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Two New records of Rust Fungi from Karnataka State, India

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Two rust taxa of Teliomycetes fungi viz. *Aecidium merremiae-umbellatae* T. R. Kavale on *Merremia umbellate* (L.) Hall. F. Engl. (Fam.- Convolvulaceae) and *Puccinia leonotis-nepetifoliae* T. R. Kavale on *Leonotis nepetifolia* (L.) R. Br. (Fam.: Lamiaceae) are illustrated and described. They have been recorded for the first time in Karnataka State, India.

Keywords: Teliomycetes, Uredinales, Pucciniaceae, *Aecidiummerremiae-umbellatae* and *Puccinia leonotis-nepetifoliae*

INTRODUCTION

Rust fungi comprise, ca. 10% of all the known fungi i.e. 6930 spp. of 163 genera and 14 families (Kirk *et al.,* 2001). In India, ca. 900 spp. of 75 genera of rust fungi are known (Jamaluddin *et al*. 2002). Rust fungi are obligate parasites of vascular plants with ecogeographical association, high host specificity and having different types of life cycle patterns from the most complex to simple as a result of reductional series by omission of spore forms, which pose a problem in their identification.

In continuation of taxonomical studies on rust fungi, the author came across interesting collections on the living leaves of *Merremia umbellate* (L.) Hall. F. Engl. (Fam.- Convolvulaceae) belonging to the genus *Aecidium* Pers. ex Pers., and *Leonotis nepetifolia* (L.) R. Br. (Fam.: Lamiaceae) belonging to the genus *Puccinia* Pers. ex Pers., from Belgaum district (Karnataka State, India). These rust species are not reported from the Karnataka State and thus, become new records to the Fungi of Karnataka State, India

MATERIALS AND METHODS

The fresh living materials were collected by repeated visits to different localities of Belgaum district (Karnataka State, India). These materials were critically studied by usual laboratory methods. The collections were identified with the help of up-to-date available literature to their respective genera, species and varieties along with their host plants. Ranges of variations of the same taxa collected from different localities were also taken into consideration. All the materials have been deposited in the Ajrekar Mycological Herbarium (AMH), National Fungal Culture Collection of India (NFCCI), Pune, Maharashtra, India.

RESULTS AND DISCUSSION

Aecidium merremiae-umbellatae

T. R. Kavale, IJCRT 9(11): 218-226, 2021; Fig.1 (A-H); Fig 2.

Pycnia, uredinia and telia not observed; Aecia foliicolous, hypophyllous, mostly interveinal forms distinct necrotic spots, scattered on leaf lamina showing swelling or hypertrophy, sub-epidermal, deeply sunken in mesophyll, peridiate cupulate or cylindriceous, erumpent, upto 0.5-01 mm in diameter; peridial cells thick-walled, rectangular to polygonal in shapes, hyaline with striations, 25-30 x 19-23 μm; aeciospores catenulate, one-celled, globose to angular, thin-walled, 22-27 x 18-20 μm, minutely verrucose, hyaline but yellowish in mass.

Habit: On the leaves of *Merremia umbellate* (L.) Hall. F. Engl. (Fam.- Convolvulaceae),

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Ghataprapha River bank, Gokak, Dist.- Belgaum (Karnataka State, India), 28-11-2021, T. R. Kavale, AMH-10413.

Puccinia leonotis-nepetifoliae

T. R. Kavale , IJRAR 8(4): 553-559, 2021; Fig. 3(A-G), Fig.4

Pycnidia and Aecidia not observed; Uredia foliculus, mostly hypophyllous, when severe amphigenous, numerous, scattered or grouped, small, roundish, 1-2 mm, across, early naked, erumpent, subepidermal, ruptured epidermis noticeable, cinnamon brown; urediospores globose to subglobose, rounded, 19-28 µm in diameter, smooth walled (seen under 100 x oil emmersion), cinnamon brown, 2-3 µm thick, lenticular germpores 3-6 in number either arranged in ring or diagonally in the centre (Fig.3 B and C); Telia amphigenous, few in number, appears late in the form of whitish brown spotes along with uredia when uredinal infection become very severe, about 2-4 mm in diameter, scattered, erumpent, subepidermal, with graded teleutospores; teleutospores fusiform, graded, young teleutosporeshyline, mature whitish-brown, upto 16-28 x 48-70 µm (average of 3-5 specimens collected and examined), two celled, germ pore apical in apical cell and near the septum of lower cell, constricted at septum, obovoid, smooth walled, wall thickening upto 0.5-1 µm, thickened at apex upto 5 µm with a papilla; pedicel hyline, as long as spore, upto 65-70 µm, slightly swollen at the attachment when young (Fig 3 G).

Habit: On the living leaves of *Leonotis nepetifolia* (L.) R. Br. (Fam.: Lamiaceae), Chikkodi, Nipani Dist.- Belgaum (Karnataka State, India), 05-12-2021, Dr. T. R. Kavale, AMH-10415.

The rust species, *Aecidium merremiae-umbellatae* has been reported as a new species from Maharashtra State (India) on *Merremia umbellate* (L.) Hall. F. Engl. (Fam.- Convolvulaceae) (Kavale, 2021a). The present collection collected on same host from Ghataprapha River bank, Gokak, Dist.- Belgaum is well matched in all morphological respect with *Aecidium merremiae-umbellatae* T. R. Kavale hence referred to it. It makes new records to the Fungi of Karnataka State (India). During mycological survey, it is found that this rust species appears more severe on lower surface of leaves and mostly restricted to the river banks on respected hosts.

The other rust species, *Puccinia leonotis-nepetifoliae* has also been reported by Kavale (2021b) as a new species on *Leonotis nepetifolia* (L.) R. Br. (Fam.: Lamiaceae) from Kagal, Kolhapur and Sangali (Maharashtra State, India). The new species was published on the basis of smooth walled uredospores even at 100x (Oil emersion) and having 3-6 germ pores either arranged in ring or diagonally in the center and not basal, teleutospores development is graded and the length of teleutospore and pedicel is moderate as compare to all existing species. Since from 1895 to 1926, eight species of rust have been recorded on the species of *Leonotis* viz. *Puccinia* (3 spp.), *Aecidium* (1 sp.) and *Uredo* (4 spp.) reported from South Africa, Jamaica, Cuba, Santo Domingo, America and India. All these species as synonyms to *Puccinia leonotidis* (P. Henn.) Arthur, except *P. dominicana* Frag. and Cif., having large, fusiform teliospores reported from Santo Domingo and *Uredo basipora Lagerh.,* reported from Jamaica. *Puccinia leonotidis* (P. Henn.) Arthur is based on the teleutospores which were only known from South Africa collected on *Leonotis veluntina* R. Br. by Henning in 1899. The uredospores studied by Arthur having 3-5 germpores usually-4, but basal, close to hilum. The uredospores of the species of Uredo in which ornamentation is verrucose described by *P. Hennings*. It is also have also reported that this rust as *Puccinia leonotidicola* (P. Henn.) Arthur, on *Leonotis nepetifolia* from Satara (Maharashtra State, India) in which they described as thin-walled, puccinoid telentospores and uredospores but no measurements were given either of the spore types. Patil, *et al*. (2011) reported a new variety viz. *Uredo leonotidis P. Hennings*, var. inidca var. nov. on the same host form Sinnar (Maharashtra State, India) and described only *uredospores*. Randive, *et al.* (2018) reviewed this rust as *Puccinia leonotidis* (P. Henn.) Arth. - as severe threat to *Leonotis nepetaefolia* (L.) R. Br. from Pune (Maharashtra State, India).

The present collection collected on *Leonotis nepetifolia* (Linn.) R. Br. form Chikkodi, Nipani Dist.- Belgaum is well matched in all morphological respect with *Puccinia leonotis-nepetifoliae* (Kavale , 2021b), hence referred to it. It makes new records to the Fungi of Karnataka State (India).

During mycological survey, it is found that this rust species is very common during winter season from

Table 1: Comparison between the species of *Puccinia* found on *Leonotis veluntina* Fen. ex Ben. and *Leonotis nepetifolia* (Linn.) R. Br.

Species	Uredinia	Uredospore	Telia	Teleutospore	Pycnidia and Aecidia
Puccinia leonotidicola P. Henn. from South Africa Type species on *Leonotis veluntina* Fen. ex Ben.	Amphigenous, minute, Scattered, Cinnamon Brown or Reddish Brown	Globose to Subglobose, 21-25 µm, Wall echinulate, (verrucose), 3-5 Germ pores basal closed to hilum, usually -4	Amphigenous, Intermixed, Yellowish – Brown	Ellipsoids, rounded at end, smooth, Papillate, 18-22 x 25-30 µm; Pedicel hyaline, 30 µm as long as teleutospore	Not seen
Puccinia leonotidis (P. Henn) Arthur from Central and North America, South Africa =*Aecidium leonotidis* P. Henn. =*Dicaeomaleonotidis* (P. Henn.) Arth. =*Puccinia leonotidicola* P. Henn. =*Uredo cancerina* P. Henn. =*Uredo leonoticola* P. Henn. =*Uredo leonotidis* P. Henn. on *Leonotis nepetifolia* (L.) R. Br.	Amphigenous, minute, Scattered, Cinnamon Brown	Oblate Spheroid, 19-27 µm, Wall echinulate, (verrucose), 3-5 Germ pores basal closed to hilum, usually -4	Amphigenous, Intermixed, Yellowish – Brown	Ellipsoids, rounded at end, smooth, Papillate, 18-23 x 25-32 µm; Pedicel hyaline, 32 µm as long as teleutospore	Pycniahypophyllous; pycniospores oblong, 2.5-3 x 4-5 µm; Aecia amphigenous, chiefly hypophyllous aeciospores globoid, oblong, or ovoid, 20-24 x 20-32 µm; w all hyaline or paleyellow , verrucose.
Puccinia leonotidis (P. Henn) Arthur from Satara, (Maharashtra, India) on *Leonotis nepetifolia* (L.) R. Br.	This rust was reported as *Puccinia leonotidicola* (P. Henn.) Arthur, on *Leonotis nepetifolia*, and described as thin-walled, puccinoid teleutospores and uredospores, in which they described as basal germ pores but no measurements were given either of the spore types. They mentioned that the measurement and morphology of these two spores are similar to those described by Hennings for the rust *Puccinia leonotidicola*.				Not seen
Puccinia dominicana Frag. and Cif. from Santo Domingo on *Leonotis nepetifolia* (L.) R. Br.	Amphigenous, minute, Scattered, Reddish Brown	Globose to Subglobose, 20-28 µm, Wall echinulate, (verrucose), 3-4 Germ pores, Peripheral	Amphigenous, Intermixed, Yellowish – Brown	Fusiform, brownish, smooth, Papilate, 18-24 x 60-92 µm; Pedicel hyaline, Persistent, 175 µm long.	Not seen
Puccinia leonotis-nepetifoliae Kavale from Kagal, Kolhapur and Sangli (Maharashtra, India) on *Leonotis nepetifolia* (L.) R. Br.	Amphigenous Severe, minute, Scattered, Cinnamon Brown	Globose to Subglobose, Reddish-brown, 19-28 µm, (Smooth walled (under 100 x Oil emmersion), 2-3 µm thick, Cinnamon brown; 3-6 Germ pores, lenticular, arranged diagonally in the centre).	Amphigenous, Intermixed, scattered, few, Whitish-Brown	Fusiform, whitish-brown, smooth, constricted at septum, Papillate, (16-28 x 48-70 µm; Pedicel hyaline, persistant, as long as teleutosporesupto 65-70 µm, slightly swollen at the attachment when young).	Not seen
Puccinia leonotis-nepetifoliae Kavale form Chikkodi, Nipani Dist.-Belgaum (Karnataka State, India) on *Leonotis nepetifolia* (L.) R. Br.	Amphigenous Severe, minute, Scattered, Cinnamon Brown	Globose to Subglobose, Reddish-brown, 19-28 µm, (Smooth walled (under 100 x Oil emmersion), 2-3 µm thick, Cinnamon brown; 3-6 Germ pores, lenticular, arranged diagonally in the centre).	Amphigenous, Intermixed, scattered, few, Whitish-Brown	Fusiform, whitish-brown, smooth, constricted at septum, Papillate, (16-28 x 48-70 µm; Pedicel hyaline, persistant, as long as teleutosporesupto 65-70 µm, slightly swollen at the attachment when young).	Not seen

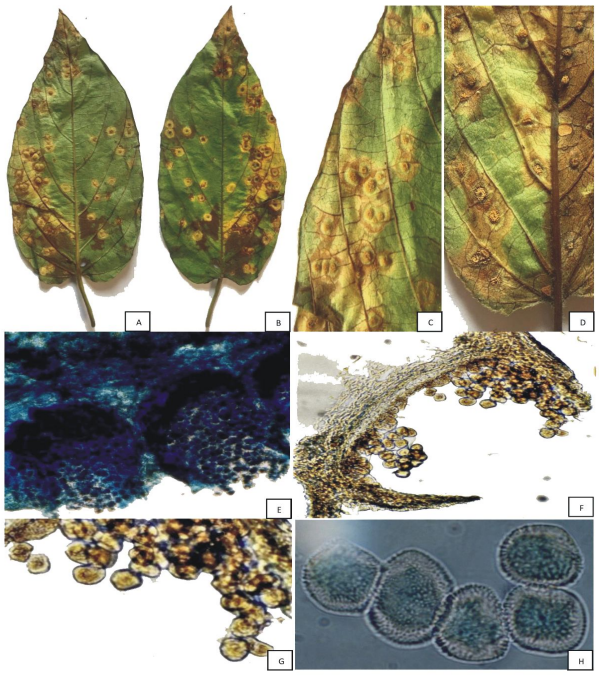

Fig.1. (A) Leaf of *Merremia umbellate* infected with *Aecidium merremiae-umbellatae* showing Aecidia on lower surface with necrotic circles, x N.S., (B) Infected leaf showing yellow spots on upper surface x N.S., (C & D) Magnified Aecidia on lower surface of leaf showing swellings and necrotic rings x2, (E) T.S. of leaf passing through Aecidia x 62, (F) Magnified Aecidial cup, (G) Aeciospores x 220, (H) Peridial cells x 670

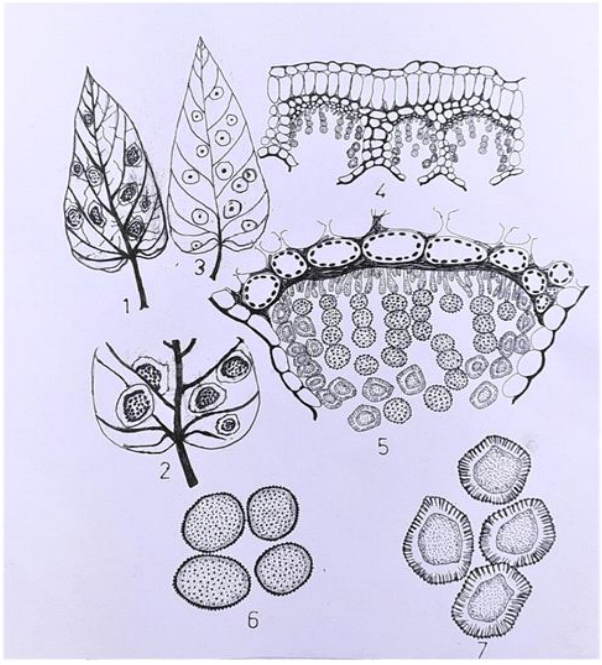

Fig 2 :. Hand drawing of (1) infected leaf of *Merremia umbellate* showing Aecidia of *Aecidium merremiae-umbellatae* on lower surface with necrotic circles, (2) Magnified Aecidia with necrotic circles, (3) Infected leaf showing spots on upper surface, (4) T.S. of leaf passing through Aecidia, (5) Magnified Aecidial cup with Aeciospores and Peridial cells, (6) Aeciospores, (7) Peridial Cells

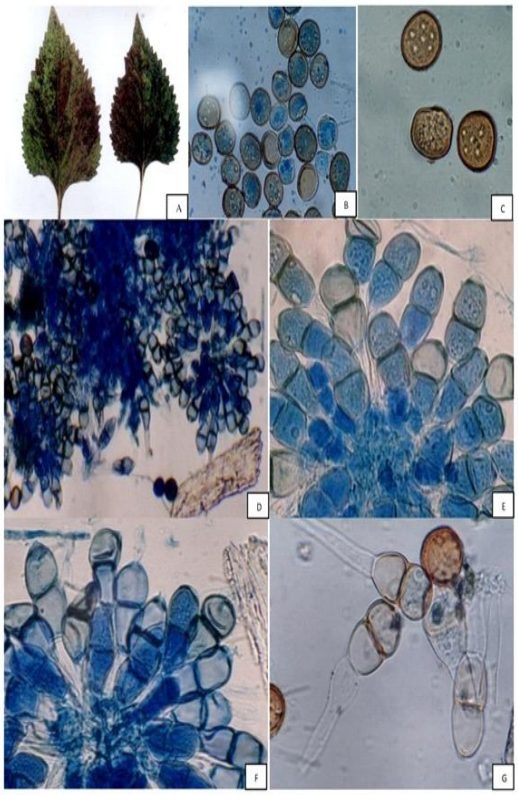

Fig.3. (A) Leaves of *Leonotis nepetifolia* infected with *Puccinia leonotis-nepetifoliae* showing uredinia on lower surface, x ½ of N.S., (B) Urediniospores x 345. (C) Urediniospores showing up to 6 germ pores x375, (D) Teleutosori with teleutospores x 325, (E&F) Magnified Teleutosori with fusiform, graded teleutospores x 665, (G) Young Teleutospores x 635

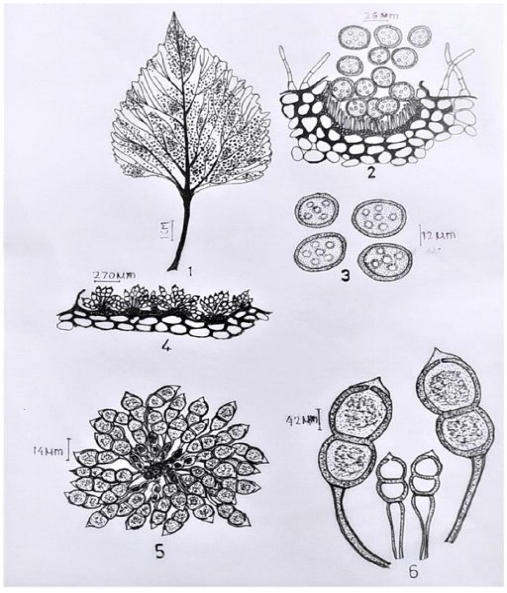

Fig. 4: Hand drawing of (1) infected leaf of *Leonotis nepetifolia* showing uredinia of *Puccinia leonotis-nepetifoliae* on lower surface, x N.S., (2) T.S. of leaf passing through Urediniosorus, (3) Urediniospores, (4) Teleutosori with teleutopsores, (5) Magnified Teleutosori with fusiform, graded teleutopsores, (6) Young and Mature Teleutopsores.

December to February on the leaves of *Leonotis nepetifolia* (Linn.) R. Br. In early stage of infection only brown colour eduredenia severely observed on lower surface of leaves. In the later stage of uredenia become amphigenous. The telia appeared on lower surface of infected leaves in the form of whitish-brown coloured spots. Severe infection during later stage causes curling of leaves and then defoliation. As this species is very common with their uredial and telial stage, now a day there is need to concentrate on its alternative host.

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