First report of powdery mildew caused by anamorphic *Podosphaera* sp. on *Coreopsis* sp. in India

Pankaj Baiswar^{A,B}, Satish Chandra^A, T. K. Bag^A and S. V. Ngachan^A

^AICAR Research Complex for NEH Region, Umiam-793103, Meghalaya, India.

^BCorresponding author. Email: pbaiswar@yahoo.com

Abstract. This is the first report of powdery mildew on leaves of *Coreopsis* sp., an ornamental plant, caused by the anamorph of *Podosphaera* sp. in India.

Coreopsis belongs to the Asteraceae and is the largest genus in the tribe Coreopsideae. It is used as an ornamental plant in India. African species of *Coreopsis* are now considered as belonging to the genus *Bidens*. *Coreopsis* is now regarded as a New World genus in which the evolution of morphologically useful taxonomic characters has been complex and their value compromised for delimitation of monophyletic groups (Crawford and Mort 2005).

Powdery mildew symptoms were observed in April 2010 on almost 80% of the *Coreopsis* sp. plants grown in a garden at Umsaw Khawan (RiBhoi, Meghalaya, India). Symptoms included circular to irregular white patches on both sides of the leaves (Fig. 1). Symptoms were more severe on upper leaves. Voucher specimens have been deposited in the herbarium collection of Agharkar Research Institute, Pune and ICAR Research Complex for NEH Region, India (AMH 9333, ICARHNEH-125).

Fungal structures present on the fresh leaves were removed using a strip of adhesive tape and examined by light microscopy with 3% potassium hydroxide as mounting medium (Correll *et al.* 1987). Suitable areas from dried leaves for scanning electron

microscopy (SEM) were selected using a dissecting microscope. Sputter coating with gold was done using a fine coat ion sputter, JFC-1100 (JEOL, Tokyo, Japan). Gold-coated samples (120 nm thickness) were then examined in a SEM JEOL model JSM 6360 (JEOL, Tokyo, Japan).

Previously, *Golovinomyces*, *Podosphaera* and *Leveillula* have been reported on *Coreopsis* (Amano 1986; Farr and Rossman 2009). Moreover, *Oidium heliotropii-indici* has been reported on *Coreopsis* from India (Paul and Thakur 2006). *O. heliotropii-indici* has nipple-shaped appressoria and this species is common on plants belonging to the family Boraginaceae. The specimens (AMH 9333, ICARHNEH-125) have ectophytic mycelium, conidia in chains, fibrosin bodies and indistinct appressoria, which indicated they belonged to the genus *Podosphaera* (Braun *et al.* 2002). Conidiophores were mostly erect, with some curved, and contained a foot cell (27–44 × 11–13.5 µm); conidia were ovoid, (27.5) 29–36 (–42) × (14.5–) 16–19 µm, with length : width 1.5–2.5 (av. 2) (Figs 2, 3). The basal septum of the conidiophore was just

Fig. 1. Symptoms of powdery mildew on *Coreopsis* sp. leaves (AMH 9333, ICARHNEH-125).

Fig. 2. Conidia of the anamorph of *Podosphaera* sp. on *Coreopsis* sp. (AMH 9333, ICARHNEH-125). Bar = 10 µm.

Fig. 3. Conidiophores of the anamorph of *Podosphaera* sp. on *Coreopsis* sp. (AMH 9333, ICARHNEH-125) Bar = 20 µm.

Fig. 5. Pycnidial conidiomata and conidia of the hyperparasite *Ampelomyces quisqualis* on *Podosphaera* sp. on *Coreopsis* sp. Bar = 20 µm.

Fig. 4. Wrinkling pattern as evident from SEM on conidia of *Podosphaera* sp. on *Coreopsis* sp. (AMH 9333, ICARHNEH-125). Bar = 10 µm.

adjacent to the mycelium. Smooth wrinkles and indistinct appressoria (Fig. 4) were observed in SEM studies (Cook *et al.* 1997). Germination pattern was of *Fibroidium* subtype *brevitubus*, which is further evidence that this pathogen belonged to *Podosphaera* (section *Sphaerotheca* subsection *Magnicellulatae*) (Cook and Braun 2009). A perfect stage (chasmothecium) was not found. Species delimitation in the subsection *Magnicellulatae* is still controversial and requires revision (Hirata *et al.* 2000; Braun *et al.* 2001; Ito and Takamatsu 2010). Pathogenicity tests yielded positive results. Inoculated plants developed symptoms after 10 days, whereas

control plants remained healthy. The hyperparasite *Ampelomyces quisqualis* was found associated with this pathogen (Fig. 5).

To our knowledge, this is the first record of powdery mildew of *Coreopsis* caused by *Podosphaera* sp. in India (Paul and Thakur 2006; Ahmed *et al.* 2007; Farr and Rossman 2009).

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