

Peronospora variabilis on *Chenopodium murale* in India

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Abstract. Downy mildew was observed on *Chenopodium murale* at Barapani, Meghalaya, India. *C. murale* is used as a leafy vegetable in the north-eastern hills region of India. Light and scanning electron microscopy revealed the presence of *Peronospora variabilis*.

Chenopodium murale, also known as nettle-leaved goosefoot belongs to the family Chenopodiaceae. This annual herb is native to parts of Asia, Africa and Europe. In north-east India tribal communities use it as a leafy vegetable. Many ethnic communities also use the leaves of *Chenopodium* for curing urinary problems and also for removing intestinal worms. The leaves are considered a rich and inexpensive source of protein, carotenoids and vitamins. This is considered as a potential crop since it can thrive in adverse situations with minimum agricultural input. It also has potential for use in bioremediation programs as it can accumulate large amounts of heavy metals (Bhargava *et al.* 2008 and references cited therein).

Typical downy mildew symptoms were observed on *C. murale* in 2009. Symptoms included greyish felt-like growth with corresponding yellow lesions on underside of both mature and immature leaves. Heavily infected leaves turned necrotic. Surveys in nearby areas also revealed the widespread occurrence of this disease. Voucher specimens have been deposited in the herbarium collection of MACS Agharkar Research Institute, Pune, India and ICAR Research Complex for NEH Region, India (AMH No. 9327, ICARHNEH-120).

Light microscopy was done using 3% potassium hydroxide (KOH) as mounting media. Fifty measurements were made following the recommendation of Hamilton and Cunnington (2006). Areas containing greyish growth were selected using a dissecting microscope, and were cut and placed on double-sided cellotape then sputter-coated with gold using Fine Coat Ion Sputter JFC-1100 (JEOL, Tokyo, Japan). Gold-coated samples were then placed on aluminium stubs in JEOL JSM 6360 (JEOL, Tokyo, Japan). Observations were made regarding the broadening of conidiophores toward ramifications and fine structure of ultimate branchlets (Thines 2006).

Conidiophores were straight or curved and measured 390–810 µm and trunks were 181.5–513 µm long. Callose plugs were absent. Branching was monopodial, ultimate branchlets were in pairs, curved, measuring 6.5–16 µm and

widths at the base were 2–4 µm (Fig. 1). Conidia were pale brown, broadly ellipsoidal to ellipsoidal measuring 25.5–32.5 × 18–21 µm (length : breadth ratio, 1.2 : 1.7). Pedicel was also present on conidia (Fig. 2). Scanning electron microscopy observations revealed truncate conical tips of



Fig. 1. Conidiophore of *Peronospora variabilis* on *Chenopodium murale* (AMH No. 9327, ICARHNEH-120). Bar = 20 µm.

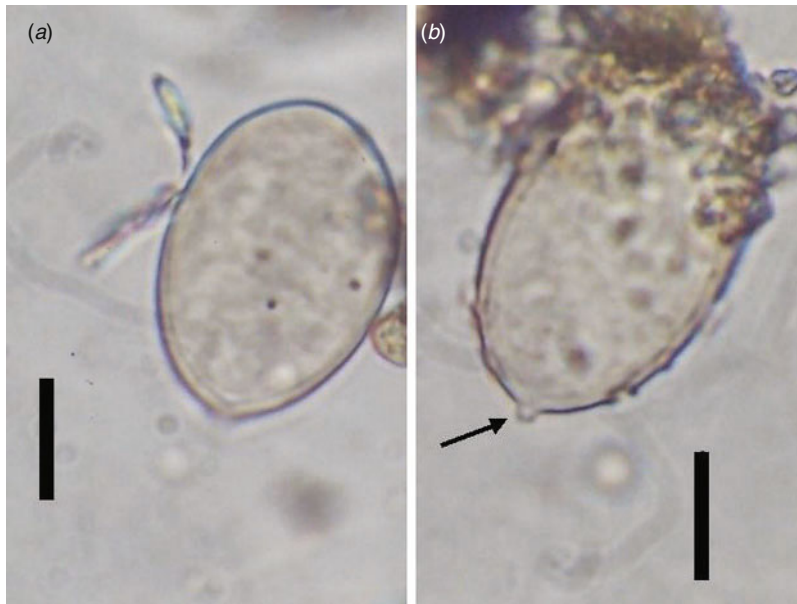


Fig. 2. Conidia of *Peronospora variabilis* on *Chenopodium murale* (AMH No. 9327, ICARHNEH-120). Bar = 10 μ m.

ultimate branchlets and widening of conidiophores toward ramifications (Figs 3, 4). Based on these morphological characters the pathogen was identified as *Peronospora variabilis* (Choi *et al.* 2008, 2010). Resting organs were not observed. Pathogenicity tests yielded positive results.

Previously, a broad species concept for the *Peronospora* species parasitic on Chenopodiaceae prevailed, with all considered identical to *P. farinosa* (Yerkes and Shaw 1959). More recently, a narrow species concept has been proven in case of *Peronospora* infecting Chenopodiaceae (Choi *et al.* 2007, 2008). They suggested that *P. variabilis*, *P. boni-henrici*, *P. chenopodii*, and *P. chenopodii-polyspermi* are four downy mildew pathogens specific to *C. album*, *C. bonus-henricus*, *C. hybridum* and *C. polyspermum*, respectively. *P. muralis* has also been reported on *C. murale* but conidia of *P. muralis* are subglobose to broadly ellipsoidal and without pedicels (Gäumann 1923).

Following the broad species concept, *P. farinosa* f. sp. *chenopodii* and *P. farinosa* have been reported on *C. quinoa* and *C. murale*, respectively from India (Verma *et al.* 1964;

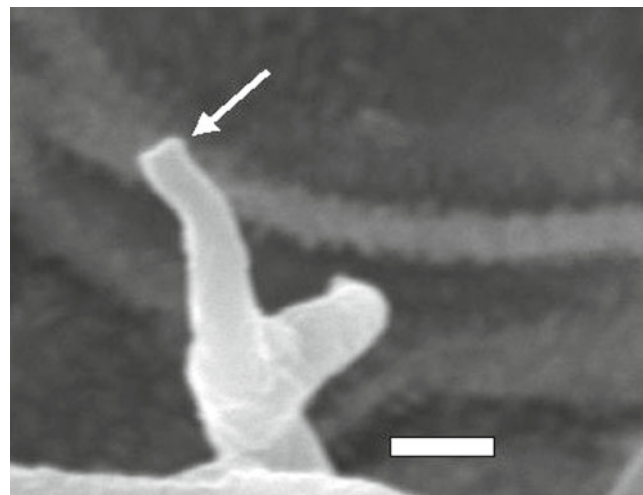


Fig. 3. Tips of ultimate branchlets in *Peronospora variabilis* on *Chenopodium murale* (AMH No. 9327, ICARHNEH-120). Bar = 2 μ m.

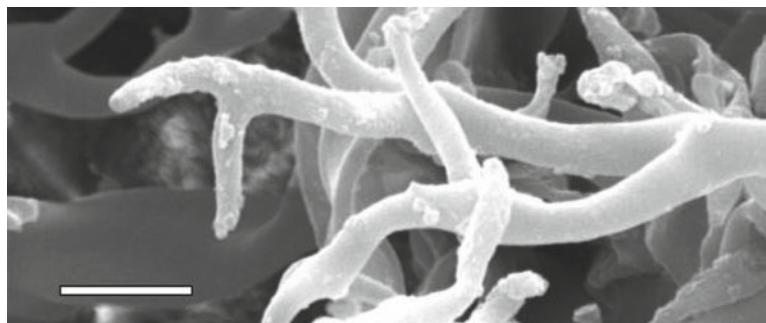


Fig. 4. Ultimate branchlets of *Peronospora variabilis* on *Chenopodium murale* (AMH No. 9327, ICARHNEH-120). Bar = 10 μ m.

Kumar *et al.* 2006). Since both these reports were based on a broad species concept, they did not mention any morphological information related to presence or absence of pedicels and range of length: breadth ratio of the conidia, which have emerged to be important characters for delimitation of *Peronospora* species parasitic on *Chenopodium* spp. (Choi *et al.* 2008, 2010). Possibility of two different species infecting *C. murale* cannot be denied since the conidial dimensions provided by Verma *et al.* (1964) were very close to *P. muralis*.

Our report on the presence of the downy mildew pathogen *P. variabilis* on *C. murale* is the first fully described record from India. Since the correct identity of a pathogen is of utmost importance in any kind of research related to management of a disease, we hope this report will be of help in the future.

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