Morphological and Molecular Identification of Powdery Mildew caused by *Neoerysiphe galeopsidis* on *Stachys sieboldii* Miq.

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**ABSTRACT**

From August to October 2013, a powdery mildew was found on Japanese artichoke (*Stachys sieboldii*) in Jinju, Korea. White colonies were present on leaves and petioles. Severely infected lesions were discolored, being brown. In the present study, the morphological features of anamorphic and teleomorphic Korean specimens were studied. To complete the identification, the sequence of the internal transcribed spacer region of the ribosomal RNA gene (ITS rRNA) was analyzed. Based on morphological characteristics, including anamorphic and teleomorphic features, as well as analysis of the ITS rRNA gene region, the fungus associated with the symptoms was identified as *Neoerysiphe galeopsidis*. Although the host ranges of powdery mildew caused by *N. galeopsidis* has been previously recorded, no full description or illustration of fungal symptoms and signs on Japanese artichoke has yet appeared. To the best of our knowledge, this is the first full description of powdery mildew disease on Japanese artichoke featuring molecular identification, morphological features, symptoms, and signs in Korea.

**Key words** - Japanese artichoke, *Neoerysiphe galeopsidis*, Powdery mildew, *Stachys sieboldii*
Introduction

Powdery mildew is a fungal disease that affects a wide range of plants. Powdery mildew diseases are caused by many different species of fungi in the order Erysiphales. Powdery mildew occurs and spreads well in environments of high humidity with moderate temperatures (Huang et al., 2000; Siebold & Tiedemann, 2012). From August to October 2013, a powdery mildew disease was observed on the leaves of Japanese artichoke (Stachys sieboldii) in Jinju, Korea. Japanese artichoke is a perennial herbaceous plant of the family Lamiaceae, and the rhizome thereof can be eaten as a root vegetable (Wikipedia Foundation).

Powdery mildew fungi cause serious diseases on a wide variety of crops, including cereal plants, vegetables, fruit plants, and ornamental plants. Powdery mildew fungi are biotrophic parasites and invade only epidermal cells of host plants using the haustoria (Huckelhoven, 2005). The genus Neoerysiphe of powdery mildew fungi includes six teleomorphs: N. chelones, N. cumminsiniana, N. galii, N. rubiae, N. geranii, and N. galeopsidis; as well as three anamorphs: Oidium baccharidis, O. aloysiae, and O. maqui(Liu et al., 2005; Takamatsu et al., 2008).

Each species has a different distribution. N. galeopsidis, parasitizing many Lamiaceae as the main host family, but also a few species of Acanthaceae, Bignoniaceae, Dipsacaceae, and Malvaceae, is nearly circumglobal, being found in Europe, Asia, Africa, North America, and New Zealand (Amano, 1986; Braun, 1987; Braun & Takamatsu, 2000; Mori et al., 2000; Liu et al., 2005; Takamatsu et al., 2008).

Japanese artichoke, which has a nutty artichoke-like flavor, is used as a vegetable, in salads, and as a garnish. In Japanese cuisine, the Japanese artichoke is primarily pickled. In particular, the tuber is a part of Osechi, and is cooked to celebrate the Japanese New Year. In French cuisine, the cooked tuber is often served alongside Japanese-styled dishes. A powdery mildew disease was observed on Japanese artichoke plants in Jinju, Korea. Powdery mildew on Japanese artichoke plants, caused by Erysiphe, has not previously been reported in Korea (Shin, 2000; Farr & Rossman, 2014). In addition, no full description or illustration of symptoms, signs, and anamorphic and teleomorphic features; no detailed information on molecular identification and phylogenetic analysis of such a fungal species, have yet been recorded from Korea.

In the present study, we explored the morphological features of anamorphic and teleomorphic Korean specimens, and obtained the complete sequence of internal transcribed spacer region of the ribosomal RNA gene (ITS rRNA) of the powdery mildew fungus infecting Japanese artichoke plants. Based on morphological characteristics and analysis of the ITS rRNA gene sequence, the fungus associated with the symptoms was identified as Neoerysiphe galeopsidis. To the best of our knowledge, this is the first full description of powdery mildew disease on Japanese artichoke plants, featuring molecular identification, symptoms, and signs. It is important to be aware of powdery mildew because the disease may significantly reduce Japanese artichoke production.

Materials and Methods

1 Sample sources

Conidial and cleistothecial specimens of powdery mildews were collected from the farmer's field (35°13′47.15″N, 128°08′15″E) in Jinju, Korea, in 2013. Fungal DNA was extracted from fresh materials as soon as possible. The remaining