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The genus *Stachybotrys* (anamorphic fungi) in the semi-arid region of Brazil

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ABSTRACT – (The genus *Stachybotrys* (anamorphic fungi) in the semi-arid region of Brazil). *Stachybotrys* is characterized by macronematous, mononematous, unbranched or branched conidiophores, with discrete terminal and phialidic conidiogenous cells, and aseptate, reniform, ellipsoidal to spherical, smooth or verrucose conidia, which are produced in a slimy mass. Eight species have been reported from Brazil, occurring in the soil, air and leaf litter. During investigation of conidial fungi on decaying leaf litter in semi-arid areas of Brazil nine species were found: *S. bisbyi* (Sriniv.) G.L. Barron, *S. chartarum* (Ehrenb.) S. Hughes*, S. globosa* P. C. Misra & S. K. Srivast.*, S. kampalensis* Hansf.*, S. longispora* Matsush.*, S. nephrospora* Hansf.*, S. nilagirica* Subram., *Stachybotrys parvispora* S. Hughes and *S. verrucispora* Matsush. *Stachybotrys nilagirica* is a new record from Brazil. Descriptions, comments, geographic distribution and illustrations are presented for above mentioned species. A key for all species recorded in semi-arid region of Brazil is presented.

Key words - conidial fungi, *Memnoniella*, taxonomy

RESUMO – (O gênero *Stachybotrys* (fungos anamórficos) na região semi-árida do Brasil). *Stachybotrys* é caracterizado por apresentar conidióforos macronemáticos, mononemáticos simples ou ramificados, células conidiogênicas evidentes, terminais e fialídicas e conídios asseptados, reniformes, elipsóides a esféricos, lisos ou verrucosos, produzidos em mucilagem. No Brasil já foram relatadas oito espécies, ocorrendo no solo, no ar e em material vegetal em decomposição. Durante investigação de fungos conidiais associados à serapilheira em áreas do semi-árido brasileiro foram encontradas nove espécies: *S. bisbyi* (Sriniv.) G.L. Barron, *S. chartarum* (Ehrenb.) S. Hughes*, S. globos*a P. C. Misra & S. K. Srivast., *S. kampalensis* Hansf.*, S. longispora* Matsush.*, S. nephrospora* Hansf.*, S. nilagirica* Subram., *S. parvispora* S. Hughes e *S. verrucispora* Matsush., dentre estas *S. nilagirica* constitui um novo registro para o Brasil. Descrições, comentários, distribuição geográfica e ilustrações são apresentadas para as espécies citadas. Chave de identificação para as espécies registradas no Brasil é apresentada.

Palavras-chave - fungos conidiais, *Memnoniella,* taxonomia

Introduction

The genus *Stachybotrys* Corda is worldwide in distribution although some species are restricted to the tropics and subtropics (Pinruan *et al.* 2004). The genus was erected for a single species *Stachybotrys atra* (Corda 1837), and it is characterized by macronematous, monomenatous, single or branched conidiophores, with discrete phialidic conidiogenous cells, and 0-septate conidia, produced in a slimy mass, usually appearing dark in colour (Jong & Davis 1976, Mercado-Sierra *et al.* 1997).

The genus has been subject to controversy since it was proposed (Li & Yang 2005). Corda (1837) described the conidia as 2-celled, but up to the present, all accepted members of *Stachybotrys* produce unicellular conidia (Jong & Davis 1976). After re-examining the type material of *S. atra,* Hughes (1958) recombined it as *S. chartarum* (Ehrenb.) S. Hughes.

Stachybotrys and *Memnoniella* Höhn have been considered distinct genera (Ellis 1971, 1976, Jong & Davis 1976). However, members of *Stachybotrys* and *Memnoniella* are morphologically and physiologically closely related (Jong & Davis 1976). The main difference between these two genera is that the conidia are in long dry chains in *Memnoniella* while they form slimy masses in *Stachybotrys* (Jong & Davis 1976). Smith (1962) and Carmichael *et al.* (1980) have considered this is not a valid generic distinction and have suggested the two genera be combined under the older name of *Stachybotrys*. Following phylogenetic and morphological analyses, Haugland *et al.* (2001) considered *Memnoniella echinata* (Rivolta) Galloway and *M. subsimplex* (Cooke) Deighton to be better placed as *Stachybotrys echinata* (Rivolta) G. Sm and *S. subsimplex* Cooke. The four remaining

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species of *Memnoniella* should probably be transferred to *Stachybotrys*, following molecular analysis (Pinruan *et al.* 2004).

Many species of *Stachybotrys* are commonly found in soil and are capable of utilizing cellulose and damaging fabric made of plant fibers (Jong & Davis 1976). Stachybotryotoxicosis is a disease of farm animals, particularly of horses, caused by *S. chartarum*. It has increasingly attracted public attention to its effect on human health following reports of its association with idiopathic pulmonary hemorrhage in infants (Dearborn *et al.* 1999). Subsequently, this species was reportedly isolated for the first time from the lung of a child diagnosed with pulmonary hemosiderosis (Elidemir *et al.* 1999).

More than 50 species are accepted in the genus (Pinruan *et al.* 2004). However, only eight species are reported for semi-arid region of Brazil: *S. bisbyi* (Sriniv.) G.L. Barron and *S. kampalensis* Hansf. (Marques *et al.* 2007); *S. chartarum* (Ehrenb.) S. Hughes (as *S. atra* var. *cylindrospora* (C.N. Jensen) Rayss & Borut) (Batista & Upadhyay 1965); *S. globos*a P.C. Misra & S.K. Srivast. and *S. verrucispora* Matsush. (Leão-Ferreira *et al.* 2008); *S. longispora* Matsush. (Castañeda-Ruiz *et al.* 2003); *S. nephrospora* Hansf (Gusmão *et al.* 2006; Barbosa *et al.* 2008) and *S. parvispora* S. Hughes (Barbosa *et al.* 2009).

Stachybotrys atra var. *cylindrospora* was reported from semi-arid region by Batista & Upadhyay (1965), however, Li (2007) after reexamining the type material of *S. cylindrospora* and *S. atra* var. *cylindrospora* concluded that these taxa are synonymous of *S. chartarum.*

Stachybotrys alternans Bonord. was reported from semi-arid region but was not accepted in the review by Pinruan *et al.* (2004) and is not included in the following key.

Materials and methods

During several expeditions from 2000 to 2007 in areas of semi-arid Caatinga biome, at the state of Bahia, Ceará, Pernambuco and Rio Grande do Norte, in Northeast region of Brazil, samples of leaf litter were collected, placed in separate paper bags and taken to the laboratory. The samples were washed and incubated in moist chambers consisting of Petri dishes (15 cm diam.). The dishes were placed within plastic containers (170 L capacity) with 200 mL of sterile water plus 2 mL of glycerol, with the internal temperature and relative humid around 25 °C and 85%, respectively (Castañeda-Ruiz 2005). The leaf litter was examined at regular intervals for the presence of microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g in 100 mL of water, plus 5 mL of glycerol) and measurements made at a magnification of × 1000. All materials have been deposited in the Herbarium of Universidade Estadual de Feira de Santana (HUEFS).

Results and discussion

From the leaf litter collected in the semi-arid regions investigated, nine species of *Stachybotrys* were found: *Stachybotrys bisbyi, S. chartarum, S. globosa, S. kampalensis*, *S. longispora, S. nilagirica* Subram., *S. nephrospora, S. parvispora* and *S. verrucispora.* Of these, *S. nilagirica* is a new record for Brazil. All these listed species are described, illustrated and commented. A key for all *Stachybotrys* species recorded from semi-arid region is included.

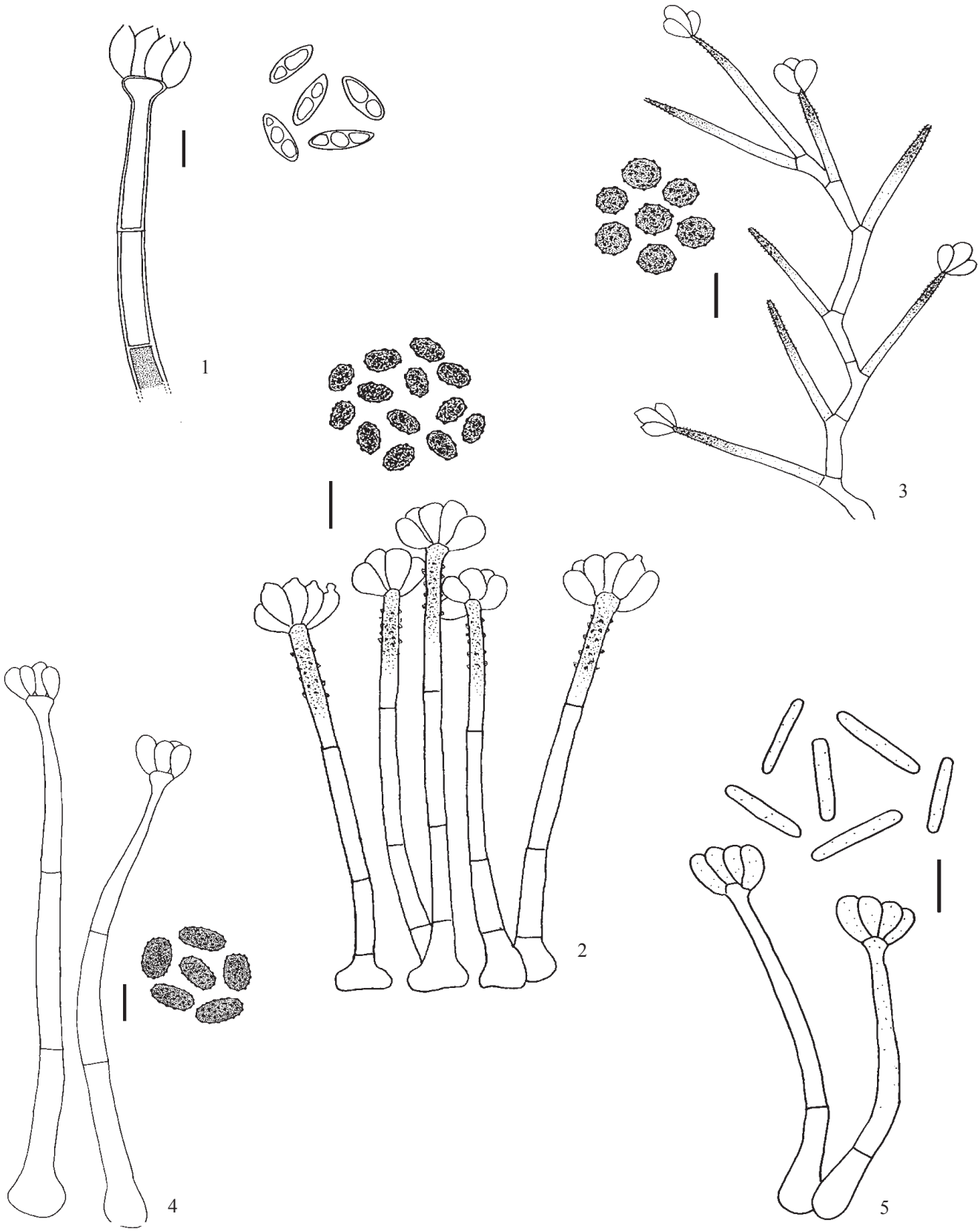
Stachybotrys bisbyi (Sriniv.) G.L. Barron, Mycologia 56:315. 1964. ≡ *Hyalostachybotrys bisbyi* Sriniv, *J. Indian bot. Soc*. 37: 340. 1958.
Figure 1

Conidiophores erect, straight or flexuous, rarely branched, septate, smooth, rarely verrucose, median region pale brown, apex hyaline, 108-315 × 5-9 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores determinate, ellipsoidal, smooth, hyaline 12-15 × 2-3 µm; conidia, ellipsoidal, aggregated in slimy masses, smooth, guttulate, hyaline, 10-15 × 3-5 µm.

Specimens examined: BRAZIL. Bahia: Santa Terezinha, on decaying petiole of an unidentified dicotyledonous plant, 03-XI-2005, *M.F.O. Marques s.n.* (HUEFS105743).

Distribution: Brazil (Marques *et al.* 2007), Canada, Egypt, India, Mozambique, (Jong & Davis 1976), China, Philippines (Whitton *et al.* 2001), Cuba (Mercado-Sierra *et al.* 1997), Italy (Piontelli *et al.* 1999), Slovak Republic (Kubátová 1994), Japan (Matsushima 1975), Papua New Guinea (Matsushima 1971), South Africa, USA (Morgan-Jones 1977).

Stachybotrys bisbyi, *S. bambusicola* Rifai and *S. palmijunci* Rifai are the only species with hyaline conidia in white slimy masses; however, *S. bisbyi* differs by conidiogenous cell without percurrent proliferation, a character observed in the last two species. Of the other similar species *S. bambusicola* has smaller conidia while those of *S. palmijunci* are wider (Matsushima 1980, Piontelli *et al.*1999). These species appear to have a restricted geographic distribution and are found on several substrates such as stems, leaves and cortex (Piontelli *et al.* 1999). The conidiophores observed on the Brazilian



Figures 1-5. Conidiophores, conidiogenous cells and conidia. 1. *Stachybotrys bisbyi*. 2. *S. chartarum*. 3. *S. globosa*. 4. *S. kampalensis*. 5. *S. longispora*. Bar = 10 µm.

material are wider than those reported for the species (Jong & Davis 1976, Kubátová 1994, Mercado-Sierra *et al.* 1997, Piontelli *et al.* 1999). The species, despite a relatively worldwide geographic distribution, was not reported in South America before Marques *et al.* (2007).

Stachybotrys chartarum (Ehrenb.) S. Hughes, *Can. J. Bot*. 36: 812. 1958. ≡ *Stilbospora chartarum* Ehrenb., *Sylv. mycol. berol.* (Berlin) 9: 21 (1818). ≡ *Oidium chartarum* Link, in Willdenow, *Willd.*, *Sp. pl.*, Edn 4 6(1): 124 (1824). ≡ *Oospora chartarum* (Ehrenb.) Wallr., *Fl. crypt. Germ.* (Nürnberg) 2: 184 (1833).
Figure 2

Conidiophores erect, straight or flexuous, unbranched, septate, smooth, hyaline at the base, verrucose and light brown at the apex, 28-100 × 3-4.5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, clavate, smooth, 7-12 × 3-5 µm; conidia ellipsoidal, ridged or banded surface, aggregated in slimy masses, verrucose, black, 6.5-10 × 3-5.5 µm.

Specimen examined: BRAZIL. Bahia: Morro do Chapéu, on dead leaves of an unidentified dicotyledonous plant, 29-VI-2007, *T.S. Santa Izabel s.n.* (HUEFS131813); Macajuba, on dead leaves of *Arrabidaea cinerea* Bureau ex K. Schum., 15-IV-2000, *L.F.P. Gusmão s.n.* (HUEFS42748); Rio de Contas, on dead leaves of *Stachytarpheta crassifolia* Schrad., 20-IV-2001, *L.F.P. Gusmão s.n.* (HUEFS56581); Pernambuco: Buíque, on dead leaves of an unidentified dicotyledonous plant, 16-X-2007, *T. S. Santa Izabel s.n.* (HUEFS131814).

Distribution: Cosmopolitan (Jong & Davis 1976).

The dimensions of the taxonomic characters are in agreement with other authors (Ellis 1971, Jong & Davis 1976, Matsushima 1975, Whitton *et al.* 2001). The main characteristic of the species is the morphology and roughness of the conidia. *S. chartarum* is a cellulolytic saprophyte frequently isolated from paper, wallpaper and gypsum wallboard in buildings or residences that have experienced water damage (Li & Yang 2005). This species has a broad morphological variability in culture and is the most common species collected around the world (Jong & Davis 1976).

Stachybotrys globosa P. C. Misra & S. K. Srivast., *Trans. Br. Mycol. Soc.* 78: 556. 1982.
Figure 3

Conidiophores macronematous, mononematous, erect, straight, sympodially branched, septate, smooth, hyaline at the base, echinulate and pale gray at the apex, 108-185 × 2-3.5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, obovate, smooth, hyaline, 4.5-8.5 × 2.5-4.5 µm; conidia solitary 0-septate, spherical, aggregated in slimy masses, verrucose, dark brown, 4.5-7.5 µm diam.

Specimen examined: BRAZIL. Rio Grande Do Norte: Seridó, on dead leaves of an unidentified plant, 18-IV-2006, *S. M. Leão-Ferreira s.n* (HUEFS105746); Bahia: Pilão Arcado, on dead fruit of an unidentified dicotyledonous plant, 08-III-2007, *A.C.R. Cruz s.n.* (HUEFS125380); on dead leaves of an unidentified dicotyledonous plant, 07-III-2007, *A.C.R Cruz s.n.* (HUEFS125381).

Distribution: Brazil (Leão-Ferreira *et al.* 2008), India (Misra & Srivastava 1982).

Among the species circumscribed in the genus, *S. microspora* (B. Marthur & Sankina) Jong & Davis and *S. nilagirica* Subram. are closest to *S. globosa* in having spherical or globose conidia (Misra & Srivastava 1982). However these species, differ from *S. globosa* by pattern of branching conidiophores and size of conidia (Pinruan *et al.* 2004). The examined specimen has conidiophores larger than those described in the literature (Misra & Srivastava 1982, Pinruan *et al.* 2004). *S. globosa* has a restricted geographic distribution and was not found in the American Continent before Leão-Ferreira *et al.* (2008).

Stachybotrys kampalensis Hansf. *Proc. Linn. Soc. London* 155: 45. 1943.
Figure 4

Conidiophores erect, straight or flexuous, unbranched, septate, smooth, hyaline, 127.5-155 × 7.5-10 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, elliptic to clavate, smooth, hyaline 8-12 × 6-7 µm; conidia ellipsoidal, aggregated in slimy masses, verrucose at maturity, dark olivaceous to black, 10-12 × 5-7 µm.

Specimen examined: BRAZIL. Bahia: Santa Terezinha, on dead leaves of an unidentified dicotyledonous plant 09-XII-2005, *M.F.O. Marques s.n.* (HUEFS107200).

Distribution: Australia, India, USA, formerly USSR (Farr & Rossman 2008), Brazil (Marques *et al.* 2007), China (Wong & Hyde 2001), Cuba (Mercado-Sierra *et al.* 1997), Japan (Matsushima 1975), Papua New Guinea (Matsushima 1971).

Stachybotrys kampalensis is found in tropical and subtropical areas, and is characterized by smooth conidiophores and verrucose conidia (Mercado-Sierra *et al.* 1997). Of the related species, *S. microspora* and *S. parvispora* have smaller conidia those of *S. kampalensis* (Mercado-Sierra *et al.* 1997). The measurements of conidiophores and conidia are smaller than those reported by Matsushima (1971), Ellis (1971) and Mercado-Sierra *et al.* (1997). The species was not found in South America before Marques *et al.* (2007).

Stachybotrys longispora Matsush. *Icon. microfung. Matsush. lect.* (Kobe): 145.1975.
Figure 5

Conidiophores erect, straight or flexuous, unbranched, septate, smooth, hyaline or rarely subhyaline at the apex, 53-83 × 4-5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, obovate, smooth, subhyaline, 6-9 × 2-3 µm; conidia solitary, 0-septate, cylindrical, rounded at the ends, aggregated in slimy masses, smooth, subhyaline, 12-15 × 1.8-2.4 µm.

Specimens examined: BRAZIL. Bahia: Santa Terezinha, on dead leaves of *Clusia melchiori* Gleason, 29-II-2006, *F.R. Barbosa s.n.* (HUEFS122232); 27-IV-2006, *F.R. Barbosa s.n.* (HUEFS123372); 28-VI-2006, *F.R. Barbosa s.n.* (HUEFS125438).

Distribution: Brazil (Castañeda-Ruiz *et al.* 2003), Cuba (Mercado-Sierra & Mena-Portales 1988), Japan (Matsushima 1975).

Stachybotrys longispora was described from Japan on dead leaves of *Ilicis latifoliae* (Matsushima 1975). The specimens examined present larger conidiophores and smaller conidiogenous cells than other literature examined (Matsushima 1975, Mercado-Sierra & Mena-Portales 1988). *Stachybotrys longispora* is related to *S. eucylindrospora* Li, however, the latter species has conidia with ornaments or striations (Li 2007). *Stachybotrys yunnanensis* has cylindrical or subcylindrical conidia, but they are wider than those of *S. longispora* (Kong 1997). In Brazil, the species was found by Castañeda-Ruiz *et al.* (2003) on rotten leaves in Northeast region at Paraiba State.

Stachybotrys nephrospora Hansf., *Proc. Linn. Soc. London* 155: 45. 1943.
Figure 6

Conidiophores erect, straight or flexuous, occasionally branched, septate, verrucose and subhyaline at the base, smooth and hyaline at the apex, up to 320 × 3-4 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, hyaline at the base, brown at the apex, 9-12 × 5-6 µm.; conidia reniform, aggregated in slimy masses, verrucose, black, 8.5-11 × 5-7 µm.

Specimens examined: BRAZIL. Ceará: Crato, on dead leaves of an unidentified dicotyledonous plant, 10-VII-2007, *T. S. Santa Izabel s.n.* (HUEFS131815); Bahia: Jacobina, on dead leaves of Asteraceae, 06-VIII-2001, *L.F.P Gusmão s.n.* (HUEFS56643).

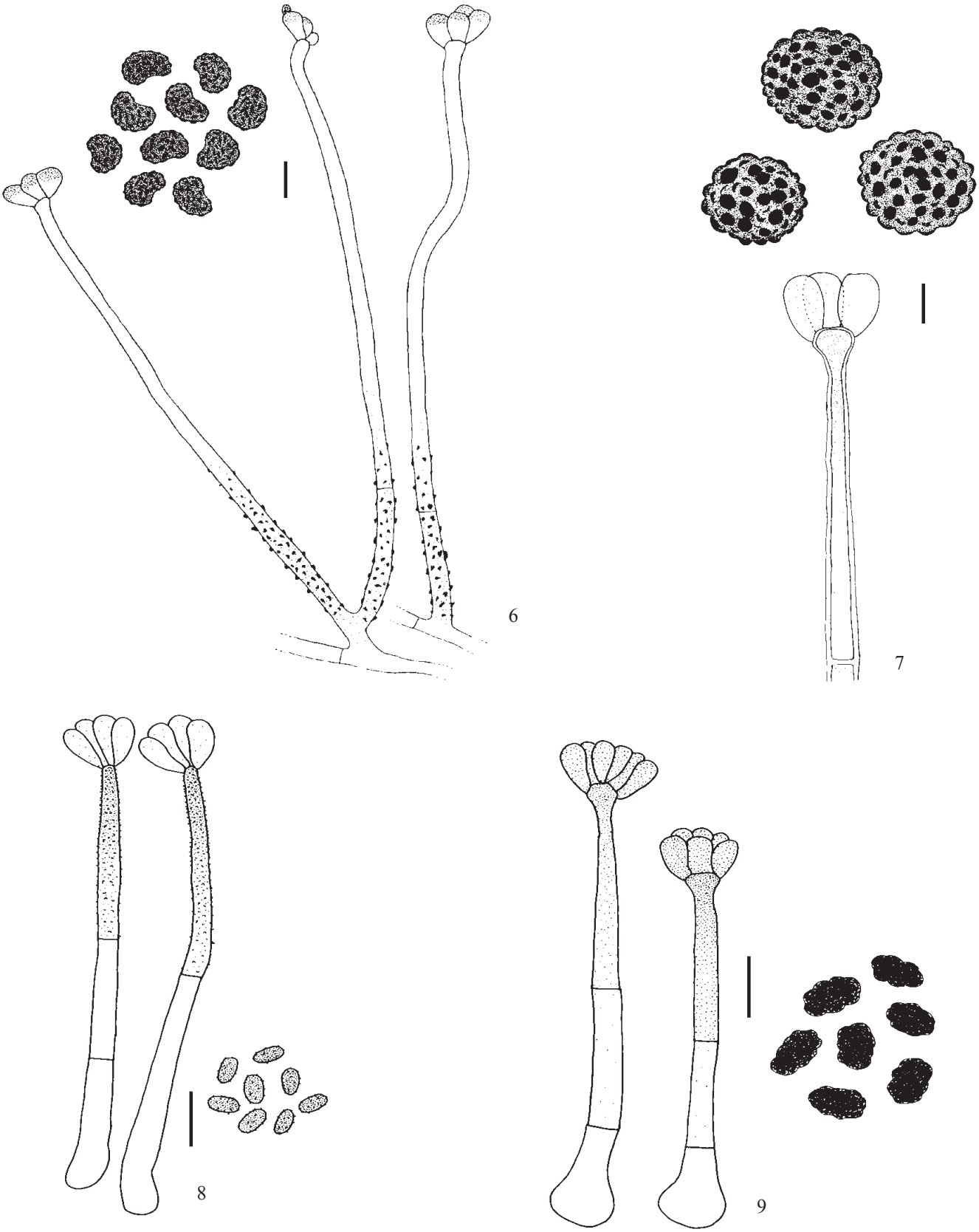
Distribution: Brazil (Barbosa *et al.* 2008), Canada, Cuba, Nigeria, Pakistan (Mercado-Sierra *et al.* 1997), India, Jamaica, Sierra Leone (Ellis 1971), Japan, Uganda (Jong & Davis 1976), New Zealand (Whitton *et al.* 2001), Papua New Guinea (Matsushima 1971), Thailand, USA (Farr & Rossman 2008).

The dimensions of the taxonomic characters are in agreement with the measurement given in literature (Ellis 1971, Matsushima 1975, Jong & Davis 1976, Whitton *et al.* 2001), except for dimensions of the conidia that are smaller. The main characteristics of the species are the morphology of branched conidiophores and reniform conidia. Six species of *Stachybotrys* are known to produce reniform conidia (Whitton *et al.* 2001). *Stachybotrys reniverrucosa* Whitton, McKenzie & K. D. Hyde has unbranched conidiophores and conidia are larger than those of *S. nephospora* (Whitton *et al.* 2001); *S. renispora* P. C. Misra, *S. renisporoides* K. G. Karand., S. M. Kulk. & Patw. and *S. proliferata* K. G. Karand., S. M. Kulk. & Patw. have smooth and smaller conidia (Misra 1976, Whitton *et al.* 2001). *Stachybotrys oenanthes* M. B. Ellis has verrucose conidia as in *S. nephrospora*, however, the conidiophores are unbranched and smaller (Ellis 1976). The species was not reported from South America, before Gusmão *et al.* (2006).

Stachybotrys nilagirica Subram. *Proc. Indian Acad. Sci.,* Pl. Sci. 46: 331. 1957.
Figure 7

Conidiophores erect, straight or flexuous, septate, unbranched, smooth, hyaline at the base, olive gray at the apex, 225-300 × 13.5-16.5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, obovate, smooth, subhyaline, 13.5-16.5 × 6-9 µm; conidia spherical, tuberculate, aggregated in slimy masses, dark olive gray to black, 23.5-25.5 µm diam.

Specimen examined: BRAZIL. Bahia: Santa Terezinha, on dead leaves of an unidentified dicotyledonous plant, 20-XII-2005, *A. C. R. Cruz s.n.* (HUEFS105744).



Figures 6-9. Conidiophores, conidiogenous cells and conidia. 6. *Stachybotrys nephrospora*. 7. *S. nilagirica*. 8. *S. parvispora.* 9. *S. verrucispora.* Bar = 10 µm.

Distribution: Cuba (Mercado-Sierra *et al.* 1997), India (Subramanian 1957), Japan (Matsushima 1975), New Zealand (Hughes 1978), Peru (Matsushima 1993).

The material observed is in agreement with the descriptions given in the literature (Subramanian 1957, Matsushima 1975, Hughes 1978, Mercado-Sierra *et al.* 1997). However, the Brazilian specimen has two or three conidiogenous cells clustered in a fascicle, differing from the other specimens that display four to six conidiogenous cells. *Stachybotrys sphaerospora* Morgan-Jones & R.C. Sinclair has spherical conidia similar to *S. nilagirica*, however, it differs by smaller conidia and branched conidiophores (Morgan-Jones & Sinclair 1980).

Stachybotrys parvispora S. Hughes, *Mycol. Pap*. 48:74. 1952.
Figure 8

Conidiophores erect, straight or flexuous, solitary or in groups, unbranched, septate, smooth, rarely verrucose at the apex, hyaline, 75-128 × 3-4.5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, clavate to ellipsoidal, smooth, hyaline, 7-9 × 3-4 µm; conidia ellipsoidal, aggregated in slimy masses, finely verrucose, dark brown, 4-6 × 3-4.5 µm.

Specimens examined: BRAZIL. Bahia: Santa Terezinha, on dead leaves of *Clusia melchiorii* Gleason, 29-XII-05, *F.R. Barbosa s.n.* (HUEFS114762); on dead leaves of *Clusia nemorosa* G.F.W. Meyer, 18-X-05, *F.R. Barbosa* s.n. (HUEFS105742).

Distribution: Brazil (Barbosa *et al.* 2009), China, Thailand (Farr & Rossman 2008), Colombia (Goos 1997), Congo, Malaysia, Sierra-Leone (Ellis 1971), Cook Islands, Solomon Islands, New Caledonia (McKenzie 1991), Cuba (Mercado-Sierra *et al.* 1997), Ghana (Hughes 1952), Ivory Coast (Rambelli *et al.* 1981), Japan (Matsushima 1985), New Zealand (GBIF 2008), Spain, Zaire (Stalpers 2003).

Stachybotrys parvispora was originally described by Hughes (1952) on dead leaves from Gold Coast in tropical Africa. *Stachybotrys parvispora* is related with *S. kampalensis,* however, the latter species has larger conidia (Jong & Davis 1976). The characteristics of specimens examined are in accordance with previous descriptions (Jong & Davis 1976, McKenzie 1991, Goos 1997, Mercado-Sierra *et al.* 1997).

Stachybotrys verrucispora Matsush. *Matsush. Mycol. Mem.* 4: 18. 1985.
Figure 9

Conidiophores erect, straight or flexuous, solitary, unbranched, smooth, hyaline at the base, pale gray at the apex, 58-70 × 4.5-6.5 µm; conidiogenous cells monophialidic, terminal, discrete, clustered at the apex of conidiophores, determinate, clavate, smooth, pale gray to pale brown, 7.5-10.5 × 3-3.5 µm; conidia broadly ellipsoidal, aggregated in slimy masses, verrucose, black, 7-10.5 × 4.5-6 µm.

Specimens examined: BRAZIL. Rio Grande do Norte: Seridó, on dead leaves of an unidentified dicotyledonous plant, 26-IV-2006, *S. M. Leão-Ferreira s.n.* (HUEFS105764).

Distribution: Brazil (Leão-Ferreira *et al.* 2008), Brunei, Philippines (Whitton *et al.* 2001), Palau, Seychelles Islands (Matsushima 1985).

The species was collected for the first time on a petiole of *Cyatheae* sp. (Matsushima 1985). *Stachybotrys waitakere* Whitton, McKenzie & K. D. Hyde has verrucose and broadly ellipsoid conidia similar to *S. verrucispora*, however, it differs by possessing a rounded base or broad truncate papilla on the conidia (Whitton *et al.* 2001).The conidia and conidiophores of examined material are smaller than reported in the literature (Matsushima 1985, Whitton *et al.* 2001, Pinruan *et al.* 2004). *Stachybotrys verrucispora* was first reported in South America by Leão-Ferreira *et al.* (2008).

Key to species of *Stachybotrys* found in semi-arid region of Brazil.

1. Mature conidia hyaline ..... *S. bisbyi*
1. Mature conidia subhyaline, olive gray, dark brown or black 2
   2. Mature conidia smooth ..... *S. longispora*
   2. Mature conidia verrucose 3
3. Mature conidia ellipsoidal 4
3. Mature conidia reniform or spherical 7
   4. Mature conidia 10-12 µm in length ..... *S. kampalensis*
   4. Mature conidia up to 10 µm in length 5

5. Mature conidia less than 6 µm in length ..... *S. parvispora*
5. Mature conidia more than 6 µm in length 6
   6. Conidiophores verrucose and light brown at the apex ..... *S. chartarum*
   6. Conidiophores smooth and pale gray at the apex ..... *S. verrucispora*
7. Mature conidia reniform ..... *S. nephospora*
7. Mature conidia spherical 8
   8. Conidiophores sympodially branched, conidia 4.5-7.5 µm diam. ..... *S. globosa*
   8. Conidiophores unbranched, conidia 23.5-25.5 µm diam. ..... *S. nilagirica*

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