used to supplement traditional methods of identification.

Members of this genus identified at the Mycology Unit in recent years were often found to differ somewhat from the descriptions given by Pitt (1979). This raised the question of whether these variations are consistent for all South African isolates. In addition, preliminary investigations indicated that Penicillium species are frequently only briefly mentioned in publications or included in lists of fungi from surveys. It was therefore considered advantageous to gather this scattered information in order to compile a list of Penicillium species recorded in southern Africa, to bring this information in line with modern taxonomic systems, and to indicate areas requiring further research.

This paper is an overview of publications dealing with all aspects of the Penicillium species reported in South Africa, Lesotho, Mozambique, Namibia, Swaziland and Transkei up to 1990. Literature is grouped according to various fields of research and presented in chronological order. The National Collection of Fungi, including the dried collection and the culture collection, collections donated to the Mycology Unit, the collection of the Medical Research Council as well as catalogues of international culture collections, served as additional sources of information. Foreign isolates used for chemical work, have been mentioned but not listed. No attempt has been made to verify published data, the identity of Penicillium isolates, or any other information.

OVERVIEW OF LITERATURE

General mycology

The first published record of the genus Penicillium in southern Africa appears to be that of P. digitatum (Pers. ex Fr.) Sacc. on citrus (Pole Evans 1911). In this publication Pole Evans mentioned that in 1903, the Government Entomologist for Natal reported great losses to the orange crop, due to a mould. He noted that he had collected the causative fungus, P. digitatum, from fallen oranges in the Northern Transvaal five years before (i.e in 1906). Dodge (1950) listed all Penicillium species recorded up to 1945, including specimens in the Collection of the Timber Research Laboratories, Chamber of Mines, Johannesburg, as well as those mentioned by Thom (1930).

The Penicillium specimen accessioned in the National Collection of Fungi first was ‘P. armeniacum Berk’ (PREM 187—see checklist), recorded by the Government Laboratories Johannesburg, on Zea mays on 12 September 1906. This fungus was not a Penicillium, however, but probably belongs in Monilia (Thom 1930).

The second Penicillium entry, ‘P. grattii Sartory’ (PREM 5587—see checklist), was recorded by P.A. van der Bijl from the City Deep Mine in Johannesburg, on 7 December 1912. Thom (1930) provided more data about this isolate, recording its optimum temperature and utilization of various sugars. Its true identity is not clear, however, as the name is no longer in use and Raper & Thom (1949) referred to P. grattii only as: ‘apparently some member of the P. janthinelium series’.

Numerous penicillia have been reported subsequently in general surveys of fungi on various substrates. Cohen (1950) conducted the first survey of soil fungi in South Africa, comparing the effect of different burning and grazing treatments, and he recorded nine Penicillium species. Scott (1968a) described eight new Eupenicillium species from soil and included these in a more extensive monograph of the genus (Scott 1968b). Penicillium was found to be the genus of Fungi Imperfecti with the largest number of species represented in Zululand soil (Eicker 1969). The same locality yielded P. olsonii Bain. & Sartory throughout the soil profile, whereas P. javanicum Van Beyma showed a marked decrease with increasing soil depth (Eicker 1970). Eicker (1973) found the penicillia to have an even distribution in different litter layers of Eucalyptus maculata Hook. f. and later found the genus to be common on Panicum coloratum L. litter (Eicker 1976). P. cyclopium Westling was isolated from angora goat dung, but Mitchel (1970) indicated that it was probably an aerial contaminant.

High quality stored maize obtained from six localities, studied by Van der Westhuizen & Bredell (1972) was found to have a high percentage of Penicillium spp., with P. oxalidic Currie & Thom often comprising 30% of the fungi recorded. On stored lucerne seed, species of this genus did not increase during an increased period of storage (Marasas & Bredell 1973). The composition and distribution of soil fungi in the western Transvaal was studied by Papendorf (1976) and one of his isolates, described as the new species P. striatosporum Stolk (Stolk 1969), was later re-identified by Pitt (1979) as P. restrictum Gilman & Abbott. Penicillium spp. were found to be scarce on leaves and litter of Cenchrus ciliaris L. (Bezuidenhout 1977), in aerospora of an Eragrostis curvula (Schrad.) Nees pasture (Van der Merwe et al. 1979) and in the soil of Kaokoland. Namibia (Eicker et al. 1982). Many of the above-mentioned species are included in the checklist and bibliography of South African fungi compiled by Gotter (1979) for the period 1947–1977.

Allsop et al. (1987) found a more varied fungal flora present in the rhizosphere than in the non-rhizosphere area of a fynbos site; several Penicillium species were reported, including P. novae-zeelandiae Van Beyma and Eupenicillium pinetorum Stolk, reported in South Africa for the first time. McLean & Berjak (1987) studied the mycoflora of maize and indicated P. variabile Sopp as the most frequent internal contaminant of maize seed, while P. brevicomptum Dierckx was isolated from 15% of the seedlings. Wittaker et al. (1989) reported a decline in Penicillium species after hot water treatment of stored maize seed. penicillia were found to be present on Eucalyptus (Lundquist & Baxter 1985), Pinus in the Transvaal (Lundquist 1986), Pinus in the Cape (Lundquist 1987) and common on stored seed of indigenous plants (Isaacs & Benic 1990). P. crustosum Thom and P. purpureascens (Sopp) Biourge have been indicated as endophytes of grass species (De Villiers 1989). Ramirez (1990) based the description of P. krugeri Ramirez on 26 isolates collected from soil at different localities in the Kruger National Park in 1987.
Apparently the type material of this fungus has been lost (C. Ramirez pers. comm.).

Additional reports of South African isolates may be found in the monographs on *Penicillium* by Thom (1930), Raper & Thom (1949), Pitt (1979) and Stolk & Samson (1983), as well as in catalogues of international culture collections.

**Plant pathology**

During the early 1900’s the deteriorators, *P. digitatum*, *P. expansum* Link and *P. italicum* Wehmer, became a major problem for the fruit producing industry by hampering exports to Europe (Pole Evans 1920). Most of the South African isolates mentioned by Thom (1930) had been sent to the USA for identification by V.A. Putterill. Putterill was in charge of a mycological laboratory in Cape Town in 1918, and later worked at the fruit inspection service (Doidge 1950). These first South African *Penicillium* records probably concerned fruit rot, although they are listed as having an undetermined host.

*P. digitatum* on citrus was reported by Pole Evans (1911) who stressed the importance of good sanitation in orchards to combat this fungus. To determine the presence of pathogenic fungal spores at the Cape harbour, Pole Evans (1920) exposed agar plates in the railway trucks and in cold storage rooms on the docks and on the ships.

These pathogens were later listed by Verwoerd (1929). Doidge & Van Der Plank (1936) subsequently conducted a survey on the fungi causing rot of oranges and lemons, indicating *P. digitatum* as the most important, with *P. italicum* and *P. verrucosum* Dierckx also present. They (Doidge & Van Der Plank 1936) remarked that although a large number of additional *Penicillium* spp. were isolated during the survey, no attempt was made to identify these species, which were apparently saprophytic and growing on decaying tissues. Van der Plank (1945) did experimental work with hypochlorous acid as a bleach and disinfectant of citrus fruit, finding it effective against *P. digitatum* conidia. Martin (1960) listed seven saprophytic *Penicillium* species in citrus soil and found five species in adjacent virgin soil. Other *Penicillium* species of plant pathological interest were mentioned by Doidge et al. (1953), Roth (1967), Wager (1972) and Gorter (1977). The bulb pathogen *P. corymbiferum* Westling, isolated by Wager, was deposited in the IMI culture collection where it was examined by Pitt (1979).

Matthee (1968) studied *P. expansum*, the pathogen and deteriorator of stored pome fruits, and indicated that older or bruised fruit was more susceptible. Holtzhausen & Knox-Davies (1974) used this fungus as an experimental organism in chemical seed treatments. Combrink et al. (1980) found that a longer exposure time of apples to a sodium hypochlorite solution had a better fungicidal effect on *P. expansum* conidia than a stronger solution. *P. funiculosum* Thom reportedly caused a core rot of apples and formed a moist infection (Combrink et al. 1985). Members of the genus were also isolated from litchi fruit (Roth 1963), bananas (Roth & Loest 1965) and mangoes (Wehner et al. 1981). *P. pinophilum* Hedgcock apparently enhances disease symptoms of groundnut pods in the presence of *Chalara elegans* Nag Raj & Kendrick (Baard 1988). This fungus was able to decompose filter paper as well as detached groundnut pods. Surface disinfected roots of *Medicago* spp. yielded eight different *Penicillium* spp. (Lamprecht et al. 1988). *P. spinulosum* Thom was found to be pathogenic on onions (Naudé & Jooste 1989) and *P. hirsutum* Dierckx on bulbs of flowering plants (Schutte 1990).

Unidentified members of the genus were reported on Japanese radish seed (Holzhauzen 1978), groundnuts (Ferreira & Lutchman 1989), recalciitrant seed (Berjak et al. 1989; Mycock & Berjak 1990), barley seed (Lübben et al. 1989) and maize cultivars (Rheeder et al. 1990).

**Industrial applications**

Penicilliia encountered in industry were first reported by Van der Bijl (1920) in his study of the deterioration of cane sugar crystals and solutions in storage. This record is also of taxonomic interest as two of these *Penicillium* isolates had been sent to Thom, whose comments accompanying the identifications are included. One of these isolates was deposited in PREM: 14262 *P. luteum-purpurogenum* group.

Davel & Neethling (1930) dealt with fungi in dairies and mentioned the use of *P. camembertii* Thom, *P. glaucum* and *P. roquefortii* Thom in cheese factories, indicating that members of this group can be troublesome in these surroundings. Coles (1925) recorded *P. glaucum* on Stilton and Wenslydale cheese and Radmore (1986) did a microbiological study of air in dairies. Other work done on penicilliia in the dairy industry is discussed under the heading ‘Mycotoxins’.

An interesting use for *Penicillium* was found in reducing the stickiness of molasses meal (Roth 1968), for which *P. notatum* Westling was used on a commercial scale. Although photographs of eight different *Penicillium* spp. are included, only the series to which they belong are given. The wine industry noted various identified and unidentified *Penicillium* spp. on grapes (Le Roux et al. 1973), their incidence on healthy grapes being 60% and on *Botrytis* infected fruit 70%.

Heat resistant fungi posing problems for apple juice canners, turned out to be teleomorphs of *P. verruculosum* Dangeard and *P. brefeldianum* Dodge (Van der Spuy et al. 1975). This work is referred to world-wide in connection with heat resistance of fungal spores. The thermophilic Talaromyces dupontii Griffen & Maublanc, was isolated during a study of fungi in mushroom compost (Eicker 1977). *Penicillium* species encountered later when various casings for mushroom production were tested, were indicated as potentially harmful (Smit 1984). Martin & Keen (1978) found *P. crustosum* to be common in homemade beer as well as on sorghum malt used for brewing. A low incidence of *Penicillium* spp. on commercial and industrial sorghum malt was reported by Rabie & Lübben (1984).

**Medical importance**

Although members of the genus are known to cause allergies and to produce mycotoxins, *Penicillium* is mentioned infrequently in literature on medical mycology.
Fungal allergy was the motivation for three five-year surveys of aerospora, two done in Johannesburg (Ordman & Ettet 1956; Ordman 1963) and one in Windhoek (Ordman 1970). Penicillium made up about 10% of the fungi isolated and showed no seasonal prevalence. Fungal contamination of food was investigated by Gilman (1972), in an attempt to correlate diet and liver cancer in man and a variety of identified penicillia were listed. Antimycotic and antibacterial activity of soil fungi was studied by Eicker (1975) who found positive effects against both organisms, by \textit{P. chrysogenum} and \textit{P. cyclopium}. Horwitz & Wehner (1977) warned that the presence of antibiotics produced by \textit{P. chrysogenum} Thom used in salami curing may pose a health hazard for persons sensitive to penicillin. \textit{Penicillium} was also amongst the fungi present on corn believed to be the cause of oesophageal cancer in Transkei and in the high rate area of the disease, 43% of the samples were infected with this organism (Marasas et al. 1981). Marasas & Van Rensburg (1986) found this genus most prevalent on crops in the area where Mseleni joint disease occurs in Kwazulu. Some of the work mentioned under the heading 'Mycotoxins' also has a medical application.

**Mycotoxins**

The discovery in the 1960's of aflatoxin and its carcinogenic effects created renewed interest in fungal contamination. In the search for members of the aflatoxin-producing \textit{Aspergillus flavus} group, numerous species of the closely related genus \textit{Penicillium} were also encountered and details of their distribution recorded. Scott (1965), the first South African to test fungi for toxicity by feeding day old ducklings with infected meal, found \textit{P. islandicum} Sopp, \textit{P. oxalicum}, \textit{P. rubrum} Stoll and \textit{P. urticae} to be acutely toxic, whereas \textit{P. piceum} Raper & Fennell had a less severe effect. This paper subsequently became a citation classic. The fungal flora of stock feeds, and the incidence of toxicity, was investigated by Van Warmelo (1967), who found that \textit{Penicillium} had a low incidence on these substrates. Wehner & Rabie (1970) did toxicity tests with micro-organisms from nuts and dried fruit, including \textit{P. notatum} Westling, \textit{P. chrysogenum} Thom, was found to be a frameshift mutagen (Wehner 1979). As no local isolates were mentioned in the above-mentioned cyclopiazonic acid work, namely CSIR 1085, was not \textit{P. cyclopium} Thom, produced by \textit{Hutchison et al.} (1973). Nagel et al. (1972) reported on the production of the highly toxic citreoviridin and made a study of the morphological characteristics of various isolates of its producer, \textit{P. pulvinum} Turfitt. Steyn et al. (1982) studied the biosynthesis of the above-mentioned citreoviridin.

Holzapfel (1968), Steyn et al. (1975), McGrath et al. (1976) and Neethling & McGrath (1977) studied various aspects of cyclopiazonic acid (e.g. biosynthesis, structure and production), a toxic metabolite of \textit{P. cyclopium}. However, Frisvad (1989) stated that the isolate used for all the above-mentioned cyclopiazonic acid work, namely CSIR 1085, was not \textit{P. cyclopium} but \textit{P. griseofulvum} Dierckx. Pitt came to the same conclusion as indicated by De Jesus et al. (1981). Frisvad (1989) stated that \textit{P. viridicatum} (CSIR 1029) used by Hutchison et al. (1973) had also been misidentified.

Various mycotoxins other than the above-mentioned were studied locally. Oxalin produced by \textit{P. oxalicum} received attention from Nagel et al. (1976), Vleggar & Wessels (1980) and Steyn & Vleggar (1983), while PR toxin produced by \textit{P. roquefortii} was studied by Gorst-Allman & Steyn (1982). Certain isolates of \textit{P. crustosum} are able to produce tremorgenic mycotoxins and these were examined in detail by Maes et al. (1982) and De Jesus et al. (1983a, b, c), \textit{P. janthinellum} Biourge, associated with rye grass staggers was found to produce jaunthrems, tremorgenic mycotoxins studied by De Jesus et al. (1984). For most of these investigations the authors obtained authenticated isolates or had their fungal cultures verified, mostly by Pitt.

In 1985, South Africa hosted the IUPAC Symposium on mycotoxins and phytotoxins (Steyn & Vleggar 1986) where a paper concerning synthesis of the \textit{Penicillium} mycotoxins cyclopiazonic acid and viridamine was presented by Holzapfel (1986).
DISCUSSION

The large number of undetermined *Penicillium* species in the literature cited is an indication that scientists in South Africa have a history of not attempting to identify members of this genus. Other than that done by Scott (1968a, b), work published on *Penicillium* in South Africa is clearly fragmentary and many of the isolates obtained early this century were identified overseas. The use of correctly identified *Penicillium* isolates in any scientific research must be stressed. Mistaken identities have been reported in overcoming this problem and will also make isolates available to other scientists.

With the exception of *P. hordei* Stolk, *P. olivicolor* Pitt and *Talaromyces stipitatus* (Thom) C. R. Benjamin, all the *Penicillium* species listed by Samson & Pitt (1985) as common, have been recorded in southern Africa. However, teleomorphic penicillia have been reported infrequently as they require special isolation techniques (Scott 1968b). Symmenatous members of the genus appear to be scarce and most representatives in the National Collection of Fungi, PREM and PPRI are recent acquisitions.

The role that penicillia play in the ecology of natural ecosystems as well as in cultivated areas, has not been investigated in this country. Certain *Penicillium* species have antmycotic as well as antibacterial activities (Eicker 1975). Others are strongly antagonistic to soil-borne plant pathogens such as *Gaemannomyces*, *Pithym and Rhizoctonia*, whereas some members of *Talaromyces* have antifungal as well as antiprotozoal capacities (Domsch et al. 1980). Biological control of plant pathogens by *Penicillium* species deserves attention, as it may well be of economic importance.

The successful use in *Penicillium* taxonomy of physiological and various biochemical methods, mycotoxin profiles and electron microscopy, has been indicated. However, these techniques have not yet been applied to this genus in South Africa and may be of value in determining relationships between species and groups as well as indicating new species.

Much meaningful work on *Penicillium*, one of the more common and economically important genera of fungi, is therefore still to be done in the fields of taxonomy, ecology, biological control and chemotaxonomy.

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REFERENCES


CHECKLIST OF *PENICILLIUM*, *EUPENICILLIUM* AND *TALAROMYCES* SPECIES RECORDED IN SOUTHERN AFRICA

*Penicillium* species recorded in southern Africa up to 1990 are arranged alphabetically and the host and/or substrate from which each species has been recorded is given with the relevant literature reference. Species names are listed as cited in the original publication in roman type, with a cross reference to the epithet currently accepted by Pitt (1979) in bold, except in the case of *Eupenicillium*, where the revision proposed by Stolk & Samson (1983) has been followed, or where older epithets have been traced (Seifert & Samson 1985). In the past, ascosporic fungi were included in the genus *Penicillium*, posing nomenclatural problems (*) in designating the anamorph-teleomorph relationship. Consequently, species known to produce a teleomorphic state have been listed under *Penicillium* with a cross reference to either *Eupenicillium* or *Talaromyces*, which are listed separately.

The following abbreviations are used in the list:


CSIR, cultures in the 1988 Catalogue of the Culture Collection of CSIR International Mycological Institute, Kew, United Kingdom.

MRC, cultures in the Culture Collection of the Medical Research Council, all identified by Pitt (C.J. Rabie pers. comm.).

PPRI, isolates listed in the Culture Collection of the National Collection of Fungi. Several of these have been identified or verified by Pitt.

PREM, isolates deposited in the National Collection of Fungi as dried material.

The National Collection of Fungi recently acquired three additional fungal culture collections. Most of these cultures were no longer viable and had scant accompanying data, but local isolates are listed with numbers under their appropriate abbreviations:

CSIR, isolates listed in a collection obtained from the Council for Scientific and Industrial Research, which included some isolates of Scott (1968a, b).

MCP, the collection of Papendorf (1976), received from the University of Potchefstroom for C.H.E. These isolates are listed under the substrate soil, but some isolates could have been isolated from *Acacia karroo* litter.

UCT, a collection obtained from the University of Cape Town which contained isolates of Allsopp *et al*. (1987).

**GENUS PENICILLIUM**


**WEHNER, F.C., THIEL, P.G., VAN RENSBURG, S.J. & DEMASIUS, I.P.C. 1978.** Mutagenicity to *Salmonella typhimurium* of some...
Bothalia 22,1 (1992)

Sorghum cafforum: CSIR 531, 547
Vitis spp.: Le Roux et al. (1975)
Zea mays: McLean & Berjak (1987); Pitt (1979); Van der Westhuizen & Bredell (1972); CSIR 81, 95, 219, 330, 378, 459, 593, 623, 665, 675; PPRI 3630; PREM 43741, 43742, 47537, 47831
undetermined host: CBS 287.53 (albino mutant) = stoloniferum Thom
soil: Cohen (1950)
Zea mays: Van der Westhuizen & Bredell (1972); CSIR 238
camembertii Thom
disease: Davel & Neethling (1930); Luck
Arachis hypogaea: PPRI 3808
flannel: PREM 33287
Protea cynaroides: PPRI 3786
soil: Papendorf (1976)
Zea mays: Van der Westhuizen & Bredell (1972)
 = acidoferus Sopp (near P. canescens. Raper & Thom 1949)
Citrus sinensis: Doidge (1950)
 = kapuscinski Zaleski
soil: MCP 384
swine meal: Van Warmelo (1967)
capsulatum Raper & Fennell
dried fish: Pitt (1979); IMI 140 284
soil: Martin (1960)
cereal and legume products: Scott (1965)
aerospora: Roth (1968)

Zea mays:
soil: Eicker (1975); Martin (1960); PREM 48767

Sorghum cafforum: CSIR 427, MRC 1682
Zea mays: Gilman (1972); McLean & Berjak (1987); Van der Westhuizen & Bredell (1972); Van Warmelo (1967); CSIR 436, 453, 477
 = notatum Westling
aerospora: Roth (1968)
Allium cepa: PREM 44738
Cenchrus ciliaris: Bezuidenhout (1977)
cereal and legume products: Scott (1965)
Medicago sativa: PREM 44466, 44552
molasses meal: Roth (1968)
natural gum: Roth (1968)
nuts and dried fruit: Wehner & Rabie (1970)
soil: Eicker (1975); Martin (1960); PREM 48767
Sorghum cafforum: CSIR 427, MRC 1682
Zea mays: Gilman (1972); McLean & Berjak (1987); Van der Westhuizen & Bredell (1972); Van Warmelo (1967); CSIR 436, 453, 477
 = notatum Westling
aerospora: Roth (1968)
Allium cepa: PREM 44777
Arachis hypogaea: Gilman (1972); MRC 241, 263, 283, 294, 209
Aspergillus spp.: PREM 47616, 47617

cereal and legume products: Scott (1965)
dried leaves: MRC 320, 333, 334
fruit: Doidge (1950); Thom (1930)
Ipsopora batatas: PPRI 3571
Manihot esculenta: MRC 212, 232, 249
Medicago spp.: Lamprecht (1988), PREM 48312
natural gum: Roth (1968)
Phaseolus spp.: MRC 178, 201, 222, 304, 313
soil: Allsopp et al. (1987); Cohen (1950); Eicker (1969, 1970); Papendorf (1976); CSIR 370, 372, 374
Sorghum cafforum: MRC 2332
Vigna subterranea: MRC 224, 280
Zea mays: Gilman (1972); McLean & Berjak (1987); Van der Westhuizen & Bredell (1972); CSIR 152, 352, 393, 394, 549, 661, 708; MRC 257, 258, 262, 266, 293, 294, 307, 437, 444, PREM 44304, 44305, 47620, 47621
 = stecki Zaleski
Arachis hypogaea: Van Warmelo (1967)
cereal and legume products: Scott (1965)
spp.: PREM 47616, 47617
soil: Eicker (1969, 1970); CSIR 346, 381, 382, 384, 385, 387
Zea mays: Van der Westhuizen & Bredell (1972); Van Warmelo (1967); CSIR 341, 383, 426, 444, 454, 595, 670; PREM 43752
claviforme (see P. vulpinum)
commune (see P. ruberulum)
concentricum (see P. coprophilum)
coprophilum (Berk. & Curt.) Seifert & Samson
cubed dogfood: PPRI 3808
cultivated beef: PPRI 3000
debris: PPRI 3725, 3902, 3903; PREM 49881
dung: PPRI 3726, 4007, 4128; PREM 49863, 50683, 50714
glass roots: PREM 47700
Zea mays: CBS 477.75
soil: PREM 3611, 4280; PREM 47700, 47701
 = concentricum Samson, Stolk & Hadlock
coraligerum (see P. herbeqi)
corylophilum Diercks
eaerospora: Doidge (1950); Thom (1930)
Aspergillus virgatus: PPRI 3785
contaminant: PREM 48550
lime juice: PPRI 4303
Medicago spp.: Lamprecht (1988); PREM 48316
soil: PREM 4304
Zea mays: PREM 44307
corymbiferum (see P. hirsutum)
crustosum Thom
Arachis hypogaea: PREM 48018
crude oil: DPP 316
fish: MRC 316
fish gut: PREM 49015
Manihot esculenta: MRC 247
meal pie: MRC 1271
Oriza sativa: MRC 285
Phaseolus spp.: MRC 228
Praunus armeniacum: MRC 3015
Praunus persica: PPRI 3587
soil: Eicker (1975)
Sorghum cafforum: Martin & Keen (1978)
Stipagrostis aspera: De Villiers (1989); PPRI 3457
Zea mays: Gilman (1972); Van der Westhuizen & Bredell (1972); PREM 47864

cyclopium (see P. aurantiogriseum)
dangeardii (see T. flavus)
decumbens Thom
Dalbergia obovata: PPRI 3721; PREM 49888
soil: Martin (1960)
Zea mays: Van der Westhuizen & Bredell (1972); CSIR 2 undetermined host. Thom (1930)
dendriticum Pitt
contaminant: PPRI 4002; PREM 48605

85
debris: PPRI 3782
fodder: PPRI 3887, 4225
Protea scolopendrifolia: PPRI 4014; PREM 47304
Waisonia marginata: PPRI 3724
digitatum (Pers. ex Fr.) Succ.
aerospora: Pole Evans (1920)
Cartica papaya: Dodge (1950, et al. 1953)
Citrus aurantium: Dodge et al. (1953)
citrus fruit: Pole Evans (1931); Roth (1967)
Citrus limonia: Dodge (1950, et al. 1953); CSIR 562, 563, PPRI 3740
Citrus nobilis var. delicosa: Dodge (1950, et al. 1953)
Citrus paradisi: PPRI 3319; PREM 48908
Citrus sinensis: Dodge (1950, et al. 1953); Dodge & Van der Plank (1936); Van der Plank (1945); Verwoerd (1929); CSIR 558, 561; PPRI 3737
=* = digitatum Succ. var. californicum Thom
Physalis peruviana: Dodge et al. (1953)
Citrus sinensis: Dodge (1950); Dodge & Van der Plank (1936); PREM 30659
digitatum var. californicum (see P. digitatum)
divaricatum Thom (Scopulariopsis, Raper & Thom 1949)
sugar: Van der Bijl (1920)
diversum Raper & Fennell
Eucalyptus cloeziana: PPRI 3731; PREM 49685
Medicago sativa: PREM 44517
ducauxii Delacr.
aerospora: Roth (1968)
Asparagus officinalis: PPRI 4083
grain roots: PPRI 3130; PREM 47754
mine timber: Dodge (1950); Pitt (1979); Raper & Thom (1949); IMI 200 309
molasses meal: Roth (1968)
natural gum: Roth (1968)
soil: PPRI 3983, 4305; PREM 48938
dupontii (see T. thermophillus)
echinulatum Raper & Thom ex Fassartová
granadilla juice: PPRI 3585
elongatum (see P. expansum)
erubescens (see E. terrenum)
expansum Link
aerospora: Pole Evans (1920)
Anachis hypogaea: Pitt (1979); MRC 199; PREM 48381
cereal and legume products: Scott (1965)
granadilla juice: PPRI 3584; PREM 49415
Malus sylvestris: Combrink et al. (1980); Dodge (1950, et al. 1953); PPRI 4215
molasses meal: Roth (1968)
natural gum: Roth (1968)
pome fruit: Matthee (1968)
poppy seed: PPRI 3306, 3679
Vigna subterranea: PPRI 3702; PREM 49887
frequentans (see P. glabrum)
funiculatum Thom
Ananas comosus: Dodge (1950, et al. 1953); PPRI 4307
Anachis hypogaea: Baard (1988); Gilman (1972); Pitt (1979); PPRI 3634; PREM 48405
cereal and legume products: Scott (1965)
Copraeae spp.: PPRI 3632; PREM 48604
Eucalyptus maculata: Eicker (1973)
Malus sylvestris: Combrink et al. (1985)
Medicago sativa: PREM 44513
Phaseolus spp.: MRC 281
soil: Allsopp et al. (1987); Doidge (1950); Eicker (1969, 1973) Martin (1960); Papendorf (1976); CSIR 141, 362, 365, 367, 368, 369; MCP 189, 336, PPRI 3904; UCT
Zeae maya: Gilman (1972); McLean & Berjak (1987); Van der Westhuizen & Bredell (1972); CSIR 23, 82, 83, 92, 93, 221, 242, 300, 633; PREM 3633; PREM 43754, 43755, 43756, 43757, 47679
underdetermined host: Thom (1930); Raper & Thom (1949)
=* = varium G. Smith
Zeae maya: Van Warmelo (1967)
fusciun (Sopp) Bourge (application uncertain, Pitt 1979)
Medicago sativa: PREM 44401
glabrum (Wehmer) Westling
dung: PPRI 4308
Medicago sativa: PREM 44535, 44550
Melianthus comosus: PPRI 3807
soil: Allsopp et al. (1987)
wine bottle cork: PPRI 3637; PREM 48406
=* = aurantiobrunneum Dierckx
soil: Cohen (1950)
=* = flavidosorus Bourge
soil: Cohen (1950)
=* = frequentans Westling
Allium cepa: PREM 44767
Anachis hypogaea: Gilman (1972)
cereal and legume products: Scott (1965)
nuts and dried fruit: Wehmer & Rabie (1970)
soil: Papendorf (1976); MCP 122, 185, 190
Sorghum caffrorum: CSIR 546
Zeae maya: Gilman (1972); Van der Westhuizen & Bredell (1972); Van Warmelo (1967); PREM 44300

gliadioli (see E. crustaceum)
glandicola (Oud.) Seifert & Samson
debris: PPRI 3705; PREM 49879
fodder: PREM 48588
cereal grass roots: PPRI 3123
=* = granulatum Bain.
aerospora: Roth (1968)
Medicago sativa: PREM 48568
soil: Cohen (1950)
molasses meal: Roth (1968)
Triticum aestivum: MRC 1135
Zeae maya: Van der Westhuizen & Bredell (1972); PREM 43750
glaucum (Link nomen confusum, Pitt 1979)
cheese: Coles (1925); Davel & Neethling (1930)
Coriulias avellana: PREM 23651
nuts: Dodge (1950)

granulatum (see P. glandicola)
gratioli Sartory (indeterminate, Pitt 1979)
underground, gold mine: Doidge (1950)
PPRI 44301
soil: CSIR 391

griseofulvim Dierckx
birdseed: PPRI 3701
cereal and legume products: Scott (1965)
cubed dogfood: PPRI 3306, 3679
Dalbergia obovata: PPRI 3702; PREM 49887
fishmoth gut: PPRI 3123
Manihot esculenta: Pitt (1979); MRC 270, 273
Medicago spp.: Lamprecht (1988); PREM 48317, 48318
silage: CBS 315.63
soil: De Jesus et al. (1981); Cohen (1950); PPRI 4281
Vigna subterranea: MRC 312
Watsonia marginata: PPRI 3809
Zeae maya: MRC 214
=* = urticae Bain.
cereal and legume products: Scott (1965)
soil: CSIR 391

flavidosorus (see P. glabrum)
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Zea mays: PREM 44308
griseoroseum Dierckx
  = roscocitrum Bourge
aerospora: Dodge (1950); Thom (1930)
herquiri Bain & Sartory
cereal and legume products: Scott (1965)
debris: PPRI 3904
soil: Eicker (1975); CSIR 359, 360, 361, 363; PPRI 4218; PREM 48559
Zea mays: Gilman (1972); Van der Westhuizen & Bredell (1972); Van Warming (1967); CSIR 364, 402, 474, 538, 731
  = conidiogenum Nicot & Pionnat
soil: CSIR 1072
hirayamae (see E. euglaucum)
hirsutum Dierckx
humuli Van Beyma
Eucalyptus maculata: Eicker (1973)
implicatum Biourge
intricatum (see P. jensenii)
islandieum Sopp
inusitatum (see E. inusitatum)
italicum Wehmer
janczewskii Zaleski
soil: Eicker (1969, 1970); PREM 44256
Janthinellum Biourge
debris: PPRI 3904
aerospora: Doidge (1950); Thom (1930)
Zea mays: Van der Westhuizen & Bredell (1972); CSIR 139, 355, 506
inflatum Stolk & Malla
soil: PPRI 3206; PREM 49071
infractum (see P. jensenii)
inustatum (see E. inustatum)
islindicium Sopp
Arachis hypogaea: Gilman (1972)
cereal and legume products: Scott (1965)
contaminant: PPRI 3124, 3714; PREM 47753, 49886
Sorghum caffrorum: Eicker (1973)
soil: CSIR 319, 320, 321, 322, 340, 342; MCP 365; PREM 4803, 4804, 48905
Zea mays: McLean & Berjak (1987); Van der Westhuizen & Bredell (1972); PREM 47545
javanicum (E. javanicum var. javanicum)
jenseni Zaleski
soil: Eicker (1969, 1970); PREM 44256
Zea mays: Van der Westhuizen & Bredell (1972); CSIR 43740, 43753
lindicium Thom (Fusarium oxysporum, Pitt 1979)
soil: Martin (1960); Papendorf (1976)
swine meal: Van Warming (1967)
Zea mays: Van der Westhuizen & Bredell (1972)
lividum Westling
debris: PPRI 3707; PREM 49886
soil: PPRI 4043
luteum (see T. luteus)
luteoviride Bourge (indeterminate, Pitt 1979)
aerospora: Dodge (1950); Thom (1930)
martensi (see P. aurantiogriseum)
megasporum Orput & Fennell
Encephalartos laevifolius: PREM 49069
melini Thom
debris: PREM 47699
Encephalartos laevifolius: PPRI 3178; PREM 49070
mouse nest material: PPRI 4223
soil: Allsopp et al. (1987); Pitt (1979); PREM 4042; PREM 47699
= atravenenatum G. Smith
Arachis hypogaea: CBS 240.65
Zea mays: Van der Westhuizen & Bredell (1972); CSIR 323, 324
meridianum (see E. meridianum)
miczynskii Zaleski
debris: PPRI 3710; PREM 49882
soil: Allsopp et al. (1987); PREM 4040
Zea mays: MRC 426
undetermined host: Pitt (1979)
  = pedemontanum Mosca & Fontana
soil: Papendorf (1976); MCP 127
Zea mays: PREM 44301
  = soppii Zaleski
Eucalyptus maculata: Eicker (1973)
undetermined host: CSIR 1398
minioluteum Dierckx
Dianthus carophyllus: PPRI 3982
Hordeum vulgare: MRC 1756
paper: PPRI 3569; PREM 49874
soil: PREM 48586, 48587
Zea mays: McLean & Berjak (1987); PREM 3984, 4020; PREM 47533, 47538, 47539, 47544, 47618
montanense Christensen & Bakus
do: PPRI 4041
multicolor (see P. sclerotiorum)
nigricans (see P. janczewskii)
notatum (see P. chrysogenum)
novae-zeelandiae Van Beyma
Protea spp.: PPRI 3978
soil: Alsopp et al. (1987); PPRI 4222
ochrochloron Bourge
soil: Eicker (1969)
ochrosalmoneum (see E. ochrosalmoneum)
olivinoviride (see P. viridicatum)
olsonii Bain. & Sartory
paraherquei (see P. simplicissimum)
palitans (see P. viridicatum)
pedemontanum (see P. miczynskii)
petchii Sartory & Bain, (indeterminate, Pitt 1979)
piceum Raper & Fennell
Protea
soil: Allsopp
soil: Eicker (1969)
piscarium (see P. simplicissimum)
debri: PPRI 4038
Eucalyptus maculata:
Eicker (1973)
Zea mays
: PREM 48260, 48567
Arachis hypogaea:
Eicker (1973)
Mushroom casing: Smit (1984)
Zea mays
: PREM 48893
Allium cepa:
Papendorf (1976); MCP 351
Ehretia rigida
: PPRI 4310
Sorghum caffrorum:
fodder: PREM 48584, 48585
Arachis hypogaea:
PPRI 3183, 3184
Ekebergia karoo:
PPRI 3706
Cenchrus ciliaris:
Papendorf (1976); MCP 23
Medicago saliva:
PREM 44370
Medicago sativa:
PPRI 3125; PREM 48315
Zea mays:
PPRI 3574
Arachis hypogaea:
PPRI 3722
Vitis vinifera:
Lamprecht (1988); PPRI 3664
Vitis riparia:
Lamprecht (1988); PPRI 4224; PREM 44773
Arachis hypogaea:
PPRI 4222; PREM 44773
Manihot esculenta:
Pitt (1979); MRC 315
mollasses meal: Roth (1968)
atural gum: Roth (1968)
nuts and dried fruit: Wehner & Rabie (1970)
Phaseolus spp.: MRC 182
soil: Alsopp et al. (1987); CSIR 350, 351
Sorghum caffrorum:
sugar: Doidge (1950); Van der Bijl (1920)
Kiwi spp.: Le Roux et al. (1973)
Zea mays: Gilman (1972); Van der Westhuizen & Breddell (1972); MRC 315; PREM 3120, 3783; PREM 49018
rubrum Stoll
Arachis hypogaea:
CSIR 13
soil: PPRI 3167, 3190, 3889; PREM 47542
Cereals and legume products: Scott (1965)
cheese: Luck & Wehner (1979)
Medicago sativa: PREM 44370
Zea mays: Gilman (1972); Van der Westhuizen & Breddell (1972); PREM 43747
purpurogenum var. rubisclerotum (see P. pinophilum)
pasillum (see E. cinnamopurpureum)
poterillii Thom (Geosmithia poterillii, Pitt 1979)
aerospora: Doidge (1950), Thom (1930)
raistrickii Zaleski
aerospora: PPRI 3712; PREM 49885
Arachis hypogaea:
PPRI 3664
soil: Stolk & Samson (1983); PPRI 4217
Watsonia maritima: PPRI 3722
raistrickii G. Smith
Arachis hypogaea: Pitt (1979); MRC 197
cereal and legume products: Scott (1965)
soil: Alsopp et al. (1987); CSIR 388
Sorghum caffrorum: CSIR 526, 528, 529, 545
Zea mays: Gilman (1972); Van der Westhuizen & Breddell (1972); CSIR 4, PREM 47636
raistrickii (see P. raciborskii)
restrictum Gilman & Abbott
Acacia karroo: Pitt (1979)
Melia azedarach: PREM 47856
soil: Alsopp et al. (1978); Papendorf (1976); MCP 23
soil: Stolk (1969); IMI 151 749
soil: Stolk (1969); Papendorf (1976); MCP 116, 213
roquefortii Thom
cheese: Davel & Neethling (1930); Doidge (1950); Lück & Wehner (1978)
soil: Papendorf (1976); MCP 163
Zea mays: Gilman (1972)
pulvillorum (see P. simplicissimum)
purpureaens (Sopp) Bourge
Fingerathia africana: De Villiers (1989); PREM 49278
Protea spp.: PPRI 4284
stored foods: IMI 141 658
Vitis sinofera: PPRI 3574
purpurogenum Stoll
soil: Allsopp
Trichoderma: PPRI 3308; PREM 49207
Zea mays: PREM 47861, 47863
= lanosum Westling
brattice cloth: Doidge (1950)
cheese: Lück & Wehner (1978)
soil: Papendorf (1976); MCP 163
Zea mays: Gilman (1972)
pulvillorum (see P. simplicissimum)
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rubrum (see P. purpureogenum)

rugulosum Thom

aerospora: Roth (1968)

Allium cepa: PREM 44775

Arachis hypogaea: PREM 48388

cocnut matting: Doidge (1950)

Gladiolus spp.: PPRI 3596; PREM 49413

natural gum: Roth (1968)

Zea mays: Van der WESTHUIZEN & BREDELL (1972); PREM 43739

= tardum Thom

aerospora: Doidge (1950); Thom (1930)

Arachis hypogaea: Gilman (1972)

soil: CSIR 344; MCP 372

timber: Doidge (1950)

Zea mays: Gilman (1972); Van der WESTHUIZEN & BREDELL (1972)

sclerotiorum Van Beyma

fodder: PREM 48806

Kniphofia spp.: PREM 48877

soil: Pitt (1959); Raper & Thom (1949); PREM 48571; PPRI 3901, 4069, 4139

Zea mays: Stolk & Samson (1983); MRC 425

= multicolor Gregorieva-Manoilova & Poradielova (application uncertain, Pitt 1979)

cereal and legume products: Scott (1965)

Eucalyptus maculata: Eicker (1973)


Zea mays: Van der WESTHUIZEN & BREDELL (1972); CSIR 208, 397; MCP; PREM 43748

senticosum (see E. senticosum)

simplicissimum (Oudem.) Thom

Arachis hypogaea: PREM 48032, 48564

cereal and legume products: Scott (1965)

dung: PPRI 3214; PREM 49084

flannel bag: Raper & Thom (1949); Pitt (1979); IMI 039 816

Medicago spp.: Lamprecht et al. (1988); PREM 48313, 48314

soil: Eicker (1969); Papendorf (1976); CSIR 339; MCP 178, 199; PPRI 4067; PREM 48902, 48903, 48904

Sorghum bicolor: MRC 2206

ventilation tubing: Doidge (1950)

Zea mays: Van der WESTHUIZEN & BREDELL (1972); CSIR 77

= paraherquii Abe

soil: Papendorf (1976); MCP 39, 105, 188

= piscatium Westling

soil: Papendorf (1976); MCP 187

= pulvillorum Turffit

cereal and legume products: Scott (1965)

Eucalyptus maculata: Eicker (1973)

soil: Eicker (1969, 1973); PREM 44287

Zea mays: Nagel & Steyn (1972); CSIR 1405, 1406

solitum (see P. aurantiogriseum)

soppu (see P. miczynskii)

spiculisporum (see T. trachyspermus)

spinulosum Thom

Allium cepa: Naude & Jooste (1989); PREM 48002, 48561, 48871, 48872, 48873

Pinus spp.: PPRI 3505

soil: Cohen (1950); Papendorf (1976); MCP 165; UCT

Zea mays: Van der WESTHUIZEN & BREDELL (1972); CSIR 200; PREM 43749

undetermined host: Thom (1930)

= terlikowskii Zaleski

Zea mays: CSIR 411, 412, 475, 684, 685

= trzebinskii Zaleski

soil: Cohen (1950)

steckl (see P. citrinum)

stokkiae (see E. stokkiae)

stoloniferum (see P. hrvicompactum)

stratisporum (see P. restrictum)

sublateritium Bourge

soil: Cohen (1950)

tardum (see P. rugulosum)

terlikowskii (see P. spinulosum)

terrenum (see E. terrenum)

terrestre Raper & Thom (application uncertain, Pitt 1979)

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

thomi Mare

aerospora: Roth (1968)

cereal and legume products: Scott (1965)

Cussonia paniculata: PPRI 3784

molasses meal: Roth (1968)

soil: Eicker (1975); Papendorf (1976); CSIR 752; MCP 38; PPRI 3237, 4044; UCT

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

trzebinskii (see P. spinulosum)

urticae (see P. griseofulvum)

vairiabile Sopp

Allium cepa

Zea mays:

= aerospora: Roth (1968)

Arachis hypogaea: Doidge (1950); Thom (1930)

Aerospora: Thom (1930)

cereal and legume products: Scott (1965)

Cussonia paniculata: PPRI 3784

soil: Eicker (1975); Papendorf (1976); CSIR 752; MCP 38; PPRI 3237, 4044; UCT

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

vulpinum (Cooke & Massee) Siefert & Samson

Zea mays:

= aerospora: Thom (1930)

soil: PPRI 3727; PREM 49880

= claviforme Bain.

terrestre Raper & Thom (application uncertain, Pitt 1979)

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

thomi Mare

aerospora: Roth (1968)

cereal and legume products: Scott (1965)

Cussonia paniculata: PPRI 3784

molasses meal: Roth (1968)

soil: Eicker (1975); Papendorf (1976); CSIR 752; MCP 38; PPRI 3237, 4044; UCT

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

Zea mays: Gilman (1972); Van der WESTHUIZEN & BREDELL (1972)

Eucalyptus maculata:

cereal and legume products: Scott (1965)

cocnut matting: Doidge & Van der Plank (1936)

dung: PPRI 3212

Phaseolus spp: MRC 220

soil: PPRI 3575

verruculosum Peyronel

Cussonia paniculata: PREM 47307

Eucalyptus maculata: Eicker (1973)

Orzya sativa: MRC 171

soil: Allsopp et al. (1987); Eicker (1969, 1970, 1973); CSIR 347; PPRI 3501; PREM 44265, 48017; UCT

Zea mays: PPRI 3873

viridicatum Westling

aerospora: Thom (1930); Doidge (1950)

Arachis hypogaea: MRC 292

birdseed: PREM 44221

cereal and legume products: Scott (1965)

soil: CSIR 15, 405, 407; PREM 48906

Zea mays: Hutchison et al. (1973); Pitt (1979); Van der WESTHUIZEN & BREDELL (1972); CSIR 255, 349, 354, 396, 413, 425, 430, 460, 570, 663, 724; MRC 422

= oenosporide Bourge

Allium cepa: PREM 44769

= palitans Westling

Allium cepa: PREM 44758

soil: Doidge (1950)

Zea mays: Van der WESTHUIZEN & BREDELL (1972)

vulpinum (Cooke & Massee) Siefert & Samson

dung: PPRI 3727; PREM 49880

= claviforme Bain.
molasses meal: Roth (1968); soil: CSIR 1088, 1089
wakamoni Zaleski
Barteria obtusa: PPRI 7044; PREM 49884
Encephalartos spp.: PPRI 4283
Medicago sativa: PREM 44474
soil: Eicker (1975), Papendorf (1976); MCP 40
Zea mays: Van der Westhuizen & Bredell (1972); MRC 203
wortmannii (see T. wortmannii)
Penicillium species undetermined
aerospora: Ordman (1963, 1970); Ordman & Eiter (1956); Radmore (1986); Van der Merwe et al. (1975)
Cenchrus ciliaris: Beuzenoudenhout (1977)
cheese: Lüück et al. (1976); Lüück & Wehner (1979)
Citrus sinensis: Doige (1950); Doige & Van der Plank (1936); Roth (1967); Verwoerd (1929)
Crucifera spp.: Holzhausen & Knox-Davies (1974)
Cucumis melo: Doige et al. (1953)
Eucalyptus spp.: Lundquist & Baxter (1985)
fodder: Dutton & Westlake (1985)
foodstuff: Martin & Keen (1978)
Hordeum vulgare: Doidge (1950); Doidge & Van der Plank (1936)
Iris spp.: Doige et al. (1953)
Litchi chinensis: Doige et al. (1953); Roth (1963)
Lupinus spp.: Van Warmelo (1967)
Mangifera indica: Wehner et al. (1981)
Malus sylvestris: Doige et al. (1953); Verwoerd (1929)
Medicago sativa: Lamprecht (1988); Marasas & Bredell (1973); Van Warmelo (1967); PREM 44530, 44551, 44554
molasses meal: Roth (1968)
Musa spp.: Roth & Loest (1965)
Narcissus spp.: Doige et al. (1953)
nuts and dried fruit: Wehner & Rabie (1970)
Panicum coloratum: Eicker (1976)
Pinus spp.: Lundquist (1987)
Prunus persica: Doige et al. (1953)
Prunus salicina: Doige et al. (1953)
recalcitrant seed: Berjak (1989)
Zea mays: Gilman (1972); Marasas & Van Rensburg (1986); McLean & Berjak (1997); Van Warmelo (1967); Wittaker et al. (1989); CSIR 218, 264, 414, 415

GENUS EUPENICILLIUM

alulateum (see E. terrenum)

anatolicum (see E. euglaucum)

baarnense (Van Beyma) Stolk & Scott
Acacia mollisjuna: CBS 339.61
soil: Scott (1968b), CSIR 1059, 1070, 1071, 1090, 1096, 1107, 1130; PPRI 3259

brefeldianum (see E. javanicum var. javanicum)

catenatum Scott
soil: Scott (1968a); Stolk & Samson (1983); CBS 325.67, CSIR 1097, PREM 48556
cinnamopurpureum Scott & Stolk
Pinus spp.: CBS 492.66, CSIR 946
soil: Scott (1968b); Stolk & Samson (1983); CBS 490.66, 491.66; CSIR 942, 943, 945, 946, 1126; PREM 48558
undetermined host: Stolk & Samson (1983)
= P. pastilum G. Smith
Zea mays: CSIR 606
crustaceum Ludwig
soil: Scott (1968b), CBS 214.71, 215.71, 216.71; CSIR 1026, 1027, 1057, 1012, 1805, 1824; PREM 48551
= P. asperum (Shear) Raper & Thom
Eucalyptus macrocarpa: Eicker (1973)
= P. gladioli McCulloch & Thom
Gladiolus spp.: Doidge (1950, et al. 1953); PREM 30706
ehrlichii (see E. javanicum var. javanicum)
erubescens (see E. terrenum)
euglaucum (Van Beyma) Stolk & Samson
soil: Stolk & Samson (1983); CBS 46767
Zea mays: Stolk & Samson (1983); CBS 238.65
= anatolicum Stolk
soil: Scott (1968b), Stolk & Samson (1983) CSIR 1095, 1113
= hirayamae Scott & Stolk
soil: Allsopp et al. (1987); Scott (1968b); CSIR 1112; PPRI 3264; PREM 49212
Zea mays: CBS 238.65; CSIR 445
= P. hirayamae Scott & Stolk
Zea mays: CSIR 487, 554, IMI 136 205
hirayamae (see E. euglaucum)
insistens Scott
soil: Scott (1968a), Stolk & Samson (1983); CBS 351.67, CSIR 1096; PREM 48570
= P. insistens Scott
soil: IMI 136 214
javanicum (Van Beyma) Stolk & Scott var. javanicum apple juice: Stolk & Samson (1983)
soil: Stolk & Samson (1983); CBS 211.71
undetermined host: Stolk & Samson (1983)
= brefidanielum (B. Dodge) Stolk & Scott
apple juice: CBS 291.62
= ehrlichii (Klebahn) Stolk & Scott
soil: Scott (1968b); CSIR 1025, 1026, 1027; MCP ; PPRI 3262, 3695; PREM 49195, 49362
= javanicum (Van Beyma) Stolk & Scott
Archaea hypogaea: CSIR 416, 417, 419, 420, 421, 424; PREM 48259
soil: Scott (1968b); CSIR 1004, 1005, 1006, 1007, 1008, 1009, 1015, 1018, 1029, 1025, 1026, 1027, IMI 136 209; 48382, 48350;
= P. javanicum Van Beyma
soil: Eicker (1969, 1970, 1973); Martin (1960); Papendorf (1976); MCP 123
Zea mays: Van der Westhuizen & Bredell (1972)
lapidosum Scott & Stolk
soil: Scott (1968b); CBS 318.66, CSIR 1035; PREM 48880
Zea mays: CSIR 1093
unrecorded host: Stolk & Samson (1983)
= P. lapidosum Raper & Fennell
soil: IMI 113 748, PREM 48880; UCT
meridianum Scott
soil: Scott (1968a, b); Stolk & Samson (1983); CBS 314.67, 21771, 21971; CSIR 1052, 1037, 1036, 1013; PREM 48884
= P. meridianum Scott
soil: IMI 136 209
ochrasalmonenum Scott & Stolk
soil: Scott (1968b); Stolk & Samson (1983); CBS 515.67; CSIR 1094; PREM 48886
Zea mays: Stolk & Samson (1983); CBS 489.66; CSIR 145
= P. ochrasalmonenum Udagawa
Zea mays: IMI 116 248
parvum (Raper & Fennell) Stolk & Scott
soil: Scott (1968b); CSIR 973, 1054, 1058; MCP, ; PPRI 3263; PREM 48557, 48881, 48887, 49194
pinetorum Stolk
soil: Allsopp et al. (1987); Scott (1968b); CBS 328.71; CSIR 1092, 1125; PPRI 3490; PREM 48883; UCT
Bothalia 22.1 (1992)

P. pinetorum Stolk
soil: CSIR 1092

senticosum Scott
soil: Scott (1968a, b); Stolk & Samson (1983); CBS 313.67, 327.71; CSIR 1042, 1034; IMI 216 905; PREM 48882
# P. senticosum Scott
soil: IMI 216 905

shearti Stolk & Scott
Medicago spp.: Lamprecht (1988); PPRI 4017; PREM 48322
soil: Scott (1968b); CSIR 1003, 1016, 1017; PREM 48549

Zea mays:
# P. stolkiae Scott
soil: Scott (1968a, b); Stolk & Samson (1983); CBS 315.67, 330.71, 331.71; CSIR 1003, 1041, 1074; PREM 48552

Eupenicillium species undetermined
soil: CSIR 1127, 1128, 1129; PPRI; UCT

1. Talaromyces
avellaneus (Thom & Turesson) C.R. Benjamin (anamorph: Merimbla inglheimense, Pitt 1979)
soil: CSIR 958, 959

bacillosporus (Swift) C.R Benjamin (anamorph: Geosmithia swiftii, Pitt 1979)
soil: CSIR 961

flavus (Klöcker) Stolk & Samson
apple juice: Pitt (1979)
contaminant: PPRI 3790; PREM 48577
Encephalartos laevifolius: PPRI 3213; PREM 49074
wine bottle cork: MCP 27
# flavus var. macrosorum Stolk & Samson
fruit: Stolk & Samson (1972); CBS 317.63; IMI 197 487
soil: Stolk & Samson (1972); CBS 226.72; PPRI 3791

thermophilus Stolk
Celtis africana litter: Pitt (1979); Stolk & Samson (1972); CBS 116.72

* P. dupontii Griffin & Maubl.
apple juice: Van der Spuy et al. (1975)
compost: IMI 197 483
mushroom compost: Eicker (1977)

wortsannii (Klöcker) C.R. Benjamin
Arachis hypogaea: MRC 332
Oryza sativa: Pitt (1979)
soil: Allsopp et al. (1987); MCP 1134; Stolk & Samson (1972); CBS 293.53; CSIR 954, 957, 964, 965
Watsomia marginata: PPRI 3675

* P. wortsannii Klöcker
Oryza sativa: MRC 243