

CHAPTER 1

GENERAL INTRODUCTION AND THESIS OUTLINE

1.1 Introduction

Powdery mildews are easily recognizable disease by their prominently, typical symptoms as white to grayish powder of mycelia in the areas of infection (Spencer, 1978). The fungi causing powdery mildews are obligate parasite and can not be cultured on artificial media. They obtain nutrients from host plant by sending special structure, termed haustorium (feeding organ) into epidermal cell of plant organs (Agrios, 2005). Powdery mildews infect a diverse range of host plants about 10,000 angiosperm plant species worldwide (Amino, 1986). They consist of about 820 species belonging to 13 genera (Braun, 2011). Powdery mildews belong to the order Erysiphales (Leotiomycetidae) of the phylum Ascomycota (Kirk *et al.* 2008). Identification of Erysiphaceae can be classified into 2 different groups as: ectoparasitism and (partial) endo-parasitism. The life cycle of Erysiphaceae showed the morphological characteristics in both imperfect (anamorph) and perfect (teleomorph) states (Braun, 1987).

Over the years, many monographs of powdery mildews have been published by mycologists worldwide (Bélanger *et al.* 2002; Braun, 1987; Braun, 1995; Blumer, 1933; Boesewinkel, 1980; Bolay, 2005; Homma, 1937; Palti, 1988; Paul and Thakur, 2006; Sharma and Khare, 1995; Shin, 2000; Zhi, 2010). A monograph of Erysiphales that published by Braun (1987) was most comprehensively studied and generally used in taxonomy.

Historic present, Linné (1753) published the name *Mucor Erysiphe*, the first binomial referring to a powdery mildew on *Humulus*, *Acer*, *Lumia*, *Geleopsis* and *Lithospermum*. And then, Linné defined a generic name in termed as *Erysiphe*, but without a definite description in 1767.

As reported in the concept of taxonomy of powdery mildew fungi, Schlechtendal (1819) was the first author who identified to species, pointing out both single and numerous asci. In 1851, the modern taxonomy of the Erysiphaceae was started by Léveillé. He divided powdery mildew fungi into 6 genera (*Calocladia*, *Erysiphe*, *Phyllactinia*, *Podophaera*, *Sphaerotheca* and *Uncinula*) based on morphological characteristics of their asci, ascospores, and appendages. Fresenius (1852) identified the fungal species that distinguished from the characteristics of their conidiophores for the first time. Anamorphic state correlated with teleomorph of powdery mildews were firstly considered and perceived by the brothers Tulasne (1931). Furthermore, de Bary (1863, 1870) pointed out for the first time to taxonomy on observation of haustoria in connection with the appressoria and conidia. On the contrary, Salmon (1900a, b) entirely ignored the taxonomic value of the anamorph and published the first monograph of powdery mildews that basically identified on the teleomorph. The conidial germination features studied by Neger (1902) were distinctly used for discrimination of different taxa.

The first systematic key for identification of fungi in *Oidium* species was created by Ferraris (1912) who grouped species of *Oidium* according to the size and shape of their conidia. In 1914, Sawada established a classification of Erysiphaceae basing solely on the anamorph. Foex (1913), Jaczewski (1927) and Brundza (1934) contributed to the classification of the conidiophore types in the genus *Oidium*. The terms *Euoidium* and *Pseudoidium* for *Oidium* states with conidia in chains and solitary conidia respectively were introduced meaningfully on taxonomic characters in the powdery mildew fungi by Jaczewski (1927). Hirata (1942, 1955a, b) provided comprehensive germination experiments with Japanese fungal species of powdery mildews. Boesewinkel (1980) provided the first real key to species of Erysiphaceae based on morphology of the imperfect states; observation on mycelium, appressoria,

haustoria, fibrosin bodies, conidiophores, conidia, germ tubes and appressoria on germ tubes. Later, Shin and La (1993) and Shin and Zheng (1998) introduced some new morphological features of taxonomic relevance.

The recent of the fungi taxonomic research on powdery mildews is the examination and characterization using scanning electron microscope (SEM) and molecular analysis. Cook *et al.* (1997) demonstrated that by using SEM differences on the conidial wall of the fungal species can be used for taxonomic features. Many morphological characters are overlapping among the genera of powdery mildew fungi. In the term of anamorphic states, conidial structures are important for the generic taxonomy. Whereas, the teleomorphic characteristics are useful features for taxonomy in the species level (Bélanger *et al.* 2002). Most sexual fruiting structures of powdery mildew fungi are absent in tropical or sub-tropical region causing the problems on identification of the fungi. The recent evolution techniques, the molecular approaches are useful tool for precise taxonomy of the powdery mildew fungi (Saenz *et al.* 1994; Takamatsu, 2004; Takamatsu and Kano, 2001; Mori *et al.* 2000a, 2000b). The molecular phylogenetic analysis combined with morphological analysis was performed to clarify taxonomy of the pathogenic fungi in order to establish information for preventing and managing strategies for powdery mildew diseases.

1.2 Research objectives

This present study has the following objectives as listed below:

- 1) To survey a host distribution of powdery mildew fungi in Tribe Phyllactinieae.
- 2) To study the occurrence of powdery mildew fungi in Tribe Phyllactinieae in Northern Thailand, with a primary focus in Chiang Mai Province.
- 3) To comprehensively study the taxonomy of powdery mildew fungi in Tribe Phyllactinieae; the morphological characteristics observation and phylogenetic analysis.
- 4) To establish phylogenetic relationship of powdery mildew fungi in Tribe Phyllactinieae using molecular techniques.
- 5) To assess the diversity and host specificity of powdery mildew fungi in Tribe Phyllactinieae.

1.3 Usefulness of the Research (Theoretical and/or Applied)

- 1) Knowledge of comprehensively taxonomic studies of powdery mildew fungi in Tribe Phyllactinieae using combination of morphological characteristics and phylogenetic approaches. My studies resolved ambiguous morphology and demonstrated anamorph-teleomorph connections of which the teleomorphic state is unknown.
- 2) Knowledge of the phylogenetic relationships of powdery mildew fungi in Tribe Phyllactinieae.
- 3) Discovery of new host plants of powdery mildew fungi which have never been reported in checklist of plant disease Thailand index.
- 4) Knowledge of powdery mildew fungi in Tribe Phyllactinieae. The results will be valuable important informations for scientific societies in Thailand such as academicians, plant pathologists, mycologists and quarantine researchers for identifying the species of powdery mildews.

1.4 Research content

This research reviews knowledge of powdery mildew fungi, taxonomy and classification including using molecular analysis to clarify the taxonomy in Chapter 2. The methods used in this research revolved in Chapter 3. Chapter 4 provide the descriptions and illustrations of powdery mildews in tribe Phyllactinieae including phylogenetic relationships in Thailand. A general discussion and conclusion of the result in this research is presented in Chapter 5.