Mysterious Asian Beauty Conquers Eastern Massachusetts

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Abstract

Radulomyces copelandii is reported for the first time from the Western Hemisphere. DNA sequence data places this fungus in a clade with the type species of *Radulomyces*. Its sudden appearance in Massachusetts is discussed.

Key words: Basidiomycota, fungi, *Radulomyces copelandii*, wood-rotting fungi

Introduction

In mid-November 2009, one of us (LM) found a quite remarkable hydnaceous fungus on a large red maple (*Acer rubrum*) log at Bradley Palmer State Park in Ipswich, Massachusetts. The fruiting body was resupinate (flat on the log's surface and lacking a pileus), and its white to pale luteous spines were both densely crowded and unusually long (8 to 12mm). Individual fruit bodies of several decimeters in length grew out of the cracks and interstices in the log's bark, presumably using this feature of the substrate for both moisture and insulation.

Having never encountered such a fungus before, LM collected a sample specimen and brought it home to identify. Finding no match for it either macroscopically or microscopically he sent the sample to JG, who, after a lot of searching and head scratching, concluded the beautiful, spiny fungus had the scientific name *Radulomyces copelandii* (Pat.) Hjortstam & Spooner. A surprising conclusion because this fungus previously had been found only in Asia.

From January 2010 to March 2010, LM found fruitings of *R. copelandii* on northern red oak (*Quercus rubra*), white oak (*Q. alba*), and beech (*Fagus grandifolia*) in four eastern Massachusetts localities: in Concord, near Walden Pond; in Lincoln, near Mt. Misery and near the commuter rail tracks; and in Sharon, at Moose Hill Audubon Sanctuary. He figured that the reason the Asian Beauty had not been collected earlier was that it fruited in the winter, a time when very few mycologists venture into the field. He suspected that the species was quite cold tolerant, as he'd found it in freezing or subfreezing temperatures with snow on the ground. Also, each time he'd brought home a sample for microscopic study, he'd found

it eagerly sporulating. This caused him to wonder whether *R. copelandii* possessed some kind of unusual glyco-protein or some other chemical that allows it to turn carbohydrates into sugars with extreme alacrity. None of the admittedly sparse literature on the species at Harvard University's Farlow Herbarium provided any mention of its chemicals, unusual or not.

But this paper concerns a mysterious Asian Beauty, not simply an Asian Beauty with a preference for cold weather, so here the story gets more complicated. During the fall of 2010, LM found *R. copelandii* on almost every collecting trip he made in eastern Massachusetts, including — most recently — at Fresh Pond in Cambridge. As before, it was fruiting on a large hardwood log, in the cracks and interstices of the bark. Thus it would appear that the species doesn't fruit only in the winter, and likewise that it has found a very comfortable niche as a saprobe in eastern Massachusetts. To date, LM has not found *R. copelandii* beyond a 35 mile radius of Boston, but he suspects that will change in the not too distant future.

Materials and methods

The description is based upon LM's collection on bark on the side and lower surface of *Acer rubrum* log, Bradley-Palmer State Park, Ipswich, MA, USA, November 13, 2009, determined by J. Ginns 11837 (CFMR, FH). Several other collections have been deposited in the Farlow Herbarium (FH). The abbreviation for the herbaria where the specimen is preserved follow Thiers (2010). The standard mounting media for examination of specimens of the Polyporaceae and allied groups were used, i.e., Melzer's iodine, 2% potassium hydroxide (KOH), and cotton blue in lactic acid. The formulae for these can be found in Kirk et al. (2001).

Macroscopic features *(Fig. 1)*

Fruiting bodies resupinate for up to ~30 cm, with spines white to pale lutelous, densely crowded, 8 to 12 mm long, odor lacking.

When dry density of the spines varies from adjacent spines touching to 2 mm between spines. Spines up to 10 mm long, slender, straight, round in cross section, gradually narrowing to a fine, acute tip, i.e., not pilose, penicillate or fimbriate. The space between spines snow white, smooth, glabrous. Small spines extend to within 0.5 mm of the margin. Margin white, appressed, dense, typically 0.5 mm wide but in areas up to 2 mm wide, the extreme edge finely fimbriate. Context white, < 1 mm thick, dense, fibrous to horny.

Microscopic features

Context hyphae 2-4 µm diameter with a large proportion being 4 µm, with a clamp connection at each septum, hyphae where loosely arranged distinct and separate easily, where densely packed they are interwoven, more frequently branched and interlocked. The context surface between spines sterile, composed of a loose palisade of clavate cells up to 8 µm diameter.

Tramal hyphae predominantely 2-3 µm diameter, distinct (i.e., not agglutinated), septa infrequent with a clamp connection at each septum, typically 45-180 µm between clamp connections. Tramal hyphae in KOH – phloxine reagent remaining hyaline (i.e., lacking cytoplasm), in cotton blue reagent after 24 h pale blue (i.e., weakly cyanophilous). Hyphae at base of spines closely packed and interwoven, walls of some 1 µm thick. Microbinding hyphae lacking.

Subhymenium narrow near the spine tip, thickening to nearly 40 µm near the base of the spines, hyphae densely arranged, interwoven, frequently branched, some segments contorted and resembling jigsaw puzzle pieces. Spine tips acute, sterile, hyphae agglutinated.

Hyphidia scattered in the hymenium, 2-3 µm diameter, some projecting to 10 µm, simple, filiform, slightly wavy, the apex obtusely rounded, walls hyaline and thin.

Basidia 29-35 x 6-7 µm, clavate, slenderly clavate or cylindrical with a constricted stem-like base, slender, contents in KOH of numerous, globose, 1-2 µm diameter oil drops, sterigmata four, 4-6 µm long.

Basidiospores (6.0-) 6.4 - 7.0 (-7.2) x 5.4 - 6.2 (-6.6) µm (n = 21), subglobose, adaxial surface slightly flattened, wall smooth, ca. 0.4 µm thick, hyaline, neither amyloid nor dextrinoid in Melzer's reagent, in cotton blue after 24 h most pale blue (i.e., weakly cyanophilous), whereas collapsed or fractured spores bluing within a few minutes, apiculus distinct, relatively large, broadly acute, contents in KOH slightly refractive due to one large, globose oil drop or numerous droplets.

Habit and distribution

The Massachusetts fruiting bodies were growing in the cracks and interstices of the bark of hardwood logs of *Acer*, *Fagus* and *Quercus* species. This fungus was previously known from China, Japan, Korea, Phillipines, Sri Lanka (Maekawa 1993: 93-95, Nakasone 2001:170-171), Malaysia (Hjortstam et al. 1990), and Russia: Far East: Sakhalin and Ussurian regions (Nikolaeva 1961: 98-100 as *Radulum licentii*) where it fruited on logs and decaying branches (presumably on the ground) of *Abies*, *Betula*, *Castanea*, *Castanopsis*, *Prunus*, *Quercus* and unidentified broad-leaved species.

Figure 1. *Radulomyces copelandii* fruiting body. From Ginns 11837. Photo by Tom Murray.

Results

It surprised us that a fungus known only from Asia would be found not just once but several times in eastern North America. We sought confirmation that our Asian Beauty was *R. copelandii* by asking Dr. Karen Nakasone, who has studied species in this and allied genera, for her opinion. She confirmed our identification, adding that this was the first collection of *R. copelandii* in the Western Hemisphere.

Most readers will not have heard of *Radulomyces* but just over 20 species have been placed in the genus. And studies (Nakasone, 2001; Stalpers, 1998) have discussed the circumscription of this genus and whether *R. copelandii* might be better placed in another genus.

To determine which species were closely related to *R. copelandii* part of 11837 was sent to Drs. Ellen and Karl-Henrik Larsson who sequenced the full nuclear ribosomal ITS region and ca 1500 basepairs of the adjacent end of the LSY region. Their results showed *R. copelandii* to be in a well defined clade with *R. confluens* (Fr.:Fr.) M.P. Christ. (type species of the genus), *R. molaris* (Fr.) M.P. Christ., and *R. rickii* (Bres.) M.P. Christ."

This species is generally included in a group called Crusts. Identification of many Crusts requires the examination of their microscopic features (such as basidiospores, cystidia, and hyphae). And that was how we named the collections *R. copelandii*. However, it is relatively easy to identify *R. copelandii* without reference to a microscope because of its long spines and large, pale luteous fruiting bodies.

The most obvious question is: how did the Asian Beauty reach eastern Massachusetts? LM's initial collection (not to mention five subsequent collections and "sightings") came from Bradley Palmer State Park, part of the former 10,000 acre estate of a wealthy attorney named Bradley Palmer (1864-1948). An avid gardener and horticulturist, Mr. Palmer imported many plants from Scotland because he thought the Scottish climate was similar to New England's. On at least one occasion, he brought in plants from Asia – a whole freight car of azaleas, rhododendrons, and laurel. Could the mycelium of *R. copelandii* have somehow hitched a ride with these acid-loving members of the heath family? Perhaps, but almost a hundred years separates this putative introduction from LM's discovery of a fruiting body. *Radulomyces copelandii* would not appear to be a slow-working pathogen like *Grifola frondosa* or *Laetiporus sulphureus*, so it would not require nearly such a lengthy time to complete its cycle.

A related question: assuming the Asian Beauty didn't arrive via the enterprise of Mr. Palmer, when did it arrive? A thorough search of the literature on hydnaceous species at Harvard's Farlow Herbarium turned up no reference to any earlier North American collection or, indeed, any description of a species that might have been *R. copelandii* in an earlier taxonomic guise. Nor did a search of the inventories from amateur and regional forays turn up an even remotely similar species. Of course, such searches don't prove that *R. copelandii* hadn't fruited before 2009, especially if fruitings typically occurred in the winter, a time when mycologists seldom go foraging. Yet 25+ collections and/or sightings from the late summer through the fall of 2010 indicates that the species also fruits during the so-called mushroom season, when it would be hard to overlook.

It might be argued that the Asian Beauty has a stubborn or desultory mycelium, one that produces a fruiting body only once in a great while. Certainly, this is true of some species mistakenly listed as rare. However, a mycelium in a deteriorating woody substrate has a life expectancy of no more than thirty or so years, or roughly as long as that substrate can provide it with nutrients. The absence of any collection in the last thirty years would seem to indicate that *R. copelandii* is a relatively recent arrival in eastern Massachusetts. Exactly how recent is probably impossible to ascertain at this point.

Another question: might the fact that the Asian Beauty has established a seemingly comfortable niche in eastern Massachusetts have negative consequences? As a saprobe, it might be replacing or at least nudging aside native polypores as well as corticioid species. Such species, in addition to being wood recyclers, would have a complex network of relationship with organisms like birds, insects, microbes, and other fungi. If the Asian Beauty was interfering with these relationships, it might be described as an invasive. Or if not an invasive, at least a takeover species, a fact evidenced by the dramatically increased number of fruitings of 2010.

We consider this paper by its very nature to be inconclusive. In writing it, we hope: to alert both mycologists and the public to a significant new species in eastern Massachusetts; to inspire further studies of this species' range and preferred habitats; and to encourage an investigation into whether the effect of *R. copelandii* on local ecosystems is good, bad, or indifferent.

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