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Taxonomic Review of and Development of a Lucid Key for Philippine Cercosporoids and Related Fungi

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1. Introduction

The genus *Mycosphaerella* Johanson, contains more than 3000 names (Aptroot 2006), and has been linked to more than 30 well-known anamorphic genera (Crous 2006a and 2006b). It has a worldwide distribution from tropical and subtropical to warm and cool regions (Crous 1998; Crous et al. 2000 and 2001). *Mycosphaer*ella, however, has been associated with at least 27 different coelomycete or hyphomycete anamorph genera (Kendrick and DiCosmo, 1979), 23 of which were accepted by Crous et al. (2000). More than 3000 names have already been published in *Cercospora* (Pollack, 1987). The genus *Cercospora* Fresen., which is one of the largest genera of hyphomycetes, has been linked to *Mycosphaerella* teleomorphs (Crous et al., 2000). *Cercospora* was first monographed by Chupp (1954), who accepted 1419 species. Subsequent workers such as, F.C. Deighton, B.C. Sutton and U. Braun divided *Cercospora* in to almost 50 different genera which are morphologically similar and distinct with each other (Crous and Braun, 2003).

Cercosporoid fungi are a collective term for a group of fungi belonging, to the genus *Cercospora* and its allied genera, namely *Pseudocercospora*, *Passalora*, *Asperisporium, Corynespora, Cladosporium.* Differences among them are based mainly on a combination of characters that include the structure of conidiogenous loci (scars) and hila, presence or absence of pigmentation and ornamentation in conidiophores and conidia, geniculate or non-geniculate conidiophore, and rare presence of additional or unique features such as knotty appearance of conidiophores.

Cercospora Fresen. is one of the largest genera of Hyphomycetes. Saccardo (1880) defined *Cercospora* as having brown conidiophores and vermiform, brown, oliivaceous or rarely subhyaline conidia. Deighton continuously studied the *Cercospora* species (Deighton, 1967a, 1967b, 1971, 1973, 1974, 1976, 1979, 1983, and 1987) and reclassified numerous species into several allied genera based mainly on two distinct taxonomic categories: thickened conidial scars occur in the *Cercospora* and in allied genera such as, *Passalora* and *Stenella,* while unthickened scars are characteristics of the genera *Pseudocercospora* and *Stigmina.*

Cercosporoid fungi are commonly associated with leaf spots (Wellman, 1972) ranging from slight, diffuse discolorations to necrotic spots or leaf blight (Shin and Kim, 2001). Cercosporoid fungi can also cause necrotic lesions on flowers, fruits, bracts, seeds and pedicels of numerous hosts in most climatic regions (Agrios, 2005). They are responsible for great damages to beneficial plants. Furthermore, other than important pathogens of major agricultural crops such as cereals, vegetables, ornamentals, forest trees, grasses and many others species are also known to be hyperparasitic to other plant pathogenic fungi (Goh and Hsieh, 1989).Cercosporoid fungi are known to cause some of the economically important diseases worldwide. One of the most important and common diseases associated with this fungus is the black sigatoka caused by *Mycosphaerella fijiensis* which was first discovered and considered to have caused epidemics in the Valley of Fiji (Stakman and Harrar, 1957).

The Cercosporoid fungi of Philippines are insufficiently known. There have been no comprehensive studies on this group of fungi in Philippines. Welles (1924 and 1925) worked with physiological behavior of Philippine Cer*cosporas* on artificial media and the extent of parasitism. There were 87 species of *Cercospora* reported in the Philippines from 1937 onwards (Quimio and Abilay, 1977). Teodoro (1937) had enumerated 65 species of *Cercospora* in the Philippines. In most cases, however, the causal species have only been cited but not characterized. No attempt was made to determine the host range of each of the species. Naming of the species was based mainly on Chupp's monograph (Chupp, 1953), which together with Vasudeva's book (Vasudeva, 1963) book on Indian *Cercosporae,* as the main reference books used by Quimio and Abilay (1977).

Identification of fungal plant pathogens is commonly done using one of several well-illustrated dichotomous keys by Ellis (1971 and 1976), Sutton (1980), Hanlin (1990), and Barnett & Hunter (1998). Multi-access keys for identifying biological agents are very useful, especially for the non-specialist, as it is not necessary to be able to detect all of the fine distinctions usually found in dichotomous keys. The disadvantage of those printed keys is that they require the user to be able to scan a series of tables of numbers and select those that are common to the specimen being examined (Michaelides *et al.* 1979; Sutton 1980). This task is ideally suited to computers. The Lucid system developed by the Centre for Biological Information Technology (CBIT), University of Queensland (Norton 2000) allows development of multi-access computer-based keys that can also incorporate graphics and text. The result is a very powerful tool. Although some keys have previously been developed for fungi using Lucid, they have generally been for specific groups such as rainforest fungi of Eastern Australia (Young 2001). The main purpose in developing these Lucid identification systems has been to contribute to taxonomic capacity building in two ways - by enabling identification keys to be easily developed and by increasing the availability and usefulness of these keys by making them available on CD or via the Internet. A Lucid was used for identifying genera for identifying genera of plant pathogenic Cercosporoid fungi of Philippine crops. The key was comprised of many characters, which has the potential for being rather cumbersome. For simplicity, the characters were placed in groups and states relating to the structures like the morphology of conidiophores, the stromata, conidia, and fruiting bodies and the names of host family and genus.

The primary objective of this study was to identify Cercosporoid fungi of the Philippines, use recent taxonomic information to amend or rename species, formulate taxonomic keys, and develop Lucid key for identification. An existing computer based software was applied

to the development of morphological Lucid key for their identification. For this purpose, field collections were conducted from 2007 to 2009. Microscopic studies on the association of Cercosporoid species to the diseased leaves were carried out at the Postharvest Pathology Lab, Crop Protection Cluster, College of Agriculture, University of the Philippines Los Baños (UPLB). The field collection was confined mostly within UPLB campus, particularly propagation farm and medicinal plant gene bank, vegetable farm of the Crop Science Cluster, UPLB, the production farm at the Jamboree site, production farm at International Rice Research Institute (IRRI), and some residential gardens in Los Baños, Laguna.

Key to Cercosporoid Genera (Crous and Braun, 2003).

1. Conidiogenous loci inconspicuous or subdenticulate, but always unthickened and not darkened or subconspicuous, i.e., unthickened, but somewhat refractive or rarely very slightly darkened, or only outer rim slightly darkened and refractive (visible as minute rings)----------*Pseudocercospora*
1. Conidiogenous loci conspicuous, i.e., thickened and darkened throughout, only with a minute central pore----------2
    2. with verruculose superficial secondary mycelium; conidia amero- to scolecosporous, mostly verruculose----------*Stenella*
    2. If superficial secondary mecelium present, hyphae smooth or almost so----------3
3. Conidia hyaline or subhyaline, scolecosporous, acicular, obclavate-cylindrical, filiform, usually pluriseptate----------*Cercospora*
3. Conidia pigmented or, if subhyaline, conidia non-scolecosporus, ellipsoid-ovoid, short cylindrical, fusoid and only few septa----------*Passalora*
    4. Conidiogenous loci protuberant, with a central convex part (dome) surrounded by a raised periclinal rim, conidia in long, often branched chains or solitary, smooth to verruculose ----------*Cladosporium*
    4. Conidiogenous loci conspicuously thickened, conidia non-scolecosporous, ellipsoid-ovoid, short subcylindrical, aseptate or only with few septa----------*Asperisporium*
5. Conidia contain from 4-20 pseudo-crosswalls (pseudosepta), the base of the conidium (hilum) conspicuously thickened---------- *Corynespora*
5. Conidia without septa or with one or a few transverse septa, conidiophores apical portion sometimes branched---------- *Periconiella*

Further descriptions of the genera and species belonging to the genus, as they were associated from the collections were presented. The last column of the table indicates whether the collection is considered a first record or has already been reported.

2. Genus *Cercospora*

Cercospora Fresen. (Crous and Braun, 2003).

Stromata lacking to well developed, subhyaline to usually pigmented; *conidiophores* mononematous, macronematous, solitary to fasciculate, arising from internal hyphae or stomata, erect, continuous to pluriseptate, subhyaline to pigmented; *conidiogenous loci* conspicuous, thickened and darkened, planate; *conidia* solitary to catenate, scolecosporous, obclavate, cylindrical, filiform, acicular, hyaline, smooth or almost so, hila thickened and darkened (Crous and Braun, 2003).

Type species: *Cercospora penicillata* (Ces.) Fresen.

In the present study, 48 *Cercospora* diseases were reported. Among them, 20 species were now considered under a compound species *Cercospora apii s. lat.* (Table 1) and 28 under *Cercospora s. str.* which is host specific with a host range confined to species of a single host genus or some allied host genera of a single family (Table 2).The reported genus *Cercospora* was introduced by Fresenius with *Cercospora penicillata* as the type species. Since then over 1000 species were reported and characterized and were compiled in the book "Monograph of the Genus *Cercospora*'' by Chupp (1953). He proposed a broad concept for the genus, simply noting whether hila were thickened or not, and if conidia were pigmented or not, single or in chains. Recently Crous & Braun (2003) recognized four true cercosporoid genera, viz. *Cercospora*, *Pseudocercospora* Speg., *Passalora* Fr. and *Stenella* Syd., and several other morphologically similar genera, based on molecular sequence analyses and a reassessment of morphological characters. They represented a compilation of more than 3000 names that have been published or proposed in *Cercospora*, of which 659 are presently recognized in this genus, with a further 281 being referred to *C.apii s.lat*. They amended the species *C. apii* and it is now a compound species, referred to as *C. apii s.lat.* It infects hundreds of plant species. *Cercospora apii s.lat*. is characterized by having solitary to fasciculate, usually long, brown, septate conidiophores with conspicuously thickened and darkened conidiogenous loci and long, acicular, hyaline, pluriseptate conidia formed singly. *Cercospora s.str* is characterized by having stromata, with numerous, densely arranged rather short conidiophores, small conidiogenous loci, and obclavate-cylindrical conidia with truncate base (Table 2).

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora amaranti	*Amaranthus viridis* (Amaranth)	lacking	2-15 in a divergent fascicle, pale to olivaceous brown, multiseptate, not branched, straight to slightly geniculate, scars conspicuously thickened, 35-200 x 4-5.5 µm	hyaline, acicular, smooth walled, straight, base-truncate, apex-acute, hilum thickened and darkened, 40-200 x 2-4.5 µm	CALP 11707	FR
Cercospora anonae	*Anona squamosa* (Sugar apple)	present	dense fascicle, pale to olivaceous brown, almost uniform in colour and width, not geniculate, slightly branched, septate, large scar present, 20-180 x 2-5 µm	hyaline, solitary, acicular, straight to curved, septate, base obconically truncate, tip acute, hilum thickened and darkened, 40-200 x 1.5-3 µm	CALP 11734	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora begoniae	*Begonia* sp. (Begonia)	lacking	2-5 in a fascicle or borne singly, pale to very pale brown in colour, paler and more narrow towards the apex, straight or geniculate, septate, truncate at the apex, scars conspicuously thickened 30-180 x 3-5 µm	hyaline, acicular, straight to mildly curved, indistinctly multiseptate, acute at the apex, truncate at the base, hilum conspicuously thickend, 50-260 x 2.5-4µm	CALP 11676	FR
Cercospora capsici	*Capsicum annum* (Chili)	lacking	5-15 in a fascicle, pale to olivaceous brown, straight to slightly curved, not branched, mildly geniculate, acicular to filiform, straight to mildly curved, scars conspicuously thickened, 30-140 x 3-6 µm	hyaline, solitary, acicular to filiform, straight to mildly curved, multiseptate, apex-acute to subacute, base truncate or obconically truncate, hilum thickened, 50-170 x 3-4.5 µm	CALP 11693	AR
Cercospora citrullina	*Cucurbita moschata* (Squash)	lacking	2-5 in a fascicle, pale to olivaceous brown, straight to slightly bent or curved, geniculate, multiseptate, simple, occasionally swollen at some points, subtruncate at the apex, scars conspicuously thickened, 35-250 x 4-6 µm	hyaline, solitary, acicular/ cylindro-obclavate, straight-curved, multiseptate, apex-subacute to obtuse, base-subtruncate or rounded, hilum thickened and darkened, 20-200 x 2-3.5 µm	CALP 11675	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora citrullina	*Momordica charantia* (Bitter gourd)	lacking	2-15 in a fascicle, pale to very pale brown, straight to mildly geniculate, multiseptate, scars conspicuously thickened, 20-180 x 4-5 µm	hyaline, solitary, acicular, multiseptate, apex- acute to subacute, base-subtruncate or rounded, hilum thickened, 45-190 x 2-4 µm	CALP 11688	AR
Cercospora citrullina	*Luffa cylindrica* (Sponge gourd)	lacking	2-5 in a fascicle, pale olivaceous brown, width irregular, straight to slightly curved, mildly geniculate, septate, conidial scars conspicuous and thickened, 40-250 x 4-5.5 µm	hyaline, solitary, acicular to obclavato-cylindric, straight to mildly curved, multiseptate, obtuse apex, truncate base, hilum conspicuously thickened and darkened, 45-200 x 3.5-5 µm	CALP 11728	FR
Cercospora cruenta	*Phaseolus lunatus* (Lima bean)	present	10-30 in a divergent fascicle, brown to dark brown at the base and apical portion rather paler, straight to mildly geniculate, multiseptate, scars large and conspicuously thickened, 40-150x 5-6.5 µm	hyaline, acicular/ cylindro-bclavate, straight - curved, multiseptate, apex- subacute, base-subtruncate to truncate, hilum thickened and darkened, 50-250 x 2-3.5 µm	CALP 11710	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora euphorbiae	*Euphorbia heterophylla* (Milk weed)	lacking	2-5 in a fascicle, pale to olivaceous brown, straight to mildly curved, sometimes branched, rarely geniculate, multiseptate, large conidial scars at the subtruncate tip, 25-100 x 4.5-6 µm	hyaline, solitary, cylindrical to acicular, straight to mildly curved, multiseptate, obconically truncate base, obtuse tip, hilum thickened and darkened, 40-120 x 3-4.5 µm	CALP 11724	FR
Cercospora fukushiana	*Impatiens balsamina* (Balsam plant)	present	divergent fascicle, pale olivaceous brown in colour, apex subtruncate, 1-4 septate, rarely branched, straight to flexuous or geniculate, scars medium sized and thickened, 40-150 x 3-4 µm	hyaline, acicular, straight to mildly curved, indistinctly multiseptate, acute to subacute at the apex, truncate at the base, hilum conspicuously thickend, 40-250 x 3-4 µm	CALP 11678	AR
Cercospora grandissima	*Dhalia variabilis* (Dahlia)	lacking	1-10 in a fascicle, pale to medium brown, straight or mildly geniculate with thickened scars, subtruncate at the apex,60-100 x 4-5 µm	Hyaline, solitary, acicular, straight to slightly curved, multiseptate, apex-acute, base-truncate, hilum thickened and darkened, 50-250 x 2-4 µm	CALP 11677	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora hydrangeae	*Hydrangea macrophylla* (Milflores)	present	3-15 in a loose fascicle, brown to deep brown throughout, irregular in width, straight to slightlybcurved, geniculate, not branched, 2-5 septate, obtuse to subtruncate at the apex, conidial scars small and conspicuous, 25-210 x 4-5 µm	hyaline, solitary, acicular to obclavate-cylindric, substraight to mildly curved, 2-13 septate, non-constricted,apex-subacute ,base-truncate, hilum conspicuously thickened, darkened, 35-150 x 3-4 µm	CALP 11733	AR
Cercospora ipomoeae	*Ipomoea triloba* (Little bell)	lacking	dense fascicle, pale olivaceous to medium brown, multiseptate, unbranched, straight, mildly geniculate towards the apex, smooth walled, large conidial scars conspicuously thickened, 40-150 x 5-7.5 µm	hyaline, solitary, obclavate, smooth walled, straight, mildly curved, base-truncate, apex-obtuse, 40-120 x2-4.5µm, hilum thickened & darkened.	CALP 11712	FR
Cercospora ipomoeae	*Ipomoea batatas* (Sweet potato)	lacking	2-5 in a fascicle or borne singly, olivaceous to medium brown, paler upward, rarely branched, mildly geniculate, scar conspicuously thickened, 25-180 x 4-6.5 µm	hyaline, acicular to obclavate, straight to mildly curved, indistinctly multiseptate, truncate at the base, acute at the base, 30-150 x 2-3 µm	CALP 11713	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora ipomoeae	*Ipomoea aquatica* (Kangkong)	lacking	arise singly or 2-7 in a fascicle, pale yellowish olivaceous to medium, brown, slightly paler and more narrow towards the tip, rearly geniculate, subtruncate at the apex, 15-150 x 4-6.5 µm	hyaline, acicular to obclavate straight to curved, indistinctly multiseptate, subacute at the apex, truncate of subtruncate at the base, 25-130 x 3-5 µm	CALP 11711	FR
Cercospora lagenariae	*Lagenaria vulgari* (Bottle gourd)	lacking	2-5 in a divergent fascicle, pale brown to brown, straight to slightly bent or curved, geniculate, occasionally branched, multiseptate, obtuse to subtruncate at the apex, conidial scars conspicuous, 60-250 x 3-6 µm	hyaline, solitary, acicular, substraight to mildly curved, multiseptate, acute to obtuse at the apex, truncate at the base, hilum thickened and darkened, 40-210 x 2-5 µm	CALP 11700	FR
Cercospora laporticola	*Laportea crenulata* (Laportea)	lacking	2-5 in a loose fascicle, pale to olivaceous brown, septate, unbranched, straight, smooth walled, large conidial scars conspicuously thickened, 30-90 x 5-7.5 µm	hyaline, solitary, acicular, smooth walled, straight, base-truncate, apex-obtuse, hilum thickened and darkened, 40-250 x 3-4.5 µm	CALP 11696	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora moricola	*Morus alba* (Mulberry)	lacking	2-15 in a fascicle, pale olivaceous brown, straight, rarely septate and geniculate, unbranched, scars conspicuously thickened,10-50 x 4-5.5 µm	hyaline, solitary, acicular, multiseptate base-truncate, tip-acute hilum thickened and darkened, 40-150 x 2-3.5µm	CALP 11690	FR
Cercospora nicotianae	*Nicotiana tabacum* (Tobacco)	lacking	2-5 in a fascicle, pale olivaceous to medium brown, paler toward the tip, not branched, multiseptate, mildly-geniculate, scars large and conspicuously thickened, 20-100 x 3-6.5 µm	hyaline, solitary, acicular, straight to mildly curved, multiseptate, acute to subacute at the apex, truncate at the base, hilum thickened and darkened, 25-250 x 2-4.5 µm	CALP 11701	AR
Cercospora zinniae	*Zinnia elegans* (Zinnia)	lacking	2-20 in a fascicle, pale to medium dark olivaceous brown, not branched, straight or geniculate, scars conspicuously thickened, 15-200 x 4-6 µm	hyaline, solitary, acicular/obclavate, straight to mildly curved, apex-acute / subacute at base-truncate to subtruncate, hilum thickened and darkened, 20-160 x 2-4 µm	CALP 11704	AR

Reference: Chupp (1954); Ellis (1971, 1976); Guo & Hsieh (1995); Guo *et al.* (1998); Hsieh & Goh(1990); Saccardo (1886); Shin & Kim (2001); Vasudeva (1963).
* AR= already reported, FR= first record.

Table 1. List and descriptions of formerly reported *Cercospora* species that were reclassified in this study as *Cercospora apii s.lat.*

Some former species of *Cercospora* that are morphologically different from *C.apii s.lat.*, are now considered to *Cercospora s.str.* As far as known, *Cercospora s.str.* are host specific or with a host range confined to species of a single host genus or some allied host genera of a single family. This phenomenon is constantly being addressed via molecular studies (Crous et al., 2000, 2001). *Cercospora s.str.* is characterized by having stromata, with numerous, densely arranged rather short, solitary to fasciculate, subhyaline to light or

olivaceous brown conidiophores with small conspicuously thickened and darkened conidiogenous loci, and obclavate-cylindrical conidia with obconically truncate base (Table 2). Teodoro (1937) had enumerated 65 species of *Cercospora* in the Philippines while 33 species were reported by Quimio and Abilay (1977). In the present study, 48 hosts exhibiting leaf spots were reported as caused by species of *Cercospora,* 32 were from medicinal plants. There were 30 first records of *Cercospora* leaf spots recorded in this study. All species of *Cercospora* associated with those hosts are known except for a species on *Basella albae*. It has not been described on this host; therefore, it warrants description on a new host record, with proposed species name of *Cercospora basellae-albae (*Begum and Cumagun, 2010).

Species	**Host**	**Stromata**	**Conidiophores**	**Conidia**	**Ref. Coll. Accession No.**	**Status of collection**
Cercospora adiantigena	*Adiantum phillipense* (Maiden hair fern)	present	small to moderately long fascicle, subhyaline, straight, subcylindrical to moderately geniculate to sinuous, unbranched, multiseptate, conidial scar thickened and darkened, 25-150 x 4-10 µm	hyaline, solitary, obclavate-cylindrical, short conidia occasionally fusoid, septate, thin walled, smooth, apex obtuse, base short obconically truncate, hilam thickened and darkened, 40-90 x 4-8 µm	CALP 11715	AR
Cercospora basellae-albae	*Basella alba* (Vine spinach-green)	present	2-15 in a divergent fascicle, light brown, straight to rarely curved, unbranched, thick walled, septate, geniculate, with rounded apex, conidial scars distinct, 30-85 x 4-5 µm	hyaline, acicular to sub-cylindrical, straight to rarely curved, unbranched, smooth walled, septate, with truncate to obconically truncate base and obtuse apex, 20-80 x 2-5 µm	CALP 11735	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora basellae-albae	*Basella albae* (Vine spinach-purple)	present	1-10 in a fascicle, pale olivaceous brown, fairly uniform in color and width, not branched, straight or mildly geniculate with thickened conidial scars, sparingly septate, 30-75 x 4-6 µm	hyaline, acicular, obclavate, straight to slightly curved, in distinctly multiseptate, rounded apex, truncate at the base with a thickened hilum, 15-70 x 1-4 µm.	CALP 11674	NHR
Cercospora brassisicola	*Brassica pekinensis* (Pechay)	present	2-15 in a divergent fascicle, emerging through stomata, pale olivaceous to medium brown, not branched, multiseptate, mildly geniculate, but rarely geniculate in the upper portion, scars large and conspicuously thickened, 20-200 x 3-5.5 µm	hyaline, solitary, acicular to cylindrical, straight to mildly curved, multiseptate, acute to rounded at the apex, truncate at the base, hilum thickened and darkened, 25-250 x 2-4.5 µm	CALP 11705	AR
Cercospora brassicicola	*Brassica campestris* (Mustard)	present	2-15 in a fascicle, pale olivaceous to medium brown, uniform in colour and width but paler the attenuated tips, rarely branched, multiseptate, mildly geniculate, conidial scars at the subtruncate tip, 25-400 x 3.5-6 µm	hyaline, acicular, straight to curved, indistinctly multiseptate, subacute to acute at the apex, truncate at the base, 25-200 x 2-5 µm	CALP 11703	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora canescens	*Dolichos lablab* (Lab bean)	present	densely fasciculate, pale to medium dark brown, multiseptate, geniculate, rarely branched, apex-truncate, conidial scars conspicuously thickened, 2-4 µm wide, 20-200 x 3-6.5 µm	hyaline, acicular, straight to curved, indistinctly multiseptate, apex-acute, base-truncate, thickened hilum, 25-200 x 2.5-5.5 µm	CALP 11732	FR
Cercospora carotae	*Daucus carota* (Carrote)	present	3-15 in a fascicle or borne singly, pale olivaceous brown, paler tips, upper portion slightly geniculate, straight, scars conspicuous thickened, 20-40 x 2.5-4 µm	hyaline, filiform to cylindric, solitary, straight to slightly curved, 1-5 septa, rounded base, obtuse apex, hilum thickened and darkened, 25-95 x 3.5-5.5 µm	CALP 11730	AR
Cercospora corchori	*Corchorus olitorius* (Jute)	present	2-7 in a fascicle or borne singly, pale to medium olivaceous brown, paler at the apex, septate, not branched, geniculate, subtruncate at tip, with thickened conidial scars, 40-230 x 2-5.5 µm	hyaline, acicular to obclavate, straight to curved, indistinctly multiseptate, obtuse at the apex, base-obconically truncate , thickened hilum, 25-165 x 2.5-5 µm	CALP 11694	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora corchori	*Corchorus acutangulus* (saluyot)	present	5-15 in a fascicle, pale to medium brown, slightly paler and more narrow towards the tip, springly septate, not branched, mildly geniculate, almost straight, large conidial scar at subtruncate tip, 30-120 x 4-5.5 µm	hyaline, acicular to obclavate, straight to curved, indistinctly multiseptate, base truncate, tip acute, 40-220 x 2.5-5 µm	CALP 11697	FR
Cercospora daturicola	*Datura metal* (Datura)	lacking	2-15 in a fascicle, pale olivaceous brown, uniform in colour, usually straight, septate, not branched, conidial scars conspicuously thickened and darkened, 30-85 x 3.5-5.5 µm	hyaline, acicular to obclavato-cylindrical, multiseptate, straight to mildly curved, tip acute to subacute and base truncate, hilum thickened and darkened, 50-150 x 3-4.5 µm	CALP 11729	FR
Cercospora eluesine	*Eluesine indica* (Dogs tail)	lacking	2-5 in a small fascicle, pale to olivaceous brown, straight to mildly curved, not branched, sometimes mildly geniculate, multiseptate, large conidial scars conspicuous, 25-85 x 4.5-6 µm	hyaline, cylindrical to obclavate, straight to mildly curved, multiseptate, obconically truncate base, rounded tip, hilum thickened and darkened, 40-120 x 3-4.5 µm	CALP 11720	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora euphorbiae	*Euphorbia* sp. (Euphorbia)	present	5-15 in a fascicle, pale olivaceous brown, uniform in colour and width, paler the tips, smooth wall, straight to mildly curved, not branched, not geniculate, multiseptate, medium conidial scar thickened and darkened, 15-65 x 4-6 µm	hyaline, solitary, cylindro-obclavate, subobtuse tip, obconically truncate base, straight to curved, multiseptate, hilum thickened and darkened, 40-100 x 3.5-5 µm	CALP 11721	FR
Cercospora gendarussae	*Gendarussa vulgaris* (Gendarussa)	present	densely fasciculate, olivaceous brown, uniform in colour and width, paler the tips, smooth wall, straight to mildly curved, not branched, rarely geniculate, multiseptate, large conidial scar thickened and darkened, 20-120 x 4-5.5 µm	hyaline, solitary, acicular to cylidro-obclavate, acute to rounded tip, obconically truncate base, straight to curved, multiseptate, hilum thickened and darkened, 45-180 x 3-4 µm	CALP 11722	FR
Cercospora guatemalensis	*Ocimum sanctum* (Basil)	lacking	2-10 in a fascicle, pale to olivaceous brown, slightly paler and more narrow towards the tip, septate, not branched, straight to slightly curved, conidial scar conspicuous , 25-100 x 4-5.5 µm	hyaline, cylindric or acicular, straight to mildly curved, indistinctly multiseptate, base truncate to obconically truncate, tip rounded to conic, 45-120 x 2.5-4 µm	CALP 11725	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora helianthicola	*Helianthus annuus* (Sunflower)	present	1-10 in a fascicle, pale to medium brown, paler and more narrow toward the tip, geniculate, rarely branched, large conidial scar at subtruncate tip, 25-100 x 3-5 µm	hyaline, acicular, sometimes curved, multiseptate, base truncate, tip acute, 40-130 x 2-3 µm	CALP 11718	FR
Cercospora kikuchii	*Glycine max* (Soybean)	present	2-10 in a fascicle, medium dark brown, uniform in colour, multiseptate, not branched, mildly geniculate, subtruncate at the apex, scars large and conspicuously thickened, 35-200 x 4-6 µm	hyaline, acicular, straight to curved, indistinctly multiseptate, hilum thickened and darkened, 45-300 x 2.5-5 µm	CALP 11698	FR
Cercospora labiatacearum	*Pogostemon cablin* (Patchouli)	lacking	5-8 in a small fascicle, pale olivacous brown, paler upwards, smooth wall, straight to mildly curved, not branched, geniculate, large conidial scar thickened and darkened, 45-300 x 5-5.5 µm	hyaline, solitary, acicular-obclavate, subacute tip, truncate base, straight to curved, multiseptate, hilum thickened and darkened, 45-180 x 4.5-5.5 µm	CALP 11706	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora lactucae-sativae	*Lactuca sativa* (Lettuce)	present	2-10 in a fascicle or borne singly, pale olivaceous brown, slightly paler and narrower towards the apex, multiseptate, not branched, springly geniculate, conidial scar at subtruncate tip, 25-100 x 4-5 µm	hyaline, solitary, acicular to obclavate, straight to curved, indistinctly multiseptate, subacute at the apex, subtruncate at the base, 20-200 x 3-5 µm.	CALP 11699	AR
Cercospora menthicola	*Mentha arvensis* (Apple mint plant)	lacking	2-5 in a small fascicle, pale to olivaceous brown, multiseptate, not branched, straight to curved, mildly geniculate towards the apex, smooth walled, conidial scars conspicuously thickened, 35-120 x 4-6.5 µm	hyaline,solitary, acicular, straight to mildly curved, multiseptate, base-subtruncate to obconically truncate. Apex-acute to rounded, hilum thickened and darkened, 40-120 x 2-4 µm	CALP 11691	FR
Cercospora mikaniicola	*Mikania cordifolia* (Climbing hemp weed)	lacking	2-5 in a fascicle, medium olivaceous brown, closely septate, not branched, straight to mildly geniculate, smooth walled, conidial scars conspicuously thickened, 50-150 x 4-6.5 µm	hyaline, solitary, obclavate, truncate at the base, acute the tip, hilum thickened and darkened, 40-80 x 4-9 µm	CALP 11716	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora pulcherrimae	*Euphorbia pulcherrema* (Poinsettia)	present	3-12 in a fascicle, pale to medium olivaceous brown, multiseptate, rarely branched, straight, mildly geniculate, conidial scars conspicuously thickened, 20-110 x 4-6 µm	hyaline, acicular, acute to subacute at the apex, truncate at the base with a thickened hilum, 30-130 x 3-4 µm	CALP 11702	AR
Cercospora ricinella	*Ricinus communis* (Castor bean)	present	densely fasciculate, pale olivaceous brown, fairly uniform in colour and width, sparingly septate, not branched, geniculate, large conidial scar present at subtruncate tip, 20-250 x 4-8 µm	hyaline, acicular to obclavate, straight to mildly curved, indistinctly multiseptate, subacute to subobtuse at the apex, subtruncate to truncate at the base, hilum thickened and darkened, 20-100 x 2-4 µm	CALP 11719	AR
Cercospora sesame	*Sesamum orientale* (Sesame)	lacking	2-5 in a small fascicle, olivaceous brown, slightly paler towards the apex, multiseptate, rarely branched, straight, mildly geniculate, large conidial scar present, 20-110 x 4-5.5 µm	hyaline, cylindric, straight to curved, indistinctly multiseptate, acute at the apex, truncate at the base, hilum thickened and darkened, 30-150 x 2-4.5 µm	CALP 11723	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora sesbaniae	*Sesbania sesban* (Sesbania)	present	2-15 in a fascicle, pale to very pale olivaceous brown, uniform in colour, 1-4 septate, width irregular, not branched, mildly geniculate, conidial scar conspicuously thickened, 20-65 x 2.5-5.5 µm	hyaline, acicular, straight to curved, multiseptate, truncate base, tip obtuse, 25-60 x 2.5-3.5 µm	CALP 11695	FR
Cercospora simulate	*Cassia alata* (Ring worm bush)	lacking	2-15 in a fascicle, dark brown in colour, paler the tip, irregular width, not branched, upper portion mildly geniculate, multiseptate, medium conidial scar at subconic tip, 50-280 x 3.5-6 µm	hyaline, cylindro-obclavate, straight to mildly curved, septate, base obconically truncate, tip obtuse, hilum thickened and darkened, 30-100 x 2.5-4 µm	CALP 11726	FR
Cercospora syndrellae	*Syndrella nodiflora* (syndrella)	lacking	5-10 in a fascicle, pale to olivaceous brown, straight to mildly curved, not branched, mildly geniculate, multiseptate, large conidial scar thickened and darkened, 40-90 x 5-6.5 µm	hyaline, cylindrical to obclavate, straight to curved, multiseptate, obconically truncate base, tip rounded, 45-100 x 2.5-4.5 µm	CALP 11727	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Cercospora tagetis-erectae	*Tagetes erecta* (Marygold)	present	densely fasciculate, very pale olivaceous, cylindric, erect or sinuous, rarely septate or geniculate, truncate or rounded at the apex, conidial scars thickened conspicuous, 10-50 x 2-3 µm	hyaline, narrowly obclavate or filiform, straight, 3-10 septate, acute at the apex, obconic or long obconically truncate at the base; hilum thickened and darkened, 25-90 x 2-3.5 µm	CALP 11714	FR
Cercospora tithoniae	*Tithonia diversifolia* (African sunflower)	lacking	2-8 in a fascicle, pale olivaceous brown, uniform in colour, straight to slightly curved, not branched, septate, mildly geniculate, conidial scars conspicuously thickened and darkened, 25-65 x 3-4.5 µm	hyaline, cylindric to obclavate, straight to slightly curved, multiseptate, rounded apex and base obconically truncate, hilum conspicuously thickened, 25-50 x 3.5-4 µm	CALP 11692	FR

Reference: Chupp (1954); Ellis (1971, 1976); Guo & Hsieh (1995); Guo *et al.* (1998); Shin & Kim (2001); Vasudeva (1963).
* AR= already reported, FR= first record, NHR= new host record.

Table 2. List and descriptions of formerly reported *Cercospora* species, that were reclassified in this study as of *Cercospora s. str.*

3. Genus *Pseudocercospora*

Pseudocercospora Speg (Crous & Braun, 2003).

Stromata lacking to well developed, usually pigmented; *conidiophores* are pigmented, pale olivaceous to medium dark brown with *conidiogenous loci* inconspicuous, unthickened and not darkened but somewhat refractive or rarely very slightly darkened, or only outer rim slightly darkened and refractive; *conidia* subhyaline to pigmented, solitary or catenulate, scolecosporous, hila unthickened and not darkened (Table 3).

Type species: *Pseudocercospora vitis* (Lev.) Speg.

Pseudocercospora was introduced by Spegazzini (1910). Deighton (1976) re-introduced this name and widened the concept of this genus considerably to include a wide range of cercosporoids with pigmented conidiophores and inconspicuous, unthickened, not darkened conidiogenous loci. It is the second largest Cercosporoid genus, with more than 300 published names (Kirk *et al.* 2001). In Taiwan, 198 species of *Pseudocercospora* have been recognized by Hsieh & Goh (1990). In the present study, 20 *Pseudocercospora* sp. were reported, of which 14 species caused diseases on medicinal plants (Table 3). There were 12 new records of *Pseudocercospora* diseases in the Philippines.

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora abelmoschi	*Abelmoschus esculentus* (Okra)	lacking or small	densely fasciculate, pale to medium olevaceous brown, uniform in colour, 0-3 septate, sometimes constricted at the septa, irregular in width or slightly clavate, simple or branched, sparingly geniculate, sinuous, rounded or conically truncate at the apex, 10-50 x 3-5 µm	pale olivaceous to brown, obclavate to cylindric, straight to mildly curved, septate, acute to subobtuse at the apex, obconic to obconicaly truncate at the base, hilum unthickened and inconspicuous, 25-80 x 2.5-4 µm	CALP 11746	AR
Pseudocercospora alternantheraenodiflorae	*Alternanthera nodiflora* (Alternenthera)	present	10-25 in a divergent fascicle, emerging through the stromata, pale brown, straight to curved, not branched, sometimes geniculate, septate, scars inconspicuous, 10-55 x 4-5 µm	subhyaline to very pale olivaceous, obclavate with gradual attenuation, hyaline to pale brown, straight to mildly curved, tip subobtuse, base obconic, 3-12 septate, sometimes constricted at the septa, hilum unthickened and inconspicuous, 30-110 x 2.5-4.5 µm	CALP 11736	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora atro-marginalis	*Solanum nigrum* (Black night shade)	lacking	4-15 in a divergent fascicle, pale olivaceous to olivaceous brown, longer ones curved, sharply bent or undulate, branched, septate, sometimes slightly constricted at the some septa, rarely geniculate, conic at the apex, scars inconspicuous, 10-50 x 3-5 µm	pale olivaceous, cylindric to obclavato-cylindric, straight to mildly curved, 2-8 septate, subobtuse to broadly rounded at the apex, sharply obconic or obconically truncate at the base, hilum unthickened and not darkened, 15-90 x 2.5-5 µm	CALP 11679	AR
Pseudocercospora balsa-minicola	*Impatiens balsamina* (Balsam plant)	well developed	10-40 in a divergent fascicle, pale olivaceous brown to brown , irregular in width, substraight to mildly curved, not geniculate, not branched, multiseptate, conidial scars inconspicuous, 15-50 x 2-3 µm	subhyaline, solitary, filiform to narrowly obclavate, straight to mildly curved, septate, subacute at the apex, truncate to obconically truncate at the base, hilum unthickened and not darkened; 30-70 x 1.5-3 µm	CALP 11741	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora blumeae	*Blumea balsamifera* (Sambong)	lacking	5-25 in a fascicle, cylindric, pale to medium brown, uniform in colour and width, straight to curved, not branched, septate, mildly geniculate, rounded to truncate at the apex, conidial scars unthickened, 15-70 x 4-5 µm	pale olivaceous brown, mostly cylindrical, rarely obclavate, straight to slightly curved, septate, subobtuse to broadly rounded at the apex, subtruncate to long obconically truncate at the base, hilum unthickened. 30-110 x 3.5-5.5 µm	CALP 11739	AR
Pseudocercospora bixicola	*Bixa orellanae* (Bixa)	lacking	densely fasciculate, pale olivaceous, cylindrical, septate, branched, rarely geniculate, conically rounded at the apex, conidial scars unthickened or inconspicuous, 15-40 x 2.5-4 µm	pale olivaceous, obclavate-cylindric, straight to mildly curved, indistinctly 3-6 septate, subobtuse at the apex, obconic or obconically rounded at the base, hilum unthickened, , 30-60 x 2-3 µm	CALP 11738	FR
Pseudocercospora borreriae	*Borreria micrantha* (Borreria)	lacking or small	medium to dark brown, arise singly, uniform in colour, irregular in width, multiseptate, branched, slightly geniculate, curved to tortuous, small spore scars at bluntly rounded tip, 35-220 x 3-5.5 µm	subhyaline to pale or medium olevaceous, cylindric to obclavato-cylindric, straight to mildly curved, 3-9 septate, base obconic to obconically truncate, hilum unthickened and inconspicuous, 30-90 x 2.5-5 µm	CALP 11740	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora chrysanthemicola	*Chrysanthemum morifolium* (Chrysanthemum)	present	2-20 in a fascicle, emerging through stomata, olivaceous brown, cylindrical, septate, rarely geniculate, very rarely branched, scars inconspicuous, 15-40 x 3-5 µm	pale olivaceous brown, obclavate or obclavato-cylindric, straight to mildly curved, multiseptate, rounded at the apex, obconically truncate at the base, hilum unthickened and inconspicuous, 25-100 x 3-5 µm	CALP 11742	FR
Pseudocercospora corchorica	*Corchorus capsularis* (Jute)	present	olivaceous brown, in a dense fascicle, paler and narrower the tips, straight to mildly curved, not geniculate, scars inconspicuous, 18-55 x 3.5-5 µm	subhyaline to very pale olivaceous brown, cylindric to obclavate, straight to mildly curved, septate, apex rounded and base subtruncate, hilum unthickened, reflective, 20-80 x 3-5 µm	CALP 11753	FR
Pseudocercospora cruenta	*Phaseolus lunatus* (Lima bean)	small	dense fascicle, subhyaline to pale olivaceous brown, straight to sinuous or mildly geniculate, occationally branched, septate, conic at the apex, scars inconspicuous, 15-60 x 3-5 µm	subhyaline to very pale olivaceous brown, cylindric or cylindro-obclavate, straight to mildly curved, multiseptate, subacute to obtuse at the apex, sharply obconic or obconically truncate at the base, hilum unthickened and inconspicuous, 25-130 x 2-5 µm	CALP 11737	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora formosana	*Lantana camara* (Lantana)	lacking	small fascicle, very pale olivaceous to brown, sparingly septate, not geniculate, straight to undulate, scars inconspicuous, 25-40 x 3-4 µm	narrowly obclavate, very pale olivaceous, straight to curved, indistinctly multiseptate, base long obconically truncate, tip subacute, hilum unthickened and inconspicuous, 30-100 x 2.5-3.5 µm	CALP 11747	FR
Pseudocercospora fuligena	*Lycopersicon esculentum* (Tomato)	well developed	loosely fasciculate usually 5-15 per fascicle, pale olivaceous to very pale olivaceous brown, uniform in color, straight to sinuous, tip rounded or truncate, sometimes geniculate, not branched, septate, conidial scars unthickened, 15-45 x 3-5 µm	subhyaline to pale olivaceous, cylindric to cylindro-obclavate, straight to mildly curved, rounded to obtuse at the apex, obconically truncate, multiseptate, hilum unthickened, not darkened, 25-110 x 2-4 µm	CALP 11748	AR
Pseudocercospora gmelinae	*Gmelina arborea* (Yemen)	lacking	2.8 in a small fascicle, pale olivaceous brown, straight to mildly geniculate, smooth, unbranched, septate, scars inconspicuous, 30-50 x 3-4.5 µm	subhyaline to pale olivaceous brown, cylindro-obclavate, straight to mildly curved, base attenuated, tip subacute, hilum unthickened and inconspicuous, 30-80 x 3-4.5 µm	CALP 11754	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora jasminicola	*Jasminum grandiflorum* (Jasmine)	present	numerous, pale olivaceous, straight or slightly sinuous, sometimes slightly geniculate, smooth, simple, septate, subtruncate at the apex, 5-30 x 2-4 µm, conidial scars unthickened	pale olivaceous, subcylindric to slightly obclavate, straight or slightly curved, smooth, thin-walled, obtuse at the apex, shortly tapered at the base, hilum unthickened and inconspicuous, 18-60 x 1.5-2.5 µm	CALP 11745	FR
Pseudocercospora ocimicola	*Ocimum basilicum* (Sweet basil)	lacking	densely fasciculate, pale to very pale olivaceous brown, conidial scar unthickened and inconspicuous, 10-40 x 3-5 µm	subhyaline, cylindric to narrowly obclavate, straight to mildly curved, septate, subacute to subobtuse at the apex, truncate at the base, hilum unthickened 25-60 x 3-4 µm	CALP 11744	FR
Pseudocercospora pachyrrhizi	*Pachyrrhizus erosus* (Turnip)	small	densely fasciculate, pale olivaceous to yellowish brown, not branched, septate, mildly geniculate, conidial scar visible but not thickened, 10-35 x 2.5-4 µm	subhyaline, obclavate, straight to slightly curved, septate, rounded at the apex, obconocally truncate base with unthickened hilum, 35-60 x 3-5.5 µm	CALP 11743	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora sesbanicola	*Sesbania sesban* (Sesbania)	lacking	5-20 in a fascicle, emerging from stromata, septate, rounded at the apex, scars inconspicuous, 15-65 x 3-4 µm	pale olivaceous brown, cylindric, sometimes obclavato-cylindric, straight or slightly curved, septate, rounded at the apex, truncate at the base, hilum unthickened, 18-30 x 3-4.5 µm	CALP 11752	FR
Pseudocercospora solani-melongenicola	*Solanum melongena* (Eggplant)	present	5-10 in a fascicle, pale olivaceous brown, paler towards the apex, straight or geniculate, sometimes branched, septate, conidial scars visible but not thickened, 30-60 x 3.5-4.5 µm	olivaceous to pale brown, cylindric to cylindro-obclavate, straight to slightly curved, obtuse at the apex, obconically truncate at the base, hilum visible but not thickened, 30-100 x 3.5-5 µm	CALP 11749	FR
Pseudocercospora synedrellae	*Synedrella nodiflora* (Syndrella)	lacking	2-15 in a fascicle , pale olivaceous brown, simple or branched, straight or slightly undulate, septate, sometimes constricted at the septa, not geniculate, rounded or conical at the apex, 5-30 x 2-4 µm	subhyaline to very pale olivaceous, narrowly obclavate or filiform, straight to slightly curved, indistinctly multiseptate, subacute at the apex, obconically truncate at the base, hilum unthickened and inconspicuous, 15-90 x 2-3 µm	CALP 11750	FR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Pseudocercospora viticis	*Vitex nigundo* (Lagundi)	well developed	pale olivaceous, borne singly or densely fasciculate, straight, not branched, not geniculate, 5-35 x 2-3.5 µm, conidial scar inconspicuous	subhyaline to pale olivaceous, cylindric to obclavate, straight to mildly curved, septate, acute to subacute at the apex and obconically truncate at the base, hilum unthickened 18-50 x 2.5-3.5 µm	CALP 11751	AR

Reference: Chupp (1954); Ellis (1971); Guo & Hsieh (1995); Guo *et al.* (1998); Hsieh & Goh (1990); Saccardo (1886); Shin & Kim (2001); Vasudeva (1963); Yen & Lim (1980).
* AR= already reported, FR= first record.

Table 3. List and descriptions of *Pseudocercospora* species found in this study.

4. Genus *Passalora*

Passalora Fr. (Crous & Braun, 2003).

Stromata absent to well developed; *conidiophores* are solitary or loosely to densely fasciculate, unbranched or branched, continuous to pluriseptate, subhyaline to pigmented, conidiogenous loci conspicuous, scars thickened and darkened-refractive, c*onidia* solitary to catenate, simple or branched, amerosporous to scolecosporous, pale to distinctly pigmented (if subhyaline, conidia non-scolecosporous), smooth to finely verruculose, with few septa, hila thickened and darkened-refractive, more or less truncate (Crous & Braun, 2003).

Type species: *Passalora bacilligera* (Mont. & Fr.)

4.1 Dichotomous Key to the Species *Passalora*

1. Stromata lacking---------- *P. bougainvilleae*
1. Stromata present, sometimes well developed----------2
    2. Conidiophores strongly geniculate---------- *P. personata*
    2. Conidiophores straight to slightly geniculate----------3
3. Conidiophores aseptate---------- *P. tinosporae*
3. Conidiophores septate----------4
    4. Conidiophores up to 50 um long---------- *P. henningsii*
    4. Conidiophores up to 100 um long---------- *P. amaranthae*

Approximately 550 names of *Passalora* that have been published or amended in the world, compiled by Crous and Braun (2003). In this study, four already known and recorded *Passalora* species were found, namely *Passalora personata* on *Arachis hypogaea* (Quimio and Abilay, 1977), formerly named as *Cercospora arachidis*, *P. bougainvilleae* causing leaf spot of

Bougainvilla, (Ponaya & Cumagun, 2008), *P. henningsii* on *Manihot esculenta,* formerly named as *Cercospora cassavae* Ellis & Everh. /*C. manihots* Henn. /*C. henningsii* Allesch (Crous and Braun, 2003) and *P. tinosporae* on *Tinospora reticulate.* The same host species and the associated fungi were reviewed in the study and were found to confirm with the descriptions of the genus *Passalora* (Table 4).

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Passalora amaranthae	*Amaranthus viridis* (Amaranth)	well developed	densely fasciculate, pale to olivaceous brown, multiseptate, straight or slightly curved, not branched, moderately geniculate, conspicuously thickened small conidial scars,25-100 x 3.5-6.5 µm	pale olivaceous, cylindric or obclavato-cylindric, straight to slightly curved, 3-7 septate, bluntly rounded at the apex, obconic at the base , small thickened hilum, 25-65 x 3.5-6.5 µm	CALP 11757	NS
Passalora bougainvilleae	*Bougainvillea spectabilis* (Bougain-villa)	lacking	5-8 in a small fascicle, pale to olivaceous brown, smooth, straight to geniculate, aseptate, conidial scar conspicuous and darkened, 10-75 x 5-7.5 µm	pale to olivaceous brown, solitary, smooth, slightly curved, cylindrical to obclavato-cylindric, 3-6 septa, truncate at the base and rounded at the apex, hilum thickened and darkened, 30-65 x 5-10 µm	CALP 11758	AR
Passalora henningsii	*Manihot esculenta* (Cassava)	well developed	densely fasciculate, subhyaline to pale olivaceous brown, uniform in colour and width, 1-3 septate, straight or slightly curved, not branched, mildly geniculate, conidial scars conspicuously thickened, 15-50 x 3.5-5 µm	pale olivaceous, cylindric, straight to slightly curved, 3-6 septate, bluntly rounded at the apex, obconic at the base with a small thickened hilum, 25-60 x 4-6.5 µm	CALP 11756	AR

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Passalora personata	*Arachis hypogea* (Peanut)	well developed	densely fasciculate, pale olivacious, smooth, slightly or strongly geniculate, straight or slightly curved, not branched, 0-3 septate, conidial scars conspicuously thickened, 20-90 x 3.5-6.5 µm	solitary, subhyaline to pale olivaceous, filiform or obclavate or obclavato-cylindric, usually very finely rough-walled, obtuse or broadly rounded at the apex, truncate or obconically truncate at the base, hilum conspicuously thickened and darkened, 2-10 septate, 20-80 x 4-7.5 µm	CALP 11755	AR
Passalora tinosporae	*Tinospora reticulate* (Maka-buhay)	present	densely fasciculate, subhyaline to very pale, not branched, geniculate, multiseptate, conidial scars conspicuous and at bluntly rounded tip, 25-110 x 3.5-5.5 µm	subhyaline to very pale, cylindrical to obclavate, aseptate, straight to curved, obconically truncate base, subobtuse tip, 10-45 x 4-6 µm	CALP 11760	AR

Reference: Chupp (1954); Ellis (1971, 1976); Guo & Hsieh (1995); Guo *et al.* (1998); Hsieh & Goh(1990); Katsuki (1965); Saccardo (1886); Shin & Kim (2001); Vasudeva (1963).
* NS= new species, AR= already reported, FR= first record.

Table 4. List and descriptions of different species of *Passalora* that were formerly classified as *Cercospora* species in the Philippines.

A species associated with *Amaranthus viridis* was believed to be new. Its characteristics are close to *P.henningsii* in terms of having amphigenous colonies and with shorter conidiophores (15-50 µm). However, its characteristics are different from others, having darker septation on conidia, and its association with a new host that warrants a new species. The proposed new species was *Passalora amaranthae* on *Amaranthus viridis.*

4.2 Genus *Asperisporium*

Asperisporium Maublanc. (Crous & Braun, 2003)

Sporodochia punctiform, pulvinate, brown, olivaceous brown or black. *Mycelium* immersed. Stromata usually well-developed, erumpent. *Conidiophores* macronematous, mononematous, closely packed together forming sporodochia, usually rather short, unbranched or occasionally branched, straight or flexuous, hyaline to olivaceous brown, smooth, polyblastic, scars prominent. *Conidia* solitary, ellipsoidal, fusiform, obovoid, pyriform, clavate or obclavate, hyaline to brown or olivaceous brown, smooth or verrucose, with 0-3 septa (Ellis, 1971).

Type species: *Asperisporium caricae* (Speg.) Maubl.

The genus *Asperisporium,* introduced by Maublanc (1913) resembles *Passalora*, but differs in having verrucose conidia (Ellis 1971, 1976; von Arx, 1983). In the present study, only one species of *Asperisporium* was identified (Table 5). It was *Asperisporium moringae* (Thirum. & Govindu) Deighton on *Moringa oleifera*. This disease was reported in the Philippines by Quimio & Abilay (1977), with *Cercospora moringae* (Thirum. & Govindu) as the causal pathogen. The black spot of papaya caused by *Asperisporium caricae* was first recorded and described in the Philippines (Cumagun and Padilla, 2007).

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Asperisporium moringae	*Moringa oleifera (Moringa)*	well developed	pale olivaceous brown, straight, geniculate, 10-35 x 4-6 µm	pale olivaceous brown, obclavate conico-truncate at the base, verruculose walled, mostly 1-2 septate, 20-45 x 5.5-7.5 µm	CALP 11761	AR

Reference: Chupp (1954); Ellis (1971); Ellis & Holliday (1972).
*AR= already reported. FR= first record.

Table 5. Characteristics of *Asperisporium moringae* associated with leaf spot of *Moringa oleifera.*

4.3 Genus *Periconiella*

Periconiella Saccardo (Ellis, 1971).

Stromata none; *conidiophores* macronematous, mononematous, each composed of an erect, straight or flexious, brown to dark blackish brown, smooth or verruculose; *conidiogenous cells* polyblastic, integrated and terminal, sympodial, cylindrical, scars often numerous; *Conidia* solitary or occasionally in very short chains, simple, ellipsoidal, obclavate or obovoid,

hyaline or rather pale olive or olivaceous brown, without septa or with one or a few transverse septa.

Type species: *Periconiella velutina* (Wint.) Sacc.

In the present study, only one *Periconiella lygodii* on *Lygodium japonicum* was reported (Table 6). Four species of *Periconiella* have been reported to occur on ferns (Braun, 2004). He noted that *P.lygodii* is distinguished from all other species of *Periconiella* on ferns by having long, obclavate-cylindrical, pluriseptate, smooth conidia. This is the first record of *P. lygodii* on *Lygodium japonicum* in the Philippines, (Begum et al. 2009).

Species	Host	Stromata	Conidiophores	Conidia	Ref. Coll. Accession No.	Status of collection
Periconiella lygodii	*Lygodium japonicum* (Japanese climbing fern)	lacking	Medium to medium –dark brown, straight, multiseptate, thick-walled, branched apical portion, two to four times dichotomously or occasionally trichotomously branched, 90-350 x 2-5.5 µm	pale olivaceous or olivaceous brown, obclavate-cylindrical, smooth, conico-truncate at the base, apex obtuse or subobtuse, 1-5 septate, 25-75 x 3-5.5 µm	CALP 11680 and BRIP 52369	FR

Reference: Chupp (1954); Ellis (1971); Braun (2004). * FR =First Record.

Table 6. Characteristics of *Periconiella lygodii* associated with leaf spot of *Lygodium japonicum.*

5. Lucid key for Philippine cercosporoid fungi

Before the advent of computers, the traditional way in which scientists identify identify biological specimens was through the use of printed pathway (or dichotomous) keys. However, with the advent of database and multi-media-software, it is now possible to store large amounts of biological data and to access this information through easy-to-use matrix-based (or multi-access) keys. Lucid is one example of a multi-media matrix key.The Lucid Program from The Centre for Biological Information Technology CBIT, University of Queensland, which was licensed to the third author was used to develop the Lucid key. The activities involved in the process of designing, developing, producing and publishing a Lucid key on CD, DVD or the Internet are outlined as follows: (1) Establishing the scope of the key; (2) designing and scoring the key; (3) sourcing, developing and editing facts sheets, images and other multi-media associated with features and entities; (4) packaging up a prototype on CD or on the Internet; (5) beta testing and user testing of the key; (6) graphic design of CD and CD-insert or web; and (7) packing of key for release.

5.1 Lucid Builder

Lucid key consists of two programs: Lucid Builder and Lucid Player. The first program is a key development tool (Fig. 1) that allows taxonomists to input their knowledge base into a form that is readily accessible by other people. A Lucid Builder enables key developers to easily build their own keys. In the present study, information from 74 Cercosporoid fungi data were entered for developed Lucid key.

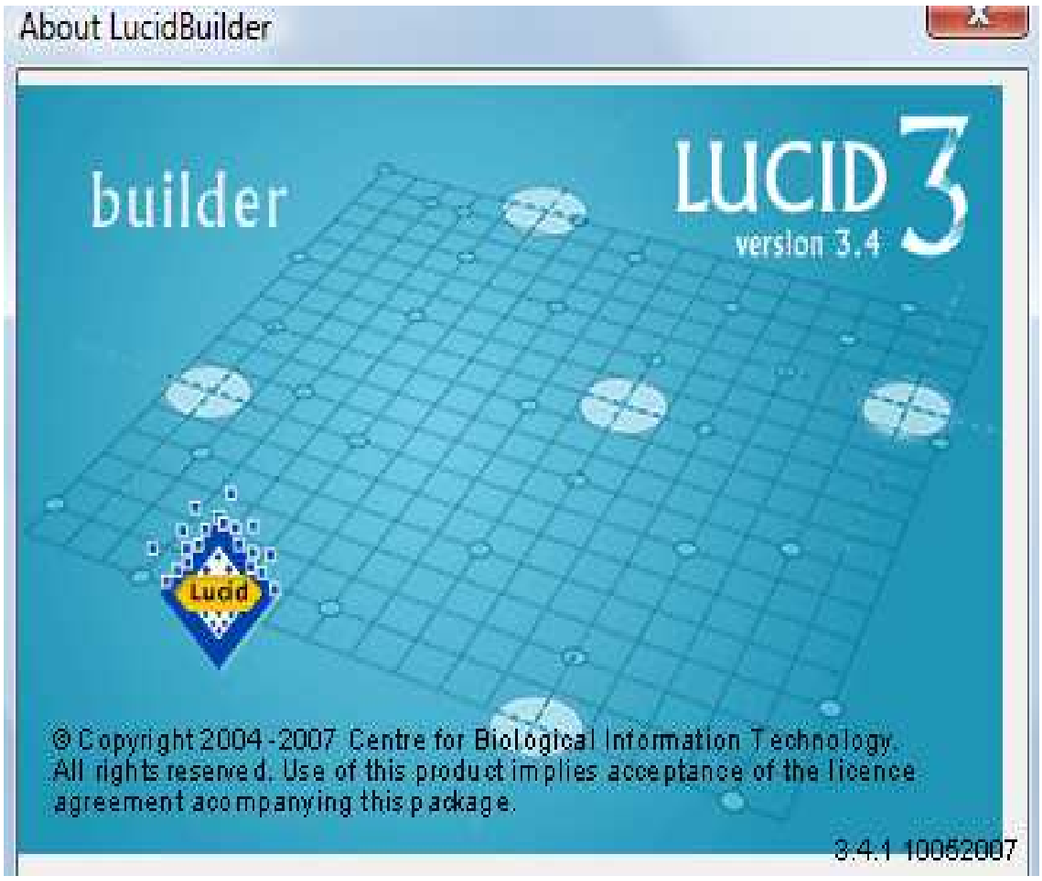


Fig. 1. Screen shot from the Lucid Builder.

In Lucid Builder, data were incorporated for example for *Cercospora adiantigena* on *Adiantum phillipense* (Fig. 2). The right side of the screen shows, all species that were inputted while left side provides the inputted characters for specific species. The information that were entered on the left side of the screen corresponds to the highlighted Cercosporoid species on the right side.

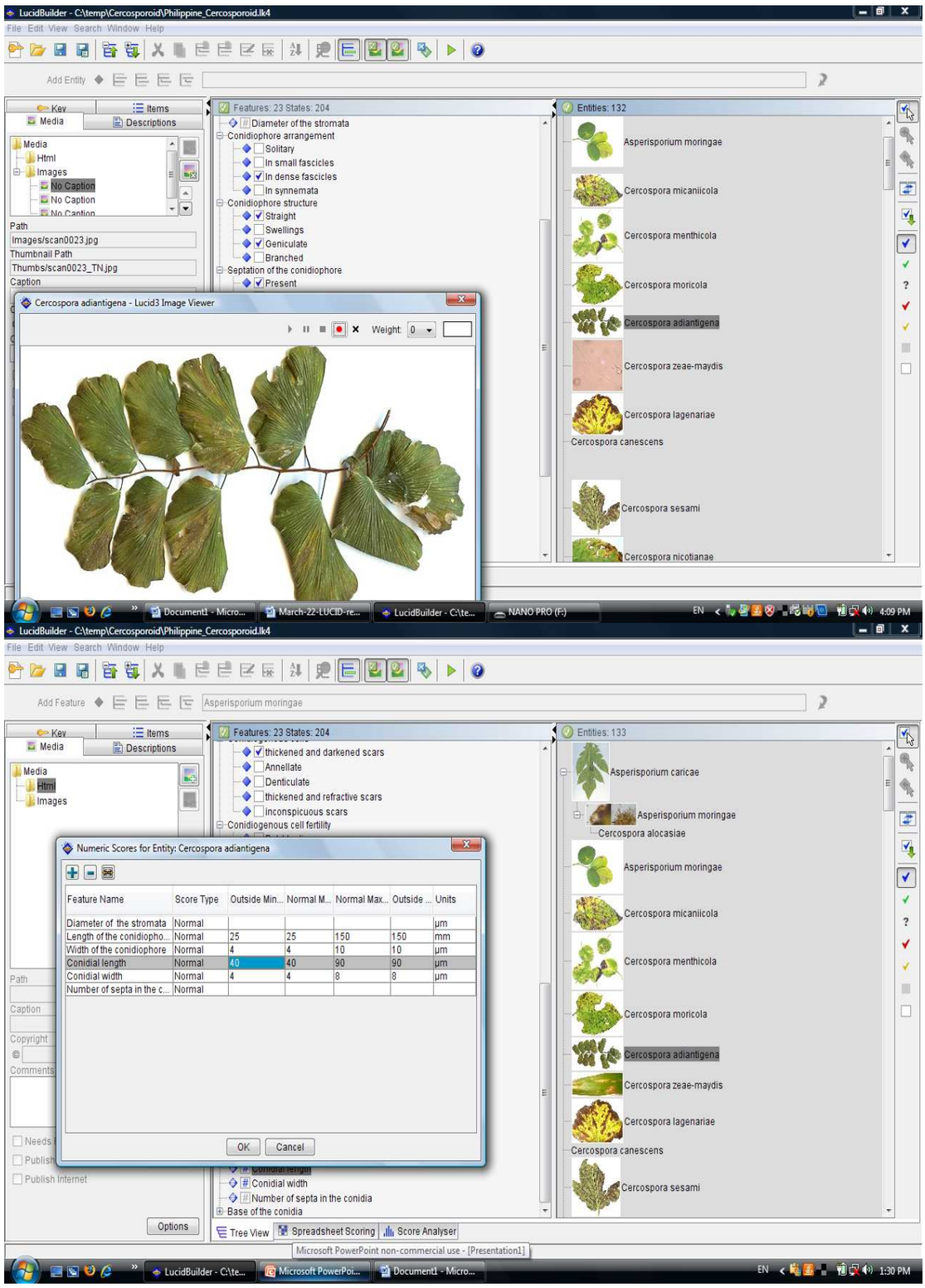


Fig. 2. Screen shot from the Lucid Builder- *Cercospora adiantigena* on *Adiantum phillipense*. Symptoms of the disease and measurement of morphological characters (Left inset).

During an identification session, Lucid Player allows one to choose any question in its list at any time, but "stepping" through the key in a structured and sensible way will make one task of identification easier. The guidelines for making identification are as follows (1) familiarity with the specimen; (2) note and use of distinctive features; (3) answering easy features first; 4) choosing multiple states; and (5) checking the result.

Familiarity with the characteristics of the specimen to be identified is essential. Briefly reviewing Lucid key and specimen's characteristics before one starts will facilitate the identification. In any key, some taxa may possess particularly distinctive features. Use of these may allow the taxon to be keyed out in a very few steps. At the very least, starting with particularly distinctive or striking features for the first character states selected may quickly reduce the list of entities remaining. One can select any features from any position in the list and start by browsing the list of features available for obvious features that one can quite quickly answer, as opposed to getting stuck on the first one. Lucid is designed to overcome problems associated with difficult and obscure features.Always choose multiple states if one is uncertain which state is the correct one to choose for a particular specimen. One can choose as many states as from any one feature. After a preliminary identification has been made, one can check the other information (notes or image) provided for the taxon.

5.2 Lucid Player

The second program of the Lucid key is key interface or Lucid Player (Fig. 3) through which end-users interact with the Lucid key that has been developed and distributed either as a CD-Rom or via the Internet. The Lucid player enables users to view and interact with the key.

Fig. 3. Screen shot from the Lucid Player.

Lucid Player allows one to input a list of character states that best describe the specimen to be identified. These character states can be selected (or de-selected) in any order, resulting in a shortening of the list of remaining taxa that best match the decribed specimen. The upper left side of the screen shows all characters for a given specimen while it's lower left side indicates the characters that were chosen. The upper right side of the screen provides the possible identity of the specimen while the lower right side shows the discarded taxa from the list (Fig. 4).

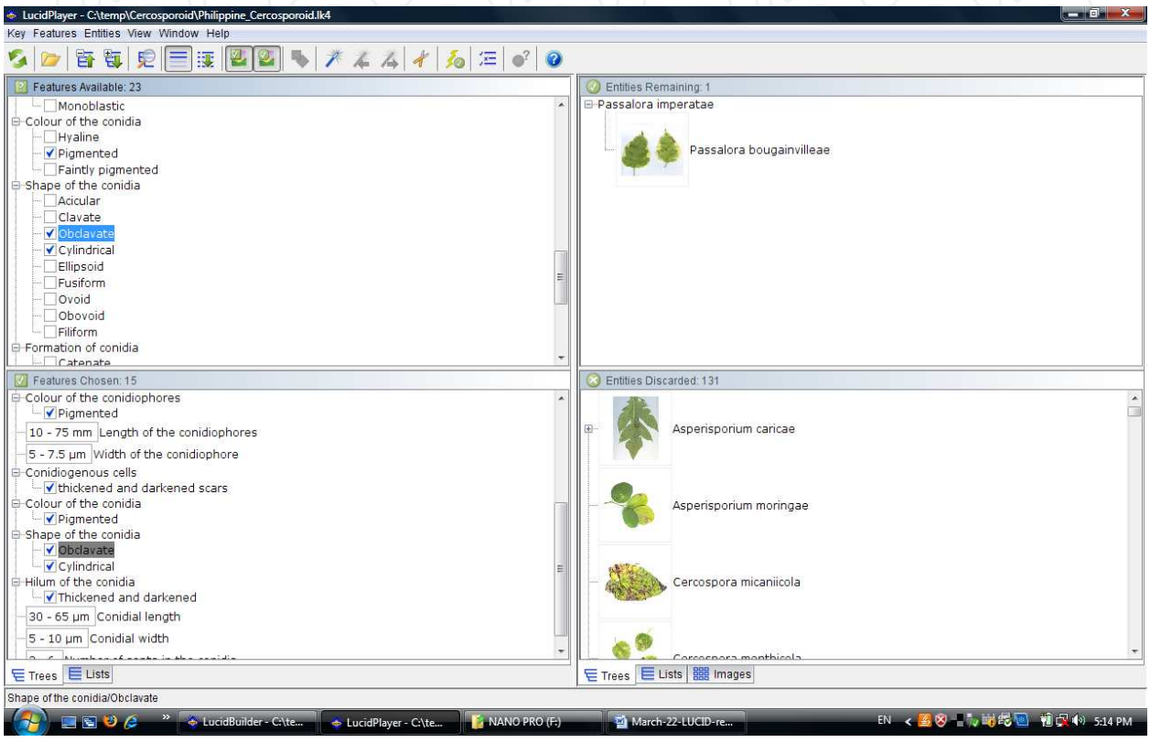


Fig. 4. Screen shot from the Lucid Player- *Passalora bougainvilleae.*

In the present study, Lucid key was developed to identify Cercosporoid fungi, even though the dichotomous keys are the most common keys encountered. The use of dichotomous keys has a major disadvantage: if a couplet is difficult or impossible to answer, the identification session often ends there. Lucid has the advantage over printed dichotomous keys in that the user is able to skip an unanswerable couplet or question and still proceed with identification because Lucid key allows to start at any point and proceed in any order. Lucid guide for smut fungi of Australia has already been completed. Its accompanying CD, incorporating a Lucid Player, provides an easy- to-use, interactive key to smut species, with comprehensive fact-sheets, distribution maps, and over 1000 images (Vanky and Shivas, 2008). On the other hand, Lucid guide for smut fungi of Thailand is still underway in collaboration with Australian plant pathologists (Shivas, personal communication). Gerald (2005) reported that, "Diagnosing Postharvest Diseases of Cantaloupe" is the first Lucid key developed in the U.S. for a set of plant diseases and one of the first plant disease identification keys ever developed in Lucid. A Lucid key was developed for the identification of *Phytophthora species* in USA based on morphological and molecular characters (Ristaino *et al*. 2008). In the

present study only the data of the true Cercosporoids like, *Cercospora, Pseudocercospora* and *Passalora* were inputted into the Lucid key.

Identification of Cercosporoid fungi is a difficult task, and the Lucid key was created to help provide individuals with easily accessible tools to distinguish species. Recent experience suggests that computer-based identification keys will become an increasingly important part of the move towards providing taxonomic information on-line.

6. Summary and conclusions

The genus *Cercospora* is one of the largest genera of hyphomycetes. i.e., commonly associated with leaf spots and is responsible for great damages to beneficial plants, such as cereals, vegetables, ornamentals, forest trees, grasses. A total of 105 Cercosporoid diseases were identified, belonging to *Cercospora* (48), *Pseudocercospora* (20), *Passalora* (5), *Asperisporium* (1), *Cladosporium* (30,) and *Periconiella* (1). From the reported *Cercospora* species, 20 were *Cercospora apii s.lat* and 28 were *Cercospora s.str.* The first report of *Cercospora basellae-albae* in the Philippines was observed causing leaf spots on *Basella alba cv. Rubra (*Begum and Cumagun, 2010*).* Twenty eight first records of Cercospora leaf spots were reported. Among Pseudocercospora leaf spots, 12 first records were reported and all were host specific. A new species of *Passalora amaranthae* found on *Amaranthus viridis* was reported. Only one specimen caused by *Asperisporium moringae* was reported on *Moringa oleifera.*

Lucid key is a powerful and highly flexible knowledge management software application designed to help users with identification and diagnostic tasks. Lucid is one of a multi-media matrix keys, that includes possible the storing of large amounts of information. Lucid key consists of two programs: Lucid Builder and Lucid Player. The first program is a key development tool, which allows developers to easily build their own keys. The second program of the Lucid key is the key interface or Lucid Player, through which end-users interacts with the Lucid key and enables users to view and interact with the key. In the present study, Lucid key was developed to identify Cercosporoid fungi, a total of 74 Cercosporoid fungi and their characters were entered into a program using Lucid Builder. Lucid has the advantage over printed dichotomous keys in that the user is able to skip an unanswerable couplet or question and still proceed with identification. Identification of Cercosporoid fungi is a difficult task, and the Lucid key was created to help provide individuals with easily accessible tools to distinguish species. The end product of the Lucid key of Philippine Cercosporoid fungi, in the future will be useful in teaching, research, and extension work in mycology and plant pathology.

7. References

Agrios, G.N. (2005). Plant Pathology. 5th ed. Academic Press. New York.

Aptroot, A. (2006). *Mycosphaerella* and its anamorphs: 2. Conspectus of *Mycosphaerella*. *CBS Biodiversity Series* 5:1 –231.

Barnett, H.L. and Hunter, B.B. (1998): Illustrated Genera of Imperfect Fungi 4th ed. APS Press, St Paul, USA. 218.

Begum, M.M., Shivas, R.G. and Cumagun, C.J.R. (2009). First record of *Periconiella lygodii* occurring on *Lygodium japonicum* in the Philippines. *Australasian Plant Disease Notes* 4: 17-18.

Begum, M.M. and Cumagun, C.J.R. (2010). First record of *Cercospora basellae-albae* from the Philippines. *Australasian Plant Disease Notes* 5: 115-116.

Braun, U. (2004). *Periconiella* species occurring on ferns. *Feddes Repertorium* 115: 50-55.

Chupp, C. (1953). A monograph of the fungus genus *Cercospora*. Ithaca New York. 9-20.

Chupp, C. (1954). A monograph of the fungus genus *Cercospora*. Ithaca. New York. 667.

Crous, P.W. (1998). *Mycosphaerella* spp. and their anamorphs associated with leaf spot diseases of *Eucalyptus*. *Mycologia Memoir* 21: 1– 170.

Crous, P.W. and Braun, U. (2003). *Mycosphaerella* and its anamorphs. . Names published in *Cercospora* and *Passalora*. *CBS Biodiversity Series* 1:1 –571.

Crous, P.W. and Groenewald J.Z. (2006a). *Mycosphaerella alistairii*. *Fungal Planet* No. 4. (www.fungalplanet.org).

Crous, P.W. and Groenewald, J.Z. (2006b). *Mycosphaerella maxii*. *Fungal Planet* No. 6. (www.fungalplanet.org).

Crous, P.W. Aptroot, A. Kang, J.C. Braun, U., and Wingfield, M.J.(2000). The genus *Mycosphaerella* and its anamorphs. *Studies in Mycology* 45:107–121.

Crous, P.W., Kang, J.C., and Braun, U. (2001). A phylogenetic redefinition of anamorph genera in *Mycosphaerella* based on ITS rDNA sequence and morphology. *Mycologia* 93: 1081-1101.

Cumagun C.J.R. and Padilla, C.L. (2007). First record of *Asperisporium caricae* causing black spot of papaya in the Philippines. *Australasian Plant Disease Notes* 2:89-90.

Deighton, F.C. (1967a). New names in *Mycosphaerella (M. arachidis and m. pruni-persicae)* and validation of *M. rosicola*. *Trans. Brit. Mycol. Soc.* 50:328-329.

Deighton, F.C. (1967b). Studies on *Cercospora* and allied genera. II. *Passalora, Cercosporidium* and some species of *Fusicladium* on *Euphorbia*. *Mycol. Papers* 112:1-80.

Deighton, F.C. (1971). Studies on *Cercospora* and allied genera. III. *Cercospora*. *Mycol Papers* 124: 1-13.

Deighton, F.C. (1973). Studies on *Cercospora* and allied genera. IV. *Cercosporella* Sacc., *Pseudocercosporella* gen. Nov. and *Pseudocercosporidium* gen.nov. *Mycol Papers*133: 1-62.

Deighton, F.C. (1974). Studies on *Cercospora* and allied genera. V. *Mycovellosiella* Rangel. and a new species of *Ramulariopsis*. *Mycol. Papers* 137: 1-73.

Deighton, F.C. (1976). Studies on *Cercospora* and allied genera. VI. *Pseudocercospora* Speg., *Pantospora* Cif. And *Cercoseptoria* Petr. *Mycol. Papers* 140:1-168.

Deighton, F.C.(1979). Studies on *Cercospora* and allied genera. VII. New Species and redispositions. *Mycol. Papers* 144:1-56.

Deighton, F.C. (1983). Studies on *Cercospora* and allied genera. VIII. Further notes on *Cercoseptoria* and some species and redispositions. *Mycol. Papers* 151: 1-13.

Deighton, F.C. (1987). New species of *Pseudocercospora* and *Mycovellosiella*, and new combinations into *Pseudocercospora* and *Mycovellosiella*. *Trans. Brit. Mycol.soc.* 88: 365-391.

Ellis, M.B. (1971). Dematiaceous Hypomycetes. Kew, UK: Commonwealth Mycological Institute.

Ellis, M.B. (1976). More Dematiaceous Hypomycetes. Kew, UK Commonwealth Mycological Institute.

Ellis, M.B. and Holliday, P. (1972). *Asperisporium caricae*. CMI Descriptions of Pathogenic Fungi and Bacteria No. 347.Kew, UK: CAB International Mycological Institute

Gerald, J.H. (2005). Diagnosing Postharvest Diseases of Cantaloupe. North Carolina State University.

Goh, T. K. & W. H. Hsieh (1989). New species of *Cercospora* and allied genera of Taiwan. *Bot. Bull. Acad. Sinica* 30: 117-132.

Guo, Y.L. and Hsieh, W.H. (1995). The genus *Pseudocercospora* in China. Mycosystema Monographieum Series No. 2. Int. Acad. Pub., Beijing, China. 388.

Guo, Y.L., Liu, Y.J. and Hsieh, W.H. (1998). Flora Fungorum Sinicorum Vol. 9, *Pseudocercospora.* Science Press, Beijing, China.

Hanlin, R.T. (1990). Illustrated Genera of Ascomycetes. 3 Vols. APS Press, St Paul, USA.

Hsieh, W. H. and Goh, T.K. (1990). *Cercospora* and Similar Fungi from Taiwan. Maw Chang Book Co., Taipei. 376.

Katsuki, S. (1965). *Cercospora* of Japan. *Trans. Mycol. Soc. Japan,* Extra Issue No. 1. 100.

Katsuki, S. and Kobayashi. (1975). *Cercospora* of Japan and allied genera (Supplement 3).*Trans. Mycol. Soc.Japan* 16:1-15.

Kendrick, W.B. and Dicosmo, F. (1979). Teleomorph-anamorph connections in ascomycetes. In: The Whole Fungus, Vol.1:283-410. National Museum of Natural Sciences, Ottawa.

Kirk, P.M., Cannon, P.F., David, J.C. and Stalpers, L.A. (2001). Dictionary of the Fungi, 9th edn. CAB International, Oxon.

Maublanc, A. (1913). Su rune maladie de feuilles du papayer "Carica papaya. *Lavoura* 16 : 208-212.

Michaelides, J. Hunter, L. Kendrick, B. and Nag Raj, T.R. (1979). Synoptic Key to 200 Genera of Coelomycetes. University of Waterloo Biology Series 20. University of Waterloo, Waterloo, Canada. 42.

Norton, G.A. (2000). Multi-media keys for identification and diagnostics: the Lucid experience. International Workshop of the Asia-Pacific Advanced Network (APAN) and its Applications*:* 27-30.

Pollack, F. G. (1987) An annotated compilation of *Cercospora* names. *Mycol. Mem*. 12:1-212.

Ponaya, A.B. and Cumagun, C.J.R. (2008). First record of *Passalora bougainvilleae* causing leaf spot of bougainvillea in the Philippines. *Australasian Plant Disease Notes* 3: 3-4.

Quimio T.H. and Abilay L.E. (1977). Cercospora Species and disease of Philippine Crops. University of the Philippines Los Banos. Philippines.

Ristaino, J.B., Haege, M.J. and Hu, C.H. (2008). Development of a *Phytophthora* Lucid key. *Journal of Plant Pathology*, 90, S2.81-S2.465.

Saccardo, P.A. (1880). Conspectus generum fungorum Italie inferriorum, nempe as Sphaeropsidas, elanconieas et Hyphomycetes pertinentium. Systemate sporologico dispositorum. *Michelia* 2 :1-38.

Saccardo, P. A. (1886). Sylloge fungorum omnium hucusgue cognitorium. Vol. IV. Padova, 810.

Shin, H.D. and Kim, J.D. (2001). *Cercospora* and allied genera from Korea. Plant Pathogens from Korea 7; 1-302.

Spegazzini, C.(1910). Myceters Argentinenses, Ser. V. *An. Mus. Nac. Hist. Nat. Buenos Aires* 20: 309-467.

Stakman E.C. and Harrar J.G. (1957). 362. The Ronald Press Company. New York.

Sutton, B.C. (1980). The coelomycetes: fungi imperfecti with pycnidia, acervuli, and stromata. Commonwealth Mycological Institute, Kew, Surrey, England, 696 p.

Teodoro, N.T. (1937). Enumeration of Philippine fungi. Commonwealth of the Phill. Dept. of Agric. & Commerce. *Tech. Bull.* No. 4. 585.

Vanky, K. and Shivas, R.G. (2008). Fungi of Australia: The Smut Fungi. Australian Biological Resources Study. CSIRO Publishing.

Vasudeva, R.S. (1963). Indian Cercosporae. Indian Council of Agricultural Research, New Delhi. 245.

von Arx, J.A. (1983). *Mycosphaerella* and its anamorphs. Proc. K. Ned. Akad. Wet. Ser. C Biol. Med. Sci. 86, 1: 15-54.

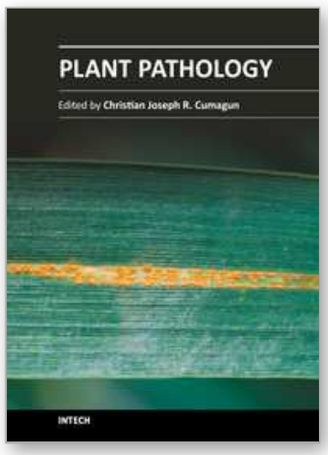
Welles, C.G. (1924). Observation on taxonomic factors used in the genus *Cercospora*. *Science* 59:216-218.

Welles, C.G. (1925). Taxonomic studies in the genus *Cercospora* in the Philippine Islands.*Am.J.Bot*.12:195-220.

Wellman, F.L.(1972). Tropical American Plant Disease. 219 pp. The Scarecrow Press, Inc. New Jersey.

Yen JM, Lim G. (1980) *Cercospora* and allied genera of Singapore and the Malay peninsula. The Gardens' Bulletin Singapore 33, 151–263.

Young, T. (2001) 101 Forest Fungi of Eastern Australia. Knowledge Books and Software,Brighton, Australia. CD ROM.



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