Chaga and Forest Health FAQ (*Inonotus obliquus*)

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This FAQ only addresses questions about chaga in the context of forest health. It should not be interpreted as an endorsement of using chaga for any purpose related to human consumption.

Left: a chaga on the main stem of a yellow birch (orange arrow); Middle: a cross section of a birch log infected by Inonotus obliquus showing advanced decay near the center of the tree (black arrow) and the extent of staining and advancing decay (yellow arrow); Right: a longitudinal section of a tree infected with I. obliquus showing the location of the chaga (orange arrow) and the staining and rot extending throughout the stem.

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What is chaga?

Chaga is the dark-colored, corky, sterile (non-spore-producing) conk formed as the result of infection by the pathogenic canker rot fungus, *Inonotus obliquus*. Since the conk appears almost as if it has been burnt, it is often referred to by the common name, cinder conk.

Information about the fungus that forms the chaga is limited. More is being learned about *Inonotus obliquus* as interest in the potential of this fungus increases, and with it, funding for research efforts.

Chaga has a history of use as a folk remedy for various ailments. While researchers are studying the chemistry and medicinal properties of chaga, there is a limited amount of scientifically proven information about chaga's impacts on human health at this time.

What is a tree pathogen?

Tree pathogens are defined as disease-causing microorganisms that impact tree health. Examples of disease-causing agents include fungi (like *Inonotus obliquus*), bacteria, viruses, phytoplasmas, parasitic plants and nematodes. Abiotic disorders caused by environmental conditions (like drought) or herbicide damage are often included as disease-causing agents.

What is a tree disease?

Tree disease is defined as any deviation in the normal functioning of a tree caused by some type of persistent agent (Manion, 1981).

What does chaga look like?

Chaga does not have a defined shape like some mushrooms (conks) seen growing on trees. The surface of the chaga almost appears burnt and has a rough and blocky texture. While chaga conks may grow on any part of the tree's main stem, they are not found on branches.

Is chaga native to Maine?

Yes, *Inonotus obliquus,* the fungus that forms the chaga, is native to Maine and can be found throughout the northern hemisphere where host trees grow (see next question for host trees).

On what tree species does chaga grow?

Host species for *Inonotus obliquus* in Maine are primarily yellow birch (*Betula alleghaniensis*) and paper birch (*Betula papyrifera*) and occasionally American beech (*Fagus grandifolia*) and hophornbeam (*Ostrya virginiana*). In Maine, anecdotal reports suggest that chaga most commonly occurs on yellow birch.

(Sinclair and Lyon, 1995)

How does chaga naturally spread in Maine's forests?

The chaga conk itself is sterile, meaning it does not produce reproductive spores. Reproduction of *Inonotus obliquus* occurs within 12 years after the death of the host tree, often once the tree has fallen to the ground. At this point, a spore mat (basidiocarp) forms on the tree and reproductive spores (basidiospores) are generated from the mat. Basidiocarps have very rarely been encountered while sporulation is occurring, and Basidiospores of *I. obliquus* are thought to be primarily spread by wind. However, there is speculation that the fungus may be vectored (spread) by insects. Some insects appear to be highly attracted to the basidiocarps of *I. obliquus*, and basidiocarps often show signs of intense insect feeding.

Are all chagas the same?

Fungal strains can differ greatly in their level of aggressiveness (virulence). Highly virulent strains are more effective at attacking their host and result in a faster progression of the disease. In the case of *Inonotus obliquus*, more virulent strains cause more internal decay faster, and will form a chaga earlier, when compared to strains of lower virulence.

Does farming chaga hurt my trees?

Because the chaga fungus disrupts normal tree functions and structure (causes disease), the answer is yes. This is evidenced by the visible swelling, staining and internal decay caused by the fungus.

When decay has advanced in a tree infected with *Inonotus obliquus*, the tree's structure may be weakened and it may break, often at the point of infection. At the microscopic, cellular level, an immune response by birch host trees is visible in the formation of blockages (occlusions) in xylem vessels in response to infection by *Inonotus obliquus*. These occlusions are either outgrowths (tyloses) of parenchyma cells that occur in the xylem or secretions of parenchyma cells (gels consisting of phenolic compounds and/or high-pectin substances). The intended function of occlusions in a tree is to block the internal spread of pathogens, in this case to stop the spread of *Inonotus obliquus* in birches. These occlusions typically do not form in response to mechanical wounding in birch, implying that the formation of occlusions is a specific host response to attack by a pathogen. However, a host-specific response to the fungus that forms chaga has not been directly studied.

(Sinclair and Lyon, 2005; Blanchette, 1982, Shigo 1969; Gilbertson, 1980, True, 1955)

Will chaga farming augment the distribution of Inonotus obliquus in Maine's forests?

The estimated chaga frequency is 3.75% in a natural northeastern forest setting, while proposed chaga farms would inoculate a higher percentage of trees (a lower estimation of 30% of suitable host trees has been proposed). This would suggest that distribution of the fungus (that is, the frequency of its occurrence) will increase with the adoption of chaga farming.

(Brydon-Williams et al., 2021)

Will augmenting the distribution of Inonotus obliquus have adverse effects on Maine's forests?

This is difficult to predict and there is currently no scientific data available to inform a response to this question. However, the estimated chaga frequency is 3.75% in a natural northeastern forest setting, while proposed chaga farms would be inoculated a higher rate (a lower estimation of 30% of suitable host trees has been proposed). This would suggest that distribution of the fungus (that is, the frequency of its occurrence) will be increased and, consequently, negative tree health impacts would be increased.

(Brydon-Williams et al., 2021)

Could chaga farming on a property potentially hurt trees in neighboring forests?

This is unclear, as there have been no formal studies clarifying the epidemiology (analysis of spore dispersal and infection potential) of *Inonotus obliquus*. In fact, due to the unusual life cycle of the fungus, the reproductive biology of *Inonotus obliquus* is poorly understood compared to many other forest pathogens.

Spores of *Inonotus obliquus* are not produced on the chaga (the chaga is sterile/it does not produce reproductive spores), but rather on a structure called a basidiocarp. Basidiospores produced on the basidiocarp of *Inonotus obliquus* are thought to be primarily spread by wind, although there is speculation that the fungus may be vectored (spread) by insects. Basidiocarps often show signs of heavy insect feeding indicating some insects are highly attracted to them.

Basidiocarps of *Inonotus obliquus* form after death of the host tree and are believed to form only one time in the life cycle of the fungus, within 12 years after tree death. Thus, basidiocarps have only very rarely been encountered while sporulation is occurring.

One important aspect of *Inonotus obliquus* that is understood is that the reproductive spores (basidiospores) of *Inonotus obliquus* need to land on a fresh wound to successfully infect a host tree (See **How does chaga naturally spread in Maine's forests?**)**.** Spores are thought to be primarily dispersed at some time during the growing season and thinning often results in wounds to the residual stand. Thus, for forests close to chaga farms with a high birch component, it may be prudent to time thinning operations in the winter months. It is, therefore a best practice to inform neighboring landowners of chaga production.

(Miina et al., 2021)

How long does it take for an inoculated tree to form a Chaga?

This is highly variable, with trees forming chaga as early as five years; however, this process can take much longer, depending on many variables primarily related to site, tree vigor and virulence of the fungal strain (see **Are all chagas the same?**).

(Miina et al., 2021)

Can someone else pick the Chaga that I've cultivated on my land?

If someone enters a property without landowner permission and any damage is caused to the landowner's trees, they could be held liable for damages including paying fines and restitution in district court. This also applies to Maine's public lands. Additional regulations and penalties may be associated with federal lands.

If private landowners intend to deter harvest of chaga on their land, they should consider posting "No Trespassing" signs in accordance with Maine's regulations.

Can I inoculate someone else's trees with Inonotus obliquus?

No. Without landowner permission, you can be held liable for any damages created including paying fines and restitution in district court. This also applies to Maine's public lands. Additional regulations and penalties may be associated with federal lands.

How does infection by Inonotus obliquus impact a host tree's life span?

This is not possible to predict, since the relationship between a pathogen and its host depends on the virulence of the pathogen (how good it is at causing disease) and host vigor (how resilient the tree is to infection / how well the tree can fight against the infection). Tree vigor is very closely related to the site where a tree grows. Perhaps the most important site factors are soil characteristics such as nutrient composition, moisture, pH and soil structure. Poor site conditions will mean a less vigorous tree and a shorter life span. Trees can persist for many years while infected by pathogens like *Inonotus obliquus*, the fungus that causes the formation of a chaga.

One factor that certainly shortens a trees life is if it breaks due to internal decay. The fungus that causes chaga formation is a 'canker rot fungus'. It kills some of the host tree's cambium tissues (the tissues that transport water and nutrients in the tree) where the chagas grow. If enough cambium is destroyed, the tree's health will suffer as the exchange of resources between the upper parts of the tree and the roots is disrupted. The fungus also rots the heartwood, the non-living center of a tree which normally provides structural integrity. As the decay caused by the fungus advances, the structural integrity of the tree decreases, leading to a higher likelihood of stem breakage. In addition, when trees are stressed they become attractive to insect pests and are more susceptible to root disease (just like people – when our immune systems are down, we tend to get more illnesses). Often a tree may be able to successfully combat a few stressors, though as stressors accumulate, it can be difficult for a tree to recover.

Can I use the birch trees that produced chaga for lumber or firewood?

Infection by *Inonotus obliquus* leads to extensive staining within the main stem of the tree that essentially makes the most valuable bottom log(s) unmarketable for lumber, boltwood and other products. Additionally, internal decay can cause bottom portions of the tree to not have sound wood, and even become hollow over time. Due to the decay associated with *Inonotus obliquus* infection, the value of the bottom portions of trees is often highly degraded, making them unsuitable for lumber, while retaining some value as biomass or firewood. The upper portions of the tree may be stained but may likewise retain their value as firewood.

(Sinclair and Lyon, 2005; Blanchette, 1982, Shigo 1969; Gilbertson, 1980)

What site types are best for chaga production?

This is somewhat unclear, and perhaps a bit hypothetical, but poorer sites may be more favorable for chaga production. Since site conditions are often major determining factors influencing tree vigor, birch trees on poorer sites (for example, wet sites) may be less vigorous. Less vigorous trees have fewer resources for defense, and therefore *Inonotus obliquus* may be better able to parasitize less-vigorous trees faster, resulting in chaga conk formation in less time. Again, this idea is not directly supported scientifically and should be carefully considered in this context. Chaga farms in Finland, where the practice has been applied for over a decade, focus chaga production on low-productivity birch-rich sites.

(Miina et al., 2021)

Can chaga production co-occur with timber production?

Since chaga farming is a very new prospect in North America, with Maine being the first state where this has been tried, there are currently no best management practices to guide both production of chaga while protecting/maximizing high-value wood-based forest products. While it seems possible that these two approaches to forest management could successfully co-exist, this has not been demonstrated in practice in North America. Chaga farming is a relatively new practice in Finland and Estonia, and more is being learned about the economic, ecological and social impacts of chaga farming.

How can I get more information on chaga and forest health?

Visit our website, www.maine.gov/foresthealth or reach out to foresthealth@maine.gov or (207) 287-2431, TTY: Maine Relay 711

How can I get more information on forest management for other uses of birch trees?

Contact your local district forester. You can find your district forester at www.maineforestservice.gov or call (207) 287-2791, TTY: Maine Relay 711.

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