CHAPTER 1

INTRODUCTION

The Erysiphales is a fungal group causing important plant diseases called "powdery mildew" on about ten thousands of angiosperm plants including many economically important cultivated plants (Amano, 1986; Braun, 2011). The host plant species are mainly distributed in the temperate regions of the Northern Hemisphere. They also infect many plant species distributed in tropical or subtropical regions, including economically important cultivated plants (Limkaisang *et al*., 2006). The powdery mildew fungi occur in both anamorphic and teleomorphic forms. The characteristics of all structures of these fungi can be of taxonomic value. Especially, among the earlier authors, the opinion was widely distributed that only a limited number of features should generally be used in Erysiphacean taxonomy (Braun, 1987).

Braun *et al.* (2002) stated that the term "ascomata" is widely accepted. Hence, the terms "cleistothecium" and "perithecium" should not be used for powdery mildew fruitbodies. If a specific name is required, the following term is proposed; chasmothecium (chasma + thecium = slit + fruitbody) as the enclosed in a fruiting

body. The taxonomy and identification of powdery mildews are based largely on the characteristics of the teleomorph, such as the shape of the appendages on the chasmothecia and whether the latter contains one or several asci. This causes problems when a powdery mildew increases its host range or geographical area, because the teleomorph may not be seen for some years, or may not be produced at all.

Linnaeus (1753) was the first author who gave binomial name to the powdery mildews. He published the name *Mucor erysiphe* for powdery mildew on *Humulus, Acer, Lumia, Geleopsis* and *Lithospermum*. The first extensive observations on the Erysiphaceae were conducted by de Candolle (1805, 1815) who described numerous species, largely on the basis of host, the appearance of the mycelium, the characteristics of the chasmothecia and the appendages. Schlechtendal (1819) was firstly cleared to explain mention the existence of powdery mildew chasmothecium with both single ascus or with numerous asci. The modern taxonomy of powdery mildew started by work of Leveille (1851). He introduced a new generic system based on the teleomorphic state. The number of asci per chasmothecia and the structure of the appendages were the main characteristic in Leveille's generic system. He divided the powdery mildew into six genera (*Calocladia, Erysiphe, Phyllactinia, Podosphaera, Sphaerotheca* and *Uncinula*) but he did not recognize the anamorphic

states. Fresenius (1852) provided several good drawings of conidiophores and he seems to be first author to point out that different species can be distinguished by their conidiophores because they are not identical in all taxa. de Bary (1863) realized the relationship between the fungus and the host. He observed haustoria in connection with appressoria and pointed out the taxonomic relevance of conidial and appressorial morphology. Salmon (1900) published the first monograph of powdery mildew, which included six genera, 49 species and 11 varieties based on only chasmothecia characteristic.

Recent advances in molecular techniques such as DNA-DNA hybridization, RFLP, RAPD-PCR, DNA sequencing and electrophoretic karyotyping have made it possible to investigate the phylogeny of a variety of organisms at the molecular level (Bruns *et al*., 1991). Among the molecular techniques, ribosomal DNA (rDNA) amplification and the direct sequencing of the PCR product developed by White *et al*.(1990) seem to be the best for phylogenetic studies of powdery mildew fungi because DNA sequences can be analyzed using only a small amount of fungal material. Shin and La (1993) and Shin and Zheng (1998) introduced some new morphological features of taxonomic relevance. He introduced the morphology of edge lines as a new character of taxonomic value. Subsequently, phylogenetic

analyses were used for identification of powdery mildew species by means of molecular methods (Saenz *et al*., 1994; Hirata and Takamatsu, 1996; Takamatsu *et al*., 1998, 1999, 2000; Saenz and Taylor 1999; Hirata *et al*., 2000; Mori *et al*., 2000; Khodaparast *et al*., 2001).