Plant Galls Unveiled – Part II:
Insect and Mite Gall Identification and Management

Figure 19: Hickory Petiole Phylloxera gall, an example of a unilocular multilarval gall.

Figure 20: Elm sack galls. All photos courtesy of the author.

By Joe Boggs

In Part 1 of this article, "Plant Galls Unveiled – Part I: Gall Types," in the April 2016 issue of *TCI*, we discussed some of the history of galls, how to identify galls in general and how to differentiate them from other gall-like structures, and how they grow. Remember that the big difference between fungal cankers and other gall imitators and true galls is that most gall-like structures involve dead or dying plant tissue, while galls involve the growth of plant tissue.

This article will focus on insect and mite gall identification and management.

Insect and mite gall identification

Identifying insect and mite galls is challenging because of the limited number of accurate and updated gall identification resources, both online and printed. This is particularly true for galls found in North America; the European gall literature is more robust. The existing gall identification resources tend to follow the same general outline. Most begin by separating galls based on the gall-maker such as wasp galls, midge galls, etc. While it is ultimately important to know the gall-maker, gall identification usually starts with the gall itself. The first step is to consider where the gall is found on the plant. Most identification resources use the following locations: leaf/petiole galls; flower/fruit galls; bud galls; stems galls; and root galls.

Figure 21: Translucent oak gall.

Leaf/petiole galls

Are the galls only found on the petiole, on leaf veins or between the leaf veins? Or, are they found on two or three of these locations. Are they found on the lower leaf surface, upper leaf surface or both? This is not splitting hairs; remember the fourth gall law! Many gall-making arthropods confine their activity to a well-defined area of the leaf.

Elm sack galls that are produced by the aphid, *Colopha ulmisacculi*, only arise on the upper leaf surface between the leaf veins. The galls have a single chamber (unilocular) filled with multiple gall-makers (multilarval). The galls split open to release the aphids. (Figures 19 & 20) The colorful, fleshy, translucent oak galls produced by the gall wasp, *Amphibolips nubilipennis*, are firmly attached to veins on the underside of leaves. (Figure 21) These galls are also unilocular, but the chamber only holds one gall-maker (unilarval).

One of the most dramatic leaf-vein galls is the so-called hawthorn pod gall produced by the gall midge, *Blaesodiplosis* (syn. *Lobopteromyia*) *venae*. The half-inch-long galls are at first light green but turn deep red as they mature. They arise from veins on the underside of leaves, and their size and weight cause affected leaves to droop down, making the galling more noticeable. (Figure 22)

The felt-like "erineum galls" produced by the eriophyid mite, *Acalitus fageri-*

Figure 22: Hawthorn pod galls.

Figure 23: Early-season erineum patch galls on beech.

Figure 24: Late-season erineum patch galls on beech.

Figure 25: Maple spindle galls.

nea, creep across the upper leaf surface of American beech (*Fagus grandifolia*). (Figures 23, 24) Some eriophyid mites induce truly unique plant growths that must involve some chemical direction. Two examples are maple bladder galls, produced under the direction of the eriophyid mite, *Vasates quadripedes*, on the upper leaf surfaces of some red and silver maples, and the finger-like spindle galls, produced by *V. aceriscrumena* on the upper leaf surface of sugar maple. (Figure 25)

Flower/fruit galls

While the vast majority of arthropod gall-makers cause little to no injury to the overall health of their plant hosts, those that only affect flowers or fruit are truly innocuous. However, they can have a serious impact on reproduction. One of the most spectacular gall types in this group is the acorn plum gall (a.k.a. acorn gall) that sprouts under the direction of the gall wasp, *Amphibolips quercusjuglans*, from acorn caps. The ball-like galls are around 1 inch in diameter, and their unique coloration of yellowish-brown shot through with purplish-brown "veins" makes the galls look like bloodshot eyeballs; a disconcerting sight once the galls detach and drop to the ground in late summer! The deep reddish-purple color of the mature galls is responsible for the "plum" in their common name. (Figure 26)

The attention drawn to North American ash trees due to emerald ash borer (*Agrilus planipennis*) has also focused a spotlight on the handiwork of the eriophyid mite, *Eriophyes fraxinivorus*. The mite targets male flowers in the spring, inducing the flowers to become distorted, brush-like witches'-brooms. The affected flowers are green while the mites are in residence and become brownish-black once the mites vacate the galls. Spent galls may cling to trees for several years. Insecticide treatments for emerald ash borer will have no effect on the eriophyid mites; treated trees may still become festooned with spent galls. (Figure 27)

Bud galls

Unlike the leaf/petiole gall-makers that commandeer a limited number of meristematic cells in the leaf buds, gall-makers that produce bud galls hijack all of the meristematic cells. In some cases, the effect is obvious. The descriptively named oak bud gall produced by the gall wasp, *Neuroterus vesicula*, is formed when a single bud is directed to become a reddish-brown, ball-like gall that is only slightly larger than a normal bud. The small size should not be allowed to contravene the complexity of this gall. A close examination of the gall's surface may reveal tiny droplets of nectar produced by nectaries located within the gall; this is one of the galls with functional plant organs. The nectar attracts ants and stinging insects, which provide protection for the developing gall-maker. (Figures 28, below, and 29, next page)

One of the most dramatic-looking bud galls is the willow pine cone gall formed by the gall midge, *Rhabdophaga strobiloides*, on its namesake host. The common name is very descriptive with the inclusion on pine cone-like scales on the surface of these fuzzy, greenish-white galls.

Figure 26: Acorn plum gall.

Figure 27: Ash flower gall.

Figure 28: Oak bud gall.

Figure 29: Yellowjacket attracted to a bud gall by nectar.

The galls are formed from terminal buds of black willow (*Salix nigra*) presenting the bizarre display of "pine cones" growing from the tips of the willow branches. (Figures 30 & 31)

Figure 30: Willow pine cone gall.

Figure 31: Willow pine cone gall opened to reveal the midge fly larva.

Stem galls

The ring of stem cambium located between the xylem and phloem is meristematic tissue; the cells are undifferentiated. However, unlike bud cells, the cambium remains meristematic tissue throughout the growing season; undifferentiated cells are continually available. Since cambial cells remain free agents throughout the growing season, galls can be formed from these cells any time during the growing season, although most stem galls start growing early on to provide ample time for the gall-maker to complete its development.

Oak bullet galls produced by the gall wasp, *Disholcaspis quercusglobulus*, are a good example of a stem gall arising from cambial cells. They are also another example of a gall that develops functional plant organs. Like the aforementioned oak bud galls, bullet galls have nectaries. The sugary treat exuded from the nectaries serves as a "bribe" to entice ants and stinging insects that offer protection to the immature gall-maker. A predator or parasitoid intent upon targeting the helpless wasp larva within the gall would need to run a gauntlet of stinging and biting insects fueled by sugar! The downside is that heavily galled trees may literally buzz with stinging insects, presenting a serious challenge if the tree is located near a home. (Figures 32 & 33)

Most stem galls arise from the surface and cause no harm because they do not disrupt vascular flow within the stem. The exception is the horned oak gall produced by the wasp, *Callirhytis cornigera*. Of the more than 800 types of galls that may be found on oak, this is one of the few that can potentially cause significant damage to its oak host. That's because the galls may completely surround and girdle the stem, and gall tissue may invade the xylem to choke off the flow of water and nutrients. As a result, the stem beyond the gall often dies. Although horned oak galls do not typically kill trees, the stem dieback can significantly disfigure tree canopies, and the stress associated with loss of leaves can make heavily infested trees more susceptible to other problems. (Figure 34, facing page)

Gall management

The vast majority of plant galls cause little to no harm to the health of their host plant, which means that gall management strategies aimed at limiting the impact on plant health are usually not needed. This perspective is particularly true for galls produced by insects and mites. Also, for reasons not clearly understood, populations of arthropod gall-makers tend to rise

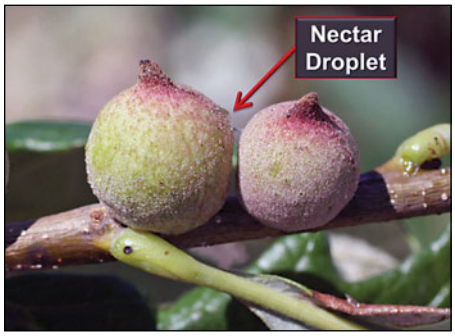

Figure 32: Oak bullet galls exuding nectar.

Figure 33: Stinging insects attracted to bullet galls by nectar.

Figure 34: Horned oak galls.

and fall dramatically from year to year. It is not unusual for a season with heavy activity by a particular gall-maker to be followed by years with almost no evidence of the gall-maker's handiwork.

Of course, the fact that plant galls may be fascinating and most cause no harm may be cold-comfort to some clients, since galls certainly affect the expected and desired appearance of the host. Couple this with the reality that gall-makers are difficult if not impossible to control, and it is not surprising that plant galls are often viewed with little wonder.

Unfortunately, gall prevention is not an option for most arthropod galls based on our current knowledge and available tools. Little is known about the life-cycles for many of our most noteworthy arthropod gall-makers. Almost nothing is known based on scientific research about pesticide efficacy against these gall-makers; much of what has been reported is based on anecdotal accounts. There is limited motivation for funding and conducting research aimed at adding arthropod gall-makers to pesticide labels because the galls are seldom of economic significance and rarely cause harm to plant health.

The complicated life-cycle of some gall-makers, such as the aforementioned horned oak gall wasp, presents a special gall-management challenge. The wasp alternates between sexual and asexual reproduction between generations, a condition called heterogamy. The wasp also produces two entirely different types of galls between generations. One generation of wasps develops from insignificant leaf galls that appear as small bumps on leaf veins; the galls are difficult to detect with an untrained eye. Leaf gall growth starts in the spring, and wasp development within the galls, from eggs to adults, takes about three months. This is the "sexual" generation, so both male and female wasps emerge from these leaf galls. Once they mate, the females fly to twigs and small branches to start the next generation of wasps that will develop in stem galls. (Figure 35)

The females' egg-laying activity stimulates the growth of stem galls

Figure 35: Horned oak gall leaf galls.

Figure 36: Immature horned oak gall.

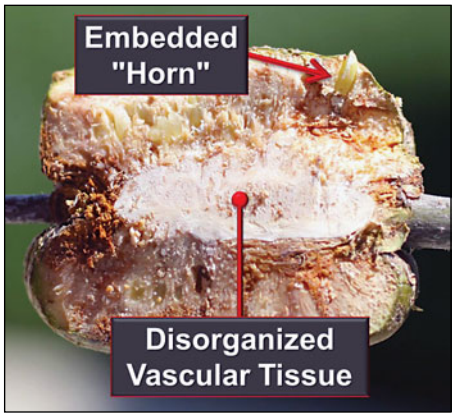

Figure 37: Immature horned oak gall with embedded horn.

from cambial stem tissue. The sizes of the galls depend on the number of eggs laid; larger galls hold more eggs and resulting wasp larvae. The larvae spend 33 months in individual chambers within these very obvious gnarled, dark-green, woody stem galls. (Figure 36)

The galls grow larger in size with each season. As the immature wasps near the completion of their development, the whitish-tan, cone-shaped "horns" that give this gall its common name begin to extend from the gall. (Figures 37, 38 & 39) Adult wasps emerge from the horns once they are fully extended. This is the "asexual" generation; all of the adults are females, there are no males in this generation. This form of asexual reproduction, where females do not require fertilization by males to produce fertile eggs, is called "parthenogenesis."

Management strategies for the horned oak gall wasp must take into account the two locations where the gall-maker resides. Adding to the complexity is that nothing is synchronized. Leaf galls occur every year, providing a constant stream of wasps producing new stem galls. The annual reservoir of wasps dedicated to producing stem galls makes managing horned oak gall by pruning out infested stems a never-ending process.

One of the most effective gall management strategies is to educate your clients. Although galls are abnormal plant structures, they are still fascinating plant structures. Plant galls are an outward result of a complicated physiological and chemical dance between the gall-maker and the plant host.

If not viewed with a sense of wonder and fascination, at least insect and mite gall-makers should garner begrudging respect. So far, no human has managed to duplicate the work so handily done by a group of organisms that are often viewed with disdain. Imagine the plant secrets that would be unlocked if we could?

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Figure 38: Mature horned oak gall.

Figure 39: Old horned oak galls.