



New record of *Nyssopsora thwaitesii* on *Schefflera leucantha* and its colonization

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Abstract

A pathogenic rust was found on *Schefflera leucantha* during a routine survey conducted in Chiang Mai province, Thailand in November – December 2018. Morphological studies based on compound and scanning electron microscopy revealed the pathogen to be a new geographical and host record of *Nyssopsora thwaitesii* on *Schefflera leucantha* from Thailand. In addition, the development of rust pustule and the colonization of mycelia of *Nyssopsora thwaitesii* are provided.

Key words – Pucciniales – Raveneliaceae – Rust – Thailand

Introduction

Schefflera leucantha Viguer (Araliaceae) is known as edible-stemmed vine in Thailand. It is locally known as ‘Hanuman Prasankai’ and widely used as an antiasthmatic herb (Potduang et al. 2007). The infusion of this plant is known to relieve cold, allergies, asthma, chronic cough and respiratory tract infection. The leaves are used for wound–healing, inflammation and cough (Pancharoen et al. 1994). Diseased young leaves of *S. leucantha* with numerous dark brown pustules were collected during the plant disease survey in Chiang Mai province, Thailand during November – December 2018. The disease also caused the malformation on shoots. Based on morphology the rust was identified to be *N. thwaitesii*. In literature *N. asiatica* (Kobayashi 2007) and *N. thwaitesii* (Boedijn 1959, Lohsomboon et al. 1990, Baiswar et al. 2014) was identified from *Schefflera* spp. In this study *N. thwaitesii* is described and introduced as a new host and geographical record on *S. leucantha* from Thailand.

Materials & Methods

Freehand sections of infected tissue and spores were mounted in lactic acid. Fungal structures were measured and photographed using Zeiss Axio A1 microscope. The infected areas were observed using stereomicroscope (Nikon SMZ745T). For scanning electron microscopy (SEM), the material was mounted onto a double sticky–sided tape, fixed in osmium vapor for 34 hours (24 hours in solution 1:1 of sodium cacodylate 0.2M and osmium tetroxide 2%, then 10 hours in osmium tetroxide 2%), gold–palladium–coated with an Emitech K550X coater, and observed with a Zeiss EVO 550X SEM.

Results

Nyssopsora thwaitesii (Berk. & Broome) Syd., Anns. Mycol. 19: 170. 1921

Fig. 1

Pathogen on leaves of *Schefflera leucantha*. Rust pustules appear as powdery masses of black spores on upper and lower leaf surface, surrounded by yellowish margins spermagonia, aecia and uredinia unknown. *Telia* 130–460 µm, amphigenous, scattered or slightly clustered, densely aggregated in groups, confluent, naked, erumpent, blackish, chestnut-brown. *Teliospores* 27–42 × 24–38 µm, 3-celled with a single proximal cell and two collateral distal cells, triquetrous pyriform, strongly constricted at septa, blackish–brown to black; walls uniformly 1–3 µm thick, pale brown or pale cinnamon-brown when young and becoming cinnamon-brown or chestnut–brown when older. *Projections* up to 15 and branched at the tips, 11–14 × 5–7 µm. *Pedicel* 35–52 × 5–7 µm, persistent, hyaline.

Material examined – THAILAND, Mueang Chiang Mai, on older and younger leaves of *Schefflera leucantha* (ARALIACEAE), 25 November 2018, Phetruang W.

Light microscope observations of fresh tissues

Observation of development of rust pustule on *S. Leucantha* is shown in Fig. 2. Rust pustules with 1–6 spores/lesion appeared on the leaf surface after 2nd day of infection and increased to 7–12 spores/lesion within 3–4 days. Yellowish margins appeared around rust pustules after 5–6 days and pustules erupt through the leaf surface.

Light microscopy of transverse sections of infected leaves indicated that mycelium of the fungus first grew subepidermally and intercellularly. The mycelium was localized in the palisade mesophyll where haustoria were commonly observed in the epidermal cells (Fig. 3).

Number of chloroplasts were reduced in pre-sporulation and sporulating pustules comparatively to the control tissue (non-infected). Linear chloroplast dimensions (both minor and major axes) were reduced by 50% in infected tissue. This has the effect of reducing the volume of chloroplast by 40%, comparative to the control chloroplasts (Fig. 4).

Discussion

Previously, *Nyssopsora asiatica* and *N. thwaitesii*, were recorded from *Schefflera* spp. (Boedijn 1959, Lohsomboon et al. 1990, Kobayashi 2007, Baiswar et al. 2014). The fungal rust collected on *Schefflera leucantha* in Thailand is a species of *N. thwaitesii* because its teliospores on morphological characteristics is similar of *N. thwaitesii* according to Lohsomboon et al. (1990) indicated teliospores 3-celled, triquetrously pyriform, strongly constricted at septum, 28-48 × 25-44 µm. walls uniformly 1-3 µm. thick, pale brown or pale cinnamon-brown when young and becoming cinnamon-brown or chestnut-brown when older, with 8-17 projections on each spore (frequently 11), much-branched at tips, 3-12 µm. high and pale brown; 1-3 germ pores in each cell (generally 2); pedicels hyaline, thick-walled, slightly rough, persistent, up to 85 µm long and 4.5-9 µm wide. In addition to host of *N. thwaitesii*, it was reported on *Schefflera* sp. In South-east Asia (Lohsomboon et al. 1990) that this specimen was found on *S. leucantha* in Thailand. (Table 1).

Nyssopsora thwaitesii has been previously reported on *Schefflera* spp. has a worldwide distribution mainly in parts of Asia such as *S. bengalensis* in India (Lohsomboon et al. 1990), *S. elliptica* in Indonesia (Lohsomboon et al. 1990) and Sri Lanka (Lutjeharms 1937), *S. lucescens* in Indonesia (Lohsomboon et al. 1990, Boedijn 1959) and Sri Lanka (Lutjeharms 1937), *S. odorata* in Philippines (Sydow 1923, Lohsomboon et al. 1990, Teodoro 1937) and Sri Lanka (Lutjeharms 1937), *S. polybotrya* in Indonesia (Lohsomboon et al. 1990) and Sri Lanka (Lutjeharms 1937), *S. roburghii* in India (Ragunathan & Ramakrishnan 1973), *S. scandens* in Indonesia (Lohsomboon et al. 1990, Boedijn 1959), *S. stellate* in Sri Lanka (Lutjeharms 1937) and *S. wallichiana* in India (Baiswar et al. 2014). However, *S. leucantha* is a new host from Thailand.



Fig. 1 – *Nyssopsora thwaitesii* on *Schefflera leucantha*. a–c Symptoms of rust on host plant. d–e Telia on leaves. f–g Telia and Teliospores. h–i Scanning electron micrograph showing a Teliospores. Scale Bars: f–g = 50 μ m, h–i = 10 μ m.

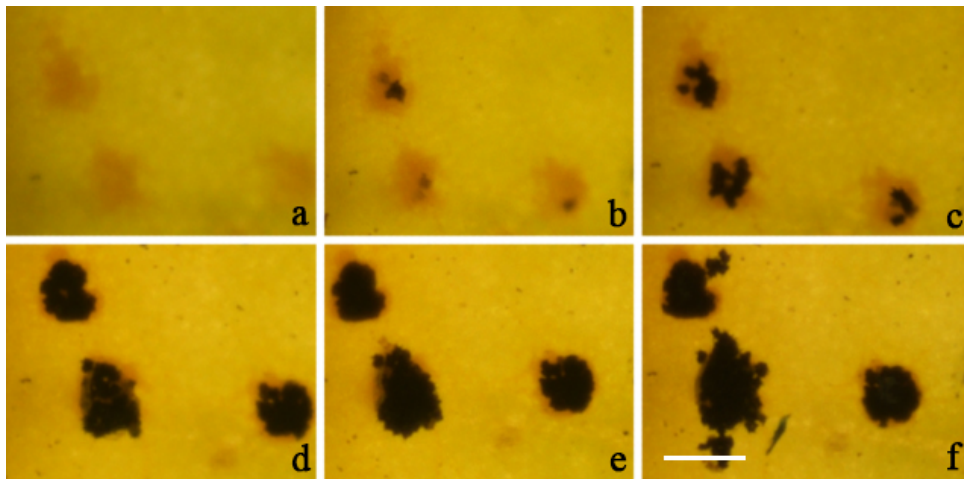


Fig. 2 – Development of rust pustules on *Schefflera leucantha*. a–f rust pustule in 1–6 days (respectively). Scale Bars = 200 μm .

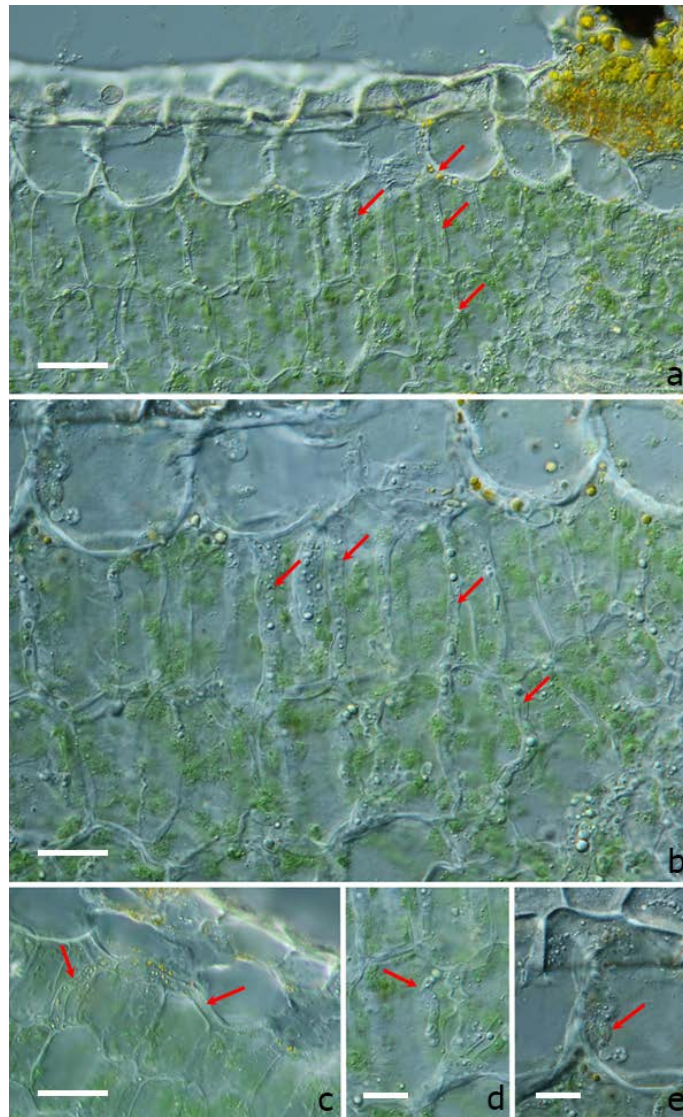


Fig. 3 – Light micrograph of cross section of *Schefflera leucantha* leaves showing the upper and lower epidermic. a–c mycelium of the fungus grew subepidermally and intercellularly. d haustorium localized in the palisade cell. e haustorium localized in the epidermal cell. Scale Bars: a–c = 10 μm , d–e = 5 μm .)

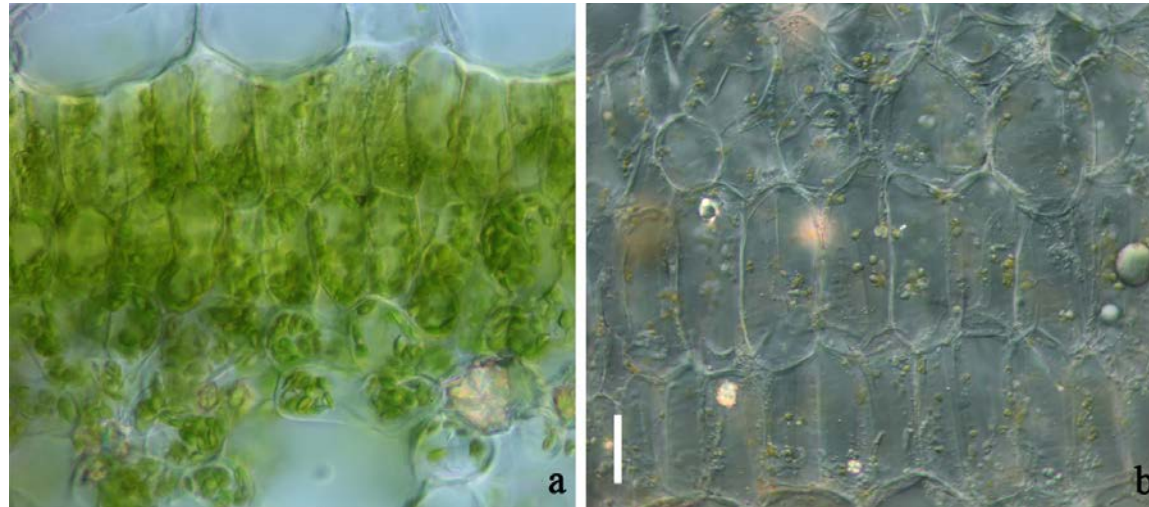


Fig. 4 – Light micrograph of cross section of *Schefflera leucantha* leaf showing chloroplast in palisade mesophyll. a normal leaf. b abnormal leaf. Scale Bar: 10 μ m.

Table 1 Morphological details of *Nyssopsora* species. (Lohsomboon et al. 1990)

Species	Host	Distribution	Teliospores							Reference
			Size (μ m)	Septal constriction	Projection/spore			GP	Pedicel	
					No.	Length (μ m)	Tip branched			
1. <i>Nyssopsora asiatica</i>	<i>Acanthopana</i> <i>Euodiopana</i> <i>Merrilliohana</i> <i>Aralia</i>	East Asia & U.S.S.R.	26–41 × 26–42	moderate	13–29	6–15	Well +	2	Somewhat deciduous	Tai 1979, Ito 1950
2. <i>Nyssopsora cedrelae</i>	<i>Cedrela</i> <i>Ailanthus</i> <i>Choerospondias</i>	South Asia & East Asia	29–44 × 27–44	slight	13–27	3–9	2–3	1–3	persistent	Tai 1979, Dietel 1899, Sydow & Sydow 1912, Ito 1950
3. <i>Nyssopsora chinensis</i> (Species Fungorum current name: <i>Nyssopsora koelreuteriae</i> (Syd. & P. Syd.) (Tranzschel 1925)										
4. <i>Nyssopsora citriobati</i>	<i>Citriobatus</i>	Eastern Australia	28–39 × 28–38	slight	14–19	2.5–6	2–6	1–3	persistent	Sydow 1938

Table 1 Continued.

Species	Host	Distribution	Teliospores							Reference
			Size (µm)	Septal constriction	Projection/spore			GP	Pedicel	
					No.	Length (µm)	Tip branched			
5. <i>Nyssopsora clavellosa</i>	<i>Aralia</i>	North America	29–37 × 26–38	Slight to moderate	10–23	4–11	3–4	2–3	persistent	Arthur 1934, Lutjeharms 1937, Zeller 1935
6. <i>Nyssopsora clavellosa</i> f. <i>asiatica</i> (Species Fungorum current name: <i>Nyssopsora asiatica</i> (Lutjeharms 1937))										
7. <i>Nyssopsora clavellosa</i> f. <i>clavellosa</i>										
8. <i>Nyssopsora echinata</i>	<i>Coelopleurum</i> <i>Conioselinum</i> <i>Ligusticum</i> <i>Meum</i> <i>Oenanthe</i> <i>Selinum</i>	Europe & North America	29–42 × 27–40	slight	14–23	4–18	Entire–2	2–3	deciduous	Sydow & Sydow 1912, Lutjeharms 1937, Wilson & Henderson 1966
9. <i>Nyssopsora formosana</i>	<i>Koelreuteria</i>	East Asia	27–35 × 25–35	slight	11–17	5–14	well	1–3	persistent	Sawada 1931, Lutjeharms 1937, Tai 1979
10. <i>Nyssopsora koelreuteriae</i>	<i>Koelreuteria</i>	East Asia	30–40 × 28–39	slight	18–30	2–10	2–4	1–2	persistent	Ito 1950
11. <i>Nyssopsora schefflerae</i> (Species Fungorum current name: <i>Nyssopsora thwaitesii</i> (Berk. & Broome) (Sydow 1921))										
12. <i>Nyssopsora thwaitesii</i>	<i>Brassaiopsis</i> <i>Hedera</i> <i>Heptapleurum</i> <i>Schefflera</i> <i>Neonauclea</i>	South Asia & South-east Asia	28–48 × 25–44	strong	8–17	3–12	well	2	persistent	Tai 1979, Berkeley & Broome 1875, Lohsomboon et al. 1990
13. <i>Nyssopsora trevesiae</i>	<i>Trevesia</i>	South-east Asia	24–37 × 25–36	Not at all to slight	10–23	2–9	entire	2–3	deciduous	Gaumann 1921, Boedijn 1959

GP = The number of germ pores (usual) in each spore.

Well + = more than 5-furcated at the tips.

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