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Puccinia senecionis-scandentis Lindroth – a new record from West Bengal, India

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ABSTRACT

Some infected plants of *Senecio scandens* Buch.-Ham ex D.Don were collected from two villages, Gorkhey and Dhotrey in Darjeeling District, West Bengal, India. The pathogen was studied in detail, and its identification was confirmed as *Puccinia senecionis-scandentis* Lindroth based on its microscopic features, its host, and the symptoms produced on the host by this causal organism. A survey of literature and also the present study revealed that it is the first report of *Puccinia senecionis-scandentis* Lindroth from the state of West Bengal, India, causing rust disease of *Senecio scandens* (Family- Asteraceae).

Keywords: Rust, *Senecio scandens*, Pathogen

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INTRODUCTION

During surveys for weed pathogens in different parts of the northern region of West Bengal, in March 2023, some plants of *Senecio scandens* Buch.-Ham. ex D.Don (Family- Asteraceae) were found to grow in two villages Gorkhey (27º N, and 88º E; 2347m a.s.l.) and Dhotrey (19º N and 74º E; 2805m a.s.l.) of the Darjeeling district, some of which were severely infected. After a thorough investigation, the pathogen of all the infected plants of *Senecio scandens* Buch.-Ham ex D.Don was identified as *Puccinia senecionis-scandentis* Lindroth. A perusal of literature (Butler and Bisby, 1960; Bilgrami *et al*., 1991; Jamaluddin *et al*., 2004; Manoharchary *et al*., 2022) revealed that it is the first report of *Puccinia senecionis-scandentis* Lindroth from the state of West Bengal, India. Notably, *Puccinia senecionis-scandentis Lindroth* was described by Lindroth (1904) about 120 years ago from Sikkim (type locality of this species), India, and later it was reported about 80 years ago in Karnataka (Bilgrami *et al*., 1991; Mundkur and Thirumalachar, 1946; Lindroth, 1904).

The symptoms of the host plants, world distribution, and taxonomic account of the pathogen *Puccinia senecionis-scandentis* Lindroth are described in detail in this paper.

MATERIALS AND METHODS

Twigs of *Senecio scandens* (host) with distinct disease symptoms were collected by Dr M. Ghosh from some plants. They were placed in well-labelled sterile self-sealing plastic bags separately during the field excursion, transported to the laboratory, and processed by following standard procedures (Hawksworth, 1974; Savile, 1962). The field diary was maintained to record information on infection in natural conditions.

The symptoms produced in the host plants were studied in detail in the field. The infected areas of the plants were photographed.

For microscopic observation, freehand sections were made from the infected areas of leaves and stems. Some sections were mounted in clear glycerine, and some were mounted in lactophenol, after being stained with cotton blue. Observations were made under an Olympus CX 33 microscope. Photographs were taken using an Omax A35180U3 microscopic camera after proper calibration. The pathogen was identified based on the host of the pathogen, the symptoms produced in

the host due to infection by the pathogen, and the characteristic microscopic features of the pathogen.

Voucher specimen (CAL 2010) has been deposited in the Central National Herbarium, BSI, Howrah, West Bengal, India (CAL)

Material examined: India, West Bengal, Darjeeling, Gorkhey, M.Ghosh, 2347m, 11 March 2023 (CAL 2010).

RESULTS

Symptoms: Symptoms of all stages of development were obtained. Symptoms appeared first on the leaf and stem (Figure 1a) as brownish pustules, which ultimately turned reddish-brown.

On the leaf, pustules were wart-like, hypophyllous, raised, borne aggregately in a circular area of up to 7 mm diameter, sometimes becoming irregular in shape (**Figure 1b**), with or without a surrounding yellowish halo zone, scattered all over the lower surface of the leaf (**Figure. 1a, b**), pulverulent, erumpent.

On the stem, pustules appeared as raised areas which were small, circular, brown, and aggregated in an elongated area of up to 5 mm in length with a yellow halo zone (Figure 1c).

The upper surface of the leaf showed no pustule but only discoloured areas in those regions where corresponding hypophyllous pustules were produced.

In case of severe infection, early senescence, severe defoliation, and eventually death of infected plants occurred.

Microscopic features: Only telia were found. In the leaf, teleutospores (Figure 1d) were subepidermal and arose from the region of the spongy parenchyma below the lower epidermis. In stem teleutospores (Fig. 1e) arose from a layer of the sporogenous tissue positioned between the cortex and epidermis.

Teleutospores (**Figure 1f**) 2-celled, puccinioid, smooth-walled, constricted in the middle, variable in shape; narrowly oblong, 49-58.92 x 18.79-22.28 µm, slightly thick-walled with a narrowed apex when young; obovoid with round or obliquely narrowed or papillate apex when mature. In mature teleutospores, the lower cell is longer, 24.45-33.36 µm long, gradually narrowed downward, slightly thick-walled, upper cell more or less rounded, 18.79 – 22.28 µm in width, clearly bilamellate, inner wall golden-yellow, up to 2 µm thick, outer wall chestnut brown 2.5 µm thick at sides, 3.67 µm at apex, the wall at apical region progressively thicker and paler with a thin chestnut brown outer layer, germ pore of lower cell was indistinct, septal while germ pore of upper cell apical. Pedicel hyaline to yellowish, 53.82 - 60.48 µm long, the same length as the spore or longer.

The upper cell of a few teleutospores germinated (**Figure 1i, j**) to form a promycelium which was thin-walled (**Figure.1i, j**)

Some teleutospores were found to be 3-celled to 4-celled (**Figure 1g, h**) intermingled with the normal 2-celled ones, which were fusoid, 60-62.23 x 18-20.3 µm.

Host: *Senecio scandens Buch.-Ham* ex D. Don.

Distribution: Philippines —There is a specimen in the Herbarium, University of California, No.17847, which was collected by M.S. Clemens on *Senecio scandens* from the Philippines, and determined by G.B. Cummins.

India -- Collected by Lindroth (1904) in India on *Senecio scandens* from Sikkim; another locality in India is Karnataka (Bilgrami *et al.* 1991; Lindroth, 1904); besides, two villages in the district of Darjeeling, West Bengal, where the present collection was made.

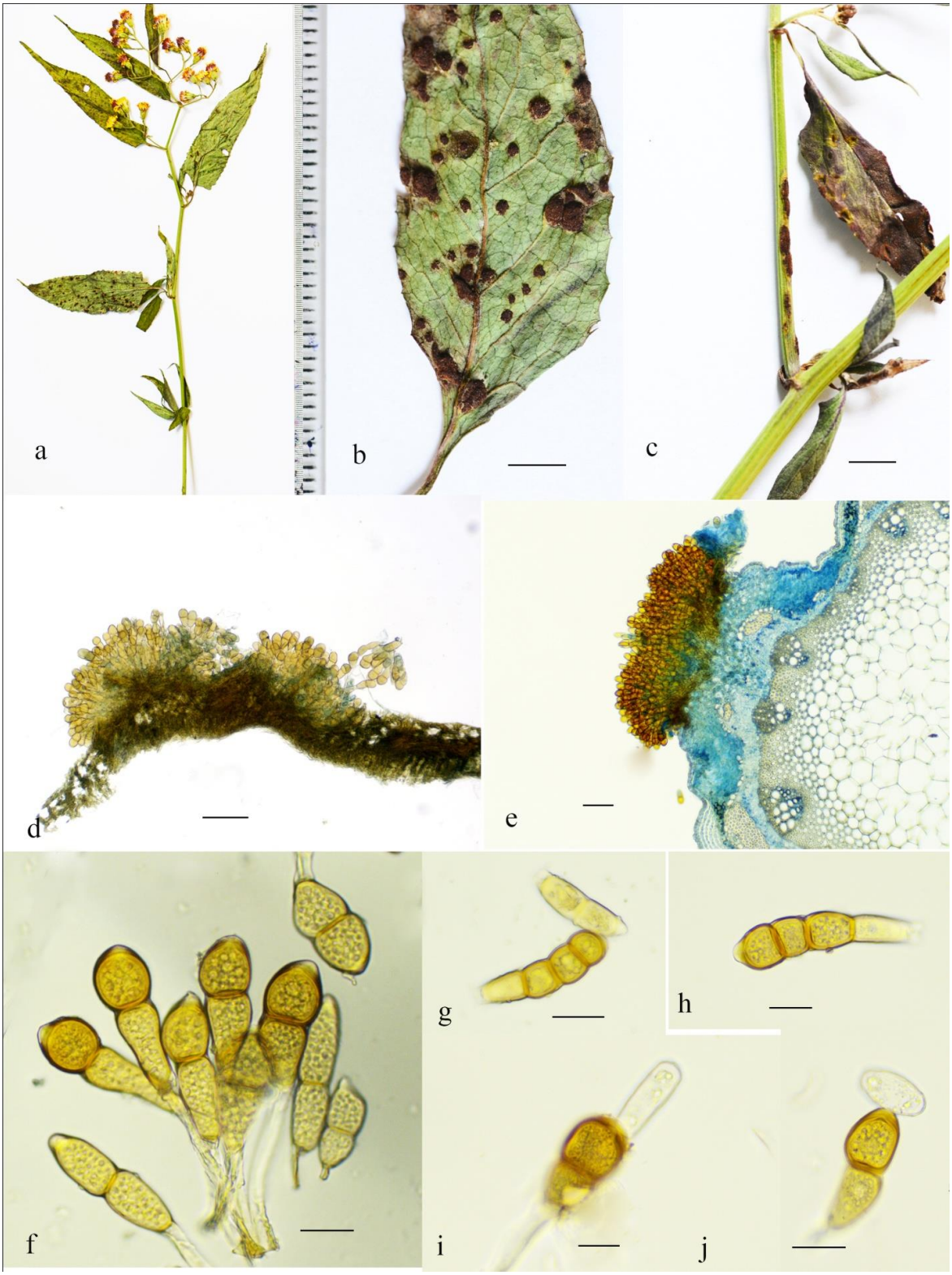


Figure 1: (a) Infected plant of Senecio *scandens* showing pustules on the leaves bearing teleutospores. (b) Infected leaf of *Senecio scandens* showing pustules bearing teleutospores. (c) Infected stem and leaf of *Senecio scandens* showing pustules on the leaf and stem bearing teleutospores. (d) T.S. of leaf showing teleutosorus. (e) T.S. of stem showing teleutosorus. (f) Some teleutospores. (g) Four-celled teleutospore. (h) Three-celled teleutospore. (i) Germinated teleutospore with promycelium. (j) Germinated teleutospore with promycelium. Scale bars: Fig.1b, c =1cm; d, e =40 µm; f, g, h, i, j = 20µm

DISCUSSION

In West Bengal, 21 species of the genus *Puccinia* Pers. have been recorded so far (Bilgrami et al. 1991; De, 1996; De, 1997a, b). In the present study, *Puccinia senecionis-scandentis* Lindroth has been collected in March from two villages in the district of Darjeeling, which constitutes the first report of this species from the state of West Bengal, India, and thus *Puccinia senecionis-scandentis* is recorded herein as an addition to the list of species of *Puccinia* in West Bengal.

In the month of February, the breeze moves from the higher altitude of Sikkim towards Darjeeling, flowing over the Teesta River valley and down the mountain slopes of Darjeeling, which is thought to carry teleutospores of *Puccinia senecionis-scandentis* from infected plants of *Senecio scandens* to the same host species growing in and around Darjeeling. Possibly, this pathogen spreads in this manner from the source in Sikkim to the host plants *Senecio scandens* growing at the target areas in Darjeeling and adjoining places. Probably, this explains how *Senecio scandens* plants get infected in the surrounding areas of Darjeeling, and symptoms appear in these plants during March.

Puccinia senecionis-scandentis has been found to parasitise only *Senecio scandens* by different workers (Bilgrami *et al.* 1991; Mundkur and Thirumalachar, 1946; Lindroth, 1904; Giri and Pradhan, 2023), and none has observed this pathogen to infect any other host during the last 120 years since its discovery in 1904 (Lindroth, 1904). So, it is evident that the host range of this pathogen is restricted to *Senecio scandens,* the single host species.

Various species of *Puccinia* have been found to parasitise various species of *Senecio* L. (Hennen and Cummins, 1969). In India, the genus *Puccinia* is represented by 279 species (Gautam *et al*., 2021), but no species except *Puccinia senecionis-scandentis* has so far been reported to parasitise any species of *Senecio.*

The species of *Puccinia* have a variety of forms of life cycle, from euform (*i.e.* macrocyclic) to microform (*i.e*. microcyclic), and show a gradual inclination of spore exclusion so that the life cycle becomes very simple, producing only teleutospores, such as *Puccinia thwaitesii* Berk., *Puccinia xanthii* Schwein. etc. From a previous study (Lindroth, 1904) and also from the present study on *Puccinia senecionis-scandentis,* it appears that this rust fungus probably produces only teleutospores and belongs to the same category as *Puccinia thwaitesii* and *Puccinia xanthii*. In our collection (CAL 2010), teleutospores of *Puccinia senecionis-scandentis* were somewhat larger (49-58.9×18.79-22.28µm) than the teleutospores (34-52×15-25µm) described by Lindroth (1904).

Puccinia senecionis-scandentis is known to produce 2-celled teleutospores (Lindroth, 1904), but the present collection from the Darjeeling district showed some abnormal type of teleutospores which were 3-4 celled, besides its normal 2-celled puccinioid ones. In 3-4 celled teleutospores, all the cells were separated by transverse septa, and thus the cells were arranged in a single row resembling teleutospores of *Phragmidium* Link. 2-4 celled teleutospores are a characteristic feature of 3 species of *Phragmidium* - *Phragmidium mexicanum* (Mains) Yum, *Phragmidium potentillae-canadensis* Dietel and *Phragmidium tomentillae* Fuckel (Yum *et al.*, 2011), with which 2-4 celled teleutospores of *Puccinia senecionis-scandentis* show close resemblance structurally.

Septal variations in teleutospores have been reported in some rust fungi (Warren, 1898; Hume, 1899; Ramachar and Bhagyanarayana, 1977; Ramachar and Bhagyanarayana *et al*., 1980; De, 1983; De, 1988), but it is unknown whether genetic or environmental factors are responsible for such types of variation. However, the study of septal variations in teleutospores may throw light on the evolution of the rust fungi, including *Puccinia senecionis-scandentis,* but this point could be decided only after further investigations on many other species.

CONCLUSIONS

Puccinia senecionis-scandentis Lindroth has been reported for the first time from the state of West Bengal, India, causing rust disease of *Senecio scandens* (Family Asteraceae). Only telia were found on the host composed of two-celled teleutospores with a few 3-4 celled ones, which draws its affinity with some species of *Phragmidium* Link.

Author contributions

The authors confirm their contribution to the paper as follows: study conception and design: Ghosh M.; data collection: Ghosh M.; analysis and interpretation of results: De A.B.; draft manuscript preparation: De A.B., Mandal A., Ghosh H. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that they have no conflict of interest**.**

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