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Short paper

Additions to the biotrophic fungi of Vancouver's North Shore, British Columbia

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Abstract: *Puccinia tanaceti* in narrow sense is reported from British Columbia for the first time. *Golovinomyces asterum* var. *solidaginis* and *G. macrocarpus* are also new members for mycobiota of BC. New hosts are reported for rusts and powdery mildews in BC and Canada.

Keywords: Pucciniales, Erysiphales, Biodiversity, Taxonomy, Canada

Introduction

During October and November 2018, the author had an opportunity to visit parks and woods in Vancouver's north shore, mainly in the city of North Vancouver. As this is the perfect time of the year to find powdery mildews, diverse annual and perennial plants infected by Erysiphales were collected. In addition, rust infected plants from various families were also collected. The current report discusses some of the specimens identified so far that contribute new information about the biotrophic fungi of western Canada. Fernando *et al*. (1999) compiled host-fungus lists for British Columbia. The species reported here are rarely documented, and since Fernando *et al*.'s compilation, no new BC herbarium specimens appear among MyCoPortal records (MyCoPortal. 2019). To our knowledge there is no specific report/list dealing with plant parasitic fungi of Vancouver's north shore. Hopefully this paper will be the starting point to compile such a checklist for north shore plant parasitic fungi.

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Materials and Methods

All microscopic slides were made using Lactic Acid in Glycerol mounting medium (Abbasi 2013). Microscopic study of specimens was carried out using Leica DMRB (Leitz) DIC microscope and BH2 Olympus compound microscope and all photomicrographs taken at 400x or 1000x with a Leica DFC420 digital color camera or Dino-Eye Eyepiece Camera using DinoCapture 2.0 software (AnMo Electronics Corporation, Taiwan). In each accession 50 fungal spores or structures were measured. Concerning identification of powdery mildews, species concept and taxonomy sensu Braun and Cook (2012) were followed. Host plant common names mostly obtained from E-FLORA BC (2020). Studied materials have been deposited at University of British Columbia (UBC) and University of Tehran (UTFH) herbaria.

Puccinia tanaceti DC. s. str. (emend. Braum 1981).
On *Tanacetum vulgare* L. (Asteraceae) [common tansy], British Columbia, North Vancouver, 17 October 2018, M. Abbasi (NV3a), UTFH 1201, duplicate at UBC, (II) + III.

Uredinia not seen. Urediniospores in telia, obovoid or ellipsoid, 25-30 × 18.5-22.5 µm, wall 2 µm thick, cinnamon-brown, echinulate,

echinulae 2-3 µm apart, germ pores 2-3, equatorial, covered by smooth cap. Telia hypophyllous and on petioles, semi-compact, exposed, blackish brown, teliospores 35-46.5 × 16-25 µm, ellipsoid or obovoid, with rounded, conic-rounded or unequal apex, tapering towards the pedicel, constricted at septum, wall 1.5-2 µm at side, up to 6.5 µm at apex, yellowish to chestnut brown, sometimes with lighter part at apex, finely and densely verrucose, verrucae more visible on upper cell, germ pore of upper cell apical and of lower one at the septum, pedicel colorless, persistent up to 75 µm long, mesospores rarely seen (Fig. 1A).

Above features fit well with the narrow species concept of *P. tanaceti* provided by Braun (1981). Teliospores of BC specimen are relatively small with mean spore lengths < 45 µm (40 µm). There are couple of reports of *P. tanaceti* from BC mentioned by Fernando *et al.* (1999). These reports are all doubtful for the following reasons. The report of *P. tanaceti* on *Artemisia dracunculina* should be considered as *P. absinthii* var. *dracunculina* (Fahrend.) U. Braun. The report on *Artemisia frigida* belongs to *P. absinthii* s.lat. Reports on *Artemisia ludoviciana* and *A. tridentata* may very probably belong to *P. ludovicianae* Fahrend. and *P. similis* Ellis & Everh., respectively. Fernando *et al*. (1999) had also reported *P. tanaceti* on *Chrysanthemum* sp. It will be difficult to confirm this report as *Chrysanthemum* species are mainly infected by Asiatic rust species *P. chrysanthemi* Roze, across the globe.

To my knowledge the current report is the first authentic finding of *P. tanaceti* s.str. from BC and *T. vulgare* is a new host for the rust in Canada.

Uromyces dactylidis G. H. Otth
On ornamental *Dactylis glomerata* L. (Poaceae) [orchard-grass], British Columbia, North Vancouver, 17 October 2018, M. Abbasi (NV8), UTFH 1202, II + III.

Uredinia amphigenous, small, elliptic or oblong, cinnamon-brown, mostly surrounded or covered by ruptured epidermis. Urediniospores 25-30 × 20-22.5 µm, obovoid, broadly obovoid, ellipsoid or globoid, wall yellowish-brown to cinnamon-brown, 1.5-2 µm thick, finely echinulate, with 8-11 scattered germ pores having a conspicuous internal ring and small pore cap (Fig. 1B). Few covered telia were present on adaxial leaf surface. Teliospores one celled, 21.25-28.75 × 15-19 µm, oblong-ellipsoid, oblong or angularly obovoid, rounded, bluntly pointed or truncate at apex, mostly attenuated below, wall chestnut-brown, smooth 1-1.5 µm thick at sides and up to 3 µm at apex (Fig. 1C). Several hyaline, narrow long cylindrical structures with more or less small capitate heads were always present in prepared microscopic slides. As mentioned by Grove (see Wilson & Henderson 1966, p. 361), these paraphyses-like structures are pedicels of urediniospore which remain in uredinia after the spores have fallen off.

Uromyces dactylidis has been previously reported from BC on the same host by Fernando *et al*. (1999). They have also reported two more rust species on *D. glomerata* including *Puccinia graminis* and *P. striiformoides* (as *P. striiformis*) from BC. When only uredinia are present, *U. dactylidis* can be distinguished from the two other rusts in having cinnamon-brown urediniospores with 8-11 conspicuous scattered germ pores.

Erysiphe adunca (Wallr.) Fr.
On *Populus trichocarpa* Torr. & A. Gray (Salicaceae) [Black cottonwood], British Columbia, North Vancouver, November 2018, M. Abbasi (NV7), UTFH 1203.

Mycelium mostly epiphyllous, effuse or in patches, on some leaves covering the entire leaf upper surface. Chasmothecia mostly gregarious on upper side of the leaves, rarely hypophyllous, 124-196 µm diam., with up to 65 stiff to flexuous appendages, up to 2 times as long as chasmothecial diam., circinate to subhelicoid at apex (Fig. 1F). This powdery mildew has been previously reported on *P. trichocarpa*, *P. tremuloides* Michx. and *Salix* spp. from BC. under the name *Uncinula adunca* (Fernando *et al*. 1999).

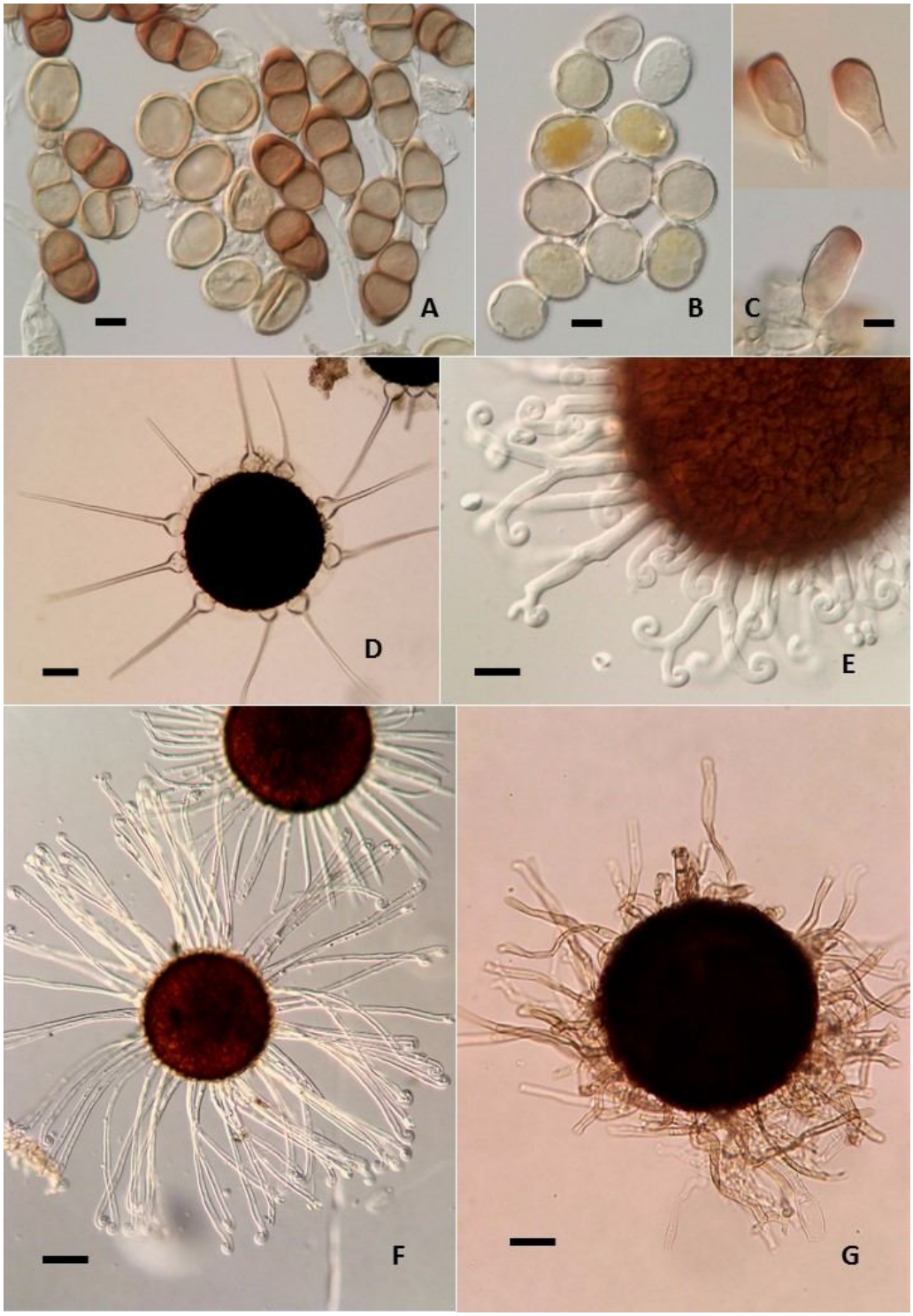

Figure 1 *Puccinia tanaceti*, urediniospores and teliospores, bar = 10 µm (A); *Uromyces dactylidis*, urediniospores (B) and teliospores (C), bar = 10 µm; *Phyllactinia corni*, chasmothecium (D), bar = 50 µm; *Sawadaea bicornis*, chasmothecium (E), bar = 15 µm; *Erysiphe adunca*, chasmothecia (F), bar = 60 µm; *Golovinomyces asterum* var. *solidaginis*, chasmothecium (G), bar = 30 µm**.**

Golovinomyces asterum var. ***solidaginis*** U. Braun
On *Solidago* sp. (Asteraceae) [goldenrod], British Columbia, North Vancouver, November 2018, M. Abbasi (NV5) UTFH 1204-*Solidago* 'Crown of Rays', North Vancouver, October 2018, M. Abbasi (NV1) UTFH 1205, duplicate at UBC.

Mycelium white, amphigenous, effused or in patches. Conidiophores mostly arising laterally from the hyphal mother cell, foot-cells often curved in the basal part, 50-82.5 µm in length. Conidia in chains, doliiform, cylindrical, doliiform-subcylindrical or ellipsoid, 27.5-42.5 × 15-18.75 µm, germ tubes mostly terminal, long up to three times as long as the conidial length, filiform, with one septum and swollen appressorium at apex, sometimes with two germ tubes. Chasmothecia amphigenous, mostly in large groups, 117.5-150 µm diam. Appendages numerous mostly in the lower part of chasmothecia, mycelium like, at first hyaline later brown, simple, septate, of variable length up to 2 times as long as chasmothecial diameter (Fig. 1G). Asci 6-8, clavate or broadly clavate with 2 ascospores.

Erysiphe cichoracearum is the only reported powdery mildew on *Solidago* sp. from BC (Fernando *et al*. 1999). This species is now recognized as *Golovinomyces cichoracearum*, which is confined to hosts of subfamily Cichorioideae in strict sense (Braun & Cook 2012). The above specimens on *Solidago* (subfamily Asteroideae) from North Vancouver fit well with the description of *G. asterum* var. *solidaginis* provided by Braun and Cook (2012). The entire plant of an ornamental *Solidago* 'Crown of Rays' was heavily infected by the powdery mildew. Heavy infection by hyperparasite species *Ampelomyces quisqualis* was also observed on this specimen. This is the first report of *G. asterum* var. *solidaginis* on this cultivated plant from BC. The Fernando *et al*.'s report of *E. cichoracearum* on *Solidago* sp. is based on an old report from literature (Barr 1953) and very probably belongs to G. *asterum* var. *solidaginis*.

Golovinomyces macrocarpus (Speer) U. Braun
On *Tanacetum vulgare* L. (Asteraceae) [common tansy], British Columbia, North Vancouver, 17 October 2018, M. Abbasi (NV3b), UTFH 1206, duplicate at UBC.

Only anamorph observed. Mycelium in dense white persistent patches on both sides of the leaf and on stem; conidiophores erect and straight with mostly cylindrical or rarely slightly curved foot cells with 50-80 µm length followed by 1-3 shorter cells; conidia mostly doliiform to ellipsoid-ovoid 26-36 × 15-17.5 µm; conidial germination with clavate, relatively short germ tubes arising from an end. These features fit the morphological characteristics of *G. macrocarpus* provided by Braun and Cook (2012). This is the first report of *G. macrocarpus* from BC on *T. vulgare*.

The studied material (UTFH 1206) was also infected by *Puccinia tanaceti*. Thus, *Tanacetum vulgare* is reported here as a contemporaneous host of two biotrophic fungi viz. *G. macrocarpus* and *P. tanaceti*.

Phyllactinia corni H. D. Shin & M. J. Park
On *Cornus occidentalis* (Torr. & A. Gray) Coville (Cornaceae) [red-osier dogwood], North Vancouver, Oct. 2018, M. Abbasi (NV6), UTFH 1207, duplicate at UBC.

Chasmothecia were present on both sides of the leaf, mainly hypophyllous, scattered or gregarious, up to 225 µm diam. Appendages 9-17, in equatorial part, acicular, rarely forked at apex, with basal swelling up to 40 µm diam (Fig. 1D). Penicillate cells mostly bifurcated or branched into several branchlets, having numerous mucilaginous appendages at apex.

Above powdery mildew was formerly reported as *Ph. guttata* on *Cornus* spp. from BC (Fernando *et al*. 1999). However, *C. occidentalis* is a new host for *Ph. corni* in BC.

Sawadaea bicornis (Wallr.) Homma
On *Acer pseudosieboldianum* (Pax) Kom. (Sapindaceae) [Korean Maple], North Vancouver, Oct. 2018, M. Abbasi (NV2), UTFH 1208, duplicate at UBC.

Mycelium on leaves mainly epiphyllous, in patches, often vein-limited. Chasmothecia

mostly hypophyllous, 150-200 µm diam., scattered with numerous (up to 45) simple or 1-3 times branched appendages arising from upper half of ascocarp. Apices of appendages were uncinated or circinate (Fig. 1E). Parmelee (1977) first reported this powdery mildew from BC, as *Uncinula bicornis* (Wallr.) Lév. on *Acer macrophyllum*. The second record belongs to Mel'nik (1995) who reported the fungus from Chilliwack, around Agassiz on the same host. *Acer pseudosieboldianum* is a new host for *S. bicornis* in North America.

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گزارشی از قارچ‌های بیوتروفیک ساحل شمالی ونکوور، بریتیش کلمبیا

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چکیده: قارچ مولد زنگ *Puccinia tanaceti* با مفهوم اخص گونه برای اولین بار از استان بریتیش کلمبیا گزارش می‌گردد. تاکسون‌های مولد سفیدک پودری *Golovinomyces asterum* var. *solidaginis* و *G. macrocarpus* نیز به‌عنوان اعضا جدید برای میکوبیوتای استان گزارش می‌شوند. گونه‌های گیاهی متعددی به‌عنوان میزبانان جدید زنگ‌ها و سفیدک‌ها در استان بریتیش کلمبیا و کانادا معرفی می‌شوند.

واژگان کلیدی: Pucciniales، Erysiphales، تنوع زیستی، تاکسونومی، کانادا