The graminicolous Species of Angiopsora and Phakopsora[1]).

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In 1934, Mains (Mycologia *26*: 122—132) established the genus *Angiopsora* to accommodate four species of graminicolous rust fungi whose subepidermal crustose telia were composed of sessile chains of teliospores. Three of the species had previously been placed in the genus *Puccinia*. Later, Mains (Mycologia **30**: 42—45. 1938) studied the type of *Puccinia apoda* Hariot et Pat. He determined that, while the telia were subepidermal and crustose, the teliospores were irregularly arranged rather than catenulate. The species was transfered to the genus *Phakopsora* as the first representative known to parasitize a grass. Since Mains studies additional species have been reported until now there are 12 species of *Angiopsora* and 5 species of *Phakopsora* known to occur on grasses.

This paper presents a brief synopsis of the spcies.

Angiospora Mains.

1. *Angiopsora africana* Cummins in Bull. Torrey Bot. Club **83**: 221, 1956.

Sori amphigenous. Uredia with hyaline or yellowish, slightly apically and dorsally thickened, incurved paraphyses; spores mostly 16—20 ⇌ 26—33 μ, ellipsoid or obovoid, wall 1.5 μ thick, yellowish or golden, echinulate, pores obscure, probably 4 and equatorial. Telia blackish brown, indehiscent; spores mostly 10—16 ⇌ 20—26 μ, in chains of 2 or 3, wall 2 μ thick at sides, 3—5 μ at apex, golden to chestnut.

Hosts and distribution: *Brachiaria brizantha* (Hochst.) Stapf, *B. decumbens* Stapf: Kenya and Uganda.

Type: Hansford No. 2178, on *B. decumbens*, Kabale, Kigezi, Uganda.

2. *Angiopsora cameliae* (Mayor) Mains in Papers Mich. Acad. Sci. Arts, Letters **22**: 154. 1936 (publ. 1937).

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[1]) Cooperative investigations between the Purdue University Agricultural Experiment Station and the Plant Disease Epidemics and Identification Section, Agricultural Research Service, United States Department of Agriculture. Journal Paper No. 983 of the Purdue University Agricultural Experiment Station. Contribution from the Department of Botany and Plant Pathology.

Syn.: *Uredo cameliae* Mayor in Mem. Soc. Neuch.Sci. **5**: 578. 1913 (telia present).

Puccinia cameliae (Mayor) Arth. in Mycologia **7**: 227. 1915.

Dicaeoma cameliae (Mayor) Arth. et Fromme in N. Am. Flora **7**: 293. 1920. —

Sori amphigenous. Uredia with hyaline, inconspicuous, thin-walled paraphyses, 6—9 ≒ 25—40 μ; spores mostly 15—21 ≒ 19—28 μ, ellipsoid or obovoid, wall 1—1.5 μ thick, yellowish to pale brownish, echinulate, pores obscure, 7—9, scattered. Telia blackish, indehiscent; spores mostly 10—15 ≒ 16—28 μ, in chains of 2 to 4, wall 2 μ thick at sides, 4—8 μ at apex, deep golden to chestnut.

Hosts and distribution: *Setaria macrostachya* H. B. K., *S. scandens* (Jacq.) Schrad., *S. scheelei* (Steud.) Hitchc., *S. setosa* (Swartz) Beauv.: Puerto Rico to Texas, Colombia, Trinidad, and Brazil.

Type: Mayor, on *S. scandens,* Cafetal La Camelia, near Angelopolis, Colombia.

3. *Angiopsora clemensiae* Arth. et Cumm. in Phil. Jour. Sci. **59**: 438. 1936.

Sori amphigenous. Ureedi with hyaline or brownish, incurved, apically and dorsally thickened paraphyses, 7—12 ≒ 25—40 μ; spores mostly 16—19 ≒ 20—26 μ, obovoid or or ellipsoid, wall 1—1.5 μ thick, hyaline to pale brownish, echinulate, pores obscure, scattered or possibly equatorial. Telia blackish, indehiscent; spores mostly 10—15 ≒ 16—29 μ, in chains of 2 or 3, wall 1—1.5 μ thick at sides, 2—3 μ thick at apex, golden to chestnut.

Hosts and distribution: *Cyrtococcum patens* (L.) A. Camus, *C. warburgii* (Mez) Stapf, *Ottochloa nodosa* (Kunth) Dandy, *Panicum carinatum* Presl: Philippine Islands.

Type: Clemens No. 6946, on *Panicum warburgii* (= *Cyrtococcum warburgii*), Anda, Anda Island.

4. *Angiopsora compressa* Mains in Mycologia **26**: 129. 1934.

Syn.: *Uredo paspalicola* P. Henn. in Hedwigia **44**: 57. 1905.

Uredo stevensiana Arth. in Mycologia **7**: 326. 1915.

Puccinia compressa Arth. et Holw. in Arthur in Proc. Amer. Phil. Soc. **64**: 157. 1925, not *P. compressa* Diet. 1907.

Sori amphigenous. Uredia with hyaline, incurved, apically and dorsally thickened paraphyses, 8—14 ≒ 26—50 μ; spores mostly 15—18 ≒ 20—26 μ, ellipsoid or obovoid, wall 1—1.5 μ thick, hyaline or yellowish, echinulate, pores obscure, probably scattered. Telia blackish, indehiscent; spores mostly 12—14 ≒ 20—32 μ, in chains of 2 or 3, wall 1.5 μ thick at sides, 3—4 μ at apex, golden to chestnut.

Hosts and distribution: *Axonopus compressus* (Swartz) Beauv., *Paspalum conjugatum* Bergius, *P. decumbens* Swartz, *P. distichophyllum* H. B. K., *P. elongatum* Griseb., *P. fasciculatum* Willd., *P. humboldtianum* Flugge, *P. paniculatum* L., *P. plicatulum* Michx.,

P. stellatum Flugge, *P. squamulatum* Fourn., *P. trachycauleon* Steud., *P. virgatum* L.: Trinidad to the southern U.S.A., Mexico, Bolivia, and Brazil.

Type: Holway No. 331½, on *Paspalum elongatum,* Cochabamba, Bolivia.

5. *Angiopsora digitariae* Cummins in Bull. Torrey Bot. Club **83**: 222. 1956.

Syn.: *Melampsora syntherismae* Saw. in Taiwan Agr. Res. Inst. Rept. **87**: 44. 1944 (nom. nud).

Sori mostly hypophyllous. Uredia with hyaline to golden, incurved, apically and dorsally thickened paraphyses, 8—11 ≒ 25—40 µ; spores mostly 15—20 ≒ 21—26 µ, wall 1—1.5 µ thick, hyaline to yellowish, echinulate, pores obscure, probably several and scattered. Telia blackish, indehiscent; as seen only one spore deep, spores mostly 9—11 ≒ 20—25 µ, wall uniformly 1—2 µ thick, yellowish to golden.

Hosts and distribution: *Digitaria chinensis* Hornem., *D. ischaemum* (Schreb.) Schreb.: Taiwan.

Type: Sawada, on *Syntherisma formosana* (= *D. chinensis*), Taipeh.

6. *Angiopsora hansfordii* Cumm. in Bull. Torrey Bot. Club **72**: 206. 1945.

Sori hypophyllous. Uredia with hyaline to pale yellowish, incurved, apically and dorsally thickened paraphyses, 9—15 ≒ 25—40 µ; spores mostly 14—19 ≒ 20—27 µ, mostly ellipsoid or obovoid, wall 1.5—2 µ thick, hyaline to pale brownish, echinulate, pores obscure, about 7—9, scattered. Telia blackish, indehiscent; spores mostly 9—17 ≒ 18—30 µ, in chains of 2 or 3, wall 1.5 µ thick at sides, 2—5 µ at apex, golden to chestnut.

Hosts and distribution: *Melinis tenuissima* Stapf: Uganda.

Type: Hansford No. 1714, Kyasoweri, Elgon.

7. *Angiopsora hiratsukae* Syd. in Ann. Mycol. **34**: 70. 1936.

Sori amphigenous. Uredia with hyaline to brownish, incurved, dorsally and apically thickened paraphyses, 8—12 ≒ 35—50 µ; spores mostly 15—22 ≒ 18—28 µ, ellipsoid or obovoid, wall 1—1.5 µ thick, hyaline to pale brownish, echinulate, pores obscure, probably scattered. Telia blackish, indeciscent; spores mostly 13—16 ≒ 15—20 µ, in chains of 2 or 3, wall 1 µ thick, yellowish to pale brownish.

Hosts and distribution: *Eragrostis* sp.: Taiwan.

Type: Hashioka No. 686, Kuraru, Prov. Takao.

8. *Angiopsora phakopsoroides* (Arth. et Mains) Mains in Mycologia **26**: 128. 1934.

Syn.: *Puccinia phapopsoroides* Arth. et Mains in Bull. Torrey Bot. Chub **46**: 412. 1919.

Dicaeoma phakopsoroides (Arth. et Mains) Arth. et Fromme in N. Am. Flora **7**: 295. 1920.

Sori amphigenous. Uredia with yellowish to brownish, incurved, apically and dorsally thickened paraphyses, 10—12 ⇌ 35—50 μ; spores mostly 21—26 ⇌ 28—35 μ, ellipsoid or obovoid, wall 1—1.5 μ thick, hyaline to yellow, echinulate, pores obscure, 7—10, scattered. Telia blackish, indehiscent; spores mostly 8—14 ⇌ 12—21 μ, in chains of 2 or 3, wall 1—1.5 μ thick, yellow to golden.

Hosts and distribution: *Olyra cordifolia* H. B. K., *O. latifolia* L.: Cuba and Puerto Rico to Ecuador and Brazil.

Type: Johnston No. 1028, on *Olyra latifolia,* Guantanamo, Cuba.

9. *Angiopsora aurea* Cummins in Bull. Torrey Bot. Club. **83**: 221. 1956.

Sori amphigenous. Uredia without paraphyses; spores mostly 16—19 ⇌ 22—26 μ, ovoid, wall 1 μ thick, hyaline or very pale yellowish, echinulate, pores obscure, probably several and scattered. Telia golden to brown, indehiscent; spores mostly 8—13 ⇌ 14—20 μ, in chains of 3 to 6, wall 1 μ thick, hyaline or very pale yellowish.

Hosts and distribution: *Panicum olivaceum* Hitchc. et Chase, *P. sphaerocarpon* Ell.: Honduras.

Type: Müller No. 419, on *P. olivaceum,* Uyuca.

10. *Angiopsora lenticularis* Mains in Mycologia **26**: 127. 1934.

Sori amphigenous. Uredia without paraphyses; spores mostly 15—20 ⇌ 22—27 μ, ellipsoid or obovoid, wall 1—1.5 μ thick, hyaline to yellowish echinulate, pores obscure, 7 or 8, scattered. Telia blackish, indehiscent; spores mostly 11—16 ⇌ 16—30 μ, in chains of 2 to 4, wall 1—1.5 μ thick at sides, 2—4 μ at apex, golden to nearly chestnut.

Hosts and distribution: *Lasiacis divaricata* (L.) Hitchc., *L. ligulata* Hitchc. et Chase, *L. procerrima* (Hack.) Hitchc., *L. ruscifolia* (Kunth) Hitchc. et Chase, *Panicum arundinariae* Trin.: Trinidad to Puerto Rico, Guatemala, Venezuela, and Ecuador.

Type: Holway No. 801, on *Lasiacis ruscifolia,* Guayaquil, Ecuador.

11. *Angiopsora pallescens* (Arth.) Mains in Mycologia **26**: 128. 1934.

Syn.: *Uredo pallida* Diet. et Holw. in Holway in Bot. Gaz. **24**: 37. 1897.

Puccinia pallescens Arth. in Bull. Torrey Bot. Club **46**: 111. 1919.
Dicaeoma pallescens (Arth.) Arth. et Fromme in N. Am. Flora **7**: 278. 1920.

Sori amphigenous. Uredia without paraphyses or these hyphoid if present; spores mostly 12—16 ⇌ 16—25 μ, ellipsoid or obovoid, wall 1 μ thick, colorless or very pale yellowish, echinulate, pores obscure,

probably several and scattered. Telia blackish, indehiscent; spores mostly 10—18 ⇌ 12—26 μ, in chains of 2 to 4, wall 1—1.5 μ thick at sides, 2—3.5 μ at apex, golden to pale chestnut.

Hosts and distribution: *Euchlaena mexicana* Schrad., *Tripsacum fasciculatum* Trin., *T. lanceolatum* Rupr., *T. latifolium* Hitchc., *T. laxum* Nash, *T. pilosum* Scribn. et Merrill: Mexico to Colombia.

Lectotype: Hitchcock No. 8720, On *Tripsacum latifolium*, Jinotepe, Nicaragua.

12. *Angiopsora zeae* Mains in Mycologia **30**: 42. 1938.

Sori amphigenous. Uredia without paraphyses; spores mostly 15—20 ⇌ 22—30 μ, ellipsoid or obovoid, wall 1.5—2 μ thick, hyaline or very pale yellowish, echinulate, pores obscure, probably several and scattered. Telia blackish, indehiscent; spores mostly 12—18 ⇌ 16—36 μ, in chains of 2 or 3, usually 2, wall 1.5 μ thick at sides, 2.5—4 μ at apex, golden to chestnut.

Hosts and distribution: *Zea mays* L.: Trinidad to Puerto Rico, Mexico, Guatemala, and Venezuela.

Type: Johnston, Alameda, Guatemala.

Phakopsora Dietel.

1. *Phakopsora apoda* (Hariot et Pat.) Mains in Mycologia **30**: 45. 1938.

Syn.: *Puccinia apoda* Hariot et Pat. in Bull. Mus. Nat. Hist. Paris **15**: 199. 1909.

Sori amphigenous. Uredia with hyaline to golden, incurved, apically and dorsally thickened paraphyses, 8—10 ⇌ 40—60 μ; spores mostly 18—23 ⇌ 24—30 μ, wall 1—1.5 μ thick, yellowish, echinulate, spores obscure, 6—8, scattered. Telia blackish, indehiscent, 2—4 spores deep; spores mostly 14—20 ⇌ 16—32 μ, wall 1.5—2 μ thick at sides, 2.5—5 μ at apex, golden or chestnut.

Hosts and distrubtion: *Pennisetum pedicellatum* Trin., *P. polystachyon* (L.) Schult., *P. setosum* (Sw.) Rich.: Sudan to Uganda, Nyassaland, and French Congo.

Type: Chevalier (Vestergr. Micromy. rar. sel. No. 1565), on *P. setosum* (probably = *P. polystachyon*), Fort Lamy, Chari, French Congo.

2. *Phakopsora incompleta* (Syd.) Cumm. in Mycologia **42**: 786. 1950.

Syn.: *Puccinia incompleta* Syd. in Ann. Mycol. **10**: 261. 1912.

Uredo polliniae-imberbis Ito in Jour. Coll. Agr. Tohoku Imp. Univ. **3**: 246. 1909.

Sori mostly hypophyllous. Uredia with hyaline to golden, incurved, apically and dorsally thickened paraphyses, 8—13 ⇌ 35—45 μ;

spores mostly 15—21 ⇌ 21—29 μ, ellipsoid or obovoid, wall 1—1.5 μ thick, hyaline to pale brownish, echinulate, pores obscure, probably several and scattered. Telia blackish, indehiscent, 2 to 4 spores deep; spores mostly 8—15 ⇌ 19—26 μ, wall 1—1.5 μ thick, golden.

Hosts and distribution: *Andropogon appendiculatus* Nees, *A. dummerii* Stapf, *A. eucomus* Nees, *Dimeria filiformis* (Roxb.) Hochst. *Exotheca abyssinica* (Hochst.) Anders., *Ischaemum aristatum* L., *I. arundinaceum* F. Muell., *I. ciliare* Retz, *I. crassipes* (Steud.) Thell., *Microstegium biaristatum* (Steud.) Keng, *M. ciliatum* (Trin.) A. Camus, *M. vimineum* (Trin.) A. Camus, *Themeda triandra* Forsk.: Africa to India, Indo China, New Guinea, The Philippine Islands, Taiwan, and China.

Type: McRae (Butler No. 1600), on *Ischaemum ciliaris* var. *wallichii,* Panora, Wynaad, India.

3. *Phakopsora loudetiae* Cummins in Bull. Torrey Bot. Club **83**: 223. 1956.

Sori amphigenous. Uredia with yellowish to brown, incurved, apically and dorsally thickened paraphyses; spores mostly 18—21 ⇌ 26—32 μ, obovoid or ellipsoid, wall 1—1.5 μ thick, yellowish brown to cinnamon-brown, echinulate, pores obscure, 7—9, scattered. Telia blackish, indehiscent, 2 to 3 spores deep; spores mostly 14—18 ⇌ 16—28 μ, wall 2 μ thick at sides, 2—3 μ at apex, golden.

Hosts and distribution: *Loudetia arundinacea* (Hochst.) Steud., *L. kagerensis* (K. Schum.) C. E. Hubb.: Kenya and Uganda.

Type: Liebmbing No. 23, on *L. arundinacea,* Omia Anyema, Uganda.

4. *Phakopsora oplismeni* Cummins in Bull. Torr. Bot. Club **83**: 223. 1956.

Syn.: *Phakopsora oplismeni* Cumm. in Mycologia **33**: 143. 1941 (nom. nud.).

Uredo oplismeni Arth. et Cumm. in Phil. Jour. Sci. **59**: 442. 1936.

Sori mostly hypophyllous. Uredia with hyaline to golden, incurved, apically and dorsally thickened paraphyses, 8—15 ⇌ 30—45 μ; spores mostly 17—21 ⇌ 22—26 μ, obovoid or ellipsoid, wall 1.5 μ thick, hyaline to yellowish, echinulate, pores obscure, scattered, probably 6—8. Telia becoming erumpent, waxy-golden in appearance, 3 to 8 spores deep; spores mostly 10—15 ⇌ 15—23 μ, wall 0.5—1 μ thick, hyaline to yellowish, germinating at once.

Hosts and distribution: *Oplismenus compositus* (L.) Beauv., *O. undulatifolius* (Ard.) Beauv.: New Guinea and the Philippine Islands.

Type: Clemens No. 10568, on *O. compositus,* Kajabit Mission, Morobe, New Guinea.

5. *Phakopsora setariae* Cummins in Bull. Torrey Bot. Club **83**: 223. 1956.

Sori amphigenous. Uredia with yellowish to golden, incurved, apically and dorsally thickened paraphyses, 8—14 ⇌ 25—40 µ; spores mostly 14—19 ⇌ 22—26 µ, ellipsoid or obovoid, wall 1—1.5 µ thick, hyaline to very pale yellowish, echinulate, pores obscure, about 8, scattered. Telia blackish, indehiscent, 2—4 spores deep; spores mostly 10—16 ⇌ 20—26 µ, wall 1—1.5 µ thick at sides, 1.5—2.5 µ at apex, golden.

Hosts and distribution: *Setaria aequalis* Stapf, *S. lancea* Stapf, *S. spacelata* (Schum.) Stapf et C. E. Hubb.: Sudan, Uganda, and Nyasaland.

Type: Tarr No. 1908, on *S. lancea,* Juba, Sudan.