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New records of pathogenic fungi on cultivated plants in Panama

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Abstract — Knowledge about the geographical distribution of species of plant pathogenic fungi is fundamental for epidemiology, decision making and recommendations for their control. For many tropical countries like Panama, however, checklists are still very incomplete. In the present publication, 20 species of pathogenic fungi on cultivated plants are cited, with 13 of them and one hyperparasitic fungus reported for the first time for Panama, mainly in the province of Chiriquí in the western part of the country. Among these are several rarely reported species: *Asterinella puiggarii* on *Psidium guajava*; *Entyloma doebbeleri* on *Dahlia* sp., which is reported for the first time outside Costa Rica; *Mycosphaerella agapanthi-umbellati* on *Agapanthus* sp., which is recorded for the first time for America; *Passalora vanderystii* on *Phaseolus vulgaris*; and *Ustilago affinis* on *Stenotaphrum secundatum*.

Key words — Central America, plant pathology, plant parasitic fungi, taxonomy, tropical fungi

Introduction

Panama is located at a hotspot of biodiversity with about 10,000 species of vascular plants documented for this country of 75,000 km² (Correa et al. 2004). Although generally fungal diversity is higher than plant diversity, only

about 2000 species of fungi are known for Panama up to now (Piepenbring 2006, 2007), corresponding to about 4% of the existing diversity estimated by applying the factor 5.3 for the proportion of fungi to plant species (Hawksworth 1998). About one-third of fungal species correspond to fungi parasitic on plants including cultivated plants (Shivas & Hyde 1997). The checklist of fungi in Panama includes almost 200 records of fungi parasitic on cultivated plants, with numerous contributions made by Toler et al. (1959) and McGuire & Crandall (1967). In these publications, fungal names are cited without voucher specimens, locality data, descriptions, or reference to specific literature used for identification, so it is not possible to review the identifications of the cited fungi.

Although the checklist of fungi in Panama is preliminary and many records cannot be verified, it is used by official plant protection agencies because no other official source of information is available. The analysis of pathogens and plant protection is performed successfully by plant pathologists in Panamanian governmental institutions and plant pathology is a subject of teaching and research at Panamanian universities. Local plant pathologists like J.B. Ferrer (1960) and E.A. Esquivel R. (1982) rarely publish their results in internationally recognized scientific journals, rather they publish in local periodicals of Panamanian institutions or on the internet (e.g. *Agrociencia*, <http://agrociencia-panama.blogspot.com/>). Specimens of fungi parasitic on cultivated plants in Panama are deposited in a collection of the National Plant Protection Organization (not registered in the Index Herbariorum). In the National Herbarium of Panama (PMA) up to now there are only some preliminarily identified specimens cited by Piepenbring et al. (2002).

In tropical countries like Panama, it is still necessary to perform the basic research of collecting and preserving specimens in recognized herbaria, light microscopical analysis, literature research and publications of results in scientific journals as a basis for applied research and political decisions. This is the conclusion of a workshop held at the University of Panama in 2009, attended by Panamanian and German plant pathologists and mycologists, who combined practical experience in agronomy with taxonomical expertise.

Materials & methods

As part of the workshop on pathogenic fungi on cultivated plants in Panama in August 2009, the participants visited farms in the province of Chiriquí in western Panama, where specimens of fungi parasitic on cultivated plants were collected opportunistically. They were immediately analysed by light microscopy in the laboratory of the Facultad de Ciencias Agropecuarias,

Universidad de Panamá. Possible fungal identifications were obtained from the database of the US Department of Agriculture (Farr & Rossman undated). They were later confirmed or revised after consulting specific literature. All the specimens cited below are deposited in the National Herbarium of Panama (PMA) at the University of Panama and in the Herbarium of the Universidad Autónoma de Chiriquí abbreviated as U.CH.

At the sites listed below, several specimens were collected in the context of the workshop. These collection data are mentioned by the names in bold in the chapter results.

PANAMA. CHIRIQUÍ: Corr. **Boquete, Finca Clavo de Oro** of Carlos Gonzales (8°47.38'N 82°28.74'W), 1600 m.a.s.l., 18.VIII.2009.

PANAMA. CHIRIQUÍ: Corr. Boquete, **Volcancito, Finca of Señor Ortega** (8°46.00'N 82°26.56'W), 1240 m.a.s.l., 18.VIII.2009.

PANAMA. CHIRIQUÍ: Distrito Boqueron, Corr. **Cordillera, Finca of Delfidia de Caballero** (8°43.91'N 82°36.19'W), 1280 m.a.s.l., 24.VIII.2009.

PANAMA. CHIRIQUÍ: **Cerro Punta, Finca of Roberto Rubio** (8°50.93'N 82°34.56'W), 2000 m.a.s.l., 24.VIII.2009.

Collections made by the participants of the workshop have “SH” (= Seminario de Hongos) collection numbers and have mostly been identified by the participants of the workshop. Some SH specimens and other collections have been identified by individual authors whose names are mentioned. Further opportunistic collections of pathogenic fungi on cultivated plants which are new for Panama have been added.

Results

The following species of fungi parasitic on cultivated plants in Panama have been identified in the present investigation.

ASCOMYCOTA

Asterinella puiggarii (Speg.) Theiss., *Microthyriales* Fig. 1

SPECIMEN EXAMINED: On leaves of *Psidium guajava* L. (*Myrtaceae*).

PANAMA. CHIRIQUÍ: Boqueron District, Corr. Cordillera, Finca of Alexis Guerra (8°42.25'N 82°35.87'W), 1080 m.a.s.l., 24.VIII.2009, SH 13. Det. T.A. Hofmann.

LITERATURE: Theissen (1912).

This fungus is reported here for the first time for Panama.

Leptosphaeria sacchari Breda de Haan, *Pleosporales*

SPECIMEN EXAMINED: On leaves of *Saccharum officinarum* L. (*Poaceae*).
Cordillera, Finca of Delfidia de Caballero, SH 15.

LITERATURE: Sivanesan (1984).

This species was cited for Panama by Chardón (1930) and Toler et al. (1959). It is reported here for the first time from the province of Chiriquí.

Mycosphaerella agapanthi-umbellati T.S. Ramakr. & Sundaram,
Capnodiales Fig. 2

SPECIMEN EXAMINED: On leaves of *Agapanthus* sp. (*Amaryllidaceae*). Cerro Punta, Finca of Roberto Rubio, R. Kirschner et al. 3353 (M, PMA). Det. R. Kirschner.

LITERATURE: Ramakrishnan & Ramakrishnan (1950)

This species was first published by Ramakrishnan & Ramakrishnan (1950) as *M. agapanthi* T.S. Ramakr. & K. Ramakr. from India and later renamed *M. agapanthi-umbellati* because of the homonymy with *M. agapanthi* (Kalchbr. & Cooke) Lindau 1897, a different species. The description and illustration of *M. agapanthi-umbellati* by Ramakrishnan & Ramakrishnan (1950) agree exactly with the specimen from Panama, particularly with respect to ascospore size, ascus size, and ascus shape as well as the morphology of the spots on living leaves. Several specimens originally identified as *M. agapanthi* (Kalchbr. & Cooke) Lindau on *Agapanthus* spp. from Africa are considered *Davidiella allicina* Crous & Aptroot by Aptroot (2006) who was unable to locate the type specimen of *M. agapanthi-umbellati*. The characteristics of *D. allicina* based on Schubert et al. (2007) differ considerably from the specimen collected in Panama. Neither *M. agapanthi* nor *M. agapanthi-umbellati* has been recorded from America up to now.

Taphrina deformans (Berk.) Tul., *Taphrinales* Fig. 3

SPECIMEN EXAMINED: On deformed parts of leaves of *Prunus persica* (L.) Batsch (*Rosaceae*). Cerro Punta, Finca of Roberto Rubio, SH 18.

LITERATURE: Mix (1969).

This species is reported here for the first time from Panama.

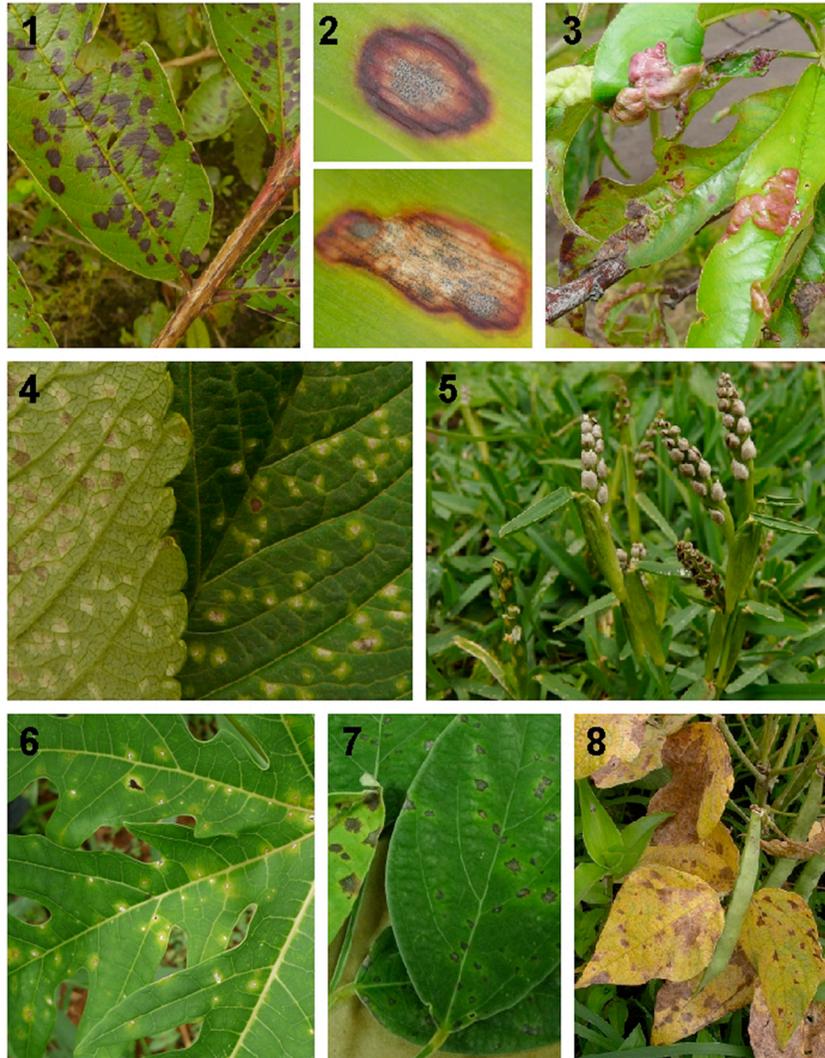
BASIDIOMYCOTA

Entyloma doebbleri M. Piepenbr., *Entylomatales* Fig. 4

SPECIMEN EXAMINED: On leaves of *Dahlia* sp. cult. (*Asteraceae*). PANAMA. CHIRIQUÍ: Volcán, close to Sitio Barriles (8°47.5'N 82°41.5'W), approx. 1300 m.a.s.l., 20.IX.2009, M. Piepenbring, O. Cáceres et al. 4938. Det. M. Piepenbring.

LITERATURE: Piepenbring (2003).

This species reduces the ornamental value of plants of *Dahlia* cultivars by causing leaf spots and necrosis. Up to now it has only been reported from Costa Rica.



Figs. 1–8. Symptoms caused by fungi parasitic on cultivated plants in Panama. **Fig. 1.** *Asterinella puiggarii* on *Psidium guajava* (SH 13). **Fig. 2.** *Mycosphaerella agapanthi-umbellati* on *Agapanthus* sp. (RoKi 3353). **Fig. 3.** *Taphrina deformans* on *Prunus persica* (SH 18). **Fig. 4.** *Entyloma doebbeleri* on *Dahlia* sp. (MP 4938). **Fig. 5.** *Ustilago affinis* in the spikelets of *Stenotaphrum secundatum* (MP 4916). Note the healthy inflorescence at the bottom of the left hand side. **Fig. 6.** *Corynespora cassiicola* on *Carica papaya* (SH 8). **Fig. 7.** *Passalora cajani* on *Cajanus cajan* (SH 7). **Fig. 8.** *Passalora vanderystii* and *Pseudocercospora griseola* on *Phaseolus vulgaris* (SH 6).

Hemileia vastatrix* Berk. & Broome, *Pucciniales

SPECIMEN EXAMINED: On leaves of *Coffea arabica* L. (*Rubiaceae*). Boquete, Finca Clavo de Oro, SH 2 (urediniospores).

LITERATURE: Gopalkrishnan (1951).

This species was first reported in 1984 by the National Plant Protection Organization on *Coffea arabica* in the Panamá Province. It was reported from many different provinces of Panamá by Páez (1972).

A part of the specimen is parasitized by *Fusarium* cf. *incarnatum* (Desm.) Sacc. (R. Kirschner 3337, PMA). *Fusarium* specimens can rarely be identified to species with certainty without cultivation, but the combination of polyphialides and relatively small conidia (<25 µm long, 3–4 µm wide) allow a tentative identification of the present specimen. The species was recorded as a mycoparasite on *H. vastatrix* in Mexico (Carrion & Rico-Gray 2002), as *F. pallidroseum* (Cooke) Sacc., a synonym according to de Hoog et al. (2000). It is reported here for Panama apparently for the first time.

Phakopsora nishidana* S. Ito, *Pucciniales

SPECIMEN EXAMINED: On leaves of *Ficus carica* L. (*Moraceae*). Cerro Punta, Finca of Roberto Rubio, SH 17 (urediniospores).

LITERATURE: Hennen et al. (2005).

This species is reported here for the first time from Panama.

Tranzschelia discolor* (Fuckel) Tranzschel & M.A. Litv., *Pucciniales

SPECIMEN EXAMINED: On leaves of *Prunus persica* (L.) Batsch (*Rosaceae*). Boquete, Finca Clavo de Oro, SH 3 (urediniospores).

LITERATURE: López-Franco & Hennen (1990), Hennen et al. (2005).

This species is reported here for the first time from Panama.

Ustilago affinis* Ell. & Everh., *Ustilaginales

Fig. 5

SPECIMEN EXAMINED: In inflorescences of *Stenotaphrum secundatum* (Walter) Kuntze (*Poaceae*). PANAMA. CHIRIQUÍ: Alto Boquete, Pastelería Marianne, approx. 1000 m.a.s.l., 16.VIII.2009, M. Piepenbring et al. 4916. Det. M. Piepenbring.

LITERATURE: Piepenbring (2003).

Ustilago affinis destroys the inflorescences and reduces the ornamental value of the St. Augustine grass, *Stenotaphrum secundatum*, which is planted as lawn. The fungus is reported here for the first time from Panama.

ANAMORPHIC FUNGI

***Cercospora coffeicola* Berk. & Cooke**

SPECIMEN EXAMINED: On leaves of *Coffea arabica* L. (*Rubiaceae*). Boquete, Finca Clavo de Oro, SH 1.

LITERATURE: Ellis (1971), cited as synonym of *Cercospora apii* Fresen.

The presence of this species in Panama reported by Toler et al. (1959) is confirmed.

***Cercospora ricinella* Sacc. & Berl.**

SPECIMEN EXAMINED: On leaves, mainly cotyledons, of *Ricinus communis* L. (*Euphorbiaceae*). Volcancito, Finca of Señor Ortega, SH 9.

LITERATURE: Ellis (1971), cited as synonym of *Cercospora apii* Fresen.

The presence of this fungus in Panama reported by Crous & Braun (2003) is confirmed. It is reported here for the first time from Chiriquí.

***Corynespora cassiicola* (Berk. & M.A. Curtis) C.T. Wei** Fig. 6

SPECIMENS EXAMINED: On leaves of *Carica papaya* L. (*Caricaceae*). PANAMA. CHIRIQUÍ: Corr. Chiriquí, Campus of the Faculty of Ciencias Agropecuarias, University of Panamá, 25 m.a.s.l., 17.VIII.2009, SH 8.

On leaves of *Cucumis sativus* L. (*Cucurbitaceae*). PANAMA. CHIRIQUÍ: Corr. Chiriquí, Facultad Ciencias Agropecuarias, 25 m.a.s.l., 25.VII.2005, Y. Guerrero 5. Det. Y. Guerrero. Corr. Chiriquí, Escuela, 5.X.2005, Y. Guerrero 12. Det. Y. Guerrero. PANAMA. LOS SANTOS: Corr. Los Santos, El Guayabal, 84 m.a.s.l., 4.IX.2005, Y. Guerrero 9. Det. Y. Guerrero.

LITERATURE: Ellis (1971).

This species is reported here for the first time from Panama.

***Marssonina coronaria* (Ellis & Davis) Davis**

SPECIMEN EXAMINED: On leaves of *Malus domestica* Baumg. (*Rosaceae*). Cerro Punta, Finca of Roberto Rubio, SH 11. Det. I. Vargas.

LITERATURE: Harada et al. (1974).

This species is reported here for the first time from Panama.

***Marssonina rosae* (Lib.) Died.**

SPECIMEN EXAMINED: On leaves of *Rosa* sp. (*Rosaceae*). Boquete, Finca Clavo de Oro, SH 4.

LITERATURE: Harada et al. (1974).

This species is reported here for the first time from Panama.

***Passalora cajani* (Henn.) U. Braun & Crous** Fig. 7

SPECIMEN EXAMINED: On leaves of *Cajanus cajan* (L.) Millsp. (*Fabaceae*). Volcancito, Finca of Señor Ortega, SH 7.

LITERATURE: Waller & Sutton (1979), as *Mycovellosiella cajani* (Henn.) Rangel & Trotter.

The presence of this fungus in Panama reported by Crous & Braun (2003) is confirmed. It is cited here for the first time from Chiriquí.

Passalora henningsii (Allesch.) R.F. Castañeda & U. Braun

SPECIMEN EXAMINED: On leaves of *Manihot esculenta* Crantz (*Euphorbiaceae*). PANAMA. CHIRIQUÍ: Distr. Dolega, Los Algarrobos, Casa de la Alemana (8°29'45"N 82°25'58"W), approx. 150 m.a.s.l., 31.XI.2008, M. Piepenbring 4597. Det. R. Kirschner.

LITERATURE: Chupp (1930), as *Cercospora cearae* Petch, a synonym according to Crous & Braun (2003).

The presence of this fungus in Panama first reported by Chupp (1930) is confirmed. It is cited here for the first time from Chiriquí.

Passalora vanderystii (Henn.) U. Braun & Crous

Fig. 8

SPECIMEN EXAMINED: On leaves of *Phaseolus vulgaris* L. (*Fabaceae*). Volcancito, Finca of Señor Ortega, SH 6. Det. R. Kirschner.

LITERATURE: Chupp (1954), Matta & Belliard (1973).

The leaf symptoms caused by *P. castellanii* (Matta & Belliard) U. Braun and *P. vanderystii* are called gray leaf spot in Central and South America (Schwartz 1991). By using the same name for diseases caused by two different species it is difficult to reconstruct records of these species. Morphological characteristics as given by Matta & Belliard (1973) allowed identifying the Panamanian material as *P. vanderystii*, which is reported here for the first time from Panama. For co-occurrence with other fungi, see *Pseudocercospora griseola*.

Phoma cucurbitacearum (Fr.) Sacc.

SPECIMENS EXAMINED: On leaves of *Citrullus lanatus* (Thunb.) Matsum. & Nakai (*Cucurbitaceae*). PANAMA. CHIRIQUÍ: La Barqueta, approx. 8 m.a.s.l., 30.IX.2005, Y. Guerrero 25. Det. Y. Guerrero.

On leaves of *Sechium edule* (Jacq.) Sw. (*Cucurbitaceae*). PANAMA. CHIRIQUÍ: Boquete District, 2.IX.2006, Y. Guerrero & C. Williams 7. Det. Y. Guerrero. San Andrés, approx. 500 m.a.s.l., 30.V.2005, Y. Guerrero 3. Det. Y. Guerrero. Cordillera, Finca of Delfidia de Caballero, SH 20. Det. I. Vargas.

LITERATURE: Boerema et al. (2004).

This species is reported here for the first time from Panama.

Pseudocercospora griseola (Sacc.) Crous & U. Braun

Fig. 8

SPECIMEN EXAMINED: On leaves of *Phaseolus vulgaris* L. (*Fabaceae*). Volcancito, Finca of Señor Ortega, SH 6. Det. R. Kirschner.

LITERATURE: Ellis (1971), as *Phaeosariopsis griseola* (Sacc.) Ferraris.

The disease caused by this fungus is called angular leaf spot. The fungus occurs on the same leaves as *Passalora vanderystii* forming similar leaf spots, together with an unidentified rust fungus. The presence of this species as *Phaeosariopsis griseola* in Panama reported by McGuire & Crandall (1967), Crous & Braun (2003), and other authors is confirmed.

***Septoria apiicola* Speg.**

SPECIMEN EXAMINED: On leaves of *Apium graveolens* L. (*Apiaceae*).

PANAMA. CHIRIQUÍ: Cerro Punta, Kiosco Ermelinda, Sr. Gilberto Santana (8°51.13'N 82°35.83'W), approx. 1900 m.a.s.l., 24.VIII.2009, SH 12.

LITERATURE: Brandenburger (1985).

This species is reported here apparently for the first time from Panama in a scientific publication. It is an abundant pathogen in plantations of *Apium graveolens* in the mountains of Chiriquí.

Discussion

About 196 different species of microfungi parasitic on cultivated plants are known for Panama and published in accessible scientific literature (Piepenbring 2006). Thirteen additional species are mentioned here for the first time. This list is still far from complete, because the new records have been found within only a short period of time at a few locations on cultivated species of plants selected opportunistically. The taxonomic knowledge about parasitic fungi on cultivated plants in Panama is incomplete, because taxonomists undertaking field collections are generally more interested in native species and, therefore, tend to ignore species associated with cultivated organisms. Plant pathologists focus on the control of the pathogens and often do not document detailed collection data, taxonomical information about the identification, and do not deposit voucher specimens of the species in internationally recognized herbaria. The value of voucher specimens may not be recognized because these species are widespread and already well documented in other countries. Misidentifications cannot be excluded, particularly when identification is mainly based on macroscopic symptoms instead of microscopic characteristics. Some common species have recently been split into several separate taxa, for example *Passalora vanderystii* and *P. castellanii*. Deposition of living voucher cultures in the National Culture Collection for Pathogenic Fungi of the National Plant Protection Organization provides resources for future research. Further studies of the present type are necessary to document the existing diversity of microfungi parasitic on cultivated plants in Panama and other tropical countries with a relatively short mycological tradition.

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