KEY FOR SMUT FUNGI KNOWN IN COSTA RICA BASED ON FAMILIES OF THE HOST PLANTS

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On Amaranthaceae:

Sori as galls on different organs; spores in balls. On *Iresine diffusa* Humb. & Bonpl. ex Willd.

Thecaphora haumani Speg.

On Asteraceae:

1 Sori as galls on stems and leaves, spore balls.

2 Sori as galls mainly in the axils of leaves. On *Smallanthus quichensis* (Coult.) H. Rob.

Thecaphora smallanthi M. Piepenbr., Paul Hanson & J. Carranza *in* Piepenbring

2′ Sori on stems and leaves. On *Bidens pilosa* L. **Thecaphora pustulata** G. P. Clinton *in* Chardón

1′ Sori on leaves, simple spores embedded in host tissue.

3 Sori as pustules protruding from the lamina, spores 13-16 µm. On *Galinsoga urticaefolia* (H.B.K.) Benth. ..... **Entyloma galinsogae** Syd. & P. Syd.

3′ Sori as leaf spots.

On *Acmella oppositifolia* (Lam.) R. K. Jansen var. *oppositifolia* **Entyloma spilanthis** Speg. (syn. *Entyloma ecuadorense* Syd.)

On *Bidens pilosa* L. ..... **Entyloma bidentis** Henn. *in* Engler

On *Dahlia imperialis* Roezl and/or *D.* sp. cult.:

4 Spots mostly up to 3 mm diam., sharply delimited, spores 8-12 µm, walls up to 1.5 µm thick. **Entyloma doebbeleri** M. Piepenbr.

4´ Spots ca. 10 mm diam., spores 13-16 µm, walls up to 3.5 µm thick. **Entyloma dahliae** Syd. & P. Syd.

On *Delilea biflora* (DC.) Kuntze ... **Entyloma delileae** Vánky, Döbbeler & U. Brown *in* Vánky

On *Tithonia rotundifolia* (Mill.) Blake ..... **Entyloma compositarum** Farl.

On *Viguiera cordata* (Hook. & Arn.) D'Arcy, *V. sylvatica* Klatt. **Entyloma compositarum** Farl.

<u>On Cyperaceae:</u>

1 Spore mass orange; spores smooth, developing inside host tissue. On *Scleria melaleuca* Reichb. ex Schlechtend. & Cham. **Aurantiosporium subnitens** (J. Schröter & Henn.) M. Piepenbr., Vánky & Oberw.

1´ Spore mass brown or black.

2 Spore masses around filaments of stamina; spores in balls. On *Rhynchospora cephalotes* (L.) Vahl ..... **Moreaua rhynchosporae-cephalotis** (Vánky & T. Vánky) Vánky

2´ Spores not in balls.

3 Sori permeated by bundles of sterile, multicellular hyphae (elaters).

4 Sori long cylindrical, with thick, brown, smooth peridia. On *Carex chordalis* Liebm., *C. jamesonii* Boott, *C. lemanniana* Boott ..... **Farysia corniculata** Vánky

4´ Sori globose, with thin peridia.

5 Spores of irregular shape, ca. 6-8 µm, covered by warts often forming rows. On *Carex polystachya* Sw. ex Wahlenb. ..... **Farysia chardoniana** Zundel

5´ Spores mostly spherical, ca. 9-12 µm, covered by warts not forming rows. On *Carex polystachya* Sw. ex Wahlenb. ..... **Farysia venezuelana** Zundel

3´ Sori not permeated by elaters with similar celular structure.

6 Sori without peridia; spores around rudimentary host tissue at the tips of rachillae of spikelets; spores flattened.

7 Sori occur in all the spikelets of an infected plant. On *Rhynchospora globosa* (Kunth) Roem. & Schult. ..... **Ustanciosporium neomontagnei** M. Piepenbr. & Begerow *in* Piepenbring

7´ Sori in groups of spikelets forming witches´ brooms. On *Rhynchospora marisculus* Lindl. & Nees ..... **Ustanciosporium standleyanum** (Zundel) M. Piepenbr.

6´ Sori with peridia.

8 Sori replacing flowers, with sack-shaped peridia and unseptate, long sterile cells in the bases of the sori. On *Rhynchospora corymbosa* (L.) Britton [*R. aurea* Vahl], *R. triflora* Vahl **Trichocintractia utriculicola** (Henn.) M. Piepenbr.

8´ Sori without sack-shaped peridia.

9 Spore mass around ovaries, without sterile stroma on the surface of the host tissue.

10 Spores rather light coloured, with lighter coloured and collapsed areas, ca. 15-17 µm. On *Carex bonplandii* Kunth **Anthracoidea uleana** (Syd. & P. Syd.) Vánky (syn. *Anthracoidea pannucea* (Liro) Zambett.)

10′ Spores rather dark coloured, without conspicuous lighter coloured areas, ca. 16-18 µm. On *Carex chordalis* Liebm., *C. jamesonii* Boott [*C. cortesii* Liebm.], *C. lemanniana* Boott **Anthracoidea altiphila** Vánky & M. Piepenbr. *in* Vánky

9′ Spore mass with sterile stroma formed by sterile fungal hyphae on the surface of the host tissue, around ovaries or other organs.

11 Sori around internodes of stems or inflorescences, with conspicuous shining white peridia when young; spores irregularly roughly warty with ridges.

12 Sori around internodes of stems or inflorescences; spores ca. 15-18 µm. On *Rhynchospora holoschoenoides* (Rich.) Herter **Leucocintractia leucodermoides** M. Piepenbr. & Begerow *in* Piepenbring

12′ Sori around all the internodes of inflorescences, not around internodes of the stem; spores ca. 12-16 µm. On *Rhynchospora corymbosa* (L.) Britton [*R. aurea* Vahl] **Leucocintractia scleriae** (DC.) M. Piepenbr., Begerow & Oberw.

11′ Sori around the bases of internodes of stems or in inflorescences, with less conspicuous peridia; spores smooth to finely warty.

13 Sori only around ovaries of some spikelets of an infected plant; spores ca. 10-12 µm. On *Fimbristylis spadicea* (L.) Vahl ..... **Cintractia fimbristylicola** Pavgi & Mundk.

13′ Sori usually around bases of peduncles, rarely in spikelets.

14 Spores ca. 11-12 µm. On *Cyperus odoratus* L. [*Torulinium odoratum* (L.) Hooper], *C. rotundus* L. ..... **Cintractia limitata** G. P. Clinton

14′ Spores ca. 14-17 µm. On *Fimbristylis dichotoma* (L.) Vahl [*F. annua* (All.) Roem. & Schult.] ..... **Cintractia axicola** (Berk.) Cornu (syn. *Cintractia peribebuyensis* (Speg.) Sawada)

On Fabaceae:

Sori as dark spots of leaves; spores dark, embedded in host tissue. On *Phaseolus vulgaris* L.

Erratomyces patelii (Pavgi & Thirum.) M. Piepenbr. & R. Bauer

On Juncaceae:

Sori as galls of roots; spores inside hypertrophied host cells.

1 Spores spherical, ca. 11-23, covered by large, blunt warts. On *Juncus tenuis* Willd.

Entorrhiza casparyana (Magnus) Lagerh.

1´ Spores ovoid to subglobose, ca. 15-22 µm, covered by warts of medium size. On *Juncus bufonius* L. ..... **Entorrhiza aschersoniana** (Magnus) Lagerh.

On Limnocharitaceae:

Sori as swollen spots of leaves; spores in balls. On *Limnocharis flava* (L.) Buchenau

Doassansiopsis limnocharidis (Cif.) Vánky

On Lobeliaceae:

Sori as leaf spots; spores embedded in host tissue.

1 Spores ca. 10-13 µm. On *Diastatea micrantha* (H.B.K.) McVaugh **Entyloma diastateae** M. Piepenbr.

1´ Spores ca. 12-15 µm. On *Lobelia laxiflora* H.B.K. ..... **Entyloma lobeliae** Farl.

On Nymphaeaceae:

Sori as leaf spots.

1 Spores single, attached to hyphae. On *Nymphaea ampla* (Salisb.) DC. **Rhamphospora nymphaeae** G. Cunn.

1´ Spores in complex balls. On *Nymphaea blanda* G. F. W. Mey. **Doassansiopsis ticonis** M. Piepenbr.

On Poaceae:

1 Sori as stripes in leaves, rarely in inflorescences.

2 Spore mass brown, powdery at maturity; spores ca. 11-12 µm. On *Holcus lanatus* L. **Ustilago striiformis** (Westend.) Niessl

2´ Spore mass grey, agglutinated; spores ca. 7-8 µm. On *Oryza sativa* L. **Eballistra oryzae** (Syd. & P. Syd.) R. Bauer, Begerow, A. Nagler & Oberw.

1´ Sori mostly in inflorescences or replacing them, rarely in leaves.

3 Sori as apically whip-shaped stems replacing inflorescences which are not developed; spores ca. 6-7 µm. On *Saccharum officinarum* L. **Sporisorium scitamineum** (Syd.) M. Piepenbr., M. Stoll & Oberw.

3´ Sori not as apically whip-shaped stems.

4 On species of *Sorghum*.

5 Sori replacing more or less large parts of the inflorecences, usually not in single spikelets; sori with conspicuous columellae; spores ca. 11-14 µm. On *Sorghum bicolor* (L.) Moench. **Sporisorium reilianum** (J. G. Kühn) Langdon & Full.

5´ Sori in spikelets.

6 Sori in all the spikelets of an infected inflorescence; one sorus with a thin, fragile peridium and a small columella; spores ca. 7-8 µm. On *Sorghum bicolor* (L.) Moench. **Sporisorium cruentum** (J. G. Kühn) Vánky

6´ Sori in all the spikelets of an infected inflorescence or in groups of spikelets; sori with thick, persistent peridia; spores ca. 6-7 µm. On *Sorghum bicolor* (L.) Moench. **Sporisorium sorghi** Ehrenb. ex Link, *in* Linné

4´ Not on species of *Sorghum*.

7 Sori destroying the entire inflorescence, all the partical inflorecences or all the spikelets of an infected inflorescence; on an infected plant usually no healthy spikelets are developed.

8 Sori replacing partial inflorecences, with conspicuous columellae; spores ca. 17-19 µm. On *Andropogon bicornis* L., *A. glomeratus* (Walter) Britton, Stern. & Poggenb. **Sporisorium culmiperdum** (J. Schröter) Vánky

8´ Sori destroying spikelets, without conspicuous columellae.

9 Spores ca. 15-19 µm. On *Paspalum conjugatum* Bergius, *P. costaricense* Mez, *P. paniculatum* L., *P. plicatulum* Michx., *P. virgatum* L. ..... **Ustilago schroeteriana** Henn.

9´ Spores ca. 6-9 µm. On *Stenotaphrum secundatum* (Walt.) Kuntze **Ustilago affinis** Ell. & Everh. *in* Cockerell

7´ At least some spikelets of the infected plant develop normally.

10 Sori in groups of densely situated spikelets (witches´ brooms), with conspicuous columellae; spores ca. 12-14 µm. On *Andropogon bicornis* L. **Sporisorium holwayi** (G. P. Clinton & Zundel) Vánky

10´ Sori not in dense groups of spikelets (witches´ brooms).

11 Sori as large parenchymatous galls (several cm diam.) in different, mostly generative organs; spores ca. 10-12 µm. On *Zea mays* L. (cult.) ..... **Ustilago maydis** (DC.) Corda

11´ Sori smaller; not this combination of characteristics.

12 Spores ca. 19-23 µm; sori in ovaries. On *Oplismenus burmannii* (Retz.) P. Beauv. **Tilletia oplismeni-cristati** Pat. & Har. *in* Durán & Fischer

12´ Spores smaller.

13 Sori in swollen ovaries; spores ca. 14-15 µm, mixed with balls of "y"-shaped conidia. On *Panicum maximum* Jacq., *Setaria paniculifera* (Steud.) Fourn. **Tilletia ayresii** Berk. *in* Massee

13´ Spores mostly smaller, not mixed with balls of conidia.

14 Sori in rachillae of spikelets, inconspicuous, with columellae; spores ca. 9-13 µm. On *Melinis minutiflora* P. Beauv. ..... **Sporisorium melinis** (Zundel) Vánky

14´ Sori as green galls formed by swollen floral organs, with very short to lacking columellae.

15 Sori in swollen ovaries; spores covered by few very large warts, spores ca. 10-13 µm. On *Dichanthelium viscidellum* (Scribn.) F. W. Gould **Sporisorium veracruzianum** (Zundel & Dunlap) M. Piepenbr.

15´ Sori in swollen ovaries, stamina, or lodiculae; spores finely warty.

16 Spores ca. 10-11 µm. On *Ixophorus unisetus* (Presl) Schlechtend. **Ustilago ixophori** R. Durán

16´ Spores ca. 7-10 µm. On *Echinochloa colona* (L.) Link **Ustilago trichophora** (Link) Körn.

<u>On Polygonaceae:</u>

1 Sori as galls on different organs (leaves, stems, inflorescences); spores in groups embedded in a slimy matrix in host tissue, ca. 11-13 µm. On *Polygonum hispidum* H.B.K.

Melanopsichium pennsylvanicum Hirschh.

1´ Sori only in flowers.

2 Sori with peridia and columellae mostly formed by sterile fungal cells; spores, when young, in chains, ca. 11-14 µm, warty. On *Polygonum acuminatum* H.B.K., *P. punctatum* Ell.

Sphacelotheca cf. koordersiana (Bref.) Zundel

2´ Sori without peridia or columellae; spores not in chains, ca. 10-11 µm, reticulate. On *Polygonum punctatum* Ell. ..... **Microbotryum tenuisporum** (Cif.) Vánky

<u>On Ranunculaceae:</u>

1 Sori as white to brown, swollen spots in leaves; spores embedded in the host tissue, single, hyaline, ca. 13-17 µm, smooth. On *Ranunculus geranioides* H.B.K., *R. pilosus* H.B.K. **Entyloma microsporum** (Unger) J. Schröter *in* Rabenhorst

1´ Sori as galls in different organs of the host plant; spore mass brown and powdery, when mature; spores in balls formed by central teliospores surrounded by sterile fungal cells. On *Ranunculus pilosus* H.B.K. ..... **Urocystis ranunculi** (Lib.) Moesz

<u>On Solanaceae:</u>

Sori as spots in leaves.

1 Spores densely packed, ca. 11-14 µm, spore wall two-layered as seen by light microscopy. On *Browallia americana* L. ..... **Entyloma browalliae** Syd.

1´ Spores less densely packed, ca. 12-16 µm, spore wall mostly one-layered as seen by light microscopy. On *Physalis cordata* Mill. ..... **Entyloma australe** Speg.

On Vitaceae:

Sori in large witches´ brooms formed by hyperamified branches of sterile plants; sori rod-shaped, their central part being filled with a brown, powdery mass of teliospores in pairs. On *Cissus rhombifolia* Vahl, *C. sicyoides* L. ..... **Mycosyrinx cissi** (DC.) Beck

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