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Rinodina chrysidiata, a new species from far eastern Asia and the Appalachian Mountains of North America

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Abstract: A new isidiate, xanthone-producing species, *Rinodina chrysidiata*, is described and compared in detail with *R. xanthophaea*, a species with which it co-occurs in eastern Asia. The two species have an identical chemistry but are clearly separated by their differing lichenized diaspores, thallus morphology and ascospore type.

Keywords: ascospore types, lichenized Ascomycetes, *Physciaceae*, phytogeography, taxonomy

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Introduction

The genus *Rinodina* (Ach.) Gray is relatively well understood among the crustaceous lichen genera of North America (Sheard 2010). Nevertheless, new species and new records continue to be discovered (Sheard 2011; Sheard *et al.* 2011). Here we describe *R. chrysidiata*, an isidiate species that produces the xanthone secalonic acid A and occurs in eastern North America and eastern Asia. We compare the new species to *R. xanthophaea* (Nyl.) Zahlbr., a species with which it occurs in Japan, Korea and far eastern Russia. The two species have an identical secondary chemistry but differ in their method of asexual reproduction and are unlikely to be closely related since they possess different spore types. *Rinodina chrysidiata* has been found only once in the fertile state.

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Materials and Methods

The study is based on material collected by the authors (JL, GT, TT) and loans from herbaria cited in the acknowledgements. Surface observations of specimens were made using a Wild M5 stereomicroscope. Measurements were taken at ×25 magnification and rounded to the nearest 0·05 mm. For *Rinodina xanthophaea*, internal ascomatal measurements were made on vertical sections (20–25 µm thick), cut with a Leitz freezing microtome, at ×50 magnification to an accuracy of 5 µm using a Wild M20 compound microscope. In the case of *R. chrysidiata*, sections were cut by hand in order to preserve the single apothecium available for study. Ascospore measurements were taken at ×500 magnification using a Wild vernier micrometer (scale of 0·1 µm) to an accuracy of 0·5 µm. Ascospore measurements are quoted as the range between the 25th and 75th percentiles with the 5th and 95th percentiles quoted in brackets. Observations of ascospore wall structure were made with an oil immersion lens at a magnification of ×1250. The scanning electron and light micrographs (SEMs and LMs) published here were prepared following the methods outlined by Lendemer & Elix (2010).

Taxonomy

Rinodina chrysidiata Sheard sp. nov.

MycoBank No.: MB561585

Similis *Rinodinae xanthophaea* sed thallo isidiato et ascosporis *Pachysporaria*-typicus.

Typus: USA, North Carolina, Clay Co., Nantahala National Forest, 1–1·5 mi N of US 64 on Buck Creek Rd., *c.* 5 mi NE of Shooting Creek, mesic upland forest, on *Liriodendron*, 10 November 2007, *J. C. Lendemer* 10425 (NY—holotypus; BG—isotypus).

(Fig. 1)

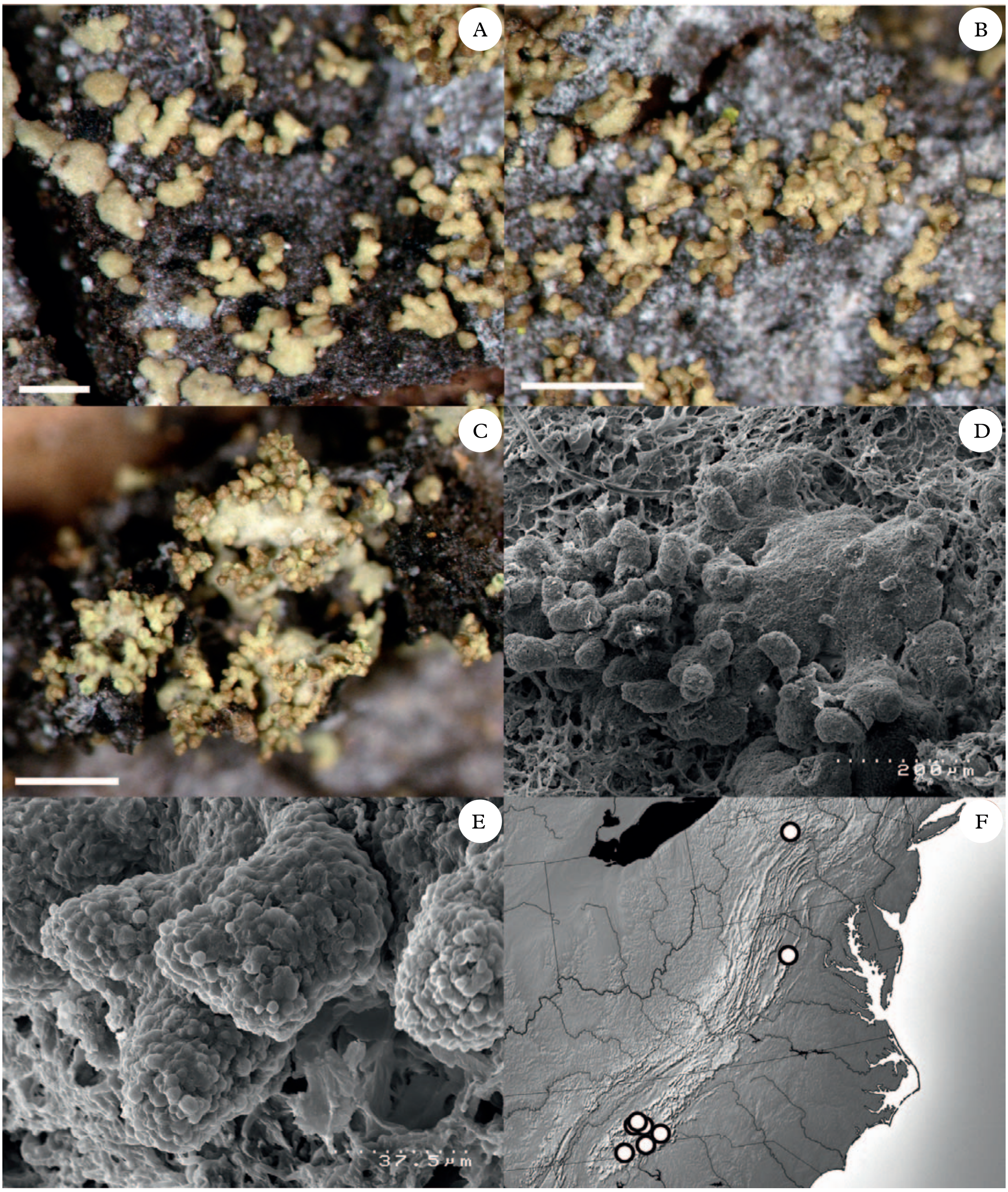

FIG. 1. *Rinodina chrysidiata*. A, young thalli with sparse short isidia (*Lendemer* 7070); B, mature thalli with abundant coralloid isidia (*Lendemer* 7070); C, robust thallus with abundant isidia (*Lendemer* 14025); D & E, scanning electronic micrographs; D, thallus; E, detail of isidia; F, geographic distribution in North America based on specimens examined. Scales: A = 0·25 mm; B & C = 0·5 mm; D & E as indicated. In colour online.

Thallus thin, golden yellow, greyish yellow or grey-brown when shaded, then more strongly pigmented marginally; plane and matt; margin indeterminate; *prothallus* lacking; areolate, areoles isolated, 0·4–1·0 mm diam., minutely lobate, lobules 0·05–

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0·15 mm wide; developing erect isidia to 0·10–0·15(–0·30) mm long, 0·05–0·10 (–0·25) mm wide, slightly club-shaped and brownish tipped, marginal at first, then usually covering areoles, sometimes branched.

Apothecia very rare, sessile, *c.* 0·4 mm diam.; *disc* dark brown, margin concolorous with thallus, *c.* 0·1 mm wide; *paraphyses c.* 2·0 µm wide, apices to *c.* 3·0 µm, lightly pigmented, immersed in a dispersed pigment forming a red-brown epihymenium. *Ascospores* mostly immature, *Pachysporaria*-type I (Sheard 2010), 19·5–22·0 × 13·0–13·5 µm (n = 6), l/b ratio 1·5–1·6, locules rounded from first, lacking well-defined canals and with persistently thick lateral walls; torus prominent; walls pigmented.

Pycnidia not seen.

Chemistry. Secalonic acid A [major], atranorin [minor], and two unknown eumitrin derivatives [eumitrin Y (submajor), eumitrin U (minor)] detected by HPLC (*TT* 21838, 23039, J. A. Elix, pers. comm., 2009). Spot tests: K−, C+ yellow-orange, KC+ yellow-orange, P−, UV+ dull orange.

Etymology. The epithet is derived from 'chrys-', Greek for golden yellow, and an abbreviation 'idiata' of the Latin 'isidium'. We selected 'chrysidiata' instead of 'chrys[is]idiata' to maximize its euphony.

Ecology and distribution. *Rinodina chrysidiata* belongs to a group of species whose ranges centre in the Appalachian Mountains of eastern North America, but also have disjunct populations in eastern Asia (Yoshimura & Sharp 1968; Culberson 1972; Sheard *et al.* 2008). In North America, the species is most frequent in the southern Appalachian Mountains (Fig. 1F) where it occurs at middle to high elevations (700–1165 m in the specimens examined). In eastern Asia, *R. chrysidiata* is known from Japan, Korea, and far eastern Russia (Fig. 3A). Disjunct distributions between eastern Asia and eastern North America are long established among phanerogams (Boufford & Spongberg 1983) and are well-documented (Wen 1999; Xiang *et al.* 2000; Qian 2002).

There is some debate regarding whether these disjunctions originated through long distance dispersal or represent fragmented relicts of a once continuous biota (Galanina *et al.* 2011). Based on the extensive studies of the lichen biota of eastern North America conducted by the first author and his colleagues, we support the latter hypothesis. This topic will be discussed further in a coming publication (Lendemer *et al.*, 2012).

Though the majority of the known populations of *Rinodina chrysidiata* are from the southern Appalachians (Fig. 1F), additional populations occur in the central Appalachians (Pennsylvania) and the Blue Ridge Mountains (Virginia). These relatively isolated populations probably indicate that the species was once widely distributed in the Appalachians and that its range has been significantly reduced as a result of the extensive anthropogenic change (deforestation followed by reforestation) that has taken place in the region. If this is the case, additional populations may also be found in the few remaining high humidity habitats with primary or secondary hardwood forests in the central and northern Appalachians. Although the species is reported here from a number of localities, it should be stressed that it is not common and is never locally abundant. In fact, the vast majority of collections consist of small isolated thalli. In the North American specimens examined, for which substratum data was recorded, the species occurred on the bark of hardwoods (*Acer*, *Aesculus*, *Carya*, *Liriodendron*, *Quercus*) and the wood of a picnic table (*Tønsberg* 30897, BG). In eastern Asia, the species has been found on *Betula* and *Quercus*.

Like many other sterile, asexually reproducing crustose lichens in North America, *Rinodina chrysidiata* is almost certainly strongly negatively impacted by collector bias (Lendemer 2009, 2011; Harris & Lendemer 2010). Thus it is likely to be more common in the southern Appalachians than the specimens cited here indicate. Nonetheless, its infrequent occurrences are restricted to high quality habitats and typically consist of small isolated populations. This may indicate that it requires some form of protection at the state or federal level.

Notes. Only a single apothecium has been detected in all of the collections studied (*Tønsberg* 21838, BG), and this was associated with greyer, non-isidiate areoles. However, on wetting, the yellow pigmentation was enhanced and became more similar to that of the bulk of the sample. The differences in pigmentation and reproductive state may reflect microhabitat differences. Given the small number of ascospores measured, their identification as belonging to *Pachysporaria*-type I must be considered tentative, although they fall within the range of species with smaller ascospores of this type, such as *Rinodina griseosoralifera* Coppins and *R. roboris* (Duf. ex Nyl.) Arnold, the latter being known to have variably sized ascospores (Giralt 2001; Sheard *et al*. 2010).

Five other species of *Rinodina* are known to possess true isidia and, most interestingly, all have *Pachysporaria*-type ascospores. One of these species, *R. citrinisidiata* Aptroot & Wolseley (Aptroot *et al*. 2007), also has a yellow pigmented thallus but the xanthone is thiomelin rather than secalonic acid A. The chemical similarity suggests that *R. citrinisidiata* may be related to *R. thiomela* (Nyl.) Müll. Arg. (Aptroot *et al*. 2007) and *R. lepida* (Nyl.) Müll. Arg. (Sheard 2010). *Rinodina isidioides* (Borrer) Olivier (Giralt *et al*. 1995; Giralt 2001; Mayrhofer & Moberg 2002) and *R. fuscoisidiata* Giralt, Kalb & Elix (Giralt *et al*. 2010*a*) have ascospores which may develop apical satellite lumina when mature to overmature, and possess atranorin. The remaining two species, *R. brasiliensis* Giralt, Kalb & H. Mayrhofer (Giralt *et al*. 2009) and *R. guianensis* Aptroot (Aptroot 1987), have ascospores with lumina surrounded by globular inclusions and lack secondary substances. However, this last species was included in *R. colobinoides* (Nyl.) Zahlbr. by Sheard (2010). These five species, with the possible exception of *R. guianensis*, have ascospores which fit the description of *Pachysporaria*-type I ascospores (Sheard 2010). We agree that this spore type may be related to the *Polyblastidium*-type as suggested by Giralt *et al*. (2010*b*) for *R. flavosoralifera* Tønsberg.

As noted above, *Rinodina chrysidiata* has frequently been collected in the southern Appalachian Mountains and has been found as far north as Pennsylvania. It also occurs in eastern Asia and it has been collected twice with *R. xanthophaea* in far eastern Russia (*Santesson* 33184 UPS, *Spribille* 23934 pers. hb.), and also in Korea (*Thor* 20300 UPS). That species has the same chemistry and frequently reproduces vegetatively but never by means of true isidia. Labriform soralia develop from marginal lobes, deforming the lobes so that the soralia become circular, sometimes with a central pore. A similar developmental sequence occurs from overgrowing lobules in the centre of the thallus, with the result that soralia appear pustulate in non-marginal positions. *Rinodina xanthophaea* mostly has larger areoles than *R. chrysidiata*, 0·50–1·60 mm wide, before they coalesce to form a continuous thallus. The areole lobules are also larger than those of *R. chrysidiata*, ranging from 0·15–0·30 mm wide. On certain substrata a dark, fimbriate prothallus can sometimes be observed, and more rarely rhizohyphae are associated with soralia in the central parts of the thallus. Apothecia occur frequently in *R. xanthophaea*, sometimes in association with soralia. The frequently large apothecia produce variably sized, and sometimes very large, ascospores belonging to the *Physcia*-type. The different spore type suggests that there is no close relationship between *R. chrysidiata* and *R. xanthophaea*, despite their identical chemistries. Soralia, a prothallus and rhizohyphae have never been observed in association with the thallus of *R. chrysidiata*.

Specimens examined. **USA:** *Georgia*: Towns Co., Southern Nantahala Wilderness, Chattahoochee National Forest, Hightower Gap to Rich Knob, 35·08°N 83·62°W, *J. C. Lendemer* 10895 (NY). *North Carolina*: Buncombe Co., 1·55 mi SE Ridgecrest, Camp Ridgecrest, *T. Tønsberg* 21887 (BG); Clay co., Nantahala National Forest, vicinity of Doe Knob, 35·08°N 83·60°W, *J. C. Lendemer* 10425 (NY); Haywood Co., S Waynesville, Blue Ridge Parkway, Grassy Ridge Mine Overlook, *T. Tønsberg* 21875 (BG); Great Smoky Mountains National Park, Boogerman Loop Trail, 35·61°N 83·09°W, *J. C. Lendemer* 18831 (BG); Henderson Co., Pisgah National Forest, North Mill River Recreation Area, 35·40°N 82·67°W, *J. C. Lendemer* 7070 (NY); Jackson Co., 12 km EES of Highlands, just off Rd. 107, S of Bull Pen Rd., *T. Tønsberg* 21838 (BG, fertile); Nantahala National

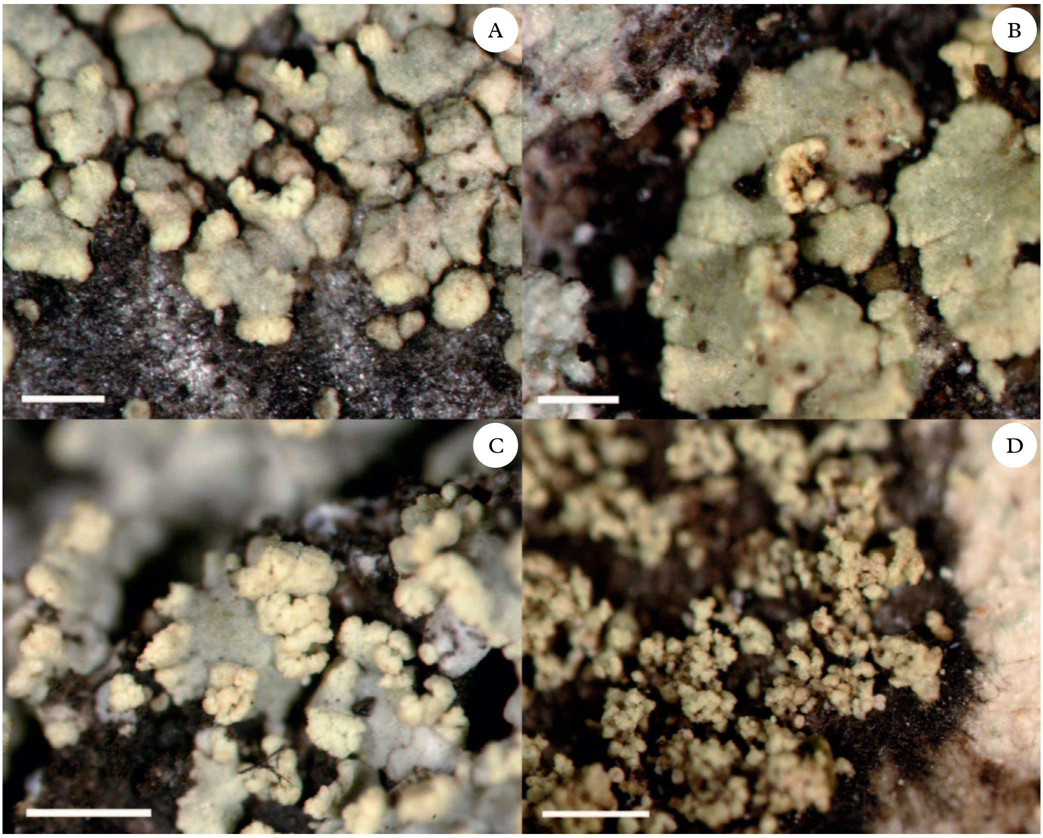

FIG. 2. *Rinodina xanthophaea*. A, thallus in which some areoles lack diaspores while others begin to develop marginal soralia (*Spribille* 30559, SASK); B, detail of areole with marginal soralium (*Spribille* 30559); C, areole with abundant well-developed soralia (*Spribille* 30559, SASK); D, thallus in which the areoles have entirely dissolved into coarse soredia (note the black prothallus; *Spribille* 30559 in hb. Spribille). Scales: A & B = 0·25 mm; C & D = 0·5 mm. In colour online.

Forest, Panthertown Valley, 35·15°N 83·01°W, *J. C. Lendemer* 6928 (NY); Swain Co., Great Smoky Mountains National Park, Collins Creek Picnic Area, *T. Tønsberg* 30897 (BG); Great Smoky Mountains National Park, Beech Gap Trail, 35·62°N 83·22°W, *J. C. Lendemer* 19189A (NY); Transylvania Co., between Brevard and Highlands, *T. Tønsberg* 21812 (BG). *Pennsylvania*: Lycoming Co., Tioga State Forest, Algerine Swamp Natural Area, Gamble Run, 41·52°N 77·47°W, *J. C. Lendemer* 16960A (NY). *South Carolina*: Oconee Co., Sumter National Forest, 8·5 mi S of Cashiers, 34°N 83°W, *Dey* 13703 (NY). *Tennessee*: Cocke Co., Great Smoky Mountains National Park, Gabes Mountain Trail, 35·75°N 83·26°W, *J. C. Lendemer* 19074 (NY), *E. A. Tripp* 674 (NY). *Virginia*: Warren/ Rappahannock Co., Shenandoah National Park, South Marshall Mountain, 38·76°N 78·21°W, *J. Guccion* 1238 (all NY).—**Japan:** *Hokkaido*: Tokachi Prov., Ashoro-gun, 42 km NNE Obihiro, 43·14°N 143·30°E, *T. Tønsberg* 23039 (BG).—**Korea:** *Gangwon Prov.*: Sorak San Nat. Park, Mt. Sorak, 38·10°N 128·29°E, *K. H. Moon* 691 (TNS); 38·07°N 128·27°E, *G. Thor* 20299, 20300 with *R. xanthophaea* (UPS).—**Russia:** *Khabarovskiy Krai*: 48·32°N 135·08°E, 1927, *A. Oxner* (photograph KW). *Primorskiy Krai*: Lazovskiy District, Tretylog, 43·11°N 133·58°E, *R. Santesson* 33184, with *R. xanthophaea* (UPS); Kedrovaya Pad' Reserve, along Poperechniy River, 43°N 131°E, 1935, *N. Kabanov* (photograph KW); Terneyskiy Rayon, Sikhote Alin' Mountains, 44·41°N 136·13°E, *T. Spribille* 23934 with *R. xanthophaea*, 23948; Sikhote Alin' Mountains, Verkhnaya Ussurskiy Biocoenotic Station, 44·02°N 134·13°E, *T. Spribille* 23418 (all pers. hb.).

Rinodina xanthophaea (Nyl.) Zahlbr.

Cat. Lich. Univers. **7:** 559 (1931).—*Lecanora xanthophaea* Nyl., *Lich. Jap*. 41 (1890); type: Japan, Magayesi, 1879, *E. Almquist* (H–NYL 29084—lectotype here designated; H–NYL 29085—isolectotype *pro parte*).

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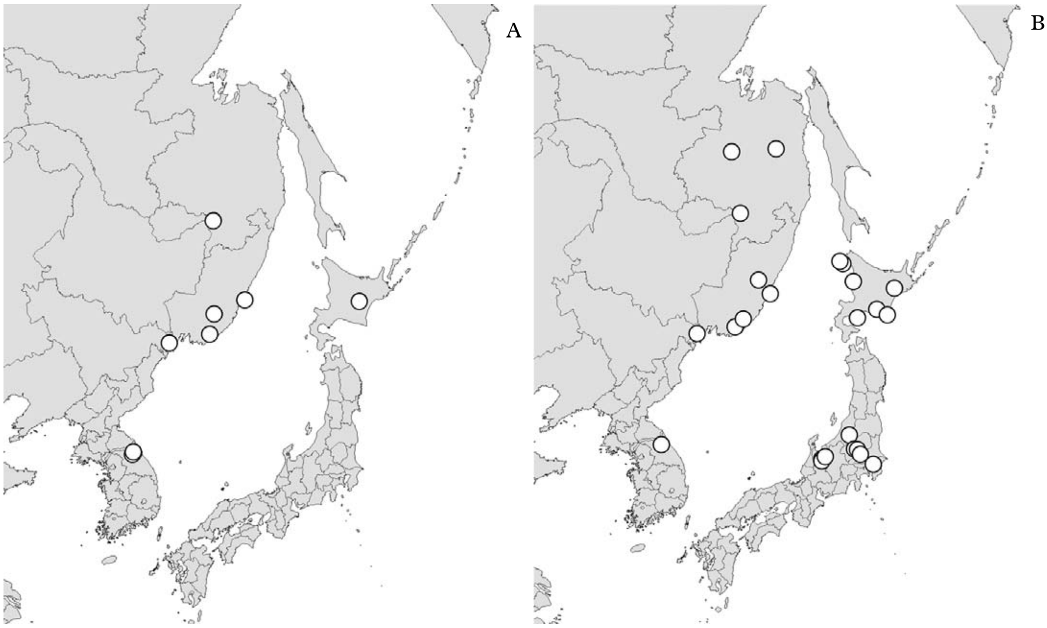

FIG. 3. Geographic distributions of *Rinodina* species in Asia based on the specimens examined for this study. A, R. *chrysidiata*; B, *R. xanthophaea*.

(Fig. 2)

Thallus thick, golden yellow or grey; areolate, areoles isolated at first, 0·50–1·60 mm wide, sometimes coalescing to form a continuous thallus, areole margins minutely lobate; lobules at first to 0·10–0·30 mm wide, then forming larger lobes which may overgrow each other, thallus then becoming continuous; surface otherwise plane and matt; vegetative propagules present or not, developing as marginal, labriform soralia, often becoming circular, *c.* 0·20–0·25(–0·35) mm diam., sometimes with a central perforation, then pustulate; soredia 40–50 µm diam., larger consoredia sometimes present which may develop into blastidia *c.* 0·25 × 0·10 mm; thallus indeterminate; prothallus typically present, black, entire, then sometimes thick, rimose-areolate, or fimbriate at the margins, particularly when overgrowing foliose lichens (Fig. 2).

Apothecia frequent but often absent in sorediate thalli, rarely contiguous, to 0·70–1·80 mm diam., narrowly attached; *disc* dark reddish brown, plane; margin concolorous with thallus, 0·15–0·25 mm wide, flexuose and persistent. *Thalline exciple c.* 70–140 µm wide laterally; cortex 10–25 µm wide, reddish orange crystals present in the cortex and medulla obscuring the structure of both, less dense in medulla; cortical cells to 4·5–6·5 µm wide, not pigmented; algal cells 7·5–16·0 µm wide; thalline exciple to 110–140 µm wide below, cortex to 20–60(–80) µm thick, columnar; medullary hyphae radiating and continuous with columnar hyphae of lower cortex; *proper exciple* often indistinguishable from the hymenium, *c.* 10 µm wide laterally, to 10–25 µm wide at the periphery; *hypothecium* 50–90 µm tall, hyaline throughout; *hymenium* highly gelatinized and often desiccated, 90–120 µm high; *paraphyses* 2·0–2·5 µm wide, apices to 3·0–5·0 µm wide, not pigmented but immersed in dispersed pigment forming an orange-brown epihymenium; *asci c.* 60–95 × 20–30 µm, with 2–8 ascospores. *Ascospores* with Type A development, *Physcia*-type, (19·5–)23·5–28·5 (–36·0) × (10·0–)12·0–15·0(–18·5) µm, (n = 180), l/b ratio (1·6)1·8–2·1(–2·2), lumina becoming more rounded but mostly retaining

TABLE 1. *Comparison of characters distinguishing* Rinodina chrysidiata, R. chrysomelaena *and* R. xanthophaea

	R. chrysidiata	*R. chrysomelaena*	*R. xanthophaea*
Ecology	Corticolous/lignicolous	Saxicolous	Corticolous/lignicolous
Geographic distribution	East Asia / Appalachians	Appalachians and Central North America	East Asia
Thallus			
areole size	0·4–1·0 mm	0·6–1·8 mm	0·5–1·6 mm
lobe size	0·05–0·15 mm	0·1–0·3 mm	0·1–0·3 mm
prothallus	absent/unknown	black (variably developed)	black
lichenized diaspores	isidia	none	soredia
Major secondary compounds	Secalonic acid A	Atranorin and secalonic acid W	Secalonic acid A
Ascospore-type	*Pachysporaria-I*	*Physcia*	*Physcia*

apical wall thickening, sometimes slightly waisted; torus present; walls not ornamented.

Chemistry. Secalonic acid A [major], atranorin [minor or trace], and three unknown eumitrin derivatives [eumitrin Y (submajor), eumitrin X (minor), eumitrin U (minor)] [*TT* 22986, 22308, (23028 no eumitrin X) J. A. Elix, pers. comm., 2009]. Spot tests: K−, C+ yellow-orange, KC+ yellow-orange, P−, UV+ dull orange.

Ecology and distribution. The species is known from Japan and far eastern Russia (Fig. 3B). It has been collected on *Abies nephrolepis, A. sachalinensis, Betula costata, B. mandshurica, Fraxinus, Magnolia obovata, Phellodendron amurense, Picea jezoensis, Quercus mongolica, Tilia amurensis*, wood and on detritus over rocks, at elevations of 70–1535 m. It is sometimes found growing over decaying thalli of *Parmelia* species.

Notes. The thallus morphology, pigmentation, and *Physcia*-type ascospores of *Rinodina xanthophaea* indicate a relationship with the saxicolous, Appalachian species *R. chrysomelaena* (Ach.) Tuck. (Lendemer & Sheard 2006; Sheard 2010), which has been rediscovered recently in the southern Appalachians (Lendemer *et al*., in press).

Despite their similar yellow pigmentation, the chemistries of the two species are different; *Rinodina chrysomelaena* contains atranorin and secalonic acid W as the major constituents rather than the secalonic acid A of *R. xanthophaea*. The relatively large ascospores of *R. xanthophaea* are similar in length to those of *R. chrysomelaena*. The two species also differ in their biogeographic patterns and the production of lichenized diaspores (see Table 1).

Rinodina xanthophaea is a rather variable species with two reproductive morphotypes, one primarily with apothecia and the other primarily with marginal soredia. The latter has been described as forma *sorediosa* by Pczelkin (1987). In the same paper, Pczelkin also described forma *isidiosa*. The types (LE) of these forms have not been available for study so it is not known if the latter corresponds to the rare blastidiate form of *R. xanthophaea* or to the isidiate *R. chrysidiata* which has been found growing with *R. xanthophaea* in eastern Asia.

This species is typically characterized by a black prothallus around the thallus margin and is frequently seen between the separate areoles in marginal regions of thalli. The prothallus is sometimes fimbriate at its margin, particularly when thalli are colonizing foliose lichens (mostly *Parmelia* spp.). Marginal rhizohyphae are rarely associated with soralia in the central regions of the thallus where lobules overgrow each other. The rhizohyphae are interpreted as being homologous with fibres of the fimbriate prothallus.

The new species, *Rinodina chrysidiata*, is chemically identical and has similar thallus characters but the vegetative propagules are true isidia rather than soredia. Also, this species tends to have smaller areoles and lobules, is never associated with a dark prothallus, and has smaller, *Pachysporaria*-rather than *Physcia*-type ascospores in the single fertile specimen (Table 1).

Specimens examined. **Japan:** *Hokkaido*: Iburi Prov., Tarumae, 42·41°N 141·21°E, *H. Kashiwadani* 14473 (TNS); Ishikari Prov., Mt. Ashibetsu, 1935, *Y. Asahina* (TNS); Kitami Prov., Rishiri-to Island, 45·09°N 141·17°E, *T. Tønsberg* 22501, 22308, 22528 (all BG); Kushiro Prov., Akan-gun, E Akan Kohan, 45·09°N 141·17°E, *T. Tønsberg* 23028 (BG); Akkeshi-gun, 44 km E Kushiro, 42°N 144°E, *T. Tønsberg* 22986 (BG); Lake Akan, 43·26°N 144·08°E, *Y. Ohmura* 1890 (TNS); Teshio Prov., 28 km NE Obira, 44·08°N 141·58°E, *G. Thor* 13525 (UPS); Tokachi Prov., Mt. Rakko, 42·16°N 143·07°E, *S. Kurokawa* 70590 (TNS); Mt. Tsurgi, 42·51°N 142·54°E, *H. Kashiwadani* 7653 (TNS). *Honshu*: Aki Prov., Mt. Garyu, 34°N 132°E, *H. Kashiwadani* 2309 (TNS); Chiba Prov., Mt. Ohtaki, 35·58°N 140·07°E, *T. Inobe* 184 (TNS); Etchu Prov., 25 km ESE Toyama, 36·35°N 137·28°E, *G. Thor* 12662 (UPS); 33 km ESE Toyama, 36·34°N 137·34°E, *G. Thor* 12695 (UPS); Aramine, 36·29°N 137·27°E, 1936, *Y. Asahina* (TNS); Shimotsuke Prov., Kirigome, 36·45°N 139·37°E, 1931, *Y. Asahina* (TNS); Mt. Shirane, 36·23°N 139·51°E, *M. Ogata* 97 (TNS); Shinano Prov., 16 km NW Shinano-Ohmachi, 36·33°N 137·43°E, *G. Thor* 12720, 12721 (UPS); Mt. Shirouma, 36·45°N 137·45°E, *K. Matsushima* 101 (TNS); Teshio Prov., Rumoi-gun, 21 km ENE Obira, 44·09°N 141·55°E, *T. Tønsberg* 21958 (BG); Yamagata Prov., Murayama, 34°N 132°E, 1879, *E. Almquist* (H-NYL 29085, accompanying isolectotype).—**Korea:** *Gangwong Prov.*, Sorak-san Nat. Park, 38·07°N 128·27°E, *G. Thor* 20300 with *R. chrysidiata* (UPS).—**Russia:** *Khabarovskiy Krai*: 48·32°N 135·08°E, 1927, *A. Oxner* [KW (photograph)]; Amgun' River Region, 51·30°N 135·14°E, *Spribille* 31390 (hb. Spribille); Bureinskij Zapovednik, 25 km SE Sofiysk, *T. Spribille* 32018 (GZU); Komsomolsk-De Kastri route, Khomi Mts., 51·05°N 138·57°E, *T. Spribille* 30559 (GZU), 30560 (GZU); Sredniy Khrebet Mountains, Polosataya Mtn., *T. Spribille* 31021 (GZU). *Primorskiy Krai*: Kedrovaya Pad' Reserve, along Poperechniy River, 43°N 131°E, 1935, *N. Kabanov* [KW (photograph)]; Sikhote-Alin' Mountains, Oblachnaya Mountain., 43·40°N 134·13°E, *T. Spribille* 23515, 23525, 23569, 23682 (all hb. Spribille); Terneyskiy Rayon, Sikhote-Alin' Mountains, 45·08°N 135·52°E, *T. Spribille* 23766, 23807, 23867, 23877, 23934 (all hb. Spribille); Sikhote-Alin'skiy Zapovednik, 45·08°N 135·52°E, *T. Spribille* 23820 (hb. Spribille); Zakharovskiy River, 1935, *B. Kolesnikov* [KW (photograph)]; "Lazovskiy Krai", Tretylog, 43·11°N 133·58°E, *R. Santesson* 33184p.p. [with *R. chrysidiata*] (UPS), 33199 (UPS).

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