Chapter 1
Various Methods of Long-Term Preservation of Fungal Cultures in All-Russian Collection of Microorganisms (VKM)

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1.1 Introduction

Microorganisms are fundamental materials for scientific and practical studies. Culture collections (biological resource centers) play a primary role in the stable preservation and long-term storage of microbial resources and ensure regular access to well-documented strains after a long time from their isolation for scientific or biotechnological use [32, 33].

Various methods of preservation of fungal cultures have been reported [13, 25, 29]. Freeze-drying (lyophilization) and cryopreservation methods are utilized for thousands of fungal strains in microbial collections all over the world [7, 12, 27]. Nevertheless, it is clear that the fungal strains of different species vary in the ability to survive after long-time storage preservation under laboratory conditions. Some of them are very difficult to maintain *ex situ*, whereas others could be easily and successfully preserved alive by using almost any conservation technique.

Storage methods for filamentous fungi result from the type and degree of sporulation. Spore-forming strains (as opposed to nonsporulating strains) can be effectively freeze-dried. Both types can be frozen and stored for long periods in liquid nitrogen or in a low-temperature refrigerator. The experience of long-term preservation of fungal strains shows that the duration of storage directly depends not only on the choice of the method but also on the laboratory protocol and temperature of subsequent cultures storage.

This chapter presents the methods of cryopreservation, freeze-drying, drying on silica gel, and preservation in sterile soil that are utilized in VKM fungal collection, accompanied by data on maximal storage time registered. The methods take into consideration the special features of cultures preserved as well as the equipment used.

VKM fungal collection (All-Russian Collection of Microorganisms, Russia) was established in 1955 and has a long-term experience in the preservation and storage of fungal cultures. Collection of filamentous fungi is currently composed of approximately 7000 strains (590 genera, 1600 species) belonging to species of the kingdoms Chromista (*Oomycota*) and Fungi (zygomycetous, ascomycetous and basidiomycetous fungi).

All the information on preservation methods for each VKM fungal strain is presented in the MS Access database. It keeps curated data on the strain numbers, preservation dates as well as inspection dates in various methods, and other technical information. Fields in the database table are presented in Annex 1. For operational analysis of these data, we use MS Access requests – «FunPreservEnd», «FunPreserv_Times», «FunPreserv_MaxTimes». The maximal preservation time is calculated automatically; the latest results (25.11.2019) are presented in Annex 2.

Preserved for many years fungi of various taxa retain their ability to produce different substances suitable as a material for industry and medicine. For instance, the zygomycetous fungus *Cunninghamella japonica* VKM F-1204D was found to be a promising lipid producer for biodiesel production [22]. Fungi of the genus *Penicillium*, which are supported in the collection for more than 40 years (VKM

F-325, VKM F-691, VKM F-1823), are able to synthesize active compounds with diverse structures [10]. *Aspergillus brasiliensis* VKM F-1119, which was accepted by VKM 52 years ago, engaged in the vital process of biotransformation of artemisinin, uncial medicine for the treatment of tropical malaria [34]. Recently published data on the assessment of the effect of freeze-drying and long-term storage on the biotechnological potential of *Aspergillus* section Nigri strains show maintaining of biotechnological properties after preservation [19].

1.2 Cryopreservation of Filamentous Fungi

According to published data, the fast cooling rates followed by storage in liquid nitrogen at -196 °C allow secure and long-term preservation of some fungal cultures [21]. However, the ability to resist damage by freezing and warming differs considerably among genera/species and depends on their particular features (presence and type of sporulation, chemical composition of cytoplasmic membrane and cell wall, physiological state, etc.). Selection of optimal cryoprotectants, rates of cooling, and warming has enabled increasing the number and diversity of taxa preserved by this method [24, 28].

More than 75% filamentous fungi of VKM are stored using various cryopreservation protocols. Cultures with abundant sexual and nonsexual sporulation usually were preserved by using fast cooling rates followed by storage either in liquid nitrogen or in ultralow temperature freezers at −70 °C.

It was noticed that some cultures of zygomycetous fungi belonging to the genera *Mortierella*, *Basidiobolus*, *Coemansia*, and *Entomophthora* do not survive the ultrarapid freezing procedure even if they have abundant sporulation. Successful preservation of such strains was achieved by modification of the cryopreservation regime, for example, using slow programmed freezing. The same method was used either for nonsporulating fungi (basidiomycetous fungi) or zoosporeforming former fungi (*Chromista*, *Oomycota*).

According to our data, some parts of strains of *Oomycota* (20%), basidiomycetous fungi (4%), zygomycetous fungi (1%), and ascomycetous fungi (1%) did not survive cryopreservation at all freezing regimes and modification applied [9]. The strains most difficult to maintain belong to genera *Dictyuchus* and *Phytophthora* and to some species of *Achlya* and *Saprolegnia*. Similar situations have also been seen with some species of basidiomycetous fungi (*Suillus*, *Amanita*, *Dictyophora*, *Mutinus*, etc.). They are usually maintained by subculturing and preservation under mineral oil.

It has been suggested that those microbial cultures that are able to survive the freezing and a short storage will permanently stay in the vital state after any length of storage [20]. According to our data, this is not quite true: some strains of *Achlya colorata*, *Achlya intricata*, *Clitocybe odora*, *Choanephora conjuncta*, *Conidiobolus thromboides*, *Kickxella alabastrina*, *Phanerochaete sanguinea*, *Rhodocollybia butyracea*, and *Saprolegnia terrestris* have lost their ability to grow after 5–7

years of storage in liquid nitrogen, although they were in the viable state after 24 h of storage. The reason is not yet known. Nevertheless, the viability test showed that representatives of 311 species of fungi remain alive after 20–30 years of storage (Annex 2).

The cooling equipment being used in VKM is storage tanks "Bioproducts-0.5" with a capacity of 500 liters of liquid nitrogen and ultralow temperature freezers (−80 °C, Sanyo, Japan).

1.3 Freeze-Drying of Filamentous Fungi

Currently, freeze-drying is used to preserve approximately 85% of filamentous fungi maintained in VKM. Fungi from different taxonomical groups (zygomycetous fungi, ascomycetous fungi – both teleo- and anamorph) able to produce dormant structures (spores, sclerotia, etc.) usually survive freeze-drying [11]. According to our data, about 90% of strains of these fungal groups remain alive in this method. We noticed that the freeze-dried strains of 817 species stored at 5 °C for more than 20 years were in a viable state, and cultures of 289 species have been sustained for even 40–50 years of storage. Some species did not survive freeze-drying even when the sporulation is abundant, those are *Conidiobolus coronatus*, *C. thromboides*, *Entomophthora thaxteriana*, *E. conica*, *E. dipterigena*, *Cunninghamella homothallica*, and *C. vesiculosa*. Species of genus *Botrytis* (*B. fabae* and *B. squamosa)*, forming only sclerotia as a dormant structure, remain in a vital state in freeze-drying only for rather a short time – less than 10 years [9].

Nonsporulating microorganisms from *Oomycota* and basidiomycetous fungi are not stored in VKM by freeze-drying, since sterile mycelia generally do not remain viable.

The equipment used in VKM for freeze-drying is the centrifugal freeze-dryer system Micromodulyo (Edwards, UK).

1.4 Drying in Sterile Soil of Filamentous Fungi

This simple and popular method for the preservation of fungi was applied at the beginning of the twentieth century [18]. Species of *Aspergillus* and *Penicillium* can be maintained by this way more effectively than other micromycetes. According to T.P. Suprun [31] who investigated the preservation of 78 *Penicillium* species (more than 1000 strains) in sterile soil for 7–10 years, the best preserved strains were representatives of *Assymmetrica* section. Less effectively preserved species were *Biverticillata-Symmetrica*, and the lowest effectiveness was observed with strains of the section *Monoverticillata*.

This method is also efficient for preservation of some human, animal, and plant pathogens with retaining their virulence [21]. For example, *Alternaria japonica* (syn.

A. raphani), *Fusarium oxysporum*, and the species of *Septoria* (*S. avenae*, *S. nodorum*, *S. passerinii*, *S. tritici*) have retained their ability to infect a plant host after 2–5 years of storage [2, 8, 23]. Some degraded strains of micromycetes partly recuperated their lost qualities after preservation in soil [30].

According to our data, fungal strains of 167 species stored by this method are able to maintain viability for more than 30 years, and cultures of 87 species have been sustained for even 40–55 years of storage.

1.5 Drying of Filamentous Fungi on Silica Gel

Immobilized cells of microorganisms retain viability and biological activity at action of different stressors, as a rule, better than free ones [4]. Therefore, the preliminary drying of the cells on the adsorbent allows the microorganisms to remain viable for a longer time. As an adsorbent on which a suspension of microorganisms is applied for subsequent drying, silica gel (a dried gel of polysilicic acid with numerous pores) is most often used [5]. Silica gel promotes the dehydration of microorganisms and helps them to survive a thermal stress [24]. Since the silica gel can prevent all fungal growth and metabolism, the risk of any morphological, physiological, and genetic changes could be minimized [1].

Using of anhydrous silica gel particles for maintaining stock cultures of *Neurospora crassa* was suggested by D. Perkins in 1962 [17]. This new method has proved consistently useful and effective over several years.

At present, this method is widely used in relation to different taxa and ecological groups of fungi. So, the method was effective for the storage of entomopathogenic fungi of the order of *Hypocreales* for 2 years [3] and, in particular, *Metarhizium anisopliae* [6], as well as for fungi of many other taxa, including the spores of obligate biotrophic parasite *Podosphaera fusca* [16] and rust fungi, which cannot be grown on agar media [1].

As a disadvantage of the silica gel preservation method, researchers note that the time of storage is quite short (between 2 and 4 years) [14, 26]. But it is clear that the features of the methodological protocols can be crucial for the fungi preservation by this method, wherein the temperature at which frozen fungi are stored affects how long they could be preserved while remaining viable.

The method of storage on silica gel was introduced in VKM in the middle of the 1980s [24]. Our experience has shown that several groups of fungi can be preserved by this method without losing vitality for many years (Table 1.1).

The viability of more than 300 strains of zygomycetous fungi with various types of sporogenous structures (6 classes, 6 orders, 15 families, 35 genera, and 118 species) and near 300 strains of dark-colored anamorphic ascomycetous fungi with different types of conidiogenesis (7 classes, 18 orders, 34 families, 79 genera, and 164 species) (Table 1.2) was assessed from 1 to near 30 years of preservation (Figs. 1.1 and 1.2).

Table 1.1 Drying of VKM fungal cultures on silica gel (storage time)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
1	*Absidia caerulea* Bainier 1889	4	13,98	8,84	29,95
2	*Absidia cuneospora* G.F. Orr et Plunkett 1959	1	1,21	1,21	30,57
3	*Absidia cylindrospora* Hagem 1908	2	16,15	11,79	30,02
4	*Absidia glauca* Hagem 1908	4	10,77	7,78	29,95
5	*Absidia repens* van Tieghem 1878	1	1,07	1,07	29,44
6	*Absidia spinosa* Lendner 1907	1	1,66	1,09	30,00
7	*Acrophialophora fusispora* (S.B. Saksena 1953) Samson 1970	1	32,24	22,34	32,24
8	*Actinomucor elegans* (Eidam 1884) C.R. Benjamin et Hesseltine 1957	7	15,52	11,34	30,04
9	*Albifimbria verrucaria* (Albertini et Schweinitz 1805) L. Lombard et Crous 2016	1	11,05	11,05	32,41
10	*Alternaria alternata* (Fries 1832) Keissler 1912	5	10,98	8,66	31,61
11	*Alternaria atra* (Preuss 1852) Woudenberg et Crous 2013	4	31,81	13,31	31,87
12	*Alternaria botrytis* (Preuss 1851) Woudenberg et Crous 2013	9	25,40	11,32	32,11
13	*Alternaria brassicicola* (Schweinitz 1832) Wiltshire 1947	1	21,75	10,36	31,68
14	*Alternaria chartarum* Preuss 1848	4	26,64	10,07	31,97
15	*Alternaria consortialis* (Thuemen 1876) Groves et Hughes 1953	3	9,63	8,25	32,25
16	*Alternaria japonica* Yoshii 1941	1	6,96	3,04	32,26
17	*Alternaria macrospora* Zimmermann 1904	2	5,47	1,63	31,97
18	*Alternaria multirostrata* E.G. Simmons et C.R. Jackson 1968	1	1,30	6,18	31,56
19	*Alternaria oudemansii* (E.G. Simmons 1967) Woudenberg et Crous 2013	1	1,00	4,89	31,26
20	*Alternaria radicina* Meier et al. 1922	1	5,88	2,84	32,32
21	*Alternaria solani* Sorauer 1896	1	1,19	3,21	31,91
22	*Alternaria tenuissima* (Kunze 1818) Wiltshire 1933	1	22,35	10,91	32,26
23	*Amerosporium concinnum* Petrak 1953	1	31,26	9,91	31,26
24	*Ampelomyces artemisiae* (Voglino 1905) Rudakov 1979	1	10,61	6,64	31,95
25	*Ampelomyces heraclei* (Dejeva 1967) Rudakov 1979	1	10,61	10,61	31,97
26	*Ampelomyces humuli* (Fautrey 1890) Rudakov 1979	1	31,99	10,61	31,95
27	*Ampelomyces polygoni* (Potebnia 1907) Rudakov 1979	1	0,72	2,51	22,56
28	*Ampelomyces ulicis* (Adams 1907) Rudakov 1979	1	22,03	10,61	31,95
29	*Ampelomyces uncinulae* (Fautrey 1893) Rudakov 1979	1	21,69	1,35	31,62

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
30	*Apenidiella strumelloidea* (Milko et Dunaev 1986) W. Quaedvlieg et P.W. Crous 2014	1	0,96	3,09	32,48
31	*Aposphaeria caespitosa* (Fuckel 1869) Jaczewski 1917	1	10,64	3,30	32,05
32	*Arthrinium arundinis* (Corda 1838) Dyko et Sutton 1981	1	10,28	10,30	31,62
33	*Arthrinium sphaerospermum* Fuckel 1874	1	21,99	10,57	31,91
34	*Ascochyta malvicola* Saccardo 1878	1	2,17	2,17	31,62
35	*Aureobasidium melanogenum* (Hermanides-Nijhof 1977) Zalar et al. 2014	6	28,72	8,05	32,33
36	*Aureobasidium microstictum* (Bubak 1907) W.B. Cooke 1962	1	31,99	6,68	31,99
37	*Aureobasidium pullulans* (de Bary 1866) G. Arnaud 1918	7	24,50	9,05	32,09
38	*Backusella circina* J.J. Ellis et Hesseltine 1969	1	4,30	7,25	29,98
39	*Backusella indica* (Baijal et B.S.Mehrotra 1965) G. Walther et de Hoog 2013	1	4,42	4,42	30,49
40	*Backusella lamprospora* (Lendner 1908) Benny et R.K. Benjamin 1975	3	6,55	4,25	29,93
41	*Backusella oblongielliptica* (H. Naganishi et al. ex Pidoplichko et Milko 1971) G. Walther et de Hoog 2013	1	1,33	1,33	29,67
42	*Backusella recurva* (E.E. Butler 1952) G. Walther et de Hoog 2013	1	4,45	7,42	29,84
43	*Backusella tuberculispora* (Schipper 1978) G. Walther et de Hoog 2013	1	4,11	6,66	28,58
44	*Backusella variabilis* (A.K. Sarbhoy 1965) G. Walther et de Hoog 2013	1	7,42	4,45	29,84
45	*Beauveria brongniartii* (Saccardo 1892) Petch 1926	1	2,98	6,02	32,37
46	*Benjaminiella poitrasii* (R.K. Benjamin 1960) Arx 1981	1	16,01	7,33	29,84
47	*Berkeleyomyces basicola* (Berkeley et Broome 1850) W.J. Nel et al. 2017	1	3,24	3,24	31,99
48	*Bipolaris australiensis* (M.B. Ellis 1971) Tsuda et Ueyama 1981	4	19,07	5,70	31,58
49	*Bipolaris cynodontis* (Marignoni 1909) Shoemaker 1959	1	21,62	10,21	31,56
50	*Bipolaris sorokiniana* (Saccardo 1890) Shoemaker 1959	2	8,51	8,45	31,82
51	*Bipolaris victoriae* (F. Meehan et H.C. Murphy 1946) Shoemaker 1959	1	0,96	0,96	21,23
52	*Bispora antennata* (Persoon 1801) E.W. Mason 1953	1	4,79	1,70	31,19

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
53	*Bispora betulina* (Corda 1838) S. Hughes 1958	1	3,38	3,38	3,38
54	*Bispora effusa* Peck 1891	1	6,24	2,17	10,30
55	*Blakeslea trispora* Thaxter 1914	8	16,69	12,33	29,84
56	*Botryotrichum piluliferum* Saccardo et Marchal 1885	4	17,10	6,78	25,82
57	*Botrytis aclada* Fresenius 1850	2	10,87	6,84	32,22
58	*Botrytis anthophila* Bondartsev 1913	1	5,82	2,72	32,20
59	*Botrytis cinerea* Persoon 1794	8	1,30	1,65	15,34
60	*Botrytis convoluta* Whetzel et Drayton 1932	2	5,23	6,26	32,11
61	*Botrytis elliptica* (Berkeley 1881) Cooke 1901	1	1,02	1,02	1,02
62	*Botrytis galanthina* (Berkeley et Broome 1873) Saccardo 1886	1	1,02	1,02	1,02
63	*Botrytis gladiolorum* Timmermans 1941	2	2,11	4,48	17,66
64	*Botrytis tulipae* (Libert 1830) Lind 1913	1	0,08	0,08	2,90
65	*Cadophora fastigiata* Lagerberg et Melin 1928	1	10,76	3,35	32,14
66	*Cadophora malorum* (Kidd et Beaumont 1924) W. Gams 2000	4	8,82	6,40	32,16
67	*Cadophora melinii* Nannfeldt 1934	1	3,31	8,34	32,07
68	*Cephalotrichum gorgonifer* (Bainier 1907) Sandoval-Denis et al. 2016	1	3,02	7,00	32,24
69	*Cephalotrichum purpureofuscum* (Schweinitz 1832) S. Hughes	1	0,98	0,98	31,24
70	*Cephalotrichum stemonitis* (Persoon 1801) Nees 1812	3	3,21	4,22	23,24
71	*Chaetocladium brefeldii* van Tieghem et G. Le Monnier 1873	2	23,8	12,77	30,4
72	*Chaetocytostroma* sp.	1	0,01	1,02	21,34
73	*Chloridium caesium* (Nees et T. Nees 1818) Réblová et Seifert 2016	1	1,32	1,32	31,58
74	*Chloridium virescens* (Persoon 1797) W. Gams et Holubova-Jechova 1976 var. *caudigerum* (Hoehnel 1903) W. Gams et Holubova-Jechova 1976	1	1,13	1,13	31,39
75	*Choanephora infundibulifera* (Currey 1873) Saccardo 1891	1	17,56	7,35	29,88
76	*Circinella muscae* (Sorokin 1870) Berlese et de Toni 1888	3	21,11	5,88	30,11
77	*Circinella umbellata* van Tieghem et G. Le Monnier 1873	1	15,27	6,34	28,33
78	*Cladophialophora chaetospira* (Grove 1886) Crous et Arzanlou 2007	1	10,57	3,21	31,91
79	*Cladosporium aecidiicola* Thuemen 1876	1	1,01	4,82	31,24

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
80	*Cladosporium brevicompactum* Pidoplichko et Deniak 1941	2	6,23	6,21	31,65
81	*Cladosporium cladosporioides* (Fresenius 1850) G.A. de Vries 1952	2	9,08	5,15	32,41
82	*Cladosporium colocasiae* Sawada 1916	1	1,04	2,94	32,15
83	*Cladosporium cucumerinum* Ellis et Arthur 1889	1	1,07	1,07	32,07
84	*Cladosporium elegantulum* Pidoplichko et Deniak 1938	2	10,51	10,53	31,86
85	*Cladosporium gossypiicola* Pidoplichko et Deniak 1941	2	16,32	6,72	32,08
86	*Cladosporium herbarum* (Persoon 1794) Link 1816	15	9,14	7,05	29,98
87	*Cladosporium lycoperdinum* Cooke 1883	1	4,82	4,82	31,24
88	*Cladosporium macrocarpum* Preuss 1848	3	3,32	4,61	31,68
89	*Cladosporium pseudocladosporioides* Bensch et al. 2010	1	31,22	9,87	31,22
90	*Cladosporium sphaerospermum* Penzig 1882	5	10,02	7,61	30,28
91	*Cladosporium straminicola* Pidoplichko et Deniak 1938	1	3,09	3,09	32,48
92	*Cladosporium transchelii* Pidoplichko et Deniak 1938	1	11,13	3,09	32,48
93	*Cokeromyces recurvatus* Poitras 1950	2	16,73	7,31	29,45
94	*Colletotrichum gloeosporioides* (Penzig 1882) Penzig et Saccardo 1884	2	13,94	2,12	20,95
95	*Colletotrichum musae* (Berkeley et M.A. Curtis 1874) Arx 1957	1	9,94	1,00	31,26
96	*Conidiobolus coronatus* (Costantin 1897) Batko 1964	1	1,74	1,74	30,37
97	*Coniothyrium concentricum* (Desmazieres 1840) Saccardo 1878	1	31,62	21,69	31,62
98	*Coniothyrium hellebori* Cooke et Massee 1886	1	10,96	1,05	10,96
99	*Coniothyrium rosarum* Cooke et Harkness 1882	2	10,49	6,52	31,83
100	*Coniothyrium wernsdorffiae* Laubert 1905	1	1,28	2,15	2,15
101	*Cunninghamella blakesleeana* Lendner 1927	1	7,80	7,80	30,16
102	*Cunninghamella echinulata* (Thaxter 1891) Thaxter ex Blakeslee1905	11	17,54	6,51	30,00
103	*Cunninghamella japonica* (Saito 1905) Pidoplichko et Milko 1971	7	10,65	7,76	29,56
104	*Curvularia comoriensis* Bouriquet et Jauffret 1955 ex M.B. Ellis 1966	1	3,17	10,59	31,93
105	*Curvularia geniculata* (Tracy et Earle 1896) Boedijn 1933	2	5,44	3,45	16,72

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
106	*Curvularia inaequalis* (Shear 1907) Boedijn 1933	1	31,91	6,96	32,01
107	*Curvularia lunata* (Wakker 1898) Boedijn 1933	2	5,93	3,35	32,11
108	*Dematioscypha delicata* (Berkeley et Broome 1859) Hosoya 2014	1	0,00	1,94	4,99
109	*Dicyma ampullifera* Boulanger 1897	1	6,20	6,20	6,20
110	*Dicyma olivacea* (Emoto et Tubaki 1970) Arx 1982	1	0,80	5,90	5,90
111	*Didymella glomerata* (Corda 1840) Q. Chen et L. Cai 2015	6	32,92	8,97	31,92
112	*Didymella pomorum* (Thümen 1879) Q. Chen et L. Cai 2015	2	16,31	6,67	31,95
113	*Dinemasporium strigosum* (Persoon 1801) Saccardo 1881	1	1,30	1,30	31,56
114	*Discula brunneotingens* E.I. Meyer 1953	1	0,00	0,96	0,96
115	*Discula pinicola* (Naumov 1926) Petrak 1927 var. *mammosa* Lagerberg et al. 1927	1	5,83	5,83	31,28
116	*Dothiora prunorum* (Dennis et Buhagiar 1973) Crous 2016	1	31,97	10,62	31,97
117	*Entomophthora conica* Nowakowski 1883	1	1,33	6,86	29,67
118	*Entomophthora thaxteriana* I.M. Hall et J. Bell 1963	1	0,10	0,10	30,7
119	*Epicoccum nigrum* Link 1815	2	2,20	2,20	31,98
120	*Exophiala castellanii* Iwatsu et al. 1984	1	0,00	2,92	32,33
121	*Exophiala salmonis* J.W. Carmichael 1966	1	5,99	5,99	31,42
122	*Fennellomyces linderi* (Hesseltine et Fennell 1955) Benny et R.K. Benjamin 1975	1	16,94	7,34	29,39
123	*Fonsecaea pedrosoi* (Brumpt 1922) Negroni 1936	1	1,07	1,07	29,34
124	*Fulvia fulva* (Cooke 1883) Ciferri 1954	1	0,00	0,00	1,32
125	*Geomyces pannorum* (Link 1824) Sigler et J.W. Carmichael 1976	1	5,82	5,82	10,79
126	*Gilbertella persicaria* (E.D. Eddy 1925) Hesseltine 1960	1	16,72	16,72	30,37
127	*Gliocephalotrichum bulbilium* J.J. Ellis et Hesseltine 1962	1	1,04	1,04	32,24
128	*Gliomastix murorum* (Corda 1838) S. Hughes 1958 var. *murorum*	1	6,23	6,23	31,66
129	*Gongronella butleri* (Lendner 1926) Peyronel et Dal Vesko 1955	5	0,90	3,34	24,40
130	*Gonytrichum macrocladum* (Saccardo 1880) S. Hughes 1951	1	22,34	22,34	32,24
131	*Hansfordia pulvinata* (Berkeley et M.A. Curtis 1875) S. Hughes 1958	1	0,98	5,83	31,24
132	*Harzia acremonioides* (Harz 1871) Costantin 1888	3	6,29	6,31	31,46

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
133	*Helicostylum elegans* Corda 1842	1	18,23	18,23	30,33
134	*Helicostylum pulchrum* (Preuss 1851) Pidoplichko et Milko 1971	2	10,5	10,5	30,36
135	*Hesseltinella vesiculosa* H.P. Upadhyay 1970	1	0,10	0,10	0,98
136	*Hormoconis resinae* (Lindau 1906) Arx et G.A. de Vries 1973	8	17,31	13,39	32,08
137	*Hormonema macrosporum* L. Voronin 1986	1	3,21	10,60	31,97
138	*Humicola fuscoatra* Traaen 1914	2	16,11	2,02	31,73
139	*Hyphopichia burtonii* (Boidin et al. 1964) Arx et Van der Walt 1976	1	10,98	3,11	32,33
140	*Kickxella alabastrina* Coemans 1862	1	8,30	8,30	17,34
141	*Lecythophora decumbens* (J.F.H. Beyma 1942) E. Weber et al. 2002	1	11,05	11,05	32,41
142	*Lecythophora fasciculata* (J.F.H. Beyma 1939) E. Weber et al. 2002	1	31,99	10,62	31,99
143	*Lecythophora hoffmannii* (J.F.H. Beyma 1939) W. Gams et McGinnis 1983	2	27,12	10,72	32,08
144	*Lecythophora mutabilis* (J.F.H. Beyma 1944) W. Gams et McGinnis 1983	1	32,18	2,98	32,18
145	*Lichtheimia blakesleeana* (Lendner 1924) Kerst. Hoffmann et al. 2009	3	16,79	11,03	30,38
146	*Lichtheimia corymbifera* (Cohn 1884) Vuillemin 1903	11	15,65	7,93	29,86
147	*Lichtheimia hyalospora* (Saito 1906) Kerst. Hoffmann et al. 2009	1	16,72	11,88	30,37
148	*Linderina pennispora* Raper et Fennell 1952	1	1,00	1,00	30,16
149	*Macrophoma mantegazziana* (Penzig 1882) Berlese et Voglino 1886	1	1,19	1,19	31,91
150	*Memnoniella echinata* (Rivolta 1884) Galloway 1933	2	12,21	6,52	31,57
151	*Menispora ciliata* Corda 1837	1	0,96	0,96	31,15
152	*Microsphaeropsis olivacea* (Bonorden 1869) Höhnell 1917	1	22,13	10,73	32,03
153	*Monodictys paradoxa* (Corda 1938) S. Hughes 1958	1	32,47	11,05	32,41
154	*Mortierella alpina* Peyronel 1913	1	7,10	4,51	28,99
155	*Mortierella beljakovae* Milko 1973	1	0,10	0,10	29,63
156	*Mortierella capitata* Marchal 1891	1	22,67	7,03	29,8
157	*Mortierella dichotoma* Linnemann 1936 ex W. Gams 1977	1	1,33	4,35	29,67
158	*Mortierella exigua* Linnemann 1941	1	6,87	1,29	29,63
159	*Mortierella gemmifera* M. Ellis 1940	1	6,90	4,34	29,63

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
160	*Mortierella globulifera* O. Rostrup 1916	1	1,33	1,33	29,67
161	*Mortierella hyalina* (Harz 1871) W. Gams 1970 var. *hyalina*	3	2,24	3,24	29,47
162	*Mortierella jenkinii* (A.L. Smith 1898) Naumov 1935	1	1,15	1,15	7,06
163	*Mortierella lignicola* (G.W. Martin 1937) W. Gams et R. Moreau 1959	1	15,82	7,06	28,99
164	*Mortierella mutabilis* Linnemann 1941	1	0,10	15,44	28,38
165	*Mortierella parvispora* Linnemann 1941	4	2,43	2,43	18,19
166	*Mortierella polycephala* Coemans 1863	1	2,12	6,20	28,16
167	*Mortierella pusilla* Oudemans 1902	1	4,78	1,29	29,63
168	*Mortierella reticulata* van Tieghem et G. Le Monnier 1873	1	0,42	0,42	1,29
169	*Mortierella stylospora* Dixon-Stewart 1932	1	7,16	7,16	7,16
170	*Mortierella verticillata* Linnemann 1941	5	2,12	3,32	29,52
171	*Mortierella zychae* Linnemann 1941	1	0,10	0,75	3,05
172	*Mucor aligarensis* B.S. Mehrotra et B.R. Mehrotra 1969	1	1,24	2,40	29,27
173	*Mucor bainieri* B.S. Mehrotra et Baijal 1963	1	6,27	6,27	29,10
174	*Mucor circinelloides* van Tieghem 1875 var. *circinelloides*	9	20,75	6,18	29,34
175	*Mucor circinelloides* van Tieghem 1875 var. *janssenii* (Lendner 1907) Schipper 1976	7	21,2	11,56	30,09
176	*Mucor circinelloides* van Tieghem 1875 var. *lusitanicus* (Bruderlein 1916) Schipper 1976	6	12,73	5,61	30,02
177	*Mucor durus* G. Walther et de Hoog 2013	1	15,4	6,43	29,27
178	*Mucor exponens* (Burgeff 1924) G. Walther et de Hoog 2013	4	7,54	2,87	29,95
179	*Mucor flavus* Bainier 1903	13	10,27	7,5	30,04
180	*Mucor fuscus* Bainier 1903	3	5,72	4,15	30,19
181	*Mucor genevensis* Lendner 1908	3	3,02	2,95	28,98
182	*Mucor griseocyanus* Hagem 1908	2	16,08	4,08	29,88
183	*Mucor guilliermondii* Nadson et Philippow 1925	1	7,27	4,39	29,78
184	*Mucor heterogamus* Vuillemin 1903	1	4,62	4,62	30,16
185	*Mucor hiemalis* Wehmer 1903 var. *corticolus* (Hagem 1910) Schipper 1973	2	12,46	12,2	30,24
186	*Mucor hiemalis* Wehmer 1903 var. *hiemalis*	13	10,78	7,06	29,94
187	*Mucor hiemalis* Wehmer 1903 var. *silvaticus* (Hagem 1908) Schipper 1973	3	2,30	2,30	29,78
188	*Mucor indicus* Lendner 1930	2	16,86	12,54	30,29
189	*Mucor laxorrhizus* Y. Ling 1930	5	4,24	5,36	25,11

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
190	*Mucor luteus* Linnemann 1936	2	0,70	0,70	30,14
191	*Mucor microsporus* Namyslowski 1910	1	0,71	0,71	28,16
192	*Mucor moelleri* (Vuillemin 1903) Lendner 1908	4	12,54	9,00	29,84
193	*Mucor mousanensis* Baijal et B.S. Mehrotra 1966	1	30,38	8,33	30,38
194	*Mucor mucedo* Linnaeus 1753	6	6,99	6,70	29,71
195	*Mucor odoratus* Treschew 1940	2	1,46	3,22	29,02
196	*Mucor piriformis* A. Fischer 1892	3	8,27	5,37	29,02
197	*Mucor plasmaticus* van Tieghem 1875	1	0,99	0,99	29,88
198	*Mucor plumbeus* Bonorden 1864	10	16,68	9,50	28,71
199	*Mucor psychrophilus* Milko 1971	1	17,19	7,02	29,75
200	*Mucor racemosus* Fresenius 1850 var. *racemosus*	17	17,53	10,28	30,10
201	*Mucor racemosus* Fresenius 1850 var. *sphaerosporus* (Hagem 1908) Schipper 1970	1	16,79	30,07	30,07
202	*Mucor ramosissimus* Samoutsevitch 1927	1	15,23	6,27	29,10
203	*Mucor saturninus* Hagem 1910	1	4,47	17,10	30,55
204	*Mucor sinensis* Milko et Beliakova 1971	1	16,57	7,95	30,29
205	*Mucor strictus* Hagem 1908	1	7,32	7,32	29,84
206	*Mucor zonatus* Milko 1967	2	16,42	7,75	29,97
207	*Mucor zychae* Baijal et B.S. Mehrotra 1965 var. *zychae*	1	0,10	0,10	30,49
208	*Mycogone cervina* Ditmar 1817	1	31,58	5,33	31,58
209	*Mycogone nigra* (Morgan 1895) C.N. Jensen 1912	3	15,45	7,84	31,88
210	*Mycogone rosea* Link 1809	4	0,87	1,23	31,30
211	*Mycosticta cytosporicola* Frolov 1968	2	5,76	2,06	21,25
212	*Mycotypha africana* R.O. Novak et Backus 1963	1	18,05	18,05	30,51
213	*Myrothecium* sp.	2	0,94	0,94	31,12
214	*Neocamarosporium betae* (Berlese 1888) Ariyawansa et K.D. Hyde 2015	1	11,01	11,01	32,37
215	*Neottiospora caricina* (Desmazieres 1836) Hoehnel 1924	1	4,76	4,76	31,17
216	*Nigrospora gorlenkoana* Novobranova 1972	2	6,00	6,00	31,78
217	*Nigrospora gossypii* Jaczewski 1929	1	5,91	5,96	31,24
218	*Nigrospora oryzae* (Berkeley et Broome 1873) Petch 1924	2	10,55	4,13	31,90
219	*Nodulisporium verrucosum* (J.F.H. Beyma 1929) G. Smith 1954	1	5,82	2,94	29,15
220	*Ochrocladosporium elatum* (Harz 1871) Crous et U. Braun 2007	1	22,58	11,13	32,48
221	*Oidiodendron cereale* (Thuemen 1880) G.L. Barron 1962	1	9,92	9,92	31,24

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
222	*Paraconiothyrium fuckelii* (Saccardo 1878) Verkley et Gruyter 2012	1	10,28	21,69	31,62
223	*Paraconiothyrium sporulosum* (W. Gams et Domsch 1969) Verkley 2004	2	7,00	6,78	32,05
224	*Paramyrothecium roridum* (Tode 1790) L. Lombard et Crous 2016	1	31,81	10,46	31,81
225	*Parasitella parasitica* (Bainier 1884) Sydow 1903	1	6,31	6,31	28,33
226	*Pestalotia pezizoides* de Notaris 1841	1	21,69	9,27	30,59
227	*Phialophora atrovirens* (J.F.H. Beyma 1935) Schol-Schwarz 1970	1	2,94	1,04	32,15
228	*Phialophora bubakii* (Laxa 1930) Schol-Schwarz 1970	1	10,83	22,82	32,18
229	*Phialophora lagerbergii* (Melin et Nannfeldt 1934) Conant 1937	1	0,98	3,22	31,99
230	*Phialophora verrucosa* Medlar 1915	1	8,27	8,27	31,99
231	*Phycomyces blakesleeanus* Burgeff 1925	4	4,75	5,50	23,91
232	*Phycomyces nitens* (C. Agardh 1823) Kunze 1823	2	7,47	5,91	29,44
233	*Phyllosticta pucciniospila* C. Massalongo 1900	1	3,19	3,19	31,95
234	*Pilaira anomala* (Cesati 1851) J. Schroeter 1886	1	4,39	4,39	29,78
235	*Pilaira caucasica* Milko 1970	1	6,92	17,12	29,75
236	*Pirella circinans* Bainier 1882 var. *volgogradensis* (Milko 1974) Benny et Schipper 1988	1	6,29	6,29	29,1
237	*Pirella naumovii* (Milko 1970) Benny et Schipper 1992	1	8,05	8,05	30,33
238	*Pleotrichocladium opacum* (Corda 1837) Hernández-Restrepo et al. 2017	1	22,09	10,64	31,99
239	*Pleurophoma cava* (Schulzer 1871) Boerema 1996	3	18,57	7,63	21,54
240	*Pyrenophora biseptata* (Saccardo et Roumeguere 1881) Crous 2013	1	9,89	0,98	31,24
241	*Radiomyces spectabilis* Embree 1959	1	15,95	7,16	29,98
242	*Rhinocladiella atrovirens* Nannfeldt 1934	1	22,34	6,95	32,24
243	*Rhizomucor miehei* (Cooney et R. Emerson 1964) Schipper 1978	1	17,04	8,54	30,49
244	*Rhizomucor pusillus* (Lindt 1886) Schipper 1978	3	16,98	16,65	30,10
245	*Rhizomucor tauricus* (Milko et Schkurenko 1970) Schipper 1978	1	16,52	7,92	30,24
246	*Rhizopus arrhizus* A. Fischer 1892	8	17,71	8,60	29,74
247	*Rhizopus microsporus* van Tieghem 1875 var. *chinensis* (Saito 1904) Schipper et Stalpers 1984	2	16,67	10,37	30,17
248	*Rhizopus microsporus* van Tieghem 1875 var. *microsporus*	4	15,88	6,76	29,38

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
249	*Rhizopus stolonifer* (Ehrenberg 1818) Vuillemin 1902 var. *stolonifer*	13	19,86	9,71	29,17
250	*Scopulariopsis brevicaulis* (Saccardo 1882) Bainier 1907	1	31,22	9,87	31,22
251	*Spadicesporium acrosporum* V.N. Borisova et Dvoinos 1982	1	21,69	10,32	31,64
252	*Spadicesporium acrosporum-majus* V.N. Borisova et Dvoinos 1982	1	6,22	6,22	31,64
253	*Spadicesporium bifurcatum* V.N. Borisova et Dvoinos 1982	1	6,22	6,22	31,64
254	*Spadicesporium bifurcatum-majus* V.N. Borisova et Dvoinos 1982	1	21,69	6,22	31,64
255	*Spadicesporium copiosum* V.N. Borisova et Dvoinos 1982	1	10,32	6,22	31,64
256	*Spadicesporium persistens* V.N. Borisova et Dvoinos 1982	1	10,28	2,14	31,60
257	*Spadicesporium ramosum* V.N. Borisova et Dvoinos 1982	1	21,69	10,30	31,64
258	*Sphaerostilbella penicillioides* (Corda 1840) Rossman et al. 2015	2	9,88	5,80	31,22
259	*Stachybotrys chartarum* (Ehrenberg 1818) S. Hughes 1958	9	18,27	5,33	31,88
260	*Stachybotrys cylindrospora* C.N. Jensen 1912	1	31,95	10,57	31,91
261	*Stemphyliomma* sp.	1	10,57	5,52	31,91
262	*Stemphylium botryosum* Wallroth 1833	1	10,59	10,59	31,93
263	*Stemphylium sarciniforme* (Cavara 1890) Wiltshire 1938	1	3,17	6,67	31,93
264	*Striaticonidium brachysporum* (Nicot 1961) L. Lombard et Crous 2016	1	10,37	6,31	31,70
265	*Striaticonidium cinctum* (Corda 1842) L. Lombard et Crous 2016	1	0,01	2,35	5,16
266	*Syncephalastrum racemosum* Cohn ex J. Schroeter 1886	6	18,97	8,06	30,08
267	*Syncephalis cornu* van Tieghem et G. Le Monnier 1873	1	18,62	18,62	30,48
268	*Thamnidium elegans* Link 1809	2	19,05	6,77	29,2
269	*Thamnostylum piriforme* (Bainier 1880) Arx et H.P. Upadhyay 1970	2	16,7	23,5	30,35
270	*Thysanophora canadensis* Stolk et Hennebert 1968	1	0,90	3,50	32,26
271	*Thysanophora penicillioides* (Roumeguere 1890) W.B. Kendrick 1961	4	0,61	2,13	18,34
272	*Torula ligniperda* (Willkomm 1866) Saccardo 1906	1	31,91	1,28	31,91

(continued)

Table 1.1 (continued)

No.	Name of species	Number of strains	Storage time at different temperature (years)		
			5 °C	−12 °C	−70 °C
273	*Trichocladium asperum* Harz 1871	1	32,13	3,31	32,07
274	*Trichocladium griseum* (Traaen 1914) X. Wei Wang et Houbraken 2018	2	15,71	1,31	26,17
275	*Trichocladium nigrospermum* (Schweinitz 1832) X. Wei Wang et Houbraken 2018	1	10,83	10,83	32,18
276	*Trichoderma deliquescens* (Sopp 1912) Jaklitsch 2011	1	31,15	9,79	31,15
277	*Truncatella angustata* (Persoon 1801) S. Hughes 1958	1	1,05	1,05	31,68
278	*Umbelopsis isabellina* (Oudemans 1902) W. Gams 2003	6	16,65	6,59	29,24
279	*Umbelopsis longicollis* (Dixon-Stewart 1932) Y.N. Wang et al. 2015	3	20,11	5,82	28,9
280	*Umbelopsis nana* (Linnemann 1941) Arx 1984	2	7,07	4,29	29,78
281	*Umbelopsis ramanniana* (Moeller 1903) W. Gams 2003	6	14,18	8,67	29,29
282	*Umbelopsis vinacea* (Dixon-Stewart 1932) Arx 1984	1	4,34	3,34	29,41

The analysis of the results testifies that this method has proved very successful for the storage of most of the investigated fungi within 3–7 years (Table 1.2).

Where it is desired to keep and constantly to renew cultures within 1–2 years, a temperature of 5 °C is perfectly applicable. More than 97% of the studied zygomycetous fungi and 94% of ascomycetous fungi were viable after storage. For long-term (more than 10 years) storage, however, this temperature is not reliable, since the viability of fungi in both groups is reduced to 57% and 55 % respectively.

A temperature of −12 °C is least favorable for long storage. Only 60% of zygomycetous fungi and 35% of ascomycetous fungi stored at such a temperature were viable after 10 years. After 17–20 years viability decreased to 10–13% and 4%, respectively (Fig. 1.1). Among zygomycetous fungi representatives of the classes *Mortierellomycetes*, *Entomophthoromycetes*, and *Kickxellomycetes* lost their vitality most rapidly at these temperatures. After 17 years of storage, their viability decreased to 0–4%. In contrast, the strains from the psychrotolerant species *Helicostylum elegans* and *Thamnostylum piriforme* and thermotolerant species *Rhizomucor pusillus* remained steady. Among dark-colored anamorphic ascomycetous fungi the best viability at temperature −12 °C after 20 years was found in strains of the genera *Acrophialophora*, *Alternaria*, *Coniothyrium*, *Gonytrichum*, *Hormoconis*, *Paraconiothyrium*, *and Phialophora*. After 30 years, only 1 strain (*Hormoconis resinae)* was viable.

Table 1.2 Viability (%) of different taxa of VKM fungi after long-term preservation (30 years) at various temperatures on silica gel

Subkindom	Division	Class	Viability (%) after long-term preservation at different temperature (°C)														
			1–2 year			3–7 year			Near 10 year			Near 20 year			Near 30 yearr		
			5	−12	−70	5	−12	−70	5	−12	−70	5	−12	−70	5	−12	−70
Dikarya	*Ascomycota*	*Dothideomycetes* (27 genera, 77 species, 144 strains)	98	99	100	83	86	97	64	41	96	38	4	95	23	0	93
		Eurotiomycetes (7 genera, 12 species, 22 strains)	91	96	100	65	74	100	39	35	91	22	13	91	9	4	91
		Insertae Sedis (6 genera, 9 species, 9 strains)	89	100	100	67	56	100	22	11	89	11	11	67	11	0	56
		Leotiomycetes (5 genera, 13 species, 27 strains)	81	89	93	48	63	85	30	19	67	4	0	63	4	0	63
		Ascomycetes (1 genus, 1 species, 1 strains)	100	100	100	100	100	100	100	100	100	0	0	100	0	0	100
		Saccharomycetes (1 genus, 1 species, 1 strain)	100	100	100	100	100	100	100	0	100	0	0	100	0	0	100
		Sordariomycetes (32 genera, 51 species, 87 strains)	94	100	100	75	68	99	55	34	93	39	1	92	23	0	91
Mucoromyceta	*Mortierellomycota*	*Mortierellomycetes* (1 genus, 18 species, 27 strains)	78	86	100	41	53	96	17	16	94	4	4	74	0	0	74
	Mucoromycota	*Mucoromycetes* (28 genera, 89 species, 280 strains)	99	97	100	89	92	100	79	68	99	63	63	98	7	1	98

(continued)

Table 1.2 (continued)

Subkindom	Division	Class	Viability (%) after long-term preservation at different temperature (°C)													
			1–2 year			3–7 year			Near 10 year			Near 20 year			Near 30 yearr		
			5	−12	−70	5	−12	−70	5	−12	−70	5	−12	−70	5	−12	−70
		Umbelopsidomycetes (1 genus, 5 species, 18 strains)	100	100	100	100	96	100	94	61	100	74	74	100	11	6	100
Zoopagomyceta	*Entomophthoro-mycota*	*Entomophthoromycetes* (2 genera, 3 species, 3 strains)	67	67	67	22	33	67	0	22	67	0	0	67	0	0	67
	Kickxellomycota	*Kickxellomycetes* (2 genera, 2 species, 2 strains)	100	100	100	50	50	100	17	17	100	0	0	100	0	0	50
	Zoopagomycota	*Zoopagomycetes* (1 genus, 1 species, 1 strain)	100	100	100	100	100	100	100	100	100	100	100	100	0	0	100

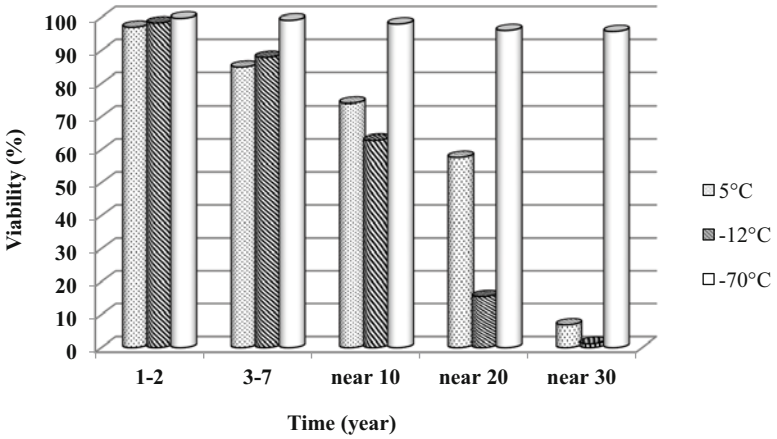

Fig. 1.1 The long-term preservation of zygomycetous fungi on silica gel at different temperatures

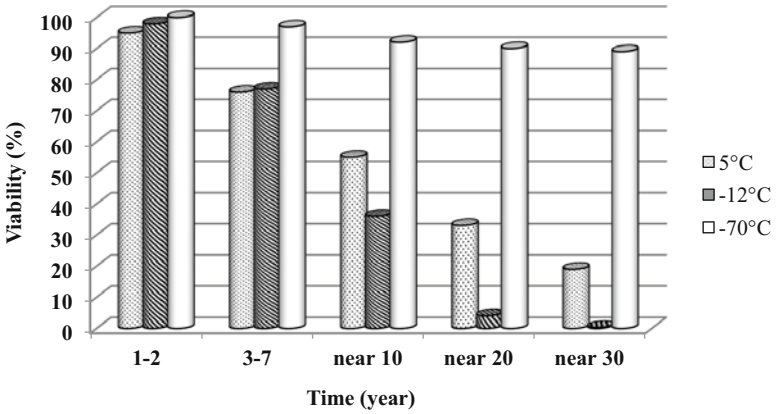

Fig. 1.2 The long-term preservation of ascomycetous fungi on silica gel at different temperatures

The most acceptable temperature for the storage of mycelial fungi is the temperature −70 °C. In these conditions after 30 years of storage, 90% of strains were viable (Fig. 1.1).

The advantages of storing mycelial fungi at different temperatures on silica gel are obvious. On one hand, this method is so simple that the storage at 5 °C and −12 °C can be carried out for the most part in poorly equipped laboratories. On the other hand, the presence of a low-temperature refrigerator (−70 °C) means it is possible to support large numbers of cultures in a small area. The advantages of this method are also a minimum of preparatory work, the rapid reconstituted part of the stored

material by transferring a few granules on appropriate culture medium, as well as the possibility of using the same vial without defrosting for a long time.

The cooling equipment being used in VKM is ultralow temperature freezers (−70–80 °C, Sanyo, Japan) and household refrigerators (5 and −12 °C).

1.6 Protocols

Protocols of cryopreservation, freeze-drying, and drying in sterile soil were described earlier [15].

1.7 Protocol of Drying on Silica Gel

1.7.1 Preparation of Sterile Silica Gel and Ampoules

- Silica gel is pre-dried and sterilized by dry heat for 3 h at a temperature of 160 °C, conducting careful control of sterility.
- Plastic ampoules (Nunc) (3 for each culture) are labeled and sterilized by autoclaving, at 121 °C for 20 min.
- Sterile silica gel that has been washed with a concentration of cobalt chloride is placed in the ampoules to indicate the humidity. The cobalt chloride is deep blue when dry and turns pink when wet.
- A sterile cotton ball is placed on top of the indicator.

1.7.2 Preparation of Cryoprotectant: 10% (v/v) Glycerol

- Pour 5 mL of 10% glycerol into 12 mL glass tubes.
- Sterilized by autoclaving at 121 °C for 20 min.
- Stored at +5 °C for no longer than a month.

1.7.3 Preparation of Cultures

- Grow sporulating fungal cultures on slant agar under optimal growth conditions and on suitable mediums (www.vkm.ru).
- Wash off spores from agar surface with 5 mL of cool sterile 10% glycerol.
- Titer of spores' suspension should be not less than 10^6 spores/mL.

1.7.4 Silica Gel Inoculation

- Add 75–100 silica gel granules (40 grade, 9–16 mesh) in a sterile Petri dish.
- Add 1 mL spore suspension to sterile and dry silica gel.
- Shake the Petri dish with the granules.
- Put the Petri dish in desiccator and store in the refrigerator 12 h at 4–7 °C.

1.7.5 Filling of Vials

- Add silica gel granules with fungal spores (20–25 pieces) to 3 plastic ampoules with a sterile spoon.
- Place cryovials in the boxes and transfer them to the refrigerators (5 and −12 °C) and the ultralow temperature freezer (−70 °C).

1.7.6 Control of Viability

- Place ampoule in a special metal container, thermostatic inside by expanded polystyrene, to prevent defrosting.
- Transfer one granule of silica gel from ampoule on fresh suitable agar medium and incubate under optimal conditions.
- The remaining granules were resealed and stored as described. Thus, each ampoule with fungal spores adsorbed on silica gel may be used repeatedly.

Result

The real storage time estimates obtained in VKM are given in Table 1 and Annex 2. They are not final data: the cultures are still being stored, and we expect to get longer storage times later on. Some cells of the table are empty; this is the case if the culture is not stored by this method.

There is at present clear that more than 98% of fungal cultures preserved by cryoconservation method remain viable after 20 years of storage. For lyophilization and storage in sterile soil methods, these figures after 30 years of storage are 95 and 85%, respectively. For long-term storage of fungal cultures on silica gel, the temperature −70 °C should be chosen. At this temperature, over 90% of spore-forming fungi retain their viability after 30 years of the experiment.

Conclusion

The conservation techniques used in VKM presents effective preservation of the stock of filamentous fungi from different taxonomic groups. The possibility and practical time estimates of secure long-term storage of fungal cultures belonging to 1600 species and 590 genera were shown. The represented information could be used as a reference for researchers intending to maintain pure cultures of microorganisms for a long time. The data produced are also accessible online on the VKM Web site.

Annexies

Annex 1: Fields Attributes in the Table «Database Preservation Methods»

Code	Counter
EntryDate	Date/Time
Method	Text
Col	Text
Strain	Numerical
dep	Text
pat	Text
Curator	Text
Dubl-cart	Text
Dubl fond	Text
Dubl fond new	Text
Ampules	Numerical
Data	Date/Time
Result	Text
Data2	Date/Time
Result2	Text
Days	Numerical
Year	Numerical
Comments	Text
Data3	Date/Time
Result3	Text
Data4	Date/Time
Result4	Text
Data5	Date/Time
Result5	Text
EditDate	Date/Time
Protector	Text
Programm	Text
Location	Text
Type	Text

Annex 2: Maximal Preservation Times for VKM Fungal Species

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1	*Absidia caerulea* Bainier 1889	5	19.70	5	45.95	5	12.42
2	*Absidia cuneospora* G.F. Orr et Plunkett 1959	1	25.41	1	27.38		
3	*Absidia cylindrospora* Hagem 1908			2	31.17	2	37.64
4	*Absidia glauca* Hagem 1908	8	24.13	10	40.90	8	49.99
5	*Absidia repens* van Tieghem 1878	1	23.67	1	45.19		
6	*Absidia spinosa* Lendner 1907	2	19.75	2	39.43	2	23.32
7	*Achlya bisexualis* Coker et Couch 1927	4	0.51				
8	*Achlya bonariensis* Beroqui 1969	1	0.16				
9	*Achlya colorata* Pringsheim 1882	2	6.32				
10	*Achlya intricata* Beneke 1948	1	0.15				
11	*Achlya radiosa* Maurizio 1899	1	28.12				
12	*Achlya sparrowii* Reischer 1949	1	23.01				
13	*Acladium curvatum* Bonorden 1851			1	35.41	1	0.73
14	*Acremonium alternatum* Link 1809	3	17.73	4	30.79	3	2.72
15	*Acremonium arxii* W. Gams 1971	2	19.46	2	27.32	2	3.20
16	*Acremonium atrogriseum* (Panasenko 1964) W. Gams 1971	3	17.47	3	32.65		
17	*Acremonium bacillisporum* (Onions et G.L. Barron 1967) W. Gams 1971	2	22.13	3	22.08		
18	*Acremonium bactrocephalum* W. Gams 1971	1	22.13	5	25.25	1	0.53
19	*Acremonium biseptum* W. Gams 1971			1	25.30		
20	*Acremonium breve* (Sukapure et Thirumalachar 1966) W. Gams 1971	3	19.31	12	40.33	1	3.56
21	*Acremonium cavaraeanum* (Jasevoli 1924) W. Gams 1971	1	19.93	1	6.05		
22	*Acremonium cereale* (P. Karsten 1887) W. Gams 1971	1	17.75	1	19.92	1	3.27
23	*Acremonium charticola* (J. Lindau 1907) W. Gams 1971	4	21.04	8	25.98	1	0.09
24	*Acremonium chrysogenum* (Schol-Schwarz 1965) W. Gams 1971			2	9.96		
25	*Acremonium crotocinigenum* (Schol-Schwarz 1965) W. Gams 1971			4	32.50	3	2.72
26	*Acremonium cymosum* W. Gams 1971	2	6.54	2	28.44		
27	*Acremonium domschii* W. Gams 1971			2	28.36	2	2.84
28	*Acremonium egyptiacum* (J.F.H. Beyma 1933) W. Gams 1971	1	16.93	1	29.72	1	0.09
29	*Acremonium fuci* Summerbell et al. 2004			3	2.15		
30	*Acremonium hyalinulum* (Saccardo 1878) W. Gams 1971			2	31.29		
31	*Acremonium implicatum* (J.C. Gilman et E.V. Abbott 1927) W. Gams 1975	2	19.57	5	27.42	3	0.68
32	*Acremonium incrustatum* W. Gams 1971	2	17.73	2	25.80	1	3.49

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
33	*Acremonium kiliense* Gruetz 1925	4	22.13	4	26.11	2	0.09
34	*Acremonium lichenicola* W. Gams 1971			1	24.26		
35	*Acremonium murorum* (Corda 1839) W. Gams 1971			11	5.74		
36	*Acremonium persicinum* (Nicot 1958) W. Gams 1971	2	19.37	2	43.88	1	26.53
37	*Acremonium polychromum* (J.F.H. Beyma 1928) W. Gams 1971	5	29.82	5	35.47	3	0.09
38	*Acremonium rutilum* W. Gams 1971	1	8.02	1	19.10		
39	*Acremonium salmoneum* W. Gams et Lodha 1975			4	2.70		
40	*Acremonium sclerotigenum* (Moreau et R. Moreau 1941 ex Valenta 1948) *W.* Gams 1971	3	20.23	3	36.56	2	3.73
41	*Acremonium strictum* W. Gams 1971	19	19.81	24	39.59	17	9.71
42	*Acremonium tubakii* W. Gams 1971			2	31.23		
43	*Acrophialophora fusispora* (S.B. Saksena 1953) Samson 1970	1	17.49	1	30.36		
44	*Acrostalagmus albus* Preuss 1851	1	19.59	1	32.45	1	3.51
45	*Acrostalagmus luteoalbus* (Link 1809) Zare et al. 2004	12	19.35	12	37.43	5	13.56
46	*Acrothecium robustum* J.C. Gilman et E.V. Abbott 1927	1	19.30	1	31.30	1	25.73
47	*Actinomucor elegans* (Eidam 1884) C.R. Benjamin et Hesseltine 1957	5	13.17	7	42.07	7	50.21
48	*Agaricus arvensis* Schaeffer 1774	1	20.04				
49	*Agaricus bisporus* (J. Lange 1926) Imbach 1946	35	26.07				
50	*Agaricus squarrosus* Oeder 1770	1	23.59				
51	*Albifimbria verrucaria* (Albertini et Schweinitz 1805) L. Lombard et Crous *2016*	3	19.83	3	48.27	1	2.57
52	*Albonectria rigidiuscula* (Berkeley et Broome 1875) Rossman et Samuels 1999	1	19.85	1	34.34	1	7.45
53	*Alternaria alternariae* (Cooke 1871) Woudenberg et Crous 2013	2	20.53	2	32.26		
54	*Alternaria alternata* (Fries 1832) Keissler 1912	13	19.30	43	48.71		
55	*Alternaria atra* (Preuss 1852) Woudenberg et Crous 2013	9	19.60	13	48.35	1	8.34
56	*Alternaria botrytis* (Preuss 1851) Woudenberg et Crous 2013	12	19.56	19	48.41	1	35.79
57	*Alternaria brassicae* (Berkeley 1836) Saccardo 1880	4	19.78	3	0.50		
58	*Alternaria brassicicola* (Schweinitz 1832) Wiltshire 1947	6	19.28	7	43.57		
59	*Alternaria chartarum* Preuss 1848	8	19.46	22	45.05		
60	*Alternaria cheiranthi* (Libert 1827) P.C. Bolle 1924	1	19.79	1	19.67		
61	*Alternaria consortialis* (Thuemen 1876) Groves et Hughes 1953	4	19.49	4	45.05		
62		1	19.79				

	Alternaria cucumerina (Ellis et Everhart 1895) J.A. Elliott 1917 var. *cucumerina*						
63	*Alternaria dauci* (J.G. Kuehn 1855) J.W. Groves et Skolko 1944	5	19.79				
64	*Alternaria dianthicola* Neergaard 1945	1	19.78				
65	*Alternaria geophila* Daszewska 1912	1	12.56				
66	*Alternaria godetiae* (Neergaard 1933) Neergaard 1945	1	12.56				
67	*Alternaria grandis* E.G. Simmons 2000			1	1.74		
68	*Alternaria japonica* Yoshii 1941	3	19.32	3	27.64		
69	*Alternaria leucanthemi* Nelen 1962	1	19.78	1	24.95		
70	*Alternaria macrospora* Zimmermann 1904	2	12.56	2	30.03		
71	*Alternaria multirostrata* E.G. Simmons et C.R. Jackson 1968	1	17.80	1	11.28		
72	*Alternaria nobilis* (Vize 1877) E.G. Simmons 2002	1	19.78				
73	*Alternaria oudemansii* (E.G. Simmons 1967) Woudenberg et Crous 2013	2	19.32	1	42.78		
74	*Alternaria radicina* Meier et al. 1922	2	17.60	2	38.20		
75	*Alternaria silybi* Gannibal 2011			3	1.97		
76	*Alternaria simmonsii* Gannibal 2011			2	1.97		
77	*Alternaria solani* Sorauer 1896	6	19.78	4	30.40		
78	*Alternaria tenuissima* (Kunze 1818) Wiltshire 1933			6	26.81		
79	*Alternariaster helianthi* (Hansford 1943) E.G. Simmons 2007			2	7.12		
80	*Amanita citrina* (Schaeffer 1762) Persoon 1797	1	17.92				
81	*Amauroascus aureus* (Eidam 1887) Arx 1971	1	6.18	1	33.15		
82	*Amblyosporium botrytis* Fresenius 1863	2	15.34	2	31.28	2	12.18
83	*Amerosporium concinnum* Petrak 1953	1	19.54	1	47.12		
84	*Ampelomyces artemisiae* (Voglino 1905) Rudakov 1979	1	12.58	1	11.42		
85	*Ampelomyces heraclei* (Dejeva 1967) Rudakov 1979	1	12.18	1	13.21		
86	*Ampelomyces humuli* (Fautrey 1890) Rudakov 1979			1	16.55		
87	*Ampelomyces polygoni* (Potebnia 1907) Rudakov 1979	2	12.28	2	34.50		
88	*Ampelomyces quercinus* (Sydow 1915) Rudakov 1979			2	0.02		
89	*Ampelomyces quisqualis* Cesati 1852	1	12.58	1	29.31		
90	*Ampelomyces ulicis* (Adams 1907) Rudakov 1979	1	12.38	2	29.15		
91	*Ampelomyces uncinulae* (Fautrey 1893) Rudakov 1979	1	12.58	1	40.64		
92	*Antrodia sinuosa* (Fries 1821) P. Karsten 1881	1	8.16				
93	*Apenidiella antarctica* Ivanushkina et al. 2019			1	7.34		
94	*Apenidiella strumelloidea* (Milko et Dunaev 1986) W. Quaedvlieg et P.W. *Crous* 2014			1	29.09		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
95	*Aphanoascus fulvescens* (Cooke 1879) Apinis 1968	1	20.42	1	43.15	1	21.16
96	*Aphanocladium album* (Preuss 1848) W. Gams 1971	4	17.73	4	27.66		
97	*Aphanomyces helicoides* Minden 1915	1	33.22				
98	*Apiospora montagnei* Saccardo 1875			1	9.90		
99	*Aplanes treleaseanus* (Humphrey 1893) Coker 1927	1	15.93				
100	*Aposphaeria caespitosa* (Fuckel 1869) Jaczewski 1917	1	19.21	1	36.11		
101	*Arachniotus aurantiacus* (Kamyschko 1967) Arx 1971			1	43.59	1	21.16
102	*Arcticomyces warmingii* (Rostrup 1888) Savile 1959	1	24.47	1	1.64		
103	*Armillaria cepistipes* Velenovsky 1920	6	13.55				
104	*Armillaria lutea* Gillet 1874	5	23.45				
105	*Armillaria mellea* (Vahl 1790) P. Kummer 1871	5	33.22				
106	*Arthrinium arundinis* (Corda 1838) Dyko et Sutton 1981	3	12.58	12	24.70		
107	*Arthrinium phaeospermum* (Corda 1837) M.B. Ellis 1965			2	13.34		
108	*Arthrinium saccharicola* F. Stevens 1917			1	16.91		
109	*Arthrinium sphaerospermum* Fuckel 1874	1	19.21	3	47.40	1	3.85
110	*Arthrobotrys arthrobotryoides* (Berlese 1888) J. Lindau 1907	1	19.32			1	3.91
111	*Arthrobotrys cladodes* Drechsler 1937	2	15.74	2	23.73	2	7.77
112	*Arthrobotrys conoides* Drechsler 1937	4	19.32	4	9.44	3	13.48
113	*Arthrobotrys longa* Mekhtieva 1973	1	10.65	1	9.96	1	0.53
114	*Arthrobotrys longispora* Preuss 1853	1	25.39			1	3.91
115	*Arthrobotrys oligospora* Fresenius 1850	6	27.60	7	24.76	7	7.81
116	*Arthrobotrys oviformis* Soprunov 1958			1	2.40	1	0.19
117	*Arthrobotrys robusta* Duddington 1951	1	19.41	1	31.56	1	7.99
118	*Arthrobotrys superba* Corda 1839	7	26.36	7	26.32	7	3.91
119	*Ascochyta cucumeris* Fautrey et Roumeguere 1891	2	20.34	2	27.91		
120	*Ascochyta malvicola* Saccardo 1878	1	19.22	1	11.74		
121	*Ascochyta pisi* Libert 1830	3	19.45	1	44.50	1	8.67
122	*Ascochyta viciae* Libert 1837	1	20.31	1	26.76		
123	*Ascotricha chartarum* Berkeley 1838	1	18.97	1	10.75		
124	*Aspergillus aculeatus* Iizuka 1953			7	18.19	2	0.35
125	*Aspergillus alliaceus* Thom et Church 1926			6	41.09	5	30.10
126	*Aspergillus amylovorus* Panasenko 1964 ex Samson 1979	1	12.47	1	27.12	1	27.64

127	*Aspergillus asperescens* Stolk 1954			2	9.95	2	0.50
128	*Aspergillus aureolatus* Muntanola-Cvetkovic et Bata 1964			1	37.60	1	9.58
129	*Aspergillus aureoterreus* Samson et al. 2011			1	33.83	1	33.41
130	*Aspergillus awamori* Nakazawa 1915			13	45.82	13	37.03
131	*Aspergillus awamori* Nakazawa 1915 var. *fumeus* Nakazawa et al. 1936			1	17.96	1	30.17
132	*Aspergillus brasiliensis* Varga et al. 2007			2	36.25	2	22.13
133	*Aspergillus brunneouniseriatus* Suj. Singh et B.K. Bakshi 1961			1	21.90		
134	*Aspergillus caespitosus* Raper et Thom 1944			2	30.61	2	19.26
135	*Aspergillus calidoustus* Varga et al. 2008			7	20.53		
136	*Aspergillus candidus* Link 1809			11	39.94	6	46.75
137	*Aspergillus carbonarius* (Bainier 1880) Thom 1916			2	40.31	2	25.81
138	*Aspergillus carneus* (van Tieghem 1877) Blochwitz in Thom and Raper 1945			5	39.44	2	30.62
139	*Aspergillus clavatus* Desmazieres 1834			10	44.38	9	46.84
140	*Aspergillus crustosus* Raper et Fennell 1965					1	0.15
141	*Aspergillus duricaulis* Raper et Fennell 1965			1	21.55	1	21.92
142	*Aspergillus echinulatus* (Delacroix 1893) Thom et Church 1926			1	9.60	1	38.16
143	*Aspergillus ficuum* (Reichardt 1867) Thom et Currie 1916			2	15.58	1	20.92
144	*Aspergillus fischeri* Wehmer 1907			7	38.87	6	47.71
145	*Aspergillus flavipes* (Bainier et R. Sartory 1911) Thom et Church 1926			8	41.10	7	20.90
146	*Aspergillus flavus* Link 1809			16	41.63	12	46.87
147	*Aspergillus flavus* Link 1809 var. *columnaris* Raper et Fennell 1965			1	32.17	1	37.25
148	*Aspergillus foetidus* Thom et Raper 1945			2	30.88	2	27.21
149	*Aspergillus fumigatus* Fresenius 1863			15	44.89	10	46.83
150	*Aspergillus giganteus* Wehmer 1901			3	42.69	3	35.55
151	*Aspergillus gorakhpurensis* Kamal et Bhargava 1969					1	0.12
152	*Aspergillus hennebergii* Blochwitz 1935			1	6.46	1	0.14
153	*Aspergillus heteromorphus* Batista et H. Maia 1957			1	27.48	1	3.35
154	*Aspergillus insuetus* (Bainier 1908) Thom et Church 1929			1	15.90	1	37.09
155	*Aspergillus janus* Raper et Thom 1944			2	36.04	2	46.78
156	*Aspergillus japonicus* Saito 1906			10	34.48	8	32.73
157	*Aspergillus kanagawaensis* Nehira 1951			2	39.62	2	42.25
158	*Aspergillus melleus* Yukawa 1911			4	39.08	4	20.75
159	*Aspergillus neoafricanus* Samson et al. 2011			1	36.34	1	33.42
160	*Aspergillus neoniveus* Samson et al. 2011					1	0.37
161	*Aspergillus nidulans* (Eidam 1883) G. Winter 1884			13	48.25	9	47.04

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
162	*Aspergillus niger* van Tieghem 1867			109	44.57	30	46.83
163	*Aspergillus niveus* Blochwitz 1929			6	37.67	4	37.78
164	*Aspergillus nomius* Kurtzman et al. 1987					2	0.07
165	*Aspergillus nutans* McLennan et Ducker 1954			2	46.76	2	37.38
166	*Aspergillus ochraceus* G. Wilhelm 1877			21	43.70	16	36.29
167	*Aspergillus oryzae* (Ahlburg 1878) E. Cohn 1884			25	43.68	19	42.05
168	*Aspergillus oryzae* (Ahlburg 1878) E. Cohn 1884 var. *effusus* (Tiraboschi 1908) Y. Ohara 1951			1	34.42	1	9.58
169	*Aspergillus pallidus* Kamyschko 1963	1	12.47	1	18.59	1	48.04
170	*Aspergillus parasiticus* Speare 1912			2	3.30		
171	*Aspergillus parvulus* G. Smith 1961			1	46.73	1	30.34
172	*Aspergillus penicilliformis* Kamyschko 1963			1	38.97	1	28.21
173	*Aspergillus penicillioides* Spegazzini 1896	1	6.90	3	5.91		
174	*Aspergillus phoenicis* (Corda 1840) Thom et Currie 1916			5	32.96	1	7.66
175	*Aspergillus proliferans* G. Smith 1943			1	10.75	1	11.13
176	*Aspergillus pseudodeflectus* Samson et Mouchacca 1975			1	36.19	1	38.11
177	*Aspergillus puniceus* Kwon-Chung et Fennell 1965			3	31.40	1	4.32
178	*Aspergillus quadrilineatus* Thom et Raper 1939			3	39.84	3	30.07
179	*Aspergillus raperi* Stolk et J.A. Meyer 1957					2	0.37
180	*Aspergillus repens* (Corda 1842) Saccardo 1882			11	47.00	11	46.92
181	*Aspergillus restrictus* G. Smith 1931			1	24.65	1	24.65
182	*Aspergillus rugulosus* Thom et Raper 1939			5	37.90	5	37.05
183	*Aspergillus sclerotiorum* G.A. Huber 1933			5	31.55	3	30.64
184	*Aspergillus silvaticus* Fennell et Raper 1955			1	36.62	1	33.75
185	*Aspergillus sojae* Sakaguchi et K. Yamada ex Murakami 1971			1	37.49	1	36.16
186	*Aspergillus stellatus* Curzi 1934			2	36.15	2	37.24
187	*Aspergillus subsessilis* Raper et Fennell 1965	1	12.44	2	46.65	1	26.30
188	*Aspergillus sulphureus* (Fresenius 1863) Wehmer 1901			3	40.12	1	42.08
189	*Aspergillus sydowii* (Bainier et R. Sartory 1913) Thom et Church 1926			30	38.84	7	46.83
190	*Aspergillus tamarii* Kita 1913			3	38.72	1	42.06
191	*Aspergillus terreus* Thom 1918	8	6.68	28	47.42	25	47.04
192	*Aspergillus terricola* Marchal et É.J. Marchal 1893			3	36.09	3	46.84

193	*Aspergillus terricola* Marchal et É.J. Marchal 1893 var. *americanus* Marchal et É.J. Marchal 1921			1	33.83	1	7.34
194	*Aspergillus tubingensis* Mosseray 1934			1	12.64	1	0.19
195	*Aspergillus umbrosus* Bainier et R. Sartory 1912			1	13.10	1	0.23
196	*Aspergillus unguis* (Weill et L. Gaudin 1919) Dodge 1935	3	12.47	5	41.10	5	42.25
197	*Aspergillus ustus* (Bainier 1881) Thom et Church 1926			17	42.48	13	46.82
198	*Aspergillus varians* Wehmer 1897			1	18.57	1	25.81
199	*Aspergillus versicolor* (Vuillemin 1903) Tiraboschi 1908			46	42.57	12	46.87
200	*Aspergillus viridinutans* Ducker et Thrower 1954			2	28.31	1	47.20
201	*Aspergillus wentii* Wehmer 1896			12	40.01	6	27.64
202	*Asterosporium orientale* Melnik 1988			1	0.07		
203	*Athelia rolfsii* (Curzi 1932) C.C. Tu et Kimbrough 1978	1	19.30				
204	*Aureobasidium melanogenum* (Hermanides-Nijhof 1977) Zalar et al. 2014			9	46.31	2	12.60
205	*Aureobasidium microstictum* (Bubak 1907) W.B. Cooke 1962	1	19.85	3	35.55		
206	*Aureobasidium pullulans* (de Bary 1866) G. Arnaud 1918	14	20.22	29	47.98	3	5.00
207	*Backusella circina* J.J. Ellis et Hesseltine 1969	2	23.57	2	44.37		
208	*Backusella indica* (Baijal et B.S. Mehrotra 1965) G. Walther et *de* Hoog 2013	1	20.66	1	25.49	1	20.12
209	*Backusella lamprospora* (Lendner 1908) Benny et R.K. Benjamin 1975	2	25.41	4	39.34	3	8.78
210	*Backusella oblongiellipticа* (H. Naganishi et al. ex Pidoplichko et Milko *1971)* G. Walther et de Hoog 2013	1	20.62	1	34.63		
211	*Backusella recurva* (E.E. Butler 1952) G. Walther et de *Hoog* 2013	1	25.31	1	19.65		
212	*Backusella tuberculispora* (Schipper 1978) G. Walther et de Hoog 2013	1	25.31	1	36.53		
213	*Backusella variabilis* (A.K. Sarbhoy 1965) G. Walther et de Hoog 2013	1	19.59	1	46.64	1	19.25
214	*Basidiobolus magnus* Drechsler 1964	1	20.06				
215	*Basidiobolus meristosporus* Drechsler 1955	1	20.21				
216	*Beauveria bassiana* (Balsamo-Crivelli 1835) Vuillemin 1912	12	29.66	14	46.45	12	22.79
217	*Beauveria brongniartii* (Saccardo 1892) Petch 1926	6	19.50	6	33.01	5	10.92
218	*Beauveria caledonica* Bissett et Widden 1988			1	3.00	1	0.70
219	*Beauveria felina* (De Candolle 1815) J.W. Carmichael 1980			1	13.51	1	0.60
220	*Benjaminiella poitrasii* (R.K. Benjamin 1960) Arx 1981	2	19.56	2	38.65	2	46.30
221	*Berkeleyomyces basicola* (Berkeley et Broome 1850) W.J. Nel et al. 2017	2	19.51	2	39.60		
222	*Bionectria ochroleuca* (Schweinitz 1832) Schroers et Samuels 1997			1	26.61		
223	*Bipolaris australiensis* (M.B. Ellis 1971) Tsuda et Ueyama 1981	6	19.30	14	49.80	2	8.53
224	*Bipolaris bicolor* (Mitra 1931) Shoemaker 1959			1	24.97		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
225	*Bipolaris cynodontis* (Marignoni 1909) Shoemaker 1959	4	19.12	4	49.79	1	8.43
226	*Bipolaris sorokiniana* (Saccardo 1890) Shoemaker 1959	4	19.35	8	49.80		
227	*Bipolaris spicifera* (Bainier 1908) Subramanian 1971			1	23.92		
228	*Bipolaris victoriae* (F. Meehan et H.C. Murphy 1946) Shoemaker 1959	1	17.47	1	26.99		
229	*Biscogniauxia nummularia* (Bulliard 1790) Kuntze 1891	1	19.32	1	7.17	1	0.10
230	*Bispora antennata* (Persoon 1801) E.W. Mason 1953	2	19.16	3	27.07		
231	*Bispora betulina* (Corda 1838) S. Hughes 1958	2	17.45	2	34.55		
232	*Bispora effusa* Peck 1891	1	20.22	1	15.09		
233	*Bjerkandera adusta* (Willdenow 1787) P. Karsten 1879	7	8.31				
234	*Blakeslea trispora* Thaxter 1914	14	26.15	16	48.52	7	11.74
235	*Blumeriella jaapii* (Rehm 1907) Arx 1961	1	8.61	1	9.62		
236	*Boeremia hedericola* (Durieu et Montagne 1855) Aveskamp et al. 2010			1	4.61		
237	*Boeremia lycopersici* (Cooke 1885) Aveskamp et al. 2010			1	14.02		
238	*Botryodiplodia malorum* (Berkeley 1836) Petrak et Sydow 1926	1	20.00				
239	*Botryosphaeria rhodina* (Berkeley et M.A. Curtis 1889) Arx 1970	1	19.98	1	26.19	1	0.12
240	*Botryosporium longibrachiatum* (Oudemans 1890) Maire 1903	2	21.41				
241	*Botryotinia narcissicola* (P.H. Gregory 1941) N.F. Buchwald 1949	1	18.96	1	28.02	1	0.11
242	*Botryotinia polyblastis* (P.H. Gregory 1938) N.F. Buchwald 1949			1	27.67		
243	*Botryotrichum piluliferum* Saccardo et Marchal 1885	6	19.23	7	48.07		
244	*Botryotrichum verrucosum* (Pugh et al. 1964) X. Wei Wang et Houbraken 2018			1	17.82		
245	*Botryoxylon geniculatum* (Corda 1839) Ciferri 1962	1	17.71	1	28.41		
246	*Botrytis aclada* Fresenius 1850	2	19.30	2	37.80		
247	*Botrytis anthophila* Bondartsev 1913	2	19.20	2	40.66		
248	*Botrytis bifurcata* J.H. Miller et al. 1958			1	6.88		
249	*Botrytis cinerea* Persoon 1794	14	19.23	24	37.74		
250	*Botrytis convallariae* (Klebahn 1930) Ondrej 1972 ex Boerema et Hamers *1988*	3	15.32	3	15.42		
251	*Botrytis convoluta* Whetzel et Drayton 1932	2	19.23	2	47.64		
252	*Botrytis fabae* Sardina 1929	1	19.12				
253	*Botrytis galanthina* (Berkeley et Broome 1873) Saccardo 1886	1	19.23	1	27.67		
254	*Botrytis gladiolorum* Timmermans 1941	2	19.30	2	38.79		
255	*Botrytis hyacinthi* Westerdijk et J.F.H. Beyma 1928	1	19.20				

256	*Botrytis lutescens* Saccardo et Roumeguere 1882	1	19.20				
257	*Botrytis squamosa* J.C. Walker 1925	1	19.33				
258	*Botrytis tulipae* (Libert 1830) Lind 1913	1	19.50	1	13.16		
259	*Bovista pusilla* (Batsch 1789) Persoon 1801	1	16.61				
260	*Brachysporium nigrum* (Link 1824) S. Hughes 1958	1	20.58	1	26.08		
261	*Burgoa anomala* (Hotson 1912) Goidanich 1937			1	8.98		
262	*Byssochlamys nivea* Westling 1909	2	19.44	2	36.44	2	44.03
263	*Cadophora fastigiata* Lagerberg et Melin 1928	6	19.41	7	28.68		
264	*Cadophora luteo-olivacea* (J.F.H. Beyma 1940) T.C. Harrington et McNew 2003			3	0.54		
265	*Cadophora malorum* (Kidd et Beaumont 1924) W. Gams 2000	7	19.76	9	45.39		
266	*Cadophora melinii* Nannfeldt 1934	1	19.49	5	45.37		
267	*Calcarisporium arbuscula* Preuss 1851	4	1.99	5	28.45		
268	*Calcarisporium griseum* Spegazzini 1902	3	17.70	3	27.88		
269	*Celosporium* sp.			1	6.56		
270	*Cephalotrichum gorgonifer* (Bainier 1907) Sandoval-Denis et al. 2016	1	17.70	1	27.05		
271	*Cephalotrichum microsporum* (Saccardo 1878) P.M. Kirk 1984			3	11.54		
272	*Cephalotrichum purpureofuscum* (Schweinitz 1832) S. Hughes	1	19.39	2	31.05		
273	*Cephalotrichum stemonitis* (Persoon 1801) Nees 1809	4	19.41	10	36.99	1	5.68
274	*Ceratellopsis equiseticola* (Boudier 1917) Corner 1950	1	23.34				
275	*Ceratocystis adiposa* (E.J. Butler 1906) C. Moreau 1952					1	0.10
276	*Ceratocystis paradoxa* (Dade 1928) C. Moreau 1952	2	19.85	2	40.51	2	26.12
277	*Ceratocystis pilifera* (Fries 1822) C. Moreau 1952	2	18.86	2	39.58		
278	*Cercospora armoraciae* Saccardo 1876	1	20.34	1	17.87	1	0.53
279	*Cercospora beticola* Saccardo 1876			2	25.47		
280	*Cercospora carotae* (Passerini 1887) Kaznowski et Siemaszko 1929	1	20.34	1	23.40		
281	*Cercospora rosicola* Passerini 1875	1	16.67			1	22.04
282	*Cercospora violae* Saccardo 1876			1	23.85		
283	*Ceriporiopsis gilvescens* (Bresadola 1908) Domanski 1963	1	12.58				
284	*Cerrena unicolor* (Bulliard 1788) Murrill 1903	1	12.58				
285	*Chaetocladium brefeldii* van Tieghem et G. Le Monnier 1873	2	17.59	2	38.59	2	16.98
286	*Chaetocladium jonesii* (Berkeley et Broome 1854) Fresenius 1863	1	23.67	1	27.42		
287	*Chaetocytostroma* sp.			1	20.53		
288	*Chaetomidium pilosum* (C. Booth et Shipton 1966) Arx 1975	1	14.46	1	43.99	1	24.33
289	*Chaetomium amesii* Sergeeva 1965	1	19.28	1	31.01	1	24.33

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
290	*Chaetomium angustispirale* Sergeeva 1956	1	19.28	1	43.64	1	23.33
291	*Chaetomium aureum* Chivers 1912	2	20.51	1	42.33	2	23.86
292	*Chaetomium brasiliense* Bat. et Pontual 1948			1	38.87		
293	*Chaetomium crispatum* (Fuckel) Fuckel 1870	1	20.04				
294	*Chaetomium elatum* Kunze 1817	3	20.51	3	43.64	3	24.33
295	*Chaetomium fieberi* Corda 1837			1	32.08	1	11.25
296	*Chaetomium funicola* Cooke 1873	1	19.28	1	26.15	1	0.72
297	*Chaetomium globosum* Kunze 1817	11	19.44	21	48.45	14	28.00
298	*Chaetomium homopilatum* Omvik 1953	1	19.33	2	35.37	2	0.32
299	*Chaetomium indicum* Corda 1840	1	19.28	2	42.28	1	23.47
300	*Chaetomium megalocarpum* Bainier 1910	2	19.28	2	43.64	2	23.47
301	*Chaetomium nozdrenkoae* Sergeeva 1961	1	18.87	1	35.25	1	0.11
302	*Chaetomium perlucidum* Sergeeva 1956	1	19.28	1	35.29	1	0.27
303	*Chaetomium seminis-citrulli* Sergeeva 1956	1	25.68	1	43.67	1	0.11
304	*Chaetomium spirale* Zopf 1881	1	19.28	1	37.32		
305	*Chaetomium subaffine* Sergeeva 1961	1	19.28	1	35.29	1	23.47
306	*Chaetomium subspirilliferum* Sergeeva 1960	1	20.42	1	25.61	1	22.62
307	*Chaetomium trilaterale* Chivers 1912			1	11.80		
308	*Chaunopycnis alba* W. Gams 1979			1	2.01		
309	*Chloridium caesium* (Nees et T. Nees 1818) Réblová et Seifert 2016			1	27.64		
310	*Chloridium virescens* (Persoon 1797) W. Gams et Holubova-Jechova 1976 var. *caudigerum* (Hoehnel 1903) W. Gams et Holubova-Jechova 1976	1	19.67	1	30.31		
311	*Chlorophyllum rhacodes* (Vittadini 1835) Vellinga 2002	1	12.02				
312	*Choanephora conjuncta* Couch 1925	1	3.78				
313	*Choanephora cucurbitarum* (Berkeley et Ravenel 1875) Thaxter 1903	1	20.21	1	20.93		
314	*Choanephora infundibulifera* (Currey 1873) Saccardo 1891	1	25.41	1	33.99		
315	*Chondrostereum purpureum* (Persoon 1794) Pouzar 1959	1	20.10				
316	*Chordomyces antarcticus* Bilanenko et al. 2015			6	8.00		
317	*Chromelosporium fulvum* (Link 1824) McGinty et al. 1975	2	1.88	2	18.07		
318	*Chrysonilia sitophila* (Montagne 1843) Arx 1981			1	43.95	1	22.14
319	*Chrysosporium keratinophilum* D. Frey 1959 ex J.W. Carmichael 1962	2	9.57	2	32.84	1	5.95
320	*Chrysosporium lobatum* Scharapov 1978			1	38.25	1	29.86

321	*Chrysosporium lucknowense* Garg 1966	6	5.62	6	22.03		
322	*Chrysosporium merdarium* (Link 1818 ex Greville 1823) J.W. Carmichael 1962	3	11.87	4	25.63	1	35.73
323	*Chrysosporium queenslandicum* Apinis et R.G. Rees 1976	2	31.45	2	38.32	2	31.26
324	*Chrysosporium tropicum* J.W. Carmichael 1962	3	9.10	3	37.15	2	25.87
325	*Chrysosporium undulatum* P. Vidal et al. 1999	3	20.41	4	42.69	3	35.66
326	*Circinella muscae* (Sorokin 1870) Berlese et de Toni 1888	4	22.71	5	43.04	5	47.39
327	*Circinella umbellata* van Tieghem et G. Le Monnier 1873	1	19.68	1	40.08	1	37.94
328	*Cistella* sp.			2	1.87		
329	*Cladobotryum dendroides* (Bulliard 1791) W. Gams et Hoozemans 1970	3	26.47	3	38.61	1	3.20
330	*Cladobotryum multiseptatum* de Hoog 1978			1	16.25		
331	*Cladobotryum varium* Nees 1817	5	21.79	7	43.99	5	7.73
332	*Cladobotryum verticillatum* (Link 1809) S. Hughes 1958			2	43.99		
333	*Cladophialophora chaetospira* (Grove 1886) Crous et Arzanlou 2007			1	33.14		
334	*Cladosporium aecidiicola* Thuemen 1876	1	19.20	1	26.20		
335	*Cladosporium allicinum* (Fries 1817: Fries 1832) Bensch et al. 2012			1	33.11		
336	*Cladosporium antarcticum* K. Schubert et al. 2007			1	7.32		
337	*Cladosporium brevicompactum* Pidoplichko et Deniak 1941			2	34.24		
338	*Cladosporium cladosporioides* (Fresenius 1850) G.A. de Vries 1952	4	19.53	56	47.50	4	6.72
339	*Cladosporium colocasiae* Sawada 1916	1	19.35	1	19.16		
340	*Cladosporium cucumerinum* Ellis et Arthur 1889			1	48.92		
341	*Cladosporium elegantulum* Pidoplichko et Deniak 1938			2	26.47	1	7.58
342	*Cladosporium gossypiicola* Pidoplichko et Deniak 1941			2	34.83		
343	*Cladosporium halotolerans* Zalar et al. 2007			2	28.46		
344	*Cladosporium herbarum* (Persoon 1794) Link 1816	19	19.35	101	47.52	10	5.76
345	*Cladosporium lycoperdinum* Cooke 1883			1	41.76		
346	*Cladosporium macrocarpum* Preuss 1848	4	19.01	5	47.72		
347	*Cladosporium pseudocladosporioides* Bensch et al. 2010			1	23.56		
348	*Cladosporium sphaerospermum* Penzig 1882	7	19.30	22	47.50	2	14.36
349	*Cladosporium straminicola* Pidoplichko et Deniak 1938			1	26.05		
350	*Cladosporium transchelii* Pidoplichko et Deniak 1938			1	13.10		
351	*Clathrus archeri* (Berkeley 1859) Dring 1980	1	1.65				
352	*Clavariadelphus pistillaris* (Linnaeus 1753) Donk 1933	1	19.70				
353	*Claviceps paspali* F. Stevens et J.G. Hall 1910	3	18.95				
354	*Claviceps purpurea* (Fries 1823) Tulasne 1853	3	26.36	7	25.22		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
355	*Clitocybe odora* (Bulliard 1784) P. Kummer 1871	1	0.01				
356	*Clonostachys byssicola* Schroers 2001			2	3.67		
357	*Clonostachys rosea* (Link 1816) Schroers et al. 1999 f. *catenulata* (J.C. Gilman et E.V. Abbott 1927) Schroers 2001	8	20.68	8	34.61	3	19.96
358	*Clonostachys rosea* (Link 1816) Schroers et al. 1999 f. *rosea*	17	19.47	18	42.09	16	15.09
359	*Clonostachys solani* (Harting 1846) Schroers et W. Gams 2001			2	1.65		
360	*Clonostachys solani* (Harting 1846) Schroers et W. Gams 2001 f. *nigrovirens* (J.F.H.Beyma 1931) Schroers 2001			2	32.42	1	4.92
361	*Coemansia aciculifera* Linder 1943	1	21.05				
362	*Cokeromyces recurvatus* Poitras 1950	3	24.14	3	42.75	3	22.74
363	*Colletoconis aecidiophila* (Spegazzini 1886) de Hoog et al. 1978	1	16.87	1	30.04		
364	*Colletotrichum coccodes* (Wallroth 1833) S. Hughes 1958			4	20.10		
365	*Colletotrichum dematium* (Persoon 1801) Grove 1918			1	6.08		
366	*Colletotrichum gloeosporioides* (Penzig 1882) Penzig et Saccardo 1884	2	19.33	4	37.54		
367	*Colletotrichum musae* (Berkeley et M.A. Curtis 1874) Arx 1957	1	19.32	1	24.90		
368	*Colpoma quercinum* (Persoon 1796) Wallroth 1823			1	37.71		
369	*Conidiobolus coronatus* (Costantin 1897) Batko 1964	4	15.93				
370	*Conidiobolus thromboides* Drechsler 1953	2	6.78				
371	*Coniochaeta verticillata* (van Emden 1973) Dania García et al. 2006	1	18.96	1	39.44	1	0.10
372	*Coniophora puteana* (Schumacher 1803) P. Karsten 1868	4	12.02				
373	*Coniothyrium concentricum* (Desmazieres 1840) Saccardo 1878	1	19.01	1	12.63		
374	*Coniothyrium hellebori* Cooke et Massee 1886	1	17.70	1	27.85		
375	*Coniothyrium rosarum* Cooke et Harkness 1882	2	19.40	2	16.28		
376	*Coniothyrium wernsdorffiae* Laubert 1905	1	19.01	1	20.34		
377	*Coprinellus disseminatus* (Persoon 1801) J.E. Lange 1938	1	32.89				
378	*Coprinellus ephemerus* (Bulliard 1786) Redhead et al. 2001	1	32.87				
379	*Coprinellus micaceus* (Bulliard 1785) Vilgalys et al. 2001	3	32.83				
380	*Coprinellus radians* (Desmazieres 1828) Vilgalys et al. 2001	1	32.83				
381	*Coprinopsis atramentaria* (Bulliard 1783) Redhead et al. 2001	2	32.83				
382	*Coprinopsis gonophylla* (Quélet 1884) Redhead et al. 2001	2	22.97				
383	*Coprinopsis kimurae* (Hongo et Aoki 1966) Redhead et al. 2001	1	7.92				
384	*Coprinus comatus* (O.F. Mueller 1780) Persoon 1797	2	32.83				
385	*Coprinus domesticus* (Bolton 1788) Gray 1821	1	27.36				

386	*Coprinus sterquilinus* (Fries 1821) Fries 1838	2	32.87				
387	*Coriolopsis trogii* (Berkeley 1850) Domanski 1974	1	34.10				
388	*Coriolus* sp.	1	19.42				
389	*Cortinarius bulbosus* Gray 1821	1	22.97				
390	*Cortinarius caperatus* (Persoon 1796) Fries 1838	1	23.53				
391	*Corynascella inaequalis* (Pidoplichko et al. 1973) Arx 1975	1	18.95	1	42.84	1	27.97
392	*Corynascus sepedonium* (C.W. Emmons 1932) Arx 1973	1	20.42	1	39.91	1	21.16
393	*Cosmospora arxii* (W. Gams 1971) Gräfenhan et Schroers 2011	1	16.01	1	35.44	1	0.53
394	*Cosmospora berkeleyana* (P. Karsten 1891) Gräfenhan et al. 2011			8	24.26	1	21.27
395	*Cosmospora lavitskiae* (Zhdanova 1966) Gräfenhan et Seifert 2011	1	4.33	1	30.12	1	0.09
396	*Crassicarpon hotsonii* Koukol 2016			1	13.43		
397	*Cryphonectria parasitica* (Murrill 1906) M.E. Barr 1978	5	19.35	5	41.47	1	0.19
398	*Cryptococcus depauperatus* (Petch 1932) Boekhout et al. 2015	1	23.96				
399	*Cunninghamella blakesleeana* Lendner 1927	3	14.1			2	13.81
400	*Cunninghamella echinulata* (Thaxter 1891) Thaxter ex Blakeslee1905	13	25.18	15	42.96	12	49.77
401	*Cunninghamella homothallica* Kominami et Tubaki 1952	1	20.08				
402	*Cunninghamella japonica* (Saito 1905) Pidoplichko et Milko 1971	6	25.18	7	37.02	6	35.84
403	*Cunninghamella vesiculosa* P.C. Misra 1966	1	21.95				
404	*Curvularia clavata* B.L. Jain 1962			1	13.68		
405	*Curvularia comoriensis* Bouriquet et Jauffret 1955 ex M.B. Ellis 1966	1	17.80	1	26.87		
406	*Curvularia fallax* Boedijn 1933			1	13.60		
407	*Curvularia geniculata* (Tracy et Earle 1896) Boedijn 1933	4	19.30	5	45.17		
408	*Curvularia inaequalis* (Shear 1907) Boedijn 1933	5	19.76	6	28.20	1	4.33
409	*Curvularia kusanoi* (Y. Nisikado 1928) Manamgoda et al. 2014			1	18.74		
410	*Curvularia lunata* (Wakker 1898) Boedijn 1933	6	19.35	9	44.30		
411	*Curvularia nodulosa* (Saccardo 1886) Manamgoda et al. 2014			1	23.88		
412	*Curvularia protuberata* Nelson et Hodges 1965			1	13.50		
413	*Cyathus olla* (Batsch 1783) Persoon 1801	1	14.05				
414	*Cylindrium cordae* Grove 1886			1	27.86	1	3.49
415	*Cylindrocarpon album* (Saccardo 1877) Wollenweber 1917	1	17.67	1	34.66	1	3.51
416	*Cylindrocarpon chlamydospora* Schischkina et Tzanava 1973	1	19.97	1	18.49		
417	*Cylindrocarpon congoense* J.A. Meyer 1958	1	19.56	1	28.46	1	2.49
418	*Cylindrocarpon destructans* (Zinssmeister 1918) Scholten 1964	6	15.66	12	21.12	2	2.43
419	*Cylindrocarpon didymum* (Hartig 1846) Wollenweber 1926	2	19.56	3	21.12		
420	*Cylindrocarpon gracile* Bugnicourt 1939	3	29.09	3	1.25	1	3.07

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
421	*Cylindrocarpon heteronema* (Berkeley et Broome 1865) Wollenweber 1916	3	19.53	4	28.67	1	2.49
422	*Cylindrocarpon lucidum* C. Booth 1966			1	20.70		
423	*Cylindrocarpon obtusisporum* (Cooke et Harkness 1884) Wollenweber 1926	1	25.95	1	18.94	1	2.45
424	*Cylindrocarpon peronosporae* (Fautrey et Lambotte 1896) Rudakov 1981			1	37.38	1	0.08
425	*Cylindrocarpon tenue* Bugnicourt 1939	1	3.81				
426	*Cylindrocephalum stellatum* (Harz 1871) Saccardo 1886	1	12.09	1	38.72	1	3.20
427	*Cylindrophora alba* Bonorden 1851			1	19.78		
428	*Cylindrophora hoffmannii* Daszewska 1912	1	17.73	1	28.06	1	5.65
429	*Cytospora* sp.			1	1.21		
430	*Dacrymyces stillatus* Nees 1816	1	6.62				
431	*Dactylaria acerosa* Matsushima 1975			1	0.77		
432	*Dactylaria dimorphospora* Veenbaas-Rijks 1973	1	16.10	1	23.58		
433	*Dactylellina asthenopaga* (Drechsler 1937) M. Scholler et al.1999	1	19.30	1	0.08		
434	*Daedalea quercina* (Linnaeus 1753) Persoon 1801	2	34.05				
435	*Daedaleopsis confragosa* (Bolton 1791) J. Schröter 1888 var. *confragosa*	1	10.36				
436	*Dematioscypha delicata* (Berkeley et Broome 1859) Hosoya 2014	1	19.38	1	26.79		
437	*Dendrodochium toxicum* Pidoplichko et Bilai 1947	1	19.33	1	28.29	1	4.79
438	*Dendrostilbella macrospora* W. Bally 1917	1	7.72	1	14.23	1	4.92
439	*Dendrostilbella mycophila* (Persoon 1822) Seifert 1985			1	37.05	1	2.89
440	*Dendryphion nanum* (Nees 1816) S. Hughes 1958			1	24.14	1	0.53
441	*Dendryphion penicillatum* (Corda 1838) Fries 1846			1	24.88	2	3.44
442	*Dichobotrys* sp.	1	19.28	1	18.88		
443	*Dichotomomyces cejpii* (Milko 1964) D.B. Scott 1970	1	18.96	1	19.72	1	23.17
444	*Dictyostelium discoideum* (Bosc 1811) E. Fischer 1888	1	5.75	1	24.44		
445	*Dictyuchus monosporus* Leitgeb 1870	2	12.57				
446	*Dicyma ampullifera* Boulanger 1897	1	19.21	1	12.36		
447	*Dicyma olivacea* (Emoto et Tubaki 1970) Arx 1982	1	19.40	1	48.10		
448	*Dicyma ovalispora* (S. Hughes 1951) Arx 1982	1	6.69	1	12.32		
449	*Didymella glomerata* (Corda 1840) Q. Chen et L. Cai 2015	11	19.47	8	46.45		
450	*Didymella musae* (P. Joly 1961) Q. Chen et L. Cai *2015*			4	19.59		
451	*Didymella pinodella* (L.K. Jones 1927) Q. Chen et L. Cai *2015*	1	20.54				
452	*Didymella pinodes* (Berkeley et A. Bloxam 1861) Petrak 1924	1	19.22	1	22.41		

453	*Didymella pomorum* (Thümen 1879) Q. Chen et L. Cai 2015	4	19.56	4	46.45		
454	*Didymopsis helvellae* (Corda 1854) Saccardo et Marchall 1885			1	28.44	1	2.73
455	*Dimargaris bacillispora* R.K. Benjamin 1959	1	19.37	1	8.30		
456	*Dinemasporium strigosum* (Persoon 1801) Saccardo 1881	1	17.80	1	20.15		
457	*Diplocladium majus* Bonorden 1851	2	21.84	2	38.61	2	2.84
458	*Diplocladium penicilloides* Saccardo 1886			2	27.21	2	3.73
459	*Diplodina acerina* (Passerini 1875) B. Sutton 1980			1	6.56		
460	*Dipodascopsis tothii* (Zsolt 1963) L.R. Batra et Millner 1978			1	42.60	1	0.10
461	*Dipodascopsis uninucleata* (Biggs 1937) L.R. Batra et Millner 1978 var. *uninucleata*	2	4.03	2	42.60		
462	*Dipodascus aggregatus* Francke-Grosmann 1952	2	18.88	2	42.63	2	0.10
463	*Dipodascus armillariae* W. Gams 1983	1	19.62	1	15.67		
464	*Discula brunneotingens* E.I. Meyer 1953	1	20.32	1	29.45		
465	*Discula pinicola* (Naumov 1926) Petrak 1927 var. *mammosa* Lagerberg et al. 1927	1	19.33	1	39.74		
466	*Dispira cornuta* van Tieghem 1875	1	21.05				
467	*Dissoacremoniella silvatica* Kirilenko 1970	1	28.88	1	22.90		
468	*Dothiora prunorum* (Dennis et Buhagiar 1973) Crous 2016	1	16.93	1	27.42		
469	*Drechmeria coniospora* (Drechsler 1941) W. Gams et H.-B. Jansson 1985			1	13.88	1	22.04
470	*Drechslera avenacea* (M.A. Curtis ex Cooke 1889) Shoemaker 1959			2	37.32		
471	*Drechslera campanulata* (Leveille 1841) B. Sutton 1976	3	19.38	2	23.17		
472	*Drechslera poae* (Baudys 1916) Shoemaker 1962			1	33.87		
473	*Duddingtonia flagrans* (Duddington 1949) R.C. Cooke 1969	1	19.32	1	18.30	1	2.49
474	*Echinobotryum rubrum* Sorokin ex Jaczewski 1917			1	25.93	1	0.08
475	*Eladia saccula* (E. Dale 1926) G. Smith 1961	1	20.56	1	44.21		
476	*Emericellopsis alkalina* Bilanenko et Georgieva 2013			3	7.77		
477	*Emericellopsis donezkii* Beliakova 1974	7	20.48	7	46.22	6	0.09
478	*Emericellopsis glabra* (J.F.H. Beyma 1940) Backus et Orpurt 1961	1	19.33	3	46.54		
479	*Emericellopsis humicola* (Cain 1956) Gilman 1956	1	19.33	1	48.87	1	23.47
480	*Emericellopsis maritima* Beliakova 1970	1	14.88	1	17.90		
481	*Emericellopsis minima* Stolk 1955	10	20.42	10	46.48	9	22.75
482	*Emericellopsis pallida* Beliakova 1974	1	20.44	1	49.00	1	23.10
483	*Emericellopsis robusta* van Emden et W. Gams 1971			2	44.91		
484	*Emericellopsis terricola* J.F.H. Beyma 1940	1	19.33	1	49.00	1	0.10
485	*Engyodontium album* (Limber 1940) de Hoog 1978	2	23.78	3	18.23		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
486	*Entomophthora dipterigena* (Thaxter 1888) Saccardo et Traverso 1891	1	26.20				
487	*Entomophthora thaxteriana* I.M. Hall et J. Bell 1963	5	23.20				
488	*Entyloma gaillardianum* Vanky 1982	1	12.35	1	18.84		
489	*Epicoccum nigrum* Link 1815	5	19.81	11	35.51		
490	*Epicoccum sorghinum* (Saccardo 1878) Aveskamp et al. 2010			4	3.29		
491	*Epithyrium obscurum* (Passerini 1885) Saccardo 1931			1	11.05		
492	*Eremascus fertilis* Stoppel 1907	1	18.86	1	5.73		
493	*Eremothecium ashbyi* Guilliermond 1935	5	17.32				
494	*Eremothecium gossypii* (S.F. Ashby et W. Nowell 1926) Kurtzman 1995	2	16.33				
495	*Eupenicillium pinetorum* Stolk 1968					1	0.10
496	*Eurotium amstelodami* L. Mangin 1909			16	43.08	9	46.64
497	*Eurotium chevalieri* L. Mangin 1909			8	42.86	5	46.87
498	*Eurotium halophilicum* C.M. Christensen et al. 1959			1	28.92	1	0.10
499	*Eurotium herbariorum* (F.H. Wiggers 1780) Link 1809	1	18.88	18	37.95	1	21.57
500	*Eurotium rubrum* Jos. König et al. 1901			7	43.26	6	37.41
501	*Eurotium tonophilum* Ohtsuki 1962	1	20.01	1	39.91	1	19.77
502	*Eutypa* sp.			1	0.04	1	2.69
503	*Evlachovaea kintrischica* B. Borisov et Tarasov 1999			1	15.54		
504	*Exobasidium bisporum* Sawada ex Ezuka 1991	1	23.62	1	1.64		
505	*Exobasidium karstenii* Saccardo et Trotter 1912	1	23.62				
506	*Exobasidium myrtilli* Siegmund 1879	1	19.46	1	1.64		
507	*Exobasidium pachysporum* Nannfeldt 1981	1	2.04				
508	*Exobasidium vaccinii* (Fuckel 1861) Woronin 1867	2	23.62	2	1.81		
509	*Exophiala castellanii* Iwatsu et al. 1984	2	20.40	2	23.19		
510	*Exophiala heteromorpha* (Nannfeldt 1934) de Hoog et Haase 2003	1	19.54	1	21.63		
511	*Exophiala lecanii-corni* (Benedek et Specht 1933) Haase et de Hoog 1999			1	18.56		
512	*Exophiala moniliae* de Hoog 1977			1	18.56		
513	*Exophiala salmonis* J.W. Carmichael 1966	1	17.78	1	10.32		
514	*Exophiala xenobiotica* de Hoog et al. 2006			3	2.11		
515	*Exserohilum pedicellatum* (A.W. Henry 1924) K.J. Leonard et Suggs 1974	1	19.48	1	40.52		
516	*Exserohilum rostratum* (Drechsler 1923) K.J. Leonard et Suggs 1974			1	18.33		
517	*Farlowiella carmichaeliana* (Berkeley 1836) Saccardo 1891			1	26.00	1	3.49

518	*Farrowia seminuda* (L.M. Ames 1949) D. Hawksworth 1975			1	38.09		
519	*Fennellomyces linderi* (Hesseltine et Fennell 1955) Benny et R.K. Benjamin *1975*	1	19.64	1	15.02	1	29.69
520	*Fibroporia vaillantii* (de Candolle 1815) Parmasto 1968	1	20.10				
521	*Flammulina velutipes* (Curtis 1782) Singer 1951	6	34.05				
522	*Fomes fomentarius* (Linnaeus 1753) J.J. Kickx 1867	4	34.14				
523	*Fomitopsis pinicola* (Swartz 1810) P. Karsten 1881	8	20.04	1	0.99		
524	*Fomitopsis rosea* (Albertini et Schweinitz 1805) P. Karsten 1881	1	20.10				
525	*Fonsecaea pedrosoi* (Brumpt 1922) Negroni 1936	1	19.72	1	39.24		
526	*Fulvia* fulva (Cooke 1883) Ciferri 1954	3	19.01	3	22.51		
527	*Fusarium agaricorum* Sarrazin 1887	1	17.67	1	27.21	1	2.62
528	*Fusarium aquaeductuum* (Rabenhorst et Radlkofer 1861) Lagerheim et Rabenhorst 1891	3	0.19	2	33.19	2	2.52
529	*Fusarium aquaeductuum* (Rabenhorst et Radlkofer 1861) Lagerheim et Rabenhorst 1891 var. *medium* Wollenweber 1931			1	23.04	1	5.64
530	*Fusarium arthrosporioides* Sherbakoff 1915	1	13.96	1	21.18		
531	*Fusarium avenaceum* (Fries 1832) Saccardo 1886	4	19.99	3	44.73	3	14.34
532	*Fusarium avenaceum* (Fries 1832) Saccardo 1886 var. *herbarum* (Corda 1839) Saccardo 1886			1	26.39	1	2.90
533	*Fusarium cerealis* (Cooke 1878) Saccardo 1886	1	2.21	1	26.52		
534	*Fusarium chlamydosporum* Wollenweber et Reinking 1925			2	29.57		
535	*Fusarium concolor* Reinking 1935	1	1.88	2	16.36		
536	*Fusarium culmorum* (W.G. Smith 1884) Saccardo 1895	3	17.67	3	32.72	3	11.43
537	*Fusarium decemcellulare* Brick 1908	2	19.50	2	44.40	2	11.93
538	*Fusarium epistroma* (Hoehnel 1909) C. Booth 1971			2	32.43	2	3.04
539	*Fusarium equiseti* (Corda 1838) Saccardo 1886	5	19.28	7	44.85	3	26.61
540	*Fusarium expansum* Schlechtendal 1824			1	29.47	1	2.68
541	*Fusarium fujikuroi* Nirenberg 1976	1	7.65	1	39.07	1	24.70
542	*Fusarium graminearum* Schwabe 1839	4	15.66	4	35.19	3	3.98
543	*Fusarium graminearum* Schwabe 1839 f. oxalis			1	38.91	1	7.09
544	*Fusarium heterosporum* Nees et T. Nees 1818			3	31.04	1	7.09
545	*Fusarium heterosporum* Nees et T. Nees 1818 var. *pucciniophilum Saccardo* et Sydow 1899	1	17.73	1	23.19	1	2.62
546	*Fusarium incarnatum* (Roberge 1849) Saccardo 1886	4	16.56	4	28.98	4	2.97
547	*Fusarium javanicum* Koorders 1907	2	13.36	2	35.60	2	7.90
548	*Fusarium lateritium* Nees 1816	7	20.47	8	39.14	4	21.85

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
549	*Fusarium merismoides* Corda 1838	3	17.90	3	33.20	1	3.64
550	*Fusarium oxysporum* Schlechtendal 1824	14	31.06	28	38.36	7	24.51
551	*Fusarium oxysporum* Schlechtendal 1824 f. sp. *batatas* (G.F. Atkinson *1892)* W.C. Snyder et H.N. Hansen 1940			1	18.10	1	25.21
552	*Fusarium oxysporum* Schlechtendal 1824 f. sp. *conglutinans* W.C. Snyder et *H.N.* Hansen 1940			2	23.35	1	25.52
553	*Fusarium oxysporum* Schlechtendal 1824 f. sp. *lycopersici* W.C. Snyder et *H.N.* Hansen 1940			2	29.35	2	23.85
554	*Fusarium oxysporum* Schlechtendal 1824 f. sp. *vasinfectum* W.C. Snyder et *H.N.* Hansen 1940			1	25.04	1	26.69
555	*Fusarium poae* (Peck 1903) Wollenweber 1913	3	17.81	4	45.15	3	12.68
556	*Fusarium redolens* Wollenweber 1913	3	21.67	3	21.54		
557	*Fusarium sambucinum* Fuckel 1863	11	7.69	9	37.19	7	13.96
558	*Fusarium sambucinum* Fuckel 1863 var. *ossicola* (Berkeley et M.A.Curtis 1875) Bilai 1955			1	11.59	1	0.73
559	*Fusarium sarcochroum* (Desmazieres 1850) Saccardo 1879	1	4.99	1	21.31	1	2.90
560	*Fusarium solani* (Martius 1842) Saccardo 1881	12	16.16	23	34.24	10	16.90
561	*Fusarium sporotrichioides* Sherbakoff 1915	6	17.73	6	47.20	6	18.61
562	*Fusarium tricinctum* (Corda 1838) Saccardo 1886	7	17.47	7	37.16	4	4.75
563	*Fusarium ventricosum* Appel et Wollenweber 1913			3	29.13	2	12.68
564	*Fusarium verticillioides* (Saccardo 1881) Nirenberg 1976	25	30.64	26	42.97	23	28.25
565	*Fusarium viride* (Lechmere 1912) Wollenweber 1917	1	17.67	1	23.96	1	2.62
566	*Fusarium wolgense* Rodigin 1942			1	37.26	1	3.04
567	*Fusicladium peltigericola* Crous et Diederich 2010			1	2.12		
568	*Fusicladium pomi* (Fries 1825) Lind 1913	1	19.82				
569	*Fusicoccum castaneum* Saccardo 1882			1	11.21		
570	*Fusicolla epistroma* (Höhn. 1909) Gräfenhan and Seifert 2011			1	3.70		
571	*Gabarnaudia betae* (Delacroix 1897) Samson et W. Gams 1974	2	11.05	3	33.00		
572	*Gaeumannomyces caricis* J. Walker 1980	1	5.62				
573	*Gaeumannomyces graminis* (Saccardo 1875) Arx et D.L. Olivier 1952 var. *graminis*	1	25.68				
574	*Galactomyces geotrichum* (E.E. Butler et L.J. Petersen 1972) Redhead et *Malloch* 1977			3	45.89	3	3.45
575	*Galactomyces reessii* (van der Walt 1959) Redhead et Malloch 1977	1	19.27	1	46.16	1	3.45

576	*Ganoderma lipsiense* (Batsch 1786) G.F. Atkinson 1908	3	17.39				
577	*Ganoderma lucidum* (Curtis 1781) P. Karsten 1881	1	9.55				
578	*Geastrum fimbriatum* Fries 1829	1	16.63				
579	*Geomyces asperulatus* Sigler et J.W. Carmichael 1976			1	8.54		
580	*Geomyces pannorum* (Link 1824) Sigler et J.W. Carmichael 1976	38	20.25	166	39.85	8	3.20
581	*Geosmithia lavendula* (Raper et Fennell 1948) Pitt 1980			1	44.17	1	5.31
582	*Geosmithia namyslowskii* (K.M. Zalessky 1927) Pitt 1980			1	43.86	1	22.92
583	*Geotrichum amycelicum* Redaelli et Ciferri 1935	1	18.86	1	11.15		
584	*Geotrichum bipunctatum* Rolland et Fautrey 1894			1	38.59	1	2.90
585	*Geotrichum candidum* Link 1809	24	31.24	42	45.14	15	2.90
586	*Geotrichum fragrans* (Berkhout 1923) Morenz 1960 ex Morenz 1964	4	16.13	4	31.67	1	10.53
587	*Geotrichum klebahnii* (Stautz 1931) Morenz 1964	3	19.79	3	29.62		
588	*Gibberella fujikuroi* (Sawada 1917) Wollenweber 1931	3	19.32	3	26.87	3	30.36
589	*Gibberella zeae* (Schweinitz 1821) Petch 1936	2	19.77	3	16.40	1	6.20
590	*Gibellula pulchra* Cavara 1894			1	6.13		
591	*Gibellulopsis nigrescens* (Pethybridge 1919) Zare et al. 2007			6	41.27	6	13.62
592	*Gilbertella persicaria* (E.D. Eddy 1925) Hesseltine 1960	1	11.41	1	27.13	1	37.52
593	*Gilmaniella humicola* G.L. Barron 1964			2	13.68		
594	*Gliocephalotrichum bulbilium* J.J. Ellis et Hesseltine 1962			1	15.86		
595	*Gliocladiopsis tenuis* (Bugnicourt 1939) Crous et M.J. Wingfeld 1993			1	14.46		
596	*Gliocladium album* (Preuss 1851) Petch 1926			2	26.90	2	2.49
597	*Gliocladium ammoniphilum* Pidoplichko et Bilai 1953	1	19.26	1	28.55	1	9.57
598	*Gliocladium aurifilum* (W. Gerard 1874) Seifert et al. 1985	1	0.54	1	14.41		
599	*Gliocladium cholodnyi* Pidoplichko 1931	2	16.15	2	26.27	2	9.13
600	*Gliocladium comtus* Rudakov 1981	1	7.81	1	30.99	1	3.73
601	*Gliocladium viride* Matruchot 1893			4	32.23	1	3.32
602	*Gliomastix cerealis* (P. Karsten 1887) C.H. Dickinson 1968	2	19.22	2	36.53	1	10.70
603	*Gliomastix inflata* C.H. Dickinson 1968			2	23.17	2	3.22
604	*Gliomastix luzulae* (Fuckel 1870) E.W. Mason 1953 ex S. Hughes *1958*	2	6.22	3	29.44	3	2.74
605	*Gliomastix murorum* (Corda 1838) S. Hughes 1958 var. *felina* (Marchal 1895) S. Hughes 1958	5	30.42	6	44.79	4	9.25
606	*Gliomastix murorum* (Corda 1838) S. Hughes 1958 var. *murorum*	10	30.71	9	33.64	6	14.07
607	*Gloeophyllum odoratum* (Wulfen 1788) Imazeki 1943	1	23.78				
608	*Gloeophyllum sepiarium* (Wulfen 1786) P. Karsten 1882	5	34.14				
609	*Gongronella butleri* (Lendner 1926) Peyronel et Dal Vesko 1955	6	24.55	6	32.12	3	5.42

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
610	*Gongronella lacrispora* Hesseltine et J.J. Ellis 1961	1	15.38	1	27.66		
611	*Gonytrichum macrocladum* (Saccardo 1880) S. Hughes 1951	3	17.68	4	30.36		
612	*Graphium penicillioides* Corda 1837			1	18.14		
613	*Graphium putredinis* (Corda 1839) S. Hughes 1958			1	23.88		
614	*Grifola frondosa* (Dickson 1785) Gray 1821	2	12.58				
615	*Guepiniopsis buccina* (Persoon 1801) L.L. Kennedy 1959	1	25.88				
616	*Gymnoascus reessii* Baranetzky 1872			1	36.56	1	3.35
617	*Gymnopilus sapineus* (Fries 1821) Murrill 1912	1	22.97				
618	*Gymnostellatospora japonica* Udagawa 1993			1	2.30		
619	*Hansfordia pulvinata* (Berkeley et M.A. Curtis 1875) S. Hughes 1958	2	19.44	2	26.42		
620	*Hansfordia triumfettae* (Hahsford 1943) S. Hughes 1952			1	27.00		
621	*Haplotrichum capitatum* (Link 1809) Link 1824	2	30.60	2	30.56	2	25.26
622	*Hapsidospora milkoi* Beliakova 1975	1	2.27	1	34.82	1	23.86
623	*Harposporium lilliputanum* Dixon 1952	1	19.30	1	21.69		
624	*Harposporium sinense* C.Y. Wang et K.Q. Zhang 2007	1	20.85				
625	*Harzia acremonioides* (Harz 1871) Costantin 1888	4	19.49	4	45.20		
626	*Hebeloma versipelle* (Fries 1838) Gillet 1876	1	22.96	1	6.77		
627	*Helicodendron tubulosum* (Riess 1853) Linder 1929	1	19.31	1	11.44		
628	*Helicostylum elegans* Corda 1842	1	17.59	1	44.19	1	15.39
629	*Helicostylum pulchrum* (Preuss 1851) Pidoplichko et Milko 1971	2	25.41	2	27.11	2	38.98
630	*Helminthosporium solani* Durieu et Montagne 1849	1	19.61	1	9.56		
631	*Hemicarpenteles ornatum* (Subramanian 1972) Arx 1974			1	39.58	1	5.09
632	*Hericium coralloides* (Scopoli 1772) Persoon 1794	4	32.55				
633	*Hericium erinaceus* (Bulliard 1781) Persoon 1797	4	25.07				
634	*Hesseltinella vesiculosa* H.P. Upadhyay 1970	1	21.26	1	40.75		
635	*Heterobasidion annosum* (Fries 1821) Brefeld 1888	1	20.10				
636	*Hirsutella thompsonii* F.E. Fischer 1950			1	15.26		
637	*Holwaya mucida* (Schulzer 1860) Korf et Abawi 1971 var. *mucida*			1	2.30		
638	*Hormiactis alba* Preuss 1851			1	23.26	1	2.73
639	*Hormoconis resinae* (Lindau 1906) Arx et G.A. de Vries 1973	12	19.49	12	47.50	2	17.28
640	*Hormonema macrosporum* L. Voronin 1986	1	19.81	1	26.36		
641	*Humicola fuscoatra* Traaen 1914	3	28.79	4	32.96	1	33.60

642	*Humicola grisea* Traaen 1914 var. *thermoidea* Cooney et Emerson 1964			1	11.62		
643	*Humicola insolens* Cooney et R. Emerson 1964			1	16.82		
644	*Hydnoporia tabacina* (Sowerby 1797) V. Spirin et al. 2019	1	19.56				
645	*Hyphopichia burtonii* (Boidin et al. 1964) Arx et Van der Walt 1976			1	38.10		
646	*Hyphozyma sanguinea* (C. Ramirez 1952) de Hoog et M.T. Smith 1981	1	28.74	1	20.45		
647	*Hyphozyma variabilis* de Hoog et M.T. Smith 1981	2	19.30				
648	*Hyphozyma variabilis* de Hoog et M.T. Smith 1981 var. *odora* de Hoog et M. T. Smith 1981			1	21.64		
649	*Hyphozyma variabilis* de Hoog et M.T. Smith 1981 var. *variabilis*			1	20.45		
650	*Hypomyces ochraceus* (Persoon 1801) Tulasne et C. Tulasne 1865			3	22.53		
651	*Inocutis dryophila* (Berkeley 1904) Fiasson et Niemelä 1984	1	20.73				
652	*Inonotus obliquus* (Acharius ex Persoon 1801) Pilat 1942	2	34.08				
653	*Inonotus rheades* (Persoon 1825) Bondartsev et Singer 1941	2	15.29				
654	*Irpex lacteus* (Fries 1818) Fries 1828	1	12.40				
655	*Isaria farinosa* (Holmskjold 1781) Fries 1832	7	20.34	8	35.81	3	18.38
656	*Isaria fumosorosea* Wize 1904	6	21.44	6	43.70	1	2.32
657	*Isaria javanica* (Friedrichs et Bally 1923) Samson et Hywel-Jones 2005			1	6.21		
658	*Isaria tenuipes* Peck 1879			1	6.84		
659	*Juxtiphoma eupyrena* (Saccardo 1879) Valenzuela-Lopez et al. 2017			3	17.62		
660	*Kickxella alabastrina* Coemans 1862	1	6.69	1	6.46		
661	*Kuehneromyces lignicola* (Peck 1872) Redhead 1984	1	23.50				
662	*Kuehneromyces mutabilis* (Schaeffer 1774) Singer et A.H. Smith 1946	6	24.26				
663	*Laccaria bicolor* (Maire 1937) P.D. Orton 1960	1	14.95				
664	*Laccaria laccata* (Scopoli 1772) Cooke 1884	2	22.96				
665	*Lactarius helvus* (Fries 1821) Fries 1838	1	24.01				
666	*Laetiporus sulphureus* (Bulliard 1789) Murrill 1920	6	19.99	1	8.56		
667	*Lasiodiplodia theobromae* Patouillard 1892) Griffon et Maublanc 1909	1	7.36	1	17.95		
668	*Lecanicillium dimorphum* (J.D. Chen 1985) Zare et W. Gams 2001			2	38.36		
669	*Lecanicillium fungicola* (Preuss 1851) Zare et W. Gams 2008	3	20.40	3	39.64		
670	*Lecanicillium fusisporum* (W. Gams 1971) Zare et W. Gams 2001			1	25.03		
671	*Lecanicillium lecanii* (Zimmermann 1898) Zare et W. Gams 2001	4	19.84	4	39.18	1	4.47
672	*Lecanicillium longisporum* (Petch 1925) Zare et W. Gams 2001	1	19.26	1	37.00	1	2.54
673	*Lecanicillium muscarium* (Petch 1931) Zare et W. Gams 2001	14	22.33	15	36.34	3	4.97
674	*Lecanicillium psalliotae* (Treschew 1941) Zare et W. Gams 2001	6	20.44	7	36.72		
675	*Leccinum scabrum* (Bulliard 1783) Gray 1821	1	12.08				

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
676	*Lecythophora decumbens* (J.F.H. Beyma 1942) E. Weber et al. 2002	1	20.40	1	38.10		
677	*Lecythophora fasciculata* (J.F.H. Beyma 1939) E. Weber et al. 2002	1	20.40	1	42.03		
678	*Lecythophora hoffmannii* (J.F.H. Beyma 1939) W. Gams et McGinnis 1983	3	20.52	5	42.40		
679	*Lecythophora mutabilis* (J.F.H. Beyma 1944) W. Gams et McGinnis 1983	1	20.40	4	45.70		
680	*Lentinula edodes* (Berkeley 1878) Pegler 1976	5	26.21				
681	*Lentinus sulcatus* Berkeley 1845	1	12.13				
682	*Lentinus tigrinus* (Bulliard 1782) Fries 1825	3	20.98				
683	*Lenzites betulina* (Linnaeus 1753) Fries 1838	3	13.47				
684	*Lepista luscina* (Fries 1818) Singer 1951	1	0.21				
685	*Lepista nuda* (Bulliard 1790) Cooke 1871	1	1.82				
686	*Leptobacillium leptobactrum* (W. Gams 1971) Zare et W. Gams 2016	2	3.35	2	21.46		
687	*Leptographium lundbergii* Lagerberg et Melin 1927			1	11.42		
688	*Leptosphaeria coniothyrium* (Fuckel 1870) Saccardo 1875	1	18.96	1	6.03		
689	*Leucoagaricus leucothites* (Vittadini 1835) Wasser 1977	1	3.04				
690	*Leucoagaricus nympharum* (Kalchbrenner 1873) Bon 1977	1	12.07				
691	*Leuconeurospora pulcherrima* (G. Winter 1876) Malloch et Cain 1970	1	0.54				
692	*Lichtheimia blakesleeana* (Lendner 1924) Kerst. Hoffmann et al. 2009	4	28.53	4	44.36	4	48.92
693	*Lichtheimia corymbifera* (Cohn 1884) Vuillemin 1903	12	23.06	18	40.93	18	50.21
694	*Lichtheimia hyalospora* (Saito 1906) Kerst. Hoffmann et al. 2009	1	19.38	1	19.04	1	29.82
695	*Linderina pennispora* Raper et Fennell 1952	1	11.78	1	46.29		
696	*Lobosporangium transversale* (Malloch) M. Blackwell et Benny 2004	1	7.17				
697	*Lycoperdon perlatum* Persoon 1796	1	21.10				
698	*Lycoperdon pyriforme* Schaeffer 1774	2	20.04				
699	*Macrolepiota mastoidea* (Fries 1821) Singer 1951	1	12.20				
700	*Macrolepiota procera* (Scopoli 1772) Singer 1948	1	12.32				
701	*Macrophoma mantegazziana* (Penzig 1882) Berlese et Voglino 1886	1	0.97	1	26.65		
702	*Magnusiomyces magnusii* (F. Ludwig 1886) Redhead et Malloch 1977			1	31.43	1	0.11
703	*Malbranchea flavorosea* Sigler et J.W. Carmichael 1976			1	7.19		
704	*Mammaria* echinobotryoides Cesati 1854			1	1.99		
705	*Marasmius oreades* (Bolton 1792) Fries 1836	1	34.16				
706	*Mariannaea elegans* (Corda 1838) Samson 1974	6	31.50	6	45.32	4	9.56
707	*Melanconium apiocarpum* Link 1825	2	18.22	1	24.70		

708	*Melanconium bicolor* Nees 1817			1	24.70		
709	*Melanocarpus albomyces* (Cooney et R. Emerson 1964) Arx 1975	2	18.61	2	34.85		
710	*Melanospora betae* Panasenko 1938	1	4.07	1	44.99	1	22.75
711	*Melanospora damnosa* (Saccardo 1895) Lindau 1897	2	29.97	2	22.29		
712	*Melanospora phaseoli* Roll-Hansen 1948	1	0.12	1	45.85		
713	*Memnoniella echinata* (Rivolta 1884) Galloway 1933	2	20.54	3	32.39		
714	*Menispora ciliata* Corda 1837	1	19.25	1	45.78		
715	*Menispora tortuosa* Corda 1839			1	9.82		
716	*Merimbla ingelheimense* (J.F.H. Beyma 1942) Pitt 1980			2	36.14	1	22.89
717	*Metarhizium anisopliae* (Metschnikoff 1879) Sorokin 1883	6	19.56	6	32.32	4	15.82
718	*Microascus cirrosus* Curzi 1930	1	19.32				
719	*Microascus trigonosporus* C.W. Emmons et B.O. Dodge var. *terreus* Kamyschko *1966*	1	20.42	1	36.69	1	21.16
720	*Microbotryum silenes-inflatae* (de Candolle 1815 ex Liro 1924) G. Deml et Oberwinkler 1982	2	26.41	2	19.05		
721	*Microbotryum vinosum* (Tulasne et C. Tulasne 1847) Denchev 1994	1	23.70	1	19.05		
722	*Microbotryum violaceum* (Persoon 1797) G. Deml et Oberwinkler 1982	2	21.38	2	19.05		
723	*Microdiplodia pruni* Diedicke 1914	1	19.90	1	9.94		
724	*Microdochium nivale* (Fries 1825) Samuels et I.C. Hallett 1983	1	6.04	1	31.05	1	23.41
725	*Microsphaeropsis olivacea* (Bonorden 1869) Höhnell 1917	1	19.40	1	12.05		
726	*Mirandina corticola* G. Arnaud 1952 ex Matsushima 1975	1	19.27	1	31.46		
727	*Monascus floridanus* P.F. Cannon et E.L. Barnard 1987			1	6.75		
728	*Monilia brunnea* J.C. Gilman et E.V. Abbott 1927	1	15.22	1	27.24		
729	*Monilia diversispora* J.F.H. Beyma 1933	1	15.22	1	35.69		
730	*Monilia medoacensis* (Saccardo 1913) J.F.H. Beyma 1933			1	28.21		
731	*Monilia megalospora* (Berkeley et M.A. Curtis 1869) Saccardo 1886			1	26.72	1	22.73
732	*Moniliella suaveolens* (Lindner 1895 ex Lindner 1906) Arx 1972 var. *nigra* (Burri et Staub 1909) de Hoog 1979	4	15.42	4	23.99		
733	*Moniliella suaveolens* (Lindner 1895 ex Lindner 1906) Arx 1972 var. *suaveolens*	1	18.97	1	35.38		
734	*Monilinia fructigena* (Aderhold et Ruhland 1905) Honey 1936	2	20.03				
735	*Monochaetia concentrica* (Berkeley et Broome 1874) Saccardo et D. Saccardo 1906			1	9.21		
736	*Monochaetia dimorphospora* T. Yokoyama 1975			1	24.55		
737	*Monochaetia karstenii* (Corda 1839) Nag Raj 1985			3	13.39		
738	*Monocillium dimorphosporum* W. Gams 1971			2	27.09		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
739	*Monocillium indicum* S.B. Saksena 1955	1	16.32	2	15.10		
740	*Monocillium nordinii* (Bourchier 1961) W. Gams 1971	1	19.84	2	22.59		
741	*Monocillium tenue* W. Gams 1971			2	24.20	1	0.53
742	*Monodictys paradoxa* (Corda 1938) S. Hughes 1958	1	17.68	1	11.72		
743	*Monosporium meliolicola* Spegazzini 1910			1	23.10		
744	*Mortierella alliacea* Linnemann 1953	1	13.86				
745	*Mortierella alpina* Peyronel 1913	5	21.33	3	43.35	2	27.46
746	*Mortierella ambigua* B.S. Mehrotra 1963	1	11.73	1	35.99		
747	*Mortierella angusta* Linnemann 1969	1	23.44				
748	*Mortierella beljakovae* Milko 1973	1	3.79				
749	*Mortierella bisporalis* (Thaxter 1914) Bjoerling 1936	2	13.09	2	2.74		
750	*Mortierella capitata* Marchal 1891	1	21.26	1	35.16	1	13.30
751	*Mortierella dichotoma* Linnemann 1936 ex W. Gams 1977	1	22.23	1	25.53	1	1.08
752	*Mortierella elasson* Sideris et G.E. Paxton 1929	2	10.95			2	5.88
753	*Mortierella elongata* Linnemann 1941	2	28.89	5	4.40		
754	*Mortierella exigua* Linnemann 1941	3	34.07	3	36.68		
755	*Mortierella gamsii* Milko 1974	7	18.90				
756	*Mortierella gemmifera* M. Ellis 1940	3	23.25	5	25.48	2	21.69
757	*Mortierella globalpina* W. Gams et Veenbaas-Rijks 1976	1	13.86				
758	*Mortierella globulifera* O. Rostrup 1916	3	33.28	1	2.76	2	41.39
759	*Mortierella horticola* Linnemann 1941	2	32.84				
760	*Mortierella humilis* Linnemann 1936 ex W. Gams 1977	5	14.00				
761	*Mortierella hyalina* (Harz 1871) W. Gams 1970 var. *hyalina*	3	23.57	2	31.26	3	1.08
762	*Mortierella jenkinii* (A.L. Smith 1898) Naumov 1935	3	13.28	2	36.62		
763	*Mortierella lignicola* (G.W. Martin 1937) W. Gams et R. Moreau 1959	1	13.97	1	45.23	1	23.94
764	*Mortierella minutissima* van Tieghem 1878	4	34.13	3	14.31	1	1.02
765	*Mortierella mutabilis* Linnemann 1941	2	22.07	2	14.53		
766	*Mortierella nigrescens* van Tieghem 1878	1	18.26				
767	*Mortierella oligospora* Bjoerling 1936	1	27.05	1	2.52	1	1.08
768	*Mortierella parvispora* Linnemann 1941	6	33.99	5	27.66	4	22.30
769	*Mortierella polycephala* Coemans 1863			1	24.88		
770	*Mortierella pulchella* Linnemann 1941	1	23.24	1	25.48		

771	*Mortierella pusilla* Oudemans 1902	1	33.99	1	25.11		
772	*Mortierella reticulata* van Tieghem et G. Le Monnier 1873	1	6.98	1	45.16	1	45.75
773	*Mortierella sarnyensis* Milko 1973	1	13.86				
774	*Mortierella sclerotiella* Milko 1967	1	22.97				
775	*Mortierella strangulata* van Tieghem 1875	1	3.79	1	25.26		
776	*Mortierella stylospora* Dixon-Stewart 1932	1	19.96	1	27.89	1	34.43
777	*Mortierella turficola* Y. Ling 1930	1	11.03				
778	*Mortierella verticillata* Linnemann 1941	8	23.25	8	39.71	4	24.60
779	*Mortierella zonata* Linnemann 1936 ex W. Gams 1977	1	13.96	1	5.09		
780	*Mortierella zychae* Linnemann 1941	5	26.76	5	31.68	3	20.46
781	*Mucobasispora tarikii* Moustafa et Abdul-Wahid 1990			1	23.92		
782	*Mucor abundans* Povah 1917	1	24.09	1	29.37	1	5.99
783	*Mucor aligarensis* B.S. Mehrotra et B.R. Mehrotra 1969			1	23.28		
784	*Mucor amphibiorum* Shipper 1978	1	15.38	1	27.73	1	0.58
785	*Mucor bacilliformis* Hesseltine 1954	1	20.55	1	28.79		
786	*Mucor bainieri* B.S. Mehrotra et Baijal 1963	1	20.70	1	32.41		
787	*Mucor circinelloides* van Tieghem 1875 var. *circinelloides*	15	25.31	17	44.90	14	45.75
788	*Mucor circinelloides* van Tieghem 1875 var. *janssenii* (Lendner 1907) Schipper 1976	6	22.62	7	44.93	6	49.10
789	*Mucor circinelloides* van Tieghem 1875 var. *lusitanicus* (Bruderlein 1916) Schipper 1976	6	25.18	8	44.18	7	28.44
790	*Mucor durus* G. Walther et de Hoog 2013	1	19.68	1	42.97	1	37.90
791	*Mucor exponens* (Burgeff 1924) G. Walther et de Hoog 2013	4	25.41	4	30.87		
792	*Mucor flavus* Bainier 1903	19	28.49	19	47.04	16	26.71
793	*Mucor fragilis* Bainier 1884	1	24.09	1	37.17	1	30.73
794	*Mucor fuscus* Bainier 1903	3	20.68	3	45.03	3	32.05
795	*Mucor genevensis* Lendner 1908	4	25.31	4	37.18		
796	*Mucor griseocyanus* Hagem 1908	3	25.41	3	38.26	3	24.30
797	*Mucor guilliermondii* Nadson et Philippow 1925	1	24.48	1	37.53	1	30.03
798	*Mucor heterogamus* Vuillemin 1903			1	27.33	1	1.66
799	*Mucor hiemalis* Wehmer 1903 var. *corticolus* (Hagem 1910) Schipper 1973	3	20.71	3	43.93	2	9.59
800	*Mucor hiemalis* Wehmer 1903 var. *hiemalis*	18	33.53	19	46.92	14	45.95
801	*Mucor hiemalis* Wehmer 1903 var. *silvaticus* (Hagem 1908) Schipper 1973	3	20.56	3	38.71	3	2.61
802	*Mucor inaequisporus* Dade 1937	1	19.64	1	39.72	1	0.10
803	*Mucor indicus* Lendner 1930	3	33.53	3	40.30	3	47.89

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
804	*Mucor laxorrhizus* Y. Ling 1930	5	19.59	5	31.36	5	20.52
805	*Mucor luteus* Linnemann 1936	2	19.66	2	41.88	2	16.22
806	*Mucor megaolocarpus* G. Walther et de Hoog 2013	1	19.75	1	9.93		
807	*Mucor microsporus* Namyslowski 1910	1	19.57	1	28.08		
808	*Mucor moelleri* (Vuillemin 1903) Lendner 1908	5	23.57	5	47.23	5	14.60
809	*Mucor mousanensis* Baijal et B.S. Mehrotra 1966	1	19.70	1	45.34	1	24.54
810	*Mucor mucedo* Linnaeus 1753	9	25.41	9	46.64	7	29.90
811	*Mucor odoratus* Treschew 1940	2	25.31	2	16.18		
812	*Mucor piriformis* A. Fischer 1892	5	25.41	5	35.21		
813	*Mucor plasmaticus* van Tieghem 1875	1	19.68	1	44.21	1	5.23
814	*Mucor plumbeus* Bonorden 1864	11	24.15	18	40.64	16	49.99
815	*Mucor psychrophilus* Milko 1971	1	25.41	1	14.88		
816	*Mucor racemosus* Fresenius 1850 var. *chibinensis* (Neophytova 1955) Schipper 1976	2	11.86	4	40.59	3	34.29
817	*Mucor racemosus* Fresenius 1850 var. *racemosus*	23	24.25	34	43.94	29	50.21
818	*Mucor racemosus* Fresenius 1850 var. *sphaerosporus* (Hagem 1908) Schipper 1970	3	25.41	3	44.91	3	47.36
819	*Mucor ramosissimus* Samoutsevitch 1927	1	19.64	1	17.67		
820	*Mucor saturninus* Hagem 1910	1	20.72	1	35.92	1	8.11
821	*Mucor sinensis* Milko et Beliakova 1971	2	21.24	2	36.82	2	33.55
822	*Mucor strictus* Hagem 1908	2	24.09	2	32.51	2	8.38
823	*Mucor ucrainicus* Milko 1971	1	23.18	1	25.68		
824	*Mucor zonatus* Milko 1967	2	19.75	2	27.40	1	5.69
825	*Mucor zychae* Baijal et B.S. Mehrotra 1965 var. *zychae*	2	25.31	2	44.13		
826	*Mutinus caninus* (Hudson 1778) Fries 1849	1	13.37				
827	*Myceliophthora fergusii* (Klopotek 1974) Oorschot 1977			2	7.38		
828	*Myceliophthora lutea* Costantin 1892			1	34.75	1	3.73
829	*Myceliophthora thermophila* (Apinis 1962) van Oorschot 1977	3	20.51	3	20.37	2	19.25
830	*Mycena epipterygia* (Scopoli 1772) Gray 1821	1	12.20				
831	*Mycena pura* (Persoon 1794) P. Kummer 1871	1	34.16				
832	*Mycogone cervina* Ditmar 1817	1	19.86				
833	*Mycogone nigra* (Morgan 1895) C.N. Jensen 1912	4	19.54	4	47.62		
834	*Mycogone rosea* Link 1809	4	19.38	4	38.41		

835	*Mycosticta cytosporicola* Frolov 1968	2	17.68	2	37.24		
836	*Mycotypha africana* R.O. Novak et Backus 1963			1	21.41		
837	*Mycotypha indica* P.M. Kirk et Benny 1985			1	22.42		
838	*Myrothecium* sp.	2	19.19	2	43.47		
839	*Myxotrichum setosum* (Eidam 1882) G.F. Orr et Plunkett 1963			2	38.43		
840	*Myxotrichum stipitatum* (Eidam 1882) G.F. Orr et Kuehn 1963	1	4.07	1	45.26		
841	*Nadsoniella nigra* Issatschenko 1914 var. *hesuelica* Lyakh et Ruban 1970	1	18.86	1	12.62		
842	*Nakataea sigmoidea* (Cavara 1889) Hara 1939	1	19.31				
843	*Nectria cosmariospora* Cesati et de Notaris 1863	2	18.95	2	35.78	2	3.45
844	*Nectria inventa* Pethybridge 1919			1	27.90	1	3.49
845	*Nematogonum mycophilum* (Saccardo 1886) Rogerson et W. Gams 1981	1	21.73	1	20.12		
846	*Neoantrodia serialis* (Fries 1821) Audet 2017	1	17.47				
847	*Neocamarosporium betae* (Berlese 1888) Ariyawansa et K.D. Hyde 2015	2	19.33	2	34.74		
848	*Neocosmospora vasinfecta* E.F. Smith 1899 var. *africana* (von Arx 1955) Cannon et D. Hawksworth 1984	2	20.10	2	48.22		
849	*Neonectria galligena* (Bresadola 1901) Rossman et Samuels 1999	1	18.96				
850	*Neoscytalidium dimidiatum* (Penzig 1887) Crous et Slippers 2006	1	19.40				
851	*Neottiospora caricina* (Desmazieres 1836) Hoehnel 1924			1	31.07		
852	*Neovossia setariae* (Ling 1945) Yu et Lou 1962	1	19.41				
853	*Neurospora crassa* Shear et B.O. Dodge 1927	71	18.95	77	44.92	9	23.18
854	*Neurospora sitophila* Shear et B.O. Dodge 1927	4	19.44	4	42.28	4	22.14
855	*Neurospora toroi* F.L. Tai 1935	1	18.97	1	41.71	1	21.16
856	*Newbya pascuicola* M.C. Vick et M.W. Dick 2002	1	20.71				
857	*Niesslia exilis* (Albertini et Schweinitz 1805) G. Winter 1885	1	18.96	1	7.35	1	4.37
858	*Nigrospora gorlenkoana* Novobranova 1972	2	19.47	2	39.55		
859	*Nigrospora gossypii* Jaczewski 1929	1	17.47	1	33.25		
860	*Nigrospora oryzae* (Berkeley et Broome 1873) Petch 1924			4	42.86	1	35.79
861	*Nodulisporium verrucosum* (J.F.H. Beyma 1929) G. Smith 1954	1	19.72				
862	*Nomuraea rileyi* (Farlow 1883) Samson 1974	1	9.85	1	12.70		
863	*Ochrocladosporium elatum* (Harz 1871) Crous et U. Braun 2007	1	12.58	1	27.80	1	7.91
864	*Ochroconis constricta* (E.V. Abbott 1927) de Hoog et Arx 1973			1	18.32		
865	*Oedocephalum* sp.	1	15.56	1	28.99	1	15.98
866	*Oidiodendron cereale* (Thuemen 1880) G.L. Barron 1962	5	0.18	4	28.60		
867	*Oidiodendron echinulatum* G.L. Barron 1962	2	19.58	2	31.49		
868	*Oidiodendron griseum* Robak 1934			2	13.34		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
869	*Oidiodendron periconioides* Morrall 1968			1	1.79		
870	*Oidiodendron sulphureoochraceum*			1	1.95		
871	*Oidiodendron truncatum* G.L. Barron 1962			3	8.70		
872	*Olpitrichum* sp.	1	20.47	1	19.95	1	2.49
873	*Oospora nicotianae* Pezzolato 1899	1	19.77	1	29.63	1	2.89
874	*Oospora oryzae* Ferraris 1902	1	19.95	1	1.05	1	2.90
875	*Oospora sajanica* Ogarkov 1979	1	16.12	1	25.73		
876	*Oospora sulphurea* (Preuss 1852) Saccardo et Voglino 1886	1	28.81	1	19.34		
877	*Oospora sulphurella* (Saccardo et Roumeguere 1881) Saccardo 1886	1	19.56	1	26.34		
878	*Oospora tenuis* (P. Maze 1910) Berkhout 1923	1	31.12	1	30.92	1	0.09
879	*Oospora variabilis* (Lindner 1898) J. Lindau 1907	1	19.86	1	14.69		
880	*Ophiostoma piceae* (Münch 1907) Sydow et P. Sydow 1919			2	22.04		
881	*Ovadendron sulphureo-ochraceum* (J.F.H. Beyma 1933) Sigler et J.W. Carmichael 1976	1	19.79	1	43.59		
882	*Paecilomyces borysthenicus* B.A. Borisov et Tarasov 1997	2	5.07	2	12.90		
883	*Paecilomyces carneus* (Duche et R. Heim 1931) A.H.S. Brown *et* G. Smith 1957	2	4.41	2	8.12	2	0.21
884	*Paecilomyces fulvus* Stolk et Samson 1971			1	5.53		
885	*Paecilomyces inflatus* (Burnside 1927) J.W. Carmichael 1962			3	8.19		
886	*Paecilomyces marquandii* (Massee 1898) S. Hughes 1951	4	19.56	5	44.40	3	21.91
887	*Paecilomyces penicillatus* (Höhnel 1904) Samson 1974			1	5.44		
888	*Paecilomyces suffultus* (Petch 1944) Samson 1974	1	6.10				
889	*Paecilomyces variotii* Bainier 1907	20	19.41	30	45.44	16	47.90
890	*Paecilomyces zollerniae* Stolk et Samson 1971	1	12.37	1	12.56		
891	*Panus conchatus* (Bulliard 1787) Fries 1838	1	23.84				
892	*Papulaspora biformospora* Kirilenko 1971	1	19.64	1	20.69		
893	*Paraconiothyrium fuckelii* (Saccardo 1878) Verkley et Gruyter 2012			1	9.65		
894	*Paraconiothyrium sporulosum* (W. Gams et Domsch 1969) Verkley 2004	2	19.40	2	16.28		
895	*Paradendryphiella salina* (G.K. Sutherland 1916) Woudenberg et Crous 2013			4	10.24		
896	*Paramyrothecium roridum* (Tode 1790) L. Lombard et Crous 2016	3	19.49	4	45.17		
897	*Paraphoma fimeti* (Brunaud 1889) Gruyter et al. 2010			6	2.11		
898	*Parasitella parasitica* (Bainier 1884) Sydow 1903	2	33.43	2	46.09		

899	*Penicillium adametzii* K.M. Zalessky 1927			4	40.39	4	45.81
900	*Penicillium albicans* Bainier 1907			2	22.03	2	37.14
901	*Penicillium albidum* Sopp 1912			1	4.99	1	0.95
902	*Penicillium alicantinum* C. Ramirez et A.T. Martinez 1980			1	38.03	1	12.20
903	*Penicillium anatolicum* Stolk 1968			1	33.19	1	15.32
904	*Penicillium aragonense* C. Ramirez et A.T. Martinez 1981			1	38.03	1	12.20
905	*Penicillium arenicola* Chalabuda 1950			1	22.92	1	26.18
906	*Penicillium atramentosum* Thom 1910			1	21.02	1	2.56
907	*Penicillium aurantioflammiferum* C. Ramirez et al. 1980			1	27.31	1	12.20
908	*Penicillium aurantiogriseum* Dierckx 1901	9	20.52	62	44.47	36	42.96
909	*Penicillium bilaiae* Chalabuda 1950			1	43.15	1	18.52
910	*Penicillium brevicompactum* Dierckx 1901	6	20.50	23	45.39	15	18.10
911	*Penicillium brunneum* Udagawa 1959			1	37.98	1	12.07
912	*Penicillium camemberti* Thom 1906			11	42.00	10	24.37
913	*Penicillium canescens* Sopp 1912	31	20.50	60	47.85	44	49.17
914	*Penicillium capsulatum* Raper et Fennell 1948	2	19.51	3	44.92	3	28.71
915	*Penicillium castellonense* C. Ramirez et A.T. Martinez 1981			1	38.03	1	12.20
916	*Penicillium chermesinum* Biourge 1923			4	42.92	4	45.97
917	*Penicillium chrysogenum* Thom 1910	17	18.95	96	45.01	53	55.63
918	*Penicillium cinerascens* Biourge 1923			1	41.75	1	28.22
919	*Penicillium citreonigrum* Dierckx 1901	3	18.95	13	43.65	10	46.51
920	*Penicillium citrinum* Thom 1910	9	18.31	27	45.08	17	33.21
921	*Penicillium commune* Thom 1910	10	2.52	23	44.45	22	38.12
922	*Penicillium coprophilum* (Berkeley et M.A. Curtis 1868) Seifert et Samson 1986					2	0.98
923	*Penicillium cordubense* C. Ramirez et A.T. Martinez 1981			1	38.01	1	12.20
924	*Penicillium corylophilum* Dierckx 1901			3	28.97	2	15.77
925	*Penicillium crustosum* Thom 1930			31	45.20	10	47.85
926	*Penicillium cyaneum* (Bainier et R. Sartory 1913) Biourge 1923 ex Thom 1930			1	44.58	1	9.56
927	*Penicillium daleae* K.M. Zalessky 1927	1	2.27	2	29.98	1	22.64
928	*Penicillium decumbens* Thom 1910	4	18.08	17	43.07	8	37.99
929	*Penicillium dierckxii* Biourge 1923	2	18.31	7	44.77	7	28.88
930	*Penicillium digitatum* (Persoon 1801) Saccardo 1881			3	44.23	3	21.28
931	*Penicillium diversum* Raper et Fennell 1948			3	40.50	1	38.07

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
932	*Penicillium dodgei* Pitt 1980			1	27.75	1	12.58
933	*Penicillium duclauxii* Delacroix 1892			7	44.65	7	32.90
934	*Penicillium expansum* Link 1809			27	42.88	7	41.58
935	*Penicillium fagi* A.T. Martinez et C. Ramirez 1978			1	38.05	1	12.07
936	*Penicillium fellutanum* Biourge 1923			3	1.96	1	1.15
937	*Penicillium funiculosum* Thom 1910	5	20.50	14	44.53	9	38.16
938	*Penicillium glabrum* (Wehmer 1893) Westling 1911			23	40.77	9	31.15
939	*Penicillium gladioli* Machacek 1928	2	20.46	2	36.75	2	7.91
940	*Penicillium glaucum* Link 1805	1	20.52	1	44.50	1	48.00
941	*Penicillium grancanariae* C. Ramirez et al. 1978			1	38.05	1	5.70
942	*Penicillium granulatum* Bainier 1905			17	45.20	5	21.61
943	*Penicillium griseofulvum* Dierckx 1901			11	43.90	8	43.32
944	*Penicillium herqueri* Bainier et R. Sartory 1912			4	45.41	4	28.33
945	*Penicillium hirayamae* Udagawa 1959			1	20.37	1	20.18
946	*Penicillium hirsutum* Dierckx 1901 var. *hirsutum*			1	2.77	1	5.41
947	*Penicillium hispanicum* C. Ramirez et al. 1978			1	38.05	1	12.07
948	*Penicillium humuli* J.F.H. Beyma 1937			1	44.47	1	47.94
949	*Penicillium ilerdanum* C. Ramirez et al. 1980			1	26.66	1	12.20
950	*Penicillium indonesiae* Pitt 1980			2	38.31	2	37.22
951	*Penicillium inflatum* Stolk et Malla 1971			2	2.95	1	0.15
952	*Penicillium insectivorum* (Sopp 1912) Biourge 1923			1	44.21	1	38.19
953	*Penicillium islandicum* Sopp 1912	1	2.23	3	33.12	3	23.12
954	*Penicillium italicum* Wehmer 1894			3	39.11	3	22.63
955	*Penicillium janczewskii* K.M. Zalessky 1927			13	44.47	8	47.96
956	*Penicillium jensenii* K.M. Zalessky 1927			9	47.35	8	43.44
957	*Penicillium lagena* (Delitsch 1943) Stolk et Samson 1983	3	19.46	4	39.10	4	25.92
958	*Penicillium lanosum* Westling 1911			3	44.45	3	38.02
959	*Penicillium lapidosum* Raper et Fennell 1948			5	44.45	4	42.21
960	*Penicillium lehmanii* Pitt 1980			2	40.41	2	47.99
961	*Penicillium lineatum* Pitt 1980			1	10.51	1	11.55
962	*Penicillium lividum* Westling 1911			15	38.20	1	15.33
963	*Penicillium malacaense* C. Ramirez et A.T. Martinez 1980			1	38.01	1	12.20

964	*Penicillium martensii* Biourge 1923 var. *moldavicum* Solovei 1975	1	2.27	1	20.16	1	10.71
965	*Penicillium megasporum* Orpurt et Fennell 1955			3	20.18	2	20.34
966	*Penicillium melanoconidium* Dierckx 1901			2	12.89	2	0.10
967	*Penicillium melinii* Thom 1930	1	3.99	6	41.94	4	37.14
968	*Penicillium miczynskii* K.M. Zalessky 1927	1	4.02	7	43.38	6	47.84
969	*Penicillium minioluteum* Dierckx 1901			37	38.03	2	12.20
970	*Penicillium mirabile* Beliakova et Milko 1972			1	36.90	1	9.56
971	*Penicillium multicolor* Grigorieva-Manoilova et Poradielova 1915			1	42.24	1	20.77
972	*Penicillium multicolor* Novobranova 1972			1	12.94	1	15.09
973	*Penicillium murcianum* C. Ramirez et A.T. Martinez 1981			1	31.98	1	32.01
974	*Penicillium nalgiovense* Laxa 1932			7	9.24	7	0.08
975	*Penicillium novae-zeelandiae* J.F.H. Beyma 1940			5	44.78	5	9.70
976	*Penicillium ochrochloron* Biourge 1923			7	44.30	5	26.52
977	*Penicillium olivicolor* Pitt 1980					1	0.32
978	*Penicillium olsonii* Bainier et R. Sartory 1912					2	0.95
979	*Penicillium onobense* C. Ramirez et A.T. Martinez 1981			1	38.05	1	12.20
980	*Penicillium ovetense* C. Ramirez et A.T. Martinez 1981			1	38.03	1	12.20
981	*Penicillium oxalicum* Currie et Thom 1915			6	38.05	6	38.11
982	*Penicillium palitans* Westling 1911			9	9.63	4	0.25
983	*Penicillium palmense* C. Ramirez et al. 1978			1	38.05	1	12.20
984	*Penicillium paxilli* Bainier 1907	3	19.51	8	44.47	7	18.52
985	*Penicillium phoeniceum* J.F.H. Beyma 1933			4	44.92	4	15.02
986	*Penicillium piceum* Raper et Fennell 1948	1	20.55	3	41.96	3	47.78
987	*Penicillium pinophilum* Thom 1910			3	37.80	2	32.70
988	*Penicillium polonicum* K.M. Zalessky 1927			6	6.49	6	0.08
989	*Penicillium purpurogenum* Stoll 1904			19	46.91	9	50.92
990	*Penicillium quercetorum* Baghdadi 1968	1	4.06	1	44.72	1	38.26
991	*Penicillium raistrickii* G. Smith 1933			5	36.68	3	20.13
992	*Penicillium resticulosum* Birkinshaw et al. 1942			1	26.72	1	44.28
993	*Penicillium restrictum* J.C. Gilman et E.V. Abbott 1927	2	18.31	14	44.23	8	38.51
994	*Penicillium roqueforti* Thom 1906	7	3.99	16	45.00	15	43.04
995	*Penicillium roseopurpureum* Dierckx 1901			8	44.69	5	28.62
996	*Penicillium rubrum* Stoll 1904	5	20.50	13	45.08	13	43.02
997	*Penicillium rugulosum* Thom 1910	3	28.56	23	44.08	17	43.08
998	*Penicillium sclerotiorum* J.F.H. Beyma 1937			7	42.22	7	34.33

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
999	*Penicillium severskii* Schechovtsov 1981			1	11.10	1	5.72
1000	*Penicillium simplicissimum* (Oudemans 1903) Thom 1930	3	18.31	26	45.25	19	47.55
1001	*Penicillium solitum* Westling 1911	13	18.00	15	44.01	15	38.32
1002	*Penicillium spinulosum* Thom 1910	6	4.02	25	43.47	17	46.00
1003	*Penicillium terraconense* C. Ramirez et A.T. Martinez 1980			1	38.04	1	2.55
1004	*Penicillium thomii* Maire 1917	4	2.27	9	42.32	9	36.25
1005	*Penicillium thymicola* Frisvad et Samson 2004			1	6.41	1	0.31
1006	*Penicillium turbatum* Westling 1911			1	28.44	1	43.16
1007	*Penicillium turolense* C. Ramirez et A.T. Martinez 1981			1	38.04	1	12.20
1008	*Penicillium umbonatum* Sopp 1912			1	32.95		
1009	*Penicillium valentinum* C. Ramirez et A.T. Martinez 1980			1	38.03	1	12.20
1010	*Penicillium vanbeymae* Pitt 1980			1	42.32	1	7.00
1011	*Penicillium variabile* Sopp 1912			37	42.19	17	42.68
1012	*Penicillium vasconiae* C. Ramirez et A.T. Martinez 1980			1	37.93	1	12.20
1013	*Penicillium velutinum* J.F.H. Beyma 1935			11	44.65	10	38.52
1014	*Penicillium verrucosum* Dierckx 1901	6	0.58	18	42.32	9	32.75
1015	*Penicillium verruculosum* Peyronel 1913	14	18.08	23	42.33	13	28.85
1016	*Penicillium vinaceum* J.C. Gilman et E.V. Abbott 1927			4	44.59	4	43.16
1017	*Penicillium viridicatum* Westling 1911			5	6.06	1	0.09
1018	*Penicillium vulpinum* (Cooke et Massee 1888) Seifert et Samson 1985			10	44.53	10	42.56
1019	*Penicillium waksmanii* K.M. Zalessky 1927	1	2.27	10	44.57	4	47.96
1020	*Penicillium westlingii* K.M. Zalessky 1927			1	29.52	1	21.65
1021	*Penicillium zacinthae* C. Ramírez et A.T. Martínez 1981			1	26.64	1	12.20
1022	*Penidiella* sp.			5	2.10		
1023	*Perenniporia medulla-panis* (Jacquin 1778) Donk 1967	1	18.55				
1024	*Periconia igniaria* E.W. Mason et M.B. Ellis 1953			1	9.90		
1025	*Periconia macrospinosa* Lefebvre et Aar.G. Johnson 1949	2	19.49	2	28.22		
1026	*Periconiella cocoes* M.B. Ellis 1967			1	18.12		
1027	*Pestalotia pezizoides* de Notaris 1841	2	19.86	2	39.30		
1028	*Pestalotiopsis guepinii* (Desmazieres 1840) Steyaert 1949			6	10.76		
1029	*Pestalotiopsis sydowiana* (Bresadola 1895) B. Sutton 1961	1	19.29				
1030	*Petriella sordida* (Zukal 1890) G.L. Barron et J.C. Gilman 1961			1	10.23		

1031	*Phacidium lacerum* Fries 1818			1	0.33		
1032	*Phaeococcomyces nigricans* (Rich et Stern 1958) de Hoog 1979			1	23.58	1	0.53
1033	*Phaeoisaria triseptata* Holubova-Jechova 1988			1	18.69		
1034	*Phaeosphaeria* sp.			1	1.56		
1035	*Phallus hadriani* Ventenat 1798	1	29.07				
1036	*Phallus impudicus* Linnaeus 1753 var. *togatus* (Kalchbrenner 1883) Costantin et L.M. Dufour 1895	3	21.77				
1037	*Phanerochaete sanguinea* (Fries 1828) Pouzar 1973	1	3.25				
1038	*Phellinus igniarius* (Linnaeus 1753) Quelet 1886	6	21.17				
1039	*Phellinus lundellii* Niemelae 1972	3	20.02				
1040	*Phellinus populicola* Niemelae 1975	3	27.22				
1041	*Phialophora atrovirens* (J.F.H. Beyma 1935) Schol-Schwarz 1970	1	20.40	1	28.65		
1042	*Phialophora bubakii* (Laxa 1930) Schol-Schwarz 1970	2	20.42	10	36.70		
1043	*Phialophora cyclaminis* J.F.H. Beyma 1942			2	6.36		
1044	*Phialophora lagerbergii* (Melin et Nannfeldt 1934) Conant 1937	1	19.38	1	13.60		
1045	*Phialophora melinii* (Nannfeldt 1934) Conant 1937			13	5.86		
1046	*Phialophora verrucosa* Medlar 1915	1	19.76	1	19.52		
1047	*Phlebia ochraceofulva* (Bourdot et Galzin 1911) Donk 1957	1	16.82				
1048	*Phlebia rufa* (Persoon 1801) M.P. Christiansen 1960	1	14.95				
1049	*Phlebia tremellosa* (Schrader 1794) Nakasone et Burdsall 1984	2	19.68				
1050	*Phlebiopsis gigantea* (Fries 1815) Juelich 1978	3	20.04				
1051	*Pholiota adiposa* (Batsch 1786) P. Kummer 1871	1	20.10				
1052	*Pholiota aurivella* (Batsch 1786) P. Kummer 1871	1	19.72				
1053	*Pholiota lenta* (Persoon 1801) Singer 1951	2	14.04				
1054	*Pholiota microspora* (Berkeley 1850) Saccardo 1887	1	8.08				
1055	*Phoma herbarum* Westendorp 1852			5	4.99		
1056	*Phoma leveillei* Boerema et G.J. Bollen 1975			4	13.49		
1057	*Phoma lingam* (Tode 1791) Desmazieres 1849			4	19.59		
1058	*Phomatospora* sp.	1	18.86	1	26.61		
1059	*Phomopsis castanea* (Saccardo 1879) Petrak 1921			1	11.21		
1060	*Phomopsis castaneae* Moriondo 1963			1	11.10		
1061	*Phomopsis helianthi* Muntanola-Cvetcovic et al. 1981	1	8.26	1	5.68		
1062	*Phycomyces blakesleeanus* Burgeff 1925	8	24.13	8	31.79	2	1.51
1063	*Phycomyces nitens* (C. Agardh 1823) Kunze 1823	2	23.06	2	43.00	1	0.34
1064	*Phyllosticta castaneae* Ellis et Everhart 1894			1	11.05		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1065	*Phyllosticta pucciniospila* C. Massalongo 1900	1	11.45	1	23.98		
1066	*Phytophthora cactorum* (Lebert et Cohn 1870) J. Schroeter 1886	1	17.05				
1067	*Phytophthora capsici* Leonian 1922	2	28.12				
1068	*Phytophthora cinnamomi* Rands 1922	4	18.78				
1069	*Phytophthora cryptogea* Pethybridge et Lafferty 1919	1	18.03				
1070	*Phytophthora drechsleri* Tucker 1931	3	26.22				
1071	*Phytophthora megasperma* Drechsler 1931	1	0.19				
1072	*Pidoplitchkoviella terricola* Kirilenko 1975	1	20.22	1	42.69		
1073	*Piedraia hortae* Fonseca et Leao 1928	2	19.35	1	34.74	1	23.85
1074	*Piedraia hortae* Fonseca et Leao 1928 var. *paraguayensis* Fonseca et Leao 1928			1	32.46	1	0.11
1075	*Piedraia sarmentoi* M.J. Pereira 1930	1	19.35	1	25.02	1	21.46
1076	*Pilaira anomala* (Cesati 1851) J. Schroeter 1886			1	26.00	1	1.11
1077	*Pilaira caucasica* Milko 1970	1	24.12	1	16.20		
1078	*Pilaira moreaui* Y. Ling 1926	1	23.57	1	27.53		
1079	*Pilobolus crystallinus* (F.H. Wiggers 1780) Tode 1784			1	15.64		
1080	*Pilobolus longipes* van Tieghem 1878	1	3.68	1	15.64		
1081	*Pilobolus umbonatus* Buller 1934			1	15.65		
1082	*Piptoporus betulinus* (Bulliard 1788) P. Karsten 1881	3	26.12				
1083	*Pirella circinans* Bainier 1882	2	24.09	1	46.10	1	14.40
1084	*Pirella circinans* Bainier 1882 var. *volgogradensis* (Milko 1974) Benny et Schipper 1988			1	37.71		
1085	*Pirella naumovii* (Milko 1970) Benny et Schipper 1992	1	19.32	1	15.35	1	46.87
1086	*Pithoascus schumacheri* (E.C. Hansen 1877) Arx 1973					1	0.32
1087	*Plectosphaerella cucumerina* (Lindfors 1919) W. Gams 1968	1	20.79	1	39.44		
1088	*Plenodomus tracheiphila* (Petri 1929) Gruyter et al. 2013	1	12.56				
1089	*Pleotrichocladium opacum* (Corda 1837) Hernández-Restrepo et al. 2017	3	19.43	4	32.79		
1090	*Pleurocytospora* sp.			1	7.59		
1091	*Pleurodesmospora coccorum* (Petch 1924) Samson et al. 1980			1	28.25		
1092	*Pleurophoma cava* (Schulzer 1871) Boerema 1996	3	19.81	3	44.72		
1093	*Pleurotus cornucopiae* (Paulet 1793) Rolland 1910	1	20.02				
1094	*Pleurotus eryngii* (De Candolle 1815) Quelet 1872	1	18.92				
1095	*Pleurotus ostreatus* (Jacquin 1774) P. Kummer 1871	70	34.08				

1096	*Pleurotus pulmonarius* (Fries 1821) Quelet 1872	4	8.16				
1097	*Pochonia bulbillosa* (W. Gams et Malla 1988) Zare et W. *Gams* 2001	5	19.99	7	28.36	2	2.72
1098	*Pochonia chlamydosporia* (Goddard 1913) Zare et W. Gams 2001	7	19.47	7	31.72		
1099	*Poitrasia circinans* (H. Naganishi et N. Kawakami 1955) P.M. Kirk 1984	1	20.08	1	44.36		
1100	*Polycephalomyces tomentosus* (Schrad. 1799) Seifert 1985	1	19.54	1	40.41	1	1.55
1101	*Polyporus ciliatus* Fries 1815	1	10.36				
1102	*Polyporus tomentosus* Fries 1821	1	9.07				
1103	*Polyscytalum pustulans* (M.N. Owen et Wakefield 1919) M.B. Ellis 1976	1	15.57	1	38.53		
1104	*Porodaedalea pini* (Brotero 1804) Murrill 1905	1	22.97				
1105	*Preussia fleischhakii* (Auerswald 1866) Cain 1961			1	43.78	1	23.47
1106	*Protomyces macrosporus* Unger 1834	1	19.01				
1107	*Pseudallescheria boydii* (Shear 1922) McGinnis et al. 1982	3	20.28	3	44.50	2	22.75
1108	*Pseudallescheria ellipsoidea* (Arx et Fassatiova 1973) McGinnis et al. 1982			1	42.46	1	23.42
1109	*Pseudeurotium bakeri* C. Booth 1961	1	20.48	1	43.04		
1110	*Pseudeurotium desertorum* Mouchacca 1971	1	18.88	1	41.28		
1111	*Pseudeurotium hygrophilum* (Sogonov et al. 2005) Minnis et D.L. Lindner 2013			9	1.67		
1112	*Pseudeurotium ovale* Stolk 1955 var. *milkoi* Beliakova 1969			2	44.73		
1113	*Pseudeurotium ovale* Stolk 1955 var. *ovale*	3	34.44	1	45.50	1	0.11
1114	*Pseudeurotium zonatum* J.F.H. Beyma 1937	9	20.42	20	44.28	10	24.97
1115	*Pseudogymnoascus caucasicus* Cejp et Milko 1966	1	29.35	1	39.38	1	25.13
1116	*Pseudogymnoascus roseus* Raillo 1929	2	22.61	5	47.77		
1117	*Puccinia adoxae* R. Hedwig 1805	1	19.60	1	19.05		
1118	*Puccinia bupleuri* (Opiz 1852) F. Rudolphi 1829	1	19.60	1	1.84		
1119	*Puccinia punctiformis* (F. Strauss 1811) Roehling 1813	1	23.64	1	19.05		
1120	*Purpureocillium lilacinum* (Thom 1910) Luangsa-ard et al. 2011	16	22.80	28	44.55	17	19.37
1121	*Pycnidiella resinae* (Ehrenberg 1818) Hoehnel 1915			1	25.43		
1122	*Pycnoporus cinnabarinus* (Jacquin 1776) P. Karsten 1881	2	23.74				
1123	*Pyrenochaeta* sp.			1	6.54		
1124	*Pyrenophora biseptata* (Saccardo et Roumeguere 1881) Crous 2013	1	19.30	1	33.34	1	4.33
1125	*Pyrenophora triseptata* (Drechsler 1923) Rossman et K.D. Hyde 2015			1	4.24		
1126	*Pyricularia grisea* Saccardo 1880	3	19.85	1	13.76		
1127	*Pyronema omphalodes* (Bulliard 1791) Fuckel 1870	1	18.96	1	17.28		
1128	*Pythium heterothallicum* W.A. Campbell et F.F. Hendrix 1968	2	33.45				
1129	*Pythium intermedium* de Bary 1881	1	6.50				

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1130	*Pythium irregulare* Buisman 1927	2	33.47				
1131	*Pythium mamillatum* Meurs 1928	1	17.05				
1132	*Pythium oedichilum* Drechsler 1930	1	33.28				
1133	*Pythium paroecandrum* Drechsler 1930	1	33.58				
1134	*Pythium spinosum* Sawada 1926	1	0.15				
1135	*Pythium sylvaticum* W.A. Campbell et F.F. Hendrix 1967	2	20.59				
1136	*Quambalaria cyanescens* (de Hoog et G.A. de Vries 1973) Z.W. *de* Beer et al. 2006	3	6.48				
1137	*Radiomyces embreei* R.K. Benjamin 1960			2	44.93	2	46.27
1138	*Radiomyces spectabilis* Embree 1959	1	25.31	1	39.17	1	24.89
1139	*Remotididymella destructiva* (Plowright 1881) Valenzuela-Lopez et al. 2017			3	16.86		
1140	*Rhinocladiella atrovirens* Nannfeldt 1934	3	17.70	5	13.39		
1141	*Rhinotrichum aureum* Cooke et Massee 1889			1	28.38		
1142	*Rhinotrichum lanosum* Cooke 1871	1	19.47	1	21.52		
1143	*Rhizoctonia solani* J.G. Kuehn 1858	22	20.04	1	5.53	4	21.24
1144	*Rhizoctonia tuliparum* (Klebahn 1905) Whetzel et J.M. Arthur 1924			1	14.94		
1145	*Rhizomucor miehei* (Cooney et R. Emerson 1964) Schipper 1978	1	19.68	1	26.51	1	46.10
1146	*Rhizomucor pusillus* (Lindt 1886) Schipper 1978	4	19.70	4	43.33	4	43.99
1147	*Rhizomucor tauricus* (Milko et Schkurenko 1970) Schipper 1978	2	19.64	2	45.07	2	24.69
1148	*Rhizopus arrhizus* A. Fischer 1892	23	20.72	26	45.19	25	50.01
1149	*Rhizopus microsporus* van Tieghem 1875 var. *chinensis* (Saito 1904) Schipper et Stalpers 1984	5	20.77	5	45.28	5	48.43
1150	*Rhizopus microsporus* van Tieghem 1875 var. *microsporus*	8	20.75	11	39.38	10	49.99
1151	*Rhizopus microsporus* van Tieghem 1875 var. *oligosporus* (Saito 1905) Schipper et Stalpers 1984	2	12.43	2	44.83	2	49.50
1152	*Rhizopus microsporus* van Tieghem 1875 var. *rhizopodiformis* (Cohn 1884) Schipper et Stalpers 1984			4	15.00	3	12.48
1153	*Rhizopus stolonifer* (Ehrenberg 1818) Vuillemin 1902 var. *stolonifer*	20	24.15	24	45.19	19	50.21
1154	*Rhodocollybia butyracea* (Bulliard 1792) Lennox 1979	1	2.82				
1155	*Robillarda sessilis* (Saccardo 1878) Saccardo 1880			1	18.99		
1156	*Rosellinia mammiformis* (Persoon 1801) Cesati et de Notaris 1863	1	19.28	1	31.68		
1157	*Russula aurora* (Krombholz 1836) Bresadola 1892	1	19.40				
1158	*Russula decolorans* (Fries 1821) Fries 1838	1	34.23				

1159	*Russula grisea* (Batsch 1786) Fries 1838	1	34.03				
1160	*Saksenaea vasiformis* S.B. Saksena 1953	1	27.79				
1161	*Saprochaete gigas* (Smit et L. Meyer 1928) de Hoog et *M.T.* Smith 2004	1	19.87	1	43.67	1	0.12
1162	*Saprolegnia asterophora* de Bary 1860	1	15.20				
1163	*Saprolegnia blelhamensis* (M.W. Dick 1969) Milko 1979	3	13.34				
1164	*Saprolegnia ferax* (Gruithuisen 1821) Nees 1843	2	13.81				
1165	*Saprolegnia litoralis* Coker 1923	1	13.10				
1166	*Saprolegnia mixta* de Bary 1883	1	0.17				
1167	*Saprolegnia terrestris* Cookson 1937 ex R.L. Seymour 1970	1	0.17				
1168	*Saprolegnia unispora* (Coker et Couch 1923) R.L. Seymour 1970	2	0.17				
1169	*Sarocladium strictum* (W. Gams 1971) Summerbell 2011	4	19.91	4	26.96	2	23.67
1170	*Schizophyllum commune* Fries 1815	4	34.08				
1171	*Sclerotinia borealis* Bubák et Vleugel 1917	19	3.85				
1172	*Sclerotinia nivalis* I. Saito 1997	25	3.85				
1173	*Sclerotinia ricini* G.H. Godfrey 1919	1	18.97	1	27.35	1	0.11
1174	*Sclerotinia sclerotiorum* (Libert 1837) de Bary 1884	2	31.23				
1175	*Scopulariopsis acremonium* (Saccardo 1882) Bainier 1907 (Thom 1910) Thom 1930	1	19.33	1	23.60	1	4.86
1176	*Scopulariopsis asperula* (Saccardo 1882) S. Hughes 1958	1	19.26	1	39.91	1	18.38
1177	*Scopulariopsis brevicaulis* (Saccardo 1882) Bainier 1907	15	20.49	17	48.08	12	46.09
1178	*Scopulariopsis brumptii* Salvanet-Duval 1935	3	15.25	4	21.54	1	3.33
1179	*Scopulariopsis coprophila* (Cooke et Massee 1887) W. Gams 1971			1	31.33		
1180	*Scopulariopsis croci* J.F.H. Beyma 1944			1	35.42	1	23.92
1181	*Scopulariopsis flava* (Sopp 1912) F.J. Morton et G. Smith 1963 (Thom 1910) Thom 1930	1	19.30	1	23.56	1	20.68
1182	*Scopulariopsis halophilica* Tubaki 1973	1	28.84				
1183	*Scopulariopsis koningii* (Oudemans 1902) Vuuillemin 1911			1	30.89		
1184	*Scytalidium terminale* G.V. Rao et de Hoog 1975	1	19.50	1	29.45		
1185	*Seimatosporium pestalozzioides* (Saccardo 1884) B. Sutton 1975			1	9.19		
1186	*Sepedonium macrosporum* Saccardo et Cavara 1900			1	39.83	1	25.33
1187	*Septoria lycopersici* Spegazzini 1881	1	17.25				
1188	*Septoria rosarum* Westendorp 1851				19.42		
1189	*Serpula lacrymans* (Wulfen 1781) J. Schroeter 1885	2	20.11				
1190	*Simplicillium lamellicola* (F.E.W. Smith 1924) Zare et W. Gams 2001	4	19.57	4	24.26		
1191	*Simplicillium obclavatum* (W. Gams 1984) Zare et W. Gams 2001			1	3.83		

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1192	*Sistotrema brinkmannii* (Bresadola 1903) J. Eriksson 1948	1	0.16				
1193	*Sordaria fimicola* (Roberge ex Desmazières 1849) Cesati et de Notaris *1863*	2	19.37	2	43.76	2	23.47
1194	*Sorosporium saponariae* F. Rudolphi 1830	1	17.70				
1195	*Spadicesporium acrosporum* V.N. Borisova et Dvoinos 1982	1	19.43	1	43.13		
1196	*Spadicesporium acrosporum-majus* V.N. Borisova et Dvoinos 1982	1	19.43	1	11.45		
1197	*Spadicesporium bifurcatum* V.N. Borisova et Dvoinos 1982	1	19.43	1	19.24		
1198	*Spadicesporium bifurcatum-majus* V.N. Borisova et Dvoinos 1982	1	19.43	1	13.52		
1199	*Spadicesporium copiosum* V.N. Borisova et Dvoinos 1982	1	19.43	1	32.34		
1200	*Spadicesporium persistens* V.N. Borisova et Dvoinos 1982	1	19.43	1	40.85		
1201	*Spadicesporium ramosum* V.N. Borisova et Dvoinos 1982	1	19.78	1	43.13		
1202	*Sparassis crispa* (Wulfen 1781) Fries 1821	1	7.49				
1203	*Sphaceloma* sp.			1	23.55		
1204	*Sphaeropsis sapinea* (Fries 1823) Dyko et B. Sutton 1980	2	19.90				
1205	*Sphaerostilbella aureonitens* (Tulasne et C. Tulasne 1865) Seifert et al. 1985			1	22.34		
1206	*Sphaerostilbella penicillioides* (Corda 1840) Rossman et al. 2015	6	19.19	6	34.71	2	3.20
1207	*Sporocadus lichenicola* Corda 1839			1	10.24		
1208	*Sporodiniopsis dichotoma* van Hoehnel 1903	1	15.90	1	15.95	1	10.80
1209	*Sporormiella australis* (Spegazzini 1887) S.I. Ahmed et Cain 1972			1	2.41	1	5.07
1210	*Sporormiella intermedia* (Auerswald 1868) S.I. Ahmed et Cain ex Kobayasi 1969			1	38.09		
1211	*Sporothrix fungorum* de Hoog et G.A. de Vries 1973			1	1.94		
1212	*Sporotrichum aeruginosum* Schweinitz 1886 var. *microsporum* Karsten 1905			1	32.35		
1213	*Sporotrichum bombycinum* (Corda 1839) Rabenhorst 1844	3	19.31	3	29.59	2	35.25
1214	*Sporotrichum gorlenkoanum* Kuritzina et Sizova 1967			1	23.64	1	20.27
1215	*Sporotrichum laxum* Nees 1816	1	19.31	1	26.27		
1216	*Sporotrichum mycophilum* Link 1818			1	27.68		
1217	*Sporotrichum pruinosum* J.C. Gilman et E.V. Abbott 1927	7	19.82	13	42.71	5	35.05
1218	*Sporotrichum roseolum* Oudemans et Beijerinck 1903	1	15.20	1	26.16	1	2.28
1219	*Stachybotrys chartarum* (Ehrenberg 1818) S. Hughes 1958	10	19.32	14	48.10	2	9.56
1220	*Stachybotrys cylindrospora* C.N. Jensen 1912			1	29.41		
1221	*Stachylidium variabile* Schulzer et Saccardo 1884			1	1.59		
1222	*Stagonospora paludosa* (Saccardo et Spegazzini 1879) Saccardo 1884	1	19.90				

1223	*Stagonosporopsis hortensis* (Saccardo et Malbranche 1882) Petrak 1921	1	20.34	1	27.54		
1224	*Stagonosporopsis trachelii* (Allescher 1895) Aveskamp et al. 2010	1	20.34				
1225	*Stemphyliomma* sp.			1	26.05	1	35.79
1226	*Stemphylium botryosum* Wallroth 1833	1	17.06	1	23.43		
1227	*Stemphylium sarciniforme* (Cavara 1890) Wiltshire 1938	3	17.80	3	25.45		
1228	*Stenocarpella maydis* (Berkeley 1847) B. Sutton 1980	1	21.31	1	11.57		
1229	*Stephanoma* sp.	1	16.24	1	16.03		
1230	*Stereum hirsutum* (Willdenow 1787) Persoon 1800	3	20.04				
1231	*Stereum sanguinolentum* (Albertini et Schweinitz 1805) Fries 1838	1	23.21				
1232	*Stilbella bulbicola* Hennings 1905	1	19.46	1	44.40		
1233	*Stilbotulasnella conidiophora* Bandoni et Oberwinkler 1982	1	23.91				
1234	*Striaticonidium brachysporum* (Nicot 1961) L. Lombard et Crous 2016	1	12.92	1	18.96		
1235	*Striaticonidium cinctum* (Corda 1842) L. Lombard et Crous 2016	1	19.30	1	28.18		
1236	*Strobilomyces strobilaceus* (Scopoli 1770) Berkeley 1851	1	26.53				
1237	*Stropharia rugosoannulata* Farlow ex Murrill 1922	1	12.21				
1238	*Syncephalastrum racemosum* Cohn ex J. Schroeter 1886	12	19.75	12	42.96	12	50.78
1239	*Syncephalis cornu* van Tieghem et G. Le Monnier 1873			1	46.84	1	45.50
1240	*Syncephalis nodosa* van Tieghem 1875	1	24.13	1	23.87	1	32.34
1241	*Taeniolella aquatilis* (Woronichin 1925) Milko 1985	1	19.33	1	31.75		
1242	*Talaromyces emersonii* Stolk 1965			1	30.14	1	37.44
1243	*Talaromyces flavus* (Kloecker 1902) Stolk et Samson 1972	2	18.08	4	43.58	4	46.02
1244	*Talaromyces luteus* (Zukal 1889) C.R. Benjamin 1955			9	43.25	9	36.49
1245	*Talaromyces stipitatus* (Thom 1935) C.R. Benjamin 1955			2	33.85	2	33.96
1246	*Talaromyces thermophilus* Stolk 1965			1	31.21	1	1.25
1247	*Talaromyces ucrainicus* Udagawa 1966	2	18.08	3	44.17	3	36.26
1248	*Talaromyces wortmannii* (Kloecker 1903) C.R. Benjamin 1955			3	22.58	3	12.07
1249	*Taphrina bergeniae* Döbbeler 1979	1	19.01	1	10.22		
1250	*Taphrina betulina* Rostrup 1883	1	13.27				
1251	*Taphrina carnea* Johanson 1886	1	8.12				
1252	*Taphrina coerulescens* Lindquist et Wright	1	13.25				
1253	*Taphrina flavorubra* W.W. Ray 1939	1	13.27				
1254	*Taphrina pruni* (Fuckel 1861) Tulasne 1866	1	19.01				
1255	*Taphrina purpurascens* B.L. Robinson 1887	1	13.27	1	8.72		
1256	*Taphrina robinsoniana* Giesenhagen 1892	1	13.25				
1257	*Taphrina sadebeckii* Johanson 1885	1	13.25				

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1258	*Taphrina tosquinetii* (Westendorp 1861) Tulasne 1866	1	18.91	1	9.59		
1259	*Tapinella panuoides* (Batsch 1783) E.-J. Gilbert 1931	2	7.02				
1260	*Teberdinia hygrophila* Sogonov et al. 2005			1	4.67		
1261	*Tetraploa aristata* Berkeley et Broome 1850	1	30.33				
1262	*Thamnidium elegans* Link 1809	3	17.72	3	40.96	3	33.55
1263	*Thamnostylum piriforme* (Bainier 1880) Arx et H.P. Upadhyay 1970	4	24.14	4	37.27	4	48.92
1264	*Thelebolus microsporus* (Berkeley et Broome 1865) Kimbrough 1967			3	6.54		
1265	*Thelebolus polysporus* (P. Karsten 1871) Otani et Kanzawa 1970	1	20.60	2	33.25		
1266	*Thermomyces ibadanensis* Apinis et Eggins 1966			2	28.76		
1267	*Thielavia appendiculata* Srivastava et al. 1966			1	46.06		
1268	*Thielavia hyrcaniae* Nicot 1961	1	4.06	1	42.75		
1269	*Thielavia inaequalis* Pidoplichko et al. 1973	2	4.07	2	45.58	2	0.10
1270	*Thielavia ovispora* Pidoplichko et al. 1973	3	19.33	3	43.57	3	24.15
1271	*Thielavia terrestris* (Apinis 1963) Malloch et Cain 1972	1	20.52	1	12.62		
1272	*Thielavia terricola* (J.C. Gilman et E.V. Abbott 1927) Emmons 1930	5	19.24	5	43.99	5	24.81
1273	*Thyrostroma carpophilum* (Leveille 1843) B. Sutton 1997	1	19.92				
1274	*Thysanophora canadensis* Stolk et Hennebert 1968	1	17.70	1	7.31		
1275	*Thysanophora penicillioides* (Roumeguere 1890) W.B. Kendrick 1961	6	19.21	6	32.25		
1276	*Tilachlidium pinnatum* Preuss 1851			1	29.01		
1277	*Tilletia laevis* J.G. Kühn 1873	1	23.91	1	19.05		
1278	*Tilletiopsis albescens* Gokhale 1972	1	16.41	1	20.08		
1279	*Tilletiopsis washingtonensis* Nyland 1950	3	28.64	3	29.65		
1280	*Tolypocladium cylindrosporum* W. Gams 1971	5	20.73	5	36.11	1	5.13
1281	*Tolypocladium geodes* W. Gams 1971	6	13.72	6	13.67		
1282	*Tolypocladium inflatum* W. Gams 1971	9	19.28	13	35.21	2	0.09
1283	*Tolypocladium microsporum* (Jaap 1916) Bissett 1983			1	3.92		
1284	*Torula ligniperda* (Willkomm 1866) Saccardo 1906	1	12.49	1	30.12		
1285	*Trametes gibbosa* (Persoon 1795) Fries 1838	1	23.84				
1286	*Trametes hirsuta* (Wulfen 1788) Lloyd 1924	5	26.58				
1287	*Trametes ochracea* (Persoon 1794) Gilbertson et Ryvarden 1987	1	8.25				
1288	*Trametes pubescens* (Schumacher 1803) Pilat 1939	3	34.10				
1289	*Trametes versicolor* (Linnaeus 1753) Lloyd 1920	10	34.10				

1290	*Trametes zonatella* Ryvarden 1978	1	0.41				
1291	*Tricellula aquatica* J. Webster 1959	1	16.22	1	29.30		
1292	*Tricellula aurantiaca* (Haskins 1958) Arx 1970	1	31.01	1	34.22		
1293	*Trichaptum abietinum* (Dickson 1793) Ryvarden 1972	2	25.23				
1294	*Trichocladium asperum* Harz 1871	2	19.56	2	47.73		
1295	*Trichocladium griseum* (Traaen 1914) X. Wei Wang et Houbraken 2018	2	19.30	7	48.38		
1296	*Trichocladium nigrospermum* (Schweinitz 1832) X. Wei Wang et Houbraken 2018	3	17.78	3	32.27	1	35.79
1297	*Trichoderma asperellum* Samuels et al. 1999			2	7.71	1	8.48
1298	*Trichoderma atroviride* P. Karsten 1892	5	20.24	9	46.30	4	30.59
1299	*Trichoderma aureoviride* Rifai 1969	4	19.82	4	41.99	4	29.94
1300	*Trichoderma citrinoviride* Bissett 1984			3	1.92		
1301	*Trichoderma deliquescens* (Sopp 1912) Jaklitsch 2011			1	21.12	1	12.36
1302	*Trichoderma flavofuscum* (J.H. Miller et al. 1957) Bissett 1991			1	25.05	1	0.09
1303	*Trichoderma ghanense* Yoshim. Doi et al. 1987			1	25.05	1	0.09
1304	*Trichoderma hamatum* (Bonorden 1851) Bainier 1906	1	20.36	1	25.62	1	10.01
1305	*Trichoderma harzianum* Rifai 1969	24	19.96	32	45.53	12	12.42
1306	*Trichoderma koningii* Oudemans 1902	4	19.82	4	42.75	4	35.83
1307	*Trichoderma lignorum* (Tode 1790) Harz 1872			1	2.99		
1308	*Trichoderma longibrachiatum* Rifai 1969	16	21.37	22	46.32	9	37.65
1309	*Trichoderma polysporum* (Link 1816) Rifai 1969	4	19.99	4	46.07	3	3.56
1310	*Trichoderma pseudokoningii* Rifai 1969	8	19.81	9	45.02	8	38.35
1311	*Trichoderma reesei* E.G. Simmons 1968	6	19.82	6	36.31	5	35.98
1312	*Trichoderma saturnisporum* Hammill 1970	2	0.54	2	25.05	1	4.92
1313	*Trichoderma virens* (J.H. Miller et al. 1957) Arx 1987	2	18.70	3	44.87	2	18.38
1314	*Trichoderma viride* Persoon 1794	13	20.47	12	40.53	11	29.81
1315	*Trichoderma viride* Persoon 1794 var. *kizhanicum* Krapivina 1975			1	32.63	1	8.12
1316	*Trichoderma viridescens* (A.S. Horne et H.S. Williamson 1923) Jaklitsch et Samuels 2006			5	26.99	4	26.87
1317	*Trichosporiella cerebriformis* (G.A. de Vries et Kleine-Natrop) W. Gams 1971	2	19.59	3	19.22		
1318	*Trichosporon dulcitum* (Berkhout 1923) Weijman 1979			1	27.05		
1319	*Trichosporum herbarum* Jaap 1916	1	0.54	1	27.82	1	3.73
1320	*Trichothecium roseum* (Persoon 1794) Link 1809	12	20.43	13	47.13	9	10.41
1321	*Tritirachium oryzae* (Vincens 1910) de Hoog 1972	5	17.67	5	45.93	4	3.38

(continued)

No.	Name of species	Cryopreservation		Freeze-drying		Soil	
		Number of strains	Max storage time (years)	Number of strains	Max storage time (years)	Number of strains	Max storage time (years)
1322	*Tropicoporus linteus* (Berkeley et M.A. Curtis 1858) L.W. Zhou et Y.C. Dai 2015	1	22.97				
1323	*Truncatella angustata* (Persoon 1801) S. Hughes 1958	3	19.47	4	46.76		
1324	*Tympanosporium parasiticum* W. Gams 1974	1	18.61	1	35.89	1	0.53
1325	*Ugola praticola* (Pidoplichko 1950) Stalpers 1984			1	30.96	1	8.47
1326	*Umbelopsis isabellina* (Oudemans 1902) W. Gams 2003	7	23.57	8	42.26	7	47.18
1327	*Umbelopsis longicollis* (Dixon-Stewart 1932) Y.N. Wang et al. 2015	4	19.43	4	38.84	4	50.23
1328	*Umbelopsis nana* (Linnemann 1941) Arx 1984	3	24.12	2	35.21	2	27.28
1329	*Umbelopsis ramanniana* (Moeller 1903) W. Gams 2003	11	19.43	11	40.99	11	50.21
1330	*Umbelopsis vinacea* (Dixon-Stewart 1932) Arx 1984	3	24.73	3	39.93	3	34.51
1331	*Ustilago avenae* (Persoon 1801) Rostrup 1890	1	18.51	1	1.64		
1332	*Ustilago cordae* Liro 1924	1	19.56	1	1.84		
1333	*Ustilago cynodontis* (Passerini 1870) Hennings 1893	1	21.45	1	18.84		
1334	*Ustilago filiformis* (Schrank 1793) Rostrup 1890	1	9.34	1	18.84		
1335	*Ustilago hordei* (Persoon 1801) Lagerheim 1889	1	12.32	1	18.84		
1336	*Ustilago maydis* (de Candolle 1815) Corda 1842	2	13.39				
1337	*Valsa sordida* Nitschke 1870			1	17.51		
1338	*Venturia tremulae* Aderhold 1897			1	2.11		
1339	*Verticillium albo-atrum* Reinke et Berthold 1879	3	19.33	3	29.00	3	5.02
1340	*Verticillium bulbillosum* W. Gams et Malla 1971			4	29.29		
1341	*Verticillium candidulum* W. Gams et Malla 1971			1	29.62		
1342	*Verticillium cellulose* W. Gams et Malla 1971			1	9.19		
1343	*Verticillium dahliae* Klebahn 1913	4	19.37	4	43.73	4	13.62
1344	*Verticillium epiphytum* Hansford 1943			1	38.28		
1345	*Verticillium fumosum* Seman 1968	1	19.27	1	31.86	1	4.74
1346	*Verticillium lecanii* (Zimmermann 1898) Viegas 1939	6	19.37	13	39.89	4	3.33
1347	*Verticillium longisporum* (C. Stark 1961) Karapapa et al. 1997			1	2.97		
1348	*Verticillium psalliotae* Treschew 1941			1	24.57		
1349	*Verticillium tenerum* Nees 1816			2	24.68		
1350	*Verticillium tricorpus* I. Isaac 1953	2	19.33	2	37.17	2	7.30
1351	*Verticillium villosum* Rudakov 1981			1	41.45		
1352	*Verticillium zaregamsianum* Inderbitzin et al. 2011	7	20.76	7	35.67	5	6.53

1353	*Viennotidia humicola* (Samson et W. Gams 1974) P.F. Cannon et *D.* Hawksworth 1982			1	27.31	1	27.65
1354	*Volutella ciliata* (Albertini et Schweinitz 1805) Fries 1832	2	19.84	2	21.53		
1355	*Volutella roseola* Cooke 1872	1	21.38	1	15.43		
1356	*Wallemia sebi* (Fries 1832) Arx 1970	3	19.60	2	15.96		
1357	*Wallrothiella subiculosa* Hoehnel 1912			1	21.53		
1358	*Wardomyces anomalus* Brooks et Hansford 1923			1	13.50		
1359	*Westerdykella dispersa* (Clum 1955) Cejp et Milko 1964	1	19.35	1	34.61	1	25.11
1360	*Westerdykella multispora* (Saito et Minoura ex Cain 1961) Cejp et Milko 1964	1	3.99	1	43.57	1	23.47
1361	*Xeromyces bisporus* L.R. Fraser 1953	1	18.86	1	15.48	1	0.21
1362	*Xylobolus frustulatus* (Persoon 1801) Boidin 1958	1	20.01				
1363	*Zasmidium biverticillatum* (Arzanlou et P.W. Crous 2007) S.I.R. Videira et *P.W.* Crous 2017			1	25.54		
1364	*Zygosporium echinosporum* Bunting et E.W. Mason 1941	1	19.56	1	36.47	1	1.00
1365	*Zymoseptoria passerinii* (Saccardo 1884) Quaedvlieg et Crous 2011			1	1.74		
1366	*Zymoseptoria pseudotritici* B. McDonald et al. 2012			1	6.45		

References

1. Abd-Elsalam KA, Yassin MA, Moslem MA, Bahkali AH, de Wit Pierre JGM, McKenzie EHC, Stephenson SL, Cai L, Hyde KD (2010) Culture collections, the new herbaria for fungal pathogens. Fungal Divers 45:21–32. https://doi.org/10.1007/s13225-010-0063-z
2. Atkinson RG (1953) Survival and pathogenicity of *Alternaria raphani* after five years in dried soil cultures. Can J Bot 31:542–546
3. Ayala-Zermeno M, Gallou A, Berlanga-Padilla AM, Andrade-Michel GY, Rodriguez-Rodriguez JC, Arredondo-Bernal HC, Montesinos-Matias R (2017) Viability, purity, and genetic stability of entomopathogenic fungi species using different preservation methods. Fungal Biol 121(11):920–928. https://doi.org/10.1016/j.funbio.2017.07.007
4. Bayat Z, Hassanshahian M, Cappello S (2015) Immobilization of microbes for bioremediation of crude oil polluted environments: a mini review. Open Microbiol J 9:48–54. https://doi.org/10.2174/1874285801509010048
5. Costa CP, Ferreira MC (1991) Preservation of microorganisms. Rev Microbiol 22(3):263–268
6. De Freitas A, Araújo MGBA, Hendges EA, Campos de Azevedo AG, de Olivero Lima DM, Silva da Cruz I, da Costa Mendonça M, Diniz LEC (2014) Viability of *Metarhizium anisopliae* (Metschn.) Sorok. conidia preserved in packages containing silica gel. BMC Proc 8(4):128. https://doi.org/10.1186/1753-6561-8-S4-P128
7. Guidelines for the establishment and operation of collections of cultures of microorganisms. 3rd ed. WFCC; 2010. 19p. http://www.wfcc.info/pdf/Guidelines_e.pdf
8. Hine RB (1962) Saprophytic growth of *Fusarium oxysporum* f. *niveum* in soil. Phytopathology 52:840–845
9. Ivanushkina NE, Kochkina GA, Eremina SS, Ozerskaya SM (2010) Experience in using modern methods of long-term preservation of VKM fungi. Mikol Phytopathol 44:19–30. (In Russian)
10. Kozlovskii AG, Zhelifonova VP, Antipova TV (2013) Fungi of the genus *Penicillium* as producers of physiologically active compounds (Review). Appl Biochem Microbiol (Moscow) 49:1–10. https://doi.org/10.1134/S0003683813010092
11. Milosevic MB, Medic-Pap SS, Ignatov MV, Petrovic DN (2007) Lyophilization as a method for pathogens long term preservation. Proc Natl Sci Matica Srska Novi Sad 113:203–210
12. Nakasone KK, Peterson SW, Jong S-C (2004) Preservation and distribution of fungal cultures. In: Mueller GM et al (eds) Biodiversity of fungi. Inventory and monitoring methods. Elsevier/Academic Press, Amsterdam, pp 37–47
13. OECD best practice guidelines for biological resource centers. OECD; 2007. 115p. http://www.oecd.org/science/emerging-tech/38777417.pdf
14. Onions AHS (1983) Preservation of fungi. In: Smith JE, Berry DR, Kristiansen B (eds) The filamentous fungi, Fungal technology, vol 4. Edward Arnold, London, pp 373–390
15. Ozerskaya SM, Ivanushkina NE, Kochkina GA, Eremina SS, Vasilenko AN, Chigineva NI (2013) Long-term preservation of fungal cultures in All-Russian Collection of Microorganisms (VKM): protocols and results. In: Gupta V, Tuohy M, Ayyachamy M, Turner K, O'Donovan A (eds) Laboratory protocols in fungal biology: current methods in fungal biology, Fungal biology. Springer, New York, pp 17–65
16. Perez-Garcıa A, Mingorance E, Rivera ME, Del Pino D, Romero D, Tores JA, De Vicente A (2006) Long-term preservation of *Podosphaera fusca* using silica gel. J Phytopathol 154:190–192. https://doi.org/10.1111/j.1439-0434.2006.01086.x
17. Perkins DD (1962) Preservation of *Neurospora* stock cultures with anhydrous silica gel. Can J Microbiol 8:591–594
18. Raper KB, Fennell DI (1965) The genus *Aspergillus*. Williams and Wilkins, Baltimore, p 686
19. Rodriguez R, Santos C, Simões MF, Soares C, Santos C, Lima N (2019) Polyphasic, including MALDI-TOF MS, evaluation of freeze-drying long-term preservation on *Aspergillus* (section Nigri) strains. Microorganisms 7:291. https://doi.org/10.3390/microorganisms7090291

20. Ryan MJ, Smith D, Jeffries P (2000) A decision-based key to determine the most appropriate protocol for the preservation of fungi. World J Microbiol Biotechnol 16:183–186
21. Ryan MJ, Smith D (2007) Cryopreservation and freeze-drying of fungi employing centrifugal and shelf freeze-drying. In: Day JG (ed) Methods in molecular biology, vol 368. Humana Press, Totowa, pp 127–140
22. Sergeeva YE, Galanina LA, Andrianova DA, Feofilova EP (2008) Lipids of Filamentous fungi as a material for producing biodiesel fuel. Appl Biochem Microbiol (Moscow) 44:523–527. https://doi.org/10.1134/S0003683808050128
23. Shearer BL, Zeyen RJ, Ooka JJ (1974) Storage and behavior in soil of *Septoria* species isolated from cereals. Phytopathology 64:163–167
24. Sidyakina TM (1988) Methods of preservation of microorganisms. In: Veprintzev BN (ed) Konservatziya geneticheskikh resursov. ONTI NTZBI AN USSR, Pushchino, p 59. (In Russian)
25. Smith D (1988) Culture and preservation. In: Hawksworth DL, Kirsop BE (eds) Living resources for biotechnology. Filamentous fungi. Cambridge University Press, Cambridge, pp 75–99
26. Smith D (1993) Long-term preservation of test strains (fungus). Int Biodeterior Biodegradation 31:227–230
27. Smith D, Onions AHS (1994) The preservation and maintenance of living fungi, 2nd edn. CAB International, Wallingford, p 132
28. Smith D, Thomas VE (1998) Cryogenic light microscopy and the development of cooling protocols for the cryopreservation of filamentous fungi. World J Microbiol Biotechnol 14:49–57
29. Stacey GN, Day JG (2007) Long-term *ex situ* conservation of biological resources and the role of biological resource centers. In: Day JG, Stacey GN (eds) Methods in molecular biology, vol 368. Humana Press, Totowa, pp 1–14. https://doi.org/10.1007/978-1-59745-362-2_1
30. Sundari SK, Adholeya A (1999) Freeze-drying vegetative mycelium of *Laccaria fraterna* and its subsequent regeneration. Biotechnol Tech 13:491–495
31. Suprun TP (1965) Preservation of microscopic fungi in sterile soil. Mikrobiologiya 34:539–545. (In Russian)
32. Vekeman B, Heylen K (2015) Preservation of microbial pure cultures and mixed communities. In: McGenity TJ, Timmis KN, Nogales B (eds) Hydrocarbon and lipid microbiology protocols, Springer protocols handbooks. Springer, Berlin/Heidelberg, pp 299–315. https://doi.org/10.1007/8623_2015_51
33. Wu L, Sun Q, Desmeth P, Sugawara H, McCluskey K, Smith D, Vasilenko A, Lima N, Ohkuma M, Robert V, Zhou Y, Li J, Fan G, Ingsriswang S, Ozerskaya S, Ma J (2017) World data centre for microorganisms: an information infrastructure for the exploration and utilization of microbial strains preserved worldwide. Nucleic Acids Res 45(D1):D611–D618. https://doi.org/10.1093/nar/gkw903
34. Zhan Y, Liu H, Wu Y, Wei P, Chen Z, Williamson JS (2015) Biotransformation of artemisinin by *Aspergillus niger*. Appl Microbiol Biotechnol 99:3443–3446. https://doi.org/10.1007/s00253-015-6464-x