



DESCRIPTION OF CHLAMYDOSPORES

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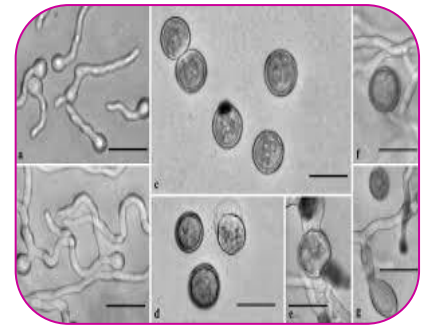
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INTRODUCTION

A) *Acaulospora*:

i) *Acaulospora bireticulata* Rothwell & Trappe: Spores are formed singly in soil, sessile, borne laterally on a hyaline, thin-walled hypha. Spores globes, 150-155 μm in diameter and become light brown coloured at maturity. Spore surface ornamented with polygonal reticulum, ridges with sinuous, dark, grayish – green sides and a paler, depressed central stratum; ridges occasionally branched toward the center of polygons or forming irregular, isolated projection at polygon centers. Spore walls are of three layers, outer layer dark grayish middle layer green to grayish brown, the inner layers hyaline. The complex spore ornamentation distinguishes it from other species (Plate 42, fig. 2).



ii) *Acaulospora delicata* Walker, Pfeiffer & Bloss: Spores are born singly in the soil. Hyaline to pale yellowish-cream coloured. Globose to subglobose, 80-125(-150) x 80 –110 (-140) μm in size. Two distinct wall groups are seen. Walls are thin, membranous and of rather fragile nature. All other described members of the genus have either ornamented outer walls or have more deeply coloured spores (Plate 42, fig. 1A, 1B).

iii) *Acaulospora foveata* Trappe & Janos: Spores are born singly in the soil, sessile. Spores globose to ellipsoid, 185-310 (-410) x 215-350 (-480) μm size, yellowish-brown “honey – coloured”. Spore surface uniformly pitted with round to oblong or occasionally irregular depressions, with rounded bottoms separated by ridges. This type of wall ornamentation conspicuously differs from that of the other species. Hyphal attachment is inconspicuous. (Plate 42, fig. 3 and 4).

iv) *Acaulospora gdanskensis* Blaskowski: Spores are born singly in the soil. Spores are pale yellow to yellow brown coloured, globose to subglobose, (55-) 65 (-75) μm in diameter, sessile on a hypha tapering to a globose to subglobose swollen hyphal terminus, 60-70 μm in diameter; hyphal terminus contents hyaline, terminus wall 0.5 μm thick; distance between the hyphal terminus and the spore 50-60 μm ; at maturity the terminus empties and collapses (Plate 43, fig. 11 and 12 & Plate 44, fig. 16).

v) *Acaulospora lacunosa* Morton: Spores yellow, globose to bunglobose, 131 μm in diameter wall surface is ornamented with irregular saucer shaped pits. Hyphae at the point of spore attachment broad, 12 – 23 μm in diameter (Plate 43 fig. 9 and 10).

vi) *Acaulospora laevis* Gerdemann & Trappe: Spores are formed singly in soil, sessile. Spores smooth, 119 – 300 x 119 –520 μm , globose to sub – globose, ellipsoid or occasionally reniform to irregular. Deep yellow – brown to red – brown colour. Spore wall continuous. Spore contents are globose to somewhat polygonal (Plate 42 fig. 5 and 6).

vii) *Acaulospora spinosa* Walker & Trappe: Spores are formed singly in soil, sessile. Spores 100-298 x 100 – 335 μm in size. Globose to subglobose, dull yellowish – brown in colour. Surface ornamented with crowded blunt spines. Encrustings of amorphous materials around spines (Plate 44, fig. 14 and 15).

viii) *Acaulospora splendida* Siverding, Chaverri & Rajas: Spores are formed singly in soil. Spores borne laterally on tapering hypha, wide at the point of spore attachment. Spores oblong broadly ellipsoid, 209 – 317 x 157 – 264 µm in diameter. Spores appear hyaline, shiny and smooth (Plate 43, fig. 7 and 8 & Plate 44, fig.13).

ix) *Acaulospora thomii* Blazkowski: Spores are formed singly in soil. Spores pale brown to dark brown in colour, globose to subglobose, 150 – 240 µm in diameter, borne laterally on hypha, wide at attachment (Plate 44, fig. 17).

B) *Archaespora*:

i) *Archaespora gerdemanni* (Rose, Daniels & Trappe) Morton & Redecker: Spores formed singly in soil, sessile, borne laterally on a hypha. Spores spherical, 200-250 µm in diameter, with globular contents, double walls, and golden brown coloured. Hyphae below the spore attachment is 10 – 12 µm wide. Outer wall shows cerebriform convolutions (Plate 45, fig.1).

ii) *Archaespora leptoticha* (Schenck & Smith) Morton & Redecker: Chlamydospores formed singly or in loose clusters in soil. Spores globose, extremely variable in size (48 -) 175 (-262) µm in diameter, with single thin wall, light yellow coloured. Young spore shows indistinct alveolate reticulum of shallow ridges. Spore contents are cream coloured (Plate 45 fig. 2).

C) *Entrophospora*:

i) *Entrophospora infrequens* (Hall) Ames & Schneider: Spores produced singly in soil. Spores dull orange to brown coloured 69 – 183 x 69 – 164 µm in diameter, subglobose or ellipsoid. Spore enclosed by hyaline wall of vesicular stalk. Spore contents of variably sized oil globose (Plate 46, fig. 1, 2 and 3).

D) *Gigaspora*:

i) *Gigaspora albida*: Schenck & Smith: Spores formed singly in soil, dull white with a light greenish – yellow tint; mostly spherical, 143 – 330 (-350) µm in diameter. Spores attached to a single, hyaline to yellow, bulbous suspensor (Plate 47, fig. 1 and 2).

ii) *Gigaspora decipiens* Hall & Abbott: Spores large, yellow or light brown coloured, globose 320 – 490 µm in diameter, thick outer wall (Plate 48, fig. 7 and 8).

iii) *Gigaspora gigantea* (Nicolson & Gerdemann) Gerdemann & Trappe: Large sized spores (up to 812 µm broad) formed singly in soil, when mature, bright yellow with a greenish tinge, spherical with thin outer wall, bulbous suspensor at the base of the spore (Plate 50, fig. 14,15).

iv) *Gigaspora margarita* Becker & Hall: Spores formed singly in the soil; globose or irregular in compact soils. Globose spores 260 – 480 µm in diameter. Spore wall smooth and hyaline, light brown coloured. Spores terminal on the subtending hypha (Plate 48, fig. 9, Plate 49, fig. 10, 11, 13, & Plate 51, fig. 17).

v) *Gigaspora rosea* Nicolson & Schenck: Globose to subglobose spores with 230 – 305 µm in diameter are produced singly in soil, yellowish to brown coloured with a rose–pink tint on the wall near the hyphal attachment. Spherical suspensor like attachment, 2.4 – 7.5 µm thick and smooth wall (Plate 47, fig. 3 – 6, Plate 49, fig. 12, & Plate 51, fig. 16, 18 and 19).

E) *Glomus*:

i) *Glomus aggregatum* Schenck & Smith emend. Koske: Spores smooth, globose to subglobose, free in the soil, 40-85 x 40 – 85 µm in size, yellow – brown coloured. Some spores with two subtending hyphae (Plate 52, fig. 1,3 and 4).

ii) *Glomus australe* (Berkeley) Berch: Spores are formed in loose clusters. Spores are ellipsoidal to globose and measure about (120-160-180) µm and have two wall layers. Outer wall layer is pale yellow coloured while the inner layer is dark brown coloured. Subtending hypha is broad spore (Plate 52, fig. 6).

iii) *Glomus cerebriforme* Mc Gee: Spores mostly globose, some are irregular, 25 x 25 – 65 x 80 µm in diameter. Outer wall thick becomes dull and roughened with age cottar (Plate 52, fig. 5 & Plate 59, fig. 37).

iv) *Glomus citricola* Tang & Zang: Spores small 35 – 65 x 60 – 90 µm, without the ephemeral hyaline outer wall. In globose spores, diameter extends up to 120 µm and the walls may show minute perforations with thickened inward projections (Plate 53, fig. 9 & Plate 54, fig. 12 - 15).

v) *Glomus clarum* Nicolson & Schenck: Chlamydospores formed singly or in small clusters in the soil. Spores are hyaline, globose to subglobose, 68 – 290 µm in diameter, mostly ± 190. Spore contents are hyaline becoming yellow with age. Wall is thick, hyaline and spores are large in size (Plate 54, fig. 17).

vi) *Glomus constrictum* Trappe: Chlamydospores naked, formed singly or in loose clusters. Spores globose to subglobose, 150 – 330 µm in diameter, dark brown to black, smooth. Typical constriction of the attached hypha near the spore base. Beyond the inflated segment, the hypha is dichotomously forked (Plate 53, fig. 8 & Plate 56, fig. 21).

vii) *Glomus dimorphicum* Boyetchko & Tewari: Spores forming singly and in loose clusters in soil. Spores reddish brown, globose to subglobose, 90 – 300 µm in diameter. Subtending hyphae straight, light yellow coloured. Point of attachment is cylindrical (Plate 53, fig. 11 & Plate 56, fig. 25).

viii) *Glomus fasciculatum* (Thaxter) Gerdemann & Trappe emend. Walker & Koske:

Chlamydospores are borne free in soil and in dead rootlets, in loose aggregations, in small compact clusters. Obovate; ellipsoidal spores with 75 – 150 x 35 – 100 µm in size, smooth, hyaline, light yellow or yellow brown in colour. Spores in coherent groups (Plate 56, fig. 20 and 23, Plate 57, fig. 29 & Plate 58, fig. 32).

ix) *Glomus flavisporum* (M. Lange & Lund) Trappe & Gerdemann: Spores ovate – oblong, slightly constricted in the middle, 171 x 95 to 159 x 152 µm in size, wall deep brown coloured (Plate 53 fig. 7).

x) *Glomus fragilistratum* Skou & Jakobsen: Spores formed singly in the soil, globose 108 – 191 µm in diameter, with fragile wall layer. Yellow to pale orange coloured. Characteristically fragile nature of the spore (Plate 53 fig. 10 & Plate 56, fig. 26).

xi) *Glomus geosporum* (Nicolson & Gerdemann) Walker: Chlamydospores formed singly in soil, globose to broadly ellipsoid, 110 – 290 µm in diameter. Spore wall extends into attached hypha for some distance (Plate 55, fig. 18 & Plate 56, fig. 24).

xii) *Glomus globiferum* Koske & Walker: Spores formed singly or in pairs, adhering to each other. Brown to red – brown coloured, globose to subglobose, 150 – 270 µm in diameter. Subtending hyphae thick walled proximally, but with the wall thickness rapidly diminishing from the point of connection to a thin walled, hyaline parent hypha (Plate 56 fig. 22).

xiii) *Glomus glomerulatum* Sieverding: Chlamydospores yellow to brown, globose to subglobose 40 – 70 µm in diameter, wall composed of two layers. Spore surface is smooth, hyaline and membranous, spore contents are hyaline, oily (Plate 59, fig. 35 and 36 & Plate 60, fig. 45).

xiv) *Glomus helon* Rose & Trappe: Chlamydospores borne singly in soil or in small loose clusters, globose to subglobose 200 – 280 µm in diameter. Light brown to brown coloured, wall two layered, thick. Amorphous nature of outer wall. Spiny ornamentation in old spores (Plate 54, fig. 16).

xv) *Glomus hoi* Berch & Trappe: Spores borne singly in the soil, globose, subglobose or ellipsoidal 80 x 120 x 75 – 120 µm in size, dark brown to black coloured. Outer wall of the spores becomes roughened and dark with age (Plate 61, fig. 46).

xvi) *Glomus lacteum* Rose & Trappe: Chlamydospores borne singly in soil, globose to subglobose, 150 – 220 µm in diameter, shiny, smooth, opaque. Single thick hyaline wall, attached hyphae straight, hyaline. Spore contents hyaline, granular globules of varying size (Plate 60, fig. 41).

xvii) *Glomus macrocarpum* Tulasne & Tulasne: Spores brown to dark brown, slightly longer than wide, subglobose or globose 120 x 110 µm. Spore wall two layered. Spore taper to the point of attachment of the single persistent hypha (Plate 58, fig. 33, Plate 60, fig. 38 & Plate 61, fig. 48, 50 and 51).

xviii) *Glomus maculosum* Miller & Walker: Spores formed singly in the soil, globose to subglobose 135 – 178 x 130 - 187 µm in size, hyaline when immature, become pale straw – coloured when mature, walls three. Spore contents are of crowded oil droplets. Spotted appearance due to ingrowths on the membranous inner wall of older spores (Plate 55, fig. 19 & Plate 60, fig. 39).

xix) *Glomus magnicaule* Hall: Spores formed singly in soil; globose to subglobose, 125 – 175 µm in diameter. Spore wall double, light brown coloured. Subtending hyphae wide at the point of attachment (Plate 58, fig. 30 & Plate 60, fig. 44).

xx) *Glomus manihot* Howeler, Sieverding & Schenck: Chlamydospores formed singly or in loose clusters in soil, obovate, globose or subglobose, 125 – 236 µm in diameter; spore contents are yellow. A sub-hyline, mucilaginous layer is associated with the outer wall (Plate 60, fig. 42).

xxi) *Glomus microcarpum* Tulasne & Tulasne: Chlamydospores borne free in soil in loose aggregations, small, with 35 – 49 µm in diameter, globose to subglobose. Spores wall hyaline to light yellow, smooth but appearing roughened from adherent debris (Plate 56, fig. 27 & Plate 61, fig. 47).

xxii) *Glomus mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe: Chlamydospores yellow to brown coloured, globose, ovoid, may be somewhat irregular, 105 - 305 µ in diameter with funnel shaped base divided from subtending hyphae by a curved septum (Plate 58, fig. 34 & Plate 60, fig. 43).

xxiii) *Glomus multicaule* Gerdemann & Bakshi: This species is unique, normally having more than one hyphal attachment. Also distinguished by its extremely thick wall. The spores particularly with attachments at opposite ends are suggestive of zygospores. However, the resemblance is probably superficial. Chlamydospores dark brown 149 – 162 µm in diameter, ellipsoidal (Plate 52 fig. 2).

xiv) *Glomus nanolumen* Koske & Gemma: Spores are of unusually small size, 30 x 34 µm in size, subglobose, pyriform or irregular, translucent, yellow, reddish – yellow or rose pink in colour, wall thick and two layered. Spores develop in sporocarps (Plate 58, fig. 31).

xv) *Glomus pachycaulis* Wu & Chen: Sporocarps yellow to yellow brown, consisting of terminal chlamydospores, radially arranged on a central plexus of hyphae. Chlamydospores yellow to yellow – brown, abovoid to ellipsoid, 27.5 x 37.5 µm in size. Chlamydospores wall yellow brown, hyaline (Plate 60 fig. 40).

xvi) *Glomus sinuosa* Gerdemann & Bakshi: Thick walled sinuous hyphae that tightly enclose the sporocarps are distinguishable. Chlamydospores 45 – 118 x 30 – 83 µm in size, obovate, fusiform – elliptical to clavate, radiating out in a single layer from a central plexus of hyphae. Chlamydospores wall brown, generally thick near spore base (Plate 57, fig. 28).

xvii) *Glomus taiwanensis* Wu & Chen: Chlamydospores formed radially in a single, tightly packed layer around a central plexus of hyphae. Chlamydospore 40 – 85 x 22 – 42 µm in size, clavate, cylindro – clavate, triangular. Wall yellowish – brown coloured, thick at the apex (Plate 61, fig. 49).

F) *Scutellospora*: **i) *Scutellospora alborosea* (Ferrer & Herrera) Walker & Sanders:** Azygospores formed free in soil, globose to subglobose, 204 – 287 µ in diameter, hyaline to pink coloured brownish when old. Subtending hypha becomes narrow further. Wall composed of an exospore and a membranous endospore (Plate 62, fig. 1 – 4 & Plate 63, fig. 5 and 10).

ii) *Scutellospora erythropha* (Koske & Walker) Walker & Sanders: Spores formed singly in the soil or occasionally within roots. Spores terminally on a bulbous suspensor like cell; variable in shape, globose, subglobose, obovoid, ellipsoidal or irregular 221 x 314 µm in size, often broader than long, orange – brown or dark red - brown in colour (Plate 63, fig. 7).

iii) *Scutellospora gregaria* (Schenck & Nicolson) Walker & Sanders: Spores of this species have the roughest surface of any of the species. Globose to subglobose, size variable, measuring surface is a characteristic feature. Spores are red – brown, become dark brown with maturity (Plate 63, fig. 9).

iv) *Scutellospora heterogama* (Nicolson & Gerdemann) Walker & Sanders: Spores borne singly in the soil, on a bulbous suspensor like cell: globose to subglobose, or irregular 150 – 220 µm in diameter. Spores brown to red – brown coloured (Plate 63, fig. 6).

v) *Scutellospora minuta* (Ferrer & Herrera) Walker & Sanders: Spores are small in size with presence of small rings on the spore surface. Spores are formed free in soil, globose, subglobose or irregular 97 – 180 µ in diameter, dark gray – brown and opaque. Hyphal attachment obovoid to sub – claviform (Plate 64, fig. 12 – 14).

vi) *Scutellospora persica* (Koske & Walker) Walker & Sanders: Spores formed singly in the soil, terminally on a bulbous suspensor – like cell; globose to subglobose to ellipsoid. 270 - 354 x 281 – 384 μm in size, pale pinkish, orange to brownish – orange coloured (Plate 63, fig. 8).

vii) *Scutellospora verrucosa* (Koske & Walker) Walker & Sanders: Spores formed singly in the soil, terminally or somewhat laterally on a bulbous suspensor – line cell; globose to subglobose; 220 – 476 x 220 – 476 μm , pale straw to yellow - brown coloured (Plate 64, fig. 15).

viii) *Scutellospora weresubiae* Koske & Walker: Spores formed singly in the soil, terminally on a bulbous suspensor – like cell, translucent, glistening, pale pink to yellowish pink., globose to subglobose or irregular; 125 – 265 x 135 – 144 (mean 210 x 210) μm in size. Subtending hypha broad, hyaline to pale brownish – yellow coloured (Plate 64 fig. 11).

CONCLUSION

Spores are pale yellow to yellow brown coloured, globose to subglobose, 65 μm in diameter, sessile on a hypha tapering to a globose to subglobose swollen hyphal terminus, 60-70 μm in diameter; hyphal terminus contents hyaline, terminus wall 0.5 μm thick; distance between the hyphal terminus and the spore 50-60 μm ; at maturity the terminus empties and collapses .

Gigaspora gigantea Gerdemann & Trappe: Large sized spores formed singly in soil, when mature, bright yellow with a greenish tinge, spherical with thin outer wall, bulbous suspensor at the base of the spore .

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